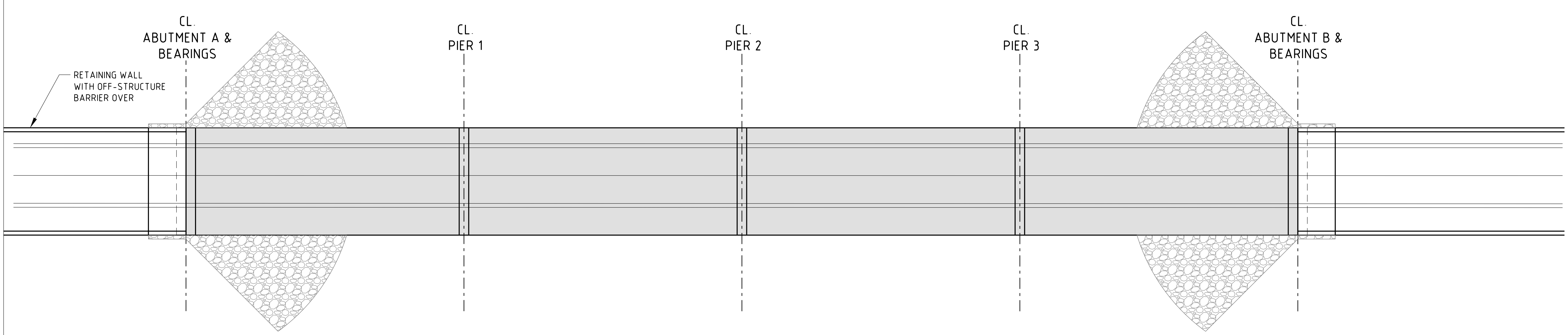


PLAN

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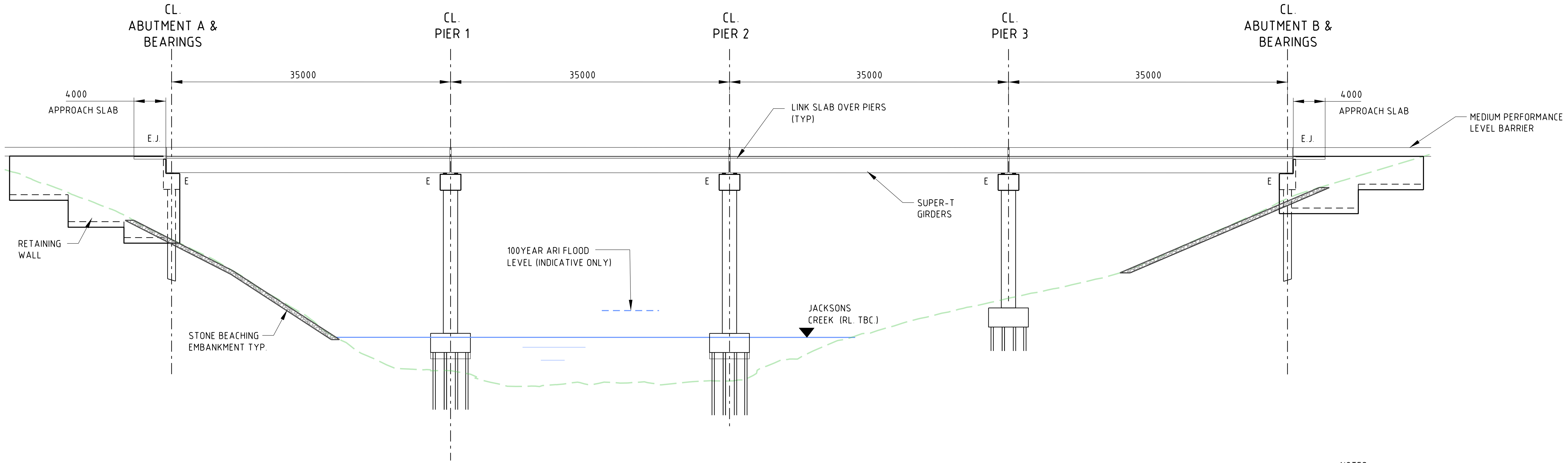


ELEVATION

1 : 500

NOTES
E - DENOTES EXPANSION BEARING

PRELIMINARY ISSUE
NOT FOR CONSTRUCTION

0100

50mm AT FULL SIZE

| REV | DATE | DESCRIPTION | DRAWN | CHECK | DESIGN | VERIFY |
|---|---|---|---|---|---|---|
| B | 7/03/16 | ISSUED FOR INFORMATION | DH | FR | JA | FR |
| A | 10/12/15 | ISSUED FOR INFORMATION | SK | GW | SHS | FR |



SCALES

0 5 10 15

Full Size 1:500 A3;
SCALE (m)

A3 ORIGINAL

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METROPOLITAN PLANNING AUTHORITY

PROJECT

SUNBURY STH AND LANCEFIELD RD PSP

JACKSON CREEK BRIDGE (SS-BD1)
GENERAL ARRANGEMENT
SHEET 1

| PROJECT No. | DISCIPLINE | NUMBER | REV. |
|---|---|---|---|
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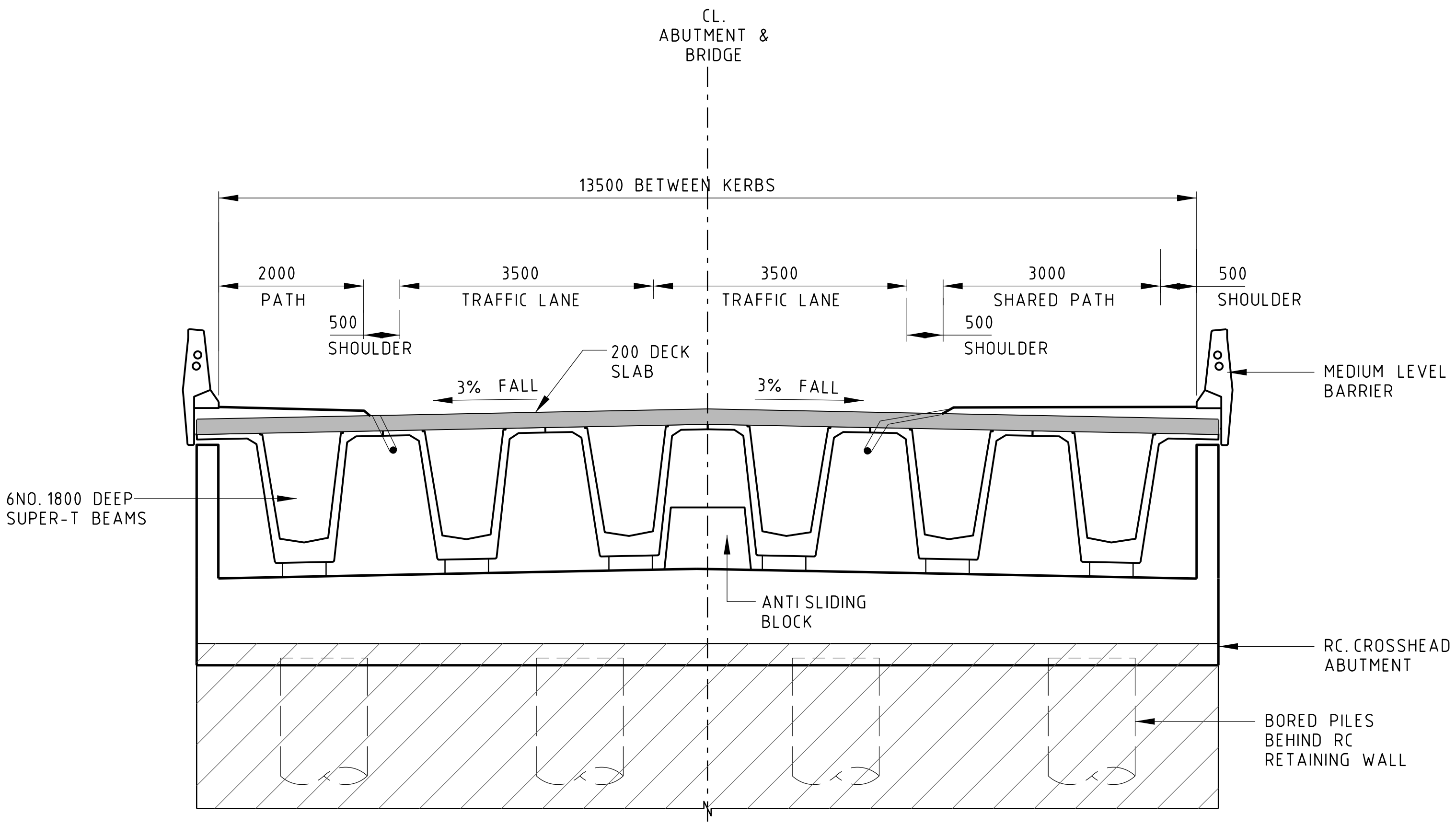
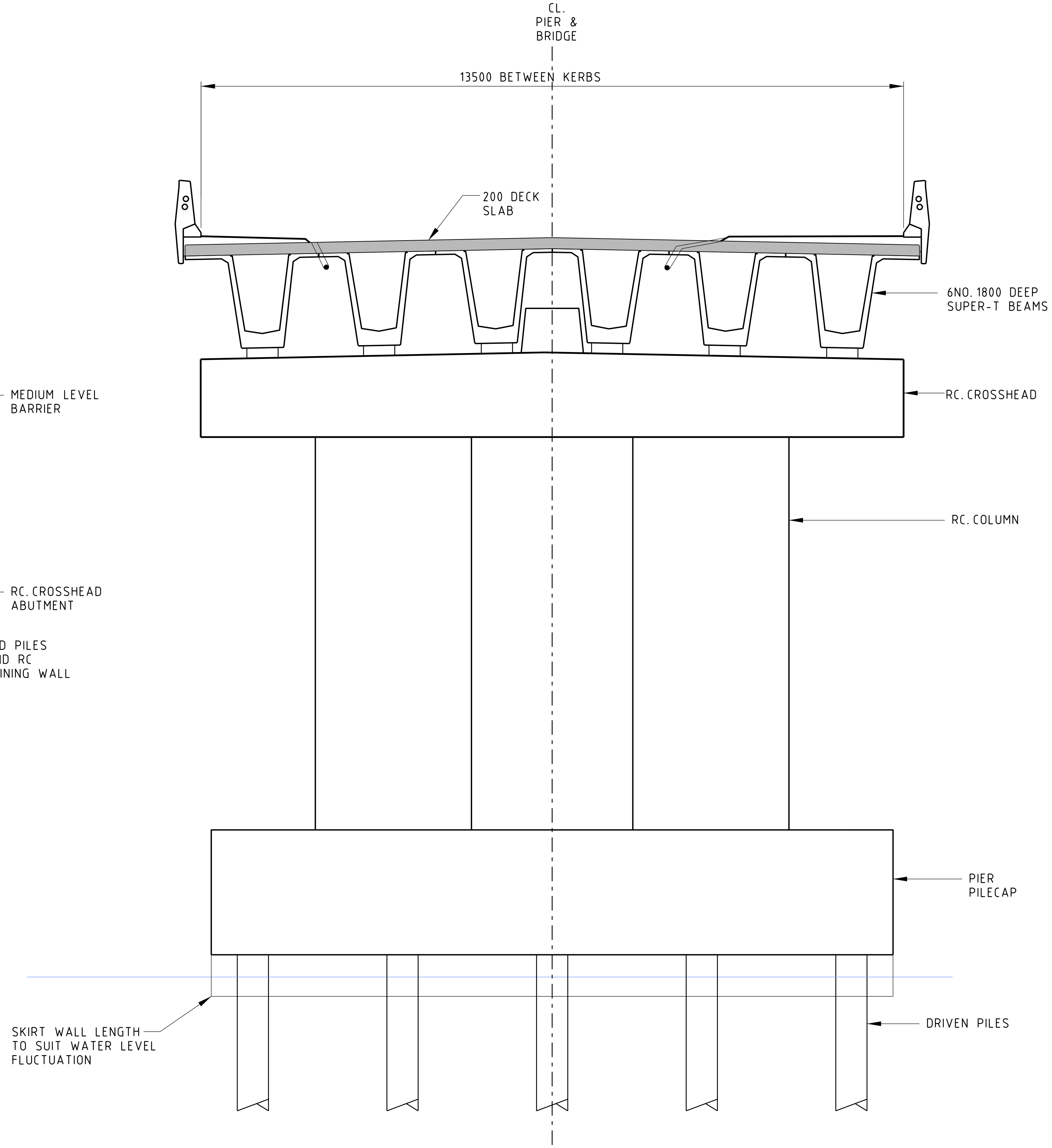



**ABUTMENT**
**FRONT ELEVATION**
1 : 100




**PIER**
**FRONT ELEVATION**
1 : 100

50mm AT FULL SIZE

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JACKSON CREEK BRIDGE (SS-BD1)
GENERAL ARRANGEMENT
SHEET 2

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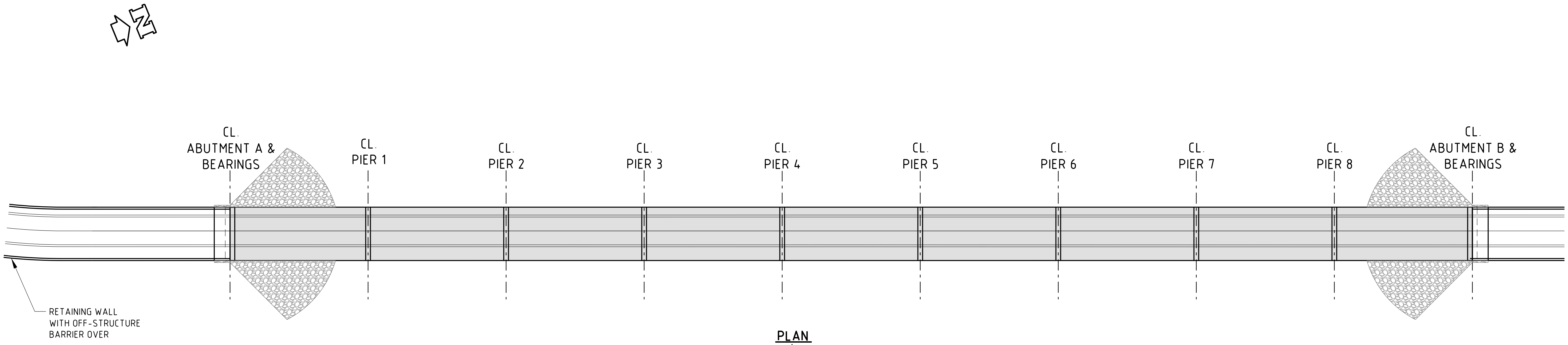
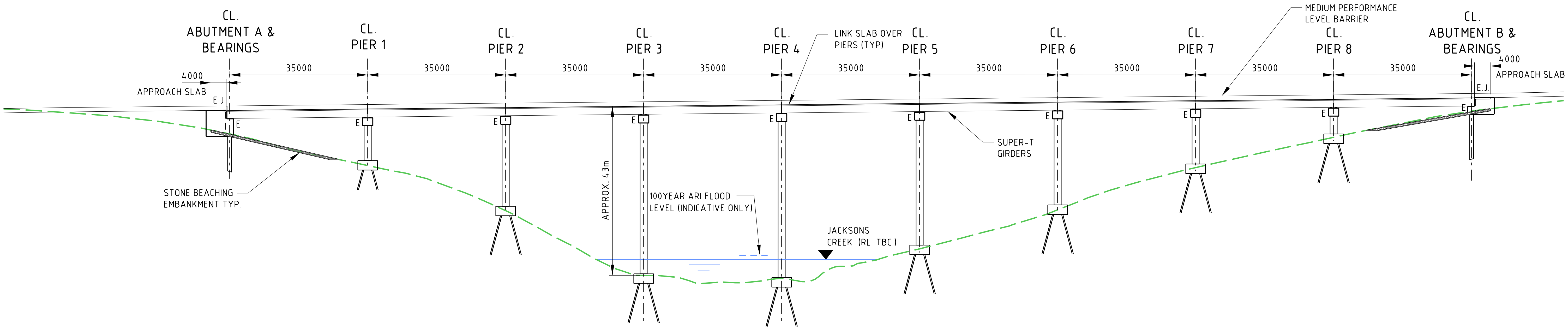



PLAN

1 : 1000




ELEVATION - OPTION E (LONG)

1 : 1000

NOTES

E - DENOTES EXPANSION BEARING

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50mm AT FULL SIZE

| REV | DATE | DESCRIPTION | DRAWN | CHECK | DESIGN | VERIFY |
|---|---|---|---|---|---|---|
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SCALES

0 10 20 30

Full Size 1:1000 A3
SCALE (m)

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PROJECT

SUNBURY STH AND LANCEFIELD RD PSP

JACKSON CREEK BRIDGE (SS-BD1)
ALTERNATIVE LONG OPTION
GENERAL ARRANGEMENT
SHEET 1

| PROJECT No. | DISCIPLINE | NUMBER | REV. |
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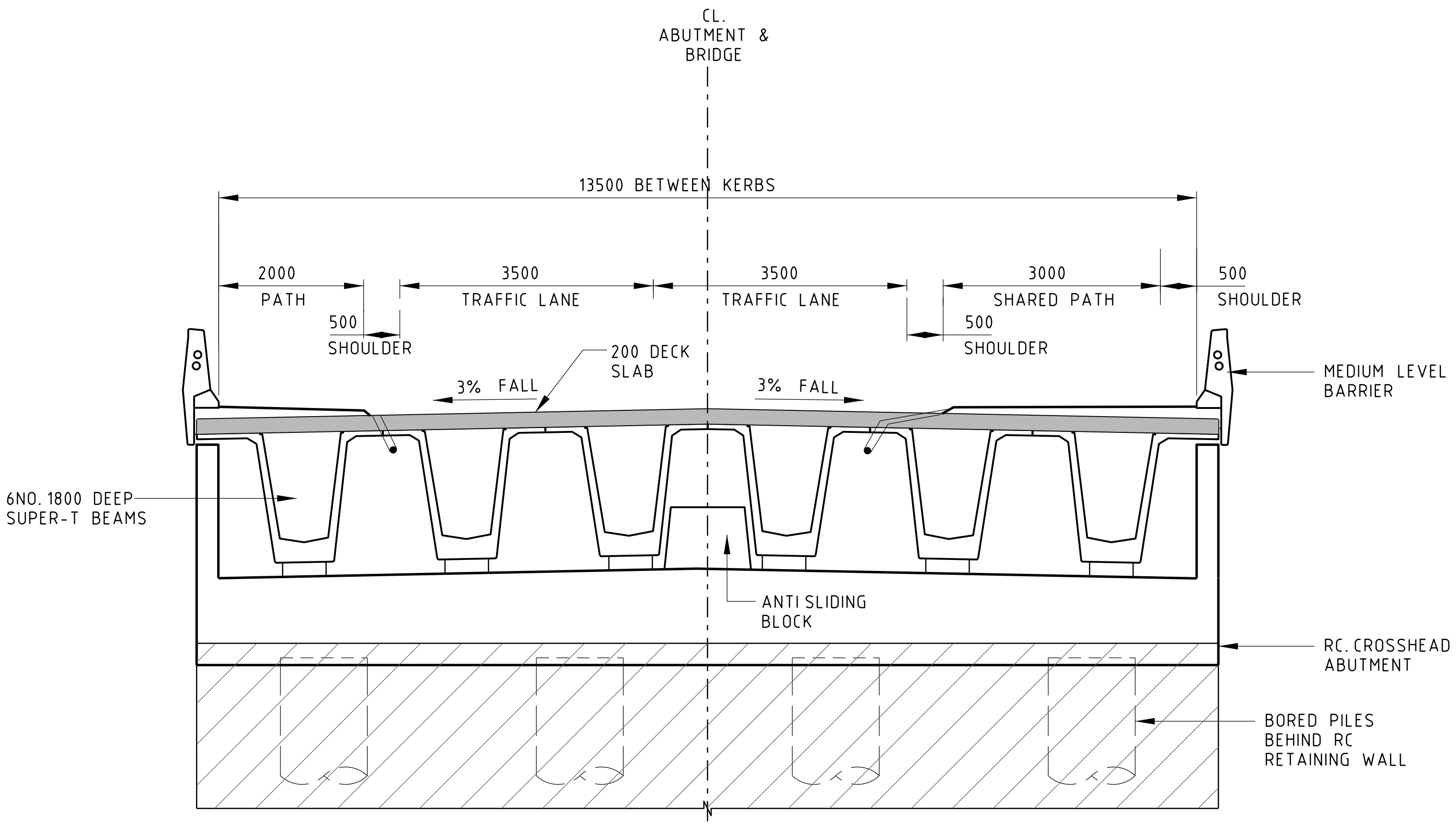
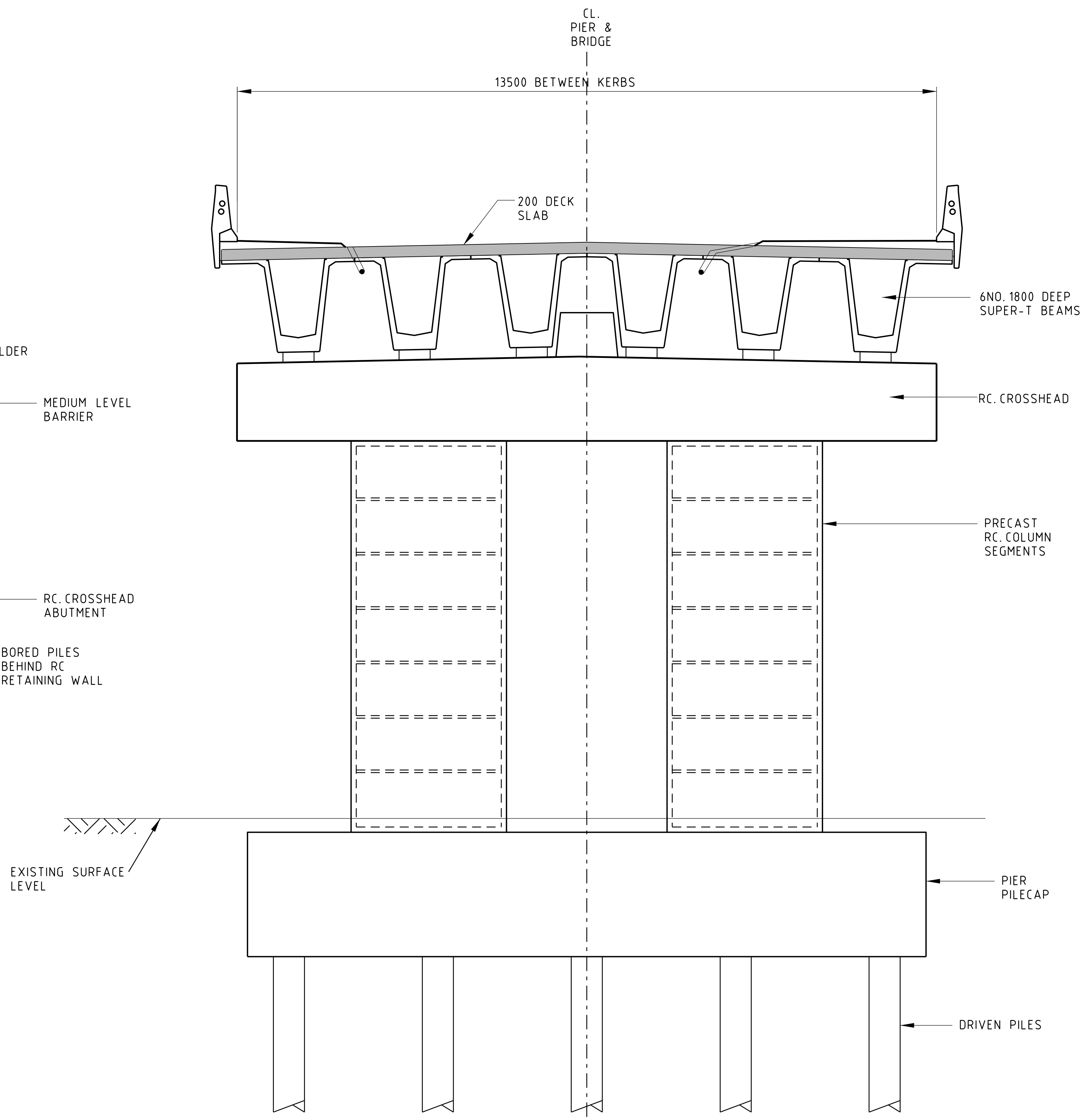



**ABUTMENT**
**FRONT ELEVATION**
1 : 100




**PIER**
**FRONT ELEVATION**
1 : 100

50mm AT FULL SIZE

PRELIMINARY ISSUE
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PROJECT
SUNBURY STH AND LANCEFIELD RD PSP

JACKSON CREEK BRIDGE (SS-BD1)
ALTERNATIVE LONG OPTION
GENERAL ARRANGEMENT
SHEET 2

| PROJECT No. | DISCIPLINE | NUMBER | REV. |
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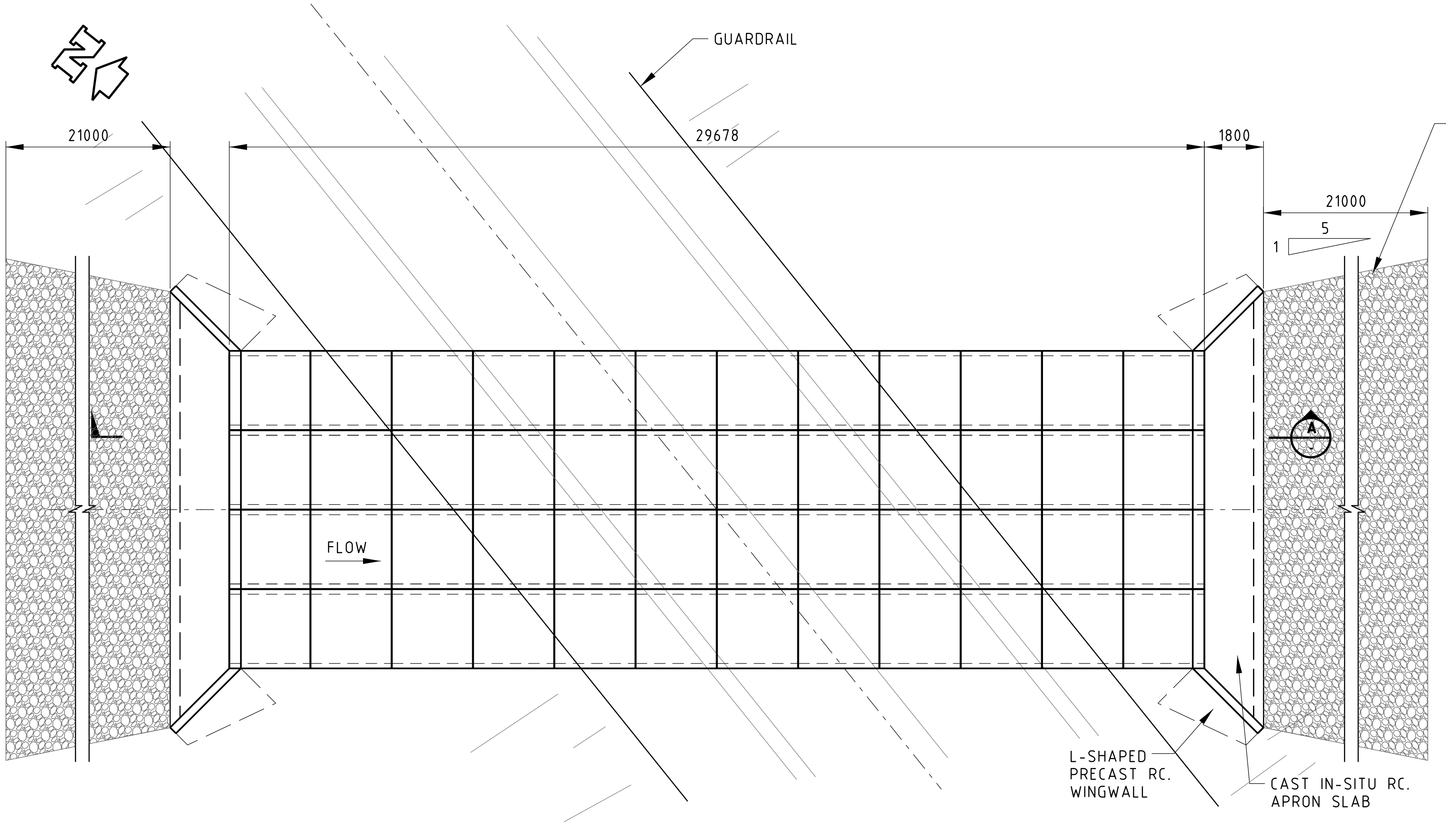
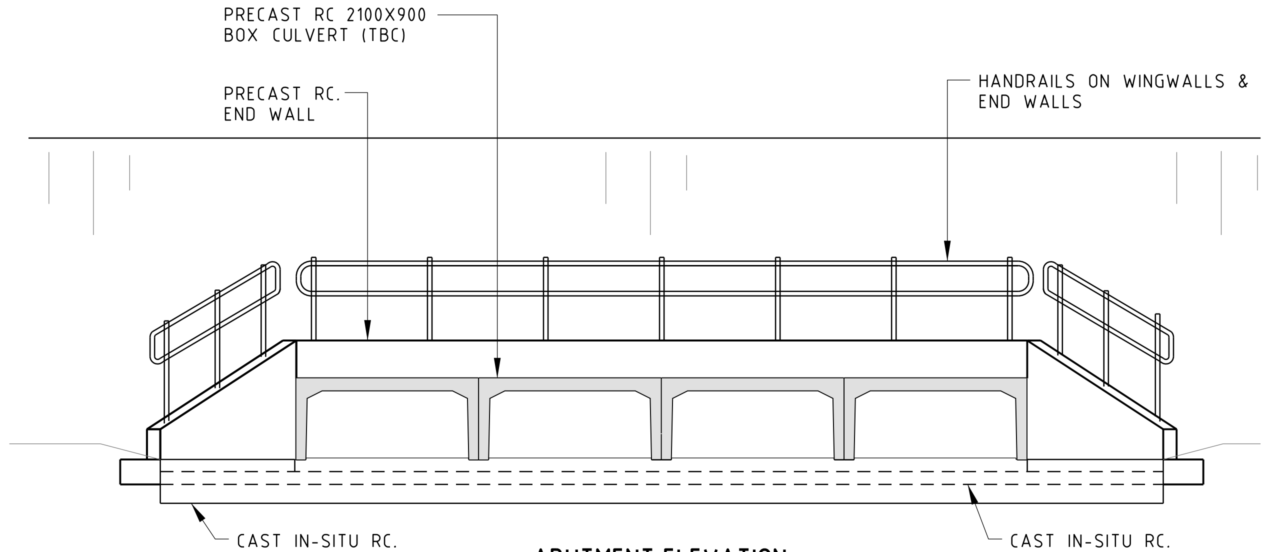


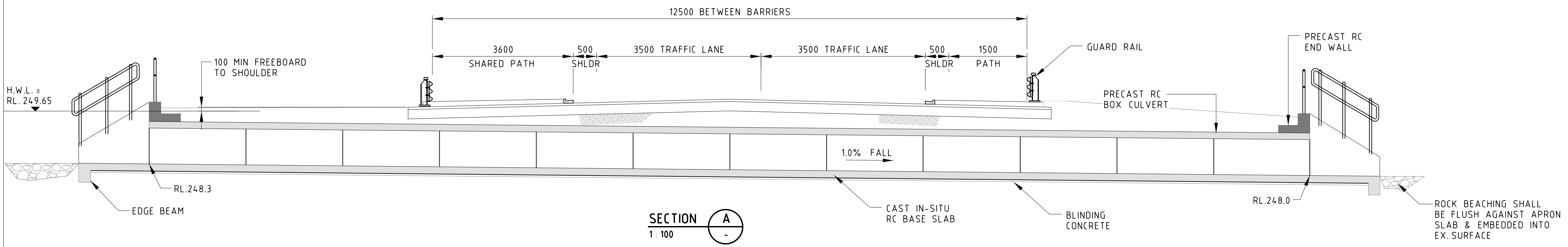

PLAN
1 : 200




ABUTMENT ELEVATION
1 : 100

NOTES:

1. PRECAST REINFORCED BOX CULVERTS SHALL BE DESIGNED IN ACCORDANCE WITH AS1597.2-2013 FOR SM1600 LOADING IN ACCORDANCE WITH AS5100.2 AND UP TO 2.0m OF FILL.
2. MANUFACTURE, TESTING DELIVERY AND INSTALLATION OF PRECAST BOX SHALL BE IN ACCORDANCE WITH VICROADS STANDARD SPECIFICATION 619 & 616 .
3. BARRIERS SHALL BE IN ACCORDANCE WITH AS3845
4. HANDRAILS SHALL BE DESIGNED IN ACCORDANCE WITH AS1657.
5. INTERNAL DIMENSION OF EACH CULVERT PRESUMED TO BE 2.1m WIDE BY 0.9m HIGH.
6. PROVIDE MIN 100mm FREEBOARD FROM SHOULDER LEVEL TO HEAD WATER LEVEL (HWL) IN 100 YEAR ARI EVENT
7. ROAD LEVEL SHOWN IS INDICATIVE ONLY.
8. 530 AFFLUX OCCURS UPSTREAM DURING 100 YEAR ARI EVENET.




SECTION A
1 : 100

50mm AT FULL SIZE

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PROJECT
SUNBURY STH AND LANCEFIELD RD PSP
HARPERS CREEK CULVERT (LR BD4)
GENERAL ARRANGEMENT

| PROJECT No. | DISCIPLINE | NUMBER | REV. |
|---|---|---|---|
| 2113308A | STR | 0106 | A |

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# Appendix C

Culvert calculations

**PROJECT:**

**Designer:**
**Checker / Reviewer:**
**Date:**

**Sheet ___ of ___**

**HYDROLOGICAL AND DESIGN INFORMATION**

$Q_1$ = 19.76 $m^3/s$ - ARI 100 yrs   $TW_1$ = 0.75 m

$Q_2$ = ______ $m^3/s$ - ARI ___ yrs   $TW_2$ = ______ m

$Q_3$ = ______ $m^3/s$ - ARI ___ yrs
$TW_3$ = ______ m
Extreme Event Check

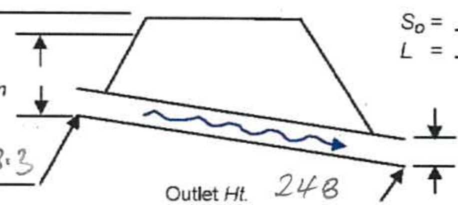
**SKETCH**

Shdlr Ht. ______

ALLOWABLE HW = ______ m

Inlet Ht. 248.3

Outlet Ht. 248




$S_o$ = 0.01 m/m
$L$ = 30 m

MAXIMUM ALLOWABLE STREAM VELOCITY ($V_{max}$) = 2.5 m/s

**HEADWATER COMPUTATION**

| CULVERT DESCRIPTION | Q per Cell ------ Q/B Ratio | Size D or Ht | INLET CONT. $\frac{HW}{D}$ | $HW_i$ (1) | OUTLET CONTROL $k_e$ | $H$ | $d_c$ | $\frac{d_c + D}{2}$ (2) | $TW$ (3) | $h_o$ | $LS_o$ | $HW_o$ (4) | CONTROLLING HEADWATER | OUTLET VELOCITY ($V_o$) | Comments (incl. check of Froude No. & AHW) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4No. 2.1×0.9 | Q = 4.9 | 0.9 | 1.5 | 1.35 | 0.5 | 0.65 | 0.822 | 0.86 | 0.75 | 0.86 | 0.3 | 1.21 | IN | 4 m/s | Fr = 1.08 OUTLET |
| | Q/B = 2.35 | | | | | | | | | | | | | | PROTECTION REQ'D. |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| Levee/block: / Energy Dissipator: | | | Figs 9B.1 - 9B.4 | $HW_i$=HW/D x D | Table 9.10.2 | Figs 9B.5 - 9B.10 | Figs 9B.13 - 9B.15 | | | If TW > D, then $h_o$ = TW. Otherwise $h_o$ is greater of (2) & (3) | Length x Slope | $HW_o$=H + $h_o$ - $LS_o$ | Greater of (1) & (4) | ⇧ Average outlet velocity: $V_o$=Q/A. Refer Sect. 9.11.9 | When inlet control: Use Figs 9B.11 & 9B.12 to determine part full area for pipes. For boxes, use Manning's to determine normal depth. When outlet control: Depth of flow based on D, $d_c$ or TW as appropriate. |

Summary and Recommendations: * ADOPT 4No. 2100mm (W) × 700(H) BOX CULVERTS WITH 21m OF $d_{50}$ = 500mm ROCK PROTECTION AT OUTLET.
* MIN SHOULDER RL 249.75

9B

PARSONS BRINCKERHOFF

**Calculation Sheet**

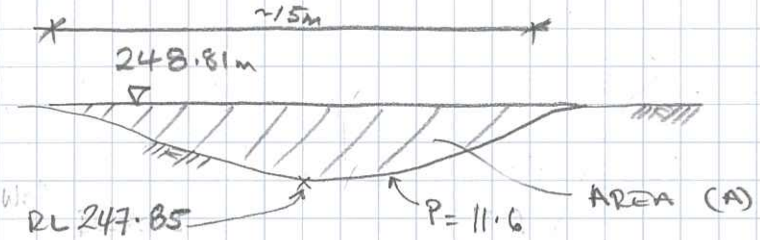
| | | |
|---|---|---|
| Job: SUNBURY SOUTH & LANCEFIELD RD PSP | Design: GW | Office: |
| | Date: 23/11/15 | Job No. 2113308A |
| | Checked: | Page No. 1 |
| | Date: | |

## LR-BD4 CULVERT CALCULATION.

MELBOURNE WATER INPUT INFORMATION: (100yr ARI).

REDUCED LEVEL AT CULVERT LOCATION = RL 248.81m AHD

FLOW WIDTH ≈ 15m.




FROM CROSS SECTION BASED OFF LIDAR CONTOURS OF EXISTING CHANNEL. (CROSS SECTION NORTH OF EXIST. UNSEALED ROAD)

A = 6.5 $m^2$

MANNING'S FORMULA

AUSTROADS GUIDE TO ROAD DESIGN (AGRD) PART 5B. CL 2.3.2

$$V = \frac{1}{n} R^{2/3} S_o^{1/2}$$

$S_o$ = slope

R = Hydraulic Radius = $\frac{A}{P}$   P = wetted perimeter.

n = Manning's roughness coefficient.

CHANNEL APPEARS TO BE NATURAL WITH FAIRLY REGULAR SECTION.
- SOME GRASS AND WEEDS, FLOW GREATER THAN WEED HEIGHT.

∴

MANNING'S n = 0.05   Tbl. 2.2

$S_o$ OF EXISTING CHANNEL ≈ 0.05 m/m

P (OF EXISTING CHANNEL) = 11.6m

**PARSONS BRINCKERHOFF** **Calculation Sheet**

Job ______ Design ______ Office ______

Date ______ Job No. ______

Checked ______ Page No. 2

Date ______

$$V = \frac{1}{0.05}\left(\frac{6.5}{11.6}\right)^{2/3}(0.05)^{1/2}$$

$$= 3.04 \ m/s$$

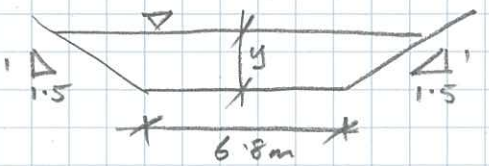
$$Q = VA$$

$$\therefore = (3.04)(6.5)$$

$$= 19.76 \ m^3/s \quad \leftarrow \text{DESIGN DISCHARGE } (Q).$$

TAIL WATER LEVEL (TWL):

ASSUME DOWNSTREAM CHANNEL IS TRAPIZODIAL. Cl. 2.3.4.




CREATE STAGE DISCHARGE CURVE

FROM CURVE WHEN $Q = 19.76$

$y = 0.75 \ m$

$\therefore$ AVERAGE FLOW VELOCITY $Q = VA$.

$$V = \frac{19.76}{6}$$

$= 3.29 \ m/s$ Check in Manning's $Q = 19.44 \ m^3/s$ $\therefore$ OK.

$\therefore TWL = y = 0.75m$

WSP | PARSONS BRINCKERHOFF

**Calculation Sheet**

Job ______ Design ______ Office ______

Date ______ Job No. ______

Checked ______ Page No. 3

Date ______

4No. 2.9 × 0.9 BOX CULVERT.

$$d_c = 0.467 \left(\frac{Q}{B}\right)^{2/3}$$ $Q = 4.9 m^3/s$ per cell. Cl. 3.10.6

$$= 0.467 \left(\frac{4.9}{2.1}\right)^{2/3}$$

$$= 0.822$$

OUTLET VELOCITY

- NEED TO CHECK BOTH INLET & OUTLET CONTROL OUTLET VELOCITY AS $HW_i$ IS CLOSE TO $HW_o$. Cl. 3.10.7.
  (1.35) (1.21)

ADOPT HIGHEST $V_o$ AN CORRESPONDING CONTROL

→ OUTLET CONTROL Cl. 3.10.8

$$V_o = \frac{Q}{A}$$

FLOW DEPTH = $d_c$ AS TWL < $d_c$

$$A = 2.1 \times 0.822$$

$$= 1.73 m^2$$

$$V_o = \frac{4.9}{1.73}$$ $Q = 4.9 m^3/s$ (per cell)

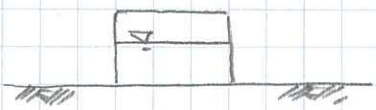
$$= 2.8 m/s$$

→ INLET CONTROL | Cl. 3.10.9.

USE MANNING'S FORMULA TO CREATE MODIFIED STAGE DISCHARGE CURVE FOR CULVERT CELL.

FROM CURVE WHEN $Q = 4.9 m^3/s$

$V_o = 4 m/s$



$y = 0.58m$

∴ INLET CONTROL.

$V_o = 4 m/s$

OUTLET FLOW ENERGY | Cl. 3.10.10

$$F_r = Q\sqrt{\frac{B}{gA^3}}$$

$$B = 2\sqrt{y(D-y)}$$

$$B = 0.86$$

$$= 4.9\sqrt{\frac{0.86}{9.81(1.218)^3}}$$

$$A = 0.58 \times 2.1$$

$$= 1.218 m^2$$

$$= 1.08$$

∴ FLOW IS SUPERCRITICAL AS $F_r > 1$

OUTLET PROTECTION IS REQUIRED.
AS $F_r > 1$ AND $V_o > 2.5 m/s$.

∴ MIN SHOULDER HEIGHT WITH 100mm FREEBOARD.

RL = 249.75

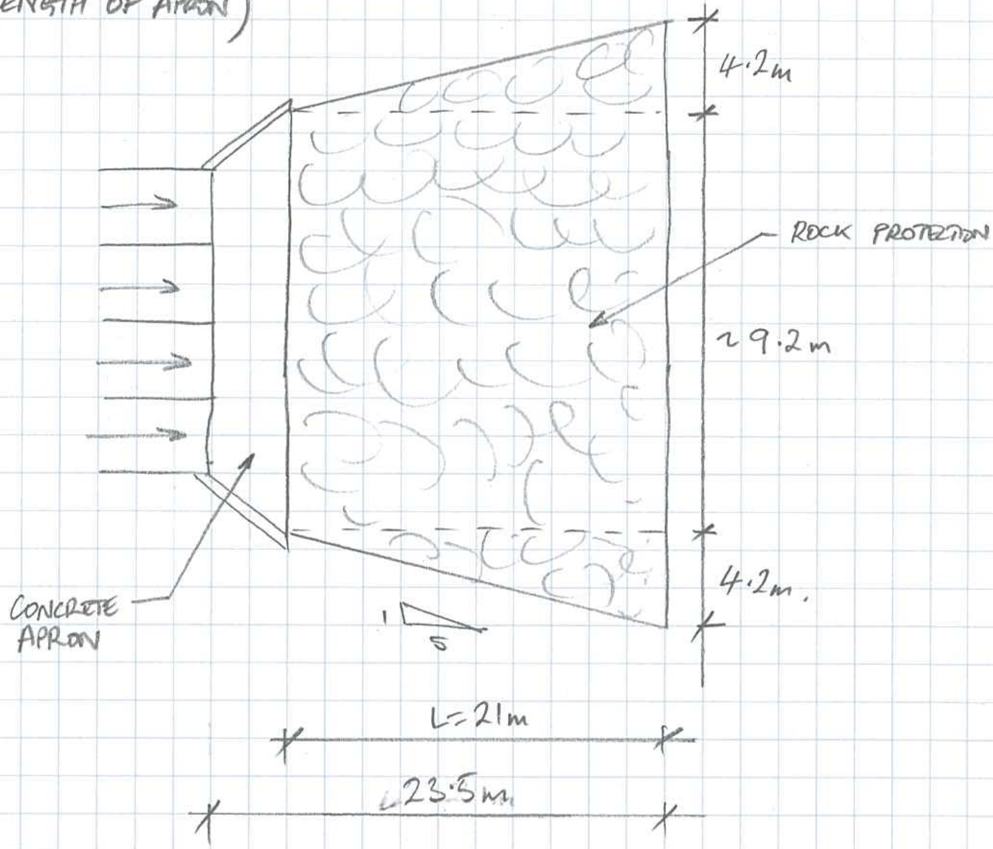
∴ OK.

OUTLET PROTECTION

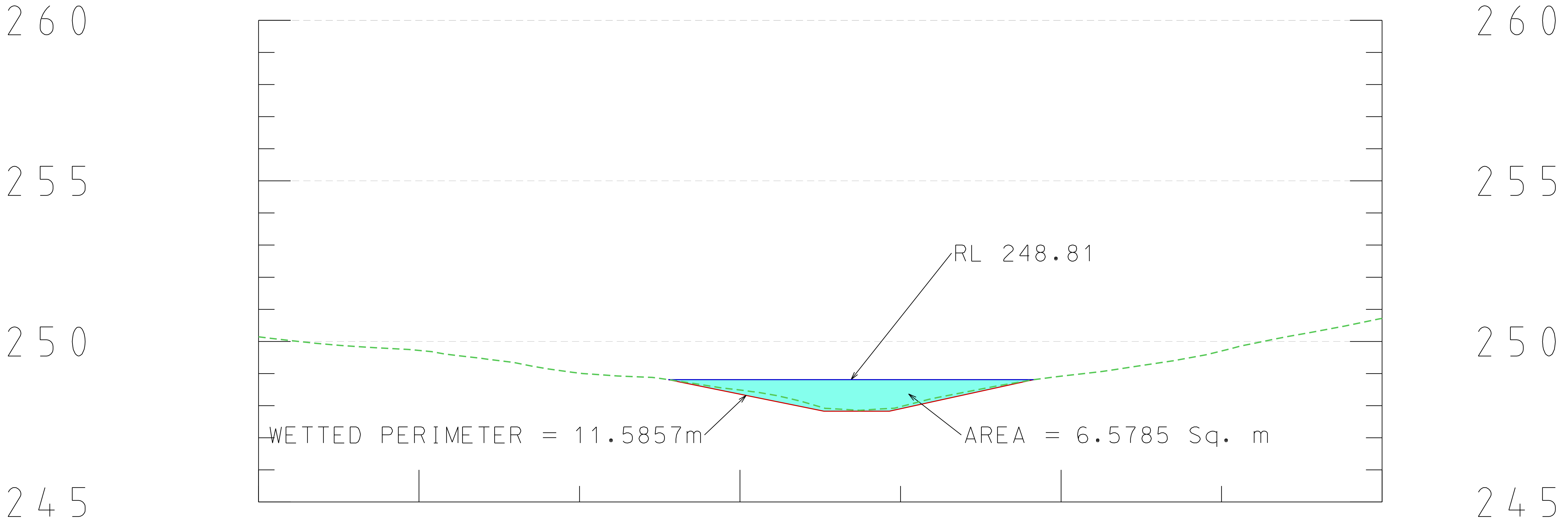
ADOPT ROCK APRON

L = 10D (LENGTH OF APRON) $d_{50}$ = 500mm (MIN. ROCK SIZE).

TMR (QLD) ROAD DRAINAGE MANUAL FIG 9.15(A)



# EXISTING CHANNEL CROSS SECTION UPSTREAM OF EXISTING CULVERT



**Stage discharge curve for the existing channel at the outlet (immediately upstream of existing culvert location)**

| | | | |
|---|---|---|---|
| Assuming a trapezoidal shape | | | |
| channel slope (S) | 0.05 | m/m | |
| Sides slope (x to y) | 1.5 | to | 1 |
| Base width | 6.8 | m | |
| Manning's n | 0.05 | | |

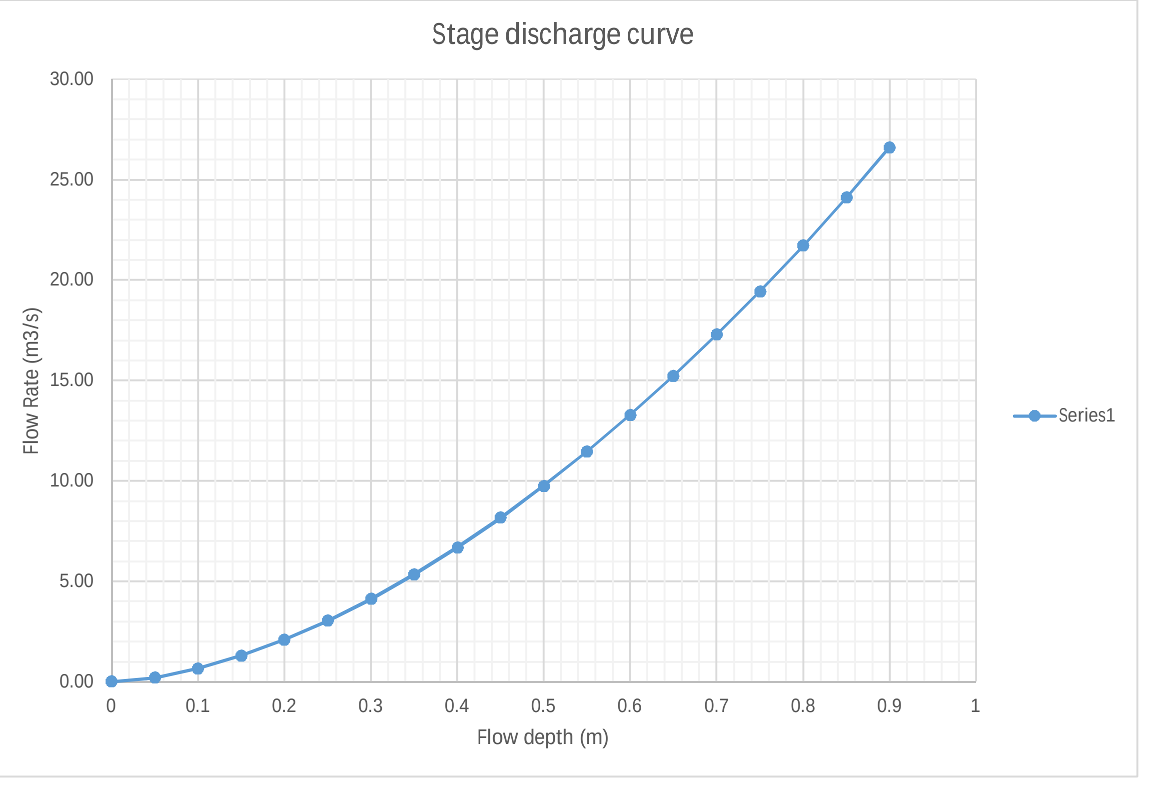
| Depth | Area (A) | Wetted perimeter (P) | Hydraulic Radius (R) | Velocity (V) | Discharge (Q) |
|---|---|---|---|---|---|
| m | m | m | m | m/s | m3/s |
| 0 | 0 | 6.8 | 0.00 | 0.00 | 0.00 |
| 0.05 | 0.34375 | 6.980278 | 0.05 | 0.60 | 0.21 |
| 0.1 | 0.695 | 7.160555 | 0.10 | 0.94 | 0.66 |
| 0.15 | 1.05375 | 7.340833 | 0.14 | 1.23 | 1.29 |
| 0.2 | 1.42 | 7.52111 | 0.19 | 1.47 | 2.09 |
| 0.25 | 1.79375 | 7.701388 | 0.23 | 1.69 | 3.04 |
| 0.3 | 2.175 | 7.881665 | 0.28 | 1.90 | 4.12 |
| 0.35 | 2.56375 | 8.061943 | 0.32 | 2.08 | 5.34 |
| 0.4 | 2.96 | 8.242221 | 0.36 | 2.26 | 6.69 |
| 0.45 | 3.36375 | 8.422498 | 0.40 | 2.43 | 8.16 |
| 0.5 | 3.775 | 8.602776 | 0.44 | 2.58 | 9.75 |
| 0.55 | 4.19375 | 8.783053 | 0.48 | 2.73 | 11.46 |
| 0.6 | 4.62 | 8.963331 | 0.52 | 2.87 | 13.28 |
| 0.65 | 5.05375 | 9.143608 | 0.55 | 3.01 | 15.22 |
| 0.7 | 5.495 | 9.323886 | 0.59 | 3.14 | 17.27 |
| 0.75 | 5.94375 | 9.504163 | 0.63 | 3.27 | 19.44 |
| 0.8 | 6.4 | 9.684441 | 0.66 | 3.39 | 21.72 |
| 0.85 | 6.86375 | 9.864719 | 0.70 | 3.51 | 24.10 |
| 0.9 | 7.335 | 10.045 | 0.73 | 3.63 | 26.60 |

check

| | | | | | |
|---|---|---|---|---|---|
| 0.75 | 5.94375 | 9.504163 | 0.63 | 3.27 | 19.44 |

| | | |
|---|---|---|
| Q = | 19.75 | m3/s |
| TWL = | 0.75 | m |

Tailwater level



**Stage discharge curve for culvert** 2100x900 Box culvert

Calculation of outlet velocity under inlet control

| | | | |
|---|---|---|---|
| culvert slope (S) | 0.01 | m/m | |
| Sides slope (x to y) | 0 | to | 1 |
| Base width | 2.1 | m | |
| Manning's n | 0.013 | | |

| Depth | Area (A) | Wetted perimeter (P) | Hydraulic Radius (R) | Velocity (V) | Discharge (Q) |
|---|---|---|---|---|---|
| m | m2 | m | | m/s | m3/s |
| 0 | 0 | 2.1 | 0.00 | 0.00 | 0.00 |
| 0.1 | 0.21 | 2.3 | 0.09 | 1.56 | 0.33 |
| 0.2 | 0.42 | 2.5 | 0.17 | 2.34 | 0.98 |
| 0.3 | 0.63 | 2.7 | 0.23 | 2.92 | 1.84 |
| 0.4 | 0.84 | 2.9 | 0.29 | 3.37 | 2.83 |
| 0.5 | 1.05 | 3.1 | 0.34 | 3.74 | 3.92 |
| 0.6 | 1.26 | 3.3 | 0.38 | 4.05 | 5.10 |
| 0.7 | 1.47 | 3.5 | 0.42 | 4.31 | 6.34 |
| 0.8 | 1.68 | 3.7 | 0.45 | 4.54 | 7.63 |
| 0.9 | 1.89 | 3.9 | 0.48 | 4.75 | 8.97 |

*check*

| | | | | | |
|---|---|---|---|---|---|
| 0.58 | 1.218 | 3.26 | 0.37 | 3.99 | 4.86 |

Q = 4.9 m3/s per barrel

V = 4 m/s Outlet velocity