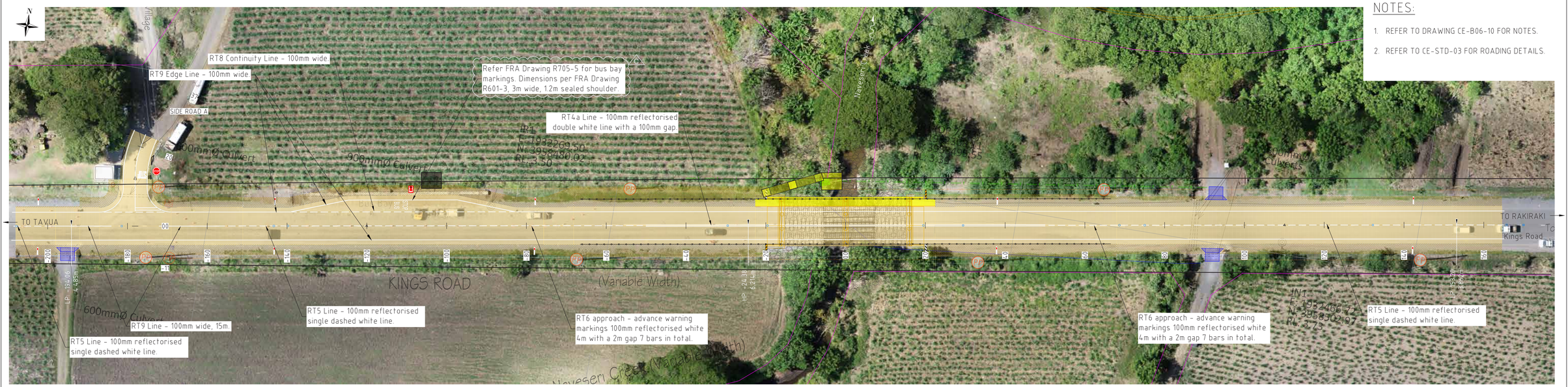
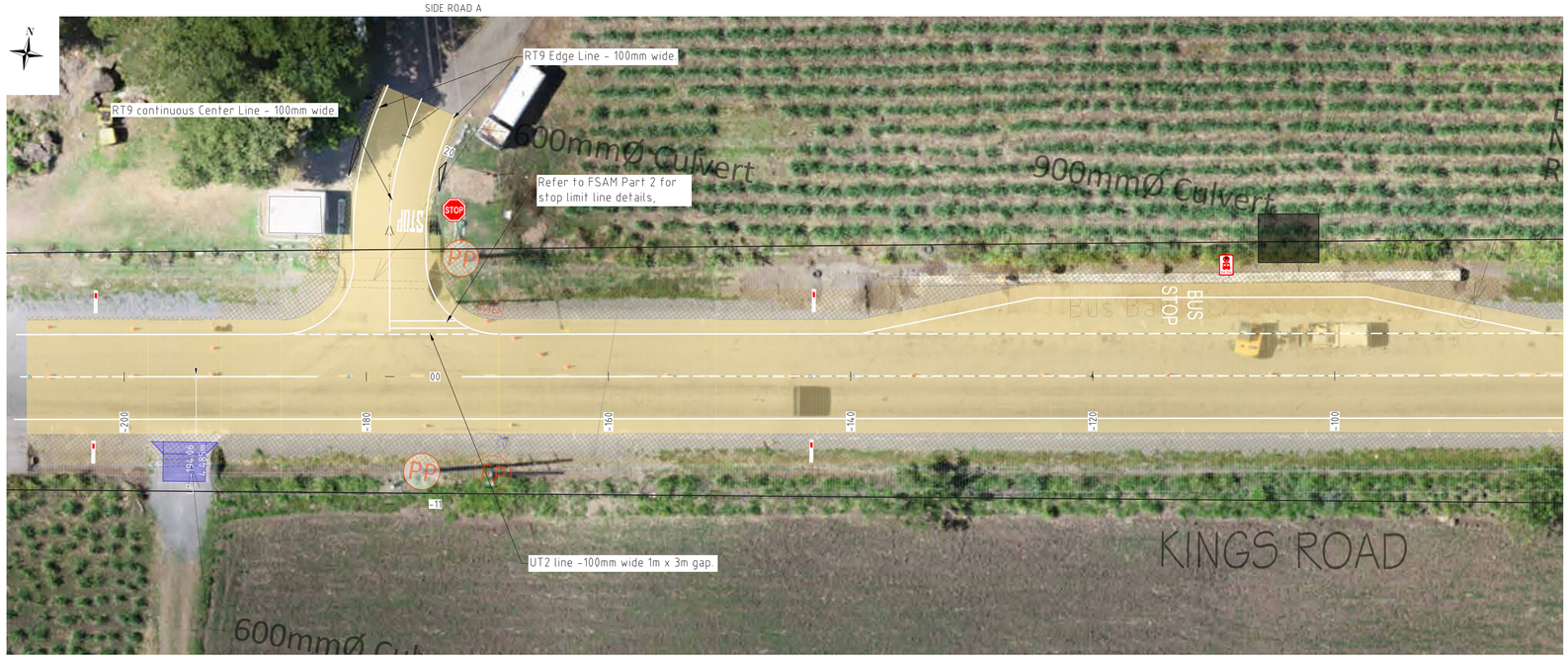


1 / - ROAD MARKING AND SIGNAGE GENERAL ARRANGEMENT PLAN

SCALE 1:1000(A3)



2 / - SIDE ROAD A ROAD MARKING AND SIGNAGE PLAN

SCALE 1:500(A3)

NOTES:

1. REFER TO DRAWING CE-B06-10 FOR NOTES.
2. REFER TO CE-STD-03 FOR ROADING DETAILS.

LEGEND EXISTING:

- CADASTRAL BOUNDARY
- FLOW DIRECTION

LEGEND PROPOSED:

- STOP SIGN RG5 750mm x 750mm
- BUS BAY SIGN. REFER FRA DRAWING R705-5.
- BRIDGE END MARKER POST W20-5.1
- BRIDGE END MARKER POST W20-5.2
- FLEXIBLE EDGE MARKER POSTS PER FRA DRAWING R705-3. INTERVALS PER NZTA MOTSAM PART 2 SECTION 5.05.

REFER TO FSAM PART 2 FOR STOP MARKING DETAILS.

FOR CLARITY OF DETAILS VIEW ELECTRONICALLY

DETAILED DESIGN NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN - FOR FRA REVIEW.	RAI	TE	CH	01/03/24
B	DETAILED DESIGN - FOR FRA REVIEW.	RAI	TE	CH	21/09/23
A	DETAILED DESIGN - FOR COMMENT.	RAI	TE	CH	22/06/23

Original Scale (A1) AS SHOWN
Reduced Scale (A3) AS SHOWN

Design	R Imrie	22/06/23	Approved For Construction×
Drawn	R Imrie	22/06/23	
Dsg Verifier	C Hatley	22/06/23	
Drg Check	C Hatley	22/06/23	Date

× Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: VITAWA BRIDGE ROAD MARKING AND SIGNS

Discipline: INFRASTRUCTURE

Drawing No.: 6103677-CE-B06-17

Rev.: C

Document No. PRE FEAS 11 A 1 P1 5.DWG

DO NOT SCALE FOR SET OUT DIMENSIONS

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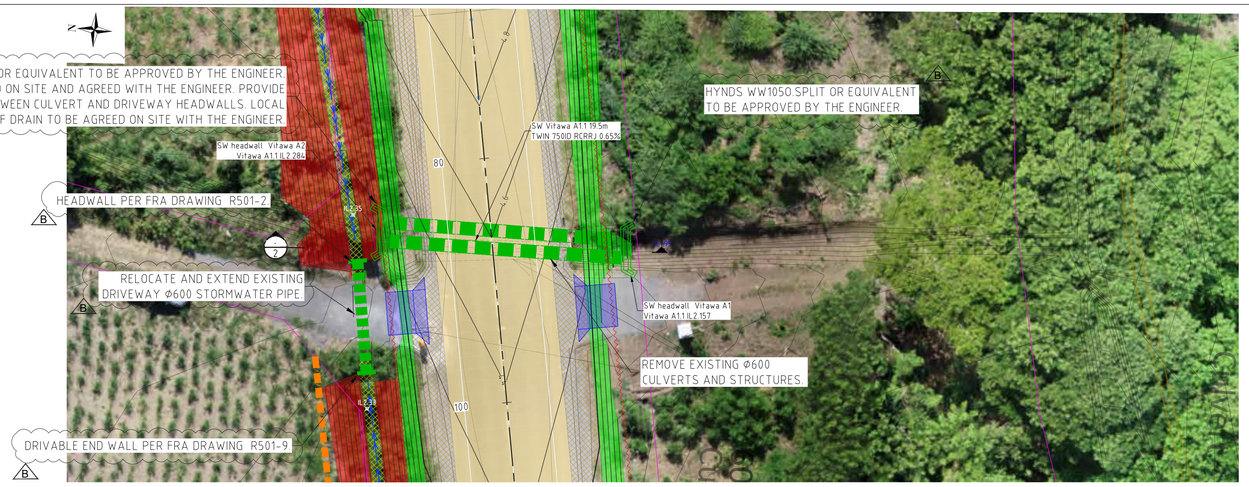

1 / - STORMWATER CULVERT AT DIST 80m PLAN

SCALE 1:500(A3)

VERTICAL ALIGNMENT PIPE INVERT	G: 0.6% L: 22.079
DESIGN GROUND LEVELS	2.24 2.77 3.37 4.22 4.26 4.30 4.35 4.39 4.43 4.47 4.50 4.41 4.36 4.32 4.27 4.23 4.18 4.15 3.24 2.74 2.23
PIPE / DRAIN INVERT LEVELS	2.30 2.28 2.29 2.27 2.26 2.26 2.25 2.25 2.24 2.23 2.23 2.22 2.22 2.21 2.21 2.20 2.19 2.19 2.18 2.17 2.17
DEPTH TO INVERT	-0.06 0.49 1.09 1.50 1.95 2.00 2.05 2.09 2.14 2.19 2.24 2.27 2.23 2.19 2.15 2.11 2.07 2.03 1.99 1.96 1.66 0.57 0.07
PIPE TOP LEVELS	3.17 3.19 3.18 3.17 3.17 3.16 3.15 3.15 3.14 3.14 3.13 3.12 3.11 3.11 3.10 3.10 3.09 3.09 3.08 3.07 3.07
COVER	-0.85 -0.34 0.27 0.71 1.13 1.18 1.23 1.28 1.33 1.37 1.41 1.45 1.41 1.38 1.34 1.31 1.27 1.22 1.18 1.13 0.24 -0.26 -0.75
EXISTING GROUND LEVELS	3.76 3.61 3.54 2.94 2.29 2.89 3.70 3.77 3.80 3.84 3.88 3.91 3.87 3.83 3.79 3.75 3.65 3.52 2.28 2.17 2.12 2.07 2.03 2.01 1.98 1.96 1.94 1.92 1.90 1.88 1.86 1.84 1.82
DISTANCE	23.0 22.0 21.0 20.0 19.0 18.0 17.0 16.0 15.0 14.0 13.0 12.0 11.0 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0 -7.0 -8.0 -9.0

2 / - STORMWATER CULVERT AT DIST 80m LONGITUDINAL PROFILE

SCALE 1:500(A3)

NOTES:

1. REFER TO DRAWING CE-B06-10 FOR NOTES.
2. REFER TO DRAWING CE-STD-03 FOR GENERAL STORMWATER NOTES.
3. FLEXIBLE GUIDE MARKER POSTS PER FRA DRAWING R705-3 TO BE INSTALLED AT CULVERT ENDS.

LEGEND EXISTING:

- CADASTRAL BOUNDARY
- FLOW DIRECTION
- EXISTING STORMWATER PIPE/STRUCTURE
- IL5.56 — DRAINAGE INVERT LEVEL

LEGEND PROPOSED:

- OPEN CHANNEL TYPE 1 AS PER DRAWING 6103677-CE-STD-25. MIN 0.3% GRADIENT.
- OPEN CHANNEL TYPE 2 AS PER DRAWING 6103677-CE-STD-25. MIN 0.3% GRADIENT.
- OPEN CHANNEL TYPE 3 AS PER DRAWING 6103677-CE-STD-25. MIN 0.3% GRADIENT.
- IL5.56 — DRAINAGE INVERT LEVEL
- 0.5% — DRAINAGE FLOW DIRECTION & GRADIENT
- STORMWATER MANHOLE.
- STORMWATER PIPELINE HEADWALL.
- STORMWATER PIPE AND HEADWALL.
- STORMWATER CATCHPIT.
- STORMWATER PIPELINE.
- SEALED ROAD.
- REINFORCED CONCRETE FOOTPATH.
- UNSEALED SHOULDER, FOOTPATH.

SCALE 1:500(A3):

0 5 10 15 20

FOR CLARITY OF DETAILS VIEW ELECTRONICALLY

DETAILED DESIGN NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN - FOR FRA REVIEW.	RAI	TE	CH	01/03/24
A	DETAILED DESIGN - FOR COMMENT.	RAI	TE	CH	29/09/23

Original Scale (A1) 1:250
Reduced Scale (A3) 1:500

Design	R Imrie	29/09/23
Drawn	R Imrie	29/09/23
Dsg Verifier	C Hatley	29/09/23
Drg Check	C Hatley	29/09/23

Approved For Construction× Date

× Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: VITAWA BRIDGE MAIN ROAD STORMWATER CULVERTS PLAN AND PROFILE

Discipline: INFRASTRUCTURE

Drawing No.: 6103677-CE-B06-18

Rev.: B

Document No. PRE FEAS 11 A 1 P1 5.DWG

DO NOT SCALE FOR SET OUT DIMENSIONS

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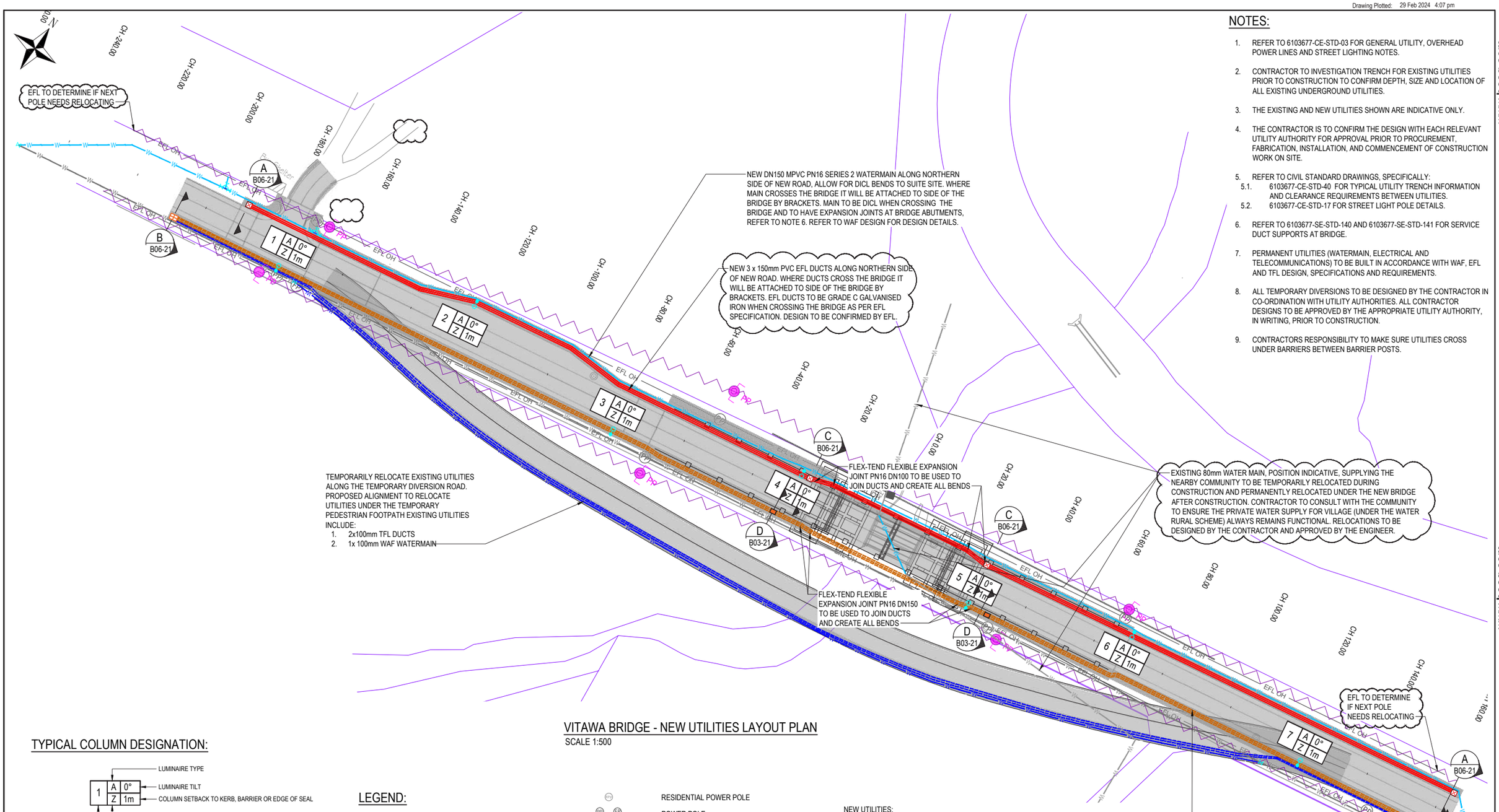


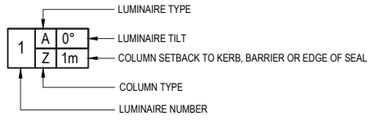
NOTES:

1. REFER TO 6103677-CE-STD-03 FOR GENERAL UTILITY, OVERHEAD POWER LINES AND STREET LIGHTING NOTES.
2. CONTRACTOR TO INVESTIGATION TRENCH FOR EXISTING UTILITIES PRIOR TO CONSTRUCTION TO CONFIRM DEPTH, SIZE AND LOCATION OF ALL EXISTING UNDERGROUND UTILITIES.
3. THE EXISTING AND NEW UTILITIES SHOWN ARE INDICATIVE ONLY.
4. THE CONTRACTOR IS TO CONFIRM THE DESIGN WITH EACH RELEVANT UTILITY AUTHORITY FOR APPROVAL PRIOR TO PROCUREMENT, FABRICATION, INSTALLATION, AND COMMENCEMENT OF CONSTRUCTION WORK ON SITE.
5. REFER TO CIVIL STANDARD DRAWINGS, SPECIFICALLY:
   - 5.1. 6103677-CE-STD-40 FOR TYPICAL UTILITY TRENCH INFORMATION AND CLEARANCE REQUIREMENTS BETWEEN UTILITIES.
   - 5.2. 6103677-CE-STD-17 FOR STREET LIGHT POLE DETAILS.
6. REFER TO 6103677-SE-STD-140 AND 6103677-SE-STD-141 FOR SERVICE DUCT SUPPORTS AT BRIDGE.
7. PERMANENT UTILITIES (WATERMAIN, ELECTRICAL AND TELECOMMUNICATIONS) TO BE BUILT IN ACCORDANCE WITH WAF, EFL AND TFL DESIGN, SPECIFICATIONS AND REQUIREMENTS.
8. ALL TEMPORARY DIVERSIONS TO BE DESIGNED BY THE CONTRACTOR IN CO-ORDINATION WITH UTILITY AUTHORITIES. ALL CONTRACTOR DESIGNS TO BE APPROVED BY THE APPROPRIATE UTILITY AUTHORITY, IN WRITING, PRIOR TO CONSTRUCTION.
9. CONTRACTORS RESPONSIBILITY TO MAKE SURE UTILITIES CROSS UNDER BARRIERS BETWEEN BARRIER POSTS.

VITAWA BRIDGE - NEW UTILITIES LAYOUT PLAN

SCALE 1:500

TYPICAL COLUMN DESIGNATION:



LUMINAIRE TYPE LEGEND:

A ADD NEW STREET LIGHT PLACE ROADLED MIDI 60W 4K 180227PH LUMINARE.

COLUMN TYPE, MOUNTING HEIGHT:

z PLACE NEW TAMPERED OCTAGONAL SHAFT POLE, 10.5m MOUNTING HEIGHT, 2m OUTREACH

LEGEND:

EXISTING:

- DRAIN INVERT FLOW DIRECTION
- POWER POLE
- SEPTIC TANK
- TELECOM CHAMBER
- WATER VALVE
- UTILITIES CHAMBER
- GULLY PIT
- CROSS CULVERT
- FLY STAY POLE
- STAY WIRE
- RESIDENTIAL POWER POLE
- POWER POLE
- OVERHEAD EFL POWER LINE RESIDENTIAL
- POWER LINE
- WATER METER
- WATER VALVE
- METER BOX ON POLE
- DRAIN STEEL COVER
- TELECOM LINE
- TELECOM POLE
- CADASTRAL BOUNDARY
- TELECOM MANHOLE
- EXISTING WATER MAIN

NEW UTILITIES:

- TFL DUCT
- WAF PIPE
- EFL DUCT
- EFL 1500mm x 1500mm STANDARD EFL LV UNDERGROUND CABLE PIT
- TFL 1100mm x 1470 JUF 4 (ONE LID CARRIAGEWAY) MANHOLE (HEAVY DUTY)
- TFL 1500mm x 1940mm PIT JUF 6 (TWO LID CARRIAGEWAY) MANHOLE (HEAVY DUTY)

RELOCATED UTILITIES:

- INDICATIVE POWER POLE POSITION. EFL TO CONFIRM.
- OVERHEAD POWER LINES. EFL TO CONFIRM.

FOR CLARITY OF DETAILS VIEW ELECTRONICALLY

DETAILED DESIGN NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN - FOR FRA REVIEW	LN	CH	CH	21.09.23
B	DETAILED DESIGN FOR COMMENT	ES	VH	CH	22.06.23
A	CONCEPT DESIGN	ES	VH	CH	03.02.23

Original Scale (A1)	1:500	Reduced Scale (A3)	1:1000

Design	M. SHEPPARD	03.02.23	Approved For Construction*
Drawn	AV, ES	03.02.23	
Dsg Verifier	C. HATLEY	03.02.23	
Drg Check	C. HATLEY	03.02.23	Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: VITAWA BRIDGE NEW UTILITIES

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B06-20

Rev.: C

Document No. 6103677-CE-B06-20.DWG

DO NOT SCALE FOR SET OUT DIMENSIONS

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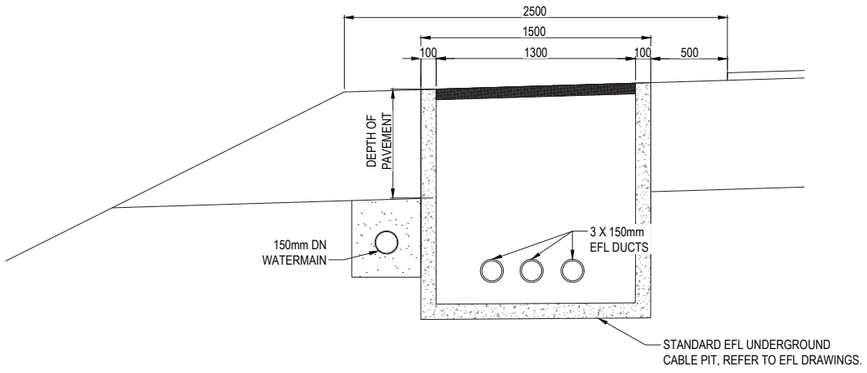
NOTES:

1. REFER TO 6103677-CE-STD-03 FOR GENERAL UTILITY NOTES.
2. UTILITIES SHOWN HAVE NOT BEEN CONFIRMED BY UTILITY COMPANIES
3. REFER TO CIVIL STANDARD DRAWINGS FOR TYPICAL UTILITY TRENCH INFORMATION, SPECIFICALLY 6103677-CE-STD-40.
4. ALL UTILITY INSTALLATIONS ARE TO BE DONE IN ACCORDANCE WITH THE APPROPRIATE UTILITY COMPANIES STANDARDS AND SPECIFICATIONS AS WELL AS THE PROJECT SPECIFICATIONS. SPECIFIC ATTENTION IS DRAWN TO THE FOLLOWING:
   - 4.1. TFL CIVIL WORKS GUIDELINES
   - 4.2. TFL PROFILE & PIT INSTALLATION GUIDELINES
   - 4.3. TFL DRAWING A3-3129-3
   - 4.4. TFL DRAWING A3-3130-1
   - 4.5. EFL DRAWING A3-01-C08-002
   - 4.6. EFL DRAWING A3-C26.20-SK04-0
   - 4.7. EFL DRAWING A3-C26.20-SK06-0
   - 4.8. EFL DRAWING A3-01-E24-028
   - 4.9. WAF STANDARD DRAWINGS



A B06-20 DETAIL A
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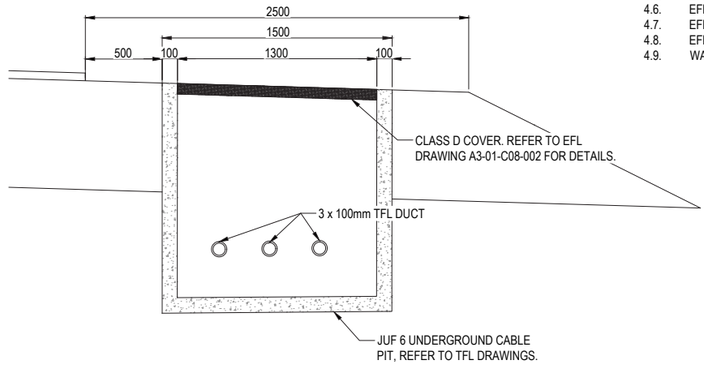
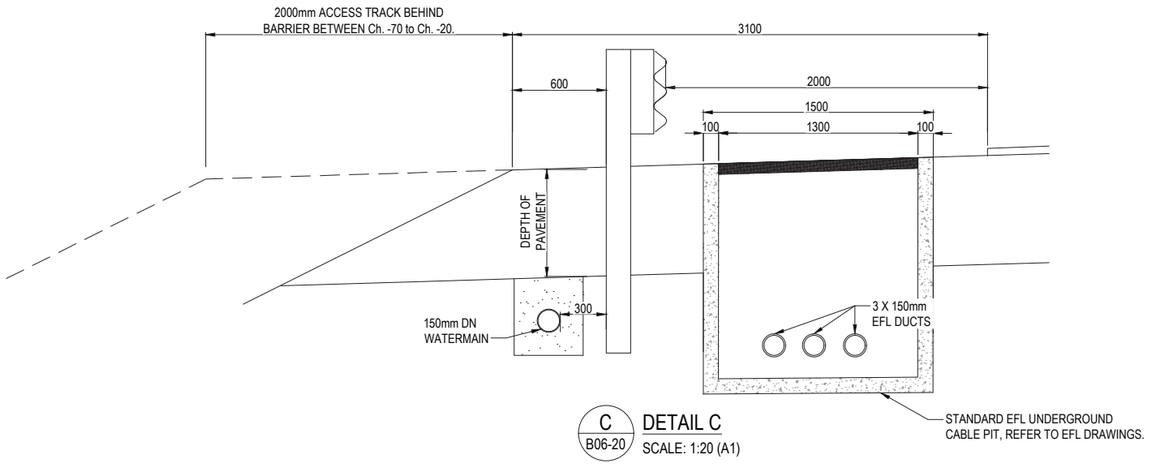
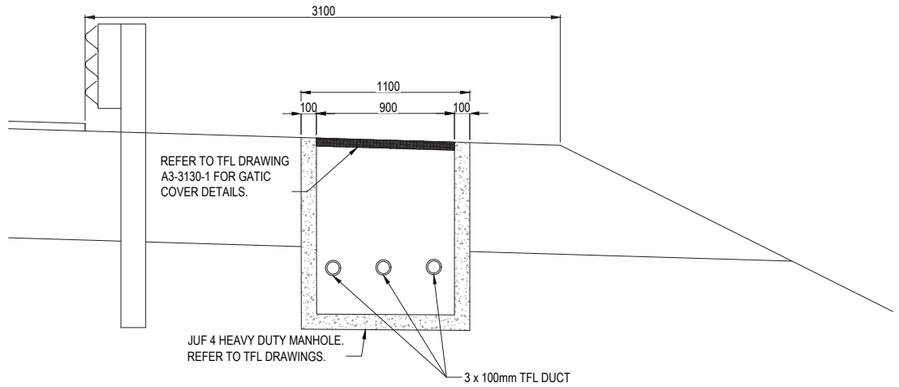


B B06-20 DETAIL B
SCALE: 1:20 (A1)



C B06-20 DETAIL C
SCALE: 1:20 (A1)



D B06-20 DETAIL D
SCALE: 1:20 (A1)

FOR CLARITY OF DETAILS
VIEW ELECTRONICALLY

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN - FOR FRA REVIEW	MS	VH	CH	21.09.23
A	DETAILED DESIGN- FOR COMMENT	MS	VH	CH	22.06.23

Original Scale (A1) 1:20	Design	M. SHEPPARD	22.06.23	Approved For Construction*
	Drawn	M. ANONUEVO	22.06.23	
Reduced Scale (A3) 1:40	Dsg Verifier	C. HATLEY	22.06.23	
	Drg Check	C. HATLEY	22.06.23	Date
	* Refer to Revision 1 for Original Signature			

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: VITAWA BRIDGE PROPOSED UTILITIES CROSS SECTIONS

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B06-21 Rev.: B

Document No. 6103677-CE-B06-21.DWG

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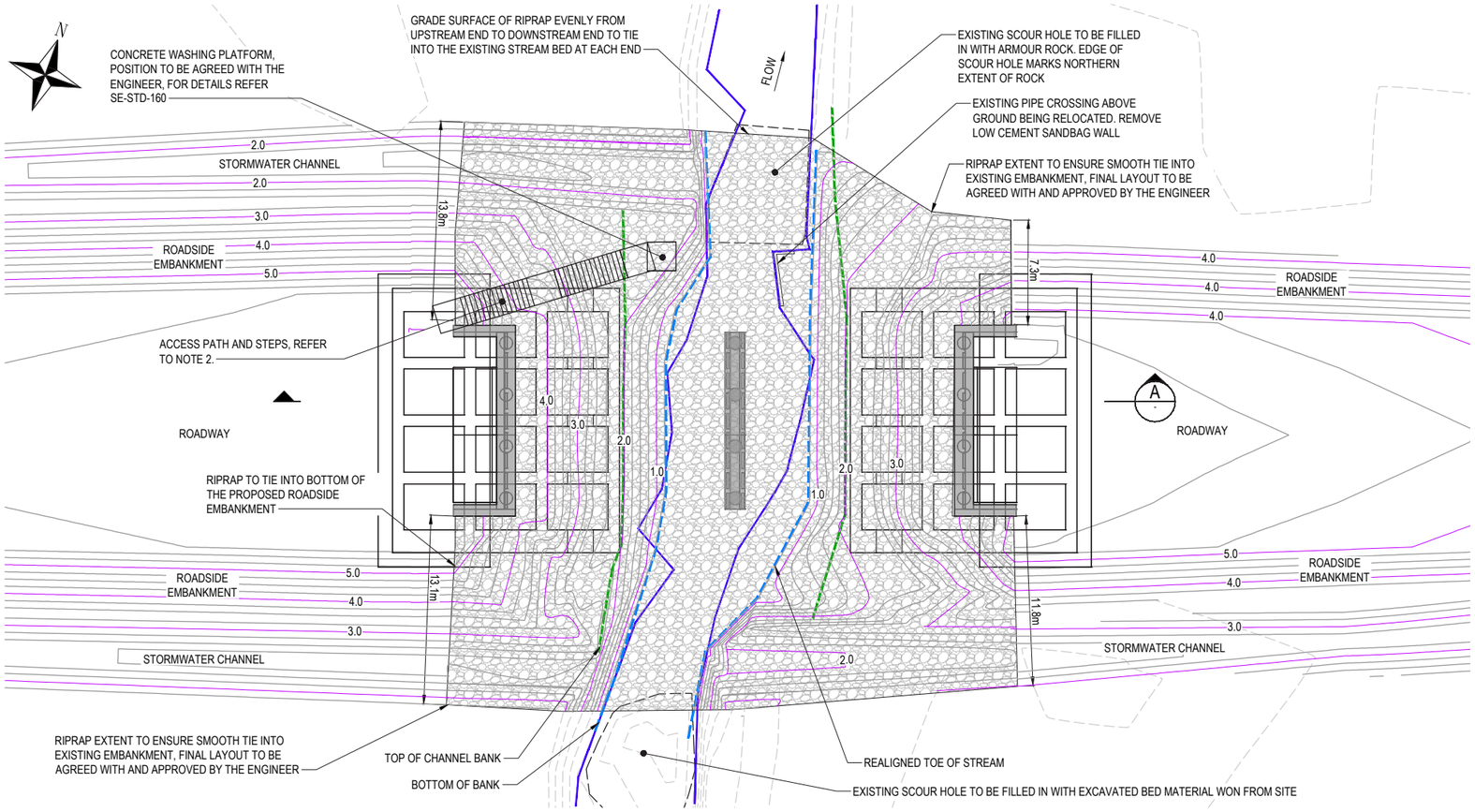
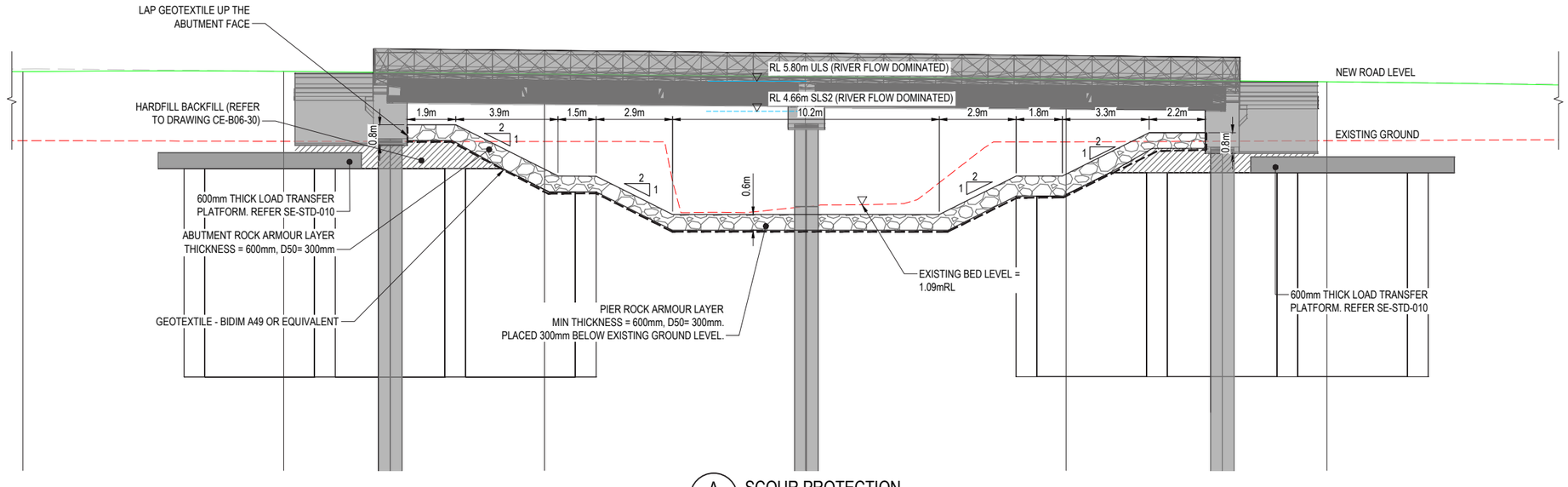


1 - SCOUR PROTECTION LAYOUT
SCALE 1:200



A - SCOUR PROTECTION
SCALE 1:100

NOTES:

1. FOR ABUTMENT DETAILS REFER TO STRUCTURAL STANDARD DETAILS 6103677-SE-STD SERIES DRAWINGS.
2. FOR ACCESS PATH DETAILS REFER TO 6103677-CE-06-10.
3. ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.
4. MAJOR CONTOURS SHOWN AT 1m INTERVALS
5. MINOR CONTOURS SHOWN AT 0.2m INTERVALS
6. EXCAVATED EXISTING GROUND TO BE REMOVED OFFSITE AFTER PLACEMENT OF ROCK RIPRAP.
7. ANY LOOSE DEBRIS WITHIN THE WATERWAY IS TO BE REMOVED
8. ROCK TO TIE INTO THE SURROUNDING EMBANKMENT. TOP OF ROCK TO MATCH EXISTING LEVELS.
9. REFER TO SECTION C0226 OF THE SPECIFICATION DOCUMENT FOR ROCK, UNDERLAYER AND GEOTEXTILE SPECIFICATIONS.

LEGEND:

- EXISTING TOE OF CHANNEL
- PROPOSED TOE OF CHANNEL
- PROPOSED TOP OF CHANNEL BANK LEVEL
- ROCK RIP RAP
- ULS RIVER FLOW LEVEL
- SLS2 RIVER FLOW LEVEL
- PROPOSED MAJOR CONTOURS (1.0m)
- PROPOSED MINOR CONTOURS (0.2m)
- EXISTING CONTOURS

FOR CLARITY OF DETAILS VIEW ELECTRONICALLY

DETAILED DESIGN NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN - FOR FRA REVIEW	HD	VH	CH	21.09.23
A	DETAILED DESIGN - FOR COMMENT	HD	VH	CH	7.09.23

Original Scale (A1) AS SHOWN	Design	H.DALLAS	7.09.23
	Drawn	H.DALLAS	7.09.23
Reduced Scale (A3) HALF SHOWN	Dsg Verifier	R.SHAFIEI	7.09.23
	Drg Check	V.HIRSCH	7.09.23

Approved For Construction* Date
* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: VITAWA BRIDGE SCOUR PROTECTION LAYOUT SHEET 1

Discipline: CIVIL ENGINEERING

Drawing No. Beca Project Number: 6103677-CE-B06-25

Rev. B

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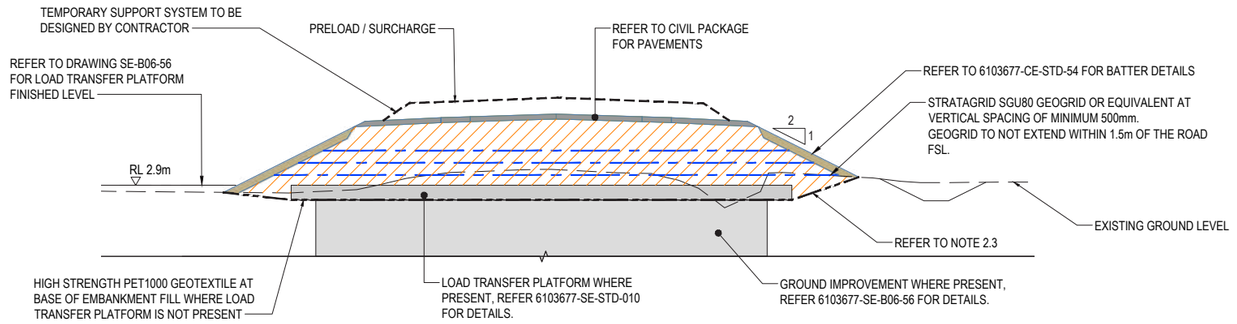
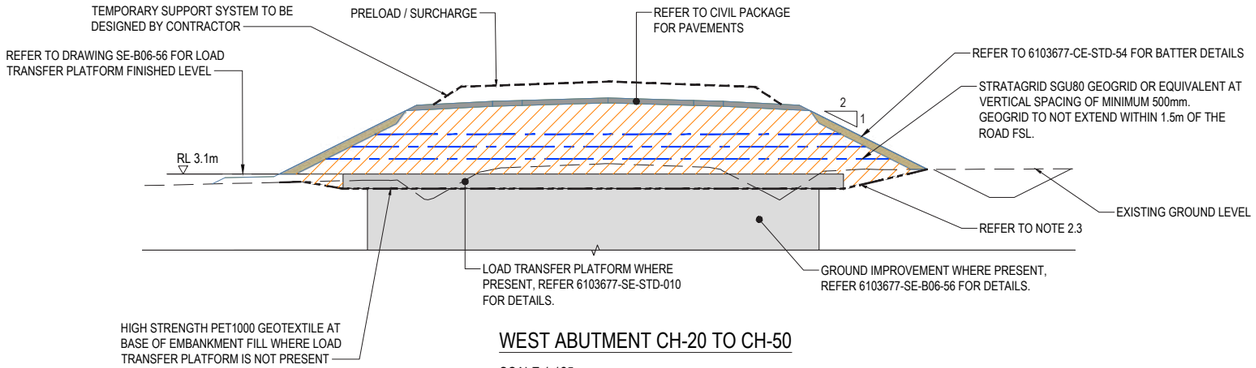
LEGEND:

- COMPACTED GAP 65
- TRANSVERSE GEOGRID LAYER
- ROAD SHOULDER
- PRELOAD TO FINISHED SURFACE LEVEL, THEN REMOVE FOR PAVEMENT CONSTRUCTION
- PRELOAD / SURCHARGE 1.0m ABOVE DESIGN GROUND LEVEL
- BASAL GEOTEXTILE LAYER



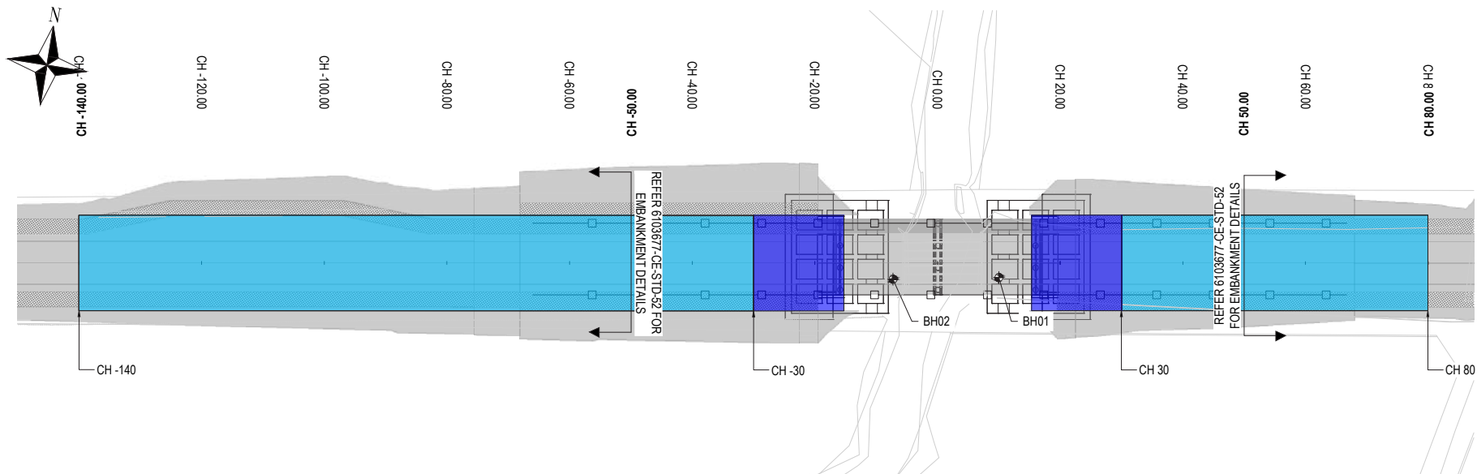
EAST ABUTMENT CH20 TO CH50

SCALE 1:125



WEST ABUTMENT CH-20 TO CH-50

SCALE 1:125



NOTE:
BOREHOLES PRESENTED ARE FROM 2022 ENTEC GEOTECHNICAL INVESTIGATION (GEOTECHNICAL FACTUAL REPORT:1107 - VITAWA BRIDGE, KINGS ROAD, VITI LEVU, FIJI, VERSION 3, 28 NOVEMBER 2022)

1 - PRELOAD EXTENTS AND EMBANKMENT PLAN

SCALE 1:500

NOTES:

1. GENERAL

1.1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING, PROTECTING AND/OR RELOCATING ANY UTILITIES AND DRAINAGE PRIOR TO WORKS COMMENCING.

1.2. ALL CONSTRUCTION WORKS SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE PROJECT EARTHWORKS SPECIFICATION.

1.3. EXISTING SWALE DRAINS ARE TO BE CLEARED OF VEGETATION AND UNSUITABLE SOILS AND BACKFILLED AS PER DETAIL A ON 6103677-CE-STD-53.

1.4. ANY SIGNIFICANT VARIANCES IN GROUND CONDITIONS FROM THOSE PRESENTED IN THESE DRAWINGS MUST BE BROUGHT TO THE ATTENTION OF THE ENGINEER.

1.5. SUBGRADE IMPROVEMENTS AND PAVEMENT LAYER NOT SHOWN ON DRAWINGS FOR CLARITY.

1.6. IN ORDER TO MINIMIZE THE POTENTIAL FOR INSTABILITY OF PERMANENT WORKS ELEMENTS, THE POSITION OF ANY TEMPORARY STOCKPILES SHALL BE AGREED WITH THE ENGINEER.

2. EMBANKMENT

2.1. PRIOR TO FILLING, TOPSOIL AND UNSUITABLE SOILS (INCLUDING HIGHLY ORGANIC SOILS OR SILT, TOXIC MATERIALS, PEAT LOGS, STUMPS, PERISHABLE OR ORGANIC MATERIALS, CONTAMINATED SOILS) SHALL BE EXCAVATED AND REMOVED.

2.2. WHERE MATERIAL IS ENCOUNTERED THAT DOES NOT MEET THE STRENGTH REQUIRED IN THE PROJECT EARTHWORKS SPECIFICATION, THE CONTRACTOR SHALL DETERMINE THE EXTENTS AND STRENGTH OF MATERIAL LESS THAN THIS REQUIREMENT FOR FURTHER UNDERCUTTING OR TREATMENT.

2.3. THE CONTRACTOR SHALL EVALUATE, DURING CONSTRUCTION, THE SAFE TAMPORARY BATTER ANGLE FOR ANY EXCAVATION OR FILLING.

2.4. THE MATERIALS AT FORMATION LEVEL SHOULD BE PROTECTED FROM SOFTENING, OVERLOADING (e.g. FROM CONSTRUCTION TRAFFIC) OR OTHER CONDITIONS WHICH MAY RESULT IN WEAKENING OF THESE MATERIALS.

2.5. POSITIVE DRAINAGE OF ALL EXCAVATION WORKS MUST BE MAINTAINED DURING CONSTRUCTION.

2.6. HOLD: ALL AREAS OF EXPOSED EMBANKMENT SUBGRADE ARE TO BE INSPECTED BY A COMPETENT PERSON TO CONFIRM UNSUITABLE SOILS HAVE BEEN REMOVED. REFER TO PROJECT EARTHWORKS SPECIFICATION FOR SUBGRADE REQUIREMENTS. QUALITY ASSURANCE DOCUMENTATION TO RECORD INSPECTION AND ACCEPTANCE.

2.7. ALL FILL MATERIALS SHALL MEET THE GRADING, COMPACTION AND TESTING REQUIREMENTS SPECIFIED IN THE PROJECT EARTHWORKS SPECIFICATION.

2.8. SETTLEMENT MONITORING INSTRUMENTATION DETAILED ON THE DRAWINGS TO BE INSTALLED, AND BASELINE MONITORING COMPLETED, PRIOR TO PLACING EMBANKMENT FILL.

2.9. PLACEMENT OF EMBANKMENT FILL MATERIAL AND PRELOAD FILL MATERIALS SHALL BE STAGED, WITH REST PERIODS OF MINIMUM 1 WEEK BETWEEN 1m HEIGHT FILL LIFTS. DURATION AND FREQUENCY OF REST PERIODS TO BE DETERMINED BY CONTRACTOR. DURATION OF REST PERIODS BETWEEN FILL STAGES TO BE ADJUSTED BY CONTRACTOR TO MANAGE INSTABILITY RISK DURING CONSTRUCTION.

2.10. EMBANKMENT FILL MATERIALS TO BE OVERFILLED TO ACCOUNT FOR SETTLEMENT, LATER TRIMMED TO DESIGN PAVEMENT SUBGRADE LEVEL.

3. GEOGRID AND BASAL GEOTEXTILE

3.1. REFER TO THE DRAWINGS AND PROJECT EARTHWORKS SPECIFICAITON FOR ALL GEOTEXTILE AND GEOGRID REQUIREMENTS.

3.2. LONGITUDINAL GEOGRID, WHERE SPECIFIED, IS LAID WITH THE PRIMARY STRENGTH DIRECTION ALONG THE ROAD CENTRELINE.

3.3. TRANSVERSE GEOGRID, WHERE SPECIFIED, IS LAID WITH THE PRIMARY STRENGTH DIRECTION PERPENDICULAR TO THE ROAD CENTRELINE.

3.4. BASAL HIGH STRENGTH GEOTEXTILES, WHERE SPECIFIED, IS WITH THE PRIMARY STRENGTH DIRECTION PERPENDICULAR TO THE ROAD CENTRELINE UNLESS SPECIFICALLY SPECIFIED OTHERWISE ON THE DRAWINGS.

3.5. HIGH STRENGTH GEOTEXTILES AND GEOGRIDS ARE TO BE CONTINUOUS IN THEIR PRIMARY STRENGTH DRIECTION AND NOT LAPPED.

3.6. WHERE THE HIGH STRENGTH GEOTEXTILES AND / OR GEOGRID LAYERS EXTEND INTO THE EXISTING GROUND SURFACE, TEMPORARY EXCAVATION WILL BE REQUIRED.

3.7. ALL HIGH STRENGTH GEOTEXTILE AND GEOGRID LAYERS ARE TO BE LAID OUT OVER THER FULL LENGTH AND COVERED AS A SINGLE OPERATION UNLESS AGREED OTHERWISE WITH THE ENGINEER. HIGH STRENGTH GEOTEXTILE AND GEOGRID LAYERS ARE TO BE COVERED WITHIN 3 DAYS OF PLACING.

3.8. NO TRAFFIC OF SITE PLANT SHALL BE PERMITTED TO TRAVEL ON THE GEOGRID OR HIGH STRENGTH GEOTEXTILE LAYERS WHERE THE FILL COVER IS LESS THAN 200mm.

3.9. GEOGRID WITHIN FILL EMBANKMENTS (EXCLUDING RETAINING STRUCTURES) SHALL BE PLACED WITH A VERTICAL SPACING OF 500mm BETWEEN LAYERS UNLESS SPECIFICALLY SPECIFIED OTHERWISE ON THE DRAWINGS.

4. PRELOAD SURCHARGING OF EMBANKMENTS

4.1. WHERE SHOWN ON THE DRAWINGS THE FILL EMBANKMENTS ARE TO BE SURCHARGED WITH PRELOAD TO ACCELERATE THE RATE OF CONSOLIDATION SETTLEMENT DURING CONSTRUCTION. REFER THE PROJECT EARTHWORKS SPECIFICATION FOR PRELOAD AND SURCHARGE SPECIFICATION.

4.2. THE PRELOAD SHALL COMPRISE AN AGGREGATE WITH A PLACED DENSITY NOT LESS THAN 2.2t/m³.

4.3. THE PRELOAD FILL SHOULD BE PLACED NO STEEPER THAN 1.5H:1V SLOPE UNLESS THE CONTRACTOR PROVIDES A TEMPORARY SUPPORT SYSTEM.

4.4. SETTLEMENT PERIODS AND HEIGHTS OF FILL TO BE REMOVED ARE DEPENDENT ON SETTLEMENT MONITORING RESULTS. ENGINEER TO CONFIRM THAT ADEQUATE CONSOLIDATION SETTLEMENT HAS OCCURRED PRIOR TO REMOVAL OF SURCHARGE AND COMMENCEMENT OF PAVEMENT WORKS.

4.5. SETTLEMENT OF THE EMBANKMENT SHALL BE MONITORED DURING CONSTRUCTION WITH INSTRUMENTATION SHOWN ON THE DRAWINGS.

4.6. PRELOAD / SURCHARGE IS TO REMAIN IN PLACE UNTIL RESIDUAL CONSOLIDATION SETTLEMENT IS ESTIMATED TO BE LESS THAN 50mm, AS ADVISED BY THE ENGINEER FOLLOWING ANALYSIS OF THE FIELD DATA TO UPDATE SETTLEMENT ESTIMATES.

4.7. FOLLOWING REMOVAL OF THE PRELOAD ALL FILL MATERIALS REMAINING IN THE PERMEANT WORKS SHALL COMPLY WITH THE MATERIALS TYPE AND FIELD COMPACTION STATED ON THE DRAWINGS AND SPECIFICATION.

4.8. ESTIMATED DURATION OF PRELOADING IS SIX MONTHS WITH THE ACTUAL DURATION TO BE CONFIRMED WITH THE ENGINEER.

4.9. THE LOWER 150mm (MIN.) OF THE PRELOAD / SURCHARGE FILL SHALL COMPLY WITH THE MATERIALS TYPE AND FIELD COMPACTION STATED ON THE DRAWINGS AND SPECIFICATION FOR THE EMBANKMENT FILL.

FOR CLARITY OF DETAILS
VIEW ELECTRONICALLY

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN - FOR FRA REVIEW	MA	TP	CH	21.09.23
A	DETAILED DESIGN- FOR COMMENT	HB	VH	CH	22.06.23

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	H.BINDON	22.06.23	Approved For Construction*
Drawn	M. ANONUEVO	22.06.23	
Dsg Verifier	M.GIBSON	22.06.23	
Drg Check	C. HATLEY	22.06.23	Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito
Main-consultant: Beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: VITAWA BRIDGE EMBANKMENT DETAILS AND PRELOAD SURCHARGE
Discipline: CIVIL ENGINEERING
Drawing No.: 6103677-CE-B06-30
Rev.: B

Document No. 6103677-CE-B06-30.DWG

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DO NOT SCALE FOR SET OUT DIMENSIONS

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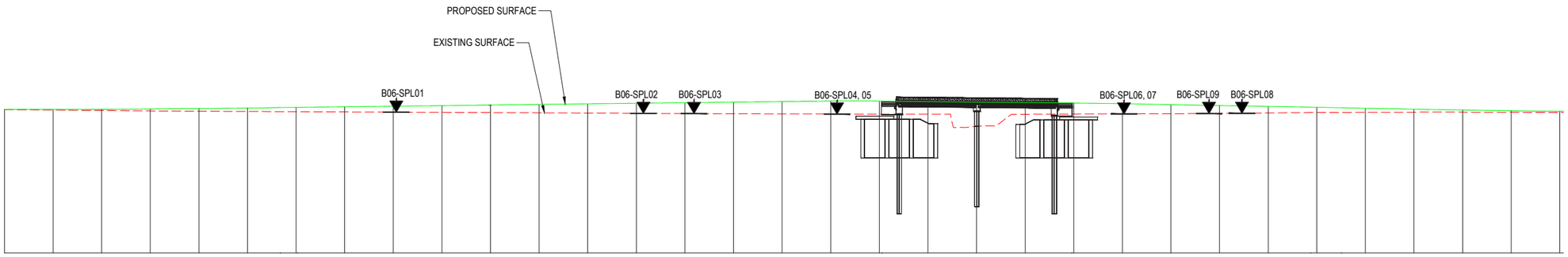
1 - INSTRUMENTATION AND MONITORING PLAN

SCALE 1:500



INSTRUMENTATION AND MONITORING SECTION

SCALE 1:500

INSTRUMENTATION & MONITORING SETOUT POINTS

INSTRUMENT	NORTHING	EASTING
B06-SPL01	3958480.3	1932238.2
B06-SPL02	3958485.5	1932288.8
B06-SPL03	3958472.4	1932301.9
B06-SPL04	3958494.5	1932327.8
B06-SPL05	3958476.9	1932330.4
B06-SPL06	3958502.4	1932386.3
B06-SPL07	3958486.5	1932388.9
B06-SPL08	3958506.1	1932410.5
B06-SPL09	3958489.6	1932406.6
B06-SPL10	3958465.2	1932250.6
B06-SP(S) 1	3958512.9	1932443.7
B06-SP(S) 2	3958493.3	1932341.2
B06-SP(S) 3	3958482.6	1932343.0
B06-SP(S) 4	3958495.9	1932357.0
B06-SP(S) 5	3958485.2	1932358.7
B06-SP(S) 6	3958498.4	1932372.7
B06-SP(S) 7	3958487.8	1932374.5

INSTRUMENTATION & MONITORING FREQUENCY

INSTRUMENT DETAILS			INSTRUMENT MONITORING FREQUENCY			
INSTRUMENT	LOCATION	INSTALLATION	PRECONSTRUCTION	DURING CONSTRUCTION	DURING PRELOAD	POST PRELOAD
SETTLEMENT PLATE B06-SPL01 - SPL09	NATURAL GROUND IMMEDIATELY BENEATH EMBANKMENT FILL	PRIOR TO INSTALLATION OF ANY FILL	THREE TIMES BEFORE FILLING	WEEKLY DURING EMBANKMENT CONSTRUCTION	EVERY SECOND WEEK UNLESS AGREED OVERWISE WITH ENGINEER	AT 3 MONTHS INTERVALS UNTIL PAVEMENT CONSTRUCTION OR AS AGREED WITH THE ENGINEER
SURVEY PINS B06-SP(S) 1	ON CULVERT					
SURVEY PINS - STRUCTURES B06-SP(S) 2 - SP(S) 7	NEW BRIDGE ABUTMENTS AND PIERS (WHEN CONSTRUCTED PRIOR TO FILLING OF PRELOAD PERIOD COMPLETE)	IMMEDIATELY AFTER CONSTRUCTION OF STRUCTURAL ELEMENT	N/A	EVERY SECOND WEEK UNLESS AGREED OTHERWISE WITH ENGINEER	N/A	N/A

NOTES:

1. CONTRACTOR CONSTRUCTION METHODOLOGY, SEQUENCING AND PROPOSED PRELODING SURCHAGE PROGRAMME TO BE PROVIDED TO THE ENGINEER PRIOR TO COMMENCMENT OF WORKS.
2. THE PROPOSED INSTALLATION LOCATIONS FOR INSTRUMENTS AIM TO POSITION THEM AWAY FROM CONSTRUCTION ACTIVITIES TO MINIMISE THE CHANCE OF DAMAGE TO THE INSTRUMENTS. THE FINAL LOCATION OF INSTRUMENTS SHALL BE CONFIRMED ON SITE WITH THE ENGINEER AND THE CONTRACTOR SHALL TAKE ALL PRACTICAL MEASURES TO PROTECT ALL MONITORING INSTRUMENTS DURING ALL PHASES OF CONSTRUCTION (e.g. EARTHWORKS, WEATHER, TRAFFIC, OTHER CONSTRUCTION ACTIVITIES).
3. IN THE EVENT THAT THE INSTRUMENTS ARE DAMAGED THE ENGINEER SHALL BE IMMEDIATELY INFORMED AND, IF REQUIRED BY THE ENGINEER DEPENDING ON THE DEGREE OF DAMAGE, ALL CONSTRUCTION WORKS NEAR TO THE AFFECTED INSTRUMENTATION SHALL CEASE. THE DAMAGED INSTRUMENTS SHALL BE IMMEDIATELY REPLACED AND RE-BASELINED WITHIN 24 HOURS (UNLESS OTHERWISE AGREED WITH THE ENGINEER) AND WHERE CONSTRUCTION WORKS ARE HALTED, THEY SHALL NOT RESTART UNTIL THE REPLACEMENT INSTRUMENT IS FULLY OPERATIONAL.
4. THE ENGINEER WILL REVIEW MONITORING RESULTS AND WILL CONFIRM THE END OF THE SETTLEMENT PERIOD.
5. MONITORING FREQUENCY MAY BE ALTERED AS ACCEPTED BY THE ENGINEER.
6. REFER TO 6103677-CE-STD-55 FOR TRIGGER LEVELS.
7. THE INSTALLATION AND MONITORING OF INSTRUMENTATION AND THE COLLATION OF DATA AND REVIEW OF RESULTS AGAINST THE TRIGGER LEVELS PROVIDED BY THE ENGINEER SHALL BE CARRIED OUT BY THE CONTRACTOR (OR SUITABLE PERSONNEL OR ORGANISATIONS NOMINATED BY THE CONTRACTOR WHO ARE EXPERIENCED AND COMPETENT IN SUCH WORK). ANY EXCEEDANCE OF THE TRIGGER LEVELS SHOULD BE REPORTED TO THE ENGINEER IMMEDIATELY
8. THE REQUIREMENTS OF INSTRUMENTATION AND MONITORING SPECIFICATION APPLY UNLESS OTHERWISE NOTED ON THESE DRAWINGS. FOR SPECIFICATION AND INSTRUMENTATION DETAILS REFER 6103677-CE-STD-55 TO 6103677-CE-STD-58.

LEGEND:

SETTLEMENT MONITORING PLATE

SURVEY PIN (STRUCTURES)

FOR CLARITY OF DETAILS
VIEW ELECTRONICALLY

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN - FOR FRA REVIEW	MA	TP	CH	21.09.23
A	DETAILED DESIGN- FOR COMMENT	HB	VH	CH	22.06.23

Original Scale (A1) 1:500
Reduced Scale (A3) 1:1000

Design	H.BINDON	22.06.23	Approved For Construction*
Drawn	M. ANONUEVO	22.06.23	
Dsg Verifier	M.GIBSON	22.06.23	
Drg Check	C. HATLEY	22.06.23	Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: VITAWA BRIDGE INSTRUMENTATION AND MONITORING DETAILS

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B06-31

Rev.: B

Document No. 6103677-CE-B06-31.DWG

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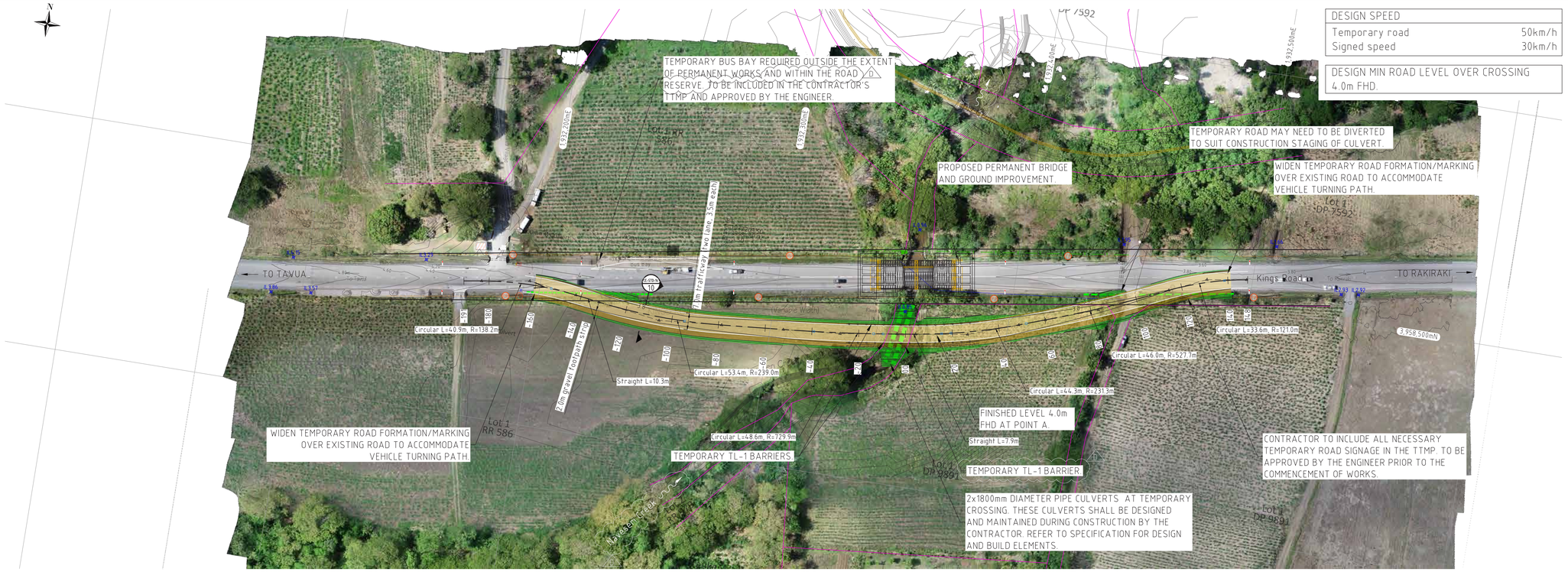


1 – ON-LINE REPLACEMENT TEMPORARY CROSSING UPSTREAM

SCALE 1:2000(A3)

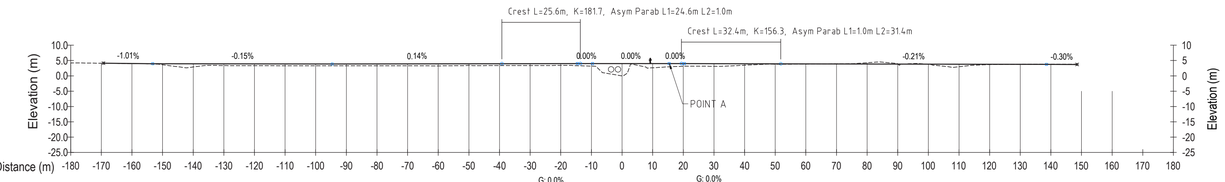
DESIGN SPEED	
Temporary road	50km/h
Signed speed	30km/h

DESIGN MIN ROAD LEVEL OVER CROSSING 4.0m FHD.

NOTES:

1. REFER TO DRAWING CE-B06-10 FOR NOTES.
2. DIVERSION ROAD MINIMUM LANE WIDTHS AND SHOULDER WIDTHS TO BE AS SPECIFIED ON THIS DRAWING AND DRAWINGS CE-B06-42, 43 & 44.
3. DIVERSION ROAD ALIGNMENT IS INDICATIVE. DESIGN VEHICLE IS 19m LONG SEMI TRAILER. CONTRACTOR TO DESIGN DIVERSION ROAD TO ALLOW 19m LONG SEMI TRAILER AND AN 8.8m SINGLE UNIT TRUCK TO PASS ONE ANOTHER. DESIGN TO MAKE ALLOWANCE FOR TRACKING OF THE DESIGN VEHICLE PLUS A 0.5m BUFFER EACH SIDE, AND PROVISION OF LANE WIDENING WHERE REQUIRED. ALIGNMENT DESIGN AND TRACKING TO BE SUPPLIED TO THE ENGINEER FOR REVIEW PRIOR TO CONSTRUCTION.
4. THE DIVERSION ROAD SHALL BE WITHIN THE CONSTRUCTION ZONE SHOWN ON DRAWING CE-B06-35.
5. DIVERSION ROAD PAVEMENT DESIGN IS CONTRACTOR'S RESPONSIBILITY. ROAD TO BE DESIGNED AS ALL WEATHER ROAD WITH CHIPSEAL SURFACE. DESIGN THICKNESS TO ALLOW FOR OVERLOADED VEHICLES AND PROTECTION OF THE SUBGRADE SOILS FROM BEARING AND/OR SHEAR FAILURE.
6. THE CONTRACTOR SHALL MAINTAIN THE DIVERSION ROAD KEEPING IT IN GOOD SAFE CONDITION, SURFACE RUT DEPTHS NOT TO EXCEED 20mm, FREE OF POT HOLES AND DEFECTS, ETC FOR THE DURATION OF ITS USE.
7. THE CONTRACTOR SHALL PROVIDE A STORMWATER DRAINAGE DESIGN FOR THE DIVERSION ROAD, TO BE REVIEWED BY THE ENGINEER PRIOR TO COMMENCEMENT OF WORKS.
8. TEMPORARY CULVERT SHALL BE DESIGNED AND MAINTAINED DURING CONSTRUCTION BY THE CONTRACTOR. REFER TO SPECIFICATION FOR DESIGN BUILD ELEMENTS. CONTRACTOR METHOD FOR INSTALLING CULVERT AND FILL SHALL LIMIT DIFFERENTIAL SETTLEMENT OF THE CULVERT TO 25mm OVER A 6m LENGTH.
9. ALL TEMPORARY RETAINING WALLS REQUIRED FOR TEMPORARY DIVERSION SHALL BE DESIGNED BY THE CONTRACTOR.

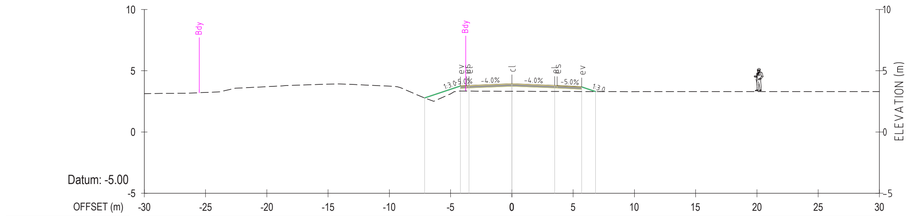
△0



| | | |

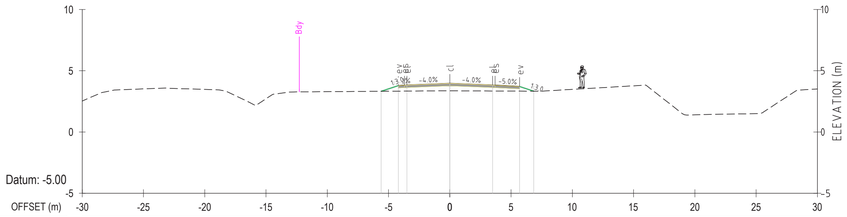
NOTES:

1. REFER TO DRAWING CE-B06-10 FOR NOTES.



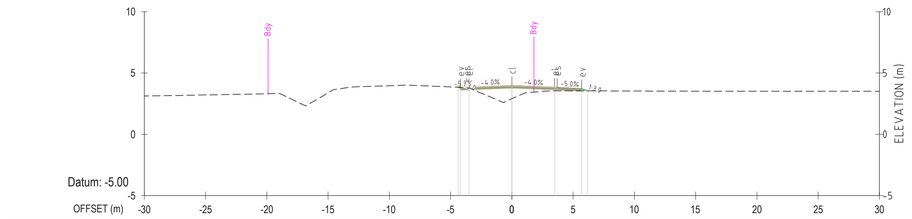
CUT/FILL			0.00	0.41	0.45	0.61	0.47	0.37	0.00	
DESIGN LEVELS			2.78	3.75	3.78	3.92	3.78	3.68	3.30	
EXISTING LEVELS			2.78	3.34	3.34	3.32	3.31	3.30	3.30	
OFFSETS		-7.12	-4.20	-3.50	0.00	3.50	5.70	6.83		

DIST: -120.00m



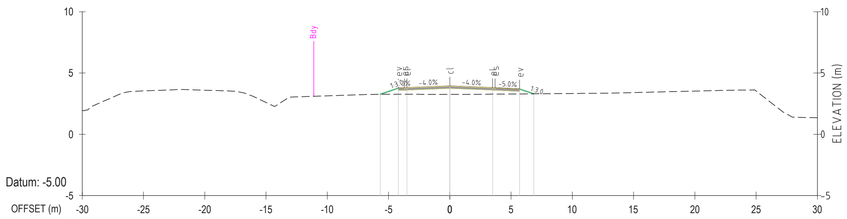
CUT/FILL			0.00	0.46	0.49	0.60	0.48	0.38	0.00	
DESIGN LEVELS			3.32	3.79	3.82	3.96	3.82	3.72	3.33	
EXISTING LEVELS			3.32	3.33	3.34	3.36	3.35	3.34	3.33	
OFFSETS		-5.60	-4.20	-3.50	0.00	3.50	5.70	6.85		

DIST: -40.00m



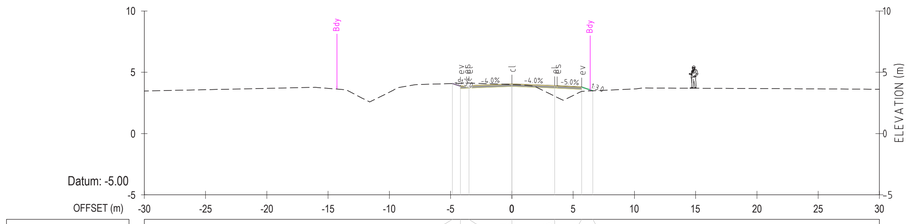
CUT/FILL			0.00	-0.06	0.04	1.05	0.27	0.16	0.00	
DESIGN LEVELS			3.84	3.78	3.81	3.95	3.81	3.71	3.54	
EXISTING LEVELS			3.84	3.84	3.78	2.90	3.54	3.54	3.54	
OFFSETS		-4.39	-4.20	-3.50	0.00	3.50	5.70	6.19		

DIST: -140.00m



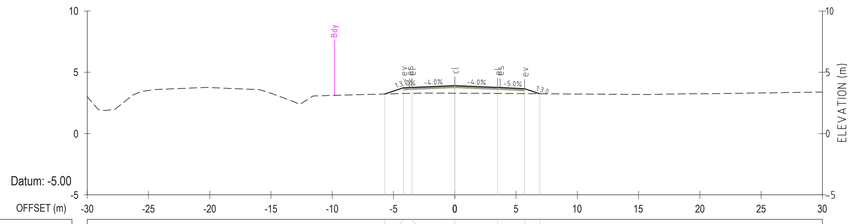
CUT/FILL			0.00	0.50	0.53	0.68	0.52	0.40	0.00	
DESIGN LEVELS			3.27	3.76	3.80	3.94	3.80	3.69	3.30	
EXISTING LEVELS			3.27	3.27	3.26	3.26	3.27	3.29	3.30	
OFFSETS		-5.68	-4.20	-3.50	0.00	3.50	5.70	6.86		

DIST: -60.00m



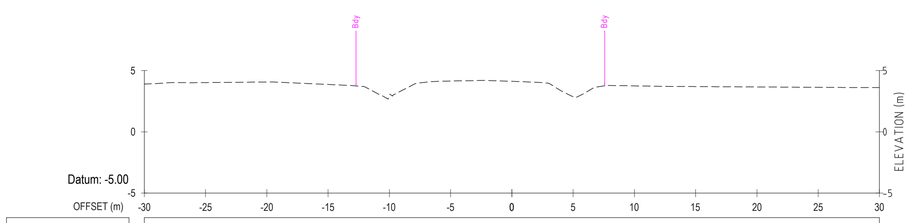
CUT/FILL			0.00	-0.24	-0.22	0.04	0.85	0.35	0.00	
DESIGN LEVELS			4.08	3.87	3.90	4.04	3.90	3.79	3.49	
EXISTING LEVELS			4.08	4.11	4.13	4.00	3.05	3.44	3.49	
OFFSETS		-4.85	-4.20	-3.50	0.00	3.50	5.70	6.61		

DIST: -160.00m



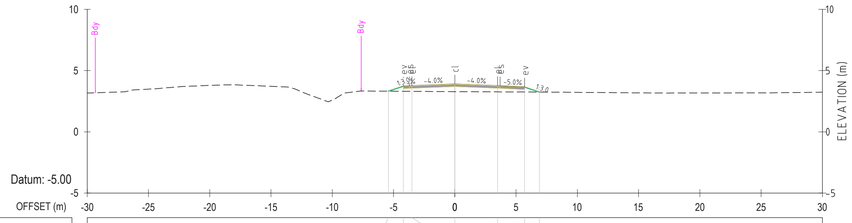
CUT/FILL			0.00	0.47	0.48	0.62	0.49	0.40	0.00	
DESIGN LEVELS			3.23	3.73	3.77	3.91	3.77	3.66	3.25	
EXISTING LEVELS			3.23	3.27	3.28	3.29	3.28	3.26	3.25	
OFFSETS		-5.72	-4.20	-3.50	0.00	3.50	5.70	6.93		

DIST: -80.00m



CUT/FILL										
DESIGN LEVELS										
EXISTING LEVELS										
OFFSETS										

DIST: -170.00m



CUT/FILL			0.00	0.41	0.45	0.61	0.49	0.39	0.00	
DESIGN LEVELS			3.32	3.72	3.76	3.90	3.76	3.65	3.25	
EXISTING LEVELS			3.32	3.31	3.30	3.28	3.26	3.25	3.25	
OFFSETS		-5.42	-4.20	-3.50	0.00	3.50	5.70	6.90		

DIST: -100.00m

LEGEND:

CADASTRAL BOUNDARY

SCALE 1:500(A3):

0 5 10 15 20

FOR CLARITY OF DETAILS VIEW ELECTRONICALLY

DETAILED DESIGN NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
D	DETAILED DESIGN - FOR FRA REVIEW.	RAI	TE	CH	01/03/24
C	DETAILED DESIGN - FOR FRA REVIEW.	RAI	TE	CH	21/09/23
B	DETAILED DESIGN - FOR COMMENT.	RAI	TE	CH	22/06/23
A	FOR FRA REVIEW.	RAI	TE	CH	03/02/23

Original Scale (A1) 1:250
Reduced Scale (A3) 1:500

Design	R Imrie	03/02/23	Approved For Construction×
Drawn	R Imrie	03/02/23	
Dsg Verifier	C Hatley	03/02/23	
Drg Check	C Hatley	03/02/23	Date

× Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: VITAWA BRIDGE TEMPORARY CROSSING SECTIONS SHEET 1

Discipline: INFRASTRUCTURE

Drawing No.: 6103677-CE-B06-42

Rev.: D

Document No. PRE FEAS 11 A 1 P1 5.DWG

DO NOT SCALE FOR SET OUT DIMENSIONS

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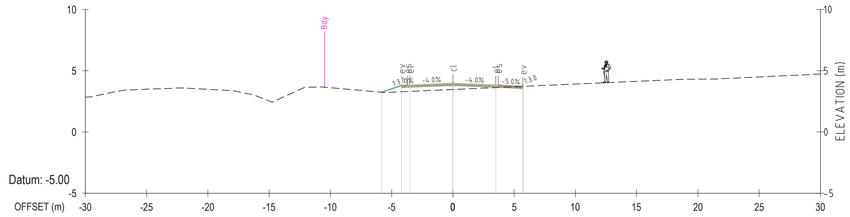
NOTES:

1. REFER TO DRAWING CE-B06-10 FOR NOTES.

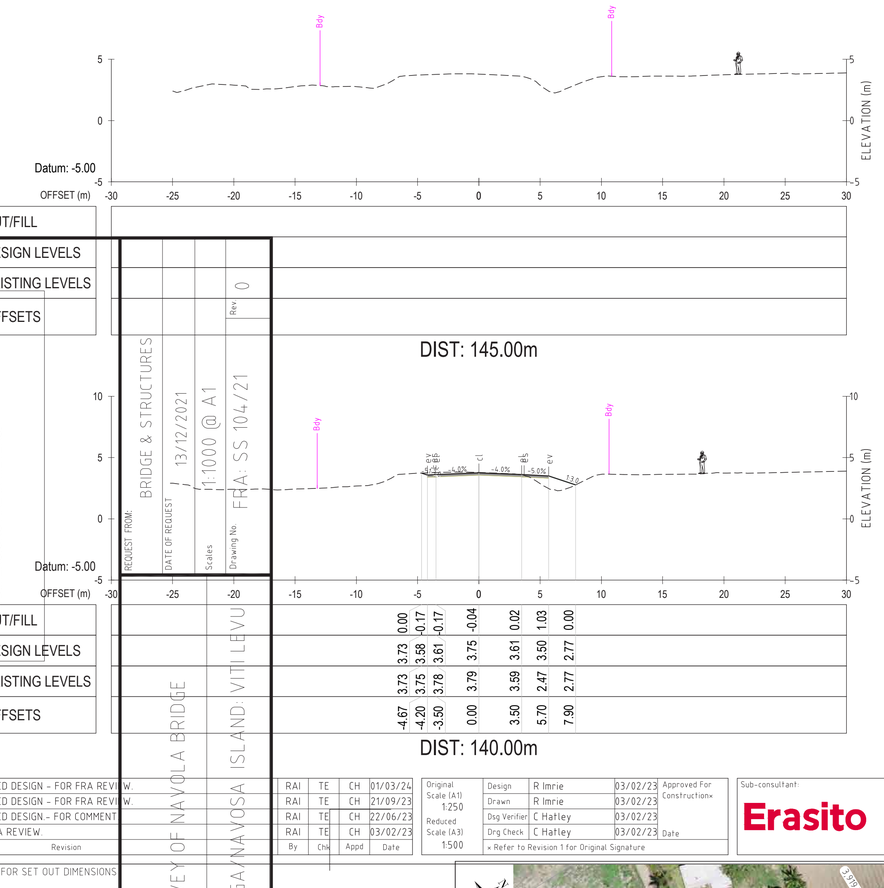


| | | |

Drawing Plotted: 29 Feb 2024 7:44 pm

NOTES:

1. REFER TO DRAWING CE-B06-10 FOR NOTES.



CUT/FILL	
DESIGN LEVELS	
EXISTING LEVELS	
OFFSETS	

DIST: 145.00m

CUT/FILL	0.00	-0.17	-0.17	-0.04		0.02	1.03	0.00						
DESIGN LEVELS	3.73	3.58	3.61	3.75		3.61	3.50	2.77						
EXISTING LEVELS	3.73	3.75	3.78	3.79		3.59	2.47	2.77						
OFFSETS	-4.67	-4.20	-3.50	0.00		3.50	5.70	7.90						

DIST: 140.00m

REQUEST FROM: BRIDGE & STRUCTURES
DATE OF REQUEST: 13/12/2021
Scales: 1:1000 @ A1
Drawing No.: FRA: SS 104/21
Rev. 0

3. CONTOUR INTERVALS: MAJOR: 1.00m
MINOR: 0.20m

4. THIS PLAN DOES NOT NECESSARILY SHOW ALL EXISTING SERVICES. IT'S THE DUTY OF THE CONTRACTOR TO ACCURATELY LOCATE AND PROTECT ALL EXISTING SERVICES BEFORE ANY EXCAVATION.

5. ALL DIMENSIONS, LEVELS & UNDERGROUND SERVICES LOCATIONS TO BE CHECKED ON SITE PRIOR TO COMMENCEMENT OF ALL WORKS.

ALL DIMENSIONS ARE IN METERS.

SURVEY OF NAVOLA BRIDGE
NAVOGA/NAYOSA ISLAND: VITI LEVU

No.	Revision	By	Chk	Appd	Date
D	DETAILED DESIGN - FOR FRA REVIEW	RAI	TE	CH	01/03/24
C	DETAILED DESIGN - FOR FRA REVIEW	RAI	TE	CH	21/09/23
B	DETAILED DESIGN - FOR COMMENT	RAI	TE	CH	22/06/23
A	FOR FRA REVIEW	RAI	TE	CH	03/02/23

DO NOT SCALE FOR SET OUT DIMENSIONS

Original Scale (A1) 1:250
Reduced Scale (A3) 1:500

Design	R Imrie	03/02/23
Drawn	R Imrie	03/02/23
Dsg Verifier	C Hatley	03/02/23
Drg Check	C Hatley	03/02/23

Approved For Construction× Date

× Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: VITAWA BRIDGE TEMPORARY CROSSING SECTIONS SHEET 3

Discipline: INFRASTRUCTURE

Drawing No.: 6103677-CE-B06-44

Rev.: D

Document No. PRE FEAS 11 A 1 P15.DWG

LEGEND:

CADASTRAL BOUNDARY

SCALE 1:500(A3):

0 5 10 15 20

FOR CLARITY OF DETAILS VIEW ELECTRONICALLY

DETAILED DESIGN NOT FOR CONSTRUCTION

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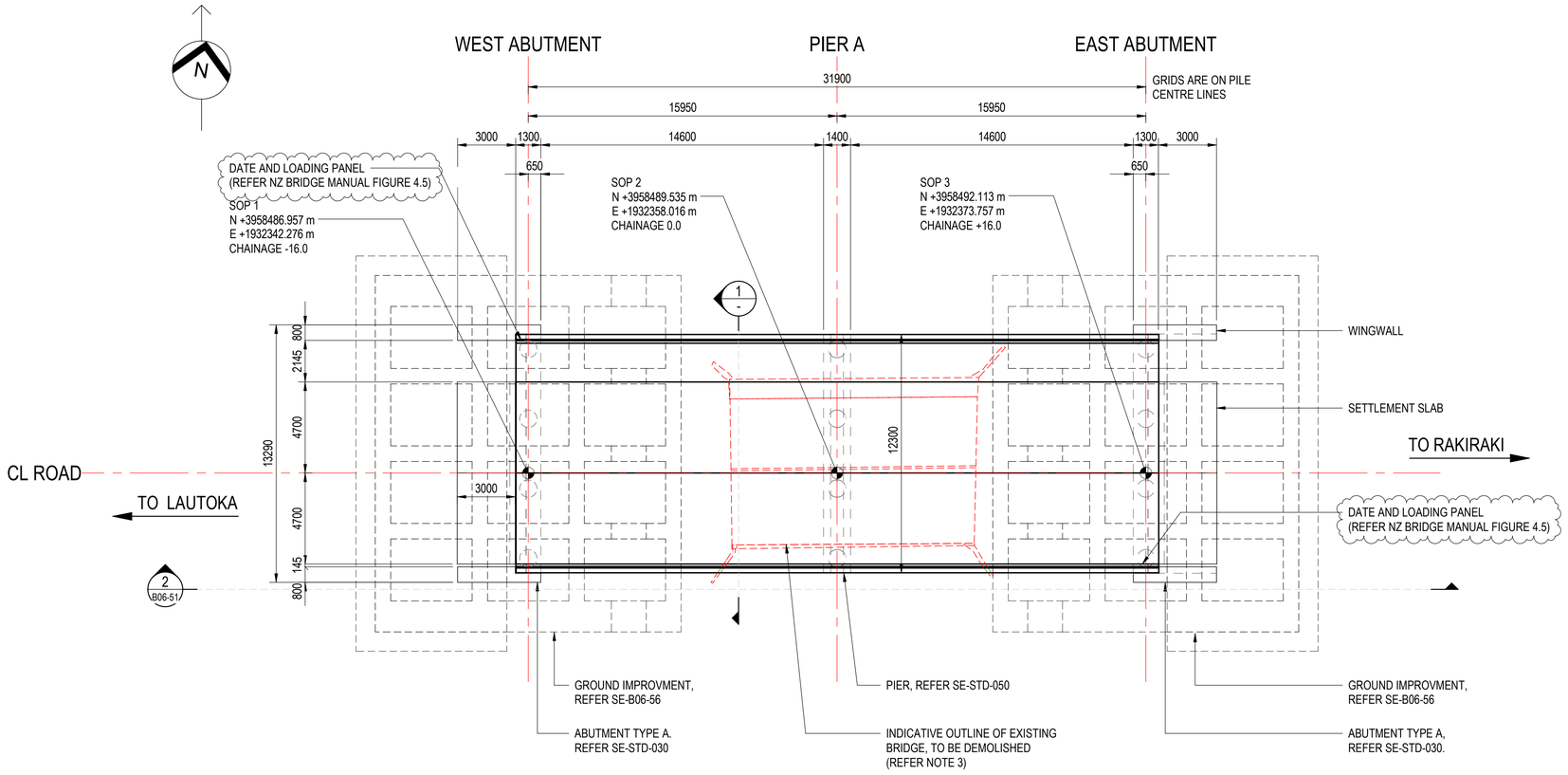
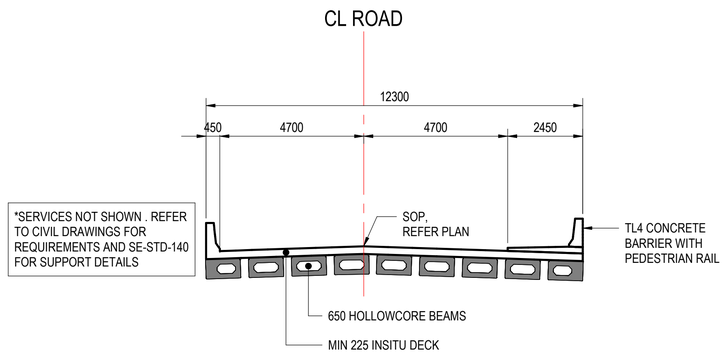
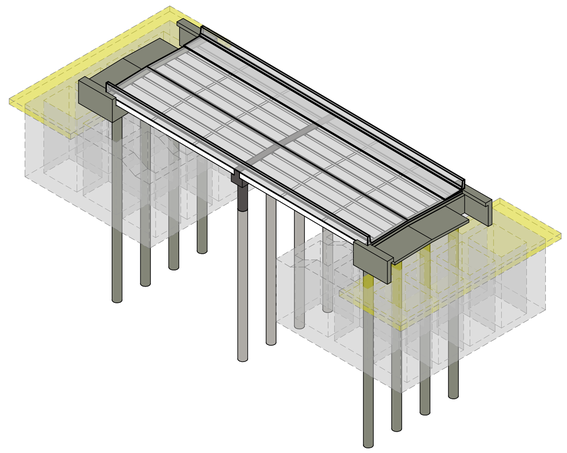


A - BRIDGE PLAN
1 : 150



FOR DETAILS REFER SECTION 3 / SE-STD-005

1 - SECTION
1 : 100



3D VIEW - B06 VITAWA BRIDGE

NOTES.

1. FOR SITE LAYOUT, FEATURES, AND ROAD CORRIDOR DETAILS REFER TO 6103677-CE-B06-10, ROADING PLAN AND PROFILE, AND THE RELATED CIVIL DRAWINGS.
2. VERTICAL HEIGHT DATUM IS FIJI HEIGHT DATUM AND COORDINATE SYSTEM IS FIJI MAP GRID (FMG). FOR DETAILS REFER TO FRA'S TOPOGRAPHICAL SURVEY DRAWING SS 102/21.
3. THE OUTLINE OF EXISTING BRIDGE IS AS PER FRA'S TOPOGRAPHICAL SURVEY DRAWING SS 102/21. THE CONTRACTOR SHALL CONFIRM POSITION OF THE BRIDGE PRIOR TO THE CONSTRUCTION.
4. THESE BRIDGE SPECIFIC DRAWINGS SHALL BE READ TOGETHER WITH AND REFER TO STANDARD DRAWINGS, SPECIFICALLY:
   - 6103677-SE-STD-001 TO 004 FOR GENERAL NOTES
   - 6103677-SE-STD-010 SERIES FOR GROUND IMPROVEMENT DETAILS
   - 6103677-SE-STD-020 SERIES FOR PILE DETAILS
   - 6103677-SE-STD-030 SERIES FOR ABUTMENT TYPE A DETAILS
   - 6103677-SE-STD-50 SERIES FOR PIER DETAILS
   - 6103677-SE-STD-060 SERIES FOR SUPERSTRUCTURE DETAILS
   - 6103677-SE-STD-070 SERIES FOR PRECAST PRESTRESSED SHC BEAM DETAILS
   - 6103677-SE-STD-100 SERIES FOR DECK DETAILS
   - 6103677-SE-STD-110 SERIES FOR BARRIERS DETAILS
   - 6103677-SE-STD-140 FOR SERVICE SUPPORT DETAILS
   - 6103677-SE-STD-180 FOR STANDARD BRIDGE ANTICIPATED CONSTRUCTION SEQUENCE
5. REFER TO PROJECT SPECIFICATION FOR EXISTING BRIDGE DEMOLITION REQUIREMENTS.
6. FOR FINISHED DESIGN LEVELS REFER TO DRAWING CE-B06-10 AND SE-B06-51.

No.	Revision	By	Chk	Appd	Date
D	DETAILED DESIGN, FOR FRA REVIEW	JRO	TP	CH	01.03.24
C	DETAILED DESIGN, FOR FRA REVIEW	JRO	TP	CH	21.09.23
B	DETAILED DESIGN, FOR COMMENT	RS	TP	CH	23.06.23
A	FOR FRA REVIEW	CRB	TP	CH	03.02.23

Drawing Plotted:31 Oct 2023 - 4:50 pm

Original Scale (A1)	As indicated	Reduced Scale (A3)	HALF A1

Design	D.CVITANICH	03.02.23	Approved for Construction*
Drawn	R.SATTAYAPORN	03.02.23	
Dsg Verifier	T.POLLEY	03.02.23	
Drg Check	D.CVITANICH	03.02.23	Date

* Refer to Revision 1 for Original Signatures

Sub-consultant: Erasito | Main-consultant: beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: B06 VITAWA BRIDGE - BRIDGE PLAN

Discipline: STRUCTURAL

Drawing No.: 6103677-SE-B06-50

Rev.: D

DETAILED DESIGN
NOT FOR CONSTRUCTION

APPROXIMATION
Y. REFER NOTE F.
134.6m²

DO NOT SCALE FOR SET OUT DIMENSIONS

NOTES

1. THESE BRIDGE SPECIFIC DRAWINGS REFER TO AND SHALL BE READ TOGETHER WITH STANDARD CIVIL

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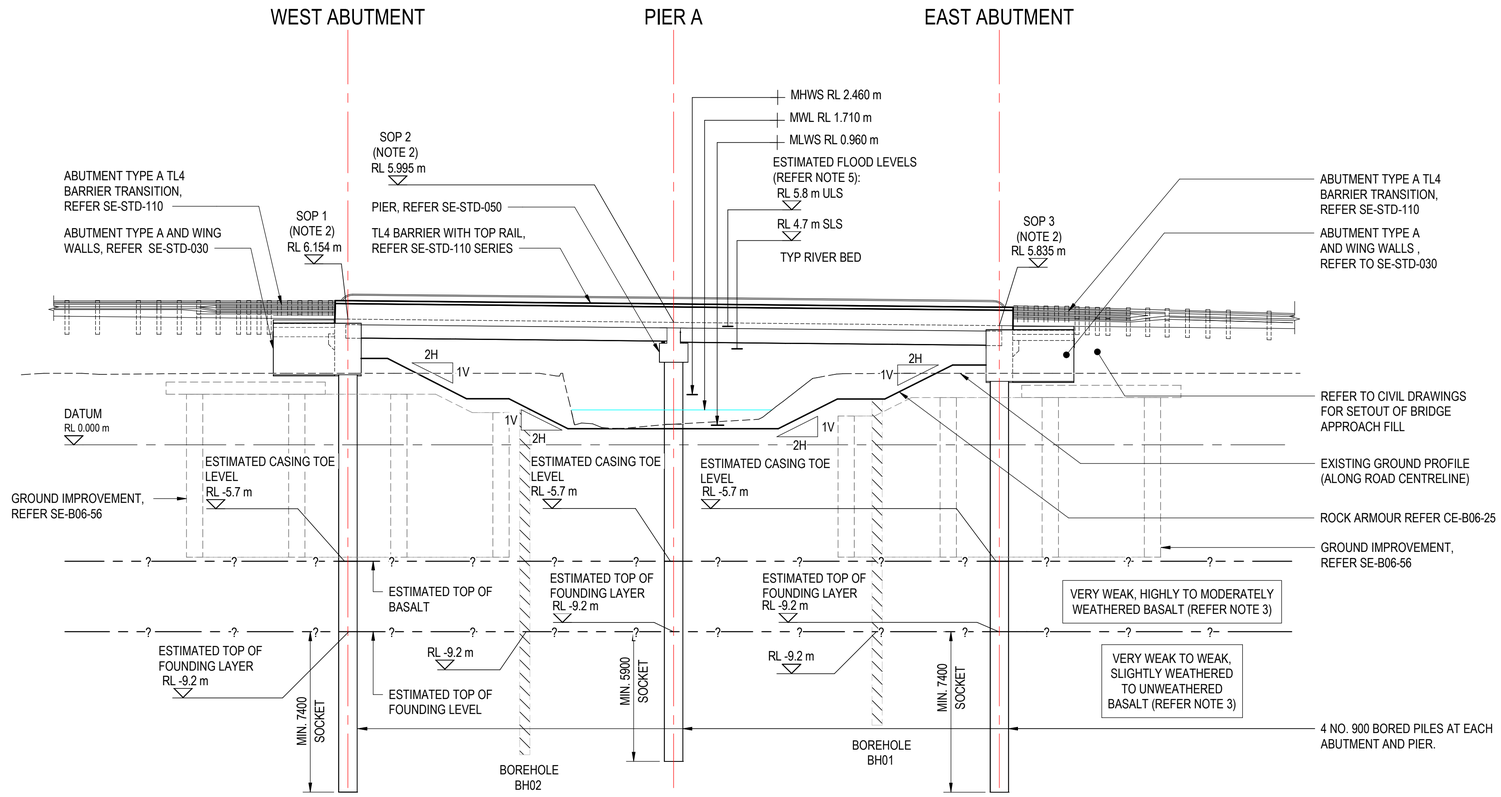

2 B06-50 ELEVATION
1 : 150

NOTES.

1. REFER TO DRAWING SE-B06-50 FOR NOTES.
2. REFER TO SE-B06-50 FOR SOP LOCATIONS. LEVELS ARE GIVEN AT THE TOP OF THE DECK AT INTERSECTION OF THE ROAD CENTRELINE AND SUPPORT GRID LINE PLACED ON THE CENTRELINE OF PILES. REFER TO SE-B06-50 DETAIL A FOR LOCATION.
3. ROCK DESCRIPTION IN ACCORDANCE WITH NEW ZEALAND GEOTECHNICAL SOCIETY GUIDANCE. REFER TO ENTEC FACTUAL GEOTECHNICAL REPORT FOR FURTHER INFORMATION. REFER TO CE-B06-30 FOR BOREHOLE LOCATIONS
4. ACTUAL CASING TOE LEVEL, TOP OF FOUNDING LAYER AND SOCKET SHALL BE CONFIRMED FOLLOWING CASING INSTALLATION AND PILE BORING. THE FINAL TOP OF FOUNDING LEVEL AND SOCKET SHALL BE CONFIRMED BY THE ENGINEER, SUBJECT TO ACTUAL ENCOUNTERED SOIL PROPERTIES.
5. FRA REQUESTED A MINIMUM FINISHED ROAD LEVEL OF 5.8m RL SHALL BE ADOPTED. FOR DETAILS REFER TO THE DESIGN REPORT.

No.	Revision	By	Chk	Appd	Date
D	DETAILED DESIGN, FOR FRA REVIEW	JRO	TP	CH	01.03.24
C	DETAILED DESIGN, FOR FRA REVIEW	JRO	TP	CH	21.09.23
B	DETAILED DESIGN, FOR COMMENT	RS	TP	CH	23.06.23
A	FOR FRA REVIEW	CRB	TP	CH	03.02.23

Original Scale (A1) 1 : 150
Reduced Scale (A3) HALF A1

Design	D.CVITANICH	03.02.23	Approved for Construction*
Drawn	R.SATTAYAPORN	03.02.23	
Dsg Verifier	T.POLLEY	03.02.23	
Drg Check	D.CVITANICH	03.02.23	Date

* Refer to Revision 1 for Original Signatures

Sub-consultant: Erasito
Main-consultant: beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: B06 VITAWA BRIDGE - BRIDGE ELEVATION
Discipline: STRUCTURAL
Drawing No.: 6103677-SE-B06-51
Rev.: D

DETAILED DESIGN
NOT FOR CONSTRUCTION

DO NOT SCALE FOR SET OUT DIMENSIONS

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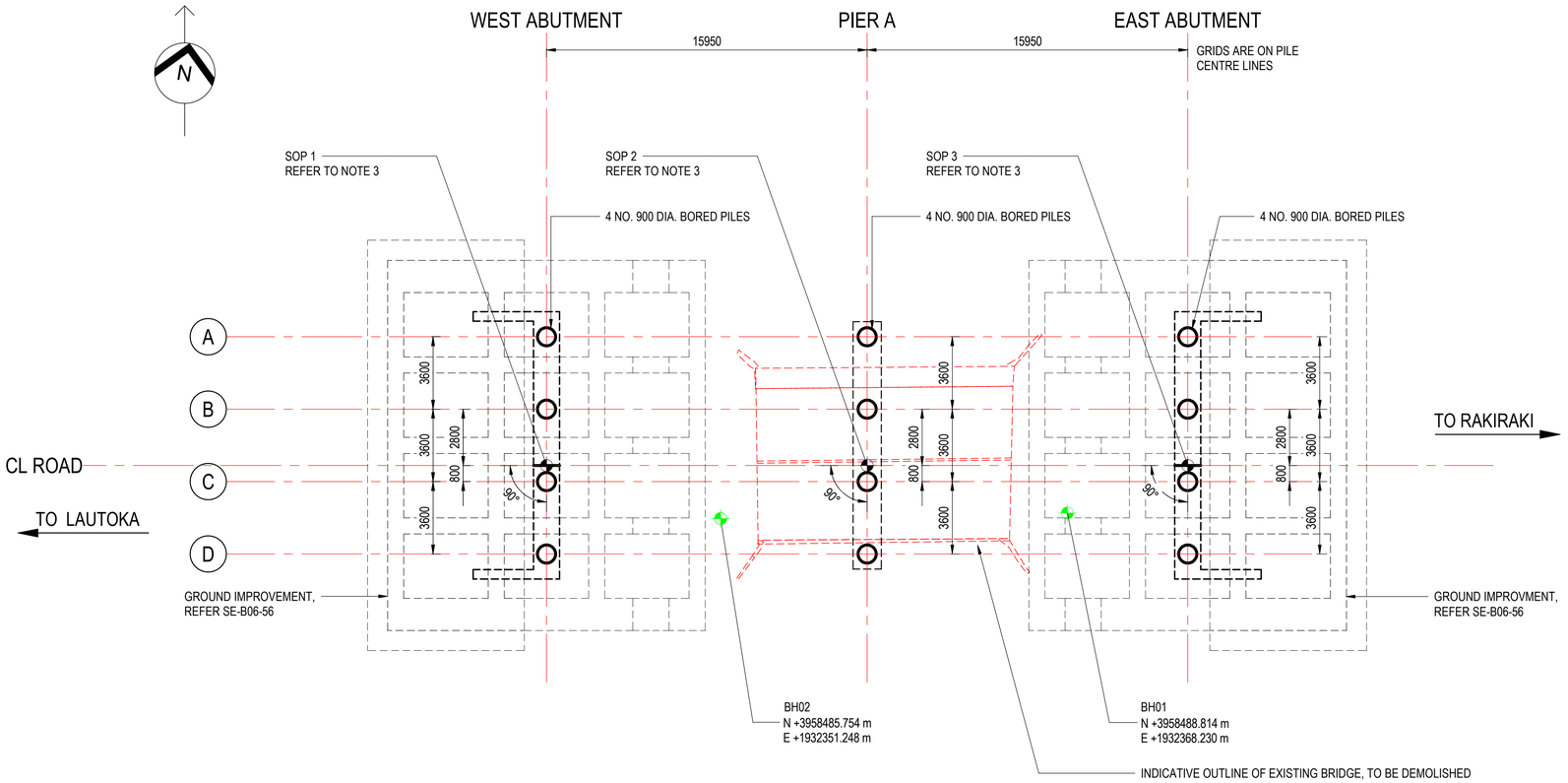
Document No. Autodesk Docs://6450911 - FRA 40+3/6103677-B06-SE-2023.rvt

NOTES:

1. REFER TO DRAWING SE-B06-50 FOR NOTES.
2. REFER TO STANDARD PILING DRAWINGS SE-STD-020 TO 021 FOR DETAILS
3. REFER TO DRAWING SE-B06-50 FOR SOP
4. ALL DIMENSIONS ARE PLAN DIMENSIONS AND ARE NOT TRUE LENGTH



FOR SET OUT OF GRID LINES REFER TO B06-SE-50.

PILING PLAN

1 : 150

BORED PILE REINFORCING INFORMATION

	LONGITUDINAL BARS				SPIRALS							
LOCATION	LENGTH "Y"	GROUP 1	GROUP 2	PHZs	SPIRAL TYPE A	DIST "A'	SPIRAL TYPE B	DIST "B"	SPIRAL TYPE C	DIST "C"	SPIRAL TYPE D	DIST "D"
WEST ABUTMENT	FULL LENGTH	12RB32	-	0m - 8.5m	RH16 - 300	7500	RH16 - 100	10500	RH16 - 300	REMAINING LENGTH	-	-
PIER A	FULL LENGTH	10RB32	-	0m - 4m& 9.5m - 15.5m	RH16 - 90	2000	RH16 - 250	6500	RH16 - 100	10000	RH16-300	REMAINING LENGTH
EAST ABUTMENT	FULL LENGTH	12RB32	-	0m - 8.5m	RH16 - 300	7500	RH16 - 100	10500	RH16 - 300	REMAINING LENGTH	-	-

*NO LAPPING OF LONGITUDINAL REINFORCEMENT IS ALLOWED IN PLASTIC HINGE ZONES (PHZs)
REFER TO BORED PILE DRAWING 6103677-SE-STD-021 FOR REINFORCEMENT CALLOUT

BEWARE:

THE CONTRACTOR SHALL CONFIRM THAT THERE IS NO CONFLICT WITH UNDERGROUND SERVICES (EXISTING, NEWLY INSTALLED AND / OR TEMPORARY) AND / OR IMPLEMENT APPROPRIATE PROTECTION MEASURES PRIOR TO CARRYING OUT ANY PILE INSTALLATION OR EXCAVATION WORKS.

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN, FOR FRA REVIEW	JRO	TP	CH	01.03.24
B	DETAILED DESIGN, FOR FRA REVIEW	JRO	TP	CH	21.09.23
A	DETAILED DESIGN, FOR COMMENT	RS	TP	CH	23.06.23

Original Scale (A1) 1 : 150
Reduced Scale (A3) HALF A1

Design	D.CVITANICH	23.06.23	Approved for Construction*
Drawn	R.SATTAYAPORN	23.06.23	
Dsg Verifier	T.POLLEY	23.06.23	
Drg Check	D.CVITANICH	23.06.23	Date

* Refer to Revision 1 for Original Signatures

Sub-consultant: Erasito
Main-consultant: beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: B06 VITAWA BRIDGE - PILING PLAN
Discipline: STRUCTURAL
Drawing No.: 6103677-SE-B06-55
Rev.: C

DO NOT SCALE FOR SET OUT DIMENSIONS
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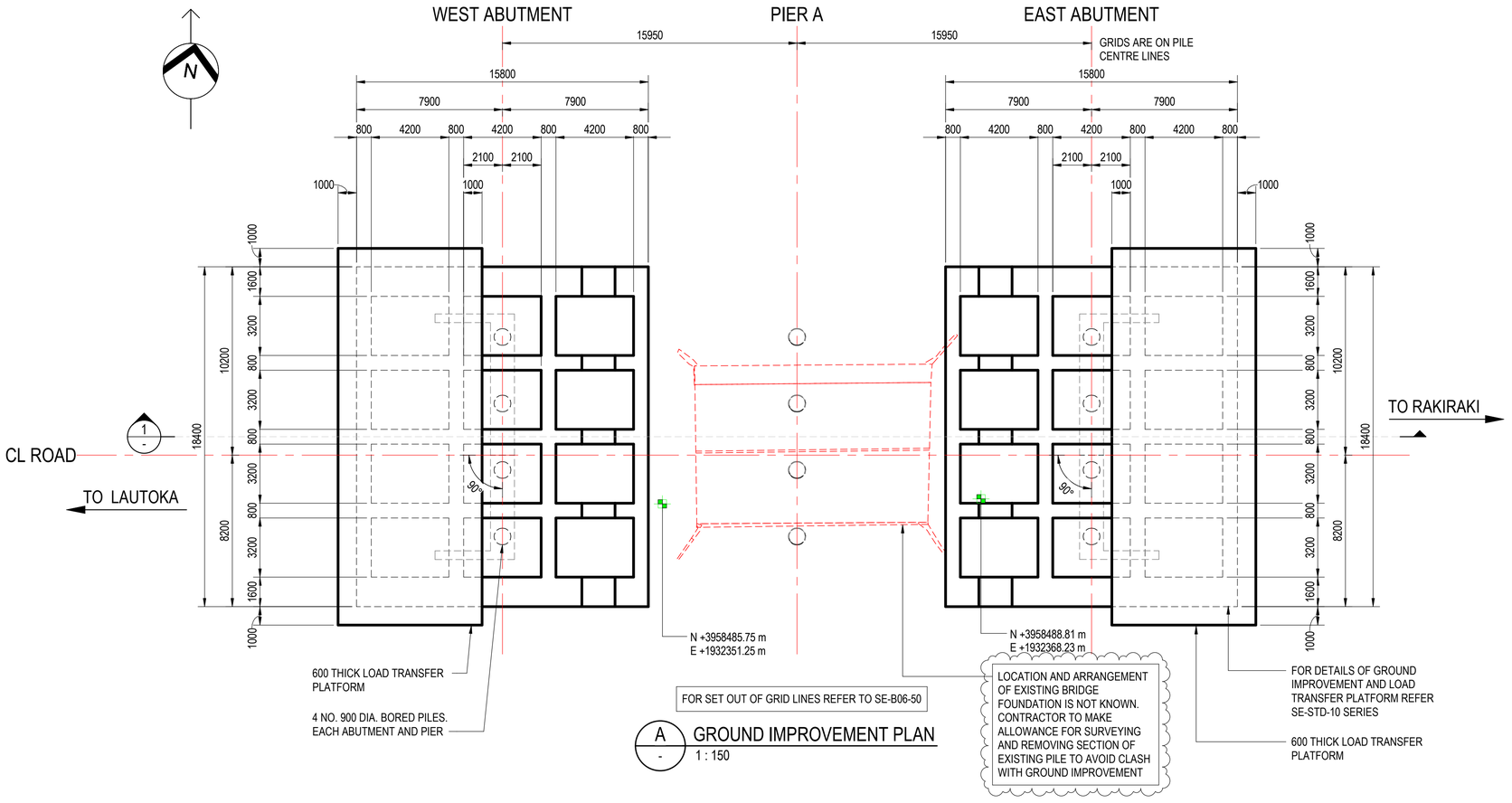
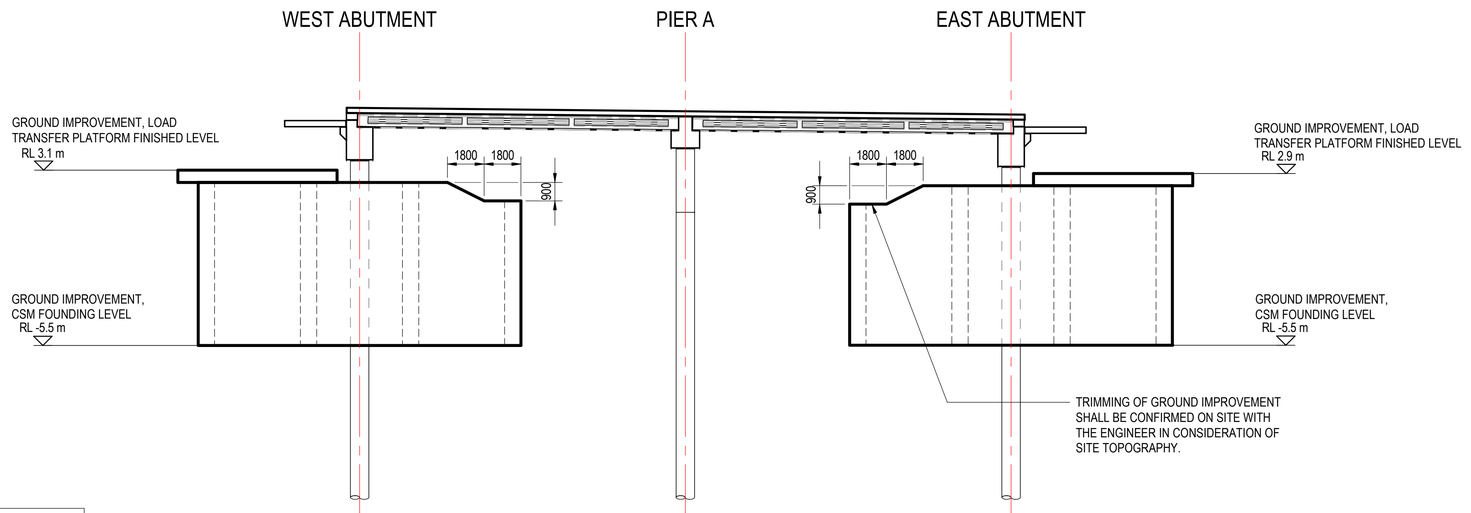
Document No. Autodesk Docs://6450911 - FRA 40+3/6103677-B06-SE-2023.rvt



A - GROUND IMPROVEMENT PLAN
1 : 150



1 - LONG SECTION
1 : 150

NOTES:

1. REFER TO DRAWING SE-B06-50 FOR NOTES.
2. CSM NOTES:

a. CSM PANELS TO BE CONSTRUCTED WITH THE FOLLOWING SPECIFICATION:

- MIN. SHEAR STIFFNESS OF 1250MPa
- MIN. YOUNG'S MODULUS OF 3000MPa
- UNCONFINED COMPRESSIVE STRENGTH OF MIN. 2.5MPa AND AVERAGE OF 3MPa
- MIN. AREA REPLACEMENT RATIO: 30%

b. CSM TO BE CONSTRUCTED IN ACCORDANCE WITH SPECIFICATION C0414.

c. CONTRACTOR TO CONSIDER THE CONSTRAINTS OF THE EXISTING BRIDGE, SITE BOUNDARIES, AND WATERWAY DURING CONSTRUCTION OF THE GROUND IMPROVEMENT.

BEWARE:

THE CONTRACTOR SHALL CONFIRM THAT THERE IS NO CONFLICT WITH UNDERGROUND SERVICES (EXISTING, NEWLY INSTALLED AND / OR TEMPORARY) AND / OR IMPLEMENT APPROPRIATE PROTECTION MEASURES PRIOR TO CARRYING OUT ANY PILE INSTALLATION OR EXCAVATION WORKS.

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN, FOR FRA REVIEW	JRO	TP	CH	01.03.24
B	DETAILED DESIGN, FOR FRA REVIEW	JRO	TP	CH	21.09.23
A	DETAILED DESIGN, FOR COMMENT	RS	TP	CH	23.06.23

Original Scale (A1): 1 : 150
Reduced Scale (A3): HALF A1

Design	D.CVITANICH	23.06.23	Approved for Construction*
Drawn	R.SATTAYAPORN	23.06.23	
Dsg Verifier	T.POLLEY	23.06.23	
Drg Check	D.CVITANICH	23.06.23	Date

* Refer to Revision 1 for Original Signatures

Sub-consultant: Erasito
Main-consultant: Beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: B06 VITAWA BRIDGE - GROUND IMPROVEMENT PLAN AND SECTION
Discipline: STRUCTURAL
Drawing No.: 6103677-SE-B06-56
Rev.: C

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Document No. Autodesk Docs://6450911 - FRA-40-3\6103677-B06-SE-2023.rvt

Co-designed by: Erasito | Co-designed, Verified and Issued by: Beca

FRA/TIISP/20-13 - 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

PRIORITY 1 - B07, NAVOLA BRIDGE

Prepared for: FIJI ROAD AUTHORITY
Prepared by: BECA INTERNATIONAL CONSULTANTS LTD

Project No.: 6103677

ISSUED FOR DETAILED DESIGN - FOR FRA REVIEW

		DRAWING STATUS	CONCEPT DESIGN	DETAILED DESIGN FOR COMMENT	DETAILED DESIGN FOR FRA REVIEW	DETAILED DESIGN FOR FRA REVIEW
		DAY	16	27	19	08
		MONTH	03	07	12	03
		YEAR	2023	2023	2023	2024
DRAWING NO	**DRAWING TITLE**		**REV.**	**REV.**	**REV.**	**REV.**
6103677-CE-B07-00	COVER SHEET AND REVISION HISTORY		A	B	C	D
FRA: SS 104 / 21	TOPOGRAPHICAL SURVEY		0	0	0	0
6103677-CE-B07-05	SITE REMOVAL PLAN		-	-	A	B
6103677-CE-B07-10	ROADING PLAN AND PROFILE - SHEET 1		A	B	C	D
6103677-CE-B07-11	STORMWATER LAYOUT - SHEET 1		-	-	A	B
6103677-CE-B07-12	DETAILED ROADING SECTIONS - SHEET 1		A	B	C	D
6103677-CE-B07-13	DETAILED ROADING SECTIONS - SHEET 2		A	B	C	D
6103677-CE-B07-14	DETAILED ROADING SECTIONS - SHEET 3		-	A	B	C
6103677-CE-B07-17	ROAD MARKING AND SIGNS		-	A	B	C
6103677-CE-B07-18	STORMWATER LONGITUDINAL SECTIONS		-	A	B	C
6103677-CE-B07-19	STORMWATER DETAILS		-	-	A	B
6103677-CE-B07-20	NEW UTILITIES		A	B	C	D
6103677-CE-B07-21	NEW UTILITIES CROSS SECTIONS		-	A	B	C
6103677-CE-B07-25	SCOUR PROTECTION LAYOUT		-	A	B	C
6103677-CE-B07-30	EMBANKMENT GEOGRID REINFORCING DETAILS		-	A	B	C
6103677-CE-B07-31	GEOTECHNICAL INSTRUMENTATION AND MONITORING DETAILS		-	A	B	C
6103677-CE-B07-32	ROCK CUT SECTION AND DETAILS		-	A	B	C
6103677-CE-B07-33	ROCKFALL SOURCE TREATMENT DECISION TREE		-	-	A	B
6103677-CE-B07-36	DETAILED ROCK CUT SECTIONS - SHEET 1		-	-	A	B
6103677-CE-B07-37	DETAILED ROCK CUT SECTIONS - SHEET 2		-	-	A	B
6103677-CE-B07-38	DETAILED ROCK CUT SECTIONS - SHEET 3		-	-	A	B
6103677-CE-B07-39	DETAILED ROCK CUT SECTIONS - SHEET 4		-	-	A	B
6103677-CE-B07-40	TEMPORARY DIVERSIONS ROADING PLAN AND PROFILE		-	-	A	B
6103677-SE-B07-50	BRIDGE PLAN		A	B	C	D
6103677-SE-B07-51	BRIDGE ELEVATION		A	B	C	D
6103677-SE-B07-55	PILING PLAN		-	A	B	C
6103677-SE-B07-56	GROUND IMPROVEMENT		-	A	B	C

make everyday better.

Drawing No. 6103677-CE-B07-00 Rev. D

REV	REVISIONS	DRN	CHK	APP	DATE
1	REMOVE OF NON SURVEYED BRIDGE PARTS, WATER LEVEL, ADJUTMENTS & DATUM	UD	SN	SN	01/11/22
2	EXTRA PICKUP NEEDED FROM BECA ON THE EAST SIDE END OF THE ROAD & TIN NATURAL GROUND	UD	SN	SN	13/06/23

SURVEYED BY	SHANVI L.L & SAMUELA T.WAKEVOU
SURVEY ASST	SAMISONI LEDUA, LEMEKI RAVAELE
DRAWN BY	USAIA DELAI
CHECKED BY	SHIRI NARAYAN
VERIFIED BY	SHAINEEL CHAND
SURVEY INSTRUCTION	(SI) No SS 104/21
DATE OF SURVEY	09/10/2022 & 05/06/2023
APPROVED	SHIRI NARAYAN

SURVEY SECTION

Fiji Roads Authority
Level 4, Fiji Development Bank Building,
360 Victoria Parade, Suva, Fiji Islands.
Postal: P. O. Box 16550, Suva, Fiji
Phone (+679) 310 0114 | Fax (+679) 310 0044 |
email: shiri.narayan@fijiroads.org

DESCRIPTION: DETAILED TOPOGRAPHICAL SURVEY OF NAVOLA BRIDGE

TIKINA: BARAVI PROVINCE: NADROGA/NAVOSA ISLAND: VITI LEVU

REQUEST FROM: BRIDGE & STRUCTURES

DATE OF REQUEST: 13/12/2021

Scales: 1:1000 @ A1

Drawing No: FRA: SS 104/21

Rev: 0

No.	Revision	By	Checked	Date
A.	FOR FRA REVIEW	RAI	TEL	13/12/21
B	DETAILED DESIGN - FOR COMMENT	RAI	TEL	13/12/21
C	DETAILED DESIGN - FOR FRA REVIEW	RAI	TEL	13/12/21
D	DETAILED DESIGN - FOR FRA REVIEW	RAI	TEL	13/12/21

DO NOT SCALE FOR SET OUT DIMENSIONS

Project: 4.0 CRITICAL BRIDGES & TEMPORARY CROSSING SECTIONS
3 MARITIME STRUCTURES SHEET 2

Title: VITAWA BRIDGE

Discipline: INFRASTRUCTURE

Drawing No: 6103677-CE-B06-43

Rev: D

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Document No: PRE FEAS 11 A 1 P1 S.DWG

DETAILED DESIGN
NOT FOR CONSTRUCTION

FOR CLARITY OF DETAILS
VIEW ELECTRONICALLY

NOTES:

1. DATUM OF LEVELS : FIJI HEIGHT DATUM
ORIGIN OF LEVELS: IR(100) [FRA SI: SS 85/21]
RL: 3.23m
2. DATUM OF COORDINATES : FIJI MAP GRID
ORIGIN OF COORDINATES: SS 2800 (SO 901)
E: 1892437.59
N: 3865149.46
3. CONTOUR INTERVALS: MAJOR: 1.00m
MINOR: 0.20m
4. THIS PLAN DOES NOT NECESSARILY SHOW ALL EXISTING SERVICES. IT'S THE DUTY OF THE CONTRACTOR TO ACCURATELY LOCATE AND PROTECT ALL EXISTING SERVICES BEFORE ANY EXCAVATION.
5. ALL DIMENSIONS, LEVELS & UNDERGROUND SERVICES LOCATIONS TO BE CHECKED ON SITE PRIOR TO COMMENCEMENT OF ALL WORKS.

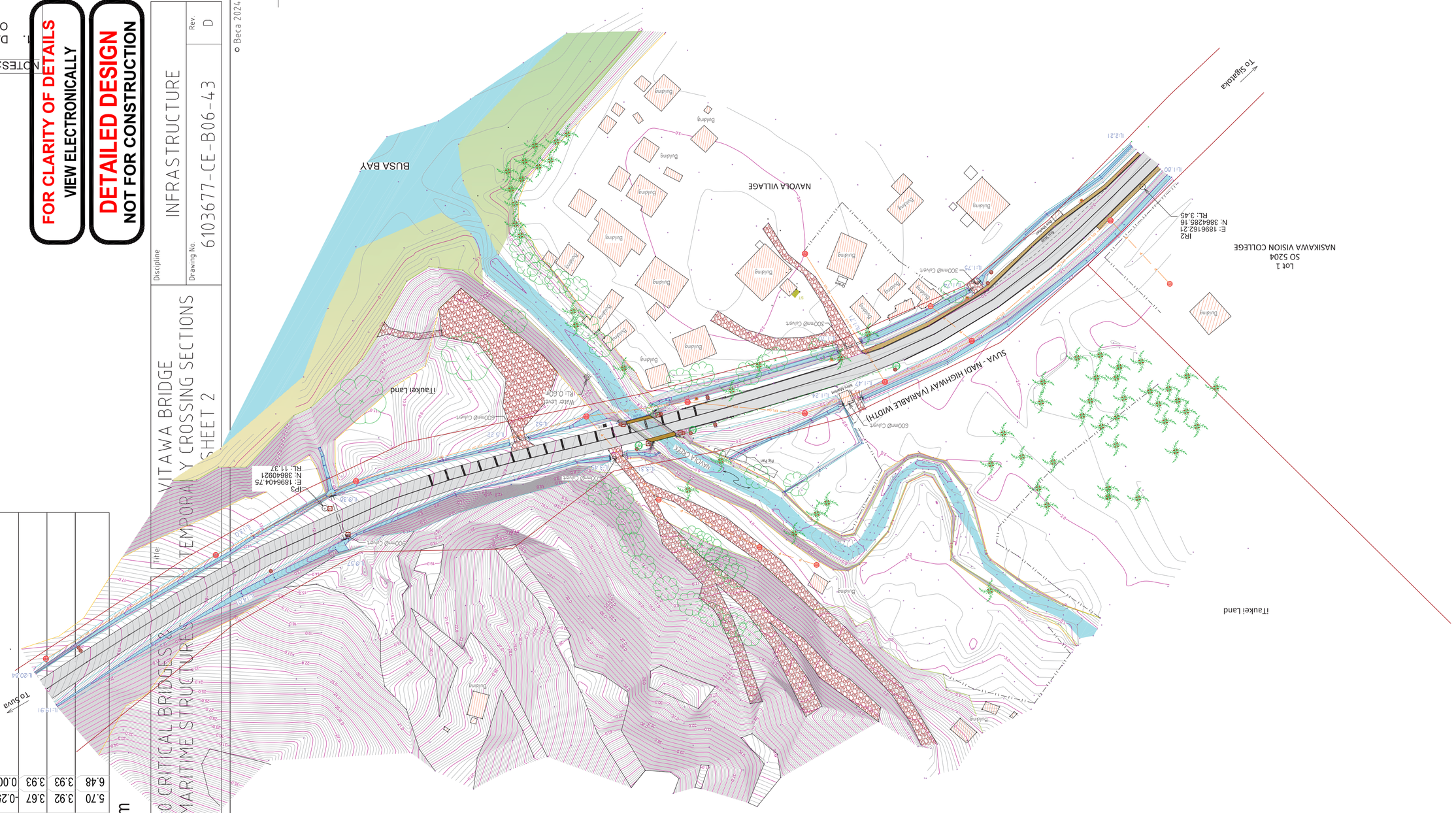
ALL DIMENSIONS ARE IN METERS.

SCALE 1:500(A3):

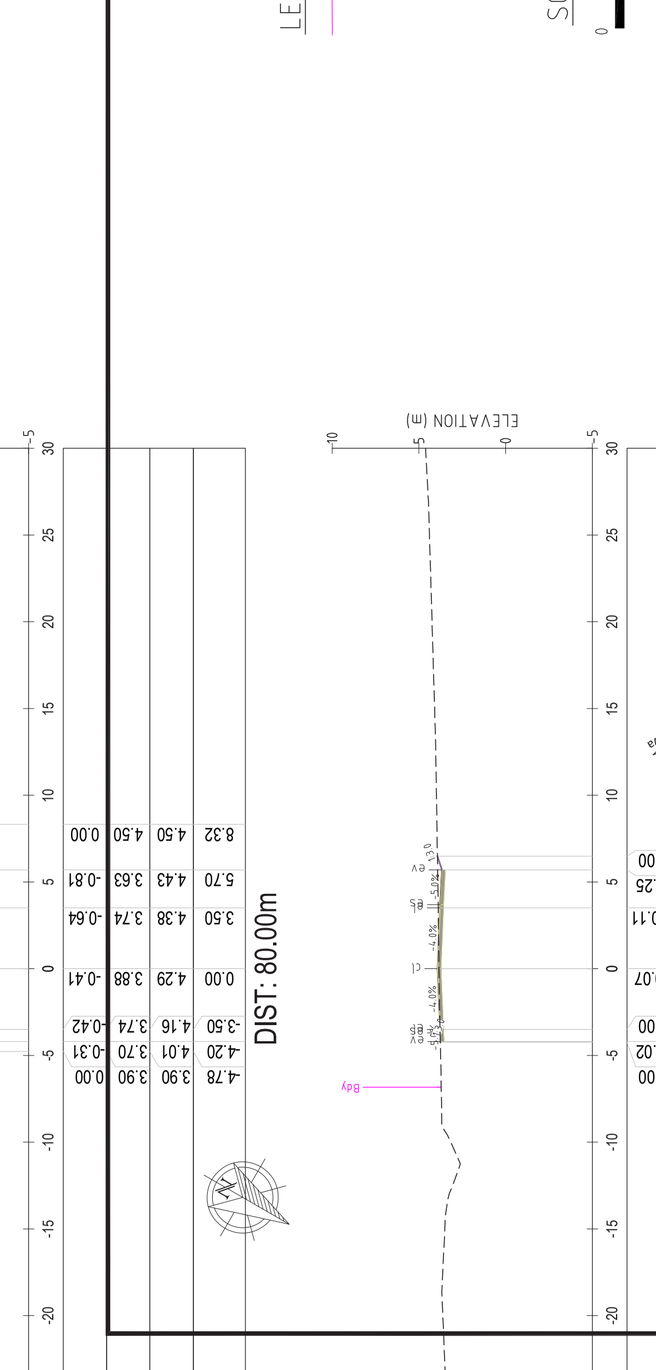
0 5 10 15 20

LEGEND:

CADASTRAL BOUNDARY

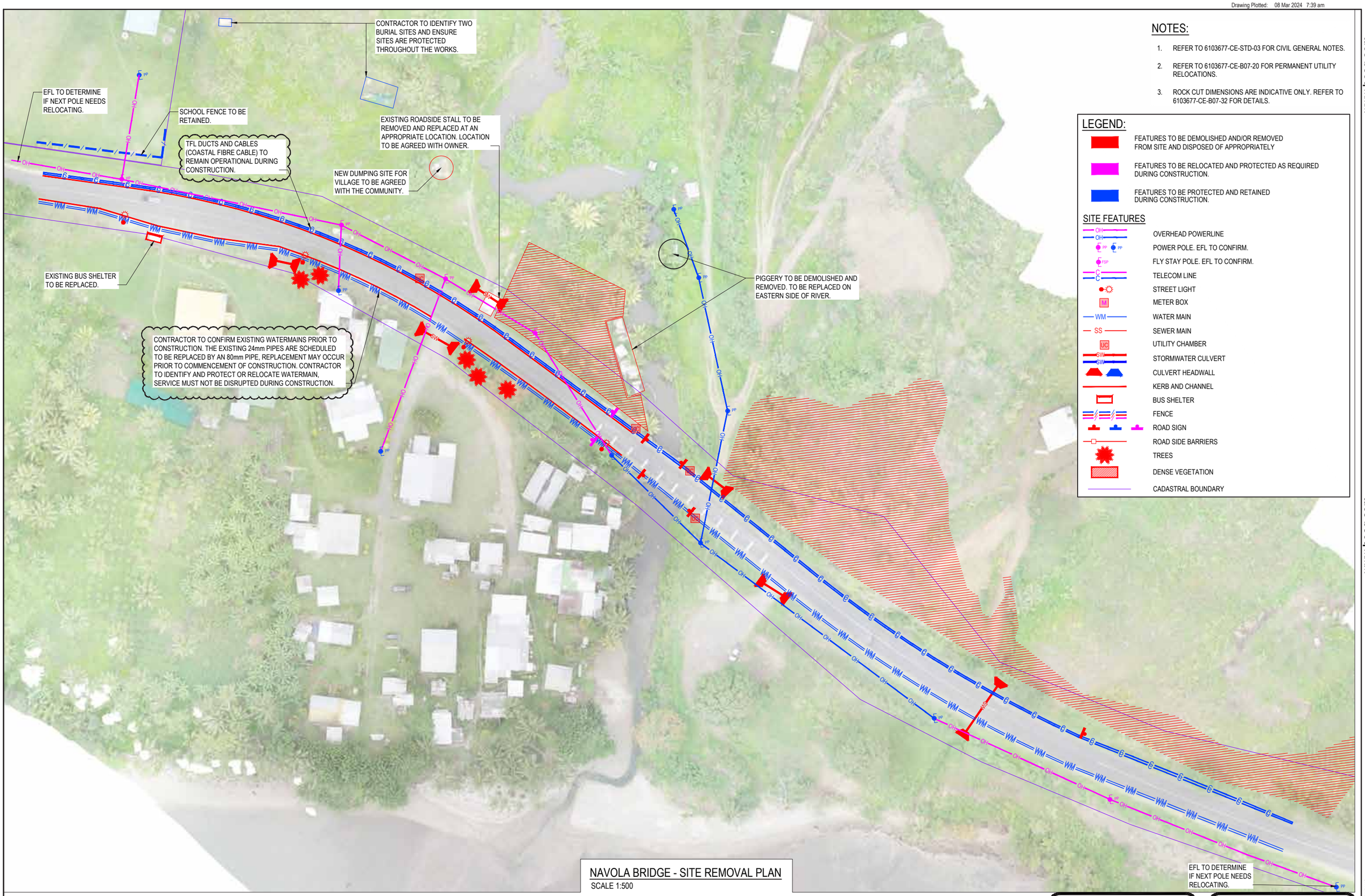


LEGEND
- Major Contour
- Minor Contour
- Top of Bank
- Bottom of Bank
- Lamp Post
- Telecom Manhole
- Power Pole
- Seal Formation
- Gravelled Formation
- Concrete Deck
- Concrete Footpath
- Drain Invert
- Fence Line
- Cross Culvert (Size Varies)
- Boundary Line
- Residential Power Pole
- EFL Overhead Powerline
- Water Authority Chamber
- Marker Post
- Road Sign
- Septic Tank
- Residential Power Pole
- Residential Power Line



CUT/FILL	4.78	3.90	3.90	0.00	4.24	3.76	3.76	0.00	6.48	3.93	3.93	0.00
DESIGN LEVELS	4.20	4.01	3.70	-0.31	4.20	3.76	3.74	-0.02	5.70	3.92	3.67	-0.25
EXISTING LEVELS	3.50	4.16	3.74	-0.42	3.50	3.78	3.78	0.00	3.50	3.88	3.78	-0.11
OFFSETS	0.00	4.29	3.88	-0.41	0.00	3.85	3.92	0.07	3.50	4.38	3.74	-0.64
	3.50	4.43	3.63	-0.81	5.70	4.43	3.63	-0.81	5.70	4.43	3.63	-0.81
	8.32	4.50	4.50	0.00	8.32	4.50	4.50	0.00	8.32	4.50	4.50	0.00

Drawing Plotted: 08 Mar 2024 7:39 am



NOTES:

1. REFER TO 6103677-CE-STD-03 FOR CIVIL GENERAL NOTES.
2. REFER TO 6103677-CE-B07-20 FOR PERMANENT UTILITY RELOCATIONS.
3. ROCK CUT DIMENSIONS ARE INDICATIVE ONLY. REFER TO 6103677-CE-B07-32 FOR DETAILS.

LEGEND:

- FEATURES TO BE DEMOLISHED AND/OR REMOVED FROM SITE AND DISPOSED OF APPROPRIATELY
- FEATURES TO BE RELOCATED AND PROTECTED AS REQUIRED DURING CONSTRUCTION.
- FEATURES TO BE PROTECTED AND RETAINED DURING CONSTRUCTION.

SITE FEATURES

- OVERHEAD POWERLINE
- POWER POLE. EFL TO CONFIRM.
- FLY STAY POLE. EFL TO CONFIRM.
- TELECOM LINE
- STREET LIGHT
- METER BOX
- WATER MAIN
- SEWER MAIN
- UTILITY CHAMBER
- STORMWATER CULVERT
- CULVERT HEADWALL
- KERB AND CHANNEL
- BUS SHELTER
- FENCE
- ROAD SIGN
- ROAD SIDE BARRIERS
- TREES
- DENSE VEGETATION
- CADASTRAL BOUNDARY

NAVOLA BRIDGE - SITE REMOVAL PLAN

SCALE 1:500

FOR CLARITY OF DETAILS VIEW ELECTRONICALLY

DETAILED DESIGN NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN - FOR FRA REVIEW	JM	AH	CH	08.03.24
A	DETAILED DESIGN - FOR FRA REVIEW	JM	AH	CH	19.12.23

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	M. SHEPPARD	19.12.23	Approved For Construction*
Drawn	M.ANONUEVO	19.12.23	
Dsg Verifier	C. HATLEY	19.12.23	
Drg Check	C. HATLEY	19.12.23	Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: NAVOLA BRIDGE SITE REMOVAL PLAN

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B07-05

Rev.: B

Document No. 6103677-CE-B07-05.DWG

DO NOT SCALE FOR SET OUT DIMENSIONS

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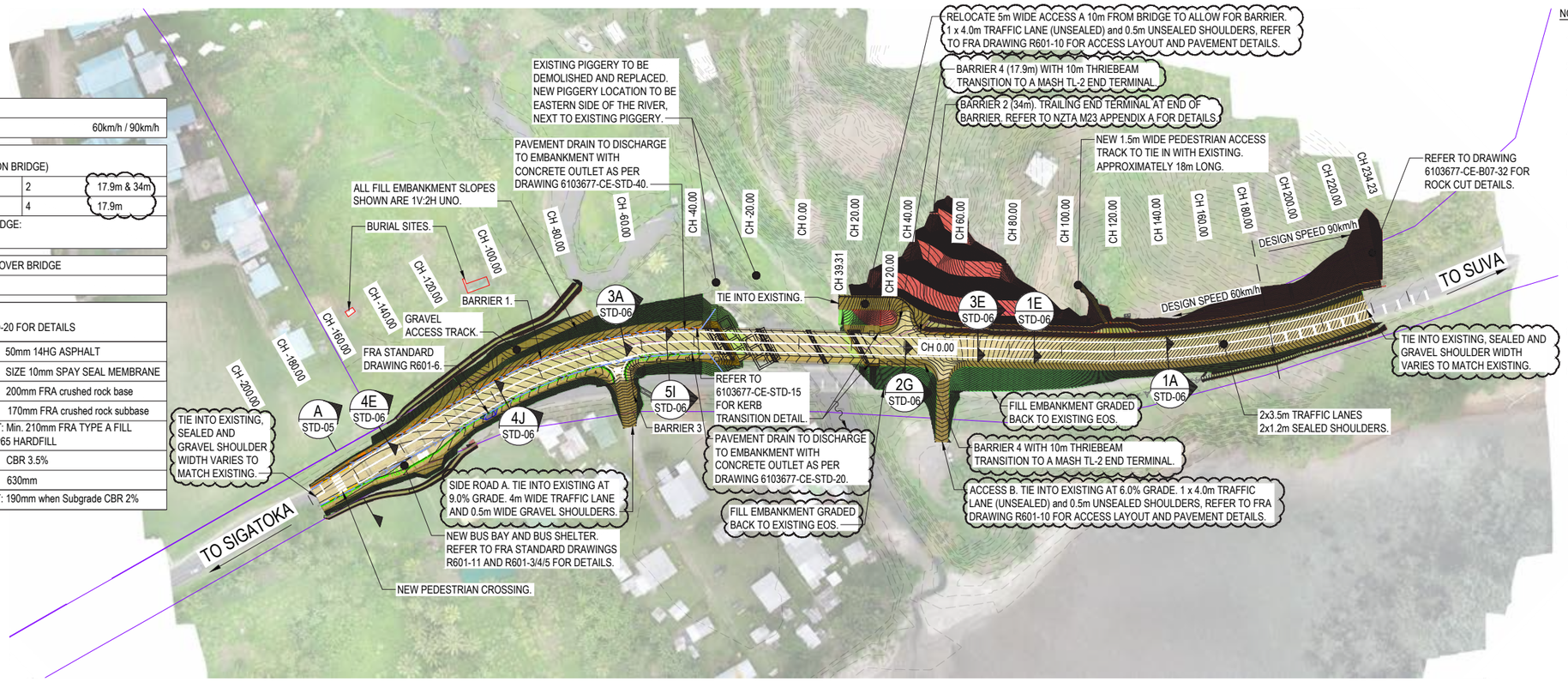
DESIGN SPEED:	
MAIN ROAD	60km/h / 90km/h

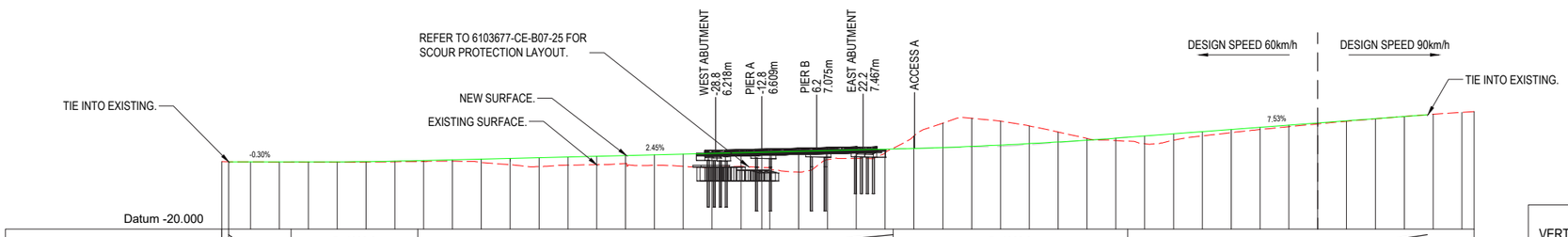
BARRIER LENGTHS: (EXCLUSIVE OF BARRIER ON BRIDGE)			
1	77m	2	17.9m & 34m
3	45m	4	17.9m
BARRIER LENGTHS ON BRIDGE: 56m BOTH SIDES			

DESIGN MIN. ROAD LEVEL OVER BRIDGE
6.10m FHD.

PAVEMENT DESIGN. REFER TO 6103677-CE-STD-20 FOR DETAILS	
SURFACING TYPE :	50mm 14HG ASPHALT
MEMBRANE:	SIZE 10mm SPAY SEAL MEMBRANE
BASECOURSE:	200mm FRA crushed rock base
SUBBASE COURSE:	170mm FRA crushed rock subbase
SUBGRADE IMPROVEMENT: Min. 210mm FRA TYPE A FILL MATERIAL CBR 8% OR GAP65 HARDFILL	
SUBGRADE STRENGTH:	CBR 3.5%
TOTAL THICKNESS:	630mm
CONTINGENCY UNDERCUT: 190mm when Subgrade CBR 2%	



OFF-LINE REPLACEMENT
SCALE 1:1000



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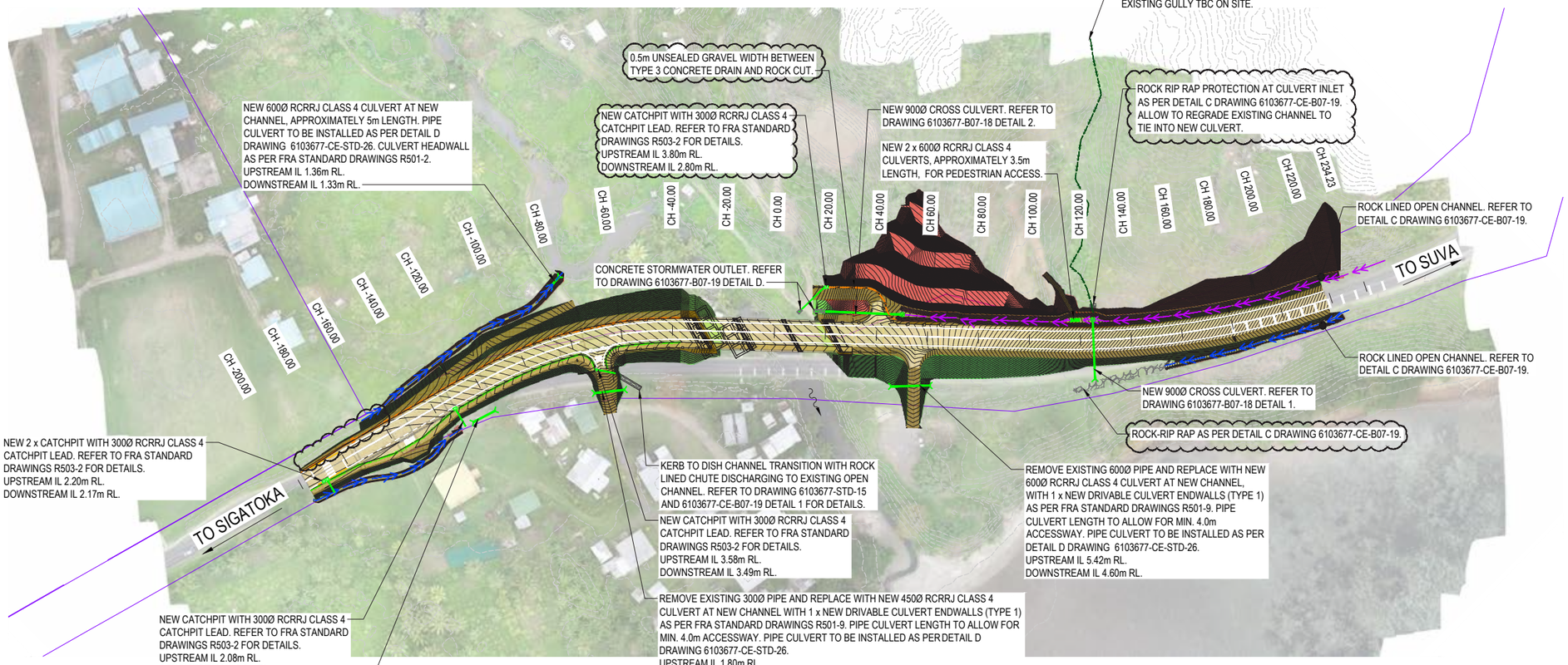

OFF-LINE REPLACEMENT
SCALE 1:1000

NOTES:

1. REFER TO 6103677-CE-STD-03 FOR GENERAL STORMWATER NOTES.
2. THIS DRAWING IS PART OF THE DETAILED DESIGN REPORT, IT SHOULD BE READ IN CONJUNCTION WITH THE REPORT.
3. AERIAL IMAGE FROM UAV SURVEY UNDERTAKEN BY ERASITO CONSULTANTS LTD AND BECA INTERNATIONAL CONSULTANTS LTS.
4. MAJOR CONTOURS AT 2m INTERVALS, MINOR CONTOURS AT 0.5m INTERVALS. CONTOURS AND ELEVATIONS ARE TO MEAN SEA LEVEL MSL-0.0, DETERMINED FRA.
5. HORIZONTAL POSITION IS FIJI MAP GRID (FMG). VERTICAL DATUM IS FIJI HEIGHT DATUM.
6. CADASTRAL BOUNDARY INFORMATION IS FRA TOPOGRAPHICAL SURVEY (UNLESS NOTED AS FROM FIJI LAND INFORMATION SYSTEM (FLIS)) AND IS REFERENCED TO FIJI MAP GRID (FMG) COORDINATE SYSTEM. NO INDEPENDENT REVIEW OF DATA CORRECTNESS HAS BEEN CARRIED OUT.
7. FOR DETAILS OF EXISTING UTILITIES AND NEW UTILITIES RELOCATIONS, REFER TO DRAWING 6103677-CE-B07-20.
8. ROCK CUT DIMENSIONS ARE INDICATIVE ONLY. REFER TO 6103677-CE-B07-32 FOR DETAILS.
9. THE CONTRACTOR IS TO CONFIRM THE EXISTING GROUND LEVELS ON SITE AND THE DESIGN CONFIRMED WITH THE ENGINEER BEFORE CONSTRUCTION COMMENCES.
10. DUE TO INCOMPLETE TOPOGRAPHICAL INFORMATION EXISTING INVERT LEVELS ARE TO BE CONFIRMED ON SITE AND THE DESIGN CONFIRMED WITH THE ENGINEER BEFORE CONSTRUCTION COMMENCES.

LEGEND:

- CADASTRAL BOUNDARY
- FLOW DIRECTION
- OPEN CHANNEL TYPE 1 AS PER DRAWING 6103677-CE-STD-25
- OPEN CHANNEL TYPE 2 AS PER DRAWING 6103677-CE-STD-25
- NEW CULVERT
- NEW CULVERT HEADWALL
- NEW SCRUFFY DOME
- NEW CATCHPIT
- TYPE 3 CONCRETE DRAIN AS PER FRA DRAWING R504-3
- ROCK RIP RAP PROTECTION

FOR CLARITY OF DETAILS VIEW ELECTRONICALLY

DETAILED DESIGN NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN - FOR FRA REVIEW	JM	DP	CH	08.03.24
A	DETAILED DESIGN - FOR FRA REVIEW	JM	DP	CH	19.12.23

Original Scale (A1) AS SHOWN	Design	J.MARSH	19.12.23
	Drawn	J.MARSH	19.12.23
Reduced Scale (A3) HALF SHOWN	Dsg Verifier	C. HATLEY	19.12.23
	Drg Check	C. HATLEY	19.12.23

Approved For Construction* Date
* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: NAVOLA BRIDGE STORMWATER LAYOUT SHEET 1

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B07-11

Rev.: B

Document No. 6103677-CE-B07-11.DWG

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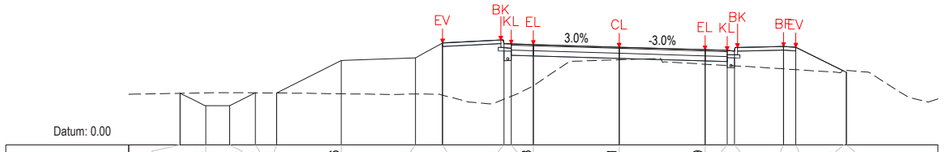
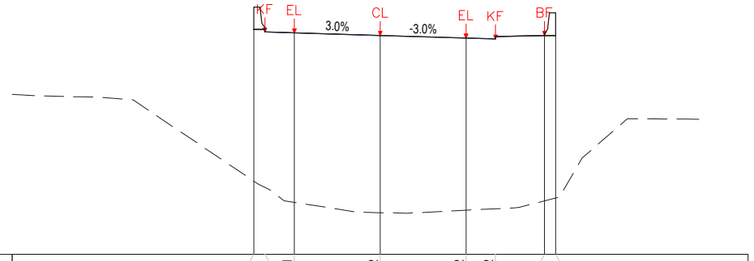

EV
BK
KL
EL
3.0%
CL
-3.0%
EL
KL
BK
BF
EV
Datum: 0.00

| | | |

NOTES

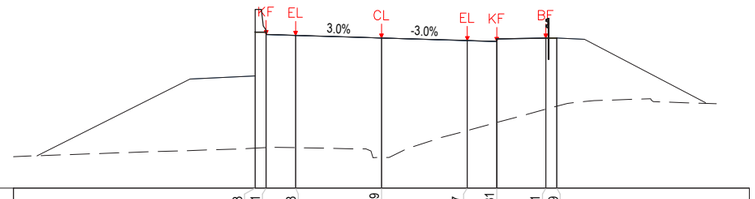
1. REFER TO 6103677-CE-STD-03 FOR CIVIL GENERAL NOTES.
2. ROCK CUT DIMENSIONS ARE INDICATIVE ONLY. REFER TO 6103677-CE-B07-32 FOR DETAILS.
3. REFER TO 6103677-CE-B07-36 TO 6103677-CE-B07-39 FOR DETAILED ROCK CUT SECTIONS FROM CHAINAGES 30 TO 100.



Datum: -2.00

CUT/FILL	6.18	6.33	6.91	7.22	7.02	6.92	6.74	6.63		
DESIGN LEVELS	7.16	7.06	7.03	6.92	6.82	6.78	6.92	6.92		
EXISTING LEVELS	0.98	0.74	0.12	-0.30	-0.20	-0.14	0.18	0.30		
OFFSETS	-5.15	-4.70	-3.50	0.00	3.50	4.70	6.70	7.15		

DIST: 0.00



Datum: 0.00

CUT/FILL	4.73	4.61	4.58	4.89	3.67	3.31	2.91	2.79		
DESIGN LEVELS	6.36	6.26	6.22	6.11	6.01	5.97	6.11	6.11		
EXISTING LEVELS	1.63	1.65	1.64	1.23	2.34	2.66	3.21	3.33		
OFFSETS	-5.15	-4.70	-3.50	0.00	3.50	4.70	6.70	7.15		

DIST: -33.00

FOR CLARITY OF DETAILS
VIEW ELECTRONICALLY

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
D	DETAILED DESIGN - FOR FRA REVIEW	JM	AH	CH	08.03.24
C	DETAILED DESIGN - FOR FRA REVIEW	JM	AH	CH	19.12.23
B	DETAILED DESIGN - FOR COMMENT	ES	CH	CH	27.07.23
A	FOR FRA REVIEW	ES	CH	CH	16.03.23

Original Scale (A1) 1:125
Reduced Scale (A3) 1:250

Design	M. SHEPPARD	16.03.23	Approved For Construction*
Drawn	AV, ES	16.03.23	
Dsg Verifier	C. HATLEY	16.03.23	
Drg Check	C. HATLEY	16.03.23	Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: NAVOLA BRIDGE DETAILED ROADING SECTIONS SHEET 2

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B07-13

Rev.: D

Document No. 6103677-CE-B07-13.DWG

DO NOT SCALE FOR SET OUT DIMENSIONS

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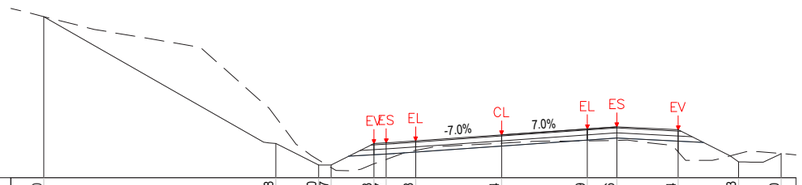
NOTES

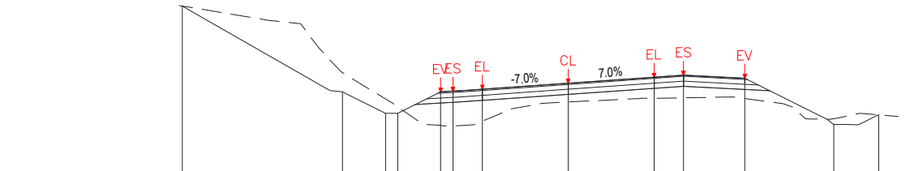
1. REFER TO 6103677-CE-STD-03 FOR CIVIL GENERAL NOTES.
2. ROCK CUT DIMENSIONS ARE INDICATIVE ONLY. REFER TO 6103677-CE-B07-32 FOR DETAILS.



Datum: 15.00

CUT/FILL	0.00			-1.08	-0.20	-0.07	0.83	0.67	0.38		0.34		0.49	0.56		0.84		-0.33		0.00				
DESIGN LEVELS	21.56			16.39	15.52	15.52	16.39	16.42	16.50		16.75		16.99	17.08		16.89		15.64		15.99				
EXISTING LEVELS	21.56			17.47	15.72	15.59	15.57	15.75	16.12		16.41		16.50	16.52		16.05		15.98		15.99				
OFFSETS	-18.65			-9.20	-7.45	-6.95	-5.20	-4.70	-3.50		0.00		3.50	4.70		7.20		9.66		11.40				

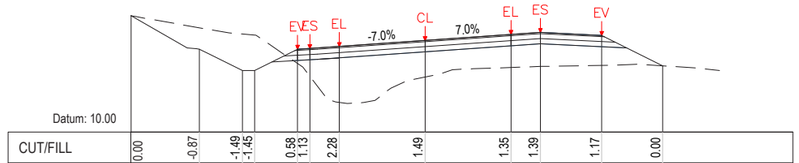
DIST: 180.00



Datum: 10.00

CUT/FILL	0.00		-0.78		-0.59	-0.27	1.36	1.41	1.30		0.77		0.86	0.92		0.83		-0.23		0.00				
DESIGN LEVELS	18.38		14.89		14.01	14.01	14.88	14.91	15.00		15.24		15.49	15.57		15.45		13.66		13.95				
EXISTING LEVELS	18.38		15.67		14.60	14.29	13.52	13.50	13.69		14.48		14.63	14.65		14.61		13.89		13.95				
OFFSETS	-15.73		-9.20		-7.45	-6.95	-5.20	-4.70	-3.50		0.00		3.50	4.70		7.20		10.83		12.66				

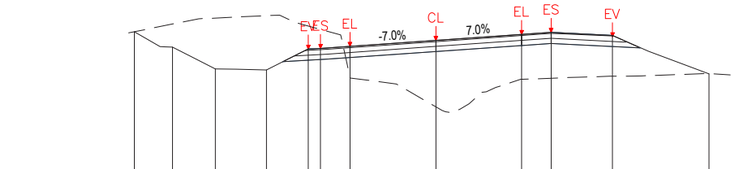
DIST: 160.00



Datum: 10.00

CUT/FILL	0.00		-0.87		-1.49	-1.45	0.58	1.13	2.28		1.49		1.35	1.39		1.17		0.00						
DESIGN LEVELS	14.74		13.38		12.51	12.51	13.38	13.41	13.49		13.74		13.98	14.06		13.88		12.70						
EXISTING LEVELS	14.74		14.25		14.00	13.95	12.80	12.28	11.21		12.25		12.64	12.68		12.72		12.70						
OFFSETS	-11.99		-9.20		-6.95	-6.95	-5.20	-4.70	-3.50		0.00		3.50	4.70		7.20		9.68						

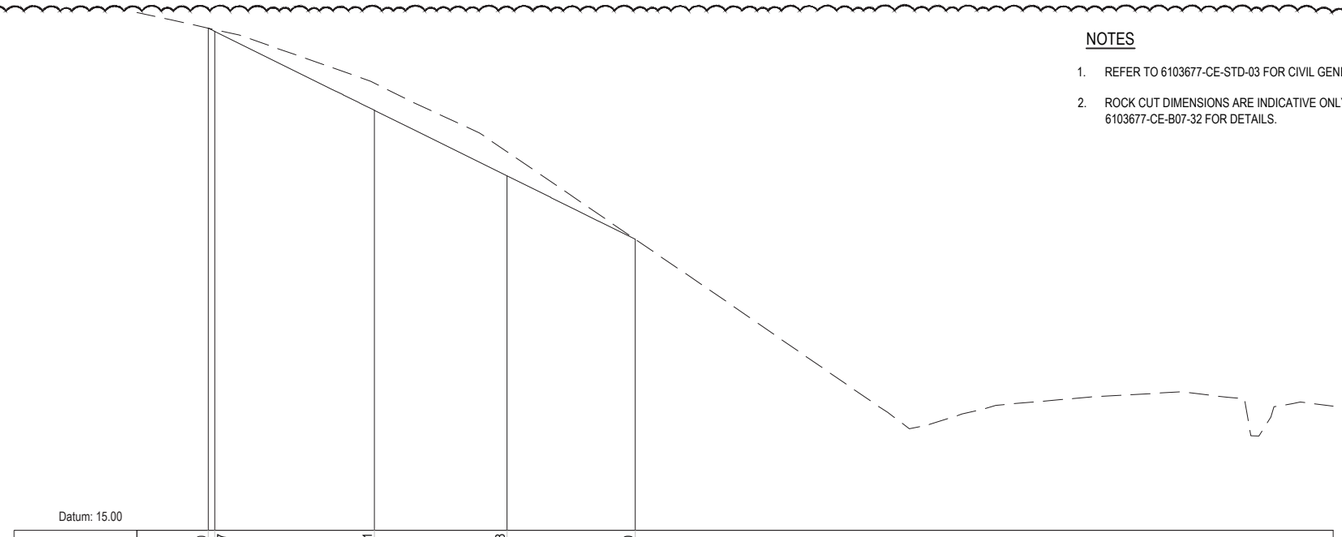
DIST: 140.00



Datum: 5.00

CUT/FILL	0.00		-0.88		-2.12		-2.21		-0.93	-0.77	1.26		2.71		1.84	1.87		1.67		-0.01				
DESIGN LEVELS	12.58		11.95		11.02		11.02		11.88	11.90	11.98		12.23		12.47	12.56		12.43		10.87				
EXISTING LEVELS	12.58		12.83		13.14		13.23		12.81	12.67	10.72		9.52		10.64	10.69		10.77		10.88				
OFFSETS	-12.29		-10.74		-8.90		-6.90		-5.20	-4.70	-3.50		0.00		3.50	4.70		7.20		11.14				

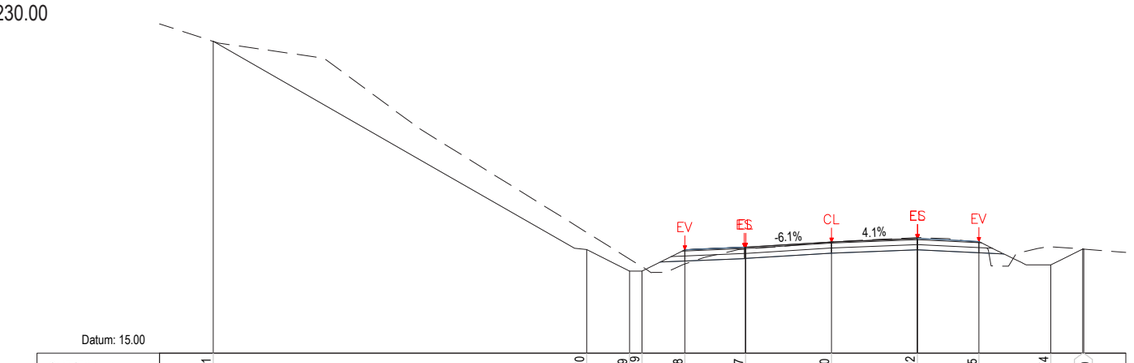
DIST: 120.00



Datum: 15.00

CUT/FILL	0.00			-0.07			-1.11				-0.98				0.00								
DESIGN LEVELS	35.46			35.33			32.11				29.44				26.86								
EXISTING LEVELS	35.46			35.40			33.22				30.43				26.86								
OFFSETS	-35.94			-35.68			-29.17				-23.76				-18.53								

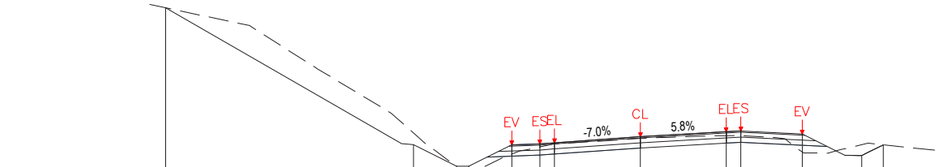
DIST: 230.00



Datum: 15.00

CUT/FILL	0.01			-0.70	0.49	-0.19	0.58		0.07		0.00		-0.02		0.05		-0.74		0.00				
DESIGN LEVELS	27.71			19.22	18.35	18.35	19.22		19.32		19.54		19.68		19.55		18.60		19.24				
EXISTING LEVELS	27.71			19.92	18.84	18.53	18.64		19.25		19.54		19.70		19.50		19.34		19.24				
OFFSETS	-25.22			-9.98	-8.23	-7.73	5.98		-3.50		0.00		3.50		6.00		8.86		10.28				

DIST: 217.00



Datum: 15.00

CUT/FILL	0.00			-0.48	0.02	0.11	0.37		0.12	0.05			0.07		0.16	0.20		0.73		-0.43		0.00		
DESIGN LEVELS	23.51			17.92	17.03	17.05	17.92		17.96	18.01			18.25		18.46	18.49		18.37		17.49		17.92		
EXISTING LEVELS	23.51			18.40	17.03	17.05	17.55		17.84	17.96			18.18		18.30	18.29		17.64		17.92		17.92		
OFFSETS	-19.36			-9.25	-7.50	-7.00	-5.24		-4.70	-3.50			0.00		3.50	4.70		6.60		9.00		9.90		

DIST: 200.00

FOR CLARITY OF DETAILS
VIEW ELECTRONICALLY

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN - FOR FRA REVIEW	JM	AH	CH	08.03.24
B	DETAILED DESIGN - FOR FRA REVIEW	JM	CH	CH	19.12.23
A	DETAILED DESIGN - FOR COMMENT	MS	CH	CH	27.07.23

Original Scale (A1) 1:125
Reduced Scale (A3) 1:250

Design	M. SHEPPARD	27.07.23	Approved For Construction*
Drawn	AV, ES	27.07.23	
Dsg Verifier	C. HATLEY	27.07.23	
Drg Check	C. HATLEY	27.07.23	Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: NAVOLA BRIDGE DETAILED ROADING SECTIONS SHEET 3

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B07-14

Rev.: C

Document No. 6103677-CE-B07-14.DWG

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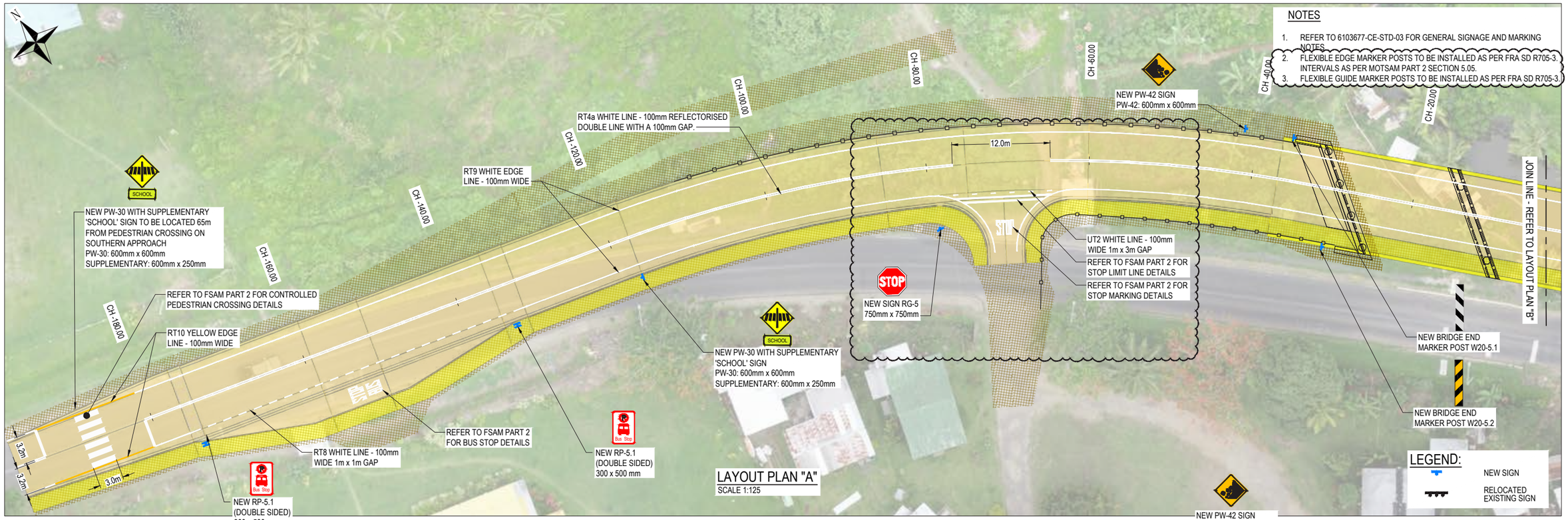
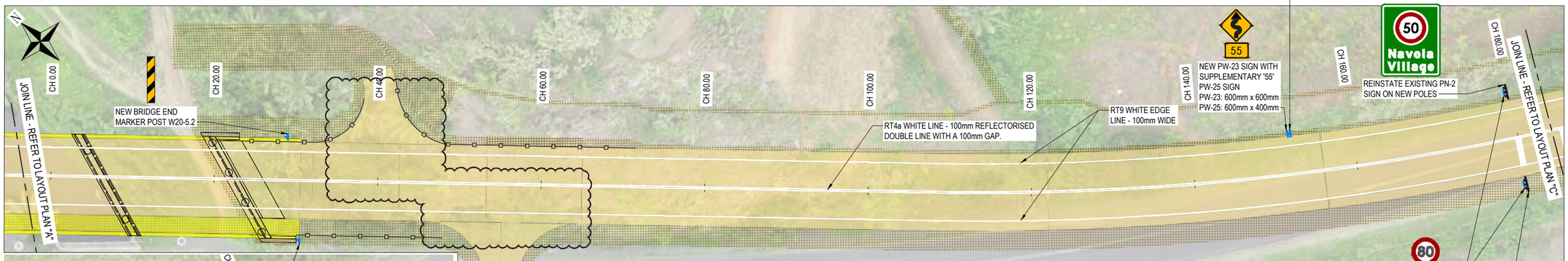
NOTES

1. REFER TO 6103677-CE-STD-03 FOR GENERAL SIGNAGE AND MARKING NOTES.
2. FLEXIBLE EDGE MARKER POSTS TO BE INSTALLED AS PER FRA SD R705-3. INTERVALS AS PER MOTSAM PART 2 SECTION 5.05.
3. FLEXIBLE GUIDE MARKER POSTS TO BE INSTALLED AS PER FRA SD R705-3.

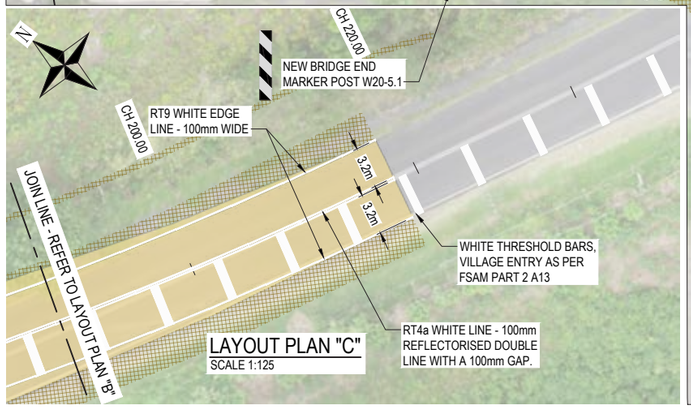


LAYOUT PLAN "A"
SCALE 1:125

LEGEND:
NEW SIGN
RELOCATED EXISTING SIGN



LAYOUT PLAN "B"
SCALE 1:125



LAYOUT PLAN "C"
SCALE 1:125

FOR CLARITY OF DETAILS
VIEW ELECTRONICALLY

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN - FOR FRA REVIEW	JM	AH	CH	08.03.24
B	DETAILED DESIGN - FOR FRA REVIEW	JM	AH	CH	19.12.23
A	DETAILED DESIGN - FOR COMMENT	JM	VH	CH	27.07.23

Original Scale (A1)	1:125	Approved For Construction*	
Reduced Scale (A3)	1:250	Date	

Design	J. MARSH	27.07.23
Drawn	J.MARSH	27.07.23
Dsg Verifier	C. HATLEY	27.07.23
Drg Check	C. HATLEY	27.07.23

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito
Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: NAVOLA BRIDGE ROAD MARKING AND SIGNS

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B07-17

Rev.: C

Document No. 6103677-CE-B07-17.DWG

DO NOT SCALE FOR SET OUT DIMENSIONS

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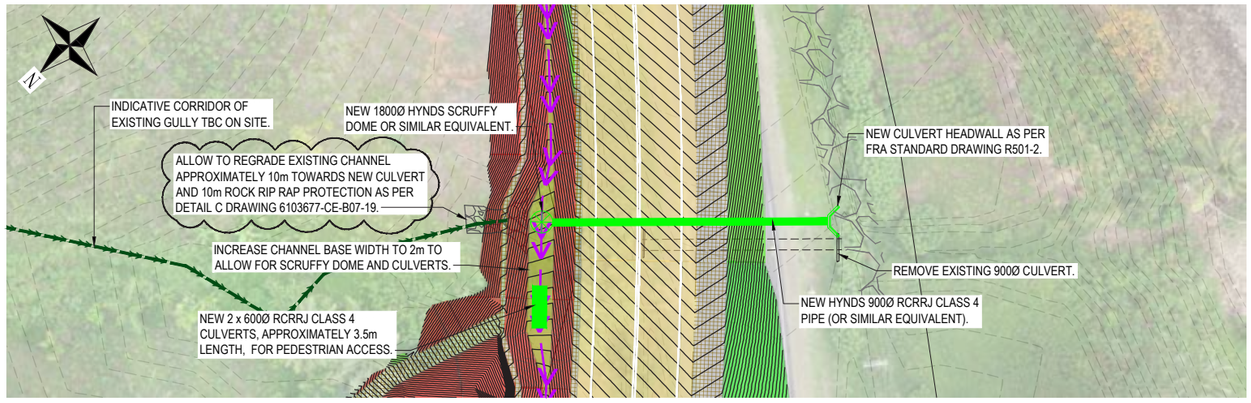
NOTES:

1. REFER TO 6103677-CE-STD-03 FOR GENERAL STORMWATER NOTES.
2. ROCK CUT DIMENSIONS ARE INDICATIVE ONLY. REFER TO 6103677-CE-B07-32 FOR DETAILS.

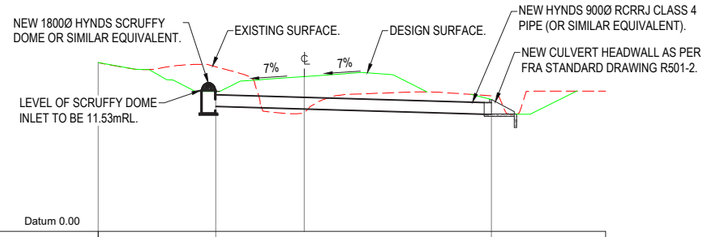
LEGEND:

- OPEN CHANNEL TYPE 1 AS PER DRAWING 6103677-CE-STD-25
- OPEN CHANNEL TYPE 2 AS PER DRAWING 6103677-CE-STD-25
- NEW CULVERT
- NEW CULVERT HEADWALL



NAVOLA CULVERT AT DIST 125 LONGITUDINAL PROFILE

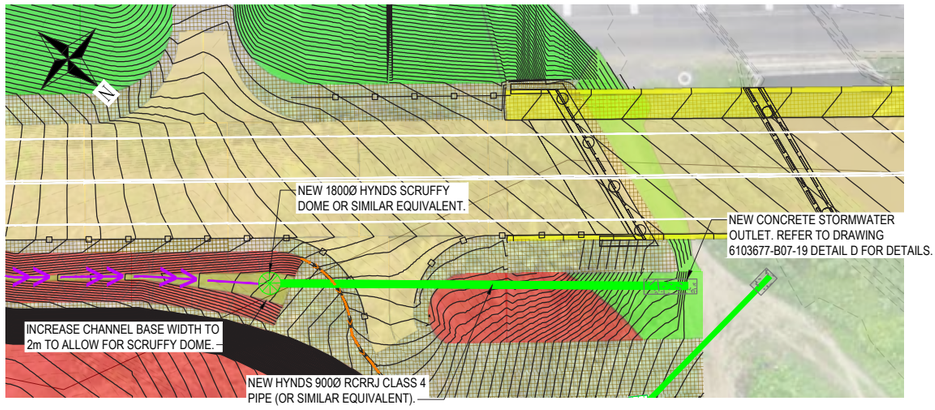
SCALE 1:250



VERTICAL ALIGNMENT		G: 2.93% L: 22.48		
DESIGN GROUND LEVELS		11.43	12.62	10.74
PIPE INVERT LEVELS		10.23	10.00	9.57
DEPTH TO INVERT		1.20	2.62	1.18
PIPE TOP LEVELS		11.16	10.94	10.51
COVER		0.27	1.67	0.23
EXISTING GROUND LEVELS		13.41	9.70	11.06
DISTANCE		0.00	7.23	22.48

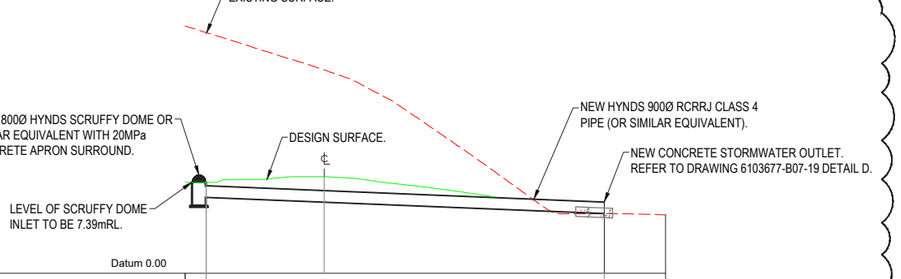
1 - STORMWATER CULVERT AT DIST 125 LONGITUDINAL PROFILES

1:250 (A1)



NAVOLA CULVERT AT DIST 55 LONGITUDINAL PROFILE

SCALE 1:250



VERTICAL ALIGNMENT		G: 4.07% L: 32.46	
DESIGN GROUND LEVELS	7.39	7.87	4.88
PIPE INVERT LEVELS	6.19	5.89	4.88
DEPTH TO INVERT	1.20	1.98	0.00
PIPE TOP LEVELS	7.14	6.83	5.82
COVER	0.25	1.04	0.00
EXISTING GROUND LEVELS	19.61	16.58	4.85
DISTANCE	0.00	9.62	32.46

2 - STORMWATER CULVERT AT DIST 55 LONGITUDINAL PROFILES

1:250 (A1)

FOR CLARITY OF DETAILS
VIEW ELECTRONICALLY

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN - FOR FRA REVIEW	JM	DP	CH	08.03.24
B	DETAILED DESIGN - FOR FRA REVIEW	JM	DP	CH	19.12.23
A	DETAILED DESIGN - FOR COMMENT	JM	VH	CH	27.07.23

Original Scale (A1) AS SHOWN	Design	J. MARSH	27.07.23	Approved For Construction*
	Drawn	J.MARSH	27.07.23	
Reduced Scale (A3) HALF SHOWN	Dsg Verifier	C. HATLEY	27.07.23	Date
	Drg Check	C. HATLEY	27.07.23	
	* Refer to Revision 1 for Original Signature			

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: NAVOLA BRIDGE STORMWATER LONGITUDINAL SECTIONS

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B07-18

Rev.: C

Document No. 6103677-CE-B07-18.DWG

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WEST ABUTMENT

PIER A

PIER B

N

30.00°
SKEW

4230

12500

15060

1400

DATE AND LOADING PANEL
(REFER NZ BRIDGE MANUAL FIGURE 4.5)

SOP 1
N +3864214.099 m
E +1896306.059 m
CH -28.8

SOP 2
N +3864202.495 m
E +1896317.057 m
CH -12.8

2
-

145
800
4700
2145
800
13290

15990

19010

CH 0.00

12300

CL
ROAD

TO SIGAKOTA

3000

4770

1
B07-51

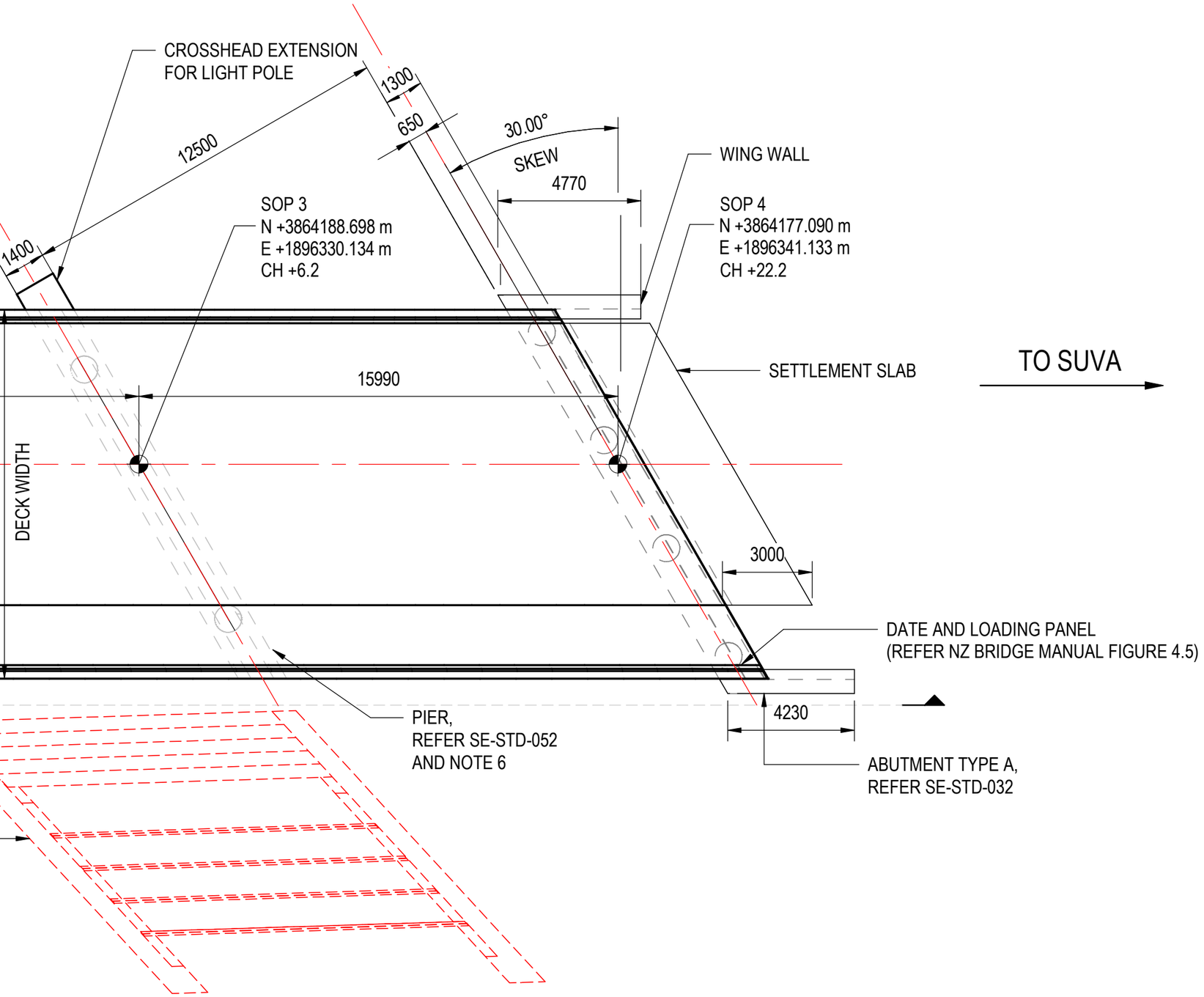
ABUTMENT TYPE A.
REFER SE-STD-032

GROUND IMPROVEMENT,
REFER SE-B07-056

INDICATIVE OUTLINE OF EXISTING BRIDGE,
TO BE DEMOLISHED, REFER NOTE 3 & 4.

A
-
BRIDGE PLAN
1 : 150

EAST ABUTMENT



NOTES.

1. FOR SITE LAYOUT, FEATURES, AND ROAD CORRIDOR DETAILS REFER TO 6103677-CE-B07-10, ROADING PLAN AND PROFILE, AND THE RELATED CIVIL DRAWINGS.

2. VERTICAL HEIGHT DATUM IS FIJI HEIGHT DATUM.AND COORDINATE SYSTEM IS FIJI MAP GRID (FMG) FOR DETAILS REFER TO FRA'S TOPOGRAPHICAL SURVEY DRAWING SS 104/21.

3. THE OUTLINE OF EXISTING BRIDGE IS AS PER FRA'S TOPOGRAPHICAL SURVEY DRAWING SS 104/21. THE CONTRACTOR SHALL CONFIRM POSITION OF THE BRIDGE PRIOR TO THE CONSTRUCTION.

4 . REFER TO PROJECT SPECIFICATION FOR EXISTING BRIDGE DEMOLITION REQUIREMENTS.

5. THESE BRIDGE SPECIFIC DRAWINGS SHALL BE READ TOGETHER WITH AND REFER TO STANDARD DRAWINGS, SPECIFICALLY:
- 6103677-SE-STD-001 TO 004 FOR GENERAL NOTES
- 6103677-SE-STD-010 SERIES FOR GROUND IMPROVEMENT DETAILS
- 6103677-SE-STD-020 SERIES FOR PILE DETAILS
- 6103677-SE-STD-030 SERIES FOR ABUTMENT TYPE A DETAILS
- 6103677-SE-STD-050 SERIES FOR PIER DETAILS
- 6103677-SE-STD-060 SERIES FOR SUPERSTRUCTURE DETAILS
- 6103677-SE-STD-070 SERIES FOR PRECAST PRESTRESSED SHC BEAM DETAILS
- 6103677-SE-STD-100 SERIES FOR DECK DETAILS
- 6103677-SE-STD-110 SERIES FOR BARRIER DETAILS.
- 6103677-SE-STD-140 FOR SERVICE SUPPORT DETAILS
- 6103677-SE-STD-180 FOR STANDARD BRIDGE ANTICIPATED CONSTRUCTION SEQUENCE

6. NOTE THIS BRIDGE PIER HEADSTOCK DEPTH IS GREATER THAN THE STANDARD DEPTH AND IS CALLED OUT ON SE-STD-050. ALL OTHER STANDARD PIER DETAILS ARE STILL APPLICABLE.

7. FOR FINISHED DESIGN LEVELS REFER TO DRAWING CE-B07-10 AND SE-B07-51

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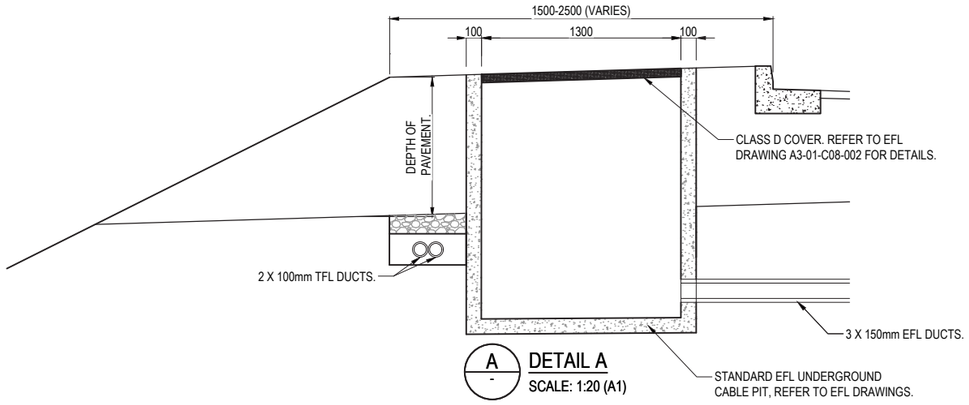
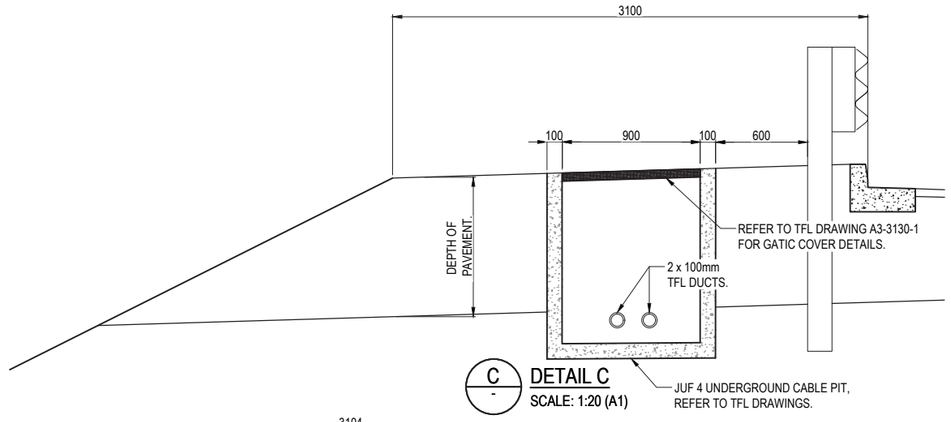


A DETAIL A
SCALE: 1:20 (A1)



C DETAIL C
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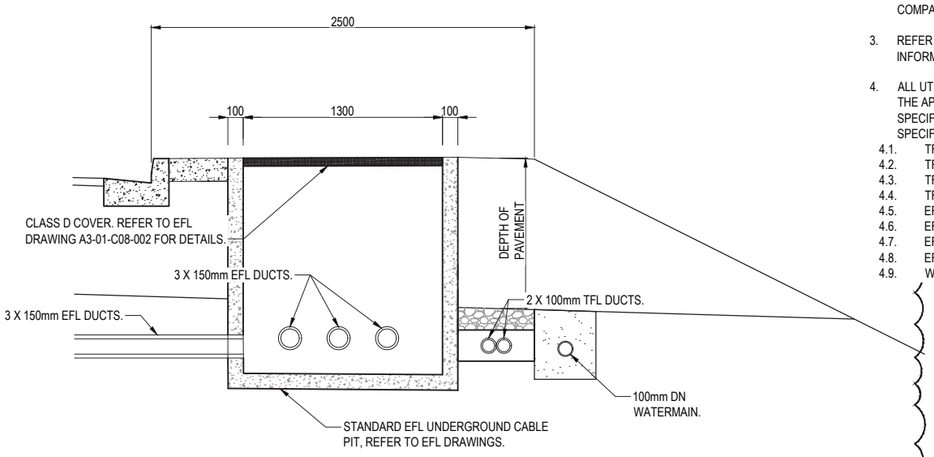
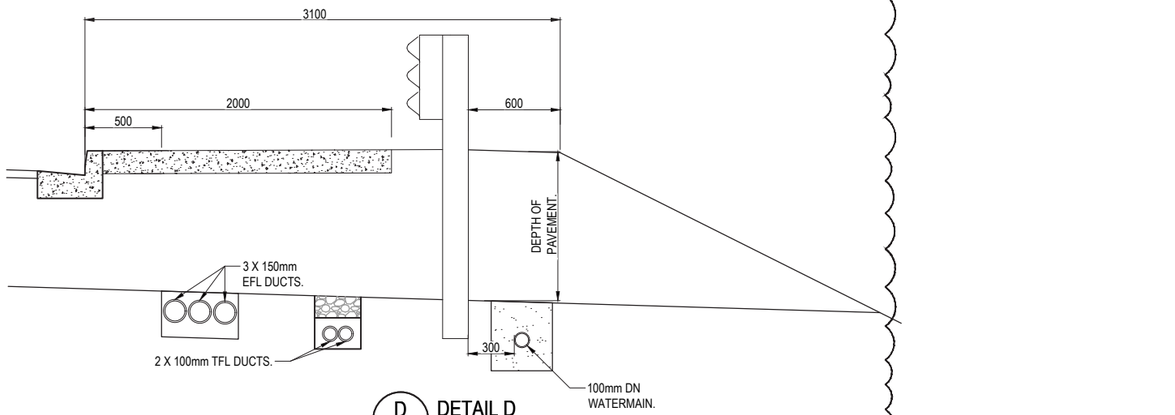


B DETAIL B
SCALE: 1:20 (A1)



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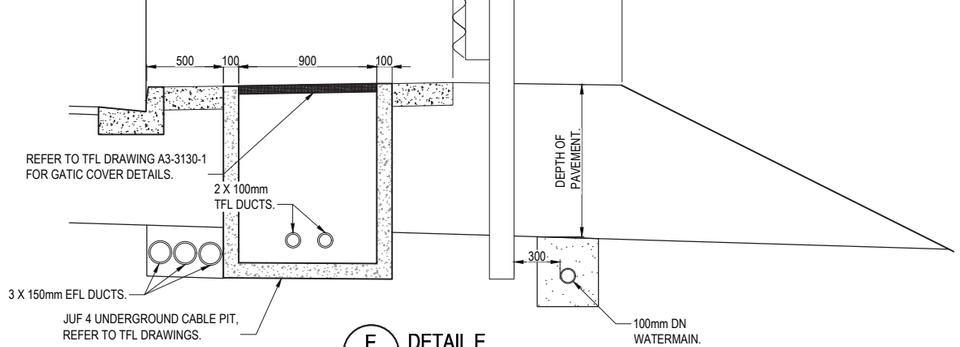
SCALE: 1:20 (A1)



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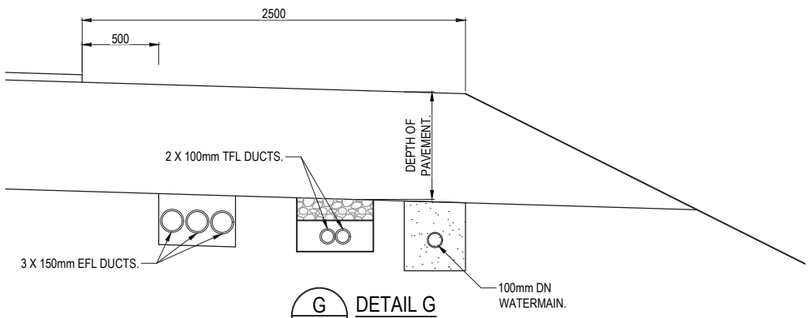
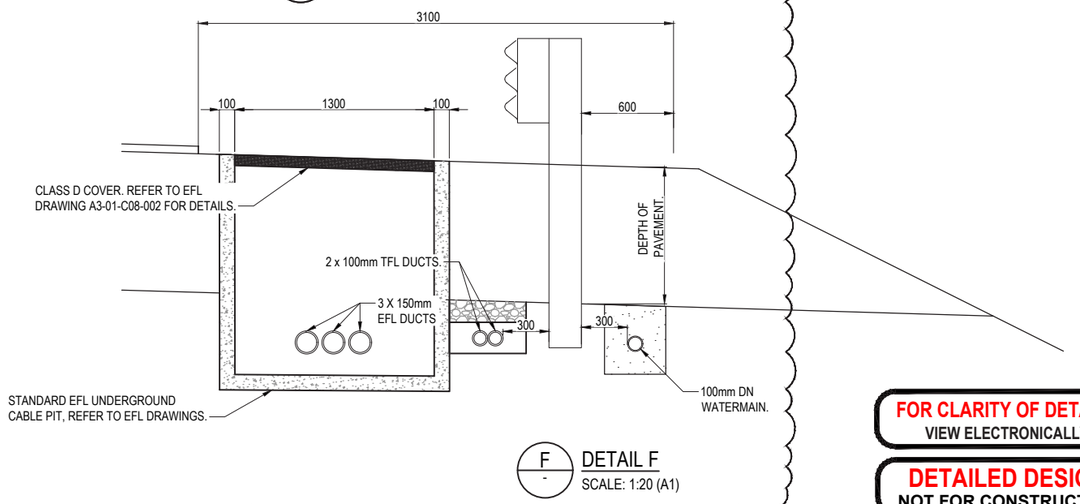


G DETAIL G
SCALE: 1:20 (A1)



F DETAIL F
SCALE: 1:20 (A1)

NOTES:

1. REFER TO 6103677-CE-STD-03 FOR GENERAL UTILITY NOTES.
2. UTILITIES SHOWN HAVE NOT BEEN CONFIRMED BY UTILITY COMPANIES
3. REFER TO CIVIL STANDARD DRAWINGS FOR TYPICAL UTILITY TRENCH INFORMATION, SPECIFICALLY 6103677-CE-STD-40.
4. ALL UTILITY INSTALLATIONS ARE TO BE DONE IN ACCORDANCE WITH THE APPROPRIATE UTILITY COMPANIES STANDARDS AND SPECIFICATIONS AS WELL AS THE PROJECT SPECIFICATIONS. SPECIFIC ATTENTION IS DRAWN TO THE FOLLOWING:
   - 4.1. TFL CIVIL WORKS GUIDELINES
   - 4.2. TFL PROFILE & PIT INSTALLATION GUIDELINES
   - 4.3. TFL DRAWING A3-3129-3
   - 4.4. TFL DRAWING A3-3130-1
   - 4.5. EFL DRAWING A3-01-C08-002
   - 4.6. EFL DRAWING A3-C26.20-SK04-0
   - 4.7. EFL DRAWING A3-C26.20-SK06-0
   - 4.8. EFL DRAWING A3-01-E24-028
   - 4.9. WAF STANDARD DRAWINGS

FOR CLARITY OF DETAILS
VIEW ELECTRONICALLY

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN - FOR FRA REVIEW	JM	AH	CH	08.03.24
B	DETAILED DESIGN - FOR FRA REVIEW	JM	AH	CH	19.12.23
A	DETAILED DESIGN - FOR COMMENT	JM	VH	CH	27.07.23

Original Scale (A1) 1:20
Reduced Scale (A3) 1:40

Design	J. MARSH	27.07.23	Approved For Construction*
Drawn	J.MARSH	27.07.23	
Dsg Verifier	C. HATLEY	27.07.23	
Drg Check	C. HATLEY	27.07.23	Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: NAVOLA BRIDGE NEW UTILITIES CROSS SECTIONS

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B07-21

Beca Project Number:

Rev.: C

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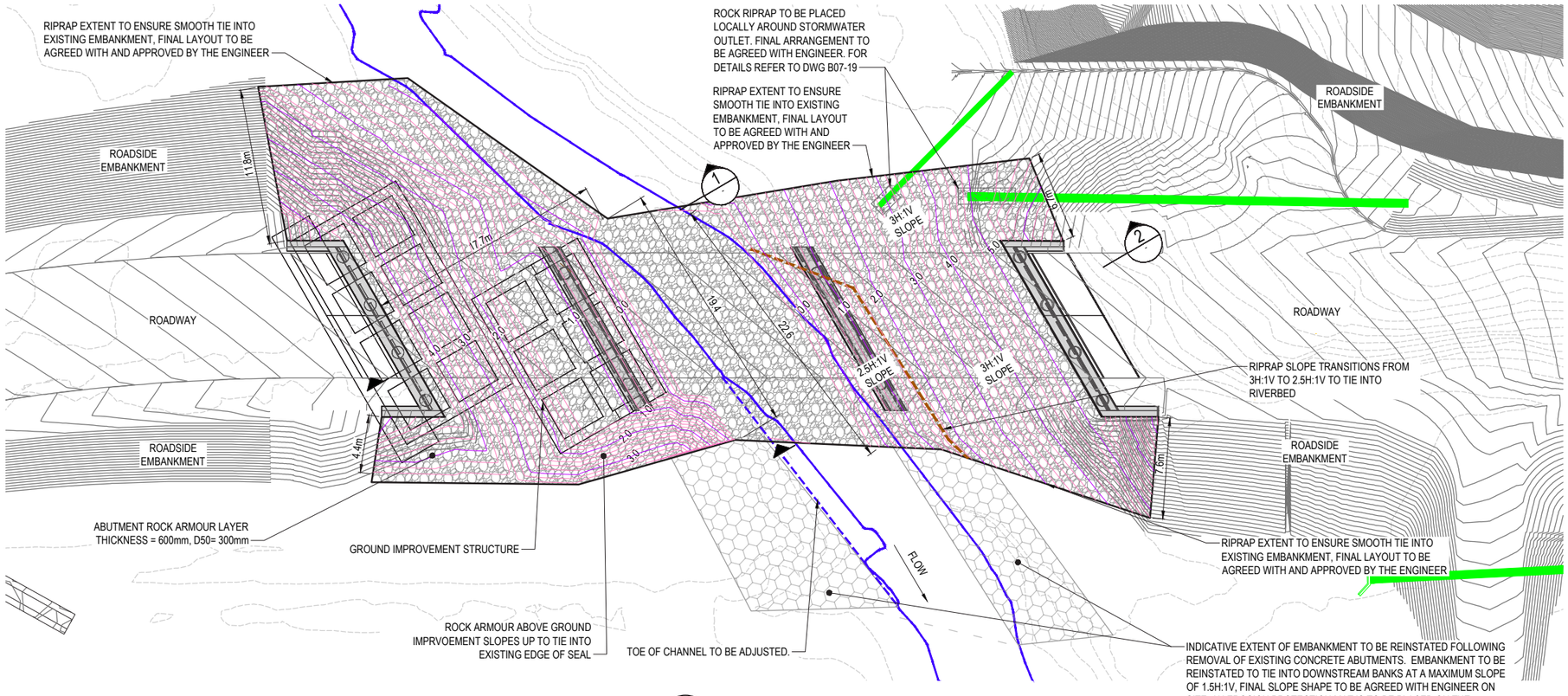


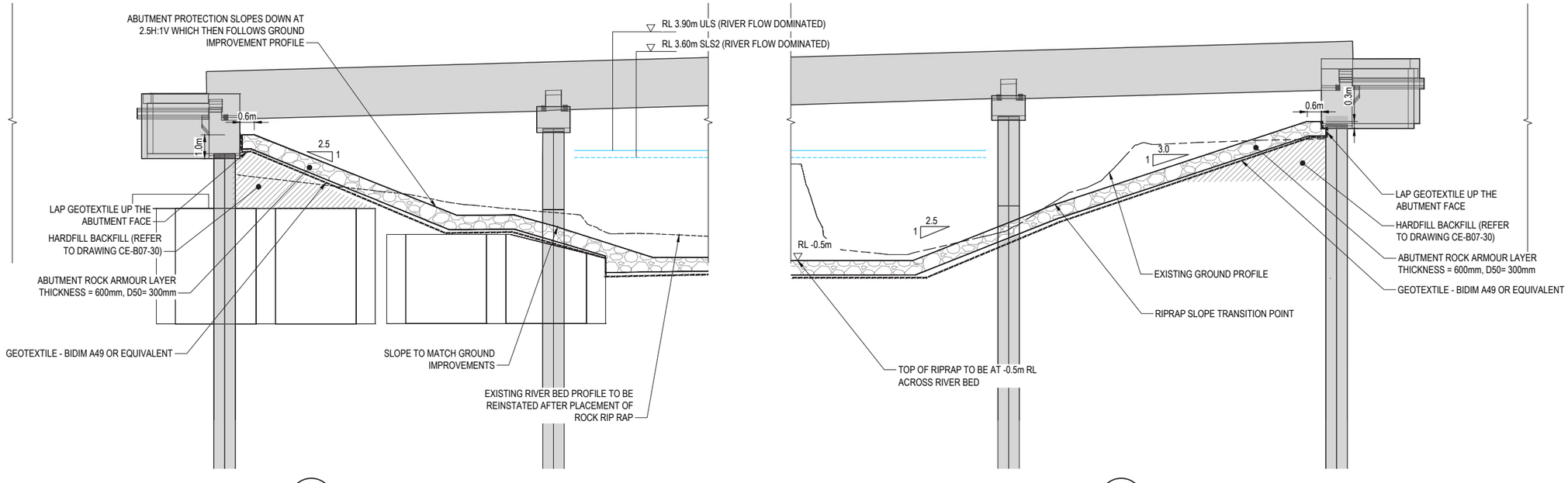
A SCOUR PROTECTION LAYOUT
SCALE 1:100

NOTES:

1. FOR ABUTMENT DETAILS REFER TO STRUCTURAL STANDARD DETAILS.
2. ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.
3. MAJOR CONTOURS SHOWN AT 1m INTERVALS
4. MINOR CONTOURS SHOWN AT 0.2m INTERVALS
5. EXCAVATED EXISTING GROUND TO BE REINSTATED AFTER PLACEMENT OF ROCK RIPRAP.
6. ANY LOOSE DEBRIS WITHIN THE WATERWAY IS TO BE REMOVED
7. ROCK TO TIE INTO THE SURROUNDING EMBANKMENTS
8. FOR ROCK, UNDERLAYER AND GEOTEXTILE SPECIFICATION PLEASE REFER TO SECTION C0226 OF THE SPECIFICATION DOCUMENT.

LEGEND:

- EXISTING TOE OF CHANNEL
- ROCK RIP RAP
- ULS RIVER FLOW LEVEL
- SLS2 RIVER FLOW LEVEL
- PROPOSED MAJOR CONTOURS (1.0m)
- PROPOSED MINOR CONTOURS (0.2m)
- EXISTING CONTOURS
- ROADSIDE EMBANKMENT CONTOURS
- STORMWATER PIPE
- EROSION PROTECTION MAT



1 SCOUR PROTECTION
SCALE 1:100

2 SCOUR PROTECTION
SCALE 1:100

FOR CLARITY OF DETAILS
VIEW ELECTRONICALLY

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN - FOR FRA REVIEW	HD	RS	CH	08.03.24
B	DETAILED DESIGN - FOR FRA REVIEW	HD	RS	CH	19.12.23
A	DETAILED DESIGN - FOR COMMENT	HD	VH	CH	27.07.23

Original Scale (A1)	1:100	Approved For Construction*	
Reduced Scale (A3)	1:200		

Design	H. DALLAS	27.07.23	Approved For Construction*
Drawn	P. BOY	27.07.23	
Dsg Verifier	R. SHAFIEI	27.07.23	
Drg Check	R. SHAFIEI	27.07.23	Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: NAVOLA BRIDGE SCOUR PROTECTION LAYOUT

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B07-25

Rev.: C

Document No. 6103677-CE-B07-25.DWG

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Drawing Plotted: 08 Mar 2024 7:46 am

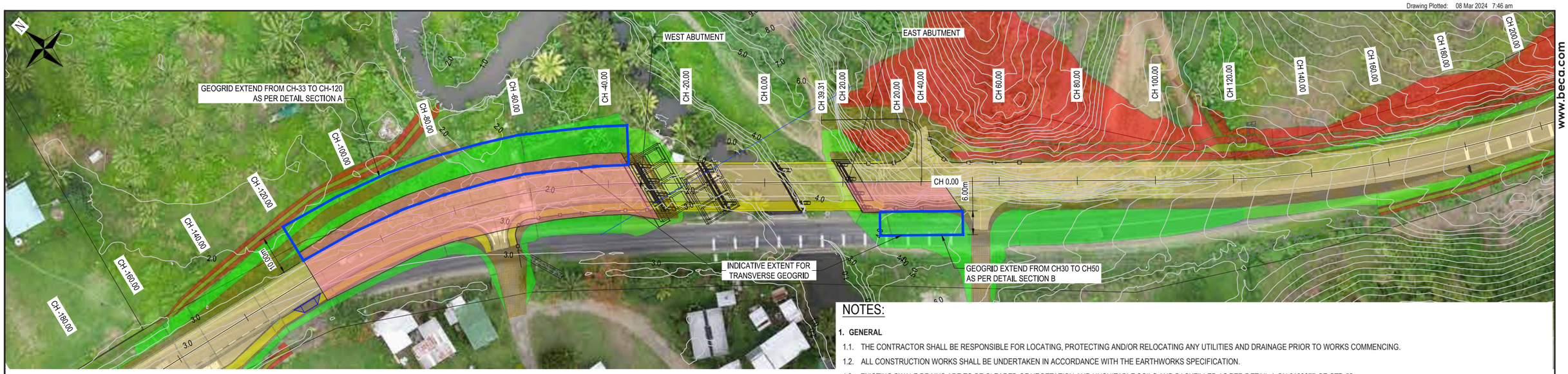
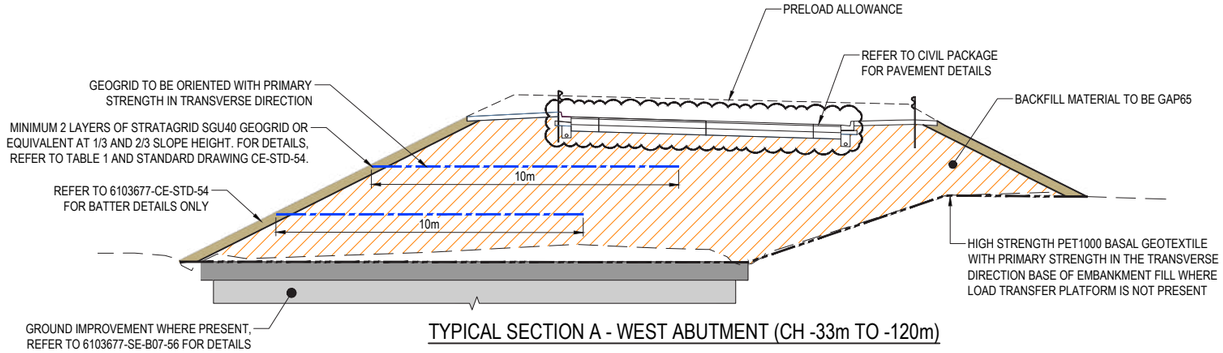


TABLE 1 - TRANSVERSE GRID ELEVATIONS AND LENGTH

CHAINAGES	LENGTH (m)
CH. -33 TO -80	10
CH. -80 TO -120	10
CH. 30 TO 40	6

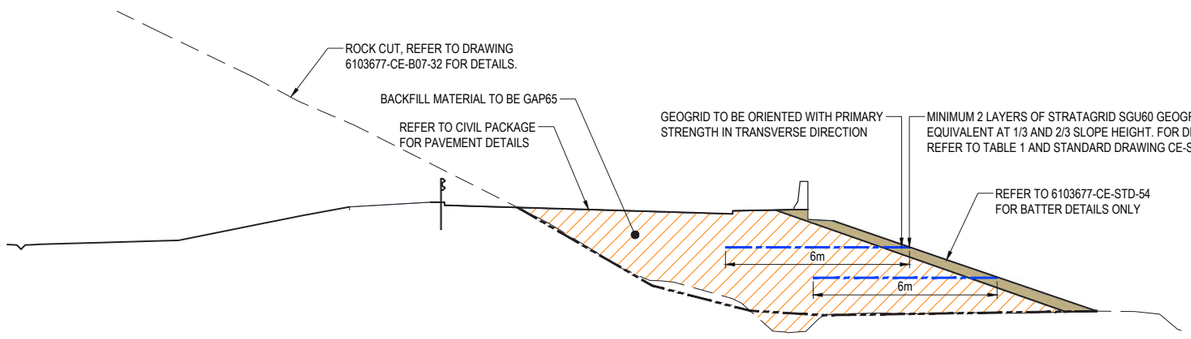
LEGEND:

- COMPACTED GAP 65
- STRATGRID SGU40 OR EQUIVALENT
- BASAL GEOTEXTILE LAYER
- PROPOSED PRELOAD SURFACE 150MM ABOVE THE PROPOSED SURFACE LEVEL FOR SETTLEMENT ALLOWANCE



TYPICAL SECTION A - WEST ABUTMENT (CH -33m TO -120m)

SCALE 1:100



TYPICAL SECTION - EAST ABUTMENT (CH 30m TO 50m)

SCALE 1:100

NOTES:

1. GENERAL

1.1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING, PROTECTING AND/OR RELOCATING ANY UTILITIES AND DRAINAGE PRIOR TO WORKS COMMENCING.

1.2. ALL CONSTRUCTION WORKS SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE EARTHWORKS SPECIFICATION.

1.3. EXISTING SWALE DRAINS ARE TO BE CLEARED OF VEGETATION AND UNSUITABLE SOILS AND BACKFILLED AS PER DETAIL A ON 6103677-CE-STD-53.

1.4. ANY SIGNIFICANT VARIANCES IN GROUND CONDITIONS FROM THOSE PRESENTED IN THESE DRAWINGS MUST BE BROUGHT TO THE ATTENTION OF THE ENGINEER.

1.5. SUBGRADE IMPROVEMENTS AND PAVEMENT LAYER NOT SHOWN ON DRAWINGS FOR CLARITY.

1.6. TO MINIMIZE THE POTENTIAL FOR INSTABILITY OF PERMANENT WORKS ELEMENTS, THE POSITION OF ANY TEMPORARY STOCKPILES SHALL BE AGREED WITH THE ENGINEER.

1.7. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS STATED OTHERWISE.

2. EMBANKMENT

2.1. PRIOR TO FILLING, TOPSOIL AND UNSUITABLE SOILS (INCLUDING HIGHLY ORGANIC SOILS OR SILT, TOXIC MATERIALS, PEAT LOGS, STUMPS, PERISHABLE OR ORGANIC MATERIALS, CONTAMINATED SOILS) SHALL BE EXCAVATED AND REMOVED.

2.2. THE MINIMUM ACCEPTABLE VANE SHEAR STRENGTH OF INSITU SUBGRADE (FROM SHEAR VANE TESTING OR CORRELATED UNDRAINED SHEAR STRENGTH (FROM SCALA PENETROMETER TESTING) IS 30kPa. REFER TO PROJECT EARTHWORKS SPECIFICATION FOR TESTING REQUIREMENT.

2.3. WHERE MATERIAL IS ENCOUNTERED THAT DOES NOT MEET THE STRENGTH REQUIRED IN THE EARTHWORKS SPECIFICATION, THE CONTRACTOR SHALL DETERMINE THE EXTENTS AND STRENGTH OF MATERIAL LESS THAN THIS REQUIREMENT FOR FURTHER UNDERCUTTING OR TREATMENT.

2.4. THE CONTRACTOR SHALL EVALUATE, DURING CONSTRUCTION, THE SAFE TAMPORARY BATTER ANGLE FOR ANY EXCAVATION OR FILLING.

2.5. THE MATERIALS AT FORMATION LEVEL SHOULD BE PROTECTED FROM SOFTENING, OVERLOADING (e.g. FROM CONSTRUCTION TRAFFIC) OR OTHER CONDITIONS WHICH MAY RESULT IN WEAKENING OF THESE MATERIALS.

2.6. POSITIVE DRAINAGE OF ALL EXCAVATION WORKS MUST BE MAINTAINED DURING CONSTRUCTION.

2.7. ALL AREAS OF EXPOSED EMBANKMENT SUBGRADE ARE TO BE INSPECTED BY THE ENGINEER TO CONFIRM UNSUITABLE SOILS HAVE BEEN REMOVED. REFER TO EARTHWORKS SPECIFICATION FOR SUBGRADE REQUIREMENTS. QUALITY ASSURANCE DOCUMENTATION SHALL RECORD INSPECTION AND ACCEPTANCE.

2.8. ALL FILL MATERIALS SHALL MEET THE GRADING, COMPACTION AND TESTING REQUIREMENTS SPECIFIED IN THE EARTHWORKS SPECIFICATION.

2.9. SETTLEMENT MONITORING INSTRUMENTATION DETAILED ON THE DRAWINGS TO BE INSTALLED, AND BASELINE MONITORING COMPLETED, PRIOR TO PLACING EMBANKMENT FILL.

2.10. PLACEMENT OF EMBANKMENT FILL MATERIAL AND PRELOAD FILL MATERIALS SHALL BE STAGED, WITH REST PERIODS OF MINIMUM 1 WEEK BETWEEN 1m HEIGHT FILL LIFTS. DURATION AND FREQUENCY OF REST PERIODS TO BE DETERMINED BY THE ENGINEER. DURATION OF REST PERIODS BETWEEN FILL STAGES TO BE ADJUSTED BY CONTRACTOR TO MANAGE INSTABILITY RISK DURING CONSTRUCTION.

2.11. EMBANKMENT FILL MATERIALS TO BE OVERFILLED TO ACCOUNT FOR SETTLEMENT, LATER TRIMMED / TOPPED UP TO DESIGN PAVEMENT SUBGRADE LEVEL.

3. GEOGRID AND BASAL GEOTEXTILE

3.1. REFER TO THE DRAWINGS AND EARTHWORKS SPECIFICAITON FOR ALL GEOTEXTILE AND GEOGRID REQUIREMENTS.

3.2. TRANSVERSE GEOGRID, WHERE SPECIFIED, IS LAID WITH THE PRIMARY STRENGTH DIRECTION PERPENDICULAR TO THE ROAD CENTRELINE.

3.3. BASAL HIGH STRENGTH GEOTEXTILES, THE PRIMARY STRENGTH DIRECTION IS TO BE PERPENDICULAR TO THE ROAD CENTRELINE UNLESS SPECIFICALLY SPECIFIED OTHERWISE ON THE DRAWINGS.

3.4. HIGH STRENGTH GEOTEXTILES AND GEOGRIDS ARE TO BE CONTINUOUS IN THEIR PRIMARY STRENGTH DRIECTION AND NOT LAPPED / JOINED.

3.5. WHERE THE HIGH STRENGTH GEOTEXTILES AND / OR GEOGRID LAYERS EXTEND BELOW THE EXISTING GROUND SURFACE, EXCAVATION WILL BE REQUIRED.

3.6. ALL HIGH STRENGTH GEOTEXTILE AND GEOGRID LAYERS ARE TO BE LAID OUT OVER THER FULL LENGTH AND COVERED AS A SINGLE OPERATION UNLESS AGREED OTHERWISE WITH THE ENGINEER. HIGH STRENGTH GEOTEXTILE AND GEOGRID LAYERS ARE TO BE COVERED ON THE DAY OF PLACING.

3.7. NO TRAFFIC OF SITE PLANT SHALL BE PERMITTED TO TRAFFIC THE GEOGRID OR HIGH STRENGTH GEOTEXTILE LAYERS WHERE COVER IS LESS THAN 200mm.

3.8. GEOGRID WITHIN FILL EMBANKMENTS (EXCLUDING RETAINING STRUCTURES) SHALL BE PLACED WITH A MINIMUM VERTICAL SPACING OF 500mm BETWEEN LAYERS UNLESS SPECIFICALLY SPECIFIED OTHERWISE ON THE DRAWINGS.

4. PRELOAD SURCHARGING OF EMBANKMENTS

4.1. WHERE SHOWN ON THE DRAWINGS THE FILL EMBANKMENTS ARE TO BE PRELOADED DURING CONSTRUCTION. REFER THE PROJECT EARTHWORKS SPECIFICATION FOR PRELOAD AND SURCHARGE SPECIFICATION.

4.2. THE PRELOAD SHALL COMPRISE GAP65 AGGREGATE WITH A PLACED DENSITY NOT LESS THAN 2.2t/m³.

4.3. THE PRELOAD FILL SHOULD BE PLACED NO STEEPER THAN 1.5H:1V SLOPE UNLESS THE CONTRACTOR PROVIDES A TEMPORARY SUPPORT SYSTEM.

4.4. SETTLEMENT OF THE EMBANKMENT SHALL BE MONITORED DURING POST CONSTRUCTION WITH INSTRUMENTATION SHOWN ON THE DRAWING 6103677-CE-B07-31.

4.5. PRELOAD IS TO REMAIN IN PLACE UNTIL RESIDUAL (POST CONSTRUCTION) CONSOLIDATION SETTLEMENT IS ESTIMATED TO BE LESS THAN 50mm, AS ADVISED BY THE ENGINEER FOLLOWING ANALYSIS OF THE FIELD DATA TO UPDATE SETTLEMENT ESTIMATES.

4.6. FOLLOWING REMOVAL OF THE PRELOAD ALL FILL MATERIALS REMAINING IN THE PERMEANT WORKS SHALL COMPLY WITH THE MATERIALS TYPE AND FIELD COMPACTION STATED ON THE DRAWINGS AND SPECIFICATION.

4.7. ESTIMATED DURATION OF PRELOADING IS SIX MONTHS WITH THE ACTUAL DURATION TO BE CONFIRMED WITH THE ENGINEER.

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN - FOR FRA REVIEW	JL	VH	CH	08.03.24
B	DETAILED DESIGN - FOR FRA REVIEW	JL	VH	CH	19.12.23
A	DETAILED DESIGN - FOR COMMENT	JL	VH	CH	27.07.23

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	J.LEE	27.07.23	Approved For Construction*
Drawn	M.ANONUEVO	27.07.23	
Dsg Verifier	C. HATLEY	27.07.23	
Drg Check	C. HATLEY	27.07.23	Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: NAVOLA BRIDGE EMBANKMENT DETAILS AND PRELOAD SURCHARGE

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B07-30

Rev.: C

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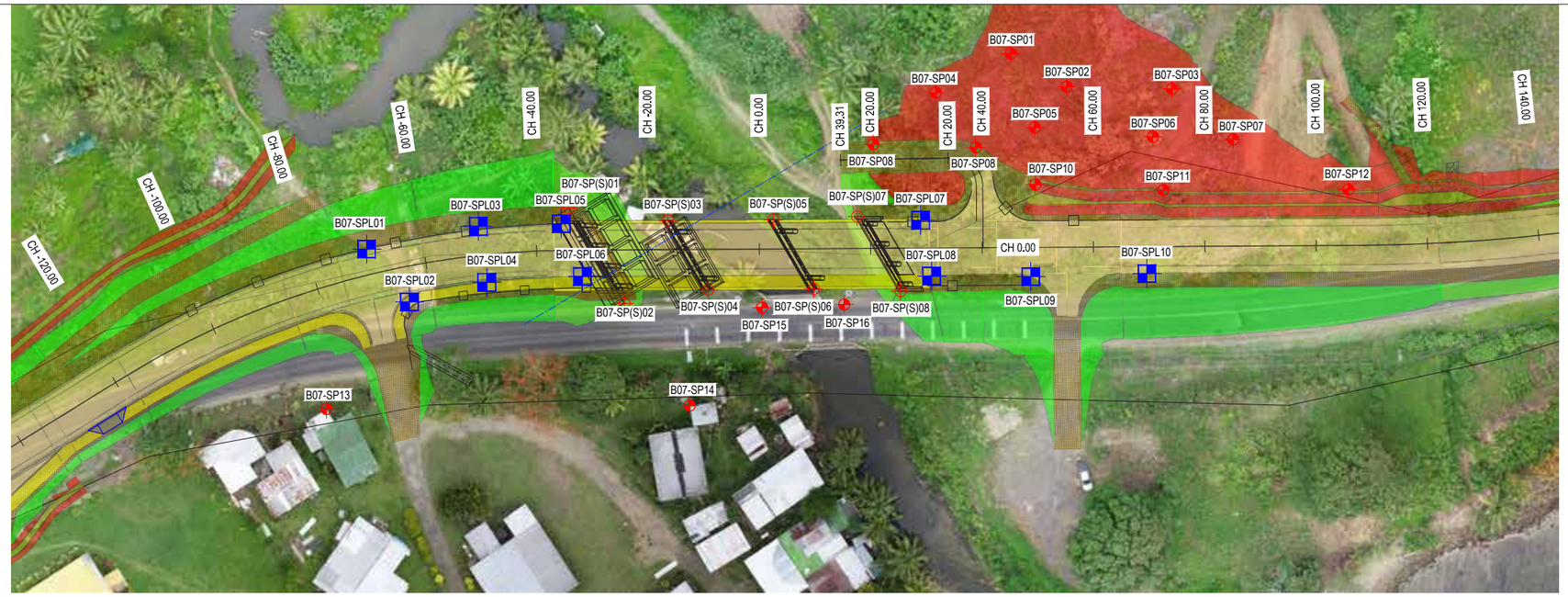
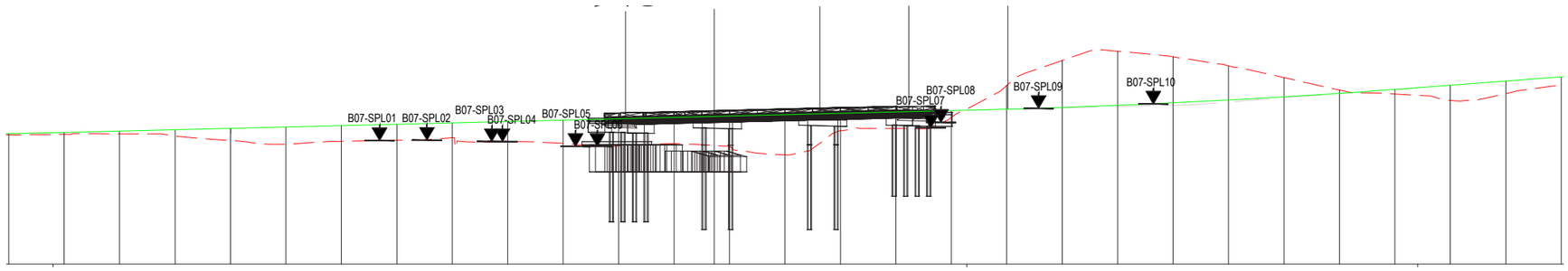


1 / - OFF-LINE REPLACEMENT
SCALE 1:500



OFF-LINE REPLACEMENT
SCALE 1:500

NOTES:

1. CONTRACTOR CONSTRUCTION METHODOLOGY, SEQUENCING AND PROPOSED PRELODING SURCHAGE PROGRAMME TO BE PROVIDED TO THE ENGINEER PRIOR TO COMMENCMENT OF WORKS.
2. THE PROPOSED INSTALLATION LOCATIONS FOR INSTRUMENTS AIM TO POSITION THEM AWAY FROM CONSTRUCTION ACTIVITIES TO MINIMISE THE CHANCE OF DAMAGE TO THE INSTRUMENTS. THE FINAL LOCATION OF INSTRUMENTS SHALL BE CONFIRMED ON SITE WITH THE ENGINEER AND THE CONTRACTOR SHALL TAKE ALL PRACTICAL MEASURES TO PROTECT ALL MONITORING INSTRUMENTS DURING ALL PHASES OF CONSTRUCTION (e.g. EARTHWORKS, WEATHER, TRAFFIC, OTHER CONSTRUCTION ACTIVITIES).
3. IN THE EVENT THAT THE INSTRUMENTS ARE DAMAGED THE ENGINEER SHALL BE IMMEDIATELY INFORMED AND, IF REQUIRED BY THE ENGINEER DEPENDING ON THE DEGREE OF DAMAGE, ALL CONSTRUCTION WORKS NEAR TO THE AFFECTED INSTRUMENTATION SHALL CEASE. THE DAMAGED INSTRUMENTS SHALL BE IMMEDIATELY REPLACED AND RE-BASELINED WITHIN 24 HOURS (UNLESS OTHERWISE AGREED WITH THE ENGINEER) AND WHERE CONSTRUCTION WORKS ARE HALTED, THEY SHALL NOT RESTART UNTIL THE REPLACEMENT INSTRUMENT IS FULLY OPERATIONAL.
4. THE MONITORING RESULTS SHALL BE PROVIDED TO THE ENGINEER ON A WEEKLY BASIS AND WILL REVIEW MONITORING RESULTS AND WILL CONFIRM THE END OF THE SETTLEMENT PERIOD.
5. MONITORING FREQUENCY MAY BE ALTERED AS ACCEPTED BY THE ENGINEER.
6. REFER TO 6103677-CE-STD-55 FOR SURVEY PINS TRIGGER LEVELS.
7. THE INSTALLATION AND MONITORING OF INSTRUMENTATION AND THE COLLATION OF DATA AND REVIEW OF RESULTS AGAINST THE TRIGGER LEVELS PROVIDED BY THE ENGINEER SHALL BE CARRIED OUT BY THE CONTRACTOR (OR SUITABLE PERSONNEL OR ORGANISATIONS NOMINATED BY THE CONTRACTOR WHO ARE EXPERIENCED AND COMPETENT IN SUCH WORK). ANY EXCEEDANCE OF THE TRIGGER LEVELS SHOULD BE REPORTED TO THE ENGINEER IMMEDIATELY
8. THE REQUIREMENTS OF INSTRUMENTATION AND MONITORING SPECIFICATION APPLY UNLESS OTHERWISE NOTED ON THESE DRAWINGS. FOR SPECIFICATION AND INSTRUMENTATION DETAILS REFER 6103677-CE-STD-55 TO 6103677-CE-STD-58.
9. FOR SURVEY PINS, CONTRACTOR SHALL SUPPLY THE X AND Y COORDINATES, AND Z LEVELS.

LEGEND:

- SETTLEMENT MONITORING PLATE
- SURVEY PINS
- SURVEY PIN (STRUCTURES)

INSTRUMENTATION & MONITORING SETOUT POINTS

SETOUT POINTS	NORTHING	EASTING
B07-SPL01	3864246.0	1896276.5
B07-SPL02	3864234.1	1896274.7
B07-SPL03	3864236.1	1896291.2
B07-SPL04	3864226.6	1896286.6
B07-SPL05	3864224.1	1896303.1
B07-SPL06	3864215.0	1896298.8
B07-SPL07	3864178.4	1896346.7
B07-SPL08	3864170.3	1896340.8
B07-SPL09	3864157.5	1896352.7
B07-SPL10	3864142.9	1896367.0
B07-SP01	3864184.0	1896381.9
B07-SP02	3864172.7	1896384.5
B07-SP03	3864158.7	1896397.2
B07-SP04	3864189.1	1896367.7
B07-SP05	3864172.0	1896375.3
B07-SP06	3864155.3	1896388.6
B07-SP07	3864144.5	1896398.1

INSTRUMENTATION & MONITORING SETOUT POINTS

SETOUT POINTS	NORTHING	EASTING
B07-SP08	3864191.1	1896353.3
B07-SP09	3864177.2	1896365.5
B07-SP10	3864165.0	1896368.0
B07-SP11	3864147.5	1896383.0
B07-SP12	3864183.4	1896297.0
B07-SP13	3864230.6	1896252.0
B07-SP14	3864183.4	1896297.0
B07-SP15	3864185.8	1896318.6
B07-SP16	3864175.4	1896329.1
B07-SP(S)01	3864223.0	1896308.0
B07-SP(S)02	3864204.2	1896302.4
B07-SP(S)03	3864208.2	1896318.8
B07-SP(S)04	3864194.6	1896314.7
B07-SP(S)05	3864194.3	1896331.9
B07-SP(S)06	3864180.7	1896327.8
B07-SP(S)07	3864183.8	1896342.5
B07-SP(S)08	3864169.1	1896338.2

TABLE 13 - INSTRUMENTATION & MONITORING FREQUENCY

INSTRUMENT DETAILS			INSTRUMENT MONITORING FREQUENCY			
INSTRUMENT	LOCATION	INSTALLATION	BASE	DURING CONSTRUCTION	DURING HOLD PERIODS	BACKGROUND CONSTRUCTION
SETTLEMENT PLATE B07-SPL01 - B07-SPL10	NATURAL GROUND IMMEDIATELY BENEATH THE EMBANKMENT FILL	PRIOR TO INSTALLATION ON ANY FILL	THREE TIMES BEFORE ANY PHYSICAL WORKS	WEEKLY	VARIES WEEKLY TO MONTHLY AS AGREED WITH ENGINEER	MONTHLY
SURVEY PINS B07-SP01 - B07-SP14	ON CUT BENCHES / EXISTING STRUCTURES	POST EXCAVATION / PRIOR TO ANY PHYSICAL WORKS				
SURVEY PINS -STRUCTURES B07-SP(S)01 - B07-SP(S)08	NEW BRIDGE ABUTMENT BEAMS AND PIER CROSSHEAD	IMMEDIATELY AFTER CONSTRUCTION OF THE STRUCTURAL ELEMENT	TWO TIMES IMMEDIATELY AFTER CONSTRUCTION OF THE STRUCTURAL ELEMENTS	EVERY SECOND WEEK UNLESS AGREED OTHERWISE WITH ENGINEER	N/A	N/A

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN - FOR FRA REVIEW	JL	VH	CH	08.03.24
B	DETAILED DESIGN - FOR FRA REVIEW	JL	VH	CH	19.12.23
A	DETAILED DESIGN - FOR COMMENT	JL	VH	CH	27.07.23

Original Scale (A1) 1:500
Reduced Scale (A3) 1:1000

Design	J.LEE	27.07.23	Approved For Construction*
Drawn	M.ANONUEVO	27.07.23	
Dsg Verifier	C. HATLEY	27.07.23	
Drg Check	C. HATLEY	27.07.23	Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: NAVOLA BRIDGE GEOTECHNICAL INSTRUMENTATION AND MONITORING DETAILS
Discipline: CIVIL ENGINEERING
Drawing No.: 6103677-CE-B07-31
Rev.: C

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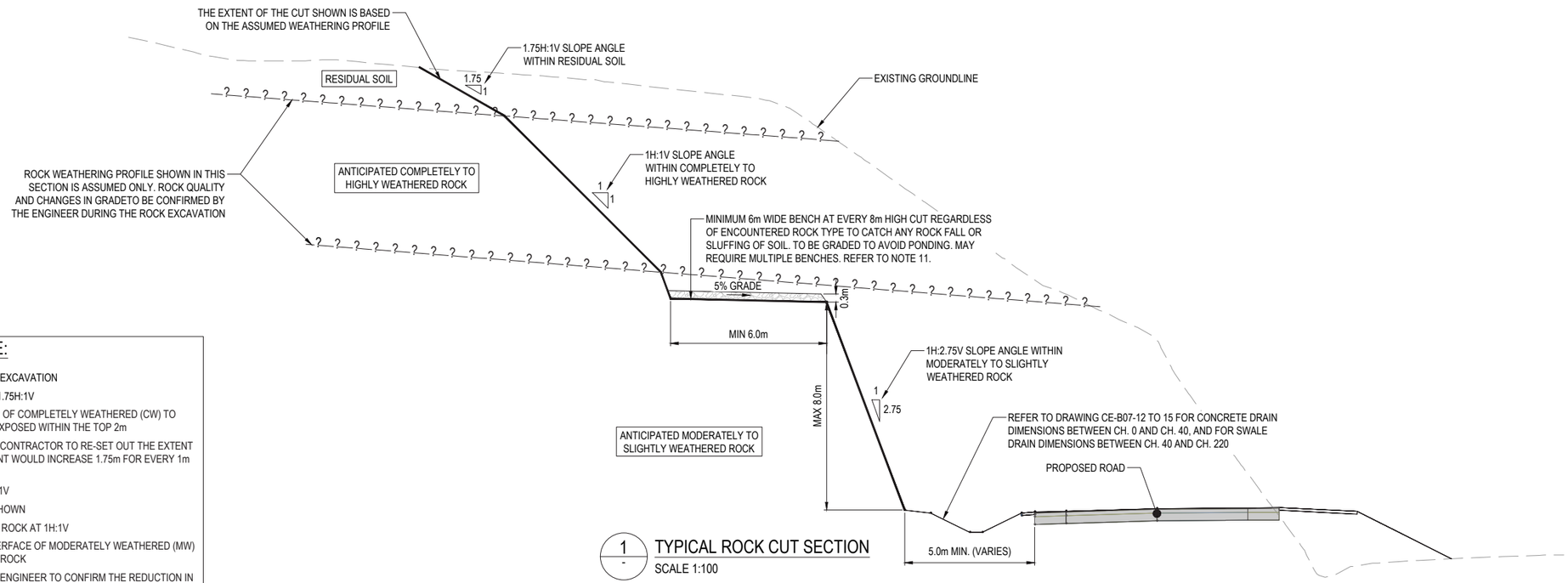
Document No. 6103677-CE-B07-31.DWG

Drawing Plotted: 08 Mar 2024 8:42 am

A - ROCK CUT AT EAST ABUTMENT
SCALE 1:400

NOTES:

1. REFER TO THE SPECIFICATION G010 - ROCKFALL SOURCE TREATMENT.
2. HOURS OF WORK FOR CONSTRUCTION OF THE CUT FOR ROAD WIDENING SHALL BE AGREED WITH COMMUNITY AND THE ENGINEER.
3. IN SOIL AND VERY WEAK ROCK, TRIMMING TO FINAL PROFILE SHOULD BE CARRIED OUT USING A SMOOTH-EDGE BUCKET.
4. DURING EXCAVATION, CUT SLOPE AND IMMEDIATE SURROUNDING AREA TO BE INSPECTED BY THE CONTRACTOR DAILY PRIOR TO COMMENCING WORK FOR ANY SIGNS OF INSTABILITY.
5. ROCK CUT FACE TO BE INSPECTED BY THE ENGINEER (GEOTECHNICAL MSQA REPRESENTATIVE) DURING CUT CONSTRUCTION TO CHECK FOR ADVERSE GEOLOGICAL OR GROUND CONDITIONS. LEVEL OF GEOTECHNICAL CONSTRUCTION MONITORING SERVICES TO BE TO A LEVEL OF CM4 AS DEFINED BY ENGINEERING NEW ZEALAND.
6. CUT FACES TO BE SCALED OF LOOSE MATERIAL AS THE CUT IS LOWERED. REFER SPECIFICATION AND DWG CE-B07-33.
7. THE ENGINEER TO IDENTIFY IF ANY LOCALIZED ROCK SUPPORT OR ADDITIONAL ROCKFALL MITIGATION OTHER THAN SCALING AND EARTHWORKS IS REQUIRED BASED ON OBSERVATIONS DURING CONSTRUCTION. A RISK ASSESSMENT SHALL BE UNDERTAKEN, AND DETERMINATION OF THE REQUIRED MITIGATION CONFIRMED BY THE ENGINEER.
8. EXPOSED SOIL FACES TO BE HYDROSEEDED ON COMPLETION
9. CONTRACTOR TO PROVIDE TEMPORARY WORKS TO MITIGATE RISK OF ROCKFALL OR DEBRIS RELEASE BEYOND THE WORKING AREA.
10. HOLD POINTS:
    - CONTRACTORS CONSTRUCTION METHODOLOGY (INCLUDING STAGING, EQUIPMENT, EXCAVATION METHODS, SAFETY EXCLUSION ZONES, SAFETY MANAGEMENT, TRAFFIC AND PEDESTRIAN MANAGEMENT) TO BE SUBMITTED TO THE ENGINEER FOR ACCEPTANCE PRIOR TO COMMENCEMENT OF EXCAVATION.
    - SETOUT OF EXCAVATION ON SITE TO BE AGREED WITH ENGINEER PRIOR TO COMMENCEMENT OF EXCAVATION.
    - ENGINEER ACCEPTANCE OF CUT SLOPE ANGLES AND CONDITION OF THE CUT FACE. TO BE UNDERTAKEN FOR EACH BENCH PRIOR TO PROGRESSING THE EXCAVATION LOWER.
11. CUT BENCH TO BE COVERED WITH A MINIMUM 300mm THICK LAYER OF GENERAL ALL PASSING 100mm UNWEATHERED ROCK SOURCED FROM THE CUT TO ASSIST WITH CUSHIONING ROCK IMPACT AND SLOWING ROCKFALL FROM ABOVE.
12. APPROPRIATE HEALTH AND SAFETY MEASURES TO BE INSTALLED BY THE CONTRACTOR TO ENSURE SAFE TRAFFIC FLOW DURING ROCK CUT OPERATION



1 - TYPICAL ROCK CUT SECTION
SCALE 1:100

ROCK CUT SEQUENCE:

1. SET OUT EXTENT OF ROCK CUT EXCAVATION
2. EXCAVATE RESIDUAL SOILS AT 1.75H:1V
3. **HOLD POINT:** CONFIRM THE TOP OF COMPLETELY WEATHERED (CW) TO HIGH WEATHERED (HW) ROCK EXPOSED WITHIN THE TOP 2m
4. IF DEEPER THAN ASSUMED THE CONTRACTOR TO RE-SET OUT THE EXTENT OF EXCAVATION. (I.E. THE EXTENT WOULD INCREASE 1.75m FOR EVERY 1m DEEPER)
5. EXCAVATE CW-HW ROCK AT 1H:1V
6. INSTALL BENCHES AT LEVELS SHOWN
7. CONTINUE EXCAVATION CW-HW ROCK AT 1H:1V
8. HOLD POINT: CONFIRM THE INTERFACE OF MODERATELY WEATHERED (MW) TO SLIGHTLY WEATHERED (SW) ROCK
9. IF DEEPER THAN ASSUMED THE ENGINEER TO CONFIRM THE REDUCTION IN BENCH WIDTH.

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN - FOR FRA REVIEW	JL	VH	CH	08.03.24
B	DETAILED DESIGN - FOR FRA REVIEW	JL	VH	CH	19.12.23
A	DETAILED DESIGN - FOR COMMENT	JL	VH	CH	27.07.23

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	J.LEE	27.07.23	Approved For Construction*
Drawn	M.ANONUEVO	27.07.23	
Dsg Verifier	C. HATLEY	27.07.23	
Drg Check	C. HATLEY	27.07.23	Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: NAVOLA BRIDGE ROCK CUT SECTION AND DETAILS
Discipline: CIVIL ENGINEERING
Drawing No.: 6103677-CE-B07-32
Rev.: C
Document No. 6103677-CE-B07-32.DWG

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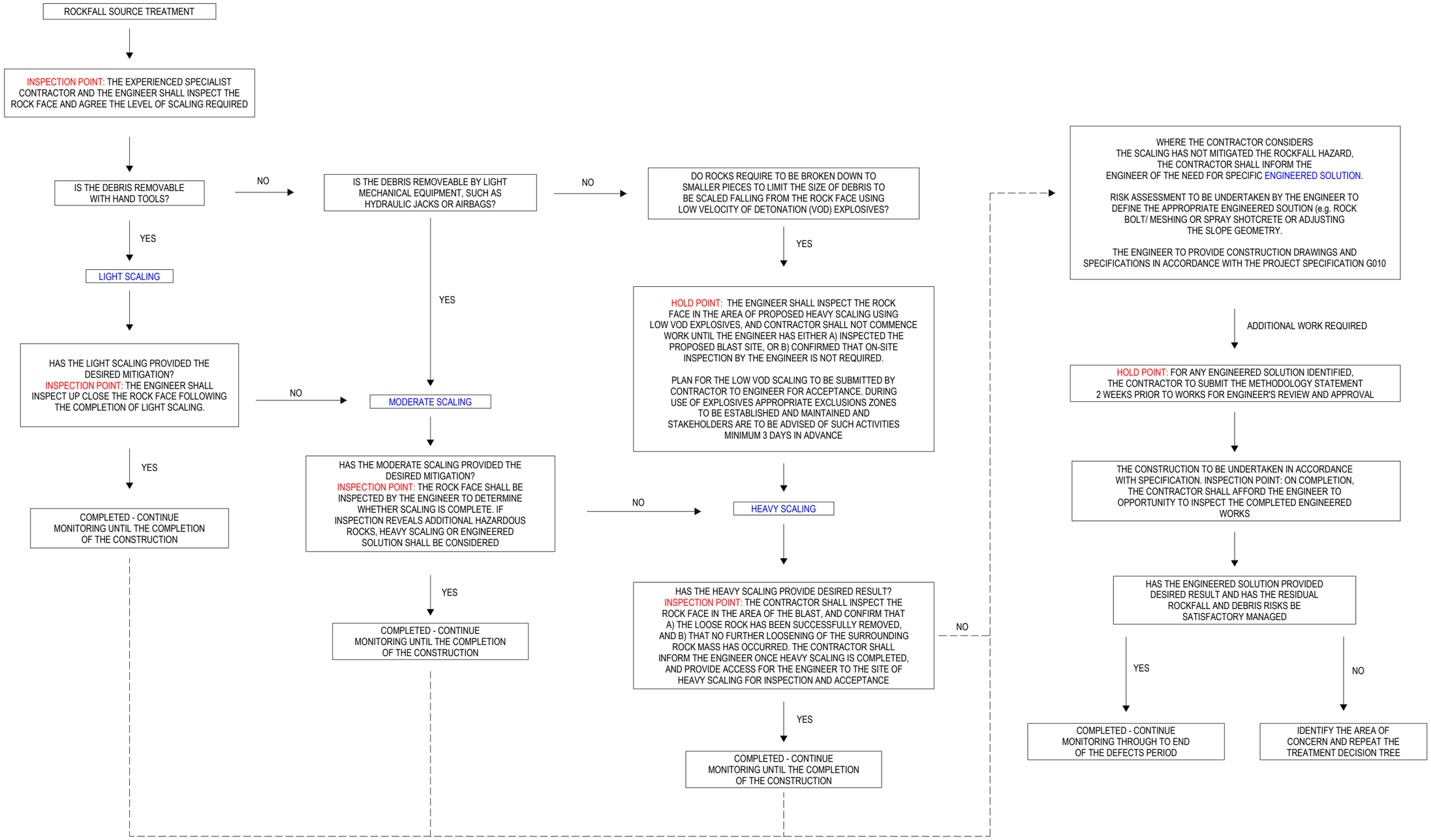

NOTES:

1. ROCK EXCAVATION SHALL BE UNDERTAKEN IN ACCORDANCE WITH TECHNICAL SPECIFICATION G010 - ROCKFALL SOURCE TREATMENT AND G011 - ROCK EXCAVATION.
2. INSPECTION POINT: FOLLOWING THE COMPLETION OF ANY SCALING, THE CONTRACTOR SHALL CHECK THE POSITION OF DEBRIS AND UNDERTAKE FURTHER SCALING
3. HOLD POINT: FOR ANY EXCAVATION / SCALING METHOD IDENTIFIED FROM ABOVE DECISION TREE, FIRST EXCAVATION / SCALING TO BE WITNESSED BY THE ENGINEER.
4. HOLD POINT: THE CONTRACTOR SHALL PROVIDE A METHODOLOGY FOR ROCK EXCAVATION A MINIMUM 2 WEEKS PRIOR TO COMMENCEMENT OF WORKS, FOR ENGINEER ACCEPTANCE.
5. ENGINEER TO UNDERTAKE SITE INSPECTION TO A LEVEL EQUIVALENT TO LEVEL CM4 FOR CONSTRUCTION MONITORING AS STATED IN ENGINEERING NEW ZEALAND GUIDANCE.

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN FOR FRA REVIEW	JL	VH	CH	06.03.24
A	DETAILED DESIGN FOR FRA REVIEW	JL	VH	CH	19.12.23

Original Scale (A1) NTS	Design	J.LEE	19.12.23	Approved For Construction* Date
Reduced Scale (A3) NTS	Drawn	M.ANONUEVO	19.12.23	
	Dsg Verifier	C. HATLEY	19.12.23	
	Drg Check	C. HATLEY	19.12.23	
	* Refer to Revision 1 for Original Signature			

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: NAVOLA BRIDGE ROCKFALL SOURCE TREATMENT DECISION TREE

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B07-33

Rev.: B

Document No. 6103677-CE-B07-33.DWG

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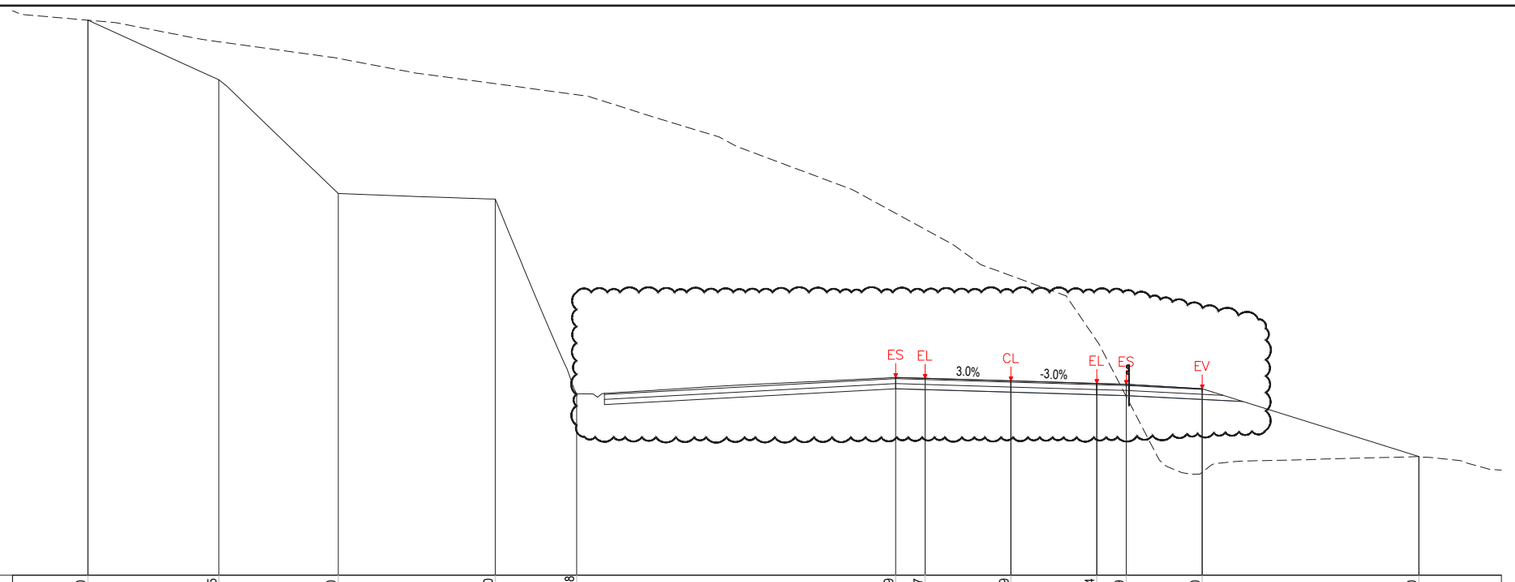
NOTES

1. REFER TO 6103677-CE-STD-03 FOR CIVIL GENERAL NOTES.
2. ROCK CUT DIMENSIONS ARE INDICATIVE ONLY. REFER TO 6103677-CE-B07-32 FOR DETAILS.



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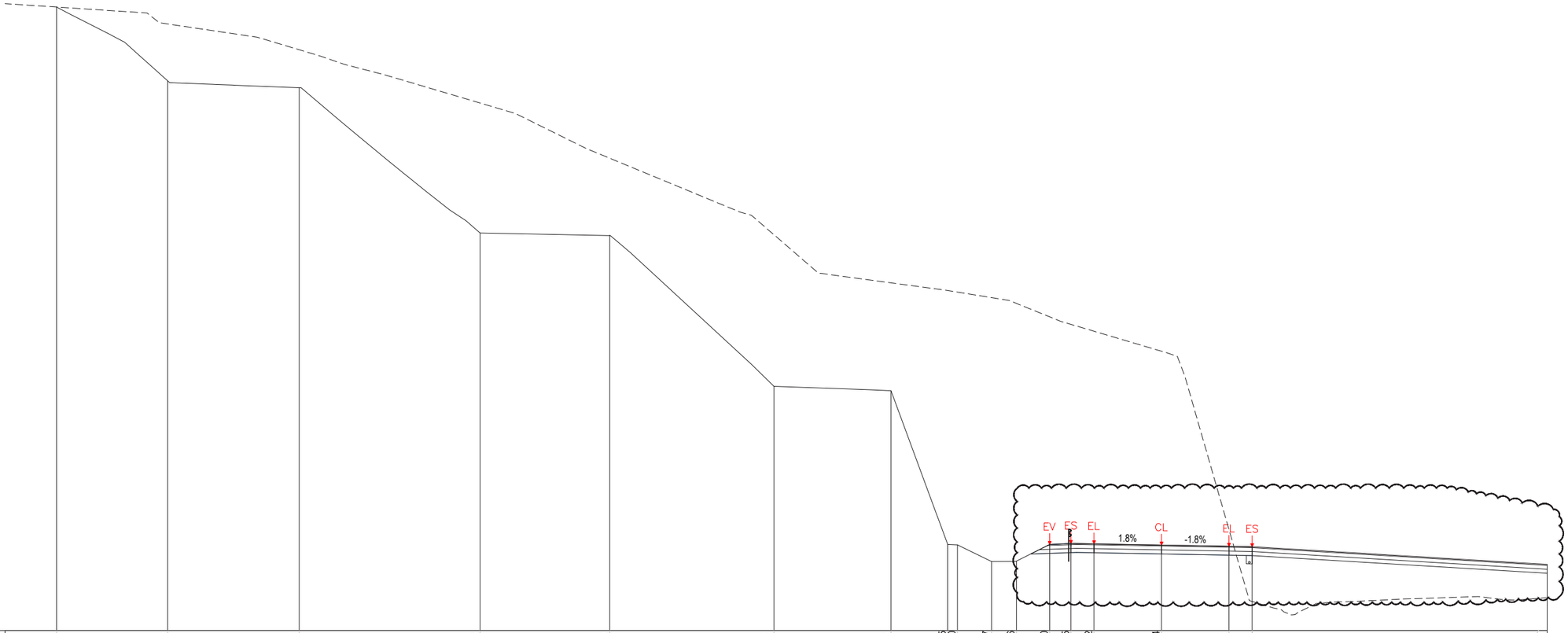
NOTES

1. REFER TO 6103677-CE-STD-03 FOR CIVIL GENERAL NOTES.
2. ROCK CUT DIMENSIONS ARE INDICATIVE ONLY. REFER TO 6103677-CE-B07-32 FOR DETAILS.



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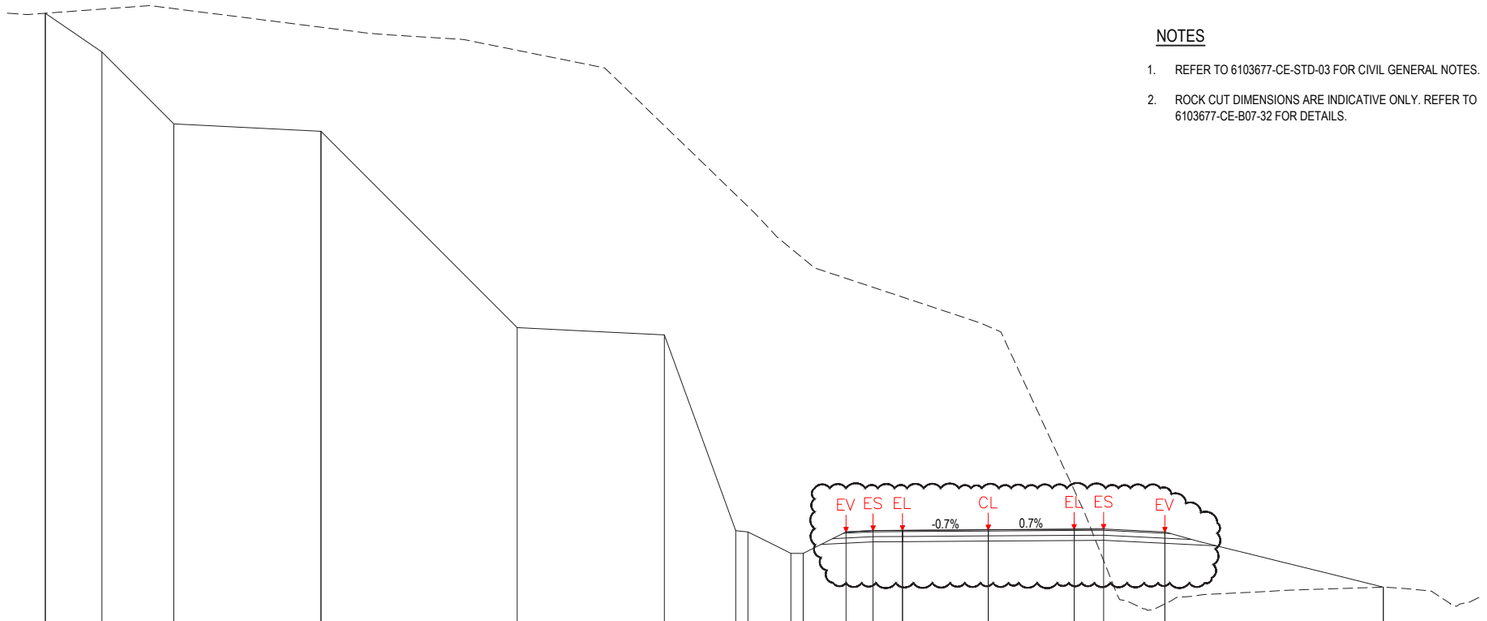
NOTES

1. REFER TO 6103677-CE-STD-03 FOR CIVIL GENERAL NOTES.
2. ROCK CUT DIMENSIONS ARE INDICATIVE ONLY. REFER TO 6103677-CE-B07-32 FOR DETAILS.



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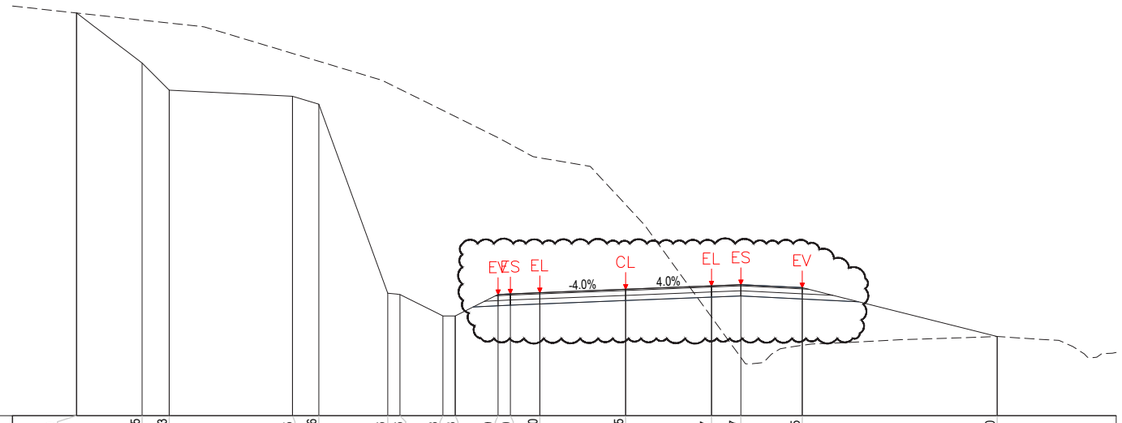
NOTES

1. REFER TO 6103677-CE-STD-03 FOR CIVIL GENERAL NOTES.
2. ROCK CUT DIMENSIONS ARE INDICATIVE ONLY. REFER TO 6103677-CE-B07-32 FOR DETAILS.



Datum: 5.00

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DESIGN SPEED
TEMPORARY SPEED 50km/h
SIGNED SPEED 30km/h

NOTES:

1. REFER TO DRAWING CE-B07-10 FOR NOTES.
2. DIVERSION ROAD ALIGNMENT IS INDICATIVE. DESIGN VEHICLE IS 19m LONG SEMI TRAILER FOR SINGLE LANE DIVERSION. FOR A TWO LANE DIVERSION, CONTRACTOR TO DESIGN DIVERSION ROAD TO ALLOW 19m LONG SEMI TRAILER AND 8.8m SINGLE UNIT TRUCK TO PASS ONE ANOTHER. CONTRACTORS DESIGN TO MAKE ALLOWANCE FOR TRACKING OF DESIGN VEHICLE PLUS A 0.5m BUFFER EACH SIDE, AND PROVISION OF LANE WIDENING WHERE REQUIRED. ALIGNMENT DESIGN AND TRACKING TO BE SUPPLIED TO THE ENGINEER FOR REVIEW PRIOR TO CONSTRUCTION.
3. THE DIVERSION ROAD SHALL BE WITHIN THE CONSTRUCTION ZONE SHOWN ON DRAWING CE-B07-35.
4. DIVERSION ROAD PAVEMENT DESIGN IS CONTRACTOR'S RESPONSIBILITY. ROAD TO BE DESIGNED AS ALL WEATHER ROAD WITH CHIPSEAL SURFACE DESIGN THICKNESS TO ALLOW FOR OVERLOADED VEHICLES AND PROTECTION OF THE SUBGRADE SOILS FROM BEARING AND / OR SHEAR FAILURE.
5. TEMPORARY CULVERT SHALL BE DESIGNED AND MAINTAINED DURING CONSTRUCTION BY THE CONTRACTOR. REFER TO SPECIFICATION FOR DESIGN BUILD ELEMENTS. CONTRACTOR METHOD FOR INSTALLING CULVERT AND FILL SHALL LIMIT DIFFERENTIAL SETTLEMENTS OF THE CULVERT TO 25mm OVER A 6m LENGTH.
6. ALL TEMPORARY RETAINING WALLS REQUIRED FOR TEMPORARY DIVERSION ROAD ALIGNMENT SHALL BE DESIGNED BY THE CONTRACTOR.
7. APPROPRIATE HEALTH AND SAFETY MEASURES TO BE INSTALLED BY THE CONTRACTOR TO ENSURE SAFE TRAFFIC FLOW DURING ROCK CUT OPERATIONS.

LEGEND:

- CADASTRAL BOUNDARY
- STORMWATER CULVERT
- INDICATIVE TEMPORARY RETAINING WALL
- TEMPORARY DIVERSION ROAD
- TEMPORARY PEDESTRIAN ACCESS
- CUT BATTER
- FILL BATTER

FOR CLARITY OF DETAILS
VIEW ELECTRONICALLY

TEMPORARY DIVERSIONS

SCALE 1:750

DETAILED DESIGN
NOT FOR CONSTRUCTION

B	DETAILED DESIGN - FOR FRA REVIEW	JM	CH	TP	08.03.24
A	DETAILED DESIGN - FOR FRA REVIEW	MS	CH	TP	19.12.23
No.	Revision	By	Chk	Appd	Date

Original Scale (A1) AS SHOWN	Design	M. SHEPPARD	19.12.23	Approved For Construction*
Reduced Scale (A3) HALF SHOWN	Drawn	M. SHEPPARD	19.12.23	
	Dsg Verifier	C. HATLEY	19.12.23	
	Drg Check	C. HATLEY	19.12.23	Date
	* Refer to Revision 1 for Original Signature			

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: NAVOLA BRIDGE TEMPORARY DIVERSIONS ROADING PLAN AND PROFILE

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B07-40

Rev.: B

Document No. 6103677-CE-B07-40.DWG

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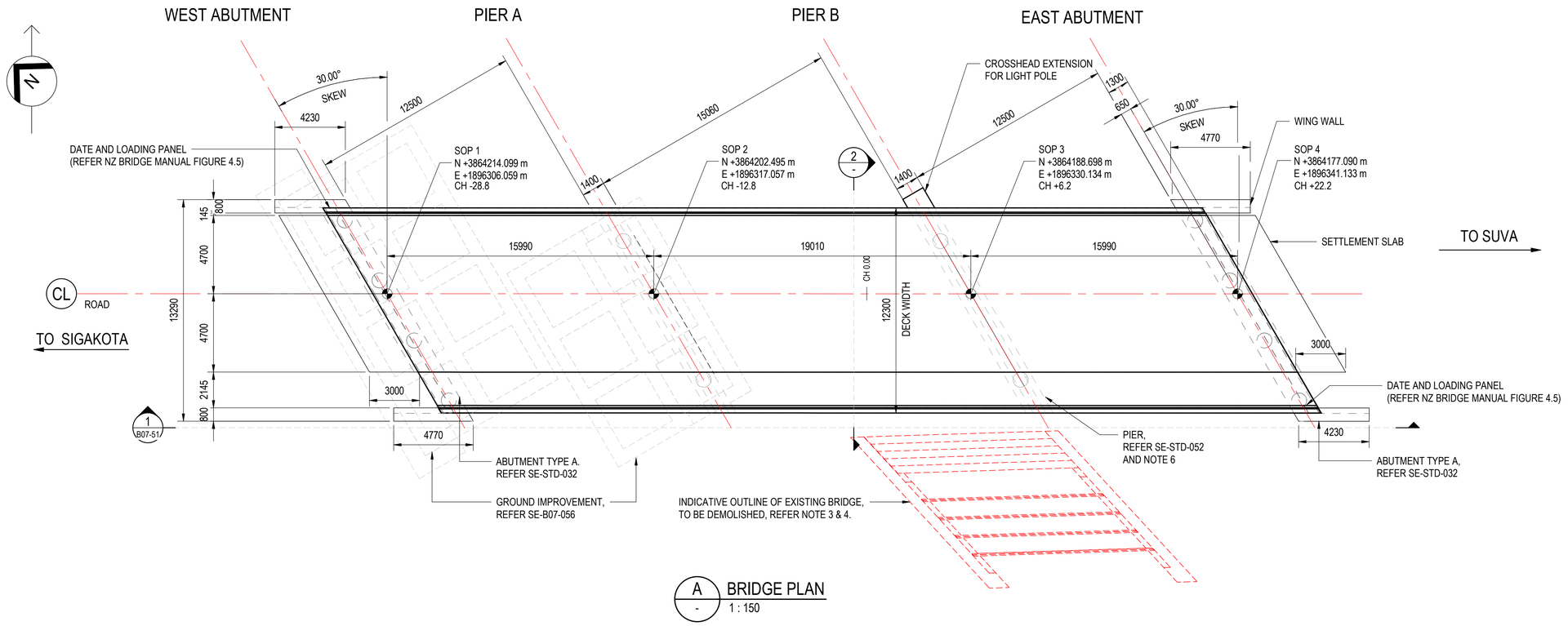
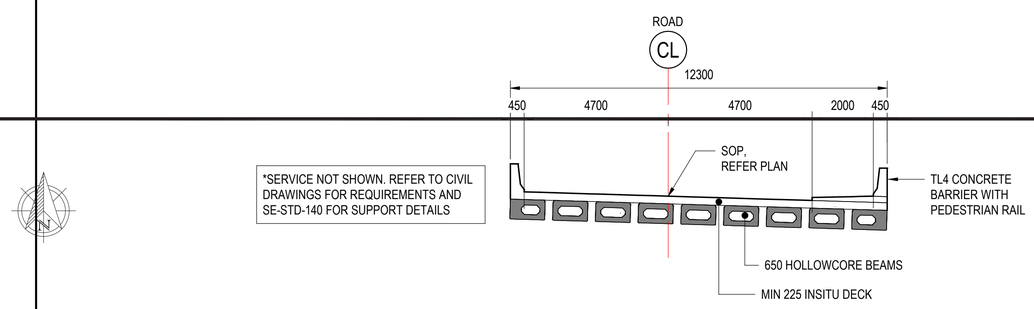


A - BRIDGE PLAN
1 : 150

NOTES.

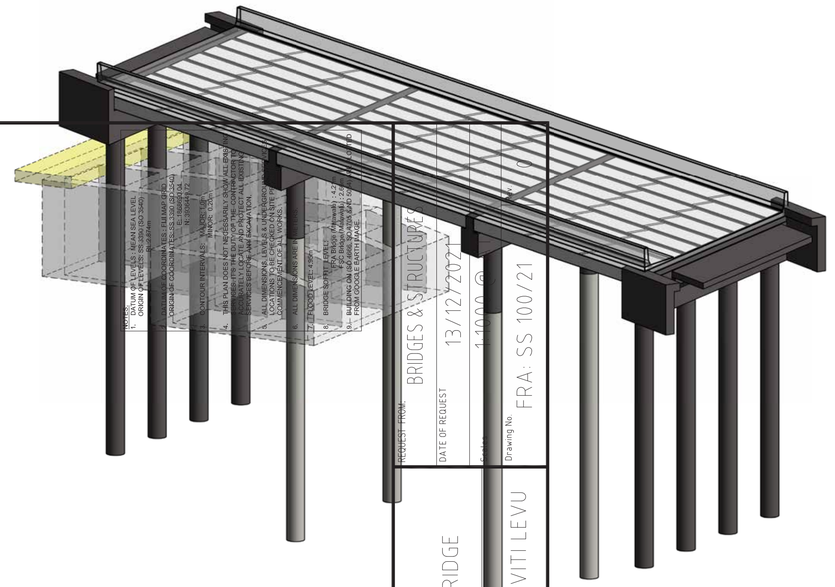
1. FOR SITE LAYOUT, FEATURES, AND ROAD CORRIDOR DETAILS REFER TO 6103677-CE-B07-10, ROADING PLAN AND PROFILE, AND THE RELATED CIVIL DRAWINGS.
2. VERTICAL HEIGHT DATUM IS FIJI HEIGHT DATUM.AND COORDINATE SYSTEM IS FIJI MAP GRID (FMG) FOR DETAILS REFER TO FRA'S TOPOGRAPHICAL SURVEY DRAWING SS 104/21.
3. THE OUTLINE OF EXISTING BRIDGE IS AS PER FRA'S TOPOGRAPHICAL SURVEY DRAWING SS 104/21. THE CONTRACTOR SHALL CONFIRM POSITION OF THE BRIDGE PRIOR TO THE CONSTRUCTION.
4. REFER TO PROJECT SPECIFICATION FOR EXISTING BRIDGE DEMOLITION REQUIREMENTS.
5. THESE BRIDGE SPECIFIC DRAWINGS SHALL BE READ TOGETHER WITH AND REFER TO STANDARD DRAWINGS, SPECIFICALLY:
   - 6103677-SE-STD-001 TO 004 FOR GENERAL NOTES
   - 6103677-SE-STD-010 SERIES FOR GROUND IMPROVEMENT DETAILS
   - 6103677-SE-STD-020 SERIES FOR PILE DETAILS
   - 6103677-SE-STD-030 SERIES FOR ABUTMENT TYPE A DETAILS
   - 6103677-SE-STD-050 SERIES FOR PIER DETAILS
   - 6103677-SE-STD-060 SERIES FOR SUPERSTRUCTURE DETAILS
   - 6103677-SE-STD-070 SERIES FOR PRECAST PRESTRESSED SHC BEAM DETAILS
   - 6103677-SE-STD-100 SERIES FOR DECK DETAILS
   - 6103677-SE-STD-110 SERIES FOR BARRIER DETAILS.
   - 6103677-SE-STD-140 FOR SERVICE SUPPORT DETAILS
   - 6103677-SE-STD-180 FOR STANDARD BRIDGE ANTICIPATED CONSTRUCTION SEQUENCE
6. NOTE THIS BRIDGE PIER HEADSTOCK DEPTH IS GREATER THAN THE STANDARD DEPTH AND IS CALLED OUT ON SE-STD-050. ALL OTHER STANDARD PIER DETAILS ARE STILL APPLICABLE.
7. FOR FINISHED DESIGN LEVELS REFER TO DRAWING CE-B07-10 AND SE-B07-51



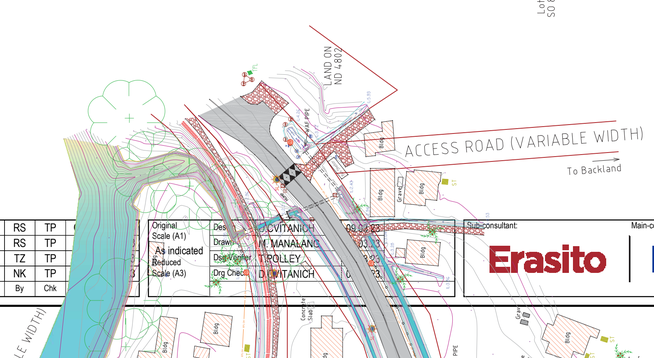
*SERVICE NOT SHOWN. REFER TO CIVIL DRAWINGS FOR REQUIREMENTS AND SE-STD-140 FOR SUPPORT DETAILS

FOR DETAILS REFER SECTION 3 / SE-STD-005
(THE REFERENCED STANDARD SECTION HAS CROSS FALL AND IS FLIPPED)

2 - SECTION
1 : 100

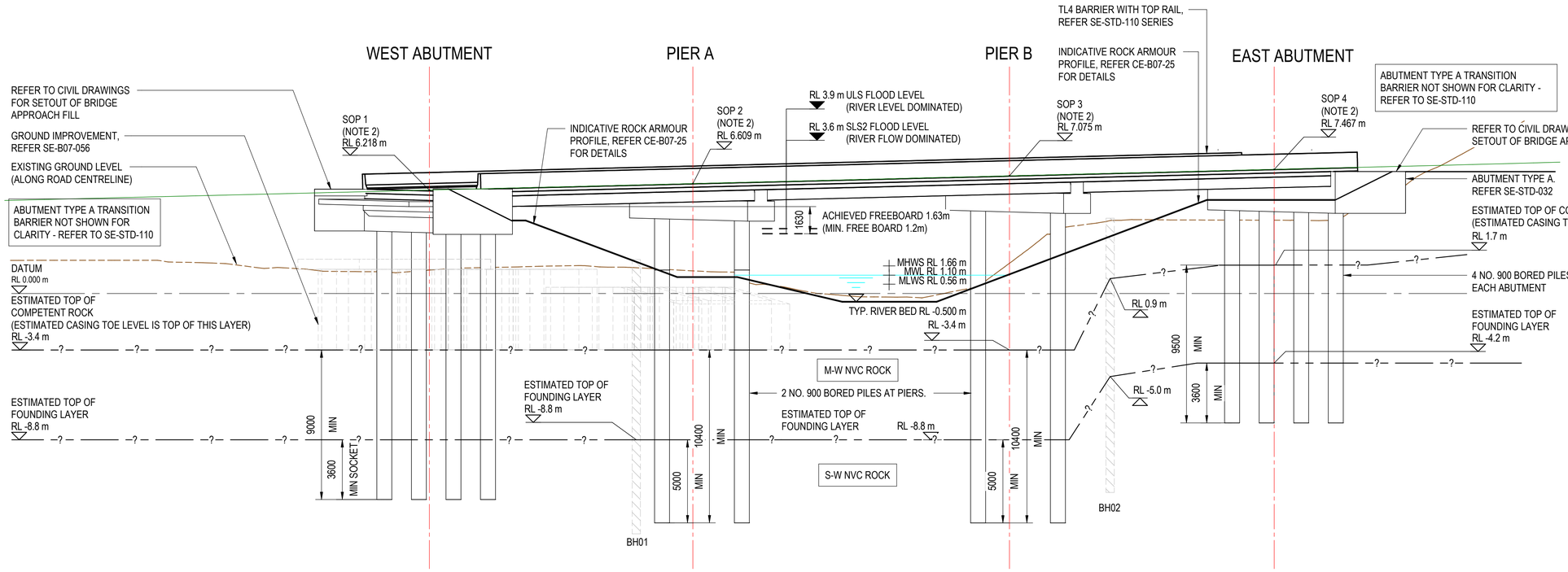


3D VIEW B07 NAVOLA BRIDGE


Lot 1 SO 831
LAND ON ND 4602
ACCESS ROAD (VARIABLE WIDTH)
To Backland
Bldg
Bldg
Bldg

NOTES.

1. REFER TO DRAWING SE-B07-050 FOR NOTES.
2. REFER TO SE-B07-50 FOR SOP LOCATIONS. LEVELS ARE GIVEN AT THE TOP OF THE DECK AT INTERSECTION OF THE ROAD CENTRELINE AND SUPPORT GRID LINE PLACED ON THE CENTRELINE OF PILES. REFER TO SE-B07-50 SECTION 2 FOR LOCATION.
3. ROCK DESCRIPTION IN ACCORDANCE WITH NEW ZEALAND GEOTECHNICAL SOCIETY GUIDANCE. REFER TO ENTEC FACTUAL GEOTECHNICAL REPORT FOR FURTHER INFORMATION. REFER TO CE-B07-55 FOR BOREHOLE LOCATIONS.
4. ACTUAL CASING TOE LEVEL, TOP OF FOUNDING LAYER AND SOCKET SHALL BE CONFIRMED FOLLOWING CASING INSTALLATION AND PILE BORING. THE FINAL TOP OF FOUNDING LEVEL AND SOCKET SHALL BE CONFIRMED BY THE ENGINEER. SUBJECT TO ACTUAL ENCOUNTERED SOIL PROPERTIES.
5. FRA REQUESTED A MINIMUM FINISHED ROAD LEVEL OF 6.1m RL SHALL BE ADOPTED, FOR DETAILS REFER TO THE DESIGN REPORT.



1 / B07-50 ELEVATION
1 : 150

NOTE: GRIDLINES SHOWN APPROXIMATELY AT ROAD CL

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
D	DETAILED DESIGN, FOR FRA REVIEW	RS	TP	CH	08.03.24
C	DETAILED DESIGN, FOR FRA REVIEW	RS	TP	CH	19.12.23
B	DETAILED DESIGN, FOR COMMENT	TZ	TP	CH	27.07.23
A	FOR FRA REVIEW	NK	TP	CH	09.03.23

Original Scale (A1) 1 : 150
Reduced Scale (A3)

Design	D. CVITANICH	09.03.23
Drawn	M. MANALANG	09.03.23
Dsg Verifier	T. POLLEY	09.03.23
Drg Check	T. POLLEY	09.03.23

Sub-consultant: Erasito
Main-consultant: Beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: B07 NAVOLA BRIDGE- BRIDGE ELEVATION
Discipline: STRUCTURAL
Drawing No.: 6103677-SE-B07-51
Rev.: D

DO NOT SCALE FOR SET OUT DIMENSIONS

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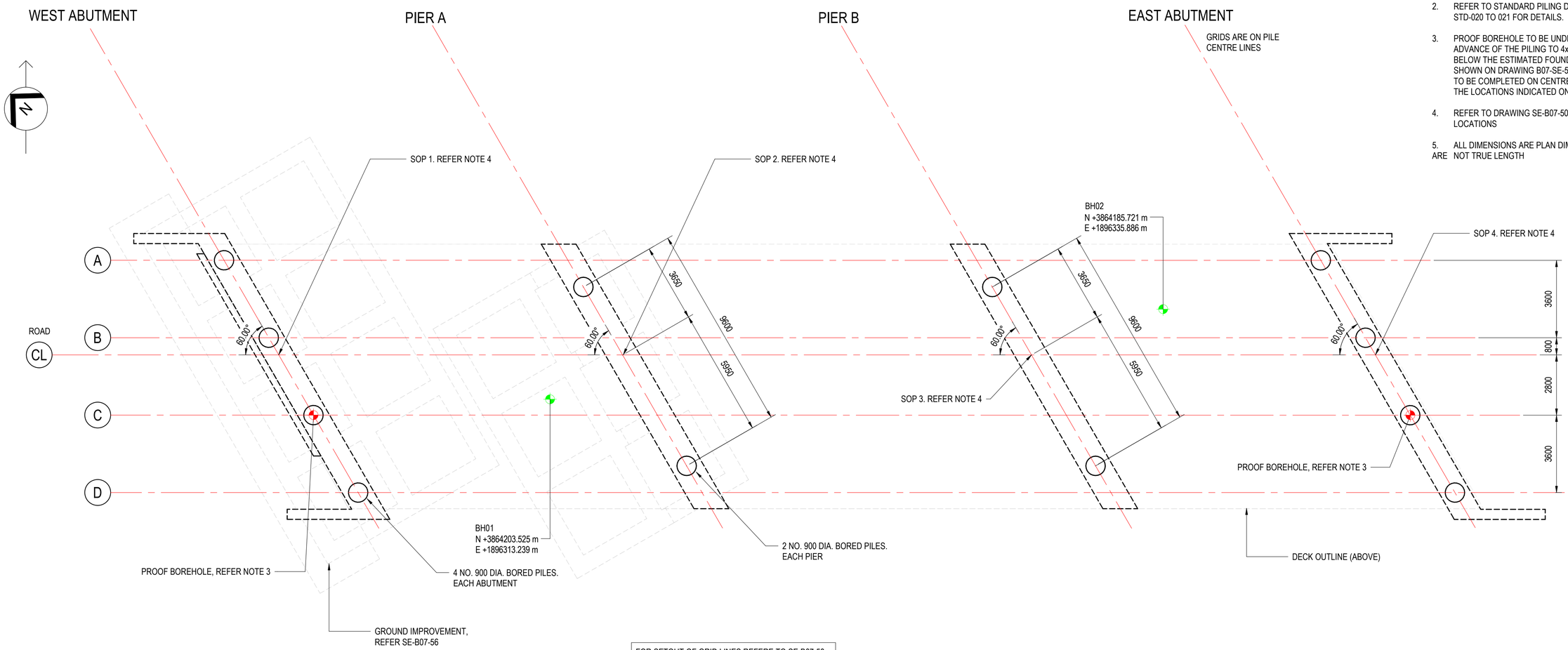
Document No. Autodesk Docs://6450911 - FRA-40+3/6103677-B07-SE-2023.rvt



FOR SETOUT OF GRID LINES REFERE TO SE-B07-50

PILING PLAN
1 : 100

NOTES

1. REFER TO DRAWING SE-B07-050 FOR NOTES.
2. REFER TO STANDARD PILING DRAWINGS SE-STD-020 TO 021 FOR DETAILS.
3. PROOF BOREHOLE TO BE UNDERTAKEN IN ADVANCE OF THE PILING TO 4xPILE DIAMETERS BELOW THE ESTIMATED FOUNDING LEVELS AS SHOWN ON DRAWING B07-SE-51. PROOF BORES TO BE COMPLETED ON CENTRELINE OF PILES AT THE LOCATIONS INDICATED ON THE PILING PLAN.
4. REFER TO DRAWING SE-B07-50 FOR SOP LOCATIONS
5. ALL DIMENSIONS ARE PLAN DIMENSIONS AND ARE NOT TRUE LENGTH

BORED PILE REINFORCING INFORMATION

	LONGITUDINAL BARS				SPIRALS					
LOCATION	LENGTH "Y"	GROUP 1	GROUP 2	PHZs*	SPIRAL TYPE A	DIST "A'	SPIRAL TYPE B	DIST "B"	SPIRAL TYPE C	DIST "C"
WEST ABUTMENT	FULL LENGTH	10RB32	—	0m - 8.5m	RH16-300	6000	RH20-120	4500	RH16-300	REMAINING LENGTH
PIERS	FULL LENGTH	10RB32	—	0m - 2.0m & 5.0m - 10.0m	RH16-90	2000	RH16 -120	11500	RH16-300	REMAINING LENGTH
EAST ABUTMENT	FULL LENGTH	10RB32	—	0m - 8.5m	PAIRED RH20-140	2000	RH20-120	9500	RH16-300	REMAINING LENGTH

* NO LAPPING OF LONGITUDINAL REINFORCEMENT IS ALLOWED IN PLASTIC HINGE ZONES (PHZs)
REFER TO BORED PILE DRAWING SE-STD-021 FOR REINFORCING CALLOUT

BEWARE:

THE CONTRACTOR SHALL CONFIRM THAT THERE IS NO CONFLICT WITH UNDERGROUND SERVICES (EXISTING, NEWLY INSTALLED AND / OR TEMPORARY) AND / OR IMPLEMENT APPROPRIATE PROTECTION MEASURES PRIOR TO CARRYING OUT ANY PILE INSTALLATION OR EXCAVATION WORKS.

LEGEND:

- PROOF BORE LOCATION
- DESIGN INVESTIGATION BORE LOCATION (FOR INFORMATION)

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN, FOR FRA REVIEW	RS	TP	CH	08.03.24
B	DETAILED DESIGN, FOR FRA REVIEW	RS	TP	CH	19.12.23
A	DETAILED DESIGN, FOR COMMENT	TZ	TP	CH	27.07.23

Original Scale (A1) 1 : 100 Reduced Scale (A3)

Design	D. CVITANICH	27.07.23
Drawn	T. ZHU	27.07.23
Dsg Verifier	T. POLLEY	27.07.23
Drg Check	D. CVITANICH	27.07.23

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: B07 NAVOLA BRIDGE - PILING PLAN

Discipline: STRUCTURAL

Drawing No.: 6103677-SE-B07-55

Rev.: C

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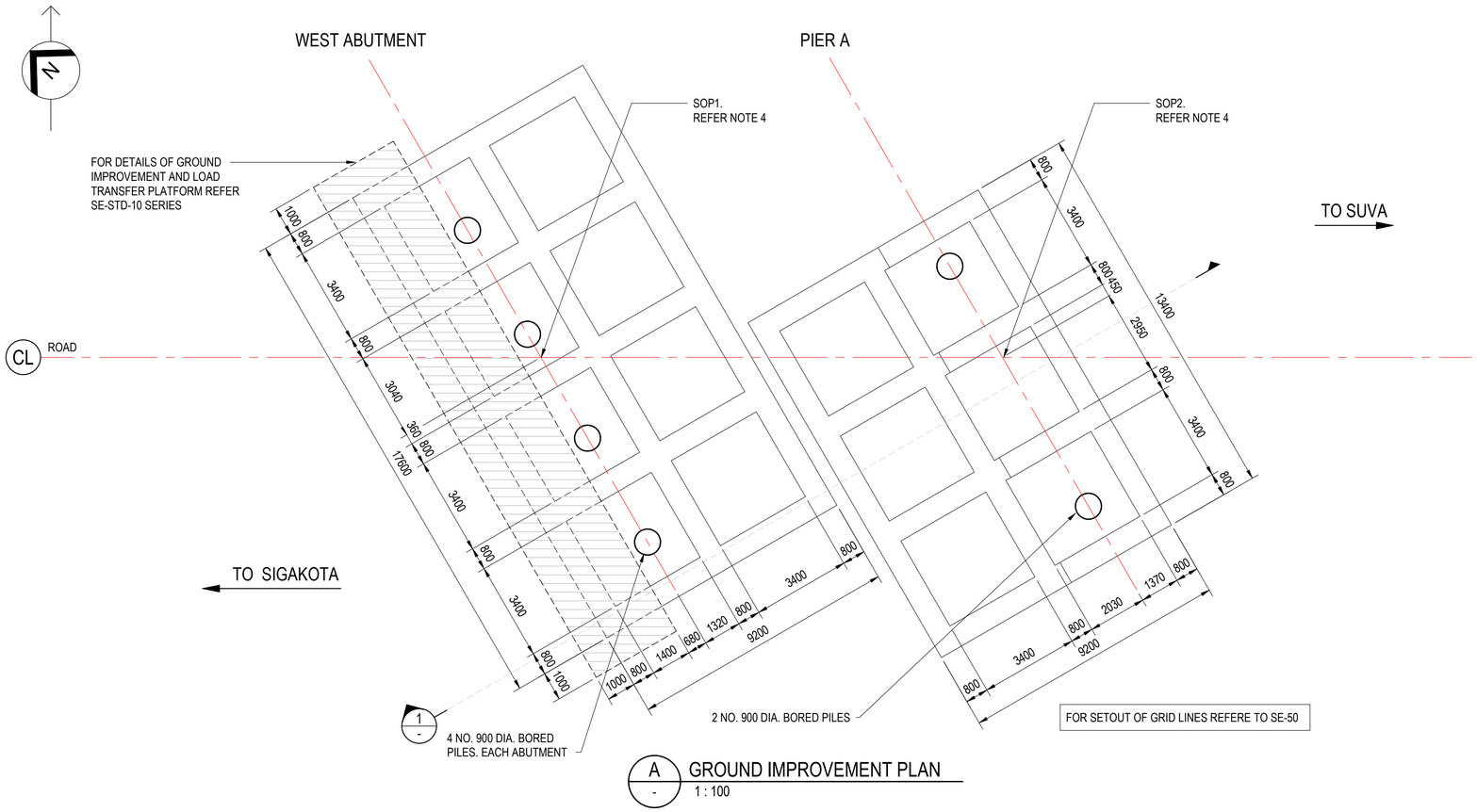
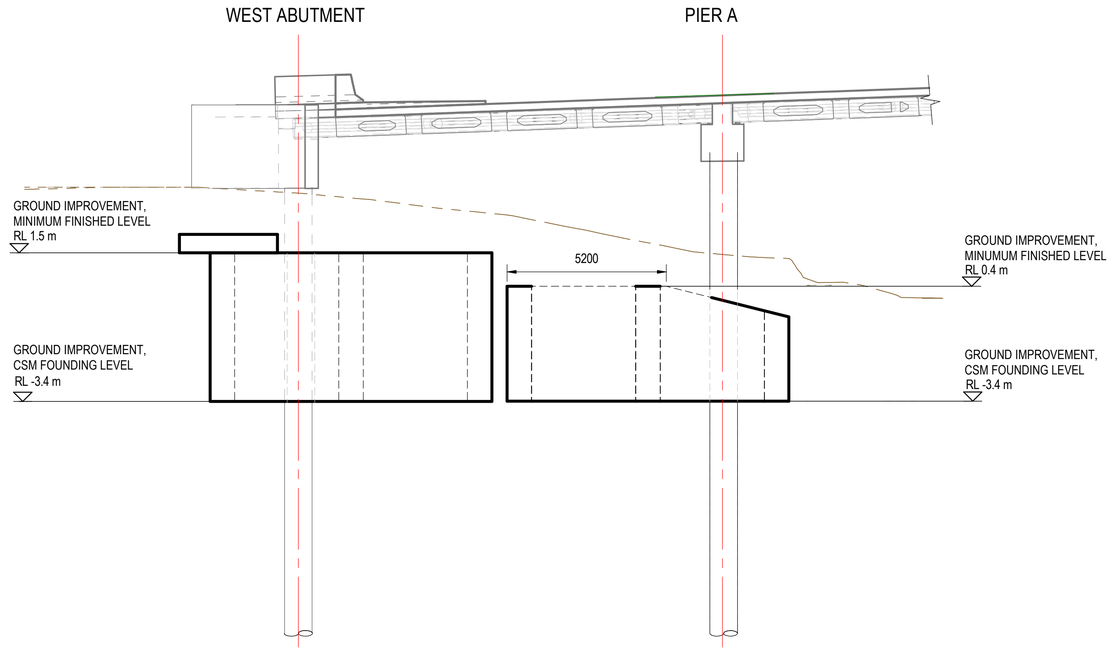


A - GROUND IMPROVEMENT PLAN
1 : 100



1 - LONG SECTION
1 : 100

NOTES:

1. REFER TO DRAWING SE-B07-050 FOR NOTES.
2. CSM NOTES:
   a. CSM PANELS TO BE CONSTRUCTED WITH THE FOLLOWING SPECIFICATION:
      -MIN. SHEAR STIFFNESS OF 1250MPa
      -MIN. YOUNG'S MODULUS OF 3000MPa
      -UNCONFINED CONCRETE STIFFNESS OF MIN. 2.5MPa
      -MIN. AREA REPLACEMENT RATIO: 30%
   b. CSM TO BE CONSTRUCTED IN ACCORDANCE WITH SPECIFICATION C0414.
   c. CONTRACTOR TO CONSIDER THE CONSTRAINTS OF THE EXISTING BRIDGE, SITE BOUNDARIES, AND WATERWAY DURING CONSTRUCTION OF THE GROUND IMPROVEMENT.
3. GROUND IMPROVEMENT SHALL BE CONSTRUCTED IN A SEQUENCE SO THAT ANY TEMPORARY RETAINING REQUIRED TO CONSTRUCT THE GROUND IMPROVEMENT IS NOT UNDERMINED OR MADE UNSTABLE.
4. REFER TO DRAWING SE-B07-50 FOR SOP LOCATIONS

BEWARE:

THE CONTRACTOR SHALL CONFIRM THAT THERE IS NO CONFLICT WITH UNDERGROUND SERVICES (EXISTING, NEWLY INSTALLED AND / OR TEMPORARY) AND / OR IMPLEMENT APPROPRIATE PROTECTION MEASURES PRIOR TO CARRYING OUT ANY PILE INSTALLATION OR EXCAVATION WORKS.

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN, FOR FRA REVIEW	RS	TP	CH	08.03.24
B	DETAILED DESIGN, FOR FRA REVIEW	RS	TP	CH	19.12.23
A	DETAILED DESIGN, FOR COMMENT	TZ	TP	CH	27.07.23

Original Scale (A1) 1 : 100
Reduced Scale (A3)

Design	D. CVITANICH	27.07.23
Drawn	T. ZHU	27.07.23
Dsg Verifier	T. POLLEY	27.07.23
Drg Check	D. CVITANICH	27.07.23

Sub-consultant: Erasito
Main-consultant: Beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

DETAILED DESIGN
NOT FOR CONSTRUCTION

Title: B07 NAVOLA BRIDGE- GROUND IMPROVEMENT
Discipline: STRUCTURAL
Drawing No.: 6103677-SE-B07-56
Rev.: C

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Document No. Autodesk Docs://6450911 - FRA 40+3/6103677-B07-SE-2023.rvt

Co-designed by: Erasito | Co-designed, Verified and Issued by: Beca

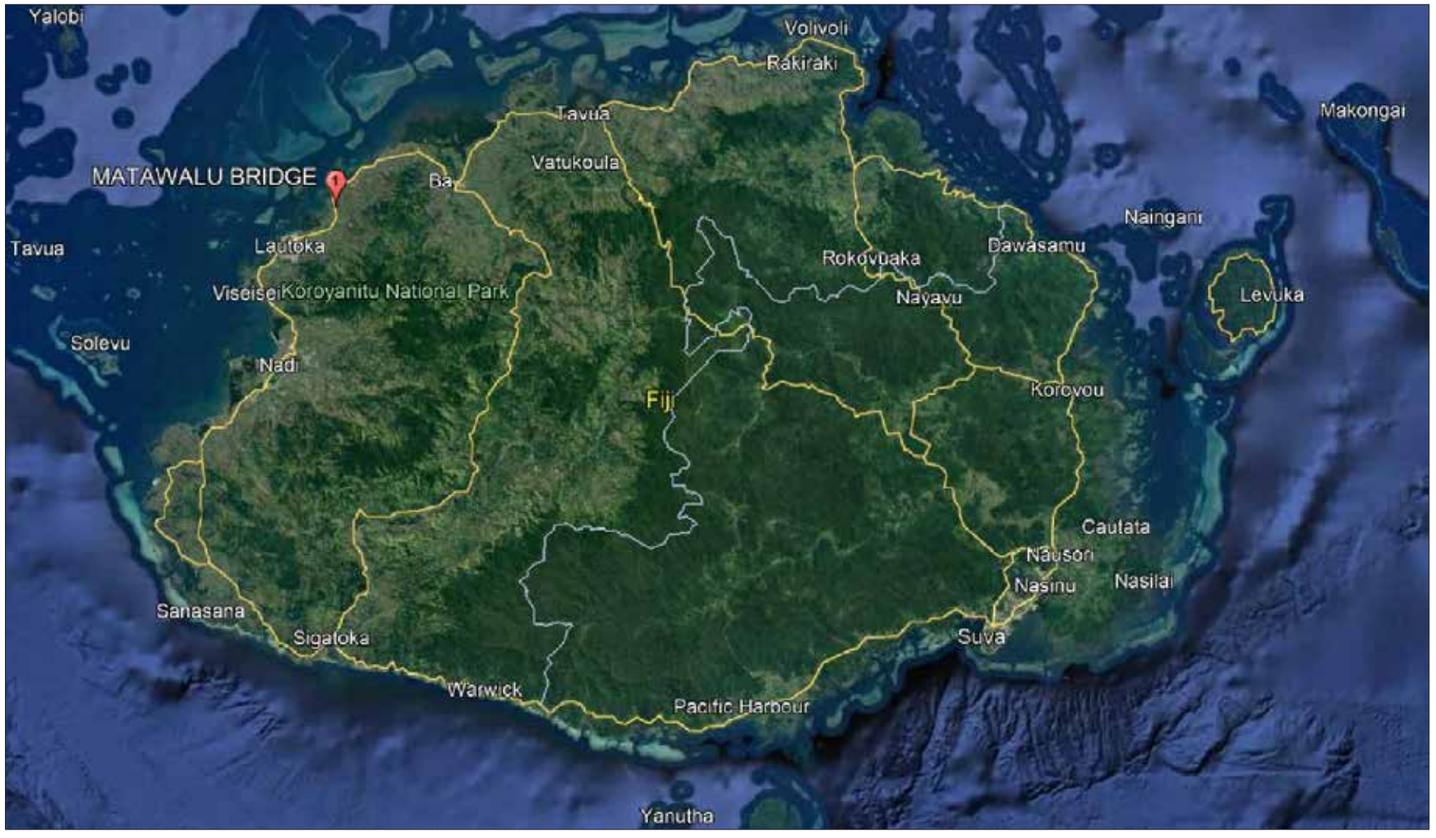
FRA/TIISP/20-13 - 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

PRIORITY 1 - B08, MATAWALU BRIDGE

Prepared for: FIJI ROAD AUTHORITY
Prepared by: BECA INTERNATIONAL CONSULTANTS LTD

Project No.: 6103677

ISSUED FOR DETAILED DESIGN

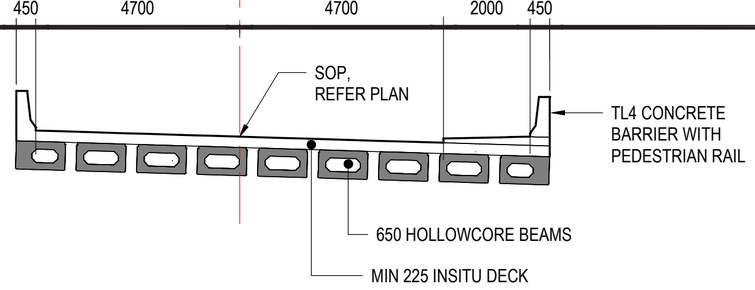


DRAWING STATUS	CONCEPT DESIGN	DETAILED DESIGN FOR COMMENT	DETAILED DESIGN FOR FRA REVIEW
DAY	14	21	31
MONTH	03	07	01
YEAR	2023	2023	2024

DRAWING NO	DRAWING TITLE	REV.	REV.	REV.
6103677-CE-B08-00	COVER SHEET AND REVISION HISTORY	A	B	C
FRA: SS 100 / 21	TOPOGRAPHICAL SURVEY	0	0	0
6103677-CE-B08-05	SITE PREPARATION PLAN	-	-	A
6103677-CE-B08-10	ROADING PLAN AND PROFILES	A	B	C
6103677-CE-B08-12	MAIN ROAD CROSS SECTIONS - SHEET 1	A	B	C
6103677-CE-B08-13	MAIN ROAD CROSS SECTIONS - SHEET 2	A	B	C
6103677-CE-B08-14	MAIN ROAD CROSS SECTIONS - SHEET 3	A	B	C
6103677-CE-B08-15	MAIN ROAD CROSS SECTIONS - SHEET 4	A	B	C
6103677-CE-B08-17	ROAD MARKING AND SIGNS	-	A	B
6103677-CE-B08-18	MAIN ROAD STORMWATER PIPELINES - PLAN AND PROFILE	-	A	B
6103677-CE-B08-20	PROPOSED UTILITIES	A	B	C
6103677-CE-B08-21	PROPOSED UTILITIES CROSS SECTIONS	-	A	B
6103677-CE-B08-25	SCOUR PROTECTION	-	A	B
6103677-CE-B08-27	RETAINING WALLS	-	A	B
6103677-CE-B08-29	PRELOAD SURCHARGE DETAILS	-	-	A
6103677-CE-B08-30	EMBANKMENT DETAILS	-	A	B
6103677-CE-B08-31	GEOTECHNICAL INSTRUMENTATION AND MONITORING DETAILS	-	A	B
6103677-CE-B08-40	TEMPORARY BRIDGE ROAD PLAN AND PROFILE	A	B	C
6103677-CE-B08-42	TEMPORARY BRIDGE ROAD CROSS SECTIONS - SHEET 1	A	B	C
6103677-CE-B08-43	TEMPORARY BRIDGE ROAD CROSS SECTIONS - SHEET 2	A	B	C
6103677-CE-B08-44	TEMPORARY BRIDGE ROAD CROSS SECTIONS - SHEET 3	-	-	A
6103677-CE-B08-45	TEMPORARY BRIDGE EMBANKMENT DETAILS	-	-	A
6103677-SE-B08-50	BRIDGE PLAN	A	B	C
6103677-SE-B08-51	BRIDGE ELEVATION	A	B	C
6103677-SE-B08-55	PILING PLAN	-	A	B
6103677-SE-B08-56	GROUND IMPROVEMENT	-	A	B
6103677-SE-B08-60	BRIDGE SUPERSTRUCTURE LAYOUT PLAN	-	-	A
6103677-SE-B08-70	TEMPORARY BRIDGE PLAN AND ELEVATION	-	A	B
25759-XXXXX-AGL-COM-002-DR-CD-101	MABEY BRIDGE COMPACT (200) BRIDGING GENERAL ARRANGEMENT	-	-	P01
25759-XXXXX-AGL-COM-002-DR-CD-201	MABEY BRIDGE COMPACT (200) BRIDGING ABUTMENT DETAILS	-	-	P01

make everyday better.

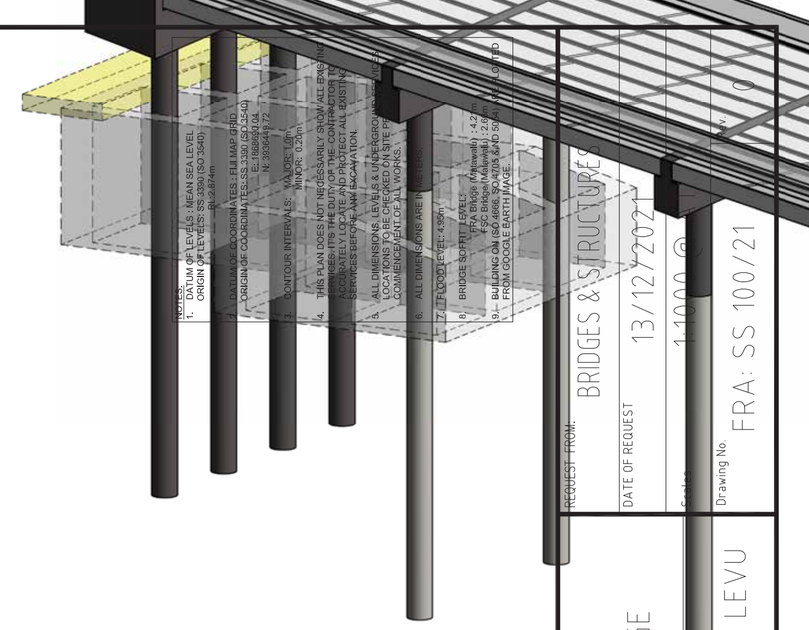
Drawing No. 6103677-CE-B08-00 Rev. C



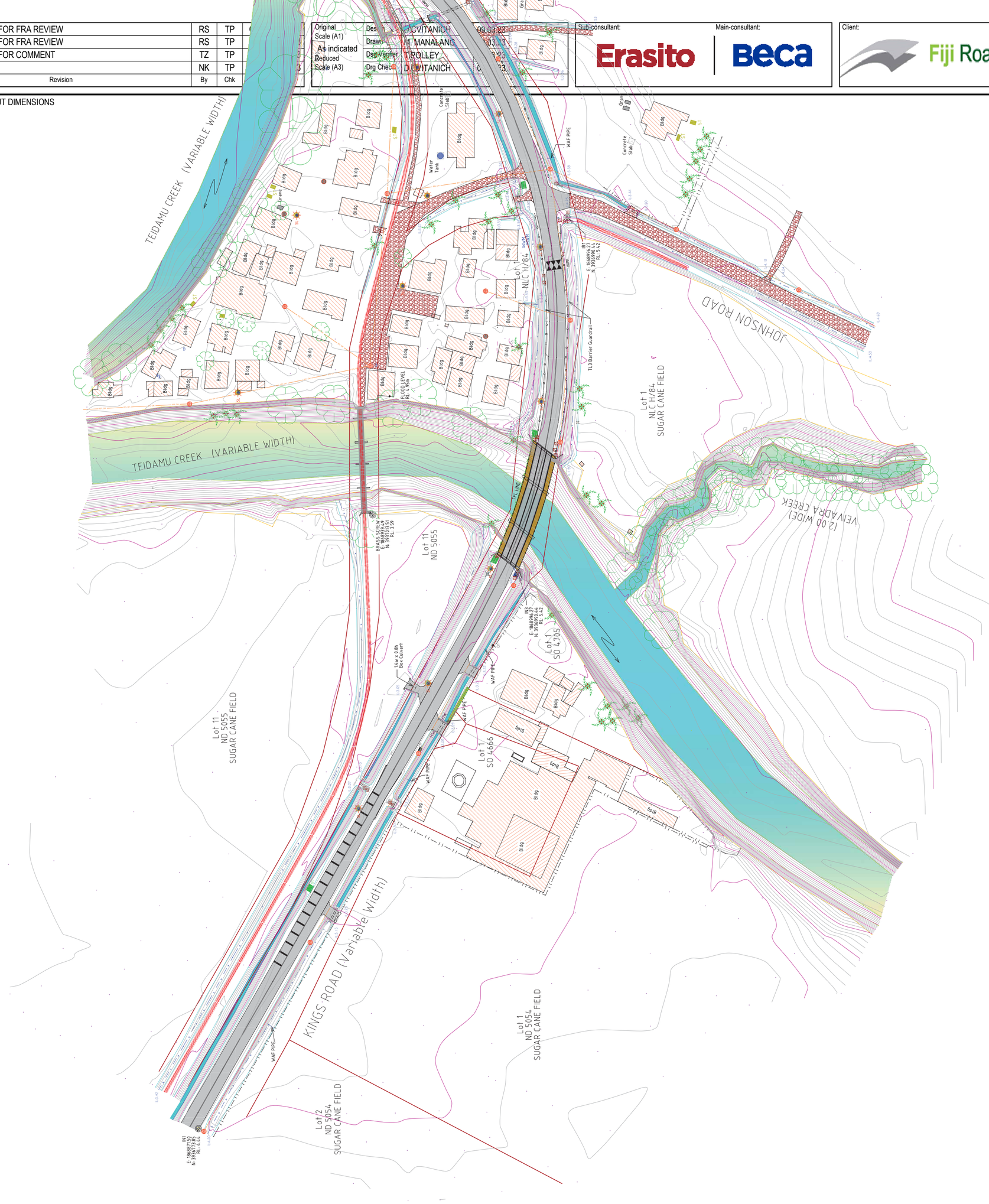
*SERVICE NOT SHOWN. REFER TO CIVIL DRAWINGS FOR REQUIREMENTS AND SE-STD-140 FOR SUPPORT DETAILS

FOR DETAILS REFER SECTION 3 / SE-STD-005
(THE REFERENCED STANDARD SECTION HAS CROSS FALL AND IS FLIPPED)

2 / - SECTION
1 : 100



3D VIEW B07 NAVOLA BRIDGE



LEGEND

- Major Contour
- Minor Contour
- Power Pole
- Sign Post
- Road Sign (Billboards)
- Telecom Box
- Water Meter
- Top of Bank
- Bottom of Bank
- Drain Invert (Open Earth Drain)
- Railway
- Culverts (Size Varies)
- Boundary Line
- Sealed Formation
- Graveled Formation
- Fence Line
- Street Light Meter Box
- Marker Post
- Street Light
- Septic Tank
- Water Authority Marker Post
- Residential Power Pole
- Headwall
- WAF Chamber
- Water Main Line
- Bridge Railings
- Utilities Chamber
- Invert Level
- Overhead EFL Powerline
- Telecom Line

No.	Revision	By	Chk	App	Date
D	DETAILED DESIGN, FOR FRA REVIEW	RS	TP		
C	DETAILED DESIGN, FOR FRA REVIEW	RS	TP		
B	DETAILED DESIGN, FOR COMMENT	TZ	TP		
A	FOR FRA REVIEW	NK	TP		

DO NOT SCALE FOR SET OUT DIMENSIONS

Original Scale (A1): As indicated
Reduced Scale (A3)

Des: J.CVITANICH 09.03.23
Drawn: M. MANALANG 03.03.23
Dsn Verified: T. ROLLEY
Drg Checked: J.CVITANICH 09.03.23

Sub-consultant: Erasito
Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURE

DESCRIPTION: DETAILED TOPOGRAPHICAL SURVEY OF NAVOLA BRIDGE

TIKINA: VUDA — PROVINCE: BA — ISLAND: VITI LEVU

REQUEST FROM: BRIDGES & STRUCTURES
DATE OF REQUEST 13/12/2021
Scale: 1:1000 @ A1
Drawing No. FRA: SS 100/21
Rev: 0

Fiji Roads Authority
Level 4, Fiji Development Bank Building,
360 Victoria Parade, Suva, Fiji Islands.
Postal: P. O. Box 16550, Suva, Fiji
Phone (+679) 310 0114 | Fax (+679) 310 0044 |
email: shiri.narayan@fijiroads.org

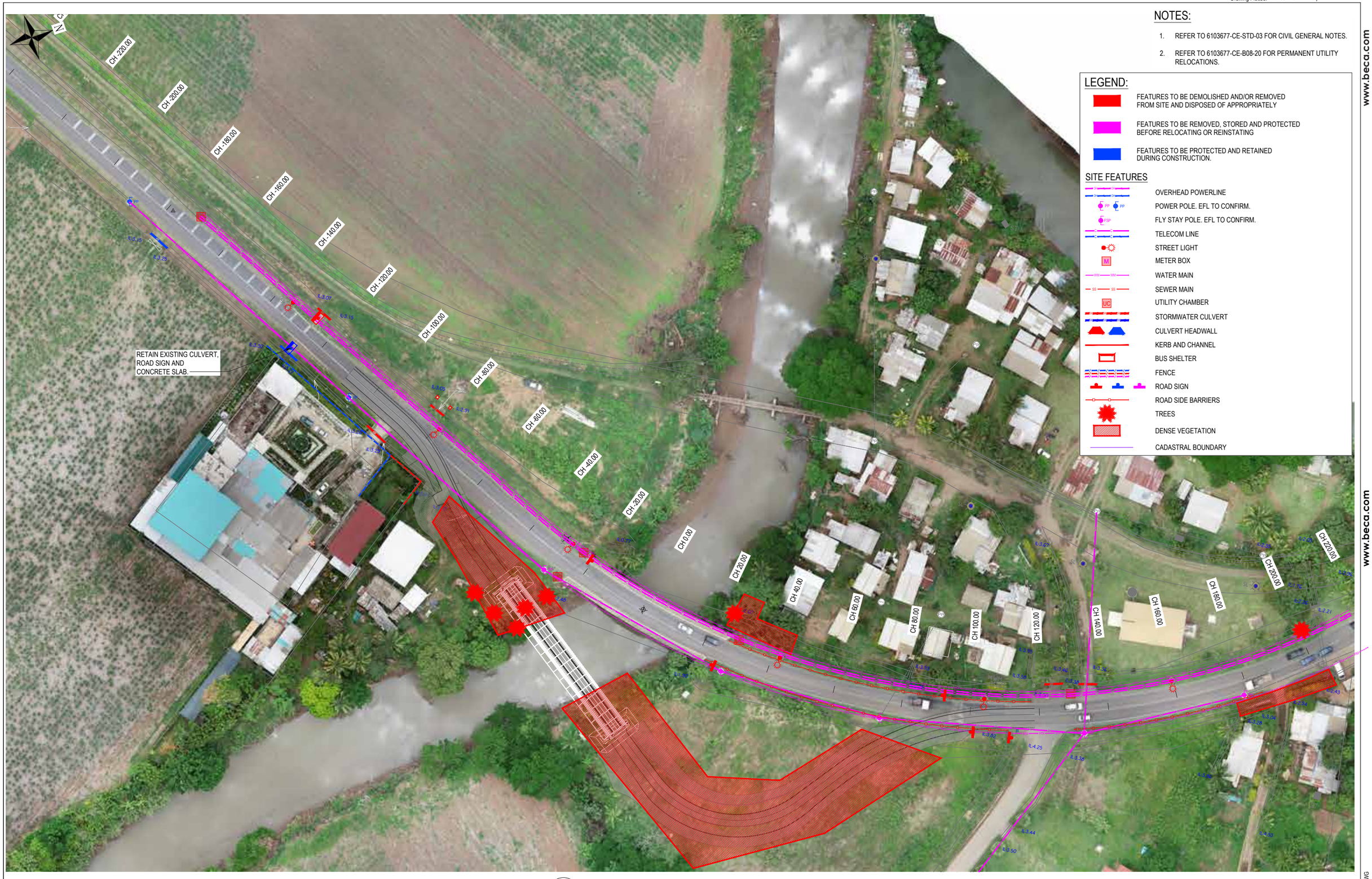
SURVEYED BY	SAMISONI LEDUA
SURVEY ASST	LEMEKI RAVAELE, SHANVI LAL
DRAWN BY	USAIA DELAI
CHECKED BY	SHIRI NARAYAN
SURVEY INSTRUCTION	(SI) No SS 99/21
DATE OF SURVEY	04/01/2022
APPROVED	SHIRI NARAYAN

SURVEY SECTION

REVISIONS

REV	DRN	CHK	APP	DATE

Drawing Plotted: 31 Jan 2024 2:19 p.m.



NOTES:

1. REFER TO 6103677-CE-STD-03 FOR CIVIL GENERAL NOTES.
2. REFER TO 6103677-CE-B08-20 FOR PERMANENT UTILITY RELOCATIONS.

LEGEND:

- FEATURES TO BE DEMOLISHED AND/OR REMOVED FROM SITE AND DISPOSED OF APPROPRIATELY
- FEATURES TO BE REMOVED, STORED AND PROTECTED BEFORE RELOCATING OR REINSTATING
- FEATURES TO BE PROTECTED AND RETAINED DURING CONSTRUCTION.

SITE FEATURES

- OVERHEAD POWERLINE
- POWER POLE. EFL TO CONFIRM.
- FLY STAY POLE. EFL TO CONFIRM.
- TELECOM LINE
- STREET LIGHT
- METER BOX
- WATER MAIN
- SEWER MAIN
- UTILITY CHAMBER
- STORMWATER CULVERT
- CULVERT HEADWALL
- KERB AND CHANNEL
- BUS SHELTER
- FENCE
- ROAD SIGN
- ROAD SIDE BARRIERS
- TREES
- DENSE VEGETATION
- CADASTRAL BOUNDARY

1 - MATAWALU BRIDGE - SITE PREPARATION PLAN
SCALE 1:500

FOR CLARITY OF DETAILS VIEW ELECTRONICALLY

DETAILED DESIGN NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
A	DETAILED DESIGN FOR FRA REVIEW	MS	GK	CH	31.01.24

Original Scale (A1) 1:500
Reduced Scale (A3) 1:1000

Design	M. SHEPPARD	20.12.23	Approved For Construction*
Drawn	M. SHEPPARD	20.12.23	
Dsg Verifier	G.KING	20.12.23	
Drg Check	C. HATLEY	20.12.23	Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: MATAWALU BRIDGE SITE PREPARATION PLAN

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B08-05

Rev.: A

Document No. 6103677-CE-B08-05.DWG

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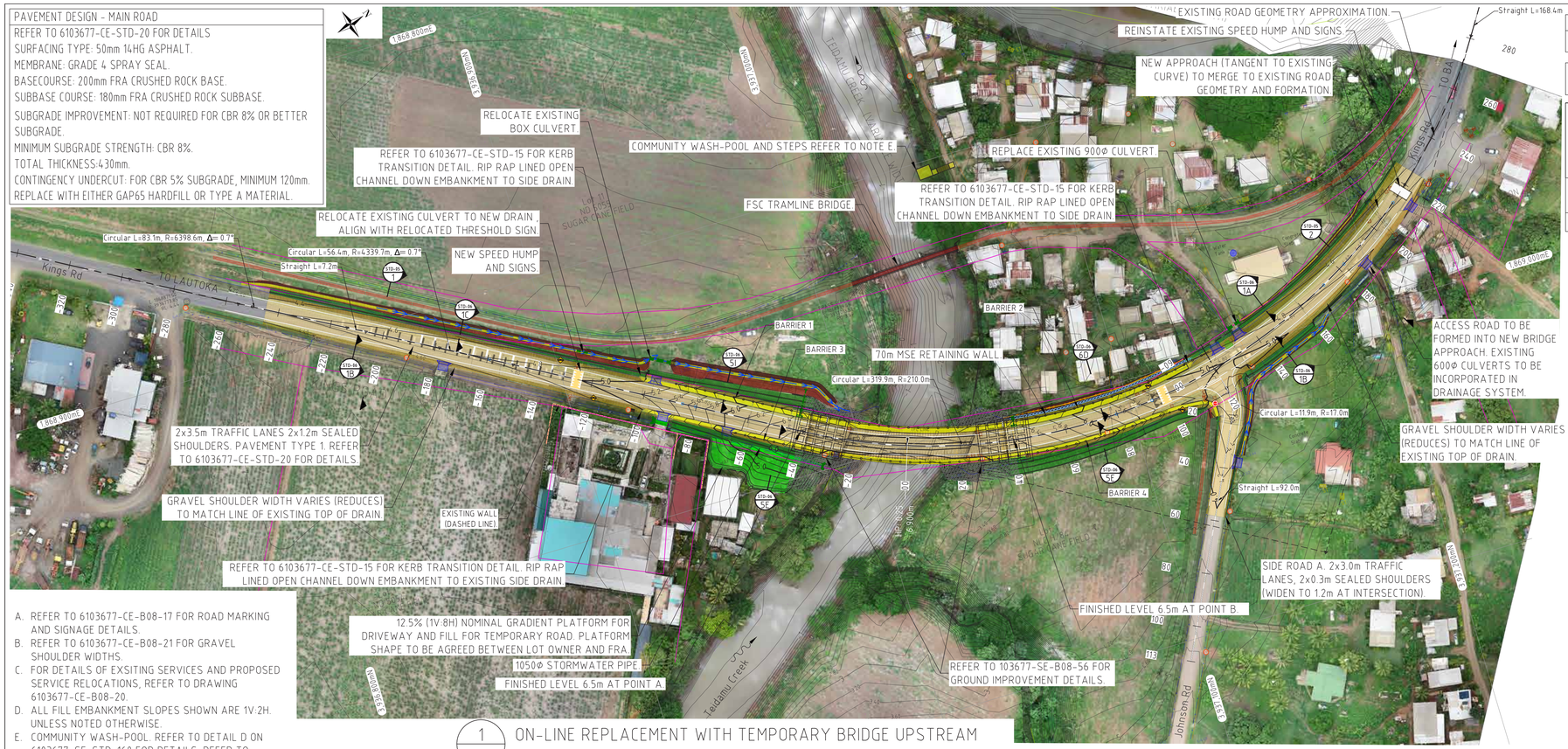
PAVEMENT DESIGN - MAIN ROAD
REFER TO 6103677-CE-STD-20 FOR DETAILS
SURFACING TYPE: 50mm 14HG ASPHALT.
MEMBRANE: GRADE 4 SPRAY SEAL.
BASECOURSE: 200mm FRA CRUSHED ROCK BASE.
SUBBASE COURSE: 180mm FRA CRUSHED ROCK SUBBASE.
SUBGRADE IMPROVEMENT: NOT REQUIRED FOR CBR 8% OR BETTER SUBGRADE.
MINIMUM SUBGRADE STRENGTH: CBR 8%.
TOTAL THICKNESS:430mm.
CONTINGENCY UNDERCUT: FOR CBR 5% SUBGRADE, MINIMUM 120mm. REPLACE WITH EITHER GAP65 HARDFILL OR TYPE A MATERIAL.



A. REFER TO 6103677-CE-B08-17 FOR ROAD MARKING AND SIGNAGE DETAILS.
B. REFER TO 6103677-CE-B08-21 FOR GRAVEL SHOULDER WIDTHS.
C. FOR DETAILS OF EXSITING SERVICES AND PROPOSED SERVICE RELOCATIONS, REFER TO DRAWING 6103677-CE-B08-20.
D. ALL FILL EMBANKMENT SLOPES SHOWN ARE 1V:2H. UNLESS NOTED OTHERWISE.
E. COMMUNITY WASH-POOL. REFER TO DETAIL D ON 6103677-SE-STD-160 FOR DETAILS. REFER TO DETAIL A ON 6103677-SE-STD-161 FOR STEPS.

1 – ON-LINE REPLACEMENT WITH TEMPORARY BRIDGE UPSTREAM
SCALE 1:2000(A3)

DESIGN SPEED
Village sign posted mandatory speed limit 50km/h

DESIGN MIN ROAD LEVEL OVER BRIDGE
6.50m FHD.

BARRIER LENGTHS (exclusive of barrier on bridge)			
1	50m	2	85m
3	27m	4	75m

BARRIER LENGTHS ON BRIDGE
72m both sides
Refer to 6103677-CE-STD-30 for barrier details.

LEGEND PROPOSED:

- OPEN CHANNEL TYPE 1 AS PER DRAWING 6103677-CE-STD-25. MIN 0.5% GRADIENT.
- OPEN CHANNEL TYPE 2 AS PER DRAWING 6103677-CE-STD-25. MIN 0.5% GRADIENT.
- OPEN CHANNEL TYPE 3 AS PER DRAWING 6103677-CE-STD-25. MIN 0.5% GRADIENT.
- CONCRETE DRAIN TYPE 3 AS PER FRA DRAWING R504-3.
- VEHICLE CROSSING AS PER FRA DRAWING R601-10, & R601-6 (FOOTPATH CROSSING) MAINTAIN EXISTING ACCESSWAY WIDTH
- STORMWATER MANHOLE
- STORMWATER PIPELINE HEADWALL.
- STORMWATER CATCHPIT
- STORMWATER PIPELINE
- UNSEALED SHOULDER, FOOTPATH
- REINFORCED CONCRETE FOOTPATH REFER DRAWING 103677-CE-STD-15
- FENCE
- MECHANICALLY STABILISED EARTH (MSE) RETAINING WALL
- BARRIER
- SPEED HUMPAS PER FRA DRAWING R705-5.

NOTES:

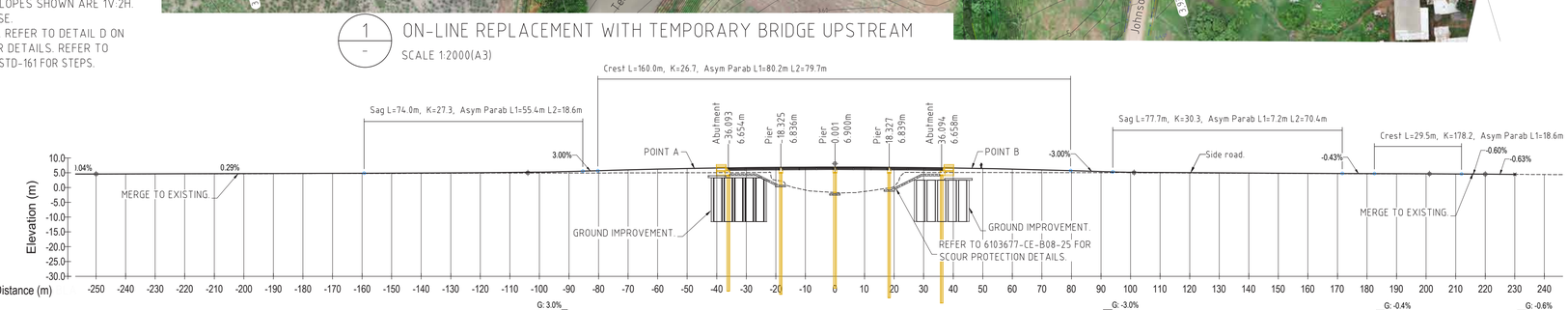
1. THESE BRIDGE SPECIFIC DRAWINGS REFER TO AND SHALL BE READ TOGETHER WITH STANDARD CIVIL DRAWINGS, 6103677-CE-STD SERIES.
2. FOR DESIGN DETAILS REFER TO THE DETAILED DESIGN REPORT - PRIORITY 1. B08 MATAWALU BRIDGE AND REFERENCED DOCUMENTS.
3. AERIAL IMAGE IS FROM UAV SURVEY UNDERTAKEN BY ERASITO CONSULTANTS LTD AND BECA INTERNATIONAL CONSULTANTS LTD IN NOVEMBER – DECEMBER 2021. TOPOGRAPHICAL SURVEY SHOWN IS BY FRA 4 JANUARY 2022.
4. MAJOR CONTOURS AT 1M INTERVALS, MINOR CONTOURS AT 0.2M INTERVALS. CONTOURS AND ELEVATIONS ARE TO FIJI HEIGHT DATUM (FHD), DETERMINED FRA.
5. HORIZONTAL POSITION IS TO FIJI MAP GRID (FMG).
6. CADASTRAL BOUNDARY INFORMATION IS FRA TOPOGRAPHICAL SURVEY (UNLESS NOTED AS FROM FIJI LAND INFORMATION SYSTEM (FLIS)) AND IS REFERENCED TO FIJI MAP GRID (FMG) COORDINATE SYSTEM. NO INDEPENDENT REVIEW OF DATA CORRECTNESS HAS BEEN CARRIED OUT.
7. NOT ALL SERVICES ARE SHOWN, AND THOSE THAT ARE SHOWN MAY NOT BE CORRECT. SOME SERVICES DETAILS HAVE BEEN PROVIDED BY FRA IN ITS TOPOGRAPHICAL SURVEY SURVEY AND LIAISON WITH UTILITY PROVIDERS (CARRIED OUT BY BICL).
8. FOR DETAILS OF EXISTING SERVICES AND PROPOSED SERVICE RELOCATIONS, REFER TO DRAWING 6103677-CE-B08-20.

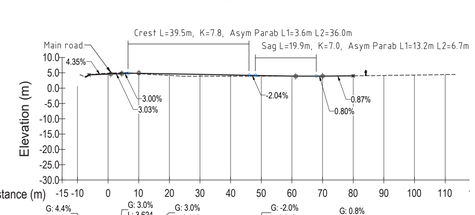
LEGEND EXISTING:

- CADASTRAL BOUNDARY
- JUHI UNDERGROUND FUEL PIPELINE
- UTILITIES
- FSC TRAMLINE
- FLOW DIRECTION

FOR CLARITY OF DETAILS VIEW ELECTRONICALLY

DETAILED DESIGN NOT FOR CONSTRUCTION





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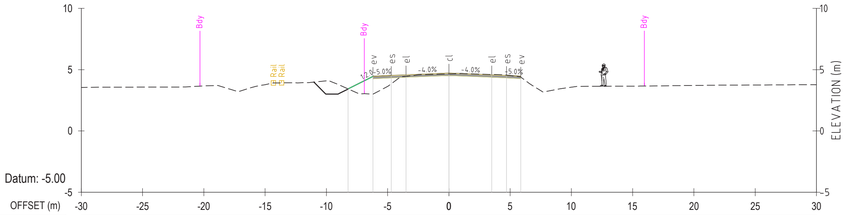
NOTES:

1. THIS DRAWING IS PART OF THE DETAILED DESIGN REPORT, AND SHOULD BE READ IN CONJUNCTION WITH THE REPORT.
2. REFER TO DRAWING CE-B08-10 FOR NOTES.



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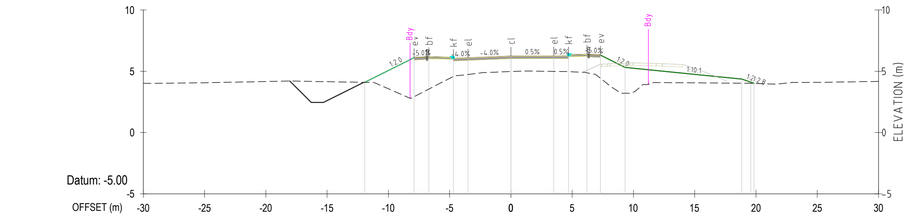
NOTES:

1. THIS DRAWING IS PART OF THE DETAILED DESIGN REPORT, AND SHOULD BE READ IN CONJUNCTION WITH THE REPORT.
2. REFER TO DRAWING CE-B08-10 FOR NOTES.



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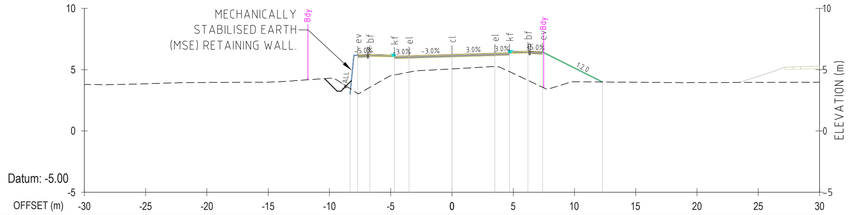
NOTES:

1. THIS DRAWING IS PART OF THE DETAILED DESIGN REPORT, AND SHOULD BE READ IN CONJUNCTION WITH THE REPORT.
2. REFER TO DRAWING CE-B08-10 FOR NOTES.



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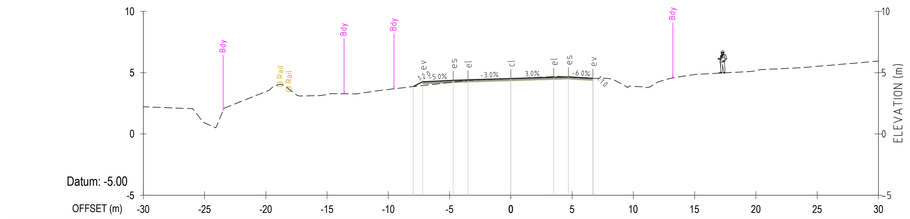
NOTES:

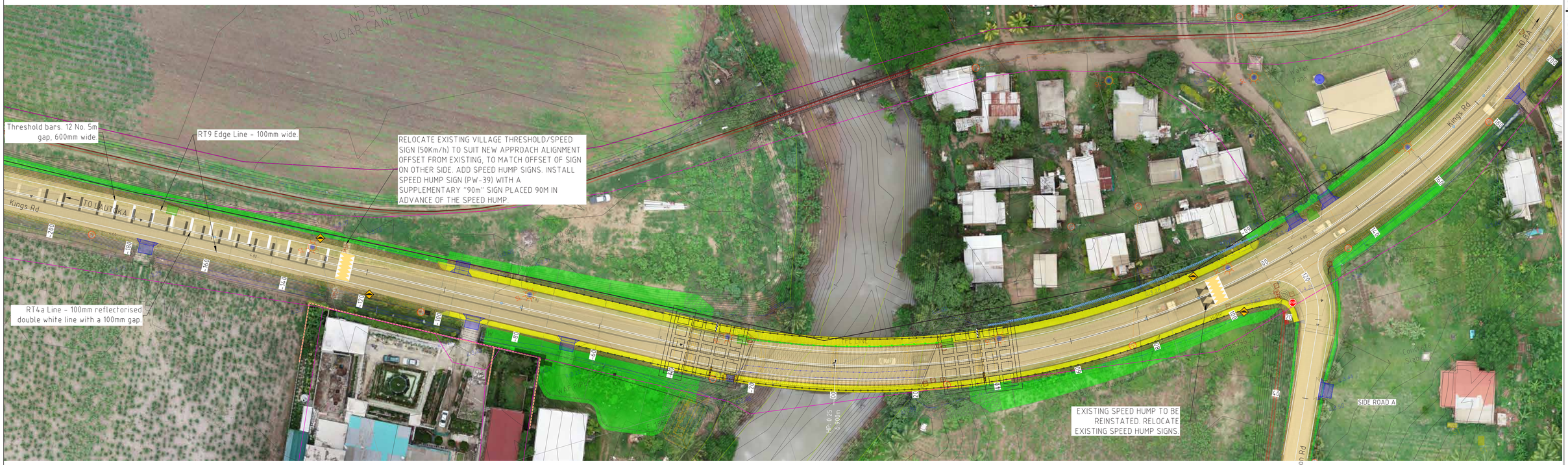
1. THIS DRAWING IS PART OF THE DETAILED DESIGN REPORT, AND SHOULD BE READ IN CONJUNCTION WITH THE REPORT.
2. REFER TO DRAWING CE-B08-10 FOR NOTES.



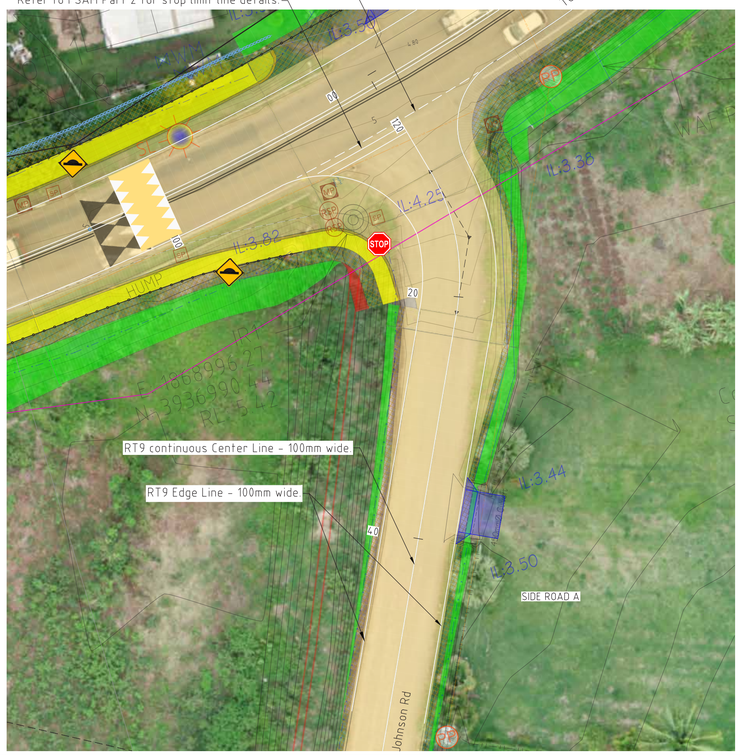
| | | |

NOTES:

1. REFER TO DRAWING CE-B08-10 FOR NOTES.
2. REFER TO CE-STD-03 FOR ROADING DETAILS.



1 — ROAD MARKING AND SIGNAGE GENERAL ARRANGEMENT PLAN
SCALE 1:1000(A3)



2 — SIDE ROAD A ROAD MARKING AND SIGNAGE PLAN
SCALE 1:500(A3)

LEGEND EXISTING:

- CADASTRAL BOUNDARY
- JUHI UNDERGROUND FUEL PIPELINE
- UTILITIES
- FSC TRAMLINE
- FLOW DIRECTION

LEGEND PROPOSED:

- STOP SIGN RG5 750mm x 750mm
- BRIDGE END MARKER POST W20-5.1
- BRIDGE END MARKER POST W20-5.2
- SPEED HUMP SIGN. REFER FRA DRAWING 705-5.
- SPEED HUMP AS PER FRA DRAWING R705-5. PROVIDE SPEED HUMP MARKINGS IN ACCORDANCE WITH FRA TRAFFIC SIGNS AND MARKING PART 2 LINEMARKING, APPENDIX A12.

REFER TO FSAM PART 2 FOR STOP MARKING DETAILS.

FOR CLARITY OF DETAILS VIEW ELECTRONICALLY

DETAILED DESIGN NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN - FOR FRA REVIEW.	RAI	TE	CH	31/01/24
A	DETAILED DESIGN - FOR COMMENT.	RAI	TE	CH	20/07/23

Original Scale (A1) AS SHOWN
Reduced Scale (A3) AS SHOWN

Design	R Imrie	31/01/24	Approved For Construction×
Drawn	R Imrie	31/01/24	
Dsg Verifier	C Hatley	31/01/24	
Drg Check	C Hatley	31/01/24	Date

× Refer to Revision 1 for Original Signature

Sub-consultant: Erasito
Main-consultant: Beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: MATAWALU BRIDGE ROAD MARKING AND SIGNS
Discipline:
Drawing No.: 6103677-CE-B08-17
Rev.: B

DO NOT SCALE FOR SET OUT DIMENSIONS

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Document No: PRE FEAS 11 A 1 P1 5.DWG

RELOCATE EXISTING CULVERT TO NEW DRAIN , ALIGN WITH RELOCATED THRESHOLD SIGN.

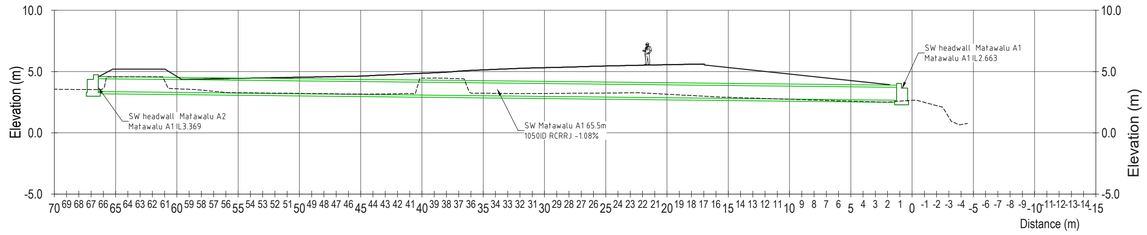
REFER TO 6103677-CE-STD-15 FOR KERB TRANSITION DETAIL AT FOOTPATH ENDS. RIP RAP LINED OPEN CHANNEL DOWN EMBANKMENT TO SIDE DRAIN, TYPICAL.

RELOCATE EXISTING BOX CULVERT.

SIDE ENTRY CATCHPIT AS PER FRA DWG 503-1, 300Ø PIPE AND OUTFALL, TYPICAL AT NW AND SW ENDS OF BRIDGE.

1 – STORMWATER PIPELINE AT DIST -95m TO -30m PLAN

SCALE 1:1000(A3)



VERTICAL ALIGNMENT PIPE INVERT	G: 1.1% L: 71.347
DESIGN GROUND LEVELS	4.37 4.39 4.41 4.42 4.44 4.46 4.48 4.50 4.52 4.54 4.56 4.57 4.59 4.61 4.63 4.68 4.72 4.77 4.82 4.86 4.91 4.95 5.03 5.09 5.14 5.18 5.22 5.26 5.29 5.32 5.34 5.37 5.40 5.43 5.45 5.48 5.50 5.52 5.54 5.56 5.58 5.60 5.61
PIPE / DRAIN INVERT LEVELS	3.36 3.35 3.34 3.33 3.31 3.30 3.29 3.27 3.26 3.25 3.24 3.23 3.22 3.21 3.20 3.19 3.18 3.17 3.16 3.15 3.14 3.13 3.11 3.10 3.09 3.08 3.07 3.06 3.05 3.04 3.03 3.02 3.01 3.00 2.98 2.97 2.96 2.94 2.93 2.92 2.91 2.90 2.89 2.88 2.87 2.86 2.85 2.84 2.83 2.82 2.81 2.80 2.79 2.77 2.76 2.75 2.74 2.73 2.72 2.71 2.70 2.69 2.68 2.67 2.66 2.65 2.64 2.63 2.61
DEPTH TO INVERT	0.30 1.22 1.24 1.25 0.90 0.30 0.27 0.21 0.13 0.04 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.02 0.04 0.06 0.09 0.11 1.39 1.40 1.39 1.37 0.20 0.20 0.20 0.20 0.21 0.21 0.23 0.27 0.29 0.31 0.32 0.34 0.36 0.32 0.28 0.24 0.20 0.15 0.11 0.08 0.06 0.04 0.02 0.00 -0.02 -0.04 -0.06 -0.08 -0.11 -0.13 -0.15 -0.16 -0.17 -0.08 0.00 -0.16 -0.44 -1.35 -1.94
PIPE TOP LEVELS	4.59 4.58 4.57 4.55 4.54 4.53 4.52 4.50 4.49 4.48 4.47 4.46 4.45 4.44 4.42 4.41 4.40 4.39 4.38 4.37 4.36 4.35 4.34 4.33 4.32 4.30 4.28 4.27 4.26 4.25 4.24 4.23 4.22 4.21 4.20 4.19 4.17 4.16 4.15 4.14 4.13 4.12 4.11 4.10 4.09 4.08 4.07 4.05 4.04 4.03 4.02 4.01 4.00 3.99 3.98 3.97 3.96 3.95 3.94 3.92 3.91 3.90 3.89 3.88 3.87 3.86
COVER	-0.14 -0.11 -0.08 -0.05 -0.02 0.01 0.03 0.06 0.09 0.12 0.15 0.18 0.21 0.24 0.27 0.33 0.39 0.44 0.50 0.56 0.67 0.76 0.83 0.89 0.94 1.00 1.05 1.09 1.13 1.16 1.19 1.23 1.28 1.31 1.35 1.38 1.41 1.44 1.47 1.50 1.53 1.56
EXISTING GROUND LEVELS	3.55 3.54 3.53 3.66 4.57 4.58 4.58 4.27 4.59 3.56 3.48 3.39 3.30 3.28 3.25 3.24 3.23 3.22 3.21 3.19 3.18 3.16 3.16 3.18 3.19 3.20 4.47 4.47 4.45 4.45 3.25 3.23 3.22 3.21 3.20 3.21 3.20 3.21 3.22 3.23 3.24 3.25 3.26 3.26 3.20 3.15 3.10 3.04 2.99 2.94 2.90 2.87 2.83 2.80 2.77 2.74 2.71 2.68 2.65 2.62 2.58 2.55 2.53 2.51 2.59 2.66 2.49 2.44 1.22 0.67
DISTANCE	69.0 68.0 67.0 66.0 65.0 64.0 63.0 62.0 61.0 60.0 59.0 58.0 57.0 56.0 55.0 54.0 53.0 52.0 51.0 50.0 49.0 48.0 47.0 46.0 45.0 44.0 43.0 42.0 41.0 40.0 39.0 38.0 37.0 36.0 35.0 34.0 33.0 32.0 31.0 30.0 29.0 28.0 27.0 26.0 25.0 24.0 23.0 22.0 21.0 20.0 19.0 18.0 17.0 16.0 15.0 14.0 13.0 12.0 11.0 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0 -7.0 -8.0 -9.0 -10.0 -11.0 -12.0 -13.0 -14.0

2 – STORMWATER PIPELINE AT DIST -95m TO -30m LONGITUDINAL PROFILE

SCALE 1:1000(A3)

NOTES:

1. REFER TO DRAWING CE-B08-10 FOR NOTES.

LEGEND EXISTING:

- CADASTRAL BOUNDARY
- FSC TRAMLINE
- FLOW DIRECTION

LEGEND PROPOSED:

- OPEN CHANNEL TYPE 1 AS PER DRAWING 6103677-CE-STD-25. MIN 0.5% GRADIENT.
- OPEN CHANNEL TYPE 2 AS PER DRAWING 6103677-CE-STD-25. MIN 0.5% GRADIENT.
- OPEN CHANNEL TYPE 3 AS PER DRAWING 6103677-CE-STD-25. MIN 0.5% GRADIENT.
- CONCRETE DRAIN TYPE 3 AS PER FRA DRAWING R504-3
- VEHICLE CROSSING AS PER FRA DRAWING R601-10, & R601-6 (FOOTPATH CROSSING) MAINTAIN EXISTING ACCESSWAY WIDTH
- STORMWATER MANHOLE
- STORMWATER PIPELINE HEADWALL.
- STORMWATER CATCHPIT
- STORMWATER PIPELINE
- UNSEALED SHOULDER, FOOTPATH
- REINFORCED CONCRETE FOOTPATH REFER DRAWING 103677-CE-STD-15
- FENCE
- RETAINING WALL
- BARRIER
- SPEED HUMP AS PER FRA DRAWING R705-5.

SCALE 1:500(A3):

0 5 10 15 20

FOR CLARITY OF DETAILS VIEW ELECTRONICALLY

DETAILED DESIGN NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN - FOR FRA REVIEW.	RAI	TE	CH	31/01/24
A	DETAILED DESIGN - FOR COMMENT.	RAI	TE	CH	20/07/23

Original Scale (A1) AS SHOWN
Reduced Scale (A3) AS SHOWN

Design	R Imrie	31/01/24
Drawn	R Imrie	31/01/24
Dsg Verifier	C Hatley	31/01/24
Drg Check	C Hatley	31/01/24

Approved For Construction× Date

× Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: MATAWALU BRIDGE MAIN ROAD STORMWATER PIPELINES PLAN AND PROFILE

Discipline

Drawing No. 6103677-CE-B08-18

Rev B

Document No. PRE FEAS 11 A 1 P15.DWG

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TYPICAL COLUMN DESIGNATION:

LUMINAIRE TYPE LEGEND:

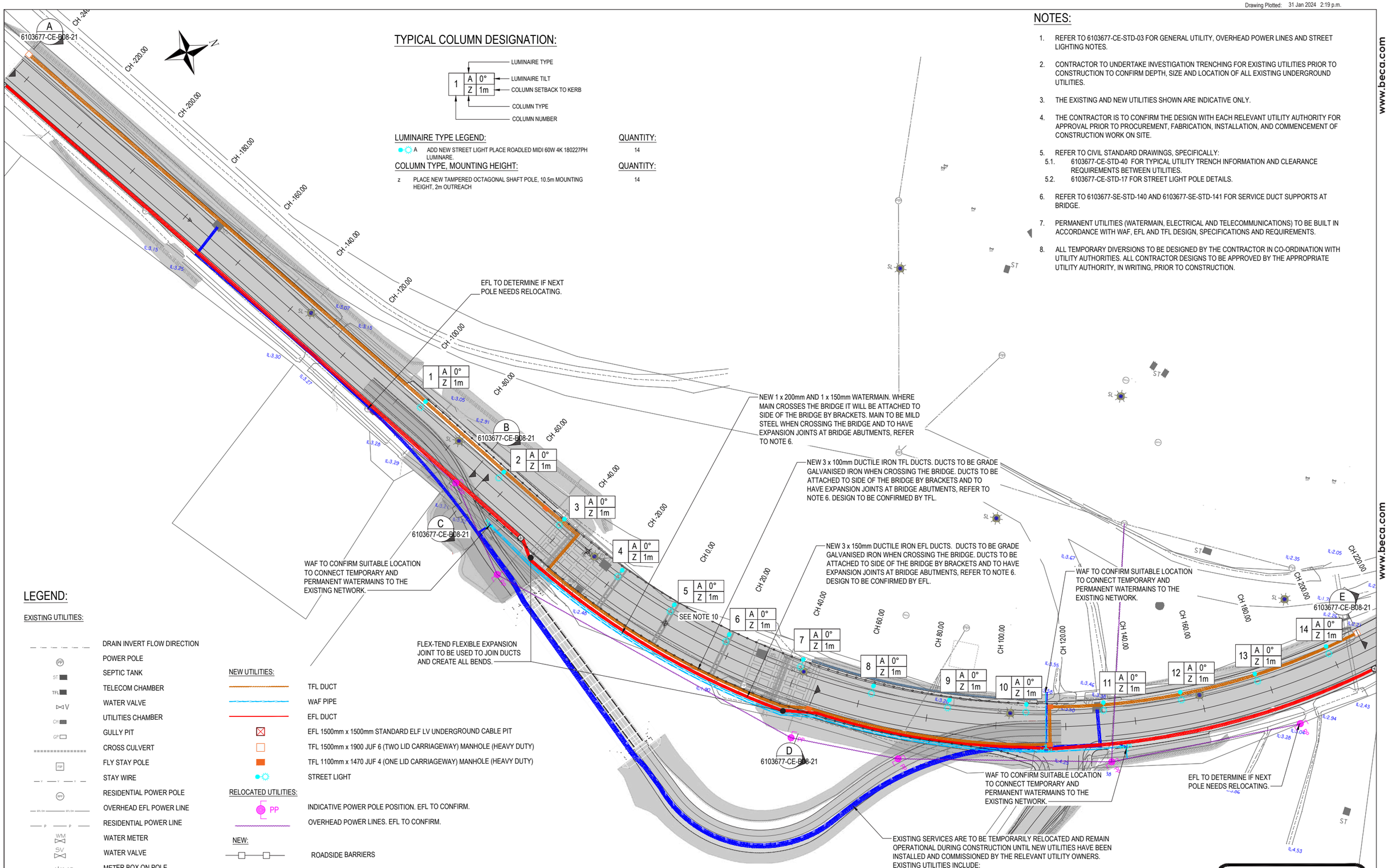
		QUANTITY:
A	ADD NEW STREET LIGHT PLACE ROADLED MIDI 60W 4K 180227PH LUMINARE.	14

COLUMN TYPE, MOUNTING HEIGHT:

		QUANTITY:
z	PLACE NEW TAMPERED OCTAGONAL SHAFT POLE, 10.5m MOUNTING HEIGHT, 2m OUTREACH	14

NOTES:

1. REFER TO 6103677-CE-STD-03 FOR GENERAL UTILITY, OVERHEAD POWER LINES AND STREET LIGHTING NOTES.
2. CONTRACTOR TO UNDERTAKE INVESTIGATION TRENCHING FOR EXISTING UTILITIES PRIOR TO CONSTRUCTION TO CONFIRM DEPTH, SIZE AND LOCATION OF ALL EXISTING UNDERGROUND UTILITIES.
3. THE EXISTING AND NEW UTILITIES SHOWN ARE INDICATIVE ONLY.
4. THE CONTRACTOR IS TO CONFIRM THE DESIGN WITH EACH RELEVANT UTILITY AUTHORITY FOR APPROVAL PRIOR TO PROCUREMENT, FABRICATION, INSTALLATION, AND COMMENCEMENT OF CONSTRUCTION WORK ON SITE.
5. REFER TO CIVIL STANDARD DRAWINGS, SPECIFICALLY:
   - 5.1. 6103677-CE-STD-40 FOR TYPICAL UTILITY TRENCH INFORMATION AND CLEARANCE REQUIREMENTS BETWEEN UTILITIES.
   - 5.2. 6103677-CE-STD-17 FOR STREET LIGHT POLE DETAILS.
6. REFER TO 6103677-SE-STD-140 AND 6103677-SE-STD-141 FOR SERVICE DUCT SUPPORTS AT BRIDGE.
7. PERMANENT UTILITIES (WATERMAIN, ELECTRICAL AND TELECOMMUNICATIONS) TO BE BUILT IN ACCORDANCE WITH WAF, EFL AND TFL DESIGN, SPECIFICATIONS AND REQUIREMENTS.
8. ALL TEMPORARY DIVERSIONS TO BE DESIGNED BY THE CONTRACTOR IN CO-ORDINATION WITH UTILITY AUTHORITIES. ALL CONTRACTOR DESIGNS TO BE APPROVED BY THE APPROPRIATE UTILITY AUTHORITY, IN WRITING, PRIOR TO CONSTRUCTION.



LEGEND:

EXISTING UTILITIES:

- DRAIN INVERT FLOW DIRECTION
- POWER POLE
- SEPTIC TANK
- TELECOM CHAMBER
- WATER VALVE
- UTILITIES CHAMBER
- GULLY PIT
- CROSS CULVERT
- FLY STAY POLE
- STAY WIRE
- RESIDENTIAL POWER POLE
- OVERHEAD EFL POWER LINE
- RESIDENTIAL POWER LINE
- WATER METER
- WATER VALVE
- METER BOX ON POLE
- DRAIN STEEL COVER
- TELECOM LINE
- TELECOM POLE

NEW UTILITIES:

- TFL DUCT
- WAF PIPE
- EFL DUCT
- EFL 1500mm x 1500mm STANDARD ELF LV UNDERGROUND CABLE PIT
- TFL 1500mm x 1900 JUF 6 (TWO LID CARRIAGEWAY) MANHOLE (HEAVY DUTY)
- TFL 1100mm x 1470 JUF 4 (ONE LID CARRIAGEWAY) MANHOLE (HEAVY DUTY)
- STREET LIGHT

RELOCATED UTILITIES:

- INDICATIVE POWER POLE POSITION. EFL TO CONFIRM.
- OVERHEAD POWER LINES. EFL TO CONFIRM.

NEW:

- ROADSIDE BARRIERS

TEMPORARY RELOCATIONS:

- TFL DUCT
- WAF PIPE

1 / - MATAWALU BRIDGE - PROPOSED UTILITIES LAYOUT PLAN
SCALE 1:500

FOR CLARITY OF DETAILS
VIEW ELECTRONICALLY

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN FOR FRA REVIEW	JM	VH	CH	31.01.24
B	DETAILED DESIGN- FOR COMMENT	JM	VH	CH	20.07.23
A	FOR FRA REVIEW	ES	VH	CH	14.03.23

Original Scale (A1) 1:1000
Reduced Scale (A3) 1:2000

Design	M. SHEPPARD	14.03.23	Approved For Construction*
Drawn	AV, ES	14.03.23	
Dsg Verifier	C. HATLEY	14.03.23	
Drg Check	C. HATLEY	14.03.23	Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: MATAWALU BRIDGE PROPOSED UTILITIES
Discipline: CIVIL ENGINEERING
Drawing No.: 6103677-CE-B08-20
Rev.: C

Document No. 6103677-CE-B08-20.DWG

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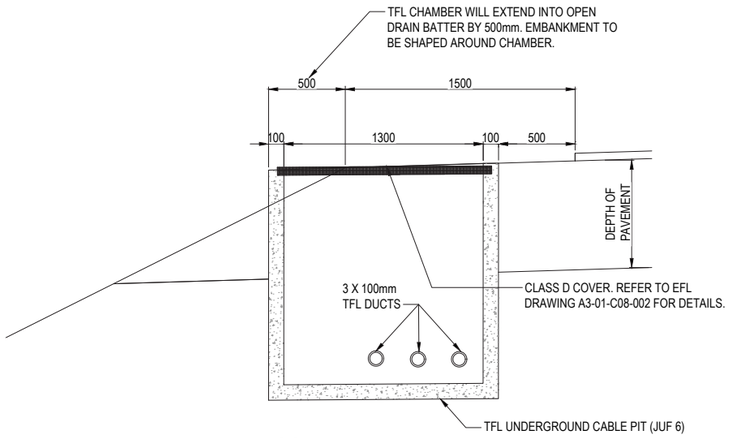
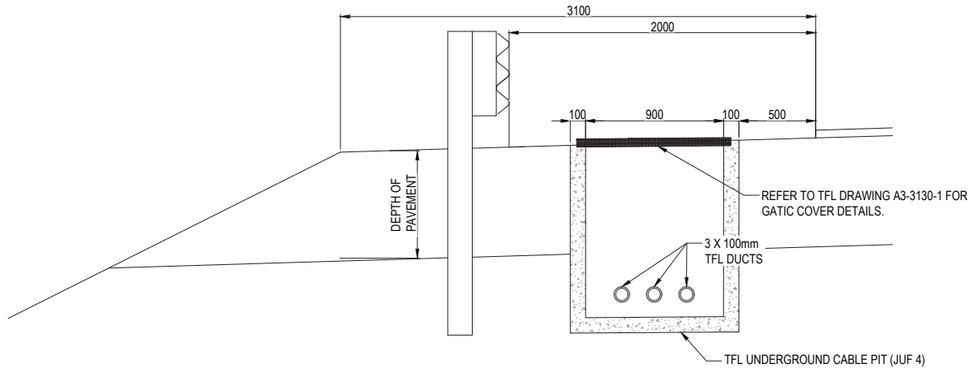
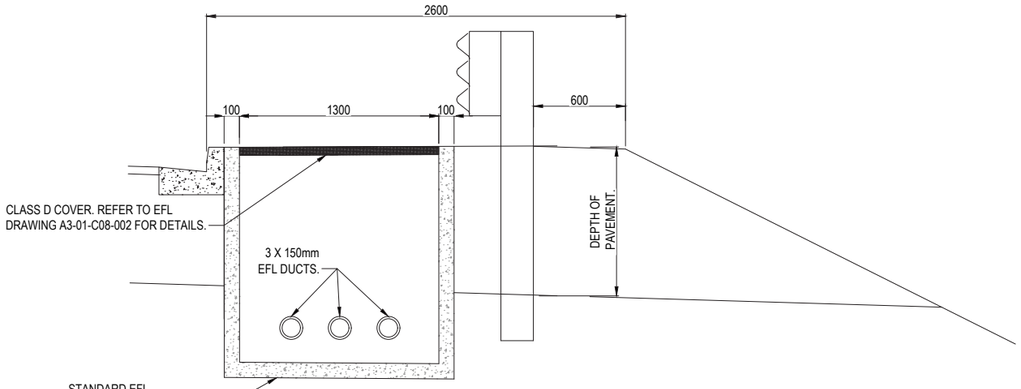


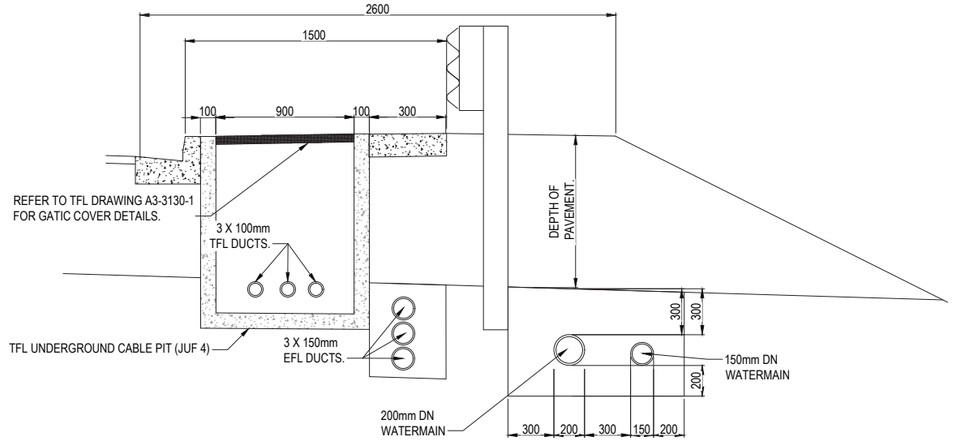
A CE-B08-20 DETAIL A
SCALE: 1:20 (A1)



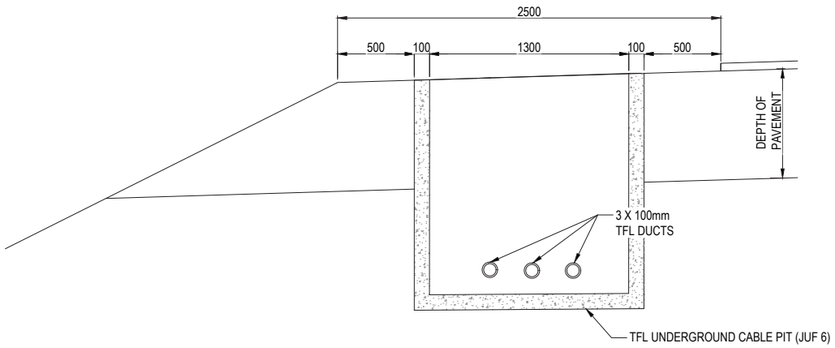
B CE-B08-20 DETAIL B
SCALE: 1:20 (A1)



C CE-B08-20 DETAIL C
SCALE: 1:20 (A1)



D CE-B08-20 DETAIL D
SCALE: 1:20 (A1)



E CE-B08-20 DETAIL E
SCALE: 1:20 (A1)

FOR CLARITY OF DETAILS
VIEW ELECTRONICALLY

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN FOR FRA REVIEW	JM	VH	CH	31.01.24
A	FOR FRA REVIEW	JM	VH	CH	20.07.23

Original Scale (A1) 1:20
Reduced Scale (A3) 1:40

Design	J. MARSH	20.07.23	Approved For Construction*
Drawn	AV, ES	20.07.23	
Dsg Verifier	C. HATLEY	20.07.23	
Drg Check	C. HATLEY	20.07.23	Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: MATAWALU BRIDGE PROPOSED UTILITIES CROSS SECTIONS

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B08-21

Beca Project Number:

Rev.: B

Document No. 6103677-CE-B08-21.DWG

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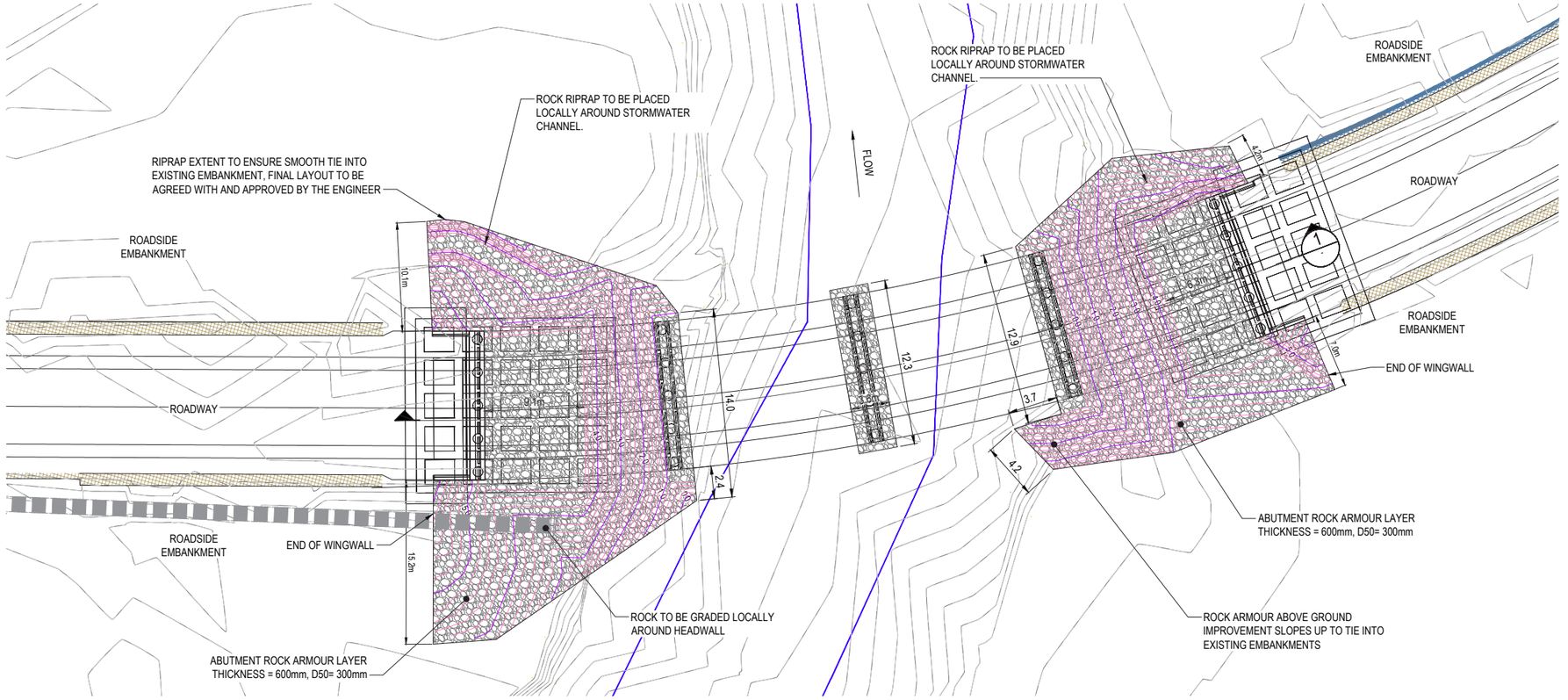


NOTES:

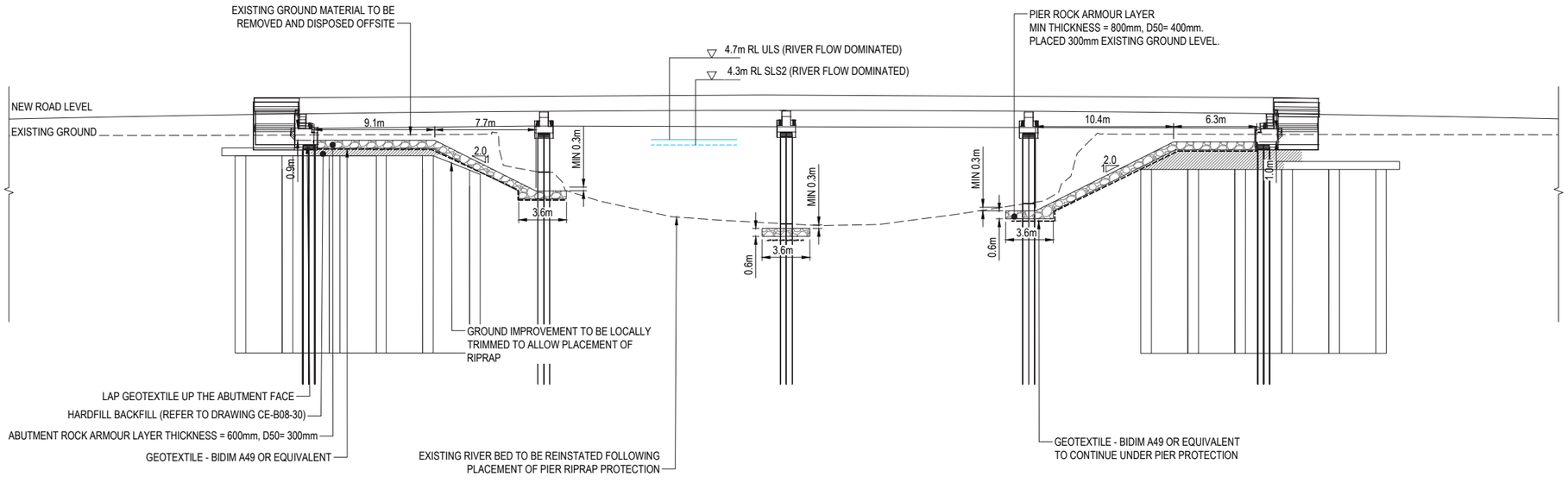
1. FOR ABUTMENT DETAILS REFER TO STRUCTURAL STANDARD DETAILS.
2. ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.
3. MAJOR CONTOURS SHOWN AT 1m INTERVALS
4. MINOR CONTOURS SHOWN AT 0.2m INTERVALS
5. EXCAVATED EXISTING GROUND TO BE DISPOSED OFF SITE.
6. ANY LOOSE DEBRIS WITHIN THE WATERWAY IS TO BE REMOVED
7. ROCK TO TIE INTO THE SURROUNDING EMBANKMENTS
8. FOR ROCK AND GEOTEXTILE SPECIFICATION PLEASE REFER TO SECTION C0226 OF THE SPECIFICATION DOCUMENT.

LEGEND:

- EXISTING TOE OF CHANNEL
- ROCK RIP RAP
- ULS RIVER FLOW LEVEL
- SLS2 RIVER FLOW LEVEL
- PROPOSED MAJOR CONTOURS (1.0m)
- PROPOSED MINOR CONTOURS (0.2m)
- EXISTING CONTOURS
- ROADSIDE EMBANKMENT CONTOURS

A - SCOUR PROTECTION LAYOUT

SCALE 1:250



1 - SCOUR PROTECTION

SCALE 1:200

FOR CLARITY OF DETAILS
VIEW ELECTRONICALLY

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN FOR FRA REVIEW	HD	VH	CH	31.01.24
A	DETAILED DESIGN- FOR COMMENT	HD	VH	CH	21.07.23

Original Scale (A1) AS SHOWN	Design	R. SHAFIEI	21.07.23
Reduced Scale (A3) HALF SHOWN	Drawn	P. BOY	21.07.23
	Dsg Verifier	A. HARVEY	21.07.23
	Drg Check	R. SHAFIEI	21.07.23

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: MATAWALU BRIDGE SCOUR PROTECTION LAYOUT SHEET 1

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B08-25

Rev.: B

Document No. 6103677-CE-B08-25.DWG

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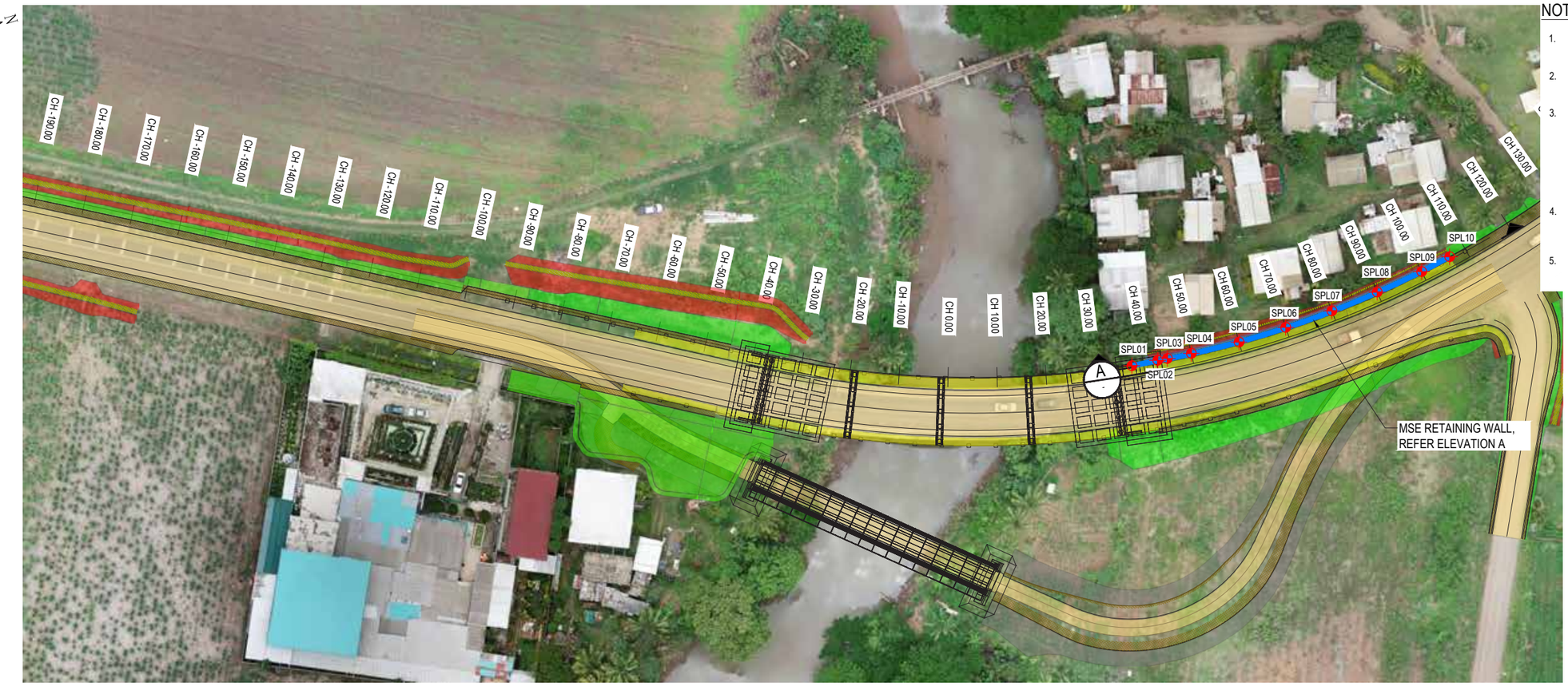
Drawing Plotted: 31 Jan 2024 2:20 p.m.

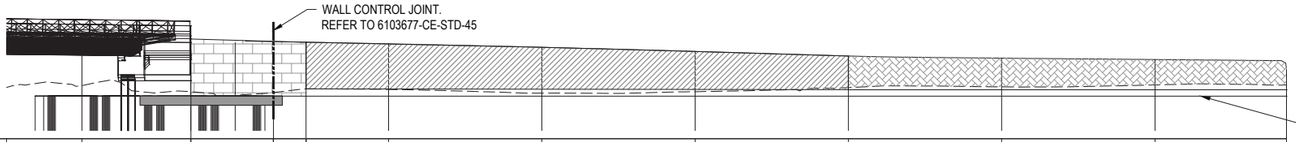


PLAN - RETAINING WALL

SCALE 1:500 (A1) 1:1000 (A3)

NOTES:

1. REFER TO 6103677-CE-STD-43 TO CE-STD-50 FOR MECHANICALLY STABILISED EARTH (MSE) RETAINING WALL DETAILS.
2. (MSE) RETAINING WALL "SOIL CONDITION A" IN ACCORDANCE WITH 6103677-CE-STD-43 TO BE ADOPTED.
3. REFER TO PROJECT EARTHWORKS SPECIFICATION FOR FORMATION LEVEL TESTING REQUIREMENTS. WHERE THE MATERIAL ENCOUNTERED DOES NOT MEET THE STRENGTH REQUIRED IN THE PROJECT EARTHWORKS SPECIFICATION, THE CONTRACTOR SHALL DETERMINE THE EXTENTS OF MATERIAL WITH STRENGTH LESS THAN THIS REQUIREMENT FOR FURTHER UNDERCUTTING OR TREATMENT.
4. SETOUT POINTS FOR RETAINING WALL ARE LOCATED AT THE TOP OF THE MSE WALL. REFER 6103677-CE-STD-45 FOR POSITION ON WALL.
5. REFER TO 6103667-CE-STD-43 TABLE 3 AND NOTES FOR DESIGN REQUIREMENTS FOR IMPROVEMENT TO GROUND BENEATH THE RETAINING WALL.



CUT/FILL	2.94	3.24	3.20	2.92	2.86	2.87	2.51	1.97	1.80	1.56	1.47
DESIGN LEVELS	6.56	6.46	6.36	6.32	6.23	6.00	5.73	5.45	5.33	5.22	5.13
EXISTING LEVELS	3.61	3.22	3.16	3.40	3.37	3.12	3.22	3.49	3.54	3.66	3.66
CHAINAGE	30.0	37.6	43.0	45.0	50.0	60.0	70.0	80.0	90.0	100.0	106.5

A LONGITUDINAL ELEVATION MSE RETAINING WALL - CHAINAGE 37.6 TO 106.5

SCALE 1:200 (A1)

RETAINING WALL SETOUT POINTS

SETOUT POINTS	NORTHING	EASTING
SPL01	3937056.34	1869002.29
SPL02	3937061.71	1869002.78
SPL03	3937063.69	1869003.00
SPL04	3937068.67	1869003.45
SPL05	3937078.65	1869004.08
SPL06	3937088.66	1869004.02
SPL07	3937098.64	1869003.56
SPL08	3937108.60	1869002.62
SPL09	3937118.51	1869001.28
SPL10	3937124.87	1869000.06

LEGEND:

- 4m MAX RETAINED HEIGHT REFER CE-STD-46 SECTION B
- 3m MAX RETAINED HEIGHT REFER CE-STD-46 SECTION C
- 2m MAX RETAINED HEIGHT REFER CE-STD-46 SECTION D

FOR CLARITY OF DETAILS
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DETAILED DESIGN
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No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN FOR FRA REVIEW	MA	DA	CH	31.01.24
A	DETAILED DESIGN- FOR COMMENT	ES	CH	VH	20.07.23

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	D. ASPIN	20.07.23	Approved For Construction*
Drawn	M.ANONUEVO	20.07.23	
Dsg Verifier	D. ANSTISS	20.07.23	
Drg Check	D. ASPIN	20.07.23	Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: MATAWALU BRIDGE RETAINING WALLS

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B08-27

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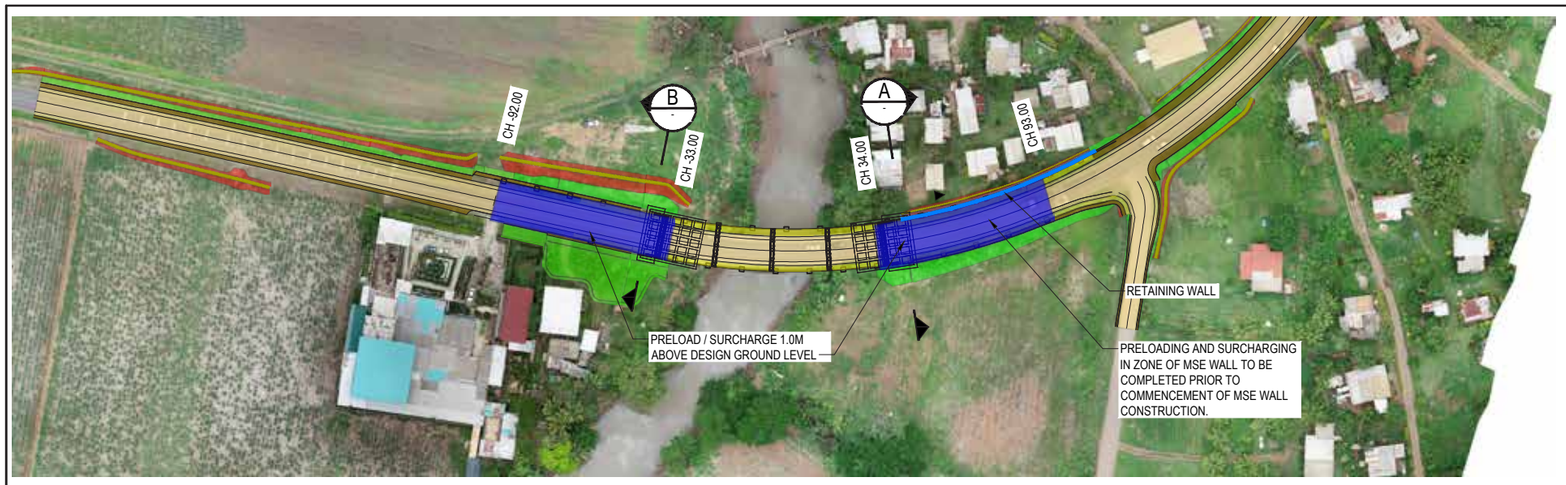


PLAN - PRELOAD EXTENT

SCALE 1:1000 (A1) 1:2000 (A3)

LEGEND:

- COMPACTED GAP 65
- LOAD TRANSFORM PLATFORM
- LONGITUDINAL BASAL MIRAFI PET 1000
- RETAINING WALL

NOTES:

1. GENERAL

1.1. FOR GENERAL NOTES REFER TO 6103677-CE-B08-30.

2. EMBANKMENT

2.1. FOR EMBANKMENT NOTES REFER TO 6103677-CE-B08-30.

3. GEOGRID AND BASAL GEOTEXTILE

3.1. FOR GEOGRID AND BASAL GEOTEXTILE NOTES REFER TO 6103677-CE-B08-30

4. PRELOAD SURCHARGING OF EMBANKMENTS

4.1. WHERE SHOWN ON THE DRAWINGS THE FILL EMBANKMENTS ARE TO BE SURCHARGED WITH PRELOAD TO ACCELERATE THE RATE OF CONSOLIDATION SETTLEMENT DURING CONSTRUCTION. REFER THE PROJECT EARTHWORKS SPECIFICATION FOR PRELOAD AND SURCHARGE SPECIFICATION.

4.2. THE PRELOAD SHALL COMPRISE AN AGGREGATE WITH A PLACED DENSITY NOT LESS THAN 2.2t/m³.

4.3. THE PRELOAD FILL SHOULD BE PLACED NO STEEPER THAN 1.5H:1V SLOPE UNLESS THE CONTRACTOR PROVIDES A TEMPORARY SUPPORT SYSTEM. THE CONTRACTOR STALL BE RESPONSIBLE FOR DESIGNING ANY TEMPORARY SUPPORTS SUCH AS RETAINING STRUCTURES.

4.4. SETTLEMENT PERIODS AND HEIGHTS OF FILL TO BE REMOVED ARE DEPENDENT ON SETTLEMENT MONITORING RESULTS. ENGINEER TO CONFIRM THAT ADEQUATE CONSOLIDATION SETTLEMENT HAS OCCURRED PRIOR TO REMOVAL OF SURCHARGE AND COMMENCEMENT OF PAVEMENT WORKS.

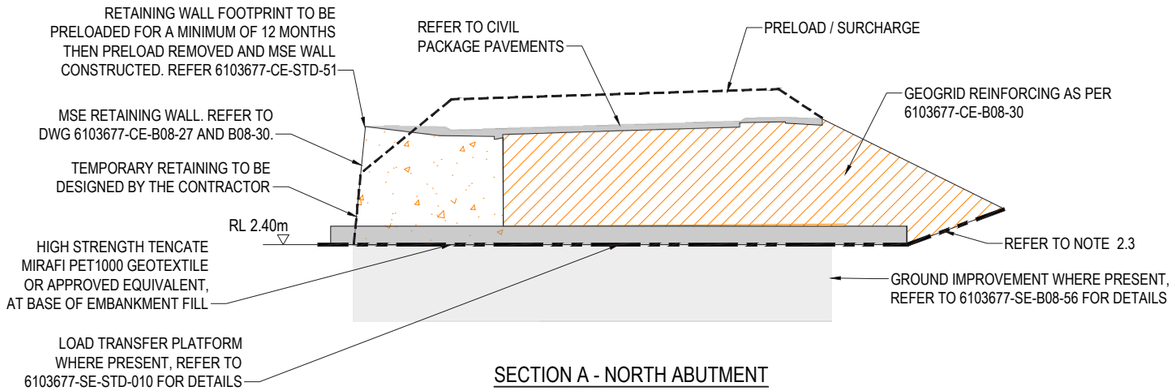
4.5. SETTLEMENT OF THE EMBANKMENT SHALL BE MONITORED DURING CONSTRUCTION WITH INSTRUMENTATION SHOWN ON THE DRAWINGS.

4.6. PRELOAD / SURCHARGE IS TO REMAIN IN PLACE UNTIL RESIDUAL CONSOLIDATION SETTLEMENT IS ESTIMATED TO BE LESS THAN 150mm, AS ADVISED BY THE ENGINEER FOLLOWING ANALYSIS OF THE FIELD DATA TO UPDATE SETTLEMENT ESTIMATES.

4.7. FOLLOWING REMOVAL OF THE PRELOAD ALL FILL MATERIALS REMAINING IN THE PERMANENT WORKS SHALL COMPLY WITH THE MATERIALS TYPE AND FIELD COMPACTION STATED ON THE DRAWINGS AND SPECIFICATION.

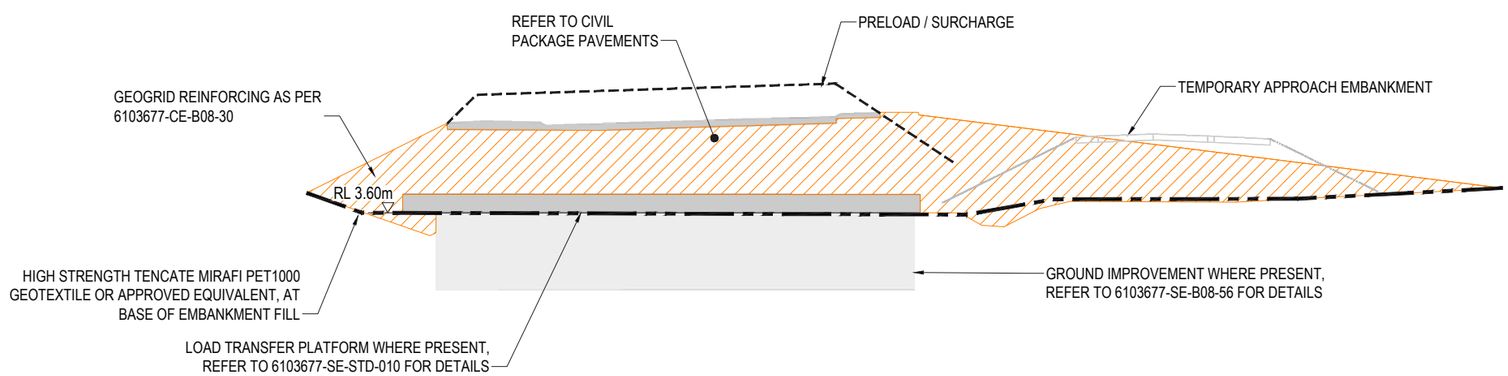
4.8. ESTIMATED DURATION OF PRELOADING IS TWELVE MONTHS WITH THE ACTUAL DURATION TO BE CONFIRMED WITH THE ENGINEER.

4.9. THE LOWER 150mm (MIN.) OF THE PRELOAD / SURCHARGE FILL SHALL COMPLY WITH THE MATERIALS TYPE AND FIELD COMPACTION STATED ON THE DRAWINGS AND SPECIFICATION FOR THE EMBANKMENT FILL.



SECTION A - NORTH ABUTMENT

1:100 (A1) 1:200(A3)



SECTION B - SOUTH ABUTMENT

SCALE 1:100 (A1) 1:200(A3)

FOR CLARITY OF DETAILS
VIEW ELECTRONICALLY

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
A	DETAILED DESIGN FOR FRA REVIEW	RH	DA	CH	31.01.24

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Reduced Scale (A3)	HALF SHOWN		
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Drawn	M.ANONUEVO	31.01.24	
Dsg Verifier	D. ANSTISS	31.01.24	
Drg Check	D. ASPIN	31.01.24	Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: MATAWALU BRIDGE PRELOAD SURCHARGE DETAILS

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B08-29

Rev.: A

Document No. 6103677-CE-B08-29.DWG

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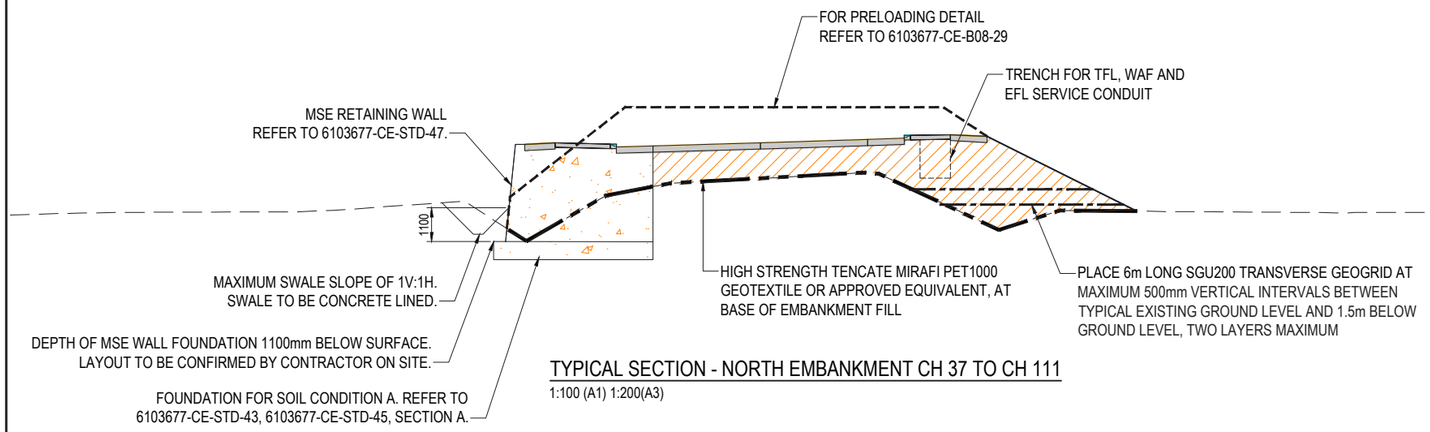
PLAN - EMBANKMENT REINFORCING EXTENT

SCALE 1:1000 (A1) 1:2000 (A3)

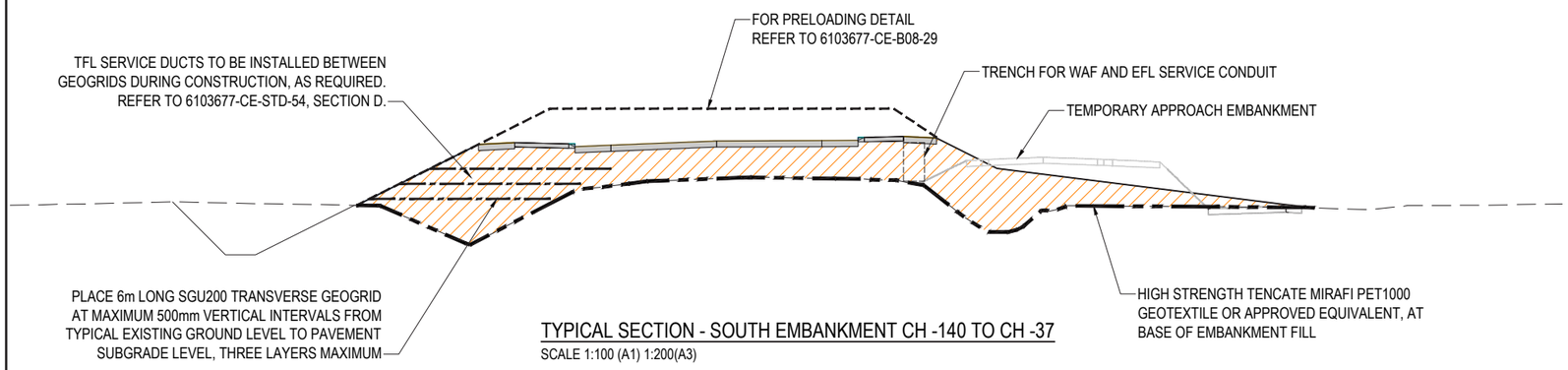
LEGEND:

- COMPACTED GAP 65
- LONGITUDINAL BASAL MIRAFI PET 1000
- GEOGRID REINFORCED EMBAKMENT
- RETAINING WALL
- SGU 200 GEOGRID



TYPICAL SECTION - NORTH EMBANKMENT CH 37 TO CH 111

1:100 (A1) 1:200(A3)



TYPICAL SECTION - SOUTH EMBANKMENT CH -140 TO CH -37

SCALE 1:100 (A1) 1:200(A3)

NOTES:

1. GENERAL

1.1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING, PROTECTING AND/OR RELOCATING ANY UTILITIES AND DRAINAGE PRIOR TO WORKS COMMENCING.

1.2. ALL CONSTRUCTION WORKS SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE PROJECT EARTHWORKS SPECIFICATION.

1.3. EXISTING SWALE DRAINS ARE TO BE CLEARED OF VEGETATION AND UNSUITABLE SOILS AND BACKFILLED AS PER DETAIL A ON 6103677-CE-STD-54.

1.4. ANY SIGNIFICANT VARIANCES IN GROUND CONDITIONS FROM THOSE PRESENTED IN THESE DRAWINGS MUST BE BROUGHT TO THE ATTENTION OF THE ENGINEER.

1.5. SUBGRADE IMPROVEMENTS AND PAVEMENT LAYER NOT SHOWN ON DRAWINGS FOR CLARITY.

1.6. IN ORDER TO MINIMIZE THE POTENTIAL FOR INSTABILITY OF PERMANENT WORKS ELEMENTS, THE POSITION OF ANY TEMPORARY STOCKPILES SHALL BE AGREED WITH THE ENGINEER.

2. EMBANKMENT

2.1. PRIOR TO FILLING, TOPSOIL AND UNSUITABLE SOILS (INCLUDING HIGHLY ORGANIC SOILS OR SILT, TOXIC MATERIALS, PEAT LOGS, STUMPS, PERISHABLE OR ORGANIC MATERIALS, CONTAMINATED SOILS) SHALL BE EXCAVATED AND REMOVED.

2.2. WHERE MATERIAL IS ENCOUNTERED THAT DOES NOT MEET THE STRENGTH REQUIRED IN THE PROJECT EARTHWORKS SPECIFICATION, THE CONTRACTOR SHALL DETERMINE THE EXTENTS AND STRENGTH OF MATERIAL LESS THAN THIS REQUIREMENT FOR FURTHER UNDERCUTTING OR TREATMENT.

2.3. THE CONTRACTOR SHALL EVALUATE, DURING CONSTRUCTION, THE SAFE TEMPORARY BATTER ANGLE FOR ANY EXCAVATION OR FILLING.

2.4. THE MATERIALS AT FORMATION LEVEL SHOULD BE PROTECTED FROM SOFTENING, OVERLOADING (e.g. FROM CONSTRUCTION TRAFFIC) OR OTHER CONDITIONS WHICH MAY RESULT IN WEAKENING OF THESE MATERIALS.

2.5. POSITIVE DRAINAGE OF ALL EXCAVATION WORKS MUST BE MAINTAINED DURING CONSTRUCTION.

2.6. HOLD: ALL AREAS OF EXPOSED EMBANKMENT SUBGRADE ARE TO BE INSPECTED BY THE ENGINEER TO CONFIRM UNSUITABLE SOILS HAVE BEEN REMOVED. REFER TO THE PROJECT EARTHWORKS SPECIFICATION FOR SUBGRADE REQUIREMENTS. QUALITY ASSURANCE DOCUMENTATION TO RECORD INSPECTION AND ACCEPTANCE.

2.7. ALL FILL MATERIALS SHALL MEET THE GRADING, COMPACTION AND TESTING REQUIREMENTS SPECIFIED IN THE PROJECT EARTHWORKS SPECIFICATION.

2.8. SETTLEMENT MONITORING INSTRUMENTATION DETAILED ON THE DRAWINGS TO BE INSTALLED, AND BASELINE MONITORING COMPLETED, PRIOR TO PLACING EMBANKMENT FILL.

2.9. PLACEMENT OF EMBANKMENT FILL MATERIAL AND PRELOAD FILL MATERIALS SHALL BE STAGED, WITH REST PERIODS OF MINIMUM 1 WEEK BETWEEN MAX 1m HEIGHT FILL LIFTS. DURATION AND FREQUENCY OF REST PERIODS TO BE DETERMINED BY CONTRACTOR. DURATION OF REST PERIODS BETWEEN FILL STAGES TO BE ADJUSTED BY CONTRACTOR TO MANAGE INSTABILITY RISK DURING CONSTRUCTION.

2.10. EMBANKMENT FILL MATERIALS TO BE OVERFILLED TO ACCOUNT FOR SETTLEMENT, LATER TRIMMED TO DESIGN PAVEMENT SUBGRADE LEVEL.

3. GEOGRID AND BASAL GEOTEXTILE

3.1. REFER TO THE DRAWINGS AND PROJECT EARTHWORKS SPECIFICATION FOR ALL GEOTEXTILE AND GEOGRID REQUIREMENTS.

3.2. LONGITUDINAL GEOGRID, WHERE SPECIFIED, IS LAID WITH THE PRIMARY STRENGTH DIRECTION ORIENTATED ALONG THE ROAD CENTRELINE.

3.3. TRANSVERSE GEOGRID, WHERE SPECIFIED, IS LAID WITH THE PRIMARY STRENGTH DIRECTION ORIENTATED PERPENDICULAR TO THE ROAD CENTRELINE.

3.4. BASAL HIGH STRENGTH GEOTEXTILES, WHERE SPECIFIED, IS WITH THE PRIMARY STRENGTH DIRECTION ORIENTATED PERPENDICULAR TO THE ROAD CENTRELINE UNLESS SPECIFICALLY SPECIFIED OTHERWISE ON THE DRAWINGS.

3.5. HIGH STRENGTH GEOTEXTILES AND GEOGRIDS ARE TO BE CONTINUOUS IN THEIR PRIMARY STRENGTH DIRECTION AND NOT LAPPED.

3.6. WHERE THE HIGH STRENGTH GEOTEXTILES AND / OR GEOGRID LAYERS EXTEND INTO THE EXISTING GROUND SURFACE, TEMPORARY EXCAVATION WILL BE REQUIRED.

3.7. ALL HIGH STRENGTH GEOTEXTILE AND GEOGRID LAYERS ARE TO BE LAID OUT OVER THER FULL LENGTH AND COVERED AS A SINGLE OPERATION UNLESS AGREED OTHERWISE WITH THE ENGINEER. HIGH STRENGTH GEOTEXTILE AND GEOGRID LAYERS ARE TO BE COVERED WITHIN 3 DAYS OF PLACING.

3.8. NO TRAFFIC OR SITE PLANT SHALL BE PERMITTED TO TRAVEL ON THE GEOGRID OR HIGH STRENGTH GEOTEXTILE LAYERS WHERE THE FILL COVER IS LESS THAN 200mm.

3.9. GEOGRID WITHIN FILL EMBANKMENTS (EXCLUDING RETAINING STRUCTURES) SHALL BE PLACED WITH A VERTICAL SPACING OF 500mm BETWEEN LAYERS UNLESS SPECIFICALLY SPECIFIED OTHERWISE ON THE DRAWINGS.

4. PRELOAD SURCHARGING OF EMBANKMENTS

4.1. FOR PRELOAD NOTES REFER TO 6103677-CE-B08-29.

FOR CLARITY OF DETAILS
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No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN FOR FRA REVIEW	RH	DA	CH	31.01.24
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Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

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Title: MATAWALU BRIDGE EMBANKMENT DETAILS

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B08-30 | Rev.: B

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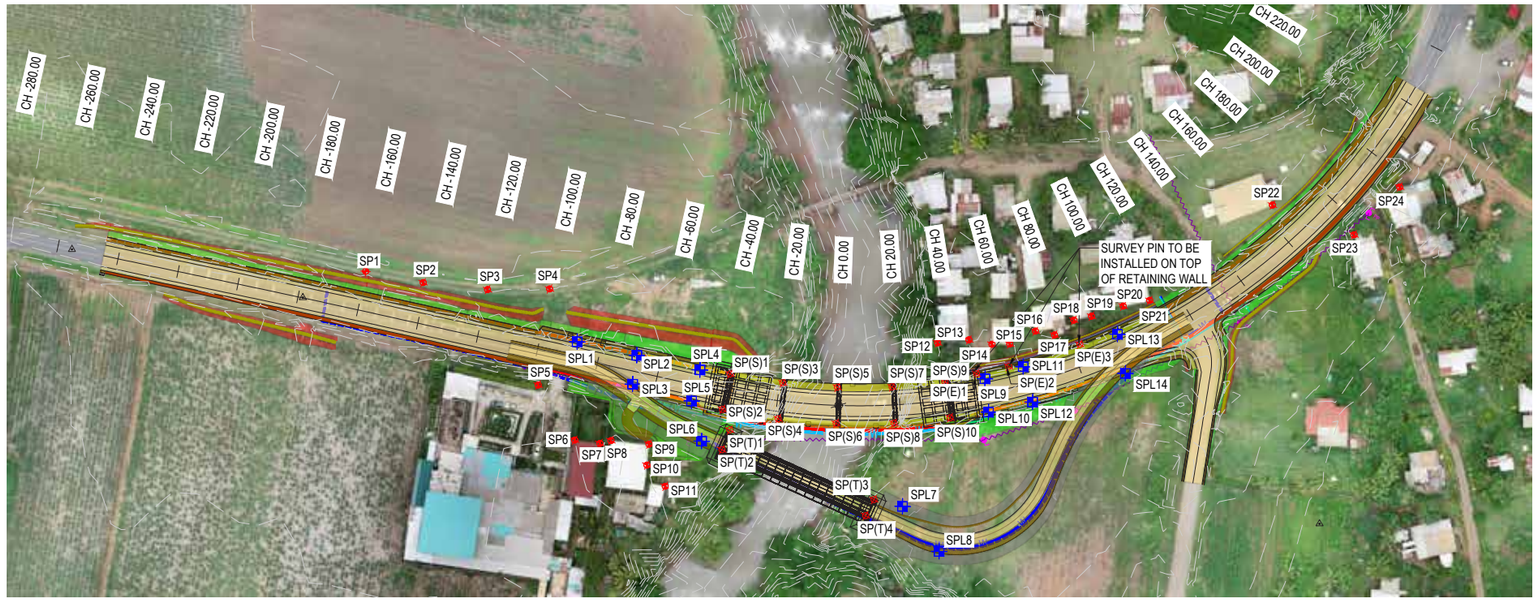
INSTRUMENTATION & MONITORING SETOUT POINTS

SETOUT POINTS	NORTHING	EASTING
SP 1	3937084.65	1868995.67
SP 2	3937090.25	1868998.71
SP 3	3937097.70	1868995.92
SP 4	3937063.08	1868992.02
SP 5	3937069.84	1868995.57
SP 6	3937075.42	1868997.23
SP 7	3937170.60	1868979.08
SP 8	3937193.26	1868996.14
SP 9	3937212.04	1868985.65
SP 10	3937103.59	1868996.39
SP 11	3937114.42	1868996.28
SP 12	3937123.23	1868997.04
SP 13	3936937.19	1868935.97
SP 14	3936924.46	1868964.83
SP 15	3936930.57	1868985.50
SP 16	3936881.54	1868912.88
SP 17	3936898.37	1868921.90
SP 18	3936917.82	1868930.23
SP 19	3936950.69	1869000.20
SP 20	3936954.35	1869008.55
SP 21	3937053.04	1868989.94
SP 22	3936938.11	1868988.94
SP 23	3936941.83	1868989.12
SP 24	3936953.35	1868993.90
SPL 1	3937062.29	1869016.42
SPL 2	3937064.38	1869005.68
SPL 3	3937033.55	1869055.10
SPL 4	3937077.45	1869005.59
SPL 5	3937108.67	1869017.45
SPL 6	3937109.94	1869004.49
SPL 7	3937077.00	1869017.50
SPL 8	3936954.01	1868973.60
SPL 9	3936958.07	1868965.03
SPL 20	3936940.77	1868955.07
SPL 11	3936976.37	1868975.61
SPL 12	3937026.45	1869037.55
SPL 13	3936970.05	1868997.99
SPL 14	3936970.77	1868984.49
SP(S)1	3937034.60	1868999.31
SP(S)2	3937013.66	1869005.33
SP(S)3	3937031.74	1869010.82
SP(S)4	3937049.76	1869014.47
SP(S)5	3937051.61	1869002.82
SP(S)6	3936979.57	1868990.08
SP(S)7	3936985.34	1868979.79
SP(S)8	3937000.92	1868987.59
SP(S)9	3937017.53	1868994.18
SP(S)10	3936996.09	1868998.35
SP(T)1	3937018.20	1869032.68
SP(T)2	3937014.06	1869036.90
SP(T)3	3936979.91	1868997.20
SP(T)4	3936975.53	1869002.57
SP(E)1	3937097.22	1869004.02
SP(E)2	3937072.95	1869004.10
SP(E)3	3937062.22	1869003.30



1 - ON-LINE REPLACEMENT
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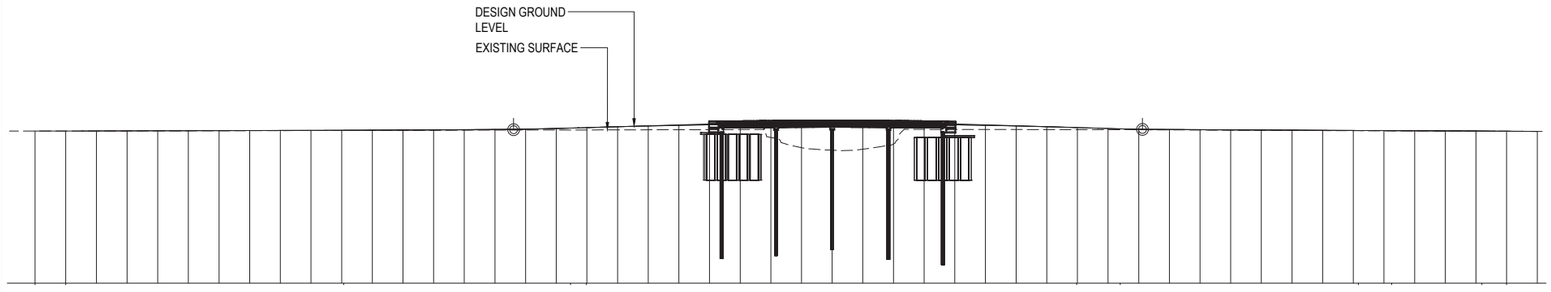

ON-LINE REPLACEMENT MAIN ROAD LONGITUDINAL
SCALE 1:1000

TABLE 13 - INSTRUMENTATION & MONITORING FREQUENCY

INSTRUMENT DETAILS			INSTRUMENT MONITORING FREQUENCY		
INSTRUMENT	LOCATION	INSTALLATION	BASE	DURING CONSTRUCTION	DURING HOLD PERIODS
SETTLEMENT PLATE B08-SPL XX	NATURAL GROUND IMMEDIATELY BENEATH THE EMBANKMENT FILL	PRIOR TO INSTALLATION ON ANY FILL	THREE TIMES BEFORE FILLING	WEEKLY	VARIES WEEKLY TO MONTHLY AS AGREED WITH ENGINEER
SURVEY PINS B08-SP(E) XX	RETAINING WALLS		IMMEDIATELY AFTER CONSTRUCTION OF THE STRUCTURAL ELEMENT		VARIES WEEKLY TO MONTHLY AS AGREED WITH ENGINEER
SURVEY PINS B08-SP(S) XX	NEW BRIDGE ABUTMENT BEAMS AND PIERS		IMMEDIATELY AFTER CONSTRUCTION OF THE STRUCTURAL ELEMENT		VARIES WEEKLY TO MONTHLY AS AGREED WITH ENGINEER
SURVEY PINS B08-SP(T) XX	TEMPORARY BRIDGE ABUTMENT		IMMEDIATELY AFTER CONSTRUCTION OF THE STRUCTURAL ELEMENTS		EVERY SECOND WEEK UNLESS AGREED OTHERWISE WITH ENGINEER
SURVEY PINS B08-SP XX	EXISTING BUILDINGS	PRIOR TO ANY PHYSICAL WORKS	THREE TIMES BEFORE FILLING		WEEKLY

NOTES:

1. CONTRACTOR CONSTRUCTION METHODOLOGY, SEQUENCING AND PROPOSED PRELODING SURCHAGE PROGRAMME TO BE PROVIDED TO THE ENGINEER PRIOR TO COMMENCMENT OF WORKS.
2. THE PROPOSED INSTALLATION LOCATIONS FOR INSTRUMENTS AIM TO POSITION THEM AWAY FROM CONSTRUCTION ACTIVITIES TO MINIMISE THE CHANCE OF DAMAGE TO THE INSTRUMENTS. THE FINAL LOCATION OF INSTRUMENTS SHALL BE CONFIRMED ON SITE WITH THE ENGINEER AND THE CONTRACTOR SHALL TAKE ALL PRACTICAL MEASURES TO PROTECT ALL MONITORING INSTRUMENTS DURING ALL PHASES OF CONSTRUCTION (e.g. EARTHWORKS, WEATHER, TRAFFIC, OTHER CONSTRUCTION ACTIVITIES).
3. IN THE EVENT THAT THE INSTRUMENTS ARE DAMAGED THE ENGINEER SHALL BE IMMEDIATELY INFORMED AND, IF REQUIRED BY THE ENGINEER DEPENDING ON THE DEGREE OF DAMAGE, ALL CONSTRUCTION WORKS NEAR TO THE AFFECTED INSTRUMENTATION SHALL CEASE. THE DAMAGED INSTRUMENTS SHALL BE IMMEDIATELY REPLACED AND RE-BASELINED WITHIN 24 HOURS (UNLESS OTHERWISE AGREED WITH THE ENGINEER) AND WHERE CONSTRUCTION WORKS ARE HALTED, THEY SHALL NOT RESTART UNTIL THE REPLACEMENT INSTRUMENT IS FULLY OPERATIONAL.
4. THE MONITORING RESULTS SHALL BE PROVIDED TO THE ENGINEER ON A WEEKLY BASIS AND WILL REVIEW MONITORING RESULTS AND WILL CONFIRM THE END OF THE SETTLEMENT PERIOD.
5. MONITORING FREQUENCY MAY BE ALTERED AS ACCEPTED BY THE ENGINEER.
6. REFER TO 6103677-CE-STD-55 FOR SURVEY PINS TRIGGER LEVELS.
7. THE INSTALLATION AND MONITORING OF INSTRUMENTATION AND THE COLLATION OF DATA AND REVIEW OF RESULTS AGAINST THE TRIGGER LEVELS PROVIDED BY THE ENGINEER SHALL BE CARRIED OUT BY THE CONTRACTOR (OR SUITABLE PERSONNEL OR ORGANISATIONS NOMINATED BY THE CONTRACTOR WHO ARE EXPERIENCED AND COMPETENT IN SUCH WORK). ANY EXCEEDANCE OF THE TRIGGER LEVELS SHOULD BE REPORTED TO THE ENGINEER IMMEDIATELY
8. THE REQUIREMENTS OF INSTRUMENTATION AND MONITORING SPECIFICATION APPLY UNLESS OTHERWISE NOTED ON THESE DRAWINGS. FOR SPECIFICATION AND INSTRUMENTATION DETAILS REFER 6103677-CE-STD-55 TO 6103677-CE-STD-58.
9. FOR SURVEY PINS, CONTRACTOR SHALL SUPPLY THE X AND Y COORDINATES, AND Z LEVELS.

LEGEND:

- SETTLEMENT MONITORING PLATE
- SURVEY PINS
- SURVEY PINS (EXISTING BUILDING FOUNDATIONS OR RAILWAY EMBANKMENT)

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
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A	DETAILED DESIGN- FOR COMMENT	ES	CH	VH	20.07.23

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Reduced Scale (A3) 1:2000

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Dsg Verifier	D. ANSTISS	20.07.23
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Approved For Construction* Date
* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: MATAWALU BRIDGE GEOTECHNICAL INSTRUMENTATION AND MONITORING DETAILS
Discipline: CIVIL ENGINEERING
Drawing No.: 6103677-CE-B08-31
Rev.: B
Document No. 6103677-CE-B08-31.DWG

DO NOT SCALE FOR SET OUT DIMENSIONS

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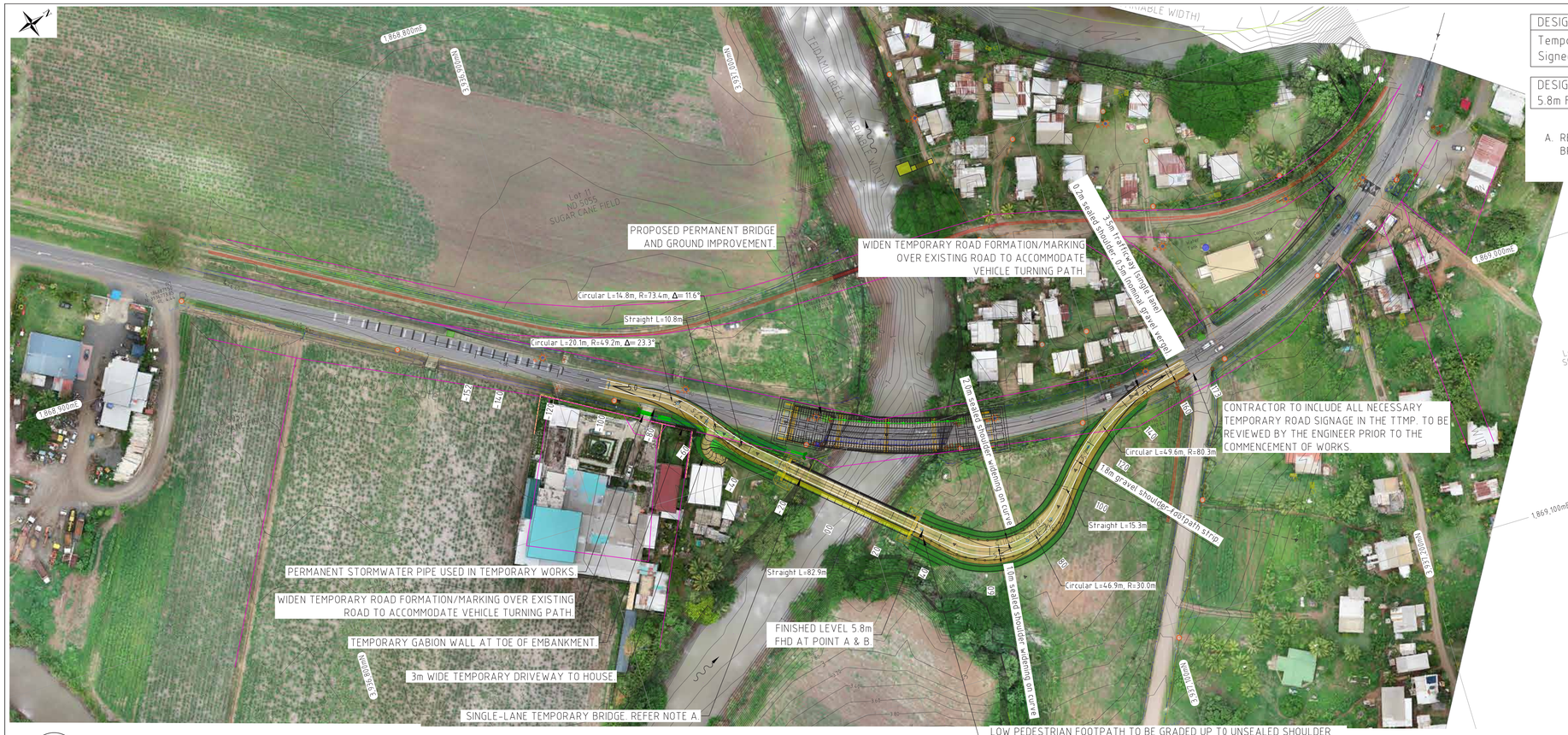


1 – TEMPORARY BRIDGE GENERAL ARRANGEMENT PLAN

SCALE 1:2000(A3)

DESIGN SPEED	
Temporary road	50km/h
Signed speed	30km/h

DESIGN MIN ROAD LEVEL OVER BRIDGE 5.8m FHD.

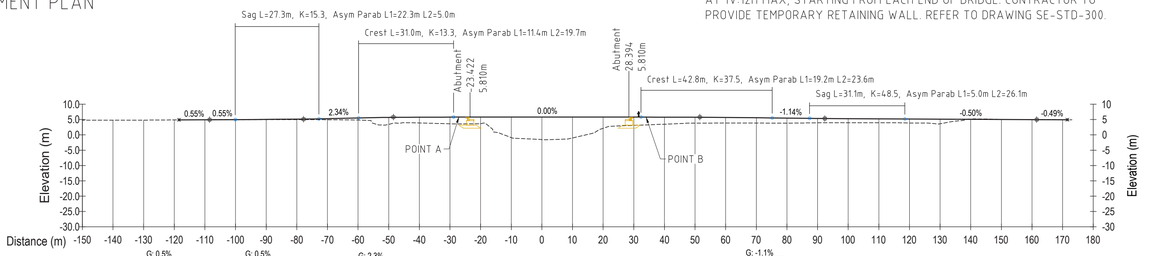
A. REFER TO DRAWING SE-B08-70 FOR TEMPORARY BRIDGE DETAILS.

NOTES:

1. REFER TO DRAWING CE-B08-10 FOR NOTES.
2. DIVERSION ROAD MINIMUM LANE WIDTHS AND SHOULDER WIDTHS TO BE AS SPECIFIED ON THIS DRAWING AND DRAWINGS CE-B08-42, 43 & 44.
3. DIVERSION ROAD ALIGNMENT IS INDICATIVE. DESIGN VEHICLE IS 19m LONG SEMI TRAILER. CONTRACTOR TO DESIGN DIVERSION ROAD TO ALLOW 19m LONG SEMI TRAILER AND AN 8.8m SINGLE UNIT TRUCK TO PASS ONE ANOTHER. DESIGN TO MAKE ALLOWANCE FOR TRACKING OF THE DESIGN VEHICLE PLUS A 0.5m BUFFER EACH SIDE, AND PROVISION OF LANE WIDENING WHERE REQUIRED. ALIGNMENT DESIGN AND TRACKING TO BE SUPPLIED TO THE ENGINEER FOR REVIEW PRIOR TO CONSTRUCTION.
4. THE DIVERSION ROAD SHALL BE WITHIN THE CONSTRUCTION ZONE SHOWN ON LAND ACQUISITION PLANS TO BE PROVIDED BY FRA AT THE TIME OF CONSTRUCTION.
5. DIVERSION ROAD PAVEMENT DESIGN IS CONTRACTOR'S RESPONSIBILITY. ROAD TO BE DESIGNED AS ALL WEATHER ROAD WITH CHIPSEAL SURFACE. DESIGN THICKNESS TO ALLOW FOR OVERLOADED VEHICLES AND PROTECTION OF THE SUBGRADE SOILS FROM BEARING AND/OR SHEAR FAILURE.
6. THE CONTRACTOR SHALL MAINTAIN THE DIVERSION ROAD KEEPING IT IN GOOD SAFE CONDITION, SURFACE RUT DEPTHS NOT TO EXCEED 20mm, FREE OF POT HOLES AND DEFECTS, ETC FOR THE DURATION OF ITS USE.
7. THE CONTRACTOR SHALL PROVIDE A STORMWATER DRAINAGE DESIGN FOR THE DIVERSION ROAD, TO BE REVIEWED BY THE ENGINEER PRIOR TO COMMENCEMENT OF WORKS.

LEGEND EXISTING:

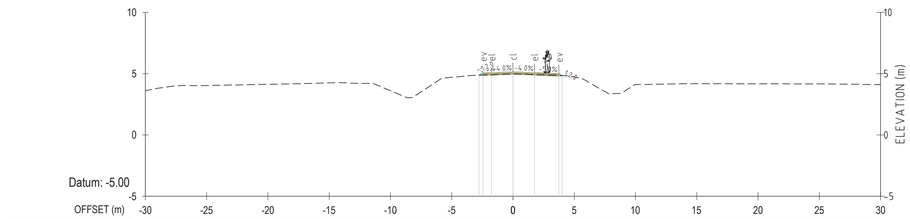
CADASTRAL BOUNDARY
FLOW DIRECTION



| | | |

NOTES:

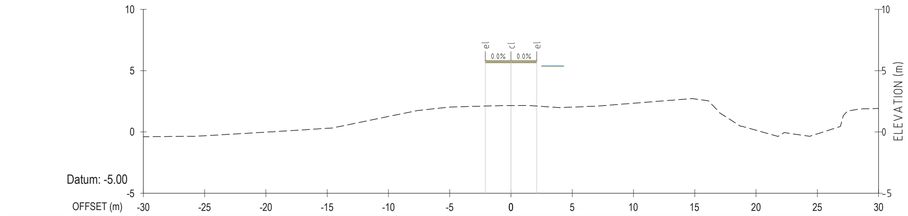
1. THIS DRAWING IS PART OF THE DETAILED DESIGN REPORT, AND SHOULD BE READ IN CONJUNCTION WITH THE REPORT.
2. REFER TO DRAWING CE-B08T-30 FOR NOTES.



| | | |

NOTES:

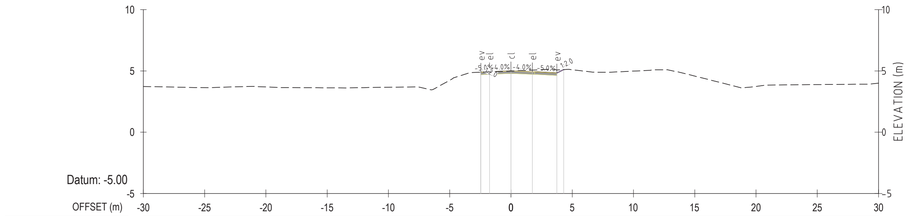
1. THIS DRAWING IS PART OF THE DETAILED DESIGN REPORT, AND SHOULD BE READ IN CONJUNCTION WITH THE REPORT.
2. REFER TO DRAWING CE-B08T-30 FOR NOTES.



| | | |

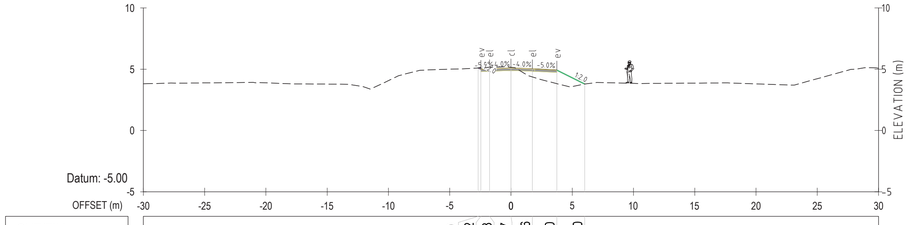
NOTES:

1. THIS DRAWING IS PART OF THE DETAILED DESIGN REPORT, AND SHOULD BE READ IN CONJUNCTION WITH THE REPORT.
2. REFER TO DRAWING CE-B08T-30 FOR NOTES.



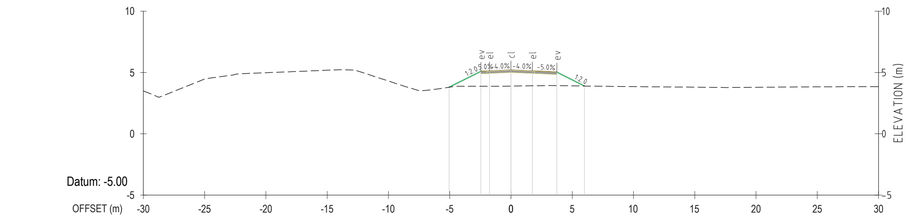
CUT/FILL					0.00	0.00	0.00	0.01	-0.14	-0.25	0.00			
DESIGN LEVELS					4.89	4.89	4.93	5.00	4.93	4.83	5.11			
EXISTING LEVELS					4.89	4.90	4.92	4.99	5.07	5.08	5.11			
OFFSETS					-2.46	-2.46	-1.75	0.00	1.75	3.74	4.30			

DIST: 160.00m



CUT/FILL					0.00	-0.12	-0.13	-0.07	0.66	1.10	0.00			
DESIGN LEVELS					5.10	4.99	5.03	5.10	5.03	4.93	3.79			
EXISTING LEVELS					5.10	5.11	5.15	5.16	4.37	3.83	3.79			
OFFSETS					-2.68	-2.46	-1.75	0.00	1.75	3.74	6.02			

DIST: 140.00m



CUT/FILL					0.00	1.22	1.25	1.31	1.21	1.10	0.00			
DESIGN LEVELS					3.80	5.09	5.13	5.20	5.13	5.03	3.90			
EXISTING LEVELS					3.80	3.88	3.88	3.89	3.92	3.93	3.90			
OFFSETS					-5.05	-2.46	-1.75	0.00	1.75	3.74	6.00			

DIST: 120.00m

LEGEND:

CADASTRAL BOUNDARY

SCALE 1:500(A3):

0 5 10 15 20

FOR CLARITY OF DETAILS VIEW ELECTRONICALLY

DETAILED DESIGN NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN - FOR FRA REVIEW.	RAI	TE	CH	31/01/24
B	DETAILED DESIGN - FOR COMMENT.	RAI	TE	CH	20/07/23
A	FOR FRA REVIEW.	RAI	TE	CH	14/03/23

Original Scale (A1) 1:250
Reduced Scale (A3) 1:500

Design	R Imrie	31/01/24	Approved For Construction×
Drawn	R Imrie	31/01/24	
Dsg Verifier	C Hatley	31/01/24	
Drg Check	C Hatley	31/01/24	Date

× Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: MATAWALU BRIDGE TEMPORARY BRIDGE ROAD CROSS SECTIONS SHEET 3

Discipline

Drawing No. 6103677-CE-B08T-44

Rev. C

Document No. PRE.FEAS.11.A.1.P15.DWG

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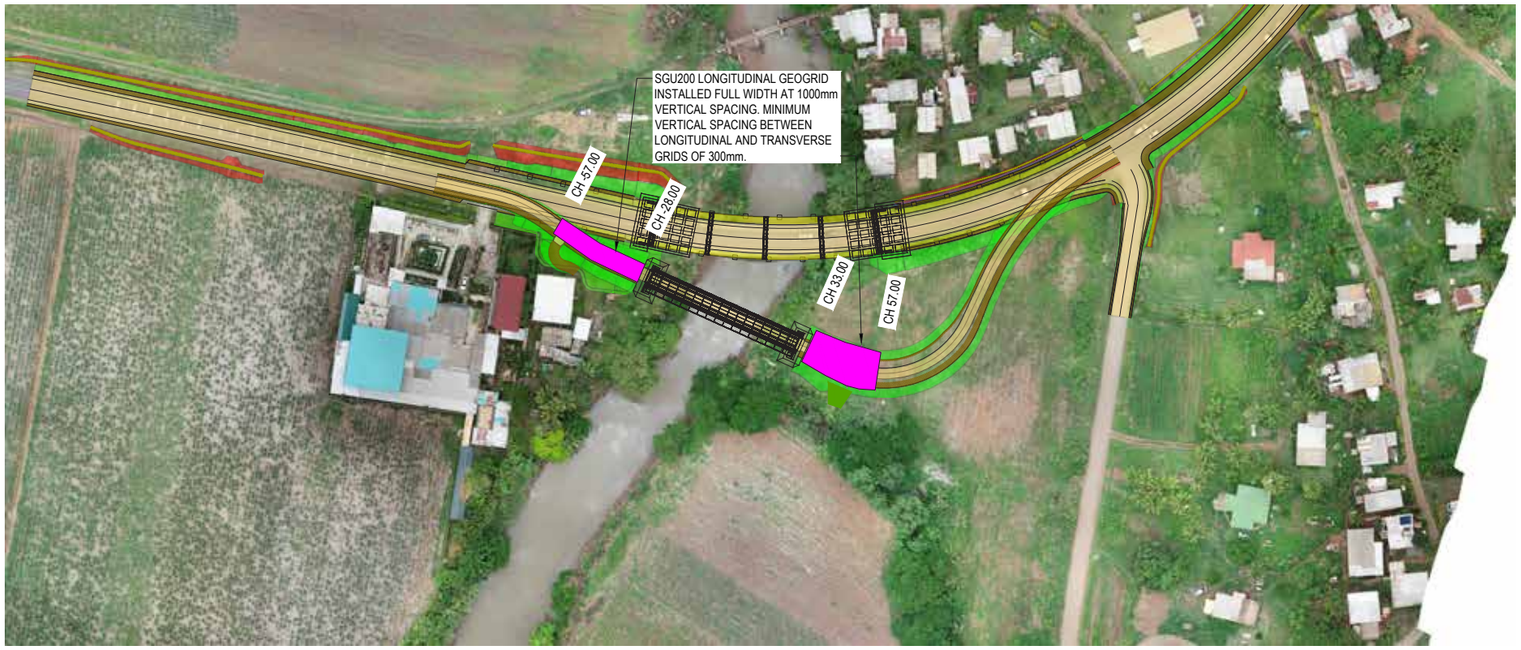

TEMPORARY BRIDGE EMBANKMENT DETAILS

SCALE 1:1000 (A1) 1:2000 (A3)

TEMPORARY BRIDGE ABUTMENT AND EMBANKMENT GEOGRID REINFORCING DETAILS

LOCATION	NUMBER OF ROWS	CENTER TO CENTER SPACING	MINIMUM LENGTH (INTO EMBANKMENT)	GEOGRID TYPE
BA APPROACH RAMP (LONGITUDINAL)	3	1.0m	25m	SGU200
LAUTOKA APPROACH RAMP (LONGITUDINAL)	3	1.0m	30m	

NOTES:

1. GENERAL

1.1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING, PROTECTING AND/OR RELOCATING ANY UTILITIES AND DRAINAGE PRIOR TO WORKS COMMENCING.

1.2. ALL CONSTRUCTION WORKS SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE PROJECT EARTHWORKS SPECIFICATION.

1.3. EXISTING SWALE DRAINS ARE TO BE CLEARED OF VEGETATION AND UNSUITABLE SOILS AND BACKFILLED AS PER DETAIL A ON 6103677-CE-STD-53.

1.4. ANY SIGNIFICANT VARIANCES IN GROUND CONDITIONS FROM THOSE PRESENTED IN THESE DRAWINGS MUST BE BROUGHT TO THE ATTENTION OF THE ENGINEER.

1.5. SUBGRADE IMPROVEMENTS AND PAVEMENT LAYER NOT SHOWN ON DRAWINGS FOR CLARITY.

1.6. IN ORDER TO MINIMIZE THE POTENTIAL FOR INSTABILITY OF PERMANENT WORKS ELEMENTS, THE POSITION OF ANY TEMPORARY STOCKPILES SHALL BE AGREED WITH THE ENGINEER.

2. EMBANKMENT

2.1. TEMPORARY CROSSING EMBANKMENT DESIGN IS THE CONTRACTOR'S RESPONSIBILITY. THIS INCLUDES EMBANKMENT TRANSVERSE BATTER SLOPES AND GEOGRID REINFORCING REQUIREMENTS. 2(H):1(V) BATTER SLOPES ARE SHOWN INDICATIVELY AND HAVE BEEN USED FOR ASSESSMENT OF SETTLEMENTS AND STABILITY ANALYSES OF THE BRIDGE ABUTMENTS.

2.2. PRIOR TO FILLING, TOPSOIL AND UNSUITABLE SOILS (INCLUDING HIGHLY ORGANIC SOILS OR SILT, TOXIC MATERIALS, PEAT LOGS, STUMPS, PERISHABLE OR ORGANIC MATERIALS, CONTAMINATED SOILS) SHALL BE EXCAVATED AND REMOVED.

2.3. WHERE MATERIAL IS ENCOUNTERED THAT DOES NOT MEET THE STRENGTH REQUIRED IN THE PROJECT EARTHWORKS SPECIFICATION, THE CONTRACTOR SHALL DETERMINE THE EXTENTS AND STRENGTH OF MATERIAL LESS THAN THIS REQUIREMENT FOR FURTHER UNDERCUTTING OR TREATMENT.

2.4. THE CONTRACTOR SHALL EVALUATE, DURING CONSTRUCTION, THE SAFE TEMPORARY BATTER ANGLE FOR ANY EXCAVATION OR FILLING.

2.5. THE MATERIALS AT FORMATION LEVEL SHOULD BE PROTECTED FROM SOFTENING, OVERLOADING (e.g. FROM CONSTRUCTION TRAFFIC) OR OTHER CONDITIONS WHICH MAY RESULT IN WEAKENING OF THESE MATERIALS.

2.6. POSITIVE DRAINAGE OF ALL EXCAVATION WORKS MUST BE MAINTAINED DURING CONSTRUCTION.

2.7. HOLD: ALL AREAS OF EXPOSED EMBANKMENT SUBGRADE ARE TO BE INSPECTED BY THE ENGINEER TO CONFIRM UNSUITABLE SOILS HAVE BEEN REMOVED. REFER TO THE PROJECT EARTHWORKS SPECIFICATION FOR SUBGRADE REQUIREMENTS. QUALITY ASSURANCE DOCUMENTATION TO RECORD INSPECTION AND ACCEPTANCE.

2.8. ALL FILL MATERIALS SHALL MEET THE GRADING, COMPACTION AND TESTING REQUIREMENTS SPECIFIED IN THE PROJECT EARTHWORKS

2.9. EMBANKMENT FILL MATERIALS TO BE OVERFILLED TO ACCOUNT FOR SETTLEMENT, LATER TRIMMED TO DESIGN PAVEMENT SUBGRADE LEVEL.

3. GEOGRID AND BASAL GEOTEXTILE

3.1. REFER TO THE DRAWINGS AND PROJECT EARTHWORKS SPECIFICATION FOR ALL GEOTEXTILE AND GEOGRID REQUIREMENTS.

3.2. LONGITUDINAL GEOGRID, WHERE SPECIFIED, IS LAID WITH THE PRIMARY STRENGTH DIRECTION ORIENTATED ALONG THE ROAD CENTRELINE.

3.3. TRANSVERSE GEOGRID, WHERE SPECIFIED, IS LAID WITH THE PRIMARY STRENGTH DIRECTION ORIENTATED PERPENDICULAR TO THE ROAD CENTRELINE.

3.4. BASAL HIGH STRENGTH GEOTEXTILES, WHERE SPECIFIED, IS WITH THE PRIMARY STRENGTH DIRECTION ORIENTATED PERPENDICULAR TO THE ROAD CENTRELINE UNLESS SPECIFICALLY SPECIFIED OTHERWISE ON THE DRAWINGS.

3.5. HIGH STRENGTH GEOTEXTILES AND GEOGRIDS ARE TO BE CONTINUOUS IN THEIR PRIMARY STRENGTH DIRECTION AND NOT LAPPED.

3.6. WHERE THE HIGH STRENGTH GEOTEXTILES AND / OR GEOGRID LAYERS EXTEND INTO THE EXISTING GROUND SURFACE, TEMPORARY EXCAVATION WILL BE REQUIRED.

3.7. ALL HIGH STRENGTH GEOTEXTILE AND GEOGRID LAYERS ARE TO BE LAID OUT OVER THER FULL LENGTH AND COVERED AS A SINGLE OPERATION UNLESS AGREED OTHERWISE WITH THE ENGINEER. HIGH STRENGTH GEOTEXTILE AND GEOGRID LAYERS ARE TO BE COVERED WITHIN 3 DAYS OF PLACING.

3.8. NO TRAFFIC OR SITE PLANT SHALL BE PERMITTED TO TRAVEL ON THE GEOGRID OR HIGH STRENGTH GEOTEXTILE LAYERS WHERE THE FILL COVER IS LESS THAN 200mm.

3.9. GEOGRID WITHIN FILL EMBANKMENTS (EXCLUDING RETAINING STRUCTURES) SHALL BE PLACED WITH A VERTICAL SPACING OF 500mm BETWEEN LAYERS UNLESS SPECIFICALLY SPECIFIED OTHERWISE ON THE DRAWINGS.

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FOR CLARITY OF DETAILS
VIEW ELECTRONICALLY

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
A	DETAILED DESIGN FOR FRA REVIEW	MA	DA	CH	31.01.24

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	D. ASPIN	31.01.24	Approved For Construction*
Drawn	M.ANONUEVO	31.01.24	
Dsg Verifier	D. ANSTISS	31.01.24	
Drg Check	D. ASPIN	31.01.24	Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: MATAWALU BRIDGE TEMPORARY BRIDGE EMBANKMENT DETAILS

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B08-45

Rev.: A

Document No. 6103677-CE-B08-45.DWG

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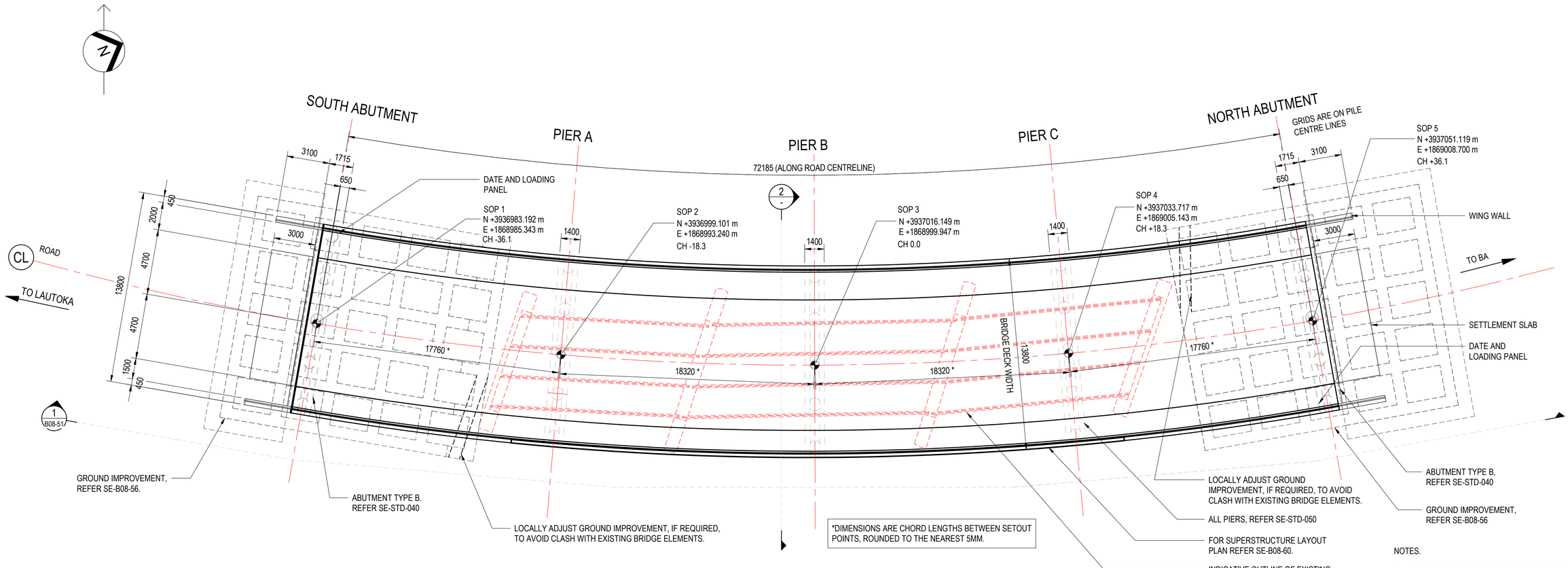
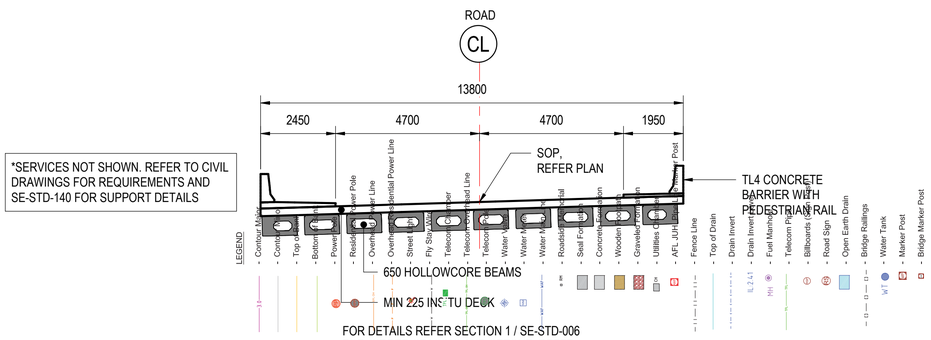


A BRIDGE PLAN
1 : 150

NOTES.

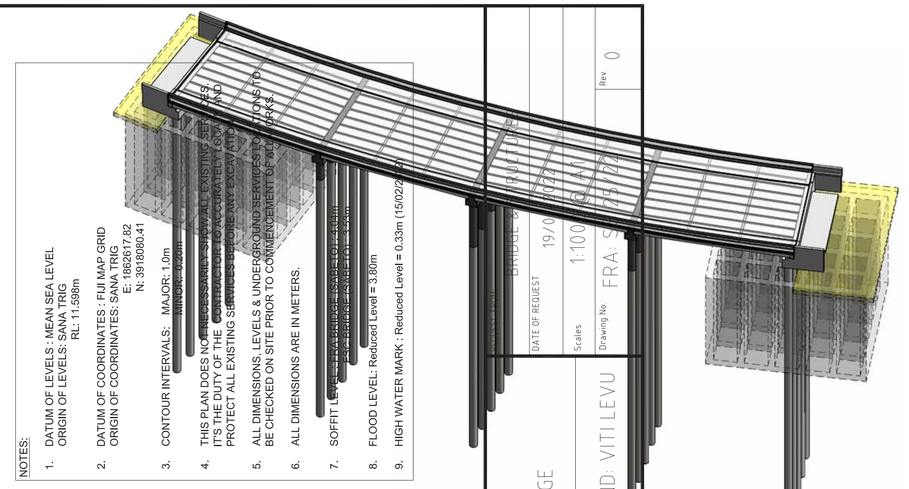
1. FOR SITE LAYOUT, FEATURES, AND ROAD CORRIDOR DETAILS REFER TO 6103677-CE-B08-10, ROADING PLAN AND PROFILE, AND THE RELATED CIVIL DRAWINGS.
2. VERTICAL HEIGHT DATUM IS FIJI HEIGHT DATUM. FOR DETAILS REFER TO FRA'S TOPOGRAPHICAL SURVEY DRAWING SS 100/21.
3. THE OUTLINE OF EXISTING BRIDGE IS AS PER FRA'S TOPOGRAPHICAL SURVEY DRAWING SS 100/21. THE CONTRACTOR SHALL CONFIRM POSITION OF THE BRIDGE PRIOR TO THE CONSTRUCTION.
4. REFER TO PROJECT SPECIFICATION FOR EXISTING BRIDGE DEMOLITION REQUIREMENTS.
5. THESE BRIDGE SPECIFIC DRAWINGS SHALL BE READ TOGETHER WITH AND REFER TO STANDARD DRAWINGS, SPECIFICALLY:
   - 6103677-SE-STD-001 T0 004 FOR GENERAL NOTES
   - 6103677-SE-STD-010 SERIES FOR GROUND IMPROVEMENT DETAILS
   - 6103677-SE-STD-020 SERIES FOR PILE DETAILS
   - 6103677-SE-STD-040 SERIES FOR ABUTMENT TYPE B DETAILS
   - 6103677-SE-STD-050 SERIES FOR PIER DETAILS
   - 6103677-SE-STD-060 SERIES FOR SUPERSTRUCTURE DETAILS
   - 6103677-SE-STD-070 SERIES FOR PRECAST PRESTRESSED SHC BEAM DETAILS
   - 6103677-SE-STD-100 SERIES FOR DECK DETAILS
   - 6103677-SE-STD-110 SERIES FOR BARRIER DETAILS
   - 6103677-SE-STD-140 FOR SERVICE SUPPORT DETAILS
   - 6103677-SE-STD-180 FOR STANDARD BRIDGE ANTICIPATED CONSTRUCTION SEQUENCE.
   - 6103677-SE-STD-300 SERIES FOR TEMPORARY BRIDGE DETAILS.
6. FOR FINISHED DESIGN LEVELS REFER TO DRAWING CE-B08-10 & SE-B08-51



*SERVICES NOT SHOWN. REFER TO CIVIL DRAWINGS FOR REQUIREMENTS AND SE-STD-140 FOR SUPPORT DETAILS

FOR DETAILS REFER SECTION 1 / SE-STD-006 FOR GIRDER SPACING AND SETOUT, REFER TO DRAWING SE-B08-60.

2 SECTION
LEVEL ND 1 : 150



NOTES:
1. DATUM OF LEVELS : MEAN SEA LEVEL
   ORIGIN OF LEVELS: SANA TRIG
   RL: 11.598m
2. DATUM OF COORDINATES : FIJI MAP GRID
   ORIGIN OF COORDINATES: SANA TRIG
   E: 1862617.82
   N: 3918080.41
3. CONTOUR INTERVALS: MAJOR: 1.0m
   MINOR: 0.20m
4. THIS PLAN DOES NOT PURPORT TO SHOW ALL EXISTING SERVICES AND IT IS THE DUTY OF THE CONTRACTOR TO LOCATE AND PROTECT ALL EXISTING SERVICES BEFORE COMMENCING EXCAVATIONS OR OTHER WORKS.
5. ALL DIMENSIONS, LEVELS & UNDERGROUND SERVICES TO BE CHECKED ON SITE PRIOR TO COMMENCEMENT OF ALL WORKS.
6. ALL DIMENSIONS ARE IN METERS.
7. SOFFIT LEVEL : Reduced Level = 4.13m
8. FLOOD LEVEL: Reduced Level = 3.80m
9. HIGH WATER MARK : Reduced Level = 0.33m (15/02/2012)

3D VIEW - B08 MATAWALU BRIDGE

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.		By	Chk		Date
C	DETAILED DESIGN, FOR FRA COMMENT	RS	AS	TP	18.01.24
B	DETAILED DESIGN, FOR FRA COMMENT	TZ	AS	TP	21.07.23
A	FOR FRA REVIEW	MM	NK		10.03.23

Original Scale (A1) As indicated
Reduced Scale (A3)

Design	A. SMITH	12.2023
Drawn	R. SATTAYAPORN	12.2023
Dsg Verifier	T. POLLEY	12.2023
Drg Check	T. POLLEY	12.2023

Sub-consultant: Erasito
Main-consultant: beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: B08 MATAWALU BRIDGE - BRIDGE PLAN
Discipline: STRUCTURAL
Drawing No.: 6103677-SE-B08-50
Rev.: C

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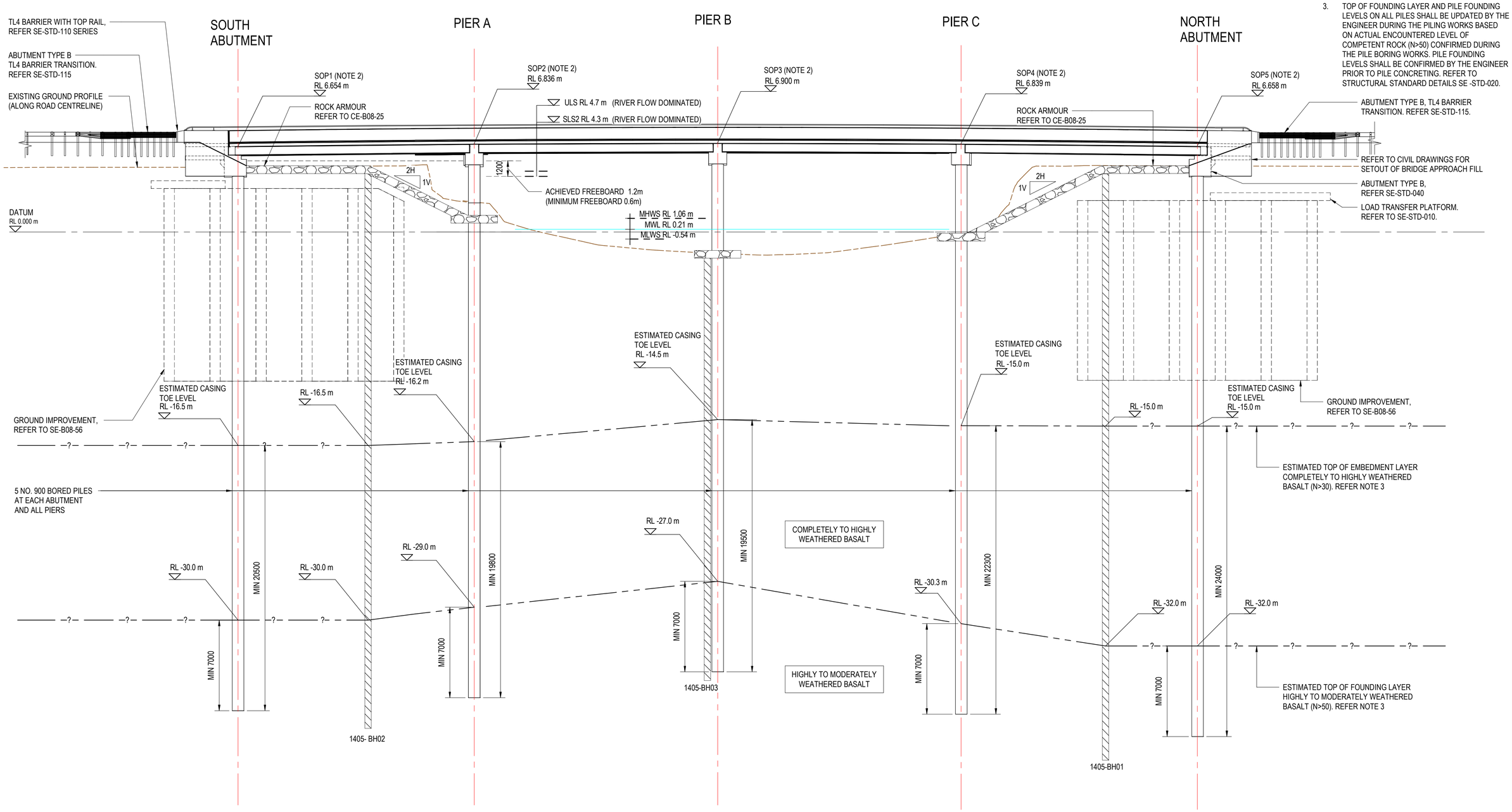
Document No. Autodesk Docs://6450911 - FRA 40+3/6103677-B08-SE-2023.rvt

NOTES.

1. REFER TO 6103677-SE-B08-50 FOR NOTES.
2. REFER TO SE-B08-50 FOR SETOUT POINTS LOCATION IN PLAN VIEW. LEVELS ARE GIVEN AT THE TOP OF DECK AT INTERSECTION WITH ROAD CENTRELINE, REFER TO SE-B08-50 SECTION 2 FOR LOCATION.
3. TOP OF FOUNDING LAYER AND PILE FOUNDING LEVELS ON ALL PILES SHALL BE UPDATED BY THE ENGINEER DURING THE PILING WORKS BASED ON ACTUAL ENCOUNTERED LEVEL OF COMPETENT ROCK (N>50) CONFIRMED DURING THE PILE BORING WORKS. PILE FOUNDING LEVELS SHALL BE CONFIRMED BY THE ENGINEER PRIOR TO PILE CONCRETING. REFER TO STRUCTURAL STANDARD DETAILS SE -STD-020.



1 / B08-50 ELEVATION
1 : 150

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN, FOR FRA COMMENT	RS	AS	TP	18.01.24
B	DETAILED DESIGN, FOR FRA COMMENT	TZ	AS	TP	21.07.23
A	FOR FRA REVIEW	MM	NK	TP	10.03.23

Original Scale (A1) 1 : 150
Reduced Scale (A3)

Design	N.KHURANA	12.2023
Drawn	R. SATTAYAPORN	12.2023
Dsg Verifier	T. POLLEY	12.2023
Drg Check	T. POLLEY	12.2023

Sub-consultant: Erasito
Main-consultant: beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: B08 MATAWALU BRIDGE - BRIDGE ELEVATION
Discipline: STRUCTURAL
Drawing No.: 6103677-SE-B08-51
Rev.: C

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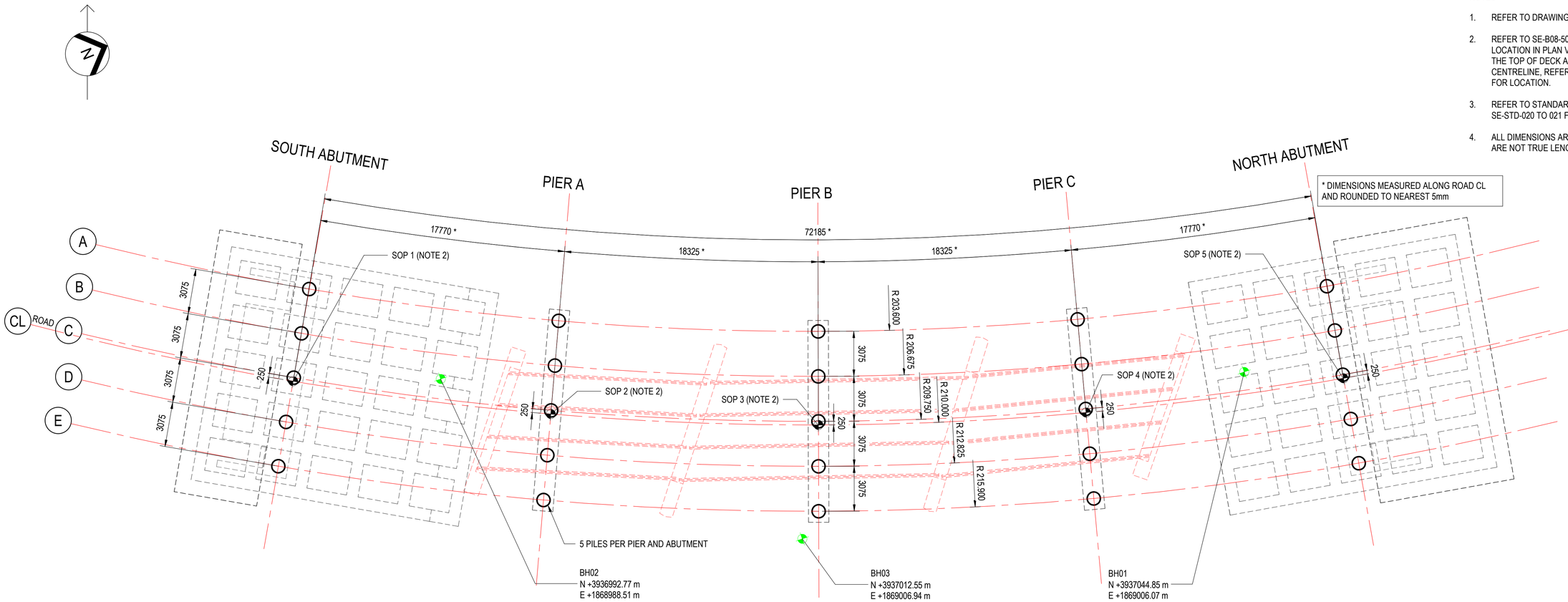
Document No. Autodesk Docs://6450911 - FRA 40+3/6103677-B08-SE-2023.rvt

NOTES

1. REFER TO DRAWING SE-B08-050 FOR NOTES.
2. REFER TO SE-B08-50 FOR SETOUT POINTS LOCATION IN PLAN VIEW. LEVELS ARE GIVEN AT THE TOP OF DECK AT INTERSECTION WITH ROAD CENTRELINE, REFER TO SE-B08-50 SECTION 2 FOR LOCATION.
3. REFER TO STANDARD PILING DRAWINGS SE-STD-020 TO 021 FOR DETAILS.
4. ALL DIMENSIONS ARE PLAN DIMENSIONS AND ARE NOT TRUE LENGTH



NOTE : ABUTMENT AND PIER PILES ARE RADIAL TO ALIGNMENT CENTRELINE

1 / B08-51 PILING PLAN
1 : 150

PILE REINFORCING INFORMATION

	LONGITUDINAL BARS				SPIRALS									
LOCATION	LENGTH "Y"	GROUP 1	GROUP 2	PHZs*	SPIRAL TYPE A	DIST "A"	SPIRAL TYPE B	DIST "B"	SPIRAL TYPE C	DIST "C"	SPIRAL TYPE D	DIST "D"	SPIRAL TYPE E	DIST "E"
SOUTH ABUTMENT	30000	20RB32 (IN 10 EQUALLY SPACED PAIRS)	10DH32	0m - 6.0m & 9.0 -18.0m	RH16-300	18500	RH16 -110	6000	RH16-220	6000	RH16 -300	REMAINING LENGTH	-	-
PIERS	30000	16RB32 (IN 8 EQUALLY SPACED PAIRS)	8DH32	0m - 2.5m & 9.0m - 19.0m	RH16-90	2500	RH16 -120	7000	RH16-300	9000	RH16 -120	6500	RH16-300	REMAINING LENGTH
NORTH ABUTMENT	30000	20RB32 (IN 10 EQUALLY SPACED PAIRS)	10DH32	0m - 6.0m & 9.0 -18.0m	RH16-300	18500	RH16 -110	6000	RH16-220	6000	RH16 -300	REMAINING LENGTH	-	-

* NO LAPPING OF LONGITUDINAL REINFORCEMENT IS ALLOWED IN PLASTIC HINGE ZONES (PHZs)
REFER TO BORED PILE DRAWING SE-STD-021 FOR REINFORCING CALLOUT

BEWARE:

THE CONTRACTOR SHALL CONFIRM THAT THERE IS NO CONFLICT WITH UNDERGROUND SERVICES (EXISTING, NEWLY INSTALLED AND / OR TEMPORARY) AND / OR IMPLEMENT APPROPRIATE PROTECTION MEASURES PRIOR TO CARRYING OUT ANY PILE INSTALLATION OR EXCAVATION WORKS.

LEGEND:

- DESIGN INVESTIGATION BORE LOCATION (FOR INFORMATION)
- SOP (REFER SE-B08-50)

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN, FOR FRA COMMENT	RS	AS	TP	18.01.24
A	DETAILED DESIGN, FOR FRA COMMENT	TZ	AS	TP	21.07.23

Original Scale (A1) 1 : 150
Reduced Scale (A3)

Design	A. SMITH	12.2023
Drawn	R. SATTAYAPORN	12.2023
Dsg Verifier	T. POLLEY	12.2023
Drg Check	T. POLLEY	12.2023

Sub-consultant: Erasito
Main-consultant: Beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: B08 MATAWALU BRIDGE - PILING PLAN
Discipline: STRUCTURAL
Drawing No.: 6103677-SE-B08-55
Rev.: B

DO NOT SCALE FOR SET OUT DIMENSIONS

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Document No. Autodesk Docs://6450911 - FRA-40-3/6103677-B08-SE-2023.rvt

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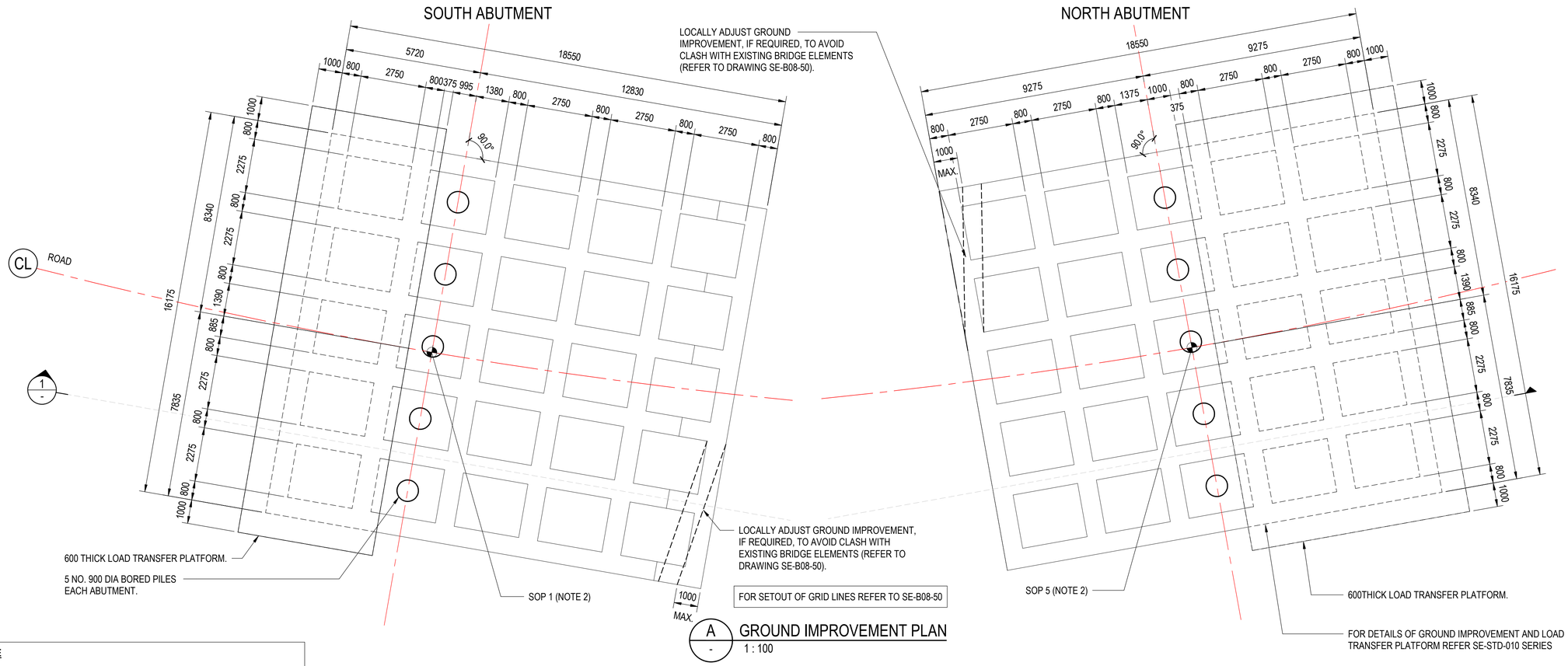


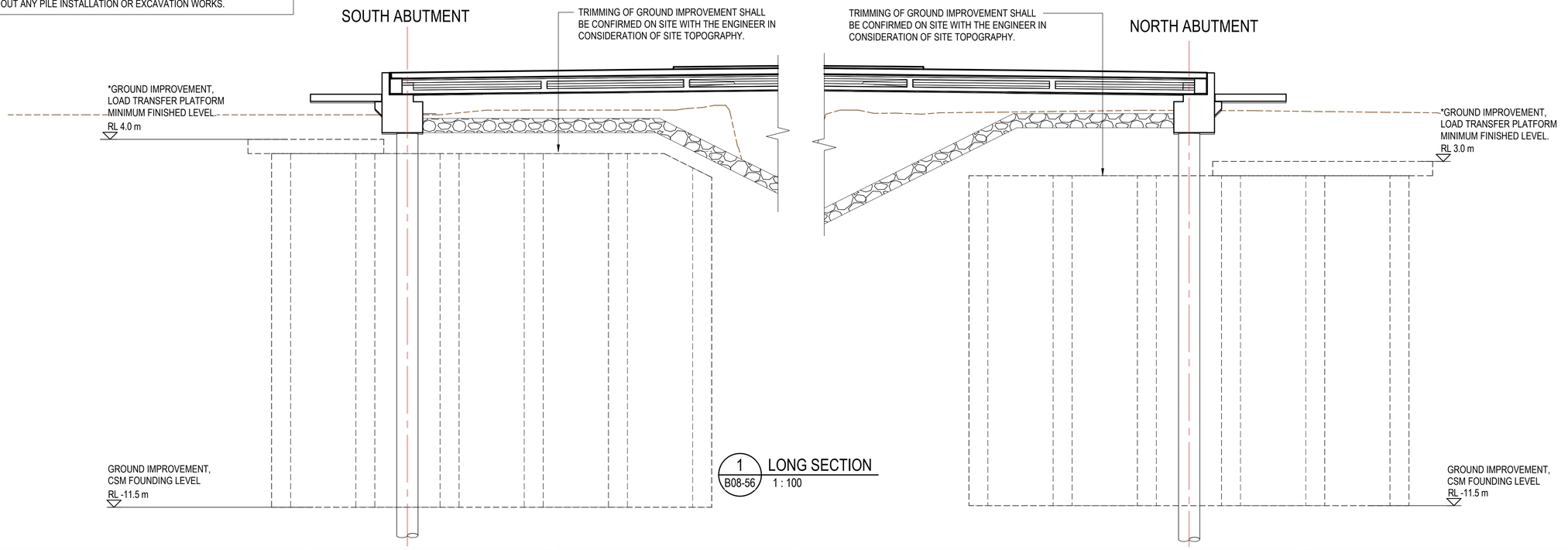
A - GROUND IMPROVEMENT PLAN
1 : 100

NOTES:

1. REFER TO DRAWING SE-B08-50 FOR NOTES.
2. REFER TO SE-B08-50 FOR SETOUT POINTS LOCATION IN PLAN VIEW. LEVELS ARE GIVEN AT THE TOP OF DECK AT INTERSECTION WITH ROAD CENTRELINE, REFER TO SE-B08-50 SECTION 2 FOR LOCATION.
3. CSM NOTES:
   a. CSM PANELS TO BE CONSTRUCTED WITH THE FOLLOWING SPECIFICATION:
      - MIN.SHEAR STIFFNESS OF 1250MPa
      - MIN. YOUNG'S MODULUS OF 3000MPa
      - MIN. AREA REPLACEMENT RATIO: 30%
   b. CSM TO BE CONSTRUCTED IN ACCORDANCE WITH SPECIFICATION C0414.
   c. CONTRACTOR TO CONSIDER THE CONSTRAINTS OF THE EXISTING BRIDGE, TEMPORARY ACCESS ROADS, SITE BOUNDARIES, AND WATERWAY DURING CONSTRUCTION OF THE GROUND IMPROVEMENT.
4. REFER TO THE PROJECT EARTHWORKS SPECIFICATION FOR FORMATION LEVEL TESTING REQUIREMENTS. THE CONTRACTOR SHALL DETERMINE THE EXTENTS OF MATERIAL WITH STRENGTH LESS THAN THIS REQUIREMENT FOR FURTHER UNDERCUTTING OR TREATMENT.
5. GROUND IMPROVEMENT SHALL BE CONSTRUCTED IN A SEQUENCE SO THAT ANY TEMPORARY RETAINING WALL IS NOT UNDERMINED OR MADE UNSTABLE.

BEWARE

THE CONTRACTOR SHALL CONFIRM THAT THERE IS NO CONFLICT WITH UNDERGROUND SERVICES (EXISTING, NEWLY INSTALLED AND / OR TEMPORARY) AND/OR IMPLEMENT APPROPRIATE PROTECTION MEASURES PRIOR TO CARRYING OUT ANY PILE INSTALLATION OR EXCAVATION WORKS.



1 / B08-56 - LONG SECTION
1 : 100

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN, FOR FRA COMMENT	RS	AS	TP	18.01.24
A	DETAILED DESIGN, FOR FRA COMMENT	TZ	AS	TP	21.07.23

Original Scale (A1)	1 : 100	
Reduced Scale (A3)		
Design	A. SMITH	12.2023
Drawn	R. SATTAYAPORN	12.2023
Dsg Verifier	T. POLLEY	12.2023
Drg Check	T. POLLEY	12.2023

Sub-consultant: Erasito
Main-consultant: Beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: B08 MATAWALU BRIDGE - GROUND IMPROVEMENT
Discipline: STRUCTURAL
Drawing No.: 6103677-SE-B08-56
Rev.: B

Document No. Autodesk Docs://6450911 - FRA-40-3/6103677-B08-SE-2023.rvt

DO NOT SCALE FOR SET OUT DIMENSIONS

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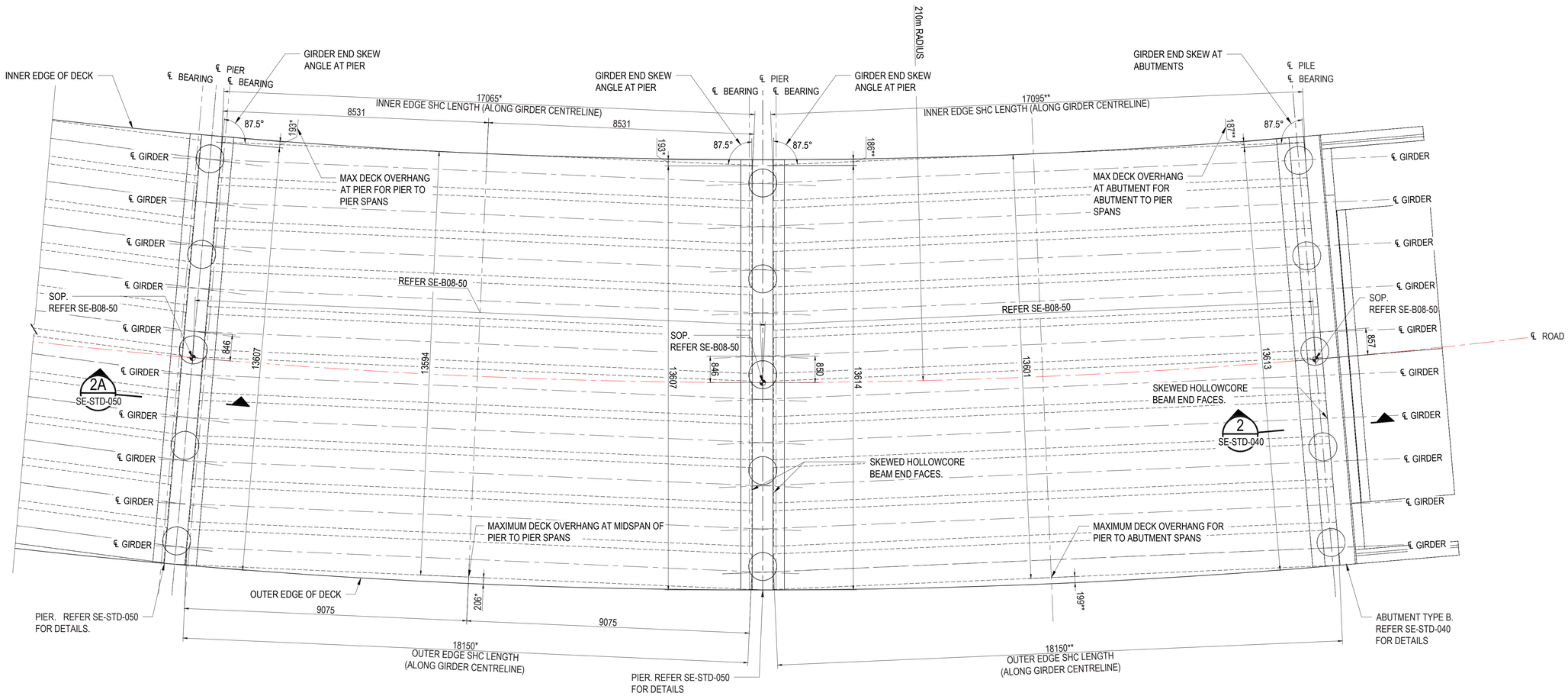
NOTES:

1. FOR GENERAL NOTES, REFER TO DRG 6103677-SE-B08-50.
2. FOR SUPERSTRUCTURE NOTES, REFER TO DRG 6103677-SE-STD-060.
3. DIMENSIONS ARE TAKEN SQUARE TO THE ALIGNMENT AT PIER AND ABUTMENT CENTRELINES, NOTING THAT PIERS AND ABUTMENTS ARE ORIENTATED PERPENDICULAR TO THE CURVED ALIGNMENT AS SHOWN BY DETAIL D/SE-STD-065.
4. ALL DIMENSIONS ARE PLAN DIMENSIONS AND ARE NOT TRUE LENGTH.



*FOR PIER TO PIER SPANS, GIRDERS ARE SETOUT BASED ON THEIR PROJECTED LOCATION AT PIER CENTRELINE, SUCH THAT:
- THERE IS ZERO DECK OVERHANG BEYOND THE PROJECTED OUTSIDE EDGE OF THE OUTER SHC GIRDER AT THE PIER CENTRELINE, AND MAXIMUM OVERHANG AT MIDSPAN
- THERE IS ZERO DECK OVERHANG BEYOND THE EDGE OF THE INNER SHC AT MIDSPAN, AND MAXIMUM OVERHANG AT ITS PROJECTED PIER CENTRELINE LOCATION.
- GIRDERS ARE SPACED EVENLY BETWEEN THESE POINTS

**FOR PIER TO ABUTMENT SPANS, GIRDERS ARE SETOUT BASED ON THEIR PROJECTED LOCATION AT PIER CENTRELINE AND THEIR END FACE AT THE ABUTMENT (WHICH OVERHANGS ABUTMENT CENTRELINE), SUCH THAT:
- THERE IS ZERO DECK OVERHANG OF THE OUTER SHC GIRDER AT ITS ABUTMENT END AND ITS PROJECTED EDGE AT PIER CENTRELINE. THE OVERHANG IS MAXIMUM AT APPROXIMATELY MIDSPAN.
- THERE IS ZERO DECK OVERHANG BEYOND THE EDGE OF THE INNER SHC AT APPROXIMATELY MIDSPAN, AND MAXIMUM OVERHANG AT THE GIRDER ABUTMENT END FACE AND ITS PROJECTED PIER CENTRELINE LOCATION
- GIRDERS ARE SPACED EVENLY BETWEEN THESE POINTS

A - B08 MATAWALU - SUPERSTRUCTURE LAYOUT PLAN

SCALE 1:75

SUPERSTRUCTURE LAYOUT PLAN IS SYMMETRICAL ABOUT CENTRAL PIER

ALL DIMENSIONS ARE PLAN DIMENSIONS. SHC GIRDER LENGTHS ARE ROUNDED TO THE NEAREST 5mm. ALSO REFER TO NOTE 12.3 ON STANDARD DRAWING SE-STD-070.

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
A	DETAILED DESIGN, FOR FRA COMMENT	SP	NK	TP	26.01.24

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	N. KHURANA	12.23	Approved For Construction*
Drawn	S. PHOLPAKA	12.23	
Dsg Verifier	T. POLLEY	12.23	
Drg Check	D. CVITANICH	12.23	Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: B08 MATAWALU BRIDGE BRIDGE SUPERSTRUCTURE LAYOUT PLAN

Discipline: STRUCTURAL

Drawing No.: 6103677-SE-B08-60

Rev.: A

Document No. 6103677-SE-B08-60.DWG

DO NOT SCALE FOR SET OUT DIMENSIONS

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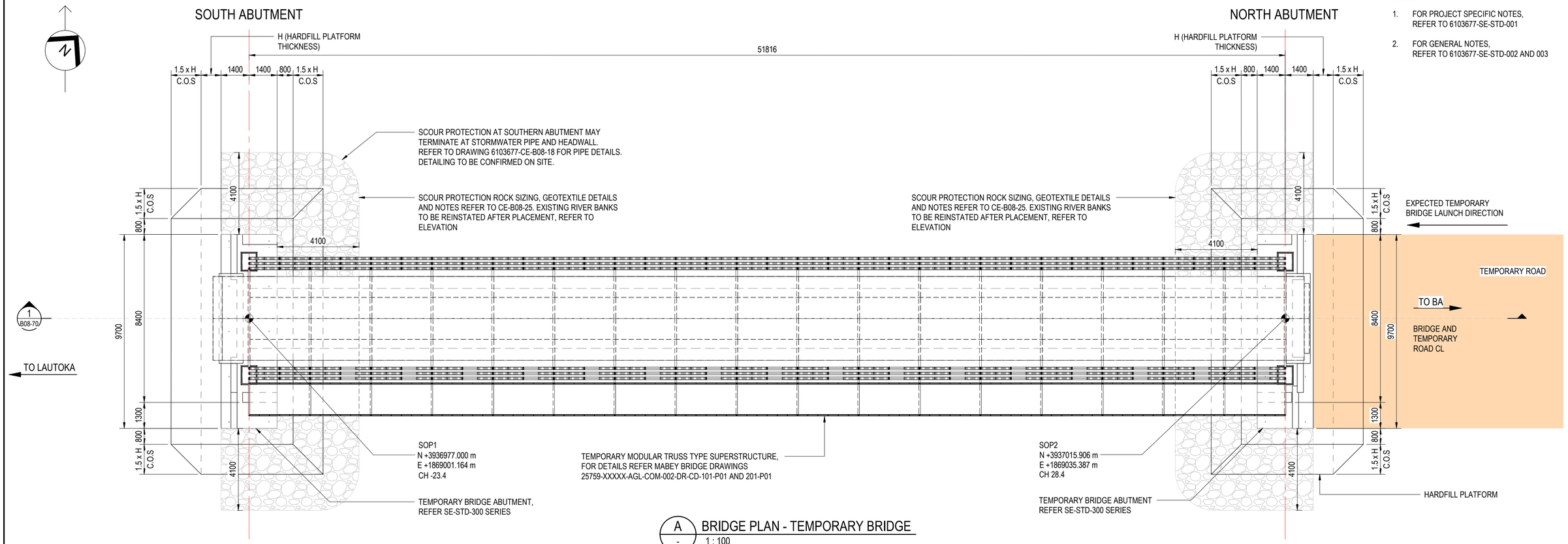
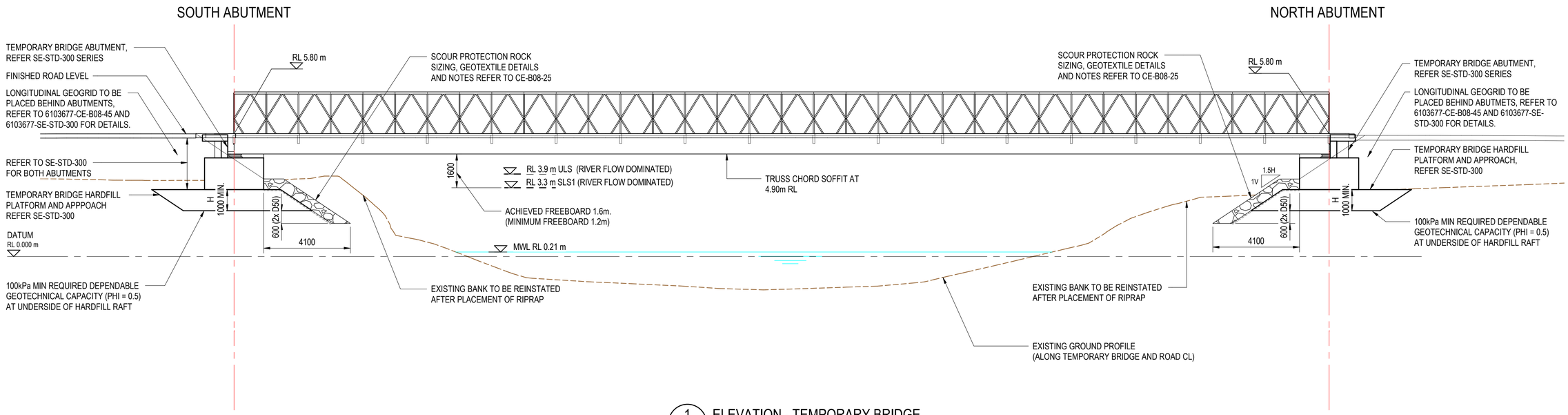
NOTES:

1. FOR PROJECT SPECIFIC NOTES, REFER TO 6103677-SE-STD-001
2. FOR GENERAL NOTES, REFER TO 6103677-SE-STD-002 AND 003



A - BRIDGE PLAN - TEMPORARY BRIDGE
1 : 100



1 - ELEVATION - TEMPORARY BRIDGE
1 : 100

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN,	RS	NK	TP	31.01.24
A	DETAILED DESIGN, FOR FRA COMMENT	TZ	AS	TP	21.07.23

Original Scale (A1)	1 : 100	
Reduced Scale (A3)		
Design	N. KHURANA	12.2023
Drawn	R. SATTAYAPORN	12.2023
Dsg Verifier	T. POLLEY	12.2023
Drg Check	T. POLLEY	12.2023

Sub-consultant: Erasito
Main-consultant: Beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: B08 MATAWALU BRIDGE- TEMPORARY BRIDGE PLAN AND ELEVATION
Discipline: STRUCTURAL
Drawing No.: 6103677-SE-B08-70
Rev.: B

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Document No. Autodesk Docs://6450911 - FRA 40+3/6103677-B08-SE-2023_Temporary Bridge.rvt

Co-designed by: Erasito

Co-designed, Verified and Issued by: Beca

FRA/TIISP/20-13 - 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

PRIORITY 1 - B09, SABETO BRIDGE

Prepared for: FIJI ROAD AUTHORITY
Prepared by: BECA INTERNATIONAL CONSULTANTS LTD

Project No.: 6103677

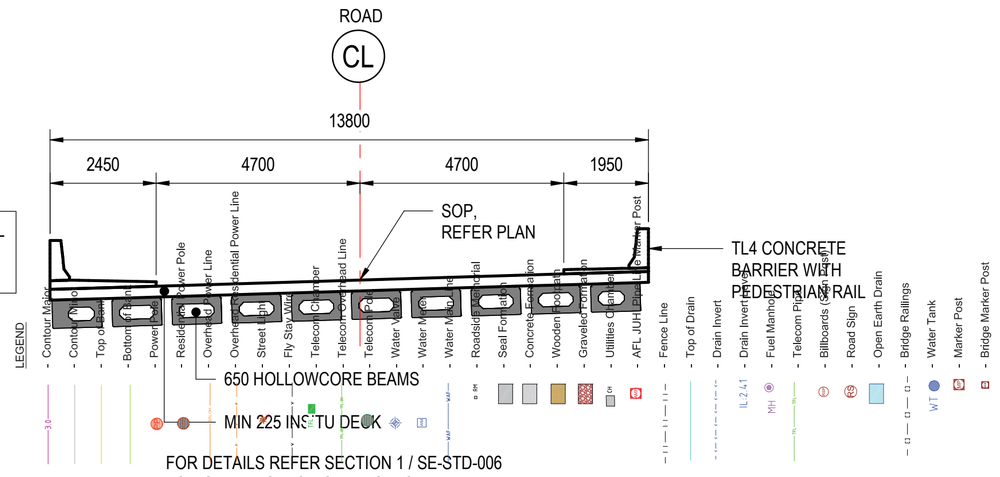
ISSUED FOR DETAILED DESIGN

	DRAWING STATUS	CONCEPT DESIGN	DETAILED DESIGN FOR COMMENT	DETAILED DESIGN - FOR FRA REVIEW
	DAY	06	13	31
	MONTH	03	07	10
	YEAR	2023	2023	2023

DRAWING NO	DRAWING TITLE	REV.	REV.	REV.
6103677-CE-B09-00	COVER SHEET AND REVISION HISTORY	A	B	C
FRA: SS 25 / 22	DETAILED TOPOGRAPHICAL SURVEY OF SABETO BRIDGE	0	0	0
6103677-CE-B09-05	SABETO BRIDGE SITE REMOVAL PLAN PREPARATION	-	-	A
6103677-CE-B09-10	SABETO BRIDGE ROADING PLAN AND PROFILE	A	B	C
6103677-CE-B09-12	SABETO BRIDGE MAIN ROAD CROSS SECTIONS - SHEET 1	A	B	C
6103677-CE-B09-13	SABETO BRIDGE MAIN ROAD CROSS SECTIONS - SHEET 2	A	B	C
6103677-CE-B09-14	SABETO BRIDGE MAIN ROAD CROSS SECTIONS - SHEET 3	A	B	C
6103677-CE-B09-15	SABETO BRIDGE MAIN ROAD CROSS SECTIONS - SHEET 4	A	B	C
6103677-CE-B09-16	SABETO BRIDGE MAIN ROAD CROSS SECTIONS - SHEET 5	-	A	B
6103677-CE-B09-17	SABETO BRIDGE ROAD MARKING AND SIGNAGE PLAN	-	A	B
6103677-CE-B09-20	SABETO BRIDGE PROPOSED UTILITES	A	B	C
6103677-CE-B09-21	SABETO BRIDGE PROPOSED UTILITIES CROSS SECTIONS - SHEET 1	-	A	B
6103677-CE-B09-25	SABETO BRIDGE SCOUR PROTECTION LAYOUT	-	A	B
6103677-CE-B09-30	SABETO BRIDGE EMBANKMENT GEOGRID REINFORCEMENT DETAILS	-	A	B
6103677-CE-B09-31	SABETO BRIDGE GEOTECHNICAL INSTRUMENTATION AND MONITORING DETAILS	-	A	B
6103677-CE-B09-40	SABETO BRIDGE TEMPORARY DIVERSIONS ROADING PLAN	-	-	A
6103677-SE-B09-50	SABETO BRIDGE PLAN	A	B	C
6103677-SE-B09-51	SABETO BRIDGE ELEVATION	A	B	C
6103677-SE-B09-55	SABETO BRIDGE PILING PLAN	-	A	B
6103677-SE-B09-56	SABETO BRIDGE GROUND IMPROVEMENT PLAN	-	A	B

make everyday better.

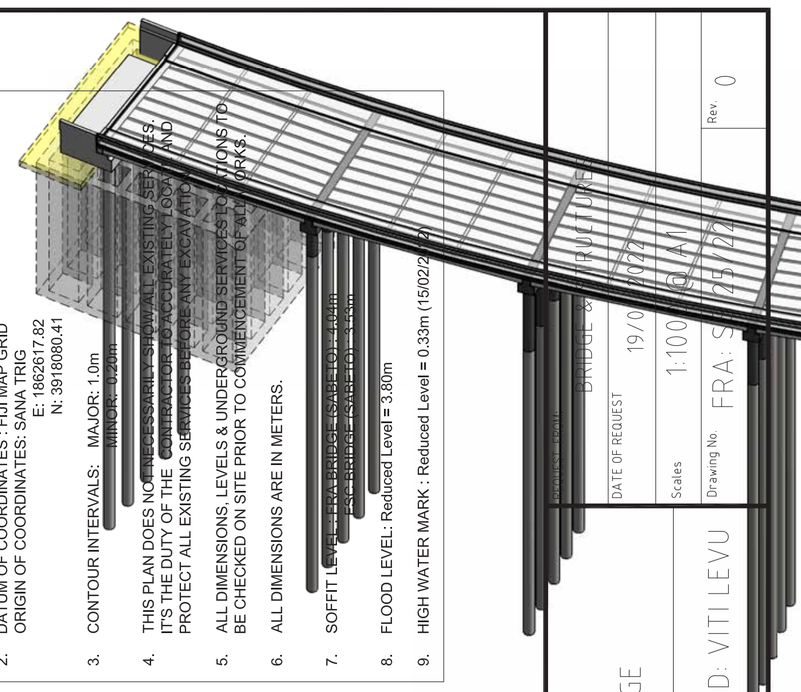
Drawing No.	Rev.
6103677-CE-B09-00	C



*SERVICES NOT SHOWN. REFER TO CIVIL DRAWINGS FOR REQUIREMENTS AND SE-STD-140 FOR SUPPORT DETAILS

2 - SECTION
Scale: 1:50

NOTES:
1. DATUM OF LEVELS : MEAN SEA LEVEL
ORIGIN OF LEVELS: SANA TRIG
RL: 11.598m
2. DATUM OF COORDINATES : FIJI MAP GRID
ORIGIN OF COORDINATES: SANA TRIG
E: 1862617.82
N: 3918080.41
3. CONTOUR INTERVALS: MAJOR: 1.0m
MINOR: 0.20m
4. THIS PLAN DOES NOT NECESSARILY SHOW ALL EXISTING SERVICES.
IT'S THE DUTY OF THE CONTRACTOR TO ACCURATELY LOCATE AND
PROTECT ALL EXISTING SERVICES BEFORE ANY EXCAVATIONS TO
5. ALL DIMENSIONS, LEVELS & UNDERGROUND SERVICES TO
BE CHECKED ON SITE PRIOR TO COMMENCEMENT OF ALL WORKS.
6. ALL DIMENSIONS ARE IN METERS.
7. SOFFIT LEVEL : FRA BRIDGE (SABETO) = 4.04m
FSC BRIDGE (SABETO) = 4.53m
8. FLOOD LEVEL: Reduced Level = 3.80m
9. HIGH WATER MARK : Reduced Level = 0.33m (15/02/22)



3D VIEW - B08 MATAWALU BRIDGE

No.		By	Chk	Date
C	DETAILED DESIGN, FOR FRA COMMENT	RS	AS	TP	18.01.24
B	DETAILED DESIGN, FOR FRA COMMENT	TZ	AS	TP	21.07.23
A	FOR FRA REVIEW	MM	NK	TP	10.03.23

DO NOT SCALE FOR SET OUT DIMENSIONS

Original Scale (A1)	Design	A. SMITH	12.2023
As indicated	Drawn	R. SATTAYAPORN	12.2023
Reduced Scale (A3)	Dsg Verifier	T. POLLEY	12.2023
	Drg Check	T. POLLEY	12.2023

Sub-consultant: Erasito
Main-consultant: Beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURE

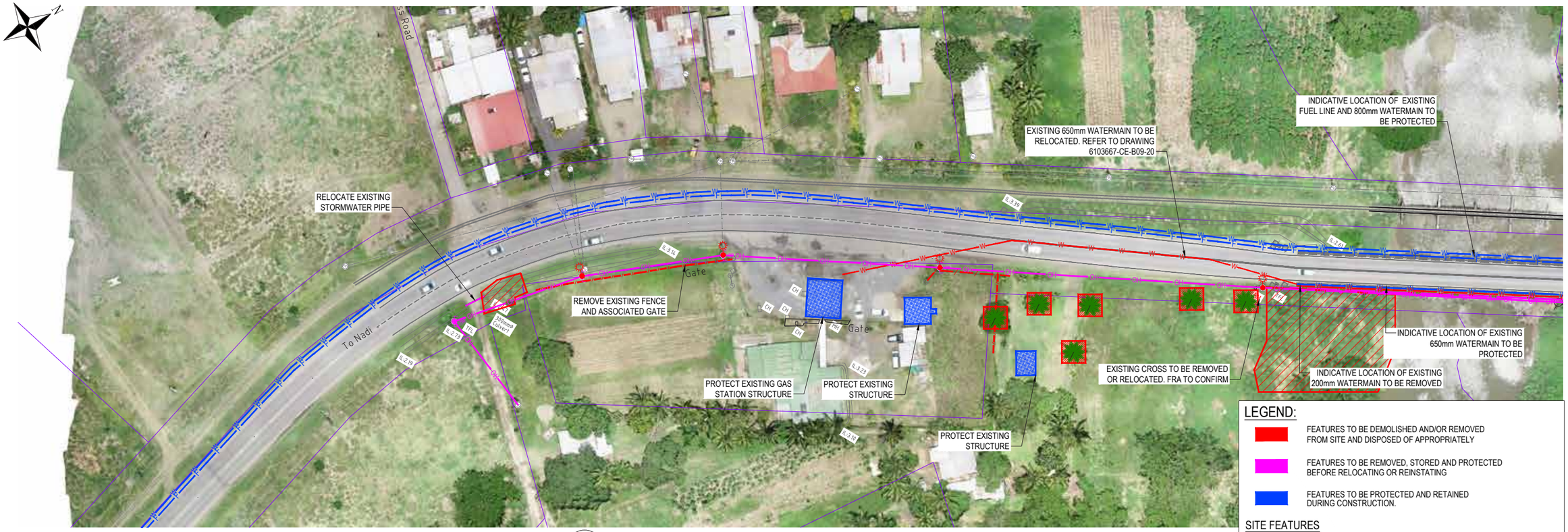
DESCRIPTION: DETAILED TOPOGRAPHICAL SURVEY OF SABETO BRIDGE
TIKINA: SABETO
PROVINCE: BA
ISLAND: VITI LEVU
DATE OF REQUEST 19/01/2022
Scales 1:100 @ A1
Drawing No. FRA: S 25/22
Rev 0

Fiji Roads Authority
Level 4, Fiji Development Bank Building,
360 Victoria Parade, Suva, Fiji Islands.
Postal: P. O. Box 16550, Suva, Fiji
Phone (+679) 310 0114 | Fax (+679) 310 0044 |
email: shiri.narayan@fijiroads.org

SURVEYED BY	KRISHNEEL LAL & SAMISONI LEDUA
SURVEY ASST	SHANVI, LEMEKI, TOMASI & VILIAME
DRAWN BY	USAIA DELAI
CHECKED BY	SHIRI NARAYAN
VERIFIED BY	SHAINEEL CHAND
SURVEY INSTRUCTION	(SI) No SS 25/22
DATE OF SURVEY	15/02/2022
APPROVED	SHIRI NARAYAN

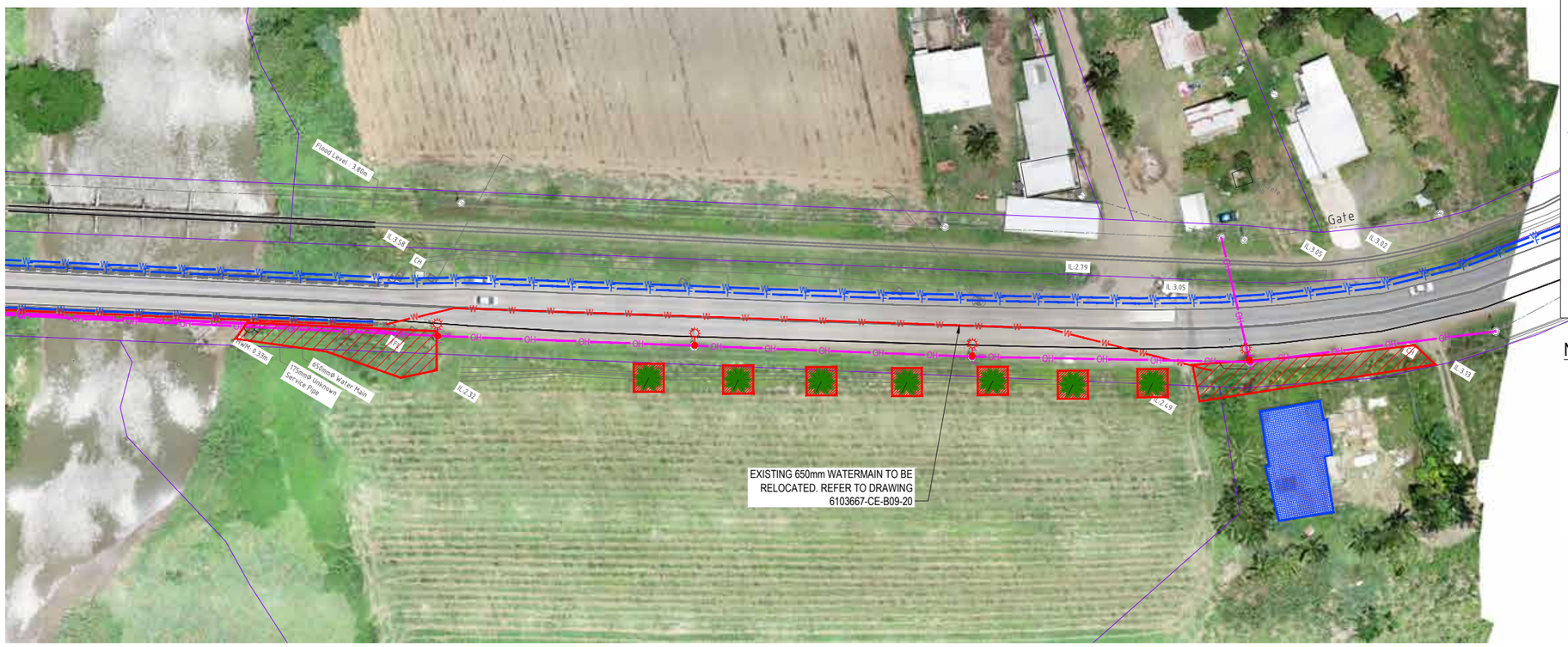
SURVEY SECTION

REV	REVISIONS	DRN	CHK	APP	DATE



1 / - SABETO BRIDGE - SITE REMOVAL PLAN

SCALE 1:500



LEGEND:

- FEATURES TO BE DEMOLISHED AND/OR REMOVED FROM SITE AND DISPOSED OF APPROPRIATELY
- FEATURES TO BE REMOVED, STORED AND PROTECTED BEFORE RELOCATING OR REINSTATING
- FEATURES TO BE PROTECTED AND RETAINED DURING CONSTRUCTION.

SITE FEATURES

- OH — OVERHEAD POWERLINE
- PP — POWER POLE
- FSP — FLY STAY POLE
- C — TELECOM LINE
- STREET LIGHT
- M — METER BOX
- MP — MARKER POST
- UC UC — UTILITY CHAMBER
- SW — STORMWATER CULVERT
- CULVERT HEADWALL
- F — FUEL LINE
- EXISTING STRUCTURES
- FENCE
- ROAD SIGN
- W — WATER LINE
- TREES
- DENSE VEGETATION

NOTES:

1. REFER TO 6103677-CE-B09-20 FOR TEMPORARY AND PERMANENT UTILITY RELOCATIONS.
2. REFER TO 6103677-CE-B09-17 FOR ROAD SIGN DETAILS.
3. REFER TO 6103677-CE-B09-10 AND 6103677-CE-B09-18 FOR STORMWATER CULVERT DETAILS.
4. REFER TO 6103677-CE-B09 FOR LOCATION AND EXTENT OF SITE FEATURES TO BE REPLACED.
5. REFER TO 6103677-CE-STD-03 FOR GENERAL NOTES.

FOR CLARITY OF DETAILS
VIEW ELECTRONICALLY

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
A	DETAILED DESIGN FOR FRA REVIEW	MS	CH	CH	31.10.23

Original Scale (A1)	1:500		
Reduced Scale (A3)	1:1000		
Design	M.SHEPPARD	06.03.23	Approved For Construction*
Drawn	M.ANONUEVO	06.03.23	
Dsg Verifier	C. HATLEY	06.03.23	
Drg Check	C. HATLEY	06.03.23	Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: SABETO BRIDGE SITE PREPARATION PLAN

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B09-05 Rev.: A

Document No. 6103677-CE-B09-05.DWG

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CH	22/06/23				
CH	03/02/23				
Appd	Date				

Reduced Scale (A3) 1:500

Dsg Verifier	C Hatley	03/02/23
Drg Check	C Hatley	03/02/23 Date

× Refer to Revision 1 for Original Signature

Erasito | Beca

Fiji Roads Authority

3 MARITIME STRUCTURES

TEMPORARY CROSSING SECTIONS SHEET 3

Drawing No 6103677-CE-B06-44

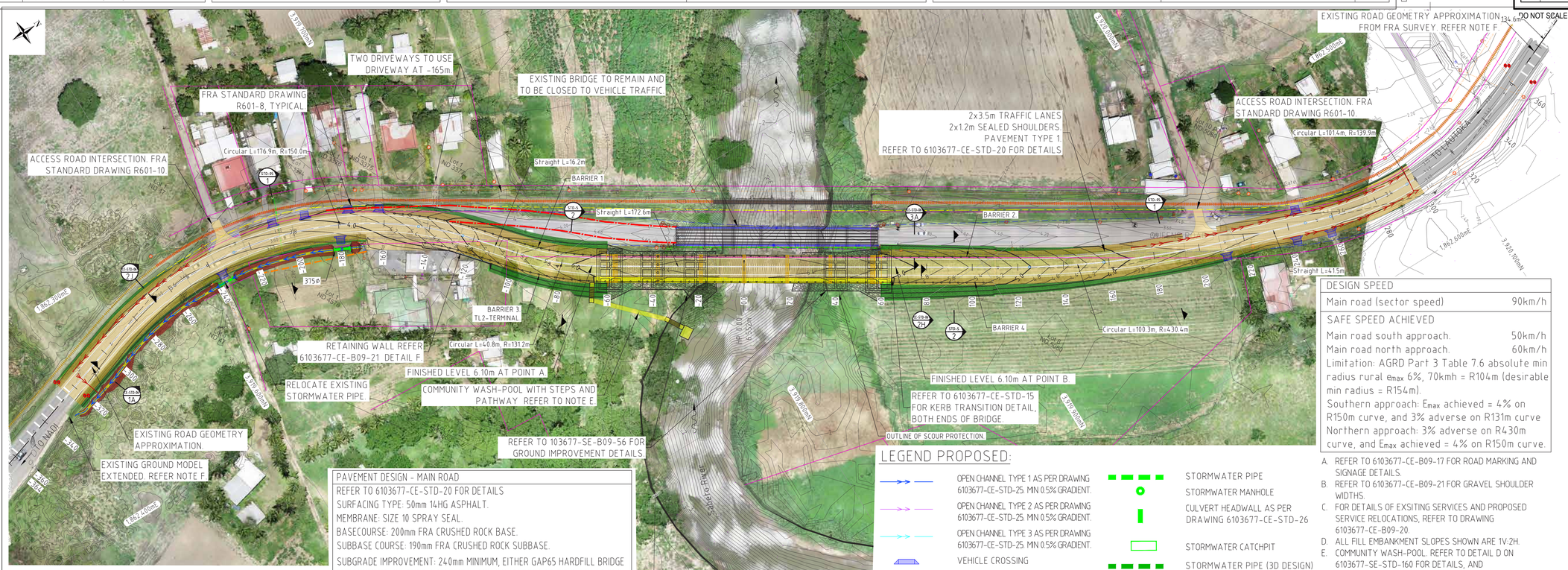
Rev. D

Document

No.	Revision	By	Chk
B	DETAILED DESIGN, FOR COMMENT	RS	TP
A	FOR FRA REVIEW	CRB	TP

Drawing Plotted 31 Oct 2023 - 4:50 pm

DO NOT SCALE FOR SET OUT DIMENSIONS



1 – OFF-LINE REPLACEMENT UPSTREAM

SCALE 1:2000(A3)

PAVEMENT DESIGN - MAIN ROAD

REFER TO 6103677-CE-STD-20 FOR DETAILS
SURFACING TYPE: 50mm 14HG ASPHALT.
MEMBRANE: SIZE 10 SPRAY SEAL.
BASECOURSE: 200mm FRA CRUSHED ROCK BASE.
SUBBASE COURSE: 190mm FRA CRUSHED ROCK SUBBASE.
SUBGRADE IMPROVEMENT: 240mm MINIMUM, EITHER GAP65 HARDFILL BRIDGE EMBANKMENT, OR TYPE A MATERIAL CBR 8% MINIMUM AT TIE IN LOCATIONS.
MINIMUM SUBGRADE STRENGTH: CBR 3.5%.
TOTAL THICKNESS:680mm.
CONTINGENCY UNDERCUT: FOR CBR 2% SUBGRADE, MINIMUM 200mm, REPLACEMENT WITH EITHER GAP65 HARDFILL OR TYPE A MATERIAL.

LEGEND PROPOSED:

- OPEN CHANNEL TYPE 1 AS PER DRAWING 6103677-CE-STD-25. MIN 0.5% GRADIENT.
- OPEN CHANNEL TYPE 2 AS PER DRAWING 6103677-CE-STD-25. MIN 0.5% GRADIENT.
- OPEN CHANNEL TYPE 3 AS PER DRAWING 6103677-CE-STD-25. MIN 0.5% GRADIENT.
- VEHICLE CROSSING
- UNSEALED SHOULDER, FOOTPATH
- REINFORCED CONCRETE FOOTPATH REFER DRAWING 103677-CE-STD-15
- STORMWATER PIPE
- STORMWATER MANHOLE
- CULVERT HEADWALL AS PER DRAWING 6103677-CE-STD-26
- STORMWATER CATCHPIT
- STORMWATER PIPE (3D DESIGN)
- FENCE
- SUBSOIL DRAIN

DESIGN SPEED	
Main road (sector speed)	90km/h
SAFE SPEED ACHIEVED	
Main road south approach.	50km/h
Main road north approach.	60km/h

Limitation: AGRD Part 3 Table 7.6 absolute min radius rural e_{max} 6%, 70kmh = R104m (desirable min radius = R154m).
Southern approach: E_{max} achieved = 4% on R150m curve, and 3% adverse on R131m curve
Northern approach: 3% adverse on R430m curve, and E_{max} achieved = 4% on R150m curve.

BARRIER LENGTHS (exclusive of barrier on bridge)			
1	95m	2	50m
3	85m	4	50m

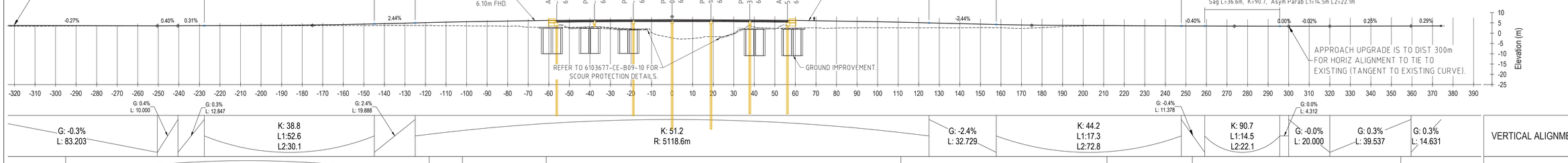
BARRIER LENGTHS ON BRIDGE
120m both sides
Refer to 6103677-CE-STD-30 for barrier details.

A. REFER TO 6103677-CE-B09-17 FOR ROAD MARKING AND SIGNAGE DETAILS.
B. REFER TO 6103677-CE-B09-21 FOR GRAVEL SHOULDER WIDTHS.
C. FOR DETAILS OF EXSITING SERVICES AND PROPOSED SERVICE RELOCATIONS, REFER TO DRAWING 6103677-CE-B09-20.
D. ALL FILL EMBANKMENT SLOPES SHOWN ARE 1V:2H.
E. COMMUNITY WASH-POOL. REFER TO DETAIL D ON 6103677-SE-STD-160 FOR DETAILS, AND 103677-CE-B09-25 FOR COORDINATION WITH SCOUR PROTECTION. REFER TO DETAIL A ON 6103677-SE-STD-161 FOR STEPS.
F. NEW APPROACH TO MERGE TO EXISTING ROAD GEOMETRY AND FORMATION. ADDITIONAL TOPOGRAPHICAL SURVEY REQUIRED. AT SOUTH END, EXISTING GROUND SURFACE MODEL FROM FRA TOPOGRAPHICAL SURVEY HAS BEEN EXTENDED BY ADDING ERASITO-BECA UAV SURVEY TERRAIN MODEL TO FRA TOPOGRAPHICAL SURVEY.

LEGEND EXISTING:

- CADASTRAL BOUNDARY
- JUHI UNDERGROUND FUEL PIPELINE
- UTILITIES
- FSC TRAMLINE
- FLOW DIRECTION
- ROAD AT MERGE POINT, FROM FRA SURVEY.

1. THESE BRIDGE SPECIFIC DRAWINGS REFER TO AND SHALL BE READ TOGETHER WITH STANDARD CIVIL DRAWINGS, 6103677-CE-STD SERIES.
2. FOR DESIGN DETAILS REFER TO THE DETAILED DESIGN REPORT - PRIORITY 1. B09 SABETO BRIDGE AND REFERENCED DOCUMENTS.
3. AERIAL IMAGE IS FROM UAV SURVEY UNDERTAKEN BY ERASITO CONSULTANTS LTD AND BECA INTERNATIONAL CONSULTANTS LTD IN NOVEMBER – DECEMBER 2021. TOPOGRAPHICAL SURVEY SHOWN IS BY FRA 15 FEBRUARY 2022.
4. MAJOR CONTOURS AT 1M INTERVALS, MINOR CONTOURS AT 0.2M INTERVALS. CONTOURS AND ELEVATIONS ARE TO FIJI HEIGHT DATUM (FHD), DETERMINED FRA.
5. HORIZONTAL POSITION IS TO FIJI MAP GRID (FMG).
6. CADASTRAL BOUNDARY INFORMATION IS FRA TOPOGRAPHICAL SURVEY (UNLESS NOTED AS FROM FIJI LAND INFORMATION SYSTEM (FLIS)) AND IS REFERENCED TO FIJI MAP GRID (FMG) COORDINATE SYSTEM. NO INDEPENDENT REVIEW OF DATA CORRECTNESS HAS BEEN CARRIED OUT.
7. NOT ALL SERVICES ARE SHOWN, AND THOSE THAT ARE SHOWN MAY NOT BE CORRECT. SOME SERVICES DETAILS HAVE BEEN PROVIDED BY FRA IN ITS TOPOGRAPHICAL SURVEY SURVEY AND LIAISON WITH UTILITY PROVIDERS (CARRIED OUT BY BICL).
8. FOR DETAILS OF EXISTING SERVICES AND PROPOSED SERVICE RELOCATIONS, REFER TO DRAWING 6103677-CE-B09-20.



2 – OFF-LINE REPLACEMENT UPSTREAM LONGITUDINAL PROFILE

SCALE 1:2000(A3)

VERTICAL ALIGNMENT	G: 0.4% L: 10.000; G: 0.3% L: 12.847; G: -0.3% L: 83.203; K: 38.8 L1:52.6 L2:30.1; G: 2.4% L: 19.888; K: 51.2 R: 5118.6m; G: -2.4% L: 32.729; K: 44.2 L1:17.3 L2:72.8; G: -0.4% L: 11.378; K: 90.7 L1:14.5 L2:22.1; G: 0.0% L: 4.312; G: -0.0% L: 20.000; G: 0.3% L: 39.537; G: 0.3% L: 14.631
HORIZONTAL ALIGNMENT	8.98 ' 06' 11"; L: 176.88 R: 150.00; L: 16.18 B: 049° 39' 57"; L: 40.78 R: 131.24; L: 172.57 B: 031° 51' 53"; L: 100.31 R: 430.38; L: 41.50 B: 018° 30' 39"; L: 101.44 R: 139.87
SUPERELEVATION (red = left, green = right)	L=29m; 4.0%L; SUPERELEVATION INDICATIVE, ADJUST TO MERGE TO EXISTING. 3.5% MAX RR, V_{OP}=80km/h.; L=364m; 3.5% MAX RR, V_{OP}=60km/h.; 4.0%R; L=full superE; L=5m; L=15m; L=25m; Normal crown; -3.0%L; -3.0%R; 3.5% MAX RR, V_{OP}=60km/h.; L=20m; L=10m; L=5m; L=5m; SUPERELEVATION INDICATIVE, ADJUST TO MERGE TO EXISTING. 3.5% MAX RR, V_{OP}=80km/h.; L=30m
CUT/FILL	0.38 0.30 0.23 0.17 0.11 0.10 0.01 -0.01 -0.02 -0.01 -0.01 -0.01 0.06 0.11 0.19 0.26 0.33 0.43 0.64 0.75 0.87 1.12 1.28 1.38 1.76 2.03 2.26 2.51 3.08 3.40 3.52 3.23 3.74 4.31 6.26 8.84 9.10 8.19 6.68 3.33 3.96 3.91 3.52 3.45 3.15 2.93 2.76 2.56 2.41 2.26 2.05 1.71 1.57 1.54 1.68 1.21 0.58 0.27 0.13 0.10 0.06 0.06 0.08 0.08 0.00 -0.01 -0.04 -0.04 0.00 0.02 0.00 -0.02 0.00 -0.01 -0.03 -0.02 0.00 0.00 0.00
DESIGN LEVELS	3.75 3.72 3.69 3.67 3.64 3.61 3.59 3.56 3.60 3.64 3.64 3.67 3.72 3.78 3.86 3.96 4.07 4.22 4.42 4.54 4.66 4.90 5.03 5.15 5.37 5.58 5.76 5.93 6.07 6.20 6.31 6.40 6.46 6.51 6.54 6.55 6.54 6.51 6.46 6.40 6.31 6.20 6.07 5.93 5.76 5.58 5.37 5.15 5.03 4.90 4.66 4.42 4.23 4.17 4.00 3.91 3.83 3.77 3.70 3.64 3.59 3.54 3.51 3.50 3.47 3.46 3.43 3.42 3.41 3.41 3.41 3.40 3.43 3.45 3.48 3.50 3.53 3.54
EXISTING GROUND LEVELS	3.37 3.42 3.46 3.50 3.53 3.51 3.58 3.58 3.62 3.65 3.66 3.68 3.66 3.67 3.68 3.68 3.69 3.74 3.79 3.78 3.79 3.78 3.75 3.76 3.61 3.55 3.50 3.42 2.99 2.80 2.79 3.16 2.72 2.20 0.28 -2.28 -2.56 -1.68 -0.21 3.06 2.35 2.29 2.56 2.48 2.61 2.65 2.61 2.58 2.62 2.65 2.61 2.71 2.66 2.63 2.32 2.70 3.25 3.49 3.57 3.54 3.53 3.49 3.43 3.42 3.47 3.47 3.47 3.46 3.41 3.39 3.41 3.43 3.40 3.44 3.48 3.49 3.50 3.53 3.54
DISTANCE	-320 -310 -300 -290 -280 -270 -260 -250 -240 -230 -227.62 -220 -210 -200 -190 -180 -170 -160 -150 -144.89 -140 -130 -125.00 -120 -110 -100 -90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 110 120 125.00 130 140 150 157.73 160 170 180 190 200 210 220 230 240 247.76 250 259.13 260 270 280 290 295.69 300 310 320 330 340 350 360 370 374.17 380 390

FOR CLARITY OF DETAILS VIEW ELECTRONICALLY

DETAILED DESIGN NOT FOR CONSTRUCTION

SCALE 1:2000(A3):

0 25 50 75

C	DETAILED DESIGN - FOR FRA REVIEW.	RAI	TE	CH	31/10/23
B	DETAILED DESIGN - FOR COMMENT.	RAI	TE	CH	05/10/23
A	FOR FRA REVIEW.	RAI	TE	CH	-
No.	Revision	By	Chk	Appd	Date

Original Scale (A1) 1:1000
Reduced Scale (A3) 1:2000

Design	R Imrie	05/10/23	Approved For Construction×
Drawn	R Imrie	05/10/23	
Dsg Verifier	C Hatley	05/10/23	
Drg Check	C Hatley	05/10/23	Date

× Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: SABETO BRIDGE ROADING PLAN AND PROFILE

Discipline: INFRASTRUCTURE

Drawing No. 6103677-CE-B09-10

Rev. C

Document No. PRE FEAS 11 A 1 P1 5.DWG

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DO NOT SCALE FOR SET OUT DIMENSIONS

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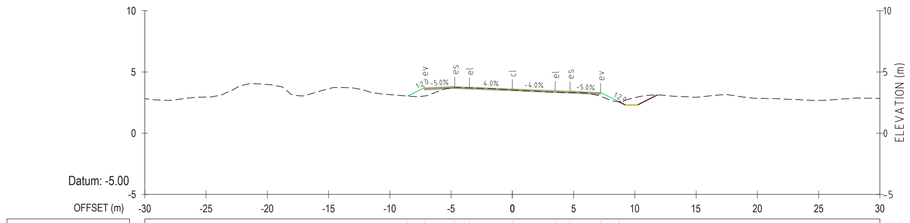
NOTES:

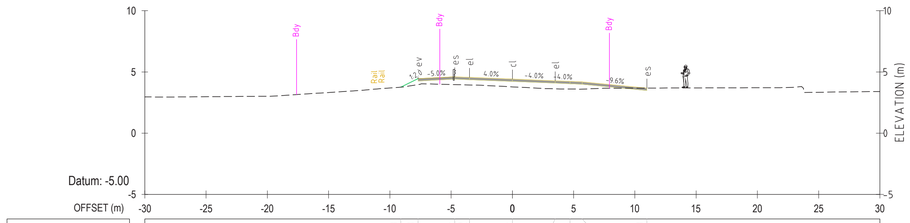
1. REFER TO DRAWING CE-B09-10 FOR NOTES.



| | | |

NOTES:

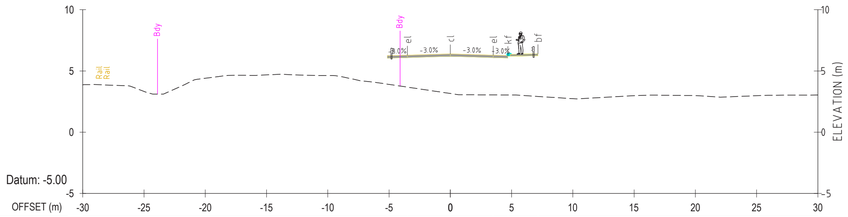
1. REFER TO DRAWING CE-B09-10 FOR NOTES.



| | | |

NOTES:

1. REFER TO DRAWING CE-B09-10 FOR NOTES.



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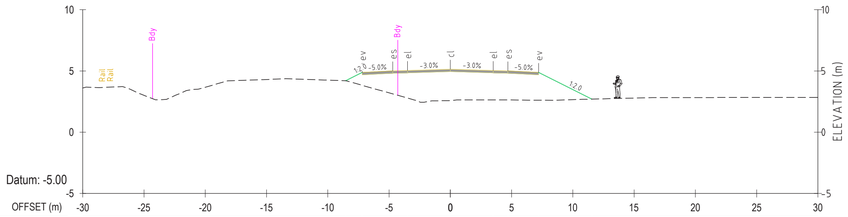
NOTES:

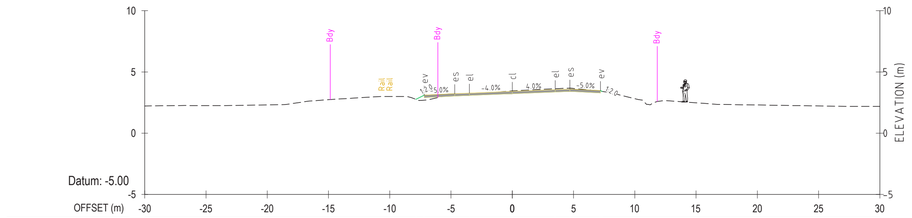
1. REFER TO DRAWING CE-B09-10 FOR NOTES.



| | | |

NOTES:

1. REFER TO DRAWING CE-B09-10 FOR NOTES.



| | | |

Drawing Plotted:31 Oct 2023 12:28 pm

NOTES:

1. REFER TO DRAWING 6103677-CE-B09-10 FOR NOTES.

LEGEND EXISTING:

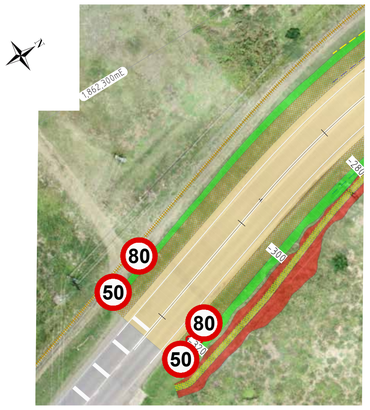
- CADASTRAL BOUNDARY
- JUHI UNDERGROUND FUEL PIPELINE
- UTILITIES
- FSC TRAMLINE
- FLOW DIRECTION

LEGEND PROPOSED:

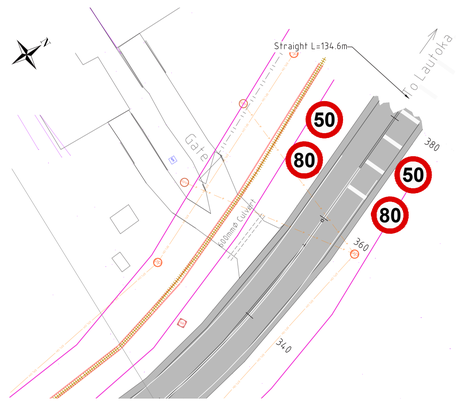
- SPEED LIMIT SIGN RG1 1200mm (SIZE SHOWN IS NTS)
- BRIDGE END MARKER POST W20-5.1
- BRIDGE END MARKER POST W20-5.2

REFER TO FSAM PART 2 FOR MARKING DETAILS.

1 – ROAD MARKING AND SIGNAGE GENERAL ARRANGEMENT PLAN
SCALE 1:2000(A3)



2 – SIGNAGE AT DIST -320m PLAN
SCALE 1:1000(A3)



3 – SIGNAGE AT DIST -360m PLAN
SCALE 1:1000(A3)

FOR CLARITY OF DETAILS VIEW ELECTRONICALLY

DETAILED DESIGN NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN – FOR FRA REVIEW.	RAI	TE	CH	31/10/23
A	DETAILED DESIGN – FOR COMMENT.	RAI	TE	CH	05/10/23

Original Scale (A1)	AS SHOWN	Design: R Imrie	05/10/23
Reduced Scale (A3)	AS SHOWN	Drawn: R Imrie	05/10/23
		Dsg Verifier: C Hatley	05/10/23
		Drg Check: C Hatley	05/10/23

Approved For Construction× Date

× Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: SABETO BRIDGE ROAD MARKING AND SIGNAGE PLAN

Discipline: INFRASTRUCTURE

Drawing No.: 6103677-CE-B09-17

Rev.: B

DO NOT SCALE FOR SET OUT DIMENSIONS

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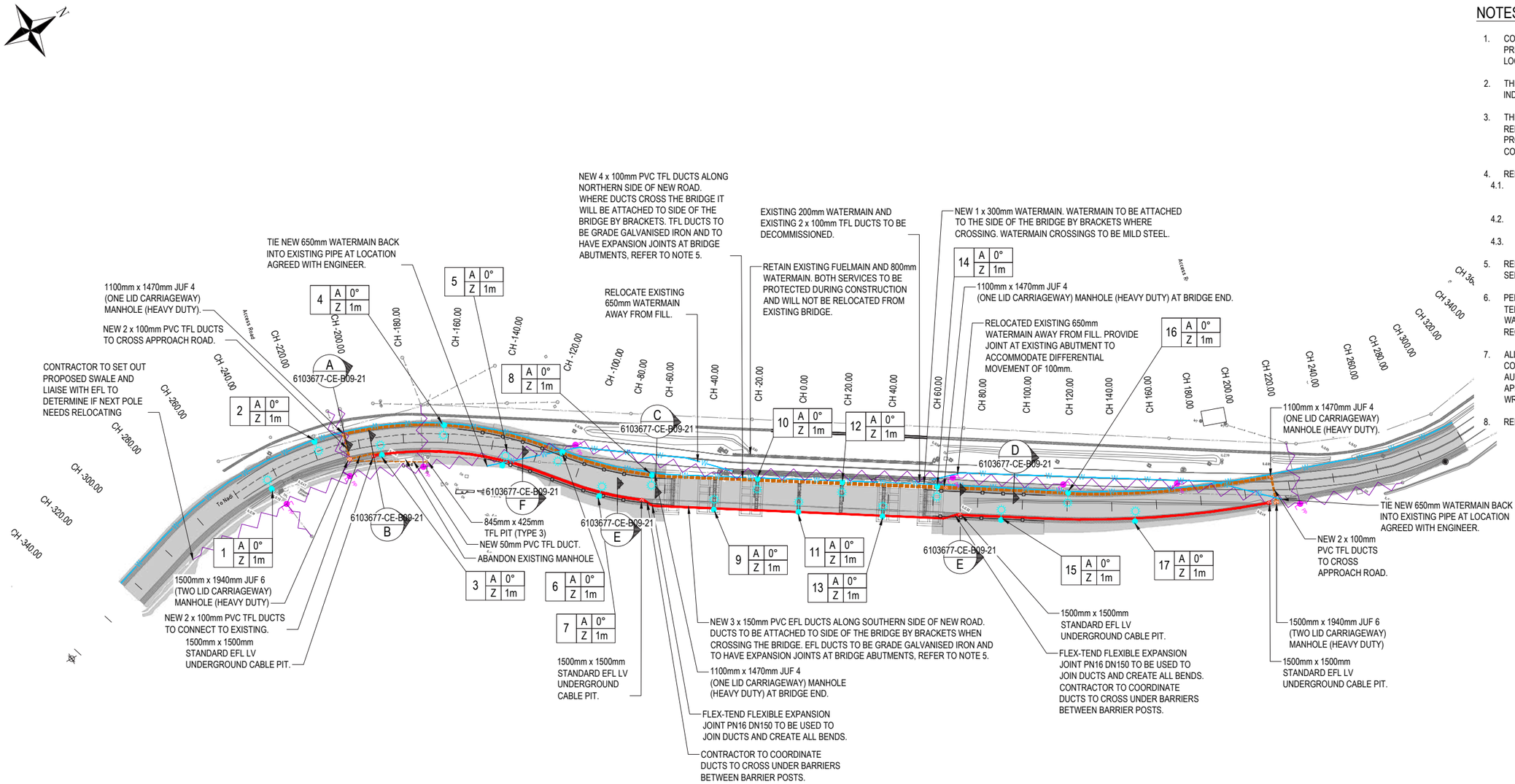
Document No. PRE FEAS 11 A 1 P1 5 DWG

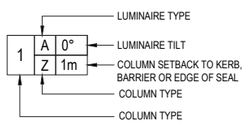
NOTES:

1. CONTRACTOR TO TRIAL TRENCH FOR EXISTING UTILITIES PRIOR TO CONSTRUCTION TO CONFIRM DEPTH, SIZE AND LOCATION OF ALL EXISTING UNDERGROUND UTILITIES.
2. THE EXISTING AND PROPOSED UTILITIES SHOWN ARE INDICATIVE ONLY.
3. THE CONTRACTOR IS TO CONFIRM THE DESIGN WITH EACH RELEVANT UTILITY AUTHORITY FOR APPROVAL PRIOR TO PROCUREMENT, FABRICATION, INSTALLATION, AND COMMENCEMENT OF CONSTRUCTION WORK ON SITE.
4. REFER TO CIVIL STANDARD DRAWINGS, SPECIFICALLY:
   - 4.1. 6103677-CE-STD-40 FOR TYPICAL UTILITY TRENCH INFORMATION AND CLEARANCE REQUIREMENTS BETWEEN UTILITIES.
   - 4.2. 6103677-CE-STD-03 FOR UTILITY GENERAL, OVERHEAD POWER LINES AND STREET LIGHTING NOTES.
   - 4.3. 6103677-CE-STD-17 FOR STREET LIGHT POLE DETAILS.
5. REFER TO 6103677-SE-STD-140 & 6103677-SE-STD-141 FOR SERVICE DUCT SUPPORTS AT BRIDGE.
6. PERMANENT UTILITIES (WATERMAIN, ELECTRICAL AND TELECOMMUNICATIONS) TO BE BUILT IN ACCORDANCE WITH WAF, EFL AND TFL DESIGN, SPECIFICATIONS AND REQUIREMENTS.
7. ALL TEMPORARY DIVERSIONS TO BE DESIGNED BY THE CONTRACTOR IN CO-ORDINATION WITH UTILITY AUTHORITIES. ALL CONTRACTOR DESIGNS TO BE APPROVED BY THE APPROPRIATE UTILITY AUTHORITY, IN WRITING, PRIOR TO CONSTRUCTION.
8. REFER TO 6103677-CE-STD-03 FOR UTILITY GENERAL NOTES.



1 SABETO BRIDGE - PROPOSED UTILITIES LAYOUT PLAN
SCALE 1:1000

TYPICAL COLUMN DESIGNATION:



LUMINAIRE TYPE LEGEND:

A ADD NEW STREET LIGHT PLACE ROADLED MIDI 60W 4K 180227PH LUMINARE.

COLUMN TYPE, MOUNTING HEIGHT:

z PLACE NEW TAMPERED OCTAGONAL SHAFT POLE, 10.5 MOUNTING HEIGHT, 2m OUTREACH. FOUNDATION AS PER DRAWING 6103677-CE-STD-17 DETAIL A1.

LEGEND:

EXISTING UTILITIES:

- DRAIN INVERT FLOW DIRECTION
- POWER POLE
- SEPTIC TANK
- TELECOM CHAMBER
- WATER VALVE
- UTILITIES CHAMBER
- GULLY PIT
- CROSS CULVERT
- FLY STAY POLE
- STAY WIRE
- RESIDENTIAL POWER POLE
- OVERHEAD EFL POWER LINE
- RESIDENTIAL POWER
- LINE WATER METER
- WATER VALVE
- METER BOX ON POLE
- DRAIN STEEL COVER
- TELECOM LINE
- TELECOM POLE
- WAF PIPE

PROPOSED UTILITIES:

- TFL DUCT
- WAF PIPE
- EFL DUCT
- STREET LIGHT

RELOCATED UTILITIES:

- INDICATIVE POWER POLE POSITION. EFL TO CONFIRM.
- OVERHEAD POWER LINES. EFL TO CONFIRM.

FOR CLARITY OF DETAILS VIEW ELECTRONICALLY

DETAILED DESIGN NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN FOR FRA REVIEW	JM	VH	CH	31.10.23
B	DETAILED DESIGN FOR COMMENT	JM	VH	CH	13.07.23
A	FOR FRA REVIEW	ES	VH	CH	06.03.23

Original Scale (A1) 1:1000
Reduced Scale (A3) 1:2000

Design	M. SHEPPARD	06.03.23	Approved For Construction* Date
Drawn	AV, ES	06.03.23	
Dsg Verifier	C. HATLEY	06.03.23	
Drg Check	C. HATLEY	06.03.23	

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito
Main-consultant: Beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: SABETO BRIDGE PROPOSED UTILITIES
Discipline: CIVIL ENGINEERING
Drawing No.: 6103677-CE-B09-20
Rev.: C

Document No. 6103677-CE-B09-20.DWG

DO NOT SCALE FOR SET OUT DIMENSIONS

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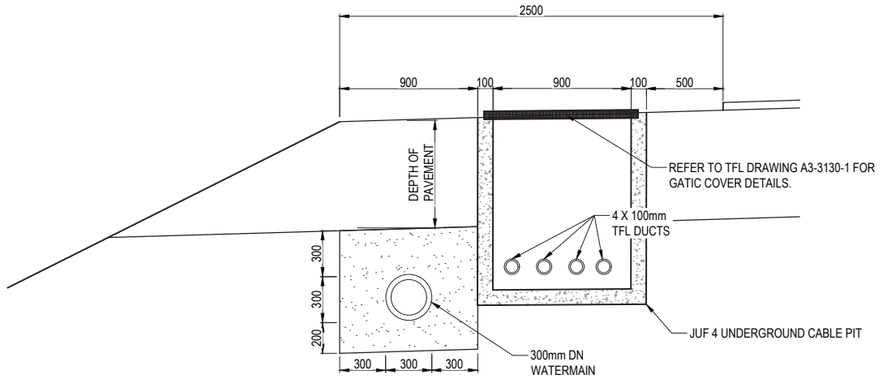
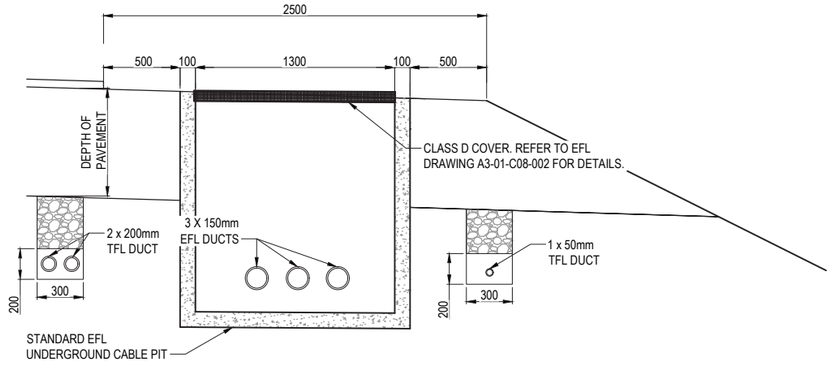
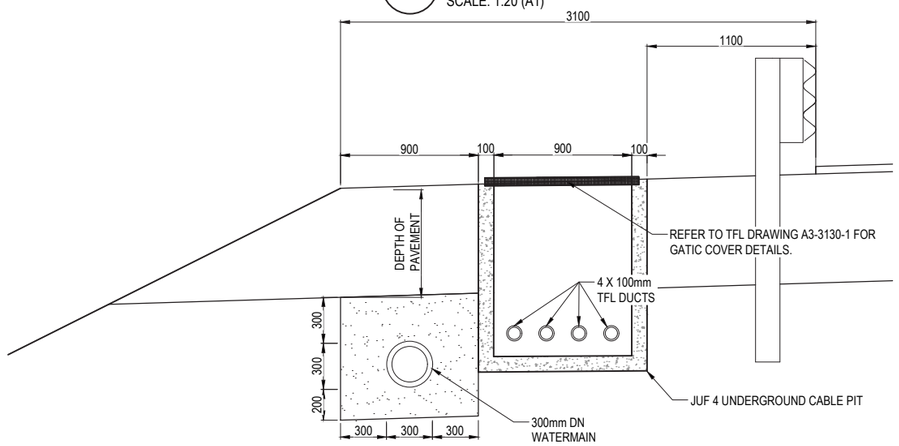
NOTES:

1. UTILITIES SHOWN HAVE NOT BEEN CONFIRMED BY UTILITY COMPANIES
2. REFER TO CIVIL STANDARD DRAWINGS FOR TYPICAL UTILITY TRENCH INFORMATION, SPECIFICALLY 6103677-CE-STD-40.
3. ALL UTILITY INSTALLATIONS ARE TO BE DONE IN ACCORDANCE WITH THE APPROPRIATE UTILITY COMPANIES STANDARDS AND SPECIFICATIONS AS WELL AS THE PROJECT SPECIFICATIONS. SPECIFIC ATTENTION IS DRAWN TO THE FOLLOWING:
   - 3.1. TFL CIVIL WORKS GUIDELINES
   - 3.2. TFL PROFILE & PIT INSTALLATION GUIDELINES
   - 3.3. TFL DRAWING A3-3129-3
   - 3.4. TFL DRAWING A3-3130-1
   - 3.5. EFL DRAWING A3-01-C08-002
   - 3.6. EFL DRAWING A3-C26.20-SK04-0
   - 3.7. EFL DRAWING A3-C26.20-SK06-0
   - 3.8. EFL DRAWING A3-01-E24-028
   - 3.9. WAF STANDARD DRAWINGS

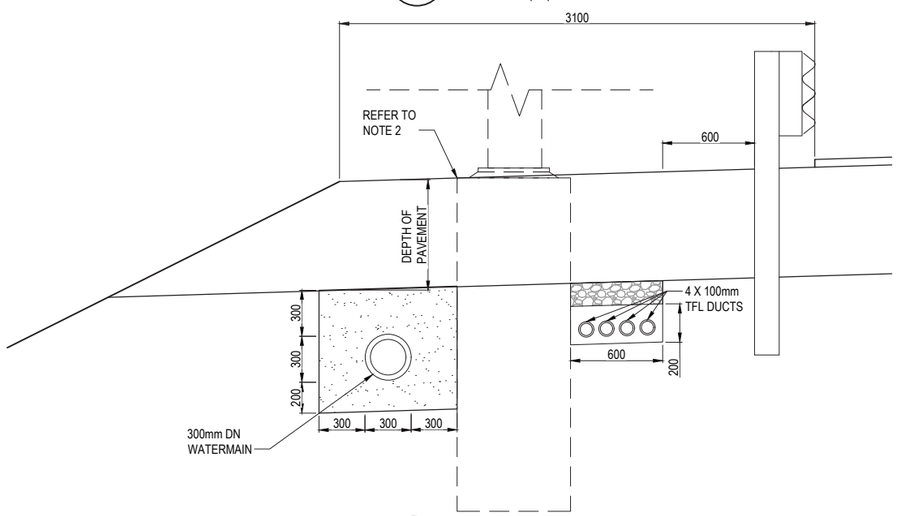




A - DETAIL A
SCALE: 1:20 (A1)



B - DETAIL B
SCALE: 1:20 (A1)



C - DETAIL C
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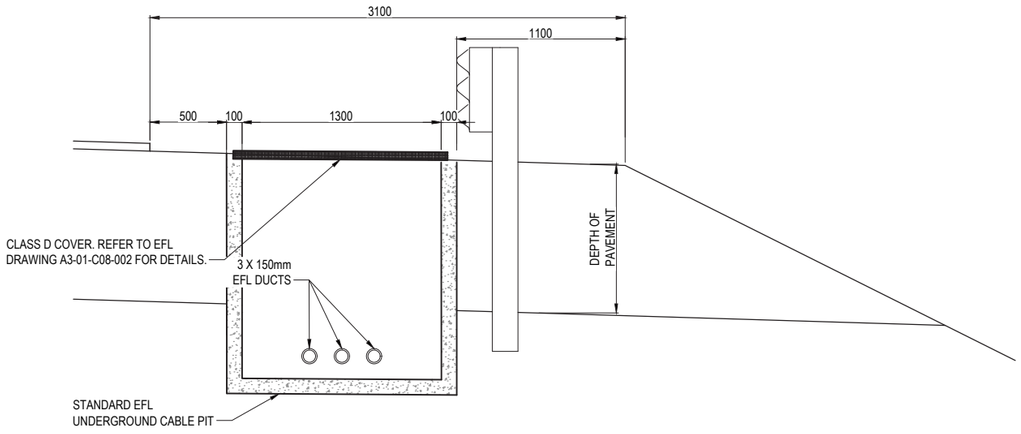
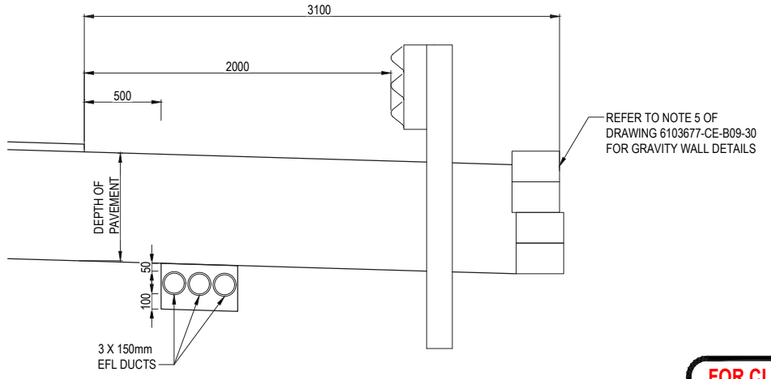


D - DETAIL D
SCALE: 1:20 (A1)



E - DETAIL E
SCALE: 1:20 (A1)

F - DETAIL F
SCALE: 1:20 (A1)

FOR CLARITY OF DETAILS
VIEW ELECTRONICALLY

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN FOR FRA REVIEW	JM	VH	CH	31.10.23
A	DETAILED DESIGN- FOR COMMENT	JM	VH	CH	13.07.23

Original Scale (A1) 1:20
Reduced Scale (A3) 1:40

Design	J.MARSH	13.07.23	Approved For Construction*
Drawn	AV, ES	13.07.23	
Dsg Verifier	C. HATLEY	13.07.23	
Drg Check	C. HATLEY	13.07.23	Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito
Main-consultant: Beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: SABETO BRIDGE PROPOSED UTILITIES CROSS SECTIONS - SHEET 1
Discipline: CIVIL ENGINEERING
Drawing No.: 6103677-CE-B09-21
Beca Project Number:
Rev.: B

Document No. 6103677-CE-B09-21.DWG

DO NOT SCALE FOR SET OUT DIMENSIONS

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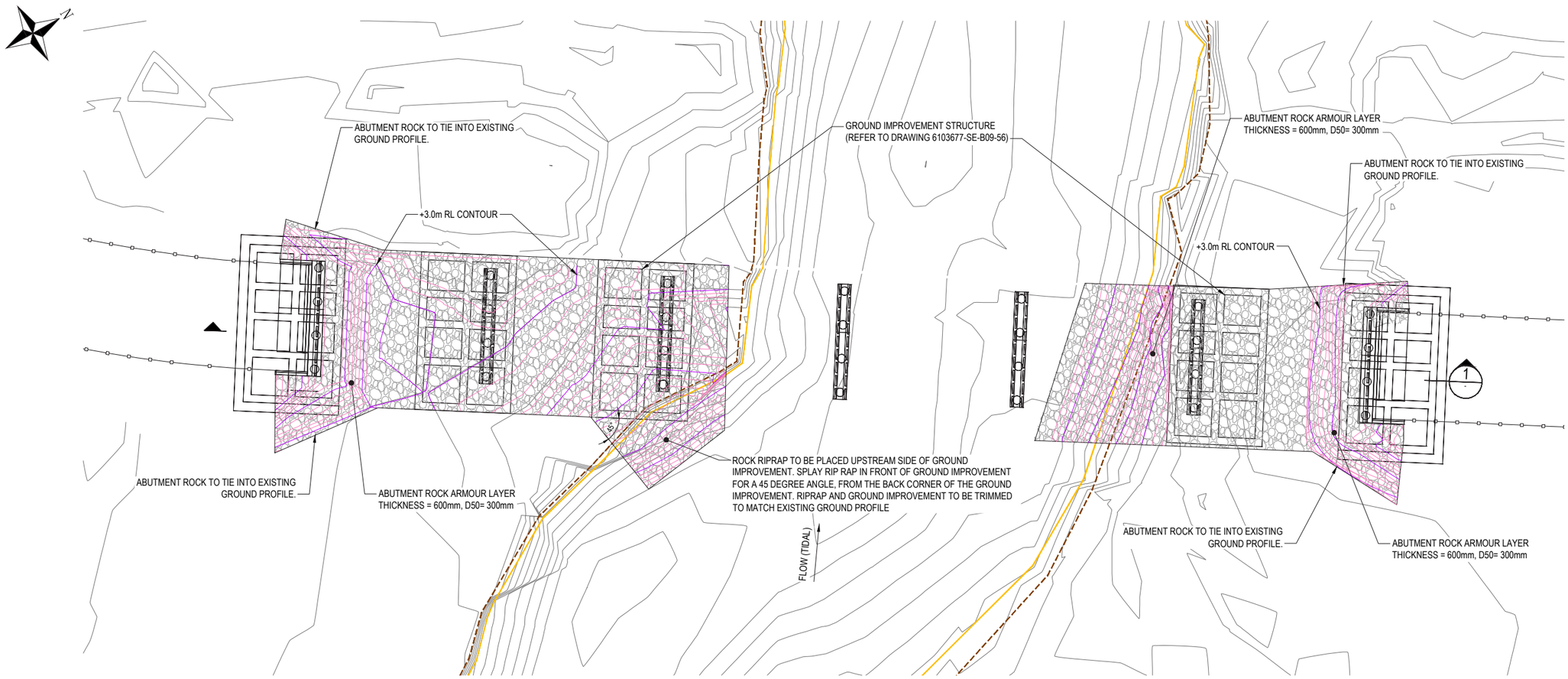
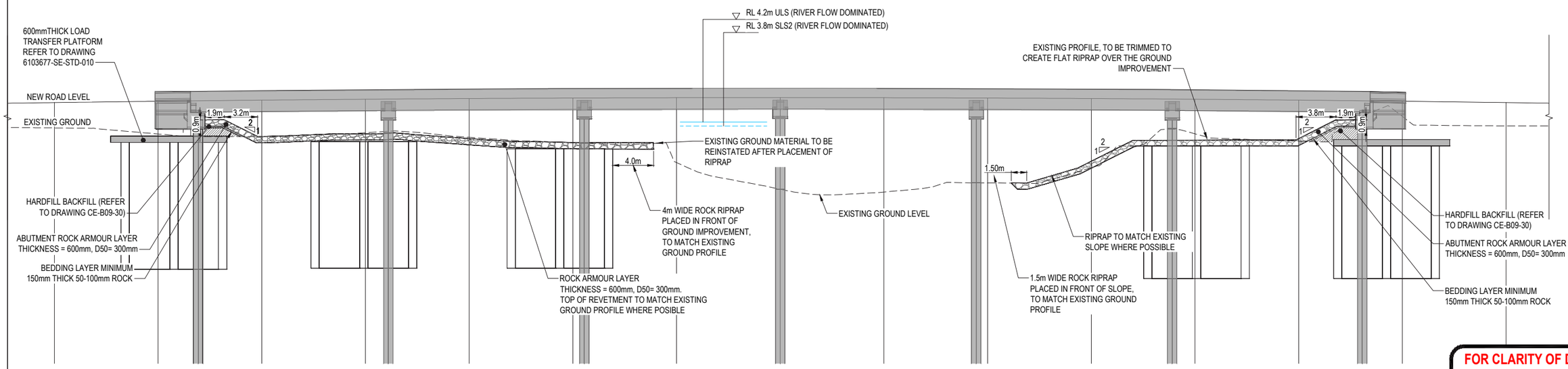


A SCOUR PROTECTION LAYOUT
SCALE 1:250



1 SCOUR PROTECTION
SCALE 1:200

NOTES:

1. FOR ABUTMENT DETAILS REFER TO STRUCTURAL STANDARD DETAILS.
2. ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.
3. MAJOR CONTOURS SHOWN AT 1m INTERVALS
4. MINOR CONTOURS SHOWN AT 0.2m INTERVALS
5. EXCAVATED EXISTING GROUND TO BE REINSTATED AFTER PLACEMENT OF ROCK RIPRAP.
6. ANY LOOSE DEBRIS WITHIN THE WATERWAY IS TO BE REMOVED
7. ROCK TO TIE INTO THE SURROUNDING EMBANKMENT. TOP OF ROCK TO MATCH EXISTING LEVELS.
8. FOR ROCK SPECIFICATION PLEASE REFER TO SECTION C0226 OF THE SPECIFICATION DOCUMENT.

LEGEND:

- ROCK RIP RAP
- EXISTING TOP OF RIVERBANK
- EXISTING BOTTOM OF RIVERBANK
- ULS RIVER FLOW LEVEL
- SLS2 RIVER FLOW LEVEL
- PROPOSED MAJOR CONTOURS (1.0m)
- PROPOSED MINOR CONTOURS (0.2m)
- EXISTING CONTOURS

FOR CLARITY OF DETAILS
VIEW ELECTRONICALLY

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN FOR FRA REVIEW	HD	VH	CH	31.10.23
A	DETAILED DESIGN- FOR COMMENT	HD	VH	CH	13.07.23

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	R. SHAFIEI	13.07.23	Approved For Construction*
Drawn	P. BOY	13.07.23	
Dsg Verifier	A. HARVEY	13.07.23	
Drg Check	R. SHAFIEI	13.07.23	Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: SABETO BRIDGE SCOUR PROTECTION LAYOUT SHEET 1

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B09-25

Rev.: B

Document No. 6103677-CE-B09-25.DWG

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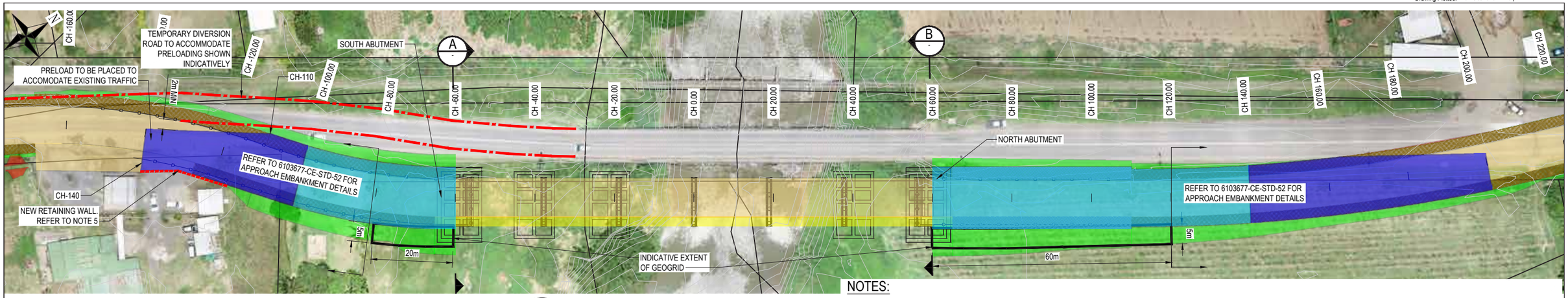


1 - PRELOAD EXTENTS AND EMBANKMENT PLAN

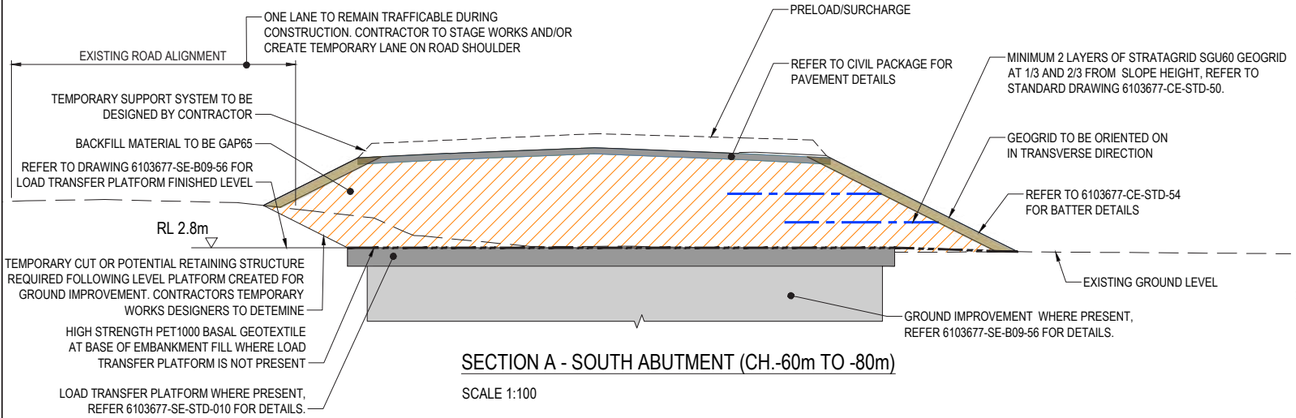
SCALE 1:500

TABLE 1 - TRANSVERSE GRID ELEVATIONS AND LENGTH

CHAINAGES	ELEVATIONS (mRL)	LENGTH (m)
CH. -60 TO -70	3.3, 4.3	5
CH. -70 TO -80	3.3	5
CH. 60 TO 70	3.3, 4.3	5
CH. 70 TO 120	3.3	5

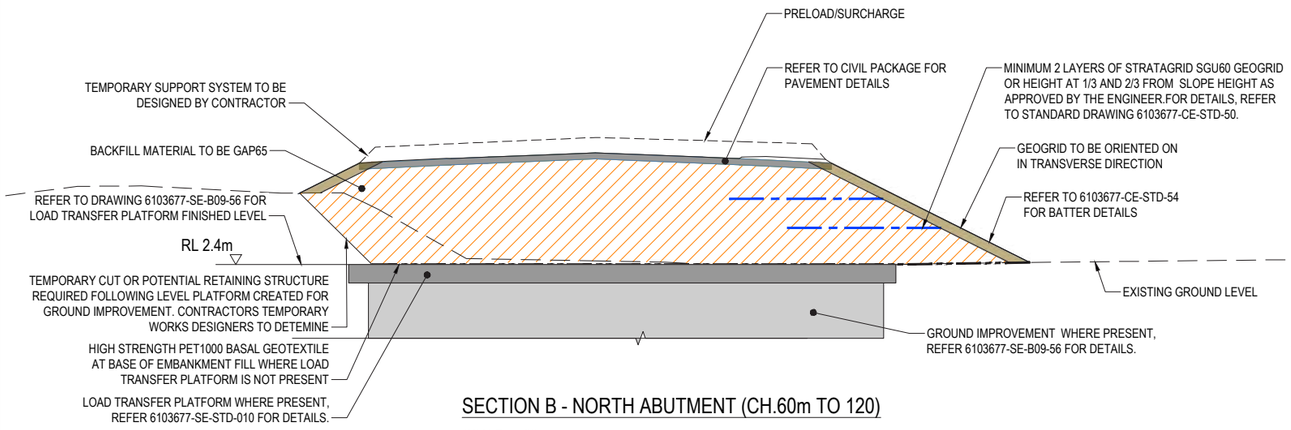
LEGEND:

- COMPACTED GAP 65
- CIRTEX SGU60 OR EQUIVALENT
- SURCHARGE FILL 2m FOR 6 MONTHS
- SURCHARGE FILL 1m FOR 6 MONTHS
- BASAL GEOTEXTILE LAYER



SECTION A - SOUTH ABUTMENT (CH.-60m TO -80m)

SCALE 1:100



SECTION B - NORTH ABUTMENT (CH.60m TO 120)

SCALE 1:100

NOTES:

1. GENERAL

1.1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING, PROTECTING AND/OR RELOCATING ANY UTILITIES AND DRAINAGE PRIOR TO WORKS COMMENCING.

1.2. ALL CONSTRUCTION WORKS SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE EARTHWORKS SPECIFICATION.

1.3. EXISTING SWALE DRAINS ARE TO BE CLEARED OF VEGETATION AND UNSUITABLE SOILS AND BACKFILLED AS PER DETAIL A ON 6103677-CE-STD-53.

1.4. ANY SIGNIFICANT VARIANCES IN GROUND CONDITIONS FROM THOSE PRESENTED IN THESE DRAWINGS MUST BE BROUGHT TO THE ATTENTION OF THE ENGINEER.

1.5. SUBGRADE IMPROVEMENTS AND PAVEMENT LAYER NOT SHOWN ON DRAWINGS FOR CLARITY.

1.6. IN ORDER TO MINIMIZE THE POTENTIAL FOR INSTABILITY OF PERMANENT WORKS ELEMENTS, THE POSITION OF ANY TEMPORARY STOCKPILES SHALL BE AGREED WITH THE ENGINEER.

1.7. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS STATED OTHERWISE.

2. EMBANKMENT

2.1. PRIOR TO FILLING, TOPSOIL AND UNSUITABLE SOILS (INCLUDING HIGHLY ORGANIC SOILS OR SILT, TOXIC MATERIALS, PEAT LOGS, STUMPS, PERISHABLE OR ORGANIC MATERIALS, CONTAMINATED SOILS) SHALL BE EXCAVATED AND REMOVED.

2.2. THE MINIMUM ACCEPTABLE CORRECTED MEASURED UNDRAINED SHEAR STRENGTH (FROM SHEAR VANE TESTING OR CORRELATED UNDRAINED SHEAR STRENGTH (FROM SCALA PENETROMETER TESTING) IS 30kPa. REFER TO PROJECT EARTHWORKS SPECIFICATION FOR TESTING REQUIREMENT.

2.3. WHERE MATERIAL IS ENCOUNTERED THAT DOES NOT MEET THE STRENGTH REQUIRED IN THE EARTHWORKS SPECIFICATION, THE CONTRACTOR SHALL DETERMINE THE EXTENTS AND STRENGTH OF MATERIAL LESS THAN THIS REQUIREMENT FOR FURTHER UNDERCUTTING OR TREATMENT.

2.4. THE CONTRACTOR SHALL EVALUATE, DURING CONSTRUCTION, THE SAFE TAMPORARY BATTER ANGLE FOR ANY EXCAVATION OR FILLING.

2.5. THE MATERIALS AT FORMATION LEVEL SHOULD BE PROTECTED FROM SOFTENING, OVERLOADING (e.g. FROM CONSTRUCTION TRAFFIC) OR OTHER CONDITIONS WHICH MAY RESULT IN WEAKENING OF THESE MATERIALS.

2.6. POSITIVE DRAINAGE OF ALL EXCAVATION WORKS MUST BE MAINTAINED DURING CONSTRUCTION.

2.7. ALL AREAS OF EXPOSED EMBANKMENT SUBGRADE ARE TO BE INSPECTED BY A COMPETENT PERSON TO CONFIRM UNSUITABLE SOILS HAVE BEEN REMOVED. REFER TO EARTHWORKS SPECIFICATION FOR SUBGRADE REQUIREMENTS. QUALITY ASSURANCE DOCUMENTATION TO RECORD INSPECTION AND ACCEPTANCE.

2.8. ALL FILL MATERIALS SHALL MEET THE GRADING, COMPACTION AND TESTING REQUIREMENTS SPECIFIED IN THE EARTHWORKS SPECIFICATION.

2.9. SETTLEMENT MONITORING INSTRUMENTATION DETAILED ON THE DRAWINGS TO BE INSTALLED, AND BASELINE MONITORING COMPLETED, PRIOR TO PLACING EMBANKMENT FILL.

2.10. PLACEMENT OF EMBANKMENT FILL MATERIAL AND PRELOAD FILL MATERIALS SHALL BE STAGED, WITH REST PERIODS OF MINIMUM 1 WEEK BETWEEN 1m HEIGHT FILL LIFTS. DURATION AND FREQUENCY OF REST PERIODS TO BE DETERMINED BY CONTRACTOR. DURATION OF REST PERIODS BETWEEN FILL STAGES TO BE ADJUSTED BY CONTRACTOR TO MANAGE INSTABILITY RISK DURING CONSTRUCTION.

2.11. EMBANKMENT FILL MATERIALS TO BE OVERFILLED TO ACCOUNT FOR SETTLEMENT, LATER TRIMMED / TOPPED UP TO DESIGN PAVEMENT SUBGRADE LEVEL.

3. GEOGRID AND BASAL GEOTEXTILE

3.1. REFER TO THE DRAWINGS AND EARTHWORKS SPECIFICAITON FOR ALL GEOTEXTILE AND GEOGRID REQUIREMENTS.

3.2. LONGITUDINAL GEOGRID, WHERE SPECIFIED, IS LAID WITH THE PRIMARY STRENGTH DIRECTION ALONG THE ROAD CENTRELINE.

3.3. TRANSVERSE GEOGRID, WHERE SPECIFIED, IS LAID WITH THE PRIMARY STRENGTH DIRECTION PERPENDICULAR TO THE ROAD CENTRELINE.

3.4. BASAL HIGH STRENGTH GEOTEXTILES, THE PRIMARY STRENGTH DIRECTION IS TO BE PERPENDICULAR TO THE ROAD CENTRELINE UNLESS SPECIFICALLY SPECIFIED OTHERWISE ON THE DRAWINGS.

3.5. HIGH STRENGTH GEOTEXTILES AND GEOGRIDS ARE TO BE CONTINUOUS IN THEIR PRIMARY STRENGTH DRIECTION AND NOT LAPPED / JOINED.

3.6. WHERE THE HIGH STRENGTH GEOTEXTILES AND / OR GEOGRID LAYERS EXTEND BELOW THE EXISTING GROUND SURFACE, TEMPORARY EXCAVATION WILL BE REQUIRED.

3.7. ALL HIGH STRENGTH GEOTEXTILE AND GEOGRID LAYERS ARE TO BE LAID OUT OVER THER FULL LENGTH AND COVERED AS A SINGLE OPERATION UNLESS AGREED OTHERWISE WITH THE ENGINEER. HIGH STRENGTH GEOTEXTILE AND GEOGRID LAYERS ARE TO BE COVERED WITHIN 3 DAYS OF PLACING.

3.8. NO TRAFFIC OF SITE PLANT SHALL BE PERMITTED TRAFFIC. THE GEOGRID OR HIGH STRENGTH GEOTEXTILE LAYERS WHERE COVER IS LESS THAN 200mm.

3.9. GEOGRID WITHIN FILL EMBANKMENTS (EXCLUDING RETAINING STRUCTURES) SHALL BE PLACED WITH A MINIMUM VERTICAL SPACING OF 500mm BETWEEN LAYERS UNLESS SPECIFICALLY SPECIFIED OTHERWISE ON THE DRAWINGS.

4. PRELOAD SURCHARGING OF EMBANKMENTS

4.1. WHERE SHOWN ON THE DRAWINGS THE FILL EMBANKMENTS ARE TO BE SURCHARGED WITH PRELOAD TO ACCELERATE THE RATE OF CONSOLIDATION SETTLEMENT DURING CONSTRUCTION. REFER THE PROJECT EARTHWORKS SPECIFICATION FOR PRELOAD AND SURCHARGE SPECIFICATION.

4.2. THE PRELOAD SHALL COMPRISE GAP65 AGGREGATE WITH A PLACED DENSITY NOT LESS THAN 2.2t/m³.

4.3. THE PRELOAD FILL SHOULD BE PLACED NO STEEPER THAN 1.5H:1V SLOPE UNLESS THE CONTRACTOR PROVIDES A TEMPORARY SUPPORT SYSTEM.

4.4. SETTLEMENT OF THE EMBANKMENT SHALL BE MONITORED DURING CONSTRUCTION WITH INSTRUMENTATION SHOWN ON THE DRAWINGS.

4.5. PRELOAD / SURCHARGE IS TO REMAIN IN PLACE UNTIL RESIDUAL CONSOLIDATION SETTLEMENT IS ESTIMATED TO BE LESS THAN 50mm, AS ADVISED BY THE ENGINEER FOLLOWING ANALYSIS OF THE FIELD DATA TO UPDATE SETTLEMENT ESTIMATES.

4.6. FOLLOWING REMOVAL OF THE PRELOAD ALL FILL MATERIALS REMAINING IN THE PERMEANT WORKS SHALL COMPLY WITH THE MATERIALS TYPE AND FIELD COMPACTION STATED ON THE DRAWINGS AND SPECIFICATION.

4.7. ESTIMATED DURATION OF PRELOADING IS SIX MONTHS WITH THE ACTUAL DURATION TO BE CONFIRMED WITH THE ENGINEER.

5. FOR NEW GRAVITY RETAINING WALL REFER TO DETAILS IN DRAWING CE-STD-45 WITH ADJUSTMENT AS SHOWN BELOW.

- NO GEOGRID
- 300 x 300m REINFORCED CONCRETE FOOTING
- MININUM 300mm EMBEDMENT DEPTH
- DH16 CENTRALLY PLACED IN EVRY BLOCK CORE AND EXTEND WITH 250mm EMBEDMENT INTO FOOTING. TO TERMINATE WITH STANDARD HOOK.

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN FOR FRA REVIEW	JL	VH	CH	31.10.23
A	DETAILED DESIGN- FOR COMMENT	JL	VH	CH	13.07.23

Original Scale (A1) AS SHOWN	Design	J.LEE	13.07.23
	Drawn	M.ANONUEVO	13.07.23
Reduced Scale (A3) HALF SHOWN	Dsg Verifier	C. HATLEY	13.07.23
	Drg Check	C. HATLEY	13.07.23

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: SABETO BRIDGE EMBANKMENT DETAILS AND PRELOAD SURCHARGE

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B09-30

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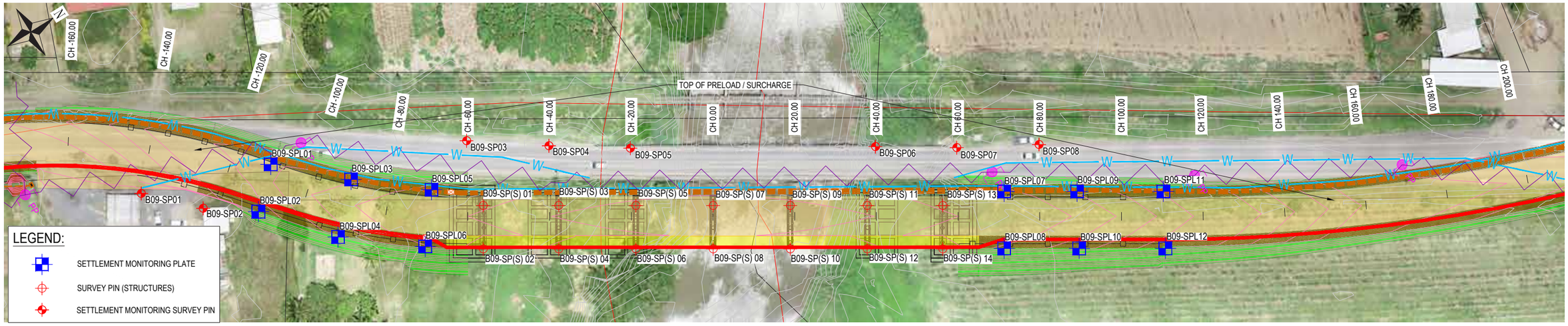
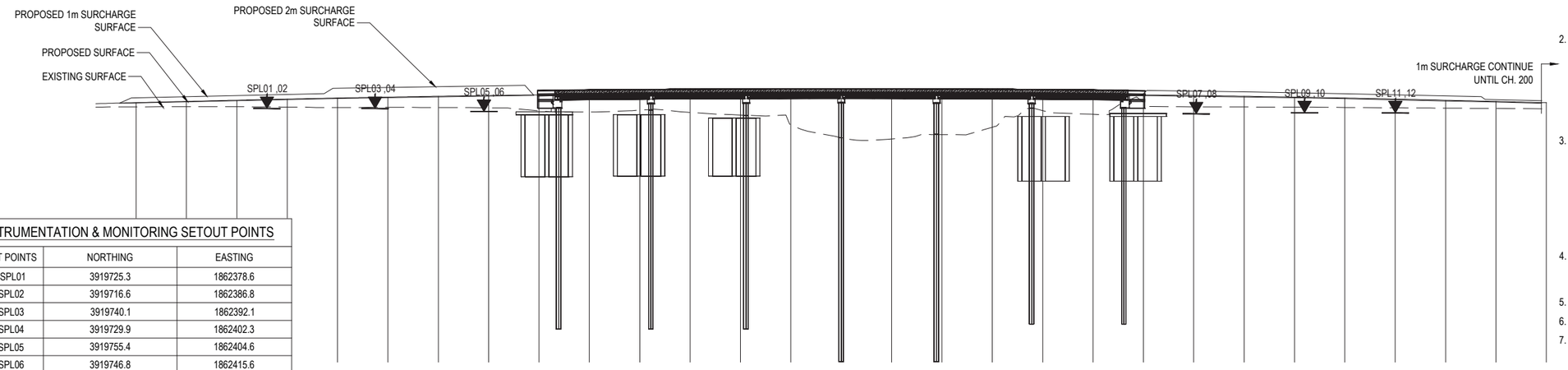


1 - OFF-LINE REPLACEMENT
SCALE 1:500



OFF-LINE REPLACEMENT
SCALE 1:500

INSTRUMENTATION & MONITORING SETOUT POINTS

SETOUT POINTS	NORTHING	EASTING
B09- SPL01	3919725.3	1862378.6
B09-SPL02	3919716.6	1862386.8
B09-SPL03	3919740.1	1862392.1
B09-SPL04	3919729.9	1862402.3
B09-SPL05	3919755.4	1862404.6
B09-SPL06	3919746.8	1862415.6
B09-SPL07	3919874.3	1862479.0
B09-SPL08	3919866.9	1862490.8
B09-SPL09	3919889.4	1862488.4
B09-SPL10	3919882.5	1862500.5
B09-SPL11	3919907.4	1862499.6
B09-SPL12	3919900.5	1862511.7
B09-SP01	3919694.6	1862367.9
B09-SP02	3919705.5	1862379.0
B09-SP03	3919769.0	1862399.0
B09-SP04	3919785.5	1862410.6
B09-SP05	3919802.1	1862421.7
B09-SP06	3919853.3	1862453.0
B09-SP07	3919870.1	1862463.8
B09-SP08	3919887.6	1862473.7
B09-SP(S) 01	3919764.1	1862414.6
B09-SP(S) 02	3919758.5	1862423.6
B09-SP(S) 03	3919779.8	1862424.3
B09-SP(S) 04	3919774.2	1862433.4
B09-SP(S) 05	3919795.9	1862434.3
B09-SP(S) 06	3919790.3	1862443.3
B09-SP(S) 07	3919811.9	1862444.3
B09-SP(S) 08	3919806.3	1862453.3
B09-SP(S) 09	3919828.0	1862454.3
B09-SP(S) 10	3919822.4	1862463.3
B09-SP(S) 11	3919844.0	1862464.2
B09-SP(S) 12	3919838.4	1862473.2
B09-SP(S) 13	3919859.7	1862474.0
B09-SP(S) 14	3919854.1	1862483.0

INSTRUMENTATION & MONITORING FREQUENCY

INSTRUMENT DETAILS			INSTRUMENT MONITORING FREQUENCY			
INSTRUMENT	LOCATION	INSTALLATION	BASE	DURING CONSTRUCTION	DURING HOLD PERIODS	BACKGROUND CONSTRUCTION
SETTLEMENT PLATE B09-SPL01 - B09-SPL12	NATURAL GROUND IMMEDIATELY BENEATH THE EMBANKMENT FILL	PRIOR TO INSTALLATION ON ANY FILL	THREE TIMES BEFORE FILLING	WEEKLY	VARIES WEEKLY TO MONTHLY AS AGREED WITH ENGINEER	MONTHLY
SURVEY PINS B09-SP01 - B09-SP08	ON EXISTING RAILWAY / PUMPSTATION	PRIOR TO ANY PHYSICAL WORKS				
SURVEY PINS -STRUCTURES B09-SP(S)01 - B09-SP(S)14	NEW BRIDGE ABUTMENT AND PIERS (WHEN CONSTRUCTED PRIOR TO FILLING OR PRELOAD PERIOD COMPLETE	PRIOR TO INSTALLATION ON ANY FILL	IMMEDIATELY AFTER CONSTRUCTION OF THE STRUCTURAL ELEMENT.	EVERY SECOND WEEK UNLESS AGREED OTHERWISE WITH ENGINEER	N/A	N/A

NOTES:

1. CONTRACTOR CONSTRUCTION METHODOLOGY, SEQUENCING AND PROPOSED PRELODING SURCHAGE PROGRAMME TO BE PROVIDED TO THE ENGINEER PRIOR TO COMMENCMENT OF WORKS.
2. THE PROPOSED INSTALLATION LOCATIONS FOR INSTRUMENTS AIM TO POSITION THEM AWAY FROM CONSTRUCTION ACTIVITIES TO MINIMISE THE CHANCE OF DAMAGE TO THE INSTRUMENTS. THE FINAL LOCATION OF INSTRUMENTS SHALL BE CONFIRMED ON SITE WITH THE ENGINEER AND THE CONTRACTOR SHALL TAKE ALL PRACTICAL MEASURES TO PROTECT ALL MONITORING INSTRUMENTS DURING ALL PHASES OF CONSTRUCTION (e.g. EARTHWORKS, WEATHER, TRAFFIC, OTHER CONSTRUCTION ACTIVITIES).
3. IN THE EVENT THAT THE INSTRUMENTS ARE DAMAGED THE ENGINEER SHALL BE IMMEDIATELY INFORMED AND, IF REQUIRED BY THE ENGINEER DEPENDING ON THE DEGREE OF DAMAGE, ALL CONSTRUCTION WORKS NEAR TO THE AFFECTED INSTRUMENTATION SHALL CEASE. THE DAMAGED INSTRUMENTS SHALL BE IMMEDIATELY REPLACED AND RE-BASELINED WITHIN 24 HOURS (UNLESS OTHERWISE AGREED WITH THE ENGINEER) AND WHERE CONSTRUCTION WORKS ARE HALTED, THEY SHALL NOT RESTART UNTIL THE REPLACEMENT INSTRUMENT IS FULLY OPERATIONAL.
4. THE MONITORING RESULTS SHALL BE PROVIDED TO THE ENGINEER ON A WEEKLY BASED. THE ENGINEER WILL REVIEW MONITORING RESULTS AND WILL CONFIRM THE END OF THE SETTLEMENT PERIOD.
5. MONITORING FREQUENCY MAY BE ALTERED AS ACCEPTED BY THE ENGINEER.
6. REFER TO 6103677-CE-STD-55 FOR SURVEY PINS TRIGGER LEVELS.
7. THE INSTALLATION AND MONITORING OF INSTRUMENTATION AND THE COLLATION OF DATA AND REVIEW OF RESULTS AGAINST THE TRIGGER LEVELS PROVIDED BY THE ENGINEER SHALL BE CARRIED OUT BY THE CONTRACTOR (OR SUITABLE PERSONNEL OR ORGANISATIONS NOMINATED BY THE CONTRACTOR WHO ARE EXPERIENCED AND COMPETENT IN SUCH WORK). ANY EXCEEDANCE OF THE TRIGGER LEVELS SHOULD BE REPORTED TO THE ENGINEER IMMEDIATELY
8. THE REQUIREMENTS OF INSTRUMENTATION AND MONITORING SPECIFICATION APPLY UNLESS OTHERWISE NOTED ON THESE DRAWINGS. FOR SPECIFICATION AND INSTRUMENTATION DETAILS REFER 6103677-CE-STD-55 TO 6103677-CE-STD-58.

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NOT FOR CONSTRUCTION

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B	DETAILED DESIGN FOR FRA REVIEW	JL	VH	CH	31.10.23
A	DETAILED DESIGN- FOR COMMENT	JL	VH	CH	13.07.23

Original Scale (A1) 1:500
Reduced Scale (A3) 1:1000

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Drawn	M.ANONUEVO	13.07.23	
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Drg Check	C. HATLEY	13.07.23	Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: SABETO BRIDGE GEOTECHNICAL INSTRUMENTATION AND MONITORING DETAILS
Discipline: CIVIL ENGINEERING
Drawing No.: 6103677-CE-B09-31
Rev.: B
Document No.: 6103677-CE-B09-31.DWG

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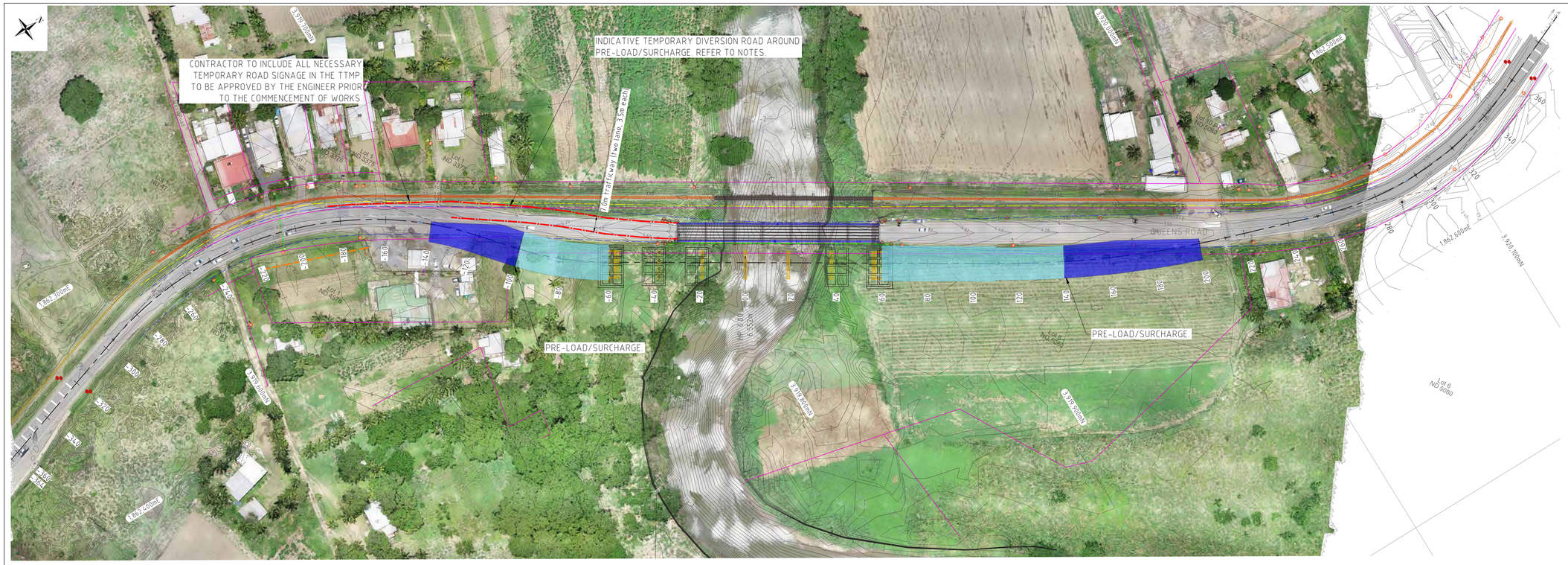
Drawing Plotted: 31 Oct 2023 5:09 pm



1 TEMPORARY DIVERSIONS PLAN

SCALE 1:1000(A3)

NOTES:

1. REFER TO DRAWING 6103677-CE-B09-10 FOR NOTES.
2. DIVERSION ROAD ALIGNMENT IS INDICATIVE DESIGN VEHICLE IS 19m LONG SEMI TRAILER CONTRACTOR TO DESIGN DIVERSION ROAD TO ALLOW 19m LONG SEMI TRAILER AND 8.8m SINGLE UNIT TRUCK TO PASS ONE ANOTHER. DESIGN TO MAKE ALLOWANCE FOR TRACKING OF DESIGN VEHICLE PLUS A 0.5m BUFFER EACH SIDE, AND PROVISION OF LANE WIDENING WHERE REQUIRED. ALIGNMENT DESIGN AND TRACKING TO BE SUPPLIED TO THE ENGINEER FOR REVIEW PRIOR TO CONSTRUCTION.
3. DIVERSION ROAD PAVEMENT DESIGN IS CONTRACTOR'S RESPONSIBILITY. ROAD TO BE DESIGNED AS ALL WEATHER ROAD WITH CHIPSEAL SURFACE DESIGN THICKNESS TO ALLOW FOR OVERLOADED VEHICLES AND PROTECTION OF THE SUBGRADE SOILS FROM BEARING AND/OR SHEAR FAILURE.
4. ANY TEMPORARY RETAINING WALLS REQUIRED FOR TEMPORARY DIVERSION ROAD ALIGNMENT SHALL BE DESIGNED BY THE CONTRACTOR.

DESIGN SPEED
TEMPORARY SPEED 50km/h
SIGNED SPEED 30km/h

SCALE 1:2000(A3):

0 25 50 75

FOR CLARITY OF DETAILS VIEW ELECTRONICALLY

DETAILED DESIGN NOT FOR CONSTRUCTION

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A	DETAILED DESIGN - FOR FRA REVIEW.	RAI	TE	CH	31/10/23

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Reduced Scale (A3) 1:2000

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Drawn	R Imrie	05/10/23
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Drg Check	C Hatley	05/10/23

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× Refer to Revision 1 for Original Signature

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Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: SABETO BRIDGE TEMPORARY DIVERSIONS ROADING PLAN

Discipline: INFRASTRUCTURE

Drawing No.: 6103677-CE-B09-40

Rev.: A

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Document No. PRE FEAS 11 A 1 P1 5 DWG

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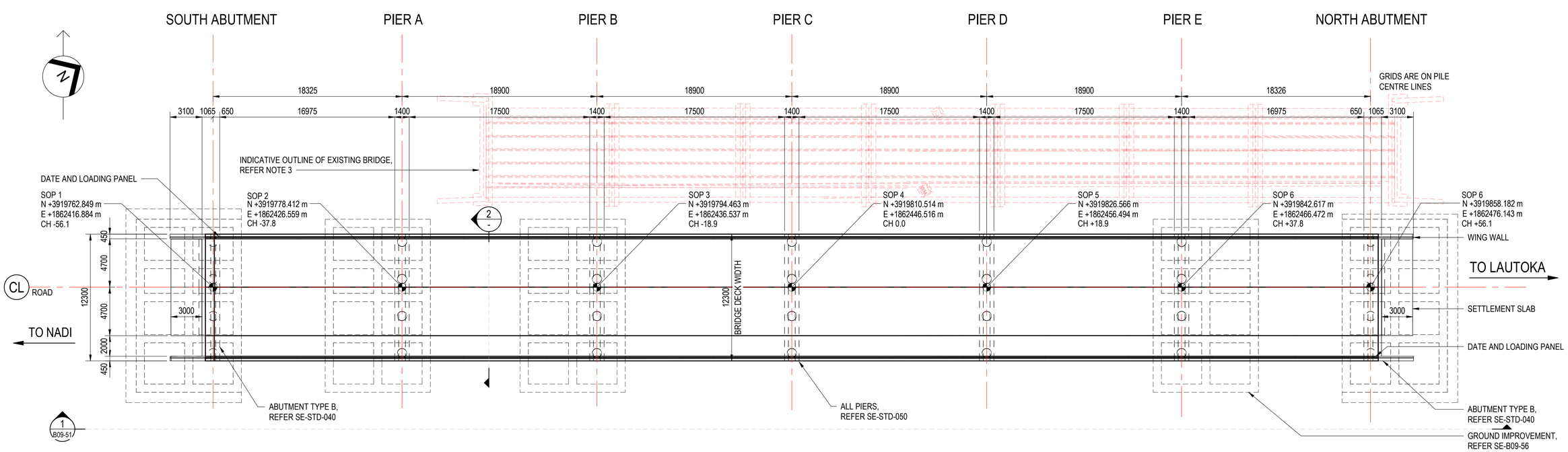
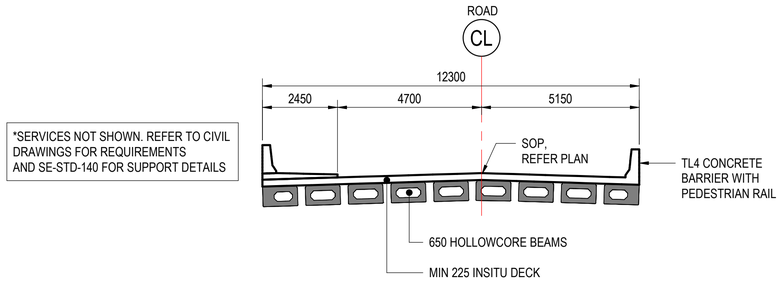


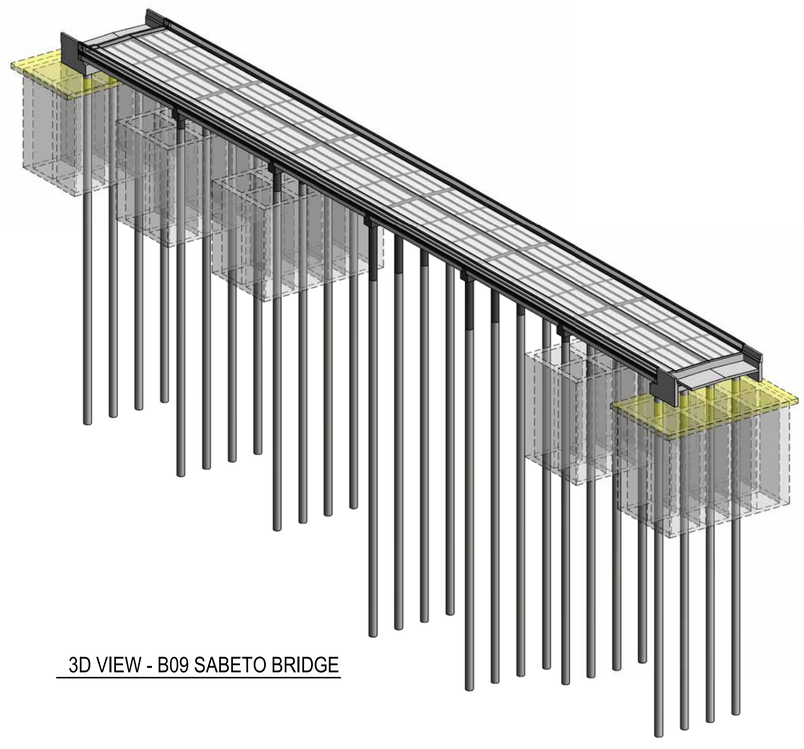
A - BRIDGE PLAN
1 : 200



*SERVICES NOT SHOWN. REFER TO CIVIL DRAWINGS FOR REQUIREMENTS AND SE-STD-140 FOR SUPPORT DETAILS

FOR DETAILS REFER SECTION 3 / SE-STD-005

2 - SECTION
1 : 100



3D VIEW - B09 SABETO BRIDGE

NOTES.

1. FOR SITE LAYOUT, FEATURES, AND ROAD CORRIDOR DETAILS REFER TO 6103677-CE-B09-10, ROADING PLAN AND PROFILE, AND THE RELATED CIVIL DRAWINGS.
2. VERTICAL HEIGHT DATUM IS FIJI HEIGHT DATUM. FOR DETAILS REFER TO FRA'S TOPOGRAPHICAL SURVEY DRAWING SS 25/22.
3. THE OUTLINE OF EXISTING BRIDGE IS AS PER FRA'S TOPOGRAPHICAL SURVEY DRAWING SS 25/22. THE CONTRACTOR SHALL CONFIRM POSITION OF THE BRIDGE PRIOR TO THE CONSTRUCTION.
4. THESE BRIDGE SPECIFIC DRAWINGS SHALL BE READ TOGETHER WITH AND REFER TO STANDARD DRAWINGS, SPECIFICALLY:
   - 6103677-SE-STD-001 T0 004 FOR GENERAL NOTES
   - 6103677-SE-STD-010 SERIES FOR GROUND IMPROVEMENT DETAILS
   - 6103677-SE-STD-020 SERIES FOR PILE DETAILS
   - 6103677-SE-STD-040 SERIES FOR ABUTMENT TYPE B DETAILS
   - 6103677-SE-STD-050 SERIES FOR PIER DETAILS
   - 6103677-SE-STD-060 SERIES FOR SUPERSTRUCTURE DETAILS
   - 6103677-SE-STD-070 SERIES FOR PRECAST PRESTRESSED SHC BEAM DETAILS
   - 6103677-SE-STD-100 SERIES FOR DECK DETAILS
   - 6103677-SE-STD-110 SERIES FOR BARRIER DETAILS.
   - 6103677-SE-STD-140 FOR SERVICE SUPPORT DETAILS
   - 6103677-SE-STD-180 FOR STANDARD BRIDGE ANTICIPATED CONSTRUCTION SEQUENCE.
5. FOR FINISHED DESIGN LEVELS REFER TO DRAWING CE-B09-10 AND SE-B09-51

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN, FOR FRA REVIEW	RS	DC	TP	31.10.23
B	DETAILED DESIGN, FOR FRA COMMENT	TZ	VH	CH	13.07.23
A	FOR FRA REVIEW	MM	NK	TP	28.02.23

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Sub-consultant: Erasito
Main-consultant: beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: B09 SABETO BRIDGE - BRIDGE PLAN
Discipline: STRUCTURAL
Drawing No.: 6103677-SE-B09-50
Rev.: C

Document No. Autodesk Docs://6450911 - FRA 40+3/6103677-B09-SE-2023.rvt

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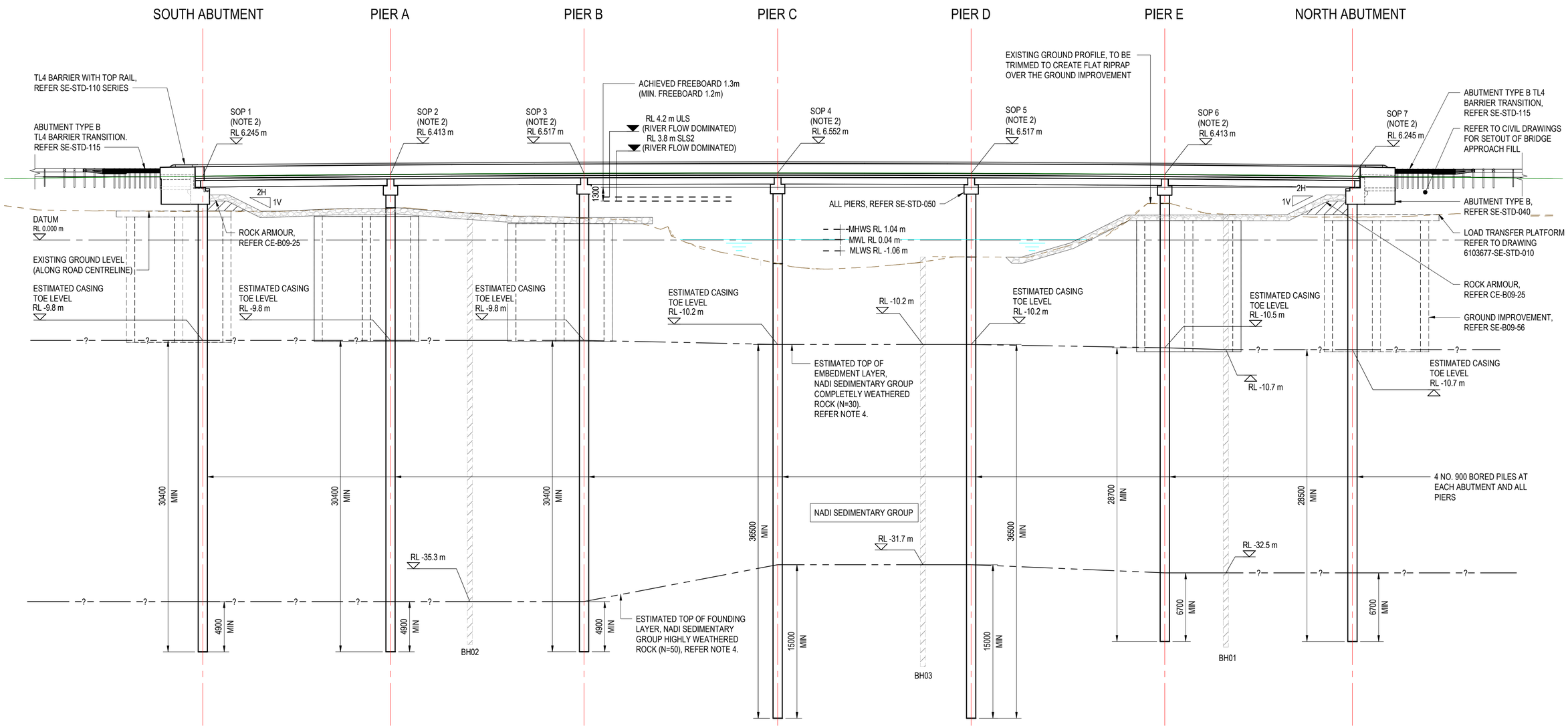
NOTES.

1. REFER TO 6103677-SE-B09-50 FOR NOTES.
2. REFER TO SE-B09-50 FOR SETOUT POINTS LOCATION IN PLAN VIEW. LEVELS ARE GIVEN AT THE TOP OF DECK AT INTERSECTION WITH ROAD CENTRELINE, REFER TO SE-B09-50 SECTION 2 FOR LOCATION.
3. SOIL/ROCK DESCRIPTION IN ACCORDANCE WITH NEW ZEALAND GEOTECHNICAL SOCIETY GUIDANCE. REFER TO ENTEC FACTUAL GEOTECHNICAL REPORT FOR FURTHER INFORMATION. FOR BOREHOLE DETAILS REFER TO ENTEC'S FACTUAL REPORT: 1419_SABETO BRIDGE,NADI,QUEENS ROAD,VITILEVU,FIJI,2022.
4. ACTUAL TOP OF EMBEDMENT LAYER (PILE CASING TOE LEVEL) AND PILE FOUNDING LAYER LEVELS FOR ALL PILES SHALL BE CONFIRMED BY THE ENGINEER FOLLOWING PROOF BORES, AND PILE FOUNDING LEVELS ADJUSTED ACCORDINGLY. REFER STRUCTURAL STANDARD DETAILS BRIDGE SPECIFIC DRAWING SE-STD-020.



1 / B09-50 ELEVATION
1 : 200

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN, FOR FRA REVIEW	RS	DC	TP	31.10.23
B	DETAILED DESIGN, FOR FRA COMMENT	TZ	VH	CH	13.07.23
A	FOR FRA REVIEW	MM	NK	TP	28.02.23

Original Scale (A1) 1 : 200
Reduced Scale (A3) 1 : 400

Design	D. CVITANICH	10.2023
Drawn	R. SATTAYAPORN	10.2023
Dsg Verifier	T. POLLEY	10.2023
Drg Check	T. POLLEY	10.2023

Sub-consultant: Erasito
Main-consultant: Beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: B09 SABETO BRIDGE - BRIDGE ELEVATION
Discipline: STRUCTURAL
Drawing No.: 6103677-SE-B09-51
Rev.: C

DO NOT SCALE FOR SET OUT DIMENSIONS

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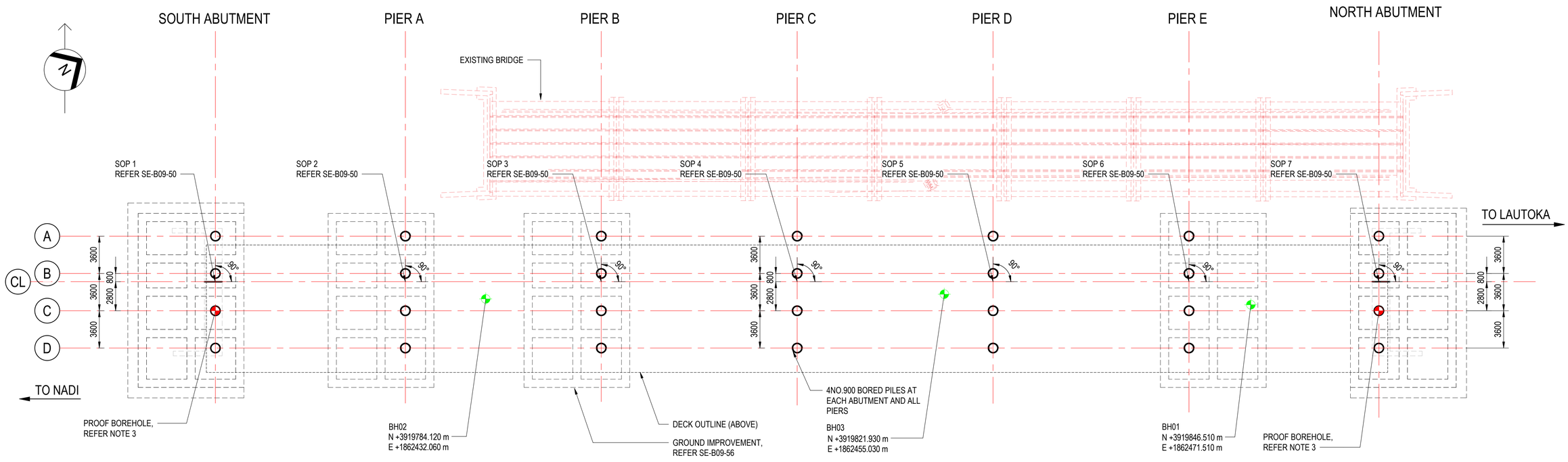
Drawing Plotted: 10/30/2023 2:09:29 PM

NOTES

1. REFER TO DRAWING SE-B09-50 FOR NOTES.
2. REFER TO STANDARD PILING DRAWINGS SE-STD-020 TO 021 FOR DETAILS.
3. PROOF BOREHOLE TO BE UNDERTAKEN IN ADVANCE OF THE PILING TO 4xPILE DIAMETERS BELOW THE ESTIMATED FOUNDING LEVEL OF THE PILES AT PROOF BORE LOCATIONS AS SHOWN ON DRAWING SE-B09-51. PROOF BORES TO BE COMPLETED ON CENTRELINE OF PILES AT THE LOCATIONS INDICATED ON THE PILING PLAN.



FOR SETOUT OF GRID LINES REFER TO SE-B09-50

PILING PLAN

1 : 200

PILE REINFORCING INFORMATION

	LONGITUDINAL BARS				SPIRALS									
LOCATION	LENGTH "Y"	GROUP 1	GROUP 2	PHZs*	SPIRAL TYPE A	DIST "A'	SPIRAL TYPE B	DIST "B"	SPIRAL TYPE C	DIST "C"	SPIRAL TYPE D	DIST "D"	SPIRAL TYPE E	DIST "E"
SOUTH ABUTMENT	FULL LENGTH	10RB32	—	0m - 3.5m & 5.5 - 16.5m	RH16-300	12000	PAIRED RH20-150	5500	RH16 -175	4000	RH16 -300	REMAINING LENGTH	—	—
PIERS A, B, E	FULL LENGTH	10RB32	—	0m - 2m & 5.5 - 16.5m	RH16-90	2000	RH16 -175	7000	RH16 -300	4000	PAIRED RH20-180	5500	RH16 -300	REMAINING LENGTH
PIERS C, D	FULL LENGTH	10RB32	—	0m - 2m & 8 - 16.5m	RH16-90	2000	RH16 -175	7000	RH16 -300	4000	RH16 -200	5500	RH16 -300	REMAINING LENGTH
NORTH ABUTMENT	FULL LENGTH	10RB32	—	0m - 3.5m & 5.5 - 16.5m	RH16-300	13000	PAIRED RH20-150	5500	RH16 -175	4000	RH16-300	REMAINING LENGTH	—	—

* NO LAPPING OF LONGITUDINAL REINFORCEMENT IS ALLOWED IN PLASTIC HINGE ZONES (PHZs)
REFER TO BORED PILE DRAWING SE-STD-021 FOR REINFORCING CALLOUT

BEWARE:

THE CONTRACTOR SHALL CONFIRM THAT THERE IS NO CONFLICT WITH UNDERGROUND SERVICES (EXISTING, NEWLY INSTALLED AND / OR TEMPORARY) AND / OR IMPLEMENT APPROPRIATE PROTECTION MEASURES PRIOR TO CARRYING OUT ANY PILE INSTALLATION OR EXCAVATION WORKS.

LEGEND:

- PROOF BORE LOCATION (2m SOUTH-EAST OF PILE LOCATION)
- DESIGN INVESTIGATION BORE LOCATION (FOR INFORMATION)

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN, FOR FRA REVIEW	RS	DC	TP	31.10.23
A	DETAILED DESIGN, FOR FRA COMMENT	TZ	VH	CH	13.07.23

Original Scale (A1)	1 : 200	
Reduced Scale (A3)	1 : 400	
Design	D. CVITANICH	10.2023
Drawn	R. SATTAYAPORN	10.2023
Dsg Verifier	T. POLLEY	10.2023
Drg Check	T. POLLEY	10.2023

Sub-consultant: Erasito
Main-consultant: Beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: B09 SABETO BRIDGE - PILING PLAN
Discipline: STRUCTURAL
Drawing No.: 6103677-SE-B09-55
Rev.: B

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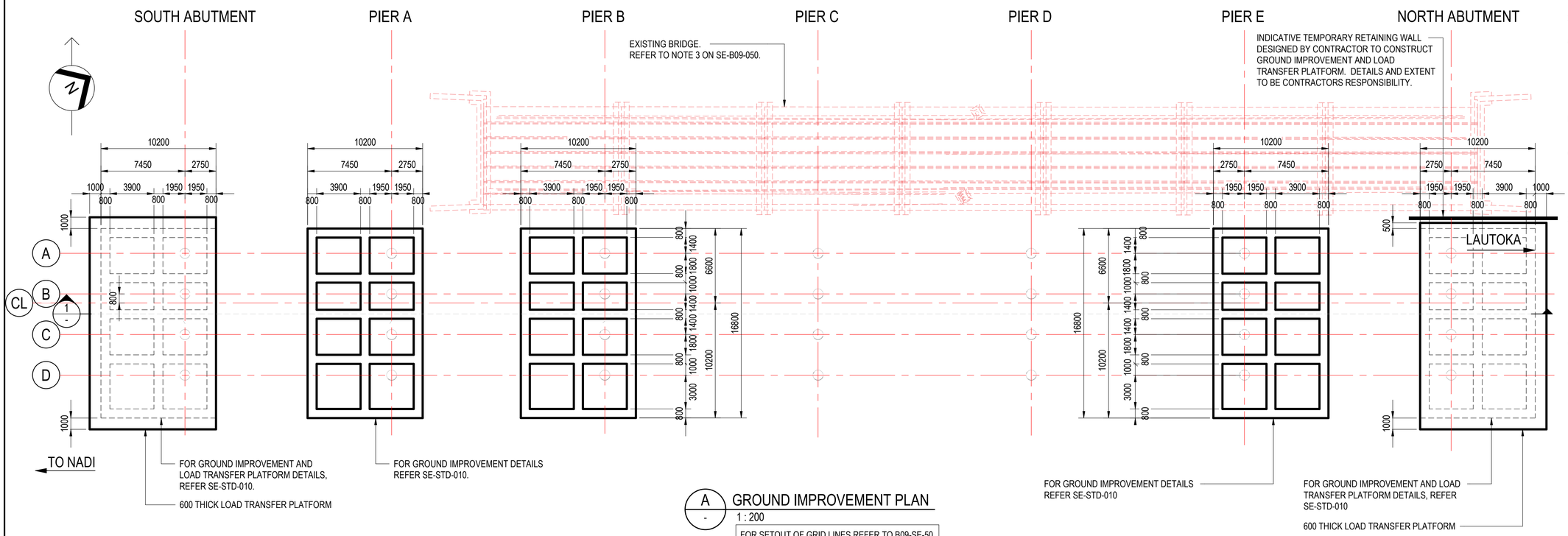


A - GROUND IMPROVEMENT PLAN
1 : 200
FOR SETOUT OF GRID LINES REFER TO B09-SE-50

NOTES:

1. REFER TO DRAWING SE-B05-50 FOR NOTES.
2. CSM NOTES:

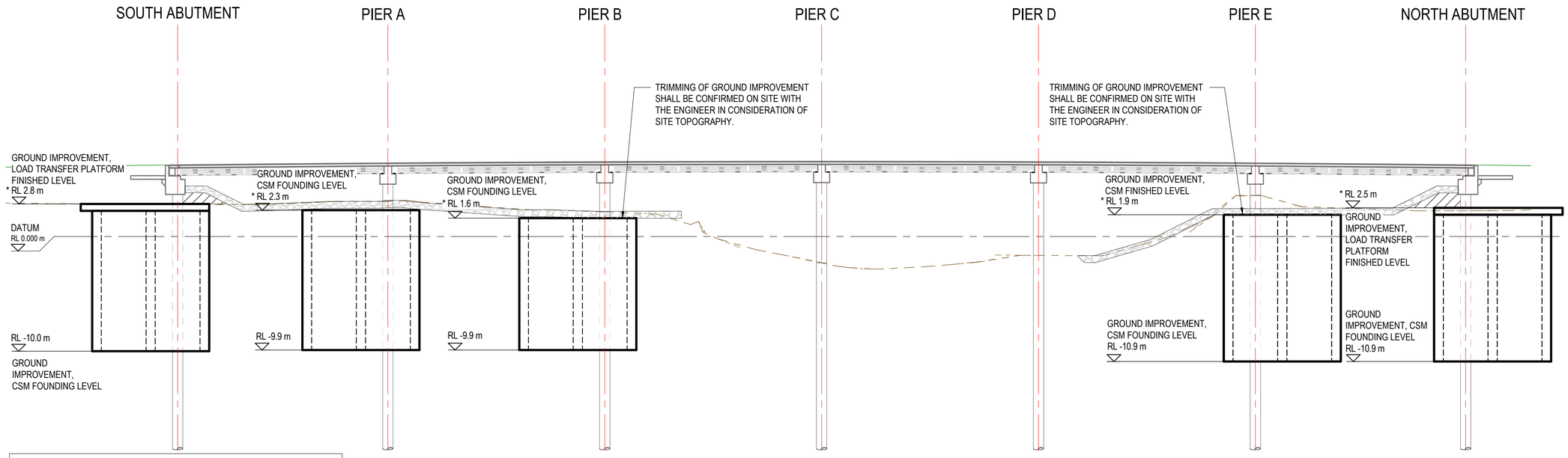
a. CSM PANELS TO BE CONSTRUCTED WITH THE FOLLOWING SPECIFICATION:

- MIN.SHEAR STIFFNESS OF 1250MPa
- MIN. YOUNG'S MODULUS OF 3000MPa
- MIN. AREA REPLACEMENT RATIO: 30%

b. CSM TO BE CONSTRUCTED IN ACCORDANCE WITH SPECIFICATION C0414.

c. CONTRACTOR TO CONSIDER THE CONSTRAINTS OF THE EXISTING BRIDGE, SITE BOUNDARIES, AND WATERWAY DURING CONSTRUCTION OF THE GROUND IMPROVEMENT.

3. REFER TO THE PROJECT EARTHWORKS SPECIFICATION FOR FORMATION LEVEL TESTING REQUIREMENTS. WHERE THE MATERIAL ENCOUNTERED DOES NOT MEET THE STRENGTH REQUIRED IN THE PROJECT EARTHWORKS SPECIFICATION, THE CONTRACTOR SHALL DETERMINE THE EXTENTS OF MATERIAL WITH STRENGTH LESS THAN THIS REQUIREMENT FOR FURTHER UNDERCUTTING OR TREATMENT.
4. GROUND IMPROVEMENT SHALL BE CONSTRUCTED IN A SEQUENCE SO THAT THE TEMPORARY RETAINING WALL IS NOT UNDERMINED OR MADE UNSTABLE.



1 / B09-56 - LONG SECTION
1 : 200
*TOP OF GROUND IMPROVEMENT TO MATCH EXISTING GROUND LEVELS. DIMENSIONS SHOWN ARE INDICATIVE

BEWARE:

THE CONTRACTOR SHALL CONFIRM THAT THERE IS NO CONFLICT WITH UNDERGROUND SERVICES (EXISTING, NEWLY INSTALLED AND / OR TEMPORARY) AND / OR IMPLEMENT APPROPRIATE PROTECTION MEASURES PRIOR TO CARRYING OUT ANY PILE INSTALLATION OR EXCAVATION WORKS.

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN, FOR FRA REVIEW	RS	DC	TP	31.10.23
A	DETAILED DESIGN, FOR FRA COMMENT	TZ	VH	CH	13.07.23

Original Scale (A1)	1 : 200	
Reduced Scale (A3)	1 : 400	
Design	D. CVITANICH	10.2023
Drawn	R. SATTAYAPORN	10.2023
Dsg Verifier	T. POLLEY	10.2023
Drg Check	T. POLLEY	10.2023

Sub-consultant: Erasito
Main-consultant: Beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: B09 SABETO BRIDGE - GROUND IMPROVEMENT PLAN
Discipline: STRUCTURAL
Drawing No.: 6103677-SE-B09-56
Rev.: B

DO NOT SCALE FOR SET OUT DIMENSIONS

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Document No. Autodesk Docs://6450911 - FRA 40+3/6103677-B09-SE-2023.rvt

Co-designed by: Erasito | Co-designed, Verified and Issued by: Beca

FRA/TIISP/20-13 - 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

PRIORITY 1 - B10, LOMOLOMO BRIDGE

Prepared for: FIJI ROAD AUTHORITY
Prepared by: BECA INTERNATIONAL CONSULTANTS LTD

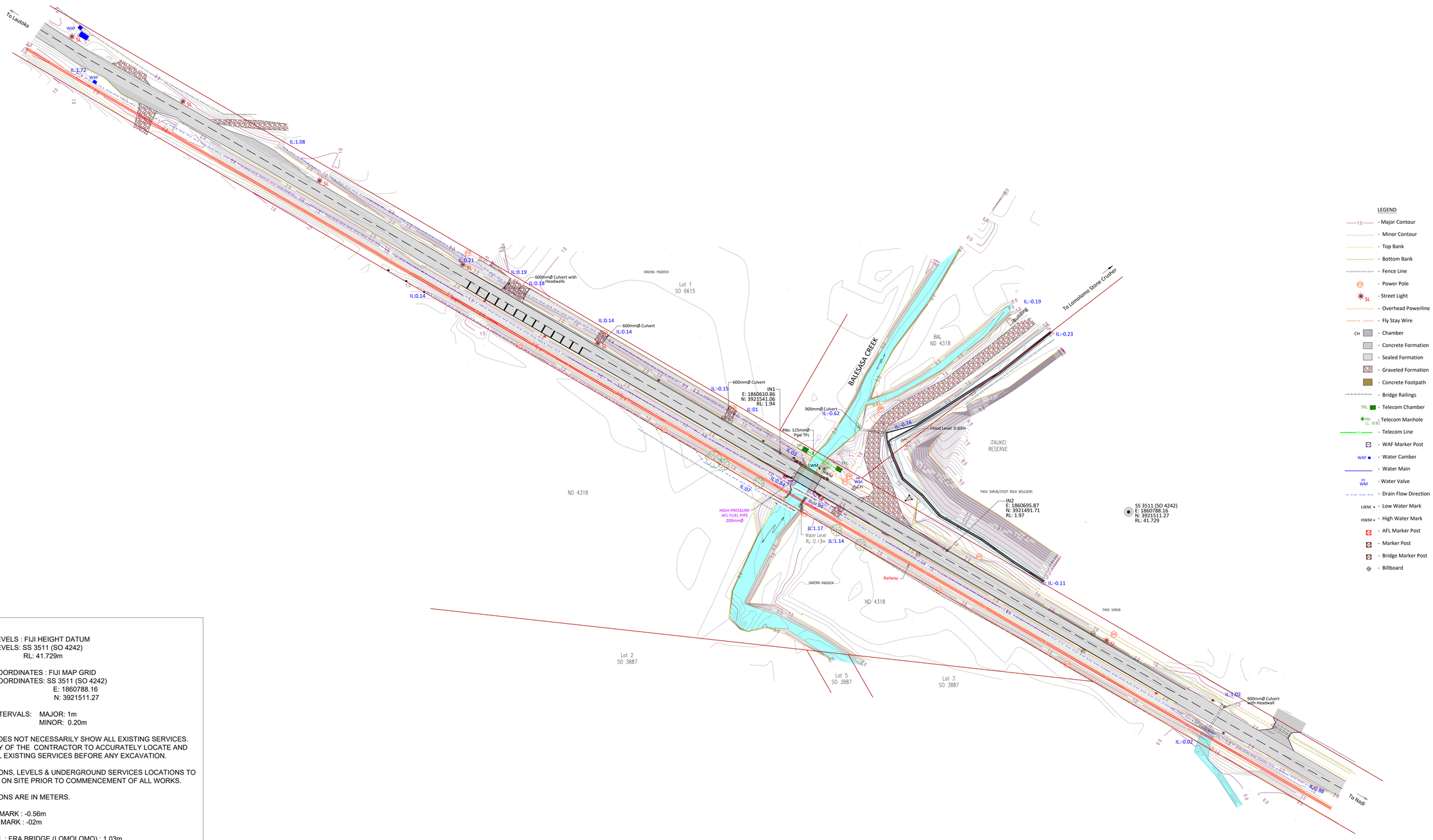
Project No.: 6103677

ISSUED FOR DETAILED DESIGN

	DRAWING STATUS	CONCEPT DESIGN	DETAILED DESIGN FOR COMMENT	DETAILED DESIGN FOR FRA REVIEW
	DAY	03	06	21
	MONTH	02	07	03
	YEAR	2023	2023	2024
DRAWING NO	DRAWING TITLE	REV.	REV.	REV.
6103677-CE-B10-00	COVER SHEET AND REVISION HISTORY	A	B	C
FRA: SS 26 / 22	TOPOGRAPHICAL SURVEY	0	0	0
6103677-CE-B10-10	LOMOLOMO BRIDGE ROADING PLAN AND PROFILE - SHEET 1	A	B	C
6103677-CE-B10-11	LOMOLOMO BRIDGE ALIGNMENT & ROADING DETAILS	-	A	B
6103677-CE-B10-12	LOMOLOMO BRIDGE MAIN ROAD CROSS SECTIONS - SHEET 1	A	B	C
6103677-CE-B10-13	LOMOLOMO BRIDGE MAIN ROAD CROSS SECTIONS - SHEET 2	A	B	C
6103677-CE-B10-14	LOMOLOMO BRIDGE MAIN ROAD CROSS SECTIONS - SHEET 3	A	B	C
6103677-CE-B10-15	LOMOLOMO BRIDGE MAIN ROAD CROSS SECTIONS - SHEET 4	A	B	C
6103677-CE-B10-16	LOMOLOMO BRIDGE MAIN ROAD CROSS SECTIONS - SHEET 5	A	B	C
6103677-CE-B10-17	LOMOLOMO BRIDGE ROAD MARKINGS AND SIGNS	A	B	C
6103677-CE-B10-18	LOMOLOMO BRIDGE STORMWATER GENERAL ARRANGEMENT PLAN	-	A	B
6103677-CE-B10-20	LOMOLOMO BRIDGE PROPOSED UTILITIES	A	B	C
6103677-CE-B10-21	LOMOLOMO BRIDGE PROPOSED UTILITIES CROSS SECTIONS	-	A	B
6103677-CE-B10-25	LOMOLOMO BRIDGE ROCK ARMOUR AND SCOUR PROTECTION	-	A	B
6103677-CE-B10-30	LOMOLOMO BRIDGE BASAL GEOTEXTILE DETAILS	-	A	B
6103677-CE-B10-31	LOMOLOMO BRIDGE GEOTECHNICAL INSTRUMENTATION AND MONITORING DETAILS	-	A	B
6103677-CE-B10-32	LOMOLOMO BRIDGE ROCK CUT SECTION AND DETAILS	-	-	A
6103677-SE-B10-50	LOMOLOMO BRIDGE BRIDGE PLAN	A	B	C
6103677-SE-B10-51	LOMOLOMO BRIDGE BRIDGE ELEVATION	-	A	B
6103677-SE-B10-55	LOMOLOMO BRIDGE BRIDGE PILING PLAN	-	A	B
6103677-SE-B10-56	LOMOLOMO BRIDGE GROUND IMPROVEMENT	-	A	B

make everyday better.

Drawing No. 6103677-CE-B10-00 Rev. C



NOTES:

1. DATUM OF LEVELS : FIJI HEIGHT DATUM
   ORIGIN OF LEVELS: SS 3511 (SO 4242)
   RL: 41.729m
2. DATUM OF COORDINATES : FIJI MAP GRID
   ORIGIN OF COORDINATES: SS 3511 (SO 4242)
   E: 1860788.16
   N: 3921511.27
3. CONTOUR INTERVALS: MAJOR: 1m
   MINOR: 0.20m
4. THIS PLAN DOES NOT NECESSARILY SHOW ALL EXISTING SERVICES. IT'S THE DUTY OF THE CONTRACTOR TO ACCURATELY LOCATE AND PROTECT ALL EXISTING SERVICES BEFORE ANY EXCAVATION.
5. ALL DIMENSIONS, LEVELS & UNDERGROUND SERVICES LOCATIONS TO BE CHECKED ON SITE PRIOR TO COMMENCEMENT OF ALL WORKS.
6. ALL DIMENSIONS ARE IN METERS.
7. LOW WATER MARK : -0.56m
   HIGH WATER MARK : -02m
8. SOFFIT LEVEL : FRA BRIDGE (LOMOLOMO) : 1.03m
   FSC BRIDGE (LOMOLOMO) : 1.18m
9. FLOOD LEVEL - Reduced Level : 0.83m

REV	REVISIONS	DRN	CHK	APP	DATE
1	OUTERMOST EDGE TOP OF BRIDGE, WINGWALL, ABUTMENT, KERBS & WATER LEVELS	UD	SN	SN	20/12/2022
2	ADDITIONAL SURVEY OF BOTH SIDES	UD	SN	SN	12/01/2023

SURVEYED BY	KRISHNEEL LAL
SURVEY ASST	TOMASI KORORUA & VILIAME ANTONIO
DRAWN BY	USAIA DELAI
CHECKED BY	SHIRI NARAYAN
VERIFIED BY	SHAINEEL CHAND
SURVEY INSTRUCTION	(SI) No.SS 108/21
DATE OF SURVEY	02/03/2022
APPROVED	SHIRI NARAYAN

SURVEY SECTION

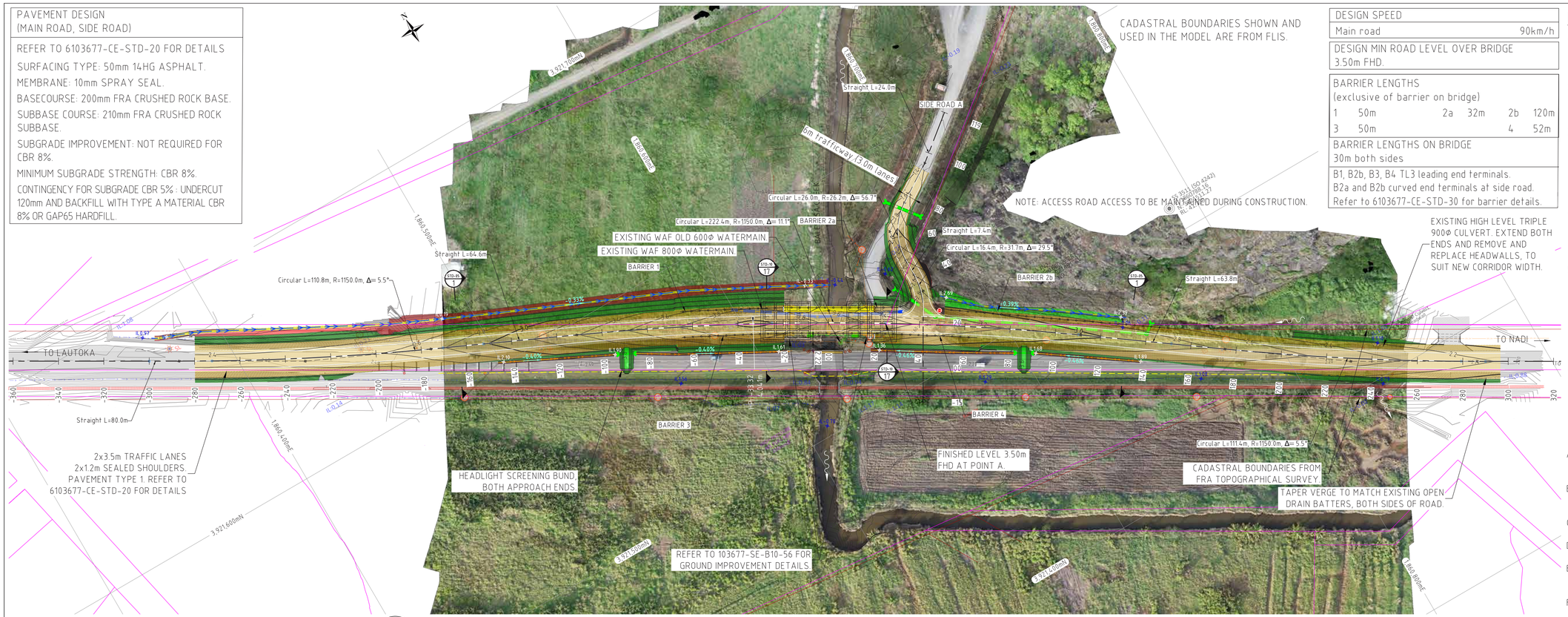
Fiji Roads Authority
Level 4, Fiji Development Bank Building,
360 Victoria Parade, Suva, Fiji Islands.
Postal: P. O. Box 16550, Suva, Fiji
Phone (+679) 310 0114 | Fax (+679) 310 0044 |
email: shiri.narayan@fijiroads.org

DESCRIPTION:
DETAILED TOPOGRAPHICAL SURVEY OF LOMOLOMO BRIDGE

TIKINA: VUDA PROVINCE: BA ISLAND: VITI LEVU

REQUEST FROM:	BRIDGES & STRUCTURES
DATE OF REQUEST	13/12/2021
Scales	1:1000 @ A1
Drawing No.	FRA: SS 108/21
Rev.	2

PAVEMENT DESIGN (MAIN ROAD, SIDE ROAD)
REFER TO 6103677-CE-STD-20 FOR DETAILS
SURFACING TYPE: 50mm 14HG ASPHALT.
MEMBRANE: 10mm SPRAY SEAL.
BASECOURSE: 200mm FRA CRUSHED ROCK BASE.
SUBBASE COURSE: 210mm FRA CRUSHED ROCK SUBBASE.
SUBGRADE IMPROVEMENT: NOT REQUIRED FOR CBR 8%.
MINIMUM SUBGRADE STRENGTH: CBR 8%.
CONTINGENCY FOR SUBGRADE CBR 5% : UNDERCUT 120mm AND BACKFILL WITH TYPE A MATERIAL CBR 8% OR GAP65 HARDFILL.



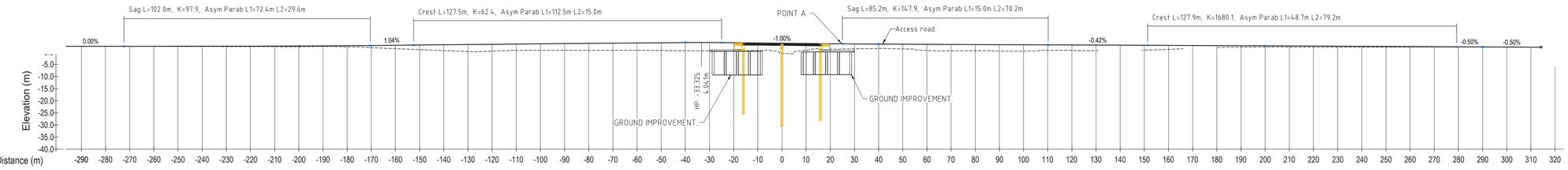
1 OFF-LINE REPLACEMENT GENERAL ARRANGEMENT PLAN
SCALE 1:2000(A3)

DESIGN SPEED	
Main road	90km/h
DESIGN MIN ROAD LEVEL OVER BRIDGE 3.50m FHD.	
BARRIER LENGTHS (exclusive of barrier on bridge)	
1 50m	2a 32m 2b 120m
3 50m	4 52m
BARRIER LENGTHS ON BRIDGE 30m both sides	
B1, B2b, B3, B4 TL3 leading end terminals. B2a and B2b curved end terminals at side road. Refer to 6103677-CE-STD-30 for barrier details.	

NOTES:

1. THESE BRIDGE SPECIFIC DRAWINGS REFER TO AND SHALL BE READ TOGETHER WITH STANDARD CIVIL DRAWINGS, 6103677-CE-STD SERIES.
2. FOR DESIGN DETAILS REFER TO THE DETAILED DESIGN REPORT - PRIORITY 1 B10 LOMOLOMO BRIDGE AND REFERENCED DOCUMENTS.
3. AERIAL IMAGE IS FROM UAV SURVEY UNDERTAKEN BY ERASITO CONSULTANTS LTD AND BECA INTERNATIONAL CONSULTANTS LTD IN NOVEMBER – DECEMBER 2021. TOPOGRAPHICAL SURVEY SHOWN IS BY FRA 2 MARCH 2022, UPDATED 12 JANUARY 2023.
4. MAJOR CONTOURS AT 1M INTERVALS, MINOR CONTOURS AT 0.2M INTERVALS. CONTOURS AND ELEVATIONS ARE TO FIJI HEIGHT DATUM (FHD), DETERMINED FRA.
5. HORIZONTAL POSITION IS TO FIJI MAP GRID (FMG).
6. CADASTRAL BOUNDARY INFORMATION IS FRA TOPOGRAPHICAL SURVEY [UNLESS NOTED AS FROM FIJI LAND INFORMATION SYSTEM (FLIS)] AND IS REFERENCED TO FIJI MAP GRID (FMG) COORDINATE SYSTEM. NO INDEPENDENT REVIEW OF DATA CORRECTNESS HAS BEEN CARRIED OUT.
7. NOT ALL SERVICES ARE SHOWN, AND THOSE THAT ARE SHOWN MAY NOT BE CORRECT. SOME SERVICES DETAILS HAVE BEEN PROVIDED BY FRA IN ITS TOPOGRAPHICAL SURVEY SURVEY AND LIAISON WITH UTILITY PROVIDERS (CARRIED OUT BY BICL).

A. JUHI PIPELINE POSITION ADOPTED FROM ERASITO SURVEY 2019 BETWEEN DIST -20m TO 20m AND WA SURVEY BEYOND.
B. WAF 800DIA TRANSFER WATERMAIN POSITION ADOPTED FROM "LOMOLOMO BRIDGE WAF ASSET MAP", 15 JULY 2023.
C. REFER TO 6103677-CE-B10-17 FOR ROAD MARKING AND SIGNAGE DETAILS.
D. REFER TO 6103677-CE-B10-21 FOR GRAVEL SHOULDER WIDTHS.
E. FOR DETAILS OF EXISTING SERVICES AND PROPOSED SERVICE RELOCATIONS, REFER TO DRAWING 6103677-CE-B10-20.
F. ALL FILL EMBANKMENT SLOPES SHOWN ARE 1V:2H.



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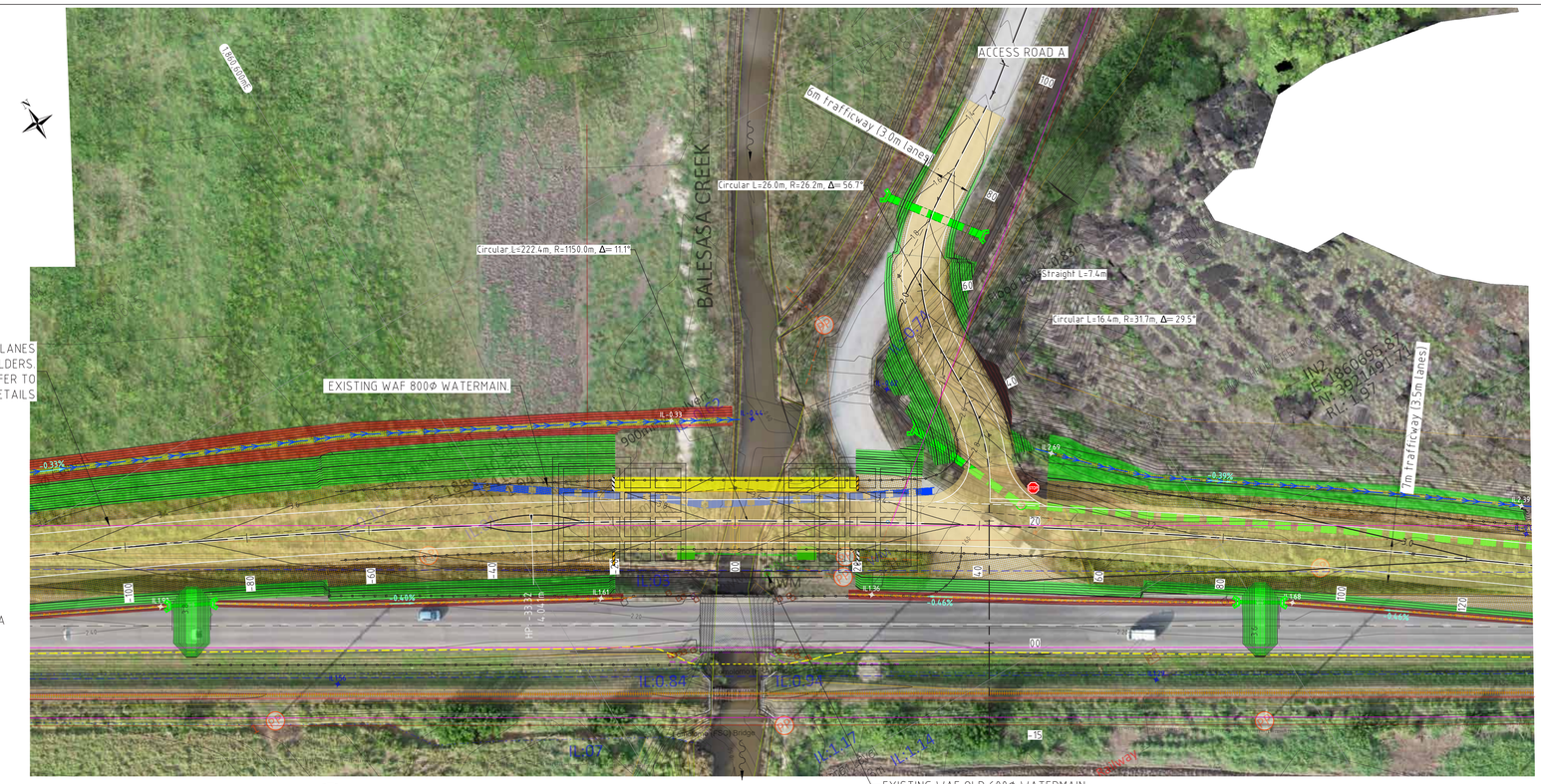
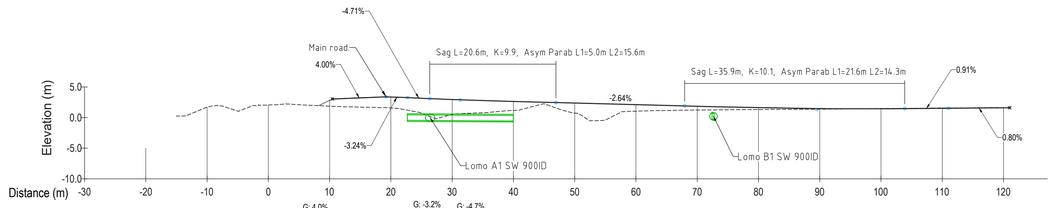


1 – MAIN ROAD AND ACCESS ROAD A ROADING DETAILS PLAN

SCALE 1:1000(A3)

CADASTRAL BOUNDARIES SHOWN AND USED IN THE MODEL ARE FROM FLIS.



| | | |

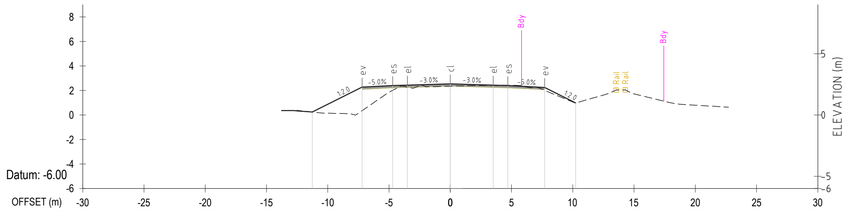
NOTES:

1. REFER TO DRAWING CE-B10-10 FOR NOTES.

LEGEND:

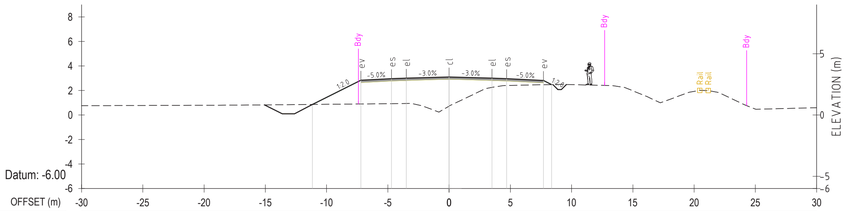
CADASTRAL BOUNDARY

CADASTRAL BOUNDARIES SHOWN AND USED IN THE MODEL ARE FROM FLIS.



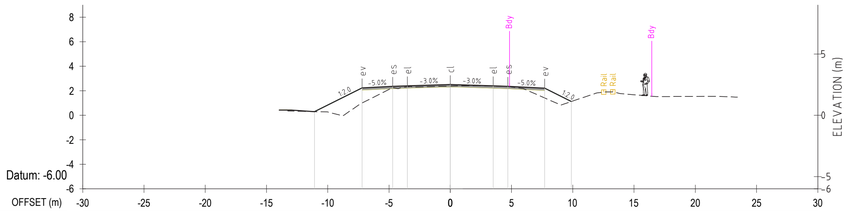
CUT/FILL	0.00	1.92	0.38	0.16	0.19	0.02	-0.02	0.24	0.00		
DESIGN LEVELS	0.24	2.27	2.40	2.44	2.54	2.44	2.40	2.25	0.98		
EXISTING LEVELS	0.24	0.35	2.01	2.28	2.35	2.41	2.42	2.01	0.98		
OFFSETS	-11.26	-7.20	-4.70	-3.50	0.00	3.50	4.70	7.70	10.24		

DIST: -220.00m



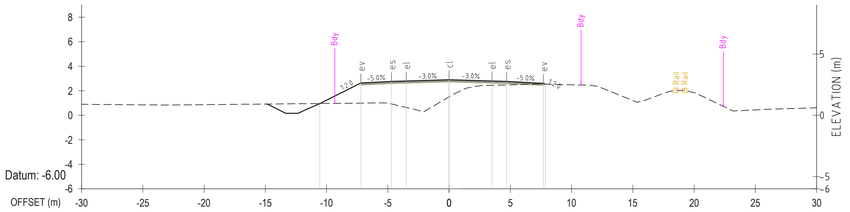
CUT/FILL	0.00	1.94	2.04	2.07	2.38	0.75	0.56	0.35	0.00		
DESIGN LEVELS	0.86	2.84	2.97	3.00	3.11	3.00	2.97	2.82	2.48		
EXISTING LEVELS	0.86	0.90	0.92	0.94	0.72	2.25	2.41	2.47	2.48		
OFFSETS	-11.16	-7.20	-4.70	-3.50	0.00	3.50	4.70	7.70	8.37		

DIST: -140.00m



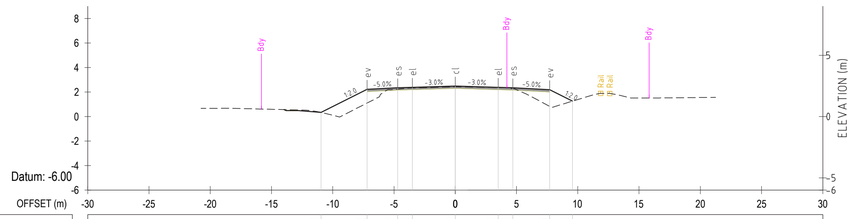
CUT/FILL	0.00	1.24	0.11	0.08	0.12	0.01	0.00	0.80	0.00		
DESIGN LEVELS	0.30	2.24	2.36	2.40	2.50	2.40	2.36	2.21	1.12		
EXISTING LEVELS	0.30	1.00	2.25	2.32	2.38	2.39	2.37	1.42	1.12		
OFFSETS	-11.09	-7.20	-4.70	-3.50	0.00	3.50	4.70	7.70	9.88		

DIST: -240.00m



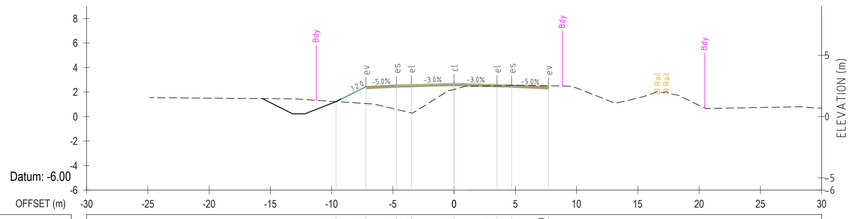
CUT/FILL	0.00	1.64	1.84	2.15	1.40	0.35	0.29	0.07	0.00		
DESIGN LEVELS	0.96	2.63	2.76	2.79	2.90	2.79	2.76	2.61	2.54		
EXISTING LEVELS	0.96	0.99	0.92	0.64	1.50	2.45	2.47	2.54	2.54		
OFFSETS	-10.55	-7.20	-4.70	-3.50	0.00	3.50	4.70	7.70	7.85		

DIST: -160.00m



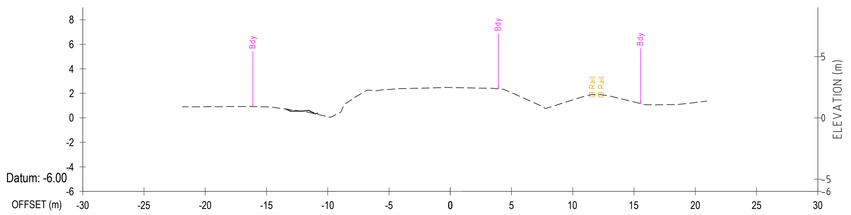
CUT/FILL	0.00	1.12	0.12	0.05	0.05	0.02	0.06	1.36	0.00		
DESIGN LEVELS	0.34	2.22	2.35	2.38	2.49	2.38	2.35	2.20	1.26		
EXISTING LEVELS	0.34	1.10	2.23	2.33	2.43	2.36	2.28	0.84	1.26		
OFFSETS	-10.96	-7.20	-4.70	-3.50	0.00	3.50	4.70	7.70	9.57		

DIST: -260.00m



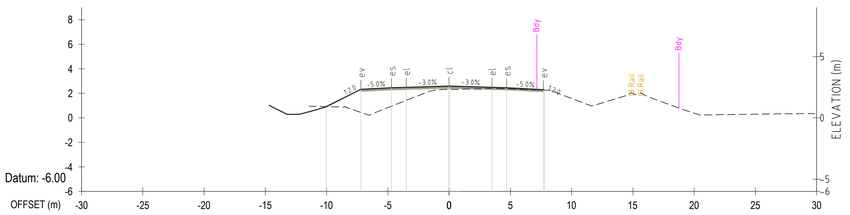
CUT/FILL	0.00	1.38	1.98	2.30	0.50	0.09	0.02	-0.10			
DESIGN LEVELS	1.22	2.44	2.56	2.60	2.70	2.60	2.56	2.41			
EXISTING LEVELS	1.22	1.06	0.58	0.30	2.21	2.51	2.54	2.51			
OFFSETS	-9.63	-7.20	-4.70	-3.50	0.00	3.50	4.70	7.70			

DIST: -180.00m



CUT/FILL											
DESIGN LEVELS											
EXISTING LEVELS											
OFFSETS											

DIST: -280.00m



CUT/FILL	0.00	1.88	1.50	1.06	0.28	0.10	0.09	0.02	0.00		
DESIGN LEVELS	0.92	2.33	2.45	2.49	2.59	2.49	2.45	2.30	2.26		
EXISTING LEVELS	0.92	0.44	0.95	1.42	2.32	2.39	2.36	2.28	2.26		
OFFSETS	-10.02	-7.20	-4.70	-3.50	0.00	3.50	4.70	7.70	7.79		

DIST: -200.00m

SCALE 1:500(A3):

0 5 10 15 20

FOR CLARITY OF DETAILS VIEW ELECTRONICALLY

DETAILED DESIGN NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN - FOR FRA REVIEW.	RAI	TE	CH	21/03/24
B	DETAILED DESIGN - FOR COMMENT.	RAI	TE	CH	06/07/23
A	FOR FRA REVIEW.	RAI	TE	CH	03/02/23

Original Scale (A1) 1:250
Reduced Scale (A3) 1:500

Design	R Imrie	03/02/23
Drawn	R Imrie	03/02/23
Dsg Verifier	C Hatley	03/02/23
Drg Check	C Hatley	03/02/23

Approved For Construction× Date

× Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: LOMOLOMO BRIDGE MAIN ROAD CROSS SECTIONS SHEET 1

Discipline: INFRASTRUCTURE

Drawing No.: 6103677-CE-B10-12

Rev: C

Document No. PRE.FEAS 11 A 1 P1.5.DWG

DO NOT SCALE FOR SET OUT DIMENSIONS

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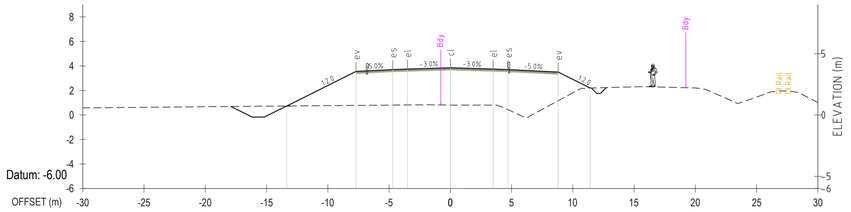
NOTES:

1. REFER TO DRAWING CE-B10-10 FOR NOTES.

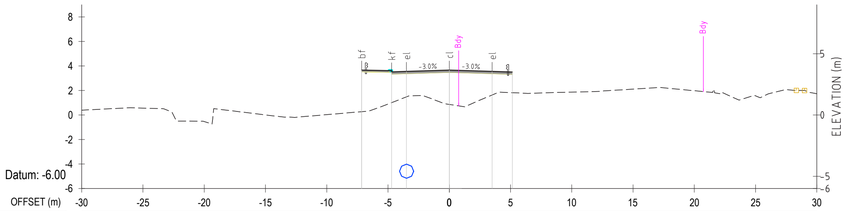
LEGEND:

CADASTRAL BOUNDARY



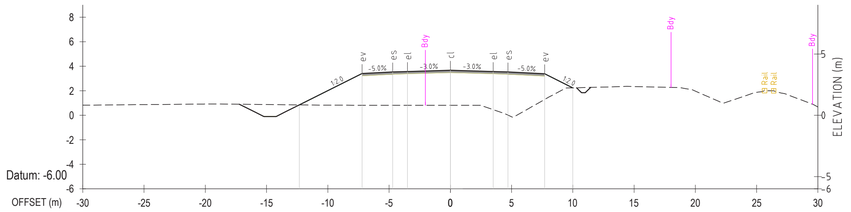
CUT/FILL		0.00		2.78	2.90	2.93	3.04	2.94	3.27	2.34	0.00
DESIGN LEVELS	0.73	0.73	3.56	3.71	3.75	3.85	3.75	3.71	3.50	2.20	
EXISTING LEVELS	0.73	0.73	0.78	0.81	0.82	0.81	0.80	0.44	1.17	2.20	
OFFSETS	-13.35	-13.35	-7.70	-4.70	-3.50	0.00	3.50	4.70	8.80	11.41	

DIST: -60.00m



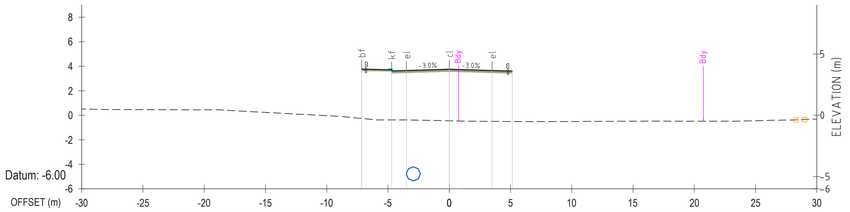
CUT/FILL					3.39	3.39	2.51	2.08	2.80	1.92	1.69
DESIGN LEVELS					3.66	3.66	3.52	3.55	3.66	3.55	3.51
EXISTING LEVELS					0.27	0.27	1.01	1.48	0.86	1.63	1.82
OFFSETS					-7.15	-7.15	-4.70	-3.50	0.00	3.50	5.15

DIST: 10.00m



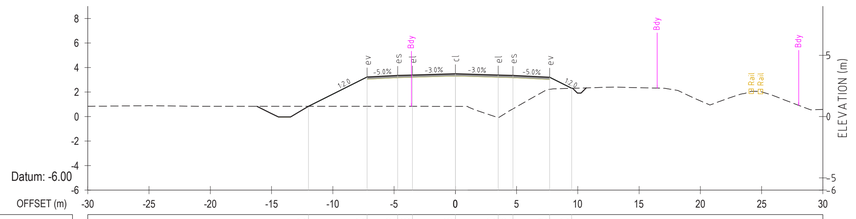
CUT/FILL		0.00		2.59	2.72	2.75	2.86	3.12	3.52	2.10	0.00
DESIGN LEVELS	0.85	0.85	3.41	3.54	3.57	3.68	3.57	3.54	3.39	2.24	
EXISTING LEVELS	0.85	0.85	0.82	0.82	0.82	0.82	0.46	0.02	1.29	2.24	
OFFSETS	-12.33	-12.33	-7.20	-4.70	-3.50	0.00	3.50	4.70	7.70	10.00	

DIST: -80.00m



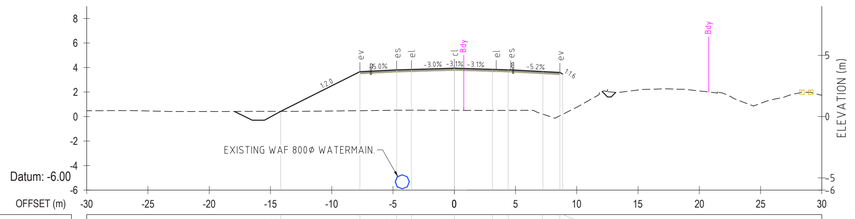
CUT/FILL					4.02	4.02	4.00	4.04	4.21	4.15	4.11
DESIGN LEVELS					3.76	3.76	3.62	3.65	3.76	3.65	3.61
EXISTING LEVELS					-0.26	-0.26	-0.38	-0.38	-0.45	-0.50	-0.51
OFFSETS					-7.15	-7.15	-4.70	-3.50	0.00	3.50	5.15

DIST: 0.00m



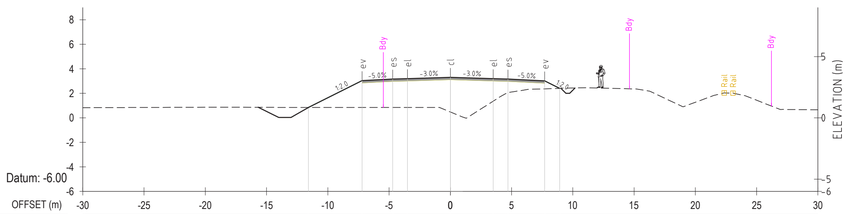
CUT/FILL		0.00		2.40	2.52	2.56	2.66	3.49	2.72	0.98	0.00
DESIGN LEVELS	0.83	0.83	3.23	3.35	3.39	3.50	3.39	3.35	3.20	2.30	
EXISTING LEVELS	0.83	0.83	0.83	0.83	0.83	0.83	-0.10	0.63	2.22	2.30	
OFFSETS	-11.99	-11.99	-7.20	-4.70	-3.50	0.00	3.50	4.70	7.70	9.50	

DIST: -100.00m



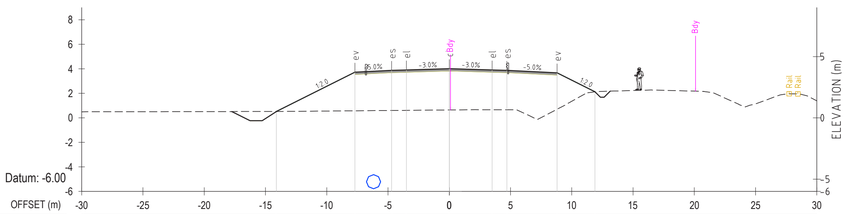
CUT/FILL		0.00		3.18	3.29	3.33	3.44	3.36	3.31	3.48	3.53	3.28
DESIGN LEVELS	0.43	0.43	3.66	3.81	3.84	3.95	3.85	3.81	3.67	3.60	3.46
EXISTING LEVELS	0.43	0.48	0.52	0.52	0.51	0.49	0.50	0.20	0.07	0.18
OFFSETS	-14.17	-7.70	-4.70	-3.50	0.00	3.12	4.39	7.23	8.62	8.84

DIST: -20.00m



CUT/FILL		0.00		2.19	2.32	2.36	2.83	1.84	1.10	0.65	0.00
DESIGN LEVELS	0.85	0.85	3.04	3.16	3.20	3.30	3.20	3.16	3.01	2.40	
EXISTING LEVELS	0.85	0.85	0.85	0.84	0.48	1.36	2.07	2.37	2.40	
OFFSETS	-11.58	-11.58	-7.20	-4.70	-3.50	0.00	3.50	4.70	7.70	8.92	

DIST: -120.00m



CUT/FILL		0.00		3.15	3.27	3.30	3.37	3.25	3.22	2.97	0.00
DESIGN LEVELS	0.52	0.52	3.72	3.87	3.91	4.01	3.91	3.87	3.67	2.12
EXISTING LEVELS	0.52	0.57	0.60	0.61	0.64	0.66	0.66	0.70	2.12
OFFSETS	-14.11	-7.70	-4.70	-3.50	0.00	3.50	4.70	8.80	11.89

DIST: -40.00m

CADASTRAL BOUNDARIES SHOWN AND USED IN THE MODEL ARE FROM FLIS.

SCALE 1:500(A3):

0 5 10 15 20

FOR CLARITY OF DETAILS VIEW ELECTRONICALLY

DETAILED DESIGN NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN - FOR FRA REVIEW.	RAI	TE	CH	21/03/24
B	DETAILED DESIGN - FOR COMMENT.	RAI	TE	CH	06/07/23
A	FOR FRA REVIEW.	RAI	TE	CH	03/02/23

Original Scale (A1) 1:250
Reduced Scale (A3) 1:500

Design	R Imrie	03/02/23	Approved For Construction×
Drawn	R Imrie	03/02/23	
Dsg Verifier	C Hatley	03/02/23	
Drg Check	C Hatley	03/02/23	Date

× Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: LOMOLOMO BRIDGE MAIN ROAD CROSS SECTIONS SHEET 2

Discipline: INFRASTRUCTURE

Drawing No.: 6103677-CE-B10-13

Rev: C

Document No. PRE FEAS 11 A 1 P1 5.DWG

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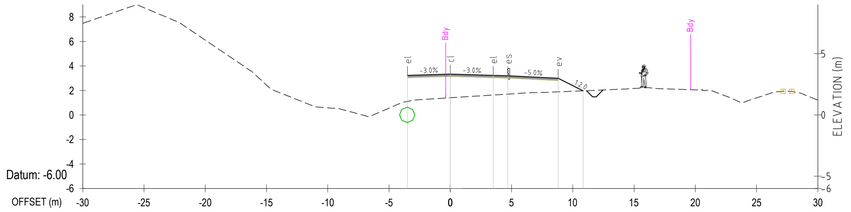
NOTES:

1. REFER TO DRAWING CE-B10-10 FOR NOTES.

LEGEND:

CADASTRAL BOUNDARY



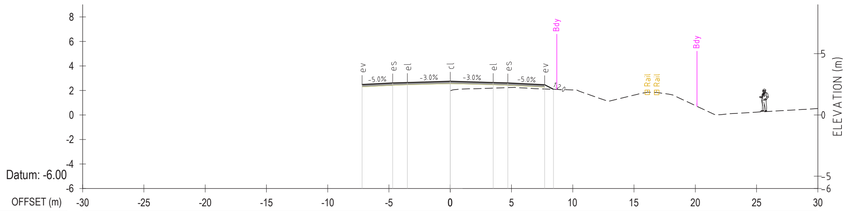
| | | |

NOTES:

1. REFER TO DRAWING CE-B10-10 FOR NOTES.

LEGEND:

CADASTRAL BOUNDARY



| | | |

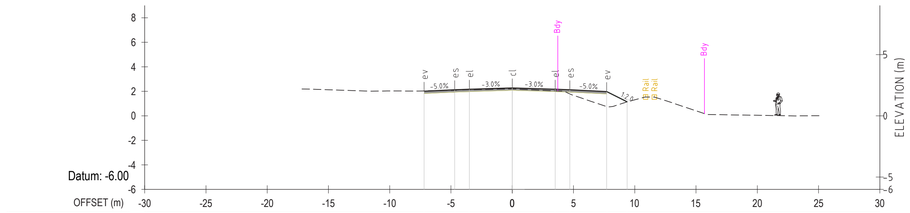
NOTES:

1. REFER TO DRAWING CE-B10-10 FOR NOTES.

LEGEND:

CADASTRAL BOUNDARY

CADASTRAL BOUNDARIES SHOWN AND USED IN THE MODEL ARE FROM FLIS.



CUT/FILL	-0.03	0.05	0.03	0.07	0.13	0.35	1.22	0.00					
DESIGN LEVELS	2.01	2.13	2.17	2.27	2.17	2.13	1.98	1.14					
EXISTING LEVELS	2.03	2.08	2.14	2.20	2.04	1.78	0.76	1.14					
OFFSETS	-7.20	-4.70	-3.50	0.00	3.50	4.70	7.70	9.38					

DIST: 280.00m

SCALE 1:500(A3):

0 5 10 15 20

FOR CLARITY OF DETAILS VIEW ELECTRONICALLY

DETAILED DESIGN NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN - FOR FRA REVIEW.	RAI	TE	CH	21/03/24
B	DETAILED DESIGN - FOR COMMENT.	RAI	TE	CH	06/07/23
A	FOR FRA REVIEW.	RAI	TE	CH	03/02/23

Original Scale (A1) 1:250
Reduced Scale (A3) 1:500

Design	R Imrie	03/02/23
Drawn	R Imrie	03/02/23
Dsg Verifier	C Hatley	03/02/23
Drg Check	C Hatley	03/02/23

Approved For Construction× Date

× Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: LOMOLOMO BRIDGE MAIN ROAD CROSS SECTIONS SHEET 5

Discipline: INFRASTRUCTURE

Drawing No.: 6103677-CE-B10-16

Rev.: C

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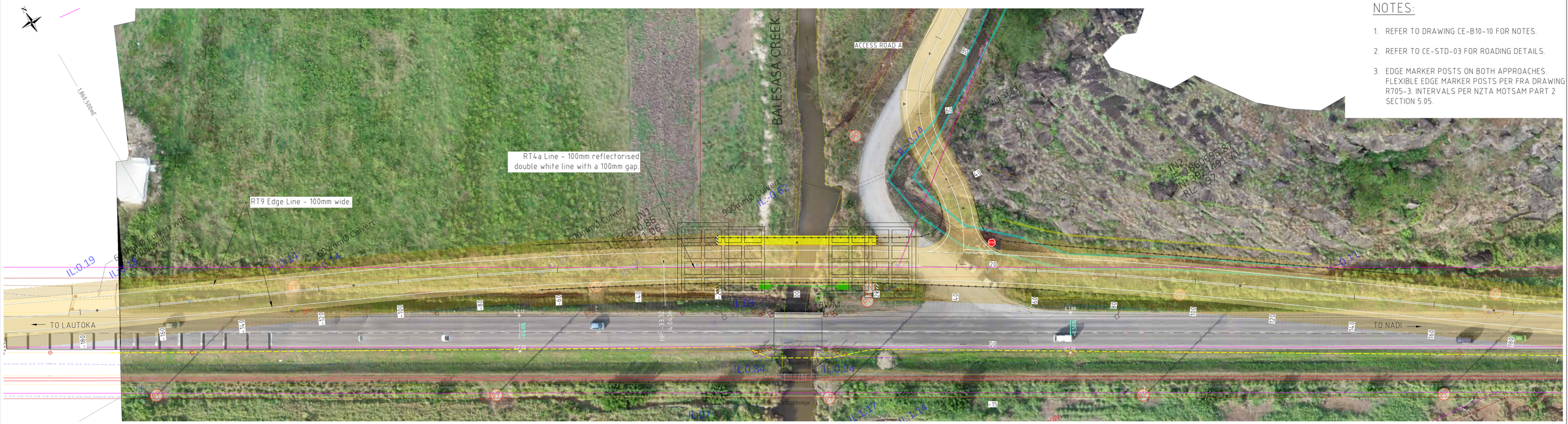
NOTES:

1. REFER TO DRAWING CE-B10-10 FOR NOTES.
2. REFER TO CE-STD-03 FOR ROADING DETAILS.
3. EDGE MARKER POSTS ON BOTH APPROACHES. FLEXIBLE EDGE MARKER POSTS PER FRA DRAWING R705-3. INTERVALS PER NZTA MOTSAM PART 2 SECTION 5.05.



1 / - ROAD MARKING AND SIGNAGE GENERAL ARRANGMENT PLAN

SCALE 1:1000(A3)

LEGEND EXISTING:

- CADASTRAL BOUNDARY
- FLOW DIRECTION

ACCESS ROAD A

2 / - ACCESS ROAD A ROAD MARKING AND SIGNAGE PLAN

SCALE 1:500(A3)

LEGEND PROPOSED:

- STOP SIGN RG5 750mm x 750mm
- BRIDGE END MARKER POST W20-5.1
- BRIDGE END MARKER POST W20-5.2

REFER TO FSAM PART 2 FOR STOP MARKING DETAILS.

FOR CLARITY OF DETAILS
VIEW ELECTRONICALLY

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN - FOR FRA REVIEW.	RAI	TE	CH	21/03/24
B	DETAILED DESIGN - FOR COMMENT.	RAI	TE	CH	06/07/23

Original Scale (A1)	AS SHOWN	Approved For Construction×	
Reduced Scale (A3)	AS SHOWN		
Design	R Imrie	06/07/23	
Drawn	R Imrie	06/07/23	
Dsg Verifier	C Hatley	06/07/23	
Drg Check	C Hatley	06/07/23	Date
× Refer to Revision 1 for Original Signature			

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: LOMOLOMO BRIDGE ROAD MARKING AND SIGNS

Discipline: INFRASTRUCTURE

Drawing No.: 6103677-CE-B10-17

Rev.: C

Document No. PRE FEAS 11 A 1 P15.DWG

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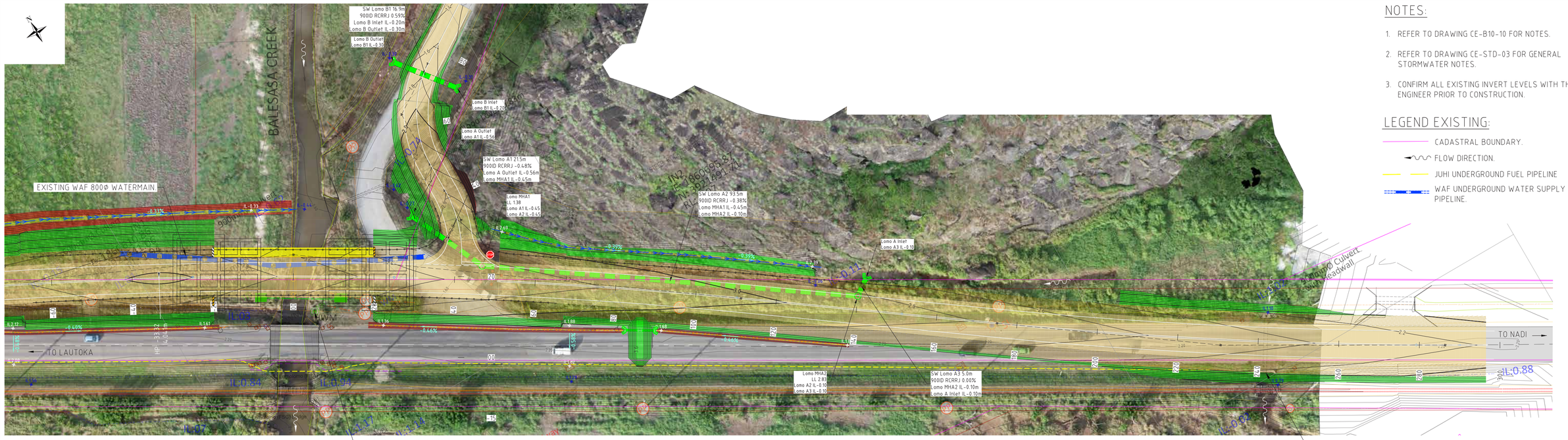

1 / - STORMWATER GENERAL ARRANGEMENT PLAN

SCALE 1:500(A3)

NOTES:

1. REFER TO DRAWING CE-B10-10 FOR NOTES.
2. REFER TO DRAWING CE-STD-03 FOR GENERAL STORMWATER NOTES.
3. CONFIRM ALL EXISTING INVERT LEVELS WITH THE ENGINEER PRIOR TO CONSTRUCTION.

LEGEND EXISTING:

- CADASTRAL BOUNDARY.
- FLOW DIRECTION.
- JUHI UNDERGROUND FUEL PIPELINE
- WAF UNDERGROUND WATER SUPPLY PIPELINE.

LEGEND PROPOSED:

- OPEN CHANNEL TYPE 1 AS PER DRAWING 6103677-CE-STD-25. MIN 0.3% GRADIENT.
- CONCRETE DRAIN TYPE 3 AS PER FRA DRAWING R504-3. MIN 0.3% GRADIENT.
- STORMWATER MANHOLE
- STORMWATER PIPELINE HEADWALL.
- STORMWATER PIPELINE.
- DRAINAGE INVERT LEVEL
- DRAINAGE FLOW DIRECTION & GRADIENT.
- SEALED ROAD.
- UNSEALED SHOULDER, FOOTPATH.
- REINFORCED CONCRETE FOOTPATH REFER DRAWING 6103677-CE-STD-15.
- FENCE
- BARRIER

SCALE 1:500(A3):

0 5 10 15 20

FOR CLARITY OF DETAILS VIEW ELECTRONICALLY

DETAILED DESIGN NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN - FOR FRA REVIEW.	RAI	TE	CH	21/03/24
A	DETAILED DESIGN - FOR FRA REVIEW.	RAI	TE	CH	13/03/24

Original Scale (A1) AS SHOWN
Reduced Scale (A3) AS SHOWN

Design	R Imrie	13/03/24
Drawn	R Imrie	13/03/24
Dsg Verifier	C Hatley	13/03/24
Drg Check	C Hatley	13/03/24

Approved For Construction× Date

× Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: LOMOLOMO BRIDGE STORMWATER GENERAL ARRANGEMENT PLAN

Discipline: INFRASTRUCTURE

Drawing No.: 6103677-CE-B10-18

Rev.: B

DO NOT SCALE FOR SET OUT DIMENSIONS

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Document No. PRE FEAS 11 A 1 P1 S.DWG

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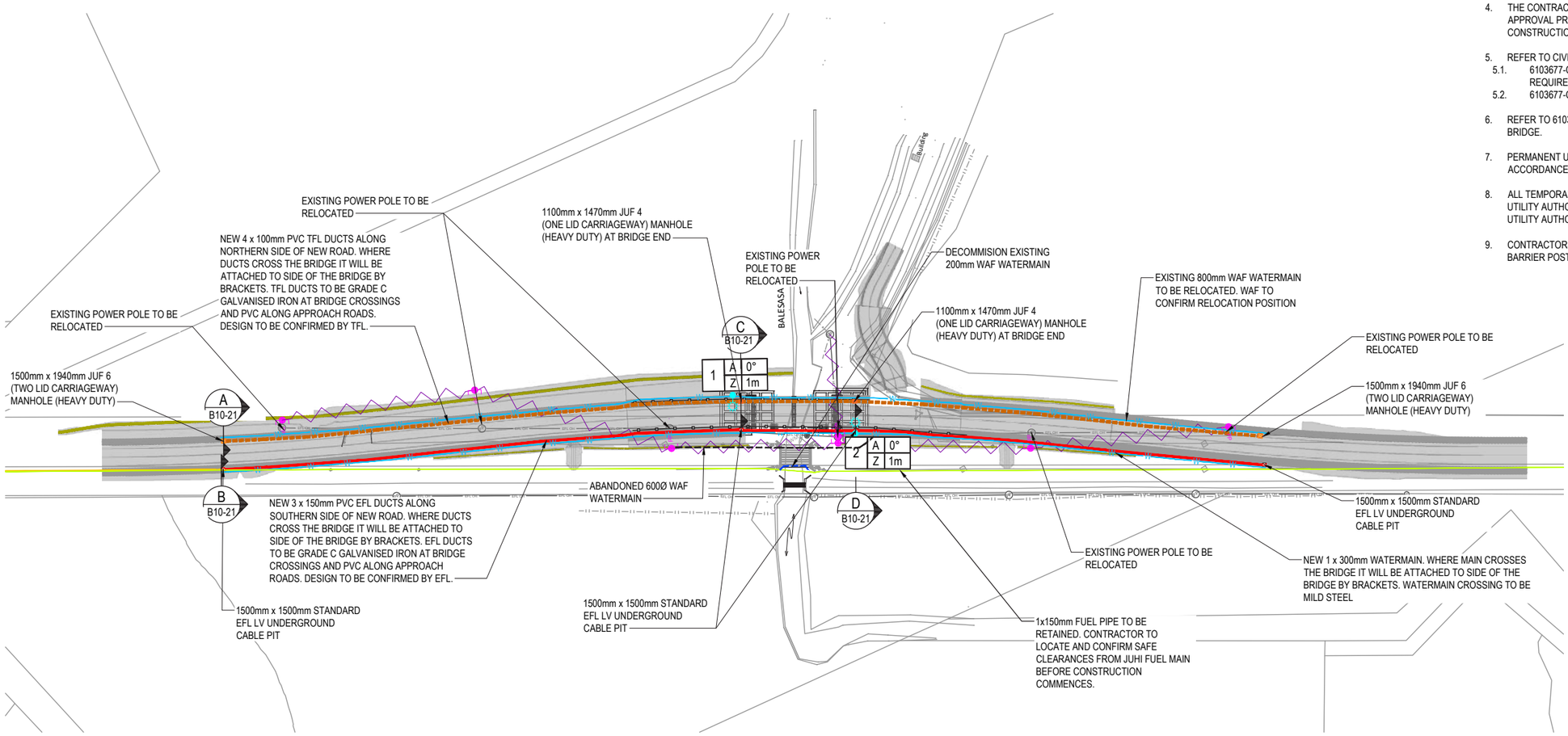
NOTES:

1. REFER TO 6103677-CE-STD-03 FOR GENERAL UTILITY, OVERHEAD POWER LINES AND STREET LIGHTING NOTES.
2. CONTRACTOR TO INVESTIGATION TRENCH FOR EXISTING UTILITIES PRIOR TO CONSTRUCTION TO CONFIRM DEPTH, SIZE AND LOCATION OF ALL EXISTING UNDERGROUND UTILITIES.
3. THE EXISTING AND NEW UTILITIES SHOWN ARE INDICATIVE ONLY.
4. THE CONTRACTOR IS TO CONFIRM THE DESIGN WITH EACH RELEVANT UTILITY AUTHORITY FOR APPROVAL PRIOR TO PROCUREMENT, FABRICATION, INSTALLATION, AND COMMENCEMENT OF CONSTRUCTION WORK ON SITE.
5. REFER TO CIVIL STANDARD DRAWINGS, SPECIFICALLY:
   - 5.1. 6103677-CE-STD-40 FOR TYPICAL UTILITY TRENCH INFORMATION AND CLEARANCE REQUIREMENTS BETWEEN UTILITIES.
   - 5.2. 6103677-CE-STD-17 FOR STREET LIGHT POLE DETAILS.
6. REFER TO 6103677-SE-STD-140 AND 6103677-SE-STD-141 FOR SERVICE DUCT SUPPORTS AT BRIDGE.
7. PERMANENT UTILITIES (WATERMAIN, ELECTRICAL AND TELECOMMUNICATIONS) TO BE BUILT IN ACCORDANCE WITH WAF, EFL AND TFL DESIGN, SPECIFICATIONS AND REQUIREMENTS.
8. ALL TEMPORARY DIVERSIONS TO BE DESIGNED BY THE CONTRACTOR IN CO-ORDINATION WITH UTILITY AUTHORITIES. ALL CONTRACTOR DESIGNS TO BE APPROVED BY THE APPROPRIATE UTILITY AUTHORITY, IN WRITING, PRIOR TO CONSTRUCTION.
9. CONTRACTORS RESPONSIBILITY TO MAKE SURE UTILITIES CROSS UNDER BARRIERS BETWEEN BARRIER POSTS.



LOMOLOMO BRIDGE - NEW UTILITIES LAYOUT PLAN

SCALE 1:500

LEGEND:

EXISTING UTILITIES:

- DRAIN INVERT FLOW DIRECTION
- POWER POLE
- SEPTIC TANK
- TELECOM CHAMBER
- WATER VALVE
- UTILITIES CHAMBER
- GULLY PIT
- CROSS CULVERT
- FLY STAY POLE
- STAY WIRE
- RESIDENTIAL POWER POLE
- OVERHEAD EFL POWER LINE
- RESIDENTIAL POWER LINE
- WATER METER
- WATER VALVE
- METER BOX ON POLE
- DRAIN STEEL COVER
- TELECOM LINE
- TELECOM POLE

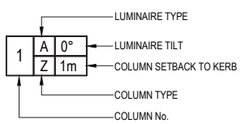
RELOCATED UTILITIES:

- INDICATIVE POWER POLE POSITION. EFL TO CONFIRM.
- OVERHEAD POWER LINES. EFL TO CONFIRM

NEW UTILITIES:

- TFL DUCT
- WAF PIPE
- EFL DUCT
- JUHI PIPE
- EFL 1500mm x 1500mm STANDARD
- EFL LV UNDERGROUND CABLE PIT
- TFL 1500mm x 1940 JUF 6
- (TWO LID CARRIAGEWAY) MANHOLE (HEAVY DUTY)
- TFL 1100mm x 1470 JUF 4
- (ONE LID CARRIAGEWAY) MANHOLE (HEAVY DUTY)

TYPICAL COLUMN DESIGNATION:



LUMINAIRE TYPE LEGEND:

A ADD NEW SOLAR POWERED STREET LIGHT PLACE ROADLED MIDI 60W 4K 180227PH LUMINARE.

COLUMN TYPE, MOUNTING HEIGHT:

PLACE NEW TAMPERED OCTAGONAL SHAFT POLE, 10.5m MOUNTING HEIGHT, 2m OUTREACH

FOR CLARITY OF DETAILS
VIEW ELECTRONICALLY

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	DETAILED DESIGN FOR FRA REVIEW	MA	VH	CH	21.03.24
B	DETAILED DESIGN FOR COMMENT	ES	VH	CH	06.07.23
A	CONCEPT DESIGN	ES	VH	CH	03.02.23

Original Scale (A1)	1:500	Design	M. SHEPPARD 03.02.23
Reduced Scale (A3)	1:1000	Drawn	AV, ES 03.02.23
		Dsg Verifier	C. HATLEY 03.02.23
		Drg Check	C. HATLEY 03.02.23

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: LOMOLOMO BRIDGE NEW UTILITIES LAYOUT PLAN

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B10-20

Rev.: C

Document No. 6103677-CE-B10-20.DWG

DO NOT SCALE FOR SET OUT DIMENSIONS

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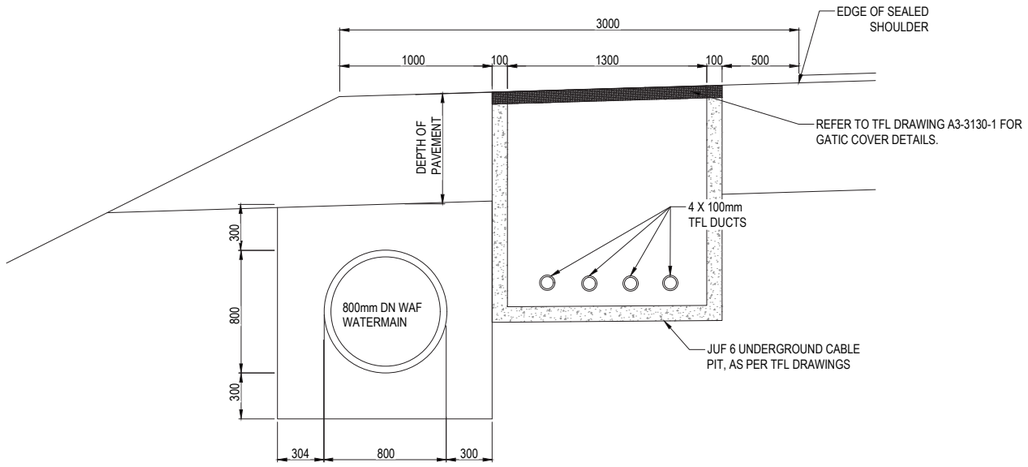

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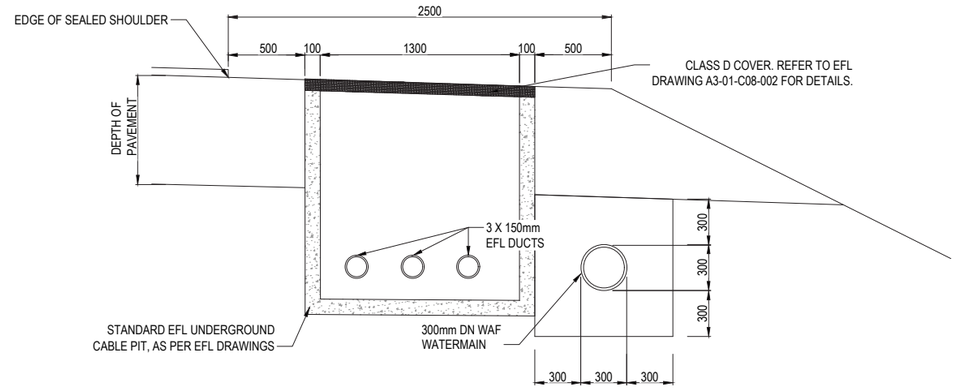
SCALE: 1:20 (A1)



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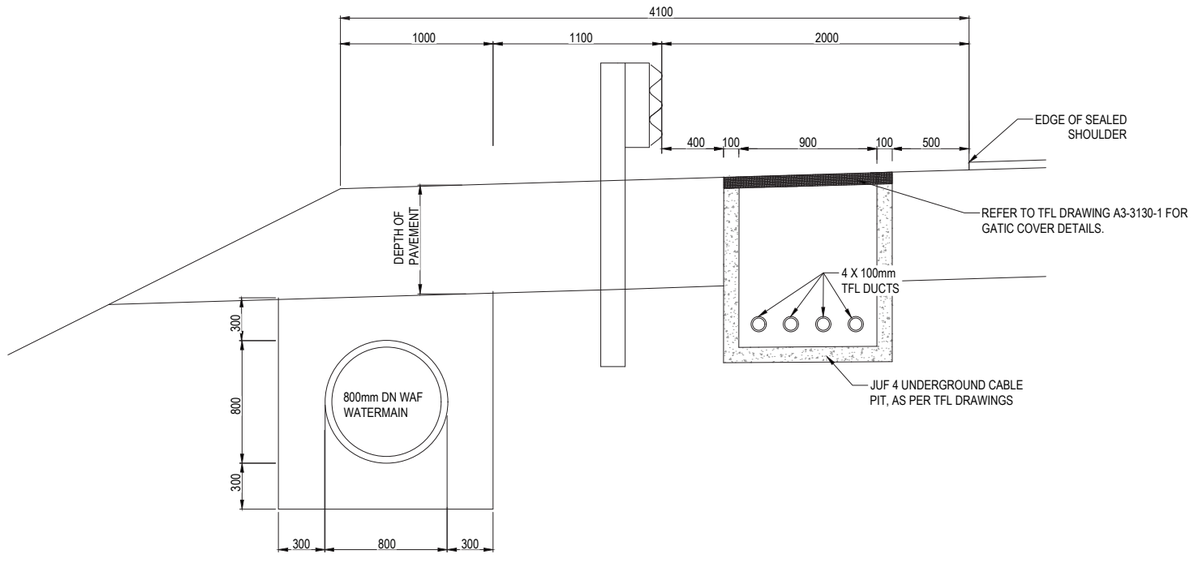

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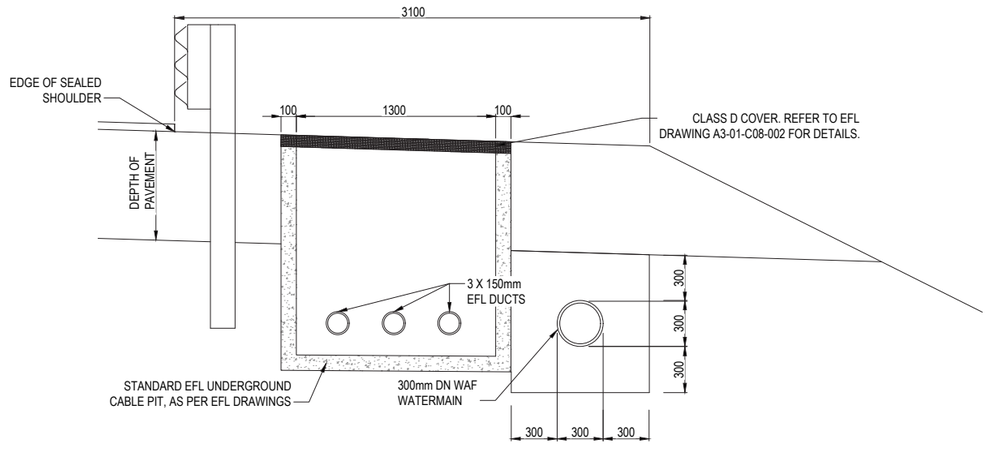

D - DETAIL D
SCALE: 1:20 (A1)

FOR CLARITY OF DETAILS
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DETAILED DESIGN
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No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN FOR FRA REVIEW	MA	VH	CH	21.03.24
A	DETAILED DESIGN- FOR COMMENT	MS	VH	CH	06.07.24

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	Drawn	AV, ES	06.07.23
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	Drg Check	C. HATLEY	06.07.23

Approved For Construction* Date
* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito
Main-consultant: Beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: LOMOLOMO BRIDGE NEW UTILITIES CROSS SECTIONS
Discipline: CIVIL ENGINEERING
Drawing No.: 6103677-CE-B10-21
Beca Project Number:
Rev.: B

Document No. 6103677-CE-B10-21.DWG

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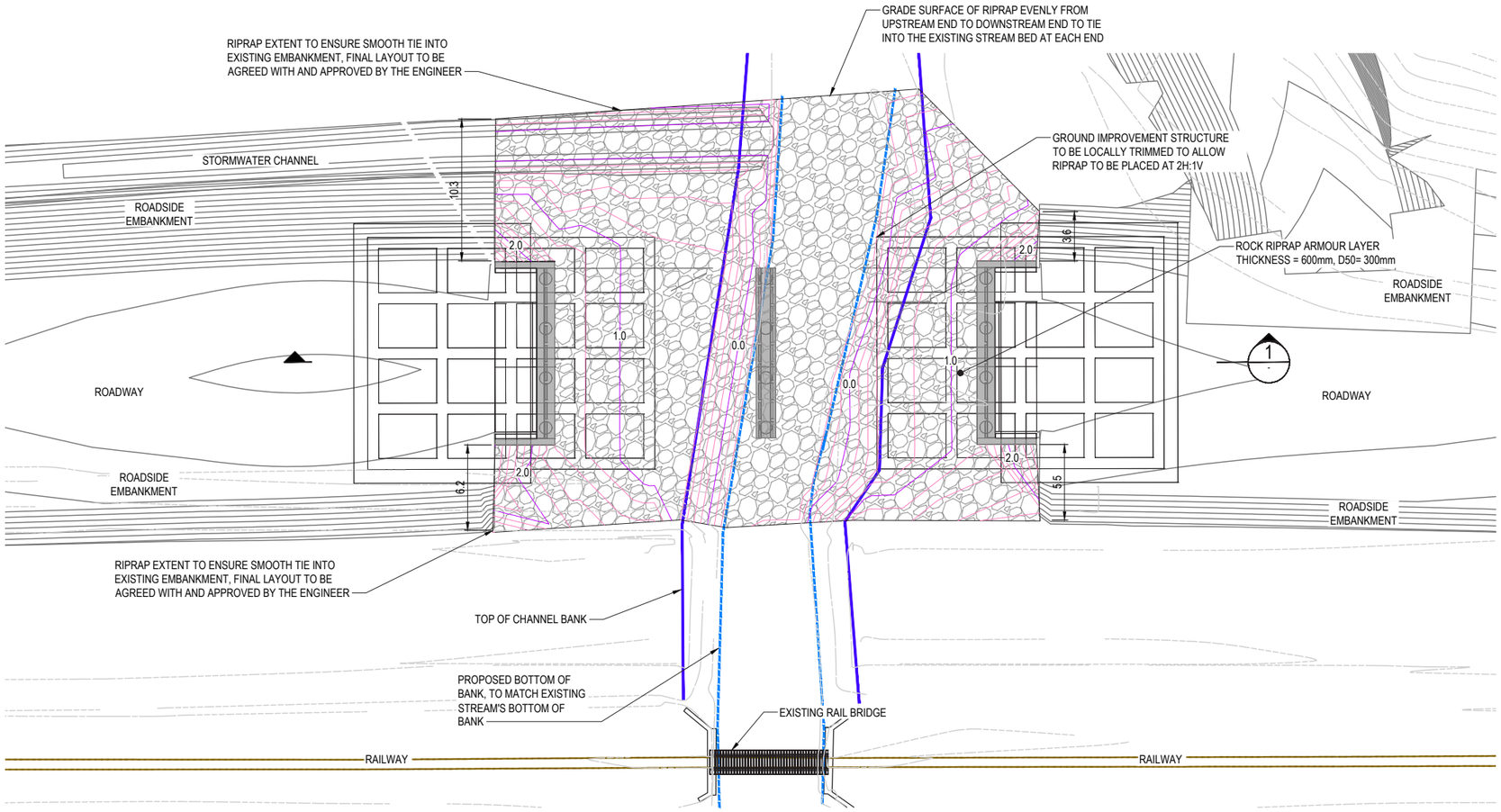
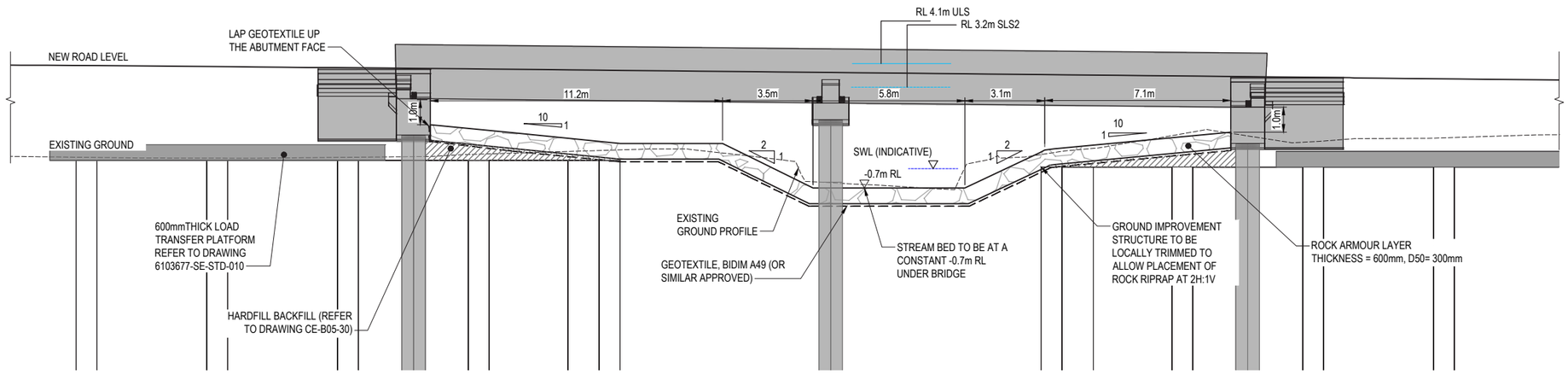


A
-
SCOUR PROTECTION LAYOUT
SCALE 1:200



1
-
SCOUR PROTECTION
SCALE 1:100

NOTES:

1. FOR ABUTMENT DETAILS REFER TO STRUCTURAL STANDARD DETAILS.
2. ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.
3. MAJOR CONTOURS SHOWN AT 1m INTERVALS
4. MINOR CONTOURS SHOWN AT 0.2m INTERVALS
5. EXCAVATED EXISTING GROUND TO BE REMOVED OFFSITE AFTER PLACEMENT OF ROCK RIPRAP.
6. ANY LOOSE DEBRIS WITHIN THE WATERWAY IS TO BE REMOVED
7. ROCK TO TIE INTO THE SURROUNDING EMBANKMENT. TOP OF ROCK TO MATCH EXISTING LEVELS.
8. FOR ROCK, UNDERLAYER AND GEOTEXTILE SPECIFICATION PLEASE REFER TO SECTION C0226 OF THE SPECIFICATION DOCUMENT.

LEGEND:

- PROPOSED TOP OF BANK
- PROPOSED BOTTOM OF BANK
- ROCK RIP RAP
- ULS RIVER FLOW LEVEL
- SLS2 RIVER FLOW LEVEL
- PROPOSED MAJOR CONTOURS (1.0m)
- PROPOSED MINOR CONTOURS (0.2m)
- EXISTING GROUND CONTOURS (1.0m)

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	Drawn	AV, ES	06.07.23
Reduced Scale (A3) HALF SHOWN	Dsg Verifier	C. HATLEY	06.07.23
	Drg Check	C. HATLEY	06.07.23

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Sub-consultant: Erasito
Main-consultant: Beca
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Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: LOMOLOMO BRIDGE SCOUR PROTECTION LAYOUT
Discipline: CIVIL ENGINEERING
Drawing No.: 6103677-CE-B10-25
Rev.: B
Document No. 6103677-CE-B10-25.DWG

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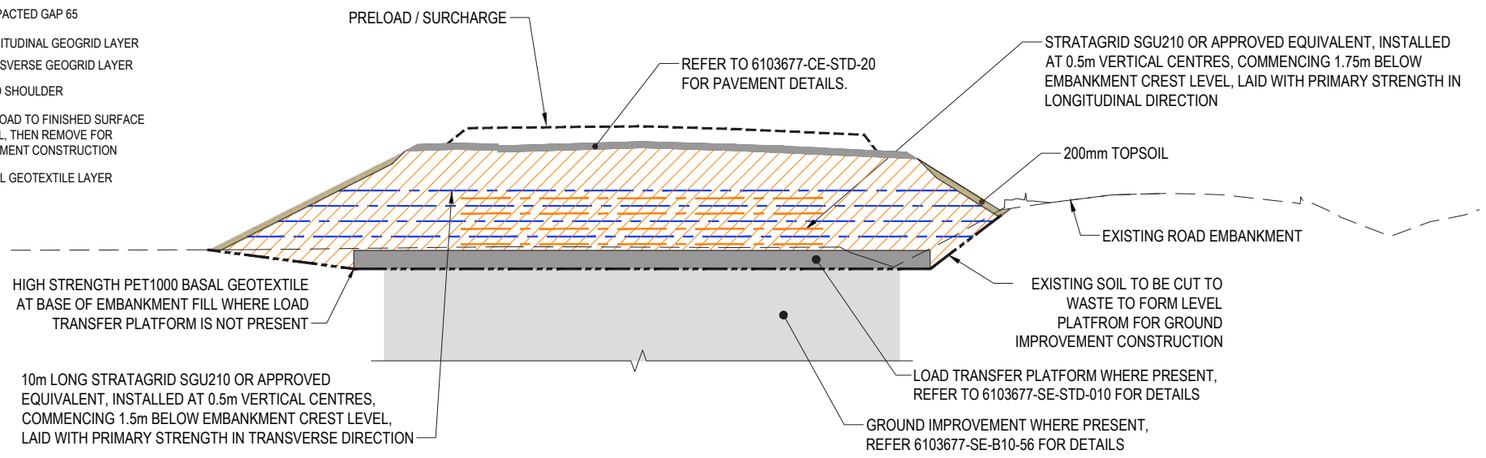
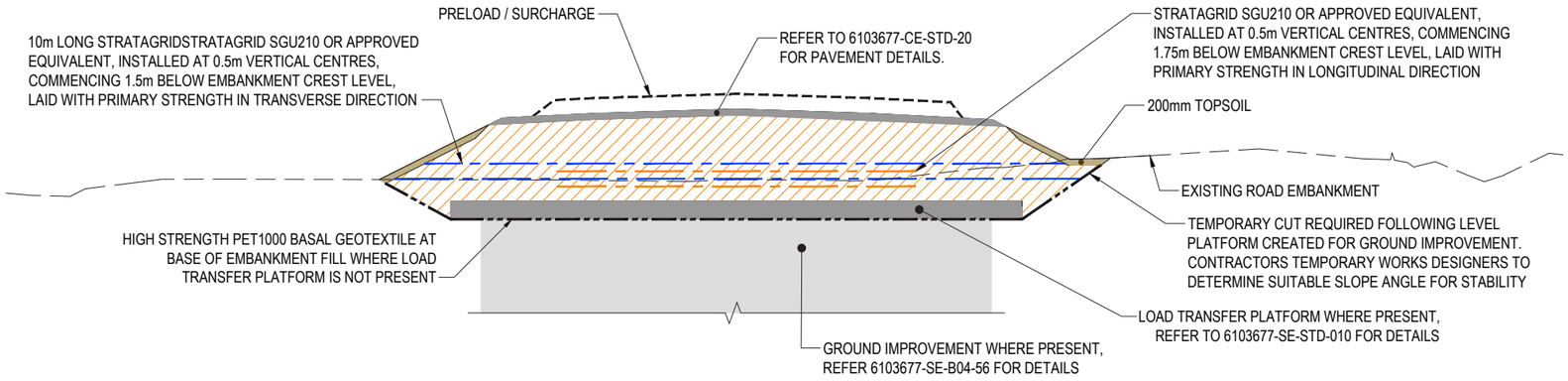
LEGEND:

- COMPACTED GAP 65
- LONGITUDINAL GEOGRID LAYER
- TRANSVERSE GEOGRID LAYER
- ROAD SHOULDER
- PRELOAD TO FINISHED SURFACE LEVEL, THEN REMOVE FOR PAVEMENT CONSTRUCTION
- BASAL GEOTEXTILE LAYER



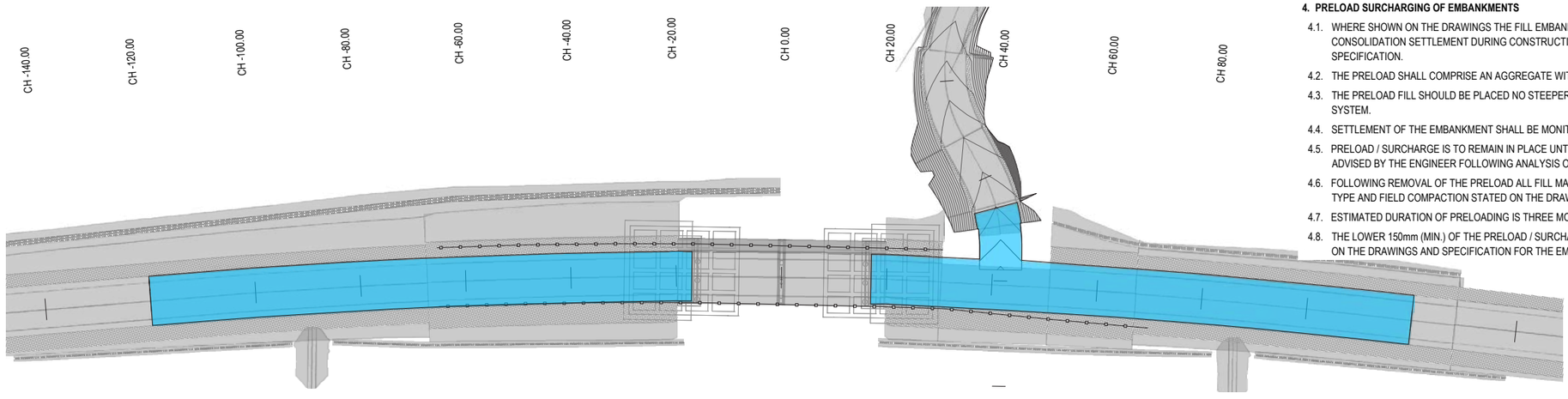
WEST ABUTMENT CH-20 TO CH-35

SCALE 1:100



EAST ABUTMENT CH20 TO CH35

SCALE 1:100



1 - PRELOAD EXTENTS AND EMBANKMENT PLAN

SCALE 1:500

NOTES:

1. GENERAL

1.1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING, PROTECTING AND/OR RELOCATING ANY UTILITIES AND DRAINAGE PRIOR TO WORKS COMMENCING.

1.2. ALL CONSTRUCTION WORKS SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE PROJECT EARTHWORKS SPECIFICATION.

1.3. EXISTING SWALE DRAINS ARE TO BE CLEARED OF VEGETATION AND UNSUITABLE SOILS AND BACKFILLED AS PER DETAIL A ON 6103677-CE-STD-53.

1.4. ANY SIGNIFICANT VARIANCES IN GROUND CONDITIONS FROM THOSE PRESENTED IN THESE DRAWINGS MUST BE BROUGHT TO THE ATTENTION OF THE ENGINEER.

1.5. SUBGRADE IMPROVEMENTS AND PAVEMENT LAYER NOT SHOWN ON DRAWINGS FOR CLARITY.

1.6. IN ORDER TO MINIMIZE THE POTENTIAL FOR INSTABILITY OF PERMANENT WORKS ELEMENTS, THE POSITION OF ANY TEMPORARY STOCKPILES SHALL BE AGREED WITH THE ENGINEER.

2. EMBANKMENT

2.1. PRIOR TO FILLING, TOPSOIL AND UNSUITABLE SOILS (INCLUDING HIGHLY ORGANIC SOILS OR SILT, TOXIC MATERIALS, PEAT LOGS, STUMPS, PERISHABLE OR ORGANIC MATERIALS, CONTAMINATED SOILS) SHALL BE EXCAVATED AND REMOVED.

2.2. WHERE MATERIAL IS ENCOUNTERED THAT DOES NOT MEET THE STRENGTH REQUIRED IN THE PROJECT EARTHWORKS SPECIFICATION, THE CONTRACTOR SHALL DETERMINE THE EXTENTS AND STRENGTH OF MATERIAL LESS THAN THIS REQUIREMENT FOR FURTHER UNDERCUTTING OR TREATMENT.

2.3. THE CONTRACTOR SHALL EVALUATE, DURING CONSTRUCTION, THE SAFE TEMPORARY BATTER ANGLE FOR ANY EXCAVATION OR FILLING.

2.4. THE MATERIALS AT FORMATION LEVEL SHOULD BE PROTECTED FROM SOFTENING, OVERLOADING (e.g. FROM CONSTRUCTION TRAFFIC) OR OTHER CONDITIONS WHICH MAY RESULT IN WEAKENING OF THESE MATERIALS.

2.5. POSITIVE DRAINAGE OF ALL EXCAVATION WORKS MUST BE MAINTAINED DURING CONSTRUCTION.

2.6. ALL AREAS OF EXPOSED EMBANKMENT SUBGRADE ARE TO BE INSPECTED BY A COMPETENT PERSON TO CONFIRM UNSUITABLE SOILS HAVE BEEN REMOVED. REFER TO PROJECT EARTHWORKS SPECIFICATION FOR SUBGRADE REQUIREMENTS. QUALITY ASSURANCE DOCUMENTATION TO RECORD INSPECTION AND ACCEPTANCE.

2.7. ALL FILL MATERIALS SHALL MEET THE GRADING, COMPACTION AND TESTING REQUIREMENTS SPECIFIED IN THE PROJECT EARTHWORKS SPECIFICATION.

2.8. SETTLEMENT MONITORING INSTRUMENTATION DETAILED ON THE DRAWINGS TO BE INSTALLED, AND BASELINE MONITORING COMPLETED, PRIOR TO PLACING EMBANKMENT FILL.

2.9. PLACEMENT OF EMBANKMENT FILL MATERIAL AND PRELOAD FILL MATERIALS SHALL BE STAGED, WITH REST PERIODS OF MINIMUM 1 WEEK BETWEEN 1m HEIGHT FILL LIFTS. DURATION AND FREQUENCY OF REST PERIODS TO BE DETERMINED BY CONTRACTOR. DURATION OF REST PERIODS BETWEEN FILL STAGES TO BE ADJUSTED BY CONTRACTOR TO MANAGE INSTABILITY RISK DURING CONSTRUCTION.

2.10. EMBANKMENT FILL MATERIALS TO BE OVERFILLED TO ACCOUNT FOR SETTLEMENT, LATER TRIMMED / TOPPED UP TO DESIGN PAVEMENT SUBGRADE LEVEL.

3. GEOGRID AND BASAL GEOTEXTILE

3.1. REFER TO THE DRAWINGS AND PROJECT EARTHWORKS SPECIFICAITON FOR ALL GEOTEXTILE AND GEOGRID REQUIREMENTS.

3.2. LONGITUDINAL GEOGRID, WHERE SPECIFIED, IS LAID WITH THE PRIMARY STRENGTH DIRECTION ALONG THE ROAD CENTRELINE.

3.3. TRANSVERSE GEOGRID, WHERE SPECIFIED, IS LAID WITH THE PRIMARY STRENGTH DIRECTION PERPENDICULAR TO THE ROAD CENTRELINE.

3.4. BASAL HIGH STRENGTH GEOTEXTILES, THE PRIMARY STRENGTH DIRECTION IS TO BE PERPENDICULAR TO THE ROAD CENTRELINE UNLESS SPECIFICALLY SPECIFIED OTHERWISE ON THE DRAWINGS.

3.5. HIGH STRENGTH GEOTEXTILES AND GEOGRIDS ARE TO BE CONTINUOUS IN THEIR PRIMARY STRENGTH DRIECTION AND NOT LAPPED.

3.6. WHERE THE HIGH STRENGTH GEOTEXTILES AND / OR GEOGRID LAYERS EXTEND BELOW THE EXISTING GROUND SURFACE, TEMPORARY JOINED. EXCAVATION WILL BE REQUIRED.

3.7. ALL HIGH STRENGTH GEOTEXTILE AND GEOGRID LAYERS ARE TO BE LAID OUT OVER THER FULL LENGTH AND COVERED AS A SINGLE OPERATION UNLESS AGREED OTHERWISE WITH THE ENGINEER. HIGH STRENGTH GEOTEXTILE AND GEOGRID LAYERS ARE TO BE COVERED WITHIN 3 DAYS OF PLACING.

3.8. NO TRAFFIC OF SITE PLANT SHALL BE PERMITTED TO TRAFFIC THE GEOGRID OR HIGH STRENGTH GEOTEXTILE LAYERS WHERE THE FILL COVER IS LESS THAN 200mm.

3.9. GEOGRID WITHIN FILL EMBANKMENTS (EXCLUDING RETAINING STRUCTURES) SHALL BE PLACED WITH A VERTICAL SPACING OF 500mm BETWEEN LAYERS UNLESS SPECIFICALLY SPECIFIED OTHERWISE ON THE DRAWINGS.

4. PRELOAD SURCHARGING OF EMBANKMENTS

4.1. WHERE SHOWN ON THE DRAWINGS THE FILL EMBANKMENTS ARE TO BE SURCHARGED WITH PRELOAD TO ACCELERATE THE RATE OF CONSOLIDATION SETTLEMENT DURING CONSTRUCTION. REFER THE PROJECT EARTHWORKS SPECIFICATION FOR PRELOAD AND SURCHARGE SPECIFICATION.

4.2. THE PRELOAD SHALL COMPRISE AN AGGREGATE WITH A PLACED DENSITY NOT LESS THAN 2.2t/m³.

4.3. THE PRELOAD FILL SHOULD BE PLACED NO STEEPER THAN 1.5H:1V SLOPE UNLESS THE CONTRACTOR PROVIDES A TEMPORARY SUPPORT SYSTEM.

4.4. SETTLEMENT OF THE EMBANKMENT SHALL BE MONITORED DURING CONSTRUCTION WITH INSTRUMENTATION SHOWN ON THE DRAWINGS.

4.5. PRELOAD / SURCHARGE IS TO REMAIN IN PLACE UNTIL RESIDUAL CONSOLIDATION SETTLEMENT IS ESTIMATED TO BE LESS THAN 50mm, AS ADVISED BY THE ENGINEER FOLLOWING ANALYSIS OF THE FIELD DATA TO UPDATE SETTLEMENT ESTIMATES.

4.6. FOLLOWING REMOVAL OF THE PRELOAD ALL FILL MATERIALS REMAINING IN THE PERMEANT WORKS SHALL COMPLY WITH THE MATERIALS TYPE AND FIELD COMPACTION STATED ON THE DRAWINGS AND SPECIFICATION.

4.7. ESTIMATED DURATION OF PRELOADING IS THREE MONTHS WITH THE ACTUAL DURATION TO BE CONFIRMED WITH THE ENGINEER.

4.8. THE LOWER 150mm (MIN.) OF THE PRELOAD / SURCHARGE FILL SHALL COMPLY WITH THE MATERIALS TYPE AND FIELD COMPACTION STATED ON THE DRAWINGS AND SPECIFICATION FOR THE EMBANKMENT FILL.

FOR CLARITY OF DETAILS
VIEW ELECTRONICALLY

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Original Scale (A1) AS SHOWN	Design	H.BINDON	03.02.23
	Drawn	AV, ES	03.02.23
Reduced Scale (A3) HALF SHOWN	Dsg Verifier	M.GIBSON	03.02.23
	Drg Check	C. HATLEY	03.02.23

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: LOMOLOMO BRIDGE BASAL GEOTEXTILE DETAIL

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B10-30

Rev.: B

Document No. 6103677-CE-B10-30.DWG

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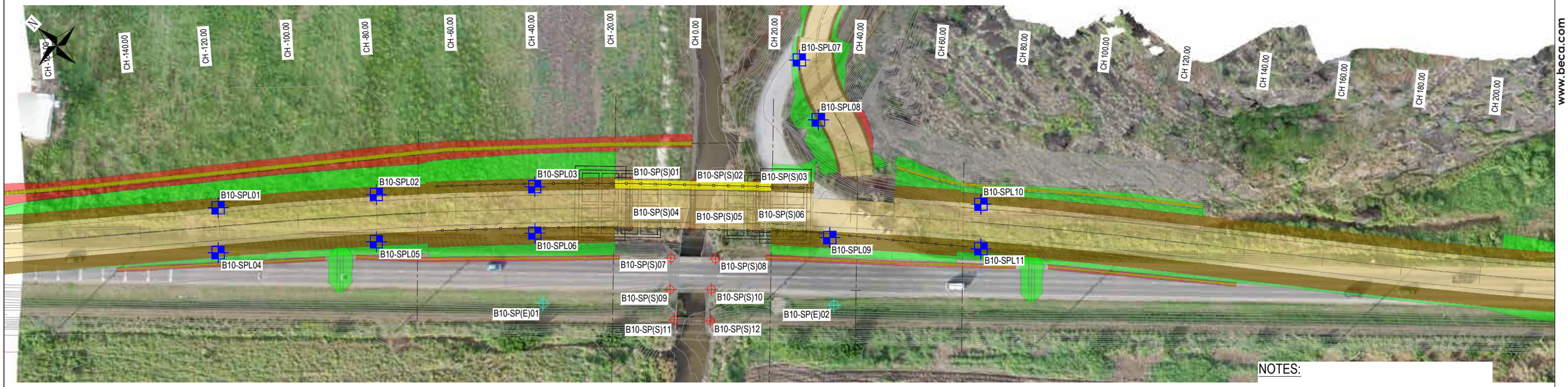

1 / - OFF LINE REPLACEMENT
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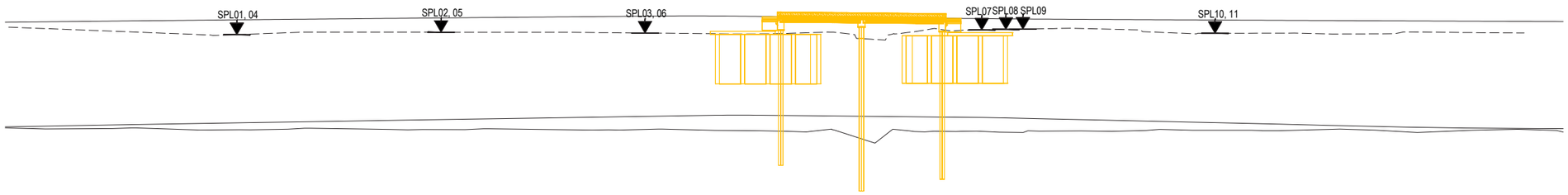

INSTRUMENTATION & MONITORING SETOUT POINTS

SETOUT POINTS	NORTHING	EASTING
B10-SPL01	3921602.7	1860528.7
B10-SPL02	3921585.9	1860565.2
B10-SPL03	3921568.0	1860601.1
B10-SPL04	3921592.8	1860523.1
B10-SPL05	3921575.5	1860559.4
B10-SPL06	3921557.7	1860595.4
B10-SPL07	3921563.0	1860675.2
B10-SPL08	3921547.5	1860672.0
B10-SPL09	3921520.1	1860659.9
B10-SPL10	3921508.7	1860697.3
B10-SPL11	3921498.9	1860691.8
B10-SP(S)1	3921557.1	1860622.7
B10-SP(S)2	3921549.0	1860636.4
B10-SP(S)3	3921541.0	1860650.2
B10-SP(S)4	3921547.7	1860617.2
B10-SP(S)5	3921539.7	1860631.0
B10-SP(S)6	3921531.6	1860644.8
B10-SP(S)7	3921535.3	1860622.3
B10-SP(S)8	3921529.6	1860632.0
B10-SP(S)9	3921528.5	1860618.2
B10-SP(S)10	3921523.4	1860627.3
B10-SP(S)11	3921521.3	1860615.4
B10-SP(S)12	3921516.6	1860623.2
B10-SP(E)01	3921541.2	1860588.5
B10-SP(E)02	3921504.7	1860652.4

INSTRUMENTATION & MONITORING FREQUENCY

INSTRUMENT DETAILS			INSTRUMENT MONITORING FREQUENCY			
INSTRUMENT	LOCATION	INSTALLATION	PRIOR TO EMBANKMENT CONSTRUCTION	DURING EMBANKMENT CONSTRUCTION	DURING PRELOAD	POST PRELOAD
SETTLEMENT PLATE B10-SPL01 - SPL13	NATURAL GROUND IMMEDIATELY BENEATH EMBANKMENT FILL	PRIOR TO INSTALLATION ON ANY FILL	THREE TIMES BEFORE FILLING	WEEKLY	WEEKLY	AT 3 MONTH INTERVALS UNTIL PAVEMENT CONSTRUCTION OR AS AGREED WITH THE ENGINEER
SURVEY PINS B10-SP(S)1-SP(S)6	NEW BRIDGE ABUTMENTS AND PIERS	IMMEDIATELY AFTER CONSTRUCTION OF STRUCTURAL ELEMENT	N/A	EVERY SECOND WEEK UNLESS AGREED OTHERWISE WITH THE ENGINEER	N/A	EVERY SECOND WEEK UNLESS AGREED OTHERWISE WITH THE ENGINEER
SURVEY PINS B10-SP(S)7-SP(S)12	EXISTING BRIDGES ABUTMENTS	PRIOR TO COMMENCING WORKS	THREE TIMES BEFORE FILLING	WEEKLY	WEEKLY	AT 3 MONTH INTERVALS UNTIL PAVEMENT CONSTRUCTION OR AS AGREED WITH ENGINEER
SURVEY PINS (B10-SP(E)01-02	GROUND ADJACENT TO RAILWAY LINE	PRIOR TO COMMENCING WORKS	THREE TIMES BEFORE FILLING	WEEKLY	WEEKLY	AT 3 MONTH INTERVALS UNTIL PAVEMENT CONSTRUCTION OR AS AGREED WITH ENGINEER

NOTES:

1. CONTRACTOR CONSTRUCTION METHODOLOGY, SEQUENCING AND PROPOSED PRELOADING SURCHAGE PROGRAMME TO BE PROVIDED TO THE ENGINEER PRIOR TO COMMENCMENT OF WORKS.
2. THE PROPOSED INSTALLATION LOCATIONS FOR INSTRUMENTS AIM TO POSITION THEM AWAY FROM CONSTRUCTION ACTIVITIES TO MINIMISE THE CHANCE OF DAMAGE TO THE INSTRUMENTS. THE FINAL LOCATION OF INSTRUMENTS SHALL BE CONFIRMED ON SITE WITH THE ENGINEER AND THE CONTRACTOR SHALL TAKE ALL PRACTICAL MEASURES TO PROTECT ALL MONITORING INSTRUMENTS DURING ALL PHASES OF CONSTRUCTION (e.g. EARTHWORKS, WEATHER, TRAFFIC, OTHER CONSTRUCTION ACTIVITIES).
3. IN THE EVENT THAT THE INSTRUMENTS ARE DAMAGED THE ENGINEER SHALL BE IMMEDIATELY INFORMED AND, IF REQUIRED BY THE ENGINEER DEPENDING ON THE DEGREE OF DAMAGE, ALL CONSTRUCTION WORKS NEAR TO THE AFFECTED INSTRUMENTATION SHALL CEASE. THE DAMAGED INSTRUMENTS SHALL BE IMMEDIATELY REPLACED AND RE-BASELINED WITHIN 24 HOURS (UNLESS OTHERWISE AGREED WITH THE ENGINEER) AND WHERE CONSTRUCTION WORKS ARE HALTED, THEY SHALL NOT RESTART UNTIL THE REPLACEMENT INSTRUMENT IS FULLY OPERATIONAL.
4. THE MONITORING RESULTS SHALL BE PROVIDED TO THE ENGINEER ON A WEEKLY BASIS. THE ENGINEER WILL REVIEW MONITORING RESULTS AND WILL CONFIRM THE END OF THE SETTLEMENT PERIOD.
5. MONITORING FREQUENCY MAY BE ALTERED AS ACCEPTED BY THE ENGINEER.
6. REFER TO 6103677-CE-STD-55 FOR SURVEY PINS TRIGGER LEVELS.
7. THE INSTALLATION AND MONITORING OF INSTRUMENTATION AND THE COLLATION OF DATA AND REVIEW OF RESULTS AGAINST THE TRIGGER LEVELS PROVIDED BY THE ENGINEER SHALL BE CARRIED OUT BY THE CONTRACTOR (OR SUITABLE PERSONNEL OR ORGANISATIONS NOMINATED BY THE CONTRACTOR WHO ARE EXPERIENCED AND COMPETENT IN SUCH WORK). ANY EXCEEDANCE OF THE TRIGGER LEVELS SHOULD BE REPORTED TO THE ENGINEER IMMEDIATELY
8. THE REQUIREMENTS OF INSTRUMENTATION AND MONITORING SPECIFICATION APPLY UNLESS OTHERWISE NOTED ON THESE DRAWINGS. FOR SPECIFICATION AND INSTRUMENTATION DETAILS REFER 6103677-CE-STD-55 TO 6103677-CE-STD-58.

LEGEND:

- SETTLEMENT MONITORING PLATE
- SURVEY PIN (STRUCTURES)
- SURVEY PIN (EARTHWORKS)

FOR CLARITY OF DETAILS VIEW ELECTRONICALLY

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Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: LOMOLOMO BRIDGE GEOTECHNICAL INSTRUMENTATION AND MONITORING DETAILS

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B10-31

Rev.: B

Document No. 6103677-CE-B10-31.DWG

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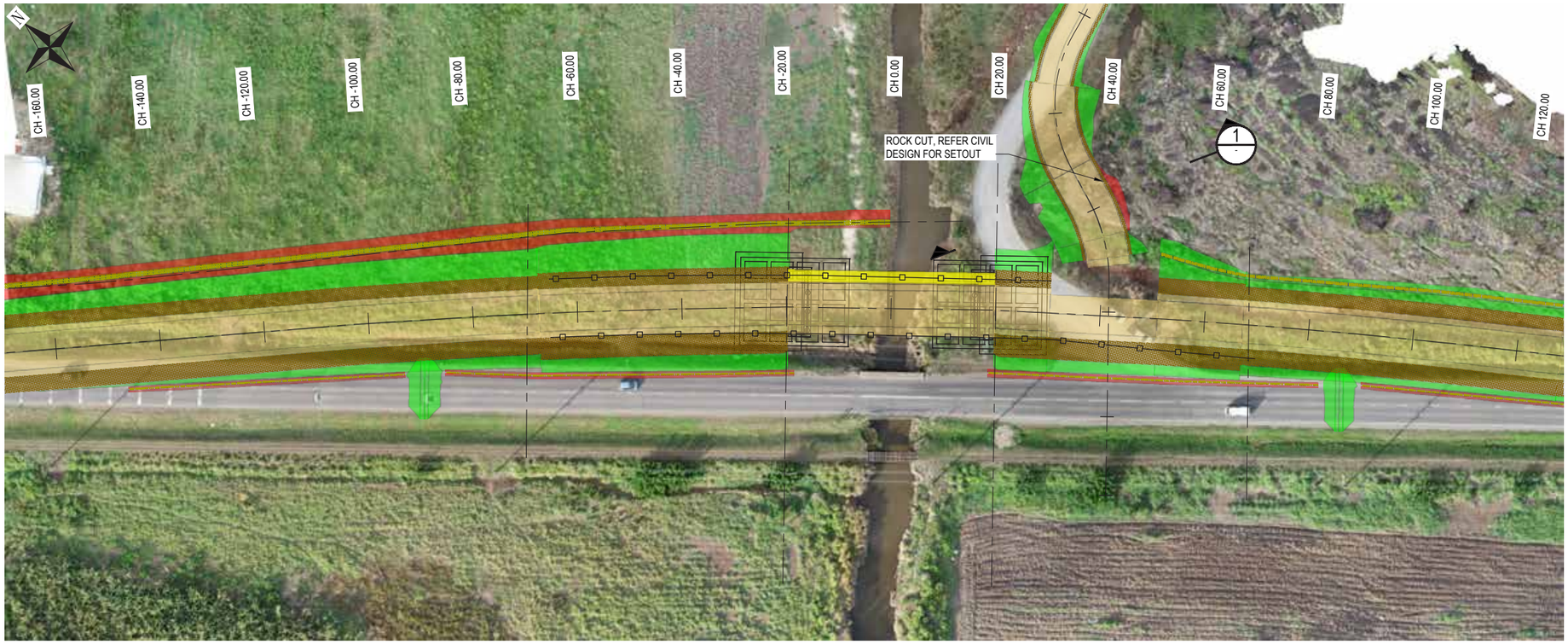


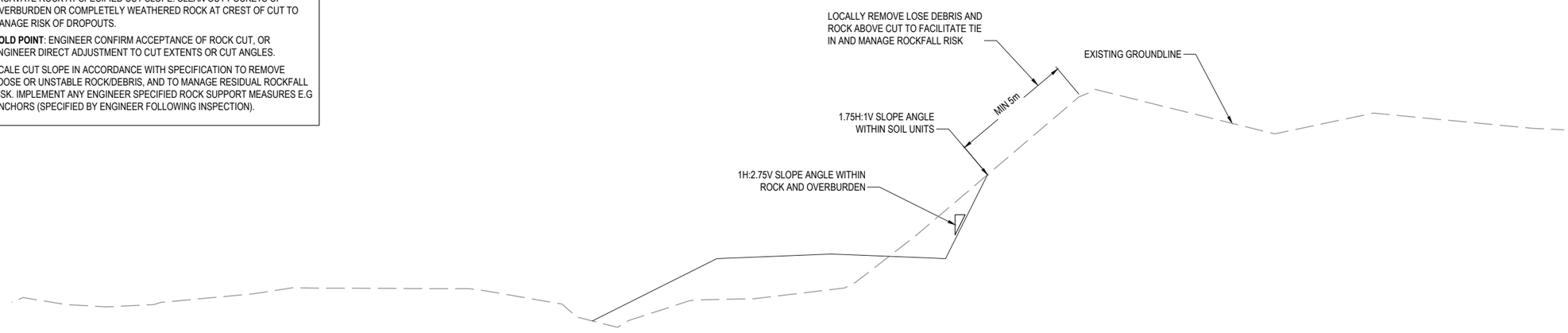
A - ROCK CUT AT EAST ABUTMENT
SCALE 1:500

NOTES:

1. REFER TO THE SPECIFICATION G010 - ROCKFALL SOURCE TREATMENT AND G011 ROCK EXCAVATION.
2. HOURS OF WORK FOR CONSTRUCTION OF THE CUT FOR ROAD WIDENING SHALL BE AGREED WITH COMMUNITY AND THE ENGINEER.
3. IN SOIL AND VERY WEAK ROCK, TRIMMING TO FINAL PROFILE SHOULD BE CARRIED OUT USING A SMOOTH-EDGE BUCKET.
4. DURING EXCAVATION, CUT SLOPE AND IMMEDIATE SURROUNDING AREA TO BE INSPECTED BY THE CONTRACTOR DAILY PRIOR TO COMMENCING WORK FOR ANY SIGNS OF INSTABILITY.
5. ROCK CUT FACE TO BE INSPECTED BY THE ENGINEER (GEOTECHNICAL MSQA REPRESENTATIVE) DURING CUT CONSTRUCTION TO CHECK FOR ADVERSE GEOLOGICAL OR GROUND CONDITIONS. LEVEL OF GEOTECHNICAL CONSTRUCTION MONITORING SERVICES TO BE TO A LEVEL OF CM4 AS DEFINED BY ENGINEERING NEW ZEALAND.
6. CUT FACES TO BE SCALED OF LOOSE MATERIAL.
7. THE ENGINEER TO IDENTIFY IF ANY LOCALIZED ROCK SUPPORT OR ADDITIONAL ROCKFALL MITIGATION OTHER THAN SCALING AND EARTHWORKS IS REQUIRED BASED ON OBSERVATIONS DURING CONSTRUCTION. A RISK ASSESSMENT SHALL BE UNDERTAKEN, AND DETERMINATION OF THE REQUIRED MITIGATION CONFIRMED BY THE ENGINEER.
8. EXPOSED SOIL FACES TO BE HYDROSEEDED ON COMPLETION
9. CONTRACTOR TO PROVIDE TEMPORARY WORKS TO MITIGATE RISK OF ROCKFALL OR DEBRIS RELEASE BEYOND THE WORKING AREA.
10. HOLD POINTS:
    - CONTRACTORS CONSTRUCTION METHODOLOGY (INCLUDING STAGING, EQUIPMENT, EXCAVATION METHODS, SAFETY EXCLUSION ZONES, SAFETY MANAGEMENT, TRAFFIC AND PEDESTRIAN MANAGEMENT) TO BE SUBMITTED TO THE ENGINEER FOR ACCEPTANCE PRIOR TO COMMENCEMENT OF EXCAVATION.
    - SETOUT OF EXCAVATION ON SITE TO BE AGREED WITH ENGINEER PRIOR TO COMMENCEMENT OF EXCAVATION.
    - ENGINEER ACCEPTANCE OF CUT SLOPE ANGLES AND CONDITION OF THE CUT FACE.
11. APPROPRIATE HEALTH AND SAFETY MEASURES TO BE INSTALLED BY THE CONTRACTOR TO ENSURE SAFE TRAFFIC FLOW DURING ROCK CUT OPERATION

ROCK CUT SEQUENCE:

1. SET OUT EXTENT OF ROCK CUT EXCAVATION
2. **HOLD POINT:** ENGINEER TO REVIEW AND ACCEPT INITIAL SETOUT.
3. EXCAVATE ROCK AT SPECIFIED CUT SLOPE. CLEAN OUT POCKETS OF OVERBURDEN OR COMPLETELY WEATHERED ROCK AT CREST OF CUT TO MANAGE RISK OF DROPOUTS.
4. **HOLD POINT**: ENGINEER CONFIRM ACCEPTANCE OF ROCK CUT, OR ENGINEER DIRECT ADJUSTMENT TO CUT EXTENTS OR CUT ANGLES.
5. SCALE CUT SLOPE IN ACCORDANCE WITH SPECIFICATION TO REMOVE LOOSE OR UNSTABLE ROCK/DEBRIS, AND TO MANAGE RESIDUAL ROCKFALL RISK. IMPLEMENT ANY ENGINEER SPECIFIED ROCK SUPPORT MEASURES E.G ANCHORS (SPECIFIED BY ENGINEER FOLLOWING INSPECTION).



1 - TYPICAL ROCK CUT SECTION
SCALE 1:100

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
A	DETAILED DESIGN FOR FRA REVIEW	MA	VH	CH	21.03.24

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	Drg Check	C. HATLEY	11.03.24

Approved For Construction* Date
* Refer to Revision 1 for Original Signature

Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: LOMOLOMO BRIDGE ROCK CUT SECTION AND DETAILS

Discipline: CIVIL ENGINEERING

Drawing No.: 6103677-CE-B10-32

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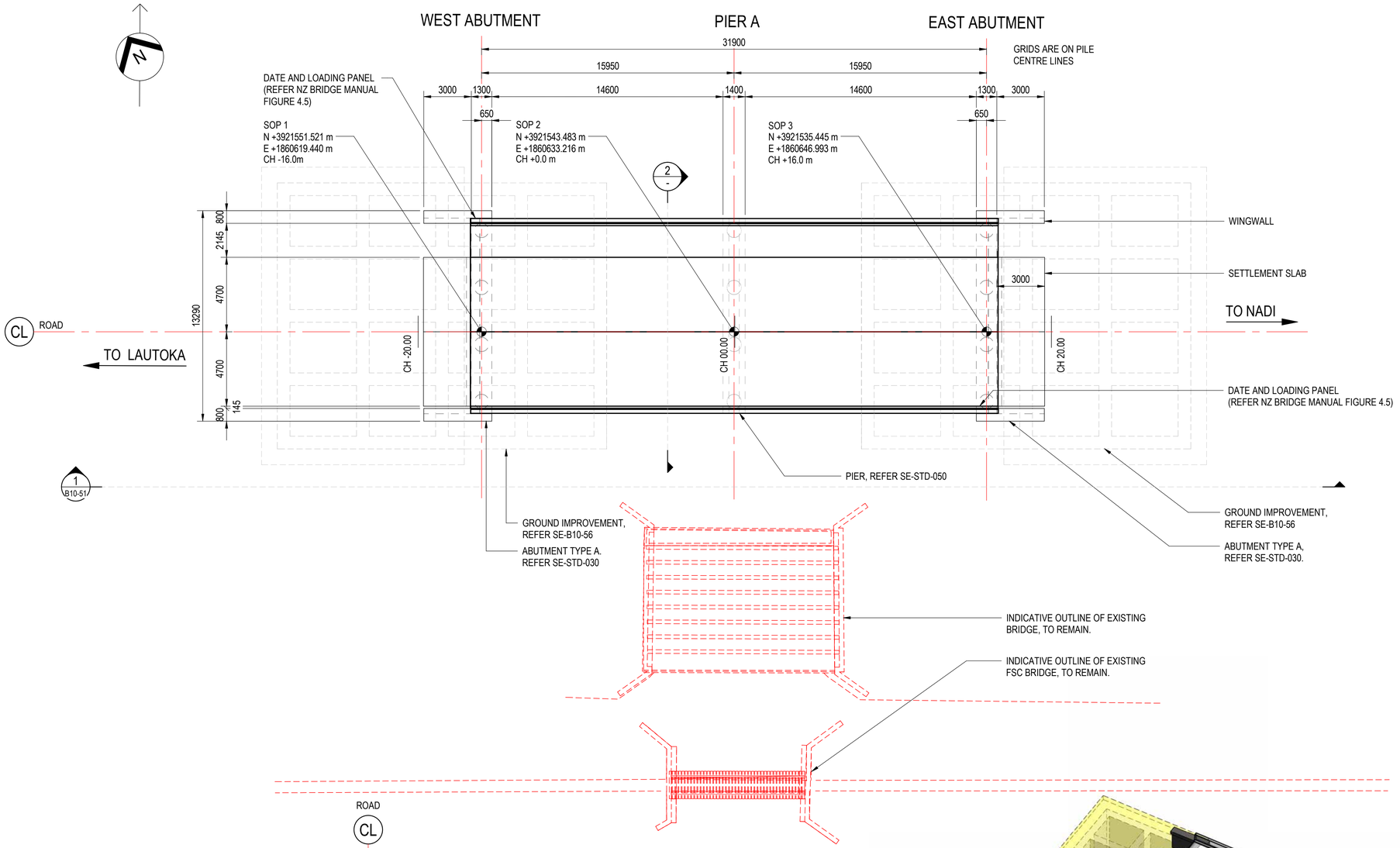
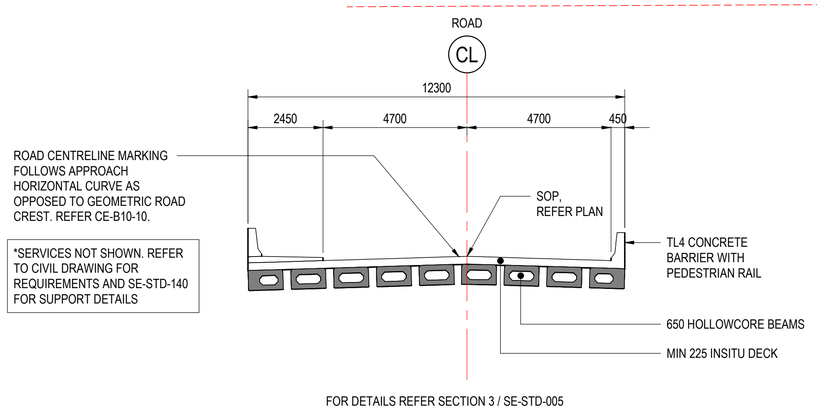
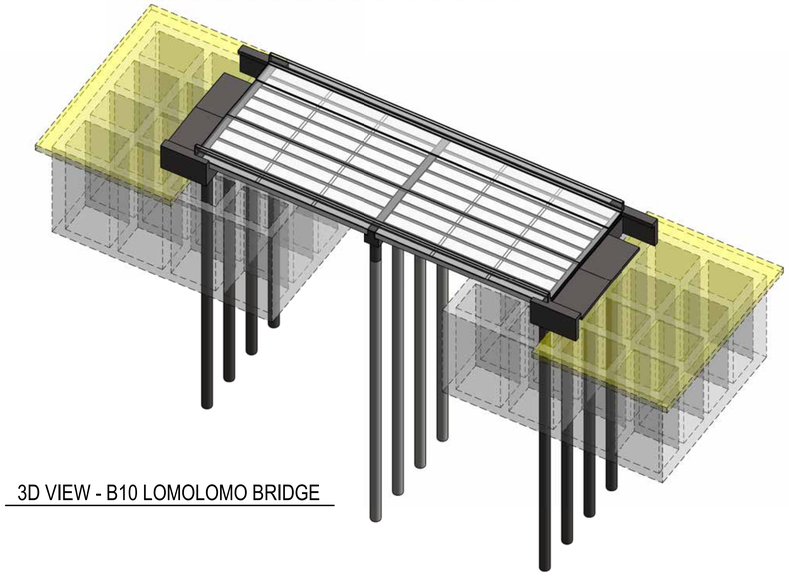


A BRIDGE PLAN
1 : 150



2 SECTION
- 1 : 100



3D VIEW - B10 LOMOLOMO BRIDGE

NOTES.

1. FOR SITE LAYOUT, FEATURES, AND ROAD CORRIDOR DETAILS REFER TO 6103677-CE-B10-10, ROADING PLAN AND PROFILE, AND THE RELATED CIVIL DRAWINGS.
2. VERTICAL HEIGHT DATUM IS FIJI HEIGHT DATUM AND COORDINATE SYSTEM IS FIJI MAP GRID (FMG). FOR DETAILS REFER TO FRA'S TOPOGRAPHICAL SURVEY DRAWING SS 24/22.
3. THE OUTLINE OF EXISTING BRIDGE IS AS PER FRA'S TOPOGRAPHICAL SURVEY DRAWING SS 24/22. THE CONTRACTOR SHALL CONFIRM POSITION OF THE BRIDGE PRIOR TO THE CONSTRUCTION.
4. FOR FINISHED DESIGN LEVELS REFER TO DRAWING CE-B10-10 AND SE-B10-51
5. THESE BRIDGE SPECIFIC DRAWINGS SHALL BE READ IN CONJUNCTION WITH AND REFER TO STANDARD DRAWINGS, SPECIFICALLY:
   - 6103677-SE-STD-001 TO 004 FOR GENERAL NOTES
   - 6103677-SE-STD-010 SERIES FOR GROUND IMPROVEMENT DETAILS
   - 6103677-SE-STD-020 SERIES FOR PILE DETAILS
   - 6103677-SE-STD-030 SERIES FOR ABUTMENT TYPE A DETAILS
   - 6103677-SE-STD-050 SERIES FOR PIER DETAILS
   - 6103677-SE-STD-060 SERIES FOR SUPERSTRUCTURE DETAILS
   - 6103677-SE-STD-070 SERIES FOR PRECAST PRESTRESSED SHC BEAM DETAILS
   - 6103677-SE-STD-100 SERIES FOR DECK DETAILS
   - 6103677-SE-STD-110 SERIES FOR BARRIER DETAILS.
   - 6103677-SE-STD-140 FOR SERVICE SUPPORT DETAILS
   - 6103677-SE-STD-180 FOR STANDARD BRIDGE ANTICIPATED CONSTRUCTION SEQUENCE

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
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Dsg Verifier	T.POLLEY	23.06.23
Drg Check	D.CVITANICH	23.06.23

Sub-consultant: Erasito Main-consultant: beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Title: B10 LOMOLOMO BRIDGE - BRIDGE PLAN

Discipline: STRUCTURAL

Drawing No.: 6103677-SE-B10-50

Rev.: C

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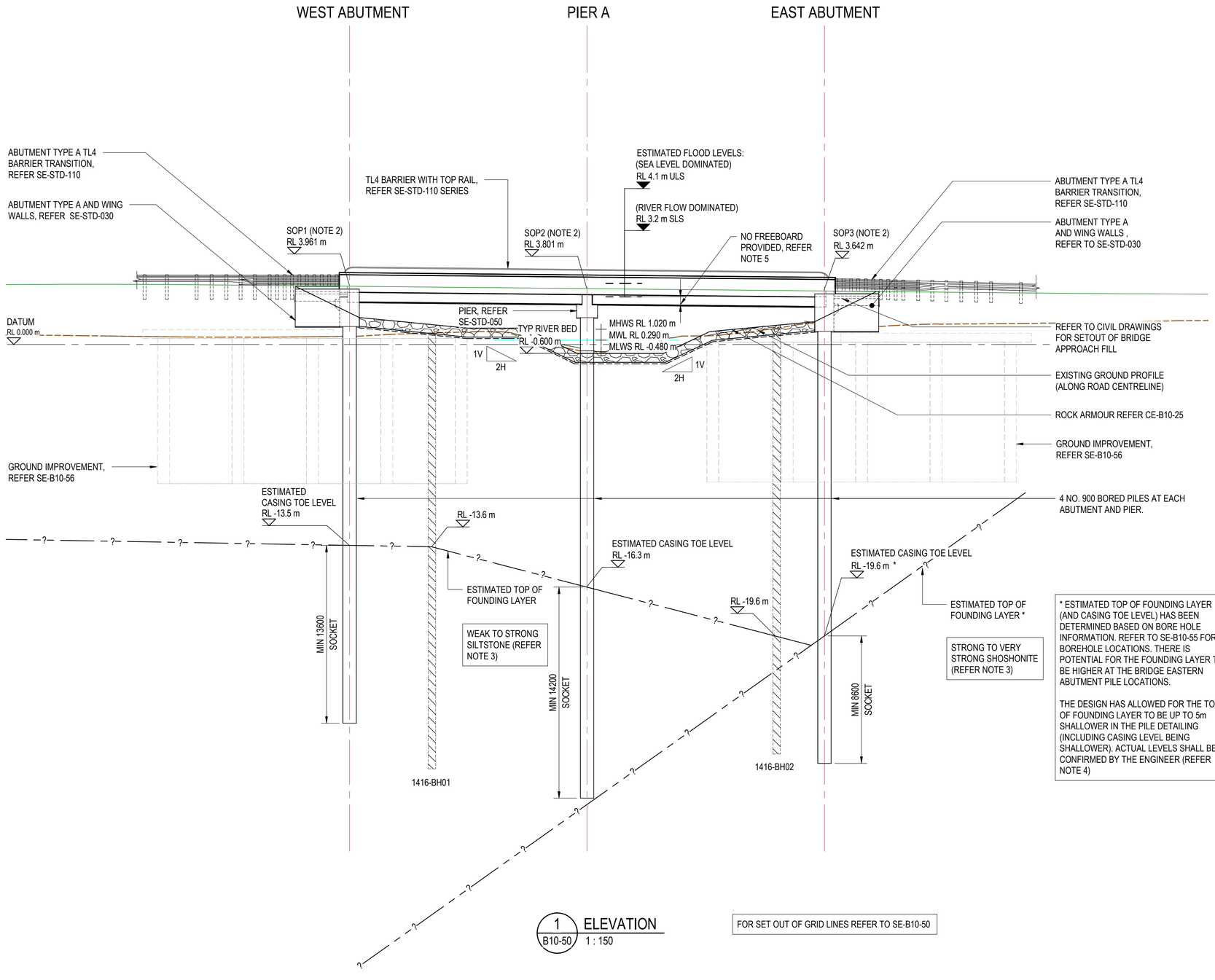

1 / B10-50 ELEVATION
1 : 150

FOR SET OUT OF GRID LINES REFER TO SE-B10-50

NOTES.

1. REFER TO DRAWING SE-B10-50 FOR NOTES.
2. REFER TO SE-B10-50 FOR SOP LOCATIONS. LEVELS ARE GIVEN AT THE TOP OF THE DECK AT INTERSECTION OF THE ROAD CENTRELINE AND SUPPORT GRID LINE PLACED ON THE CENTRELINE OF PILES. REFER TO SE-B10-50 SECTION 2 FOR LOCATION.
3. ROCK DESCRIPTION IN ACCORDANCE WITH NEW ZEALAND GEOTECHNICAL SOCIETY GUIDANCE. REFER TO ENTEC FACTUAL GEOTECHNICAL REPORT FOR FURTHER INFORMATION. REFER TO SE-B10-55 FOR BOREHOLE LOCATIONS.
4. ACTUAL CASING TOE LEVEL, TOP OF FOUNDING LAYER AND SOCKET SHALL BE CONFIRMED FOLLOWING CASING INSTALLATION AND PILE BORING. THE FINAL TOP OF FOUNDING LEVEL AND SOCKET SHALL BE CONFIRMED BY THE ENGINEER, SUBJECT TO ACTUAL ENCOUNTERED SOIL PROPERTIES.
5. FRA REQUESTED A MINIMUM FINISHED ROAD LEVEL OF 3.5mRL SHALL BE ADOPTED. FOR DETAILS REFER TO THE DESIGN REPORT

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN, FOR FRA REVIEW	RS	TP	CH	21.03.24
A	DETAILED DESIGN, FOR COMMENT	RS	TP	CH	06.07.23

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Drg Check	D.CVITANICH	06.07.23

Sub-consultant: Erasito
Main-consultant: Beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: B10 LOMOLOMO BRIDGE - BRIDGE ELEVATION
Discipline: STRUCTURAL
Drawing No.: 6103677-SE-B10-51
Rev.: B

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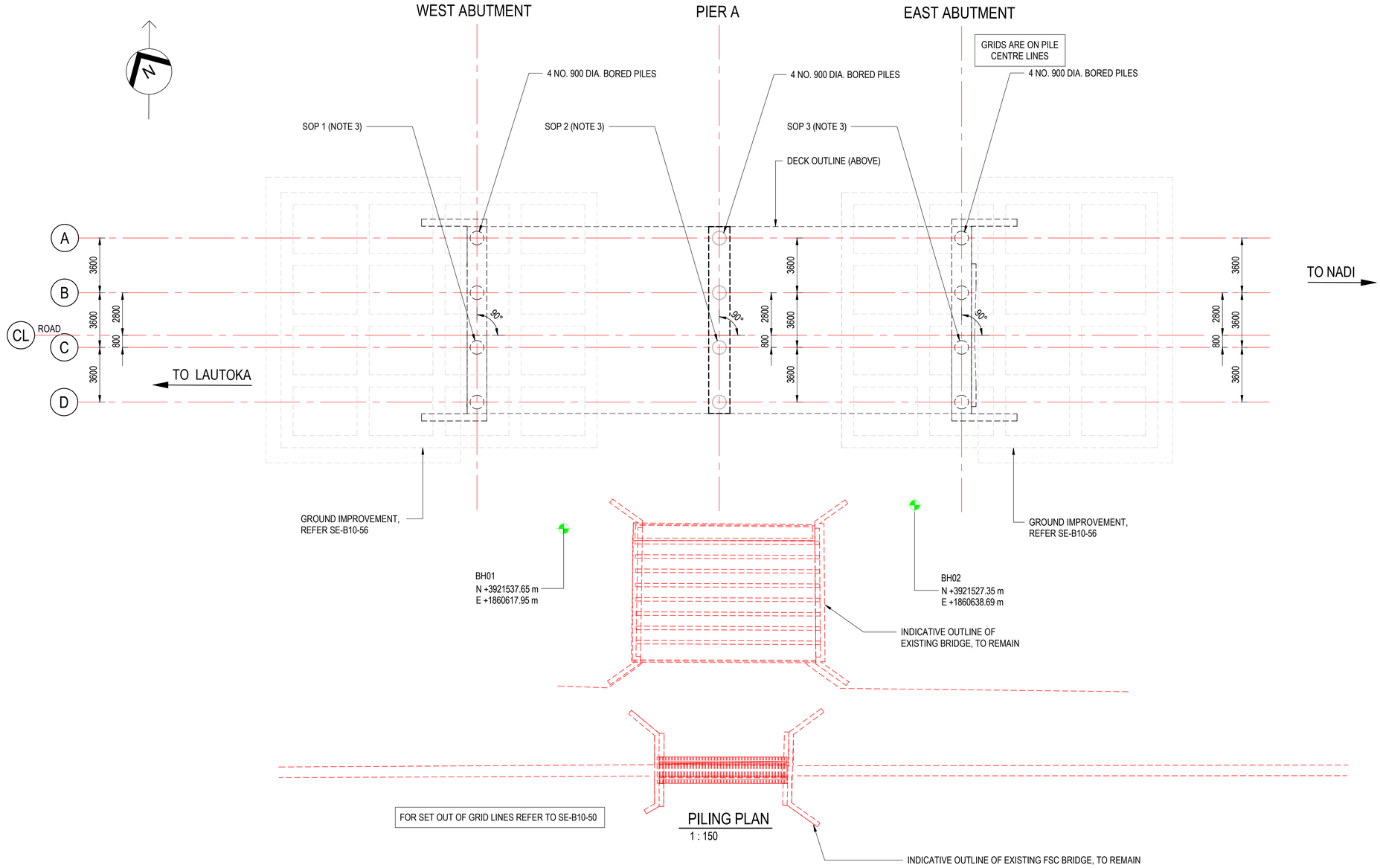
NOTES

1. REFER TO DRAWING SE-B10-50 FOR NOTES.
2. REFER TO STANDARD PILING DRAWINGS SE-STD-020 TO 021 FOR DETAILS
3. REFER TO DRAWING SE-B10-50 FOR SOP.
4. ALL DIMENSIONS ARE PLAN DIMENSIONS AND ARE NOT TRUE LENGTH



FOR SET OUT OF GRID LINES REFER TO SE-B10-50

PILING PLAN
1 : 150

BORED PILE REINFORCING INFORMATION

	LONGITUDINAL BARS				SPIRALS					
LOCATION	LENGTH "Y"	GROUP 1	GROUP 2	PHZs*	SPIRAL TYPE A	DIST "A'	SPIRAL TYPE B	DIST "B"	SPIRAL TYPE C	DIST "C"
WEST ABUTMENT	FULL LENGTH	12RB32	—	0m - 8.5m	RH16-300	FULL LENGTH	—	—	—	—
PIER A	FULL LENGTH	10RB32	—	0m - 4m & 10m - 15.5m	RH16-90	2000	RH16 -175	6000	RH16-300	REMAINING LENGTH
EAST ABUTMENT	FULL LENGTH	12RB32	—	0m - 8.5m	RH16-300	FULL LENGTH	—	—	—	—

* NO LAPPING OF LONGITUDINAL REINFORCEMENT IS ALLOWED IN PLASTIC HINGE ZONES (PHZs)
REFER TO BORED PILE DRAWING SE-STD-021 FOR REINFORCING CALLOUT

BEWARE:

THE CONTRACTOR SHALL CONFIRM THAT THERE IS NO CONFLICT WITH UNDERGROUND SERVICES (EXISTING, NEWLY INSTALLED AND / OR TEMPORARY) AND / OR IMPLEMENT APPROPRIATE PROTECTION MEASURES PRIOR TO CARRYING OUT ANY PILE INSTALLATION OR EXCAVATION WORKS.

LEGEND:

- PROOF BORE LOCATION (IF REQUIRED)
- DESIGN INVESTIGATION BORE LOCATION (FOR INFORMATION)

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN, FOR FRA REVIEW	RS	TP	CH	21.03.24
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Drg Check	D.CVITANICH	06.07.23

Sub-consultant: Erasito
Main-consultant: Beca
Client: Fiji Roads Authority
Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES
Title: B10 LOMOLOMO BRIDGE - BRIDGE PILING PLAN
Discipline: STRUCTURAL
Drawing No.: 6103677-SE-B10-55
Rev.: B

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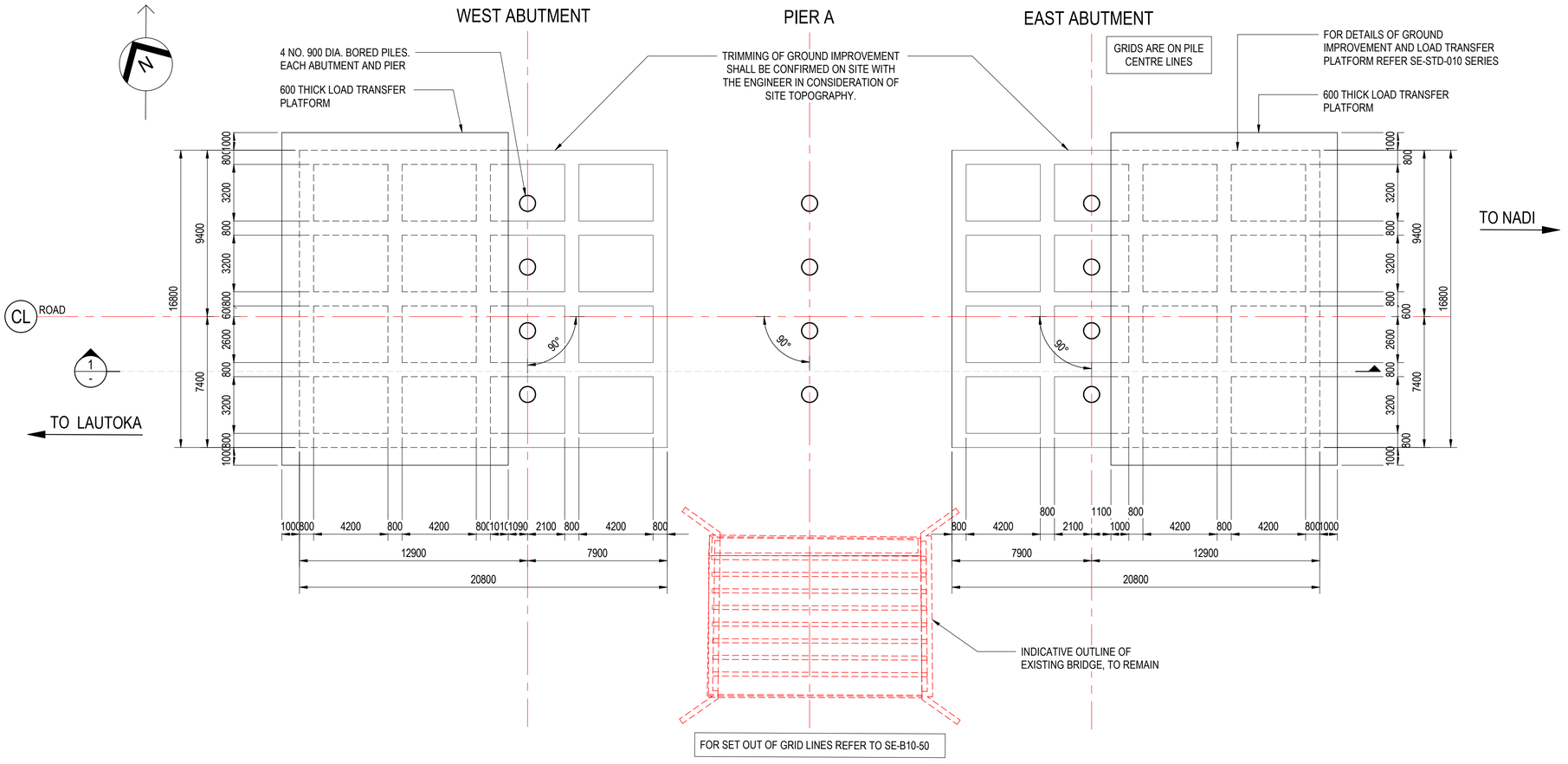
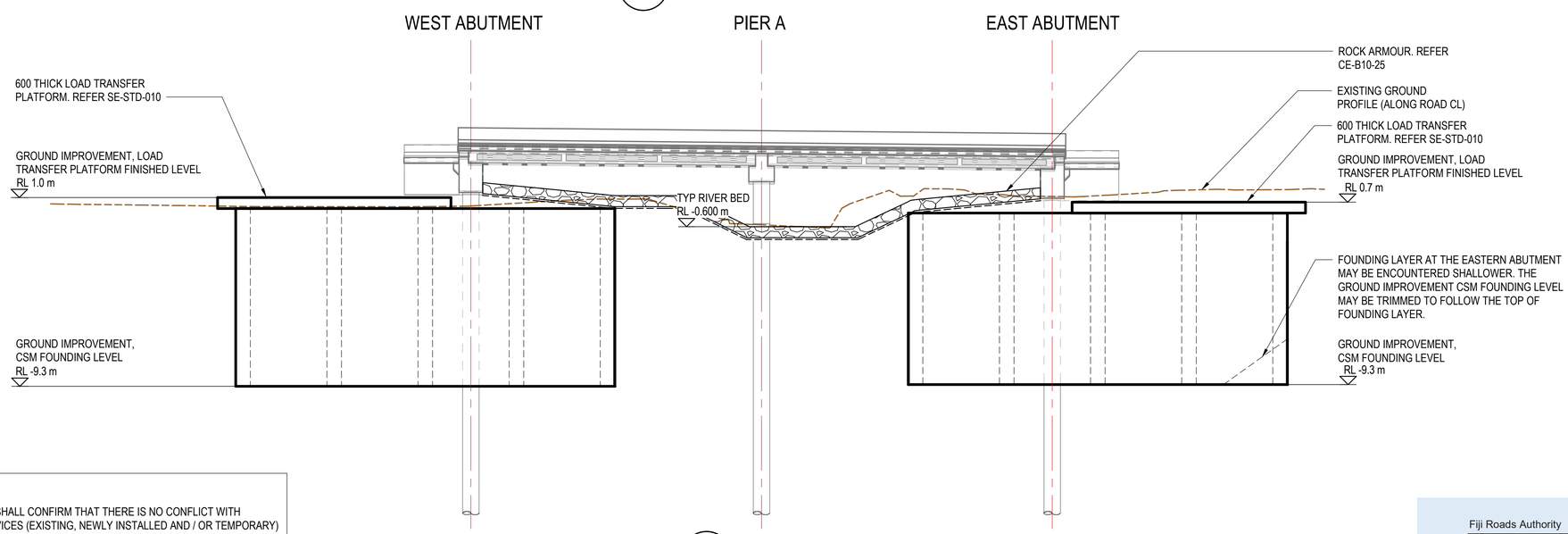


A - GROUND IMPROVEMENT PLAN
1 : 150



1 - LONG SECTION
1 : 150

NOTES:

1. REFER TO DRAWING SE-B10-50 FOR NOTES.
2. CSM NOTES:

a. CSM PANELS TO BE CONSTRUCTED WITH THE FOLLOWING SPECIFICATION:

- MIN.SHEAR STIFFNESS OF 1250MPa
- MIN. YOUNG'S MODULUS OF 3000MPa
-UNCONFINED CONCRETE STIFFNESS OF MIN. 2.5MPa
- MIN. AREA REPLACEMENT RATIO: 30%

b. CSM TO BE CONSTRUCTED IN ACCORDANCE WITH SPECIFICATION C0414.

c. CONTRACTOR TO CONSIDER THE CONSTRAINTS OF STREAM, SITE BOUNDARIES AND ADJACENT EXISTING BRIDGE ABUTMENTS DURING CONSTRUCTION OF THE GROUND IMPROVEMENT.

BEWARE:

THE CONSTRUCTOR SHALL CONFIRM THAT THERE IS NO CONFLICT WITH UNDERGROUND SERVICES (EXISTING, NEWLY INSTALLED AND / OR TEMPORARY) AND / OR IMPLEMENT APPROPRIATE PROTECTION MEASURES PRIOR TO CARRYING OUT ANY CSM INSTALLATION OR EXCAVATION WORKS.

No.	Revision	By	Chk	Appd	Date
B	DETAILED DESIGN, FOR FRA REVIEW	RS	TP	CH	21.03.24
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Sub-consultant: Erasito | Main-consultant: Beca

Client: Fiji Roads Authority

Project: 40 CRITICAL BRIDGES & 3 MARITIME STRUCTURES

Fiji Roads Authority — 40+3 Bridges and Jetties (P1 Bridges)

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Appendix B: Water Quality Assessment

Fiji Roads Authority

40 Critical Bridges and 3 Maritime Structures

Priority 1 Bridges

Water Quality Assessment

Rev A

25th March, 2024

Erasito Consultants Pte. Ltd.
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Appendix A: FRA Water Quality Field Datasheet

Appendix B: National Water Quality Laboratory Results

1 Introduction

A Water Quality Assessment has been completed for the seven of the Priority 1 bridges, listed below. Water samples were collected were collected by FRA Safeguards Officers during the month of October 2023. The samples were tested at the National Water Quality Laboratory (WAF Lab). These are:

- Medraukutu Bridge
- Lami Bridge
- Vunitogoloa Bridge
- Viseisei Bridge
- Vitawa Bridge
- Matawalu Bridge
- Sabeto Bridge

Water quality assessment with laboratory sampling and testing for 7 of 10 bridges were undertaken due to use of the immediate area for fishing/ swimming to consider environmental baseline and potential effects, with recommendations for any mitigation and management plans to be adopted.

1.1.1. Sample Analysis

Table below lists the physical and chemical tests that were conducted, parameters measured and the reference method which were used for the water analysis

Parameter Tested	Units	APHA Method Code
pH	0-14	4500-H+B
Conductivity (Chem)	µS/cm	2510B
Turbidity	NTU	2130B
Total Suspended Solids	mg/L	2540D
Total Dissolved Oxygen	mg/L	4500-0C
Nitrate	mg/L	4500-NO-3
Total Phosphorus	mg/L	4500PE
Biochemical Oxygen Demand	mg/L	5210B

Reference Methods and the parameters tested of the extracted raw water samples.

Water quality guidelines that can be used to ensure protection of freshwater aquatic organisms have not been developed specifically for the tropical Pacific islands. However, the National Liquid Waste Standards[1] may be used to estimate contaminant levels which may be harmful to aquatic organisms in a significant ecological zone.

[1] Environment Management Regulations (2007) National Liquid Waste Standards

2 Water Quality Assessment

2.1 Medraukutu Bridge

Water samples were collected from Medramata River (i.e. Upstream and Downstream) of the bridge which flows from Mount Korobaba and discharges into the estuary directly downstream of the bridge. The samples were collected by Fiji Roads Authority Safeguards team on Monday, 3rd October, 2023. The samples were collected on an Overcast Day. The samples were tested at the National Water Quality Laboratory.

The location where the two water samples were extracted is shown in figure 1

Figure 1: Locations of the water Sampling Stations at Medraukutu bridge

2.1.1 Water Quality Results

The water quality results for the nine parameters measured across the two test locations are summarised in table 1.

No.	Parameter Tested	Units	Sample Results		National Liquid Waste Standards
			Sample 1 (upstream)	Sample 2 (Downstream)	
1	pH	0-14	7.50	7.81	7 - 9
2	Conductivity (Chem)		21590.0	28740.0	-
3	Turbidity	NTU	7.50	21.90	-

No.	Parameter Tested	Units	Sample Results		National Liquid Waste Standards
			Sample 1 (upstream)	Sample 2 (Downstream)	
4	Total Suspended Solids	mg/L	110.6	148.7	60
5	Total Dissolved Oxygen	mg/L	8.67	8.65	1000
6	Nitrate	mg/L	0.10	0.12	-
7	Total Phosphorus	mg/L	0.37	0.42	5
8	Biochemical Oxygen Demand	mg/L	0.85	1.16	40
9	Total Coliform	cfu/100ml	10,400	8,800	400
10	Faecal Coliform	cfu/100ml	5,000	940	400

Table 1: Summary of the parameters tested at the two sample locations.

Water quality in the Suva Harbour is considered to be poor due to contaminants discharging into the harbour. This includes heavy metals, sewage, leachate from landfills, oil slicks from vessels, and general rubbish.

The Total Suspended Solids (TSS), Total Coliform and Faecal Coliform are substantially high at both the sampling locations. Generally, high levels of TSS is an indication of surface runoff which causes sedimentation.

2.2 Lami Bridge

Water samples were collected from Lami River (i.e. Upstream and Downstream) is a stream in Rewa Province, Central situated nearby to Suvavou village and Wainidinu. The samples were collected by Fiji Roads Authority Safeguards team on Monday, 3rd October, 2023. The samples were collected on an Overcast Day. The samples were tested at the National Water Quality Laboratory.

The location where the two water samples were extracted is shown in figure 2.

Figure 2: Locations of the water Sampling Stations at Lami bridge

2.2.1 Water Quality Results

The water quality results for the nine parameters measured across the two test locations are summarised in table 2.

No.	Parameter Tested	Units	Sample Results		National Liquid Waste Standards
			Sample 1 (upstream)	Sample 2 (Downstream)	
1	pH	0-14	7.91	7.76	7 - 9
2	Conductivity (Chem)		8997.0	27420.0	-
3	Turbidity	NTU	3.25	4.96	-
4	Total Suspended Solids	mg/L	23.1	92.5	60
5	Total Dissolved Oxygen	mg/L	8.64	8.71	1000
6	Nitrate	mg/L	0.09	0.09	-
7	Total Phosphorus	mg/L	0.36	0.31	5
8	Biochemical Oxygen Demand	mg/L	0.71	0.78	40

No.	Parameter Tested	Units	Sample Results		National Liquid Waste Standards
			Sample 1 (upstream)	Sample 2 (Downstream)	
9	Total Coliform	cfu/100ml	16,800	8,400	400
10	Faecal Coliform	cfu/100ml	63	90	400

Table 2: Summary of the parameters tested at the two sample locations.

The Total Suspended Solids (TSS) is substantially high on the dowsnstream. This may be a result of activities upstream such as farming as there are a number of communities living upstream of the Lami River.

The Total Coliform levels was substantially high at both sampling locations. This could be a result of domesticating animals near the river upstream or surface runoff from pastures.

2.3 Vunitogoloa Bridge

Water samples were collected from Wailoa creek (i.e. Upstream and Downstream) is a stream in Ra Province, Western Division situated nearby to Vunitogoloa and Naivuvuni. The samples were collected by Fiji Roads Authority Safeguards team on Monday, 5th October, 2023. The samples were collected on a Sunny Day. The samples were tested at the National Water Quality Laboratory.

The location where the two water samples were extracted is shown in figure 3

Figure 3: Locations of the water Sampling Stations at Vunitogoloa bridge

2.3.1 Water Quality Results

The water quality results for the nine parameters measured across the two test locations are summarised in table 3.

No.	Parameter Tested	Units	Sample Results		National Liquid Waste Standards
			Sample 1 (upstream)	Sample 2 (Downstream)	
1	pH	0-14	8.06	7.85	7 - 9
2	Conductivity (Chem)		102.0	491.2	-
3	Turbidity	NTU	1.53	2.21	-
4	Total Suspended Solids	mg/L	4.1	29.3	60
5	Total Dissolved Oxygen	mg/L	9.55	9.52	1000
6	Nitrate	mg/L	0.08	0.08	-
7	Total Phosphorus	mg/L	0.47	0.40	5
8	Biochemical Oxygen Demand	mg/L	1.55	2.30	40
9	Total Coliform	cfu/100ml	8,200	5,600-	400
10	Faecal Coliform	cfu/100ml	255	270	400

Table 3: Summary of the parameters tested at the two sample locations.

The Total Coliform is noted to be high at both the sampling Locations. This is a result of domesticating animals such as cows, horses near the waterways.

2.4 Viseisei Bridge

Water samples were collected from Vuda River (i.e. Upstream and Downstream) is a stream in Western, Fiji situated nearby to the localities Viseisei and Lomolomo. The samples were collected by Fiji Roads Authority Safeguards team on Monday, 5th October, 2023. The samples were collected on a Sunny Day. The samples were tested at the National Water Quality Laboratory.

The location where the two water samples were extracted is shown in figure 4.

Figure 4: Locations of the water Sampling Stations at Viseisei bridge

2.4.1 Water Quality Results

The water quality results for the nine parameters measured across the two test locations are summarised in table 4.

No.	Parameter Tested	Units	Sample Results		National Liquid Waste Standards
			Sample 1 (upstream)	Sample 2 (Downstream)	
1	pH	0-14	7.60	7.56	7 - 9
2	Conductivity (Chem)		33690.0	33150.0	-
3	Turbidity	NTU	3.99	4.63	-
4	Total Suspended Solids	mg/L	106.1	55.8	60
5	Total Dissolved Oxygen	mg/L	9.02	8.04	1000
6	Nitrate	mg/L	0.10	0.10	-
7	Total Phosphorus	mg/L	0.43	0.42	5
8	Biochemical Oxygen Demand	mg/L	2.64	1.01	40
9	Total Coliform	cfu/100ml	500	700	400

No.	Parameter Tested	Units	Sample Results		National Liquid Waste Standards
			Sample 1 (upstream)	Sample 2 (Downstream)	
10	Faecal Coliform	cfu/100ml	125	123	400

Table 4: Summary of the parameters tested at the two sample locations.

The TSS is substantially high at the sampling location upstream. This may be the result of farming practices along the upstream of the Vuda River Catchment.
The Total Coliform is noted to be high at both the sampling location. The likely cause of high coliform is a result of domesticating animals near the waterways

2.5 Vitawa Bridge

Water samples were collected from Naidadara creek (i.e. Upstream and Downstream) is a stream in Ra Province, Western situated nearby to Vitawa and Narewa. The samples were collected by Fiji Roads Authority Safeguards team on Monday, 5th October, 2023. The samples were collected on a Sunny Day. The samples were tested at the National Water Quality Laboratory.

The location where the two water samples were extracted is shown in figure 5

Figure 5: Locations of the water Sampling Stations at Vitawa bridge

2.5.1 Water Quality Results

The water quality results for the nine parameters measured across the two test locations are summarised in table 5.

No.	Parameter Tested	Units	Sample Results		National Liquid Waste Standards
			Sample 1 (upstream)	Sample 2 (Downstream)	
1	pH	0-14	7.96	8.06	7 - 9
2	Conductivity (Chem)		905.0	1009.0	-
3	Turbidity	NTU	3.26	3.79	-
4	Total Suspended Solids	mg/L	8.7	11.9	60
5	Total Dissolved Oxygen	mg/L	9.40	9.43	1000
6	Nitrate	mg/L	0.16	0.12	-
7	Total Phosphorus	mg/L	0.52	0.51	5
8	Biochemical Oxygen Demand	mg/L	2.36	2.90	40
9	Total Coliform	cfu/100ml	5,600	8,400	400
10	Faecal Coliform	cfu/100ml	155	185	400

Table 5: Summary of the parameters tested at the two sample locations.

The Total Coliform is noted to be high at both the sampling locations. This is a result of domesticating animals near the waterways as the bridge is surrounded by farming communities.

2.6 Matawalu Bridge

Water samples were collected from Teidamu creek (Upstream and Downstream) is a stream in Ba Province, Western situated nearby to Naviago and Vitogo. The samples were collected by Fiji Roads Authority Safeguards team on Monday, 5th October, 2023. The samples were collected on a Sunny Day. The samples were tested at the National Water Quality Laboratory.

The location where the two water samples were extracted is shown in figure 6.

Figure 6: Locations of the water Sampling Stations at Matawalu bridge

2.6.1 Water Quality Results

The water quality results for the nine parameters measured across the two test locations are summarised in table 6.

No.	Parameter Tested	Units	Sample Results		National Liquid Waste Standards
			Sample 1 (upstream)	Sample 2 (Downstream)	
1	pH	0-14	7.67	7.59	7 - 9
2	Conductivity (Chem)		10180.0	9805.0	-
3	Turbidity	NTU	6.48	7.64	-
4	Total Suspended Solids	mg/L	34.9	61.2	60
5	Total Dissolved Oxygen	mg/L	9.67	9.09	1000
6	Nitrate	mg/L	0.16	0.13	-
7	Total Phosphorus	mg/L	0.64	0.48	5
8	Biochemical Oxygen Demand	mg/L	1.49	4.80	40
9	Total Coliform	cfu/100ml	5,400	6,600	400

No.	Parameter Tested	Units	Sample Results		National Liquid Waste Standards
			Sample 1 (upstream)	Sample 2 (Downstream)	
10	Faecal Coliform	cfu/100ml	260	245	400

Table 6: Summary of the parameters tested at the two sample locations.

The TSS is slightly high at sampling location downstream. This may be the result of farming practices along the downstream (i.e. from surface runoff during heavy downpour).

The Total Coliform is noted to be high at both the sampling locations. This is likely result of domesticating animals near the waterways.

2.7 Sabeto Bridge

Water samples were collected from Sabeto River (i.e. Upstream and Downstream) is a stream in Ba Province, Western situated nearby to Lomolomo and Barara Settlement. The samples were collected by Fiji Roads Authority Safeguards team on Monday, 5th October, 2023. The samples were collected on a Sunny Day. The samples were tested at the National Water Quality Laboratory.

The location where the two water samples were extracted is shown in figure 7

Figure 7: Locations of the water Sampling Stations at Sabeto bridge

2.7.1 Water Quality Results

The water quality results for the nine parameters measured across the two test locations are summarised in table 7.

No.	Parameter Tested	Units	Sample Results		National Liquid Waste Standards
			Sample 1 (upstream)	Sample 2 (Downstream)	
1	pH	0-14	7.63	7.63	7 - 9
2	Conductivity (Chem)		567.7	567.7	-
3	Turbidity	NTU	3.87	3.84	-
4	Total Suspended Solids	mg/L	6.3	5.7	60
5	Total Dissolved Oxygen	mg/L	8.02	9.21	1000
6	Nitrate	mg/L	0.09	0.07	-
7	Total Phosphorus	mg/L	0.47	0.47	5
8	Biochemical Oxygen Demand	mg/L	0.98	5.06	40
9	Total Coliform	cfu/100ml	800	7,600	400
10	Faecal Coliform	cfu/100ml	120	130	400

Table 7: Summary of the parameters tested at the two sample locations.

The Total Coliform is noted to be high at both the sampling locations. Likely cause of high coliform is a result of domesticating animals near the waterways as the surroundings are mostly farming land.

Appendix A

FRA Water Quality Field Datasheet

Field Data Sheet No: 01 /CE/23

Fiji Roads Authority

FIELD DATA SHEET: 40 Bridges & 3 Jetties WQ

Site Name: NUEDRAKUTU BRIDGE, LAMI

Collection		Lab Submission	
Date	***Time***	***Date***	***Time***
03/10/23	11:30 am	09/10/23	12:48
Officer Name:	Kelekolio Tomuloa	Lab Tech Name:	Johsua Iema
Signature:		Signature:	

SAMPLE DETAILS

SP	Physical Bottle #:	Bacto Bottle #:	GPS Coordinates
1 (Upstream)	Upstream ENV 11	ENV 11	18.10328 178.38847
2 (Downstream)	Downstream ENV 7.	ENV 7	18.1035 178.38815

Weather– Past 24hrs		Current Weather
☐	Storm (heavy rain)	☐
☐	Rain (Steady rain)	☐
☑	Showers (intermittent rain)	☐
☐	Overcast	☑
☐	Clear/Sunny	☐

Comments:

N/A :

Field Data Sheet No: 02 /CE/23

Fiji Roads Authority

FIELD DATA SHEET: 40 Bridges & 3 Jetties WQ

Site Name: LAMU BRIDGE

Collection		Lab Submission	
Date	***Time***	***Date***	***Time***
03/10/23	11:45 am	03/10/23	12:48
Officer Name:	Kelekolio. Tonumaira	Lab Tech Name:	Johsua Kum
Signature:		Signature:	Jums

SAMPLE DETAILS

SP	Physical Bottle #:	Bacto Bottle #:	GPS Coordinates
1 (Upstream)	Upstream ENV 24	ENV 24	-18.114036, 178.411810
2 (Downstream)	Downstream ENV 24	ENV 24	-18.114350, 178.411750

Weather– Past 24hrs		Current Weather
☐	Storm (heavy rain)	☐
☐	Rain (Steady rain)	☐
☑	Showers (intermittent rain)	☐
☐	Overcast	☑
☐	Clear/Sunny	☐

Comments:

N/A

Field Data Sheet No:...03...../CE/23

Fiji Roads Authority

FIELD DATA SHEET: 40 Bridges & 3 Jetties WQ

Site Name: NADURU BRIDGE

Collection		Lab Submission	
Date	***Time***	***Date***	***Time***
03/10/23	1:25 pm.	05/10/23.	1415hrs
Officer Name:	Kelekolio. Tomuniko	Lab Tech Name:	Kayreli. R
Signature:		Signature:	

SAMPLE DETAILS

SP	Physical Bottle #:	Bacto Bottle #:	GPS Coordinates
1 (Upstream)	Upstream ENV 18	ENV 18	-18.020343, 178.559680
2 (Downstream)	Downstream ENV 43	ENV 43	-18.020537, 178.559442

Weather– Past 24hrs		Current Weather
☐	Storm (heavy rain)	☐
☐	Rain (Steady rain)	☐
☑	Showers (intermittent rain)	☐
☐	Overcast	☑
☐	Clear/Sunny	☐

Comments:

Field Data Sheet No: 04 /CE/23

Fiji Roads Authority

FIELD DATA SHEET: 40 Bridges & 3 Jetties WQ

Site Name: NAIVICULA BRIDGE, Korovou.

Collection		Lab Submission	
Date	***Time***	***Date***	***Time***
05/10/23	3:15pm		
Officer Name:	Filipe Cavuru	Lab Tech Name:	
Signature:		Signature:	

SAMPLE DETAILS

SP	Physical Bottle #:	Bacto Bottle #:	GPS Coordinates
1 (Upstream)	NAIVICULA US X8	X8	R Ratuli
2 (Downstream)	NAIVICULA DS S38	S38	R Ratuli

Weather– Past 24hrs		Current Weather
☐	Storm (heavy rain)	☐
☐	Rain (Steady rain)	☐
☑	Showers (intermittent rain)	☐
☐	Overcast	☐
☐	Clear/Sunny	☑

Comments:

GPS (upstream) : -17.758434, 178.492957

GPS (Downstream): -17. 758749, 178. 493369

Field Data Sheet No: 05 /CE/23

Fiji Roads Authority

FIELD DATA SHEET: 40 Bridges & 3 Jetties WQ

Site Name: WAINILOKA BRIDGE, OVALAU.

Collection		Lab Submission	
Date	***Time***	***Date***	***Time***
05/10/11	2:00pm	05/10/11	5:00pm.
Officer Name:	Kelekolio. T	Lab Tech Name:	Rayeli. R.
Signature:		Signature:	

SAMPLE DETAILS

SP	Physical Bottle #:	Bacto Bottle #:	GPS Coordinates
1 (Upstream)	11	ENV 10	Lat: 17°44'4.00"S Long: 178°46'24"E
2 (Downstream)	11	ENV 5	Lat: 17°44'4"S Long: 178°46'24.91"E

Weather– Past 24hrs		Current Weather
☐	Storm (heavy rain)	☐
☐	Rain (Steady rain)	☐
☐	Showers (intermittent rain)	☐
☐	Overcast	☐
☑	Clear/Sunny	☑

Comments:

Field Data Sheet No: 06 /CE/23

Fiji Roads Authority

FIELD DATA SHEET: 40 Bridges & 3 Jetties WQ

Site Name: Natovi Jetty.

Collection		Lab Submission	
Date	***Time***	***Date***	***Time***
11/10/23	1:20pm - 1:30pm.	11/10/23	3:20 pm.
Officer Name:	Filipe. Carega.	Lab Tech Name:	Vilimaina Naga.
Signature:		Signature:	VNaga.

SAMPLE DETAILS

SP	Physical Bottle #:	Bacto Bottle #:	GPS Coordinates
1 (Upstream)	Natovi Jetty (upstream) EW19	EW19	-17.686311, 178.578955
2 (Downstream)	Natovi Jetty (Downstream) 24	24	-17.685471, 178.578895

Weather– Past 24hrs		Current Weather
☐	Storm (heavy rain)	☐
☐	Rain (Steady rain)	☐
☐	Showers (intermittent rain)	☐
☐	Overcast	☐
☑	Clear/Sunny	☑

Comments:

Appendix B

National Water Quality Laboratory Results

Sampled By : Kelekoli	Sample date : 03/10/2023
Sample Received : 03 Oct 2023	Weather Condition : Overcast
Date Analysis Started : 03 Oct 2023	Cust Reference No : -

SL. No	DETERMINANDS	Units	APHA Method Code	SAMPLE LOCATION						General Standards
				1	2	3	4	5	6	
1	*pH	0-14	4500-H+B	7.50	7.81	7.91	7.76	7.00	6.95	-
2	*Conductivity [Chem]	µS/cm	2510 B	21590.0	28740.0	8997.0	27420.0	312.7	316.0	-
3	*Turbidity†	NTU	2130 B	7.50	21.90	3.25	4.96	54.70	30.50	-
4	*Total Suspended Solids	mg/L	2540D	110.6	148.7	23.1	92.5	71.4	19.6	-
5	*Nitrate	mg/L	4500-NO-3 I	0.10	0.12	0.09	0.09	0.11	0.11	-
6	*Total Phosphorus	mg/L	4500PE	0.37	0.42	0.36	0.31	0.50	0.31	-
7	*Dissolved Oxygen†	mg/L	4500-O C	8.67	8.65	8.64	8.71	8.21	7.59	-
8	*Biochemical Oxygen Demand	mg/L	5210B	0.85	1.16	0.71	0.78	2.93	2.02	-

Sampling Points

1 Medrakutu Bridge - Upstream
2 Medrakutu Bridge - Downstream
3 Lami Bridge - Upstream
4 Lami Bridge - Downstream
5 Naduru Bridge - Upstream
6 Naduru Bridge - Downstream

Remarks:

†All results apply to samples as received by Laboratory. Avg means Average < means Less than, > means Greater than, N/A means Not Applicable

* These tests are outside the laboratory's scope of accreditation.

Checked By:Vikash Ram
Position: Technical Officer
Signature :

Authorised By: Sher Singh
Position: Supervisor NWQL
Signature :

No : NWQL/ 265/18-19
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Lab Reference No : 850/23-24 **Date Generated: 18 Oct 2023**

SL. No	DETERMINANDS	Units	APHA Method Code	SAMPLE LOCATION						General Standards
				1	2	3	4	5	6	
1	Total Coliform	cfu/100ml	9222B	10,400	8,800	16,800	8,400	1,020	1,120	-
2	Faecal Coliform	cfu/100ml	9222D	5,000	940	63	90	160	175	-

Sampling Points

1 Medrakutu Bridge - Upstream
2 Medrakutu Bridge - Downstream
3 Lami Bridge - Upstream
4 Lami Bridge - Downstream
5 Naduru Bridge - Upstream
6 Naduru Bridge - Downstream

Checked By:Raijieli Ratuvili
Position: Technical Officer
Signature :

Authorised By: Sher Singh
Position: Supervisor NWQL
Signature :

End of Test Report.

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Clean Water for a Better Life.

IANZ
ACCREDITED LABORATORY
ACCREDITATION No: 1336
Tests indicated as not accredited are outside the scope of the laboratory's accreditation

National Water Quality Laboratory Report

Ratu Dovi Road Nasinu, Fiji Islands GPO Box 1272, Suva, Fiji Islands
Telephone (679) 3345677 or 577 (Vodafone & Inkk) users.
Email: contact@waf.com.fj Website:www.waterauthority.com.fj

Certificate of Analysis: Chemical and Biological Analysis
Sample: Environment (NGO)

Lab Reference No : NWQL/865/23-24	**Date Generated: 18 Oct 2023**
Sample From: Erasito Consultants Ltd.	Address : P. O. Box 18195, Suva
Sample Type : Grab	Sample time : 1000 - 1518hrs
Sampled By : Filipe C.	Sample date : 05/10/2023
Sample Received : 05 Oct 2023	Weather Condition : Fine
Date Analysis Started : 05 Oct 2023	Cust Reference No : -

SL. No	DETERMINANDS	Units	APHA Method Code	SAMPLE LOCATION						General Standards
				1	2	3	4	5	6	
1	*pH	0-14	4500-H+B	8.06	8.14	7.96	8.06	8.06	7.85	-
2	*Conductivity [Chem]	µS/cm	2510 B	99.3	101.7	905.0	1009.0	102.0	491.2	-
3	*Turbidity†	NTU	2130 B	1.20	1.64	3.26	3.79	1.53	2.21	-
4	*Total Suspended Solids	mg/L	2540D	0.9	3.4	8.7	11.9	4.1	29.3	-
5	*Nitrate	mg/L	4500-NO-3 I	0.12	0.11	0.16	0.12	0.08	0.08	-
6	*Total Phosphorus	mg/L	4500PE	0.44	0.44	0.52	0.51	0.47	0.40	-
7	*Dissolved Oxygen†	mg/L	4500-O C	9.63	9.69	9.40	9.43	9.55	9.52	-
8	*Biochemical Oxygen Demand	mg/L	5210B	1.07	0.97	2.36	2.90	1.55	2.30	-

Sampling Points

1 Naivicula Bridge - Upstream
2 Naivicula Bridge - Downstream
3 Vitawa Bridge - Upstream
4 Vitawa Bridge - Downstream
5 Vunitogoloa Bridge - Upstream
6 Vunitogoloa Bridge - Downstream

SL. No	DETERMINANDS	Units	APHA Method Code	SAMPLE LOCATION		General Standards
				7	8	
1	*pH	0-14	4500- H+B	7.67	7.59	-
2	*Conductivity [Chem]	µS/cm	2510 B	10180.0	9805.0	-
3	*Turbidity†	NTU	2130 B	6.48	7.64	-
4	*Total Suspended Solids	mg/L	2540D	34.9	61.2	-
5	*Nitrate	mg/L	4500-NO-3 I	0.16	0.13	-
6	*Total Phosphorus	mg/L	4500PE	0.64	0.48	-
7	*Dissolved Oxygen†	mg/L	4500-O C	9.67	9.09	-
8	*Biochemical Oxygen Demand	mg/L	5210B	1.49	4.80	-

Sampling Points

7 Matawalu Bridge - Upstream
8 Matawalu Bridge - Downstream

No : NWQL/ 265/18-19

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Remarks:

1. †All results apply to samples as received by Laboratory. Avg means Average < means Less than, > means Greater than, N/A means Not Applicable

* These tests are outside the laboratory's scope of accreditation.

Checked By:Vikash Ram
Position: Technical Officer
Signature :

Authorised By: Sher Singh
Position: Supervisor NWQL
Signature :

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BACTERIOLOGICAL ANALYSIS

Lab Reference No : 865/23-24 **Date Generated: 18 Oct 2023**

SL. No	DETERMINANDS	Units	APHA Method Code	SAMPLE LOCATION						General Standards
				1	2	3	4	5	6	
1	Total Coliform	cfu/100ml	9222B	7,000	6,000	5,600	8,400	8,200	5,600	-
2	Faecal Coliform	cfu/100ml	9222D	210	180	155	185	255	270	-

Sampling Points

1 Naivicula Bridge - Upstream
2 Naivicula Bridge - Downstream
3 Vitawa Bridge - Upstream
4 Vitawa Bridge - Downstream
5 Vunitogoloa Bridge - Upstream
6 Vunitogoloa Bridge - Downstream

SL. No	DETERMINANDS	Units	APHA Method Code	SAMPLE LOCATION		General Standards
				7	8	
1	Total Coliform	cfu/100ml	9222B	5,400	6,600	-
2	Faecal Coliform	cfu/100ml	9222D	260	245	-

Sampling Points

7 Matawalu Bridge - Upstream
8 Matawalu Bridge - Downstream

Checked By:Raijieli Ratuvili
Position: Technical Officer
Signature :

Authorised By: Sher Singh
Position: Supervisor NWQL
Signature :

End of Test Report.

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ACCREDITATION No: 1334
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National Water Quality Laboratory Report

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Email: contact@waf.com.fj Website:www.waterauthority.com.fj

Certificate of Analysis: Chemical and Biological Analysis
Sample: Environment (NGO)

Lab Reference No : NWQL/862/23-24	**Date Generated: 18 Oct 2023**
Sample From: Erasito Consultants Ltd.	Address : P. O. Box 18195, Suva
Sample Type : Grab	Sample time : 0700 - 0916hrs
Sampled By : Filipe C.	Sample date : 05/10/2023
Sample Received : 05 Oct 2023	Weather Condition : Fine
Date Analysis Started : 05 Oct 2023	Cust Reference No : -

SL. No	DETERMINANDS	Units	APHA Method Code	SAMPLE LOCATION						General Standards
				1	2	3	4	5	6	
1	*pH	0-14	4500-H+B	7.69	7.40	7.55	7.62	7.60	7.56	-
2	*Conductivity [Chem]	µS/cm	2510 B	356.5	338.6	264.5	262.3	33690.0	33150.0	-
3	*Turbidity†	NTU	2130 B	6.40	5.49	7.92	4.46	3.99	4.63	-
4	*Total Suspended Solids	mg/L	2540D	8.6	4.3	10.4	6.0	106.1	55.8	-
5	*Nitrate	mg/L	4500-NO-3 I	0.13	0.14	0.07	0.05	0.10	0.10	-
6	*Total Phosphorus	mg/L	4500PE	0.37	0.48	0.50	0.47	0.43	0.42	-
7	*Dissolved Oxygen†	mg/L	4500-O C	8.10	8.09	9.05	9.00	9.02	8.04	-
8	*Biochemical Oxygen Demand	mg/L	5210B	3.44	1.24	2.55	1.60	2.64	1.01	-

Sampling Points

1 Narewa Bridge - Upstream
2 Narewa Bridge - Downstream
3 Nadi Back Road - Upstream
4 Nadi Back Road - Downstream
5 Viseisei Bridge - Upstream
6 Viseisei Bridge - Downstream

SL. No	DETERMINANDS	Units	APHA Method Code	SAMPLE LOCATION		General Standards
				7	8	
1	*pH	0-14	4500- H+B	7.63	7.63	-
2	*Conductivity [Chem]	µS/cm	2510 B	567.7	567.7	-
3	*Turbidity†	NTU	2130 B	3.87	3.84	-
4	*Total Suspended Solids	mg/L	2540D	6.3	5.7	-
5	*Nitrate	mg/L	4500-NO-3 I	0.09	0.07	-
6	*Total Phosphorus	mg/L	4500PE	0.47	0.47	-
7	*Dissolved Oxygen†	mg/L	4500-O C	8.02	9.21	-
8	*Biochemical Oxygen Demand	mg/L	5210B	0.98	5.06	-

Sampling Points

7 Sabeto Bridge - Upstream
8 Sabeto Bridge - Downstream

No : NWQL/ 265/18-19

This test report shall not be reproduced except in full.

Remarks:

1. †All results apply to samples as received by Laboratory. Avg means Average < means Less than, > means Greater than, N/A means Not Applicable

* These tests are outside the laboratory's scope of accreditation.

Checked By:Vikash Ram
Position: Technical Officer
Signature :

Authorised By: Sher Singh
Position: Supervisor NWQL
Signature :

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BACTERIOLOGICAL ANALYSIS

Lab Reference No : 862/23-24 **Date Generated: 18 Oct 2023**

SL. No	DETERMINANDS	Units	APHA Method Code	SAMPLE LOCATION						General Standards
				1	2	3	4	5	6	
1	Total Coliform	cfu/100ml	9222B	540	780	4,400	6,400	500	700	-
2	Faecal Coliform	cfu/100ml	9222D	148	115	175	195	125	123	-

Sampling Points

1 Narewa Bridge - Upstream
2 Narewa Bridge - Downstream
3 Nadi Back Road - Upstream
4 Nadi Back Road - Downstream
5 Viseisei Bridge - Upstream
6 Viseisei Bridge - Downstream

SL. No	DETERMINANDS	Units	APHA Method Code	SAMPLE LOCATION		General Standards
				7	8	
1	Total Coliform	cfu/100ml	9222B	800	7,600	-
2	Faecal Coliform	cfu/100ml	9222D	120	130	-

Sampling Points

7 Sabeto Bridge - Upstream
8 Sabeto Bridge - Downstream

Checked By:Raijieli Ratuvili
Position: Technical Officer
Signature : Ratuvili

Authorised By: Sher Singh
Position: Supervisor NWQL
Signature : Singh

End of Test Report.

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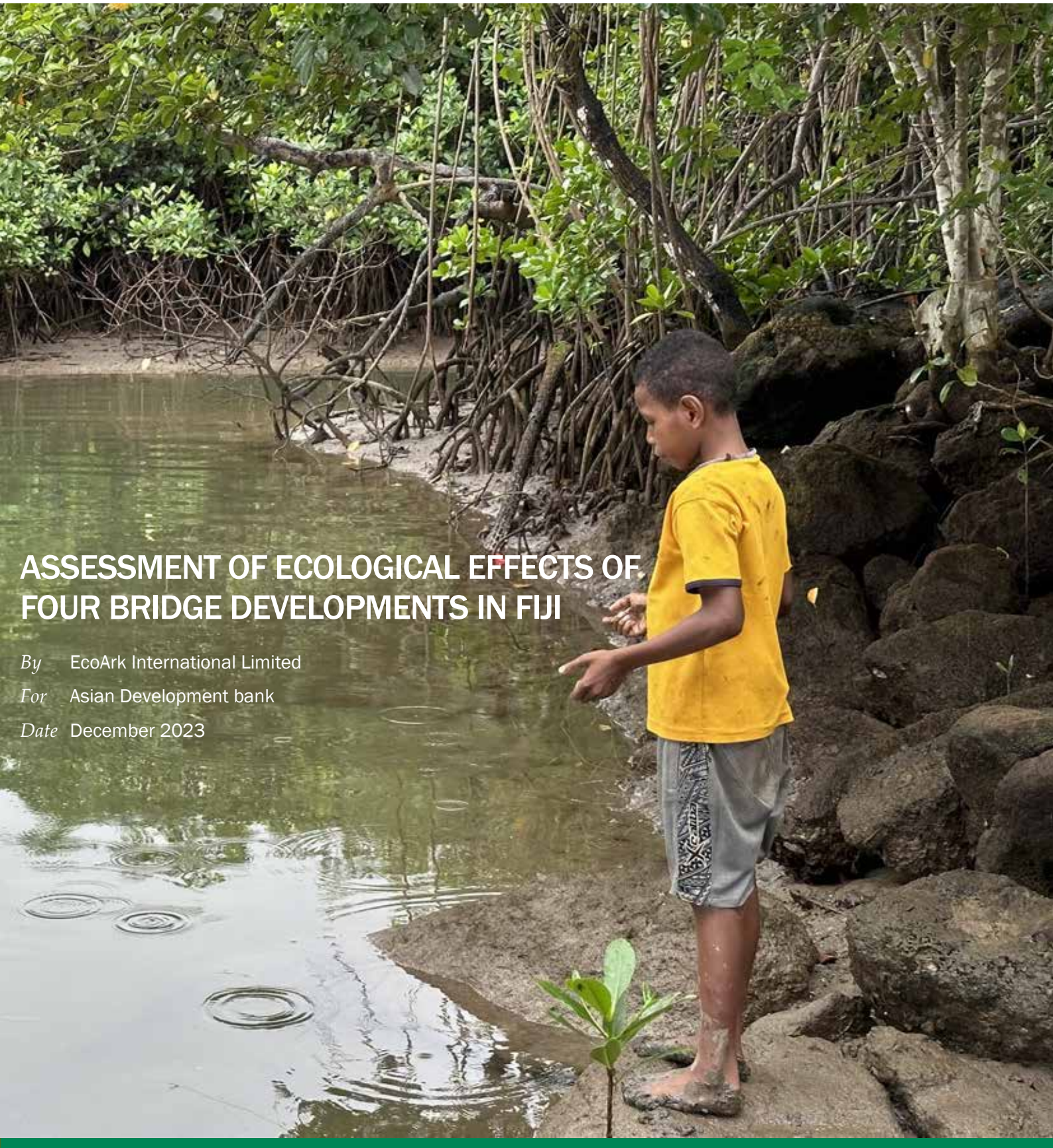
Appendix C: Assessment of Ecological Effects by EcoArk

ECOARK International



ASSESSMENT OF ECOLOGICAL EFFECTS OF FOUR BRIDGE DEVELOPMENTS IN FIJI

By EcoArk International Limited

For Asian Development bank

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Preface

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1. Introduction

EcoArk International is conducting an ecological study, commissioned by the Asian Development Bank (ADB), to assess aquatic and terrestrial environments for the Bridge Replacement Project. This involves surveys, secondary research, baseline establishment, and the formulation of strategies to mitigate ecological impacts on aquatic ecosystems, including intertidal, freshwater, and mangrove areas on four bridges which have been identified as an ecological risk.

Beca International Consultants Ltd (BICL) has been engaged by Fiji Roads Authority (FRA) to undertake investigation and design of the priority bridges. A feasibility study and design are currently being undertaken and includes the development of an Environmental and Social Management Plan (ESMP) undertaken in accordance with the Shared Approach for Management of Environmental and Social Risks and Impacts, published by the Pacific Region Infrastructure Facility (PRIF) in June 2021. Beca is also undertaking the water quality assessment of the site.

The ESMP is being undertaken in accordance with Fiji's Environmental Management Act 2005 and WB and ADB safeguards and will address inter alia: (i) natural and critical aquatic and terrestrial habitat; (ii) water quality and estuarine processes; (iii) archaeological and physical cultural resources issues; (iv) socio-economic (including livelihoods) issues and health and safety; (v) climate change; and (vii) analysis of alternatives.

2. Site description and project outline

2.1 Fiji

Fiji consists of an archipelago of more than 330 islands. Viti levu the largest island covers about 57% of the national land area and contains 70% of the population. The island is mountainous with peaks up to 1,300m rising from the shores into tropical forests. Fiji has a year-round warm tropical climate, flow of southeast trade winds and high humidity content and is prone to natural hazards such as flooding and tropical cyclones. These have considerable impacts on the quality of water.

Viti Levu has several river systems, including the Tavua, Ba, Lautoka, Nadi and Sigatoka systems. All these rivers originate from the island's central mountains. Heavy rains fall on the windward (Southeastern) side. The lowlands are well sheltered by the mountains and have a clear dry season.

The Fiji Islands are home to numerous indigenous flora and fauna. Because of their isolation and relatively recent human occupation, Fiji is especially vulnerable to invasive species, to such an extent that invasive species are the primary cause of the extinction of island native species.

2.2 The sites

The four proposed bridge sites within Fiji are all on the island of Viti Levu and will provide an upgrade to the bridges currently present with new structures being built adjacent to the old structures (see Figure 1). The brief plans of these have been provided by BECCA but are in development and subject to change.

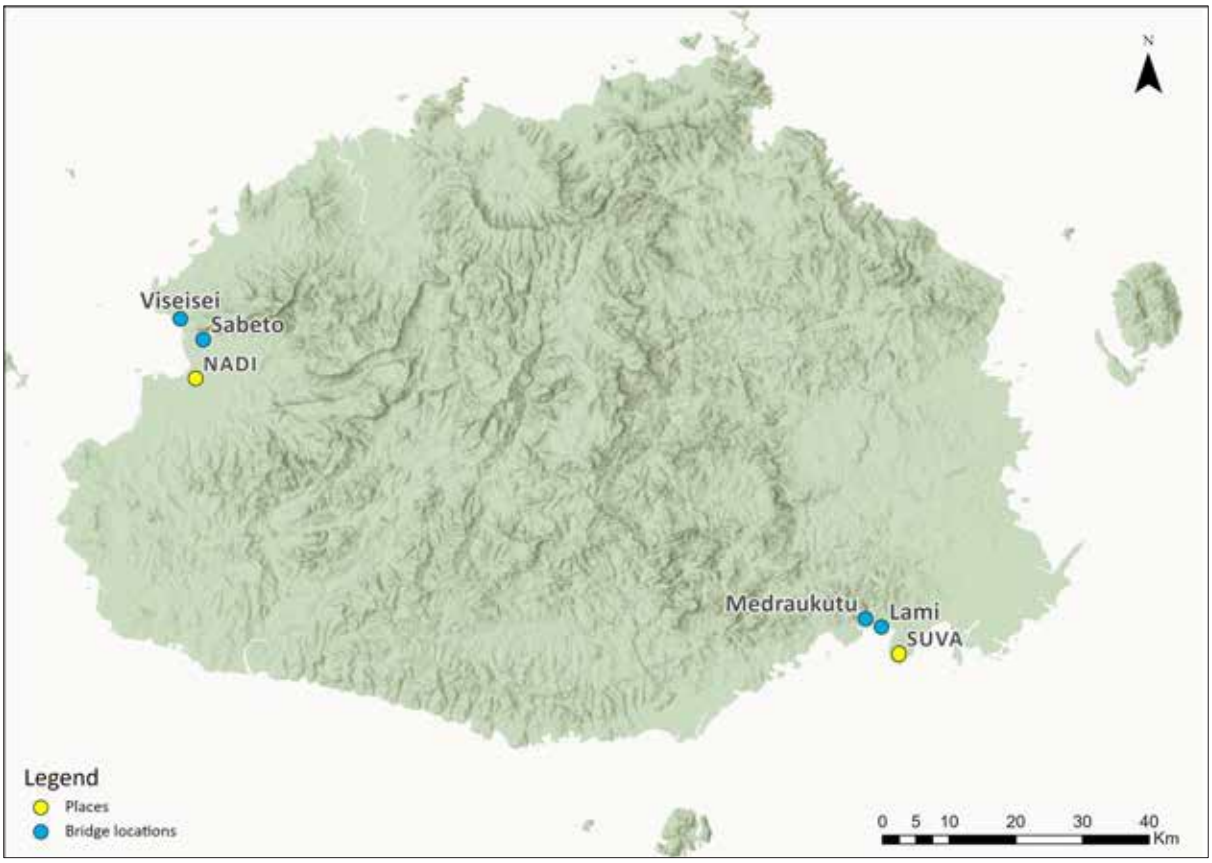

Figure 1. Map of the location of the four proposed bridges.

• Sabeto Bridge – 17°43'12"S 177°27'11"E
This site is located inland and crossed the Sabeto river in an area surrounded by agricultural land. Investigation at this site has been triggered due to an offline replacement and the presence of freshwater bivalves that are collected for food by the community in the immediate and downstream environment.

• Madraukutu Bridge – 18°06'11"S 178°23'19"E
This site is in a low elevation estuarine area with surrounding mangroves. Study is required due to an increase of the overall infrastructure footprint within the mangroves, which will result in mangroves being removed. The mangrove area that will be affected is part of a larger mangrove ecosystem that extends along the coastline and up the river and has been identified as an area used by the community for gathering of food.

• Lami Bridge –18°06'51"S 178°24'42"E
This site is in a low elevation estuarine area with surrounding mangroves. Further study is required due to an increase of the overall infrastructure footprint impacting nearby mangroves.

The mangrove area affected is part of a larger mangrove ecosystem that extends up the river and has been identified as an area used by the community for gathering of food.

• Viseisei Bridge – 17°41'29"S 177°25'14"E
This site is located inland at a low elevation which close to the sea. Further study at this site is required due to an increase of the overall infrastructure footprint within the mangroves, which would result in mangroves being removed. The mangrove area affected is part of a larger mangrove ecosystem that extends up the river and has been identified as an area used by the community for gathering food.

2.3 Project outline

The scope of this assignment is to undertake aquatic and terrestrial ecological studies of four of the ten priority bridge sites, within the project impact area. The aquatic and terrestrial ecological studies will be used to inform the development of an ESMP, to record the baseline conditions, identify risks and impacts, and measures according to the mitigation hierarchy.

EcoArk will be responsible for undertaking studies that will be used to determine the baseline ecological conditions of the study area, the ecological and habitat values, presence of flora and fauna with emphasis on endemic, rare or endangered species of conservation significance, and conduct the impact assessment that will assist with developing the ESMP.

The ecological studies will include recommendations for risk avoidance and/or mitigation to be adopted during construction, in accordance with ADB's Safeguard Policy Statement 2009 (SPS) and WB's ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources.

The project is currently at concept design stage therefore the approximate amount of vegetation clearance and temporary vegetation disturbance required to construct the bridges are potentially going to alter this would require the area of impact to be reassessed. Discussions were made with the engineers to avoid and mitigate impacts on the environment keeping in line with the mitigation hierarchy.

Additional water quality samples will be collected for assessment by BECCA at each of the sites. This information will provide additional useful key ecological baseline material.

2.4 ADB and World bank Environmental Safeguard Policies

The ADB's Safeguard Policy Statement 2009 (SPS) set out their commitment to promoting sustainable development in all its activities. The SPS requires that all Programmes and Projects enhance environmental benefits as well as ensure that adverse social and environmental risks and impacts are avoided, minimized, mitigated, and managed.

The overarching objectives of the SPS:

- Avoid adverse impacts of projects on the environment and affected people, where possible.
- Minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible; and

- Help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

The ecological studies will include recommendations for risk avoidance and/or mitigation to be adopted during construction, in accordance with ADB's Safeguard Policy Statement 2009 (SPS) and WB's ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources. An overview of key elements of the SPS is presented below:

Do not implement project activities in areas of critical habitats, unless (i) there are no measurable adverse impacts on the critical habitat that could impair its ability to function, (ii) there is no reduction in the population of any recognized endangered or critically endangered species, and (iii) any lesser impacts are mitigated. If a project is located within a legally protected area, implement additional programs to promote and enhance the conservation aims of the protected area. In an area of natural habitats, there must be no significant conversion or degradation, unless (i) alternatives are not available, (ii) the overall benefits from the project substantially outweigh the environmental costs, and (iii) any conversion or degradation is appropriately mitigated. Use a precautionary approach to the use, development, and management of renewable natural resources.

Mitigation measures will be designed to achieve at least no net loss of biodiversity. They may include a combination of actions, such as post-project restoration of habitats, offset of losses through the creation or effective conservation of ecologically comparable areas that are managed for biodiversity while respecting the ongoing use of such biodiversity by Indigenous Peoples or traditional communities, and compensation to direct users of biodiversity.

2.4.1 Critical habitat

The ADB's Safeguard Policy Statement 2009 (SPS) states: “Critical habitat is a subset of both natural and modified habitat that deserves particular attention. Critical habitat includes areas with high biodiversity value, including habitat required for the survival of critically endangered or endangered species; areas having special significance for endemic or restricted-range species; sites that are critical for the survival of migratory species; areas supporting globally significant concentrations or numbers of individuals of congregatory species; areas with unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services; and areas having biodiversity of significant social, economic, or cultural importance to local communities. Critical habitats include those areas either legally protected or officially proposed for protection, such as areas that meet the criteria of the World Conservation Union classification, the Ramsar List of Wetlands of International Importance, and the United Nations Educational, Scientific, and Cultural Organization’s world natural heritage sites.”

No project activity will be implemented in areas of critical habitat unless the following requirements are met: (i) There are no measurable adverse impacts, or likelihood of such, on the critical habitat which could impair its high biodiversity value or the ability to function. (ii) The project is not anticipated to lead to a reduction in the population of any recognized endangered or critically endangered species or a loss in area of the habitat concerned such that the persistence of a viable and representative host ecosystem be compromised.

World bank criteria for assessment

The World Bank ESF under the title for S3.1 defines Critical habitat as:

Critical habitat is defined as areas with high biodiversity importance or value, including:

(a) habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches;
(b) habitat of significant importance to endemic or restricted-range species;
(c) habitat supporting globally or nationally significant concentrations of migratory or congregatory species;
(d) highly threatened or unique ecosystems;
(e) ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).

ADB criteria for assessment

The criteria for critical habitat defined by ADB (2009) are as follows:

- Criterion 1: The area includes habitat required for the survival of critically endangered (CR) or endangered (EN) species;
- Criterion 2: The area has special significance for endemic or restricted-range species;
- Criterion 3: The area represents a site that is critical for the survival of migratory species; or supports globally significant concentrations or numbers of individuals of congregatory species;
- Criterion 4: The area includes unique assemblages of species that are associated with key evolutionary processes or provide key ecosystem services;
- Criterion 5: The area holds biodiversity of significant social, economic, or cultural importance to local communities;
- Criterion 6: The area is either legally protected or officially proposed for protection, such as areas that meet the criteria of the World Conservation Union classification, the Ramsar List of Wetlands of International Importance, and the United Nations Educational, Scientific, and Cultural Organization's World natural Heritage sites.

Table 1. IFC PS6 criteria and thresholds[1]

Criteria	Thresholds
1: Critically Endangered and Endangered Species	(a) Areas that support globally important concentrations of an IUCN Red-listed EN or CR species (≥ 0.5% of the global population AND ≥ 5 reproductive unitsGN16 of a CR or EN species). (b) Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds in GN72(a). (c) As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species
2. Endemic / Restricted Range Species	(a) Areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species.
3. Migratory / Congregatory Species	(a) Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle. (b) Areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress.
4: Highly Threatened or Unique Ecosystems	a) Areas representing ≥5% of the global extent of an ecosystem type meeting the criteria for IUCN status of CR or EN. b) other areas not yet assessed by IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning.
5: Key Evolutionary Processes	

2.4.2 Determination of Ecologically Appropriate Area of Analysis

IFC PS 6 requires identification of Ecologically Appropriate Area of Analysis (EAAA) to determine the presence of critical habitat for each species with regular occurrence in the project's area of influence, or ecosystem, covered by Criteria 1-4. The boundaries of an EAAA should be determined by taking into account the distribution of species or ecosystems (within and sometimes extending beyond the project's area of influence) and the ecological patterns, processes, features, and functions that are necessary for maintaining them. This approach ensures that all important biodiversity within the project footprint and surrounding vicinity are taken into consideration.

3. Methods

3.1 Desktop review

A desktop assessment was conducted to determine existing conditions in the Study Area and the surroundings to identify habitats and species of potential importance that may be affected by the project and included aerial photography, photos, data relating to the ecology of the wider Project area and relevant experts. Literature review included Government and private sector reports, independent and Government published literature, academic studies, vegetation maps and land use maps. Identifying areas within and surrounding the Project footprint that are listed as having

[1] https://www.ifc.org/content/dam/ifc/doc/2010/20190627-ifc-ps-guidance-note-6-en.pdf

significant ecological values using data from IBA maps, dopa-explorer, data in iNaturalist, the fish database and by checking the IUCN redlists as well as grey literature.

The literature review included reviewing key documents, reports and data including:

- Department of Environment, Government of Fiji (2020). National Biodiversity Strategy and Action Plan 2020–2025, Suva, Fiji. EDNA
- Masibalavu, V. T., and Dutson, G. C. (2006). Important bird areas in Fiji: conserving Fiji's natural heritage. Suva: BirdLife International Pacific Partnership Secretariat. McKenzie, L.J., and Yoshida, R.L. (2007).
- Seagrass-Watch: guidelines for monitoring seagrass habitats in the Fiji Islands in Proceedings of a training workshop (2007). Corpus Christi Teachers College, Laucala Bay, Fiji: Suva.
- BirdLife International (2023) Country profile: Fiji. Downloaded from http://datazone.birdlife.org/country/fiji on 14/07/2023.
- Review of Policy and Legislation Relating to the Use and Management of Mangroves in Fiji
- https://dopa-explorer.jrc.ec.europa.eu/wdpa/555547791

3.2 Relevant Legislation, Guidelines and International Conventions

The following Fijian Government legislation, guidelines and the latest environment national strategies and reports are relevant to the assessment of impacts to terrestrial, marine and freshwater ecology, including:

- Biosecurity Act 2008
- Endangered and Protected Species Act 2002 and Endangered and Protected Species (Amendment) Act 2017
- Fisheries Act [Cap. 158] 1942
- Forest Decree 1992
- Marine Spaces Act [Cap. 158] 1978
- Rivers and Streams Act [Cap. 136] 1882
- Water Supply Act (Cap. 144) 1985
- Fiji National Climate Change Policy – 2012
- Fiji Low Emission Development Strategy 2018- 2050
- Fiji National Adaption Plan Framework - 2017)
- Fiji's National Reports to the United Nations Convention on Biological Diversity (1st to 5th) Fiji Implementation Framework – Thematic Areas Annual Reports
- Fiji Environment Strategy (draft)
- Natural Resource Inventory Reports of the Republic of Fiji – 2010
- Fiji REDD-Plus Policy - 2011
- Fiji Integrated National Waste Management Strategy 2016–2020 (draft)
- Forest Policy – 2007
- Green Growth Framework for Fiji – 2014
- Integrated Coastal Management Programme – 2002
- Mangrove Management Plan (2013)
- National Plan for Disaster Management – 1998
- National Policy Plan for Fijian Mangroves – 1986
- National Rural and Land Use Policy – 2005
- Fiji State of Environment Report - 2013
- Tourism Development Plan – 2007
- Water-shed Management Master Plan – 1998

This study also takes note of the following relevant international agreements:

- Convention on the Conservation of Migratory Species of Wild Animals (CMS) and relevant Memoranda of Understanding
- The Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and SouthEast Asia (IOSEA Marine Turtle MOU)
- The Memorandum of Understanding for the Conservation of Cetaceans and their Habitats in the Pacific Island Region
- Convention on Wetlands of International Importance (Ramsar)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits
- Nagoya Protocol on Access to genetic resources and the fair and equitable sharing of benefits arising from their utilization (ABS)
- United Nations Convention on the Law of the Sea (UNCLOS)
- The Cartagena Protocol on Biosafety to the Convention on Biological Diversity
- United Nations Framework Convention on Climate Change (UNFCCC)
- Convention Concerning the Protection of the World Cultural and Natural Heritage (WHC).
- United Nations Conventions on Combating Desertification (UNCCD)

4. Site assessment methodology

Site visits were conducted to verify information from the literature review and to identify and map habitats, describe habitats, and record and identify species within the study area. Site visits were conducted from 27 May- 5 June 2023. Field surveys identified and characterised flora and fauna within the study and assessment areas. Species lists were generated for key species groups to cover the Study Area. Key species groups included plants, molluscs, decapods, and fish.

Identification of protected, threatened, or rare species were a key objective of field studies. Estimates of species abundance/richness and diversity were provided for key species groups surveyed, and special attention was given to habitats and species of conservation interest. Impacts to habitats, species or groups were assessed based on local knowledge and international standards/practice in conservation biology. A precautionary approach was taken for species which were data deficient and have not been assessed by the IUCN. This is critical since many species in Fiji are new to science and are still being named and no assessment has yet taken place.

4.1 Definition of the Ecologically appropriate area of analysis and the direct area of impact

Because river habitats are longitudinally connected from upstream areas to the marine environment, bridges can affect the surrounding environment by:

- Changing sediment movement, flow, water quality and habitat conditions in the surrounding area
- Blocking upstream and downstream migration of native aquatic fauna

- Result in disturbance to flora and fauna in the surrounding habitat and therefore result in indirect effects
- Result in the removal of surrounding vegetation

The EAAA for the majority of aquatic species is considered within this assessment to be 800 meters up and down river.

Bridges can also potentially affect the surrounding riverine/mangrove terrestrial environment by:

- Resulting in direct loss of vegetation and habitat
- Cause shading of vegetation/habitat and associated effects
- Result in disturbance to flora and fauna in the surrounding habitat and therefore indirect effects
- Result in the introduction of invasive species and the associated negative impacts

The EAA in the terrestrial environment considers the project-related impacts across the potentially affected landscape of all the intertidal area within 200 meters of the site and the connected natural terrestrial and intertidal vegetation. The intertidal environment is defined as mangrove, sand, rock or mud flats that undergo regular tidal inundation.

The four proposed bridge development sites all cover an area of land and the aquatic habitat. The Study Area of direct influence is defined as the boundary of the development sites of the 4 bridge areas with a 3m buffer area into the terrestrial and aquatic habitat. This is the area where most of the direct cumulative effects will occur and is the area which is used to calculate direct lost habitat.

4.2 Habitat and vegetation mapping

A habitat map of the study area was produced based on 2019 Government aerial photographs and through assessment from Google earth images, further ground truthing occurred at each potential bridge site. Colour photographs were taken of all habitat types surveyed and other features or species of ecological importance found during the study. The proportion of vegetation by ecotype removed was calculated based on the bridge design plans provided by Beca prior to the field visits.

4.3 Aquatic ecology

4.3.1 eDNA survey protocol

Environmental DNA (eDNA) analysis is a rapidly developing environmental survey technique involves collecting water samples and testing for signatures of target species genetic material. eDNA is a powerful tool to determine the presence of species at low densities, which might include species at risk or hard-to-find species. However, it is important to note that when species are not in the eDNA database the usefulness of this method can be limited. Exceptions being when there are no other species within the genus of concern and presence can therefore be worked out on this premise. Efforts were made to add species of concern to the database through targeted capture methods undertaken with the purpose of adding their eDNA to the

databank and verifying their presence. Efforts were also made to add new species to the databank by collecting their eDNA from museum specimens.

At each of the four bridge sites water samples were collected at the proposed bridge location, upstream and where possible downstream of the proposed bridges. These sites were considered replicates to gain a fuller understanding of taxon potentially impacted by development at the site. Water was taken from various parts of the water column to reduce the chance that stratification of eDNA within the water column did not result in species being missed.

Water samples were collected by an ecologist using standard water eDNA test kits which include a mixing bag, sterilised sampler, and a pair of gloves. Water was collected by filling either a collection bag or a clean bottle on a sample grabber pole, positioned with the bottle opening facing upstream. Water for eDNA analysis was then filtered from each site using sterile syringes. At each bridge site, 2 to 4 samples were collected. One to two were collected at the proposed bridge site and another upstream and another downstream from the site where it was possible. Each sample was collected by passing up to 1400 ml of water (mean = 748 ml) through a 1.2-micron disc filter. Filtration was undertaken on-site to reduce eDNA degradation during transport of water samples. A preservative was added to the filters after filtering to minimise eDNA degradation.

Clean, nonpowdered, single-use gloves were worn during sample collection and filter removal. Care was taken to prevent the gloves from touching any contaminated surfaces, such as equipment that had not been sterilized using a solution of 10% bleach applied with a spray bottle between sites. In cases where entering the stream was necessary, samples were collected upstream of the standing location to reduce the potential for contamination from boots, clothing, or equipment. These activities were done to avoid contaminating of the site with eDNA from another area.

Filters were stored out of sunlight and at ambient temperature before being transported to the laboratory for processing. DNA processing was undertaken by a specialist lab, Enviro DNA Pty., in Australia. Due to the preservative in each filter, refrigeration was not necessary for these samples.

Processing of eDNA

Freshwater species identification was based on DNA metabarcoding and high-throughput DNA sequencing technologies from water samples collected at the sites and up and down-stream. The specialist labs conducted DNA library preparation, high-throughput DNA sequencing, and ran extensive bioinformatics pipelines resulting in Fish, Decapods, Invertebrates, and Mollusc species identification. More specifically, DNA metabarcoding compares DNA sequences recovered from the samples to genetic reference libraries enabling identification of the species. In cases where the identity could not be adequately resolved to a single species (e.g., due to shared haplotypes), either a list of multiple species is included, or the lowest taxonomic rank without further classification was assigned.

Attempts were made to add additional species were added to the reference libraries for future identification. We were however unsuccessful in obtaining samples of these additional species (Table 2). Further eDNA of key species added in the future to verify presence.

4.4 Targeted fish surveys

Fish traps were established at each site within 15 meters of the proposed bridge sites for one trap night and day including both the dusk and dawn periods when fish movement is greatest. The following nets were used at each site: 2 Fyke nets (Mesh size of 15 mm, 2 funnel throats), 2 minnow traps, and 2 kilwell. Kilwell traps were all set in or directly beside mangroves to target key fish species of interest which favour mangrove habitat. The mouth of the fyke nets were submerged to allow fish to enter the net. Nets were marked using flagging tape and the gps. All captures were identified to species level where possible. If any species were not possible to identify a reference species was kept for later ID.

4.5 Targeted bivalve surveys

Kai/freshwater mussels (*Batissa violacea*) in Fiji grow in the lower freshwater reaches of rivers, between the upper limit of saltwater penetration, and the upper reaches of the rivers.

Freshwater mussels (kai) had been identified as a matter of concern at the Sabeto site and were also potentially present at the Viseisei Bridge site. The saltwater conditions at Lami and Madraukutu Bridge are inappropriate habitat and surveys were not carried out in these areas.

The survey method involved snorkelling surveys which searched the substrate for bivalves while swimming along four 50m transects. Advantages to snorkel surveys include increased spatial area and depth of surveys and less disturbance to natural communities. A 1.5 person-hour visual search was conducted systematically from the upstream to downstream end of the survey site. Visibility was high within 2m depth and was reduced at areas greater than this requiring some diving down to greater depths. Visibility was adequate for identifying freshwater mussel areas. Where mussel species were present at a depth which made surveys possible four 1-meter square areas were selected (2 at the bridge site and 2 below the bridge site) for density counts.

5. Fauna and Flora survey rationale

Fauna and flora species considered for management are those species listed under:

- An IUCN Red listed Threatened species.
- Listed in the Appendices of the Convention on International Trade in Endangered Species (CITES).
- Listed in the Endangered Species Protection Act (2002) and any subsequent amendment.
- Identified in Fiji's Biodiversity Strategy and Action Plan (NBSAP 2007)
- Threatened species, known by local experts, but not yet listed in the national and international documents.
- Culturally important
- Occurs in an endangered ecosystem.
- Endemic to Fiji and potentially present

Terrestrial and aquatic surveys, literature reviews and speaking to in country experts allowed classification of the potential species at risk in the area. Where the presence of any suitable habitat for species was documented within the footprint, it is assumed on a conservative basis that their presence cannot be discounted. Therefore, relevant taxa specific measures are later proposed to mitigate/offset potential impacts.

Species which are data deficient have inadequate information to make a direct, or indirect, assessment of its risk of extinction. We have taken a precautionary approach and for the purpose of this study for these species and assumed they are present so that mitigation actions are appropriately considered.

6. Assessment of effects methodology

Ecological impacts of the Project were assessed based upon the ecological resources identified as being at risk from the present development scenarios. Both negative and positive impacts were considered, and cumulative impacts of this and other projects were assessed. Mitigation measures were developed to reduce negative impacts, and residual impacts following implementation of all feasible mitigation measures. Impact assessment and development of mitigation measures were conducted in accordance with the Ecological Impact Assessment guidelines (EcIA) (Roper-Lindsey et al., 2018). A description and assessment of terrestrial, marine and freshwater ecological values is provided for the bridges and surrounding locale (project footprint).

The significance of ecological impacts is evaluated based primarily on the following criteria:

- Habitat quality.
- Species affected.
- Size/abundance of habitats/organisms affected.
- Duration of impacts.
- Reversibility of impacts; and
- Magnitude of environmental changes.

Impacts are generally ranked as "minor", "moderate" or "severe", although in a few cases a ranking of "minimal" (less than "minor") may be given. The ranking of a given impact will vary based on the criteria listed above. For example, an impact might be ranked as "minor" if it affected only common species and habitats, or if it affected only small numbers of individuals or small areas, whereas it might be ranked as "severe" if it affected rare species or habitats, large numbers of individuals or large areas. A degree of professional judgement is involved in the evaluation of impacts.

7. Literature Review

Fiji's terrestrial biodiversity consists of approximately 2641 known vascular plants (35% endemic), over 5024 insect species, more than 100 terrestrial molluscs and crustaceans, over 120 bird species of which ten are endemic, 18 mammals, 36 reptile species, 3 amphibians and 99 freshwater fish species. 98% of Fiji's endemic species are terrestrial and 1.7% are marine. Land based mammal species comprise native bats and introduced rodents and domestic animals. Thirteen reptile species in Fiji are listed as globally threatened and 55 species of plants are currently listed as globally threatened by IUCN.

Over 2000 species of fish are recorded from Fiji's coastal and marine areas (SOE 2020, Government of Fiji 2017). At present, 166 species from 47 families of freshwater and estuarine fishes in the Fiji Islands are recognised. Of these, 10 are non-native species and at least 13 species are considered endemic to the Fijian Islands (table 3). Further species have recently

been identified and are still being named (table 3). Sixty-four freshwater fish species are recorded. Many freshwater species in Fiji are widespread in the Pacific and Indo-pacific area.

Fiji's marine fish fauna consists of 1198 species of reef, pelagic and deepwater fish, only 45 species marine fish are listed as globally threatened on the IUCN Red List including 27 shark and ray species and 18 other fish. Whilst many fish species are not listed as threatened (due to their larger range and ability to occupy a variety of freshwater, estuarine and marine habitats), a large number (40%) are listed as Data Deficient, including several of the endemic species (See Table 2).

Fijis marine fauna also consists of 6 turtle species, 760 species of gastropods and bivalves, 4 species of sea snakes, 422 species of algal flora, and 33 mangrove and mangrove associated species. Fiji's invertebrate fauna has received little attention and many groups have not been studied at all.

Fiji freshwater mollusc fauna consists of 9 families and 71 species, of which 30 (43%) are endemic (Haynes, 2015). There are 28 species of *Truncatelloidean* (springs snails) gastropods in the genus *Fluviopupa* in Fiji [2][3]. Two endemic gastropods, *Acochlidium fijiense* and *Fijidoma maculata* are of conservation interest though they have not been evaluated by the IUCN (Table 2).

The Ecologically Appropriate Area of Assessment (EAAA) for molluscs is defined as the area within 800 meters up or downstream of the site. The aquatic mollusc species of concern are unlikely to occur at any of the 4 bridge sites since the habitat is not appropriate and/or the species are unlikely to occur within the EAAAs. No critical habitat is triggered by this species group at any of the four sites (see Table 2).

Table 2. Mollusc species IUCN status, distribution, and likelihood of occurrence at the bridge sites. The species potentially triggering critical habitat are highlighted in grey.

Species names	IUCN status	Distribution	Life history information	Habitat within the EAAA	Critical Habitat Rationale
Acochlidium fijiense	Not evaluated by IUCN	Endemic to Fiji and likely a restricted-range species; *Acochlidium fijiense* has only been recorded from the Nasekawa River (Vanua Levu) and Lami River (Viti Levu) despite searches in other rivers on these two islands.	Surveys conducted by Haynes and Kenchington between 1983 and 1988 showed that *A. fijiense* lives under stones and rocks in shallow parts of streams (60-140 mm deep) influenced by the tide, but where there is no inflow of sea water. It is difficult to detect as it is well camouflaged, blending in with the stones under which it lives. This species was most abundant in the months October and July, and individuals were also reproductively	Unlikely to occur as habitat not appropriate at any of the sites and has only been discovered in one small area outside the EAAA. Experts suggest it is not likely to be present at any of the sites.	Not Critical Habitat: the species is not considered likely to occur within the EAAAs.

[2] Haase, M., Ponder, W.F., and Bouchet, P. (2006). The genus *Fluviopupa Pilsbry* from Fiji. Journal of Molluscan Studies, 72, 119-135.

[3] Zielske, S and Haase, M. (2014). New insights into tateid gastropods and their radiation on Fiji based on anatomical and molecular methods (Caenogastropoda: Truncatelloidea). Zoological Journal of the Linnean Society 172, 71– 102

			mature in the month of July.		
Fijidoma maculata	Not evaluated by IUCN	Endemic to Fiji and potentially a restricted-range species; found only on Viti Levu. They are found in the headwaters.	There is not much known on this species. Species found in the headwaters and requires a habitat of stones with a fast-flowing current. They can be found in patches on stones in fast flowing current. They feed on algal film and are eaten by fish.	Unlikely to occur in EAAAs as habitat not appropriate.	Not Critical Habitat: the species is not considered likely to occur within the EAAAs.
Septaria sp.	5 species in Fiji, Not evaluated by IUCN	Endemic to Fiji and potentially restricted-range	Prefer fast flowing freshwater streams (Ovalau, Tavenui)	Unlikely to occur in EAAAs as habitat not appropriate at any of the sites	Not Critical Habitat: the species are not considered likely to occur within the EAAAs.

7.1 Freshwater fish and crustaceans

Fijian freshwater fish species are dominated by diadromous migratory species which must move between the freshwater and the ocean to complete their life cycle. It is estimated that more than 98% of freshwater ichthyofauna in Fiji are diadromous, with amphidromous and catadromous species dominating life history strategies[4]. Amphidromous gobiids that migrate across a broad range of habitats throughout their life cycle make up most migratory species. As part of this assessment, we consider if ADB Criteria 3 of critical habitats: The area represents a site that is critical for the survival of migratory species; or supports globally significant concentrations or numbers of individuals of congregatory species is triggered.

All migratory fishes rely on water flow for their passage up and downstream. The reduction in forest cover along rivers and streams, especially in the terminal reaches, and infrastructure development such as dams and weirs have deleterious effects on the migration routes of the Fijian ichthyofauna[5]. The presence of invasive species such as tilapia and sedimentation can also impact migration[6]. For example, some species (e.g., gobies), also require clean rocks and river bottoms to physically move along the riverbed. Sedimentation interferes with their movement between habitats and can potentially prevent migration movement altogether7. As many freshwater fishes in Fiji move across multiple habitats during their life cycles, the

[4] Jenkins, A.P.; Jupiter, S.D.; Qauqau, I.; Atherton, J. The Importance of Ecosystem-Based Management for Conserving Aquatic Migratory Pathways on Tropical High Islands: A Case Study from Fiji. Aquat. Conserv. Mar. Freshw. Ecosyst. 2010, 20, 224–238

5 Copeland Lekima K. F., Boseto David T., Jenkins Aaron P. (2016) Freshwater ichthyofauna of the Pacific-Asia Biodiversity Transect (PABITRA) Gateway in Viti Levu, Fiji. Pacific Conservation Biology 22, 236-241

[6] Canonico, G. C., Arthington, A. H., McCrary, J. K., and Thieme, M. L. (2005). The effects of introduced tilapias on native biodiversity. Aquatic Conservation: Marine and Freshwater Ecosystems 15, 463–483.

[7] Jenkins, A.P.; Jupiter, S.D. Spatial and Seasonal Patterns in Freshwater Ichthyofaunal Communities of a Tropical High Island in Fiji. Environ. Biol. Fishes 2011, 91, 261–274.

management area for these species covers the entire river catchment including the estuarine and marine ecosystems.[8]

A precautionary approach is adopted given the lack of population and spatial information on Critical habitat for EBA trigger species. The EAAAs are potentially Critical habitat for fulfilling some key life history events where upon species (see Table 3 and 4) migrate to or through the sites potentially triggering Criteria 3.

Criteria 1 and 2 are also potentially triggered for two EBA trigger fish species (see Table 3). The habitat requirements of species are potentially met by all four of the project sites for one species or for the three mangrove sites for other species. A precautionary approach is adopted given the lack of population and spatial information available for these species.

[8] Jenkins, A. P. (2009). Freshwater and estuarine fishes of Fiji: current taxonomic knowledge and priorities for conservation. In 'Proceedings of the Inaugural Fiji Islands Conservation Science Forum'. (Eds A. P. Jenkins, S. R. Prasad, J. Bacchiochi, P. A. Skelton and N. Yakub.) pp. 50–51. (Ecosystem Based Management Project – Fiji: Suva.)

Table 3. Freshwater fish their endemic status, distribution, and likelihood of occurrence at any of the bridge sites. The species potentially triggering critical habitat are highlighted in grey. The bridge sites Lami(L), Madraukutu (M), Sabeto (S) and Viseisei (V) triggered and the Criterion triggered are noted.

Scientific name	IUCN status	Distribution and habitat use	Likelihood of occurrence within the EAAA	Critical Habitat Rationale	L	M	S	V
Neoconger tuberculatus (Castle, 1965), Common name: Swollengut worm eel	Data deficient	Only known from larvae collected in eastern Australia and 1 adult collected in a tributary of the Rewa, Viti Levu and 2 adults collected in Tavoro river, Taveuni. With this distribution, it seems unlikely that this is a restricted-range species. Habitat: Burrowing species inhabiting muddy bottom areas. Euryhaline, spawn at sea, occur in small numbers and usually only in the lower reaches of rivers and estuaries.	The species is recorded in mangrove habitat. Mangrove habitat is present at three of the project sites (exception the Sabeto site which does not have mangroves present). Information on the population is not readily available. No records of the species have been recorded within the EAAAs.	Not Critical Habitat: The species is not currently considered threatened and is unlikely to be a restricted-range species. While individuals may use the project site, they are not considered likely to be in globally significant concentrations, and there is no reason to suspect the sites are particular migratory stopover or bottleneck areas.	no	no	no	no
Yirrkala gjellerupi (Weber and de Beaufort, 1916) Common name: Duna/Freshwater snake eel	Data deficient	This species is known from one species collected in northern New Guinea (Digoel River) 200km inland from the sea and four specimens 4km up Savura Creek Viti Levu, Fiji in the western South Pacific collected in 2003 (McCosker et al. 2007). With this distribution, it seems unlikely that this is a restricted-range species. Likely to be an estuarine breeder and migration between the estuary and adjacent aquatic habitats. Likely to have a marine larvae phase. Burrowing species collected in course river sand a river bends.	Potentially present in all sites. Information on the population is not readily available. No records of the species have been recorded within the EAAAs.	Not Critical Habitat: The species is not currently considered threatened and is unlikely to be a restricted-range species. While individuals may use the project site, they are not considered likely to be in globally significant concentrations, and there is no reason to suspect the sites are particular migratory stopover or bottleneck areas.	no	no	no	no
Hippicthys albomaculosus	Data deficient	*Hippichthys albomaculosus* occurs in the fresh and brackish waters of Vanua Levu Island, Fiji (Jenkins and Mailautoka 2010). Only known from a small side tributary of the Dreketi River, Vanua Levu Island. 22 specimens, collected from a small mangrove covered tributary stream, schooling at the bank.	Unlikely to be present as not previously found on Viti Levu. However, habitat is appropriate within the EAAAs given that the species have been previously found in both in fresh and brackish	Not Critical Habitat: the species is not considered likely to occur within Viti Levu.	no	no	no	no

		Likely to be estuarine spawners migrating between the nearby aquatic environment.	waters near mangroves and in nearby freshwater environments. Information on the population is not readily available. No records of the species have been recorded within the EAAAs.					
Microphis ??? Common name: smooth freshwater pipefish	Not Assessed	Recently discovered species. Thought to be endemic and possibly a new genus. Found in the lower part of the Nakoronawa River in Kaduvu and the middle of the Kavula River above Lekutu Vanua Levu. Likely to be freshwater spawners who enter estuaries briefly. Found in freshwater in the shallows near banks with vegetation.	No records of the species have been recorded within the EAAAs. Unlikely to be present in Viti Levu and within the EAAA.	Not Critical Habitat: the species is not considered likely to occur within Viti Levu.	no	no	no	no
Glossogobius sp. (Hoese and Jenkins in prep)	Likely to be least concern.	Amphidromous species which is common and widespread across Fiji. Endemic and potentially a restricted-range species.	Not a species of concern however likely to be migrating through the sites.	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that all 4 sites sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle qualifying them as Critical Habitat under Criterion 3.	Yes, c3	Yes, c3	Yes, c3	Yes, c3
Redigobius leveri, previously reported as Gobius leveri (Ryan 1980). Common name: Levers' goby	Data deficient	This species is endemic to Fiji and is known only from the islands of Viti Levu, Vanua Levu and Taveuni. It is potentially a restricted-range species. Records exist from the Rewa River and Savura Creek (Viti Levu); Dreketi River and Kubulau (Vanua Levu) and Tavoro Creek (Taveuni). Present in all the high islands of Fiji. Only found in clear shallow flowing water in well	Unlikely to be present at any of the sites as fully freshwater resident utilising different habitat than that available at the 4 sites. No records of the species have been recorded within the EAAAs.	Not Critical Habitat: the species is not considered likely to occur within the EAAAs.	no	no	no	no

		forested areas and entirely absent in degraded waters. This is one of only two fully freshwater resident fishes, parental care of demersal eggs. quite common (approx. 20% of sites) in less disturbed freshwater areas throughout survey; likely widespread in less disturbed freshwaters of larger islands.						
Redigobius lekutu Common name: Lekutu goby	Data deficient	Freshwaters; creeks and rivers; below about 150 m elevation; rest on bottom or mid-water schooling; solitary or in groups; carnivore; benthic invertebrates; parental care of demersal eggs, presumed Vanua Levu endemic; known only from the upper Lekutu River system in Vanua Levu. This was collected at a site in the upper Lekutu River and is a new species to science. Is probably the rarest freshwater fish in Fiji. This is because it has only been encountered in a single small pool in the upper Lekutu River in Vanua Levu. It was present in abundance with no other species present in this isolated pool. This species is likely to exhibit parental care of demersal eggs, like others in the genus, and is not an amphidromous or migratory fish and is therefore likely site restricted.	Unlikely to be present at any of the sites as only found in Vanua Levu and habitat not appropriate. No records of the species have been recorded within the EAAAs.	Not Critical Habitat: the species is not considered likely to occur within Viti Levu.	no	no	no	no
Parioglossus triquetrus	Data deficient	Only known from 11 specimens collected in Naikorokoro Creek, Viti Levu. Creek is near Pacific Harbour and near Monfort boys' home, Viti Levu. Collected in muddy habitat near creek mouth. It is thus an endemic, restricted-range species. This genus is known to utilise mangrove swamps and creeks. Found in Marine Intertidal areas-Utilize Mangrove Submerged Roots. Genus often burrows in sand and mud, hover above the substrate to feed on zooplankton. Eggs are deposited in burros	The species is recorded in mangrove habitat. Mangrove habitat is present at three of the project sites (exception Sabeto). Information on the population is not readily available. No records of the species have been recorded within the EAAAs, but it is not clear that sufficient searches have	Potential Critical Habitat: Suitable habitat potentially exists at three of the project sites (exception Sabeto). Though the species was not found at the sites, it is possible the EAAAs regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species of the global population occur at the three sites (exception Sabeto), qualifying these as Critical Habitat under Criterion 2.	Yes, c2	Yes, c2	No	Yes, c2

		and guarded by parents; larvae are pelagic.	been undertaken to demonstrate absence from any of the EAAAs. Species was in a Creek about 15 km west of Lami.	Madraukutu is the site of highest risk.				
Schismatogobius vitiensis Comon name: Fijian scaleless goby (Jenkins and Boseto, 2005)	Least concern	This species is endemic to Fiji and thus a restricted-range species. It has been recorded from several rivers on three major islands: Viti Levu, Vanua Levu and Taveuni (Jenkins and Boseto 2005). Amphidromous: spawns in freshwater and hatched larvae pass to sea to return post larvae to freshwater. Adults live in clear, fast flowing freshwater streams on sand, gravel, and pebble substrate.	Likely to migrate through all the sites. Otherwise, utilising habitat outside the EAAAs.	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical basis, ≥ 1 percent of the global population of this migratory species may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	Yes, c3	Yes, c3	Yes, c3	Yes, c3
Schismatogobius chrysonotus (Orange-spotted Scaleless Goby)	Not evaluated by IUCN	Fresh water; lowland creeks and rivers; below about 50 m elevation; rests on bottom; often buried in sand and pebbles, solitary or in small groups; carnivore; insects, larvae; presumed amphidromous; 41 mm SL; Fiji Islands endemic and therefore a restricted-range species; collected in Viti Levu, Vanua Levu, and Taveuni, presumed to be widespread in clear freshwater streams of the larger islands. Collected from 7 sites of 66 sites surveyed by David Boseto for MSc. Recently discovered new species to science.	Likely to migrate through all the sites. Otherwise, utilising habitat outside the EAAAs.	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through all 4 of the sites, qualifying them as Critical Habitat under Criterion 3.	Yes, c3	Yes, c3	Yes, c3	Yes, c3
Stenogobius (insularigobius) n. sp. Common name: teardrop goby	Not evaluated by IUCN	Recently discovered. Common species, Amphidromous, known from Viti and Vanua Levu but likely to occur on all high islands. Endemic to Fiji, and thus a restricted-range species.	Information on the population is not readily available. Likely to migrate through all the sites. Otherwise, utilising habitat outside the EAAAs.	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	Yes, c3	Yes, c3	Yes, c3	Yes, c3
Sicyopus (c.f. Juxtastiphodon) sp., Sicyopus	Not evaluated by IUCN	Found in fast moving fresh water; creeks and rivers; below about 20 m	Unlikely to be present as Tavenui	Not Critical Habitat: the species is not	no	no	no	no

"merielae" n. sp. (Jenkins & Boseto, in preparation) – Meriel's Goby		elevation; rests on bottom; solitary or in groups; carnivore; small crustaceans and fishes; presumably amphidromous; Fiji Islands endemic and therefore a restricted-range species; highly likely to be a Taveuni Island endemic restricted to fused rock wall streams; known only from specimens collected in Waitavala Creek, Taveuni.	restricted endemic. No records of the species have been recorded within the EAAAs. The species is recorded to occur in fast moving streams and this habitat type is not present within the EAAAs.	considered likely to occur outside Taveuni.				
Stiphodon sp.1, Isabella's goby	Not evaluated by IUCN	Collected on Viti Levu, Vanua Levu, Tavenui and Kadavu. Endemic, and thus a restricted-range species. Found in swift clear streams over rocky bottoms. Amphidromous	Likely to migrate through the sites otherwise utilising habitat outside the EAAAs.	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	Yes, c3	Yes, c3	Yes, c3	Yes, c3
Stiphodon sp.2 (Jenkins, Boseto and Watson)	Not evaluated by IUCN	Collected on Viti Levu, Vanua Levu, Tavenui and Kadavu. Endemic, and thus a restricted-range species. Found in swift clear streams over rocky bottoms. Amphidromous	Likely to migrate through all the sites for key life history events. Otherwise, utilising habitat outside the EAAAs.	Potential Critical Habitat: The 4 EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	Yes, c3	Yes, c3	Yes, c3	Yes, c3
Lentipes kaaea (Watson, keith and Marquet 2002) Common name: rednosed goby	Least concern	Species has been collected in New Caledonia, Vanuatu, Soloman islands and Fiji. In Fiji collected in Tavenui island from a single stream (waitavala) and from Kadavu from Wana Ck, Nakaseleka. Amphidromous- spawns in freshwater which hatch in the sea, return post larvae to freshwater. In swift, clear high gradient streams.	Unlikely to be present at any sites as only in Taveuni. No records of the species have been recorded within the EAAAs.	Not Critical Habitat: the species is not considered likely to occur outside Taveuni.				
Akihito sp.	Not evaluated by IUCN	Likely to be habitat restricted to the fused rock wall streams of	Unlikely to be present at any	Not Critical Habitat: the species is not				

Common name: Taveuni free-tongue goby		northwestern Taveuni but because they are likely amphidromous species, and their populations can exist in upper, middle, or lower reaches of these types of streams they are therefore ranked lower in terms of rarity. Endemic, and thus a restricted-range species.	sites as only in Taveuni. No records of the species have been recorded within the EAAAs.	considered likely to occur outside Taveuni.				
Sicyopterus n. sp. (Boseto, in preparation) – Tavoro Goby	Not evaluated by IUCN	Freshwater species; lowland creeks and rivers; below about 40 m elevation; rests on bottom; solitary or in groups; herbivore; filamentous algae growing on rock surfaces; hatching and larval stage presumably occurs at sea, postlarval stage to adult in freshwater; an undescribed species likely to be a Fiji endemic, most closely resembles S. lagocephalus (Pallas 1770) but with several meristic differences including much lower transverse scale counts. This is a new species to science. Endemic, and thus a restricted-range species.	Information on the population is not readily available. Potentially present. Status unclear.	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	Yes, c3	Yes, c3	Yes, c3	Yes, c3
Datnia kneri / (Bleeker, 1876) (Terapontidae) Common name: Orange-spotted Therapon/Reve	Not evaluated, likely threatened by mangrove clearance	Recorded in Kadavu, Viti levu, Taveuni and Totoya but likely to also be in Vanua levu and other islands. Endemic, and thus a restricted-range species. Juveniles found in freshwater all the way to mid catchments and adults tend to be in low reach freshwater and estuarine environments. Thought to be a catadromous obligate: spawns in the sea and juveniles and subadults must access freshwater. Found in mouth of creeks with silt in substrate mangrove forest. Species is usually found in estuarine mangroves habitats. Important food fish seen in the market.	The species is recorded in mangrove habitat. Mangrove habitat is present at three of the project sites. Juveniles and subadults could be present at the Sabeto site where there are no mangroves. Information on the population is not readily available. Potentially present. Status unclear.	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3. It is not considered likely, however, that >10% of the species' population occurs at any of the sites at any time, thus meaning they do not qualify as Critical Habitat under Criterion 2.	Yes, c3	Yes, c3	Yes, c3	Yes, c3

Crustaceans

Fiji's known crustaceans include 10 species of palaemonid prawns (all native to Fiji except *M. rosenbergii*), 14 species of shrimp of which only three (21%) are endemic (*C. devaneyi, C. fijiana*

and *C. nudirostris*) (Table 2) and three crab species (*Varuna litterata*, *Labuanium trapezoideum* and *Utica gracilipes*), which are widely distributed throughout the Indo-Pacific region.

Many of these crustacean species migrate up and down the catchment for critical life history events. *C. devaneyi*, *C. fijiana* and *C. nudirostris* potentially trigger the criteria for critical habitat defined by ADB *Criteria 3 (Teir 2) (see Table 4).*

C. nudirostris and C. devaneyi, would only potentially trigger criteria 3 at Lami and Madraukutu bridge during migration for the larval phase since they only occur on that side of the catchment according to the IUCN redlist.

Table 4. Endemic freshwater crustaceans their IUCN status Least concern (LC) and Data deficient (DD), distribution, and likelihood of occurrence at the bridge sites. The species potentially triggering critical habitat (CH) criteria are highlighted in grey. The bridge sites Lami(L), Madraukutu (M), Sabeto (S) and Viseisei (V) triggered and the Criterion triggered are noted.

Name	IUCN status	Distribution	Life history information	Presence at the sites	Critical Habitat Rationale	L	M	S	V
Caridina fijiana	LC	Viti Levu, Fiji. According to Choy (1983, 1991), *C. fijiana* is primarily a montane species recorded from altitudes above 600 m. Endemic, and thus a restricted-range species.		Adults will be outside the sites of interest. Migration may occur through all four sites for reproductive purposes.	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that >1% of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	Yes C3	Yes C3	Yes C3	Yes C3
Caridina nudirostris	DD	At present it is known only from the island of Viti Levu. Nanuku & Wainisavulevu Creeks, central Viti Levu, 160-700 m altitude. Endemic, and thus a restricted-range species.	Montane species having a few, large eggs thus suggesting abbreviated or direct larval development	Adults these will be outside the sites of interest which are not freshwater or outside the geographic range. The species maybe however maybe utilising the two sites- Lami and Madraukutu bridge for larval development. This area is therefore considered potentially important for migration of this species.	Potential Critical Habitat: The EAAAs are not habitat except possibly at Lami and Madraukutu bridge during migration. At that time, it is possible that >1% of the global population may migrate through those two sites, qualifying them as Critical Habitat under Criterion 3.	Yes C3	Yes C3	Yes C3	Yes C3
Caridina devaneyi	DD	The species is only known from the type series collected in 1933 from a single stream near Suva, Fiji (Choy 1991) and from two sites- stream at 8-mile Point near Suva, Viti Levu, Fiji Islands and recently	Amphidromous freshwater shrimps utilise freshwater as adults but require saline environments for larval development. Lecithotrophic larval development trait may be	*Caridina devaneyi* adults these will be outside the sites of interest as the habitat is not suitable or outside the geographic range, two sites- Lami and Madraukutu bridge maybe used for larval development. This area is therefore	Potential Critical Habitat: The EAAAs are not habitat except possibly at Lami and Madraukutu bridge during migration. At that time, it is possible that >1% of the global population may migrate through those two sites, qualifying them as	Yes, C3	Yes, C3	No	No

		found in the Tunuloa catchment, Vanua Levu (Ref: Tunuloa BIORAP – a rapid biodiversity assessment, archaeological survey of the Tunuloa catchment and Mataqali consultations to confirm interest to formalize existing Terrestrial Protected Area). Distribution potentially limited. Endemic, and thus a restricted range species.	selected in amphidromous shrimp species that inhabit the upper portions of rivers or streams, in which breeding and larval hatching occur. Thus, the newly hatched larvae require a relatively longer period for downstream transport in food-limited freshwater environments until they reach the sea.	considered potentially important for breeding migration of this limited distribution species.	Critical Habitat under Criterion 3.				

7.2 Mangroves

Fiji has the third-largest mangrove area (41,000 ha) in the Pacific Island Countries (Figure 1). Mangrove forests are an important ecosystem in Fiji because a large portion of Fiji's population, infrastructure, and economic activities are centred around coastal areas. Mangrove resources are one of the main livelihood support systems for coastal/deltaic dwellers. The flora consists of seven obligate species (Watling 1985,1986). These include the Rhizophora hybrid `Selala' (*R.stylosa x R. samoensis*). There are no endemic mangrove species and no terrestrial vertebrates known to be confined to mangroves in Fiji.

Mangrove forests provide various important ecological traits and ecosystem services including but not limited to:

- Habitat for a wide range of species including birds, reptiles, crustaceans, molluscs, etc.
- Nutrient filter and sediment trap.
- Spawning/breeding and nesting grounds for birds and fish.
- Habitat for numerous juvenile life stages, especially reef fishes of commercial importance.
- Buffer to coastal energy (storms, high wave energy).

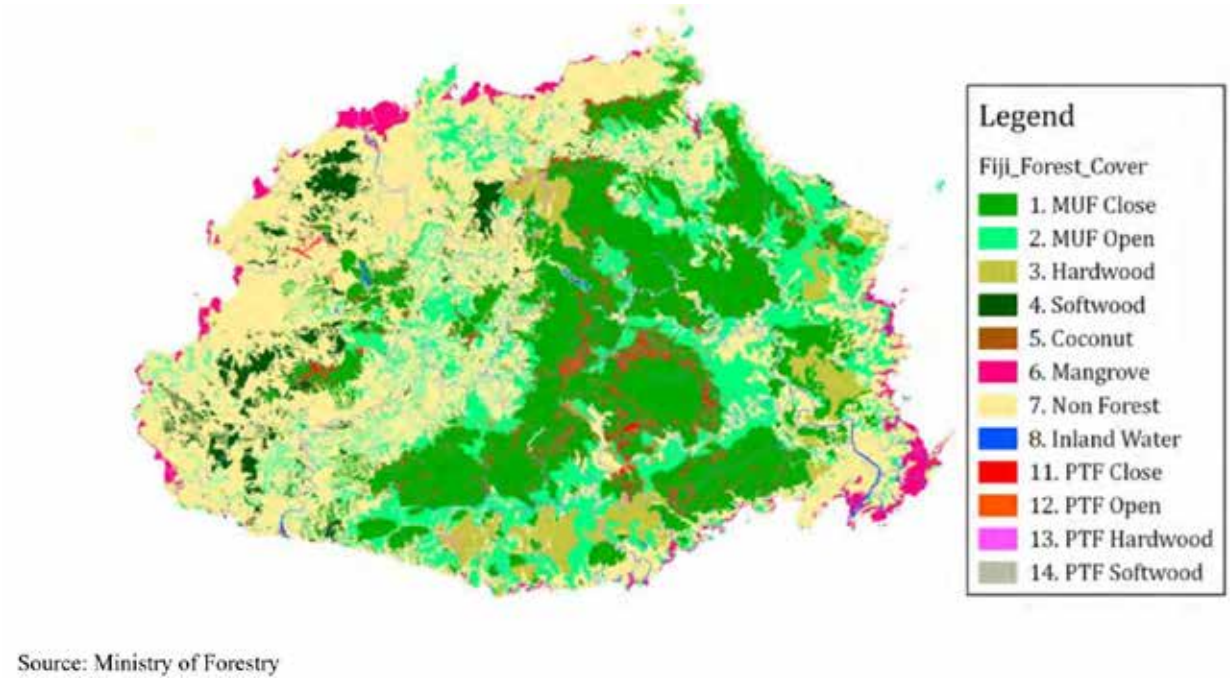

Figure 2. Vegetation Map of Viti Levu

7.2.1 Mangrove legal status

In 1933 all Mangroves were constituted Forest Reserve and were managed by the Forestry Department but in 1974 a cabinet Decision deproclaimed all Mangrove Reserves, (Legal Notice 52 of 1975), after which all Mangroves came under the jurisdiction of the Lands Survey Dept as an integral part of Foreshore. The same cabinet paper (CP 74(234)) instituted re-compensation for loss of Fishing Rights[9].

Mangroves are included within the Environmental Management Plan (2005) and the Protected Species Act (2002) and have been included as priority habitats for conservation and restoration under Fiji's Emission Development strategy 2018-2050 (MoE, 2018).

8. Madraukutu Bridge Ecological Values

8.1 Terrestrial ecology

The bridge site lies on the foreshore permeating into an area of natural habitat consisting of medium to high quality mixed mangrove forest (see Figure 3-6). The mangrove vegetation is dominated by *Bruguiera gymnorhiza, Rhizophora stylosa* and *Rhizophora samoensis.* The study area had a low plant diversity and simple structure. The mangrove trees in the natural forest were 5-20m in height. The narrow fringing belt of Rhizophera mangroves sp. on the coastal edge is consistent with that found along this coast of Fiji with a change of mangrove species dominance further inland.

The mangrove trees present on the East side of the bridge covered an area from the current present bridge and roadside all the way to the rocky foreshore. A medium quality area consisting

[9] A MANGROVE MANAGEMENT PLAN FOR FIJI (PHASE 1) – FEBRUARY 1983, Dick wattling

of mangrove habitat which had previously been disturbed had young 1-meter-tall mangrove plants covering a 2 by 3-meter area. Other than this small area where there had been previous anthropogenic disturbance the rest of the area was considered high quality natural habitat with old growth mangrove trees 5-7 meters tall. There were no alien trees present. Mangrove density was 8-12 trees per meter squared (n=4) on the East side of the bridge in the area where plants would be removed and predominantly covered the high-quality natural mangrove habitat.

Access to the West side of the bridge could only be assessed from the bridge due to the presence of an aggressive dog. However, the area of mangroves within 4 meters of the shore was considered high quality natural habitat with the mangrove area formed largely by native mangrove plants. Here human activity had not modified the area's primary ecological functions. The habitat further was increasingly modified within 6-8 meters of the road with increasing numbers of alien plants. Further sensitive natural intertidal estuarine habitat is immediately adjacent and intersects with the planned area for the bridge (see Figure 3). No terrestrial species threatened or known to be rare was found in the terrestrial study area.

Despite the occurrence of natural areas of mangrove forest at the proposed site, in the larger surrounding landscape there is strong evidence of human disturbance, clearance, and mangrove fragmentation (see Figure 3). The greater mangrove area covers an area of approximately 2.91ha.

Based on the current design, the estimated clearing of native mangrove vegetation for the proposal is approximately 2,349m^2 (inclusive of the 3m buffer surrounding the bridge where some damage may occur) on the outer edge of the larger mangrove ecosystem (see figures 3-6).

8.2 Aquatic ecology

The Madraukutu bridge site is adjacent to the Suva harbour area. The estuarine area is approximately 27m wide at the proposed development point and intertidal. The substrate substrates are muddy. The site is of high ecological value.

The eDNA sampling locations were: 1) at the proposed bridge site and 2) 54 meters within the mangroves. There was good water flow during the survey periods and good-water quality.

EDNA sampling revealed that there are 13 species of fish and 3 species of crustacean and 13 mollusc species using the Madraukutu bridge site (See appendix Tables 36-40). Netting and trapping did not add further species to the species list above that provided through eDNA sampling (Appendix, Tables 36-40) but provided an additional baselines of what was present (See appendix). No additional targeted species such as *Parioglossus triquetrus* were captured. The Tilapia (*Oreochromis spp*.) present within the site is likely to impact the native fish species present and could be led to future declines.

Many of the Fijian fish and crustacean species migrate up and downstream (are amphidromous) to complete critical life history. Given that the eDNA sampling only occurred during one period it is expected that species that will utilise the river site for key migratory life history events will be underrepresented.

Figure 3.The mangrove area surrounding the proposed bridge area shows high fragmentation.

Figure 4. The affected area of mangrove and marine habitat on a) the east side and b) west of the proposed bridge.

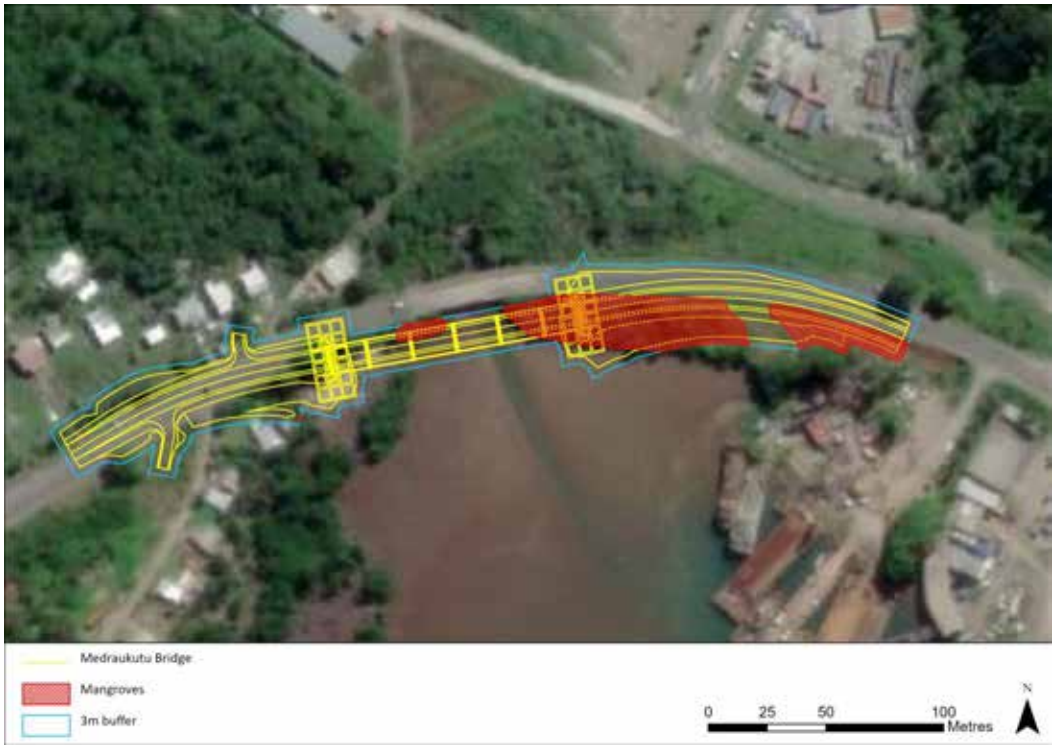

Figure 5. The proposed bridge and area of natural habitat (mangrove) which would be removed (including 3m buffer area).

Figure 6. The natural and modified habitat surrounding the proposed bridge site.

9. Madraukutu Bridge critical habitat triggers

Literature reviews, database surveys, eDNA surveys and field visits identified no endangered species of conservation significance based on the IUCN Red List of Threatened Species as present at the bridge site, or within the EAAA of the site. However, there are endemic and range restricted species of both crustacean and fish species which are data deficient and have not yet been evaluated by the IUCN for which the habitat is suitable (See Table 2 and 3). Of these eight fish species and three endemic freshwater crustaceans are only potentially present during key life cycle events or during migration. We have taken a precautionary approach and assumed they are present on a migratory bases whereby they trigger criteria 3 for critical habitat (See table 5 and 6).

Table 5. Freshwater fish triggering critical habitat and criterion triggered.

Scientific name	Critical Habitat Rationale	Criterion Triggered
Glossogobius sp. (Hoese and Jenkins in prep)	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that all 4 sites sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle qualifying them as Critical Habitat under Criterion 3.	3
Parioglossus triquetrus	Potential Critical Habitat: Suitable habitat potentially exists. Though the species was not found at the sites, it is possible the EAAAs regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species of the global population occur, qualifying these as Critical Habitat under Criterion 2. Madraukutu is considered the site of highest risk.	2
Schismatogobius vitiensis Comon name: Fijian scaleless goby(Jenkins and Boseto, 2005)	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical basis, ≥ 1 percent of the global population of this migratory species may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Schismatogobius chrysonotus (Orange-spotted Scaleless Goby)	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through all 4 of the sites, qualifying them as Critical Habitat under Criterion 3.	3
Stenogobius (insularigobius) n. sp. Common name: teardrop goby	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Stiphodon sp.1, Isabella's goby	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Stiphodon sp.2 (Jenkins, Boseto and Watson)	Potential Critical Habitat: The 4 EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Sicyopterus n. sp. (Boseto, in preparation) – Tavoro Goby	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Datnia kneri / (Bleeker, 1876) (Terapontidae) Common name: Orange-spotted Therapon/Reve	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3. It is not considered likely, however, that >10% of the species' population occurs at any of the sites at any time, thus meaning they do not qualify as Critical Habitat under Criterion 2.	3

Table 6. Endemic freshwater crustaceans triggering critical habitat (CH) criteria and rational at Madraukutu.

Name	Critical Habitat Rationale	Criterion Triggered
Caridina fijiana	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that >1% of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Caridina nudirostris	Potential Critical Habitat: The EAAAs are 3 habitat 3 at 3 Madraukutu bridge during migration. At that time, it is possible that >1% of the global population may migrate through this site, qualifying them as Critical Habitat under Criterion 3.	3
Caridina devaneyi	Potential Critical Habitat: The EAAAs are not habitat except possibly at Lami and Madraukutu bridge during migration. At that time, it is possible that >1% of the global population may migrate through those two sites, qualifying them as Critical Habitat under Criterion 3.	3

There are also two species *Datnia kneri /Mesopristes kneri* and *Parioglossus triquetrus* which are data deficient/not evaluated by the IUCN which maybe present all year. Both species are known from areas outside the EAAAs and are lacking information on population status and spatial coverage.

For *Datnia kneri /Mesopristes kneri* appropriate habitat requirements are met at this project site. This species was not however present in any of the eDNA samples collected (there was no unidentified Terapontidae genus in the eDNA) at any of the sites. This suggests that the species was not present during the survey periods at this site. Expert opinion suggests that it is unlikely the EAAAs regularly holds ≥10% of the global population size AND ≥10 reproductive units of a species. The threshold for Criteria 2 is therefore not meet for this species. However, this species triggers Criteria 3 since they are likely to migrate through the site (Table 5).

Parioglossus triquetrus is an endemic. The species has previously been recorded in a Creek 15 km west of Lami. Which is relatively close to Madraukutu bridge site. This area where the species was found previously is however a smaller tributary, so the habitat was different from this project site. The habitat requirements of this species are suitable at the Madraukutu bridge site given that mangroves are present.

No records of the species have been recorded within the EAAA. Individuals were seen in the mangroves while doing snorkel surveys and no *Parioglossus triquetrus* were captured during the surveys despite effort. However, the species is known to be difficult to capture. Further, *Parioglossus triquetrus* was not in the eDNA library which did not allow this species to be identified directly through the eDNA samples. There is unidentified Gobiidae in the eDNA samples which could be *Parioglossus triquetrus.*

It is possibile that the Madraukutu EAAA potentially regularly holds ≥10% of the global population size AND ≥10 reproductive units of a species. Therefore, consideration is given to potential project-related adverse impacts and on a precautionary bases it has triggered Criteria 2 at this site (Table 5).

9.1 Critical Habitat-qualifying ecosystems

ADB Criterion 4 states " The area includes unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services;"

Criterion 4 relates to specific landscape features which are critical for ecological functions. Examples of these within the sites includes riparian zones and rivers, dispersal/migration

corridors (rivers), hydrological regimes, and keystone or habitat-forming species (mangroves and freshwater mussels).

The rivers, estuaries, and mangrove surrounding Madraukutu provide critical shelter and food for aquatic species and function as migration corridors maintaining key life cycle events. The mangrove river systems are recognised as key ecosystem providers e.g., breeding and nursery habitats for fish species, storms and floods, erosion control functioning locally and regionally as important ecosystem services. By providing these ecosystem services they trigger critical habitat criterion 4.

9.2 Protected Areas

There is one protected area in the vicinity of the Madraukutu bridge project (Figure 7). Madraukutu bridge is in a designated locally managed marine area. This area is called Vueti Navakavu and has been designated as a Locally Managed Marine Area at National level in 2001. Vueti Navakavu MPA is now a permanent reserve, which was initiated by the community and later declared through the defined cultural protocol systems. It covers 18.70 km^2 and it is managed by Qoliqoli Committee. The community's vision is to improve the management and protection of their marine area to provide a healthy and vibrant ecosystem that will support abundant and diverse marine life for food source and secured income sources. Mangroves are included under protection as they are considered important fish spawning areas.

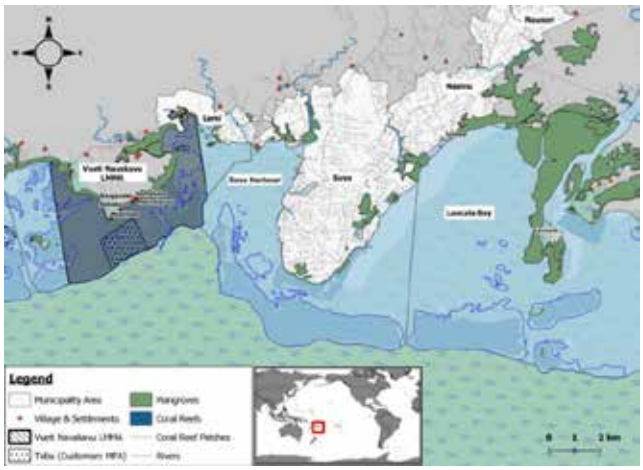

Figure 7. The Vueti Navakavu LMMA.

The reserve is not formally designated or gazetted under national law, and as such does not have formal recognition under Fijian laws that can be enforced by the local community. The community-based marine protected area is supported though by the national government's legal framework for “customary fishing rights areas" within the Fiji Fisheries Act.

9.3 Critical habitat criteria triggered

The critical habitat triggered at the Madraukutu by each of the ADB criteria are outlined (Table 7).

Table 7. ADB criteria critical habitat triggered at the by Madraukutu bridge site.

Criteria	Thresholds	Critical habitat triggered
1: Critically Endangered and Endangered Species	(a) Areas that support globally important concentrations of an IUCN Red-listed EN or CR species (≥ 0.5% of the global population AND ≥ 5 reproductive unitsGN16 of a CR or EN species). (b) Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds in GN72(a). (c) As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species	no
2. Endemic / Restricted Range Species	(a) Areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species.	Yes, potentially holds ≥10% of the global population size AND ≥10 reproductive units of the species *Parioglossus triquetrus*
3. Migratory / Congregatory Species	(a) Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle. (b) Areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress.	Yes, likely to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a number of migratory or congregatory species
4. Critical habitat qualifying processes/ecosystems	The area includes unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services	Yes, provides key ecosystem services
5: The area holds biodiversity of significant social, economic, or cultural importance to local communities		Yes, significant fishing area
Criterion 6: Protection		Yes, within a protected area

10. Ecological effects

This section of the report considers the potential impacts of project operation on terrestrial mangrove, freshwater, and intertidal ecology. Ecological effects on both the terrestrial and aquatic varies during construction and during operation are both summarised in (Table 8 and 9). Ecological impacts may operate over a longer timescale, as populations and species take time to respond to environmental changes (time-lag).

10.1 Construction effects

Severity and spatial extent of the effects will depend on construction practices, timing of construction activities and controls, river flows, composition of substrate, and effectiveness of erosion controls.

10.1.1 Noise and disturbance

Considerable noise and visual disturbance may be generated during site formation and construction, potentially affecting the distribution and behaviour of fauna of the adjacent/remaining habitats. Due to the ranking of conservation importance of the species recorded, and the temporary nature of the impact, potential impacts to fauna from this source are likely to be minor if construction activities occur outside the wet season when critical migration and life cycle activities occur. There is a possibility, however, that mangroves are used for some critical life history stages, e.g. nursery grounds, by some of the sensitive species.

10.2 Terrestrial ecology

10.2.1 Site formation

Natural Mangrove habitat will be removed from Madraukutu site during development for bridge placement. Natural habitat loss will require mitigation and offsetting (refer residual impacts-mangrove habitat loss) to ensure a net benefit.

In addition to the direct loss of vegetation for bridge placement, the project may impact vegetation by:

- unauthorised clearing outside the subprojects site boundary
- clearing elsewhere e.g., to store materials.
- causing damage to surrounding vegetation through erosion (refer Suspended solid)
- changes to water quality (Suspended solid/water quality)
- introduction of invasive species (refer invasive species).

At Madraukutu the loss of vegetation increase habitat fragmentation. The increased isolation that may be caused by the proposal is not likely to have an appreciable impact however since functional connectivity would remain in the study areas. The effects could be offset or mitigated through mangrove restoration in both additional sites (offset) and restoration of mangroves in the sites surrounding the new bridge which are damaged by construction (mitigation). Post construction monitoring would ensure construction has not led to additional destabilisation effects on nearby mangroves surrounding the proposed bridges. Monitoring can also ensure that no more than the advised proportion of mangrove has been removed during construction activities.

10.2.2 Invasive species.

Invasive species have the potential to be spread by the construction e.g., through tracking of seeds on vehicles or machinery. Pathogens and invasive species may also be carried on, or in, materials, equipment (including vessels used to transport materials or workers) and any workers

brought to the sites. This includes materials, equipment and workers bought from other countries or elsewhere in Fiji.

10.3 Intertidal ecology

10.3.1 Intertidal Construction Works

There will be no reclamation involved in the proposed development. Construction works within the intertidal zone, however, would be required for Madraukutu. The area of seabed effected for the site is sandy and muddy bottomed. Due to the small scale of construction works involved, impacts are ranked as largely minimal in nature if sedimentation impacts can be contained.

10.3.2 Suspended solid.

Construction activities, may also impact indirectly upon the intertidal marine environment through re-suspension of sediment from excavation, dredging and site formation activities, and site runoff at Madraukutu. Re-deposition of suspended solids has the potential to affect marine benthic communities and to alter seabed characteristics. No seabed assemblages of high conservation value have been recorded within the study site. Outside the study site in the greater area there is coral reefs and there is likely to be seagrass. It is recommended to avoid impacts on these ecosystems by containing and minimising sedimentation during construction activities to as close to the site of the bridge development as possible.

A plan is needed to ensure the implementation of appropriate design and management techniques to reduce sedimentation risks during construction are low particularly during dredging or when piles are being placed. Turbidity curtains are one method which could be used to create a temporary barrier to ensure silt and debris are contained during construction. Provided sedimentation risks can be manged no unacceptable indirect impacts to marine ecological resources are predicted to occur during the construction and operations if turbidity readings are within the acceptable range <25 NTUs outside the turbidity curtains and/or 15 meters from the site edge.

10.4 Aquatic ecology

10.4.1 Suspended solid/water quality.

Environment construction activities and dredging could result in the increased sediment loading and site runoff of streams and changes in turbidity may impact adversely upon aquatic populations particularly sessile species.

High suspended and deposited sediments can smoother habitats and reduce the photosynthesis of benthic plants. Suspended sediments can also impact on aquatic biota by clogging the food filtering or trapping apparatus of stream insects as well as the gills of fish, reducing the feeding efficiency (particularly for visual predators). This is a concern at all the sites.

Multiple fish species present in the wider catchment migrate both upstream and downstream within streams and rivers during different stages within their lifecycle. High suspended sediment can slow or prevent the migration of native fish species. In a study on juvenile whitebait (banded

kokopu in New Zealand), fewer fish migrated upstream at turbidity > 25 NTU[10]. The study speculated that if the rate of migration of juvenile banded kokopu was slowed there could potentially be fewer juvenile fish reaching adult habitat, fish could potentially be subject to increased risk of predation and may not reach preferred upstream habitats while they are still able to climb as juveniles.

Through the implementation of appropriate design and management sedimentation risks can be managed reducing the level of effect to low. Management tools include: 1) turbidity barriers which can be used to lessen the spread of fine particles and 2) timing construction to avoid the rainy season and key migration periods for sensitive species. A turbidity meter should be used to measure the turbidity outside of the construction area impact site to ensure that turbidity readings are within the acceptable range of <25 NTUs outside turbidity curtains and 15 meters from the construction site edge.

10.4.2 Pollution incidents

Local ecological populations may also be adversely affected by pollution incidents attributed to fuel leaks and oil spills associated with construction and maintenance operations on site.

Cement is a construction related material which can have adverse on freshwater life. Cement has the potential to be discharged to the downstream receiving environment. Cement wash water and runoff from recently placed cement are of particular concern within aquatic habitats due to their detrimental effect on in stream fauna. Crushed concrete is also increasingly used as back-fill material and more frequently as contractors seek ways to be more sustainable and reuse materials.

Cement wash water and runoff has a high lime content which is water soluble (dissolves easily in water) and can drastically increase the pH of a waterway. The alkalinity can kill or severely burn aquatic life. For fish, the alkalinity is exceptionally damaging to sensitive gill structures. In addition to alkalinity, cement wash, and runoff can similarly increase the loading of fine sediment resulting in the same effects on instream fauna and habitat as those identified above for suspended/deposited sediment.

Concrete structures can leach and cause alkaline water. In addition to potential mortality of fauna, localised increases in pH (alkaline conditions) from leaching from concrete structures may also create a barrier to fish passage. These effects can be limited through careful management.

There is a particularly high risk of discharge of contaminants following discrete wet weather events or during prolonged periods of wet weather. Appropriate design and management can reduce these risks.

10.5 Impacts on fish and crustacean species of concern

Direct impacts on migratory fish and crustacean species are unlikely if there is minimal disruption to the flow of the river during the wet season (Nov-April) and key activities such as pile construction is limited to outside critical life history and migration periods. This will ensure any fish and crustacean migration is not obstructed during construction works within the riverbed and

[10] Richardson, J., Rowe, D.K., Smith, J.P.2001. Effects of turbidity on the migration of juvenile banded kokopu (*Galaxias fasciatus)* in a natural stream, New Zealand. Journal of Marine and Freshwater Research, 35:1, 191-196, DOI: 10.1080/00288330.2001.9516989

safeguard against risks. Timing construction outside the migratory wet season reduces the severity of the effect of construction to no more than minor.

Any impacts on most potential resident species of concern, should they be present, are likely to be small and predominantly limited to the construction phase. Such impacts are likely at Madraukutu given mangroves will be removed, and represent habitat for such species. Provided careful mitigation activity is taken e.g., care involving cement/concrete should ensure minimal effects. These species cannot be assessed against measurable impacts without known populations on site. Increasing the amount of suitable habitat for these species through the restoration of mangrove habitat should offset the losses of any individuals and associated habitat lost during construction allowing for net gains for these species to be achieved.

The most significant potential for impacts at a particular species is to the fish species of concern *Parioglossus triquetrus*, although this species is not confirmed from Madraukutu, its limited global distribution means that - if it is present - it may have a significant part of its global population present. Approximately 8% of the remaining mangrove at Madraukutu is planned to be removed. If *Parioglossus triquetrus* is present, this is likely to represent a significant impact. As such, on a precautionary basis, all efforts should be made to reduce mangrove loss at Madraukutu, and adequate restoration of mangrove should occur at or near Madraukutu to fully achieve a net gain of this habitat (and thus this species, if present).

10.6 Operational effects

10.6.1 Terrestrial impacts

The presence of the bridge structures will cause some shading of the riverbank and bed thereby potentially altering the aquatic flora present in the direct vicinity of the bridge. This impact is predicted to be minimal for Madraukutu bridge since it will be highly localised and when mangroves are shaded only a small area will be impacted. Furthermore, mangrove forest is not particularly sensitive to shading. Mitigation measures are not likely to be effective and are not deemed necessary.

10.6.2 Aquatic impacts

The physical presence of bridges during operation post construction can also affect aquatic ecological populations in several ways. Physical developments such as bridge pillars, dredging and alteration of embankments, and roading construction can result in channelization, and deep pool formation resulting in an ecological disturbance for aquatic fauna if habitat corridors become severed.

Disturbances from bridge construction can be mitigated if normal water flow is maintained despite the blocking effect of embankments and bridge piers. This objective can be achieved through designs that favour long spans and hydraulically shaped piers. Abutments should be set back from the normal wetted perimeter of the watercourse to avoid constriction of the channel and reduction of the flow area.

The length of the spans required are determined by the bridge design of the engineers. However, the longer the spans the greater contact with waterways can be reduced thereby reducing freshwater impacts.

Abutments and piers should be designed and constructed to provide the least amount of hydraulic resistance. Where piers are required, hydraulic shaped piers will minimize local scour and reduce obstruction of flow reducing impacts on the aquatic benthic environment. Piers should be constructed with ends which are tapered upstream and downstream in the direction of the main flow.

10.7 Cumulative impacts

The potential biodiversity impacts of the bridge proposals must be considered because of the construction and operation of the proposal within the existing environment. The proposal would not act alone in causing impacts to biodiversity. The incremental effects of multiple sources of impact (past, present, and future) are referred to as cumulative impacts and provide an opportunity to consider the proposal within a strategic context. The accumulating impacts of historic vegetation clearing for urban development, agriculture, and development and maintenance of infrastructure have contributed to the loss of biodiversity within the Fijian landscape. The proposed developments are not found to be a major contributor to cumulative impacts upon local marine, terrestrial or aquatic ecology.

11. Avoid, minimise, and mitigate impacts.

ADB require that mitigation of ecological impacts be sought in the following order of priority: (1) avoid, (2) minimise, (3) compensate on-site and (4) compensate off-site. At each stage, residual impacts should be re-assessed to determine whether there is a need to proceed to the next stage of mitigation. The following measures are proposed to mitigate the impacts discussed in the preceding section.

11.1 Avoidance and minimisation

The primary method to avoid impacts is to locate activities away from areas of known or potential high biodiversity value. Where possible the road alignment and bridge design has been located to avoid loss of mangrove. Further loss of mangroves should also be minimised as possible with no heavy machinery being placed on the mangrove areas unless this unavoidable.

11.2 Mitigation measures

Once all practicable steps to avoid or minimise impacts have been implemented at the detailed design phase, mitigation measures would be implemented to lessen the potential ecological impacts of the proposal. Mitigation measures are to be undertaken during the construction and operational phases and are outlined in Tables 8 and 9 below.

Table 8. Activities and potential effects on aquatic ecology at Madraukutu during the various phases of the operation are summarised in the following table.

Construction phase		
Construction Activities	**Potential impact**	**Proposed Mitigation activity**
Drainage works and use of vehicles	• Negative impact on flora and fauna from increased sediment (increased turbidity) loading of river, mangrove and marine areas	• Implement robust erosion and sediment control measures. Where practical use management methods such as turbidity curtains and turbidity meters outside the area in combination with phasing of construction work to minimise sedimentation and disturbance to aquatic fauna and flora • Operation of heavy equipment should be confined to dry stable areas to reduce the amount of mud and heavily silted water at the construction site which could enter the watercourse. • Stabilise exposed areas as soon as possible. • Avoid discharge of sediment into water • Avoid or minimise sediment release downstream. • Retain vegetation on the bank. • When excavation is required within the channel, as in the placement of footings for abutments or piers, measures should be taken to separate the excavation area from the flow by cofferdams. • Storage of fuel, equipment, and construction materials to minimise the risk of soil contamination or water pollution. • A risk assessment is carried out for each substance to be used or stored on site and the appropriate containment measures installed.
Materials management	• Harm to aquatic flora and fauna from oil, fuel, cement, or other substances entering watercourses	• All practical measures must be taken to prevent cement and cement products entering flowing water, including but not limited to a) Avoiding flowing water coming into contact with the concrete until the concrete is firmly set. b) Using boxing or other similar devices to contain wet cement during construction of the structure. c) If any concrete is spilled beyond the boxing, pouring of concrete must stop immediately and all concrete must be removed from the watercourse. d) No equipment used in the pouring of concrete should be washed out onsite. (Further detail is provided in the Working with concrete, cement and lime section below) • Development of a species-specific management plan for species of concern
Physical impacts- Dredging and bridge pillar	• Habitat loss and direct mortality of sensitive flora and fauna	• Where needed turbidity barriers will be used during construction to prevent fine material from going offshore or entering other sensitive environments. • Ensure minimal disruption to the flow of the river during the wet season • Minimize turbulence and flow contraction because turbulence inhibits or prevents passage
	• Potential barrier to fish and shrimp migration along the river corridor	• Construct bridge bottoms with natural stream substrates • Construction should be phased to be outside the key periods of faunal migration.
Debris from construction	• Any debris left on the seabed from the construction activity can become a projectile during severe wave activity, and this may cause damage to sensitive benthic resources.	• A swim through by an Ecologist will be done at the site after construction when the turbidity is back to normal. The inspection will ensure that all debris are removed off site and that the stream riverbeds are appropriately restored.
Operation phase/ongoing site maintenance		
Activities	**Potential impact**	**Proposed Mitigation activity**
Physical presence of the bridge	• Changes to deposition, depth and water velocities may result in the loss of sensitive plant, invertebrate, and fish species	• Design bridge to avoid and reduce environment impacts e.g., maintain a constant grade along the length of the bridge. • Effective stabilisation of altered landforms to minimise soil erosion. • Construct during periods of low flow to minimize impacts to fish and the potential for water pollution from suspended solids

	• Potential downstream changes to the aquatic community	• During construction, minimize disturbance to the length of the natural stream channel and the natural flow of the water
Materials management from ongoing site maintenance	• Direct and indirect effects from oil, fuel or other substances entering the aquatic environment	• A risk assessment is carried out for each substance to be used or stored on site and the appropriate containment measures undertaken.

Table 9. Activities and potential effects on terrestrial ecology during the various phases of the operation are summarised in the following table.

Construction phase		
Construction Activities	**Potential impact**	**Proposed Mitigation activity**
Earthworks and excavations	• Loss of mangrove habitat, fragmentation, or severance at two of the sites	• The subproject site boundary will be clearing marked on a plan and marked out on the site and approved by the Engineer/supervision consultant prior to the commencement of clearing. Only vegetation identified on the plan will be removed. • Ensure vegetation clearance is restricted to within the subproject site boundary and is the minimum practically required for the proposed works, including allowance for shading. The proposed site boundary will be approved by SP and the PIC prior to the commencement of clearing. • Cleared vegetation will be removed from the subproject site and disposed of at a location approved of by an Environment Safeguards Expert (noting cleared vegetation includes weeds and potentially weed seeds). Vegetation will not be permanently stockpiled on site or pushed into existing vegetation adjacent to the site. • Where possible machinery storage and materials lay down areas will be established in previously disturbed areas to avoid increasing the footprint of the project site and will avoid placement in areas of mangrove. • Further habitats should be created to compensate for habitat losses and to improve the landscape and ecological potential for the site where possible
	• Disturbance to sensitive species on and near the site and changes in distribution, activity patterns	• This effect is considered minimal for these ecosystems and mitigation is not required
	• Compaction of soil and associated effects on the surrounding mangroves	• Use of techniques to minimise compaction of soil, such as restricting access during wet conditions, and using protective boarding and low ground pressure machinery. If necessary, soil should be carefully removed and stored for subsequent reinstatement.
Invasive species introduction	• Negative ecological impacts due to the introduction of invasive species	• An invasive species management will be developed with the aim to prevent or manage invasive species introductions
Operation phase/ongoing site maintenance		
Construction Activities	**Potential impact**	**Proposed Mitigation activity**
Physical presence of bridge	• Loss of mangrove habitat and associated ecosystem services	• Further habitats should be created to compensate for habitat losses and to improve the landscape and ecological potential for the site
	• Destabilisation of nearby mangroves	• Monitoring in the years post construction to ensure there is no further loss of nearby mangroves

11.3 Working with concrete, cement and lime

Concrete and cement are used extensively in construction. Many activities require in situ pouring of concrete into purpose-built boxing or form work or installing pre-cast structures into waterways. Cement and lime are also used for pavement and trench back-fill stabilisation works.

Uncured concrete, concrete slurry, cement and lime fines, dust, or washings can make water highly alkaline (pH of 11–13). This highly alkaline water will injure and kill fish and other freshwater life that encounter it. Water contaminated with concrete, cement and lime cannot be diluted or filtered to a safe level for discharge to the receiving environment, so washings, dust, fines, or slurry must not enter stormwater or freshwater receiving environments.

Concrete, cement and lime-contaminated water must be collected in a contained area and removed from site, to avoid discharging to the receiving freshwater environment. Even once cured, concrete structures will leach for some time when immersed in water, producing alkaline water. Pre-cast structures need to be soaked, with soakage water replaced (and appropriately discharged away from any of the sites) periodically. Where pre-cast structures cannot be used and in situ pouring is required, this must be done in the dry (e.g., the use of Coffer dams) and the structure may need to be soaked as described above before removing the coffer dam and exposing the structure to the waterway.

11.4 Preventing invasive species

Mitigation measures to prevent the introduction or spread of invasive species and pathogens will include:

- The contractor must obtain all required biosecurity and phyto-sanitary clearances (e.g., permits) for any material or equipment imported into Fiji.
- The contractor will obtain all permits and clearances for import of any materials and equipment to be used for the project as required by Biosecurity Fiji.
- Materials will be inspected, and any equipment imported for project purposes will be steam-cleaned and certified under biosecurity and phyto-sanitary procedures away from the sites prior to mobilization.
- Immediately following clearing and construction, restoration, and planting of the site in the mangrove areas will occur to minimise the establishment of weeds at each location.
- Weed hygiene measures will be implemented to prevent introduction or spread of invasive species, including cleaning machinery before it enters and leaves the subproject sites. Inspection of the replanting and identification of any potentially risky weeds/invasive species should occur both during construction and immediately following construction by an appropriately qualified ecologist.

12. Management measures to address CH triggers

Although all efforts have been made to avoid ecological effects at the Madraukutu bridge site complete avoidance of effects is not possible. It has been necessary to mitigate and minimise potential ecological impacts and effects. A number of mitigation measures are required at this site to address each of the critical habitat triggers (Table 10. Management measures to address specific critical habitat triggers.)

Table 10. Management measures to address specific critical habitat triggers.

Criteria triggered	Critical habitat triggered	Management measures to address
1: Critically Endangered and Endangered Species	No	No additional measures required
2. Endemic / Restricted Range Species	Yes, potentially >10% of the species' population occurs and ≥10 reproductive units of a species of endemic range restricted fish *Parioglossus triquetrus* maybe present	• Ensure vegetation clearance is restricted to within the subproject site boundary and is minimised to the area of bridge placement • Implement robust erosion and sediment control measures. Where practical use management methods such as turbidity curtains and turbidity meters outside the area in combination with phasing of construction work to minimise sedimentation and disturbance to aquatic fauna and flora • When excavation is required within the channel, as in the placement of footings for abutments or piers, measures should be taken to separate the excavation area from the flow by cofferdams. Storage of fuel, equipment, and construction materials to minimise the risk of soil contamination or water pollution. • Use of techniques to minimise compaction of soil, such as restricting access during wet conditions, and using protective boarding and low ground pressure machinery. If necessary, soil should be carefully removed and stored for subsequent reinstatement. • A risk assessment is carried out for each substance to be used or stored on site and the appropriate containment measures installed. • All practical measures must be taken to prevent cement and cement products entering flowing water, including but not limited to a) Avoiding flowing water coming into contact with the concrete until the concrete is firmly set. b) Using boxing or other similar devices to contain wet cement during construction of the structure. c) If any concrete is spilled beyond the boxing, pouring of concrete must stop immediately and all concrete must be removed from the watercourse. d) No equipment used in the pouring of concrete should be washed out onsite. (Further detail is provided in the Working with concrete, cement and lime section below) • Development of a species-specific management plan for species of concern • Restoration of lost mangrove habitat and additional mangroves planted • An invasive species management will be developed with the aim to prevent or manage invasive species introductions • Further habitats will be created to compensate for habitat losses and to improve the landscape and ecological potential for the site • Monitoring in the years post construction to ensure there is no further loss of nearby mangroves
3. Migratory / Congregatory Species	Yes, likely to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species	• Ensure vegetation clearance is restricted to within the subproject site boundary and is minimised to the area of bridge placement • Minimize turbulence and flow contraction because turbulence inhibits or prevents passage • Construct bridge bottoms with natural stream substrates • Construction should be phased to be outside the key periods of faunal migration.

		• Ensure minimal disruption to the flow of the river during the wet season • Design bridge to avoid and reduce environment impacts e.g., maintain a constant grade along the length of the bridge. • An invasive species management will be developed with the aim to prevent or manage invasive species introductions • Monitoring in the years post construction to ensure there is no further loss of nearby mangroves • All practical measures must be taken to prevent cement and cement products entering flowing water, including but not limited to a) Avoiding flowing water coming into contact with the concrete until the concrete is firmly set. b) Using boxing or other similar devices to contain wet cement during construction of the structure. c) If any concrete is spilled beyond the boxing, pouring of concrete must stop immediately and all concrete must be removed from the watercourse. d) No equipment used in the pouring of concrete should be washed out onsite. (Further detail is provided in the Working with concrete, cement and lime section below)
4. Critical habitat qualifying processes/ecosystems	Yes, provides key ecosystem services	• Ensure vegetation clearance is restricted to within the subproject site boundary and is minimised to the area of bridge placement • Monitoring in the years post construction to ensure there is no further loss of nearby mangroves • An invasive species management will be developed with the aim to prevent or manage invasive species introductions • All practical measures must be taken to prevent cement and cement products entering flowing water, including but not limited to a) Avoiding flowing water coming into contact with the concrete until the concrete is firmly set. b) Using boxing or other similar devices to contain wet cement during construction of the structure. c) If any concrete is spilled beyond the boxing, pouring of concrete must stop immediately and all concrete must be removed from the watercourse. d) No equipment used in the pouring of concrete should be washed out onsite. (Further detail is provided in the Working with concrete, cement and lime section below) • Further habitats will be created to compensate for habitat losses and to improve the landscape and ecological potential for the site • Monitoring in the years post construction to ensure there is no further loss of nearby mangroves
5: The area holds biodiversity of significant social, economic, or cultural importance to local communities	Yes, important local fishing area	• Ensure vegetation clearance is restricted to within the subproject site boundary and is minimised to the area of bridge placement • Implement robust erosion and sediment control measures. Where practical use management methods such as turbidity curtains and turbidity meters outside the area in combination with phasing of construction work to minimise sedimentation and disturbance to aquatic fauna and flora • When excavation is required within the channel, as in the placement of footings for abutments or piers, measures should be taken to separate the excavation area from the flow by cofferdams. Storage of fuel, equipment, and construction materials to minimise the risk of soil contamination or water pollution. • Use of techniques to minimise compaction of soil, such as restricting access during wet conditions, and using protective boarding and low ground pressure machinery. If necessary, soil should be carefully removed and stored for subsequent reinstatement.

		• A risk assessment is carried out for each substance to be used or stored on site and the appropriate containment measures installed. • All practical measures must be taken to prevent cement and cement products entering flowing water, including but not limited to a) Avoiding flowing water coming into contact with the concrete until the concrete is firmly set. b) Using boxing or other similar devices to contain wet cement during construction of the structure. c) If any concrete is spilled beyond the boxing, pouring of concrete must stop immediately and all concrete must be removed from the watercourse. d) No equipment used in the pouring of concrete should be washed out onsite. (Further detail is provided in the Working with concrete, cement and lime section below) • Development of a species-specific management plan for species of concern • Restoration of lost mangrove habitat and additional mangroves planted • An invasive species management will be developed with the aim to prevent or manage invasive species introductions • Further habitats will be created to compensate for habitat losses and to improve the landscape and ecological potential for the site • Monitoring in the years post construction to ensure there is no further loss of nearby mangroves
Criterion 6: Protection	Yes, protected area	Liaison needed with communities

13. Residual impacts

As required by the ADB SPS, a no-net-loss of biodiversity values is required to be achieved. Although efforts have been made to avoid, minimise, and mitigate potential ecological impacts from the proposal, some residual impacts would occur in the form of terrestrial habitat loss and loss of soft sediment habitat at the Madraukutu bridge site.

Approximately 2,349m^2 of mangrove at Madraukutu (~8% of the area present) may be lost owing to this project (Table 11). It is good practice and aligned with ADB safeguards to compensate for all such loss of natural habitat. The best option is likely to be restoration of degraded or destroyed areas of mangrove at or near the project sites – this will represent an offset for project impacts on mangrove. Where this is not feasible, owing to a limited area or land use restrictions, restoration of degraded/lost mangrove should occur as near to the sites as feasible. New mangrove habitat (i.e., on mudflats where mangroves have never previously occurred) should not be created, as this may impact other species. A replanting plan should be developed with a qualified ecologist and through community liaison prior to construction occurring. Particular attention will be needed for this site, where impacts on mangrove are predicted to be significant.

The habitat identified at the Madraukutu site is Natural high condition habitat largely of native origin, and/or where human activity has not essentially modified the primary ecological functions and species composition. There is only a small amount of disturbance present with some vegetation removal, waste, and minor introduction of invasive species.

Increasing the amount of suitable habitat for fish and crustacean species through the additional restoration of mangrove habitat should offset any the losses of individuals during construction by allowing for net gain habitat for key species to be achieved.

Natural soft sediment habitat under the water will be modified and lost as habitat for native species at the Madraukutu site in the locations where piers are placed and potentially also will impact habitat within 2 meters of the piers (Table 11). Impacts on the soft sediment area calculated to be lost underwater through pier placement is small and not significant therefore offsets are not considered necessary (see table 11).

Table 11. Modified habitat by habitat type

Site	Habitat type residual impacts	Habitat Type condition	Habitat Type Area (B)
Madraukutu	Mangrove	Natural	2,349m^2
Madraukutu	Soft sediment	Natural	30 m^2

13.1 Residual Mangrove habitat impact

The following formula has been used to calculate the Habitat impact area of the residual values of the impacted mangrove habitat:

Area of Habitat Type (A) x Habitat Type Condition (B) = Habitat Impact area (C)

Table 12.Residual values of the impacted mangrove habitats

Habitat type and site	Habitat Type condition	Condition Score (A)	Habitat Type Area (B)	Habitat Impact Area (C) in Habitat hectares (HH)
Mangrove-Madraukutu	Natural	0.95	2,349m^2	0.2232 HH

The number of Habitat Hectares that require to be offset to achieve a no-net loss of biodiversity values of the mangrove sites is 2,349 HH for mangrove in the Madraukutu site.

However, a ratio of 1:6 is required by the Fijian Ministry of Environment as a replanting offset of the area of mangrove lost. This ratio will more than compensate for the loss of mangrove habitat removed for this project even if only a 50% condition score is achieved (See table 13).

Table 13. Calculation of the mangrove condition that the x6 area would achieve in the project timeframe

Habitat type and area	Habitat Type Area (A)	Ratio (B) 1:6	Condition Score (C) achieved following restoration	Habitat Restoration area with 1:6 ratio and 50% quality achieved. Habitat hectares (HH)
Mangrove-Madraukutu	2,349m^2	14,094 m^2	0.5	0.7047 HH

A further offset option is the restoration of degraded mangrove habitat. Further calculations would be needed to calculate the final size of the offset site required should this option be selected since the size of the restoration area required is dependent on the condition of the habitat currently present.

The area of mangrove replanting should, follow the Guidelines for Best Practice Mangrove Planting in Fiji [11] to increase the likelihood of restoration success and prevent another valuable ecological habitat such as the intertidal zone habitat being converted. Recommendations include only planting mangroves on areas they have occurred previously to prevent the conversion of other important natural habitat and to increase the chance of success.

The time recommended for management of the offset areas is 20 years. This would cover the period needed for the mangrove restoration to reach maturity.

Compensatory planting locations have not been identified. Community consultations to determine location and ensure community support are required. However, as much as possible restoration should occur near to the mangrove sites of impact. Where possible the area directly adjacent to the bridge area should also be restored to reduce the area of impact and associated edge effects.

14. Post construction monitoring

Monitoring programs are recommended:

- A qualified engineer and ecologist should evaluate bridge impacts on erosion and riparian areas to ensure habitat integrity throughout the construction phase.
- Post construction monitoring by both a qualified ecologist and an engineer within 3 weeks on construction being completed should ensure construction has not led to destabilisation effects on nearby mangroves and that no more than the advised proportion of mangrove has been removed during construction activities.
- Monitor success of offset/mitigation mangrove planting at 2-, 5- and 10-years post planting to ensure planting success and a net gain was achieved should be undertaken by a qualified ecologist.
- Ecological health (fish survival is not impacted by construction) using eDNA sampling should be undertaken by a qualified ecologist during construction and 1 year following construction.

Monitoring of turbidity is required daily during the construction phase to ensure levels are not higher than <25 NTUs outside turbidity curtains within 15 meters of the edge of the construction area.

15. Madraukutu bridge site conclusion

We conclude that the key period of impact will be: 1) during the construction phase of the project, and specifically to water quality (i.e., unmitigated discharge of sediments and potential concrete contamination) and 2) due to the removal of the mangrove vegetation. Management plans are

[11] A Review of Mangrove Planting, D. WATLING, 2021

needed to ensure these do not have an impact. It is also important that limits on key construction activities during aquatic migration periods (during the wet season Nov-April) should be maintained when migratory EBA trigger species are potentially utilising the area.

We conclude that potential significant environmental impacts can be addressed if appropriate management and mitigation options are undertaken in addition to offsetting/mitigation for the loss of mangrove habitat, there will be no measurable adverse impacts, or likelihood of such, on the aquatic or mangrove habitat which could impair its high biodiversity value or the ability to function after planned mitigation and offset measures. Impacts are not expected to be anywhere near the level that could impair the ability of the Critical Habitat to perform ecological functions

Following the implementation of the management and mitigation measures, including those for residual effect it is concluded that at Madraukutu bridge site the ADB SPS and World bank ESF ESS6 requirements are fulfilled allowing the project to go ahead in an area of Critical Habitat (CH).

16. Viseisei Bridge Ecological Values

16.1 Terrestrial ecology

The proposed bridge site is 600m upstream from the vuda/vunda river mouth which is also called Varangge Creek/Vuda river. The proposed location of the bridge covers a section of a large and relatively undisturbed high quality natural mixed Rhizophora mangrove forest. The total area of natural mangrove forest is 21 hectares (Figure 8-9).

On the western side of the bridge the natural habitat mangrove forest impacted by the proposed development is dominated *Rhizophora stylosa* and *Rhizophora samoensis* mangrove species with little sign of anthropogenic disturbance. On the east side of the bridge in addition to *Rhizophora stylosa* and *Rhizophora samoensis* mangrove species various other common obligatory mangrove plant species which can tolerate brackish conditions such as *Cocos nucifera* (coconut), *Pandanus verus*, *Hibiscus tiliaceus* also occurred within the vegetation. The western side of the proposed bridge the area was inundated and only mangroves were present with no herb or grass ground cover. Within this mature intact area of impacted mangrove forest, two one-meter square plots had on average 11 large mature mangrove trees and 15 mangrove seedlings <60 cm in height (n= 4), Canopy height was approximately 20-23 m. No species threatened or known to be rare were found in the Study Area. The Study Area supported plant species typical of those types of habitats and had a low plant diversity and simple structure. Despite this the site is of high natural habitat quality and high ecological value.

Based on the current design, the estimated clearing of natural habitat mangrove vegetation for the proposal is 1,912 m^2. This area includes a 3m buffer area surrounding the proposed bridge design (Figure 8 and 9). This is a small proportion of the overall surrounding mangrove habitat. Loss of this vegetation will however contribute to further fragmentation of mangrove habitat. This effect is higher because the area of clearance is positioned at a central location within the mangrove habitat.

16.2 Aquatic ecology

The Varaciva catchment area in which the Vuda river or Varangge Creek occurs has a small watershed area. At the proposed bridge development site, the river is approximately 40m wide and has a maximum depth of approximately 9 meters. The edge sediment was muddy with some rocky areas. The river flow was swift with good clarity to 3 meters on the survey days.

EDNA sampling occurred 20 meters upstream from the proposed bridge and at the proposed bridge location. Edna testing at and near to the proposed bridge site revealed that up to 24 species of fish, 3 species of crustacean (shrimps and crabs) and 8 mollusc species (See appendix). Snorkel surveys were conducted at the bridge and downstream from the bridge. No kai/freshwater mussel were found in the area. Netting and trapping did not add further species to the species list above that provided through eDNA sampling (Appendix, tables 36-40).

Additional targeted surveys for specimens of *Parioglossus* and other gobies utilising kilwell bait traps were not successful in capturing any additional species. The freshwater fish utilising the area are likely to include migratory species which pass this site seasonally. However, surveys have not occurred during the best period for detecting these species (the wet season). We take a precautionary approach and assume they are present at key migration periods.

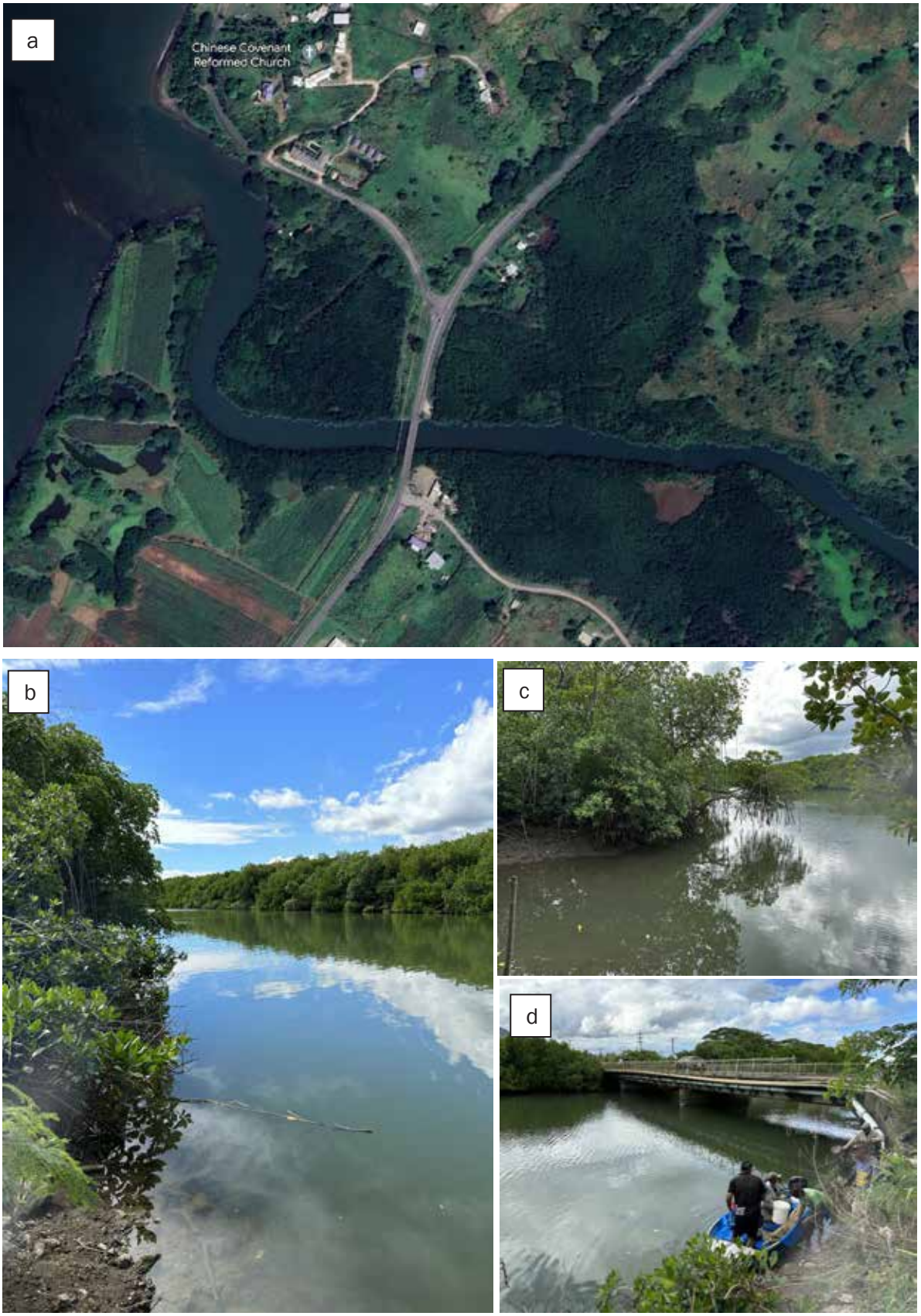

Figure 8. a) landscape depiction of the mangroves surrounding the site the proposed bridge is located immediately north of the current bridge, b) western bank looking upstream showing healthy mangroves to the river edge, c) within the mangroves on the western.

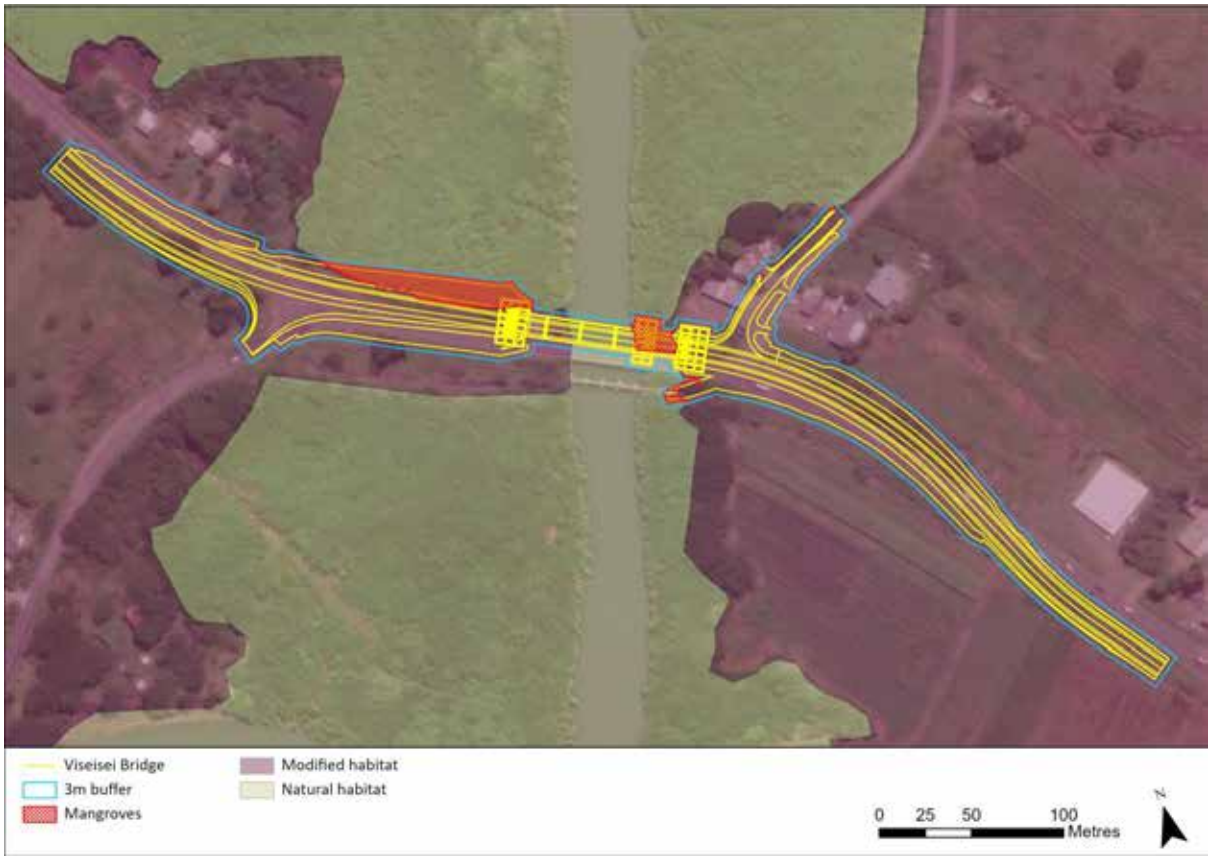

Figure 9. The proposed bridge design and area of mangroves which will be potentially removed includes a 3-meter buffer impact zone and the surrounding modified and natural habitat.

17. Viseisei Bridge critical habitat triggers

Literature reviews, database surveys, eDNA surveys and field visits identified no endangered species of conservation significance based on the IUCN Red List of Threatened Species as present at the Viseisei bridge site, or within the EAAA of the site. However, there are endemic or range restricted species fish species which are data deficient or have not yet been evaluated by the IUCN for which the habitat is suitable (See Table 14). The majority of thse species of crustaceans and fish are only potentially present during migration triggering criteria 3 for critical habitat. We have taken a precautionary approach and assumed they are present at key times in the year (See table 14-15).

There are also two species *Datnia kneri /Mesopristes kneri* and *Parioglossus triquetrus* which are data deficient/not evaluated by the IUCN which maybe present all year. Both species are known from areas outside the EAAAs and are lacking information on population status and spatial coverage.

For *Datnia kneri /Mesopristes kneri* appropriate habitat requirements are met at this project site. This species could also trigger Criteria 3 since they migrate. This species was not however present in any of the eDNA samples collected (there was no unidentified Terapontidae genus in the eDNA) at any of the sites. This suggests that the species was not present during the survey periods at this site. *Datnia kneri* therefore does not trigger criteria 2.

Table 14. Freshwater fish triggering critical habitat and criterion triggered at Viseisei.

Scientific name	Critical Habitat Rationale	Criterion Triggered
Glossogobius sp. (Hoese and Jenkins in prep)	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that all 4 sites sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle qualifying them as Critical Habitat under Criterion 3.	3
Parioglossus triquetrus	Potential Critical Habitat: Suitable habitat potentially exists. Though the species was not found at the sites, it is possible the EAAAs regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species of the global population occur, qualifying these as Critical Habitat under Criterion 2.	2
Schismatogobius vitiensis Comon name: Fijian scaleless goby(Jenkins and Boseto, 2005)	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical basis, ≥ 1 percent of the global population of this migratory species may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Schismatogobius chrysonotus (Orange-spotted Scaleless Goby)	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through all 4 of the sites, qualifying them as Critical Habitat under Criterion 3.	3
Stenogobius (insularigobius) n. sp. Common name: teardrop goby	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Stiphodon sp.1, Isabella's goby	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Stiphodon sp.2 (Jenkins, Boseto and Watson)	Potential Critical Habitat: The 4 EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Sicyopterus n. sp. (Boseto, in preparation) – Tavoro Goby	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Datnia kneri / (Bleeker, 1876) (Terapontidae) Common name: Orange-spotted Therapon/Reve	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3. It is not considered likely, however, that >10% of the species' population occurs at any of the sites at any time, thus meaning they do not qualify as Critical Habitat under Criterion 2.	3

Table 15. Endemic freshwater crustaceans triggering critical habitat (CH) criteria and rational at Viseisei.

Name	Critical Habitat Rationale	Criterion Triggered
Caridina fijiana	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that >1% of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Caridina nudirostris	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that >1% of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3

Parioglossus triquetrus is endemic. The habitat requirements of this species are met by this project site given that mangroves are present. No records of the species have been recorded within the EAAA. No potential individuals were seen in the mangroves or while doing snorkel surveys and no individuals were captured during the surveys despite effort. However, the species is known to be difficult to capture.

Parioglossus triquetrus was not in the eDNA library which did not allow this species to be identified directly through the eDNA samples. Furthermore, there is unidentified Gobiidae in the

eDNA samples which could be *Parioglossus triquetrus*. This species could trigger Criteria 2 and therefore consideration is given to potential project-related adverse impacts (table 14).

17.1 Critical Habitat-qualifying ecosystems

ADB Criterion 4 states " The area includes unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services;"

Criterion 4 relates to specific landscape features which are critical for ecological functions. Examples of these within the sites includes riparian zones and rivers, dispersal/migration corridors (rivers), hydrological regimes, and keystone or habitat-forming species (mangroves and freshwater mussels).

The rivers, estuaries, and mangrove surrounding Viseisei provide critical shelter and food for aquatic species and function as migration corridors maintaining key life cycle events. The mangrove river systems are recognised as key ecosystem providers e.g., breeding and nursery habitats for fish species, storms and floods, erosion control functioning locally and regionally as important ecosystem services. By providing these ecosystem services they trigger critical habitat criterion 4.

17.2 Critical habitat criteria triggered

The critical habitat triggered at the Viseisei is outlined (See Table 16**Error! Reference source not found.**)

Criteria	Thresholds	Critical habitat triggered
1: Critically Endangered and Endangered Species	(a) Areas that support globally important concentrations of an IUCN Red-listed EN or CR species (≥ 0.5% of the global population AND ≥ 5 reproductive unitsGN16 of a CR or EN species). (b) Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds in GN72(a). (c) As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species	no
2. Endemic / Restricted Range Species	(a) Areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species.	Yes, potentially hold ≥10% of the global population size AND ≥10 reproductive units of *Parioglossus triquetrus.*
3. Migratory / Congregatory Species	(a) Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle. (b) Areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress.	Yes, likely to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species
4. Critical habitat qualifying processes/ecosystems	The area includes unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services	Yes, provides key ecosystem services
5: The area holds biodiversity of significant social, economic, or cultural importance to local communities		Yes, important fishing area
Criterion 6: Protection		None identified

Table 16. Critical habitat triggered.

18. Ecological effects

This section of the report considers the potential impacts of project operation on terrestrial mangrove, freshwater, and intertidal ecology at the Viseisei bridge site. Ecological effects on both the terrestrial and aquatic varies during construction and during operation are both summarised in (Table 17 and 18). Ecological impacts may operate over a longer timescale, as populations and species take time to respond to environmental changes (time-lag).

18.1 Construction effects

Severity and spatial extent of the effects will depend on construction practices, timing of construction activities and controls, river flows, composition of substrate, and effectiveness of erosion controls.

18.1.1 Noise and disturbance

Considerable noise and visual disturbance may be generated during site formation and construction, potentially affecting the distribution and behaviour of fauna of the adjacent/remaining habitats. Due to the ranking of conservation importance of the species recorded, and the temporary nature of the impact, potential impacts to fauna from this source are likely to be minor if construction activities occur outside the wet season when critical migration and life cycle activities occur. There is a possibility, however, that mangroves are used for some critical life history stages, e.g. nursery grounds, by some sensitive species.

18.2 Terrestrial ecology

18.2.1 Site formation

Natural Mangrove habitat will be removed from Viseisei bridge site. Natural habitat loss will require mitigation and offsetting (refer residual impacts-mangrove habitat loss) to ensure a net benefit.

In addition to the direct loss of vegetation for bridge placement, the project may impact vegetation by:

- unauthorised clearing outside the subprojects site boundary
- clearing elsewhere e.g., to store materials.
- causing damage to surrounding vegetation through erosion (refer Suspended solid)
- changes to water quality (Suspended solid/water quality)
- introduction of invasive species (refer invasive species).

At Viseisei the loss of vegetation would fragment habitat. The increased isolation that may be caused by the proposal is not likely to have an appreciable impact however since functional connectivity would remain in the study areas. The effects could be offset or mitigated through mangrove restoration in both additional sites (offset) and restoration of mangroves in the sites surrounding the new bridge which are damaged by construction (mitigation). Post construction monitoring would ensure construction has not led to additional destabilisation effects on nearby mangroves surrounding the proposed bridges. Monitoring can also ensure that no more than the advised proportion of mangrove has been removed during construction activities.

18.2.2 Invasive species.

Invasive species have the potential to be spread by the construction e.g., through tracking of seeds on vehicles or machinery. Pathogens and invasive species may also be carried on, or in, materials, equipment (including vessels used to transport materials or workers) and any workers brought to the sites. This includes materials, equipment and workers bought from other countries or elsewhere in Fiji.

18.3 Aquatic ecology

18.3.1 Suspended solid/water quality.

Environment construction activities and dredging could result in the increased sediment loading and site runoff of streams and changes in turbidity may impact adversely upon aquatic populations particularly sessile species.

High suspended and deposited sediments can smoother habitats and reduce the photosynthesis of benthic plants. Suspended sediments can also impact on aquatic biota by clogging the food filtering or trapping apparatus of stream insects as well as the gills of fish, reducing the feeding efficiency (particularly for visual predators). This is a concern at all the sites.

Multiple fish species present in the wider catchment migrate both upstream and downstream within streams and rivers during different stages within their lifecycle. High suspended sediment can slow or prevent the migration of native fish species. In a study on juvenile whitebait (banded kokopu in New Zealand), fewer fish migrated upstream at turbidity > 25 NTU[12]. The study speculated that if the rate of migration of juvenile banded kokopu was slowed there could potentially be fewer juvenile fish reaching adult habitat, fish could potentially be subject to increased risk of predation and may not reach preferred upstream habitats while they are still able to climb as juveniles.

A plan is needed to ensure the implementation of appropriate design and management techniques to reduce sedimentation risks during construction are low particularly during dredging or when piles are being placed. Through the implementation of appropriate design and management sedimentation risks can be managed reducing the level of effect to low. Management tools include turbidity barriers which can be used to lessen the spread of fine particles and timing construction to avoid the rainy season and avoid key migration periods for sensitive species. A turbidity meter should be used to measure the turbidity outside of the construction area impact site to ensure that turbidity readings are within the acceptable range of <25 NTUs outside turbidity curtains.

18.3.2 Pollution incidents

Local ecological populations may also be adversely affected by pollution incidents attributed to fuel leaks and oil spills associated with construction and maintenance operations on site.

Cement is a construction related material which can have adverse on freshwater life. Cement has the potential to be discharged to the downstream receiving environment. Cement wash water and runoff from recently placed cement are of particular concern within aquatic habitats due to their detrimental effect on in stream fauna. Crushed concrete is also increasingly used as back-fill material and more frequently as contractors seek ways to be more sustainable and reuse materials.

Cement wash water and runoff has a high lime content which is water soluble (dissolves easily in water) and can drastically increase the pH of a waterway. The alkalinity can kill or severely burn aquatic life. For fish, the alkalinity is exceptionally damaging to sensitive gill structures. In addition to alkalinity, cement wash, and runoff can similarly increase the loading of fine sediment resulting in the same effects on instream fauna and habitat as those identified above for suspended/deposited sediment.

[12] Richardson, J., Rowe, D.K., Smith, J.P.2001. Effects of turbidity on the migration of juvenile banded kokopu (*Galaxias fasciatus)* in a natural stream, New Zealand. Journal of Marine and Freshwater Research, 35:1, 191-196, DOI: 10.1080/00288330.2001.9516989

Concrete structures can leach and cause alkaline water. In addition to potential mortality of fauna, localised increases in pH (alkaline conditions) from leaching from concrete structures may also create a barrier to fish passage. These effects can be limited through careful management.

There is a particularly high risk of discharge of contaminants following discrete wet weather events or during prolonged periods of wet weather. Appropriate design and management can reduce these risks.

18.4 Impacts on fish and crustacean species of concern

Direct impacts on migratory fish and crustacean species are unlikely if there is minimal disruption to the flow of the river during the wet season (Nov-April) is ensured and key activities such as pile construction is limited to outside critical life history and migration periods. This will enable any fish and crustacean migration is not obstructed during construction works within the riverbed and ensure these risks are unlikely. Timing construction outside the migratory wet season reduces the severity of the effect of construction to no more than minor.

Any impacts on most potential resident species of concern, should they be present, are likely to be small and predominantly limited to the construction phase. Such impacts are more likely at Viseisei since mangroves will be removed, and potentially represent habitat for such species. Provided careful mitigation activity is taken e.g., care involving cement/concrete should ensure minimal effects. These species cannot be assessed against measurable impacts without known populations on site. Increasing the amount of suitable habitat for these species through the restoration of mangrove habitat should however offset the losses of any individuals and associated habitat during construction and should allow for net gains of these species to be achieved.

The most significant potential for impacts to a particular species is to *Parioglossus triquetrus*, which may be resident at Viseisei. Although this species is not confirmed, its limited global distribution means that - if it is present - it may have a significant part of its global population present at one of these sites. Impacts on habitat at this site is not significant given the proportion of the mangrove area impacted.

18.5 Operational effects

18.5.1 Terrestrial impacts

The presence of the bridge structures will cause some shading of the riverbank and bed thereby potentially altering the aquatic flora present in the direct vicinity of the bridge. This impact is predicted to be minimal for the Viseisei bridge site since it will be highly localised and when mangroves are shaded only a small area will be impacted. Furthermore, mangrove forest is not particularly sensitive to shading. Mitigation measures are not likely to be effective and are not deemed necessary.

18.5.2 Aquatic impacts

The physical presence of bridges during operation post construction can also affect aquatic ecological populations in several ways. Physical developments such as bridge pillars, dredging and alteration of embankments, and roading construction can result in channelization, and deep

pool formation resulting in an ecological disturbance for aquatic fauna if habitat corridors become severed.

Disturbances from bridge construction can be mitigated if normal water flow is maintained despite the blocking effect of embankments and bridge piers. This objective can be achieved through designs that favour long spans and hydraulically shaped piers. Abutments should be set back from the normal wetted perimeter of the watercourse to avoid constriction of the channel and reduction of the flow area.

The length of the spans required are determined by the bridge design by the engineers. However, the longer the spans the more contact with waterways is reduced thereby reducing freshwater impacts.

Abutments and piers should be designed and constructed to provide the least amount of hydraulic resistance. Where piers are required, hydraulic shaped piers will minimize local scour and reduce obstruction of flow reducing impacts on the aquatic benthic environment. Piers should be constructed with ends which are tapered upstream and downstream in the direction of the main flow.

18.6 Cumulative impacts

The potential biodiversity impacts of the bridge proposals must be considered because of the construction and operation of the proposal within the existing environment. The proposal would not act alone in causing impacts to biodiversity. The incremental effects of multiple sources of impact (past, present, and future) are referred to as cumulative impacts and provide an opportunity to consider the proposal within a strategic context. The accumulating impacts of historic vegetation clearing for urban development, agriculture, and development and maintenance of infrastructure have contributed to the loss of biodiversity within the Fijian landscape. The proposed developments are not found to be a major contributor to cumulative impacts upon local marine, terrestrial or aquatic ecology.

19. Avoid, minimise, and mitigate impacts.

ADB require that mitigation of ecological impacts be sought in the following order of priority: (1) avoid, (2) minimise, (3) compensate on-site and (4) compensate off-site. At each stage, residual impacts should be re-assessed to determine whether there is a need to proceed to the next stage of mitigation. The following measures are proposed to mitigate the impacts discussed in the preceding section.

19.1 Avoidance and minimisation

The primary method to avoid impacts is to locate activities away from areas of known or potential high biodiversity value. Where possible the road alignment and bridge design has been located to avoid loss of mangrove. Further loss of mangroves should be minimised with no heavy machinery being placed on the mangrove areas unless this is not avoidable.

19.2 Mitigation measures

Once all practicable steps to avoid or minimise impacts have been implemented at the detailed design phase, mitigation measures would be implemented to lessen the potential ecological impacts of the proposal. Mitigation measures are to be undertaken during the construction and operational phases and are outlined in Tables 17 and 18 below.

Table 17. Activities and potential effects on aquatic ecology during the various phases of the operation are summarised in the following table

Construction phase		
Construction Activities	**Potential impact**	**Proposed Mitigation activity**
Drainage works and use of vehicles	• Negative impact on flora and fauna from increased sediment (increased turbidity) loading of river, mangrove and marine areas	• Implement robust erosion and sediment control measures. Where practical use management methods such as turbidity curtains and turbidity meters outside the area in combination with phasing of construction work to minimise sedimentation and disturbance to aquatic fauna and flora • Operation of heavy equipment should be confined to dry stable areas to reduce the amount of mud and heavily silted water at the construction site which could enter the watercourse. • Stabilise exposed areas as soon as possible. • Avoid discharge of sediment into water • Avoid or minimise sediment release downstream. • Retain vegetation on the bank. • When excavation is required within the channel, as in the placement of footings for abutments or piers, measures should be taken to separate the excavation area from the flow by cofferdams. • Storage of fuel, equipment, and construction materials to minimise the risk of soil contamination or water pollution, • A risk assessment is carried out for each substance to be used or stored on site and the appropriate containment measures installed.
Materials management	• Harm to aquatic flora and fauna from oil, fuel, cement, or other substances entering watercourses	• All practical measures must be taken to prevent cement and cement products entering flowing water, including but not limited to a) Avoiding flowing water coming into contact with the concrete until the concrete is firmly set. b) Using boxing or other similar devices to contain wet cement during construction of the structure. c) If any concrete is spilled beyond the boxing, pouring of concrete must stop immediately and all concrete must be removed from the watercourse. d) No equipment used in the pouring of concrete should be washed out onsite. (Further detail is provided in the Working with concrete, cement and lime section below) • Development of a species-specific management plan for species of concern
Physical impacts- Dredging and bridge pillar	• Habitat loss and direct mortality of sensitive flora and fauna • Potential barrier to fish and shrimp migration along the river corridor	• Where needed turbidity barriers will be used during construction to prevent fine material from going offshore or entering other sensitive environments. • Ensure minimal disruption to the flow of the river during the wet season • Minimize turbulence and flow contraction because turbulence inhibits or prevents passage, • Construct bridge bottoms with natural stream substrates, • Construction should be phased to be outside the key periods of faunal migration.
Debris from construction	• Any debris left on the seabed from the construction activity can become a projectile during severe wave activity, and this may cause damage to sensitive benthic resources.	• A swim through by an Ecologist will be done at the site after construction when the turbidity is back to normal. The inspection will ensure that all debris are removed off site and that the beds are appropriately restored.
Operation phase/ongoing site maintenance		
Activities	**Potential impact**	**Proposed Mitigation activity**

Physical presence of the bridge	• Changes to deposition, depth and water velocities may result in the loss of sensitive plant, invertebrate, and fish species • Potential downstream changes to the aquatic community	• Design bridge to avoid and reduce environment impacts e.g., maintain a constant grade along the length of the bridge. • Effective stabilisation of altered landforms to minimise soil erosion. • Construct during periods of low flow to minimize impacts to fish and the potential for water pollution from suspended solids • During construction, minimize disturbance to the length of the natural stream channel and the natural flow of the water
Materials management from ongoing site maintenance	• Direct and indirect effects from oil, fuel or other substances entering the aquatic environment	• A risk assessment is carried out for each substance to be used or stored on site and the appropriate containment measures undertaken.

Table 18. Activities and potential effects on terrestrial ecology during the various phases of the operation are summarised in the following table.

Construction phase		
Construction Activities	**Potential impact**	**Proposed Mitigation activity**
Earthworks and excavations	• Loss of mangrove habitat, fragmentation, or severance at two of the sites	• The subproject site boundary will be clearing marked on a plan and marked out on the site and approved by the Engineer/supervision consultant prior to the commencement of clearing. Only vegetation identified on the plan will be removed. • Ensure vegetation clearance is restricted to within the subproject site boundary and is the minimum practically required for the proposed works. The proposed site boundary will be approved by SP and the PIC prior to the commencement of clearing. • Cleared vegetation will be removed from the subproject site and disposed of at a location approved of by an Environment Safeguards Expert (noting cleared vegetation includes weeds and potentially weed seeds). Vegetation will not be permanently stockpiled on site or pushed into existing vegetation adjacent to the site. • Where possible machinery storage and materials lay down areas will be established in previously disturbed areas to avoid increasing the footprint of the project site and will avoid placement in areas of mangrove. • Further habitats should be created to compensate for habitat losses and to improve the landscape and ecological potential for the site where possible
	• Disturbance to sensitive species on and near the site and changes in distribution, activity patterns	• This effect is considered minimal for these ecosystems and mitigation is not required
	• Compaction of soil and associated effects on the surrounding mangroves	• Use of techniques to minimise compaction of soil, such as restricting access during wet conditions, and using protective boarding and low ground pressure machinery. If necessary, soil should be carefully removed and stored for subsequent reinstatement.
Invasive species introduction	• Negative ecological impacts due to the introduction of invasive species	• An invasive species management will be developed with the aim to prevent or manage invasive species introductions
Operation phase/ongoing site maintenance		
Construction Activities	**Potential impact**	**Proposed Mitigation activity**
Physical presence of bridge	• Loss of mangrove habitat and associated ecosystem services	• Further habitats should be created to compensate for habitat losses and to improve the landscape and ecological potential for the site

	• Destabilisation of nearby mangroves	• Monitoring in the years post construction to ensure there is no further loss of nearby mangroves

19.3 Working with concrete, cement and lime

Concrete and cement are used extensively in construction. Many activities require in situ pouring of concrete into purpose-built boxing or form work or installing pre-cast structures into waterways. Cement and lime are also used for pavement and trench back-fill stabilisation works.

Uncured concrete, concrete slurry, cement and lime fines, dust, or washings can make water highly alkaline (pH of 11–13). This highly alkaline water will injure and kill fish and other freshwater life that encounter it. Water contaminated with concrete, cement and lime cannot be diluted or filtered to a safe level for discharge to the receiving environment, so washings, dust, fines, or slurry must not enter stormwater or freshwater receiving environments.

Concrete, cement and lime-contaminated water must be collected in a contained area and removed from site, to avoid discharging to the receiving freshwater environment. Even once cured, concrete structures will leach for some time when immersed in water, producing alkaline water. Pre-cast structures need to be soaked, with soakage water replaced (and appropriately discharged away from any of the sites) periodically. Where pre-cast structures cannot be used and in situ pouring is required, this must be done in the dry (e.g., the use of Coffer dams) and the structure may need to be soaked as described above before removing the coffer dam and exposing the structure to the waterway.

19.4 Preventing invasive species

Mitigation measures to prevent the introduction or spread of invasive species and pathogens will include:

- The contractor must obtain all required biosecurity and phyto-sanitary clearances (e.g., permits) for any material or equipment imported into Fiji.
- The contractor will obtain all permits and clearances for import of any materials and equipment to be used for the project as required by Biosecurity Fiji.
- Materials will be inspected, and any equipment imported for project purposes will be steam-cleaned and certified under biosecurity and phyto-sanitary procedures away from the sites prior to mobilization.
- Immediately following clearing and construction, restoration, and planting of the site in the mangrove areas will occur to minimise the establishment of weeds at each location.
- Weed hygiene measures will be implemented to prevent introduction or spread of invasive species, including cleaning machinery before it enters and leaves the subproject sites. Inspection of the replanting and identification of any potentially risky weeds/invasive species should occur both during construction and immediately following construction by an appropriately qualified ecologist.

20. Residual impacts

As required by the ADB SPS, a no-net-loss of biodiversity values is required to be achieved. Although efforts have been made to avoid, minimise, and mitigate potential ecological impacts from the proposal, some residual impacts would occur in the form of terrestrial habitat loss and loss of soft sediment habitat at the bridge site at Viseisei.

Approximately 1,912 m^2 of mangroves at Viseisei (<1% of the area present) may be lost owing to this project (Table 19. Modified habitat by habitat type). It is good practice and aligned with ADB safeguards to compensate for all such loss of natural habitat. The best option is likely to be restoration of degraded or destroyed areas of mangrove at or near the project sites – this will represent an offset for project impacts on mangrove. Where this is not feasible, owing to a limited area or land use restrictions, restoration of degraded/lost mangrove should occur as near to the sites as feasible. New mangrove habitat (i.e., on mudflats where mangroves have never previously occurred) should not be created, as this may impact other species. A replanting plan should be developed with a qualified ecologist and through community liaison prior to construction occurring.

The habitat identified at these two sites is Natural high condition habitat largely of native origin, and/or where human activity has not essentially modified the primary ecological functions and species composition. There is only a small amount of disturbance present with some vegetation removal, waste, and minor introduction of invasive species.

Increasing the amount of suitable habitat for fish and crustacean species through the additional restoration of mangrove habitat should offset any the losses of individuals during construction by allowing for a net gain of habitat for key species to be achieved.

Natural soft sediment habitat under the water will be modified and lost as habitat for native species where piers are placed and potentially will impact habitat within 2 meters of the piers (Table 19. Modified habitat by habitat type). The current engineering plans have 2-3 piers placed in under the water in Viseisei. Impacts on the soft sediment area calculated to be lost underwater through pier placement is small and not significant therefore offsets are not considered necessary (see Table 19. Modified habitat by habitat type).

Table 19. Modified habitat by habitat type

Site	Habitat type residual impacts	Habitat Type condition	Habitat Type Area (B)
Viseisei	Mangrove	Natural	1,912 m^2
Viseisei	Soft sediment	Natural	120 m^2

20.1 Residual Mangrove habitat impact

The number of Habitat Hectares that require to be offset to achieve a no-net loss of biodiversity values of the mangrove sites is 1,912 HH for mangrove in Viseisei (Table 20.Residual values of the impacted mangrove habitats).

Table 20.Residual values of the impacted mangrove habitats

Habitat type and site	Habitat Type condition	Condition Score (A)	Habitat Type Area (B)	Habitat Impact Area (C) in Habitat hectares (HH)
Mangrove-Viseisei	Natural	0.95	1,912 m^2	0.1816 HH

The following formula has been used to calculate the Habitat impact area of the residual values of the impacted mangrove habitat:

Area of Habitat Type (A) x Habitat Type Condition (B) = Habitat Impact area (C)

However, a ratio of 1:6 is required by the Fijian Ministry of Environment as a replanting offset of the area of mangrove lost. This ratio will more than compensate for the loss of mangrove habitat removed for this project even if only a 50% condition score is achieved (See Table 21. Calculation of the mangrove condition that the x6 area would achieve in the project timeframe).

Table 21. Calculation of the mangrove condition that the x6 area would achieve in the project timeframe

Habitat type and area	Habitat Type Area (A)	Ratio (B) 1:6	Condition Score (C) achieved following restoration	Habitat Restoration area with 1:6 ratio and 50% quality achieved. Habitat hectares (HH)
Mangrove-Viseisei	1,912 m^2	11,472 m^2	0.5	0.5736 HH

A further offset option is the restoration of degraded mangrove habitat. Further calculations would be needed to calculate the final size of the offset site required should this option be selected since the size of the restoration area required is dependent on the condition of the habitat currently present.

The area of mangrove replanting should, follow the Guidelines for Best Practice Mangrove Planting in Fiji [13] to increase the likelihood of restoration success and prevent another valuable ecological habitat such as the intertidal zone habitat being converted. Recommendations include only planting mangroves on areas they have occurred previously to prevent the conversion of other important natural habitat and to increase the chance of success.

The time recommended for management of the offset areas is 20 years. This would cover the period needed for the mangrove restoration to reach maturity.

Compensatory planting locations have not been identified. Community consultations to determine location and ensure community support are required. However, as much as possible restoration should occur near to the mangrove sites of impact. Where possible the area directly

[13] A Review of Mangrove Planting, D. WATLING, 2021

adjacent to the bridge area should also be restored to reduce the area of impact and associated edge effects.

21. Post construction monitoring

Monitoring programs are recommended to:

- A qualified engineer and ecologist should evaluate bridge impacts on erosion and riparian areas to ensure habitat integrity throughout the construction phase.
- Post construction monitoring by both a qualified ecologist and an engineer within 3 weeks on construction being completed should ensure construction has not led to destabilisation effects on nearby mangroves and that no more than the advised proportion of mangrove has been removed during construction activities.
- Monitor success of offset/mitigation mangrove planting at 2-, 5- and 10-years post planting to ensure planting success and a net gain was achieved should be undertaken by a qualified ecologist.
- Ecological health (fish survival is not impacted by construction) using eDNA sampling should be undertaken by a qualified ecologist during construction and 1 year following construction.
- Monitoring of turbidity is required daily during the construction phase to ensure levels are not higher than < 25 NTUs outside turbidity curtains.

22. Management measures to address CH triggers

Although all efforts have been made to avoid ecological effects at the Viseisei Bridge site complete avoidance of effects is not possible. It has also been necessary to mitigate and minimise potential ecological impacts and effects. A number of mitigation and offset measures are required at this site to address each of the critical habitat triggers (See Table 22)

Table 22. Critical habitat triggered and associated management measures to address each trigger.

Criteria triggered	Critical habitat triggered	Management measures to address
1: Critically Endangered and Endangered Species	No	No additional measures required
2. Endemic / Restricted Range Species	Yes, it is possible >10% of the species' population occurs AND ≥10 reproductive units of a species of *Parioglossus triquetrus* maybe present	• Ensure vegetation clearance is restricted to within the subproject site boundary • Implement robust erosion and sediment control measures. Where practical use management methods such as turbidity curtains and turbidity meters outside the area in combination with phasing of construction work to minimise sedimentation and disturbance to aquatic fauna and flora • When excavation is required within the channel, as in the placement of footings for abutments or piers, measures should be taken to separate the excavation area from the flow by cofferdams. Storage of fuel, equipment, and construction materials to minimise the risk of soil contamination or water pollution. • Use of techniques to minimise compaction of soil, such as restricting access during wet conditions, and using protective boarding and low ground pressure machinery. If necessary, soil should be carefully removed and stored for subsequent reinstatement. • A risk assessment is carried out for each substance to be used or stored on site and the appropriate containment measures installed. • All practical measures must be taken to prevent cement and cement products entering flowing water, including but not limited to a) Avoiding flowing water coming into contact with the concrete until the concrete is firmly set. b) Using boxing or other similar devices to contain wet cement during construction of the structure. c) If any concrete is spilled beyond the boxing, pouring of concrete must stop immediately and all concrete must be removed from the watercourse. d) No equipment used in the pouring of concrete should be washed out onsite. (Further detail is provided in the Working with concrete, cement and lime section below) • Restoration of lost mangrove habitat and additional mangroves planted • An invasive species management will be developed with the aim to prevent or manage invasive species introductions • Monitoring in the years post construction to ensure there is no further loss of mangroves and that restoration was successful
3. Migratory / Congregatory Species	Yes, likely to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species	• Minimize turbulence and flow contraction because turbulence inhibits or prevents passage • Construct bridge bottoms with natural stream substrates • Construction should be phased to be outside the key periods of faunal migration. • Ensure minimal disruption to the flow of the river during the wet season • Design bridge to avoid and reduce environment impacts e.g., maintain a constant grade along the length of the bridge. • An invasive species management will be developed with the aim to prevent or manage invasive species introductions

		• Monitoring in the years post construction to ensure there is no further loss of nearby mangroves and replanted mangroves restoration has been successful • All practical measures must be taken to prevent cement and cement products entering flowing water, including but not limited to a) Avoiding flowing water coming into contact with the concrete until the concrete is firmly set. b) Using boxing or other similar devices to contain wet cement during construction of the structure. c) If any concrete is spilled beyond the boxing, pouring of concrete must stop immediately and all concrete must be removed from the watercourse. d) No equipment used in the pouring of concrete should be washed out onsite. (Further detail is provided in the Working with concrete, cement and lime section below)
4. Critical habitat qualifying processes/ecosystems	Yes, provides key ecosystem services	• Monitoring in the years post construction to ensure there is no further loss of nearby mangroves • An invasive species management will be developed with the aim to prevent or manage invasive species introductions • All practical measures must be taken to prevent cement and cement products entering flowing water, including but not limited to a) Avoiding flowing water coming into contact with the concrete until the concrete is firmly set. b) Using boxing or other similar devices to contain wet cement during construction of the structure. c) If any concrete is spilled beyond the boxing, pouring of concrete must stop immediately and all concrete must be removed from the watercourse. d) No equipment used in the pouring of concrete should be washed out onsite. (Further detail is provided in the Working with concrete, cement and lime section below) • Ensure vegetation clearance is restricted to within the subproject site boundary
5: The area holds biodiversity of significant social, economic, or cultural importance to local communities	Yes, important local fishing area	• Ensure vegetation clearance is restricted to within the subproject site boundary • Implement robust erosion and sediment control measures. Where practical use management methods such as turbidity curtains and turbidity meters outside the area in combination with phasing of construction work to minimise sedimentation and disturbance to aquatic fauna and flora • When excavation is required within the channel, as in the placement of footings for abutments or piers, measures should be taken to separate the excavation area from the flow by cofferdams. Storage of fuel, equipment, and construction materials to minimise the risk of soil contamination or water pollution. • Use of techniques to minimise compaction of soil, such as restricting access during wet conditions, and using protective boarding and low ground pressure machinery. If necessary, soil should be carefully removed and stored for subsequent reinstatement. • A risk assessment is carried out for each substance to be used or stored on site and the appropriate containment measures installed. • All practical measures must be taken to prevent cement and cement products entering flowing water, including but not limited to a) Avoiding flowing water coming into contact with the concrete until the concrete is firmly set. b) Using boxing or other similar devices to contain wet cement during construction of the structure. c) If any concrete is spilled beyond the boxing, pouring of concrete must stop immediately and all concrete must be removed from the watercourse. d) No equipment used in the pouring of concrete should be washed out

		onsite. (Further detail is provided in the Working with concrete, cement and lime section below) • Development of a species-specific management plan for species of concern • Restoration of lost mangrove habitat and additional mangroves planted • An invasive species management will be developed with the aim to prevent or manage invasive species introductions • Further habitats will be created to compensate for habitat losses and to improve the landscape and ecological potential for the site • Monitoring in the years post construction to ensure there is no further loss of nearby mangroves
Criterion 6: Protection	No	No additional measures required

23. Viseisei bridge site conclusion

We conclude that the key period of impact will be: 1) during the construction phase of the project, and specifically to water quality (i.e., unmitigated discharge of sediments and potential concrete contamination) and 2) due to the removal of the mangrove vegetation. Management plans are needed to ensure these do not have an impact. It is also important that limits on key construction activities during aquatic migration periods (during the wet season Nov-April) are maintained when migratory trigger species are potentially utilising the area.

We conclude that the significant environmental impacts of the Viseisei bridge development can be addressed if appropriate management and mitigation options are undertaken in addition to offsetting/mitigation for the loss of mangrove habitat. As a result there will be no measurable adverse impacts, or likelihood of such, on the terrestrial or aquatic habitat which would impair its high biodiversity value or the ability to function after the planned mitigation and offset measures. Impacts are not expected to be anywhere near the level that could impair the ability of the Critical Habitat to perform ecological functions.

Following the implementation of the management and mitigation measures, including those for residual effect it is concluded that at Viseisei the ADB SPS and World bank ESF ESS6 requirements are fulfilled allowing the project to go ahead in an area of Critical Habitat (CH).

24. Sabeto Bridge Ecological Values

24.1 Terrestrial ecology

The land use adjacent to the Sabeto river, where the proposed bridge is located, is highly modified habitat with residential and farmland with little to no natural vegetation cover remaining and only large, introduced grasses growing along the banks alongside agricultural land (Figure 10-11).

Based on the current design, the closest sensitive terrestrial habitat is over 3000 m downstream where an intact mangrove ecosystem is present outside the EAAA. The vegetation of this site is too distant to be impacted by the proposed development. No native mangrove vegetation was present at the site. No terrestrial species threatened or known to be rare was found in the study site. The terrestrial habitat at this site is therefore of little ecological interest is defined as modified habitat (Figure 10-11).

Figure 10. a) Landscape visual of the site of proposed bridge development and the surrounding vegetation and b) a picture of the vegetation on the Sabato river bank where the proposed bridge would be layed.

24.2 Aquatic ecology

The Sabeto river drains the Mount Evans Ranges and flows in a south westerly and then westerly direction into Nadi Bay. The river itself has many names along its route, including Lutunakuve Creek, Nasasa Creek, Nanggara Creek, Tuvatu Creek (near the Tuvatu Gold mine), and Savuleiringa Creek. The river mouth is at Nadi Bay.

The Sabeto River drains the Sabeto and Mount Evans Ranges of western Viti Levu, Fiji. The river's catchment is narrow and elongate. It is underlain by sedimentary, intrusive, volcanic and volcaniclastic rocks. The catchment extends over 137 km2 and reaches an altitude of 1195 m asl on its northeastern margin. The trunk stream is 34.8 km long (Kushaal Raj). It rises at an elevation of just over 1000 m on the northern rim of the great amphitheatre within which lies the village of Navilawa. The river flows west to reach the ocean at Nadi Bay. The river possesses few significant tributaries capable of introducing coarse sediment into the main channel. Between 15 -18 km downstream, the river flows in a relatively confined valley and the hillslope and channel

systems are closely linked. Beyond that point, the valley widens, and the presence of a floodplain means that the channel is dissociated from the surrounding hillsides.

The mean annual rainfall is 1864 mm, with a drier winter (the mean precipitation in July is 49 mm) and a wet summer (the mean precipitation in January is 312 mm), although high daily falls may be expected at any time of the year. Major erosion due to extreme flooding has been observed on the riverbanks (Kushaal Raj).

At the proposed bridge development site, the river is approximately 41m across at the proposed site of the new bridge development and at its deepest point approximately 5-6m. The edge and bottom substrate are predominantly fine muddy sediment however water clarity was high on the days when surveys occurred.

EDNA Sampling in May-June 2023 at three points along the river: located 1) 150 meters upstream, 2) at the proposed bridge site and 3) 40 meters downstream. These sampling locations detected a total of 23 species of fish, 6 species of crustacean (2 crab species and 4 freshwater shrimp species) and 16 species within the Mollusca taxon (gastropods and bivalves) using the Sabeto river at or close to the proposed bridge site (See appendix Tables 36-40).

Of the identified fish species most are classified as least concern. There are a couple of data deficient species, but these have extremely wide distributions such as long finned eels. Freshwater flora remain unstudied. The freshwater fish utilising the area are likely to include migratory species. However, surveys have not occurred during the best period for detecting these species. We take a precautionary approach and assume they are present at key migration periods.

Results from the snorkel surveys showed freshwater mussel or kai (*Batissa violacea*) an important local resource for the local people were located during under the proposed bridge site and downstream from the site. The species was predominantly in the deeper water where there is firm sediment rather than soft silt. Average estimated density in the 1-meter plots where the freshwater mussel (kai) was present was calculated at 55 individuals/m^2 where the proposed bridge will be developed and 32 individuals/m^2 in the area below the bridge. Surprisingly, kai was not detected in the eDNA tests. This may be because of stratification of the water column. The aquatic area is of high ecological value because of the presence of these species.

Figure 11. Critical and modified habitat surrounding the proposed Sabato bridge.

25. Sabeto Bridge critical habitat triggers

Literature reviews, database surveys, eDNA surveys and field visits identified no endangered species of conservation significance based on the IUCN Red List of Threatened Species as present at the Sabeto bridge site, or within the EAAA of the site.

However, there are endemic or range restricted species of both crustacean and fish species which are data deficient or have not yet been evaluated by the IUCN for which the habitat at Sabeto is suitable. These species are potentially present undertaking life cycle events during migration. We have taken a precautionary approach and assumed they are present at key times in the year and trigger Critical habitat criteria 3 (See table 23-24).

Is one species *Datnia kneri /Mesopristes kneri* which is data deficient/not evaluated by the IUCN, which maybe present all year. This species is known from areas outside the EAAAs and are lacking information on population status and spatial coverage. Expert opinion suggests that the EAAA is unlikely to regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species. Critical habitat criteria 2 is therefore not triggered (Table 23).

Criteria 3 of critical habitat in Sabeto is triggered however, since this this area is known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of various migratory or congregatory species during their lifecycle (See Table 23-24).

The EAAA holds biodiversity of significant social, economic, or cultural importance to local communities in the form of bivalves. This triggers ADB criteria 5. No other critical habitat criteria thresholds are meet (Table 25). No protected areas of concern were identified so Criteria 6 was not triggered.

Table 23. Freshwater fish triggering critical habitat and criterion triggered at Sabeto.

Scientific name	Critical Habitat Rationale	Criterion Triggered
Glossogobius sp. (Hoese and Jenkins in prep)	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that at Sabeto, on a cyclical or otherwise regular basis supports, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle qualifying them as Critical Habitat under Criterion 3.	3
Schismatogobius vitiensis Comon name: Fijian scaleless goby(Jenkins and Boseto, 2005)	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical basis, ≥ 1 percent of the global population of this migratory species may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Schismatogobius chrysonotus (Orange-spotted Scaleless Goby)	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through all 4 of the sites, qualifying them as Critical Habitat under Criterion 3.	3
Stenogobius (insularigobius) n. sp. Common name: teardrop goby	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Stiphodon sp.1, Isabella's goby	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Stiphodon sp.2 (Jenkins, Boseto and Watson)	Potential Critical Habitat: The 4 EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Sicyopterus n. sp. (Boseto, in preparation) – Tavoro Goby	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Datnia kneri / (Bleeker, 1876) (Terapontidae) Common name: Orange-spotted Therapon/Reve	Potential Critical Habitat: At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3. Potentially habitat outside of migration it is not considered likely, however, that >10% of the species' population occurs at any of the sites at any time, thus meaning this species does not trigger Critical Habitat under Criterion 2.	3

Table 24. Endemic freshwater crustaceans triggering critical habitat (CH) criteria and rational at Sabeto.

Name	Critical Habitat Rationale	Criterion Triggered
Caridina fijiana	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that >1% of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Caridina nudirostris	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that >1% of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3

25.1 Critical habitat criteria triggered

The critical habitat triggered at the Sabeto is outlined (See

Table 25. ADB critical habitat criteria triggered.).

Criteria	Thresholds	Critical habitat triggered
1: Critically Endangered and Endangered Species	(a) Areas that support globally important concentrations of an IUCN Red-listed EN or CR species (≥ 0.5% of the global population) AND ≥ 5 reproductively important CR or EN species.	no
1: Critically Endangered and Endangered Species	(b) Areas that support globally important concentrations of an IUCN Red-listed EN or CR species (≥ 0.5% of the global population) AND ≥ 5 reproductively important CR or EN species. (c) Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the threshold in GN72(a). (d) As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species	no
2. Endemic / Restricted Range Species	(a) Areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species.	no
2. Endemic / Restricted Range Species	(a) Areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species.	no
3. Migratory / Congregatory Species	(a) Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species during periods of the species' lifecycle. (b) Areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress.	Yes, likely to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a number of migratory or congregatory species
3. Migratory / Congregatory Species	(a) Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species during periods of the species' lifecycle. (b) Areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress.	
4. Critical habitat qualifying processes/ecosystems	The area includes unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services	Yes, key ecosystem services are provided for by Kai at the site
4. Critical habitat qualifying processes/ecosystems	The area includes unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services	
5: The area holds biodiversity of significant social, economic, or cultural importance to local communities		Yes, important area for collection of kai
5: The area holds biodiversity of significant social, economic, or cultural importance to local communities		
6: Protection		no
6: Protection		no

Table 25. ADB critical habitat criteria triggered.

26. Ecological effects

This section of the report considers the potential impacts of project operation on terrestrial and freshwater ecology. Ecological effects on both the terrestrial and aquatic varies during construction and during operation are both summarised in (See Table 27. Activities and potential effects on terrestrial ecology during the various phases of the operation are summarised in the following table.). Ecological impacts may operate over a longer timescale, as populations and species take time to respond to environmental changes (time-lag).

26.1 Construction effects

Severity and spatial extent of the effects will depend on construction practices, timing of construction activities and controls, river flows, composition of substrate, and effectiveness of erosion controls.

26.1.1 Noise and disturbance

Considerable noise and visual disturbance may be generated during site formation and construction, potentially affecting the distribution and behaviour of fauna of the adjacent/remaining habitats. Due to the ranking of conservation importance of the species recorded, and the temporary nature of the impact, potential impacts to fauna from this source are likely to be minor if construction activities occur outside the wet season when critical migration and life cycle activities occur.

26.2 Terrestrial ecology

26.2.1 Site formation

No natural vegetation types will be removed at the Sabeto bridge site. The terrestrial habitats found within the Study Areas of Sabeto bridge is disturbed and surrounded by developed/urbanised area and therefore there are little terrestrial ecological constraints to the development. The impact on the terrestrial environment and fauna is minor for both these sites. However, there could still be negative effects from:

- unauthorised clearing outside the projects site boundary
- clearing elsewhere e.g., to store materials.
- causing damage to surrounding vegetation through erosion (refer Suspended solid)
- changes to water quality (Suspended solid/water quality)
- introduction of invasive species (refer invasive species).

26.2.2 Invasive species.

Invasive species have the potential to be spread by the construction e.g., through tracking of seeds on vehicles or machinery. Pathogens and invasive species may also be carried on, or in, materials, equipment (including vessels used to transport materials or workers) and any workers brought to the sites. This includes materials, equipment and workers bought from other countries or elsewhere in Fiji.

26.3 Aquatic ecology

26.3.1 Suspended solid/water quality.

Environment construction activities and dredging could result in the increased sediment loading and site runoff of streams and changes in turbidity may impact adversely upon aquatic populations particularly sessile species.

High suspended and deposited sediments can smoother habitats and reduce the photosynthesis of benthic plants. Suspended sediments can also impact on aquatic biota by clogging the food filtering or trapping apparatus of stream insects as well as the gills of fish, reducing the feeding efficiency (particularly for visual predators). This is a concern at the Sabeto bridge site.

Multiple fish species present in the wider catchment migrate both upstream and downstream within streams and rivers during different stages within their lifecycle. High suspended sediment can slow or prevent the migration of native fish species. In a study on juvenile whitebait (banded kokopu in New Zealand), fewer fish migrated upstream at turbidity > 25 NTU[14]. The study speculated that if the rate of migration of juvenile banded kokopu was slowed there could potentially be fewer juvenile fish reaching adult habitat, fish could potentially be subject to increased risk of predation and may not reach preferred upstream habitats while they are still able to climb as juveniles.

Smothering benthic communities is the key concern for maintaining the native freshwater mussels, kai at the Sabeto site. A species-specific management plan for Kai is required to reduce the severity of the effect for moderate to minor. Key components of the Kai management plan and are discussed below (section 13.5). The use of turbidity curtains at this site would further limit the area of impact on Kai from sedimentation. A turbidity meter should be used to measure the turbidity outside of the construction area impact site to ensure that turbidity readings are within the acceptable range of <25 NTUs outside turbidity curtains. Through the implementation of appropriate design and management sedimentation risks can be managed reducing the level of effect to low.

26.3.2 Pollution incidents

Local ecological populations may also be adversely affected by pollution incidents attributed to fuel leaks and oil spills associated with construction and maintenance operations on site.

Cement is a construction related material which can have adverse on freshwater life. Cement has the potential to be discharged to the downstream receiving environment. Cement wash water and runoff from recently placed cement are of particular concern within aquatic habitats due to their detrimental effect on in stream fauna. Crushed concrete is also increasingly used as back-fill material and more frequently as contractors seek ways to be more sustainable and reuse materials.

Cement wash water and runoff has a high lime content which is water soluble (dissolves easily in water) and can drastically increase the pH of a waterway. The alkalinity can kill or severely burn aquatic life. For fish, the alkalinity is exceptionally damaging to sensitive gill structures. In addition to alkalinity, cement wash, and runoff can similarly increase the loading of fine sediment resulting in the same effects on instream fauna and habitat as those identified above for suspended/deposited sediment.

Concrete structures can leach and cause alkaline water. In addition to potential mortality of fauna, localised increases in pH (alkaline conditions) from leaching from concrete structures may also create a barrier to fish passage. These effects can be limited through careful management.

[14] Richardson, J., Rowe, D.K., Smith, J.P.2001. Effects of turbidity on the migration of juvenile banded kokopu (*Galaxias fasciatus)* in a natural stream, New Zealand. Journal of Marine and Freshwater Research, 35:1, 191-196, DOI: 10.1080/00288330.2001.9516989

There is a particularly high risk of discharge of contaminants following discrete wet weather events or during prolonged periods of wet weather. Appropriate design and management can reduce these risks.

26.4 Impacts on fish and crustacean species of concern

Direct impacts on migratory fish and crustacean species are unlikely if there is minimal disruption to the flow of the river during the wet season (Nov-April) is ensured and key activities such as pile construction is limited to outside critical life history and migration periods. This will enable any fish and crustacean migration is not obstructed during construction works within the riverbed and ensure these risks are unlikely. Timing construction outside the migratory wet season reduces the severity of the effect of construction to no more than minor.

26.5 Operational effects

26.5.1 Aquatic impacts

The physical presence of bridges during operation post construction can affect aquatic ecological populations in several ways. Physical developments such as bridge pillars, dredging and alteration of embankments, and roading construction can result in channelization, and deep pool formation resulting in an ecological disturbance for aquatic fauna if habitat corridors become severed.

Disturbances from bridge construction can be mitigated if normal water flow is maintained despite the blocking effect of embankments and bridge piers. This objective can be achieved through designs that favour long spans and hydraulically shaped piers. Abutments should be set back from the normal wetted perimeter of the watercourse to avoid constriction of the channel and reduction of the flow area.

The length of the spans required are determined by the bridge design by the engineers. However, the longer the spans the more contact with waterways can be reduced reducing freshwater impacts.

Abutments and piers should be designed and constructed to provide the least amount of hydraulic resistance. Where piers are required, hydraulic shaped piers will minimize local scour and reduce obstruction of flow reducing impacts on the aquatic benthic environment. Piers should be constructed with ends which are tapered upstream and downstream in the direction of the main flow.

26.5.2 Management of effects on freshwater mussels (Kai)

At Sabeto Bridge freshwater mussels/kai were present around the area where the bridge will be constructed as well as downstream within the potential area of impact. Freshwater mussels (kai) are not threatened but are an important food source for local people and provide an important ecosystem service. They are sensitive to:

- Poor water quality
- Sedimentation-siltation
- Direct impacts to substrate and river bottom

- Changes in local hydraulics- both during construction and permanent changes

Construction activities in or near water bodies can have substantial effects on freshwater mussels through hydrologic alterations and siltation. Incidental loss of mussels can result directly from construction efforts or indirectly by habitat alteration in the immediate vicinity of construction sites. An example of a direct effect would be burial while dredging, and an example of an indirect effect would be changes in habitat which may interfere with growth or reproduction.

The area of direct effects is the locations where mussels were likely to die or be displaced during or shortly after construction activities for example the dredging area and the area where piers would be added. The indirect-effects can occur due to scouring, sedimentation, and pooling from construction-related changes in river flow Indirect impacts can occur 50 to 100 m upstream of the bridge and 50 to 200 m downstream of the bridge. The effect is determined to be moderate, and mitigation is required to minimize impacts so freshwater mussels will continue to occur in this area and maintain their important ecological function.

26.6 Cumulative impacts

The potential biodiversity impacts of the bridge proposals must be considered because of the construction and operation of the proposal within the existing environment. The proposal would not act alone in causing impacts to biodiversity. The incremental effects of multiple sources of impact (past, present, and future) are referred to as cumulative impacts and provide an opportunity to consider the proposal within a strategic context. The accumulating impacts of historic vegetation clearing for urban development, agriculture, and development and maintenance of infrastructure have contributed to the loss of biodiversity within the Fijian landscape. The proposed developments are not found to be a major contributor to cumulative impacts upon local terrestrial or aquatic ecology.

27. Avoid, minimise, and mitigate impacts.

ADB require that mitigation of ecological impacts be sought in the following order of priority: (1) avoid, (2) minimise, (3) compensate on-site and (4) compensate off-site. At each stage, residual impacts should be re-assessed to determine whether there is a need to proceed to the next stage of mitigation. The following measures are proposed to mitigate the impacts discussed in the preceding section.

27.1 Avoidance and minimisation

The primary method to avoid impacts is to locate activities away from areas of known or potential high biodiversity value. Where possible the road alignment and bridge design has been located to avoid effects on natural areas of aquatic and terrestrial fauna.

27.2 Mitigation measures

Once all practicable steps to avoid or minimise impacts have been implemented at the detailed design phase, mitigation measures would be implemented to lessen the potential ecological impacts of the proposal. Mitigation measures are to be undertaken during the construction and operational phases and are outlined in Tables 26 and 27 below.

Table 26. Activities and potential effects on aquatic ecology during the various phases of the operation are summarised in the following table.

Construction phase		
Construction Activities	**Potential impact**	**Proposed Mitigation activity**
Drainage works and use of vehicles	• Negative impact on flora and fauna from increased sediment (increased turbidity) loading of river, mangrove and marine areas	• Implement robust erosion and sediment control measures. Where practical use management methods such as turbidity curtains and turbidity meters outside the area in combination with phasing of construction work to minimise sedimentation and disturbance to aquatic fauna and flora • Operation of heavy equipment should be confined to dry stable areas to reduce the amount of mud and heavily silted water at the construction site which could enter the watercourse. • Stabilise exposed areas as soon as possible. • Avoid discharge of sediment into water • Avoid or minimise sediment release downstream. • Retain vegetation on the bank. • When excavation is required within the channel, as in the placement of footings for abutments or piers, measures should be taken to separate the excavation area from the flow by cofferdams. • Storage of fuel, equipment, and construction materials to minimise the risk of soil contamination or water pollution, • A risk assessment is carried out for each substance to be used or stored on site and the appropriate containment measures installed.
Materials management	• Harm to aquatic flora and fauna from oil, fuel, cement, or other substances entering watercourses	• All practical measures must be taken to prevent cement and cement products entering flowing water, including but not limited to a) Avoiding flowing water coming into contact with the concrete until the concrete is firmly set. b) Using boxing or other similar devices to contain wet cement during construction of the structure. c) If any concrete is spilled beyond the boxing, pouring of concrete must stop immediately and all concrete must be removed from the watercourse. d) No equipment used in the pouring of concrete should be washed out onsite. (Further detail is provided in the Working with concrete, cement and lime section below) • Development of a species-specific management plan for species of concern e.g., freshwater mussels/kai
Physical impacts- Dredging and bridge pillar	• Habitat loss and direct mortality of sensitive flora and fauna • Potential barrier to fish and shrimp migration along the river corridor	• Where needed turbidity barriers will be used during construction to prevent fine material from further impacting kai. • Ensure minimal disruption to the flow of the river during the wet season • Minimize turbulence and flow contraction because turbulence inhibits or prevents passage, • Construct bridge bottoms with natural stream substrates, • Construction should be phased to be outside the key periods of faunal migration.
Debris from construction	• Any debris left on the seabed from the construction activity can become a projectile during severe wave activity, and this may cause damage to sensitive benthic resources.	• A swim through by an Ecologist will be done at the site after construction when the turbidity is back to normal. The inspection will ensure that all debris are removed off site and that the riverbeds are appropriately restored.
Operation phase/ongoing site maintenance		
Activities	**Potential impact**	**Proposed Mitigation activity**
Physical presence of the bridge	• Changes to deposition, depth and water velocities may result in the loss of sensitive plant, invertebrate, and fish species	• Design bridge to avoid and reduce environment impacts e.g., maintain a constant grade along the length of the bridge. • Effective stabilisation of altered landforms to minimise soil erosion.

		• Construct during periods of low flow to minimize impacts to fish and the potential for water pollution from suspended solids
	• Turbidity may contribute to reduced ecological diversity • Potential downstream changes to the aquatic community	• Reintroduction of sensitive species e.g., kai/freshwater muscles to ensure ecological processes and key species for consumption are maintained • During construction, minimize disturbance to the length of the natural stream channel and the natural flow of the water
Materials management from ongoing site maintenance	• Direct and indirect effects from oil, fuel or other substances entering the aquatic environment	• A risk assessment is carried out for each substance to be used or stored on site and the appropriate containment measures undertaken.

Table 27. Activities and potential effects on terrestrial ecology during the various phases of the operation are summarised in the following table.

Construction phase		
Construction Activities	**Potential impact**	**Proposed Mitigation activity**
Invasive species introduction	• Negative ecological impacts due to the introduction of invasive species	• An invasive species management will be developed with the aim to prevent or manage invasive species introductions

27.3 Working with concrete, cement and lime

Concrete and cement are used extensively in construction. Many activities require in situ pouring of concrete into purpose-built boxing or form work or installing pre-cast structures into waterways. Cement and lime are also used for pavement and trench back-fill stabilisation works.

Uncured concrete, concrete slurry, cement and lime fines, dust, or washings can make water highly alkaline (pH of 11–13). This highly alkaline water will injure and kill fish and other freshwater life that encounter it. Water contaminated with concrete, cement and lime cannot be diluted or filtered to a safe level for discharge to the receiving environment, so washings, dust, fines, or slurry must not enter stormwater or freshwater receiving environments.

Concrete, cement and lime-contaminated water must be collected in a contained area and removed from site, to avoid discharging to the receiving freshwater environment. Even once cured, concrete structures will leach for some time when immersed in water, producing alkaline water. Pre-cast structures need to be soaked, with soakage water replaced (and appropriately discharged away from any of the sites) periodically. Where pre-cast structures cannot be used and in situ pouring is required, this must be done in the dry (e.g., the use of Coffer dams) and the structure may need to be soaked as described above before removing the coffer dam and exposing the structure to the waterway.

27.4 Preventing invasive species

Mitigation measures to prevent the introduction or spread of invasive species and pathogens will include:

- The contractor must obtain all required biosecurity and phyto-sanitary clearances (e.g., permits) for any material or equipment imported into Fiji.
- The contractor will obtain all permits and clearances for import of any materials and equipment to be used for the project as required by Biosecurity Fiji.
- Materials will be inspected, and any equipment imported for project purposes will be steam-cleaned and certified under biosecurity and phyto-sanitary procedures away from the sites prior to mobilization.
- Weed hygiene measures will be implemented to prevent introduction or spread of invasive species, including cleaning machinery before it enters and leaves the subproject sites. Inspection of the replanting and identification of any potentially risky weeds/invasive species should occur both during construction and immediately following construction by an appropriately qualified ecologist.

27.5 Minimise and mitigating impacts on Kai

It is recommended that at the proposed Sabeto bridge site undertakes active management of freshwater mussel/kai and develops a Kai management plan. This should be completed by an appropriately qualified ecologist prior to any construction activities occurring). We provide specific recommendations to mitigate the risks to the species at the Sabeto bridge development sites to these species. This can be achieved by:

- Stabilizing sediment and using methods such as sediment curtains during construction to reduce the area of impact.
- Following completion of the construction phase kai mussels should be recovered in the bridge site so ecosystem services and food sources are preserved (e.g., water filtration)

27.5.1 Translocation of kai

Prior to any disturbance of the riverbanks or bed associated with the bridge developments; a translocation program should be undertaken for reestablishment of kai on site post construction. Seeding locations upstream from the site should be identified.

Following completion of the construction phase of the developments, similar numbers of mussels should be relocated to the bridge sites to avoid density dependent impacts on the population and to ensure the ecosystem services (particularly water filtration) provided by the species are maintained at the impact sites. The water quality (particularly DO^2 and turbidity) of the impact site should be monitored to ensure that conditions are suitable before the mussels are released back on site. Monitoring post development in year 1, 2 should occur after the development to ensure success of the translocation.

A kai management plan should include a detailed description and plan for translocation of kai back to the site at Sabeto Bridge and monitoring plan to ensure success. The kai management plan should be developed by a qualified ecologist prior to construction commencing.

28. Residual impacts

As required by the ADB SPS, a no-net-loss of biodiversity values is required to be achieved. Although efforts have been made to avoid, minimise, and mitigate potential ecological impacts from the proposal, some residual impacts would occur in the form of loss of soft sediment habitat at the Sabeto Bridge site.

Natural soft sediment habitat under the water will be modified and lost as habitat for native species at all four of the sites in the locations where piers are placed and potentially also will impact habitat within 2 meters of the piers (Table 28). The current engineering plans have 3 piers under water in Sabato. Impacts on the soft sediment area calculated to be lost underwater through pier placement is small and not significant therefore offsets are not considered necessary (see table 28).

Table 28. Modified habitat by habitat type

Site	Habitat type residual impacts	Habitat Type condition	Habitat Type Area (B)
Sabeto	Soft sediment	Natural	30 m^2

29. Post-construction monitoring

Monitoring programs are recommended to:

- A qualified engineer should evaluate bridge impacts on erosion to ensure habitat integrity throughout the construction phase.
- Monitor the success of kai restoration a week after seeding and 1, 2- and 5-years post restoration should occur by a qualified ecologist.
- Ecological health (fish survival is not impacted by construction) using eDNA sampling or physical sampling, should be undertaken by a qualified ecologist during construction and 1 year following construction.
- Monitoring of turbidity is required daily during the construction phase to ensure levels are not higher than < 25 NTUs outside turbidity curtains (Set within 10m from the bridge).
- Once all practicable steps to avoid or minimise impacts have been implemented at the detailed design phase, mitigation measures would be implemented to lessen the potential ecological impacts of the proposal. Mitigation measures are to be undertaken during the construction and operational phases and are outlined in Tables 5 and 6 below.

30. Management measures to address CH triggers

Although all efforts have been made to avoid ecological effects at the Sabeto Bridge site complete avoidance of effects is not possible. It has also been necessary to mitigate and minimise potential ecological impacts and effects. A number of mitigation measures are required at this site to address each of the critical habitat triggers (**Error! Reference source not found.**)

Table 29. Critical habitat triggered and associated management measures to address each trigger.

Criteria triggered	Critical habitat triggered	Management measures to address
1: Critically Endangered and Endangered Species	No	No additional measures required
2. Endemic / Restricted Range Species	No	No additional measures required
3. Migratory / Congregatory Species	Yes, likely to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species	• Minimize turbulence and flow contraction because turbulence inhibits or prevents passage • Construct bridge bottoms with natural stream substrates • Construction should be phased to be outside the key periods of faunal migration. • Ensure minimal disruption to the flow of the river during the wet season • Design bridge to avoid and reduce environment impacts e.g., maintain a constant grade along the length of the bridge. • An invasive species management will be developed with the aim to prevent or manage invasive species introductions • All practical measures must be taken to prevent cement and cement products entering flowing water, including but not limited to a) Avoiding flowing water coming into contact with the concrete until the concrete is firmly set. b) Using boxing or other similar devices to contain wet cement during construction of the structure. c) If any concrete is spilled beyond the boxing, pouring of concrete must stop immediately and all concrete must be removed from the watercourse. d) No equipment used in the pouring of concrete should be washed out onsite. (Further detail is provided in the Working with concrete, cement and lime section below)
4. Critical habitat qualifying processes/ecosystems	Yes, provides key ecosystem services	• An invasive species management will be developed with the aim to prevent or manage invasive species introductions • All practical measures must be taken to prevent cement and cement products entering flowing water, including but not limited to a) Avoiding flowing water coming into contact with the concrete until the concrete is firmly set. b) Using boxing or other similar devices to contain wet cement during construction of the structure. c) If any concrete is spilled beyond the boxing, pouring of concrete must stop immediately and all concrete must be removed from the watercourse. d) No equipment used in the pouring of concrete should be washed out onsite. (Further detail is provided in the Working with concrete, cement and lime section below) • Development of a species-specific management plan for species of concern is designed and implemented E.g. kai • Implement robust erosion and sediment control measures. Where practical use management methods such as turbidity curtains and turbidity meters outside the area in combination with phasing of construction work to minimise sedimentation and disturbance to aquatic fauna and flora • When excavation is required within the channel, as in the placement of footings for abutments or piers,

		measures should be taken to separate the excavation area from the flow by cofferdams. Storage of fuel, equipment, and construction materials to minimise the risk of soil contamination or water pollution.
5: The area holds biodiversity of significant social, economic, or cultural importance to local communities	Yes, important local clam collection area	• Implement robust erosion and sediment control measures. Where practical use management methods such as turbidity curtains and turbidity meters outside the area in combination with phasing of construction work to minimise sedimentation and disturbance to aquatic fauna and flora • When excavation is required within the channel, as in the placement of footings for abutments or piers, measures should be taken to separate the excavation area from the flow by cofferdams. Storage of fuel, equipment, and construction materials to minimise the risk of soil contamination or water pollution. • A risk assessment is carried out for each substance to be used or stored on site and the appropriate containment measures installed. • All practical measures must be taken to prevent cement and cement products entering flowing water, including but not limited to a) Avoiding flowing water coming into contact with the concrete until the concrete is firmly set. b) Using boxing or other similar devices to contain wet cement during construction of the structure. c) If any concrete is spilled beyond the boxing, pouring of concrete must stop immediately and all concrete must be removed from the watercourse. d) No equipment used in the pouring of concrete should be washed out onsite. (Further detail is provided in the Working with concrete, cement and lime section below) • Development of a species-specific management plan for species of concern (kai) • An invasive species management will be developed with the aim to prevent or manage invasive species introductions
Criterion 6: Protection	No	No additional measures required

31. Sabato bridge site conclusion

We conclude that the key period of impact will be: during the construction phase of the project, and specifically to water quality (i.e., unmitigated discharge of sediments and potential concrete contamination). Management plans are needed to ensure these do not have an impact. It is also important that limits on key construction activities during aquatic migration periods (during the wet season Nov-April) should be maintained when migratory EBA trigger species are potentially utilising the area.

We conclude that potential significant environmental impacts can be addressed if appropriate management and mitigation options are undertaken in addition to mitigation for the restoration of freshwater mussel habitat, there will be no measurable adverse impacts, or likelihood of such, on the aquatic habitat which could impair its high biodiversity value or the ability to function after planned mitigation and offset measures. Impacts are not expected to be anywhere near the level that could impair the ability of the Critical Habitat to perform ecological functions.

Following the implementation of the management and mitigation measures at the Sabato site, including those for residual effect it is concluded that the ADB SPS and World bank ESF ESS6 requirements for allowing a project to go ahead in an area of Critical Habitat (CH).

32. Lami bridge Ecological Values

32.1 Terrestrial Ecology

The current proposed bridge site is located approximately 20 meters from the edge of a natural mixed Rhizophora mangrove habitat. The mangrove forest is dominated by *Rhizophora stylosa* and *Rhizophora samoensis.* Mangrove associated species and backshore species including *Hibiscus tiliaceus* were also found on the edge habitat. The larger mangrove habitat to the Northeast and in the centre of the river to the North was mature and high quality showing little sign of anthropogenic disturbance. Accessible trees in the Larger Northeast mangrove fragment measured 2-5 meters in height and were at a density of 8-12 trees per meter (n=4). No terrestrial species threatened or known to be rare was found in the Study Area.

Based on the current design, the estimated clearing of natural habitat mangrove vegetation for the proposal will result in no mangrove clearance (See Figure 12-15). The terrestrial area outside the mangrove site where the development is proposed had modified habitat, where the natural habitat has been altered, through the introduction of alien species of plants with lawn, planted garden and trees (Figure 12 and 15). This habitat is of little ecological value.

Figure 12. The areas of impact for the proposed Lami bridge.

Natural intertidal marine habitat is immediately adjacent to the bridge site and intersects with the planned area for the bridge development. The Assessment Area cover intertidal sandflat and subtidal habitats. The substrate is mainly sand with shell fragment. A walk through of the greater site area revealed no close seagrass during low tide within 50m of the site. There has been no long-term monitoring of changes in biodiversity in soft shores in Fiji and only a few studies of selected organisms have been made. The rarity of these species could therefore not be determined. This area is considered natural habitat.

The intertidal soft sediment zone is also considered migratory fish habitat and is included in the critical habitat measure (Figure 15). Currently the development is calculated to impact 2,082m^2 of natural habitat and 15,583m^2 of modified habitat. Of this 2,082m^2 is calculated to be critical fish habitat.

Figure 13. Natural and modified areas surrounding the proposed bridge structure are made up of mangroves, estuary, and intertidal habitat.

Figure 14. mangrove areas (red) surrounding the proposed bridge development (yellow).

Figure 15. The critical habitat intertidal and river habitat surrounding the proposed bridge development.

32.2 Aquatic ecology

The Lami River is approximately 9.5 kilometres in length and an estimated terrain elevation above sea level of 13 metres. It has two major tributaries and discharges to Laucala Bay. The total area of the catchment is approximately 21.54 square kilometres. River erosion is visible in different areas, as most of the banks are composed of soft soil and logs have also been found blocking the flow of the waterway.

At the proposed bridge development site, the mouth of the river is approximately 51m across. The edge and bottom substrate are predominantly sandy sediment, water clarity was high on the days when surveys occurred. EDNA sampling occurred at low tide. Edna samples were taken 15m above the proposed bridge and at the proposed bridge site. 18 species of fish were detected. No crustacean (shrimp or crab) and molluscan taxon were detected in the eDNA sampling (See appendix tables 36-40). This should not be interpreted as absence of species in these taxa. It is likely that the absence of these taxon according to the DNA technician is because the filter was likely to be clogged prior to any mollusc eDNA being collected. Netting and trapping did not add further fish species to the total species number provided through eDNA sampling (Appendix, table 36-40).

EDNA surveys revealed no species of concern. However, several species of concern were not within the eDNA database library during the analysis period which would prevent them being identified except through elimination e.g., the only species of that genus. Additional targeted surveys for specimens of *Parioglossus* and other gobies utilising kilwell traps in the mangrove area were not successful in finding any additional species at the site. Of the identified fish

species, several species were invasive. However, tilapia was not detected at this site. The lack of tilapia is likely to result in a higher fish diversity being maintained in this area.

The freshwater fish and crustaceans moving through this site are likely to include migratory species. However, surveys have not occurred during the best period for detecting these species. Migratory freshwater species are likely to utilise the site and as with the other sites we take a precautionary approach and assume they are present at key migration periods. The site is of high ecological value.

33. Lami bridge critical habitat triggers

Literature reviews, database surveys, eDNA surveys and field visits identified no endangered species of conservation significance based on the IUCN Red List of Threatened Species as present at the Lami bridge site, or within the EAAA of the site. However, there are endemic or range restricted species of both crustacean and fish species which are data deficient or have not yet been evaluated by the IUCN for which the habitat is potentially suitable (See Table 30 and 31). Some of these species are only likely to be present during key life cycle events where it is likely ≥ 1 percent of the global population of this migratory species migrate through the site triggering criteria 3 for critical habitat (See table 30-31). We have taken a precautionary approach and assumed they are present at key times in the year (See table 30-31).

There are also two species *Datnia kneri /Mesopristes kneri* and *Parioglossus triquetrus* which are data deficient/not evaluated by the IUCN which maybe present all year. Both species are known from areas outside the EAAAs and are lacking information on population status and spatial coverage.

For *Datnia kneri /Mesopristes kneri* appropriate habitat requirements are met at this project site. This species could also trigger Criteria 3 since they migrate. This species was not however present in any of the eDNA samples collected (there was no unidentified Terapontidae genus in the eDNA) at any of the sites. This suggests that the species was not present during the survey periods. Expert opinion suggests it is not likely, that >10% of the species' population occurs at the Lami EEEAs, meaning this species does not trigger Critical Habitat under Criterion 2.

Parioglossus triquetrus is endemic. The habitat requirements of this species are met by this project site given that mangroves are present. No records of the species have been recorded within the EAAA and no *Parioglossus triquetrus* were captured during the surveys despite effort. No potential individuals were seen in the mangroves or while doing snorkel surveys. However, the species is known to be difficult to capture. *Parioglossus triquetrus* was not in the eDNA library which did not allow this species to be identified directly through the eDNA samples. Furthermore, there is unidentified Gobiidae in the eDNA samples which could be *Parioglossus triquetrus*.

The species has previously been recorded in a Creek 15 km west of Lami. Which is relatively close to the Lami bridge site. The site where the species as previously seen is a smaller tributary, so the habitat was somewhat different than this project site. It is possible the EAAAs regularly hold ≥10% of the global population size AND ≥10 reproductive units of the global population of *Parioglossus triquetrus* qualifying these as Critical Habitat under Criterion 2. Consideration is given to potential project-related adverse impacts on this species.

Table 30. Freshwater fish triggering critical habitat and criterion triggered at Lami.

Scientific name	Critical Habitat Rationale	Criterion Triggered
Glossogobius sp. (Hoese and Jenkins in prep)	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical basis, ≥ 1 percent of the global population of this migratory species may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Parioglossus triquetrus	Potential Critical Habitat: Suitable habitat potentially exists. Though the species was not found at the sites, it is possible the EAAAs regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species of the global population occur, qualifying these as Critical Habitat under Criterion 2.	2
Schismatogobius vitiensis Comon name: Fijian scaleless goby(Jenkins and Boseto, 2005)	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical basis, ≥ 1 percent of the global population of this migratory species may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Schismatogobius chrysonotus (Orange-spotted Scaleless Goby)	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through all 4 of the sites, qualifying them as Critical Habitat under Criterion 3.	3
Stenogobius (insularigobius) n. sp. Common name: teardrop goby	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Stiphodon sp.1, Isabella's goby	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Stiphodon sp.2 (Jenkins, Boseto and Watson)	Potential Critical Habitat: The 4 EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Sicyopterus n. sp. (Boseto, in preparation) – Tavoro Goby	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Datnia kneri / (Bleeker, 1876) (Terapontidae) Common name: Orange-spotted Therapon/Reve	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that on a cyclical or otherwise regular basis, ≥ 1 percent of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3. It is not considered likely, however, that >10% of the species' population occurs at any of the sites at any time, therefore this species does not trigger Critical Habitat under Criterion 2.	3

Table 31. Endemic freshwater crustaceans triggering critical habitat (CH) criteria and rational at Lami.

Name	Critical Habitat Rationale	Criterion Triggered
Caridina fijiana	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that >1% of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Caridina nudirostris	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that >1% of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3
Caridina devaneyi	Potential Critical Habitat: The EAAAs are not habitat except during migration. At that time, it is possible that >1% of the global population may migrate through the sites, qualifying them as Critical Habitat under Criterion 3.	3

33.1 Critical Habitat-qualifying ecosystems

ADB Criterion 4 states " The area includes unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services;"

Criterion 4 relates to specific landscape features which are critical for ecological functions. Examples of these within the sites includes riparian zones and rivers, dispersal/migration corridors (rivers), hydrological regimes, and keystone or habitat-forming species (mangroves and freshwater mussels).

The rivers, estuaries, and mangrove surrounding Lami provide critical shelter and food for aquatic species and function as migration corridors maintaining key life cycle events. The mangrove river systems are recognised as key ecosystem providers e.g., breeding and nursery habitats for fish species, storms and floods, erosion control functioning locally and regionally as important ecosystem services. By providing these ecosystem services they trigger critical habitat criterion 4.

33.2 Critical habitat criteria triggered

The critical habitat triggered at the Lami is outlined in table 32. No protected areas of concern were identified so Criteria 6 was not triggered.

Table 32. ADB criteria critical habitat triggered.

Criteria	Thresholds	Critical habitat triggered
1: Critically Endangered and Endangered Species	(a) Areas that support globally important concentrations of an IUCN Red-listed EN or CR species (≥ 0.5% of the global population AND ≥ 5 reproductive unitsGN16 of a CR or EN species). (b) Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds in GN72(a). (c) As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species	No
2. Endemic / Restricted Range Species	(a) Areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species.	Yes, potentially ≥10% of the global population size AND ≥10 reproductive units of *Parioglossus triquetrus* present
3. Migratory / Congregatory Species	(a) Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle. (b) Areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress.	Yes, likely to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species
4. Critical habitat qualifying processes/ecosystems	The area includes unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services	Yes, provides key ecosystem services
5: The area holds biodiversity of significant social, economic, or cultural importance to local communities		Yes, important local fishing area
Criterion 6: Protection		No

34. Ecological effects

This section of the report considers the potential impacts of project operation on terrestrial mangrove, freshwater, and intertidal ecology at the Lami bridge site. Ecological effects on terrestrial and aquatic varies during construction and operation are summarised in (Table 33 and 34). Ecological impacts may operate over a longer timescale, as populations and species take time to respond to environmental changes (time-lag).

34.1 Construction effects

Severity and spatial extent of the effects will depend on construction practices, timing of construction activities and controls, river flows, composition of substrate, and effectiveness of erosion controls.

34.1.1 Noise and disturbance

Considerable noise and visual disturbance may be generated during site formation and construction, potentially affecting the distribution and behaviour of fauna of the adjacent/remaining habitats. Due to the ranking of conservation importance of the species recorded, and the temporary nature of the impact, potential impacts to fauna from this source are likely to be minor if construction activities occur outside the wet season when critical migration and life cycle activities occur.

34.2 Terrestrial ecology

34.2.1 Site formation

The Lami bridge site has mangrove habitat of ecological value. Removal of these mangroves is avoided by aligning the bridge on the seaward side of the road where only disturbed vegetation habitat remains. However, there could still be indirect loss of natural vegetation loss through the Lami bridge placement project, the project may impact vegetation by:

- unauthorised clearing outside the subprojects site boundary
- clearing elsewhere e.g., to store materials.
- causing damage to surrounding vegetation through erosion (refer Suspended solid)
- changes to water quality (Suspended solid/water quality)
- introduction of invasive species (refer invasive species).

Post construction monitoring would ensure construction has not led to additional destabilisation effects on nearby mangroves surrounding the proposed Lami bridge and that none of the surrounding mangrove has been removed during construction activities. The impact on the terrestrial environment and fauna is likely to be minor for the Lami bridge site.

34.2.2 Invasive species.

Invasive species have the potential to be spread by the construction e.g., through tracking of seeds on vehicles or machinery. Pathogens and invasive species may also be carried on, or in,

materials, equipment (including vessels used to transport materials or workers) and any workers brought to the sites. This includes materials, equipment and workers bought from other countries or elsewhere in Fiji.

34.3 Intertidal ecology

34.3.1 Intertidal Construction Works

Construction works within the intertidal zone, would be required at Lami. The area of seabed effected for this site is sandy bottomed. Due to the small scale of construction works involved, impacts are ranked as largely minimal in nature if sedimentation impacts can be contained.

34.3.2 Suspended solid.

Construction activities, may indirectly impact upon the intertidal marine environment through re-suspension of sediment from excavation, dredging and site formation activities, and site runoff at the Lami site. Re-deposition of suspended solids has the potential to affect marine benthic communities and to alter seabed characteristics. No seabed assemblages of high conservation value have been recorded within the study site. Outside the study site in the greater area there is coral reefs and there is likely to be seagrass. It is recommended to avoid impacts on these ecosystems by containing and minimising sedimentation during construction activities to as close to the site of the bridge development as possible.

A plan is needed to ensure the implementation of appropriate design and management techniques to reduce sedimentation risks during construction are low particularly during dredging or when piles are being placed. Turbidity curtains are one method which would be very useful to create a temporary barrier to ensure silt and debris are contained during construction. Provided sedimentation risks can be manged no unacceptable indirect impacts to marine ecological resources are predicted to occur during the construction and operations if turbidity readings are within the acceptable range <25 NTUs outside the turbidity curtains.

34.4 Aquatic ecology

34.4.1 Suspended solid/water quality.

Environment construction activities and dredging could result in the increased sediment loading and site runoff of streams and changes in turbidity may impact adversely upon aquatic populations particularly sessile species.

High suspended and deposited sediments can smoother habitats and reduce the photosynthesis of benthic plants. Suspended sediments can also impact on aquatic biota by clogging the food filtering or trapping apparatus of stream insects as well as the gills of fish, reducing the feeding efficiency (particularly for visual predators). This is a concern at all the sites.

Multiple fish species present in the wider catchment migrate both upstream and downstream within streams and rivers during different stages within their lifecycle. High suspended sediment can slow or prevent the migration of native fish species. In a study on juvenile whitebait (banded

kokopu in New Zealand), fewer fish migrated upstream at turbidity > 25 NTU[15]. The study speculated that if the rate of migration of juvenile banded kokopu was slowed there could potentially be fewer juvenile fish reaching adult habitat, fish could potentially be subject to increased risk of predation and may not reach preferred upstream habitats while they are still able to climb as juveniles.

Through the implementation of appropriate design and management sedimentation risks can be managed reducing the level of effect to low. Management tools include turbidity barriers which can be used to lessen the spread of fine particles and timing construction to avoid the rainy season and avoid key migration periods for sensitive species. A turbidity meter should be used to measure the turbidity outside of the construction area impact site to ensure that turbidity readings are within the acceptable range of <25 NTUs outside turbidity curtains.

34.4.2 Pollution incidents

Local ecological populations may also be adversely affected by pollution incidents attributed to fuel leaks and oil spills associated with construction and maintenance operations on site.

Cement is a construction related material which can have adverse on freshwater life. Cement has the potential to be discharged to the downstream receiving environment. Cement wash water and runoff from recently placed cement are of particular concern within aquatic habitats due to their detrimental effect on in stream fauna. Crushed concrete is also increasingly used as back-fill material and more frequently as contractors seek ways to be more sustainable and reuse materials.

Cement wash water and runoff has a high lime content which is water soluble (dissolves easily in water) and can drastically increase the pH of a waterway. The alkalinity can kill or severely burn aquatic life. For fish, the alkalinity is exceptionally damaging to sensitive gill structures. In addition to alkalinity, cement wash, and runoff can similarly increase the loading of fine sediment resulting in the same effects on instream fauna and habitat as those identified above for suspended/deposited sediment.

Concrete structures can leach and cause alkaline water. In addition to potential mortality of fauna, localised increases in pH (alkaline conditions) from leaching from concrete structures may also create a barrier to fish passage. These effects can be limited through careful management.

There is a particularly high risk of discharge of contaminants following discrete wet weather events or during prolonged periods of wet weather. Appropriate design and management can reduce these risks.

34.5 Impacts on fish and crustacean species of concern

Direct impacts on migratory fish and crustacean species are unlikely if there is minimal disruption to the flow of the river during the wet season (Nov-April) is ensured and key activities such as pile construction is limited to outside critical life history and migration periods. This will enable any fish and crustacean migration is not obstructed during construction works within the

[15] Richardson, J., Rowe, D.K., Smith, J.P.2001. Effects of turbidity on the migration of juvenile banded kokopu (*Galaxias fasciatus)* in a natural stream, New Zealand. Journal of Marine and Freshwater Research, 35:1, 191-196, DOI: 10.1080/00288330.2001.9516989

riverbed and ensure these risks are unlikely. Timing construction outside the migratory wet season reduces the severity of the effect of construction to no more than minor.

Any impacts on most potential resident species of concern, should they be present, are likely to be small and predominantly limited to the construction phase. Such impacts are most likely when mangroves will be removed. Provided careful mitigation activity is taken e.g., care involving cement/concrete should ensure minimal effects. These species cannot be assessed against measurable impacts without known populations on site.

The most significant potential for impacts at a particular species is to *Parioglossus triquetrus*, which may be resident in the Lami site. Although this species is not confirmed from any of the sites, its limited global distribution means that - if it is present - it may have a significant part of its global population present at one of these sites. Impacts on habitat at Lami is expected to be low and are not significant.

34.6 Operational effects

34.6.1 Aquatic impacts

The physical presence of bridges during operation post construction can also affect aquatic ecological populations in several ways. Physical developments such as bridge pillars, dredging and alteration of embankments, and roading construction can result in channelization, and deep pool formation resulting in an ecological disturbance for aquatic fauna if habitat corridors become severed.

Disturbances from bridge construction can be mitigated if normal water flow is maintained despite the blocking effect of embankments and bridge piers. This objective can be achieved through designs that favour long spans and hydraulically shaped piers. Abutments should be set back from the normal wetted perimeter of the watercourse to avoid constriction of the channel and reduction of the flow area.

The length of the spans required are determined by the bridge design by the engineers. However, the longer the spans the more contact with waterways can be reduced thereby reducing freshwater impacts.

Abutments and piers should be designed and constructed to provide the least amount of hydraulic resistance. Where piers are required, hydraulic shaped piers will minimize local scour and reduce obstruction of flow reducing impacts on the aquatic benthic environment. Piers should be constructed with ends which are tapered upstream and downstream in the direction of the main flow.

34.7 Cumulative impacts

The potential biodiversity impacts of the bridge proposals must be considered because of the construction and operation of the proposal within the existing environment. The proposal would not act alone in causing impacts to biodiversity. The incremental effects of multiple sources of impact (past, present, and future) are referred to as cumulative impacts and provide an opportunity to consider the proposal within a strategic context. The accumulating impacts of

historic vegetation clearing for urban development, agriculture, and development and maintenance of infrastructure have contributed to the loss of biodiversity within the Fijian landscape. The proposed developments are not found to be a major contributor to cumulative impacts upon local marine, terrestrial or aquatic ecology.

35. Avoid, minimise, and mitigate impacts

ADB require that mitigation of ecological impacts be sought in the following order of priority: (1) avoid, (2) minimise, (3) compensate on-site and (4) compensate off-site. At each stage, residual impacts should be re-assessed to determine whether there is a need to proceed to the next stage of mitigation. The following measures are proposed to mitigate the impacts discussed in the preceding section.

35.1 Avoidance and minimisation

The primary method to avoid impacts is to locate activities away from areas of known or potential high biodiversity value. Where possible the road alignment and bridge design has been located to avoid loss of mangrove. Further loss of mangroves should also be minimised as possible with no heavy machinery being placed in the mangrove areas in areas surrounding the Lami bridge site.

35.2 Mitigation measures

Once all practicable steps to avoid or minimise impacts have been implemented at the detailed design phase, mitigation measures would be implemented to lessen the potential ecological impacts of the proposal. Mitigation measures are to be undertaken during the construction and operational phases and are outlined in Tables 33 and 34 below.

Table 33. Activities and potential effects on aquatic ecology during the various phases of the operation at Lami are summarised in the following table.

Construction phase		
Construction Activities	**Potential impact**	**Proposed Mitigation activity**
Drainage works and use of vehicles	• Negative impact on flora and fauna from increased sediment (increased turbidity) loading of river, mangrove and marine areas	• Implement robust erosion and sediment control measures. Where practical use management methods such as turbidity curtains and turbidity meters outside the area in combination with phasing of construction work to minimise sedimentation and disturbance to aquatic fauna and flora • Operation of heavy equipment should be confined to dry stable areas to reduce the amount of mud and heavily silted water at the construction site which could enter the watercourse. • Stabilise exposed areas as soon as possible. • Avoid discharge of sediment into water • Avoid or minimise sediment release downstream. • Retain vegetation on the bank. • When excavation is required within the channel, as in the placement of footings for abutments or piers, measures should be taken to separate the excavation area from the flow by cofferdams.

Materials management	• Harm to aquatic flora and fauna from oil, fuel, cement, or other substances entering watercourses	• Storage of fuel, equipment, and construction materials to minimise the risk of soil contamination or water pollution, • A risk assessment is carried out for each substance to be used or stored on site and the appropriate containment measures installed. • All practical measures must be taken to prevent cement and cement products entering flowing water, including but not limited to a) Avoiding flowing water coming into contact with the concrete until the concrete is firmly set. b) Using boxing or other similar devices to contain wet cement during construction of the structure. c) If any concrete is spilled beyond the boxing, pouring of concrete must stop immediately and all concrete must be removed from the watercourse. d) No equipment used in the pouring of concrete should be washed out onsite. (Further detail is provided in the Working with concrete, cement and lime section below)
Physical impacts- Dredging and bridge pillar	• Habitat loss and direct mortality of sensitive flora and fauna • Potential barrier to fish and shrimp migration along the river corridor	• Where needed turbidity barriers will be used during construction to prevent fine material from going offshore or entering other sensitive environments. • Ensure minimal disruption to the flow of the river during the wet season • Minimize turbulence and flow contraction because turbulence inhibits or prevents passage • Construct bridge bottoms with natural stream substrates, • Construction should be phased to be outside the key periods of faunal migration.
Debris from construction	• Any debris left on the river bed from the construction activity may cause damage to sensitive benthic resources.	• A swim through by an Ecologist will be done at the site after construction when the turbidity is back to normal. The inspection will ensure that all debris are removed off site and that the bed is appropriately restored.
Operation phase/ongoing site maintenance		
Activities	**Potential impact**	**Proposed Mitigation activity**
Physical presence of the bridge	• Changes to deposition, depth and water velocities may result in the loss of sensitive plant, invertebrate, and fish species • Potential downstream changes to the aquatic community	• Design bridge to avoid and reduce environment impacts e.g., maintain a constant grade along the length of the bridge. • Effective stabilisation of altered landforms to minimise soil erosion. • Construct during periods of low flow to minimize impacts to fish and the potential for water pollution from suspended solids • During construction, minimize disturbance to the length of the natural stream channel and the natural flow of the water
Materials management from ongoing site maintenance	• Direct and indirect effects from oil, fuel or other substances entering the aquatic environment	• A risk assessment is carried out for each substance to be used or stored on site and the appropriate containment measures undertaken.

Table 34. Activities and potential effects on terrestrial ecology at the Lami site during the various phases of the operation are summarised in the following table.

Construction phase		
Construction Activities	**Potential impact**	**Proposed Mitigation activity**
Earthworks and excavations Invasive species introduction	• Disturbance to sensitive species on and near the site and changes in distribution, activity patterns • Negative ecological impacts due to the introduction of invasive species	• This effect is considered minimal for these ecosystems and mitigation is not required • An invasive species management will be developed with the aim to prevent or manage invasive species introductions
Operation phase/ongoing site maintenance		
Construction Activities	**Potential impact**	**Proposed Mitigation activity**
Physical presence of bridge	• Destabilisation of nearby mangroves	• Monitoring in the years post construction to ensure there is no loss of nearby mangroves

35.3 Working with concrete, cement and lime

Concrete and cement are used extensively in construction. Many activities require in situ pouring of concrete into purpose-built boxing or form work or installing pre-cast structures into waterways. Cement and lime are also used for pavement and trench back-fill stabilisation works.

Uncured concrete, concrete slurry, cement and lime fines, dust, or washings can make water highly alkaline (pH of 11–13). This highly alkaline water will injure and kill fish and other freshwater life that encounter it. Water contaminated with concrete, cement and lime cannot be diluted or filtered to a safe level for discharge to the receiving environment, so washings, dust, fines, or slurry must not enter stormwater or freshwater receiving environments.

Concrete, cement and lime-contaminated water must be collected in a contained area and removed from site, to avoid discharging to the receiving freshwater environment. Even once cured, concrete structures will leach for some time when immersed in water, producing alkaline water. Pre-cast structures need to be soaked, with soakage water replaced (and appropriately discharged away from any of the sites) periodically. Where pre-cast structures cannot be used and in situ pouring is required, this must be done in the dry (e.g., the use of Coffer dams) and the structure may need to be soaked as described above before removing the coffer dam and exposing the structure to the waterway.

35.4 Preventing invasive species

Mitigation measures to prevent the introduction or spread of invasive species and pathogens will include:

- The contractor must obtain all required biosecurity and phyto-sanitary clearances (e.g., permits) for any material or equipment imported into Fiji.
- The contractor will obtain all permits and clearances for import of any materials and equipment to be used for the project as required by Biosecurity Fiji.

- Materials will be inspected, and any equipment imported for project purposes will be steam-cleaned and certified under biosecurity and phyto-sanitary procedures away from the sites prior to mobilization.
- Weed hygiene measures will be implemented to prevent introduction or spread of invasive species, including cleaning machinery before it enters and leaves the subproject sites. Inspection of the replanting and identification of any potentially risky weeds/invasive species should occur both during construction and immediately following construction by an appropriately qualified ecologist.

36. Management measures to address CH triggers

Although all efforts have been made to avoid ecological effects at the Lami Bridge site complete avoidance of effects is not possible. It has also been necessary to mitigate and minimise potential ecological impacts and effects. Mitigation measures are required at this site to address each of the critical habitat triggers (See Table 35)

Table 35. Management measures to address specific critical habitat triggers at the Lami site.

Criteria triggered	Critical habitat triggered	Management measures to address
1: Critically Endangered and Endangered Species	No	No additional measures required
2. Endemic / Restricted Range Species	Yes, potentially ≥10% of the global population size AND ≥10 reproductive units of *Parioglossus triquetrus* present	• Implement robust erosion and sediment control measures. Where practical use management methods such as turbidity curtains and turbidity meters outside the area in combination with phasing of construction work to minimise sedimentation and disturbance to aquatic fauna and flora • When excavation is required within the channel, as in the placement of footings for abutments or piers, measures should be taken to separate the excavation area from the flow by cofferdams. Storage of fuel, equipment, and construction materials to minimise the risk of soil contamination or water pollution. • Use of techniques to minimise compaction of soil, such as restricting access during wet conditions, and using protective boarding and low ground pressure machinery. If necessary, soil should be carefully removed and stored for subsequent reinstatement. • A risk assessment is carried out for each substance to be used or stored on site and the appropriate containment measures installed. • All practical measures must be taken to prevent cement and cement products entering flowing water, including but not limited to a) Avoiding flowing water coming into contact with the concrete until the concrete is firmly set. b) Using boxing or other similar devices to contain wet cement during construction of the structure. c) If any concrete is spilled beyond the boxing, pouring of concrete must stop immediately and all concrete must be removed from the watercourse. d) No equipment used in the pouring of concrete should be washed out onsite. (Further detail is provided in the Working with concrete, cement and lime section below) • Development of a species-specific management plan for species of concern • An invasive species management will be developed with the aim to prevent or manage invasive species introductions
3. Migratory / Congregatory Species	Yes, likely to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species	• Ensure vegetation clearance is restricted to within the subproject site boundary and is minimised to the area of bridge placement • Minimize turbulence and flow contraction because turbulence inhibits or prevents passage • Construct bridge bottoms with natural stream substrates • Construction should be phased to be outside the key periods of faunal migration. • Ensure minimal disruption to the flow of the river during the wet season • Design bridge to avoid and reduce environment impacts e.g., maintain a constant grade along the length of the bridge. • An invasive species management will be developed with the aim to prevent or manage invasive species introductions • Monitoring in the years post construction to ensure there is no loss of nearby mangroves • All practical measures must be taken to prevent cement and cement products entering flowing water, including

		but not limited to a) Avoiding flowing water coming into contact with the concrete until the concrete is firmly set. b) Using boxing or other similar devices to contain wet cement during construction of the structure. c) If any concrete is spilled beyond the boxing, pouring of concrete must stop immediately and all concrete must be removed from the watercourse. d) No equipment used in the pouring of concrete should be washed out onsite. • Post construction monitoring
4. Critical habitat qualifying processes/ecosystems	Yes, provides key ecosystem services	• Monitoring in the years post construction to ensure there is no loss of nearby mangroves • An invasive species management will be developed with the aim to prevent or manage invasive species introductions • All practical measures must be taken to prevent cement and cement products entering flowing water, including but not limited to a) Avoiding flowing water coming into contact with the concrete until the concrete is firmly set. b) Using boxing or other similar devices to contain wet cement during construction of the structure. c) If any concrete is spilled beyond the boxing, pouring of concrete must stop immediately and all concrete must be removed from the watercourse. d) No equipment used in the pouring of concrete should be washed out onsite. • Post construction monitoring
5: The area holds biodiversity of significant social, economic, or cultural importance to local communities	Yes, important local fishing area	• Implement robust erosion and sediment control measures. Where practical use management methods such as turbidity curtains and turbidity meters outside the area in combination with phasing of construction work to minimise sedimentation and disturbance to aquatic fauna and flora • When excavation is required within the channel, as in the placement of footings for abutments or piers, measures should be taken to separate the excavation area from the flow by cofferdams. Storage of fuel, equipment, and construction materials to minimise the risk of soil contamination or water pollution. • Use of techniques to minimise compaction of soil, such as restricting access during wet conditions, and using protective boarding and low ground pressure machinery. If necessary, soil should be carefully removed and stored for subsequent reinstatement. • A risk assessment is carried out for each substance to be used or stored on site and the appropriate containment measures installed. • All practical measures must be taken to prevent cement and cement products entering flowing water, including but not limited to a) Avoiding flowing water coming into contact with the concrete until the concrete is firmly set. b) Using boxing or other similar devices to contain wet cement during construction of the structure. c) If any concrete is spilled beyond the boxing, pouring of concrete must stop immediately and all concrete must be removed from the watercourse. d) No equipment used in the pouring of concrete should be washed out onsite. (Further detail is provided in the Working with concrete, cement and lime section below) • An invasive species management will be developed with the aim to prevent or manage invasive species introductions • Monitoring in the years post construction
Criterion 6: Protection	No	No additional measures required

37. Post construction monitoring

Monitoring programs are recommended to:

- A qualified engineer should evaluate bridge impacts on erosion to ensure habitat integrity in the surrounding area throughout the construction phase.
- Post construction monitoring by both a qualified ecologist and an engineer within 3 weeks on construction being completed should ensure construction has not led to destabilisation effects on nearby mangroves.
- Ecological health (fish survival is not impacted by construction) using eDNA sampling or physical sampling should be undertaken by a qualified ecologist during construction and 1 year following construction.
- Monitoring of turbidity is required daily during the construction phase to ensure levels are not higher than < 25 NTUs outside turbidity curtains.

38. Lami bridge site conclusion

We conclude that the key period of impact will be: during the construction phase of the project, and specifically to water quality (i.e., unmitigated discharge of sediments and potential concrete contamination). Management plans are needed to ensure these do not have an impact. It is also important that limits on key construction activities during aquatic migration periods (during the wet season Nov-April) should be maintained when migratory EBA trigger species are potentially utilising the area.

We conclude that potential significant environmental impacts can be addressed if appropriate management and mitigation options are undertaken there will be no measurable adverse impacts, or likelihood of such, on the aquatic or terrestrial habitat which could impair its high biodiversity value or the ability to function after planned mitigation and offset measures. Impacts are not expected to be anywhere near the level that could impair the ability of the Critical Habitat to perform ecological functions

Following the implementation of the management and mitigation measures, including those for residual effect it is concluded that at the Lami site the ADB SPS and World bank ESF ESS6 requirements are fulfilled allowing the project to go ahead in an area of Critical Habitat (CH).

39. Conclusion

This biodiversity assessment has investigated the potential impacts to terrestrial and aquatic flora and fauna associated with the proposed development of four bridges in Fiji, Lami, Madrakutu, Sabeto and Viseisei. The investigation has involved desktop investigation and field surveys.

The rivers, estuaries, and mangrove surrounding the three project areas (Lami, Madrakutu and Viseisei) provide critical shelter and food for aquatic species and function as migration corridors maintaining key life cycle events. The mangrove river systems are recognised as key ecosystem providers e.g., breeding and nursery habitats for fish species, storms and floods, erosion control functioning locally and regionally as important ecosystem services. By providing these ecosystem services they trigger critical habitat criterion 4.

The project is not anticipated to lead to a net reduction in the population of any IUCN listed Critically Endangered, Endangered species. However, we have identified some non-threatened migratory species (many of which are also restricted-range species) which trigger ADB Critical Habitat criterion 3 during migration. Though these species have not been found at the sites, many of the species are very poorly-known, and habitat at some of the sites is appropriate for some of the species. As a result, we have taken a precautionary approach and considered these species potentially present. The project should assume these species are present, and plan mitigation and offsets accordingly in order to achieve no net loss or, preferably, a net gain for the species. This should be quite straightforward with standard mitigation measures and simple, low-cost offset measures to restore/replant areas of mangroves, in alignment with requirements under national law.

The outcomes of this work were used to assess potential impacts on biodiversity associated with preferred options design. We conclude that the key period of impact will be: 1) during the construction phase of the project, and specifically to water quality (i.e., unmitigated discharge of sediments and potential concrete contamination) and due to the removal of the mangrove vegetation. Management plans will be needed to ensure these do not have an impact. It is also important that limits on key construction activities during aquatic migration periods (during the wet season Nov-April) should be maintained when migratory EBA trigger species are potentially utilising the area.

We conclude that potential significant environmental impacts can be addressed if appropriate management and mitigation options are undertaken in addition to offsetting/mitigation for the loss of mangrove habitat and restoration of freshwater mussel habitat, there will be no measurable adverse impacts, or likelihood of such, on the aquatic or mangrove habitat which could impair its high biodiversity value or the ability to function after planned mitigation and offset measures. Impacts are not expected to be anywhere near the level that could impair the ability of the Critical Habitat to perform ecological functions at any of the four sites.

40. Appendix

Table 36. EDna Metadata for all of the four bridge sites

Site	Replicate	Location	Latitude	Longitude	Sample type	Notes	Collection date	Volume	Assays
SR	1	Sabeto River	-17.72014361	177.4534386	Sample	Sabeto River - Top left bank, water at lowest	29/05/2023	90	Fish, Decapod, Invertebrate, Mollusca
SR	2	Sabeto River	-17.72024187	177.4534852	Sample	Sabeto River - Upstream, 150m up from bridge	29/05/2023	90	Fish, Decapod, Invertebrate, Mollusca
SR	3	Sabeto River	-17.72021573	177.4532853	Sample	Sabeto River - from top water centre of river off current bridge	29/05/2023	100	Fish, Decapod, Invertebrate, Mollusca
VC	1	Varangge Creek	-17.6912269	177.420392	Sample	Viseisei Bridge - Up river from current bridge 3m viseisei town side	29/05/2023	1400	Fish, Decapod, Invertebrate, Mollusca
VC	2	Varangge Creek	-17.69141735	177.4205424	Sample	Viseisei Bridge - Taken from current bridge centre, low tide	29/05/2023	1300	Fish, Decapod, Invertebrate, Mollusca
VC	3	Varangge Creek	-17.69098463	177.4204495	Sample	Viseisei Bridge - 25m up fromcurrentbridge	29/05/2023	1000	Fish, Decapod, Invertebrate, Mollusca
LR	1	Lami River	-18.11406635	178.4116549	Sample	LamiInside river - side, under current bridge low tide	1/06/2023	900	Fish, Decapod, Invertebrate, Mollusca
LR	2	Lami River	-18.1142274	178.4116101	Sample	Lami - On open ocean side, low tide	1/06/2023	800	Fish, Decapod, Invertebrate, Mollusca
SH	1	Suva Harbour	-18.1028146	178.388413	Sample	Medraukutu - Up river 30 m	1/06/2023	900	Fish, Decapod, Invertebrate, Mollusca
SH	2	Suva Harbour	-18.1031694	178.38888	Sample	Medraukutu - Under bridge,mid to low tide	1/06/2023	900	Fish, Decapod, Invertebrate, Mollusca

Table 37. Fish taxon by sample detection table with sequence reads.

	Class	Order	Family	Genus	Species	Common Name	Status	Threat status	SR 1	SR 2	SR 3	VC 1	VC 2	VC 3	LR 1	LR 2	SH 1	SH 2
Fish	Actinopteri					Fish, unassigned			2022	831	5681	2106	630	9831	1170	2735	4352	29407
	Actinopteri	Anguilliformes	Anguillidae	*Anguilla*		Genus of freshwater eels			790	66	653	0	3882	0	0	0	0	0
	Actinopteri	Anguilliformes	Anguillidae	*Anguilla*	*Anguilla marmorata*	Giant mottled eel	Native	LC	0	581	0	0	2832	0	0	0	0	0
	Actinopteri	Anguilliformes	Anguillidae	*Anguilla*	*Anguilla obscura*	Pacific shortfinned eel	Native	Data Deficient but extremely large distribution	0	785	3939	0	0	0	0	277	0	0
	Actinopteri	Anguilliformes	Muraenidae			Family of moray eels			0	0	0	0	0	0	0	0	25	0
	Actinopteri	Anguilliformes	Muraenidae	*Strophidon*	*Strophidon sathete*	Slender giant moray	Native	LC	0	0	0	0	0	0	0	0	81566	12612
	Actinopteri	Anguilliformes	Ophichthidae	*Ophichthus*		Genus of snake eels		Potentially two LC species	205	0	0	0	0	0	0	0	0	0
	Actinopteri	Beloniformes	Zenarchopteridae	*Zenarchopterus*	*Zenarchopterus dispar*	Feathered river-garfish	Native	LC	0	5355	7680	22130	8815	757	0	0	685	1595
	Actinopteri	Blenniiformes	Blenniidae	*Omobranchus*		Genus of combtooth blennies			0	0	0	0	904	0	0	0	0	0
	Actinopteri	Carangiformes	Carangidae	*Caranx*		Genus of trevally and kingfish			388	0	0	0	0	0	0	0	0	0
	Actinopteri	Centrarchiformes	Kuhliidae	*Kuhlia*		Genus of flagtails			460	0	101	5868	0	0	0	0	111	729
	Actinopteri	Centrarchiformes	Kuhliidae	*Kuhlia*	*Kuhlia mugil*	Barred Flagtail	Native	LC	2433	46	33	1289	0	0	2531	3516	0	600
	Actinopteri	Centrarchiformes	Terapontidae	*Terapon*	*Terapon jarbua*	Jarbua terapon	Native	LC	0	0	326	0	7847	0	0	3420	0	0
	Actinopteri	Chaetodontiformes	Leiognathidae			Family of ponyfishes and slimies			0	0	0	391	0	1606	2886	0	0	0
	Actinopteri	Cichliformes	Cichlidae	*Oreochromis*		Genus of oreochromine cichlids	Introduced		43437	36988	69035	2473	7981	3157	0	0	0	0
	Actinopteri	Clupeiformes	Clupeidae			Family of herrings and sprats	Introduced		1576	2891	938	0	7221	0	0	0	124	0
	Actinopteri	Clupeiformes	Engraulidae	*Encrasicholina*	*Encrasicholina heteroloba*	Shorthead anchovy	Native	LC	0	0	0	1102	606	3174	0	0	0	0
	Actinopteri	Clupeiformes	Engraulidae	*Stolephorus*		Genus of schooling fish			0	0	0	1218	0	1093	0	0	0	0
	Actinopteri	Clupeiformes	Engraulidae	*Thryssa*	*Thryssa baelama*	Baelama anchovy	Native	LC	292	0	80	0	3902	0	3438	0	0	0
	Actinopteri	Cypriniformes	Cyprinidae	*Carassius*	*Carassius auratus*	Goldfish	Introduced		0	0	0	12066	0	0	0	0	55	0
	Actinopteri	Cypriniformes	Cyprinidae	*Cyprinus*	*Cyprinus carpio*	Common carp	Introduced		0	0	0	0	0	7805	0	6892	0	0
	Actinopteri	Cyprinodontiformes	Poeciliidae	*Poecilia*		Genus of mollies and guppies			28	0	0	0	0	0	0	0	0	74
	Actinopteri	Cyprinodontiformes	Poeciliidae	*Poecilia*	*Poecilia mexicana*	Shortfin molly	Introduced		545	545	0	0	0	0	0	0	42	0
	Actinopteri	Elopiformes	Megalopidae	*Megalops*	*Megalops cyprinoides*	Indo-Pacific tarpon	Native	DD large distribution young inhabit river mouths	0	2328	1171	1172	0	0	0	0	0	0
	Actinopteri	Gobiiformes	Eleotridae			Family of sleeper gobies			0	45	0	0	61	0	260	110	0	403
	Actinopteri	Gobiiformes	Eleotridae	*Butis*		Genus of sleeper gobies			0	27	205	0	880	2781	0	0	0	0
	Actinopteri	Gobiiformes	Eleotridae	*Eleotris*		Genus of sleepers			0	431	0	630	2086	0	3981	1718	184	1492
	Actinopteri	Gobiiformes	Eleotridae	*Eleotris*	*Eleotris fusca*	Dusky sleeper	Native	LC	0	0	23	0	0	0	0	343	0	372
	Actinopteri	Gobiiformes	Eleotridae	*Eleotris*	*Eleotris melanosoma*	Broadhead sleeper	Native	LC	0	742	0	0	0	0	0	2435	78	1022
	Actinopteri	Gobiiformes	Eleotridae	*Giuris*		Genus of gobies and gudgeons			605	0	373	0	1313	0	1783	1211	78	2287
	Actinopteri	Gobiiformes	Eleotridae	*Hypseleotris*		Genus of carp gudgeons			0	0	0	0	0	0	14874	19993	3808	16270
	Actinopteri	Gobiiformes	Eleotridae	*NA*	*Ophieleotris OR Giuris OR Eleotris sp.*			Potentially Not evaluated: *Hypseleotris guentheri*. Large distribution	1740	0	0	0	0	0	0	6110	453	1259
	Actinopteri	Gobiiformes	Gobiidae			Family of gobies			0	0	28	0	0	3035	0	2310	56	604
	Actinopteri	Gobiiformes	Gobiidae	*Awaous*		Genus of gobies		LC- all three potential species.	0	0	0	0	413	0	0	0	0	0
	Actinopteri	Gobiiformes	Gobiidae	*Glossogobius*		Genus of gobies			0	0	0	0	91	0	0	0	0	0
	Actinopteri	Gobiiformes	Gobiidae	*Glossogobius*	*Glossogobius celebius*	Celebes goby	Native	LC	0	38	302	0	0	0	0	0	0	0
	Actinopteri	Gobiiformes	Gobiidae	*Periophthalmus*		Genus of mudskippers		Lc	0	0	0	1113	0	0	0	0	0	0
	Actinopteri	Gobiiformes	Gobiidae	*Schismatogobius*		Genus of gobies		LC	281	220	91	0	0	0	0	0	0	0
	Actinopteri	Gonorynchiformes	Chanidae	*Chanos*	*Chanos chanos*	Milkfish	Native	LC	597	1031	259	505	0	0	0	0	0	0
	Actinopteri	Kurtiformes	Apogonidae			Family of cardinalfishes			0	0	0	0	0	4346	0	0	182	136
	Actinopteri	Kurtiformes	Apogonidae	*Fibramia*	*Fibramia lateralis*	Humpback cardinal	Native	LC	0	0	0	0	0	0	0	0	366	1452
	Actinopteri	Kurtiformes	Apogonidae	*Pristicon*		Genus of cardinalfishes			0	0	0	822	0	0	2267	0	0	0
	Actinopteri	Kurtiformes	Apogonidae	*Taeniamia*	*Taeniamia buruensis*	Buru cardinalfish	Native	LC	0	0	0	0	0	0	0	0	33	0
	Actinopteri	Kurtiformes	Apogonidae	*Zoramia*		Genus of cardinalfishes			0	0	0	0	0	0	0	0	593	5720
	Actinopteri	Lutjaniformes	Haemulidae	*Plectorhinchus*		Genus of sweetlips			0	0	0	0	1374	0	0	0	0	0
	Actinopteri	Lutjaniformes	Haemulidae	*Plectorhinchus*	*Plectorhinchus gibbosus*	Harry hotlips	Native	LC	0	0	0	3983	0	0	0	0	0	0
	Actinopteri	Lutjaniformes	Lutjanidae	*Lutjanus*		Genus of common snapper			0	0	0	0	0	0	0	3955	0	0
	Actinopteri	Lutjaniformes	Lutjanidae	*Lutjanus*	*Lutjanus argentimaculatus*	Mangrove red snapper	Native	LC	926	0	254	2769	1190	2713	0	0	0	0
	Actinopteri	Lutjaniformes	Lutjanidae	*Lutjanus*	*Lutjanus fulvus*	Blacktail snapper	Native	LC	0	1132	692	544	3995	0	0	0	46	125
	Actinopteri	Mugiliformes	Mugilidae			Family of mullet			0	0	0	472	0	0	0	0	0	0
	Actinopteri	Mugiliformes	Mugilidae	*Crenimugil*	*Crenimugil seheli*	Bluespot mullet	Native	LC	0	0	0	0	1094	0	0	0	0	0
	Actinopteri	Mugiliformes	Mugilidae	*Mugil*		Genus of mullet			1612	454	0	0	1196	0	0	0	0	0
	Actinopteri	Mugiliformes	Mugilidae	*Mugil*	*Mugil cephalus*	Flathead grey mullet	Native	LC	0	0	0	0	0	0	0	3288	0	0
	Actinopteri	Mugiliformes	Mugilidae	*Planiliza*		Genus of mullet			15889	35172	33984	33987	16885	17546	0	2229	0	587
	Actinopteri	NA	Ambassidae	*Ambassis*		Genus of glassfish			0	0	36	0	883	0	0	514	0	55
	Actinopteri	NA	Scatophagidae	*Scatophagus*	*Scatophagus argus*	Spotted scat	Native	LC	0	0	461	0	3221	0	0	315	0	0
	Actinopteri	Scombriformes	Scombridae			Family of mackerel and tuna			0	0	0	0	0	0	0	0	0	30
	Actinopteri	Scombriformes	Scombridae	*Katsuwonus*	*Katsuwonus pelamis*	Skipjack tuna	Native		0	0	0	0	0	0	0	0	308	11
	Actinopteri	Scombriformes	Scombridae	*Thunnus*		Genus of tuna			0	0	0	0	0	0	0	0	0	246
	Actinopteri	Spariformes	Lethrinidae	*Lethrinus*		Genus of emperors			0	0	0	545	0	0	0	0	0	0
TOTAL numbers of fish taxon per sample:									**18**	**20**	**23**	**20**	**24**	**12**	**9**	**18**	**20**	**23**

Table 38. Decapod taxon by sample detection table with sequence reads.

	Family	Genus	Species	Common Name	SR 1	SR 2	SR 3	VC 1	VC 2	VC 3	LR 1	LR 2	SH 1	SH 2
DECAPODS	Atyidae	*Caridina*		Genus of freshwater shrimp	0	5545	2181	7017	12998	0	0	0	0	0
	Atyidae	*Caridina*	*Caridina serratirostris*	Ninja shrimp	0	3090	0	0	0	0	0	0	0	0
	Atyidae	*Caridina*	*Caridina typus*	Australian amano shrimp	0	0	0	2429	24	0	0	0	0	0
	Gecarcinidae	*Cardisoma*	*Cardisoma carnifex*	Brown land crab	0	699	0	0	0	0	0	0	0	0
	Ocypodidae	*Austruca*	*Austruca citrus*	Lemon fiddler crab	0	0	0	650	0	0	0	0	0	0
	Ocypodidae	*Ocypode*	*Ocypode ceratophthalmus*	Horned ghost crab	0	0	0	0	0	0	0	0	19	0
	Palaemonidae	*Macrobrachium*		Genus of freshwater prawn or shrimp	32668	0	2294	0	0	0	0	0	0	0
	Parastacidae			Family of freshwater crayfish	0	0	0	0	0	0	0	0	37	0
	Penaeidae	*Metapenaeus*		Genus of prawns	0	0	478	0	0	0	0	0	0	0
	Sesarmidae	*Parasesarma*	*Parasesarma lividum*	Shore crab, Bluish mangrove crab	0	0	0	0	0	1001	0	0	0	0
	Varunidae	*Varuna*	*Varuna litterata*	River swimming crab	1776	168	0	0	0	0	0	0	277	5603
TOTAL numbers of taxon per sample:					2	4	3	3	2	1	0	0	3	1

Table 39. Mollusc taxon by sample detection table with sequence reads.

	Class	Order	Family	Genus	Species	Common Name	Status	SR 1	SR 2	SR 3	VC 1	VC 2	VC 3	LR 1	LR 2	SH 1	SH 1
MOLLUSC								0	0	0	0	0	15	0	0	0	104
	Bivalvia	Cardiida	Psammobiidae					0	0	0	0	27	0	0	0	0	0
	Bivalvia	Myida	Dreissenidae	*Mytilopsis*				8068	82	1318	863	19299	407	0	0	0	0
	Bivalvia	Myida	Teredinidae	*Teredo*				0	0	0	126	0	0	0	0	0	0
	Bivalvia	Venerida	Cyrenidae					56	10	0	0	0	0	0	0	0	0
	Gastropoda							0	0	0	0	177	0	0	0	0	4461
	Gastropoda	NA	Cerithiidae	*Cerithium*				0	0	0	260	0	0	0	0	0	0
	Gastropoda	NA	Physidae	*Physella*				0	0	11	0	0	0	0	0	0	0
	Gastropoda	NA	Physidae	*Physella*	*Physella acuta*			0	15	0	0	0	0	0	0	0	0
	Gastropoda	NA	Thiaridae					4525	48530	156264	0	493	0	0	0	0	3012
	Gastropoda	NA	Thiaridae	*Sermyla*				299	46	0	0	2668	0	0	0	0	0
	Gastropoda	NA	Thiaridae	*Stenomelania*				244	261	201	0	0	0	0	0	0	0
	Gastropoda	NA	Thiaridae	*Stenomelania*	*Stenomelania aspirans*			97028	37564	125514	0	0	0	0	0	0	3203
	Gastropoda	NA	Thiaridae	*Thiara*				17122	146226	62	0	0	0	0	0	0	0
	Gastropoda	Cycloneritida	Neritidae					371	0	0	0	0	0	0	0	0	1352
	Gastropoda	Cycloneritida	Neritidae	*Neritina*				0	0	10	0	0	0	0	0	0	0
	Gastropoda	Cycloneritida	Neritiliidae	*Neritilia*				1109	99	0	0	0	44985	0	0	0	3151
	Gastropoda	Littorinimorph	Assimineidae					53	5591	33	0	0	0	0	0	0	0
	Gastropoda	Stylommatophora						0	0	0	0	0	0	0	0	0	1015
	Gastropoda	Stylommatop	Ariophantidae	*Macrochlamys*	*Macrochlamys tersa*			173	10	0	0	291	0	0	0	0	837
	Gastropoda	Stylommatop	Camaenidae	*Bradybaena*	*Bradybaena similaris*		Introduced	1882	89	0	0	0	0	0	0	0	0
	Gastropoda	Stylommatop	Dyakiidae	*Quantula*	*Quantula striata*		Introduced	1062	56	0	0	0	0	0	0	0	2868
	Gastropoda	Stylommatop	Helicarionidae	*Parmacochlea*	*Parmacochlea balios*			0	0	0	0	0	0	0	0	0	13676
	Gastropoda	Systellommat	Rathouisiidae					0	31	0	0	0	0	0	0	0	0
	Gastropoda	Systellommat	Veronicellidae	*Sarasinula*	*Sarasinula plebeia*		Introduced	3335	186	72	0	5054	0	0	0	0	13594
	Gastropoda	Systellommat	Veronicellidae	*Semperula*	*Semperula wallacei*		Introduced	0	0	17	0	0	0	0	0	0	1577
UNASSIGNED								24335	3418	1816	36457	50845	25723	0	0	0	75144
TOTAL numbers of taxon per sample:								15	16	11	4	8	4	0	0	0	13

Table 40. Fish captured during surveys at the four bridge sites.

Bridge	Species	Scientific name	Number	Range	IUCN status
Madraukutu	Feathered river garfish	*Zenarchopterus dispar*	3	native	Least concern
	Barred flagtail	*Kuhlia mugil*	1		Least concern
	Short fin molly	*Poecilia mexicana*	2	introduced	
	Broadhead sleeper	*Eleotris melanosoma*	1	Large range	
	Humpback cardinal	*Fibramia lateralis*	2		
Sabato	Pacific Short finned eel	*Anguilla obscura*	2	Large range	Data deficient
	Barred flagtail	*Kuhlia mugil*	1		Least concern
	Indo-Pacific tarpon	*Megalops Cyprinoides*	1		Least concern
	Flat head grey mullet	*Mugil cephalus*	3		Least concern
	Mangrove red snapper	*Lutjanus argentimaculatus*	1		Least concern
	milk fish	*Chanos chanos*	1		Least concern
	celebes goby	*Glossogobius celebius*	1	Large range	Least concern
	Short fin molly	*Poecilia latipinna*	4		Introduced
Lami	Pacific Short finned eel	*Anguilla obscura*	1	Large range	Data deficient
	barred flagtail	*Kuhlia mugil*	1		Least concern
	flathead grey mullet	*Mugil cephalus*	1		Least concern
	Spotted scat	*Scatophagus argus*	3		Least concern
Viseisei	Mangrove red snapper	*Lutjanus argentimaculatus*	3		Least concern
	Feathered river garfish	*Zenarchopterus dispar*	3	native	Least concern
	Nile Tilapia	*Oreochromis niloticus*	2	introduced	Least concern
	Indo-Pacific tarpon	*Megalops Cyprinoides*	1	large distribution	data deficient
	Goldfish	*Carassius auratus*	1	introduced	

Appendix D: Consultation Minutes

Project Name:	**40 Critical Bridges and 3 Maritime Structures Stakeholder Consultation Meeting Minutes**
Structure(s):	Medraukutu Bridge (P1)
Place of Meeting:	Waiqanake Village Hall, Waiqanake Village
Meeting Date:	Tuesday, October 5th 2021 **Meeting Time:** 2:00 PM
Prepared By:	PLANIT Pacific Pte Limited

Attendees:

Project Team

- Jacqueline Hughes, PLANIT Pacific—Land & Resettlement Specialist
- Julia Whippy, PLANIT Pacific—Social Safeguards
- Manisha Nandan, Erasito—Environmental Safeguards
- Vaclav Hirsch, BICL—Bridge Engineer

Stakeholders

- Kelekolio T, FRA
- Tukai Maiwiriwiri, FRA
- Jaashinta, FRA
- Soroveveli Vura, A/Roko Rewa Provincial Office

Natalau Village member

- Semi Savenakama, Turaga ni Koro
- Samuela Koroi
- Viliame Baleiwai
- Varinava C
- Kelera Waqatevuya
- Peni Gaunimeke
- Niko Radua
- Marika T
- Taniela T
- Mosese R
- Sakiusa B
- Jovilisi Suveinakama - Vanua of Waiqanake's legal representative
- Paula K

Item	Action

1. Introductions

- The Assistant Roko Tui began with the presentation of our Sevusevu to the villagers before the presentation began. He welcomed and thanked the community for their presence at the meeting. He then opened the meeting with a very brief introduction to the 40 Bridges and 3 Jetties structures project as well as introduced the project team that will be presenting to the community about the project and the various processes.

2. Presentation by PLANIT

- A PowerPoint presentation was presented in the iTaukei language explaining the project, the priority bridges & jetties and upgrade development activities
- Provided an explanation of what is involved in the Feasibility study and Design Phase
- Explanation on the option of the proposed new bridge to be located on the seaward side and other options to be evaluated – bridge on landward side, new bridge at the location of existing and traffic to be diverted onto temporary bridge during construction
- Gathering stakeholders/communities' concerns and issues and information about the bridge

3. Discussion Session

- The Mataqali Natodre of Waiqanake village are the landowners of land along the foreshore near the Medraukutu bridge located at Wailekutu and the traditional Qoliqoli resource owners/users is the Vanua of Waiqanake
- A question was asked if houses close by to the bridge would be told to move and who would facilitate their move. FRA confirmed that they would help facilitate the relocation only if the need arises but that all depended upon the investigations and confirmation on the bridge alignment. FRA indicated that all factors including engineering, environmental and social issues, would be taken into consideration and that they would be further studies before any relocation would take place.
- FRA land valuation staff further explained that in terms of compensation, not only would the value of the land be considered but also the house value and any crops/plantations that may have to be removed/damaged as a result of the proposed temporary or new alignment. It was explained if their land was needed temporarily, then FRA would enter into a rental agreement with them but if it was permanent, then FRA would acquire the land and compensate them accordingly.
- It was queried whether it would be an entirely new bridge upstream/downstream or whether it would be a temporary bridge with the new bridge in the same alignment as the existing. Beca's engineer responded that currently there were looking at a few options and trying to evaluate which one would be better. He said the option to put a new bridge downstream on the foreshore side of the bridge seemed more viable as it would result in a better alignment on approach with less mangrove removal but that homes would likely be affected. However, they would need to complete all their investigations before they could present the various options and evaluations for to consider and FRA decide.

- A community member enquired as to whether there would be any employment opportunities that could be provided during construction of the bridge. PLANIT suggested that it would be good for the community to communicate with the Turaga-ni-Koro to put a list of names, age, contacts and trade/skills/qualifications together and provide it to the project team so that we could pass it onto FRA for consideration as part of their discussions and requirements with the selected Contractor. It is important to note that it will be up to the Contractor to engage with the community directly for any employment opportunities and requirements for the project.
- When the community was asked if they use the Wailekutu area where the existing Matanukutu bridge is located, they said us they go all the way to fish there.
- The community members queried if the protection of mangroves and marine life would be taken into consideration during construction and long term. The PLANIT team confirmed that this was part of the EIA process before any construction can take place, all environmental and social impacts must be taken into consideration so as not to damage the existing environment and if any impacts are envisaged, that the mitigation measures are put in place to minimum the impacts to the community and the environment. The EIA process must comply with the Environmental Management Act and must be approved by the Department of Environment.
- The women present raised their concern over their fishing area as there are a lot of silt built up in and around the foreshore around Lami, including the subject Medraukutu bridge site and this silt has destroyed their iqoliqoli. They wondered if the new bridge would factor in the silt build up that runs down from Mount Korobaba beside the two cement factors and requested if this could be looked into for the proposed new bridge structure
- Mr Jovilisi Suveinakama who was present at the meeting and who is the legal representative for the Navakavu Development Trust and is also from Waiqanake Village. He indicated that the Vanua have a Navakavu Blue Economic Zone which is a development master plan which stems from their Navakavu Strategic Plan 2018-2022 which was launched by the Prime Minister in June 2018. The plan covers all their native land and foreshore area that they would like to develop and protect. The Trust looks after any development projects in the area including this bridge and would take into consideration other developments that the Trust has already considered.
- Jovilisi indicated that the Trust are currently working with few companies such as:

  1) Cruz Holdings regarding their new barge landing and jetty project which will involve dredging the mouth of the river at the foreshore side of the Medramata bridge and use that for reclamation fill. The proposed barge landing area is targeted at easing access for smaller outer island barges to to be services, refueled and reloaded.

  2) Swire Shipping (delivery/offload of Clinker to the nearby cement factory) via an automated fully closed conveyor belt

  3) Castle Properties (development at Draunibota Island). Their Fisheries Impact Assessment was just completed last week by Department of Fisheries and provided to the Department of Lands.

  4) Victoria Marine who plan to lease the mangrove area next to the bridge.
- The project team queried as to whether the fishing rights waiver form had been signed for these projects. Jovilisi confirmed that the Turaga ni Yavusas have given consent to these companies. He further added that he

would be able to provide the project team copies of each of these companies' plans as well as the Navakavu Development Plan.

- The community indicated that they would like their proposed projects to be supported by government projects too.
- The project team explained on the 100 years lifespan of bridge design as part of the design criteria and therefore it would be critical for FRA to understand what future projects are coming up in the area to project the future traffic demand forecast. The project team further explained a traffic demand forecast is part of the engineering feasibility study and added that in order to do a traffic forecast and do an economic assessment to understand benefits of the new bridge, with the proposed development by the community, the project team needs to know what they are and their timeframe so that it can inform the assessment and design the bridge accordingly. For example, the project team indicated that the amount of traffic will influence how wide the lanes will be or the need for a single footpath or 2 footpaths on either side of the bridge
- Jovilisi queried that if the new bridge was to be built to last 100-year what is the forecast to the traffic flow that the engineering designers are using. The Project engineer explained that the BECA team was working on the draft traffic forecast report and it would be up to FRA to disclose this information. However, for the individual projects comings up, FRA has a requirement that each of these developments must do a Traffic Impact Assessment which would then have to provide their own traffic forecast for their projects on to the existing road network and model how their development would affect the existing and future traffic network and recommend in the TIA what upgrade works would be needed to be done by the proposed development to cater for their proposed new development. This is usually how it is done though if FRA were aware of these projects beforehand and if a TIA has already been done, then the projected traffic numbers could be factored in as part of this projects draft traffic forecast otherwise, we can provide for it now and if the project never took place or was built then it would be a waste of project funds which could be used elsewhere. Therefore, it is important for the design team and FRA to know the timing of these developments as well and whether or not they will happen and within what timeframe. If it within the same timeframe of the proposed bridge design and construction then maybe it can be factored in but if its down the line, it would be FRA's decision as to whether or not to provide for these developments now or later by the developer.
- With regards to the 2 bridge options of upstream or downstream, the project team asked the question as to which location the community preferred. A member of their trust raised that they would prefer to have it constructed where the old bridge was because of the proposed plan for the other developments such as the proposed jetty and other proposed development that has already been considered by their Navakavu Development Trust.
- The Beca Engineer explained that why the downstream was more feasible from an engineering perspective was that it straightens up the road on approach and on the bridge without having a sharp bend as would be required on the upstream side which can be dangerous for big trucks and a safety issue as well. However, he acknowledged that this downstream option could potentially affect nearby houses by the road side and close to the bridge on the Nadi side. The Engineer also acknowledge that with the downstream option, the design could also factor in pedestrian access for locals to access the sea to fish, as well as to anchor boats to out to sea and fish.
- However, Jovilisi indicated that they would like to provide a map or a plan for ease of reference so that the project team can see where their projects

have been planned for and how their access and needs can be integrated or taken into consideration in the new bridge design options.

- Jovilisi said that the Development Trust would like to support the proposed bridge development if FRA's project supports their projects. He said the proposed jetty proposals are commercial in nature and would benefit their communities though the EIA for the proposed marina jetty is still not yet completed nor has Department of Lands approved the lease yet.
- The BECA bridge engineer confirmed that whilst the bridge abutments on both sides would be included in the bridge design, access to other developments would need to be considered on a case by case basis by FRA as to whether it can be considered as part of this project.
- The community asked the project team as to where they got the name of the bridge as Madraukutu as they indicated that they have known the area and stream to be Medramata and request that this be looked into. The Project team indicated that this was the name that FRA had used in the tender documents for the name of the bridge and that it was likely that they had got it from their asset register. The project team confirmed that they would raise this with FRA to verify the name and adjust the name accordingly if incorrect. The bridge is also referred to as the Wailekutu bridge to some of the locals that live nearby as well.
- Should the downstream (foreshore) bridge option be selected and the houses close to the bridge need to be relocated, the project team enquired with the Vanua members present at the meeting and the Development Trust representatives, if there was any of their land available that these homes and people could potentially be relocated to. Jovilisi confirms as part of the Master Development Plan there were areas allocated for housing/residential so there was not a shortage of land but that they would be able to identify areas as part of the FRA's relocation process to be considered. It was indicated that some of these people living close to the bridge have been there for more than 17 years and one of the households claim to have been given permission by the previous Turaga ni Yavusa/Chief though he was not alive today and a written agreement that they had had was lost in a recent fire of his house which he was about to rebuild but he heard about this bridge project and which is why he wanted to attend this meeting.
- If the downstream option was chosen, the old Queen's Road and bridge could potentially be used as a temporary access which would mean that the existing house on the bridge abutment would need to be temporarily relocated though the household there claims to have a tenancy at will issued to him from FRA. This will need to verified by FRA.

4. Actions from Meeting

- Obtain from the Navakavu Trust a copy of their Master Plan
- Obtain contacts and development information from the 4 companies mentioned by the Navakavu Development Trust, that have received fishing rights waiver for their proposed development to see how this impacts the proposed foreshore (upstream) alignment of the new bridge.
- Obtain the contact details for the households that may like be affected in terms of temporary or permanent relocation
- Verify if FRA has issued a tenancy at will to the household that has built his home and business operation on the old Queens Road Reserve and bridge alignment.

• Verify with FRA and their asset register the official name of the subject bridge which the community indicates to be Medraumata and not Medrakutu.	

Project Name:	**40 Critical Bridges and 3 Maritime Structures Stakeholder Consultation Meeting Minutes**
Structure(s):	Medraukutu Bridge (P1)
Place of Meeting:	Waiqanake Village Hall, Waiqanake Village
Meeting Date:	Tuesday, January 23rd 2024 **Meeting Time:** 11:00 AM
Prepared By:	PLANIT Pacific Pte Limited

Attendees:

Project Team

- Jacqueline Hughes, PLANIT Pacific—Land & Resettlement Specialist
- Tevita King, PLANIT Pacific - Land & Resettlement Team
- Julia Whippy, PLANIT Pacific - Presenter
- Alex Revell, BICL - Bridge Engineer
- Noa Sakapo, FRA – FRA Valuation Officer

Stakeholders

- Zafiya Shamim, FRA
- Kelekolio T, FRA
- Selaima Maitoga, LTC
- Eminoni N, WAF
- Paula K, WAF
- Stephanie F, DoL
- Apenisa R, DoL
- Salome T, DoF
- Joseva R, DoF
- Miti D, TFL
- Emerson, TFL
- Akeneta, FPCL
- Kishnit C, FPCL
- Taito V, FPCL
- Rohitesh L, EFL
- Samuela R, EFL
- Shareena B, China Railway 14th
- Ji Hogyang, China Railway 14th
- Jona D, Fletcher Fiji
- Shaneil M, Fletcher Fiji
- Capt. Henele Ma'afu, Victoria Marine Ltd
- Netani Q, Victoria Marine Ltd
- Mikaele V, Blue Horizon
- Mark A, Blue Horizon

Community

- Taniela Koroi, Waiqanake

- Lovoti Bilia, Namakala
- Togalevu, Mateo Uduya
- Seveci Naisilasila, Matanitikina
- Roseru, turaga ni yavusa - Togalevu
- Namaoli Rubukele, Turaga ni Koro – Nabaka
- Josaia Tamani, Waiqanake
- Rt Anare Tuisolia, Turaga ni Koro – Togalevu
- Paula Kautaca2, Waiqanake
- Sireli Caginidaveta, Muaivuso – Trust Navakavu
- Suliasi Sugucolo, Turaga ni Koro – Kalokolevu
- Jovilisi Suveinakama – Yavua advisor (legal representative) – Nabaka
- Maika Druano, Turaga ni Koro – Waiqanake
- Tevita, Waiqanake - Natodre
- Paula K, Vanua – Muaivuso
- Uraia R, Waiqanake – Trust Navakavu
- Waisae Tokaibua, Waiqanake – Natodre
- Taniela T, Lewe ni Koro – Waiqanake
- Netani B, Turaga ni Koro - Namakala

Item	Action
1. Introductions • The Turaga ni Koro began with the presentation of our Sevusevu to the villagers before the presentation began. The Chief of Waiqanake welcomed and thanked the community for their presence at the meeting and asked the Talatala (Pastor) to open the meeting with a prayer. The Turaga ni Koro then briefly introduced the 40 Bridges and 3 Jetties structures project as well as introducing the project team that will be presenting (the 2nd round) to the community about the project and the various processes.	
2. Presentation by PLANIT • A PowerPoint presentation was presented in the iTaukei language providing an update on the project to the community members and relevant stakeholders since October 2021 • Summarize design process and environmental and social safeguards, including summary of site investigations and data gathered • Respond to communities and stakeholder comments and issues	
3. Discussion Session • A question was raised by the villages about the water problem that is faced by the 5 villages around the area of Waiqanake; WAF representative Mr. Paula (planning and design team), had explained that his department is working on plans to get water to this village and the neighboring communities. There were previous plans to find a water source near the area to tap into but it did not come to fruition. But WAF is working with some	

consultants to locate these water sources where they can then tap into and supply piped water. For now, the villages and communities will have to continue to use tank water which are supplied via WAF water trucks. However, WAF will take back their comments and record them.

- Victoria Marine representative Mr. Ma'afu, advises the consultants and stakeholders to deal directly with the landowners as they have been doing for 7 years. It would be much easier to solve the land issues because you would be dealing directly with the landowners.
- A question was raised about the life span of the bridge; Alex (BECA) answered, a 100 years.
- A question was raised to FRA about the houses that were erected beside the bridge, who gave them permission to build their houses there, and will they be removed or compensated, how is FRA dealing with them? Noa Sakapo (FRA Valuer) noted the question and said that he would respond to it in his presentation about Land Acquisition.
- A iqoliqoli owner of Navakavu asked a question of compensation for damages to their foreshore; and wanted FRA to note that the land that is being developed has been given to Victoria Marine by the landowners. Mr. Ma'afu also notes that Victoria Marine and FRA have been in talks and they are willing to give up the acquired land for FRA development.
- Mr Jovilisi Suveinakama (who is the legal representative for the Navakavu Development Trust and is also from Waiqanake Village) asked a question on whether or not an EIA was done yet or is this the meeting for the EIA. Jackie (PLANIT) answers in saying that the screening applications has been completed and waiting on the final design which will then go in to DoE to determine the nature of the EIA and then that process will start.
- Mr Jovilisi Suveinakama also asks once the EIA is done if it could be shared to the resource owners, the villages and the community. As there are different levels of discussion, he asks not to keep it to ourselves and being privy to this document will give the people a better understanding of the work and give approval to it. They will be expecting a copy for the EIA and the FIA reports.
- Noa Sakapo (FRA) presents and explains about the areas that are being acquired by FRA team for this project. He explains about the extent of the road reserve boundaries and that the proposed bridge falls within the road reserve and that FRA will not cross into the land owned by the yavusa. The only land that FRA will look at is the iqoliqoli area, which will be assessed by the Lands department Foreshore Unit who will explain more on their process. Noa also states that they will only give compensation for the land that is just behind the government reserves of the proposed development area. The structures or land within the government (FRA) road reserves will not be compensated as it is already government owned.
- Noa also responds to the question raised earlier about the structures erected beside the bridge and who gave them permission to stay there; Noa explains that he does not know but he knows that that land is reclaimed and suggests that the Lands department might know. The resource owner urges that the government stakeholders present to be aware and careful about these things in future.
- Mr Jovilisi Suveinakama questions about the term "reserve". He gives the example of the Veisari bridge, mentioning that it is a new bridge which is in the government reserve and that the old veisari bridge has now turned into freehold. He questions about whether or not this old bridge (existing bridge) will be the same. Mr. Sakapo replies by saying that if the government sees that it serves no purpose, then it will be given back to the landowners. Mr. Suveinakama mentions that these structures are designated for specific purposes by law and asks if it is no longer in use, for it to be returned to the

landowners. To which Mr. Sakapo confirms that it can be returned to the Yavusa because it was there's in the beginning and ensures that there is a process for that.

- A member of the Yavusa asked if this is the final requisition plan; Mr. Sakapo replied that the requisition part will come in once the final design comes in.
- A question was raised from Victoria Marine, Mr. Netani, on why the new bridge alignment wasn't put on the existing alignment. Mr. Alex Revell (BECA) mentioned that there would be no alternative bridge or road where the traffic could use if it was on the existing alignment.
- Mr. Netani further mentions that with the new design, the curves on both the approach of the bridge are a technical flaw, as it is, the traffic may speed off due to the unfinished curves or sharp bends. Mr. Nevell replied to say that this is due to land constraints and has reassured that the geometrics has been reviewed and the entire alignment has gone through a robust process both with BECA and FRA to get the best possible alignment.
- The Chief of the village requests the team to please take note of the dangers of the bends leading up to the bridge as Mr. Netani is a Engineer and knows what he is talking about. To which the team acknowledges.
- A question was raised on the lot that Cruise Holdings currently occupy as it will be affected by the design; Jackie (PLANIT) had confirmed that it is Cruise Holdings lot and that FRA are currently in talks with them and they had mentioned that they (Cruise Holdings) will work around FRA design; the member of the yavusa commented that they only know about Cruise Holdings and not the new area that will be given to FRA, so they request to consider their views as landowners.
- Mr Jovilisi Suveinakama speaks to the yavusa members (as advisor) reminding them that in their strategic plan as a yavusa, there is a mention about the government development programs like this bridge project. He advises the members of the yavusa not to stop these kinds of development as it helps their yavusa and families. He speaks then to the stakeholders present on behalf of the Yavusa in saying that they approve of this development. They have learnt from the past with some experiences and also requests for a copy of the EIA to keep them informed.
- A question was asked on whether or not this is the final consultation, of which it was confirmed that this is the final consultation.
- The matanitikina asked a question of the transport problem that is faced by the students and communities staying near Ro Delainamako Primary School in Naboro; He expressed that he had already raised this issue with the minister for roads, that their children have to walk for miles to get to school as the bus stops at a certain point because the road is too slippery to maneuver and therefore the bus does not take the chance. He raises this concern as there are government stakeholders present and wanted them to take note of this issue. The concern was noted and the team will pass on the message to the divisional officer for roads.
- A question was raised about the area that is currently the Victoria Marines land where two structures are sitting on, Kalivati and a Rotuman gentleman who are not moving because they say they will be compensated for the new bridge development but has already built his house in another location; Mr. Ma'afu adds on from the Victoria Marines side explaining that they had wanted them to move all the houses along that strip and so they had a meeting with the turaga ni mataqali and the mataqali Natodre to which they gave the land for them to be relocated to, they did the vanua procedure and constructed their new homes and gave them the keys. But Kalivati had said that he will wait for FRA to relocated and compensate them. Mr. Ma'afu had asked Mr. Kalivati to give the key of the new home back to the

mataqali Natodre (the landowner) since he does not want to move. However the other houses along the Victoria Marine land have relocated except for Mr. Kalivati and the Rotuman gentleman, Mr. Taito. Jackie (PLANIT) mentions that FRA needs to get verification from the landowners on what process they have done to relocate the houses and if they confirm to FRA that they have already organized relocation of the affected houses then there will not be any payment of compensation to them at all. Mr. Ma'afu replies that the land is the turaga ni yavusa's now and not Kalivati's as the landowners have given them the opportunity to move and they have not. Jackie had mentioned that they just needed confirmation from the landowners.

- Lands Department and Fisheries department presented on their part of the project being the iqoliqoli and the fisheries assessment (FIA).
- The village chief touches on the land that Mr. Taito and Mr. Kalivati are still residing on even though they were told to move. The mataqali Natodre has been very generous with the residents in building their new house but yet they do not want to move. So the chief had said that they have done all they can for them and have washed their hands of this issue. They request FRA to intervene and take over the situation.
- A question was raised to the Ports Authority & MSAF on the vessels that are stranded in their iqoliqoli area in Draunibota bay and Uduya point, what will happen to them and how will they be addressed as the yavusa and mataqali's have already requested on the matter but nothing has been done to date; Taito from the Fiji Ports Corporation Ltd (Assets & Facility Coordinator) explains the work that goes into pulling these vessels on to dry land with it being a high risk exercise because of the oil that is trapped inside the vessels. It is done carefully so that the oil does not spill into the open sea and affect the marine life. The process is a lengthy on due to these high risks which is carefully assessed beforehand. FPCL asks for the people's patience and forgiveness for taking long to carry out these jobs.

With no further questions from the community, the meeting was therefore closed.

4. Actions from Meeting

- Verify with FRA and their asset register the official name of the subject bridge which the community indicates to be Medraumata and not Medrakutu.
- Landowners and villages request a copy of the EIA and FIA be released to them
- FRA has received verbal confirmation from the landowners on the process that they took to have the houses relocated. However, two houses, Mr. Taito and Mr. Kalivati, have not relocated, therefore the landowners are requesting FRA to intervene as they are refusing to move when requested to by the landowners and Victoria Marine.

Project Name:	**40 Critical Bridges and 3 Maritime Structures Stakeholder Consultation Meeting Minutes**
Structure(s):	Lami Bridge (P1) Nabukalou Creek Bridge, Suva City (P2)
Place of Meeting:	Lami Police Station Bure
Meeting Date:	Tuesday, October 5th 2021 **Meeting Time:** 10:00 AM
Prepared By:	PLANIT Pacific Pte Limited

Attendees:

Project Team

- Jacqueline Hughes, PLANIT Pacific—Safeguard Land & Resettlement
- Julia Whippy, PLANIT Pacific—Social Safeguards
- Manisha Nandan, Erasito—Environmental Safeguard
- Vaclav Hirsch, BICL—Bridge Engineer

Stakeholders

- Kelekolio T, FRA
- Apisai Ketenalagi, FRA
- Jaashinta, FRA
- Soroveveli Vura, A/Roko Rewa Provincial Office
- Revoni R, DO Suva
- Olinda Ramoala, A/DO Suva

Suvavou & Lami Village members

- Kolinio Nakawara, Lami Village Turaga ni Koro
- Saula Baikeirewa, Lami village Mtq Nasevou
- Salacieli Batimoko, Lami village
- Filimoni Drotini, Lami village
- Timoci Saukuru, Lami village
- George L, Lami Police Station
- Ame Gavidi, Lami Police Station
- Solomoni K, Suvavou village
- Lesi D, Suvavou village Women Secretary
- Sanaila Tuilau, Suvavou village Youth President
- Kalaveti Naisoro, Wailekutu
- Tevita Tawake, Lami Town Council Building Surveyor
- Josefa Tokaibua, Police
- Suman Prasad, Wailekutu
- W.B. Zinck, District Advisory Councilor Lami

Item	Action

1. Introductions

- Constable George from the Lami Police Station welcomed everyone to the Lami Police Station
- Mr Apisai Ketenalagi of FRA then opened the meeting with a very brief introduction of the 40 Bridges and 3 Jetties structures project as well as introduced the project team that will be presenting to the community about the project and the various processes.
- The Assistant Roko Tui later presented sevusevu to the 2 villages (Suvavou & Lami) after the presentation due to his late arrival from another engagement.

2. Presentation by PLANIT

- A PowerPoint presentation was presented in the iTaukei language explaining the project, the priority bridges & jetties and upgrade development activities
- Provided an explanation of what is involved in the Feasibility study and Design Phase
- Explanation on the bridge replacement with replacement options to be developed and evaluated: upstream, downstream or at current locations and diverting traffic onto temporary bridge during construction
- Gathering stakeholders/communities' concerns and issues and information about the bridge

3. Discussion Session

- Concerns raised at the narrow foot path on the existing bridge that it is very dangerous especially when two big container trucks pass each other, people have to lean towards the railing for safety. If one person is walking on the bridge, the other person has to wait for him/her to get off the bridge or walk on the road to pass.
- The community put forward their request to have a wider walkway be included as part of the bridge design/construction for the safety of those that cross the bridge
- The community requested if road humps could be installed in front of Suvavou Village for safety reason as there is a lot of traffic speeding in the area and it is a danger to the children especially crossing the roads. FRA stated that this request would be considered separately but that they would take the request on board for consideration.
- The Turaga Ni Koro of Lami Village expressed appreciate for being included in this bridge project consultation with Suvavou Village. He wanted to raise his disappointment with regards to why previous upgrade works to the Lami Bridge, they were never consulted or informed about the works - FRA responded stating that the approach to their projects are different now and the nearly community as well as landowners, need to be consulted and to voice their concerns about the proposed bridge works so that FRA can ensure they build a bridge that takes into account all the local information, issues and concerns as part of the design, construction and operational phase of the bridge.
- A village member raised her concern over stormwater and road runoff that pools at the entrance to Harbour Point Commercial Centre which is close to the entrance of Suvavou Village during heavy downpour periods. She added that a

child's life was taken away due to the leptospirosis breeding in the ponding water as the kids play in these puddles when they are walking to and from the village. She said this was discovered after that ponded water was tested. They have raised their concern to the Lami Town Council and still yet to receive a response from them. FRA responded saying they would take that issue on board and look into the matter to drain the road run off and stormwater as part of the design and construction for the approach to the new bridge.

- The Suvavou and Lami Village community raised concern that the river upstream and around the industrial area was really shallow and needed to be dredged as there was a huge build of sediment in the river caused by erosion upstream along the river banks.
- The Lami Town Council (LTC) indicated that they fully supported the project. LTC indicated that in case the bridge project needed to use part of Tikaram Park for the bridge realignment upstream, LTC had plans to reclaim the foreshore area to extend the park and also provide coastal protection and this could be considered as an option as part of the project. Any plans for reclamation would obviously require proper consultation with iqoliqoli owners
- The Lami Town Council added that Tikaram Park is used regularly by Lami community for lunch, sports, church groups etc but due to COVID, the park has been closed. LTC indicated that the park was mostly used during the weekends, lunch time and after school from 3-5pm.
- Suvavou Village confirmed that children and adults use the park daily for volleyball and other sports, walk to and from the park, crossing the bridge and therefore, the safety issue is always a concern. At times children had to jump from the bridge into the sea if they find that crossing over the bridge is a concern particularly when two container trucks to go past each other right at the bridge.
- A community member raised that during heavy rain, the rise in water level at the bridge is mainly due to the debris that get stuck at the bridge, the water sometimes backflows upstream which floods settlements living upstream - FRA added this would be consider when clearing the waterway during construction as well as being factored into the design by raising the bridge levels
- FRA indicated to the community that the consideration for the new bridge at the upstream location was mainly because WAF's pipeline which is located downstream of the bridge, the impacts to Tikaram Park losing land and the building under construction at Harbour Point being too close to the road reserve.
- However, with regards to the upstream option, there are mangroves that will be affected and it was confirmed by the Suvavou village community present that the area is used for catching crabs, fishing and as a boat access/refuge.
- The Suvavou community representatives at the meeting confirmed that there were 2-3 houses that located immediately adjacent to the upstream bridge option and these homes were confirmed to be part of Suvavou Village.
- The project team indicated that they had seen some boats spotted by the mangroves near the existing bridge, and the community confirmed that those boats belonged to Suvavou Village.
- The community representatives confirmed that other settlements located upstream often brings their boat downstream to go fishing out at sea and boats sizes range from 23 ft to 19ft to as small as 17 ft.
- A community member queried on who is monitoring the waste discharges from industries upstream as it affects their fishing ground and also concerns over the health of the fish being caught along the stream – response was provided to the community that the Department of Environment is responsible for monitoring waste discharges from industries and the community can also raise their concern to the Lami Town Council to act on it
- Suggestion was raised by a community member to move the new bridge location at the mouth of River in front of the park - FRA responded that it will be

challenging to try and construct the road to link back into the main road and this would also be too costly

- A community member requested all big container trucks be diverted to another road which was discussed back during the Rokobili Port project, where a new foreshore by pass road was planned.
- With regards to the Medraukutu bridge near Wailekutu, residences who reside near the bridge raised their concerns stating that the proposed upstream bridge option would most definitely affect the residence living there close to the bridge. One of the home owners present, stated he was concerned with what would happen to his house and his neighbours house as they have been living there for nearly 20 years – the response was that before confirmation of the bridge location, investigations will be carried first and if decision is made and these houses will be impacted, a process of relocation or compensation will be assessed and discussed further with the home owners before any works commence on the site.
- The community was advised that another meeting will be held in the afternoon at the Waiqanake village for the proposed Medraukutu bridge and if they had any issues or concerns with regards to that bridge as well that they provide their feedback.
- The presentation also covered the Nabukalou Creek bridge replacement as the Suvavou village are the Qoliqoli Resource Owners, however, no issues from the community was raised on the Nabukalou Creek bridge. A separate stakeholder consultation for the Nabukalou Creek Bridge is intended on being carried out to address any issues or concerns and will be arranged separately and in due course.

4. Actions from Meeting

- Project team to confirm landowner's details for parcels of land on the upstream side behind the mangroves and also on the Nadi side of the bridge (occupied by Shredhar Motors) as well as property owners for the Commercial Site (under construction at Harbour Point) on the Suva side of the downstream option.
- Distribution of community questionnaires for those affected by the proposed bridge replacement/realignment/widening. Turaga ni Koro for both Lami Village and Suvavou to assist he distribution and collection of the questionnaires.

Project Name:	**40 Critical Bridges and 3 Maritime Structures Stakeholder Consultation Meeting Minutes**
Structure(s):	Navutu Bridge (P1)
Place of Meeting:	FSC Conference Room, Lautoka
Meeting Date:	Friday, October 15th 2021 **Meeting Time:** 10.00AM
Prepared By:	PLANIT Pacific Pte Limited

Attendees:

Project Team

- Jacqueline Hughes, PLANIT Pacific—Safeguard Land & Resettlement
- Julia Whippy, PLANIT Pacific—Social Safeguards
- Manisha Nandan, Erasito—Environmental Safeguards
- Vaclav Hirsch, BICL—Bridge Engineer

Stakeholders

- Livai Koro, FRA
- S Prasad, FRA

Fiji Sugar Corporation

- Inoke T, Civil Engineer
- L Ramesh, General Manager
- Asaeli Tawake, HR

Item	Action
1. Introduction & Presentation by PLANIT • The Project Team thanked the FSC management for taking the time out to meet and learn more about the FRA Project. • A PowerPoint presentation was presented in the English language explaining the project, the priority bridges & jetties and upgrade development activities • An explanation was provided on what was involved in the Feasibility study and Design Phase • An explanation was provided on the single option – to construct a new bridge within the existing bridge alignment including widening with traffic to be diverted around the existing roads through the industrial area to enable the online replacement to take place • Gathering stakeholders/communities' concerns and issues and information about the bridge and proposed works	
2. Discussion Session • The General Manager queried about the construction timeframe. The project team stated that the construction timeline has yet to be determined and that the	

study covered the feasibility of options and then design of the preferred option. In terms of construction, the bridge priorities could then be repackaged again based on locality or funding, practicality or logistics and complexity. For example, all the western bridges may be packaged together or all the bridge replacements that require a temporary bridge first could be done together in the Western Division. It all depends on the funding and therefore, the construction timelines have yet to be determined but could be within 2-4 years.

- The General Manager inquired if the project is fully funded by outsider donor agencies. The project team stated that the project is funded by the World Bank, ADB and the Fiji Government up to the design phase, and that once the project team receives pricing and assessment, it will be put to FRA to work with World Bank and ADB to see how it is packaged up for further funding of the construction phase based on the feasibility, design and costings for the construction phase.
- The General Manager stated that he had his representative from his Civil Engineering Team present and if the project team has any more technical questions his engineering team would be able to answer it.
- The project team inquired about the tramline on the downstream side and asked whether the general setback from the tramline reserve was 9m as the road reserve was also 9m. The FSC engineering representative stated that the setback was 10m or rather 5m on either side of the centre of the tramline.
- The project team stated that the bridge engineer was considering widening the bridge and recognized that a good buffer should be set aside between the new bridge alignment and the tramline and this setback from the tramline would have an impact on which side to widen.
- The General Manager stated that leaving more distance is preferred in case the locomotive may derailed and travel further off the track and cause damage to other properties like the bridge or pedestrians. He said obviously putting a 30m diameter would be much better for safety reasons. The project team confirmed that yes, the bridge would have to also provide for pedestrian footpath as presently we see people using the tramline to cross the river when there are no trains coming.
- The project team asked FSC if they have any plans to upgrade the tramline. The General Manager stated that FSC is trying to upgrade the tramlines by requesting financing from the government, but right now they have no plans of changing any of the tramline's structures.
- The bridge engineer asked if FSC had plans to rebuild this particularly tramline bridge as the base was eroding and FSC said they will simply consider upgrade the base but not the tracks though nothing has been confirmed as yet.
- The project team mentioned that many of the bridges that they have undertaken consultations of so far have had raised the issue of flooding as their primary concern, with some communities blaming the tramline structure that runs parallel to the subject bridges as one of the main problems because debris gets caught and dams up the river, flooding communities again and again. As a result, when asked if FSC intends to widen the span of their tramlines and the base, the General Manager stated that the height and structure will remain the same.
- FSC's engineering team representative mentioned that if there was any flooding at their tramline structures, FSC will clear out the debris from underneath.
- FSC was asked if there was a lot of flooding at the Navutu bridge and the adjoining FSC quarters; FSC stated that they have never received any complaints or issues about flooding at the Navutu bridge.

- When asked if the flood level reaches the tramline, FSC stated that the flood water level does not reach so high up to the tramline, but rises a little and then recedes.
- The project team stated that the 5m tramline restrictions and setbacks indicated on either side will force the widening of the bridge to be shifted to the upstream side of the bridge but the shift would also be affected by the existing WAF sewer pump located within the adjacent park boundary though close to the road reserve.
- When it comes to the larger FSC property on the tramline side downstream, FSC representatives were queried on the portion of land that was owned by FSC. FSC stated that their land only extends to where the tramline runs and the nearby FSC residential quarters.
- In terms of the WAF pumping station, the project team will communicate directly with the Water Authority as well as the Lautoka City Council about the surrounding park.
- FSC was advised that the awarded contractor will require a laydown site during construction but FSC General Manager wanted to know what the length of the construction timeframe and the area of the construction site – the bridge engineer responded that it will take about a year and the area will be 50m x 50m or slightly larger in a rectangular shape due to the precast material that will need to be pushed across. During the construction time, the contractor will inquire about leasing the space from the property owner.
- The project team enquired if they are experiencing flooding on their side downstream; FSC responded that they have not experienced flooding on their side of the bridge and confirmed with the bridge engineer that was present in the meeting that there is no flood gate downstream so the water is able to flow out easily and they do not have any tidal issues.
- The project team enquired if the majority of FSC employees who live in the quarters near the Navutu Bridge had access to a vehicle; FSC stated that they do. This was basically to establish that if the bridge was closed, the FSC employees would have to use the diversion route to get to work and back home.
- When asked if they have seen people crossing on the tramline rather than the bridge, FSC said that they have, but that they are from the Navutu settlements near the industrial area past the FSC quarters.
- When asked if the large trees beside the bridge and along the road were planted by FSC, they stated that they were not planted by FSC and that the trees had been there for a long time and was likely to have been planted by the Lautoka City Council.
- The bridge engineer from the project team expressed his hope that the construction works would not harm the trees, as the bridge is being widened and will not be on the tramline side, but rather on the pump station side with the other property owner opposite the pump station where plantations are located – The FSC acknowledged that it is not their property.
- The project team inquired about cane trucking, namely from which side of the bridge do they typically come from to go to the mill - FSC said that cane trucks come from both sides.
- The project team inquired about FSC's concerns if the contractor closes the Navutu bridge and diverts traffic whether this would this be an issue for FSC. FSC stated that the tramline was their main issue and that would should avoid any damage or disruption to the tramline.
- The project team mentioned that the tramline will remain operational during construction, but that road traffic will be affected. Livai of FRA responded that the main concern for FSC will be the cane trucks, but that the public can

easily be diverted onto the main road; the General Manager then added that it will only be a year or so problem until the new widen bridge is open again, so they do not see it as a major issue.

- The project team requested if FSC could issue a notice to the staff living in the quarters, in addition to FRA providing its public notice on the road diversion - the General Manager affirmed that they will issue the letter to their employees once the works are confirmed.
- The project team inquired if their employees cross the bridge on their way to work; FSC stated that they either cross the bridge from the back gate or go around the front gate.
- When it came to traffic, the project team indicated that there was a lot of industrial traffic crossing the bridge so this would need to be factored in for the maintenance of the road that the traffic will be diverted too and would need to be included into the construction programme.
- When asked how many people live in the FSC quarters, FSC responded that there was roughly 40-50 people that lived in the compound.
- The project team asked if the management of FSC know of any of the residents from the quarters uses the river for swimming or fishing in the river. FSC management said they do not know.
- The bridge engineer of the project team asked FSC if during the construction period, whether the 5 metres clearance could be reduced to 2.5 metre, at least temporarily. The justification was that the project team understood during the cane crushing season there would be large volumes of cane going to the mill but in between crushing season, when there will be no cane going to the mill, can they consider a reduction during the non-crushing period. FSC responded saying that the tramline area should not be disturbed because of the formation/foundation and the loco is always 21-22 ton, which is why they always allow 10m, and any construction or machinery moving around should stay away from the preserved area.
- According to the bridge engineer, the present bridge is roughly 5 meters away from the tramline, and the contractor will have to walk into the area between the tramlines for some working space even if the existing bridge is demolished. There will be times when they must encroach into the 5m – FSC stated that they may work jointly onsite.
- When the project team inquired about their crushing season, FSC stated that it runs from May to November every year. FSC requested that during construction, the contractor must notify the FSC so that the FSC engineer could make himself available to supervise the bridge contractor's works near the tramline.
- The project bridge engineer stated that for the construction methodology they will look at the bridge being demolished first, followed by building the bridge foundation and once this completed, both banks will be reinstated to allow for the crushing season to begin. Then the contractor can carry on with the barrier, the footpath, and remainder of the works.
- The project team also expressed concern that if the Contractor uses the downstream land area for their construction site laydown area, they will have to go over the tramline, which will be difficult. Therefore, the contractor may either have to use the park land or the plantation area on the upstream side and both the Council and landowner will need to be consulted.
- The project bridge engineer also indicated that another option could be that if the road is closed, the closed road could also be used as a construction staging area.
- The FSC requirement is to stay clear away from the tramline foundation and this was made very clear by the FSC management present at the meeting.

- This will apply to all other bridges where tramlines run parallel to the bridge, as well as one or two bridges with tramlines on the bridge itself, which will need to be replaced before the rail is installed.
- The project team proposed that the powerpoint presentation be repackaged to include all of the bridges with the railway lines on them and beside them so that FSC could provide comments to the design team. After the bridge engineer completes his design, further one on one consultation with FSC should be undertaken to establish their concerns and issues regarding the tramline.

With no other questions raised, the meeting was closed.

3. Actions from Meeting

- Project team to get the name and contact details of:
  a) the landowners on the upstream side and downstream of the existing bridge both sides
  b) Confirm that Lautoka City Council or Fiji Sugar Corporation owns the park land on the upstream Lautoka side
  c) Confirm if any of the Water Authority of Fiji infrastructure will be affected in the park land
- Land tenure and ownership will need to be confirmed of all affected land - once the preliminary design options are done by the Engineers.
- BECA Design team to have further consultation with FSC and confirm with FSC on the tramline requirements for setbacks from the tramline reserve for proposed bridge widening & footpath location
- Distribution of community questionnaires of those households living in the FSC compound close to the existing bridge proposed to be replaced and for the traffic diversion plan.

Project Name:	**40 Critical Bridges and 3 Maritime Structures Stakeholder Consultation Meeting Minutes**
Structure(s):	Navutu Bridge (P1)
Place of Meeting:	Lautoka City Council meeting hall, Lautoka
Meeting Date:	Wednesday, January 24th 2024 **Meeting Time:** 11:00 AM
Prepared By:	PLANIT Pacific Pte Limited

Attendees:

Project Team

- Jacqueline Hughes, PLANIT Pacific—Land & Resettlement Specialist
- Tevita King, PLANIT Pacific - Land & Resettlement Team
- Julia Whippy, PLANIT Pacific - Presenter
- Alex Revell, BICL - Bridge Engineer
- Noa Sakapo, FRA – FRA Valuation Officer

Stakeholders

- Apisai Vularika, DO Lautoka/Yasawa
- Sitiveni Tavaga, DO Lautoka
- Amelia Bai, DAC Navutu, Nasoata, Taiperia
- Josefa Saumailagi, Waterways Department
- Vikant Sharma, EFL
- Elvin Kavitesh, EFL
- Inosi Nabuka, FPCL
- Alvin Nair, FPCL
- Shaneel Prasad, FSC Ltka
- Mohammed Imraz, FSC Ltka
- Sanil Nand, WAF
- Daniel H Pickering, WAF
- Vilimoni Ravouvou, WAF
- Daniel Chand, LCC
- Shalendra Dass, LCC
- Pooja Prakash, FNPF
- Vishwan Dass, FNPF
- Aisea Tivakanoa, DoL
- Livai Koro, Fiji Roads Authority
- Zafiya Shamim, FRA
- Epeli B, FRA
- Salome T, DoF
- Joseva R, DoF

Community members

- *Sakiusa Naqesa, Turaga ni Koro Navutu Community*
- *Vasiti Mole, Navutu Womens Club Secretary*

- *Roslyn Madama Yee, Transformation International*
- *Helen Shaw, Transformation International*

Item	Action
1. Introductions • Jackie Hughes of the Land Acquisition team (PLANIT) welcomed everyone and thanked them for their presence. • Jackie introduced the 40 bridges and 3 jetties structures project and the project team and asked everyone to introduced themselves while they wait for the those arriving late.	
2. Presentation by PLANIT • A PowerPoint presentation was done in the iTaukei language explaining the project, overall priority of bridges & jetties and upgrade development activities • Explanation of the design process and environmental and social safeguards including summary of site investigations and data gathered was expressed • Responding to the villagers and stakeholder comments and issues through Q & A • Explaining next steps and indicative timeframes	
3. Discussion Session • During the presentation there was a question from a villager who was speaking on behalf of Vilimaina who has recently built her house on the Suva side of the bridge on the hill. She had requested that her house be relocated further in land as, according to the land acquisition plan, her house is sitting on the edge of where FRA is intending to cut the hill. She also requests an access to her house as well for pedestrian and vehicle. Mr. Nevell noted this request and will raise it with FRA. • A villager asked about whether or not FRA will compensate them for the relocation of their pigs pen. Mr. Sakapo informed them that FRA have decided that they will only compensate them by buying the materials for a new pigs pen. He also mentions that only the land required for construction, the plantations affected and the pigs pen will be compensated for. • A villager asked if they can be employed by the development when the time comes; Mr. Sakapo replies that it is not like before as now it is up to the contractors who is hired for the job. The villager's requests FRA if they can inform the chosen contractor to consider the villagers as laborers or security. • Another villager asks if those working on the construction of the bridge will want to be billeted in the village; to which Mr. Sakapo replied that they have teams based in Nadroga who would not need to be billeted as they stay in the area already. • A question was asked if they can build in the acquisition areas; Mr. Sakapo advised them that FRA will buy that land off of the landowners to which the title will be changed and written to the Director of Lands. • A question was raised on whether or not the excess rock that would be blasted from the works on the hill, could be used to make their seawall or beach works (this was mentioned in the 1st consultation meeting); Julie (PLANIT) and Alex from BECA replied that they had discussions internally and mentioned that the rock would be stock piled at the site after blasting and if the villages want	○

it for construction of the seawall, they will have to request it from Department of Environment to use the excess rock.

- The village head mentions that FRA cannot construct the seawall as it has to be an engineer who specializes in that work to do so. The villages also asks if they should request now to the Department of Environment (DoE) or should they wait for the rocks to be extracted from the hill; of which Julie (PLANIT) mentions that they should wait for the rock to be extracted before apply for it from DoE
- Livai Nadore (FRA Environmentalist WEST) informed the villages that DoE has their laws that is called the "Environment Management Act 2005". He states that these are two different works or upgrade discussed here, one is the bridge upgrade and the other would be the seawall construction. These cannot go together because the seawall construction would need a separate EIA. The only thing that FRA can do is extract the rocks and keep it onsite for the villages until they have completed the request and process with DoE. Julie (PLANIT) adds on to say that it would be an added bonus if they could get the advice of a marine or coastal engineer to help design the seawall because if it is not designed properly, it will cause damage to other places along the beach.
- Mr. Livai Nadore (FRA Environmentalist WEST) informs the villagers that this is the final consultation and there will be an EIA consultant who will be coming around to do their inspection for the EIA report which is a separate process to this current stage which is the design stage.

With no further questions from the villagers, the meeting was closed.

4. Actions from Meeting

- FRA team to discuss and get back to Vilimaina (who lives on the hill) about her request of moving her house to the back as the cut line of the hill affects her newly built house. Also, the possibility of a vehicle access point.

Project Name:	**40 Critical Bridges and 3 Maritime Structures Stakeholder Consultation Meeting Minutes**	
Structure(s):	Navola Bridge (P1)	
Place of Meeting:	Navola Community Hall, Nadroga	
Meeting Date:	Tuesday, January 26th 2024	**Meeting Time:** 11.00 AM
Prepared By:	PLANIT Pacific Pte Limited	

Attendees:

Project Team

- Jacqueline Hughes, PLANIT Pacific—Land & Resettlement Specialist
- Tevita King, PLANIT Pacific - Land & Resettlement Team
- Aisake Raratabu, Facilitator/Presenter
- Alex Revell, BICL - Bridge Engineer
- Noa Sakapo, FRA – FRA Valuation Officer

Stakeholders

- Alesi Nasikolikoli, MoL
- Asea T, MoL
- Emori Latibau, Ra Provincial Office, Assistant Roko
- Veniana Marama, Ra Provincial Office, DO
- Josefa W, NFA

Community Members

- *Sundres Chetty, Landowner*
- *Devneshwar Rao, Farm Manager*

Vunitogoloa Village members

- *Sailosi Senitoga, Village member*
- *Esala Vukitoga, Village member*
- *Opeti Mokia, Village member*
- *Pailato Qarau, Village member*
- *Kalivati Manono, Village member*
- *Pio Nakauta, Village member*
- *Pita Matakibau,Turaga ni Yavusa*
- *Laisa Tukana, Village member*
- *Sovata Tui, Village member*
- *Josefa Mamakiwai, TNK*
- *Eroni Naivalu, Village member*
- *Joape Valiti, Village member*
- *Litiana Lotu, Village member*
- *Mereia Rotoka, Village member*
- *Joana Silimaibau, Village member*
- *Eparama Saqali, Village member*

- *Tevita N, Village member*
- *Tema Loganimoce, Village member*
- *Aseri Coa, Village member*
- *Meresoni, Village member*
- *Amele Koto, Village member*
- *Mereani, Village member*
- *Salanieta Galo, Village member*
- *Seniana Nomawi, Village member*
- *Akisi Adivonodaudau, Village member*
- *Makereta Seru, Village member*
- *Karalaini Namono, Village member*
- *Suliana Vutuni, Village member*
- *Eseta Vai, Village member*
- *Repeka Salaivalu, Village member*

Item	Action
1. Introductions • The Assistant Roko welcomed and thanked the villagers for their presence. He then handed it over to Mr. Aisake Raratabu (Facilitator/Presenter) to briefly introduce the 40 bridges and 3 jetties structures project and the project team. He advised them that the project team would then present the details of the project. • No sevusevu was presented as the meeting was being held at the church due to their community hall and village grounds being flooded. As we had presented our sevusevu back in 2021, the TNK said it was not necessary to present another sevusevu.	
2. Presentation by PLANIT • A PowerPoint presentation was done in the iTaukei language explaining the project, overall priority of bridges & jetties and upgrade development activities • Explanation of the design process and environmental and social safeguards including summary of site investigations and data gathered was expressed • Responding to the villagers and stakeholder comments and issues through Q & A • Explaining next steps and indicative timeframes	
3. Discussion Session • A village member asked on behalf of the women if it was possible to sell food to the workers during the bridge upgrade and also asked if permits/licences to sell was required. Aisake advised her that because they were located in the village, the town rules do not apply to them so they are free to sell food in front of the village provided they use proper hygiene and health and safety requirements. Jackie (PLANIT) also advised that it would be best for the women in the village to liaise with the Contractors directly and to find out their worker's needs, meal requirements/preferences during the construction period. The women in the village were very appreciative for this opportunity.	

- Sundresh (freehold landowner) stated that the community needed a proper drainage system to minimize damages to farms and houses especially in the village. He mentioned that further down the road, away from the bridge, near the tramline there are no culverts. He requested if FRA or the engineers could look into the possibility of installing culverts so waterflow can be good for both sides of the bridge. He further discussed that water gets stuck/blocked at the tramline crossing and rushes down the end and into the fields and then goes over the bridge. He asked what could be done to ensure proper drainage. Alex (BECA) stated that they would do everything possible within their scope of works to minimize drainage issues.
- Sundresh also questioned why the drains in Vunitogoloa break at the tramline as opposed to being continuous like a normal drain. Alex (BECA) stated that beyond the tramline is outside their scope of works though they will do their best to incorporate drains on both side of the footpaths within the bridge upgrade area. Outside of that Alex can raise it with FRA to see if it can be included and connected to the new drains for the bridge. Jackie also indicated that she would pass on the contacts for Ministry of Waterways and FSC to the Turaga ni Koro to get them to come out to site and see how they can assist with the flooding issues as the Ministry of Waterways are responsible for drainage issues.
- A village member asked if the construction works and footpaths would be affecting any building structures in the village during the bridge upgrade. Jackie (PLANIT) confirmed that construction would not affect any house structures as a result of putting in the new footpaths. She explained that the only affected person in the village that would need temporary relocation would be Pita Matakibau whose access and steps to his house will be affected but it will be replaced to come from the side of his house as well as his driveway access. Further Jackie explained how the footpath from the bridge to the waterway via the new steps and washing platform, would require the removal of Pita's front hedges where the footpath would be constructed.
- Alex (BECA) also confirmed that the village access roads on both sides will be upgraded.
- Jackie (PLANIT) stated that the bus shelter will be permanently removed during the bridge upgrade to accommodate for the temporary road and asked the village members where they would want it moved to. The community indicated that it would best moved to the bus bay on the downstream Rakiraki side of the bridge.
- Another village member questioned where the best place would be to sell their food. Alex (BECA) stated that it would be advisable to ask the contractors where it would be best to sell depending on where their construction works will be.
- Jackie (PLANIT) added that the red area (rental) on the plan is the minimum area that is required at this stage by the contractors and that they may need more area for stockpile/office/ parking. The contractors will need to identify this once they are awarded the contract and then they will negotiate directly with landowners.
- A village member asked how long the duration of the bridge upgrade will be. Alex (BECA) stated that he did not have an exact answer but estimates a minimum of 3 years and somewhere between 3.5 to 4 years.
- A village member shared her concerns since 80% of the village using the ocean for their livelihood. She questioned if during the bridge upgrade it would affect them with oil spills and contamination of their waterways and fishing areas. Alex (BECA) stated that the contractor will have an environmental management plan in place to minimize any environmental impacts of vibrations, damage, and contamination to ensure no long-term impacts.

- Jackie (PLANIT) mentioned that a FRA safeguards team will be monitoring and the contractor will be reporting every month. She reiterated that the village members are encouraged to use the grievance redress mechanism to note any changes and raise any concerns. She encouraged the members to be proactive and speak out to address all issues and concerns. She also stated that since the project is ADB/World Bank funded, they are very strict when dealing with environmental and social impacts so FRA will have to follow all proper guidelines as part of their funding requirements.
- The village members and TNK raised concerns about the recent road works carried out on the Kings Road in front of the village. They said that since the raising of their road, the water from the upstream side of their village cannot go through the culvert that was installed and now their village faces flooding which is affecting their village hall and church. He said they have gone to the media in the last week and then only FRA's consultant came out to inspect from SMEC. He said that they have been advised that they cannot make the culvert bigger or it will affect the downstream side of the village and flood that side of the village. The SMEC consultant stated they would instead dig a drain along the road and have a new drain and culvert to drain the area towards the shop and out to sea. He said he hopes that they do not face similar issues with the bridge works in terms of flooding to the village.

With no further questions from the villagers and stakeholders, the meeting was closed.

4. Actions from Meeting

- Alex to include area for new bus stop and amend land plan if additional area is required from the village reserve.

Project Name:	**40 Critical Bridges and 3 Maritime Structures Stakeholder Consultation Meeting Minutes**
Structure(s):	Vunitogoloa Bridge (P1)
Place of Meeting:	Vunitogoloa Village Meeting Area, Rakiraki
Meeting Date:	Wednesday, October 20th 2021 **Meeting Time:** 2.00pm
Prepared By:	PLANIT Pacific Pte Limited

Attendees:

Project Team

- Jacqueline Hughes, PLANIT Pacific—Safeguard Land & Resettlement
- Julia Whippy, PLANIT Pacific—Social Safeguards
- Manisha Nandan, Erasito—Environmental Safeguards
- Vaclav Hirsch, BICL—Bridge Engineer

Stakeholders

- Livai Koro, FRA

Vunitogoloa Village

- Titilia Sereana
- Mereadani Savuna
- Vivita Turaga
- Tokasa Vunisinu
- Temalesi Tale
- Simi Nakauta
- Joape Valiti
- Isimeli Suga
- Opeti Mokia
- Ana Suraki
- Sereana salele
- Josefa Manakiwai – village headman
- Pailato Qarau
- Vasemaca Yawa
- Litiana Lotu
- Josaia Ratu
- Sakiusa N
- Kitione N

Item	Action

1. Introduction & Presentation by PLANIT

- A PowerPoint presentation was presented in the Fijian language explaining the project, the priority bridges & jetties and upgrade development activities
- The project team provided an explanation of what is involved in the Feasibility study and Design Phase.
- Explanation on the possible two options - new bridge to replace the existing bridge alignment with a temporary traffic diversion required (similar to that at nearby bridges under construction that are being replaced by Fletcher Construction by way of being temporarily located either upstream or downstream
- Gathering stakeholders/communities' concerns and issues and information about the bridge

2. Discussion Session

- A question was raised about whether the FSC tramline bridge near the river mouth downstream will also be included in the bridge upgrade. The community stated that the tramline has not been used since the Cyclone Winston and it was a concern as the Rarawai Mill is connected to the tramline. The project team confirmed that the tramline bridge belonged to the FSC and therefore, FRA was not in a position to upgrade it and they would have to raise this matter with FSC.
- They also inquired about the road hump and whether it would be included in the upgrade; they were told that they could submit their request to the FRA because it was not included in the bridge upgrade for this project.
- Concerns about speeding traffic along the highway in front of their village due to the lack of a hump
- The FRA representative inquired about the how recent FRA made the road to which the community stated that it is new. The FRA representative continued, "For new roads, there is a timeframe given to see if the road is stable enough before they return all of the humps that were originally there before any road upgrade," adding that "for new roads, there is a timeframe given to see if the road is stable enough before they return all of the humps that were initially there before any road upgrade."
- They bathe, fish, and swim in the river, catching tilapia, jumping jack, prawns, and other fish.
- Because the bridge is low, the debris stops the water flow and therefore floods the village.
- They are not connected to WAF, so their drinking water comes from a borehole, and the pipeline crosses the road and is located further away from the bridge
- There is a TFL line on the bridge site
- The community is concerned about a small culvert bridge that is causing flooding in the village because the culvert is too small for large volume of water to pass through; they are requested that the project team could look into it as there are more houses downstream than upstream that usually impacted by the flood.
- With the option of placing the temporary bridge upstream, there is a lay preacher's house located on the way of the temp bridge – the project team suggests to the community that the lay preacher's house be relocated
- Also located upstream is the EFL high voltage powerline, which could obstruct placing the temporary bridge upstream

- The villagers suggest diverting the road in the village upstream – the bridge engineer responds that it is preferable.
- The lay preacher's home has been there for 17 years, and the locals have confirmed that the region around it floods.
- The project team asked if there is any space in the village to relocate the lay preacher's house, and the villagers confirmed that the surrounding area floods.
- The village headman asked who will be responsible for moving the house if it is to be relocated, and the response was given to the community that once the studies are completed and if there is a need for relocation, the community will be notified.
- One solution suggested by the project team is to temporarily relocate the house, demolish it, and rebuild it in a new position, and then demolish the temporary bridge and replace it with a permanent one in the same area. They were told that the existing bridge, which is currently 8 meters wide, will be widened to about 14 meters.
- One of the village elders totally supports the idea of dismantling the lay preacher's house upstream and using the land for bridge building because the most important issue is to upgrade their flooded bridge. The village headman is also in favor of the proposal; however, they must first confer with the church elder and furnish the project team with the possibilities they have suggested. If the church wishes to have the lay preacher's house transferred back, or if the church believes the house is too close to the road and decides not to remove it back, the space can be turned into a youth and children's play area.
- The local headman suggested that the lay preacher's home be permanently relocated near the church.
- When it comes to the construction site, the community was questioned who owns the land on the opposite side of the bridge downstream — they don't know.
- The community has requested that the bridge be raised because the current one is too low.
- The lay preachers' house will be relocated near the church and then returned once construction is completed.
- The freehold land opposite the lay preacher belongs to Sudresh Chetty, a former CEO of the Sugar Cane Growers Council - 9928857, who lives in Lautoka.
- The freehold land opposite the village downstream of the bridge belongs to Rajesh Kumar - 9811238, who is the principal of one of Rakiraki's schools.
- A community member inquired about the project's duration; a response was supplied on the timeframe as per the presentation.
- A community member inquired whether the discussion on the bridge upgrade would continue if the government changed in 2022 after the general election – the response was that the project is not only funded by the government, but also by the World Bank and the Asian Development Bank, and they will still want to move forward.
- The community was asked how high the flood water is during flooding; they said the road floods and the flood level in the house would reach 4 feet.
- Residents inquired about the street light and if it was included in the project.
- A question was posed to the community if they have boats and whether they travel upstream; the community responded that they cannot travel upstream because the water is too shallow, and that they move their boat upstream to the bridge to shelter during cyclones. In the village, there are a total of 18 boats.
- To travel to Nanuku Sangam School and Drauniivi Public school in Vatukoula, the children in the village cross a bridge.

- The village headman informed the Church Steward (Tuirara) about the discussion, and he expressed his full support for the project team's ideas and suggestions. He confirmed that he will discuss the suggestions of relocating the lay preacher's dwelling near the church with the church officials. He went on to say that he will make the final choice, but that because it is church land, he will ask the Church Pastor to pray and bless the project if it uses the site, and that no concerns arise later during construction or study.
- Once the drawing is completed by the bridge engineer, it will be presented back the Church Steward.
- The village headman asked whether the project team could help them install a street light for their nursing station, and the question was passed on to FRA.
- Request from the village headman for employment for the village's youth during construction - response was to provide a list of youth, their abilities, and contact information, which will be forwarded to FRA and subsequently to the contractor who wins the tender. The village headman will make direct contact with the contractor.

With no further questions from the community, the meeting was closed.

3. Actions from Meeting

- Further consultation meeting with the freehold landowners on the Ba side to be undertaken separately after the community meeting to obtain their contacts and inform them of the project.
- Further land ownership confirmation with iTLTB in terms of the land required for the temporary bridge.
- Distribution of community questionnaires for those affected by the proposed bridge replacement/realignment/widening. Roko and Advisory Councils to facilitate the distribution and collection of the questionnaires.
- Need to confirm the road upgrade works being carried out by FRA in front of the village which is putting new footpaths which will likely be destroyed and damaged by the new bridge construction. Villages have requested this be looked into for fear of wasting resources and money.

Project Name:	**40 Critical Bridges and 3 Maritime Structures Stakeholder Consultation Meeting Minutes**
Structure(s):	Viseisei Bridge (P1)
Place of Meeting:	Viseisei Community Hall, Vuda
Meeting Date:	Thursday, October 14th 2021 **Meeting Time:** 10.00 AM
Prepared By:	PLANIT Pacific Pte Limited

Attendees:

Project Team

- Jacqueline Hughes, PLANIT Pacific—Safeguard Land & Resettlement
- Julia Whippy, PLANIT Pacific—Social Safeguards
- Manisha Nandan, Erasito—Environmental Safeguards
- Vaclav Hirsch, BICL—Bridge Engineer

Stakeholders

- Livai Koro, FRA
- Kitione D, Assistant Roko Tui Lautoka

Viseisei Village Member

- Josefa Qoro
- Save nalibu
- Anare Tudraki
- Apisai Dawai
- Apenisa V
- Joseva Saweta
- Pitawaqa Tairewa
- Merelita Valuma
- Salote Tuidraki
- Ilisapeci Bola
- Anaseini Dibilo
- Salaseini Kalo

Item	Action
1. Introductions • The Assistant Roko Tui presented the project team's Kava as Sevusevu to the village and then welcomed and thanked the villagers for their presence. He then briefly introduced the 40 bridges and 3 jetties structures project and the project team who would present to them the details of the project.	

2. Presentation by PLANIT

- A PowerPoint presentation was presented in the iTaukei language explaining the project, the priority bridges & jetties and upgrade development activities
- Provided an explanation of what is involved in the Feasibility study and Design Phase
- Explanation on the possible options: 1) new bridge to be constructed on the upstream from the existing 2) temporary bridge on the upstream side to enable the construction of a new bridge within the existing bridge alignment. The first option being consist with future 4 lanes plans by FRA between Nadi and Lautoka which is a separate project to these bridge replacement projects).
- Gathering stakeholders/communities' concerns and issues and information about the bridge

3. Discussion Session

- The village community in the meeting requested if the bridge works could include the dredging of the river downstream from the bridge, which is adjacent to the village.
- Further they requested if the new bridge plans could look at straightening the river downstream instead of meandering as this would reduce flooding impacts to the village.
- They also asked if the little bridge upstream along the Vuda Back Road could be upgraded to access their native reserve land because they have their plantations up there and the floodwaters are damaging their crops and also affecting them being able to cross the stream to their farms. They specified that flood levels could rise to half the height of the houses along the river.
- In terms of the other uses upstream, they confirmed that the Vuda Pork slaughterhouse is located upstream, with access via the Vuda backroad. Other businesses in the same area include Pratap Quarry and Flame Tree Stone Crusher.
- The villagers also confirmed that they could take a fiber boat under the Viseisei bridge and upstream and that they often take their boats to shelter under the bridge to shelter during cyclone periods.
- The villagers requested clarification if the tramline bridge will also be removed as they believe it is the main reason for the cause of the flooding in the area. They indicated that a lot of debris and large trees get washed down the river and gets stuck on the existing bridge and the water rises quickly right under the train tracks. They indicated that the flood levels rise very quickly within 15 minutes and the shop on the corner near the bridge – where Vuda Pork operates their retail store, the water level nearly reached their roof. A mark on the wall that shows the flood levels
- They use the mangroves upstream to catch mud crab, small crabs, and mana, and they also fish from the bridge.
- When asked if they have any future plans for the area around the bridge - the community responded that they are waiting for the international borders to open and will confirm if they have any tourism or residential plans for the area.
- When asked which route they take to get to the Tiri area near the bridge - the community responded that they can find their own way down the sides of the bridge to the mangrove as well as cross the bridge to get to the mangrove area on the opposite side.

- The community requested that a stairs going down the side of the bridge for ease of access to the water under the bridge would be useful for them to access the mangroves.
- The community also requested if we could have a walkway on the bridge with barriers or bollards to protect pedestrians and noted that they too also have their animals (cows and horses) crossing the Viseisei Bridge as they take their animals from the village to their plantation upstream to graze. When asked how many times they have to cross the bridge with their animals, the community responded that they cross the animals when the road is not busy and that they know certain times to take them across, around midday and in the afternoon. They may transport one horse and two cows at the same time.
- When asked if they are willing to grant permission for the use of the mangrove area as a construction site, as the fishing rights users, they responded that they must all agree because it will benefit not only them but the entire country of Fiji.
- The map and explanation of the area in which the proposed new or temporary bridge will sit upstream immediately above the existing bridge was explained to them, emphasizing that part of the mangroves will need to be removed for bridge construction – they responded that they all agreed and gave their approval for the project to use part of the mangrove area but FRA will need to follow the approval process. Another request made by the community was for their iqoliqoli committee to be involved, and they once again expressed their full support for the project. They also have a Yaubula Committee, and the project team asked those who attended the meeting to sit with their Yaubula Committee and advise them if they had any questions for them to forward to the project team. The community members then raised the point that one of the Yaubula committee members, who is also the Roko Tui, was present at the meeting and he noted his duty to inform his committee.
- The project team indicated that during construction, the contractor will need some space to do pre-casting of the bridge slabs and then have the slabs pushed across in the bridge alignment, highlighting that they will need to use part of the mangrove area. Once the exact area is defined by the engineers, this information and details will then go back to the community for their information.
- Roko Tui reassured them that this is only the first stage of the project; investigations will be conducted, and once completed, another round of consultations will be held to inform the community of the findings and the final details of the bridge alignment options after taking into considerations their comments and concerns from these meetings.
- In response to a question from the Turaga ni Koro about compensation, the project team stated that once the investigations are completed, the decision on whether or not compensation will be made available to the villagers will be handled by Fiji Roads Authority through their acquisition and compensation process and this will be another round of meetings with the village.
- The project team asked the community if they have a cultural committee in the village, to which they replied they do, and the project team added that the new bridge can have an entry and exit statement for the cultural significance of the area as well as some historical design/features so this was an opportunity to work with their artists and creative members of the village to add some cultural features to the bridge design. The community agreed and provided a contact to the Bridge Engineer to make contact once the art work was required. The community indicated that the Uto leaf was one of their motifs for the village that could be featured on the bridge.
- The community asked if the design could include steps on the bridge site because if they are late, they can always travel to the bridge to catch the boat – the project team responded that a step will have to be placed next to the bridge

as the bridge will be raised a little high to take into account sea level rise and climate change.

- They were asked if they tie their boat at the bridge – they confirmed that they do and they have three boats belonging to the village that they often take to the tie up during cyclone periods so if they could have an area to tie their boats up and store them safely near the bridge that would be appreciated.
- The river is known as Naisaro River, and the bridge is also known as Naisaro, but it is now known as Vuda Bridge and not Viseisei Bridge. A village member then stated that the river has historical significance to them because an old village site (Koro makawa) is located upstream on the hill site (the location of which needs to be confirmed – about 3km from existing bridge) but was there in 1826 and also the first person to bring Christianity to the village also used the river.
- There are two yavusa in Vanua Vuda: Yavusa Sabutoyatoya and Yavusa Tubuvere.

With no further questions from the community, the meeting was closed.

4. Actions from Meeting

- Project team to get the name and contact details of:
- the landowners on the upstream side of the existing bridge both on the Lautoka and Nadi sides.
- Boat owners
- Land tenure and ownership will need to be confirmed of all affected land - once the preliminary design options are done by the Engineers.
- Confirm with the utility provides the services located in close proximity to the existing and proposed bridge alignments that will need to be relocated esp. the existing fuel line
- Distribution of community questionnaires for those affected by the proposed temporary bridge upstream and existing bridge replacement, the Turaga ni Koro, the Provincial Council reps and the Women's group rep for the village to facilitate the distribution and collection of the questionnaires. Need to also contract the District Councillor who is responsible for the Indo-Fijian settlement located on the Lautoka side of the village to obtain their comments as well.
- Confirm with Lands Department on the name of the river that flows underneath the Viseisei Bridge.
- Confirm with FRA the name of the bridge – is it Viseisei or Vuda Bridge.
- Need to confirm the location of the old village site in relation to the existing bridge and the proposed site upstream.

Project Name:	**40 Critical Bridges and 3 Maritime Structures Stakeholder Consultation Meeting Minutes**
Structure(s):	Viseisei Bridge (P1)
Place of Meeting:	Viseisei Village Hall
Meeting Date:	Wednesday, March 20th 2024 **Meeting Time:** 11.00 AM
Prepared By:	PLANIT Pacific Pte Limited

Attendees:

Project Team

- Jacqueline Hughes, PLANIT Pacific—Land & Resettlement Specialist
- Tevita King, PLANIT Pacific - Land & Resettlement Team
- Aisake Raratabu, Facilitator/Presenter
- Alex Revell, BICL - Bridge Engineer
- Noa Sakapo, FRA – FRA Valuation Officer

Stakeholders

- Tabitha King, PLANIT Pacific
- Kelekolio T, FRA
- Serona F, FRA
- Vikant Sharma, EFL
- Rauluioro R, EFL
- Luke Niumatawalu, Mobil
- Wame Tagilala, Standard Concrete Industries

Community Attendees

- Shakuntla Permal, Property Owner, State Lease
- Permal, Industrial Garage Operator
- Avinash Reddy, Vuda Shopping Center Director
- Avinash Ratnam, Vuda Shopping Center, Manager
- Shorab Khan, Property Owner, State Lease
- Nisha Khan, Community Member/NGO Rep/Property Owner (State Lease)

Viseisei Village members

- Timoci Tuiweli, Tokatoka Nakelo, Vuda
- Epeli Saukuru, Tokatoka Nakelo, Vuda
- Inoke, Baleinasauva, Tokatoka Nakelo, Vuda
- Patilioni Tuisabeto, Village member
- Josefa Qoro, Village member
- Inoke Modoedonu, Village member, Turaga Ni Koro (TNK)
- Josefa Selo, Village member
- Osea Kiliraki, Village Member

- Repeka Naileqe, Village Member
- Asinate Varo, Village Member
- Alipate Bola, Village Member
- Pita Waqa T, Village Member, VRC

Item	Action

1. Introductions

- The Turaga ni Koro presented the project team's Sevusevu to the village as the Assistant Roko from the Provincial Office could not attend the meeting. DO also was not present.
- The Turaga ni Koro welcomed and thanked the villagers for their presence. He then handed it over to Mr. Aisake Raratabu (Western Presenter/Facilitator) to briefly introduce the 40 bridges and 3 Jetties Structures Project and the project team.

2. Presentation by PLANIT

- A PowerPoint presentation was done in the iTaukei language explaining the project, overall priority of bridges & jetties and upgrade development activities
- Explanation of the design process and environmental and social safeguards including summary of site investigations and data gathered was expressed
- Responding to the villagers and stakeholder comments and issues through Q & A
- Explaining next steps and indicative timeframes

3. Discussion Session

- A question was raised by the TNK about the areas being affected and how many iTaukei landowners were affected, and from which Mataqali. Jackie (PLANIT Pacific) clarified the areas of which was state land and iTaukei lease land. The TNK also queried about the Fisheries Impact Assessment and expressed his disappointment that there was no one representing the Fisheries department to discuss the FIA since they use the mangrove areas for fishing and catching crabs. Jackie (PLANIT) noted the TNK's concerns and explained that the Ministry of Fisheries would be in contact with them soon to come out and undertake the FIA. She explained that they would come and undertake interviews and do some fishing over a week's period to see what type of fish they catch in the area. Once they complete their field work they will write their report which will be send to Lands Department for their consideration on the fisheries compensation amount. This will be shared with the registerd Qoliqoli Resource Users before payment will be made by FRA to DoL and then on to iTLFC.
- The TNK questioned how FRA calculate their compensation and if there was a standard formula they used. Mr. Sakapo (FRA Valuer) re explained the valuation process for crown land, native and mataqali land. Jackie (PLANIT) explained that Ministry of Fisheries, based it on the species they catch and the surveys they undertake to confirm

what is caught by the locals, and then they use commercial values of the fish species and numbers to calculate the value of loss of use of the area.

- A villager raised a concern on the compulsory acquisition by FRA. Mr Sakapo (FRA) discussed further that compulsory land acquisition is only done when land cannot be acquired by a mutual agreement between Government and the landowners. Its only used as a last resort, when Government can exercise its powers given under the Crown Acquisition of Lands Act to compulsorily acquire a land for public interest and purpose. He also assured the village members that their first step in land acquisition will always be to discussions with landowners and try to find mutual ground.
- A landowner/community member, Mr. Khan, queried how community members would visit the health center in Viseisei, if the access to Viseisei back road to the village will be closed during construction. Alex (Beca) assured Mr. Khan that a temporary access will be provided by the contractor during construction, in order for the community members on the Vuda Back Road side to access the dispensary at Viseisei.
- Mr. Khan asked how and who they could make complaints to as he has had bad experiences with past authorities taking advantage of him with regards to the land acquisition process in terms of what they say they will do and they don't follow through and complete the process. Mr. Raratabu (Facilitator/Presenter) and Jackie (PLANIT Pacific) reiterated that there was a Grievance Redress Mechanism in place in order to address community or stakeholder conflicts, complaints and grievances at any stage of the project. Mr Khan was reassured that FRA's Land Acquisition team (Noa/Save) with whom he has already met, would be in contact with him to ensure that all the concerns are captured in the Sales & Purchases Agreement.
- Mr. Wame Tagilala (Standard Concrete Industries) questioned when they might expect FRA contractors to commence construction. Alex (BECA) stated that tentatively construction should begin by end of the year (2024) or early next year 2025.
- Ms Shakuntla Permal, community member/representative of her two sons who owns the commercial land beside the bridge (Nadi upstream side), shared that they had future plans for their commercial property to create a recreational area, a park and a canteen for the community. She requested that FRA not disturb any permanent structures present in the project area that could hinder the sales of the tenants, especially the new shop tenants who have just signed a 3-year lease. She also requested that the valuers and owners/tenants have further stakeholders' discussions to fully understand the impact of the bridge upgrade to the business operators in Viseisei. She stated that the main concern during the bridge upgrade is the loss of access for community members and those traveling past on the Vuda Back Road, who find it convenient having a shop at that junction. She added that children and women from nearby villages such as Saru and Navula use that road often and if access is disrupted, they will have to travel the longer route and it greatly affects the rural dwellers.
- Alex (BECA) described the new temporary access to the community members. Avinash Reddy (Vuda Shopping Center) stated that it would severely affect his business (shop located in the junction). He shared that when choosing the site for his shop he considered the highway location which would now be affected by the proposed bypass road. He shared his concerns that customers who now find it

convenient to stop by his shop when passing will not opt for the bypass road as it would be inconvenient for them to turn left of the proposed bypass and therefore, would prefer to drive to the next shop with easier access. Avinash also stated that since the road would be raised 2 meters higher his shop and other commercial properties in the area will not be seen from the side view of the highway. His shop has only been in operation for a short period and he is unhappy with the bridge design and impact to his shop access, and requested that these issues and impact to his business be taken into consideration.

- Wame (Standard Concrete Industries) questioned whether the Viseisei and Lomolomo bridges will begin construction at the same time. Alex (BECA) stated that it would depend on the staging of the contractors and this would only be able to be confirmed once the preferred contractors have been selected.
- TNK of Viseisei said that they ought to consider the major traffic that would be caused if both bridges were built simultaneously. He also stated that the design team be mindful of Mobil Oil's pipelines that supply fuel to the planes at the airport which is greatly needed for our airport to operate and for our Tourism industry.

With no further questions from the villagers and other stakeholders, the meeting was closed.

4. Actions from Meeting

- FRA valuation team to have further discussions with commercial properties regarding impacts to the loss of business during the construction phase.

Project Name:	**40 Critical Bridges and 3 Maritime Structures Stakeholder Consultation Meeting Minutes**
Structure(s):	Vitawa Bridge (P1)
Place of Meeting:	Vitawa Village Meeting Area, Rakiraki
Meeting Date:	Wednesday, October 20th 2021 **Meeting Time:** 10.00am
Prepared By:	PLANIT Pacific Pte Limited

Attendees:

Project Team

- Jacqueline Hughes, PLANIT Pacific—Safeguard Land & Resettlement
- Julia Whippy, PLANIT Pacific—Social Safeguards
- Manisha Nandan, Erasito—Environmental Safeguards
- Vaclav Hirsch, BICL—Bridge Engineer

Stakeholders

- Livai Koro, FRA

Vitawa Village

- Viliame Tonu
- Semesa K
- Nailiti B
- Napolioni Nasara
- Inia Waqa
- Aseri Sekidela
- Akuila K
- Waisake R
- Miriama T
- Seini Marama
- Anaseini Duguci
- Mere Tupou
- Amelia Uluivuda
- Kiti R
- Kelera Nai
- Siteri N
- Sairusi
- Sitiveni Sikitoro
- Susana Samilala
- Viema N
- Rama N
- N Solomone

Item	Action
1. Introduction & Presentation by PLANIT • A PowerPoint presentation was presented in the Fijian language explaining the project, the priority bridges & jetties and upgrade development activities • Provided an explanation of what is involved in the Feasibility study and Design Phase • Explanation on the possible options – new bridge to replace the existing bridge. A temporary traffic diversion required (similar to that at nearby bridges that are being replaced by Fletcher Construction). The temporary bridge location to be confirmed on either upstream or downstream (upstream option being presented) • Gathering stakeholders/communities' concerns and issues and information about the bridge	
2. Discussion Session • The community member indicated that they use the both upstream and downstream for bathing, washing, swimming for kids especially when theres no water in the village • The community is not currently connected to WAF, but pipelines have been installed so that it can be connected in the future. They also mentioned that they get their water from a spring upstream on the opposite side of the road. Their water supply pipeline runs beneath the bridge. • The village is connected to EFL • Children cross the bridge to go to Rakiraki Public School, a school nearby to the village • The community requested if both sides of the bridge to have walkways • Their animals also cross the bridge • The bridge floods as a result of debris blocking the bridge, spilling flooded water onto the road, fields, and lower ground around the village. • The community requested that both sides of the bridge be widened, deepened, and raised, and that when it is raised, a small crossing to the other side of the native lease be considered, as some of them farm there, particularly the mataqali owner. • Because the main village is on a hill, the bridge floods almost every time there is severe rain or cyclones, and it can reach as high as the lower part of the village. • Option of temporary bridge to be placed upstream, the land connecting to the bridge, one is native leased land belonging to Waisake rawaidranu - 7801458 and on the opposite side is a freehold land belonging to Haroon - 9923742 who owns a hardware in Rakiraki town • There was a lot of silt on the stream, and they said it was being swept away by the flood water, which settles in the stream after the water recedes. • When asked whether flood water simply recedes or flows, the communities stated that it flows to the stream when the stream is cleared and the water level gradually decreases. • Women wash on both sides of the bridge, and children use it to swim when the water level in the stream is high. • They either cross the field or utilize the side of the bridge to get to the stream. • They requested if walkway could be on both sides of the bridge	

- Upstream, Naidadara Creek meets with Naivisere Creek, which flows into the river downstream of the bridge. Women further downstream of the river catch large and little prawns.
- They fish in the river - tilapia, crab, baby mullet, jumping jack and because the stream is a mix of both seawater and freshwater, fish species on both are found on this stream. The stream is a tidal stream
- Requested to consider their pipeline running underneath the bridge and when they are connected to the Water Authority pipeline, they will still keep their spring source
- Requested to place steps on the side of the bridge as access to the river
- Because their water pipe is running underneath the bridge and most floods, the debris always break the pipe. The community are requesting if it could be attached nicely under the new raised bridge so that its clear from the flow and any debris
- Due to the increased population in the village, the village now has two water sources, both of which are used to fill the village's water tank. They'd also like to hear from the Water Authority on whether the two sources should have separate water tanks or if it's still fine to put everything into one tank. They don't need a pump to fill their water tank because the pressure from the source is sufficient.
- Concerns that the stream is already causing flooding on houses downstream, once the stream is widen, if the project team to consider this point so theres no further flooding of these houses
- The hydrology assessment will determine how long the bridge will be as it will be dependent on how much the water the river receives
- The sea level rise will also need to be studied to determine the height of the bridge
- They have a fish pond that they started about 5-6 years ago with milk fish and subsequently tilapia. The tilapia is for both eating and sale, and the feed comes from the Ministry of Agriculture. They said that every time it floods, the pond gets flooded as well.
- Request for employment during construction
- Contact person for the village is Napolioni Nasara - 9306595 and contact for youth is Seini - 2022933

With no further questions from the community, the meeting was closed.

3. Actions from Meeting

- Further consultation meeting with the native leaseholder (who is also part of the Mataqali) Mr Waisake who works at Fiji Water required to inform him of the project. Further land ownership confirmation with iTLTB in terms of the land required for the temporary bridge on Ba side of the bridge.
- Further consultation meeting with the freehold landowner Mr Haroon (who runs a hardware in Rakiraki Town) on the Rakiraki side of the bridge for land required for the temporary bridge.
- Distribution of community questionnaires for those affected by the proposed bridge replacement/realignment/widening. Roko and Advisory Councils to facilitate the distribution and collection of the questionnaires.

Project Name:	**40 Critical Bridges and 3 Maritime Structures Stakeholder Consultation Meeting Minutes**
Structure(s):	Vitawa Bridge (P1)
Place of Meeting:	Vitawa Village Hall, Vitawa
Meeting Date:	Monday, January 25th 2024 **Meeting Time:** 11.00 AM
Prepared By:	PLANIT Pacific Pte Limited

Attendees:

Project Team

- Jacqueline Hughes, PLANIT Pacific—Land & Resettlement Specialist
- Tevita King, PLANIT Pacific - Land & Resettlement Team
- Julia Whippy, Itaukei Presenter
- Alex Revell, BICL - Bridge Engineer
- Noa Sakapo, FRA – FRA Valuation Officer

Stakeholders

- *Apisai Vularika, DO Lautoka/Yasawa*
- *Samu Saumatia, Ra Provincial Office*
- *Benedito Levu, Rural Development*
- *Alesi Masikolikoli, Lands & Minerals Department*
- *Aisea Tivakanoa, DoL*
- *Salome T, DoF*
- *Sairusi Qanaika, EFL*
- *Marvin Richard, EFL*
- *Zafiya Shamim, FRA*
- *Joseva R, DoF*
- *Epeli B, FRA*
- *Rusiate L, Lands*
- *Livai Koro, Fiji Roads Authority*

Community members

- *Ridwan Haroon, Vitawa-Haroons Hardware*
- *Jone Baleilagi, Leweni vanua*
- *Joji Namoko, Leweni vanua*
- *Watisoni Namure, Leweni vanua*
- *Elesi Ranuinui, Leweni vanua*
- *Amele J, Leweni vanua*
- *Apimeleki Wailomo, Leweni vanua*
- *Noa Rawaidranu, Leweni vanua*
- *Penaia Navunisinu, Leweni vanua*
- *Wanuku R, Leweni vanua*
- *Emosi Koniferedi, Leweni vanua*
- *Inia Waqa, T/M Navotua*

- *Asea Saudela, T/M Narukuni*
- *Waisake Waraidranu, Nativelease Holder*
- *Rizwan Haroon, Freehold Owner*

Item	Action

1. Introductions

- The Assistant Roko welcomed everyone and thanked them for their presence.
- Julia Whippy introduced the 40 bridges and 3 jetties structures project and the project team.

2. Presentation by PLANIT

- A PowerPoint presentation was done in the iTaukei language explaining the project, overall priority of bridges & jetties and upgrade development activities
- An explanation of the design process, social safeguards and land acquisition included
- Responding to the community/village and stakeholder comments and issues through Q & A

3. Discussion Session

- Mr Waisake Rawaidranu (native lease holder) asked how much area will be temporarily/permanently acquired from his native lease land. Jackie (PLANIT) stated that the permanent land acquisition is approximately 2300m^2 and temporary area required for renting is approximately 3000m^2.
- The freehold landowner, Mr Rizwan Haroon, queried about the bypass road cutting through his property and how much of his freehold land would be affected. Jackie (PLANIT) stated that the freehold land acquisition is over 1000m2 for permanent acquisition and 1500m^2 for rental. The temporary acquisition/rental will be for approximately 3-year period and the landowners will be compensated via market rental over that period and an agreement will be entered between the landowner and the Contractor. She stated that the contractor will need areas for office and stockpiling, and may ask for more area but that will also be an agreement between the landowner and the contractor which FRA will vet. The land will be given back to the respective owners after use. The landowner asked what the compensation was for permanent acquisition. Jackie replied that FRA will do a valuation based on market value and enter into a sale and purchase agreement with the landowner. Upon signing the Sales & Purchase Agreement, 75% payment will be paid to the landowners and once construction is completed, a survey will be done to confirm the area taken up and the balance 25% will be paid accordingly. If more area or less area is taken, then the balance payment will be adjusted accordingly.
- Alex (BECA) stated that the timeframes for construction was just their design team's estimated timeframes but upgrades could take longer depending on the construction methodology, weather and contractor.
- A villager raised that they have already made complaints to FRA regarding the bus bay which is too far away (on the Rakiraki side) from the village and unsafe for children to walk to with no footpath. He requested it be moved

closer to the village to the bus stop. Alex (BECA) stated that the project is only limited to replacing the bridge and the road that connects to the bridge. The extent of the project goes up to 100meters beyond the bridge and if they extend toward the existing bus stop (on the corner of the village road turning into the village) that would be outside the project area. He advised that the project is a bridge replacement project and not a road upgrade project and does not think that they have the ability to extend outside the scope. He agreed to check with FRA, if it was possible. An FRA representative clarified that they have a standard called a siting distance where a vehicle turning out of the village onto the main road must be clearly seen in both directions. If the bus bay was moved to the bus stop it could cause accidents turning out of the village. He confirmed that a way forward was to build a new shelter at the new bus bay and create a proper footpath to the village for better and safer access for school children.

With no further questions from the stakeholder and community members of Vitawa, the meeting was closed.

4. Actions from Meeting

- Bus shelter and footpath to be provisioned for at the bus bay area, as part of the bridge project.

Project Name:	**40 Critical Bridges and 3 Maritime Structures Stakeholder Consultation Meeting Minutes**
Structure(s):	Navola Bridge (P1)
Place of Meeting:	Navola Community Hall, Nadroga
Meeting Date:	Monday, October 11th 2021 **Meeting Time:** 2.00 PM
Prepared By:	PLANIT Pacific Pte Limited

Attendees:

Project Team

- Jacqueline Hughes, PLANIT Pacific—Safeguard Land & Resettlement
- Julia Whippy, PLANIT Pacific—Social Safeguards
- Manisha Nandan, Erasito—Environmental Safeguard
- Vaclav Hirsch, BICL—Bridge Engineer

Stakeholders

- Kiniviliame, Yaubula Officer Provincial Office
- Lui Manual, Conservation Officer Nadroga
- Livai Koro, Fiji Roads Authority

Navola Village members

- Timoci N, village chief
- Wiliame V, village chairman
- Iowane V, villager
- Dreu Vukailagi, villager
- Lasaro S, Turaga ni Koro
- Joweli Yara, village deputy chairman
- Jiuta T, villager
- Waisake Rerega, villager
- Lasaro S, villager
- Laitia C, villager
- Misiwata L, villager
- Loata P, villager
- Adi Eva Maria, villager
- Sanivalati M, villager
- Edy T, villager
- Joeli S, villager
- S Bula, villager
- Mereisi Dreka, villager

1. Jiese Lewabobo, villager

- Ovanalagi S, villager
- Tarusila Vugakoto, villager
- Makelesi Raloga, villager

Item	Action
1. Introductions • The Turaga ni Koro presented the project team's Kava as Sevusevu to the village because the Roko Tui from the Provincial Office could not attend the meeting but the Conservation Officer from their office arrived at the meeting after it had started to represent the Roko Tui. • The Turaga ni Koro welcomed and thanked the villagers for their presence. He then briefly introduced the 40 bridges and 3 jetties structures project and the project team. He advised them that the project team would then present the details of the project.	
2. Presentation by PLANIT • A PowerPoint presentation was presented in the iTaukei language explaining the project, the priority bridges & jetties and upgrade development activities • An explanation of what is involved in the Feasibility study and Design Phase was explained • Explanation on the possible options for new bridge being reviewed included: 1) a new bridge on the upstream, traffic to use existing bridge during construction and once new bridge completed, demolish the existing bridge; OR 2) building temporary bridge downstream and remove existing bridge and replace within existing alignment with traffic to be diverted during construction to the temporary downstream bridge. • Gathering stakeholders/communities' concerns and issues and information about the bridge	
3. Discussion Session • Based on the 2 options presented, the community members were asked which option they preferred. The majority responded that they would prefer to build the temporary bridge upstream so that the two (2) houses located downstream of the bridge, at the front of the village and along the main road, would not have to be relocated. • The project team raised the challenge that with placing the temporary bridge on the upstream there is the hill that needs to be partly taken down in order to make way for the temporary bridge crossing. • A village member who was present said he worked for Public Works when the original bridge and main highway was built. He stated that it would not be an easy task to remove the hill as the rock on the hill is very hard and the FRA contractor would need to use dynamite to break the hill, which would still impact the houses close by but also be a big risk to the large number of motorist who use the highway now. He said the rock was metamorphic and igneous rock and the big rock boulders that were previously removed was used at the village foreshore as coastal protection against waves breaking against their foreshore. This was a request from the village at that time to stop their foreshore from eroding. • The project team asked the community who owned the land on which the hill sits and they responded that it was on native reserve land owned by the	○

village.

- Another challenged faced by the project team with cutting into the hill would be dangerous in that it would leave part of the hill exposed to weathering and rock fall on exposed motorist and other road users to hazardous conditions
- The project team then mentioned that the feasible option would be to put the temporary bridge downstream and upgrade the existing the bridge
- Other issues raised by the community present at the meeting included:
    - The children from the village use the mouth of the river at the foreshore to swim
    - The village members fish in the river but mainly at the river mouth as they feel it is not safe to sit at the bridge and fish as the existing bridge shakes whenever a truck passes. This is because the existing bridge's steel beams are corroded.
    - The village raised concerns with the existing bridge had one half of it widened and the other half was still the old bridge and therefore, that was why it was shaking and unsafe.
    - The villages uses the bridge to cross over daily to go to their plantation
    - Primary school students travel by bus to go to school in Namatakula (towards Suva) and secondary school students walk to Nasekawa secondary which is just across from the village.
    - The river floods only when there is continuous rain which coincides with the high tide
    - The last flood level was at knee high when standing inside one of the homes located close to the river
    - No sign of erosion near the houses located next to the river banks downstream however, there were signs of erosion on the bridge abutments downstream
    - The Project team were asked whether the water always damned upstream and the Village Chief responded saying there were big trees blocking the flow of the water under the bridge and the villagers had to work together to get these trees removed so that the water could flow under the bridge and the flood levels upstream could go down
    - The villagers were asked whether the river mouth was dredged before and they responded that it had never been dredged and that was why there was such a build up of sediment at the mouth together with a build up of sand from coastal wash-ups.
    - The villages raised that they have put in their formal request to the government to assist them in putting up a seawall on their village foreshore but government has not responded.
    - The villages confirmed that 10-15 years ago their village was completely under water due to a little tsunami or spring/king tide that went through their village and so if the hill top was blasted they would welcome the rocks to be placed along their foreshore
    - The village members had their pig pen situated upstream of the creek bank. These pigs belong to different members in the village some of whom were present at the meeting. They indicated that during flooding, the pigs are taken to the owner's homes in the village and when the water recedes they take them back to the pig pen.
    - They were asked on the owner of the market on the road side, the plantation near the pig pen and plantation on the hill top, they responded that the market belonged to a village member who was not present at the meeting as he had gone to town, the plantation behind the market belonged to Sailasa and the plantation on the hill top belonged to Ilikimi.

    - The villagers also expressed their concerns with speeding vehicles on the Highway especially coming down the hill and even with the camera, the vehicles still speed and therefore, there should be some traffic calming measures to slow them down or it could be fatal for pedestrians and other road users.
- The villagers expressed their support towards the bridge project and their willingness to provide a space for the construction laydown site as well as a site for processing of the precast material for the bridge
- The villagers requested to have an Agreement in place between Navola village & FRA on the use of their land and the two houses to be relocation (should the need arise), employment for youths in the village, etc
- The villagers were asked as to whether they have available land in the village to move the piggery too – they responded that they have a lot of land to move their pig pens too
- The village community confirmed that they have a total land area of 1800 acres and this includes land from their village all the way to Komave Village. They added that the Nasikawa Vision College located opposite the village was part of their village area and it had a total land area of 50 acres.
- Question was asked to the community on whether the two households who would need to temporarily relocate were present in the meeting? The village members confirmed that both owners were present and they were brothers who had been living in that house their whole lives and were 3rd generation. The project team members sat with the two household owners to again explain options and the one who owned the house closest to the bridge said at night they could feel the house shaking when large trucks would pass and that they were used to the sound and the shaking. He said the whole house would shake and when they got visitors in the house, the visitors would not be able to sleep because of the noise and that they were scared of the house being shaken in the middle of the night from the truck/vehicle movement over the bridge. The household owners were asked if they would temporarily relocate to another area within the village and they agreed. They said they would not mind provided they were given a nice house to live in. When asked if they would come back, they initially said yes but then later considering there would be no more dust from the road, noise and shaking of their house, they said they would potentially like to move permanently to their new home rather than come back once the temporary bridge was demolished. The project team explained that once the preferred option was selected, we would return with more details and also explain to them further with FRA the relocation and compensation process
- The village community members were asked if they had any further questions regarding the new bridge project and they responded that they would like to meet amongst themselves again and will advise us as to whether they have any more query regarding the project.

With no further questions from the community, the meeting was closed.

4. Actions from Meeting

- Project team to get the name and contact details of:
  a) the two households likely to be relocated due to the temporary downstream bridge option
  b) market vendor and the owner of the plantation and hilltop
  c) owners of the pig pens
- Land tenure and ownership will need to be confirmed of all affected land once the preliminary design options are done by the Engineers.

- Distribution of community questionnaires for those affected by the proposed temporary bridge downstream and existing bridge replacement, the Turaga ni Koro, the Provincial Council reps and the Women's group rep for the village to facilitate the distribution and collection of the questionnaires.

Project Name:	**40 Critical Bridges and 3 Maritime Structures Stakeholder Consultation Meeting Minutes**	
Structure(s):	Navola Bridge (P1)	
Place of Meeting:	Navola Community Hall, Nadroga	
Meeting Date:	Tuesday, January 23rd 2024	**Meeting Time:** 3.00 PM
Prepared By:	PLANIT Pacific Pte Limited	

Attendees:

Project Team

- Jacqueline Hughes, PLANIT Pacific—Land & Resettlement Specialist
- Tevita King, PLANIT Pacific - Land & Resettlement Team
- Julia Whippy, PLANIT Pacific - Presenter
- Alex Revell, BICL - Bridge Engineer
- Noa Sakapo, FRA – FRA Valuation Officer

Stakeholders

- Kiniviliame, Yaubula Officer Provincial Office
- Lui Manual, Conservation Officer Nadroga
- Livai Koro, Fiji Roads Authority
- Zafiya Shamim, FRA
- Kelekolio T, FRA
- Livai Nadore, FRA
- Rusiate Tabua, FRA
- Epeli B, FRA
- Stephanie F, DoL
- Apenisa R, DoL
- Salome T, DoF
- Joseva R, DoF
- Rauluioro R, EFL
- Timoci V, EFL

Navola Village members

- Ratutoka Dreunimolea, villager/farmer
- Sanaila Kaikai, village headman
- Sakiusa Dreunimolea, villager/farmer
- Joweli Yara, villager pastor
- Waisale Tuinalia, fisherman
- Jack Dreunimolea, villager/farmer
- Ratu Orisi Tokanavanua, villager/farmer
- Jone B, villager/farmer
- Emili Uluimalolo, villager/self employed
- Viliame T, villager/farmer
- Laitia Cagiloaloa, villager/hotel worker

- Susana, villager/hotel worker
- Sainimere Bati, villager/domestic duties
- Selina Sigadrodro, villager/domestic duties
- Mereani Dua, villager/domestic duties
- Unaisi Tikoicolo, villager/domestic duties
- Siteri Nawaibalavu, villager/domestic duties
- Loata P, villager/domestic duties
- Romera Leqe, villager/domestic duties
- Dreu V, villager/farmer
- Etuate T, village/farmer
- Misiwati Tuibau, villager/farmer
- Varanisese Vanawa, villager
- Seveci N, village

Item	Action
1. Introductions • The Turaga ni Koro presented the project team's Kava as Sevusevu to the village because the Roko Tui from the Provincial Office could not attend the meeting. • The Turaga ni Koro welcomed and thanked the villagers for their presence. He then handed it over to Mr. Epeli (FRA West Team) to briefly introduce the 40 bridges and 3 jetties structures project and the project team. He advised them that the project team would then present the details of the project.	
2. Presentation by PLANIT • A PowerPoint presentation was done in the iTaukei language explaining the project, overall priority of bridges & jetties and upgrade development activities • Explanation of the design process and environmental and social safeguards including summary of site investigations and data gathered was expressed • Responding to the villagers and stakeholder comments and issues through Q & A • Explaining next steps and indicative timeframes	
3. Discussion Session • During the presentation there was a question from a villager who was speaking on behalf of Vilimaina who has recently built her house on the Suva side of the bridge on the hill. She had requested that her house be relocated further in land as, according to the land acquisition plan, her house is sitting on the edge of where FRA is intending to cut the hill. She also requests an access to her house as well for pedestrian and vehicle. Mr. Nevell noted this request and will raise it with FRA. • A villager asked about whether or not FRA will compensate them for the relocation of their pigs pen. Mr. Sakapo informed them that FRA have decided that they will only compensate them by buying the materials for a new pigs pen. He also mentions that only the land required for construction, the plantations affected and the pigs pen will be compensated for. • A villager asked if they can be employed by the development when the time comes; Mr. Sakapo replies that it is not like before as now it is up to the	○

contractors who is hired for the job. The villager's requests FRA if they can inform the chosen contractor to consider the villagers as laborers or security.

- Another villager asks if those working on the construction of the bridge will want to be billeted in the village; to which Mr. Sakapo replied that they have teams based in Nadroga who would not need to be billeted as they stay in the area already.
- A question was asked if they can build in the acquisition areas; Mr. Sakapo advised them that FRA will buy that land off of the landowners to which the title will be changed and written to the Director of Lands.
- A question was raised on whether or not the excess rock that would be blasted from the works on the hill, could be used to make their seawall or beach works (this was mentioned in the 1st consultation meeting); Julie (PLANIT) and Alex from BECA replied that they had discussions internally and mentioned that the rock would be stock piled at the site after blasting and if the villages want it for construction of the seawall, they will have to request it from Department of Environment to use the excess rock.
- The village head mentions that FRA cannot construct the seawall as it has to be an engineer who specializes in that work to do so. The villages also asks if they should request now to the Department of Environment (DoE) or should they wait for the rocks to be extracted from the hill; of which Julie (PLANIT) mentions that they should wait for the rock to be extracted before apply for it from DoE
- Livai Nadore (FRA Environmentalist WEST) informed the villages that DoE has their laws that is called the "Environment Management Act 2005". He states that these are two different works or upgrade discussed here, one is the bridge upgrade and the other would be the seawall construction. These cannot go together because the seawall construction would need a separate EIA. The only thing that FRA can do is extract the rocks and keep it onsite for the villages until they have completed the request and process with DoE. Julie (PLANIT) adds on to say that it would be an added bonus if they could get the advice of a marine or coastal engineer to help design the seawall because if it is not designed properly, it will cause damage to other places along the beach.
- Mr. Livai Nadore (FRA Environmentalist WEST) informs the villagers that this is the final consultation and there will be an EIA consultant who will be coming around to do their inspection for the EIA report which is a separate process to this current stage which is the design stage.

With no further questions from the villagers, the meeting was closed.

4. Actions from Meeting

- FRA team to discuss and get back to Vilimaina (who lives on the hill) about her request of moving her house to the back as the cut line of the hill affects her newly built house. Also, the possibility of a vehicle access point.

Project Name:	**40 Critical Bridges and 3 Maritime Structures Stakeholder Consultation Meeting Minutes**
Structure(s):	Matawalu Bridge (P1)
Place of Meeting:	Matawalu Community Hall, Lautoka
Meeting Date:	Thursday, October 14th 2021 **Meeting Time:** 2.00PM
Prepared By:	PLANIT Pacific Pte Limited

Attendees:

Project Team

- Jacqueline Hughes, PLANIT Pacific—Safeguard Land & Resettlement
- Julia Whippy, PLANIT Pacific—Social Safeguards
- Manisha Nandan, Erasito—Environmental Safeguards
- Vaclav Hirsch, BICL—Bridge Engineer

Stakeholders

- Livai Koro, FRA

Matawalu Village Member

- Joseph Rakoto
- Esekaia Tavu
- Vilikesa Mata
- Aporosa Rakoto
- Peni Barisavu
- Sainimili Sadrau
- Lusiana Vudoi
- Adi Mere Rarogo
- Mesulame
- Saimoni
- Lilieta Ranitu

Item	Action

1. Introduction

- The project team presented Kava as Sevusevu to the Turaga-ni-koro and villagers. The Turaga-ni-koro welcomed everyone and apologized on behalf of their Chief and elders who could not be present at the meeting as the Chief was getting married the following day and everyone was busy preparing. The Turaga-ni-koro arranged for their youth group to be present at the meeting as their new youth committee was active and had been tasked to listen at this meeting and present the project and issues to their elders at the next village meeting. He then briefly introduced the 40 bridges and 3 jetties structures project and stated that the project team would present to them the details of the project.

2. Presentation by PLANIT

- A PowerPoint presentation was presented in the iTaukei language explaining the project, the priority bridges & jetties and upgrade development activities
- Provided an explanation of what is involved in the Feasibility study and Design Phase
- Explanation on the possible options is that it will be a bridge replacement as requested by FRA with traffic diversion and temporary bridge required upstream or downstream to enable bridge replacement along the existing alignment. One of the issues is the limited space at the bridge (both upstream and downstream), thus diversion around the properties just south of the bridge is being considered as Option B.
- Gathering stakeholders/communities' concerns and issues and information about the bridge

3. Discussion Session

- A village member mentioned that the old bridge (ie. tramline crossing bridge) was causing flooding in the village, and that the new bridge (vehicular access), whenever there is heavy rain, debris often get stuck at the bridge, causing the bridge and land upstream to dam, causing the bridge downstream to overflow and flood the village. Another reason for the rapid damming is the shallowness of the river.
- A community suggestion is to raise the bridge slightly so that the water can flow freely down the river. When the debris becomes stuck, the water flows around the bridge and floods the surrounding area.
- They requested that a barrier be erected to separate the carriageway from the walkway because there have been numerous accidents at the bridge and because young boys from the village cross the road to the other side of the bridge to swim, it is quite dangerous as cars and trucks get close to the pedestrians crossing the bridge.
- They were asked about the name of the river, and their response was that they are unsure of the name but have known it as the Matawalu River.
- When asked if they use the river for any activity, the community responded that the upstream river is mostly used by children to fish because it is close to where they live, whereas the downstream river is used by adults. They catch mangrove red snapper, trevally and crabs among other things. They also stated that the river upstream is freshwater, whereas the river downstream of the bridge is saltwater.

- There is a cassava plantation and a sugarcane field on the ground opposite the settlement (recommended temporary bridge placement upstream of the river). The land is already leased to someone who lives in the community. Mr Opeti Naio (mobile no. 9434353) is the contact person for the Tokatoka Leleavula native land owners. The land on the other side of the river, further upstream, is owned by Naviago village. Opeti's house is close to where the consultation is taking place, according to the village headman, and people present at the meeting will inform him of the proposed bridge development as well as the map (referring to Option 2 – the longer temporary diversion which is the expensive option). Option 1 they feel is a good option; however, it will have an impact on the building that looks like a temple so the project team will need to discuss with those freehold owners as well.
- For the downstream option or existing alignment widening, there are five households that will potentially be impacted if the option to go close the village side is chosen; the project team then inquired as to whether these homes have been in the village for a long time; they responded that they were born there with second to third generation living in the homes now. Another member went on to say that their properties were initially destroyed in 2016 during Cyclone Winston, and that as part of the Government flood relief schemes for damaged homes, about 10 homes were replaced with new homes.
- They raised that whenever there is continuous heavy rain, the village floods and the height of the floods is knee high even though these new homes were raised when they were newly built.
- The children in the village attend Satya Sai School, Teidamu Primary School, Vitogo District School, and Drasa Secondary on the Rakiraki side of the bridge. Children from the village also attend schools in town. They take the bus to school and cross the bridge, but the bridge is mostly used by students to swim after school.
- Some parents exercise with their children in the morning, and walking on the bridge but it is too dangerous due to the close proximity of the bridge walkway to the main carriageway.
- When questioned if they take their animals across on the bridge, they said their animals were either downstream or up in the mountains. Another member went on to say that when the floodwaters gradually rise, they utilize the bridge to transport their pigs from under the bridge to the village because the FSC tramline is the first to flood.
- The youths have expressed an interest in working on the building site.
- The youth members were informed that the contractor will require a laydown site during construction, and they were asked about the land opposite the village on the upstream side where the plantations are located. The youth members responded that the land belonged to the Mataqali Leleavula, and they are willing to listen to the construction team's request if they need to use the area. Closer to the road (for temporary bridge Option 1) is land belonging to Opeti, Setareki Rakoto's uncle (mob no. 7111980) which was used as a playground but is now planted with cassava which they sell. These two parcels of native lands are separated by a small creek.
- The project team advised that the present bridge will need to be widened and this could potentially require some village land on either side of the existing bridge. The village members indicated that it would be best to take the land from the upstream side as the downstream side was where there were about 10 homes that were recently built from the last floods by the Government. However, they indicated that if they had to move then they would consider it but would have to talk to the home owners who were not at the meeting. Only one person who lived in the house closest to the river was present and he said that he really wanted the bridge to be fixed and if it could take care of putting up a seawall/retaining wall along the river in their village directly downstream

from the bridge to stop the water from coming into their village and their homes and also to stop river bank erosion.

- The youth of the village indicated that there is a track on both sides of the bridge that they use to go into the river or their plantation so they hoped that the new design would take into account this access for the villages.
- The villagers confirmed that they have boats but they only move upstream towards the existing bridge at high tide and boats are always tied downstream for fishing.
- The village community is also requesting if river could be dredged during the bridge construction to help with the flooding issue and flow of the river downstream.
- The bridge engineer explained the only issue with moving the temporary bridge and widening to the upstream side of the road was the buildings and temple like structure that was existing. The villagers mentioned that the land was owned by an Indo-Fijian person who lived on the land and that we should go and meet with him after the meeting to obtain his views on the matter.
- After the meeting, we drove to meet with the owner of the property and he stated that he was happy with the new proposed bridge replacement and would be happy to provide land for rent on the downstream side for the construction site but complained that the villages had their pig pens under the existing bridge which caused nuisance in terms of odour. He asked if the new design could have a wall alongside the bridge and embankment to stop the villagers from putting a pig pen there but also the wall would help stop erosion under the bridge. He further indicated that the land on the upstream side directly beside the existing bridge (on the Ba side) was his sisters land and she lived in the house with her husband and their sons. He said whilst they didn't talk much, she would talk to her sister to convince her sister to give up some of their land for the temporary bridge provided they were compensated. She also said that the land further down beside her sister's house belonged to her and she had multiple apartments that she was willing to rent to FRA and the contractors during the construction phase.

With no further questions from the community, the meeting was closed.

4. Actions from Meeting

- Project team to get the name and contact details of:
  a) the landowners on the upstream side and downstream of the existing bridge both on the Ba and Rakiraki sides
  b) Boat owners
  c) Homeowners in the village along the road on the downstream side of the bridge who may be required to be relocated due to road widening.
- Land tenure and ownership will need to be confirmed of all affected land - once the preliminary design options are done by the Engineers.
- Distribution of community questionnaires for those affected by the proposed temporary bridge upstream and existing bridge replacement, the Turaga ni Koro, the Provincial Council reps and the Women's group rep for the village to facilitate the distribution and collection of the questionnaires.
- Confirm with Lands Department on the name of the river that flows underneath the Matawalu Bridge.

Project Name:	**40 Critical Bridges and 3 Maritime Structures Stakeholder Consultation Meeting Minutes**	
Structure(s):	Matawalu Bridge (P1)	
Place of Meeting:	Matawalu Village Hall	
Meeting Date:	Wednesday, March 20th 2024	**Meeting Time:** 5.30 PM
Prepared By:	PLANIT Pacific Pte Limited	

Attendees:

Project Team

- Jacqueline Hughes, PLANIT Pacific—Land & Resettlement Specialist
- Tevita King, PLANIT Pacific - Land & Resettlement Team
- Aisake Raratabu – Facilitator/Presenter
- Alex Revell, BICL - Bridge Engineer
- Noa Sakapo, FRA – FRA Valuation Officer

Stakeholders

- Tabitha K, PLANIT Pacific – Environment Officer
- Kelekolio T, FRA – Environment Officer
- Serona F, FRA – Engineer

Matawalu Village members

- Makelesi Salele, Village Member
- Joeli Tuivaga, Village Member
- Noa Ledua, Village Member
- Mere Kurumare, Village Member
- Jonetani Rawaqa, Village Member, Turaga ni mataqali
- Lesu Vakarua, Village Member
- Laisa Marama, Village Member
- Nanise Vereivalu, Village Member
- Temaleti Tubu, Village Member
- Keleni Marawa, Village Member
- Penjamini Natou, Village Member, landowner
- Mosese Saikova, Village Member
- Korobogo Biautubu, Village Member
- Ana Baleinaika, Village Member
- Sainimere VAkacegu, Village Member
- Laite Rabua, Village Member
- Lasela Rakoto, Village Member
- Vasiti Silalu, Village Member
- Vani Vakasuka, Village Member
- Irineta Biau, Village Member
- Luse Watimo, Village Member

Item	Action

1. Introductions

- The Assistant Turaga ni Koro presented the project team's Sevusevu to the village as the Roko Tui from the Provincial Office could not attend the meeting.
- The Turaga ni Mataqali welcomed and thanked the villagers for their presence. He then handed it over to Mr. Aisake Raratabu to briefly introduce the 40 bridges and 3 Jetties Structures Project and the project team. He advised them that the project team would then present the details of the project.

2. Presentation by PLANIT

- A PowerPoint presentation was done in the iTaukei language explaining the project, overall priority of bridges & jetties and upgrade development activities
- Explanation of the design process and environmental and social safeguards including summary of site investigations and data gathered was expressed
- Responding to the villagers and stakeholder comments and issues through Q & A
- Explaining next steps and indicative timeframes

3. Discussion Session

- During the presentation of the bridge design a question was raised by a village member concerning the safety of the school children during the construction phase who have to catch the bus to Lautoka. The village member stated that the school children normally wait for their school bus at the junction of the new by pass and Kings Road, where construction is proposed. She asked whether they should advise their children to catch the bus from a different location, away from the construction area towards the shop side. Alex (BECA) agreed that it would be advisable that the children catch the bus from near the shop. The village member requested a bus stop be made near the shop for the village school children. Alex advised that this would be arranged by the contractor with the village before they start work on site.
- A village member questioned whether the river would be dredged during the bridge upgrade. Alex (BECA) stated that the river bed would be excavated slightly to open it and rocks placed around the foundations which up making the river channel bigger. However, this would be within the immediate vicinity of the bridge works as show in pink on the drawing. He advised that no dredging would be done outside these construction areas or down the river channel. This would be something they would have to raise with Ministry of Waterways.
- Another village member requested that FRA create a cemented driveway in the access from the main road all the way into their village. Alex (BECA) confirmed that they have provisioned only for a standard FRA driveway and it is only within their scope to replace/upgrade existing structures.
- A village member raised that one of the actions from the last consultations was to include access to the river via steps. Alex (BECA) confirmed that they had included steps into the new design but presented that it was away from the bridge downstream and not at

the bridge. Alex asked the community what they thought of this new location? A village member requested a change in location of the steps further downstream to an area where two streams meet and a large areas of soil is being eroded, so that the cement for the steps would help hold the soil intact. He said there was one house int hat location and the owner was very concerned that with the erosion faced his house would soon be separated from the village. However, Alex (BECA) confirmed that the cemented area for the steps was not big enough to hold the soil together in that area and it would not change the effects of the erosion.

- One village member queried if the women of the village were able to sell food to the contractors. It was confirmed that that was possible like other roading projects, and suggested that the women best communicated with the contractors before construction commenced to see what type of food and drinks would be required and at what times, as well as number of staff.
- Penjamini (village member) asked if FRA was using as built plans particularly of the utility services and pipelines in the area because he was concerned that water pipes and power lines would be disrupted by the contractor if they did not know where the services ran. Alex (BECA) confirmed that they had the services as-builts which were considered in the design and that is how the design team has made provisions for it. But Alex advised that the contractor has to check all of these through ground truthing to ensure that they do not damage any of these services and if they need to be relocated, the contractor would take care of it.
- Jackie (PLANIT) questioned what times the church was being used for services/meetings. A village member stated that the church was used mainly on Sundays from 6am-8am for the children's programs, and services, 10am and 3pm. During important celebrations like Christmas or the upcoming Easter, the church is used for the whole week every afternoon.
- Request for landscaping on the side of the bridge as part of the design to screen people from overlooking into the village houses along the bridge. However, it was explained that the side of the bridge would be a retaining wall which will not have any soil so the villages were advised if they could plant tall trees and palms at ground level to provide the necessary screening for those houses along the bridge. Alex also explained that there would be a drain at the bottom of the wall so they would have to plant away from the drain as well.
- One of the women members present from the village was asked to give a vote of thanks. She thanked the project team for the presentation and refreshments provided stating that this was the first time for them to be a part of this type of development project meeting, to be asked to be specifically involved and provide their feedback. She said they really appreciated being made of aware of what was going to happen on the bridge project.

With no further questions from the villagers, the meeting was closed.

4. Actions from Meeting

- PLANIT to carry out socio-economic surveys with AP – Penjamini Natou.
- Alex to check the query about the bus top location near the shop
- Alex to raise with FRA the communities' request to seal their road inside their village
- Alex to recheck location of stairs to the water from the village

Project Name:	**40 Critical Bridges and 3 Maritime Structures Stakeholder Consultation Meeting Minutes**
Structure(s):	Sabeto Bridge (P1)
Place of Meeting:	Natalau Community Hall, Nadi
Meeting Date:	Wednesday, October 13th 2021 **Meeting Time:** 10.00 AM
Prepared By:	PLANIT Pacific Pte Limited

Attendees:

Project Team

- Jacqueline Hughes, PLANIT Pacific—Safeguard Land & Resettlement
- Julia Whippy, PLANIT Pacific—Social Safeguards
- Manisha Nandan, Erasito—Environmental Safeguards
- Vaclav Hirsch, BICL—Bridge Engineer

Stakeholders

- Livai Koro, FRA
- Aminiasi Sikivou, A/DO Nadi
- Apisai Vularika, DO Lautoka
- Kitione D, A/Roko Tui Lautoka

Natalau Village Member

- Nikola Vetawa, Village Headman
- Kolinio Naulag
- Eparama Natu
- Inia Cakau
- Timoci Tuirakiwaimaro
- Ana Wakawaka
- Vilimaina Vetawa
- Eroni Turuva
- Jofiliti Saubuli
- Tevita Nabaro
- Petero Nuku
- Saimoni Matainaboutini
- Joseva Nabaro
- Mosese
- Vani
- Julie Tuirakiwaimaro
- Sera Rounds
- Joseva Kanacagi
- Livai Naivogo
- Ilami Waqe
- Tomasi Draunimasi
- Alitia Votea

- Lisita Tabua
- Josese Saukuru
- Akosi T
- Vika Bete
- Tuli Nacokula
- Taniela Quto
- Tabua Y
- Mosese
- Josefa
- Ana Tabele
- Votea
- Niraj Dutt, Advisory Councilor Sabeto
- Kamenioni Driu

Item	Action
1. Introductions • The Assistant Roko Tui presented the project team's Kava as Sevusevu to the village and then welcomed and thanked the villagers for their presence. He then briefly introduced the 40 bridges and 3 jetties structures project and the project team. He advised them that the project team would then present the details of the project.	
2. Presentation by PLANIT • A PowerPoint presentation was presented in the iTaukei language explaining the project, the priority bridges & jetties and upgrade development activities • Provided an explanation of what is involved in the Feasibility study and Design Phase • Explanation on the possible options for replacing the existing bridge with a temporary bridge upstream or a new bridge on the upstream side of the existing bridge (with the existing bridge to be used during construction) and how this alignment fits in with Fiji Roads Authority's future plans though separate to this bridge replacement project. • Gathering stakeholders/communities' concerns and issues and information about the bridge	
3. Discussion Session • The community enquired whether other bridges near to this main sabeto bridge are also part of the upgrade – the project team responded that FRA only this Sabeto bridge part of FRA's upgrade package and not the other smaller bridges in their area. • The community further raised that they have a temporary crossing going from their village through their plantation as a short cut in order to get to the service station and shop on the main road before the subject Sabeto bridge. The villagers use this temporary crossing upstream to cross the river to buy kerosene and access the main highway as a faster route than walking along the village road to the main road and across the subject Sabeto bridge to get to the shops. They requested if FRA could consider building them a new temporary crossing to make it easier for them to cross the river instead of walking along the village access road to the main	

highway and then along the highway and across the Sabeto Bridge. The villagers said that was their preference to have that temporary bridge upgraded as it is shorter for them to the main road.

- The community also expressed their concerns about a culvert bridge that is closer to the main road which easily floods during heavy rain periods.
- The community raised their concern over the pedestrian walkway on Sabeto bridge because there has been a lot of accidents where lives were almost lost while crossing the bridge. They requested that the new bridge be properly constructed as well as widened and that the pedestrian walkways too should also be wider. The villagers stated that whenever they cross the Sabeto bridge to go to the shop, they are always afraid to cross because of how close the carriage way and trucks are to the walkway especially during cane cutting season, when the cane trucks pass on the bridge and the cane is sticking out nearly knocking them over on the footpath.
- The community raised that they use the river to catch fish and collect freshwater mussels and in order for them to get to the river, they cross the sugarcane fields to get to the river bank. One of the villagers raised their concern about the new proposed bridge construction works affecting their food source in the river.
- The community were asked whether they go through the plantation in order to get to the river downstream for freshwater mussels or go under the bridge - they responded that they do both and they even collect mussels underneath the Sabeto bridge.
- The community expressed their concerns if there will be any chemicals used during construction because it could be washed into the river and affect their food source. FRA's representative present stated that for every construction, there will always be impacts to the environment but it will only be short term and during construction only. He said there will be environmental monitoring reports in pace to ensure that the contractor is compliant in order to minimize or avoid the impacts to the environment especially during construction. The contractors may use fuel or oils for their machines and these will need to be kept well away from the waterways and if there are any spills, this will need to be contained immediately with a spill kit to contain the spill within a confined space so as not to have it enter into the environment and especially not the waterways to affect the communities' food source.
- The community requested that they could be granted access to cross under the bridge to swim downstream to looking for freshwater mussels during construction. The Project Engineer indicated that they would need to discuss this with the contractor on this possibility and the community would be notified accordingly and communicated with prior to construction works commencing and also during construction.
- The community were asked by the Project Team as to whether they mostly used the upstream or downstream of the river and the community responded that they use both to collect freshwater mussels (also known as kai).
- The community queried on how the bridge will look like and whether it will be like Rewa bridge – the project team responded that the new bridge will be raised to also cater for climate change, rise in sea level, etc but will not be as big and wide as the Rewa Bridge.
- The village community members in attendance were asked whether they experienced flooding in the village – their response was that the village is on a higher ground to the river, however, they noticed that when it was high tide together with long periods of heavy rain, the runoff from the mountains comes down and floods the lower grounds near the river and their low lying farm lands are usually underwater.
- The community are happy that the new bridge will be raised to take into account climate change and sea level rise, as they stated that a lot of debris get stuck at the bridge whenever it floods, and they feel that they are not safe whilst crossing the

river at this time. They believe that in the next coming heavy rain or cyclone the large debris coming from upstream will completely destroy the Sabeto bridge so they say that this bridge needs to be replaced quickly.

- The project team requested information on the land tenure and ownership of land where the service station and beside it abutting the river. The community responded stating that the land where the service station is on is native land belonging to Mataqali Navakalolo (landowner is in Sabeto village) and Mataqali Eloto in Natalau village and they suggested that we go and do a presentation to Natalau village as well so that they are informed of the proposed bridge plans.
- They raised that during flooding, the flood level at the bridge usually reaches up to where the FSC tramline is which is downstream of the existing Sabeto bridge.

With no further questions from the community, the meeting was closed.

4. Actions from Meeting

- Project team to get the name and contact details of:
  a) the two households and landowners on the upstream side next to the shop who own the homes and land beside the Sabeto Bridge.
  b) Owner of the service station and shop
  c) Owners of land on the downstream Lautoka side of the bridge as well as the owners of the land on the upstream Lautoka and Nadi sides of the bridge. It was noted that on the upstream side there was different traditional land owners that we needed to verify with TLTB.
- Land tenure and ownership will need to be confirmed of all affected land - once the preliminary design options are done by the Engineers.
- Confirm with the utility provides the services located in close proximity to the existing and proposed bridge alignments that will need to be relocated esp. the existing fuel line
- Distribution of community questionnaires for those affected by the proposed temporary bridge upstream and existing bridge replacement, the Turaga ni Koro, the Provincial Council reps and the Women's group rep for the village to facilitate the distribution and collection of the questionnaires.
- Organize another meeting for next week with the Sabeto Village community.

Project Name:	**40 Critical Bridges and 3 Maritime Structures Stakeholder Consultation Meeting Minutes**
Structure(s):	Sabeto Bridge (P1)
Place of Meeting:	Sabeto Village Meeting Area, Nadi
Meeting Date:	Tuesday, October 19th 2021 **Meeting Time:** 10.00am
Prepared By:	PLANIT Pacific Pte Limited

Attendees:

Project Team

- Jacqueline Hughes, PLANIT Pacific—Safeguard Land & Resettlement
- Julia Whippy, PLANIT Pacific—Social Safeguards
- Manisha Nandan, Erasito—Environmental Safeguards
- Vaclav Hirsch, BICL—Bridge Engineer

Stakeholders

- Livai Koro, FRA

Sabeto Village

- Apisalome Saukuru
- Samuela Naquto – Village Headman
- Kiniviliame
- Livai Koro
- Timoci T
- Limiva Bogitini
- Viniana Gaugau
- Kelera Mokotanavanua
- Makereta Vala
- Nanise Lewatu
- Jolame G
- Joana Uqeuqe
- Merewalesi Qoro
- Sailasa Moko

Item	Action

1. Introduction & Presentation by PLANIT

- A PowerPoint presentation was presented in the Fijian language explaining the project, the priority bridges & jetties and upgrade development activities
- Provided an explanation of what is involved in the Feasibility study and Design Phase
- Explanation on the possible options – replacement on the upstream (4 lane side) and 4 lanes between Nadi and Lautoka planned by FRA (separate project to these bridge replacements)
- Gathering stakeholders/communities' concerns and issues and information about the bridge

2. Discussion Session

- A community member raised that the river provides them food and queried that once the construction starts, whether it will affect their livelihood – response was provided to them
- A question was put forward to the community on whether they agree on the proposed location of where the two-lane bridge will be i.e., upstream of the existing bridge – a member of the landowner of where the new bridge will be located was asked to respond. He mentioned that he noticed that where the new bridge will sit is on part of their land and added that 2 other elders that were supposed to be present had left already to their plantation. He indicated that on the presentation that there will be a second consultation to be held in future and has asked since they're the landowner, the second consultation should be held at their little community residing near the bridge. There has been a lot of accidents on the sabeto bridge and is thankful that the bridge will be upgraded to improve the look and safety. Theres few families residing on the house near the river and is close to where the proposed bridge will sit and has asked that they be consulted directly to avoid any disruption or delay from the landowner. For the second consultation, he has requested that they be advised a week before the consultation so that their mataqali to be present at the meeting.
- FRA representative explained further regarding all the process that will be carried out before any construction
- Request from the village headman to advise them in advance on the second meeting and the second meeting to have it with the mataqali who lives near the bridge - mataqali Navakalolo who are the landowner instead of having it in sabeto village
- They queried if the new bridge will be similar to the Rewa bridge – the team replied that the look will be similar but the length will be different. The new bridge will follow the New Zealand and Australia standard and will only be 2 lanes and since FRA is planning on the 4 lanes, the old bridge will be demolished and will build a new 2 lane bridge which will accommodate the 4 lanes and will be separate from this package.
- The community requested to allow for more space for the pedestrian - the team responded that the pedestrian width will be 2m as per the requirements for NZ and Australian standards
- The community asked if the FRA tramline will be demolished – response to them was that the new bridge will be upstream of the existing bridge
- FRA questioned them regarding the food they get from the river and if it's mainly the mussels and fish or other food source – they responded that they fish tilapia, eel and collect mussels. They also have their plantation close to

the river. Because of their food supply from the river, the team mentioned that there will be no dredging but only pile driving and the bridge will be precast on one side and will be pushed to the other side

- The community queried on whether the contractor will block the river during construction – the team responded that the river will continue to flow. The hydrologist will study the flow and the bridge will be designed.
- The community indicated that they fish and collect kai from the river every day and are mainly eaten at home and not for selling. They access the side of the bridge to get to the river and the mussels are mainly collected from underneath the bridge.
- The team pointed out to the community that during construction, the contractor will have to allow you to move free and ensuring the community safety whilst in the river collecting
- The community had requested to have their totem i.e., the freshwater mussels and a type of fish known in Fijian as *busa* to be designed on the bridge. Also, to be included is what their village is known for i.e., the sleeping giant. The team had requested the email of the *Turaga ni Koro* (village headman) email so that the bridge engineer to send him some information
- The school children don't cross the bridge to get to school, its mainly the Natalau children that crosses the bridge often. The students from sabeto village attend the District School nearby which is just further up from the village
- They confirmed that flood water sometimes goes over the bridge and the biggest flood ever that they've experienced was back in 2012. They also mentioned that with the last flood, the flood water went as high up to the roof top of the house that's located at the entrance to the village but not where we're holding the consultation as it's on a higher ground
- The land where the service station and the tin house sit belong to the Mataqali Navakalolo. They were thoroughly informed again on the proposed alignment that it will encroached onto where the tin house is sitting. They indicated that the lease owner of the service station lives in overseas, however the person that's running the service station is renting the place. On the opposite side of the river where the sugarcane is, is under state land lease.
- A community member raised regarding the lease holders located where the proposed bridge will sit, with compensation being given, is there any amount of money that will be given to the landowner – the team responded that it will depend on how much area will be impact, however the compensation will only go to the lease holder that will be affected.
- Another landowner raised if they will be relocated too – the team responded that there is also a process that will need to be followed should the need arises for relocation. Once the assessment and studies that will be carried out points out that relocation is required then the FRA will carry out that process including any affected crops and area.
- The community raised if the machines that will be used will affect the settlements living close to the bridge – the team responded that the contractor will need land for their laydown area where they can put all their equipment, site office, etc and the team are looking at the sugarcane field side on state land. They were informed that when the engineers are designing the bridge, they will try to not impact houses as much as possible to avoid the relocation process
- They community raised as to what year the project commences – the team responded that the investigation works will be 4th quarter 2021 to 2022 with the design to be completed by end of year 2023. The contractor will then be

engaged, etc. Once the design is completed, the team will return to present on the design before commence construction

- The community requested if there could be a step to be constructed beside the bridge so that its easier for them to go into the river
- The community use the floating bamboo known in Fijian as *bilibili* to travel u and down the river and also, they have 2 boats which are tied under the bridge
- A community member had requested to have the flood marker be included as part of the new bridge
- The community mentioned that not only the villagers access the stream for food but also people coming all the way from Lautoka and upland area in Sabeto to collect freshwater mussels and fish in the river
- The villagers mentioned that they access the river from both sides of the river – the team had advised the community that during construction, the community to enter the river from the sugarcane side
- A community member raised if dredging will also be carried out – the team responded that dredging is not part of the bridge development and that its part of the Ministry of Waterways. He added that the reason why he queried about the dredging is because the houses living close the bridge always flood. They requested if dredging could also be part of the construction to help relieve flooding around the area
- The community requested if they could be contacted for employment during construction phase
- The representative of the Mataqali that own the land where the proposed new bridge will sit has put forward his request that for the second round of consultation, that he be contacted in advance so that all his Mataqali member to sit in the meeting. Name is Samuela Naquto – 9217754.
- They're more concerned over the depletion of the iqoliqoli during construction – FRA explained briefly on the proposed plan that it will be precast and pile driving and should there be any oil spill or damage on the environment, the Department of Environment will be contacted to investigate and findings from the investigation will determine the type of penalty given to FRA

With no further questions from the community, the meeting was closed.

3. Actions from Meeting

- Project team to get the name and contact details of:
  a) the two households and landowners on the upstream side next to the shop who own the homes and land beside the Sabeto Bridge.
  b) Owner of the service station and shop
  c) Owners of land on the downstream Lautoka side of the bridge as well as the owners of the land on the upstream Lautoka and Nadi sides of the bridge. It was noted that on the upstream side there was different traditional land owners that we needed to verify with TLTB.
- Land tenure and ownership will need to be confirmed of all affected land - once the preliminary design options are done by the Engineers.
- Confirm with the utility provides the services located in close proximity to the existing and proposed bridge alignments that will need to be relocated esp. the existing fuel line

Project Name:	**40 Critical Bridges and 3 Maritime Structures – 3rd Stakeholder Consultation Meeting Minutes**
Structure(s):	Sabeto Bridge (P1)
Place of Meeting:	Sabeto Revival Church building, Sabeto
Meeting Date:	Wednesday, January 24th 2024 **Meeting Time:** 6.00 PM
Prepared By:	PLANIT Pacific Pte Limited

Attendees:

Project Team

- Jacqueline Hughes, PLANIT Pacific—Land & Resettlement Specialist
- Tevita King, PLANIT Pacific - Land & Resettlement Team
- Julia Whippy, PLANIT Presenter/Facilitator
- Alex Nevell, BICL - Bridge Engineer
- Noa Sakapo, FRA – FRA Valuation Officer

Stakeholders

- Daniel H Pickering, WAF
- Aisea Tivakanoa, DoL
- Livai Koro, Fiji Roads Authority
- Epeli B, FRA
- Salome T, DoF
- Joseva R, DoF
- Luke Lomata, TFL
- Joseva Sauta, FRA
- Josefa Saumailagi, Waterways Department
- Aisea Tivakanoa, Ministry Lands
- Salome T, Ministry of Fisheries
- Joseva Ragitawa, Ministry of fisheries

Attendee

- Bill Falalima, Sunshine Aerated Water
- Nikola Veitawa, Turaga Ni Koro Narua
- Sevuloni V, Church C
- Vuivuna T., Church C
- Mosese Susa, Landowner
- Sailosi Taka, Landowner
- Naiqama Daucina, ITLTB
- Laniana M, Ba Provinicial Council
- Matelita Kurulo, Church C
- Sereima Nocei, Church C
- Olivani Narogo Church
- Lice N, Mobil Oil

- Timoci Botitu Ba Provincial Council
- Varanisese Church C
- Raj Kumar, Swamy Diary Shop
- MunSamy, Swamy Dairy Shop
- Yathosh, Mobil Oil
- Nishchal Rai,
- Ane Vuniyaya, Fiji Police Force
- Sevuloni Nasilasila, Landowner
- Varanisese Navoka
- Saimoni Vatu
- Josese Ramatau, Landowner
- Leone Nayavu, Landowner
- Waisiki, Landowner
- Josese Ramatau 2, Landowner
- Noa Nasilasila, Landowner
- Peniasi Sabolo, Landowner
- Alivereti Togabale, Landowner
- Samuela Naqato, Landowner
- Timoci Q, Landowner

Item	Action
1. Introductions • The Assistant Roko welcomed everyone and thanked them for their presence. • Julia Whippy of the Land Acquisition team (PLANIT) introduced the 40 bridges and 3 jetties structures project and the project team.	
2. Presentation by PLANIT • A PowerPoint presentation was done in the iTaukei language explaining the project, overall priority of bridges & jetties and upgrade development activities • An explanation of the design process, social safeguards and land acquisition was presented • Responding to the community/village and stakeholder comments and issues through Q & A	
3. Discussion Session • A question was raised by the community members on the acquisition map and what the red meant. • Mr. Sakapo (FRA Valuation Officer) explains that that area is the temporary area which will be required to be used for the construction works but will not be acquired or purchased by FRA but rented from the lot owner by the Contractor. It is demarcated as an approximate area to ensure no one uses or develops that area between now and the commencement of construction of the bridge. The area may be bigger or smaller but that will be determined by the	

Contractor once appointed and a rental agreement will be signed between the Contractor and the owner of the properties. Once the construction works is finished, the land will be given back to the owner and the Contractor will have to give back the land in a good condition. It is clarified that only the area that is shaded 'Blue' on the Land Plan will be acquired or bought from the owner and will not be returned, but will be held by the State through the Director of Lands.

- Another question was asked about the temporary areas (rented areas), if there are machines parked on it, will they be charged rent for them or anything sitting on the temporary areas? Mr. Sakapo mentions that those areas are to be identified for rental by the Contractor before he starts work on site and an agreement in place to pay rental for its use. Once the contractor starts work on site, they will be able to answer specific questions of areas needed for their site setout and this can be answered before you sign the rental agreement.
- A comment was raised by a community member about the monies allocated to compensate the landowners. When the contractor is chosen, he signs the contract for the work, which means the funding/money has been locked into the work. And if the compensation is needed in that time, is it true that it will not be paid because it has been locked into the contract with the contractor.
- Mr. Sakapo confirmed that for the compensation of land and structures or crops, payment is made by FRA directly and the payment is usually made in two installments, 75% upon signing of the Sales & Purchases Agreement, and 25% upon completion of the final survey after the construction works is completed to confirm the final area taken up. If more area is taken up by the bridge works, then FRA will pay for the extra area taken up. For the rental amount, the Contractor will have to make allowances for payment of this rental monthly to the lessee.
- A question was asked about the size of the total area taken up by the development. Mr. Sakapo (FRA) replied stating that they needed a total area of 7000sqm which is about 1.7 acres approximately. Jackie (PLANIT) added that the red area on the plan is the minimum area that is required at this stage and that the Contractor may need more area for stockpile, office, parking but they will need to identify this once they are awarded the Contract.
- A villager raised his concern that he has been living in Nadi for 25 years and mentioned that the flooding issues faced by the communities when roads and bridges are constructed appears to elevate the flooding issues. When these structures are raised above the existing levels, the surrounding area becomes a basin that traps water when flooding occurs and Sabeto area is the same. The water does not drain fast enough and it spills into our community like ever since Grace Roads in Sabeto constructed their new complex along Sabeto Road we have survived flooding. These flood waters also destroy their farm as well. To mitigate the flood problem, the villager requests if there could be culverts under the road to help the water flow out and away from their farms. Another issue that was raised was the issues of the bridge height which would be much higher than the existing bridge but the tramline bridge will remain the same. This will cause the wood and debris to still get trapped on the lower structures which is a concern for us in the community.
- Alex (BECA) acknowledged the flooding comments made by the villager and advises that he will take it to the team and hydrologist to discuss these issues and requests.
- The villager also suggested to put the wash stairs on the downstream side of the bridge as it would not get washed away in times of floods, however, it was raised the reason why it was not put on the downstream side was that the local community would then have to cross the road to use it and this was considered dangerous.

- Another villager asked if they could have the stairs on both sides of the river, however, Jackie (PLANIT) mentions that the other side being the Lautoka side of the bridge, would result in access easements being required through a State Lease land, and therefore, it was thought best to keep it within the native reserve land.
- Another villager mentioned his concern about the natural movement of the river with erosion and asked what design measures were in place for this. He asked if there could be proper drainage within their village reserve land abutting the bridge and road to ensure their property is well drained from the run off from the road and that they do not flood considering the bridge and the approach would be higher than their native reserve land.
- Alex (BECA) acknowledges the question and mentioned that they have measures in place such as increasing the length of the bridge to cater for future erosion, adding scourer protection and monitoring the erosion per site, and in future putting in some rock lining wall along the river near the bridge.
- Jackie (PLANIT) also adds on that there are some ways the villagers who live upstream along the river can do to help stop the river from changing. These measures include planting "vetiva" grass and other trees along the riverbanks to help hold the soil together. Further she advised that the villagers should also avoid clearing so close to the river bank to avoid exposure of the soil of the banks that get washed into the river during high flows and heavy rain.
- An issue was raised with regards to the requirement of a Fisheries Impact Assessment (FIA) and so the Ministry of Fisheries officers explained that they would come to the site and to the local community and conduct interviews and do some fishing assessments to see what fish are in the area before they repor their report recommending the final qoliqoli compensation value which will be sent to the Department of Lands, who will then inform FRA. FRA will then have to pay the compensation money to DoL and DoL will send the money to iTLFC to hold on behalf of the registered Qoliqoli Resource users for their future access in accordance with the iTLFC policy requirements.
- A community member asks if there are any committees set up to monitor development project and the general wellbeing of the community when these companies like Grace Road build their development which causes flooding.
- Livai (FRA) advised that monitoring of developments like is comes under the Department of Environment through the Environment Management Act, and they should have monitored the development during construction. However, a community member stated that just with small amounts of rain the drains get flooded and maybe the drains were approved too small or not cleaned.
- Josefa (Ministry of Waterways) informed the Sabeto village members present that Waterways had plans to clear out the drains outside of the Sabeto Village in the agricultural areas. The community asked what about the drains just outside of the Sabeto Revival Church Hall where the meeting was being held and, Waterways confirmed that it was FRA's responsibility to clean the road side drains. The community raised their concerns that it was all very confusing for them as to who was responsible for what drains in their area and requested that this be something that is clarified for the local communities to understand. One community representative said, they were very concerned that there was flooding in the Waimalika area which now floods all the time because of a recent development in the area and they are very concerned that the authorities are allowing development to happen and its affecting the communities during flood, high tide and heavy rainfall events and their complaints seem to be falling on deaf ears. Waterways and Land Dept representatives together with Roko present said that they would look into the issue and revert back to the villagers.
- A concern was raised by a household staying on the native reserve land on the upstream Nadi approach to the bridge regarding speeding along that stretch of

road. He stated that there were a lot of accidents and their children normally board the bus along this stretch. He also stated that there were no bus shelters for the students and the community members to use especially during rainy days and hot weather and requested if FRA could consider putting in a bus stop as well as a crossing to the other side of the road for the safety of their children in the new bridge design. Alex (BECA) mentions that it is not currently in their scope but it is something that can be requested directly to FRA in future.

With no further questions from the stakeholder and community members of Sabeto, the meeting was closed.

4. Actions from Meeting

- Alex to confirm with FRA on provision for bus shelter and crossing near the bridge
- Alex to discuss speeding measures on the approaches to the bridge with FRA as currently there has been so many accidents along that stretch of road
- Alex to review drainage concerns raised by the affected native landowners abutting the bridge and road approach to ensure that there is proper drainage and culverts so that their land does not flood from the run off from the road considering it will be higher than their existing road
- Waterways, Lands Dept and Roko's office to liaise with community members in Waimalika and Sabeto near Grace Roads to investigate drainage and flooding complaints by the community.

Project Name:	**40 Critical Bridges and 3 Maritime Structures Stakeholder Consultation Meeting Minutes**
Structure(s):	Lomolomo Bridge (P1)
Place of Meeting:	Lomolomo Community Hall, Lomolomo
Meeting Date:	Wednesday, October 13th 2021 **Meeting Time:** 1.30 PM
Prepared By:	PLANIT Pacific Pte Limited

Attendees:

Project Team

- Jacqueline Hughes, PLANIT Pacific—Safeguard Land & Resettlement
- Julia Whippy, PLANIT Pacific—Social Safeguards
- Manisha Nandan, Erasito—Environmental Safeguards
- Vaclav Hirsch, BICL—Bridge Engineer

Stakeholders

- Livai Koro, FRA
- S Prasad, FRA
- Apisai Vularika, DO Lautoka
- Kitione D, Assistant Roko Tui Lautoka

Lomolomo Village Member

- Jolame Koroi Assistant Village Headman
- Isoa V
- Mosese Tuisa
- Solomoni Rawaqa, Village Headman
- Anasa Ramawanawa
- Noa Turuva
- Alivina Rubemua
- Seini Lauwai
- Waisele Beci
- Vilimaina Kuru
- Mosese Waqa
- S Rawaqa

Item	Action

1. Introductions

- The Assistant Roko Tui presented the project team's Kava as Sevusevu to the village and then welcomed and thanked the villagers for their presence. He then briefly introduced the 40 bridges and 3 jetties structures project and the project team who he said would present the project in detail to the villagers.

2. Presentation by PLANIT

- A PowerPoint presentation was presented in the iTaukei language explaining the project, the priority bridges & jetties and upgrade development activities
- Provided an explanation of what is involved in the Feasibility study and Design Phase
- Explanation on the possible option to replace the existing bridge in its current alignment and before this is done a temporary bridge is to be constructed upstream to temporarily divert the traffic during construction of the new bridge. This option is also in line with Fiji Roads Authority future 4 lane plan as it was on the same side as planned due to the railway crossing and existing utilities on the upstream side. The 4 lane plans between Nadi and Lautoka by Fiji Roads Authority is a separate project to these bridge replacements.
- Gathering stakeholders/communities' concerns and issues and information about the proposed new Lomolomo bridge project.

3. Discussion Session

- The local headman expressed concern about flooding at the Lomolomo Bridge especially during long periods of heavy rainfall and high tide events. He stated that the water comes down from the mountains and flows down the creek and at the same time floods the adjacent low lying areas including the village. He says when this happens to coincide with high tide, the flood waters remain until the tide recedes.
- The Lomolomo village community stated its full support for the Lomolomo bridge upgrade, citing the fact that the bridge has caused floods in their village on several occasions and this issue has been raised during Provincial Council meetings. They went on to say that when stormwater runoff from the mountain meets high tides and waves running upstream, water pours into the village, with floodwater levels around chest high. They confirmed that the village's most recent major flooding occurred in 2018.
- They brought up the fact that there is a floodgate downstream at the Standard Concrete operation site.
- They said that in the past, Lomolomo was the first village to flood since the village is on lower ground and the road is much higher than the village.
- In terms of the creek usage, the village members fish in the river, especially when the river is still flooded, as fish are washed upstream with the tides and it is their main source of livelihoods. He said their children also swim in the river.
- Their school children from the village attend Vuda District and Lomolomo Public School, and they do not cross the bridge to go there as it is in the other direction. Only a few children from their village attend Namaka Public School, and only a few of them cross the bridge to get to school in Nadi Town but most times they catch the bus.
- The village headman noted that because his house is on higher ground, it has been used as an evacuation shelter for villagers during flooding.
- The villages also asked if dredging of the creek could be included in the design and construction phase to deepen the creek's capacity to take more water to flow out to see.
- They stated that the name of the creek is Edronu which also runs alongside the village and down crossing under the Lomolomo bridge.
- When the project team asked if the creek running through the sugarcane farms upstream and downstream were natural, the community stated that the sugarcane farmers built the drains which flow into the creek and are now part of the creek.

- When asked about the tenure of the land adjacent to the bridge, the community stated that the sugarcane field is leased from the state, while the land on the opposite side of the bridge is native, and the land adjacent to the bridge belongs to the village.
- When the project team asked if they farm near the bridge upstream, the community stated that they used to plant there but not anymore due to the seawater overflowing onto their farm and ruining their crops.
- The community requested that the bridge plan include the construction of a barrier/seawall on the upstream side of the bridge to prevent wave surges from entering the village.
- They catch maleya, eel, jumping jack, and prawn in the river, but their main source of income is collecting and catching fish from the sea.
- The villagers indicated that they are willing to provide their land to be used for a construction site
- They have expressed their concern over the flood gate being left open due to the high tide traveling upstream even past the bridge, which would flood the village especially when there is heavy rain.
- They expressed their concern regarding the new bridge as it might further caused flooding to their village if the river system and the bridge is not maintained.
- They complained that the flood gates downstream were not being maintained, and that the Ministry of Waterways was responsible for them but were not doing so.
- The community had requested the downstream farmers to straighten the stream or drains; however, the farmers had yet to respond. This is an issue they request for FRA and Ministry of Waterways or Ministry of Agriculture' Drainage and Irrigation Board should be looking at to protect their land and village upstream.

With no further questions from the community, the meeting was closed.

4. Actions from Meeting

- Project team to get the name and contact details of:
  a) the landowners on the upstream and downstream
- Land tenure and ownership will need to be confirmed of all affected land - once the preliminary design options are done by the Engineers.
- Confirm with the utility provides the services located in close proximity to the existing and proposed bridge alignments that will need to be relocated esp. the existing fuel line
- Distribution of community questionnaires for those affected by the proposed temporary bridge upstream and existing bridge replacement, the Turaga ni Koro, the Provincial Council reps and the Women's group rep for the village to facilitate the distribution and collection of the questionnaires. Need to also contract the District Councilor who is responsible for the indo-fijian settlement located on the Lautoka side of the village to obtain their comments as well.

Project Name:	**40 Critical Bridges and 3 Maritime Structures Stakeholder Consultation Meeting Minutes**	
Structure(s):	Lomolomo Bridge (P1)	
Place of Meeting:	Lomolomo Village Hall	
Meeting Date:	Wednesday, March 20th 2024	**Meeting Time:** 2.30 PM
Prepared By:	PLANIT Pacific Pte Limited	

Attendees:

Project Team

- Jacqueline Hughes, PLANIT Pacific—Land & Resettlement Specialist
- Tevita King, PLANIT Pacific - Land & Resettlement Team
- Aisake Raratabu, Facilitator/Presenter
- Alex Revell, BICL - Bridge Engineer
- Noa Sakapo, FRA – FRA Valuation Officer

Stakeholders

- Tabitha K, PLANIT Pacific
- Kelekolio T, FRA
- Serona F, FRA
- Wame T, Standard Concrete Industries
- Raulioro R, EFL
- Sairusi Q, EFL

Lomolomo Village members

- Sairusi Tuiweli, Village member
- Amele Ratu, Village member
- Neisease Moala, Village member
- Ratu Epeli, Village member
- Jolame K, Village member, Assistant TNK
- Samisoni S, Village member
- Tuame Baranage, Village member
- Pauliasi Banuve, Village member
- Luisa Sumo, Village member
- Leveni Wainiqolo, Village member
- Solomoni Rawaqa, Village member
- Solo Rawaqa, T Village member, TNK
- Solomone Vuluma, Village member, Turaga ni Yavusa

Item	Action
1. Introductions • The Assistant Turaga ni Koro welcomed and thanked the villagers for their presence. He then handed it over to Mr. Aisake Raratabu (Facilitator/Presenter) to briefly introduce the 40 bridges and 3 Jetties Structures Project and the project team. He advised them that the project team would then present the details of the project.	
2. Presentation by PLANIT • A PowerPoint presentation was done in the iTaukei language explaining the project, overall priority of bridges & jetties and upgrade development activities • Explanation of the design process and environmental and social safeguards including summary of site investigations and data gathered was expressed • Responding to the villagers and stakeholder comments and issues through Q & A • Explaining next steps and indicative timeframes	
3. Discussion Session • During the presentation a village member raised concerns about the cutting of the side of the hill. Noa (FRA) assured the village member that they have taken note of all their concerns raised with their past TNK during the previous consultation. Jackie (PLANIT) explained that the previous TNK (Jolame) had advised that the hill was considered sacred to the village and that if FRA wanted to cut any part of the hill there was a process that needed to follow, with a special traditional ceremony with the Tui Vuda. Jackie advised the community as this was an ADB/WB funded project and we have informed them of what Jolame has indicated, and they advised us to come and reconfirm with the Lomolomo village community if this was correct in terms of what Jolame had advised. Jackie explained as FRA was confused as they only want to shave off a little bit of the rock but also understand that there is an existing native lease issued by iTLTB over the same area and also that Standard Concrete too as also quarrying rock at the back of the same hill. Jackie stated that PLANIT had also been in contact with Fiji Museum who confirmed that whilst they didn't have any information recorded on the scared hill, they would need to come and undertake further consultation with Lomolomo Village and Vuda Village to record the information. • The Lomolomo community members present at the meeting, all confirmed that the stone hill was indeed scared and confirmed that permission would need to be obtained from Tui Vuda. They advised that it would take several consultation meetings with the community to gather the info. When asked by Jackie what makes it scared and significant, they advised that it stems from the arrival of the first Fijians to Vuda, which has a historical significance which they want preserved. Jackie (PLANIT) advised that she would go back and inform Fiji Roads and liaise with Fiji Museum to arrange a time to come and underk take their assessment of the significance to which the community was grateful and appreciative.	○

- A village member raised concerns of the flooding issues the village has been facing for the past 18+ years. He questioned whether the bridge upgrade would increase their risk of flooding or relieve some of the flooding issues. Alex (BECA) stated that he does not expect the new bridge to solve the issue of flooding as the problem is that the village is lower than the road and where the flooding gets to. Without something drastic like raising the level of the village for example or putting in a large wall it would not help. What the design team has done is lengthen and raised the bridge as long and high as possible.
- A village member also raised the issue of flooding and was concerned that during high tide the seawater would inundate the village with the new bridge because it is wider. The village floods after 2-3 days of rain from runoff from the mountain but the concern raised was water coming in from the sea during high tide as well now that the bridge is wider and higher. Alex (BECA) confirmed that with the new bigger bridge, it should not bring any additional seawater into the village. If anything, having a wider stream channel will mean it does not get pushed up as much from the sea.
- Jackie ((PLANIT) stated that Ministry of Waterways is the authority that should be coming to the village to address flooding concerns. Jackie provided the community with the contact of the Ministry of Waterways who they should call to ask about their plans to address the flooding in the area. A village member requested that a floodgate be put in place to help relieve the flooding. He indicated that they had one in their area but that it was too far down and that they needed an additional flood gate closer and in front of their village to help with keeping the salt water out during flood events and letting the flood waters go down when it was open. Jackie advised the village members that these would be the type of issued they should raise in the Bose ni Tikina the following week as concerns from their village, with the help of the Roko and the District Office.
- A village member thanked the project team for their time and braving the rain and weather. He also expressed his thanks for the presentation and talanoa and discussions had. The village members were extremely grateful that the Lomolomo Bridge was in Priority 1 and were thankful that it was getting funding from ADB and World Bank and looked forward to the outcome.
- The Standard Concrete representative at the meeting also expressed his concern about their water meter located right at the junction of where the by pass is being proposed and wondered who would pay for the cost of the relocation. Alex (BECA) confirmed to him that they were aware of the water meter and it would be part of the contractor's responsibility to have those services relocated before bridge construction works began.

With no further questions from the villagers, the meeting was closed.

4. Actions from Meeting

- Project team to confirm with Fiji Roads the significance of hilltop to the village members and to arrange with Fiji Museum to undertake further consultation to record the level of significance so that it can be documented and appropriate recommendations, actions and mitigation measures can be put in place to be further addressed by Fiji Roads Authority and the contractor.