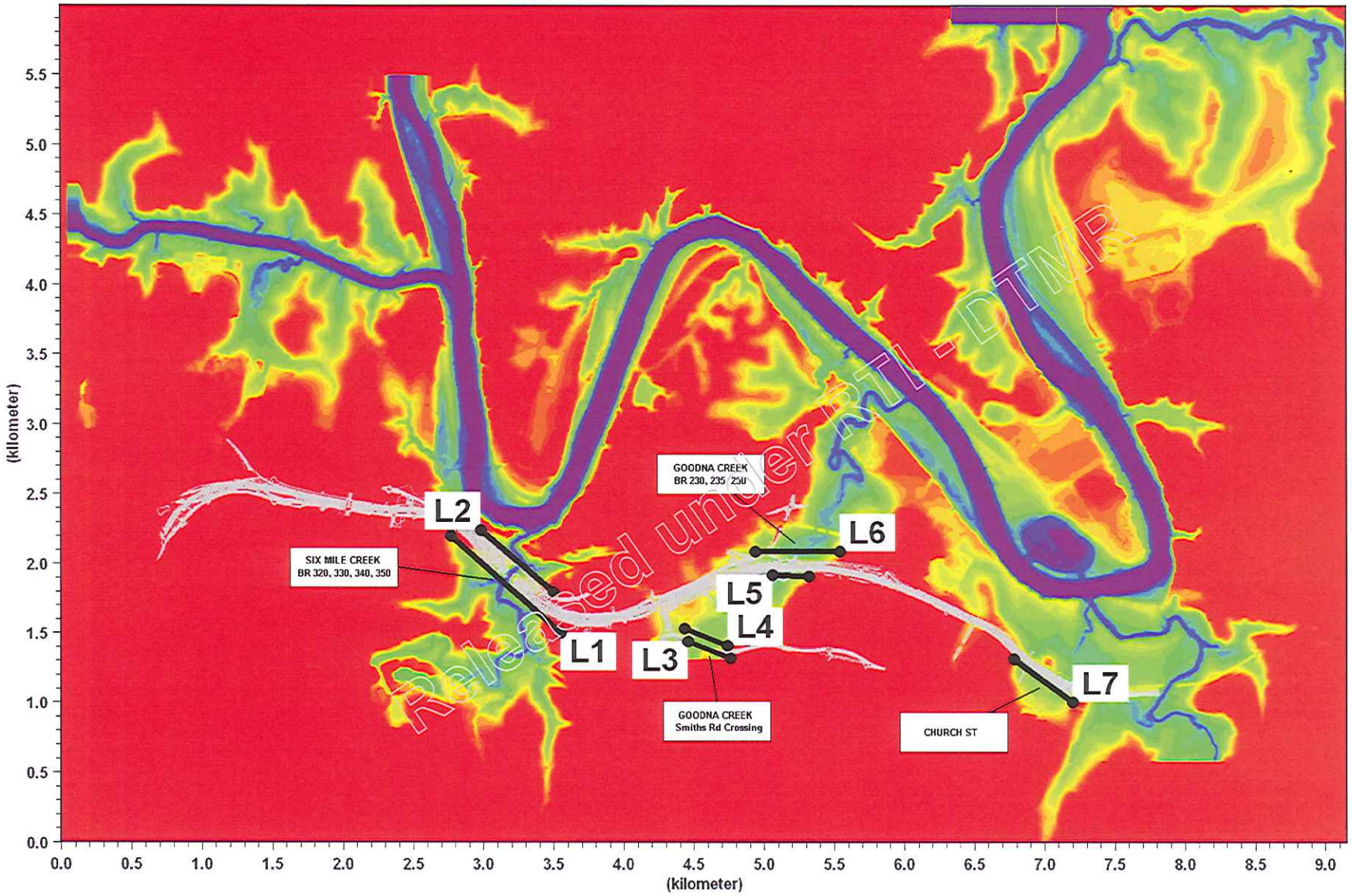


Figure 4-32: Location of reported water surface levels and afflux

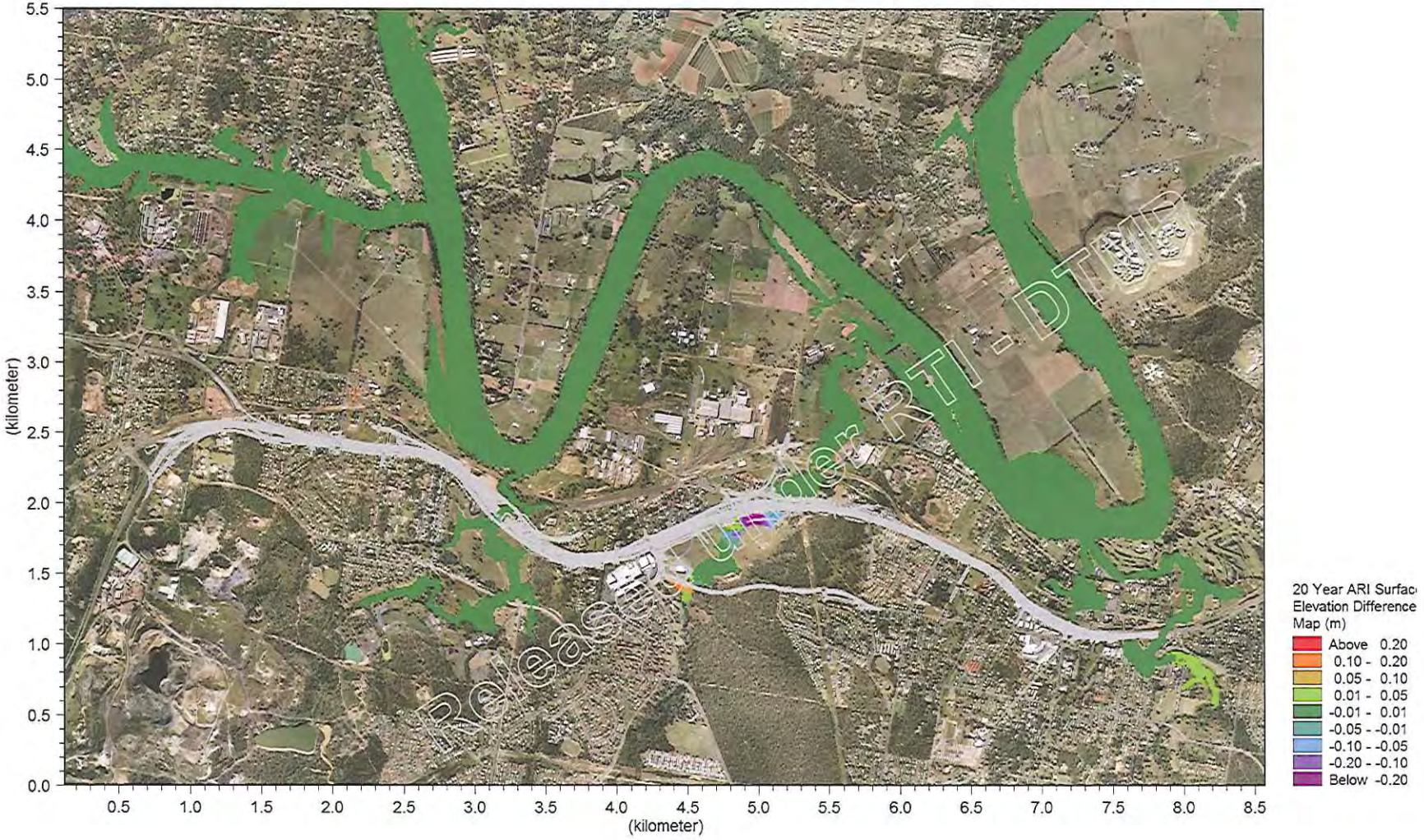


Figure 4-33: 20 year ARI afflux map

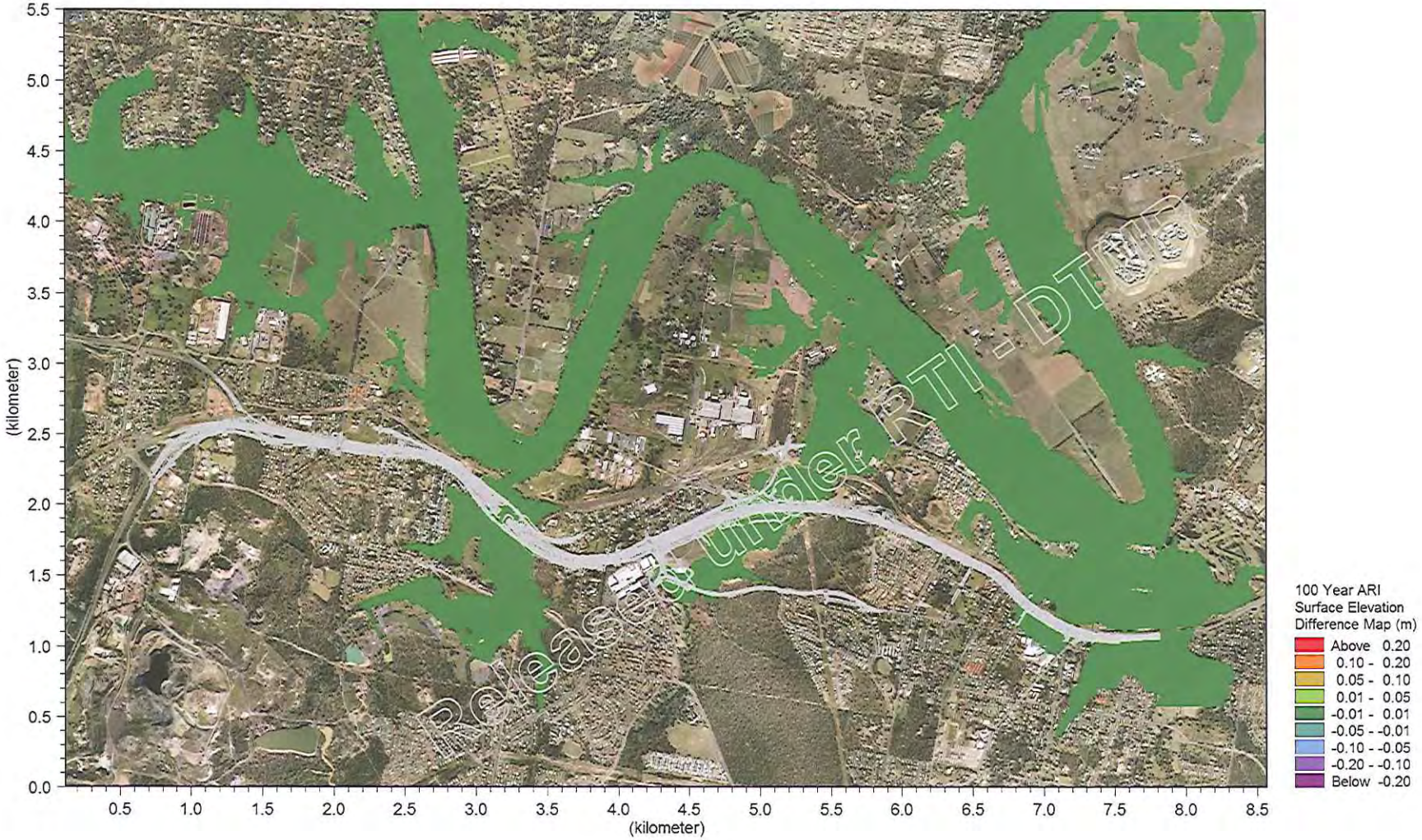


Figure 4-34: 100 year ARI afflux map

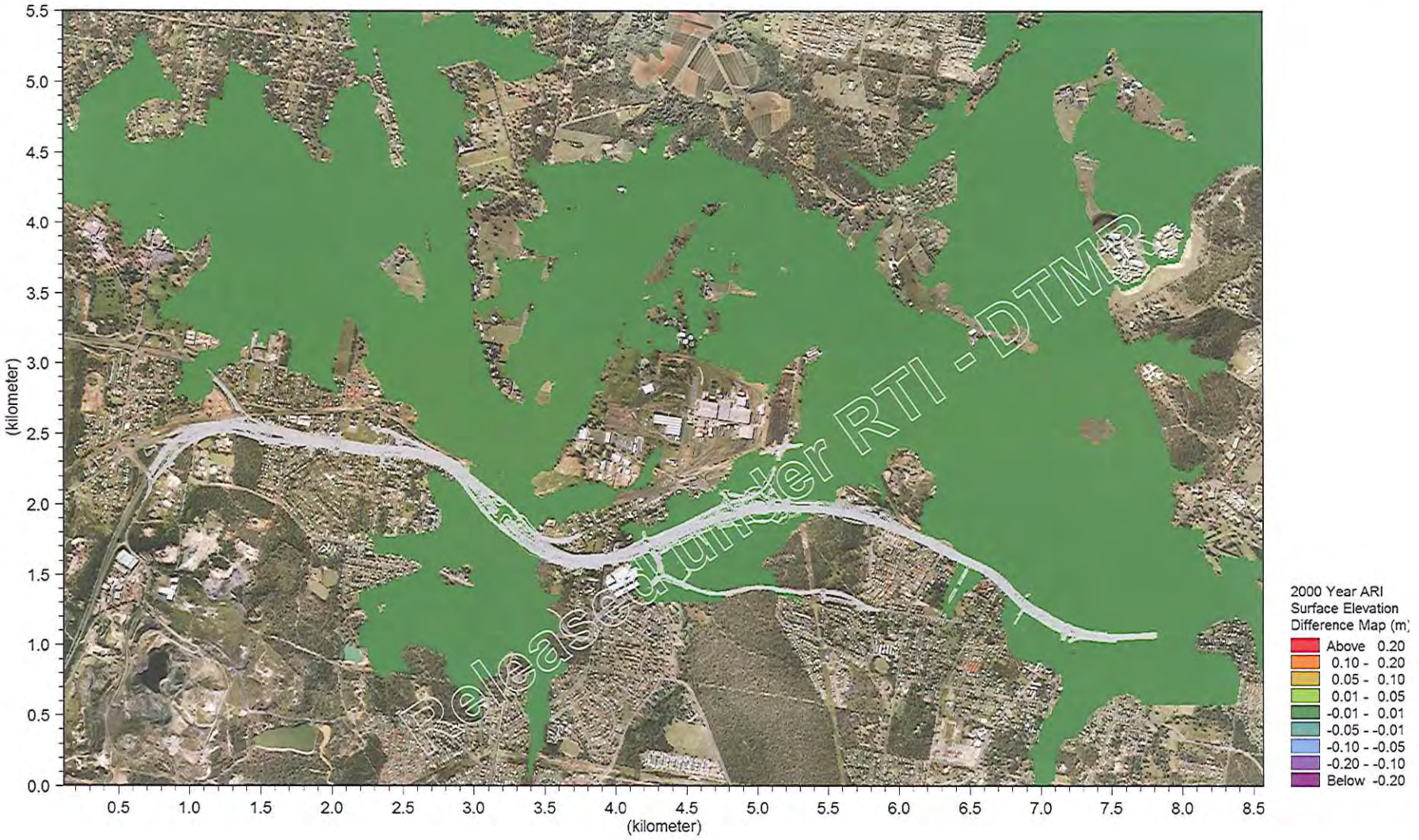


Figure 4-35: 2000 year ARI afflux map

Figure 4-36: Velocity difference map for 20 year ARI scenario

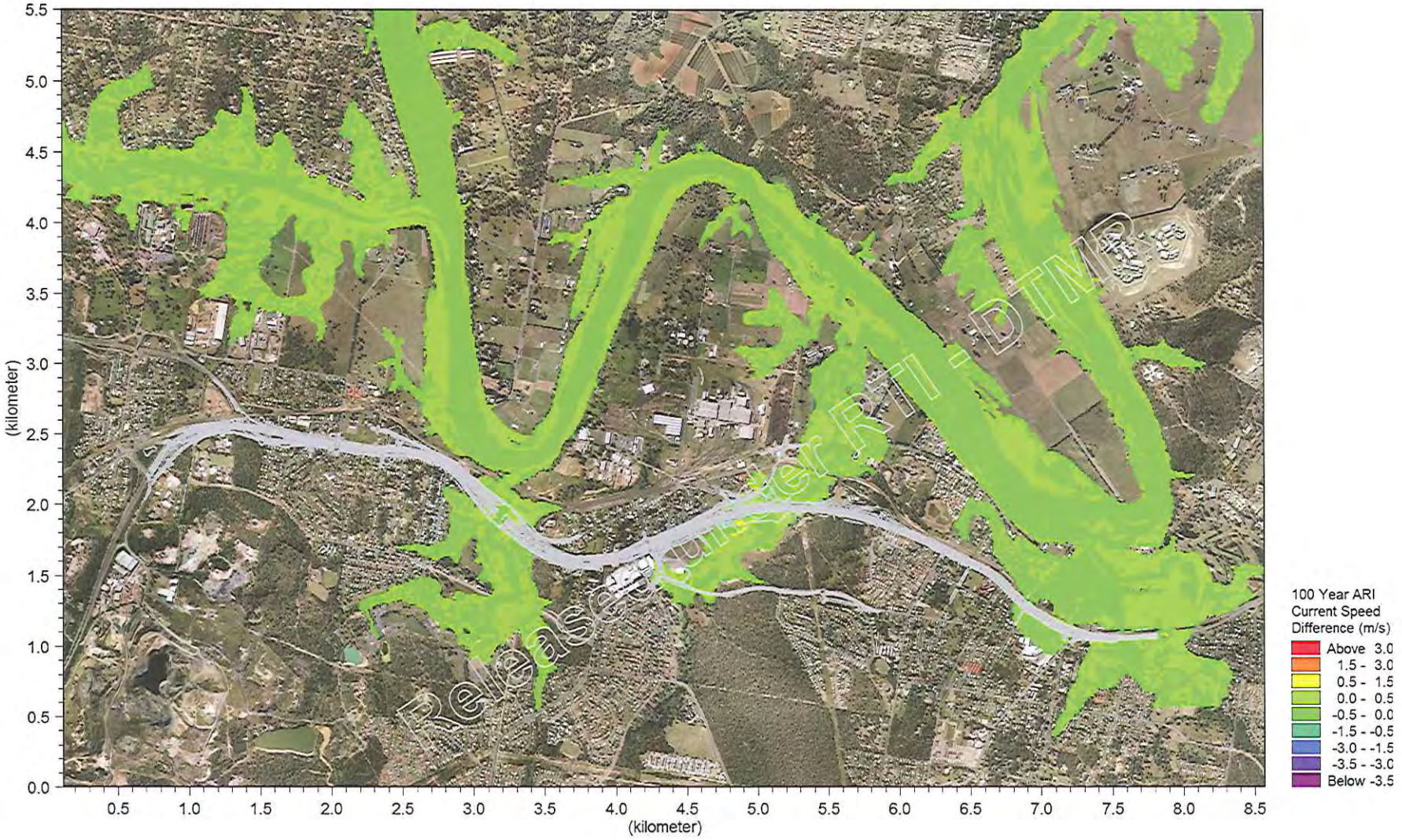


Figure 4-37: Velocity difference map for 100 year ARI scenario

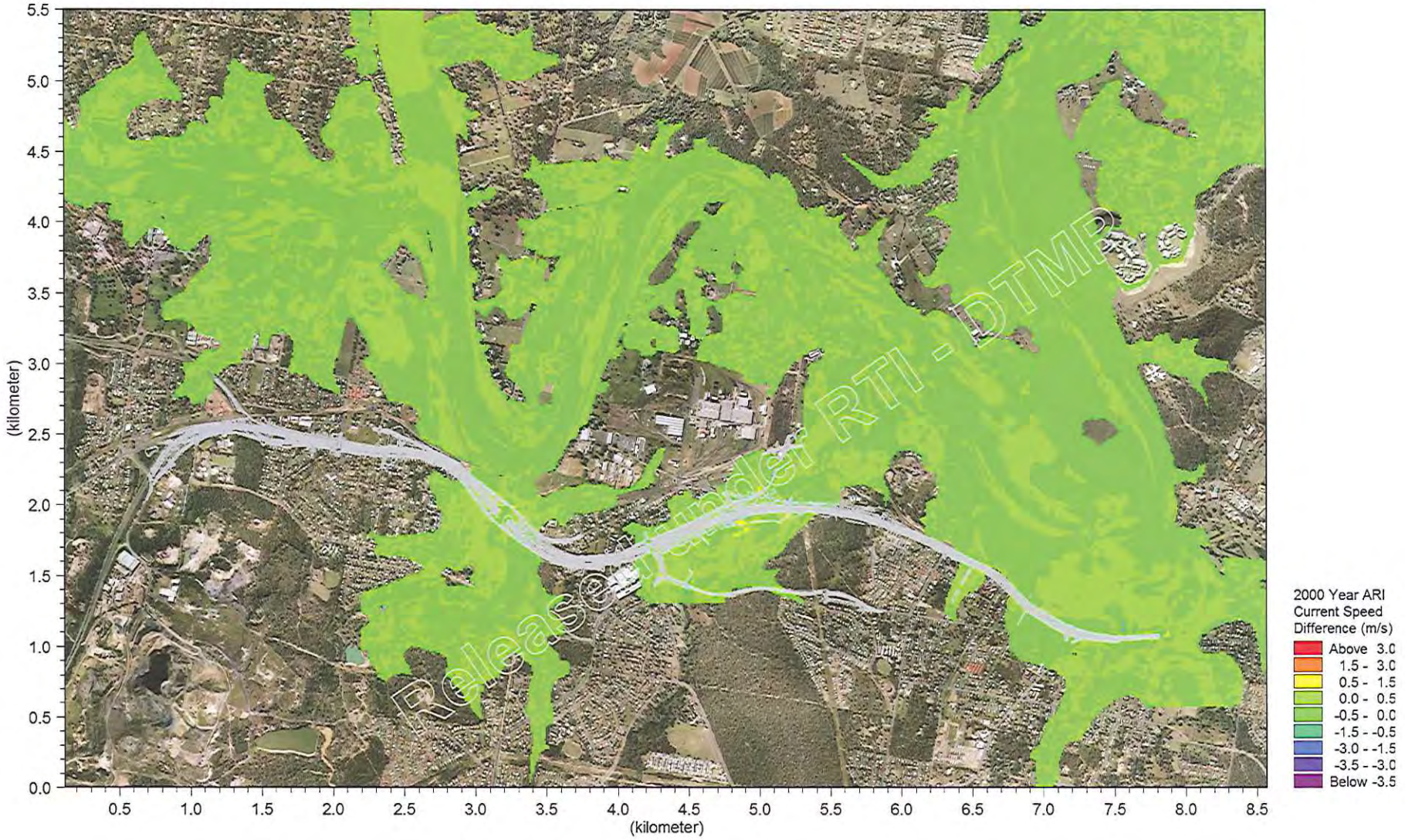


Figure 4-38: Velocity difference map for 2000 year ARI scenario

4.2.8 Design flood levels

Table 4-4 presents a summary of the design flood levels for the mainline road alignment.

Table 4-4: Flood levels for mainline alignment (Q100)

Flood Level Location	Brisbane River Q100 Flood Levels	Lowest point along the vertical curve of the main alignment in vicinity of flood areas	
		WB Mainline (MCW0)	EB Mainline (MCE0)
Eastern End of Motorway (Zone 1)	RL. 13.841	RL. 17.843 (Ch:13584)	RL. 17.319 (Ch:13264)
	Freeboard [1]	4.00 m	3.478 m
Goodna Creek (Zone 2)	RL. 14.088	RL. 14.583 (Ch:15887)	RL. 14.426 (Ch:15560)
	Freeboard [1]	0.495 m	0.338 m
Six Mile Creek (Zone 3)	RL. 14.951	RL. 15.515 (Ch: 18026)	RL. 15.521 (Ch: 17690)
	Freeboard [1]	0.564 m	0.57 m

Notes:

(1) Freeboard is the difference between the Brisbane River Q100 flood level and the lowest pavement surface point along the main alignment. The Design Criteria states this to be a minimum of 100 mm.

The mainline alignment has greater than the required freeboard of 100mm. This is discussed in the road alignment design package.

Table 4-5 present a summary of the design flood levels for the local road alignments.

Table 4-5: Flood levels for local roads (Q20)

Flood Level Location	Brisbane River Q20 flood levels	Locations of low points along affected local roads	Design Height of Low Points	Freeboard (m)
Church Street (Zone 1)	N/A	Church Street northern tie-in to existing (MCP0, Ch 0)	RL. 8.2	N/A
Goodna Creek (Zone 2) (Francis Street)	RL 8.40	Francis Street (MCR3, Ch 197)	RL. 10.71	2.31
Goodna Creek (Zone 2) (McAulife Street)	RL 8.40	McAulife Street (MCR6, Ch 954	RL. 18.8	8.40
Goodna Creek (Zone 2) (Monash Road)	RL 8.40	Monash Road (MCR0, Ch 787)	RL. 13.50	5.10
Goodna Creek (Zone 2) (Smiths Road)	RL 11.77	Smiths Rd (MCS0 Ch 276)	RL. 12.14	0.37
Six Mile Creek (Southern Service)	RL 9.05	Southern Service Rd (MCV0, Ch 650)	RL. 11.61	2.56
Six Mile Creek (Zone 3)	RL 9.04	Northern Service Rd (MCU0, Ch 525)	RL. 12.70	3.66

Church Street northern tie-in to existing does not meet the freeboard requirements. This is discussed in the road alignment design package.

Table 4-6 presents a summary of the design levels for the bridge structures.

Table 4-6: Flood levels for specific structures

Waterway structure	Waterway	Required immunity	Bridge / road deck levels [1]	Associated flood level
Bridge 250 FS	Goodna Creek	20 year	> RL 10.7	RL 8.486
Bridge 235 EB	Goodna Creek	100 year	> RL 14.4	RL 14.095
Bridge 230 WB	Goodna Creek	100 year	> RL 14.4	RL 14.095
Bridge 340 NSR	Six Mile Creek	20 year	> RL 12.7	RL 9.046
Bridge 320 EB	Six Mile Creek	100 year	> RL 15.2	RL 14.951
Bridge 330 WB	Six Mile Creek	100 year	> RL 15.2	RL 14.951
Bridge 350 SSR	Six Mile Creek	20 year	> RL 11.6	RL 9.046
Smiths Road culverts	Goodna Creek	20 year	> RL 12.1	RL 11.774

Notes:

1. See Appendix C for actual bridge deck levels.

4.2.9 Scour potential

Scour is addressed in the local flood models. Refer to REFHKS100 and RIFHKS100 for additional information.

4.3 Design Changes

4.3.1 Changes between Reference Design and Concept Design

The Origin Alliance has undertaken a Due Diligence Review of the reference design.

As part of the design development of the Concept Design a Value Engineering review has also been undertaken. Outputs of this review were included in Appendix J of the 15% submission.

The reference design did include a regional flood model for the Brisbane River. The differences are highlighted in the previous report sections and summarised in Table 4-7.

Table 4-7: Key Differences between Reference Design and Concept Design

Location	Description	Reason
Global	Road Alignment	Design development changed the road alignment (vertical and horizontal)
Goodna Creek bridges	Location and size of bridge abutments	Bridge design changes location and size of bridge abutments
Goodna Creek bridges	Location and elevation of roads	Design development changed the road elevation and horizontal alignment
Goodna Creek at Smiths Road	Location and type of road crossing	Design development changed the structure required at this location
Goodna Creek at Smiths Road	Location and elevation of roads	Design development changed the road elevation and horizontal alignment

Goodna Creek Rehabilitation	Rehabilitation of Goodna Creek upstream of proposed motorway	Environmental considerations required Goodna Creek to be rehabilitated. Bridge locations required Goodna Creek to be re-aligned.
Six Mile Creek bridges	Location and size of piers	Bridge design changes location and size of piers
Six Mile Creek bridges	Location and elevation of roads	Design development changed the road elevation and horizontal alignment

4.3.2 Changes between Concept Design and Detailed Design

In terms of hydraulic modelling and this report, there are no differences between the concept design and the detailed design.

4.3.3 Changes between Detailed Design and Final Design

In terms of hydraulic modelling and this report, there are no differences between the detailed design and the final design.

Table 4-8: Key Differences between Detailed Design and Final Design

Location	Description	Reason
Global	Road alignment	Design development changed the road alignment (vertical and horizontal)
Goodna Creek bridges	Location and size of bridge abutments	Bridge design changes location and size of bridge abutments
Goodna Creek bridges	Location and elevation of roads	Design development changed the road elevation and horizontal alignment
Goodna Creek at Smiths Road	Location and type of road crossing	Design development changed the structure required at this location
Goodna Creek at Smiths Road	Location and elevation of roads	Design development changed the road elevation and horizontal alignment
Goodna Creek Rehabilitation	Rehabilitation of Goodna Creek upstream of proposed motorway	Environmental considerations required Goodna Creek to be rehabilitated. Bridge locations required Goodna Creek to be re-aligned.
Six Mile Creek bridges	Location	Bridge design changes location of piers
Six Mile Creek bridges	Location and elevation of roads	Design development changed the road elevation and horizontal alignment

4.4 Items for Resolution

The items in Table 4-8 are to be resolved in the next stage of this design package:

Table 4-9: Items to be resolved in the next submission of this design package

Location	Description	Method of Resolution
NIL	NIL	NIL

Verification and Reviews

4.4.1 Internal Design Verification

No internal design verification comments were received for this stage of design.

4.4.2 Independent Verifier

Independent verifier review was undertaken for the Detailed Design (85%). The comments are addressed in Appendix F.

4.4.3 DTMR Reviews

DTMR review was undertaken for the Detailed Design (85%). The comments are addressed in Appendix G.

4.4.4 Third Party Reviews

No third party review comments were received for this stage of design.

4.5 Design Drawings

No drawings are associated with this design lot.

4.6 Technical Standards and Specifications

Refer to Appendix B for the list of Technical Standards and Specifications that apply to of this design lot.

5 Safety in Design

Safety in Design is an integral part of the Origin Alliance Risk Management process.

5.1 Safety in Design and Constructability Review (SIDR)

The purpose of the SIDR is to identify any significant construction, operation, maintenance and demolition risks inherent in the design that may prove significant. Specifically, the identification and understanding of these risks early in the project allows risk controls to be established to ensure that, if the risks cannot be eliminated by design, they are mitigated and managed in the design process so that they are as low as practicable. Risks identified and mitigation measures incorporated into the design are to be documented in the design report at the conclusion of the detailed design. Residual risks, if any, are to be managed by other teams in the OA, i.e., Construction, Maintenance, etc. This will eventually be handed over to the owner or operator of the road should any risk remains.

A Global SIDR on the Concept Design has been undertaken and forms a separate design submission (Report ref D2G-DPSM-R-0001)

During the Detailed Design, a SIDR for this package has been convened as part of the Drainage All Zone workshop on 21 May 2009 / 09 July 2009 / 21 July 2009. The SIDR as mentioned above has been updated to clearly identify the following:

- design mitigation measures applied for the hazards as identified in the original SIDR workshop
- residual risks following design mitigation for the hazards as identified in the original SIDR workshop
- responsible group for mitigation and recipient group for transfer of residual risk
- any additional hazards, control and mitigations for items that were identified through design that may not have been captured in the original SIDR workshop

Details of the revised SIDR for this particular design lot are attached in Appendix K.

A Global SIDR focussed on the operation and maintenance phase of the project will be held when most design lots are at the Detailed Design stage. The outputs of this review are reported separately.

5.2 Design to Facilitate Safe Use

5.2.1 Normal Use – Road Safety Audits

The Road Safety Audit of the Detailed Design has been undertaken. Refer to Road Safety Audit Ipswich Motorway Upgrade – Dinmore to Goodna: Zone 2 – 85% (report number 2108208A-RPT015-B:db, as listed in Appendix D). The audit findings have been addressed and closed out.

5.2.2 Emergency Use

Origin Alliance facilitates a forum with emergency services personnel to obtain input to the safe emergency use of the facility.

An Emergency Response Management Plan (Report Ref D2G-MPPL-V-016) has been developed by the Alliance in consultation with emergency services and DTMR and is the subject of a separate submission.

5.2.3 Design for Safe Maintenance

Origin Alliance facilitates a forum with DTMR maintenance personnel to obtain input to the design process to ensure the design is safe for maintenance. This review and input occurs as part of the design development process in formal and informal meetings etc. and at staged reviews of major design submissions at Concept Design and Detailed Design.

The principal method adopted by the design to address safety during maintenance is to reduce or eliminate maintenance requirements. Refer to bridge package for specific feature to address safe maintenance.

Specific elements of the design which may require maintenance are detailed in Table 5-1. These are address in further detail in the Transverse Drainage package for Zone 3 (RIRODR301) and the Transverse Drainage packages for Zone 2 (RERODR205, RERODR206 and RERODR207).

Table 5-1: Summary of specific features addressing Design for Safe Maintenance

Elements	Design Response
Culvert Inlets	Regular inspections and removal of debris / vegetation
Culvert Outlets	Regular inspection and rehabilitation of downstream scour protection
Culvert Inlet and Outlet channels	Regular inspection and removal of weeds / vegetation choking culvert inlets and outlets

5.2.4 Design for Safe Alteration

The SWTC requires provision for the future alteration of the facility at the specific locations as follows:

- Future Goodna bypass configuration
- Future quadruplication of Queensland Rail Darra – Ebbw Vale
- Provision for future Motorway works – dynamic land management in the form of either hard shoulder running or eight land configuration.

Reference should be made to the Transverse Drainage design package (RIRODR300) and the Longitudinal Drainage design package (RIRIDR301) for Zone 3, the Transverse Drainage design packages (RERODR205, RERODR206 and RERODR207) and the Longitudinal Drainage design package (RERODR201) for Zone 2 as well as the Goodna Creek rehabilitation design package (RERODR204) for further information.

6 Design Integration

The final design involved the integration of requirements from all relevant design disciplines and is the subject of 'spatial fit' and other interface checks as each design lot develops.

A summary of the key disciplines that have impacted on this design package are provided below.

6.1 Roadworks and Alignment

The road geometry is defined by the Regional Flood Model. Refer to Table 4-4 and Table 4-5 for summary of alignment details with respect to the regional flood model.

6.2 Geotechnical

No design integration has occurred. Geotechnical data is required for the scour analyses and this is included in the local flood model reports.

6.3 Drainage

Where applicable the regional flood levels are used to determine tailwater conditions for transverse drainage, longitudinal drainage and water quality elements.

6.4 Structures

A summary of the flood levels at specific structures is presented in Table 4-6.

6.5 Intelligent Transport Systems (ITS)

It should be noted that the location of ITS and Lighting Equipment must allow for the safe operation, access and maintenance of all equipment in all climatic conditions

Any alteration to the final position of ITS / Lighting equipment should consider the flood extents predicted by the regional flood model.

6.6 Traffic and Transport Management (TTM)

Traffic and transport management impacts on the regional floodplain will be detailed in separate TTM design lots.

6.7 Environment

Design requirements from the Brief and other environmental documents have been summarised in the Environmental Requirements Checklist (refer to Appendix E).

To assist with the correct implementation or refinement of environmental design a range of investigations have been, or are being, undertaken. Environmentally sensitive areas have been identified by these investigations. The management of these areas will be required during the construction phase of the project.

Flora, fauna and ecology: flora and fauna surveys have been undertaken within and around Six Mile Creek and Goodna Creek. Design requirements for terrestrial and aquatic ecology from the Brief and other environmental documents are as follows:

- Structure designed to be fish-friendly once operational, piers to be located out of low flow channel with suitable rehabilitation and revegetation of disturbed riparian areas post construction.
- Dry passage incorporated into the design to allow movement of terrestrial fauna, space provided adjacent to bridge abutments.

Environment and Approvals requirements have been identified and summarised on the Environmental Requirements Checklist included in Appendix E. Approvals and permits specific to this location are as follows:

- Waterway Barrier Permit: This permit is required from the Queensland Environmental Protection Agency and the Queensland Department of Primary Industry and Fisheries to allow for construction of a barrier within the waterway, and is necessary to undertake bridge construction.
- Vegetation Clearing Permit: This permit is required from the Department of Natural Resources and Water (DNRW) to allow removal of native vegetation, including areas from unallocated state land within the bed and banks of Six Mile Creek.
- Tidal Works Permit: This permit is required from the Environmental Protection Agency to undertake works (including clearing vegetation, excavating and placing fill) within the bed and banks of Six Mile Creek.

Additional consultation and investigation is required with regards to fauna (both dry and aquatic passage) with relevant authorities.

6.8 Urban and Landscape design

Landscape and Urban Design treatments have taken into account the locations of the proposed bridges.

6.9 Community

Community requirements have been identified and summarised on the Community Requirements Checklist included in Appendix I.

6.10 Local Roads

The road geometry is defined by the Regional Flood Model. Refer to Table 4-4 and Table 4-5 for summary of alignment details with respect to the regional flood model.

6.11 Public Utilities

Design development includes a review of proposed PUP infrastructure to identify any issues with development inside the Brisbane River floodplain. Proposed services including water mains, telecommunications and gas mains that are within the floodplain will need to take this into account during construction.

7 Durability considerations

7.1 General

A durability assessment will be undertaken to ensure the bridge structures meet the durability standards as outlined in the SWTC.

Durability considerations are not directly relevant to this regional flood report for the Brisbane River. Reference should be made to the Transverse Drainage design packages (RIRODR300, RERODR205, RERODR206 and RERODR207) and the Longitudinal Drainage design packages (RIRIDR301 and RERODR201) for further details on durability considerations.

7.2 Design Life

The design life is the period over which as asset must perform its intended function without replacement, refurbishment or significant maintenance. Clause 5.2 of the SWTC details the minimum design life for asset types associated with this project, as follows:

- Bridge structures, including underpasses and wildlife tunnels, tunnel and approach structures, supports and structural linings – 100 years
- Abutment protection subject to scour – 20 years
- Abutment protection not subject to scour – 100 years

7.2.1 Durability assessment

Refer to separate submissions for the durability considerations.

8 Items on HOLD

Formal review of the design lot is to occur on all drawings included in this design package.

HOLD clouds have been used to identify those areas of the Drawings awaiting further design development or PSTR revisions. The HOLD clouds for review are outlined in Table 8-1.

8.1 Holds Closed

Not applicable at this stage.

8.2 Holds for Review, Verification and Certification

Table 8-1 lists the HOLDS for Review, Verification and Certification.

Table 8-1: Summary of HOLDS for review, verification and certification

HOLD No.	Description
Nil	Not applicable at this stage

8.3 Holds not for Review, Verification and Certification

The items listed in Table 8-2 are on HOLD and are not for Verification and Certification. These HOLDS should be considered in the integrated design and can be reviewed and commented on, but they are not subject to the IV certification at this stage, as they do not necessarily comply with the PSTR as it currently stands. Subsequent design submissions will be presented to remove these HOLDS.

Table 8-2: Summary of HOLDS not for review, verification and certification

HOLD No.	Description	Separable Portion
Nil	Not applicable at this stage	

Appendix A – Relevant Design Drawings

Not relevant drawings for this package.

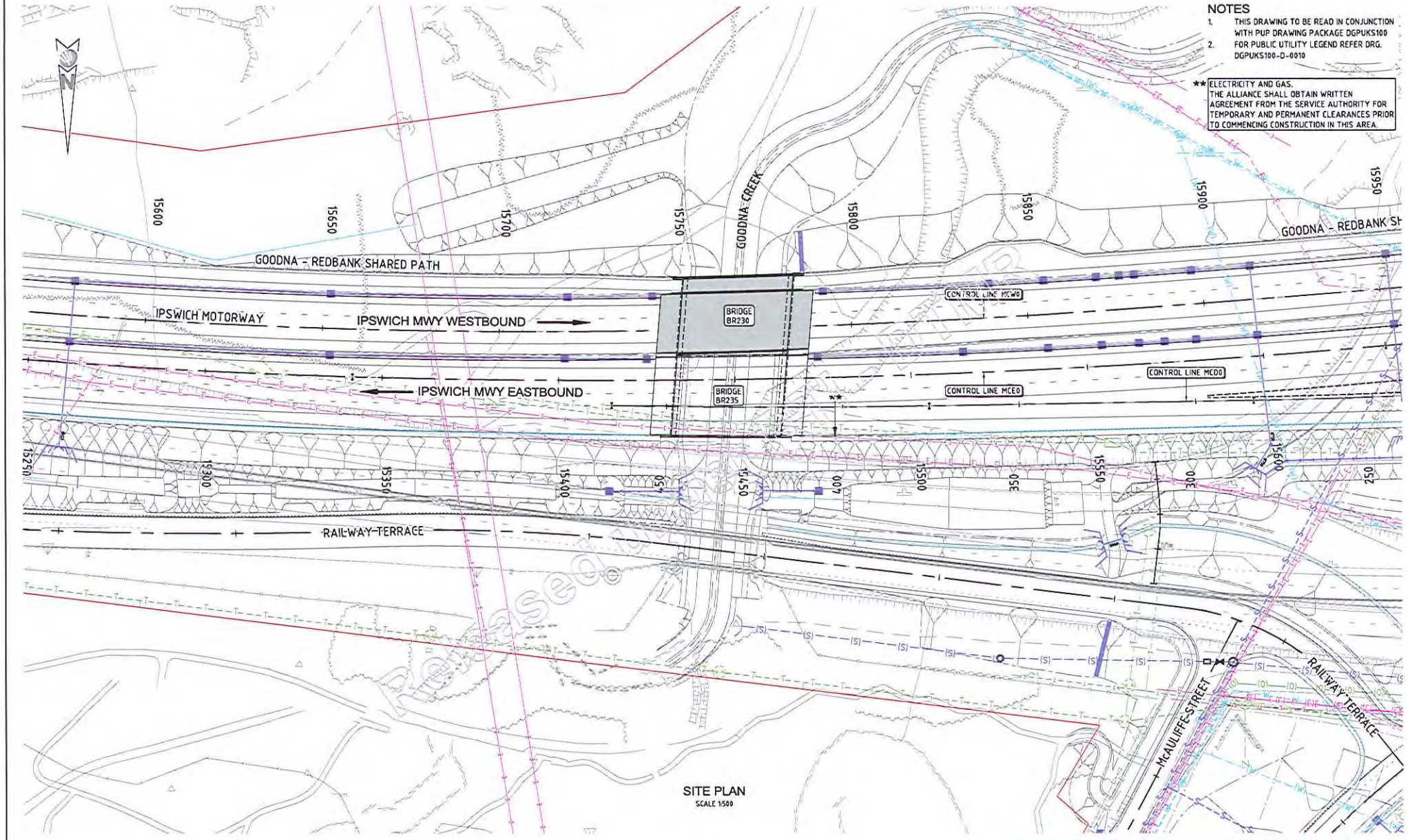
Appendix B – Technical Standards and Specifications

Not applicable

Appendix C – Reference Drawings

List of Reference Drawings applying to this design lot.

Number	Description	Revision
D2G-BASD-RESTBR230-D-0011	General arrangement of Bridge 230	
D2G-BASD-RESTBR230-D-0012	General arrangement of Bridge 230	
D2G-BASD-RESTBR235-D-0012	General arrangement of Bridge 235	
D2G-BASD-RESTBR250-D-0012	General arrangement of Bridge 250	
D2G-BASD-RISTBR320-D-0012	General arrangement of Bridge 320	
D2G-BASD-RISTBR330-D-0012	General arrangement of Bridge 330	
D2G-BASD-RISTBR340-D-0011	General arrangement of Bridge 340	
D2G-BASD-RISTBR340-D-0012	General arrangement of Bridge 340	
D2G-BASD-RISTBR350-D-0011	General arrangement of Bridge 350	
D2G-BASD-RISTBR350-D-0012	General arrangement of Bridge 350	
D2G-BASD-GOFHKS100-K-2001	General arrangement of Goodna Creek Rehabilitation	



Revisions		Verified	Date	Designer's Site Note
1	Detail Design (BSX)		08/12/09	

Plotted By: bwhitting Plot Date: 16/12/09 - 15:40 Cad File: P:\TS-CADD\DRAWINGS\Detailed Design Lighty Five\Zone 2_ Redbank\BR\BR230\3003326-BR230-0011dwg

Terrain Data	
Coord. Data	
Azimuth Datum	
Height Datum	Australian Height Datum (AHD)
Terrain Models	D2G-BASD-DGROAL110-M-1000
	D2G-BASD-DGROAL110-M-2000

Scales
SCALE 1:500 5 0 5 10 15 20 25m
Scales Shown are for A1

IPSWICH MOTORWAY UPGRADE - DINMORE TO GOODNA

CTL CHGE ch 13200 to ch 20770

Reference Points

Preceding RP	Distance to start of job (km)	From start to end of job	From end to Following RP	Following RP
17A/2	1.50	6.29	0.00	17A/4
17B/1	0.00	1.46	4.00	17B/3
18A/1	0.00	0.89	0.60	18A/1A
301/1	0.00	0.60	2.82	301/2

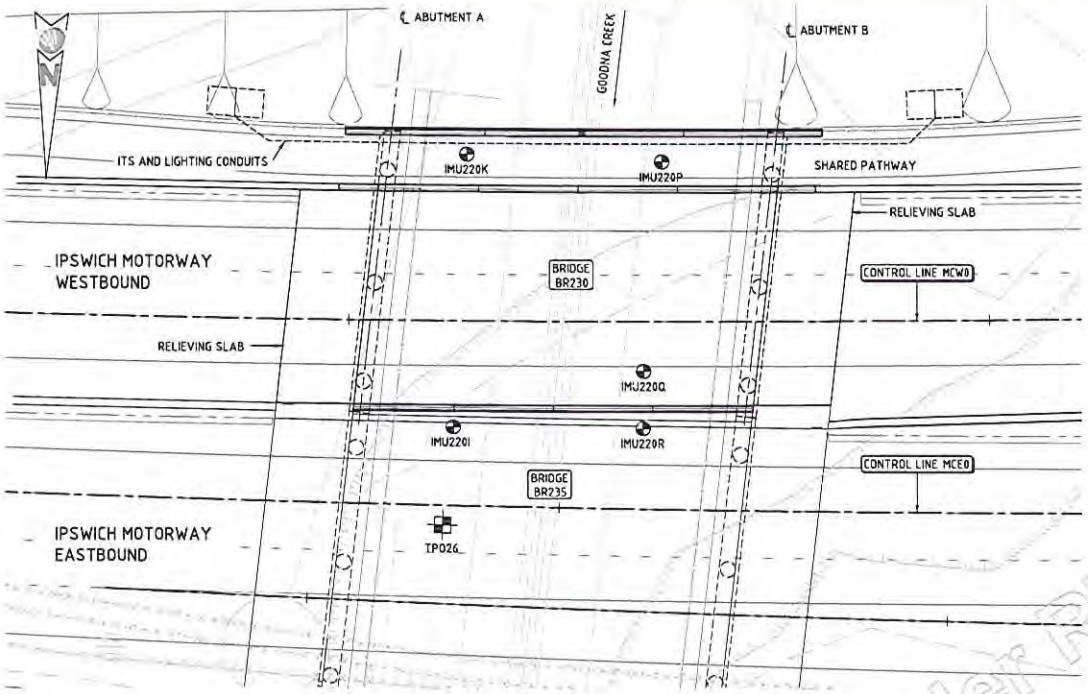
Through Chainage From

BRIDGE BR230
IPSWICH MOTORWAY OVER GOODNA CREEK (WESTBOUND)
GENERAL ARRANGEMENT - SHEET 1

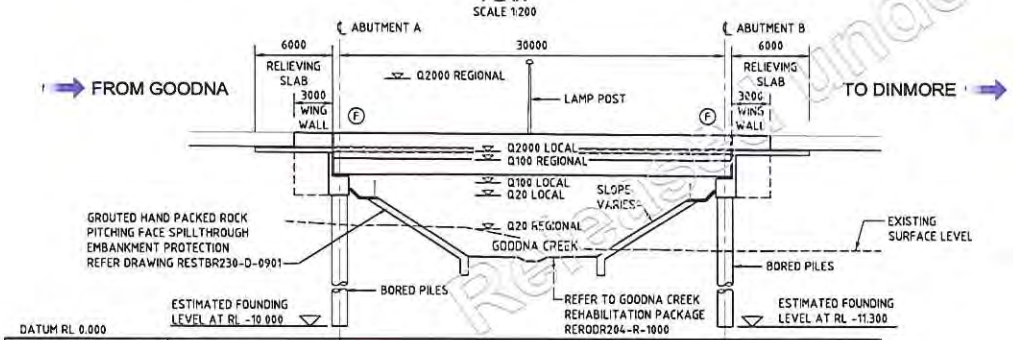
Drawing	Design	Design Review	Engineering Certification	Approved by Alliance manager
BW Checked	AG Verified		RPEQ No. Date	DC No.

Queensland Government
Department of Main Roads

MR JOB No.	148/17A/59
MR Drg No.	
Series Number	of
	D2G-BASD-RESTBR230-D-0011
CAD No.	3003326-BR230-0011 1

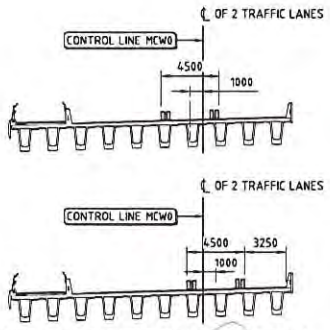


PLAN
SCALE 1:200

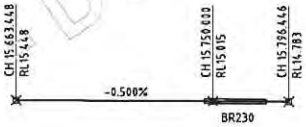


DESIGN RL ON CONTROL LINE MCW0	15.607	14.857
EXISTING RL ON CONTROL LINE MCW0	8.939	6.922
CHAINAGE ON CONTROL LINE MCW0	15751659	15781718

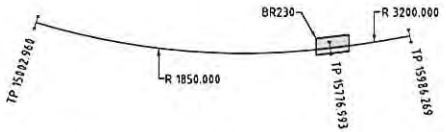
LONGITUDINAL ELEVATION OF BR230 THROUGH CONTROL LINE MCW0
SCALE 1:200



HLP400 LOADING CONFIGURATION
NTS



VERTICAL ALIGNMENT ON MCW0
NOT TO SCALE



HORIZONTAL ALIGNMENT ON MCW0
NOT TO SCALE

NOTES

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH STD DRGS:
   DGSTBR000-D-0004: GENERAL NOTES
   DGSTBR000-D-0012: ARTICULATION DETAILS SHEET 2
2. FOR PUBLIC UTILITY LEGEND REFER DRAWING DGPUKS100-0010
3. STREAM DATA
   Q20 (LOCAL) = 2.2m/s, LEVEL = 11.30m
   Q100 (LOCAL) = 2.5m/s, LEVEL = 12.30m
   Q2000 (LOCAL) = 2.7m/s, LEVEL = 14.70m
   Q20 (REGIONAL) = 1.7m/s, LEVEL = 8.70m
   Q100 (REGIONAL) = 2.1m/s, LEVEL = 14.20m
   Q2000 (REGIONAL-ESTIMATED) = 2.8m/s, LEVEL = 20.40m
4. POTENTIAL SCOUR DEPTH
   Q20 (LOCAL) AT:
   ABUTMENT A = 5.0m
   ABUTMENT B = 4.9m
   Q2000 (LOCAL) AT:
   ABUTMENT A = 7.4m
   ABUTMENT B = 9.4m
5. LIVE LOADS:
   a) SM1600 LOADING ON FIVE STANDARD DESIGN LANES
   b) HLP400 HEAVY LOAD PLATFORM LOADING VEHICLE LOCATED WITHIN 1m MAXIMUM ON EITHER SIDE OF CENTRELINE OF 2 TRAFFICABLE LANES - PLUS HALF SM1600 ON THE ADJACENT LANES.

BRIDGE CONSTRUCTION SEQUENCE

1. BACK FILL BEHIND ABUTMENT NOT TO COMMENCE UNTIL AFTER THE DECK IS POURED AND THE DIAPHRAGM DOWELS ARE INSTALLED.
2. BACKFILL BEHIND EACH ABUTMENT SHALL BE DONE SIMULTANEOUSLY AND THE DIFFERENCE IN FILL HEIGHT AT ANY ONE TIME SHALL BE LIMITED TO 300mm.

LEGEND

- (F) FIXED JOINT
- DENOTES BORE HOLE LOCATION
- DENOTES TEST PIT LOCATION

NOT FOR CONSTRUCTION

Origin Alliance
CONNECTING DINMORE TO GOODNA

No.	Revisions	Verified	Date	Designer's Site Note
2	Detail Design (85%)		08/12/09	
1	CONCEPT DESIGN ISSUE		06/02/09	

Terrain Data
Coord. Data:
Azimuth Datum:
Height Datum: Australian Height Datum (AHD)
Terrain Models: D2G-BASD-DGROAL110-M-1000, D2G-BASD-DGROAL110-M-2000

Scales
SCALE 1:200 (2 0 2 4 6 8 10m)
Scales Shown are for A1

IPSWICH MOTORWAY UPGRADE - DINMORE TO GOODNA
CTL CHGE ch 13200 to ch 20770
Reference Point's

Preceding RP	Distance to start of job (km)	From start to end of job	From end to Following RP	Following RP
17A/2	1.50	6.29	0.00	17A/6
17B/1	0.00	1.46	4.00	17B/3
18A/1	0.00	0.89	0.60	18A/1A
301/1	0.00	0.60	2.82	301/2

Through Chainage From

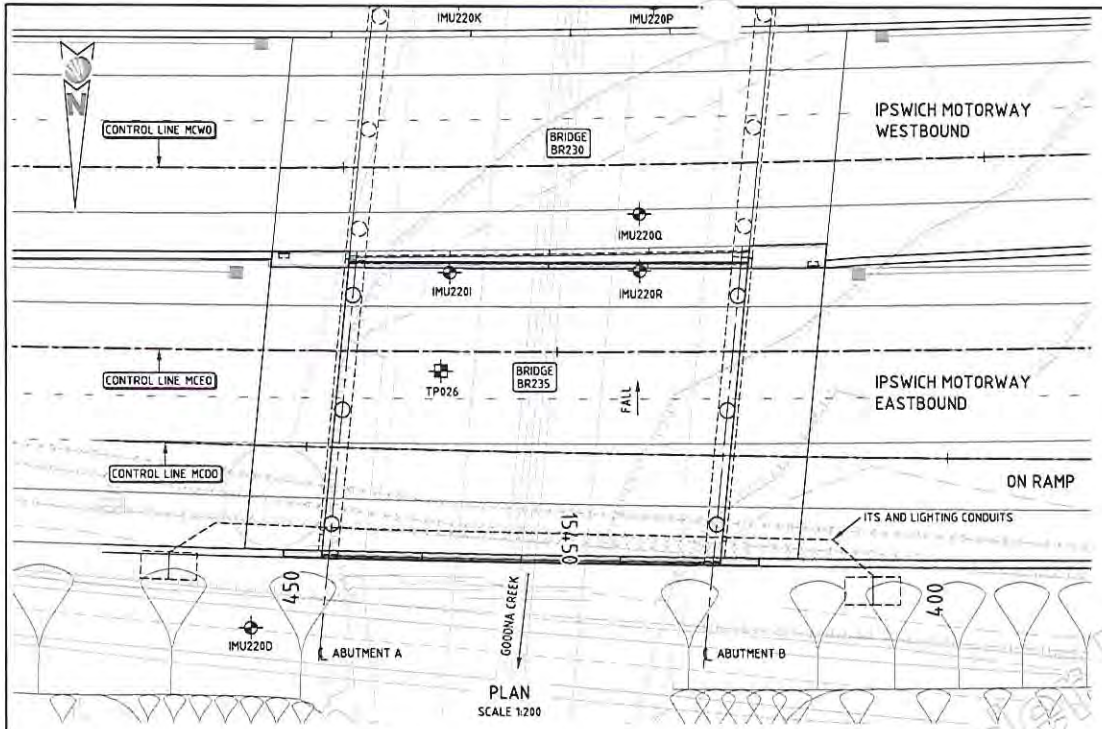
BRIDGE BR230
IPSWICH MOTORWAY OVER GOODNA CREEK (WESTBOUND)
GENERAL ARRANGEMENT - SHEET 2

Drawing BW	Design AG	Design Review	Engineering Certification	Approved by Alliance manager
Checked	Verified		RPEQ No. Date:	DC No.:

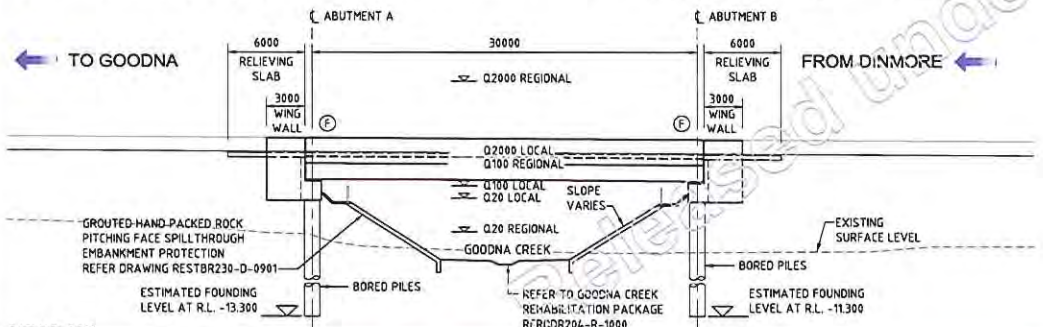
Queensland Government
Department of Main Roads

MR JOB No.	148/17A/59
MR Drg No.	
Series Number	of
	D2G-BASD-RESTBR230-D-0012
CAD No.	3003326-BR230-0012 | 2

Plotted By: bwhitting Plot Date: 11/12/09 - 1955 Cad File: P:\TS-CADD\DRAWINGS\Detailed Design Eighty Five\Zone 2 - Redbank\BR\BR230\3003326-BR230-0012.dwg



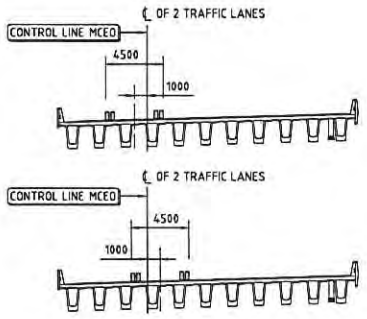
PLAN
SCALE 1:200



DATUM RL 0.000

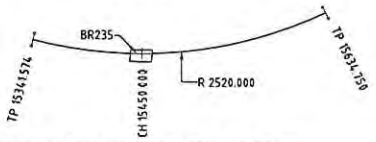
DESIGN R.L. ON CONTROL LINE MCE0	14.859	14.709
EXISTING R.L. ON CONTROL LINE MCE0	8.339	7.005
CHAINAGE ON CONTROL LINE MCE0	15433.700	15463.701

LONGITUDINAL ELEVATION OF BR235 THROUGH CONTROL LINE MCE0
SCALE 1:200



HLP400 LOADING CONFIGURATION
NTS

VERTICAL ALIGNMENT ON MCE0
NOT TO SCALE



HORIZONTAL ALIGNMENT ON MCE0
NOT TO SCALE

NOTES

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH STD DRGS:
   DGSTBR000-D-0004: GENERAL NOTES
   DGSTBR000-D-0012: ARTICULATION DETAILS SHEET 2
2. FOR PUBLIC UTILITY LEGEND REFER DRAWING DGPUKS100-0010
3. STREAM DATA
   Q20 (LOCAL) = 2.2m/s, LEVEL = 11.24m
   Q100 (LOCAL) = 2.5m/s, LEVEL = 12.23m
   Q2000 (LOCAL) = 2.7m/s, LEVEL = 14.68m
   Q20 (REGIONAL) = 1.7m/s, LEVEL = 8.60m
   Q100 (REGIONAL) = 2.1m/s, LEVEL = 14.20m
   Q2000 (REGIONAL-ESTIMATED) = 2.8m/s, LEVEL = 20.40m
4. POTENTIAL SCOUR DEPTH
   Q20 (LOCAL) AT:
   ABUTMENT A = 5.0m
   ABUTMENT B = 4.9m
   Q2000 (LOCAL) AT:
   ABUTMENT A = 7.4m
   ABUTMENT B = 9.4m
5. LIVE LOADS:
   a) SM1600 LOADING ON FIVE STANDARD DESIGN LANES
   b) HLP400 HEAVY LOAD PLATFORM LOADING VEHICLE LOCATED WITHIN 1m MAXIMUM ON EITHER SIDE OF CENTRELINE OF 2 TRAFFICABLE LANES - PLUS HALF SM1600 ON THE ADJACENT LANES.

BRIDGE CONSTRUCTION SEQUENCE

1. BACK FILL BEHIND ABUTMENT NOT TO COMMENCE UNTIL AFTER THE DECK IS POURED AND THE DIAPHRAGM DOWELS ARE INSTALLED.
2. BACKFILL BEHIND EACH ABUTMENT SHALL BE DONE SIMULTANEOUSLY AND THE DIFFERENCE IN FILL HEIGHT AT ANY ONE TIME SHALL BE LIMITED TO 300mm.

LEGEND

- (F) FIXED JOINT
- DENOTES BORE HOLE LOCATION
- DENOTES TEST PIT

NOT FOR CONSTRUCTION

Origin Alliance
CONNECTING DINMORE TO GOODNA

No.	Revisions	Verified	Date	Designer's Site Note
2	Detail Design (BSX)		08/12/09	
1	CONCEPT DESIGN ISSUE		06/02/09	

Terrain Data
Coord. Data:
Azimuth Datum:
Height Datum: Australian Height Datum (AHD)
Terrain Models: D2G-BASD-DGROAL110-M-1000, D2G-BASD-DGROAL110-M-2000

Scales
SCALE 1:200 (2 0 2 4 6 8 10m)
Scales Shown are for A1

IPSWICH MOTORWAY UPGRADE - DINMORE TO GOODNA
CTL CHGE ch 13200 to ch 20770

Reference Point's

Preceding RP	Distance to start of job (km)	From start to end of job	From end to Following RP	Following RP
17A/2	1.50	6.29	0.00	17A/6
17B/1	0.00	1.46	4.00	17B/3
18A/1	0.00	0.89	0.60	18A/1A
301/1	0.00	0.60	2.82	301/2

Through Chainage From

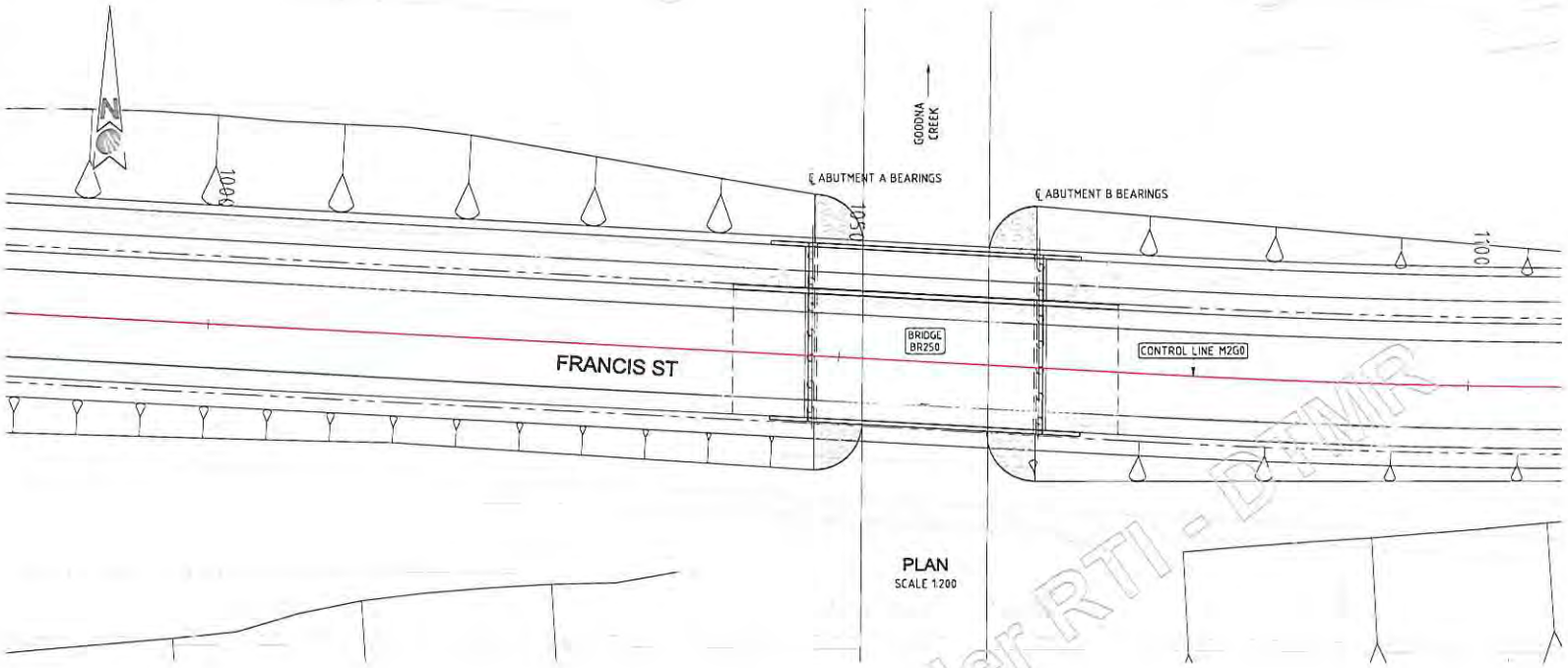
BRIDGE BR235
IPSWICH MOTORWAY OVER GOODNA CREEK (EASTBOUND)
GENERAL ARRANGEMENT - SHEET 2

Drawing	Design	Design Review	Engineering Certification	Approved by
AN	SH			Alliance manager
Checked	Verified		RPEQ No.	
			Date:	DC No.:

Queensland Government
Department of Main Roads

MR JOB No.	148/17A/59
MR Drg No.	
Series Number	of
	D2G-BASD-RESTBR235-D-0012
CAD No.	3003326-BR235-0012 | 2

Plotted By: bwhitting Plot Date: 14/12/09 - 15:52 Cad File: P:\15-CADD\DRAWINGS\Detailed Design Lighty River\Zone 2_Redbank\BR\BR235\3003326-BR235-0012.dwg



PLAN
SCALE 1:200

NOTES

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH STD DRGS:
   - BR000-0001 : GENERAL NOTES - BRIDGES
   - BR000-0011 : ARTICULATION DETAILS SHEET 1
   - BR000-0101 : 550 PSC PILE DETAILS
   - BR000-0201 : BARRIER DETAILS SHEET 1
   - BR000-0401 : 6m RELIEVING SLAB
   - BR000-0501 : DRAINAGE DETAILS SHEET 1
   - BR000-0601 : STONE PITCHED SPILL THROUGH DETAILS

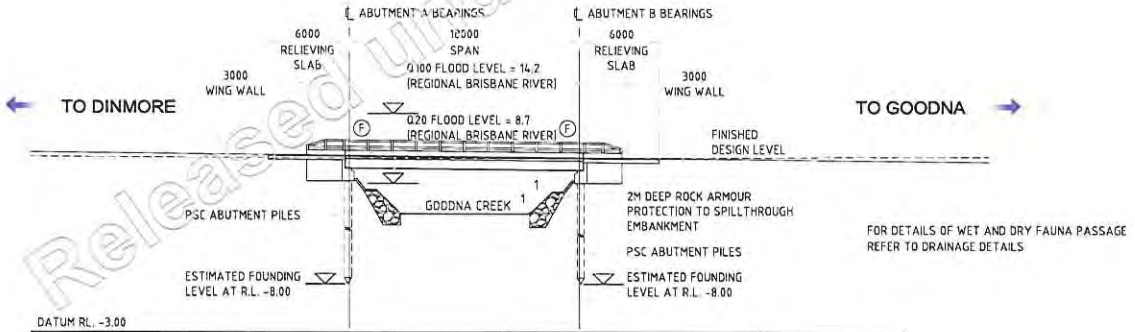
CONSTRUCTION STAGING NOTES.

ASSUMED CONSTRUCTION SEQUENCE FOR BRIDGE 250 AS FOLLOWS:

1. CONSTRUCT NEW MAINLINE CREEK CROSSINGS.
2. TRANSFER EASTBOUND AND WESTBOUND TRAFFIC TO NEW MOTORWAY ALIGNMENT.
3. DEMOLISH EXISTING CREEK CROSSINGS.
4. CONSTRUCT BRIDGE 250.
5. OPEN BRIDGE 250 TO TRAFFIC.

LEGEND

(F) FIXED JOINT



FOR DETAILS OF WET AND DRY FAUNA PASSAGE REFER TO DRAINAGE DETAILS

DATUM RL. -3.00

PROPOSED R.L. ON CONTROL LINE M2G0	11.024	10.928	10.811	10.755	10.619
EXISTING R.L. ON CONTROL LINE M2G0	10.760	10.718	10.718	10.721	10.765
CHAINAGE ON CONTROL LINE M2G0	1040	1047.88	1050	1055.88	1080

LONGITUDINAL ELEVATION OF BR250 THROUGH CONTROL LINE M2G0
SCALE 1:200

NOT FOR CONSTRUCTION

Origin Alliance
CONNECTING DINMORE TO GOODNA

Revisions	Verified	Date	Microfiled
1 Concept Design Issue			

Associated Job Nos

Auxiliary Drg Nos

Survey Data: Horiz Datum; Azimuth Datum; Height Datum; Survey Books

Scales: SCALE 1 : 200 (2 0 2 4 6 8 10m)
Scales Shown are for A1
Dimensions shown in brackets except for Structural Elements, Conduits & Culverts

IPSWICH MOTORWAY UPGRADE
DINMORE TO GOODNA
CTL CHGE ch 13187 to ch 20770

Reference Points

Preceding RP	Dist. to start of job (km)	From start to end of job	From end to Following RP	Following RP

Through Chainage From

BRIDGE BR250
FRANCIS STREET OVER GOODNA CREEK
GENERAL ARRANGEMENT - SHEET 2

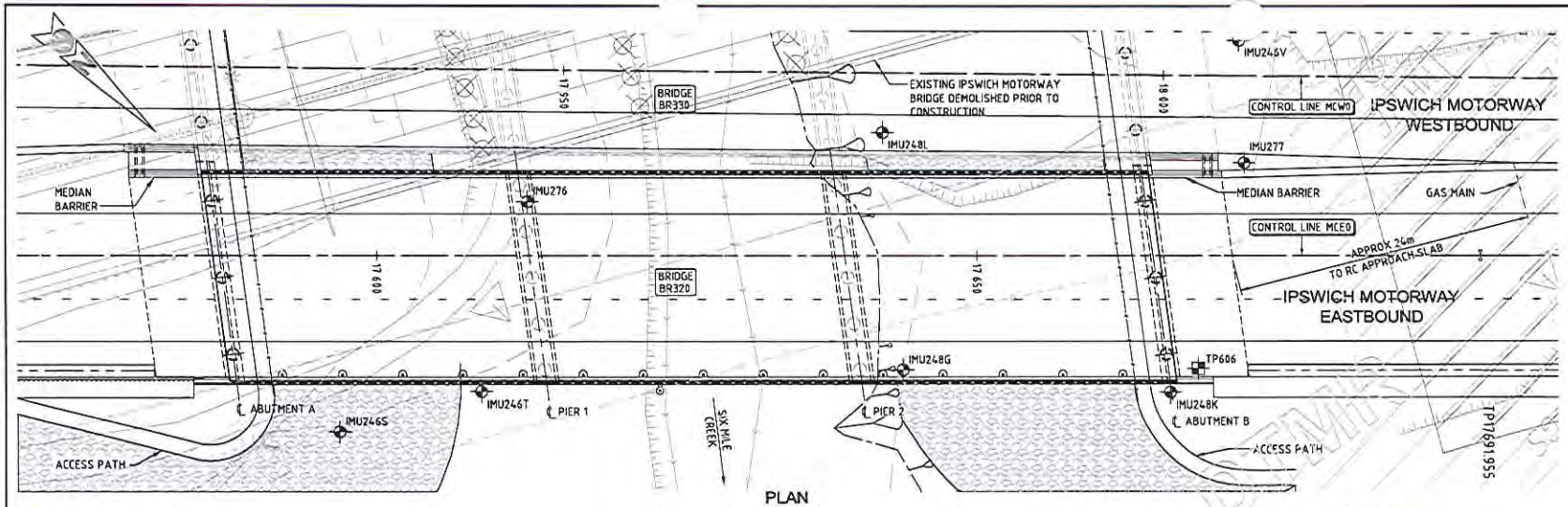
Drawing RB Checked	Design SG Verified	Design Review	Engineering Certification RPEQ No. Date	Approved by Alliance manager Date	Approved by Main Roads Date

Queensland Government
Department of Main Roads

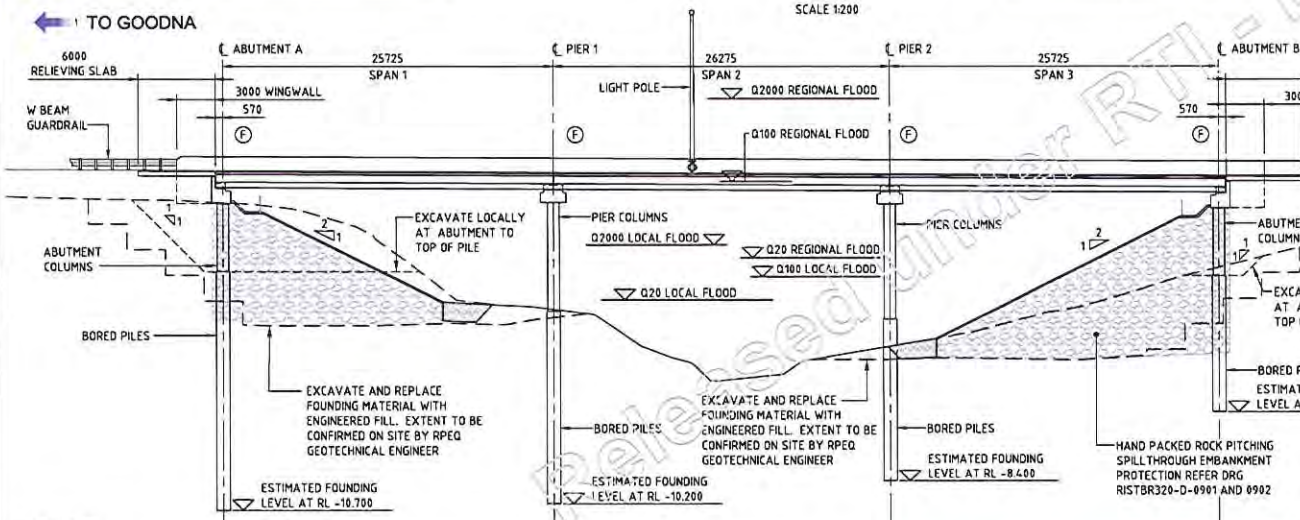
D2G-BASD-RESTBR250-D-0012

MR JOB No.	148/17A/59
MR Drawing No.	1
Series Number	of

CAD FILE | Plotted By: rbloing | Plot Date: 15/01/09 - 11:59 | Cad File: P:\15-LAND\DRAWINGS\Detailed Design Fifteen\Zone 2 - Redbank\BR\BR250\Detailed_Design_Fifteen\3003326-BR250-0012.dwg



PLAN
SCALE 1:200

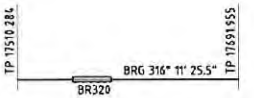


DATUM -13.000

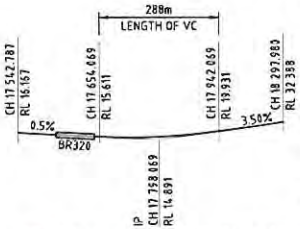
DESIGN RL ON CONTROL LINE MCE0	15.967	15.818	15.637	15.555
EXISTING RL ON CONTROL LINE MCE0	13.37	4.97	2.27	8.59
CHAINAGE ON CONTROL LINE MCE0	17 586.944	17 612.659	17 638.943	17 654.659

LONGITUDINAL ELEVATION OF BRIDGE BR320 THROUGH CONTROL LINE MCE0
SCALE 1:200

LEGEND
- (F) DENOTES FIXED JOINT
- DENOTES BORE HOLE LOCATION
- DENOTES TEST PIT



HORIZONTAL ALIGNMENT ON MCE0
NOT TO SCALE



VERTICAL ALIGNMENT ON MCE0
NOT TO SCALE

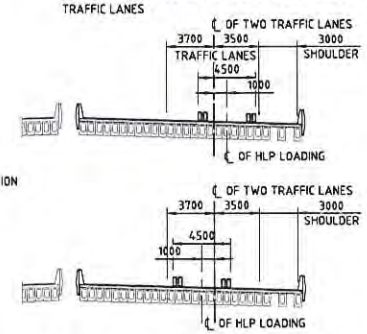
NOTES
1. THIS DRAWING TO BE READ IN CONJUNCTION WITH STD DRGS: DGSTBR000-D-0004: GENERAL NOTES DGSTBR000-D-0011: ARTICULATION DETAILS SHEET 1
2. FOR PUBLIC UTILITY LEGEND REFER DRG. DGPUKS100-0010

STREAM DATA
ULTIMATE LIMIT STATE
Q20 (REGIONAL ESTIMATED) = 0.6m/s, LEVEL = 9.1m *
Q100 (REGIONAL ESTIMATED) = 1.0m/s, LEVEL = 15.1m *
Q2000 (REGIONAL-ESTIMATED) = 2.0m/s, LEVEL = 21.6m *
Q20 (LOCAL) = 1.22m/s, LEVEL = 5.8m
Q100 (LOCAL) = 1.48m/s, LEVEL = 7.6m
Q2000 (LOCAL) = 1.85m/s, LEVEL = 10.1m

* MODELLING IN PROGRESS. VALUES PROVIDED BY HYDROLOGY TEAM ARE ESTIMATES ONLY

POTENTIAL SCOUR DEPTH
Q20 (LOCAL) AT PIER = 1.9m
Q20 (LOCAL) PIER CONTRACTION = 0m
Q2000 (LOCAL) AT PIER = 2.4m
Q2000 (LOCAL) PIER CONTRACTION = 0.5m

LIVE LOADS:
SM1600
LOADING IN ACCORDANCE WITH AS 5100.2-2004.
NUMBER OF DESIGN LANES = 5
HLP400 LOADING
HLP400 HEAVY LOAD PLATFORM LOADING VEHICLE LOCATED WITHIN 1m MAXIMUM ON EITHER SIDE OF CENTRELINE OF TWO TRAFFIC LANES



HLP400 LOADING CONFIGURATION
NOT TO SCALE

CONSTRUCTION STAGING NOTES

ASSUMED CONSTRUCTION SEQUENCE FOR THE SIX MILE CREEK BRIDGES IS AS FOLLOWS:
1. CONSTRUCT THE SOUTHERN SERVICE ROAD AND BRISBANE ROAD BRIDGES BR340 AND BR350.
2. DIVERT THE IPSWICH MOTORWAY EASTBOUND CARRIAGEWAY OVER THE BRISBANE ROAD BRIDGE AND THE IPSWICH MOTORWAY WESTBOUND CARRIAGEWAY OVER THE SOUTHERN SERVICE ROAD BRIDGE.
3. DEMOLISH THE EXISTING IPSWICH MOTORWAY MAIN LINE BRIDGES AND CUT THE EXISTING SUBSTRUCTURE/PILES TO BELOW FINISHED GROUND LEVEL.
4. CONSTRUCT THE NEW IPSWICH MOTORWAY MAIN LINE BRIDGES BR320 AND BR330.
5. TRANSFER THE IPSWICH MOTORWAY EASTBOUND AND WESTBOUND CARRIAGEWAYS ONTO THE NEW IPSWICH MAIN LINE BRIDGES.
6. COMPLETE SERVICE ROAD CONSTRUCTION FOR THE NEW SERVICE ROAD BRIDGES.
7. REFER TO THE EXISTING BRIDGE DRAWINGS FOR LOCATIONS OF THE BRIDGES TO BE DEMOLISHED.

NOT FOR CONSTRUCTION

Origin Alliance
CONNECTING DINMORE TO GOODNA

No	Revisions	Verified	Date	Designer's Site Note
2	Detail Design (85%)		22/01/10	
1	Concept Design Issue		12/12/08	

Terrain Data
Coord. Data:
Azimuth Datum:
Height Datum: Australian Height Datum (AHD)
Terrain Models: D2G-BASD-DGROAL110-M-1000, D2G-BASD-DGROAL110-M-2000

Scales
SCALE 1:200 2000 0 2000 4000 6000 8000 10000mm
Scales Shown are for A1

IPSWICH MOTORWAY UPGRADE - DINMORE TO GOODNA
CTL CHGE ch 13200 to ch 20770
Through Chainage From

Reference Points

Preceding RP	Distance to start of Job (km)	From start to end of Job	From end to Following RP	Following RP
17A/2	1.50	6.29	0.00	17A/6
17B/1	0.00	1.46	4.00	17B/3
18A/1	0.00	0.89	0.60	18A/1A
301/1	0.00	0.60	2.82	301/2

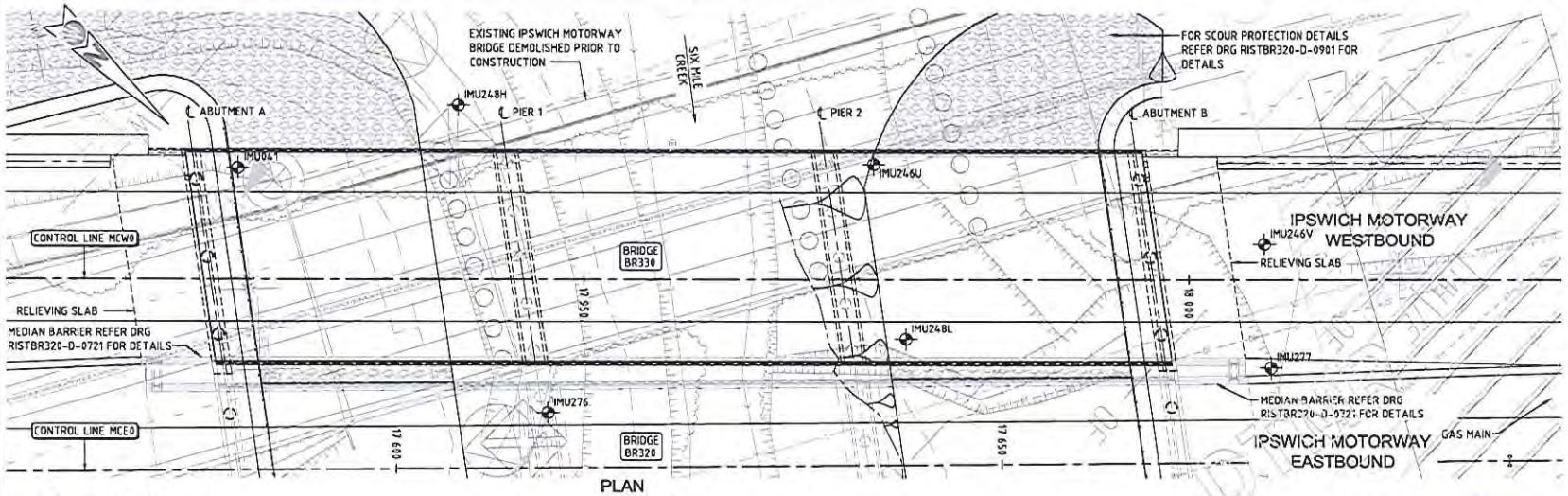
BRIDGE BR320
IPSWICH MOTORWAY OVER SIX MILE CREEK (EASTBOUND)
GENERAL ARRANGEMENT - SHEET 2

Drawing	Design	Design Review	Engineering Certification	Approved by
CH	CH			Alliance manager
Checked	Verified	HH	RPEQ No.	
DM	ND		Date	DC No.

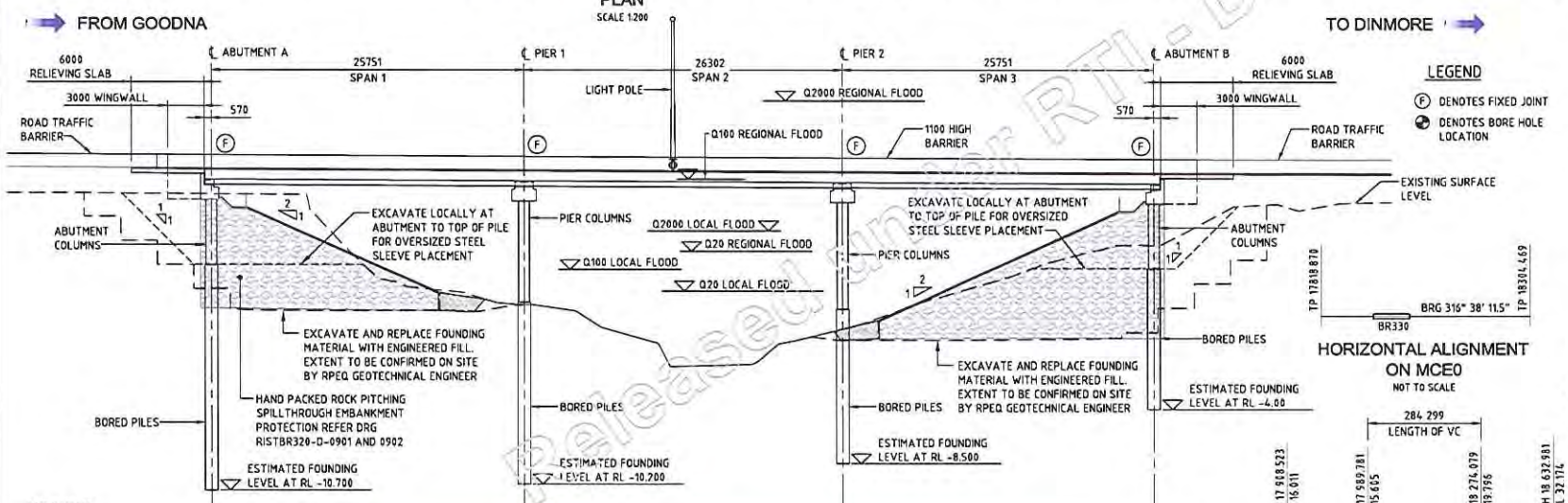
Queensland Government
Department of Main Roads

MR JOB No.	148/17A/59
MR Drg No.	
Series Number	of
D2G-BASD-RISTBR320-D-0012	
CAD No.	3003326-BR320-0012 | 2

Plotted By: isware Plot Date: 27/01/10 - 17:16 Cad File: P:\135-CADD\DRAWINGS\Detailed Design Eighty Five\Zone 3_ Riverview\BR\BR320\3003326-BR320-0012.dwg



PLAN
SCALE 1:200



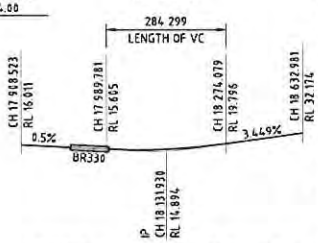
DATUM -13.000

DESIGN RL ON CONTROL LINE MCW0	15.958	15.829	15.697	15.573
EXISTING RL ON CONTROL LINE MCW0	13.87	4.69	2.69	9.56
CHAINAGE ON CONTROL LINE MCW0	17 919.258	17 965.615	17 971.311	17 937.652

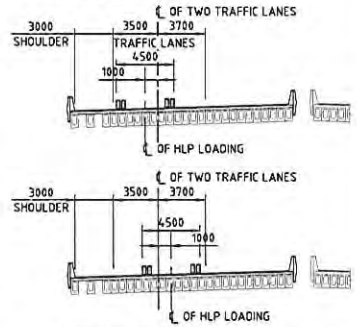
LONGITUDINAL ELEVATION OF BRIDGE BR330 THROUGH CONTROL LINE MCW0
SCALE 1:200

LEGEND
- (F) DENOTES FIXED JOINT
- DENOTES BORE HOLE LOCATION

HORIZONTAL ALIGNMENT ON MCE0
NOT TO SCALE



VERTICAL ALIGNMENT ON MCW0
NOT TO SCALE



HLP400 LOADING CONFIGURATION
NOT TO SCALE

NOTES

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH STD DRGS:
   DGSTBR000-D-0004: GENERAL NOTES
   DGSTBR000-D-0011: ARTICULATION DETAILS SHEET 1
2. FOR PUBLIC UTILITY LEGEND REFER DRG. DGPUKS100-0010

STREAM DATA

ULTIMATE LIMIT STATE
- Q20 (REGIONAL) = 1.18m/s, LEVEL = 9.1m
- Q100 (REGIONAL) = 1.2/s, LEVEL = 15.1m
- Q2000 (REGIONAL) = 1.9, LEVEL = 21.6m
- Q20 (LOCAL) = 1.22m/s, LEVEL = 5.8m
- Q100 (LOCAL) = 1.48m/s, LEVEL = 7.6m
- Q2000 (LOCAL) = 1.85m/s, LEVEL = 10.1m

POTENTIAL SCOUR DEPTH
- Q20 (LOCAL) AT PIER = 1.9m
- Q20 (LOCAL) PIER CONTRACTION = 0m
- Q2000 (LOCAL) AT PIER = 2.4m
- Q2000 (LOCAL) PIER CONTRACTION = 0.5m

LIVE LOADS:

SM1600
LOADING IN ACCORDANCE WITH AS 5100.2-2004.
NUMBER OF DESIGN LANES = 5

HLP400 LOADING
HLP400 HEAVY LOAD PLATFORM LOADING VEHICLE LOCATED WITHIN 1m MAXIMUM ON EITHER SIDE OF CENTRELINE OF TWO TRAFFIC LANES

CONSTRUCTION STAGING NOTES

ASSUMED CONSTRUCTION SEQUENCE FOR THE SIX MILE CREEK BRIDGES IS AS FOLLOWS:

1. CONSTRUCT THE SOUTHERN SERVICE ROAD AND BRISBANE ROAD BRIDGES BR340 AND BR350.
2. DIVERT THE IPSWICH MOTORWAY EASTBOUND CARRIAGEWAY OVER THE BRISBANE ROAD BRIDGE AND THE IPSWICH MOTORWAY WESTBOUND CARRIAGEWAY OVER THE SOUTHERN SERVICE ROAD BRIDGE.
3. DEMOLISH THE EXISTING IPSWICH MOTORWAY MAIN LINE BRIDGES AND CUT THE EXISTING SUBSTRUCTURE/PILES TO BELOW FINISHED GROUND LEVEL.
4. CONSTRUCT THE NEW IPSWICH MOTORWAY MAIN LINE BRIDGES BR320 AND BR330.
5. TRANSFER THE IPSWICH MOTORWAY EASTBOUND AND WESTBOUND CARRIAGEWAYS ONTO THE NEW IPSWICH MAIN LINE BRIDGES.
6. COMPLETE SERVICE ROAD CONSTRUCTION FOR THE NEW SERVICE ROAD BRIDGES.
7. REFER TO THE EXISTING BRIDGE DRAWINGS FOR LOCATIONS OF THE BRIDGES TO BE DEMOLISHED.

NOT FOR CONSTRUCTION

Origin Alliance — CONNECTING DINMORE TO GOODNA

No.	Revisions	Verified	Date	Designer's Site Note
2	Detail Design (85%)		23/2/10	
1	Concept Design Issue		06/02/09	

Terrain Data: Coord. Data; Azimuth Datum; Height Datum: Australian Height Datum (AHD); Terrain Models: D2G-BASD-DGROAL110-M-1000, D2G-BASD-DGROAL110-M-2000

Scales: SCALE 1:200 — 2000 0 2000 4000 6000 8000 10000mm — Scales Shown are for A1

IPSWICH MOTORWAY UPGRADE - DINMORE TO GOODNA
CTL CHGE ch 13200 to ch 20770
Reference Points

Preceding RP	Distance to start of Job (km)	From start to end of Job	From end to Following RP	Following RP
17A/2	1.50	6.29	0.00	17A/6
17B/1	0.00	1.46	4.00	17B/3
18A/1	0.00	0.89	0.60	18A/1A
301/1	0.00	0.60	2.82	301/2

Through Chainage From

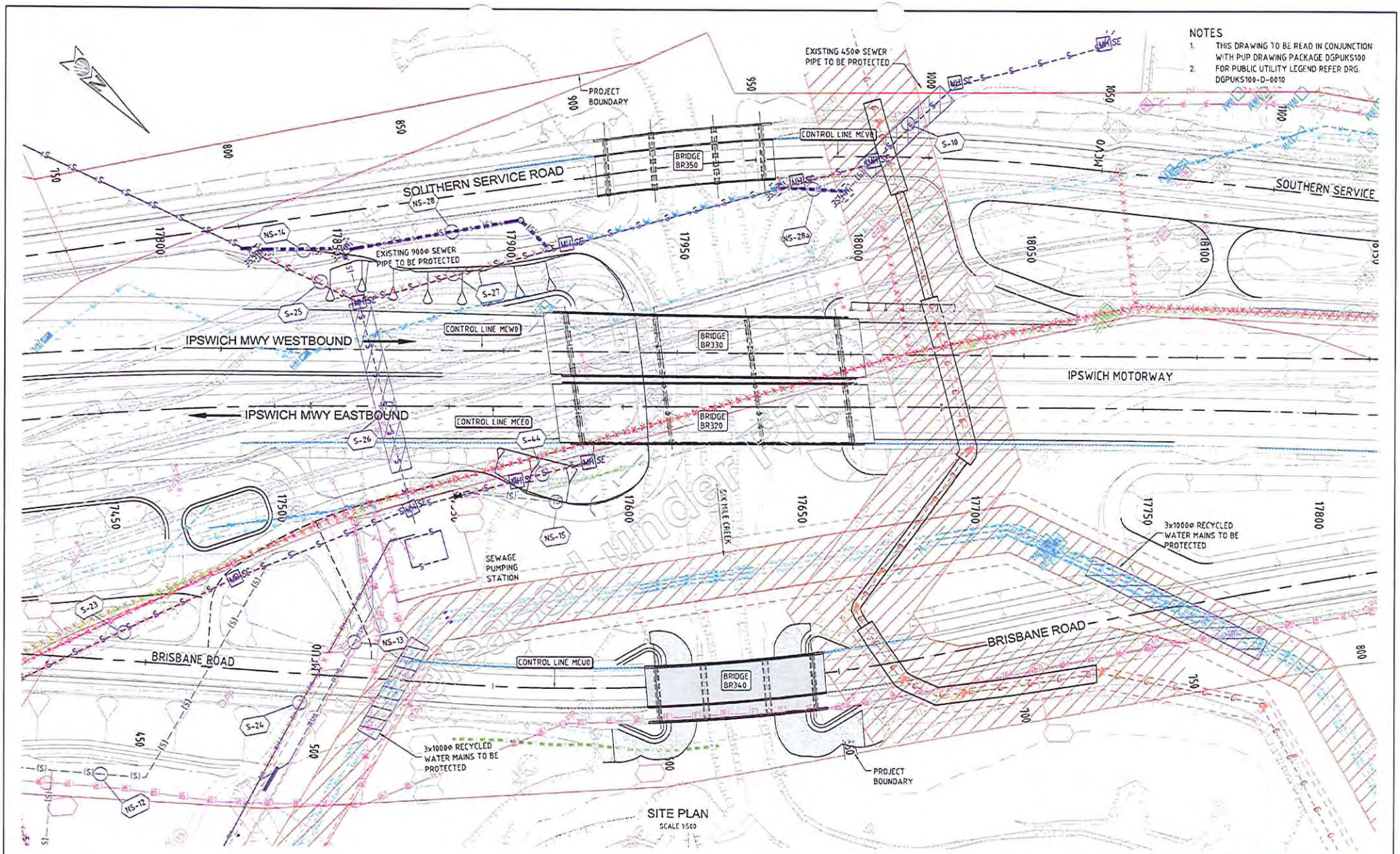
BRIDGE BR330
IPSWICH MOTORWAY OVER SIX MILE CREEK (WESTBOUND)
GENERAL ARRANGEMENT - SHEET 2

Drawing	Design	Design Review	Engineering Certification	Approved by Alliance manager
CH	CH			
Checked	Verified		RPEQ No.	
DM	HH		Date	DC No.

Queensland Government — Department of Main Roads

MR JOB No. 148/17A/59
MR Drg No.
Series Number — of
D2G-BASD-RISTBR330-D-0012
CAD No. 3003326-BR330-0012 | 2

Plotted By: chamilton Plot Date: 23/02/10 - 16:47 Cad File: P:\TS-CADD\DRAWINGS\Detailed Design Eighty Five\Zone 3 Riverview\BR\BR330\3003326-BR330-0012.dwg



OriginAlliance
CONNECTING DINMORE TO GOODNA

Revisions	Verified	Date	Microfilm
A Original Issue - For Construction		20/08/09	

Plotted by: dmitchell Plot Date: 20/08/09 - 15:10 Cad File: P:\TS-CADD\Drawings\Detailed Design Eighty Five%Zone 1 Riversview\BR\BR340\3001324-BR340-0011.dwg

Associated Job Nos

Auxiliary Org Nos

Terrain Data

Coord. Data	
Azimuth Datum	
Height Datum	Australian Height Datum (AHD)
Terrain Models	DZG-BASD-DGROAL110-M-1000
	DZG-BASD-DGROAL110-M-2000

Scales

SCALE 1: 500 5 0 5 10 15 20 25m

Scales Shown are for A1

IPSWICH MOTORWAY UPGRADE - DINMORE TO GOODNA

CTL CHGE ch 13200 to ch 20770

Reference Points

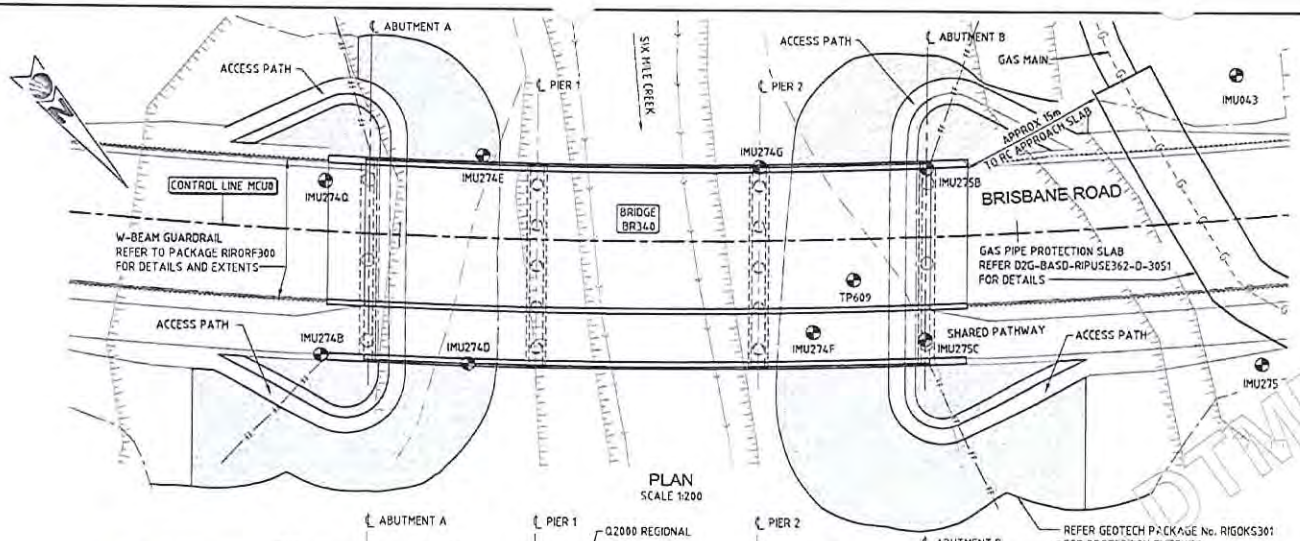
Preceding RP	Distance to start of Job (km)	From start to end of Job	From end to following RP	Following RP
17A/2	1.50	6.79	0.00	17A/6
17B/1	0.00	1.46	4.00	17B/3
18A/3	0.00	0.89	0.60	18A/1A
18B/1	0.00	0.60	2.82	20/2

BRIDGE BR340
BRISBANE ROAD OVER SIX MILE CREEK
GENERAL ARRANGEMENT - SHEET 1

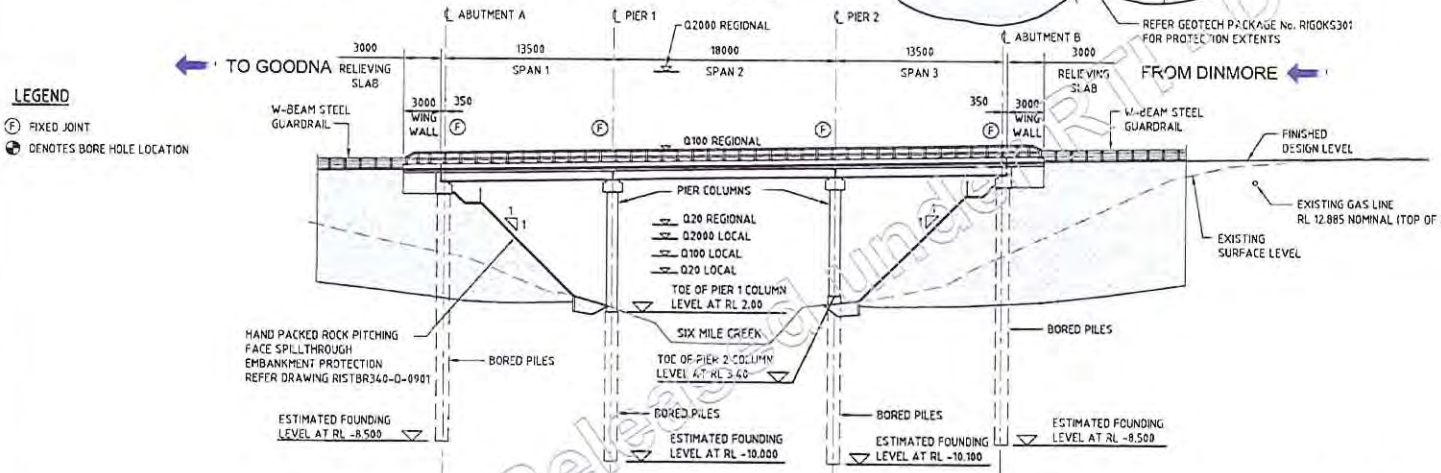
Drawing	Design	Design Review	Engineering Certification	Approved by Alliance Manager
AG	CH			
Checked	Verified			
DM	ND	HH	RPEQ No. 09659 Date 20/8/09	Date 24/8/09

Queensland Government
Department of Main Roads

MR JOB No.	148/17A/59
MR Drg No.	474853
Series Number	of
	D2G-BASD-RISTBR340-D-0011
CAD No.	3003326-BR340-0011 A



PLAN
SCALE 1:200

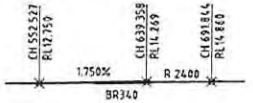


LEGEND
- (F) FIXED JOINT
- DENOTES BORE HOLE LOCATION

DATUM -16.000

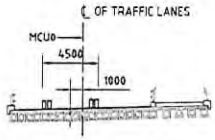
DESIGN R.L. ON CONTROL LINE MCU0	13.535	13.772	14.687	14.322
EXISTING R.L. ON CONTROL LINE MCU0	6.112	2.362	2.742	6.655
CHAINAGE ON CONTROL LINE MCU0	597.580	611.382	628.682	642.583

LONGITUDINAL ELEVATION OF BR340 THROUGH CONTROL LINE MCU0
SCALE 1:200

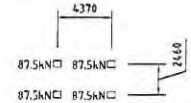


VERTICAL ALIGNMENT ON MCU0
NTS

NOTES
1. THIS DRAWING TO BE READ IN CONJUNCTION WITH STD DRGS: DGSTBR000-D-0004: GENERAL NOTES DGSTBR000-D-0011: ARTICULATION DETAILS SHEET 1
2. FOR PUBLIC UTILITY LEGEND REFER DRG. DGPUKS100-0010
3. STREAM DATA
   - Q20 (LOCAL) = 1.0m/s, LEVEL = 5.2m
   - Q100 (LOCAL) = 1.4m/s, LEVEL = 6.6m
   - Q2000 (LOCAL) = 1.8m/s, LEVEL = 8.1m
   - Q20 (REGIONAL) = 0.6m/s, LEVEL = 9.1m
   - Q100 (REGIONAL) = 1.0m/s, LEVEL = 15.1m
   - Q2000 (REGIONAL-ESTIMATED) = 2.0m/s, LEVEL = 21.5m
4. POTENTIAL SCOUR DEPTH
   - Q20 (LOCAL) AT ABUTMENT = 2.17m
   - Q20 (LOCAL) AT PIER = 2.51m
   - Q2000 (LOCAL) AT ABUTMENT = 5.57m
   - Q2000 (LOCAL) AT PIER = 3.56m
5. LIVE LOADS:
   SM1600
   LOADING IN ACCORDANCE WITH AS5100.2-2004.
   NUMBER OF DESIGN LANES = 3
   HLP400 LOADING
   HLP400 HEAVY LOAD PLATFORM LOADING VEHICLE LOCATED WITHIN 1m MAXIMUM ON EITHER SIDE OF CENTRELINE OF TWO TRAFFIC LANES.



HLP400 LOADING CONFIGURATION



SB-2500D CONSTRUCTION LOADING

CONSTRUCTION STAGING NOTES

ASSUMED CONSTRUCTION SEQUENCE FOR THE SIX MILE CREEK BRIDGES IS AS FOLLOWS:
1. CONSTRUCT THE BRISBANE ROAD AND SOUTHERN SERVICE ROAD BRIDGES BR340 AND BR350.
2. DIVERT THE IPSWICH MOTORWAY EASTBOUND CARRIAGEWAY OVER BRISBANE ROAD BRIDGE AND THE IPSWICH MOTORWAY WESTBOUND CARRIAGEWAY OVER THE SOUTHERN SERVICE ROAD BRIDGE.
3. DEMOLISH THE EXISTING IPSWICH MOTORWAY MAIN LINE BRIDGES AND CUT THE EXISTING SUBSTRUCTURE/PILES TO BELOW FINISHED GROUND LEVEL.
4. CONSTRUCT THE NEW IPSWICH MOTORWAY MAIN LINE BRIDGES BR320 AND BR330.
5. TRANSFER THE IPSWICH MOTORWAY EASTBOUND AND WESTBOUND CARRIAGEWAYS ONTO THE NEW IPSWICH MOTORWAY MAIN LINE BRIDGES.
6. COMPLETE SERVICE ROAD PAVEMENT WORKS ADJACENT TO THE NEW SERVICE ROAD BRIDGES.

Revisions	Verified	Date	Marked	Associated Job Nos
A Original Issue – For Construction		20/08/09		

Auxiliary Drg Nos

Terrain Data: Coord Data; Azimuth Datum; Height Datum: Australian Height Datum (AHD); Terrain Models: D2G-BASD-DGROAL110-M-1000, D2G-BASD-DGROAL110-M-2000

Scales: SCALE 1:200 (2000 0 2000 4000 6000 8000 10000mm)
Scales Shown are for A1

Plotted By: ajones Plot Date: 20/08/09 - 09:46 Cad File: P:\TS-CAD\DRAWINGS\Detailed Design Lightly Trees\Zone 1_Riverview\BR\BR340\3003326-BR340-0012.dwg

IPSWICH MOTORWAY UPGRADE – DINMORE TO GOODNA
CTL CHGE ch 13200 to ch 20770

Reference Points

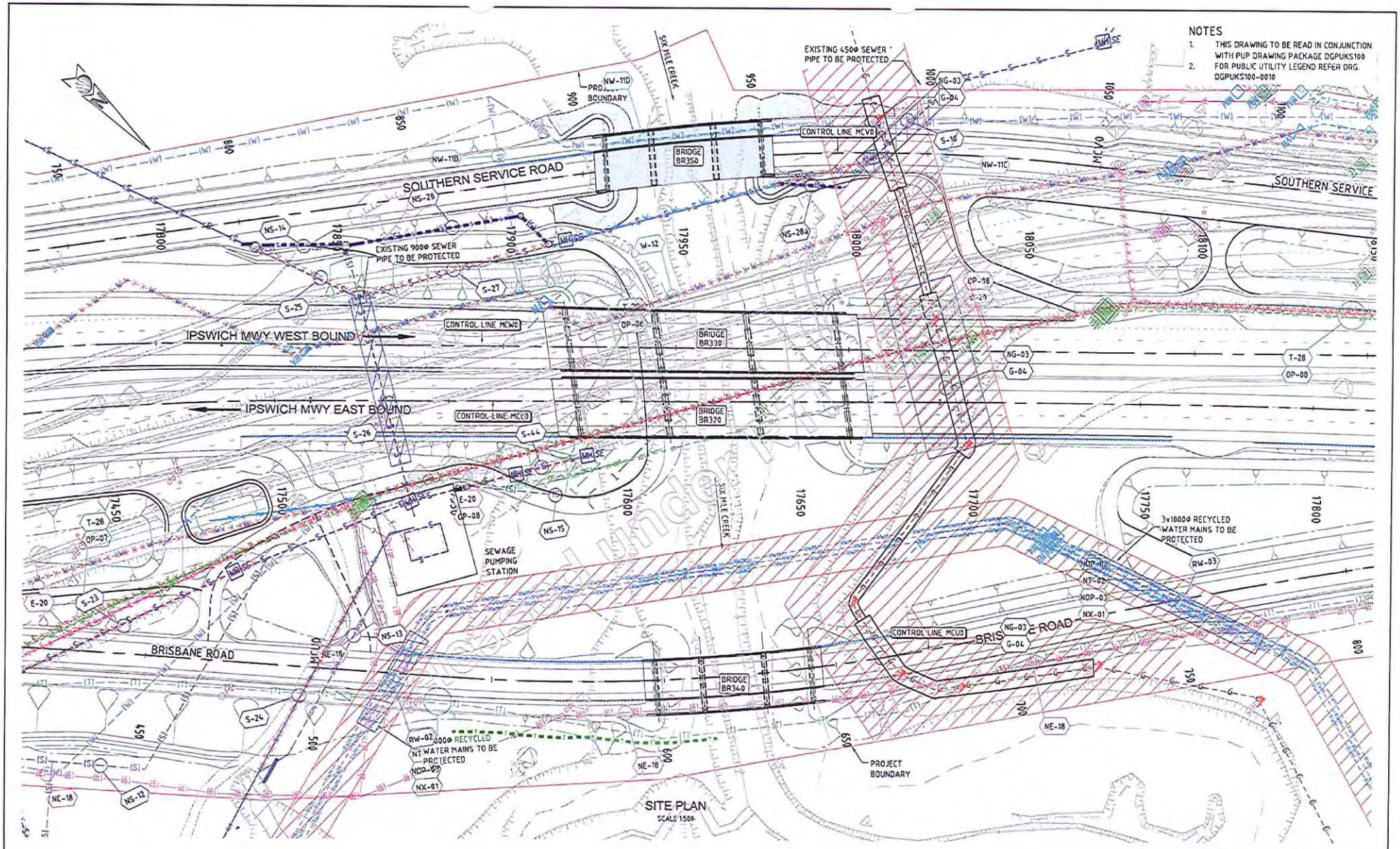
Preceding RP	Distance to start of Job (km)	From start to end of Job	From end to Following RP	Following RP
17A/2	1.50	0.44	0.00	17A/3
17B/1	0.00	1.44	4.05	17B/3
18A/1	0.00	0.89	0.40	18A/1A
18B/1	0.00	0.60	2.82	18B/2

Through Chainage From

BRIDGE BR340
BRISBANE ROAD OVER SIX MILE CREEK
GENERAL ARRANGEMENT – SHEET 2

Drawing	Design	Design Review	Engineering Certification	Approved by Alliance Manager
AG	CH	HH	RPEQ No 9859	Date 24/8/09
Checked DM	Verified ND		Date 20/8/09	

Queensland Government Department of Main Roads
MR JOB No. 148/17A/59
MR Drg No. 474854
Series Number of
D2G-BASD-RISTBR340-D-0012
CAD No. 3003326-BR340-0012 A



OriginAlliance
CONNECTING DINMORE TO GOODNA

Revisions	Verified	Date	Marcelled
A Original Issue - For Construction		17/8/09	

Associated Job Nos

Auxiliary Drg Nos

Terrain Data
Coord. Data
Azimuth Datum
Height Datum: Australian Height Datum (AHD)
Terrain Models: D2G-BASD-DGROAL110-M-1000, D2G-BASD-DGROAL110-M-2000

Scales
SCALE 1:500 0 5 10 15 20 25m
Scales Shown are for A1

IPSWICH MOTORWAY UPGRADE - DINMORE TO GOODNA
CTL CHGE ch 13200 to ch 20770

Reference Points

Preceding RP	Distance to start of job (km)	From start to end of job	From end to Following RP	Following RP
17A/2	1.40	4.29	0.00	17A/6
17B/1	0.00	1.46	4.05	17B/3
18A/1	0.00	0.89	0.60	18A/1A
301/1	0.00	0.60	2.82	301/2

Through Chainage From

BRIDGE BR350
SOUTHERN SERVICE ROAD OVER SIX MILE CREEK
GENERAL ARRANGEMENT - SHEET 1

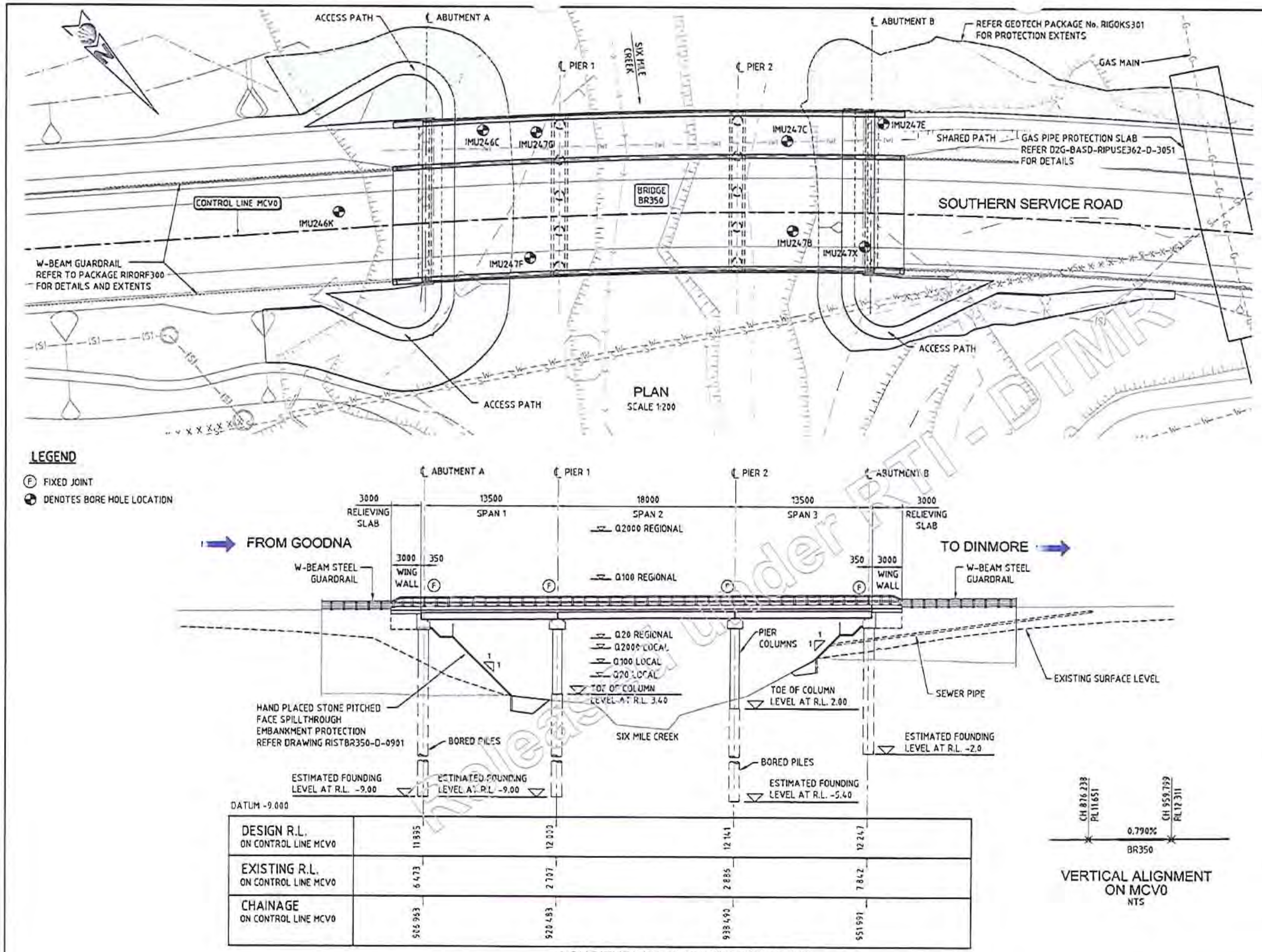
Drawing AG | Design AG | Design Review
Checked DM | Verified ND | HH

Engineering Certification
RPEQ 9859
Date 17/8/09

Approved by Alliance Manager
Date 18/8/09

Queensland Government
Department of Main Roads

MR JOB No. 148/17A/59
MR Drg No. 474885
Series Number
D2G-BASD-RISTBR350-D-0011
CAD No. 3003326-BR350-0011 A



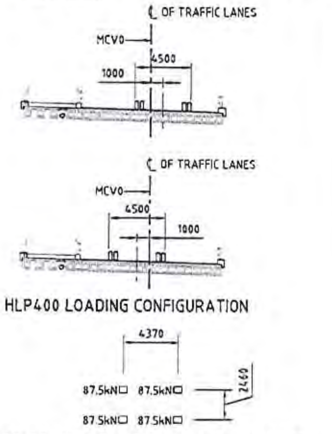
LONGITUDINAL ELEVATION OF BR350 THROUGH CONTROL LINE MCV0
SCALE 1:200

LEGEND

Ⓕ FIXED JOINT
DENOTES BORE HOLE LOCATION

NOTES

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH STD DRGS: DGSTBR000-D-0004: GENERAL NOTES; DGSTBR000-D-0011: ARTICULATION DETAILS SHEET 1
2. FOR PUBLIC UTILITY LEGEND REFER DRG. DGPUKS100-0010
3. STREAM DATA:
   - Q20 (LOCAL) = 0.9m/s, LEVEL = 5.2m
   - Q100 (LOCAL) = 1.6m/s, LEVEL = 6.6m
   - Q2000 (LOCAL) = 2.1m/s, LEVEL = 8.1m
   - Q20 (REGIONAL) = 0.6m/s, LEVEL = 9.1m
   - Q100 (REGIONAL) = 1.0m/s, LEVEL = 15.1m
   - Q2000 (REGIONAL) = 2.0m/s, LEVEL = 20.0m
4. POTENTIAL SCOUR DEPTH:
   - Q20 (LOCAL) AT ABUTMENT = 2.69m
   - Q20 (LOCAL) AT PIER = 2.99m
   - Q2000 (LOCAL) AT ABUTMENT = 7.38m
   - Q2000 (LOCAL) AT PIER = 4.87m
5. LIVE LOADS:
   SM1600
   LOADING IN ACCORDANCE WITH AS5100.2-2004.
   NUMBER OF DESIGN LANES = 3
   HLP400 LOADING
   HLP400 HEAVY LOAD PLATFORM LOADING VEHICLE LOCATED WITHIN 1m MAXIMUM ON EITHER SIDE OF CENTRELINE OF TWO TRAFFIC LANES.



HLP400 LOADING CONFIGURATION

SB-2500D CONSTRUCTION LOADING

VERTICAL ALIGNMENT ON MCV0
NTS

CONSTRUCTION STAGING NOTES

ASSUMED CONSTRUCTION SEQUENCE FOR THE SIX MILE CREEK BRIDGES IS AS FOLLOWS:

1. CONSTRUCT THE BRISBANE ROAD AND SOUTHERN SERVICE ROAD BRIDGES BR340 AND BR350.
2. DIVERT THE IPSWICH MOTORWAY EASTBOUND CARRIAGEWAY OVER BRISBANE ROAD BRIDGE AND THE IPSWICH MOTORWAY WESTBOUND CARRIAGEWAY OVER THE SOUTHERN SERVICE ROAD BRIDGE.
3. DEMOLISH THE EXISTING IPSWICH MOTORWAY MAIN LINE BRIDGES AND CUT THE EXISTING SUBSTRUCTURE/PILES TO BELOW FINISHED GROUND LEVEL.
4. CONSTRUCT THE NEW IPSWICH MOTORWAY MAIN LINE BRIDGES BR320 AND BR330.
5. TRANSFER THE IPSWICH MOTORWAY EASTBOUND AND WESTBOUND CARRIAGEWAYS ONTO THE NEW IPSWICH MOTORWAY MAIN LINE BRIDGES.
6. COMPLETE SERVICE ROAD PAVEMENT WORKS ADJACENT TO THE NEW SERVICE ROAD BRIDGES.

FOR CONSTRUCTION

OriginAlliance — CONNECTING DINMORE TO GOODNA

Revisions	Verified	Date
A Original Issue - For Construction		17/8/09

Terrain Data: Height Datum — Australian Height Datum (AHD); Terrain Models — D2G-BASD-DGROAL110-M-1000, D2G-BASD-DGROAL110-M-2000

SCALE 1:200 — Scales shown are for A1

IPSWICH MOTORWAY UPGRADE - DINMORE TO GOODNA
CTL CHGE ch 13200 to ch 20770

BRIDGE BR350
SOUTHERN SERVICE ROAD OVER SIX MILE CREEK
GENERAL ARRANGEMENT - SHEET 2

Drawing AG · Design AG · Design Review HH · Checked DM · Verified ND
RPEQ No 9859

Queensland Government — Department of Main Roads

MR JOB No.	148/17A/59
MR Drg No.	474886
Series Number	D2G-BASD-RISTBR350-D-0012
CAD No.	3003326-BR350-0012 A

Appendix D – Reference Documents

List of Reference Documents applying to this design lot.

Number	Description	Revision
	Queensland Urban Drainage Manual	2nd Ed 2007
	Road Drainage Design Manual	June 2002
	Australian Rainfall and Runoff	2001
D2G-BASD-DGRODR101-R-1000	Drainage Design Criteria Report	01
D2G-DPSM-R-0001	Safety in Design CHAIR 1Report	
D2G-BASD-REFHKS100-R-1000	Goodna Creek local flood report	2
D2G-BASD-RIFHKS100-R-1000	Six Mile Creek local flood report	2
D2G-BASD-RIRODR300-R-1000	Zone 3 Transverse Drainage	1
D2G-BASD-RIRODR301-R-1000	Zone 3 Longitudinal Drainage	1
D2G-BASD-RERODR200-R-1000	Zone 2 Transverse Drainage	1
D2G-BASD-RERODR201-R-1000	Zone 2 Longitudinal Drainage	1
D2G-BASD-RERODR204-R-1000	Goodna Creek rehabilitation	1
	Ipswich Motorway Upgrade – Dinmore to Goodna, Hydraulic Investigations and Impact Assessment, DHI, May 2008	
	Ipswich Rivers Flood Study Rationalisation Project, Phase 3 – Re-estimation of Design Flood Levels, Sargent Consulting (December 2006)	
	Goodna Bypass Supplementary Hydraulic Investigations, Maunsell (2007)	

Queensland Government
Department of Main Roads

Minutes

Ipswich Motorway Dinmore to Goodna

Hydraulic Modelling Meeting

Date 31 January 2008 **Time** 10:00 – 11:30am

Place Main Roads, Metropolitan District, Floor 1, 183 Wharf St

Chair [redacted]

Minute taker

Attendees

Organisation	Name	Presence
DHI	[redacted]	Present
Maunsell		Present
Maunsell		Present
Brisbane City Council		Present
Ipswich City Council		Present
Main Roads		Present
Main Roads		Present
Main Roads		Present

Introduction

[redacted] opened the meeting and described the background to the project including:

- Project extents
- Maunsell/KBR review of the 2002/2003 planning, currently underway
- Changes in design standards from that adopted for the previous planning
- Agreed change in design speed from 100km/h to 110 km/h east of Redbank shopping centre
- Potential for some changes to meet the newly adopted design speed
- Potential need for application of Extended Design Domain (EDD) due to tight vertical and horizontal geometry
- Planning intent to remain within corridor

[redacted] described the Goodna Bypass (previously ANC) flood modelling, what was included and some of the assumptions adopted.

Issues discussed

[redacted] explained that DHI have completed a desktop review of the Goodna Bypass flood model to assess its applicability for use on this project.

[redacted] explained that the Goodna Bypass model was a Mike flood model approximately 10km wide by 6km north to south. With regard to the model [redacted] explained the following:

- It included survey of the Brisbane River bed
- It did not look at the impacts on the Ipswich Motorway (IM) as the IM was of secondary importance given the model was developed for the Goodna Bypass project
- It was a regional model
- It was based on a 10m grid
- It was not suitable for looking at the Goodna flood plain south of the IM
- DHI propose to use a finer scale (5m grid) model to look at Goodna and 6 Mile Creeks

[redacted] explained that there were essentially two issues that the modelling would aim to answer:

- Flooding to the north of the IM
- Flood plain impacts south of the IM due to filling some of the flood plain for the realignment through the Redbank area

[redacted] also explained that:

- DHI have datasets from BCC and Mike 11 for Brisbane and Bremer Rivers
- Also have Q100 flows for the Ipswich City creeks
- Have Q10, 20, 50 and 2000 yr levels from BCC hydrology but when reviewed, there appears to be some disparity

[redacted] advised that BCC are currently working on the discrepancies but the results would not be ready in time for the IM Dinmore to Goodna project.

There was discussion about 100 yr flows and it was agreed that 7000 cumecs was acceptable to all three stakeholders, BCC, ICC and Main Roads.

[redacted] explained that ICC has particular concerns about flood-prone houses on Woogooroo Ck. Upstream flooding of these houses must not be worsened.

[redacted] stressed that local flooding with no tailwater in the river is the critical event ICC are concerned about.

ICC's flood model is an integrated model that includes the Brisbane River, Woogooroo Ck, Goodna Ck and Six Mile Ck. This model can be made available for use on this project. Main Roads agreed to make a formal request to ICC for a copy of the model.

It was agreed that DHI will cut the creek sections out of ICC's model, take the flows from it and use these flows in the existing Goodna Bypass model.

[redacted] advised that a flood immunity of Q20 should be achieved for all local roads. It was agreed that Maunsell/DHI would have a look at what that meant. Until the model is completed the consequences of this are unknown. It was thought that the Brisbane River Q20 would probably govern as the flood levels are likely be greater than the creeks'.

[redacted] requested ongoing feedback as the project progresses and suggested that any flood related feedback should be included in the agenda for meetings with [redacted]

Agreements

1. 7000 cumecs is an acceptable flow for the Q100 flood event
2. Main Roads shall formerly request a copy of the ICC flood model
3. DHI will use the flows for the creeks from the ICC flood model and use them in the Goodna Bypass flood model
4. Maunsell/DHI will assess Q20 flood immunity for the local road network and advise of any consequences/concerns
5. Main Roads will keep ICC informed and provide regular feedback through meetings with [redacted]

Appendix E – Environmental Requirements Checklist

	Zone 1	Zone 2	Zone 3	Zone 4	Drainage	Design Response	Status (Compliant/ Partially compliant/ Non-compliant/ Not applicable)	Date Closed
All permanent water quality treatment structures should be designed for the adequate control of pollution and sediment in the one year Average Recurrence Interval (ARI) peak flow as a minimum, and also designed for stability for at least the 20 year ARI peak storm event.	Y	Y	Y	Y	Y	Not applicable to this design lot. Refer to the water quality packages GORODR103, RERODR202, RIRODR302, DIRODR402.	Not applicable	28.01.10
Implement WSUD measures in accordance with design objectives in the Healthy Waterways' WSUD Action Plan (Section 3.3.1).	Y	Y	Y	Y	Y	Not applicable to this design lot. Refer to the water quality packages GORODR103, RERODR202, RIRODR302, DIRODR402.	Not applicable	28.01.10
Design sedimentation ponds with sufficient holding times to reduce suspended solids to at or less than the suspended solid concentration of the receiving watercourse before release or use on site.	Y	Y	Y	Y	Y	Not applicable to this design lot. Refer to the water quality packages GORODR103, RERODR202, RIRODR302, DIRODR402.	Not applicable	28.01.10
Any dewatering of trenches containing exposed acid sulphate soils shall be discharged to a holding pond and not directly into local waterways. Water testing and treatment, if necessary, is to be performed prior to water reuse or release.	Y	Y	Y	Y	Y	Addressed during construction in accordance with the Construction Environmental Management Plan (D2G-MPPL-V-017).	Compliant	28.01.10
Carry out weekly inspections of water quality treatment devices and implement regular maintenance regimes through operational phase.	Y	Y	Y	Y	Y	Weekly inspection will be carried out during construction and a maintenance plan for the operational phase of the devices are contained within the design report. Applicable to the water quality packages only (GORODR103, RERODR202, RIRODR302, DIRODR402)	Not applicable	28.01.10
Outfalls should meet the requirements of QUDM Chapter 3.02 – Lawful points of discharge.	Y	Y	Y	Y	Y	Not applicable to this design package.	Not applicable	28.01.10
Surface flows that are concentrated by an open channel or conduit should be controlled prior to discharge on a downstream system or owner. Concentrated flows should be dissipated by the use of detention and energy dissipaters.	Y	Y	Y	Y	Y	Not applicable to this design package.	Not applicable	28.01.10
Summary of the Water Quality Objectives applicable to the IMU. • Frequent Flow Management: Capture the first 15mm/d of Runoff. • Waterway Stability Management: Limit post development 1-year ARI to pre-development (undeveloped) 1-Year ARI; Limit post development 100-year ARI to pre-development (undeveloped) 100-Year ARI. • Stormwater Quality Management Achieve the following reductions in total pollutant load: 90% reduction in gross pollutants; 80% reduction in TSS; 60% reduction in Total Phosphorous; 45% reduction in Total Nitrogen.	Y	Y	Y	Y	Y	Not applicable to this design lot. Refer to the water quality packages GORODR103, RERODR202, RIRODR302, DIRODR402.	Not applicable	28.01.10
It is recommended that, where feasible, all permanent water quality treatment structures should be designed for the adequate control of discharge, pollution, and sediment in the 1-year Average Recurrence Interval (ARI) event and 100 year ARI event.	Y	Y	Y	Y	Y	Not applicable to this design lot. Refer to the water quality packages GORODR103, RERODR202, RIRODR302, DIRODR402.	Not applicable	28.01.10
All water quality works designed for the IMU should be developed with an operation and maintenance plan for the construction and operational phases of the project. These plans should be provided to ICC's maintenance department to ensure the long term operation of constructed water quality facilities.	Y	Y	Y	Y	Y	Not applicable to this design lot. Refer to the water quality packages GORODR103, RERODR202, RIRODR302, DIRODR402.	Not applicable	28.01.10

	Zone 1	Zone 2	Zone 3	Zone 4	Drainage	Design Response	Status (Compliant/ Partially compliant/ Non-compliant/ Not applicable)	Date Closed
All contractors must, where possible, provide sandbag and/or bunding protection at the points of intersections of the construction site and the Six Mile and Goodna Creeks. Use of additional ITS in notifying vehicles travelling along the corridor and adjoining motorways of the delays in traffic movement and the location of the flooding.	Y	Y	Y	Y	Y	Not applicable to this design lot. To be addressed during the construction phase of the project in accordance with the Construction Environmental Management Plan (D2G-MPPL-V-017).	Not applicable	28.01.10
The durability portions of the Project Plans and the Maintenance Manual must demonstrate how the selected design, materials, construction, operation and maintenance will achieve the durability objectives of each Asset, in conjunction with the specified Design Life for that Asset in section 5.2 of this Scope of Works and Technical Criteria. For each Asset which comprises part of the Upgrade, the Project Plans must: (i) define the characteristics of the environment; (ii) identify the potential deterioration mechanisms in that environment; (iii) determine the likely rate of deterioration; (iv) assess the material life; (v) define the required material performance; (vi) assess the need for further protection; (vii) if appropriate, develop procedures for replacement of Asset Items and Asset Sub-Items at intervals consistent with the Design Life specified in section 5.2 of this Scope of Works and Technical Criteria; (viii) determine inspection and monitoring requirements for both critical and non-critical Assets; and (ix) if appropriate, outline possible remedial measures.	Y	Y	Y	Y	Y	Not applicable to this design package	Not applicable	28.01.10
The results of the Condition Surveys must be taken into account during design, construction and operation of the Upgrade	Y	Y	Y	Y	Y	Any condition surveys will be addressed during construction	Not applicable	28.01.10
Except as specified in Appendix 36, the various Assets must have the following minimum Design Life: Drainage elements that are accessible for refurbishment, including building drainage, sedimentation and detention ponds, 20 years;	Y	Y	Y	Y	Y	Addressed during design process. Refer to Design Criteria Report - Drainage (D2G-BASD-DGRODR000-R-001-A0)	Compliant	28.01.10
The Contractor must develop, maintain and operate a drainage system and develop design solutions which avoid or minimise any potential damage or loss that may result from, or may be contributed to by water discharge from the Project Works and Temporary Works.	Y	Y	Y	Y	Y	Not applicable to this package. Addressed as part of the TTM works as temporary construction staging drainage design has been shown on these drawings.	Not applicable	28.01.10
The Contractor must provide a water management system that requires a minimum of maintenance consistent with the need to ensure appropriate water quality discharge from the Project Works and Temporary Works.	Y	Y	Y	Y	Y	Addressed during design process. Refer to Design Criteria Report - Drainage (D2G-BASD-DGRODR000-R-001-A0)	Compliant	28.01.10

	Zone 1	Zone 2	Zone 3	Zone 4	Drainage	Design Response	Status (Compliant/ Partially compliant/ Non-compliant/ Not applicable)	Date Closed
Waterway habitat degradation: • Incorporate a filtration system into the drainage design in order to minimise pollutants entering Goodna and Six Mile Creeks. (Chainage 15000 to 16300 and 17700 to 18200) • Revegetate creek banks with local provenance		Y	Y		Y	Not applicable to this design lot. Refer to the water quality packages GORODR103, RERODR202, RIRODR302, DIRODR402. Revegetation of Goodna Creek will be in accordance with the Goodna Creek Rehabilitation package (RERODR204).	Not applicable	28.01.10
Loss of faunal connectivity through vegetation at Six Mile Creek: • Minimise vegetation clearance at Six Mile Creek through design by including the back spanning of bridges with bridge clearance heights of >10 metres. • Ensure dry passage for fauna (set back of abutments so to leave areas above permanent water level). • Where possible avoid placement of piles in stream or on the water's edge. • Establish fauna friendly culverts catering for a variety of faunal groups (Chainage 17700 to 18200) • Revegetate Six Mile Creek area using local provenance.			Y		Y	Not applicable to this design package.	Not applicable	28.01.10
Incorporate fauna underpass into road design at Goodna Creek (Chainage 15000 to 16300)		Y			Y	Not applicable to this design package.	Not applicable	28.01.10
Establish fauna friendly culverts catering for a variety of faunal groups (Chainage 15000 to 16300)		Y			Y	Not applicable to this design package.	Not applicable	28.01.10
Capture of road runoff in sedimentation/detention basins reducing the likelihood of seeds passing into nearby riparian areas (assuming adequate weed monitoring and control is carried out at each basin)	Y	Y	Y	Y	Y	Not applicable to this design lot. Refer to the water quality packages GORODR103, RERODR202, RIRODR302, DIRODR402. Basin have been design to accommodate a spill only.	Not applicable	28.01.10
Swales and drainage channels longitudinal alignments to gently meander reflecting natural landform and to be of a more naturalised appearance with maximum side slope of 1:3. Investigate the use of rock lined wet, macrophyte planted and grass swale types.	Y	Y	Y	Y	Y	Not applicable to this design package.	Not applicable	28.01.10
In the event of a spill, Emergency Services to be contacted immediately. Construction of settling ponds along the road corridor for the capture of any dangerous goods or hazardous substances. Contaminated water to be disposed of at a licensed waste transfer station.	Y	Y	Y	Y	Y	In the event of a spill, controls will be implemented in accordance with the Construction Environmental Management Plan (D2G-MPPL-V-017) and the Emergency and Incident Response Management Plan (D2G-MPPL-V-016).	Compliant	28.01.10
DMR shall insist on the use of recycled material, where they are available and cost-competitive, by all contractors. Furthermore, recycling shall be utilised where available and cost-competitive for the disposal of all waste materials.	Y	Y	Y	Y	Y	Not applicable to this design package.	Not applicable	28.01.10
Contractors are to develop and implement a Stormwater Management Plan (SMP) that clearly identifies potential flood sections along the upgrade corridor. The SMP must include emergency procedures, contact numbers and an action plan outlining 'what to do in the event of a flood'.	Y	Y	Y	Y	Y	Not applicable to this design lot. To be addressed during the construction phase of the project in accordance with the Construction Environmental Management Plan (D2G-MPPL-V-017).	Not applicable	28.01.10

	Zone 1	Zone 2	Zone 3	Zone 4	Drainage	Design Response	Status (Compliant/ Partially compliant/ Non-compliant/ Not applicable)	Date Closed
The drainage system must: (i) preserve the existing elements such as natural channels, wetland and riparian vegetation; (ii) manage both the quality and quantity of runoff such that it is as close to its sources as possible and include the installation of devices which treat the stormwater and retain the run-off so that the system changes the existing water regime to the smallest amount practicable; (iii) be integrated with the construction process so that the total investment in drainage infrastructure is minimised and access is available to all devices which need on-going maintenance during both the construction phase, operation phase and the maintenance phase; (iv) be capable of being partitioned to contain spillage from incidents; (v) be designed for ease of maintenance; and (vi) be structurally safe in any storm.	Y	Y	Y	Y	Y	Addressed during design process. Refer to Design Criteria Report - Drainage (D2G-BASD-DGRODR000-R-001-A0)	Compliant	28.01.10
Bridge drainage, bridge scuppers and underpass drainage must be connected to the road drainage system.	Y	Y	Y	Y	Y	Addressed during design process. Refer to Design Criteria Report - Drainage (D2G-BASD-DGRODR000-R-001-A0)	Compliant	28.01.10
The drainage system must prevent any flooding inside underpasses for a 10 year ARI.	Y	Y	Y	Y	Y	Addressed during design process. Refer to Design Criteria Report - Drainage (D2G-BASD-DGRODR000-R-001-A0) and refer to the Transverse Drainage design lots RERODR205, RERODR206, RERODR207.	Compliant	28.01.10
The Upgrade must be designed so that the motorway carriageways are protected by physical means to prevent flooding of the Upgrade such that the lowest point of each carriageway's pavement surface is 100mm above the 100 year ARI flood level for cross drainage.	Y	Y	Y	Y	Y	Not applicable to this package. Addressed as part of the Transverse Drainage design lots RERODR205, RERODR206, RERODR207.	Not applicable	28.01.10
The Upgrade must be designed so that the above requirement of sub-section (a) is maintained for the design life of the Assets. Flood levels must be measured during representative storm events immediately following completion of construction of relevant sections of the Project Works to verify the likely compliance of the Project Works with the predicted inundation limits and inundation times. In the event that the measurements required in sub-section (b) demonstrate flood levels and/or inundation times greater than those predicted, the Contractor must immediately commence a process to modify the Project Works to the meet the required limits, unless otherwise agreed by Main Roads.	Y	Y	Y	Y	Y	Addressed during design process. Refer to Design Criteria Report - Drainage (D2G-BASD-DGRODR000-R-001-A0) and the transverse drainage design lots RERODR205, RERODR206, RERODR207. Flood model achieves these criteria in the required events (up to 100 year ARI)	Compliant	28.01.10

	Zone 1	Zone 2	Zone 3	Zone 4	Drainage	Design Response	Status (Compliant/ Partially compliant/ Non-compliant/ Not applicable)	Date Closed
A high standard environmental design must be developed for the Project Works, including provision for: (i) erosion, sedimentation and water quality infrastructure (ii) groundwater movements (iii) fauna underpasses and fauna fencing (iv) fish-friendly structures, including waterway design (v) management and mitigation measures for environmentally sensitive areas, including marine environments, and (vi) construction and operational noise and vibration measures.	Y	Y	Y	Y	Y	Not applicable to this design package.	Not applicable	28.01.10
Concrete safety barriers must not be used in areas where fauna habitat is adjacent to the Project Site and fauna has not been effectively prevented from crossing the Project Site, or where a concrete safety barrier could adversely impact the effects of floods.	Y	Y	Y	Y	Y	Not applicable to this design package.	Not applicable	28.01.10
Bridge drainage over streams shall satisfy the requirements of the Environmental Management Plan (EMP). In general, collection and treatment of drainage water is not required unless specified in the EMP. Where drainage pipes are required, they must be able to be cleaned effectively, and placed between beams or behind an edge skirt to maintain clean lines on the bridge profile. Drainage system shall be hot dip galvanized steel. PVC drains are not permitted.	Y	Y	Y	Y	Y	Not applicable to this design package.	Not applicable	28.01.10
The drainage design must comply with the following requirements: (a) The drainage design must be in accordance with Reference Documents, the Main Roads Road Drainage Design Manual, Australian Rainfall and Runoff (AR&R) 2001 and the requirements of all relevant Authorities.	Y	Y	Y	Y	Y	Not applicable to this design package.	Not applicable	28.01.10
The drainage design must comply with the following requirements: (b) The Contractor must obtain approval for the drainage design from all relevant Authorities.	Y	Y	Y	Y	Y	Design has been developed in consultation with DTMR and ICC.	Compliant	28.01.10
The drainage design must comply with the following requirements: (c) The drainage design must hydraulically model watercourses which are crossed by the Project Works for flooding and impact of the PMF, and must provide flood mitigation measures where required.	Y	Y	Y	Y	Y	The regional flood model has not investigated PMF but has investigated 2000 year ARI as accepted in RFI #383.	Non-compliant (refer to RFI #383)	28.01.10
The drainage design must comply with the following requirements: (d) For all drainage design, the storm modelled must be the one producing the largest peak discharge for the required storm event.	Y	Y	Y	Y	Y	The regional flood model has investigated 20, 100 and 2000 year ARI as accepted in RFI #383. The largest peak discharge for each event was used in the analysis.	Non-compliant (refer to RFI #383)	28.01.10
The drainage design must comply with the following requirements: (e) The Project Works must not increase inundation levels more than those contained in section 5.13 of this Scope of Works and Technical Criteria or the Environmental Documents.	Y	Y	Y	Y	Y	Not applicable in this design package. Please refer to longitudinal and transverse drainage packages for each zone.	Not applicable	28.01.10
The drainage design must comply with the following requirements: (f) Runoff from/along ramps or turning roadways must not flow beyond noses and across the main carriageway for a 2 year ARI storm event.	Y	Y	Y	Y	Y	Not applicable in this design package. Please refer to longitudinal and transverse drainage packages for each zone.	Not applicable	28.01.10
The drainage design must comply with the following requirements: (g) Where the pipe system is not self-cleaning, the drainage design must make provision for acceptable alternative cleaning strategies.	Y	Y	Y	Y	Y	Not applicable in this design package. Please refer to longitudinal and transverse drainage packages for each zone.	Not applicable	28.01.10

	Zone 1	Zone 2	Zone 3	Zone 4	Drainage	Design Response	Status (Compliant/ Partially compliant/ Non-compliant/ Not applicable)	Date Closed
The drainage design must comply with the following requirements: (h) If embankment or formation settlement occurs, the required waterway areas must be maintained.	Y	Y	Y	Y	Y	Not applicable to this design report.	Not applicable	28.01.10
The drainage design must comply with the following requirements: (i) The design of waterway areas must accommodate any embankment or formation settlement.	Y	Y	Y	Y	Y	Not applicable to this design report.	Not applicable	28.01.10
The drainage design must comply with the following requirements: (j) The part(s) of the drainage system that deal(s) with general pavement drainage must incorporate methods for retention of 40,000 litres of polluted run-off (including oil and chemical pollutants, and oil and chemical spills) at each point of discharge from the Project Site and the Local Road Works, including discharges into existing wetlands or tidal channels.	Y	Y	Y	Y	Y	Not applicable to this design lot. Refer to the water quality packages GORODR103, RERODR202, RIRODR302, DIRODR402.	Not applicable	28.01.10
The drainage design must comply with the following requirements: (k) The drainage system must separate cross-drainage systems from pavement drainage systems and from longitudinal drainage systems.	Y	Y	Y	Y	Y	Not applicable in this design package. Please refer to longitudinal and transverse drainage packages for each zone.	Not applicable	28.01.10
The drainage design must comply with the following requirements: (l) Oil and chemical spill collection and treatment must be provided at water crossings nominated by Main Roads.	Y	Y	Y	Y	Y	Not applicable to this design lot. Refer to the water quality packages GORODR103, RERODR202, RIRODR302, DIRODR402, and the Design Criteria Report - Drainage (D2G-3ASD-DGRODR000-R-001-A0)	Not applicable	28.01.10
Drainage of surface run-off from pavement wearing surfaces must be designed for a 1 in 10 year ARI. A 1 in 100 year ARI must be modelled and a check made of flow levels to ensure that nuisance flooding is avoided. A drainage system must be provided to pick up all pavement water, including any drainage layers.	Y	Y	Y	Y	Y	Not applicable in this design package. Please refer to longitudinal and transverse drainage packages for each zone.	Not applicable	28.01.10
Watercourses must be modelled and have impacts assessed for 50 year and 100 year ARIs and the PMF	Y	Y	Y	Y	Y	The regional flood model has investigated 20, 100 and 2000 year ARI as accepted in RFI #383. The 2, 5, 20, 50, 100, 200, 2000 year ARI and PMF events have been modelled in the local flood models.	Non-compliant (refer to RFI #383)	28.01.10
The following minimum ARI must be applied to the drainage design: (i) cross highway drainage - 100 year ARI (ii) channels and open drains - 10 year ARI (iii) gutter flow spread limited to width of shoulder - 10 year ARI (iv) piped system (including pits) - 10 year ARI (v) major storm event check for no property damage - 100 year ARI (vi) major storm event check for no structure damage - 2000 year ARI (vii) surface run-off from pavement - as per Clause 7.12.1.2 and Clause 7.12.1.5.	Y	Y	Y	Y	Y	Not applicable in this design package. Please refer to longitudinal and transverse drainage packages for each zone.	Not applicable	28.01.10

	Zone 1	Zone 2	Zone 3	Zone 4	Drainage	Design Response	Status (Compliant/ Partially compliant/ Non-compliant/ Not applicable)	Date Closed
A catchment drawing must be provided within the design report and must show: (a) existing and design contours, gullies/pits, manholes, culverts, bridges and pipes (b) catchment areas (c) pervious and impervious percentages (d) coefficients of runoff (e) overland flow times, including times of concentration, and (f) extent of proposed work.	Y	Y	Y	Y	Y	Not applicable in this design package. Please refer to transverse drainage packages for each zone.	Not applicable	28.01.10
Continuity of ground water flow from one side of tunnel or underpass structures (including approach structures) to the other side of tunnel or underpass structures must be provided. The infrastructure to accommodate the groundwater flow across the tunnel or underpass and its approaches must be designed to address the chemical properties of the groundwater and the potential for iron compound precipitation from the groundwater to block pipe work, making any provisions necessary to facilitate maintenance activities and removal of blockages from the pipes.	Y	Y	Y	Y	Y	Not applicable to this design lot as no tunnels are present in this design lot.	Not applicable	28.01.10
All outlets of the surface drainage system must incorporate energy dissipation, erosion and sediment control.	Y	Y	Y	Y	Y	Not applicable to this design package.	Not applicable	28.01.10
Construction of the drainage system must be consistent with the acid sulphate soils management plan.	Y	Y	Y	Y	Y	Not applicable to this design package.	Not applicable	28.01.10
The Contractor must design scour protection for all areas susceptible to scouring, including batters and bridge abutments. Scour protection must be designed for a minimum maintenance-free life of 50 years. Scour protection for waterway areas must be designed in consultation with the relevant Authorities, address fauna access requirements, and comply with the requirements of Appendix 21 (if used) of this Scope of Works and Technical Criteria.	Y	Y	Y	Y	Y	Scour protection has been designed and detailed in the local flood model reports REFHKS100 and RIFHKS100. Fauna access requirements at Goodna Creek are detailed in the Goodna Creek Rehabilitation package (RERODR204).	Not applicable	28.01.10
Water to be discharged from the Project Site must meet EPA requirements.	Y	Y	Y	Y	Y	Not applicable to this design lot. Refer to the water quality packages GORODR103, RERODR202, RIRODR302, DIRODR402, and the Design Criteria Report - Drainage (D2G-BASD-DGRODR000-R-001-A0)	Not applicable	28.01.10
Further to the requirements of sections 5.5 and 5.13 of the SWTC, service roads must be designed so that the lowest point of each carriageway's pavement surface is above the 20-year ARI flood level (target) or the 10-year ARI flood level (minimum).	Y	Y	Y	Y	Y	Not applicable to this design lot. Refer to the transverse drainage packages for each zone.	Not applicable	28.01.10
Consideration shall be given to the following: (i) identification of potentially affected water bodies or sensitive receiving areas (ii) construction activities and their potential impact on water quality (iii) monitoring location(s), triggers and frequency (iv) water quality objectives (performance criteria)	Y	Y	Y	Y	Y	Not applicable to this design lot. Refer to the water quality packages GORODR103, RERODR202, RIRODR302, DIRODR402.	Not applicable	28.01.10
All permanent and temporary water quality treatment measures shall be reviewed from the scenario presented within the interim EAR in Exhibit C. This review shall consider the purpose, design, placement and size of these measures.	Y	Y	Y	Y	Y	Not applicable to this design lot. Refer to the water quality packages GORODR103, RERODR202, RIRODR302, DIRODR402.	Not applicable	28.01.10

	Zone 1	Zone 2	Zone 3	Zone 4	Drainage	Design Response	Status (Compliant/ Partially compliant/ Non-compliant/ Not applicable)	Date Closed
Consideration shall be given to the need for temporary or permanent water treatment devices to treat first flush events and the collection of runoff from bridges.	Y	Y	Y	Y	Y	Not applicable to this design lot. Refer to the water quality packages GORODR103, RERODR202, RIRODR302, DIRODR402.	Not applicable	28.01.10
Water discharged from site or from any water treatment devices must comply with water quality provisions of the Environmental Protection (Water) Policy 1997, as well as ANZECC and/or locally relevant water quality guidelines.	Y	Y	Y	Y	Y	Not applicable to this design lot. Refer to the water quality packages GORODR103, RERODR202, RIRODR302, DIRODR402, and the Design Criteria Report - Drainage (D2G-BASD-DGRODR000-R-001-A0)	Not applicable	28.01.10
Consideration shall be given to the following information in all relevant documentation: (i) identification of significant habitat areas (ii) identification of fauna known or likely to occur within the area (iii) identification of significant habitat features such as hollows, nests (iv) methods available to minimise impacts, such as: A. preserving areas by prohibiting disturbance or construction activities B. preserving habitat logs, rock, other shelters and subsequent re-instatement C. minimising clearing within the construction zone D. implementation of two-stage clearing procedures E. procedures to treat fauna injured by the construction activities. (v) use of an EPA-authorised "fauna spotter-catcher" during works (vi) inclusion of contact details for emergency wildlife care on the project's emergency contact list (vii) detail of procedures implemented to treat fauna injured by construction activities (viii) immediate reporting of any fauna injured or dead, which are known as rare, endangered or vulnerable, to Main Roads and the EPA. (ix) implementation of fauna mitigation measures such as underpasses and exclusion fencing.	Y	Y	Y	Y	Y	Clearing and fauna handling (if required) will be in accordance with the Construction Environmental Management Plan (D2G-MPPL-V-017).	Compliant	28.01.10
The design of the motorway bridges [over Goodna Creek] considers the Brisbane River floodplain; with the motorway bridges designed to provide Q100 immunity (Brisbane River).		Y			Y	Motorway has Q100 immunity. See report and RIFHKS100 and REFHKS100 for more detail.	Compliant	28.01.10
Local roads and/or service roads are designed to provide Q20 immunity (Brisbane River) [Goodna Creek].		Y			Y	Local and service roads have Q20 immunity. See report and RIFHKS100 and REFHKS100 for more detail.	Compliant	28.01.10
Re-design within the vicinity of the GA Garden allwoing retention of the majority of individual plants.				Y	Y	The regional flood model has no impact on the GA Garden as it is out of the flood plain in Zone 4. Please refer to DIRODR400.	Compliant	28.01.10
Establish a 'no-go' zone around the retained section of the GA Garden as shown in Figure 3.				Y	Y	The regional flood model has no impact on the GA Garden as it is out of the flood plain in Zone 4. Please refer to DIRODR400.	Compliant	28.01.10
Mark a 'no-go' area as identified above in Figure 3 [GA Garden].				Y	Y	The regional flood model has no impact on the GA Garden as it is out of the flood plain in Zone 4. Please refer to DIRODR400.	Compliant	28.01.10
All clearing of native vegetation within the approved clearling limit.	Y	Y	Y	Y	Y	To be addressed by construction team in accordance with the Construction Environmental Management Plan (D2G-MPPL-V-017).	Compliant	28.01.10

	Zone 1	Zone 2	Zone 3	Zone 4	Drainage	Design Response	Status (Compliant/ Partially compliant/ Non-compliant/ Not applicable)	Date Closed
Construction of a permanent five (5) cell box culvert crossing over Goodna Creek that is part of the extension of Smiths Road. To be constructed in accordance with the attached Origin Alliance drawing D2G-BASD-RIRODR203-D-2470 Ipswich Motorway Upgrade - Dinmore to Goodna ch13200 to ch20770, Transverse Drainage Zone 2 Fish Culvert Typical Section dated 11/06/2009.		Y			Y	Not applicable to this design lot. Please refer to RERODR206.	Not applicable	28.01.10
The realignment of Goodna Creek as per proposal detail 4 is to be constructed such that the realignment provides for upstream and downstream fish passage and fish habitat including riparian vegetation.		Y			Y	Not applicable to this design lot. Please refer to RERODR204.	Not applicable	28.01.10
The site [Goodna Creek] (including all disturbed areas such as slopes, borrow pits, stockpile and screening areas) must be rehabilitated in a manner such that: (c) the quality of stormwater, other water and seepage released from the site will not cause environmental harm;		Y			Y	Not applicable to this design lot. Please refer to RERODR204.	Not applicable	28.01.10
The site [Goodna Creek] (including all disturbed areas such as slopes, borrow pits, stockpile and screening areas) must be rehabilitated in a manner such that: (e) the final landform is stabel and not subject to slumping; and		Y			Y	Not applicable to this design lot. Please refer to RERODR204.	Not applicable	28.01.10
All clearing of native vegetation within the approved clearing limit.	Y	Y	Y	Y	Y	To be addressed by construction team in accordance with the Construction Environmental Management Plan (D2G-MPPL-V-017).	Compliant	28.01.10

Appendix F – Independent Verification Comments and Closeout

Ipswich Motorway Upgrade
Dinmore to Goodna Alliance Verification

Package: DGFHKS100
Title: Global - Flood Hydrology - Key Stone Report
Stage: Global
Issue: 15% Design

Alliance Verifier: [redacted]
Date Distributed: 9/03/2009
Date Compiled: 11/03/2009

Ref No	Item	Reviewer	Reference	Reviewer Comment	Designer Comment	Status - Originator Comments Internal Use Only
1	Report	Hyder AV	D2G-BASD-DGFHS100-R-1000 Cl3.2	Proposed non-conformances are noted. These will require Main Roads acceptance. General comment. Relevant approvals by Ipswich City Council and Department of Main Roads need to be included with the final report.	Noted. Relevant RFI's / approval will be generated where needed.	Closed 01/02/2010
2	Report	Hyder AV	Cl 4.1 & Append L	The Design Criteria Report has not been received. This review does not include the Design Criteria Report.	Noted.	Closed 8/09/2009 Hydrology comments are closed in this report
3	Report	Hyder AV	Cl 4.2.1	Section 4.2.1, indicates that the Brisbane River floods back into the creeks. Please advise if flows back into the creeks will be considered during scour and other structural forces impacts.	The Brisbane River flood flows are not considered for scour calculations as the higher velocities occur ni the local flood events (i.e. Goodna Creek and Six Mile Creek). The Regional Q2000 is used for structural analyes.	Closed 8/09/2009
4	Report	Hyder AV	Cl 4.2.1	Section 4.2.1, indicates that the regional flood model will be undertaken for various flood events. Please include these details in the following report.	Report updated.	Closed 01/02/2010
5	Report	Hyder AV	General	General, please indicate the Courant value for the modelling in the report.	Report updated.	Closed 8/09/2009
6	Report	Hyder AV	General	General, the figures included in the report is very difficult to read due to the small size of legends and image detail. Please make these images clearer in the following reports.	Report updated.	Closed 8/09/2009
7	Report	Hyder AV	Figure 4-2	Figure 4-2, please include a 0mm impact area as well as change the colour scheme as to show impacted areas in a colour such as red. Furthermore, please label the different creeks and add water levels in areas of interest.	This figure is a direct copy of the DHI report and refers to DHI 2008 model results. Please refer to the DHI 2008 report for additional information required.	Closed 8/09/2009
8	Report	Hyder AV	Figure 4-6	Figure 4-2, indicates an area of impact in pale blue colour. Please clarify the impacted area.	This figure is a direct copy of the DHI report and refers to DHI 2008 model results. Please refer to the DHI 2008 report for additional information required. The pal blue colour indicates an area of decreased peak flood levels.	Closed 8/09/2009
9	Report	Hyder AV	Figure 4-3	Figure 4-6, please make use of different colours or line types as it is difficult to distinguish between the different lines.	Figure updated.	Closed 8/09/2009
10	Report	Hyder AV	Table 4-2 and Figure 4-10	Table 4-2 and Figure 4-10, indicates the main roughness factors. Please clarify if sub-roughness values were used. If not, please clarify the lack of vegetation roughness as well as a roughness of 0.04 for Ponds/lakes. Furthermore, please clarify the use of 0.024 for a road roughness.	Sub-roughness values were not used. The roughness values were determined by Maunsell / DHI for the Regional Flood model through extensive sensitivity analyses. Reference is made to the Maunsell / DHI report of 2008 and 2007.	Closed 8/09/2009
11	Report	Hyder AV	Figure 4-18 and 4-19	Figure 4-18 and 4-19, please update the labels as to correspond with the reference in Section 4.2.7 on page 30.	Report updated.	Closed 8/09/2009
12	Report	Hyder AV	Table 4-6	Table 4-6, please include a column with the bridge deck levels.	Report updated.	Closed 8/09/2009

Ipswich Motorway Upgrade
Dinmore to Goodna Alliance Verification

Package: DGFHKS100
Title: Global - Flood Hydrology - Key Stone Report
Stage: Global
Issue: 15% Design

Alliance Verifier: Hyder
Date Distributed: 9/03/2009
Date Compiled: 11/03/2009

Ref No	Item	Reviewer	Reference	Reviewer Comment	Designer Comment	Status - Originator Comments Internal Use Only
1	Report	Hyder AV	D2G-BASD-DGFHS100-R-1000 Cl3.2	Proposed non-conformances are noted. These will require Main Roads acceptance. General comment. Relevant approvals by Ipswich City Council and Department of Main Roads need to be included with the final report.	Noted. Relevant RFI's / approval will be generated where needed.	**Closed 01/02/2010**
2	Report	Hyder AV	Cl 4.1 & Append L	The Design Criteria Report has not been received. This review does not include the Design Criteria Report.	Noted.	**Closed 8/09/2009 Hydrology comments are closed in this report**
13	Report	Hyder AV	General	General, please supply graphs with water surface levels obtained from the different models in the report. Specifically indicating the head loss from the different structures along the model. The graphs should also indicate the position of tributaries, trunk drains and other infrastructure.	Report updated	**Closed - 4/2/10**
14	Report	Hyder AV	General	General, please include a velocity impact image indicating the changes in velocities as a result of the planed works.	Report updated.	**Closed 8/09/2009**

Ipswich Motorway Upgrade
Dinmore to Goodna Alliance Verification

Package: DGFHKS100
Title: Flood Design Report – Regional Flood Model
Stage: Global
Issue: 85% Design

Alliance Verifier: Hyder
Date Distributed: 26/08/2009
Date Compiled: 8/09/2009

Ref No	Reviewer	Reference	Reviewer Comment	Designer Comment	Status - Originator Comments Internal Use Only
18	Hyder AV	Cl 4.2.1 (from 15%)	Section 4.2.1, Please clarify this section, as the 1:2000 ARI were considered in the report, as well as provide correct reference to the RFI number on page 11 (and page 8).	RFI #383 has been included in the report.	**Closed 11/2/10**
19	Hyder AV	General (from 15%)	Please supply a figure for the 1:100 ARI event indicating water levels obtained from the different models in the report. Specifically indicating the head loss from the different structures along the model. The graphs should also indicate the position of tributaries, trunk drains and other infrastructure.	There is only one model in this report and this model was undertaken for three ARI design events (20, 100 and 2000). The resultant water surface levels are presented in separate figures for each event. Table 4-3 presents the before and after scenarios. In conjunction with Figure 4-34, and headloss can be derived from the data in this table	**Closed 11/2/10**
20	Hyder AV	Section 4.2.2	Please clarify the last paragraph on page 15, as the water levels in Fig 4-3 suggest that the water levels are higher and are from local drainage rather than from the Brisbane River.	Can we get clarification on this comment please. The smaller creeks (i.e. Goodna and Six Mile) act as flood storage when the Brisbane River is in flood. The regional event has a critical duration of 4 days or so and the smaller creeks are closer to 1 hour. Therefore any contribution of flows from the local catchments will peak before the brisbane river will peak. However the higher flood levels will be determined by the Brisben River rather than the local catchments. In all cases the maximum water surface levels are reported.	**Closed 11/2/10**
21	Hyder AV	Figure 4-10	The adopted DHI roughness map seems to be very simplistic for a region flood analysis. Please confirm that there are no updates to this roughness map since 2007 that could be used as a base case map.	There are no updates to the roughness map that was developed by DHI in 2007. DTMR were happy to use this model as the preliminary model. DHI undertook extensive calibration and sensitivity testing of the roughness map as part of the goodna bypass studies	**Closed 11/2/10**
22	Hyder AV	Page 31	Please note that the heading refers to the 'design event' and that the figures refer to the 'base case'.	The report text now matches the figure labels so that they both read "base scenario". See pp 27, 31, 35.	**Closed 11/2/10**
23	Hyder AV	Figure 4-18	Figure 4-18 and the section below indicates that BCC made use of 5500 vs. the Mike Flood model's 7000 for a 1:100 ARI flow. Please plot the water levels for the Mike Flood model with a 5500 m3/s flow as to indicate the comparative levels	D2G does not have access to the BCC 5500 m3/s model files. Therefore undertaking this comparison is not an option. Figure 4-21 is the best available comparison between BCC model results and D2G / DHI modelling.	**Closed 11/2/10**
24	Hyder AV	Section 4.2.8	The non compliance with the design criteria of 100mm freeboard is noted. Please adjust the road levels or supply a RFI addressing the aspect.	Section 4.2.8 includes table showing that all freeboard requirements are met. This is due to minor changes in the vertical geometry and the revision of the regional flood models.	**Closed 11/2/10**
25	Hyder AV	Section 4.4	Comment - It is expected that RFIs would be all raised and closed prior to the 85% Detailed Design Report	All RFIs have been raised and closed out.	**Closed 11/2/10**
26	Hyder AV	Section 4.4	Please explain proposed RFIs relating to structures. These are not mentioned in the structures integrated design reports egBR340 & BR350	The issue relates to the satement in the design brief "structurally safe in the 2000 year ARI design event". A notional 2000 year ARI event was undertaken as 1.8 times the 100 year ARI peak flows, not the actual 2000 year ARI design event. RFI #383 addresses this. The 2000 year ARI design water surface levels were supplied to the structural engineers who use this information to determine if the structure is safe in the 2000 year ARI design event.	**Closed 11/2/10**

Opportunities for Improvement

Ipswich Motorway Upgrade
Dinmore to Goodna Alliance Verification

Package: DGFHKS100
Title: Flood Design Report – Regional Flood Model
Stage: Global
Issue: 85% Design

Alliance Verifier: Hyder
Date Distributed: 26/08/2009
Date Compiled: 8/09/2009

Ref No	Reviewer	Reference	Reviewer Comment	Designer Comment	Status - Originator Comments Internal Use Only
18	Hyder AV	Cl 4.2.1 (from 15%)	Section 4.2.1, Please clarify this section, as the 1:2000 ARI were considered in the report, as well as provide correct reference to the RFI number on page 11 (and page 8).	RFI #383 has been included in the report.	**Closed 11/2/10**
19	Hyder AV	General (from 15%)	Please supply a figure for the 1:100 ARI event indicating water levels obtained from the different models in the report. Specifically indicating the head loss from the different structures along the model. The graphs should also indicate the position of tributaries, trunk drains and other infrastructure.	There is only one model in this report and this model was undertaken for three ARI design events (20, 100 and 2000). The resultant water surface levels are presented in separate figures for each event. Table 4-3 presents the before and after scenarios. In conjunction with Figure 4-34, and headloss can be derived from the data in this table	**Closed 11/2/10**
1	Reviewers Initials	General comment			
2	Reviewers Initials	General comment			

Ipswich Motorway Upgrade
Dinmore to Goodna Alliance Verification

Package: DGFHKS100
Title: Flood Design Report - Regional Flood Model Global
Stage: Global
Issue: 100% Draft IFC

Alliance Verifier: Hyder
Date Distributed: 28/01/2010
Date Compiled: 11/02/2010
Updated: 12/02/2010
IV Designer Name & Contact Details: Not Relevant
OA Designer Name & Contact Details:

Ref No	Reviewer	Reference	Reviewer Comment	Category (Minor / Moderate / Major)	Designer Comment	Status - Originator Comments Internal Use Only
27	Hyder AV	Page i	This 100% draft report has not been verified or approved. Please confirm that there has been an internal review of the report.	Major	Draft IFC report will go through internal verification before it is issued to IFC.	Closed 11/2/10
28	Hyder AV	85% Comments	It is noted that the 85% comments have not been responded to. Please respond to all comments.	Major	Comments addressed. See 85% comments.	Closed 11/2/10
29	Hyder AV	Appendix G	DTMR comments remain open at 85%. Please clarify on the status of comments from DTMR.	Moderate	Issues will be closed out. Since they are minor issues they have no major bearing on the engineering outcomes of this package.	Closed. DMR comments need to be closed prior issuing IFC
30	Hyder AV	Appendix H	QR comments remain open. Please clarify on the status of comments from QR. Further, please clarify that QR have responded to the 100% package.	Moderate	No comments were received from QR for the 85% design.	Closed 11/2/10
31	Hyder AV	Appendix H	It is noted that comments from QR have been received. Has ICC supplied any feedback?	Moderate	No comments were received from ICC for the 85% design.	Closed 11/2/10
32	Hyder AV	Cl. 4.2.2	It is noted that Goodna Creek & Six Mile Creek are break out packages to improve the accuracy of the flood impact assessments. Please confirm that the results from the break out packages have been included in the regional flood model.	Moderate	The detailed results of the local flood analyses of Goodna and Six Mile creeks are contained in REFHKS100 and RIFHKS100. Since they are considered mutually exclusive of the regional results, their results have not been included in regional flood model.	Closed 11/2/10
33	Hyder AV	Cl. 4.2.4	It is noted that the Hydrology is based on the DHI 2008 flood model with the model being augmented with updated survey & new bridge structures. Please provide additional details on the Hydrology model (ie inputs - areas, losses & impervious areas, catchment plans.) Further has a rational formula check been made to confirm the flow rates from the previous model?	Major	DHI 2008 references a report undertaken by Sargent Consulting. This report contains the development of hydrology for these studies. A rational methiod check on the Brisbane River catchment was not undertaken as the catchment area exceeds the acceptable limits of application for applying the Rational Method.	Closed 11/2/10
34	Hyder AV	Cl. 4.2.7	At Smiths Rd, there is 108mm afflux in the 20 yr ARI. The culverts have been modelled as 6x3.3 m & 2x1.8m with design optimisation in the "Zone 2 Other Culverts" package. Please confirm that the final design culverts have been modelled in this package. Further, please confirm that the afflux is accepted by DTMR & ICC.	Minor	At this stage of this package, Smiths Rd culvert has not been optimised, however as stated on pg 18, the impact of the structure at Smiths Rd is expected to be insignificant during a regional flood event.	Closed 11/2/10
35	Hyder AV	Appendix C & Table 4-6	The flood levels in table 4.6 do not match with those in Appendix C. Please confirm that the reference drawings have been updated with the correct flood levels (ie drawing d-0012 shows a Q20 flood level of 8.7 and table 4.6 shows a flood level of 8.486.)	Moderate	The flood levels shown in Appendix C relate to results from a previous stage of design. The information extracted from these drawings for the flood modelling is the bridge structure cross section.	Closed 11/2/10
36	Hyder AV	Cl.4.2.6	Please provide in the plan the locations of bridges, L1, L2 etc for better understanding of the flood report	Moderate'	Locations have been detailed on Figure 4-35 in the report.	Closed 11/2/10

Ipswich Motorway Upgrade
Dinmore to Goodna Alliance Verification

Package: DGFHKS100
Title: Flood Design Report - Regional Flood Model Global
Stage: Global
Issue: 100% Draft IFC

Alliance Verifier: Hyder
Date Distributed: 28/01/2010
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Ref No	Reviewer	Reference	Reviewer Comment	Category (Minor / Moderate / Major)	Designer Comment	Status - Originator Comments Internal Use Only
37	Hyder AV	General	Impact of fillings in the catchment considered in MIKE model? Please update the report illustrating possible outcome with cut and temporary/permanent fills. Also include if there is any calculations for temporary/ permanent	Moderate	See page 18 of report. Calculation details will be attached separately. There is no allowance made for temporary filling of the floodplain (e.g. D2G operations). A cut and fill calculation would be made as part of the earthworks design package. Please refer to this package. The impact of the earthworks on flood levels during construction staging was analysed with the local flood model at Goodna Creek to determine if the earthworks had affected downstream flood levels and hence damaged property on Not Relevant land. It was expected that the earthworks' impact would be greatest when the local creek was in flood. However all impact was contained locally around areas with loss of storage and there was no impact on flood levels downstream or upstream of construction. By extension, it is expected that the impact of earthworks on flood levels whilst the Brisbane River is in flood will be less than during Goodna Creek in flood and therefore will be negligible. Refer to [redacted] memo (18/12/09).	Closed 12/02/10
37a	Hyder AV		Please submit the cut/fill calculation as discussed in the workshop on 2/2/10			
38	Hyder AV	Table 4-3	Please provide names of bridges for L1, L2 etc for better understanding of the flood report	Moderate	Extra information has been added to the report.	Closed 11/2/10
39	Hyder AV	General	Please confirm that the IMU road levels have been derived using Regional Model flood levels	Minor	Originally this was done, but at this stage of design, the levels of the new motorway alignment was determined to have 100 year ARI immunity.	Closed 11/2/10
40	Hyder AV	Section 5.2.1	Report section outdated. Please correct the report	Minor		as per discussion report section is updated. Closed 12/02/10

Opportunities for Improvement

1	Reviewers Initials	General comment				
2	Reviewers Initials	General comment				

Appendix G – DTMR Comments and Closeout

OriginAlliance
Connecting Dinmore to Goodna

DESIGN COMMENT AND RESPONSE (DCR) D2G-MP13-F-4033

This form is used for Checks and Reviews. It is NOT used for Internal Verification

DRR No.	MR0184	Section:	Dinmore to Goodna	Design Lot No.	D2G-BASD-DGFHKS100-R-1000	Review Level:	Overall Compliance with PAA and SWTC
Description:	85% Flood Design Report-Regional Flood Model [redacted]						

Issue Reference No.	Notes by Reviewer			Notes by Designer in response	Close out
	Document No. (list specific drawing or page number)	Issues or observations (list adequate details to enable review)	Category (Major/minor observation)	Designer's response (ensure adequate details to enable acceptance)	Reviewer Acceptance (initial)
1.	D2G-BASD-DGFHKS100-R-1000	Section 3.2.1 MR will agree to RFI raised by Origin Alliance		This issue has been raised in RFI #383 and closed out.	[redacted]
2.	General	Afflux effects for other design scenarios: Please update report (MR has agreeed to RFI # in section 3.2.1)		As above.	
3.	General	Scour potential: No comments		Noted.	
4.					
5.					
6.					
7.					
8.					

Categories:
Major Issues: Develop Design Further – correction mandatory before completion of Stage (Close-out required)
Minor Issues: Correct and Close-out – correction mandatory before completion of Stage
Observations: are noted and work should be revised

[redacted] 01/02/10

Appendix H – Third Party Reviews and Closeouts

OriginAlliance
Connecting Dinmore to Goodna

QR Design Review Comments

Design Package	Flood Design Report - Regional Flood Model
Design Phase	15 % Concept
Zone	All
OA Design Lot No	D2G-BASD-DGFHKSI 00-R-I 000

Item	Component / Section	Design Comments	Designer's Response
3.2.2	DGFHKS100-2	Safety to QR railway corridor especially the Formation should be checked for ARI 100 events.	The Q100 afflux shows no increase in peak flows within the Brisbane River floodplain. Therefore saftey to the QR corridor is not impacted in terms of peak water levels.
		Interface near to rail corridor like Zone 1 & Zone 4 will require QR's review and must meet QR requirements.	This is not a hydraulic modelling issue.
3.3	ARI 100 yrs Safety in Design	All QR assets / embankments are not easily accessible and any nearby structures be designed for safe life.	
		QR Formations and Bridges / Culverts are designed for 100 years of Life.	No comment
	Emergency Access	QR Corridors to have an all weather access road for emergency events, repairs and maintenance.	The Q100 afflux shows no increase in peak flows within the Brisbane River floodplain. Therefore saftey to the QR corridor is not impacted in terms of peak water levels.
Fig 4.2	Afflux	Level of surface water to QR rail levels be explained / shown.	This figure is from DHI 2008 hydraulic modelling. It shows no increase in peak water levels in the Brisbane River floodplain.
Fig 4.2	Afflux 20 Years ARI	ARI 50 & 100 years be investigated for possible Impacts to QR rail formation.	This figure is from DHI 2008 and refers to the 100 year ARI scenario. Figure 4-4 refers to DHI's 20 year ARI scenario. Figures 4-11 onwards present the current hydraulic modelling results.
4.2.3	Design Methodology	May be satisfactory for Roads. However, looks incomplete in terms of nearby Rail Assets.	The hydraulic assessment is for a road design.
4.2.7	Design case model	Not only Motoruay upgrade design bust also, QR's existing and 3rd Track be checked for safety.	The design scenario includes the motorway design. Future design of QR tracks have not been included.

OriginAlliance
Connecting Dinmore to Goodna

QR Design Review Comments

Design Package	Flood Design Report - Regional Flood Model
Design Phase	15 % Concept
Zone	All
OA Design Lot No	D2G-BASD-DGFHKSI 00-R-I 000

Item	Component / Section		Design Comments	Designer's Response
7	Durability consideration	Flood immunity	All QR Assets / Infrastructures be immune to 100 years Floods due to difficulty to access / repair.	The hydarulic modelling shows no impact in the Brisbaen River floodplain. Durability considerations form a separate design package.

QR Project Manager		IMU Design Manager	
	[redacted]		
Date		Date	

Appendix I – Community Requirements Checklist

Community issues and concerns

Zone	Area/Street/Issue	Stakeholder	Impact/ weighting	Issues	Mitigation measures
2	Traffic Impacts on safety and amenity of Smiths Rd	Goodna residents who currently use Stuart Street on and off ramps	H	1. Concerned that Smiths Road extension will not be opened before Stuart Street on and off ramps are permanently closed - this will severely limit their travel movements if an alternative is not in place. 2. Residents are concerned about the speed of motorists travelling along Smiths Road and are constantly asking if there will be traffic lights connecting between the old section and into the new extension of the road.	Intention is that Williams St ramp intersection is open before Stuart St connection is closed. ICC suggested at meeting held 10 June 09 that Stuart/Smith intersection signalisation may not now be funded by them, and that they are considering signalisation of Smith/William and /or Smith/Albert in lieu. Issue will need to be clarified following receipt of pending letter from ICC re their funding contribution. Ongoing community engagement.
2	Traffic Impacts on safety and amenity of Smiths Rd	Local resident	L	Wants Alice Street extension rather than Smiths Road	CLOSED
2	Traffic Impacts on safety and amenity of Smiths Rd	Local resident	L	Increased traffic, accidents & vehicle speed on Smiths Road.	To be followed up with ICC project liaison representative (see status comment for Global - Permanent Alignment)
2	Traffic Congestion at Mine St	Local resident	L	Mine St & Francis St - traffic concerns	CLOSED
2	Access to Sport Complex	ICC officers	L	Access arrangements of Mine Street	Meeting held with ICC 10 June 09 included discussion on access to Sports complex from Smiths Road. Item now CLOSED.
2	Item closed	Redbank Plaza	L	Very supportive of Smiths Road. The road will generate more traffic to the shopping centre.	CLOSED
3&4	Traffic Impacts on safety and amenity of Southern Service Road	Local resident	M	Noise barriers along the Service Road in Riverview be increased to match increased elevation of bridges.	Confirm strategy for advising the community of the final placement of noise barriers.
	Traffic Impacts on safety and amenity of Brisbane Road	Local resident	M	Traffic on Webb St & poor condition of Webb St, Riverview	To be raised with ICC following discussion with [Not Relevant]
3	Proximity of Construction Works	Local resident (x2)	L	Traffic volumes on Brisbane Road	Concerns will be addressed by ongoing community engagement. No need for specific response.
3&4	Safety and Amenity of Access to Local Road Network	Local resident	L	Limited Riverview access	No further action required
2	Alignment of Monash Road	ICC	L	Alignment of Monash Road and associated property impacts	Meeting held with ICC 10 June 09 included discussion on Monash Road design development. Access to [redacted] via DMR land to the west is favoured by ICC.
2	Alignment of Monash Road	[redacted]	M	Alignment of Monash Road and associated property impacts	[redacted] maintaining contact with landowner. Proposal put to ICC and awaiting feedback.
2	Alignment of Monash Road	[redacted]	M	Alignment of Monash Road and associated property impacts	Resumption progressing. No design issues anticipated. Item to be CLOSED.
2	Alignment of Monash Road	QR	M	Alignment of Monash Road and associated property impacts	Design being developed to confirm extent of splay required at SE corner of QR land.
2	Alignment of Monash Road	Units	M	Alignment of Monash Road and associated property impacts	Design options being considered for the affected tennis court which will either be re-oriented N-S or a retaining wall constructed.
1	Safety and Amenity of Access to Goodna Station Across Motorway	QR	H	Ownership of pedestrian access - lift v ramp	NP to follow up. See above also.
1	Staging of Pedestrian Access to Goodna Station	Pedestrians / local elected reps	H	Concerned about the demolition of BR140 before the completion of the new pedestrian bridge - potentially utilising bus service during construction could be drawn out because of length of time between operational bridges	Construction team current position is to closely match the programs for demolition of old and opening of new. Any gap will be addressed by temporary use of buses.
1	Safe access to the motorway	Local Goodna residents	L	Local Goodna residents do not believe closing Stuart Street (which is considered a safe and long ramp) to be a good idea. However most are appeased with the Smiths Road extention alternative	Concern is addressed by program decision to open Williams st connection before Stuart St is closed. The situation would be further improved by opening of Smiths Rd but timing/funding is uncertain.
3	Proposed pedestrian arrangement for Riverview	Riverview residents	M	Would like pedestrian overpass at Tessman Street. Small number of residents are concerned about limited ped access at Riverview. [redacted] have expressed concerns.	Briefing paper (based on the text prepared to date) describing the options considered and conclusions on the preferred way forward has been issued to comms team. Calculation of travel distances from community to rail station have also been provided (9 Jun)
1	Traffic Congestion at Williams Street	Goodna local residents [redacted]	L	Are concerned that by opening William Street access to the motorway, the on ramp will not be able to cope with increased traffic and are concerned it will cause congestion in front of the Caltex service station and McDonalds. Residents believe there will be an increased traffic volume at the Church Street / Queen Street roundabout intersection that is already very congested after the closure of Stuart Street, as more local residents will be forced to use this access point to get onto the motorway	Awaiting outcome of traffic modelling to be able to respond to residents. Extensive traffic modelling to date suggests William St will handle extra traffic.
2	Item closed	Shell Service Station, Big Dad's pies and [redacted]	L	1. Shell Service Station and Big Dad's pies have been briefed early in the project that they will not have access off the motorway. They are aware of this, but not the expected timeframe, therefore they will be increasingly aware their business will be closing down soon. 2. [redacted] is not aware that access is being removed - [redacted] to brief this stakeholder this week (*new issue)	No specific action required.

Community issues and concerns

Zone	Area/Street/Issue	Stakeholder	Impact/ weighting	Issues	Mitigation measures
2	Traffic congestion due to ramp closures	Local resident	L	Riverview resident believes there will be an increased traffic volume at the Mine Street intersection and it will become similar to Church Street / Queen Street roundabout intersection at Goodna that is already very congested, as more local residents will be forced to use this access point to get onto the motorway	No further action required
All	Incident management	Local resident	L	Not enough on & off ramps when there is an accident on motorway	On a related issue need to reconfirm/update motorway access arrangements with emergency services
2	Incident management	Local resident	L	Would like an additional east bound exit to Redbank (near Tessman St).	No further action required
	Nil				
3	Vehicle access to Riverview	Mayor Paul Pisasale	L	Very supportive of project. Wants a design Entry Statement into Ipswich	Justification for an additional entry treatment in the vicinity of Bridge 450 to be clarified on the basis that City of Ipswich entry statement is incorporated into ILM project (which is at the municipal boundary). Possible further consultation with ICC officers required.
2	Vehicle Access from Smiths Road	Not Relevant	L	Smiths Road - concerns about residents needing to do a left turn into the Christian College.	Meeting held with ICC 10 June 09 included discussion on left turn access. Design team confirming that access is suitable for buses.
1	Safety and Amenity of Access to Goodna Station Across Motorway		H	Lifts at Goodna ped bridge. Neither of them supports this option	Translink pedestrian count survey completed and Stuart Lutton of DMR analysis underway. By observation the ex bridge is highly utilised. Structural form has been reviewed and separate lift and stairs structures are being pursued, with a less 'blocky' structure as a result. Concept review and signoff by [redacted] required. [redacted] arranging stakeholder discussions (incl politicians and police). Display material incl 3D photo montage to be finalised with potential display at St Ives shopping centre (and railway station?).
3	Vehicle access to Riverview		L	1. Traffic impacts where Southern Service Road goes into Law Street. 2. Traffic impacts where Southern Service Road hits Collingwood Drive. 3. Issues with residents access to Southern Service Road.	Ongoing community engagement
3	Traffic Congestion at Mine St		M	1. Limited Riverview access 2. Concerned that Northern Service Road does not extend to River Road. Council would like this for commercial access. Have suggested a 1-way ramp off Brisbane Road	Ongoing community engagement. Designers to advise Comms team of outcome of design considerations. Follow up with briefings for local member(s) and councillors.
4	Numerous		L	1. Pedestrian overpass at St Peter Claver College 2. Would like old motorway to remain four lanes from site office area east. 3. Wants ramp to remain into Brisbane Road (north side) going east.	Ongoing community engagement
3	Noise barrier extents	Redbank School	L	Need to consider where the Law Street ped bridge will land and how students enter the school	Further consultation to be undertaken with the school to clarify what the concern is and further design development to address the concern to be undertaken.
All	Location of noise walls with respect to property boundaries.	Community DMR ICC	M	Where noise walls are to be constructed on the boundary of an existing property there is an issue regarding location of the wall. Whilst the posts and panels may be located close to the boundary the footings are larger and also need to be considered. A noise fence on the actual boundary alignment would mean that part of the footings encroach into private property, whereas if the footings are placed outside the boundary then the wall impinges on the road reserve (very narrow in places) and also creates a remnant portion of crown land excised by the wall. Maintenance access to the rear of the wall (for inspection or repairs) must also be considered.	Current direction given to the design team is for the noise walls to be located on the property boundary with footings projecting into private property. The edge of the steel column will be on the boundary with the wall panel fixed to the inside edge of the column flange nearest the roadway. There will be a gap of approximately 250mm between the property boundary and the rear of the noise wall panel. Footings would be 600 dia meaning a small encroachment into private property. Further, it was considered that volumetric resumption would not be required. Confirm design direction given with respect to noise wall placement. Discuss traffic staging aspects with [redacted] Advise DMR by RFI of adopted approach.
2	Concerned about visibility during construction		L	Business owner is concerned about visibility of his business being obstructed during construction. Also concerned that new noise walls will be constructed as part of the project that are not currently there. [redacted]	See E - Permanent Noise Walls 1
2	Provision of Noise Walls		L	Business owner is concerned about visibility of his business being obstructed during construction. Also concerned that new noise walls will be constructed as part of the project that are not currently there. [redacted]	Comms team currently preparing for initial consultation with property owners potentially impacted by noise walls proposed on existing boundaries.

Community issues and concerns

Zone	Area/Street/Issue	Stakeholder	Impact/ weighting	Issues	Mitigation measures
1	Noise wall provision during construction	Businesses and Goodna State School	L	1. Demolition and construction of replacement noise wall (parallel to Barram Street and up to Goodna State School 2. Noise issues during construction during school hours, but main issue will be the timing of the removal of the old noise wall and the period prior to construction of replacement	Being followed up by Construction team in conjunction with Comms team. No concerns - business as usual.
2	Item closed	Residents and properties that back along Enfield Street that back onto Francis Street on ramp		1. Relocation of noise wall along Francis Street - may be an issue during the removal of old noise wall and construction of its replacement. 2. Relocation of "mural" noise wall is of personal interest to Not Relevant - there is the expectation this will be temporarily removed and replaced in same condition	Comms team currently preparing for initial consultation with property owners potentially impacted by noise walls proposed on existing boundaries.
1	Parking provisions & street arangements Permanent noise walls	Hinton Street residents	L	1. Have been promised by former DMR Minister that there will be no impact to their properties as a result of the project. 2. Are aware that local road will be upgraded with access not being affected. 3. There may also be issues during the removal of the old noise wall and construction of its replacement. 4. Is any parking being removed? 5. They need to be consulted re the proposed noise walls	Following up drainage design to quantify impacts on private property (afflux). Will require signoff to any non-conformance with the brief (ICC via DMR). Alternatively, the two affected properties could be resumed. To be followed up. Parking and access to properties has been assessed. It has been proven that vehicles can access driveways from Hinton St. Whilst there is no designated on-street parking it is possible for residents to access their properties even if vehicles are parked in the street provided that at least one lane remains clear. Comms team currently preparing for initial consultation with property owners potentially impacted by noise walls proposed on existing boundaries.
1	Noise wall provision during construction	Hinton Street residents	L	1. Have been promised by former Main Roads Minister that there will be no impact to their properties as a result of the project. 2. Are aware that local road will be upgraded with access not being affected. 3. There may also be issues during the removal of the old noise wall and construction of its replacement. 4. Is any parking being removed? 5. They need to be consulted re the proposed noise walls	Comms team currently preparing for initial consultation with property owners potentially impacted by noise walls proposed on existing boundaries.
1	Impact of Mway construction on construction of stadium	Goodna State School	L	Goodna State School will be receiving a [redacted] from Dept of Education to contruct an indoor stadium. They are concerned about the construction of this facility at the same time as the motorway upgrade and the uncertainty of the impact to the school from the project over the coming years.	Construction team request that Comms team ask the school to nominate their construction access location so that it can be built into TCPs. Comms team to follow up.
All	ICC liaison	ICC	M	1. Establishing ongoing point of contact 2. Selection of design standards (can/should local government standards be adopted in lieu of DMR?) 3. Identification of assets to be transferred to ICC on completion ("Limit of Responsibility" map, usually produced by DMR).Need to identify reliable and appropriately authorised ICC point of contact for ongoing liaison.	Identified issues being followed up. ICC is sharing funding for Smiths Rd extension and will also be adopting significant assets delivered by the project overall. [redacted] to be contacted in relation to management of ICC liaison. [redacted] to be approached re identification of assets for handover.
1	Vehicle access during construction	Caltex / Hungry Jack's / Mc Donalds / Car Wash	L	1. Concerned about access to these businesses during completion of Brisbane Rd on ramp at Goodna. 2. There may be a need to place a pit / storage facility on Caltex land which could be costly, either through a lease or partial resumption 3. Potential connection of motorway transverse drainage into existing water quality pond within private property	Options for motorway transverse drain being considered with intention of avoiding works within private property (associated with connecting to existing water quality/detention pond). Designers considering upgrading motorway footprint section only, or justification for leaving existing culverts untouched (cf 100yr design life requirement). Case to be developed for submission to DMR (Derek Millar).
4	Impacts of Vibration during construction	[redacted]	L	Issues: 1. Business access for trailer (transports boats on) 2. Business access during construction and after property resumption and new project alignment 3. Asked how [redacted] will be able to travel East bound and West Bound with changes to motorway access 4. Advised the trailer was very long and needed a large radius for turning circle 5. Also advised the trailer was very high when stacked with boats, and could be up to 5 metres high. 6. [redacted] said that with Tessman Street access being removed from the IM, asked how [redacted] was to access the motorway, as the trailer cannot fit underneith the railway bridge on Endeavour Road to exit out the back way via Riverview Road.	Investigation to show how access can be maintained to the existing standard.
4	Entry statement	Aciril	M	Concerned about impacts of construction on their lab testing work. Need at least 8 weeks notice of works. Additional concerns regarding access and car parking.	Main concerns addressed. [redacted] to follow up compensation aspect.
1	Item closed	ICC	L	ICC would like this ped bridge at Goodna to be designed to be an icon for Ipswich - "Welcome to Ipswich"	CLOSED
4	Reduced access	Local resident	L	Access from Riverview to Warrego Highway	Ongoing community engagement. Designers to advise Comms team of outcome of design considerations. Follow up with briefings for local member(s) and councillors.
4		QR	L	Very long lead times for approvals. Currently re-designing Dinmore carpark - need to engage with community. Need to finalise Woogaroo St funding from DMR	No further action required
3	Construction impacts	Redbank School	H	Concerned about construction staging, noise, disruption.	Ongoing community engagement.

Appendix J – Value Engineering Outputs

IPSWICH MOTORWAY UPGRADE
DINMORE TO GOODNA

OriginAlliance
Connecting Dinmore to Goodna

Drainage
Action List

HH	Not Relevant	KN	
SG		BH	
BJ		JW	
BL		GG	
GR		DB	
AG		AZ	
JB			

Givens

No.	Description	Evaluation 1	Action By	Due Date	Comment
1	Standard precast components (maximised use) and standard types	Yes			
2	Q100 on the motorway, Q20 service roads (target and Q10 minimum)	Yes			
3	Q2 for temporary surface drainage (pavement)	CH *	AZ	21/11/2008	
4	Cross drainage during construction is no worse than existing	Yes			
5	40,000l spill capture at every discharge point	CH	BJ	21/11/2008	Water Quality report under discussion
6	Zero afflux at boundaries	CH	AG	28/11/2008	Discussed with ICC. Some allowence for afflux acceptable
7	Main roads drainage specifications	Yes			
8	EPA water requirements for discharge	CH	BJ	21/11/2008	Water Quality report under discussion
9	Can't increase flows for downstream systems	CH	BJ	28/11/2008	
10	Q100 for QR embankments	Yes			

Assumptions

No.	Description	Evaluation 1	Action By	Due Date	Comment
1	Predominantly gravity except where least cost outcome is pumping system	OK			
2	Staging is fully considered and cross and longitudinal drainage can be maintained during construction	OK			
3	Goodna Ck will be rehabilitated	CH	AG	28/11/2008	Goodna Creek will be re-instated
4	Can't reuse existing culverts	CH	BJ	21/11/2008	RFI returned to confirm this
5	New culverts will be in same location (assumes 4)	CH	BJ	21/11/2008	New culverts will be at or close to existing location, depending on conflicts
6	New culverts will be in same location (staging or construction reason)	CH	JB	21/11/2008	Staging to be considered
7	During construction water will be treated to normal temporary processes (ERSC)	OK			
8	All roads need runoff treatment	CH	BJ	21/11/2008	Motorway drainage requires treatment. Local roads do not
9	DMR standards apply to both local and services roads	CH	AZ	28/11/2008	
10	Flooded width to accommodate skinny eight	OK			Road drainage undertaken for ultimate lane configuration
11	Extent of flooded width into traffic lane in ultimate configuration (1.2m assumed to date)	CH	AZ	28/11/2008	Road drainage undertaken for ultimate lane configuration
12	All future works is included in hydraulic analysis	CH	BJ	21/11/2008	
13	Use existing hydrology from ICC and BCC (	OK			
14	Model the PMF for cross drainage structures (RFI submitted)	CH	AG	28/11/2008	RFI returned. PMF will be modelled
15	Bridge drainage will be Q20	CH	BJ	28/11/2008	
16	Capture shared path off the bridges	CH	BJ	28/11/2008	
17	Flows will increase with development upstream (effects some areas)	OK			
18	Permanent transverse drainage has to be installed to allow earthworks	CH	BJ	28/11/2008	15% transverse concept design report due Xmas 08
19	Modelling is based on adequate and accurate survey (continuing updates happening)	OK			

Zone 1 and 2

No.	Description	Evaluation 1	Action By	Due Date	Comment
	Can we.....(by).....				
14	**Zone 2**				
15	Use existing C4 culverts (check vertical of motorway)	P1	BJ/JB	28/11/2008	
16	Remove humeceptors at northern service road because it comes from local roads (DMR) (Check ICC objectives(	P1	BJ	28/11/2008	
17	Adopts swales where guardrails used on local roads (footpath will have kerb and channel)	P1	AG	28/11/2008	
18	Use scuppers to break the concrete barrier and capture in swales to treat water? (need to check brief)	P1	AG	28/11/2008	
19	Remove the need for pipes across the structure by adding additional need for treatment	P2	BJ	5/12/2008	
20	Use the area between west off ramps & motorway to locate with treatment to prevent pipes over bridge	P2	AG	5/12/2008	
21	Increase the flow width capability on local roads	P1	AG	28/11/2008	
22	Use Acco drains where longitudinal levels suit for construction staging	P1	AG	28/11/2008	
23	Use Acco drains where longitudinal levels suit for permanent	P1	AG	28/11/2008	
24	Reuse culvert C8 and C10	P1	BJ/JB	28/11/2008	

Appendix K – SIDR Outputs

"SAFETY IN DESIGN" RISK SCHEDULE

Applicable Design Lot: DGFHKS100 (Flooding- Regional)

Note: Parts of the SIDR highlighted in grey have been added after the original workshop date

Design Package: Drainage – All Zones

Project Name: Ipswich Motorway Upgrade – Dinmore to Goodna

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Zone 1 – 21/07/2009	Zone 2/3 – 21/05/2009	Zone 4 – 21/07/2009	Zone 4 Basin – 09/07/2009
Not Relevant – Drainage Design Lead	– Project Engineer	– Senior Project Engineer	– QR
– Urban Designer	– Project Engineer	– Rail Interface Manager	– QR
– Drainage Designer	– Project Engineer	– Designer	– Drainage Design Lead
– Drainage Designer	– Project Engineer	– Project Engineer	
– Rail Interface Manager	– Area Manager	– Site Engineer	– Rail Interface Manager
– Senior Project Engineer	– Drainage Lead	– Designer	Pat Dennehy – DMR Project Manager
– Design Interface Manager	– SID, R&O Eng	– Drainage Design Lead	– Project Engineer
	– Construction Manager	– Urban Designer	– Project Engineer
	– Drainage Designer	– Design Area Manager (West)	– SID, R&O Eng
	– Drainage Designer	– Design Interface Manager	
	– Construction Manager		
	– Design Mngr (Const.)		
	– DIM		

	Consequence				How Likely is it to Occur?				
Rating	Safety	Environment	Quality	Community	Almost Certain (A) Expected in most circumstances	Likely (L) Will probably occur in most circumstances	Possible (P) Might occur at some time	Unlikely (U) Could occur at any time	Rare (R) May occur, only in exceptional circumstances
5	Catastrophic (Death/Permanent Injury)	Environmental Disaster	Huge financial loss (> $100k)	Adverse national media or public attention	9 A	8 A	7 A	6 H	5 H
4	Major (Extensive Injuries) (Major Plant Damage)	Environmental Harm (Loss of Protection)	Major financial loss ($50k - $100k)	Attention from media or heightened concern from the community	8 A	7 A	6 H	5 H	4 M
3	Moderate (Medical Treatment) (Minor Plant Damage)	Environmental Nuisance (Spill contained with outside help)	Moderate financial loss ($5k - $50k)	Local public or media attention and complaints	7 A	6 H	5 H	4 M	3 L
2	Minor (First Aid Treatment)	Insignificant Event (Spill contained by site)	Minor financial loss (< $5k)	Public concern limited to complaints	6 H	5 H	4 M	3 L	2 L
1	Insignificant (No Injuries)	No environmental impact	No financial loss	No complaints or concerns	5 H	4 M	3 L	2 L	1 N

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No	Job Step	What are the Hazards	Risk Score	Controls Required	Target Risk Score	Responsible Group
Construction and Demolition – Risk Assessment (CHAIR 2)						
1.0	ZONE 3					
1.1	**Construction of drainage crossing of IM East of Endeavour Rd**	• Damage to existing buried 1050mm dia. drain o Struck by plant o Struck by jacking pipes	5H	• Develop Integrated Work Method Statement (includes Permit To Excavate)	3L	Construction
1.2	**Retaining Wall / Drainage interface**	• Introduction of constant water path to retaining structure o Potential for retaining wall failure due to erosion	6H	• Retaining wall solution to link to drainage requirements	4M	Design, Construction
1.3	**Construction of drainage crossing IM West of Mine St underpass (BR280/285)**	• Proximity to traffic o Struck by vehicle o Struck by object	7A	• Develop Integrated Work Method Statement • Investigate alternative option to dual 1050mm dia., e.g. single 1650mm dia. to reduce boring length and construction time (hence exposure)	3L	Design, Construction
		• Location of cast-in-place chamber on service road ramp (proximity to traffic) o Struck by vehicle o Struck by object	7A	• Develop Integrated Work Method Statement • Investigate relocating chamber out of road way (South side)	3L	Design, Construction

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No	Job Step	What are the Hazards	Risk Score	Controls Required	Target Risk Score	Responsible Group
		• Proximity of manhole to northern IM retaining wall and traffic o Struck by vehicle o Struck by object	7A	• Investigate manhole configuration to north of motorway – from 3 no. to 2 no. • Investigate options to remove the need for manhole against retaining wall • Develop Integrated Work Method Statement	3L	Design, Construction
1.4	**Construction of channel drain over buried gas pipe**	• Working in/adjacent gas pipe exclusion zone o Struck by plant o Damage to infrastructure o Explosion / ignition	7A	• Develop Integrated Work Method Statement • Install protection slab over gas main incorporated into works • Confirm that channel works consistent with protection slab	3L	Construction
1.5	**Cross drain along Endeavour Rd to cross QR**	• Proximity to traffic o Struck by vehicle o Struck by object	7A	• Investigate alternative route for crossing rail corridor: o Thrust/jack from council land on south through to Moggill Ferry Rd (Eastern side of Endeavour Rd) • Develop Integrated Work Method Statement	3L	Design, Construction
		• Cranage and lifting underneath QR bridge o Struck by vehicle o Struck by object o Electrification	7A	• Carry out under a QR SCA (Safety Clarification Advice)	4M	Construction

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No	Job Step	What are the Hazards	Risk Score	Controls Required	Target Risk Score	Responsible Group
		• Excavation under QR bridge o Potential for undermining of bridge abutments o Conflict with existing buried services under bridge	7A	• Develop Integrated Work Method Statement (includes Permit To Excavate)	4M	Construction
1.6	**Construction of Longitudinal Drainage**	• Working adjacent traffic: o Construction of pipe work and pits o Installation of water quality devices o Public entering open excavations	7A	• Develop Integrated Work Method Statements • Develop and implement Traffic Control Plans as required • Review construction of permanent exclusion fencing prior to drainage works where practical • Fence off construction works securely	3L	Construction
		• Working adjacent/within rail corridor: o Damage to rail equipment or infrastructure o Damage to plant, equipment or work force o Electrocution o Open excavations within/adjacent the rail corridor o Public access to rail corridor o Personnel safety	7A	• Develop Integrated Work Method Statements • Carry out work under a QR SCA (Safety Clarification Advice) or closure if required • Securely fence work areas to prevent public accessing rail corridor from worksite, and to protect rail workers from accessing worksite	3L	Construction

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2.0	ZONE 2					
2.1	**Construction of Monash Rd**	• Potential dam effect between Monash Rd and adjacent housing estate during significant rain event o Damage to property o Drowning	7A	• Investigate drainage capacity / high flow culverts	3L	Design
2.2	**Construction of culverts adjacent housing and motorway**	• Localised flooding at upstream side of key culverts o Damage to property o Drowning	7A	• Consider over-sizing of key culverts to provide additional flood protection to residents	3L	Design
2.3	**Construction of Smiths Rd**	• Working within power easement o Electrification	7A	• Compliance with asset owner requirements regarding encroachment and exclusion zones • Develop Integrated Work Method Statement	3L	Construction
		• Working in UXO clearance area o Explosion	6H	• Develop Integrated Work Method Statement (incorporate UXO precautions)	3L	Construction

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2.4	**Construction of drainage adjacent the rail corridor**	• Working adjacent/within rail corridor: o Damage to rail equipment or infrastructure o Damage to plant, equipment or work force o Construction of chamber at tie in to existing QR culvert and potential undermining of rail embankment, tracks and other infrastructure o Electrocution o Public access to rail corridor	7A	• Develop Integrated work Method Statements • Carry out under a QR SCA (Safety Clarification Advice) or closure if required • Review design to utilise the existing upstream headwall as part of the new tie in chamber, or join the existing to new to minimise risk of undermining the rail formation • Securely fence work areas to prevent public accessing rail corridor from worksite, and to protect rail workers from accessing worksite	3L	Design, Construction
2.5	**Retaining Wall / Drainage interface**	• Introduction of constant water path to retaining structure o Potential for retaining wall failure due to erosion	6H	• Retaining wall solution to link to drainage requirements	4M	Design, Construction
2.6	**Construction of Longitudinal Drainage**	• Working adjacent traffic: o Construction of pipe work and pits o Installation of water quality devices o Public entering open excavations	7A	• Develop Integrated Work Method Statements • Develop and implement Traffic Control Plans as required • Review construction of permanent exclusion fencing prior to drainage works where practical • Fence off construction works securely	3L	Construction

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		• Working adjacent/within rail corridor: o Damage to rail equipment or infrastructure o Damage to plant, equipment or work force o Electrocution o Open excavations within/adjacent the rail corridor o Public access to rail corridor o Personnel safety	7A	• Develop Integrated Work Method Statements • Carry out work under a QR SCA (Safety Clarification Advice) or closure if required • Securely fence work areas to prevent public accessing rail corridor from worksite, and to protect rail workers from accessing worksite	3L	Construction
3.0	ZONE 1					
3.1	Construct culverts around Church St	• Damage to existing services: o Telstra, power, sewer, signalling	7A	• Develop an Integrated Work Method Statement • Undertake potholing to prove service locations to incorporate during design, and construction	3L	Design, Construction
		• Working adjacent traffic: o Construction of pipe work and pits (large in size) o installation of water quality devices	7A	• Develop and implement a Traffic Control Plan • Develop an Integrated Work Method Statement • Use precast structures to minimise time excavations are open as much as practical	3L	Design, Construction

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		• Working adjacent/within rail corridor: o Damage to rail equipment or infrastructure o Damage to plant, equipment or work force o Electrocution o Public access to rail corridor o Personnel safety	7A	• Develop Integrated work Method Statements • Carry out work under a QR SCA (Safety Clarification Advice) or closure if required • Review design to utilise the existing upstream headwall as part of the new tie in chamber, or join the existing to new to minimise risk of undermining the rail formation • Securely fence work areas to prevent public accessing rail corridor from worksite, and to protect rail workers from accessing worksite	3L	Design, Construction
		• Access to pipes after construction o Public safety around outlets (CPTED) o Public safety during storm events	6H	• Investigate the use of screw or lock down grates • Review use of personnel exclusion fencing around inlets/outlets verses screens to structures	4M	Design, Construction
3.2	**Construct culverts around William St**	• Working adjacent traffic: o Construction of pipe work and pits (large in size) o Potential flooding issues during construction due to closure of existing open channel o Public access to open excavations	7A	• Use precast pits to minimise time excavations are open as much as practical • Develop Integrated Work Method Statements • Develop and implement Traffic Control Plans as required • Review construction of permanent exclusion fencing prior to drainage works where practical • Fence off construction works securely	3L	Design, Construction

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		• Working adjacent/within rail corridor: o Damage to rail equipment or infrastructure o Damage to plant, equipment or work force o Construction of chamber at tie in to existing QR culvert and potential undermining of rail embankment, tracks and other infrastructure o Electrocution o Public access to rail corridor	7A	• Develop Integrated work Method Statements • Carry out under a QR SCA (Safety Clarification Advice) or closure if required • Review design to utilise the existing upstream headwall as part of the new tie in chamber, or join the existing to new to minimise risk of undermining the rail formation • Securely fence work areas to prevent public accessing rail corridor from worksite, and to protect rail workers from accessing worksite	3L	Design, Construction
		• Damage to culverts during installation of subsequent works: o Construction of TLS pile foundation could clash with and damage new culvert	6H	• Review as built information as part of Integrated Work Method Statement	3L	Construction
		• Access to pipes after construction o Public safety around outlets (CPTED) o Public safety during storm events	6H	• Investigate the use of screw or lock down grates • Review use of personnel exclusion fencing around inlets/outlets verses screens to structures	4M	Design, Construction

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3.3	**Construct culvert 3 at the eastern end of Hinton St**	• Working adjacent traffic: o Construction of pipe work and pits (large in size) o Installation of water quality devices o Public access to open excavations	7A	• Use precast pits to minimise time excavations are open • Develop Integrated Work Method Statements • Develop and implement Traffic Control Plans as required • Review construction of permanent exclusion fencing prior to drainage works where practical • Fence off construction works securely	3L	Design, Construction
		• Working adjacent/within rail corridor: o Damage to rail equipment or infrastructure o Damage to plant, equipment or work force o Construction of chamber at tie in to existing QR culvert and potential undermining of rail embankment, tracks and other infrastructure o Electrocution o Public access to rail corridor	7A	• Develop Integrated Work Method Statements • Carry out under a QR SCA (Safety Clarification Advice) or closure if required • Review design to utilise the existing upstream headwall as part of the new tie in chamber, or join the existing to new to minimise risk of undermining the rail formation • Securely fence work areas to prevent public accessing rail corridor from worksite, and to protect rail workers from accessing worksite	3L	Design, Construction
		• Working adjacent Goodna State School o Public entering open excavations o Public entering culverts	6H	• Securely fence work areas to prevent public accessing worksites • Review permanent protection to culverts to prevent public from accessing pipes	4M	Design, Construction

		• Damage to culverts during installation of subsequent works: o Construction of TL5 pile foundation could clash with and damage new culvert	5H	• Review as built information as part of Integrated Work Method Statement	3L	Construction
		• Access to pipes after construction o Public safety around outlets (CPTED) o Public safety during storm events	6H	• Investigate the use of screw or lock down grates • Review use of personnel exclusion fencing around inlets/outlets verses screens to structures	3L	Design
3.4	**Construction of Longitudinal Drainage**	• Working adjacent traffic: o Construction of pipe work and pits o Installation of water quality devices o Public entering open excavations	7A	• Develop Integrated Work Method Statements • Develop and implement Traffic Control Plans as required • Review construction of permanent exclusion fencing prior to drainage works where practical • Fence off construction works securely	3L	Design, Construction
		• Working adjacent/within rail corridor: o Damage to rail equipment or infrastructure o Damage to plant, equipment or work force o Construction of chamber at tie in to existing QR culvert and potential undermining of rail embankment, tracks and other infrastructure o Electrocution o Open excavations within/adjacent the rail corridor o Public access to rail corridor	7A	• Develop Integrated Work Method Statements • Carry out under a QR SCA (Safety Clarification Advice) or closure if required • Review design to utilise the existing upstream headwall as part of the new tie in chamber, or join the existing to new to minimise risk of undermining the rail formation • Securely fence work areas to prevent public accessing rail corridor from worksite, and to protect rail workers from accessing worksite	3L	Design, Construction

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3.5	**Retaining Wall / Drainage interface**	• Introduction of constant water path to retaining structure o Potential for retaining wall failure due to erosion	6H	• Retaining wall solution to link to drainage requirements	4M	Design, Construction
4.0	**ZONE 4**					
4.1	**Construction of transverse drainage, including upgrading of McEwen and Verral St drainage**	• Working adjacent traffic: o Construction of pipe work and pits o Installation of water quality devices o Public entering open excavations	7A	• Develop integrated Work Method Statements • Develop and implement Traffic Control Plans as required • Review construction of permanent exclusion fencing prior to drainage works where practical • Fence off construction works securely	3L	Design, Construction
		• Working adjacent/within rail corridor: o Damage to rail equipment or infrastructure o Damage to plant, equipment or work force o Construction of chamber at tie in to existing QR culvert and potential undermining of rail embankment, tracks and other infrastructure o Electrocution o Open excavations within/adjacent the rail corridor o Public access to rail corridor	7A	• Develop Integrated Work Method Statements • Carry out under a QR SCA (Safety Clarification Advice) or closure if required • Review design to utilise the existing upstream headwall as part of the new tie in chamber, or join the existing to new to minimise risk of undermining the rail formation • Securely fence work areas to prevent public accessing rail corridor from worksite, and to protect rail workers from accessing worksite	3L	Design, Construction
		• Access to pipes after construction o Public safety around outlets (CPTED) o Public safety during storm events	6H	• Investigate the use of screw or lock down grates • Review use of personnel exclusion fencing around inlets/outlets verses screens to structures	3L	Design, Owner

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4.2	**Construction of Longitudinal Drainage**	• Working adjacent traffic: o Construction of pipe work and pits o Installation of water quality devices o Public entering open excavations	6H	• Develop Integrated Work Method Statements • Develop and implement Traffic Control Plans as required • Review construction of permanent exclusion fencing prior to drainage works where practical • Fence off construction works securely	3L	Construction
		• Working adjacent/within rail corridor: o Damage to rail equipment or infrastructure o Damage to plant, equipment or work force o Electrocution o Open excavations within/adjacent the rail corridor o Public access to rail corridor	7A	• Develop Integrated Work Method Statements • Carry out under a QR SCA (Safety Clarification Advice) or closure if required • Securely fence work areas to prevent public accessing rail corridor from worksite, and to protect rail workers from accessing worksite	3L	Construction
4.3	**Retaining Wall / Drainage interface**	• Introduction of constant water path to retaining structure o Potential for retaining wall failure due to erosion	6H	• Retaining wall solution to link to drainage requirements	4M	Design, Construction
5.0	**ZONE 4 RETENTION BASIN**					

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5.1	**Retention Basin Bulk Earthworks in proximity to Bridge construction, and existing rail formation**	• Space Constraints o Proximity to large plant o Struck by plant	5H	• Bridge and basin construction are programmed to minimise interference between construction activities. Bulk Earthworks for basin will occur prior to bridge construction. • Integrated Work Method Statement • Origin Alliance site access rules apply – permission from site supervisor, sign-on to IWMS, JHA and daily pre-start.	4M	Construction
		• Flooding in QR access track o Localised ponding of water against rail formation o Overtopping of rail formation	5H	• Basin designed to retain Q100 water levels, therefore expect ponding to be caused from rainfall within small catchment of access track • QR may consider an emergency response procedure in the case of ponding	4M	Design, Construction
		• Working adjacent/within rail corridor: o Damage to rail equipment or infrastructure o Damage to plant, equipment or work force o Electrocution o Open excavations within/adjacent the rail corridor o Public access to rail corridor	7A	• Develop Integrated Work Method Statements • Carry out under a QR SCA (Safety Clarification Advice) or closure if required • Securely fence work areas to prevent public accessing rail corridor from worksite, and to protect rail workers from accessing worksite	3L	Construction
6.0	**FLOODING**					

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6.1	**Construction during flood events**	• Flooding of the work areas and traffic areas • Electrical hazards • Public/environmental health hazards due to waste products/pollution • Emergency vehicle access restrictions • Drowning	7A (5P)	• Flood modelling to be undertaken to assess flood extents • Drainage designs to consider flood impacts and design storm events • Construction to consider weather reports/BOM reports • Traffic control plans as required, Develop integrated work method statements. • Temporary bunding	5H (3P)	Design Construction

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No	Actions Taken by Responsible Group	Residual Risk	Achieved Risk Score	Responsible Group Sign Off	Residual Risk Transferred to Group	Recipient Group Acceptance Initial
Construction and Demolition – Mitigation (CHAIR 2)						
1.0	Zone 3					
1.1	Damage to existing buried 1050mm dia. Drain Alignment of the proposed transverse drainage system at Endeavour underpass has been moved to avoid the potential conflict during construction. Existing services have been potholed to locate the service prior to construction. Existing service locations are shown on design drawings.	• Struck by plant • Damage to existing culverts through construction activity • Harm to people and/or equipment	4M (3U)	Design – 12/2/10 [redacted]	Construction	[redacted]
1.2	Introduction of constant water path to retaining structure Catch drains and toe drains have been provided where required to control stormwater runoff. Local drainage requirements have been incorporated in the design of the retaining walls. Wall drainage is shown on the structural retaining wall drawings	• Potential for retaining wall failure due to erosion • Potential for overtopping drainage system due to abnormally large rainfall event • Potential for erosion around wall following large rainfall event • Harm to people and/or equipment	4M (3U)	Design – 12/2/10 [redacted]	Construction	[redacted]

ST : Not Relevant

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No	Actions Taken by Responsible Group	Residual Risk	Achieved Risk Score	Responsible Group Sign Off	Residual Risk Transferred to Group	Recipient Group Acceptance Initial
1.3	Proximity to traffic Options for culvert crossing investigated and a single culvert has been designed to minimise the construction risk. The alignment of the drainage system has been offset to assist in construction staging.	• Harm to people and/or equipment • Struck by vehicle • Struck by object	5H (5R)	Design – 12/2/10 [redacted]	Construction	[redacted]
	Location of cast-in-place chamber on service road ramp (proximity to traffic) Not able to be mitigated through design. Options for the manhole location were investigated and the manhole was required to be installed directly behind the kerb and channel to achieve cover and maintenance requirements, as well as provide connectivity to existing drainage system. Location of manhole off service road is limited by location of retaining wall.	• Harm to people and/or equipment • Struck by vehicle • Struck by object	7A (5P)	Design – 12/2/10 [redacted]	Construction	
	Proximity of manhole to northern IM retaining wall and traffic Options for the manhole location were investigated and the manhole was required to be installed directly behind the kerb and channel to achieve cover and maintenance requirements. The manhole C16500A and C16500B1 are located behind the kerbs of the ramp and out of the direct traffic path	• Harm to people and/or equipment • Struck by vehicle • Struck by object	5H (5R)	Design – 12/2/10 [redacted]	Construction	

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No	Actions Taken by Responsible Group	Residual Risk	Achieved Risk Score	Responsible Group Sign Off	Residual Risk Transferred to Group	Recipient Group Acceptance Initial
1.4	Working in/adjacent gas pipe exclusion zone The design has been optimised to limit the number of gas main crossings. The gas mains have been highlighted on the design drawings (layout plans). The gas main has been shown on the longitudinal drainage sections. A protection slab has also been designed for the gas main (refer PUP package).	• Harm to people and/or equipment • Struck by plant • Damage to infrastructure • Explosion / ignition	5H (4U)	Design – 12/2/10 [redacted]	Construction	[redacted]
1.5	Proximity to traffic The alignment of the drainage system optimised to avoid crossing under the QR underpass. The design provides for a thrust bored crossing to the east of the underpass.	• Damage to QR infrastructure due to thrust boring activities • Harm to people and/or equipment • Working adjacent to and within live rail corridor leading to personnel harm	5H (5R)	Design – 12/2/10 [redacted]	Construction	
	Cranage and lifting underneath QR bridge Design has eliminated the interaction with the existing QR bridge by optimising the design to avoid crossing under the QR bridge.	• No residual risk due to removal of this specific hazard situation.	N/A	Design – 12/2/10 [redacted]	Construction	
	Excavation under QR bridge Design has eliminated the interaction with the existing QR bridge by optimising the design to avoid crossing under the QR bridge.	• No residual risk due to removal of this specific hazard situation.	N/A	Design – 12/2/10 [redacted]	Construction	

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No	Actions Taken by Responsible Group	Residual Risk	Achieved Risk Score	Responsible Group Sign Off	Residual Risk Transferred to Group	Recipient Group Acceptance Initial
1.6	Working adjacent traffic The longitudinal drainage has been designed in accordance with the appropriate guidelines. The longitudinal drainage design incorporates the requirements of the temporary traffic management plans.	• Harm to people and/or equipment • Public safety due to entering open excavations	7A (5P)	Design – 12/2/10 [redacted]	Construction	[redacted]
	Working adjacent/within rail corridor The longitudinal drainage has been designed in accordance with the appropriate QR and Project standards	• Damage to rail equipment or infrastructure • Damage to plant, equipment or work force • potential undermining of rail embankment, tracks and other infrastructure • Electrocution • Public access to rail corridor	7A (5P)	Design – 12/2/10 [redacted]	Construction	
2.0	ZONE 2					
2.1	Potential dam effect between Monash Rd and adjacent housing estate during significant rain event Monash road culverts have been designed to an acceptable level of immunity (PMF) for the road.	• Damage to property • Drowning • Harm to people and/or equipment	5H (5R)	Design – 12 [redacted]	Construction	

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No	Actions Taken by Responsible Group	Residual Risk	Achieved Risk Score	Responsible Group Sign Off	Residual Risk Transferred to Group	Recipient Group Acceptance Initial
2.2	Localised flooding at upstream side of key culverts Options for over-sizing key culverts were considered. Where it did not adversely impact on residents downstream, hydraulic regime, or maintenance, over-sizing was adopted. Culverts have been designed with the appropriate level of immunity as specified in the Design Brief. Desktop study undertaken for all the Transverse culverts detailing the expected impact of a full blockage or significant rain event. Safety screens to culvert inlets/outlets have been designed in accordance with QUDM section 12.04 where required.	• Damage to property • Drowning • Harm to people and/or equipment	5H (5R)	Design – 12/2/10 [redacted]	Construction	[redacted]
2.3	Working within power easement Existing electricity and overhead power lines have been identified and shown on the design drawings.	• Harm to people and/or equipment • Electrocution • Damage to power poles / power lines • Damage to plant	6H (5U)	Design – 12/2/10 [redacted]	Construction	
	Working in UXO clearance area UXO clearance areas have been shown on the exclusion zone drawings and the drainage design has avoided this exclusion zone	• Harm to people and/or equipment • Explosion if UXO uncovered inside or outside of exclusion zone	5H (4U)	Design – 12/2/10 [redacted]	Construction	

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No	Actions Taken by Responsible Group	Residual Risk	Achieved Risk Score	Responsible Group Sign Off	Residual Risk Transferred to Group	Recipient Group Acceptance Initial
2.4	Working adjacent/within rail corridor The design has located the proposed gully infrastructure outside of the QR boundary to allow for ease of construction and to minimise the risk of damage to QR assets. Permanent and temporary fencing locations and details developed to restrict access to the rail corridor. Fencing details are shown in another package (refer Fencing Package DGRORF101) Utilising existing QR infrastructure where possible to minimise risk of undermining/affecting rail formation.	• Harm to people and/or equipment • Damage to QR infrastructure • Electrocution • Public access to rail corridor	4M (4R)	Design – 12/2/10 [redacted]	Construction	[redacted]
2.5	Introduction of constant water path to retaining structure Catch drains and toe drains have been provided where required to control stormwater runoff. Local drainage requirements have been incorporated in the design of the retaining walls. Wall drainage is shown on the structural retaining wall drawings	• Potential for retaining wall failure due to erosion • Potential for overtopping drainage system due to abnormally large rainfall event • Potential for erosion around wall following large rainfall event • Harm to people and/or equipment	4M (3U)	Design – [redacted]	Construction	

Design Package: Drainage – All Zones **Project Name:** Ipswich Motorway Upgrade – Dinmore to Goodna

Date: 21 May 2009 / 09 July 2009 / 21 July 2009 **S.I.D. Report No:** SIDR#16

No	Actions Taken by Responsible Group	Residual Risk	Achieved Risk Score	Responsible Group Sign Off	Residual Risk Transferred to Group	Recipient Group Acceptance Initial
2.6	Working adjacent traffic The longitudinal drainage has been designed in accordance with the appropriate guidelines. The longitudinal drainage incorporates the requirements of the temporary traffic management plans.	• Public safety due to entering open excavations • Harm to people and/or equipment	7A (5P)	Design – 12/2/10 [redacted]	Construction	[redacted]
	Working adjacent/within rail corridor: Permanent and temporary fencing locations and details developed to restrict access to the rail corridor. Fencing details are shown in another package (refer Fencing Package DGRORF101.)	• Damage to rail equipment or infrastructure • Damage to plant, equipment or work force • potential undermining of rail embankment, tracks and other infrastructure • Electrocution • Public access to rail corridor • Personnel harm	4M (4R)	Design – 12/2/10/ [redacted]	Construction	
3.0	**Zone 1**					
3.1	Damage to existing services Potholing of the existing services has been undertaken and included in the survey model. Existing services information also included in services model. Applicable existing services have been shown on the design drawings	• Damaging existing services requiring replacement • Personnel/equipment harm due to contact with live services	4M (4R)	Design – 12/2/10 [redacted]	Construction	

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No	Actions Taken by Responsible Group	Residual Risk	Achieved Risk Score	Responsible Group Sign Off	Residual Risk Transferred to Group	Recipient Group Acceptance Initial
	Working adjacent traffic The longitudinal drainage design incorporates the requirements of the temporary traffic management plans. Precast pits have been specified as part of the design.	• Damage to people and/or equipment • Public safety due to entering open excavations	7A (4P)	Design – 12/2/10 [redacted]	Construction	[redacted]
	Working adjacent/within rail corridor The design has located the proposed culvert infrastructure outside of the QR boundary to and allow for ease of construction and to minimise the risk of damage to QR assets. Permanent and temporary fencing locations and details developed to restrict access to the rail corridor. Fencing details are shown in another package (refer Fencing Package DGRORF101.) The design has utilised as much of the existing upstream headwall as possible (subject to geometric positioning of the connecting culverts).	• Damage to rail equipment or infrastructure • Damage to plant, equipment or work force • potential undermining of rail embankment, tracks and other infrastructure • Electrocution • Public access to rail corridor • Personnel harm	4M (4R)	Design – 12/2/10 [redacted]	Construction	

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No	Actions Taken by Responsible Group	Residual Risk	Achieved Risk Score	Responsible Group Sign Off	Residual Risk Transferred to Group	Recipient Group Acceptance Initial
	Access to pipes after construction Fencing has been provided to limit falls from stormwater culverts and some fencing provided to limit access as per fencing package. Safety grates and screens have been located in accordance with QUDM section 12.04, risk assessment. Stakeholders (ICC) have been included in the selection of locating inlet screens	• Public safety around outlets (CPTED) • Public safety during storm events • Damage to public infrastructure • Harm to people and/or equipment	6H (4P)	Design – 12/2/10 [redacted]	Construction	[redacted]
3.2	Working adjacent traffic Permanent fencing and temporary fencing locations and details developed to restrict access. Fencing details are shown in another package (refer Fencing Package DGRORF101.) Precast pits have been specified as part of the design.	• Damage to people and/or equipment • Public safety due to entering open excavations	7A (5P)	Design – 12/2/10 [redacted]	Construction	

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No	Actions Taken by Responsible Group	Residual Risk	Achieved Risk Score	Responsible Group Sign Off	Residual Risk Transferred to Group	Recipient Group Acceptance Initial
	Working adjacent/within rail corridor The design has located the proposed gully infrastructure outside of the QR boundary and allow for ease of construction and to minimise the risk of damage to QR assets. Permanent and temporary fencing locations and details developed to restrict access to the rail corridor. Fencing details are shown in another package (refer Fencing Package DGRORF101) The design has utilised as much of the existing upstream headwall as possible (subject to geometric positioning of the connecting culverts).	• Damage to rail equipment or infrastructure • Damage to plant, equipment or work force • potential undermining of rail embankment, tracks and other infrastructure • Electrocution • Public access to rail corridor • Personnel harm	4M (4R)	Design – 12/2/10 [redacted]	Construction	[redacted]
	Damage to culverts during installation of subsequent works Interdisciplinary reviews and checks have been undertaken as part of the design process. Clashes identified as part of the design process and services realigned or relocated as appropriate. Stormwater pipes are shown on structural drawings where the stormwater is integral with the structure. Pipe class and cover has been assessed for likely construction and permanent loads (refer to Design Report for details)	• Damage to culverts/pipes installed on site requiring replacement	4M (3U)	Design – 12/2/10 [redacted]	Construction	

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Project Name: Ipswich Motorway Upgrade – Dinmore to Goodna
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No	Actions Taken by Responsible Group	Residual Risk	Achieved Risk Score	Responsible Group Sign Off	Residual Risk Transferred to Group	Recipient Group Acceptance Initial
	Access to pipes after construction Fencing has been provided to limit falls from stormwater culverts and some fencing provided to limit access as per fencing package. Safety grates and screens have been located in accordance with QUDM section 12.04, risk assessment. Stakeholders (ICC) have been included in the selection of locating inlet screens	• Public safety around outlets (CPTED) • Public safety during storm events • Damage to public infrastructure • Harm to people and/or equipment	6H (4P)	Design – 12/2/10 [redacted]	Construction	[redacted]
3.3	Working adjacent traffic The longitudinal drainage has been designed in accordance with the appropriate guidelines. Permanent and temporary fencing locations and details developed to restrict access. Fencing details are shown in another package (refer Fencing Package DGRORF101.) Precast pits have been specified as part of the design.	• Damage to people and/or equipment • Public safety due to entering open excavations	7A (5P)	Design – 12/2/10 [redacted]	Construction	

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No	Actions Taken by Responsible Group	Residual Risk	Achieved Risk Score	Responsible Group Sign Off	Residual Risk Transferred to Group	Recipient Group Acceptance Initial
	Working adjacent/within rail corridor The design has located the proposed gully infrastructure outside of the QR boundary and allow for ease of construction to minimise the risk of damage to QR assets. The design has utilised as much of the existing upstream headwall as possible (subject to geometric positioning of the connecting culverts). Permanent and temporary fencing locations and details developed to restrict access to the rail corridor. Fencing details are shown in another package (refer Fencing Package DGRORF101)	• Damage to rail equipment or infrastructure • Damage to plant, equipment or work force • potential undermining of rail embankment, tracks and other infrastructure • Electrocution • Public access to rail corridor • Personnel harm	4M (4R)	Design – 12/2/10 [redacted]	Construction	[redacted]
	Working adjacent Goodna State School Permanent and temporary fencing locations developed to restrict access. Fencing details are shown in another package (refer Fencing Package DGRORF101)	• Public entering open excavations resulting in injury • Public entering culverts resulting in injury • Property damage/vandalism	6H (4P)	Design – 12/2/10 [redacted]	Construction	

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No	Actions Taken by Responsible Group	Residual Risk	Achieved Risk Score	Responsible Group Sign Off	Residual Risk Transferred to Group	Recipient Group Acceptance Initial
	Damage to culverts during installation of subsequent works Interdisciplinary reviews and checks have been undertaken as part of the design process. Clashes identified as part of the design process and services realigned or relocated as appropriate. Stormwater pipes are shown on structural drawings where the stormwater is integral with the structure. Pipe class and cover has been assessed for likely construction and permanent loads (refer to Design Report for details)	• Damage to services installed on site • Damage to culverts/pipes installed on site requiring replacement	4M (3U)	Design – 12/2/10 [redacted]	Construction	[redacted]
	Access to pipes after construction Fencing has been provided to limit falls from stormwater culverts and some fencing provided to limit access as per fencing package. Safety grates and screens have been located in accordance with QUDM section 12.04, risk assessment. Stakeholders (ICC) have been included in the selection of locating inlet screens	• Public safety around outlets (CPTED) • Public safety during storm events • Damage to public infrastructure	6H (4P)	Design – 12/2/10 [redacted]	Construction	

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No	Actions Taken by Responsible Group	Residual Risk	Achieved Risk Score	Responsible Group Sign Off	Residual Risk Transferred to Group	Recipient Group Acceptance Initial
3.4	Working adjacent traffic The longitudinal drainage has been designed in accordance with the appropriate guidelines. The longitudinal drainage design incorporates the requirements of the temporary traffic management plans.	• Damage to people and/or equipment • Public safety due to entering open excavations	7A (5P)	Design – 12/2/10 [redacted]	Construction	[redacted]
	Working adjacent/within rail corridor The longitudinal drainage has been designed in accordance with the appropriate guidelines. (QR) Minimal length of longitudinal drainage has been proposed within the QR corridor to minimise the risk.	• Damage to rail equipment or infrastructure • Damage to plant, equipment or work force • potential undermining of rail embankment, tracks and other infrastructure • Electrocution • Open excavations within/adjacent the rail corridor • Public access to rail corridor	7A (5P)	Design – 12/2/10 [redacted]	Construction	
3.5	Introduction of constant water path to retaining structure Catch drains and toe drains have been provided where required to control stormwater runoff. Local drainage requirements have been incorporated in the design of the retaining walls. Wall drainage is shown on the structural retaining wall drawings	• Potential for retaining wall failure due to erosion • Potential for overtopping drainage system due to abnormally large rainfall event • Potential for erosion around wall following large rainfall event	4M (3U)	Design – 12/2/10 [redacted]	Construction	

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No	Actions Taken by Responsible Group	Residual Risk	Achieved Risk Score	Responsible Group Sign Off	Residual Risk Transferred to Group	Recipient Group Acceptance Initial
4.0	ZONE 4					
4.1	Working adjacent traffic Permanent fencing locations and details developed to restrict access to the Motorway. Fencing details are shown in another package (refer Fencing Package DGRORF101) Location of proposed drainage designed to limit the extent of excavation required to reduce the risk	• Damage to people and/or equipment • Public safety due to entering open excavations	7A (5P)	Design – 12/2/10 [redacted]	Construction	[redacted]
	Working adjacent/within rail corridor The design has located the proposed gully infrastructure outside of the QR boundary to allow for ease of construction and to minimise the risk of damage to QR assets. Stakeholder approval has been sort to agree on the proposed crossing alignments. Crossings are significantly below track level and located away from all masts, signals and sidings, and are in accordance with the QR standards. Permanent fencing locations and details developed to restrict access to the rail corridor. Fencing details are shown in another package (refer Fencing Package DGRORF101)	• Damage to rail equipment or infrastructure • Damage to plant, equipment or work force • potential undermining of rail embankment, tracks and other infrastructure • Electrocution • Open excavations within/adjacent the rail corridor • Public access to rail corridor	4M (4R)	Design – 12/2/10 [redacted]	Construction	

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No	Actions Taken by Responsible Group	Residual Risk	Achieved Risk Score	Responsible Group Sign Off	Residual Risk Transferred to Group	Recipient Group Acceptance Initial
	Access to pipes after construction Fencing has been provided to limit falls from stormwater culverts and some fencing provided to limit access as per fencing package. Safety grates and screens have been located in accordance with QUDM section 12.04, risk assessment. Stakeholders (ICC) have been included in the selection of locating inlet screens All stormwater infrastructure has been design in accordance with relevant standard drawings.	• Public safety around outlets (CPTED) • Public safety during storm events • Damage to public infrastructure • Harm to people and/or equipment	6H (4P)	Design – 12/2/10 [redacted]	Construction	[redacted]
4.2	Working adjacent traffic Permanent fencing locations and details developed to restrict access to the Motorway. Fencing details are shown in another package (refer to DGPCAL101). The stormwater has been design in accordance with the relevant design documentation. The longitudinal drainage design incorporates the requirements of the temporary traffic management plans.	• Damage to people and/or equipment • Public safety due to entering open excavations	6H (5U)	Design – 12/2/10 [redacted]	Construction	

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No	Actions Taken by Responsible Group	Residual Risk	Achieved Risk Score	Responsible Group Sign Off	Residual Risk Transferred to Group	Recipient Group Acceptance Initial
	Working adjacent/within rail corridor: No longitudinal drainage proposed within rail corridor. Permanent fencing locations and details developed to restrict access to the rail corridor. Fencing details are shown in relevant fencing package (refer DGRORF101)	• Damage to rail equipment or infrastructure • Damage to plant, equipment or work force • Electrocution • Public access to rail corridor	4M (4R)	Design – 12/2/10 [redacted]	Construction	[redacted]
4.3	Introduction of constant water path to retaining structure Catch drains and toe drains have been provided where required to control stormwater runoff. Local drainage requirements have been incorporated in the design of the retaining walls. Wall drainage is shown on the structural retaining wall drawings	• Potential for retaining wall failure due to erosion • Potential for overtopping drainage system due to abnormally large rainfall event • Potential for erosion around wall following large rainfall event	4M (3U)	Design – 12/2/10 [redacted]	Construction	
5.0	ZONE 4 RETENTION BASIN					
5.1	Space Constraints Design of basin completed to ensure that all earthworks are within Project Boundary and no works cross into QR corridor.	• Damage to people or plant	4M (3U)	Design – 12/2/10 [redacted]	Construction	

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No	Actions Taken by Responsible Group	Residual Risk	Achieved Risk Score	Responsible Group Sign Off	Residual Risk Transferred to Group	Recipient Group Acceptance Initial
	Flooding in QR access track Design of basins included emergency overflow provisions to contain runoff in large rainfall events within designated drainage corridors. Design checked to confirm Q100 flood levels are contained within the basin. Geotechnical team has been consulted over embankment stability issues	• Flooding into QR • Overtopping of rail formation • Harm to people and/or equipment	5H (4U)	Design – 12/2/10 [redacted]	Construction	[redacted]
	Working adjacent/within rail corridor Permanent fencing locations and details developed to restrict access to the rail corridor. Fencing details are shown in relevant fencing package. Design footprint reduced to be contained fully with DTMR land Included relevant stakeholders (QR) in design solutions and have received signoff	• Unintentional damage to infrastructure due to works in and around the QR rail corridor • Damage to plant, equipment or work force • Electrocution • Public access to rail corridor resulting in property damage or public harm	4M (4R)	Design – 12/2/10 [redacted]	Construction	
6.0	**FLOODING**					
6.1	Construction during flood events Advice on expected design event inundation areas Local flooding impacts of IMU designs have been assessed by flood models/drainage assessment	• Local flooding causing dangerous work site/traffic accidents • Harm to people and or equipment • Drowning	6H (4P)	Design – 22/2/10 [redacted]	Construction	

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No	Job Step	What are the Hazards	Risk Score	Controls Required	Target Risk Score	Responsible Group
Operation and Maintenance – Risk Assessment (CHAIR 3)						
1	**Access to manholes**	• Proximity to traffic o Struck by vehicle	6H	• Traffic control required in advance of and around manhole where access is directly adjacent to or in roadway • Design manhole locations so that they are offset from highly trafficked areas • Develop and implement IWMS/JSA/HESP for maintenance activities, including Traffic Control Plan as required.	3L (3R)	Owner Design
2	**Capture and treatment of flammable spills around Church St**	• Drainage discharges to an open drain that runs adjacent houses and public space	5H	• Provide spill containment basin at the end of each longitudinal drainage wherever possible • Develop and implement an emergency response procedure in the case of spillage	3L (3R)	Owner, Design
3	**Maintenance of pits under kerb lines or within roadway**	• Proximity to traffic o Struck by vehicle o Closure of local roads or the motorway during maintenance	6H	• Traffic control required in advance of and around manhole where access is directly adjacent to or in roadway • Design drainage pit to provide easy access to the gully invert • Develop and implement IWMS/JSA/HESP for maintenance activities, including Traffic Control Plan as required.	3L (2U)	Owner, Design

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No	Job Step	What are the Hazards	Risk Score	Controls Required	Target Risk Score	Responsible Group
4	**Maintenance of inlet/outlet safety structures required to prevent public access.**	• Objects/people caught in inlet/outlet structures with no means of escape • Access to structure for maintenance (potential confined space depending upon the structure	6H	• Maintenance to be completed in dry conditions • Design of inlet/outlet structure to consider removal of cage for maintenance purposes • Apply controls and safety systems for access as per Australian Standard where drainage pit is deemed to be a confined space • Review design and apply sloped face of grate to inlet/outlet • Develop and implement IWMS/JSA/HESP for maintenance activities, including Traffic Control Plan as required.	4M (4R)	Owner, Design
5	**> Q100 Rain Event**	• Overtopping of basin spillway o Refer to Item 1.2 o Flooding o Scour and erosion o High depths and velocities in pedestrian/road areas	5H	• Develop an emergency response procedure in the case of basin spillway overtopping • Design emergency overflow systems to allow drainage of extremely large rainfall events	4M (4R)	Owner, Design
		• Catastrophic failure of basin embankment o Refer to Item 1.2 o Flooding o Scour and erosion o High depths and velocities in pedestrian/road areas	5H	• Develop an emergency response procedure in the case of basin embankment failure • Design emergency overflow systems to allow drainage of extremely large rainfall events	4M (4R)	Owner, Design

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No	Job Step	What are the Hazards	Risk Score	Controls Required	Target Risk Score	Responsible Group
6	**Significant Rain Event**	Rainfall greater than design storm o Flooding o Scour and erosion o High depths and velocities in pedestrian/road areas	5H	• regular inspection and maintenance regime to stormwater infrastructure • Review design to assess impacts due to large rainfall events	4M (4R)	Owner, Design
7	**Basin sediment removal activities**	• Significant build-up of silt / sediment raising level of basin o Reduction of basin's storage capacity o Contaminants/chemical	3L	• regular inspection and maintenance regime to check sediment levels in basin • provide depth gauge markers in basin as reference for water depth/sediment depth • Develop and implement IWMS/JSA/HESP for maintenance activities, including Traffic Control Plan as required	3L (3R)	Owner, Design
		• Access to basin o Slip / trip / fall	3L	• Design to allow for designated maintenance access ramp into basins • Dewater dam prior to maintenance (silt removal) activities • Work Method Statement to be developed for maintenance of basins to cover vehicle access, dewatering and personnel access and safety.	2L (2R)	Owner, Design

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No	Job Step	What are the Hazards	Risk Score	Controls Required	Target Risk Score	Responsible Group
8	**Longitudinal Drainage pipes behind walls**	• Restricted access • Damage to wall • Working adjacent to traffic	6H (3L)	• Design to allow for future access to pipe for replacement/maintenance • Develop and implement IWMS/JSA/HESP for maintenance activities, including Traffic Control Plan as required	3L (3R)	Owner, Design
9	**Longitudinal drainage pipes in front of walls**	• Retaining wall failure • Working adjacent to traffic	6H (3L)	• Design to allow for pipe to be maintained in front of wall • Develop and implement IWMS/JSA/HESP for maintenance activities, including Traffic Control Plan as required	3L (3R)	Owner, Design
10	**Scour protection at stormwater outlets**	• Access to structure for maintenance • Loose debris / rubble	5H (2L)	• Work Method Statement to be developed for maintenance of outlets. • regular inspection and maintenance regime to check scour protection and possible blockages to culverts • review scour protection design to ensure installation requires minimal maintenance	3L (2U)	Owner, Design

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No	Job Step	What are the Hazards	Risk Score	Controls Required	Target Risk Score	Responsible Group
11	**Regional Flood management**	• Flooding of the traffic areas • Electrical hazards, public/environmental health hazards due to waste products/pollution • Emergency vehicle access restrictions, public access/escape prevented by floodwaters • Drowning • Increase depth and area of flood inundation	7A (5P)	• Flood modelling to be undertaken to assess flood extents • Bulk motorway to be designed to not worsen/change the pre-existing regional flood regime • Disaster/emergency management plans • Traffic control plans as required, Develop integrated work method statements for maintenance during floods • Liaise with flood emergency response personnel/emergency services	6H (4P)	Owner

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No	Actions Taken by Responsible Group	Residual Risk	Achieved Risk Score	Responsible Group Sign Off	Group Risk Transferred to	Recipient Group Acceptance Initial
Operation and Maintenance – Mitigation (CHAIR 3)						
1	Proximity to traffic: Manhole locations designed (where practical) to be offset from roadways to allow safe access, and in accordance with the applicable design standards. Step irons have also been provided inside manholes as per Australian Standards (where required)	• Working adjacent to live traffic and being struck by vehicle (where pits are adjacent to roadways) • Harm to people and/or equipment	6H (5U)	Design – 12/2/10 [redacted]	Owner	
2	Dangerous liquid discharges: Spill containment (40 000L) has been included in the water quality device within Zone 1 and 2	• Pollution due to drainage discharges to an open drain that runs adjacent houses and public space leading to environmental harm and/or harm to people. • Ignition of liquid leading to injury/fire • Public safety and health	4M (4R)	Design – 12/2/10 [redacted]	Owner	
3	Proximity to traffic: Design carried out in accordance with the applicable design standards.	• Working adjacent to live traffic and being struck by vehicle (where pits are adjacent to roadways) • Harm to people and/or equipment	6H (5U)	Design – 12/2/10 [redacted]	Owner	

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4	Pit inlets and outlets: Inlet structures and outlet structures provided in locations in accordance with QUDM 12.04 and in consultation with ICC where applicable. Maintenance tracks or access points have been provided to assist in inspection where there are no spatial constraints.	• Objects/people caught in inlet/outlet structures with no means of escape • Access to structure for maintenance (potential confined space depending upon the structure • Harm to people and/or equipment	5H (4U)	Design – 12/2/10 [redacted]	Owner	
5	Overtopping basin spillway: Design provides an outlet for a controlled discharge up to the design storm event for the basin.	• Overtopping of basin spillway causing downstream harm to environment and /or people • Nuisance Flooding/erosion	5H (4U)	Design – 12/2/10 [redacted]	Owner	
	Basin failure: Design provides an outlet for a controlled discharge from the basin up to the design storm event for the basin.	• Overtopping of basin spillway causing downstream harm to equipment, environment and /or people • Nuisance Flooding/erosion	5H (4U)	Design – 12/2/10 [redacted]	Owner	
6	Rainfall greater than design storm: Design undertaken includes a desk top study of the events that may occur based on culverts becoming blocked or for events greater than a Q100.	• Flooding impacts due to rainfall greater than design storm • Overtopping of basin spillway causing downstream harm to equipment, environment and /or people • Nuisance Flooding/erosion	4M (3U)	Design – 12/2/10 [redacted]	Owner	

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No	Actions Taken by Responsible Group	Residual Risk	Achieved Risk Score	Responsible Group Sign Off	Group Risk Transferred to	Recipient Group Acceptance Initial
7	Sediment build-up: Depth gauge markers have been added to basins that are designed to retain water A rock lined invert to the basins has been proposed to indicate the base of the basins and to assist with maintenance.	• Improper access by personnel or plant resulting in comprising the basins functionality • Increased difficulty for maintenance people/equipment to service the basin causing harm to people and/or equipment.	3L (2U)	Design – 12/2/10 [redacted]	Owner	
	Access to basin: Designated maintenance access ramps have been provided in the design and highlighted on the construction plans. All water quality basin devices have been fenced and are generally located in between high volume traffic road with access tracks. Warning signage has been provided.	• Public safety due to forced access to basin • Damage to basin during maintenance activities • Personnel safety during maintenance activities (working over water)	3L (3R)	Design – 12/2/10 [redacted]	Owner	
8	Longitudinal drainage behind walls: Buried Longitudinal drainage pipes in close proximity behind walls have been avoided where possible throughout the design. Where longitudinal pipe are required behind a retaining wall, the design of the pipe has been integrated into the design of the wall (refer to individual retaining wall packages for details)	• Future access to pipes behind permanent walls • Damage to wall structural components causing harm to people or equipment	4M (3U)	Design – 12/2/10 [redacted]	Owner	

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9	Longitudinal drainage in front of walls: Buried Longitudinal drainage pipes in close proximity to the front of the wall have been avoided where possible throughout the design. However where the longitudinal drainage line is located in front of the wall the retaining wall footing design has allowed for the possible future excavation.	• Retaining wall failure if trench is over-excavated in front of wall causing harm to people or equipment	4M (3U)	Design – 12/2/10 [redacted]	Owner	
10	Access to stormwater outlets: Access tracks have been designed to provide access to stormwater outlets where space allows, assisting in the visual inspection of stormwater outlet structures. Scour protection sized for the design flood velocities and detailed to minimise the need for maintenance	• Access via rock protection/unstable ground leading to personnel injury • Access during flood event causing personnel injury due to water pressures/flows.	4M (2P)	Design – 12/2/10 [redacted]	Owner	
11	Regional Flood Management Bulk motorway designed so to not worsen/change the pre-existing regional flood regime. Drainage infrastructure designed for recognised and appropriate design storm events.	• Flooding to traffic areas causing accidents and harm to people and or equipment • Drowning • Impacts on local business and economy	7A (5P)	Design 22/2/10 [redacted]	Owner	

Design Package: Drainage – All Zones
Project Name: Ipswich Motorway Upgrade – Dinmore to Goodna
Date: 21 May 2009 / 09 July 2009 / 21 July 2009
S.I.D. Report No: SIDR#16

Design Lot	Design Lot Description
DGENKS103	Environmental Works Report
DGRODR100	Drainage Details
GORODR102	Longitudinal Drainage
GORODR103	Water Quality
GORODR105	Longitudinal Drainage - Church St. EB Exit Ramp
GORODR106	Transverse Drainage - Culvert 1
GORODR107	Transverse Drainage - Culverts 2 & 3
RERODR104	Goodna Creek Rehabilitation
RERODR201	Longitudinal Drainage
RERODR202	Water Quality
RERODR205	Transverse Drainage (Early works culvert)
RERODR206	Transverse Drainage (Other Zone 2 culverts)
RIRODR300	Transverse Drainage
RIRODR301	Longitudinal Drainage
RIRODR302	Water Quality
RIRODR304	Longitudinal Drainage - Southern Service Roads
DIRODR400	Transverse Drainage
DIRODR401	Longitudinal Drainage
DIRODR402	Water Quality
✓ DGFHKS100	Regional Flood Modelling Report

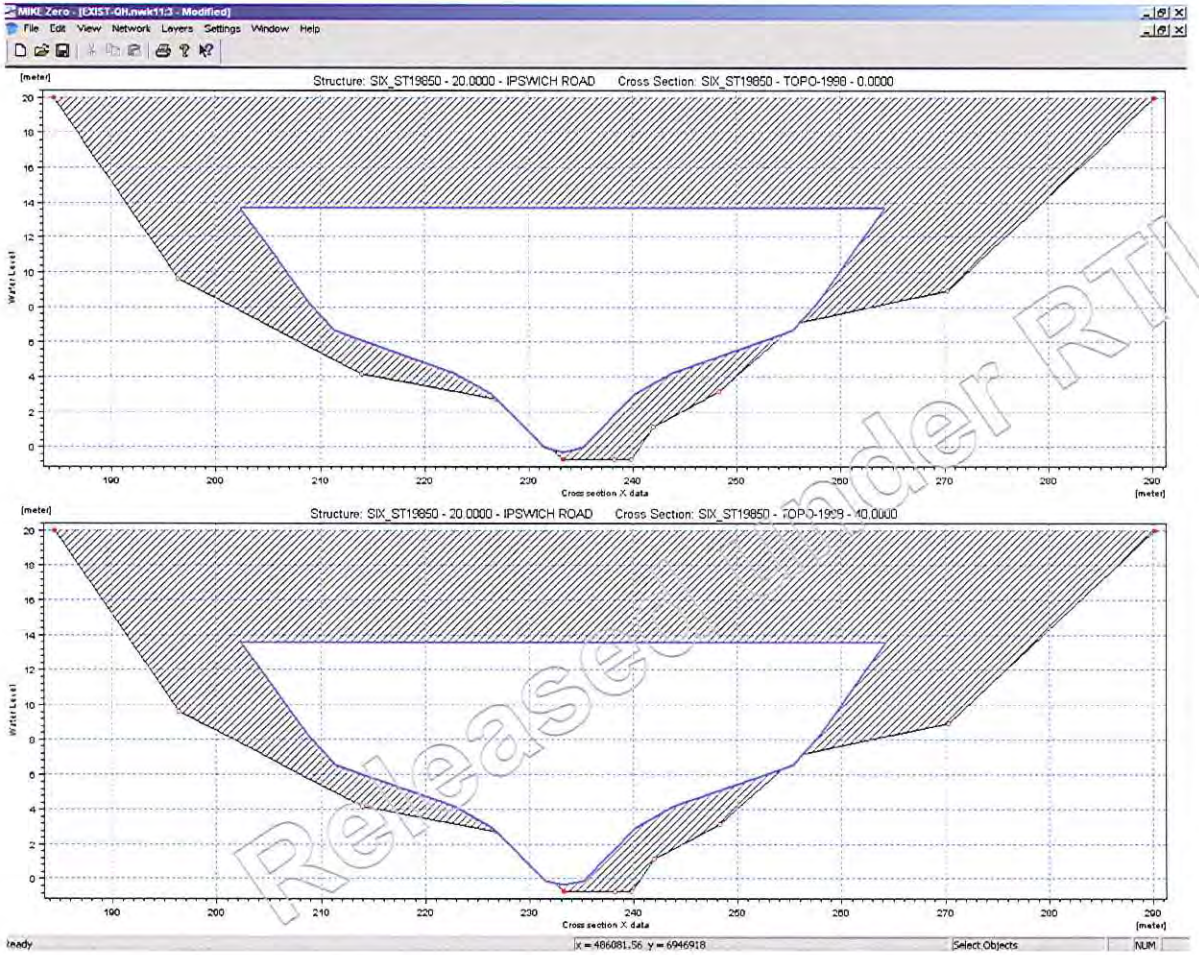
Appendix L – Design Criteria Report

Refer to D2G-BASD-DGRODR101-R-1000 Design Criteria Report.

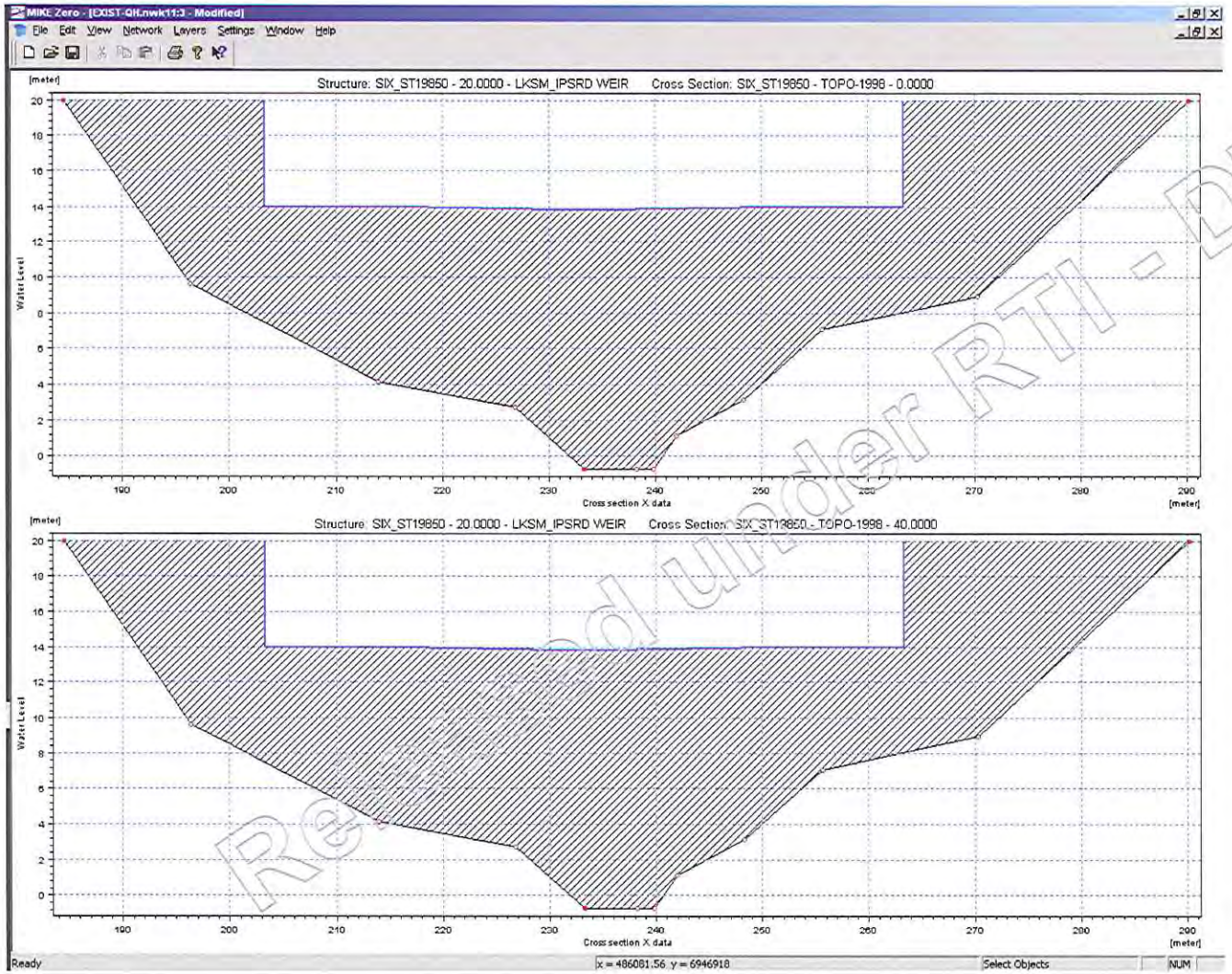
Appendix M – Hydraulic analyses input

EXISTING Regional Q100 Six Mile Creek MIKE11 input

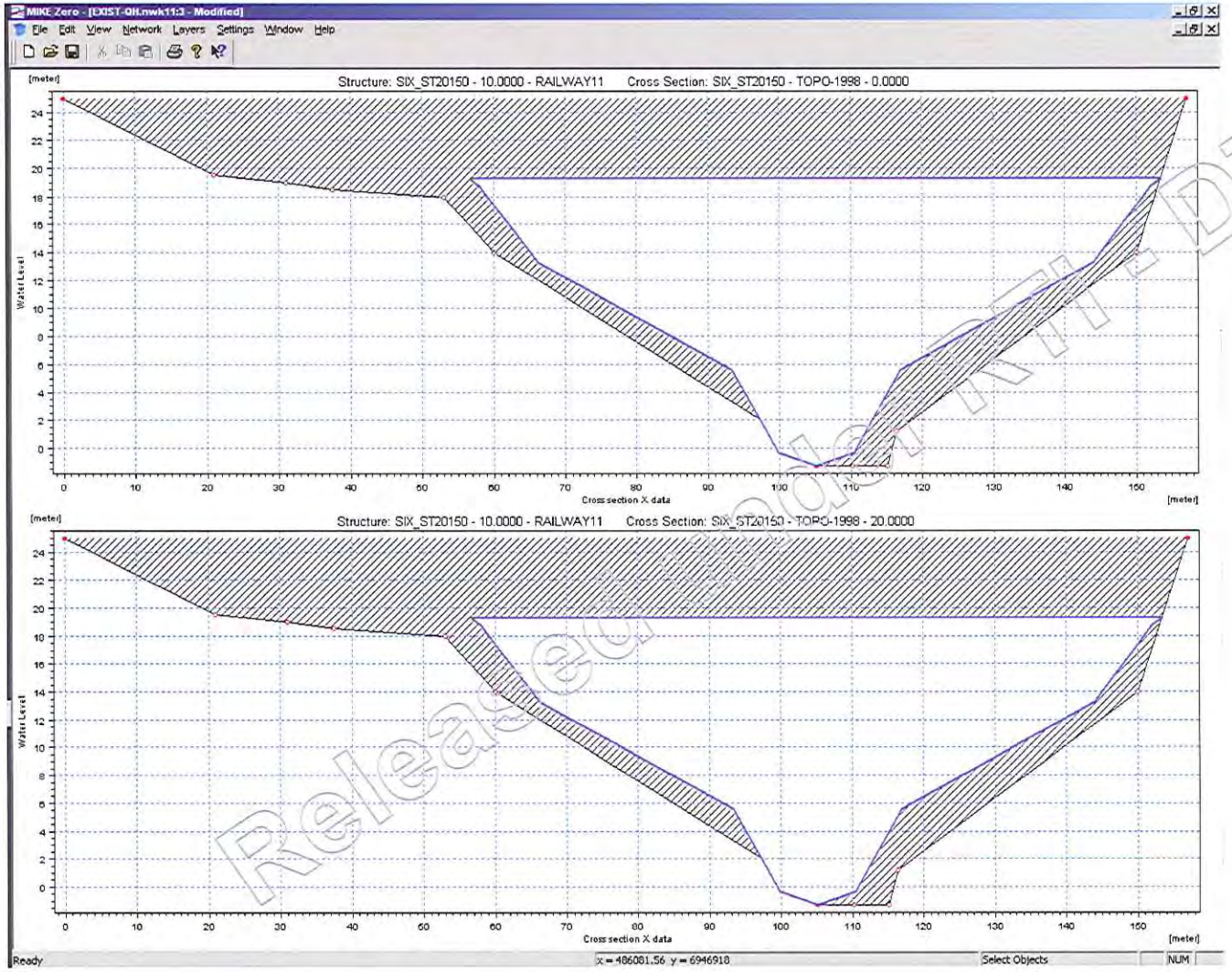
Motorway – culvert



Motorway – Weir



QR – culvert



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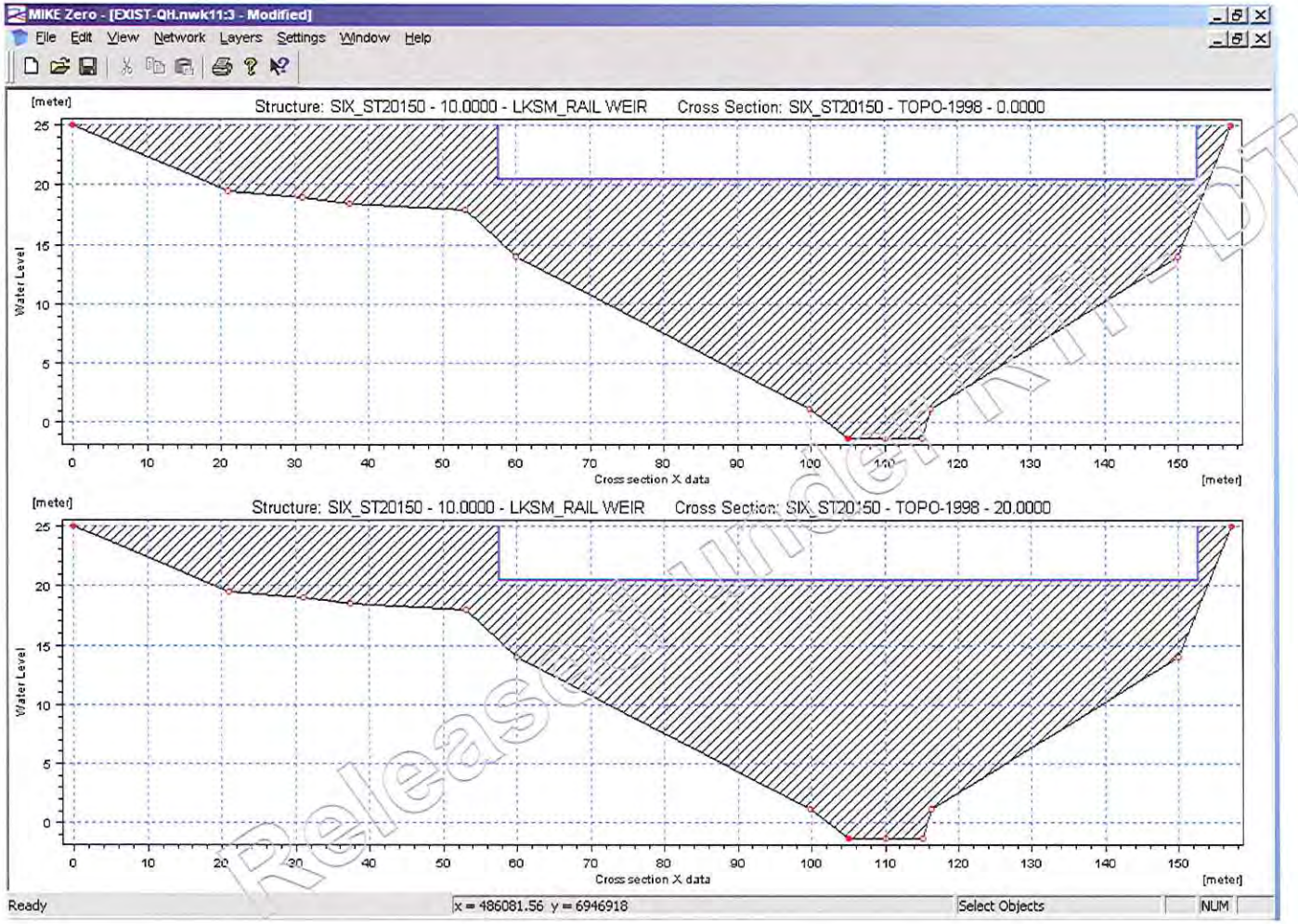
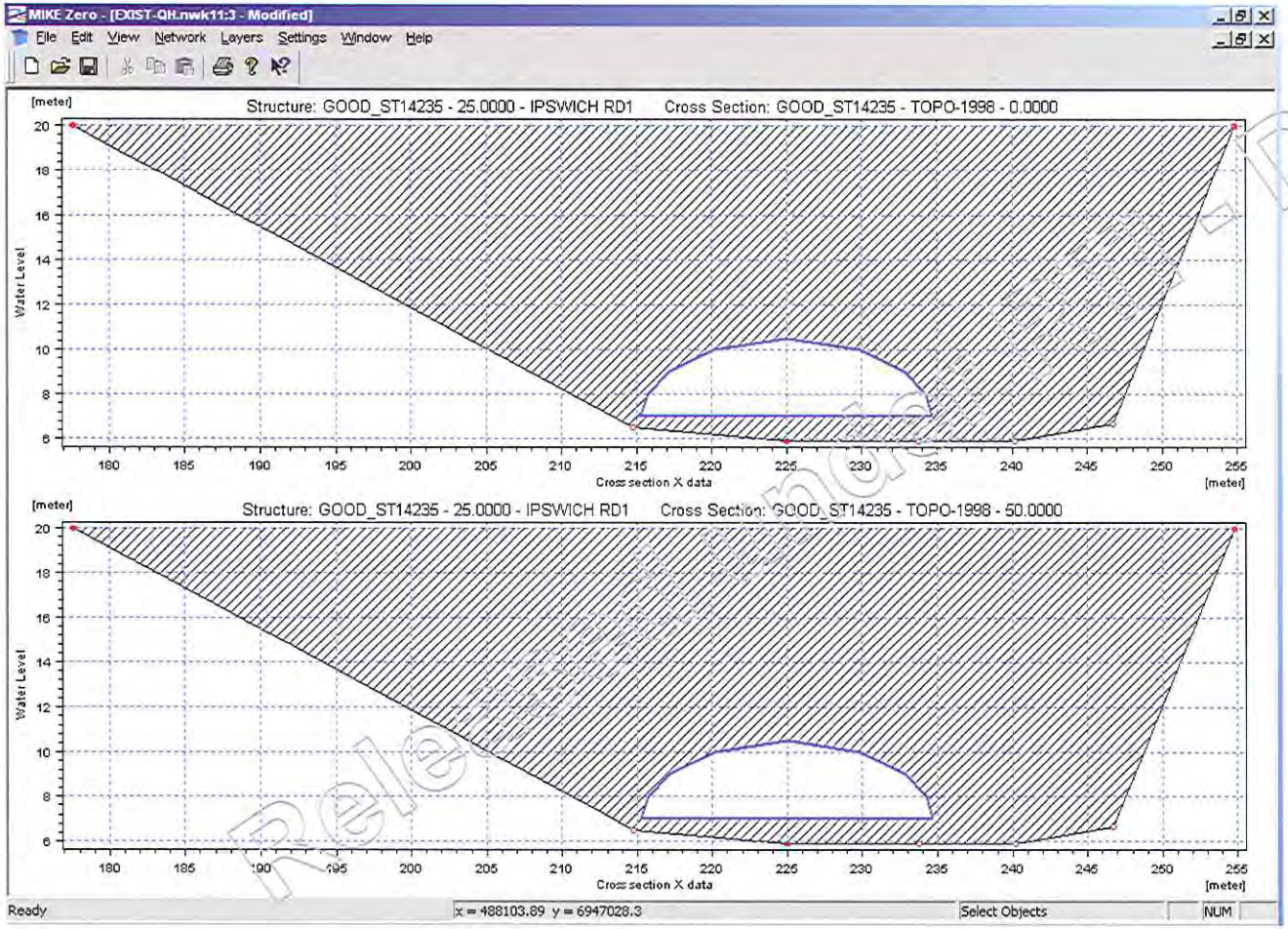
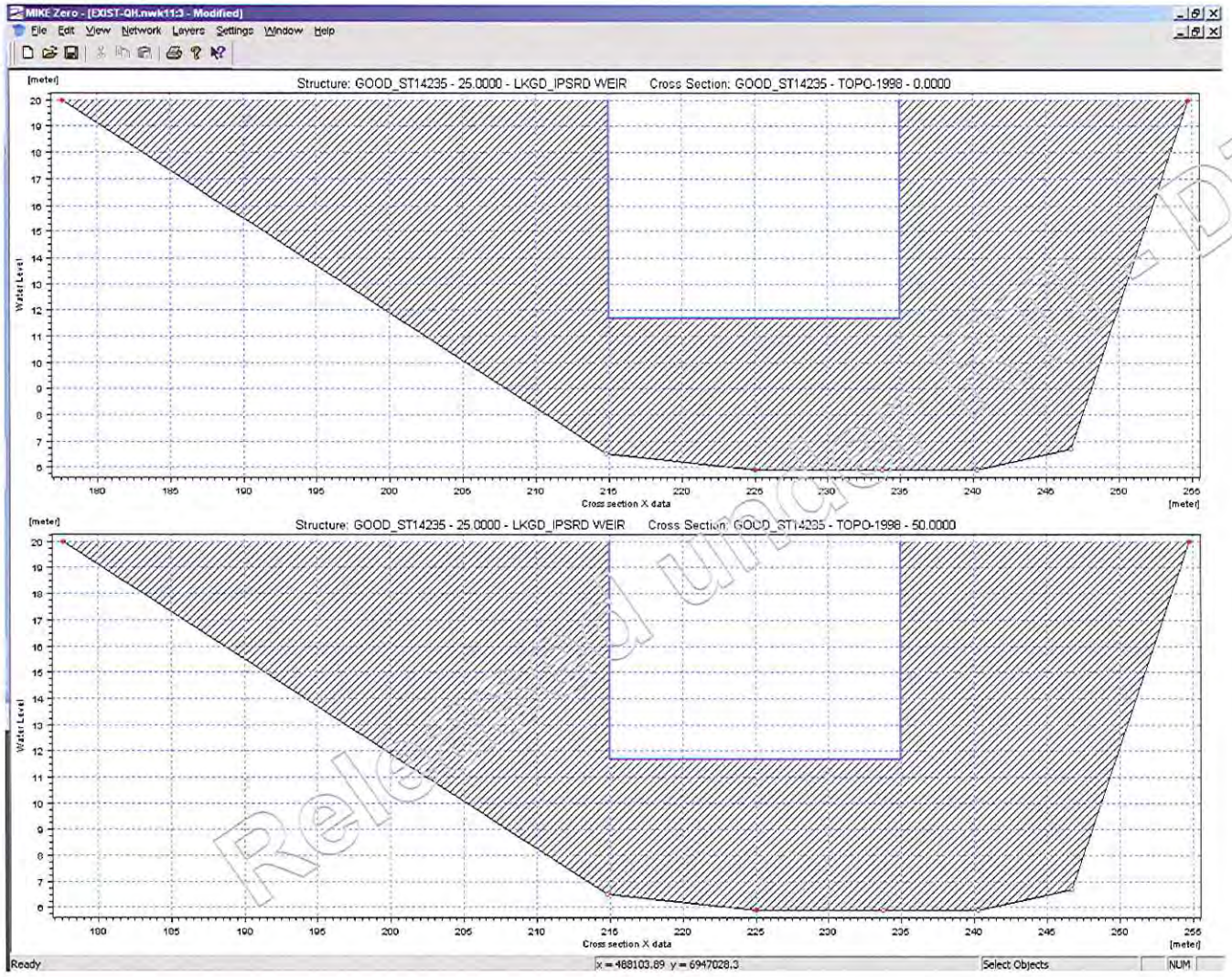


EXISTING Regional Q100 Goodna Creek MIKE11 input

Motorway – Culvert



Motorway – Weir



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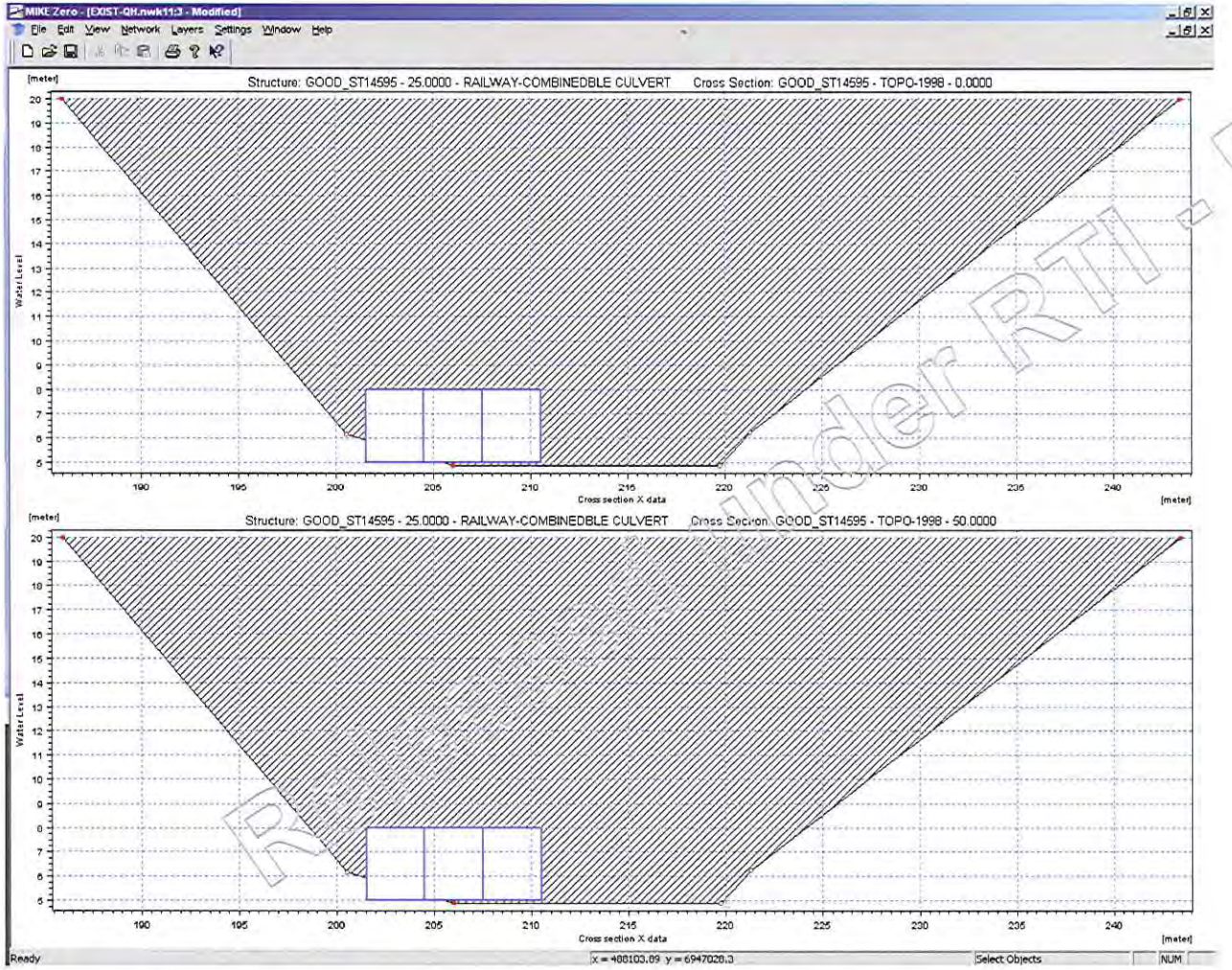

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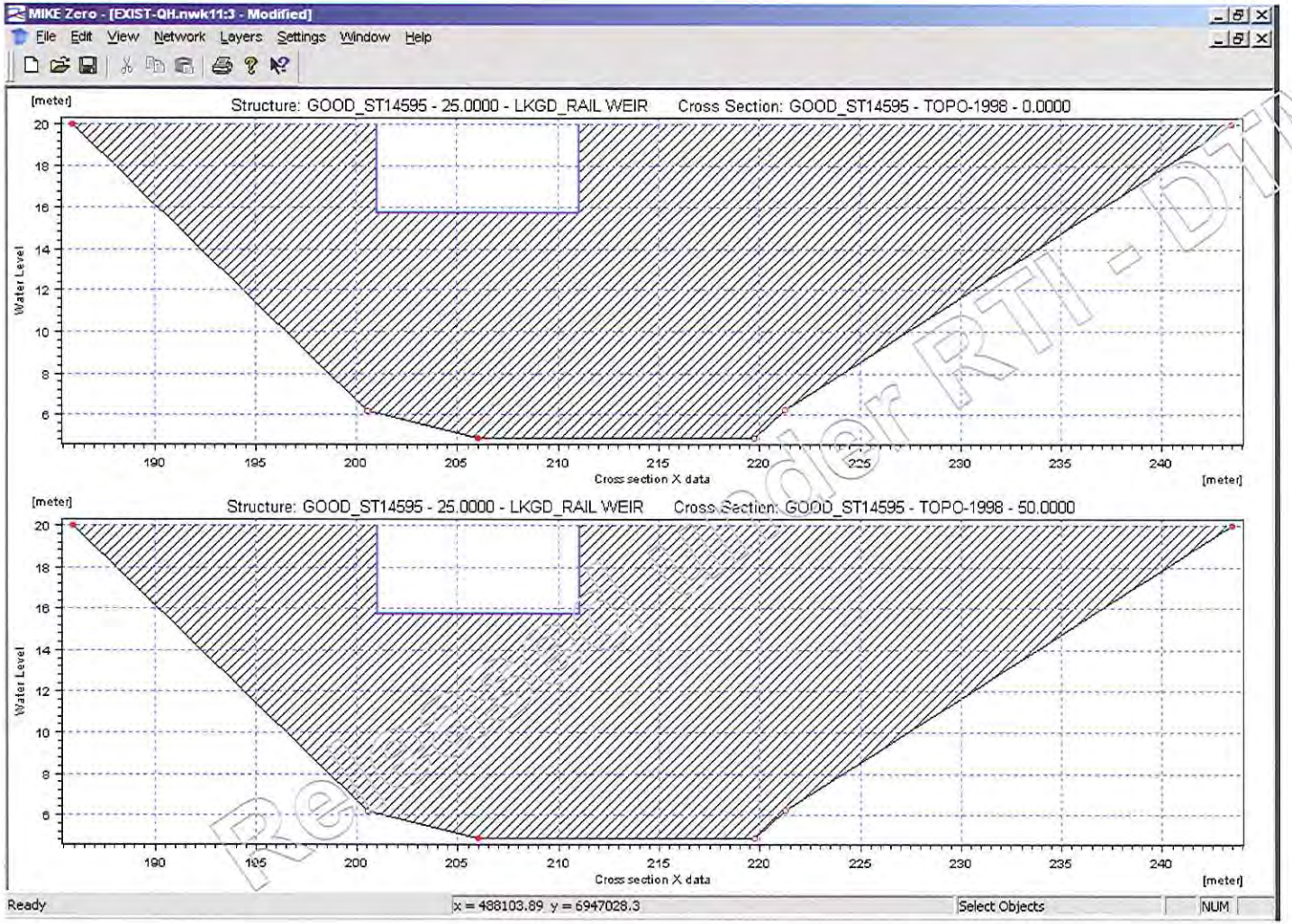
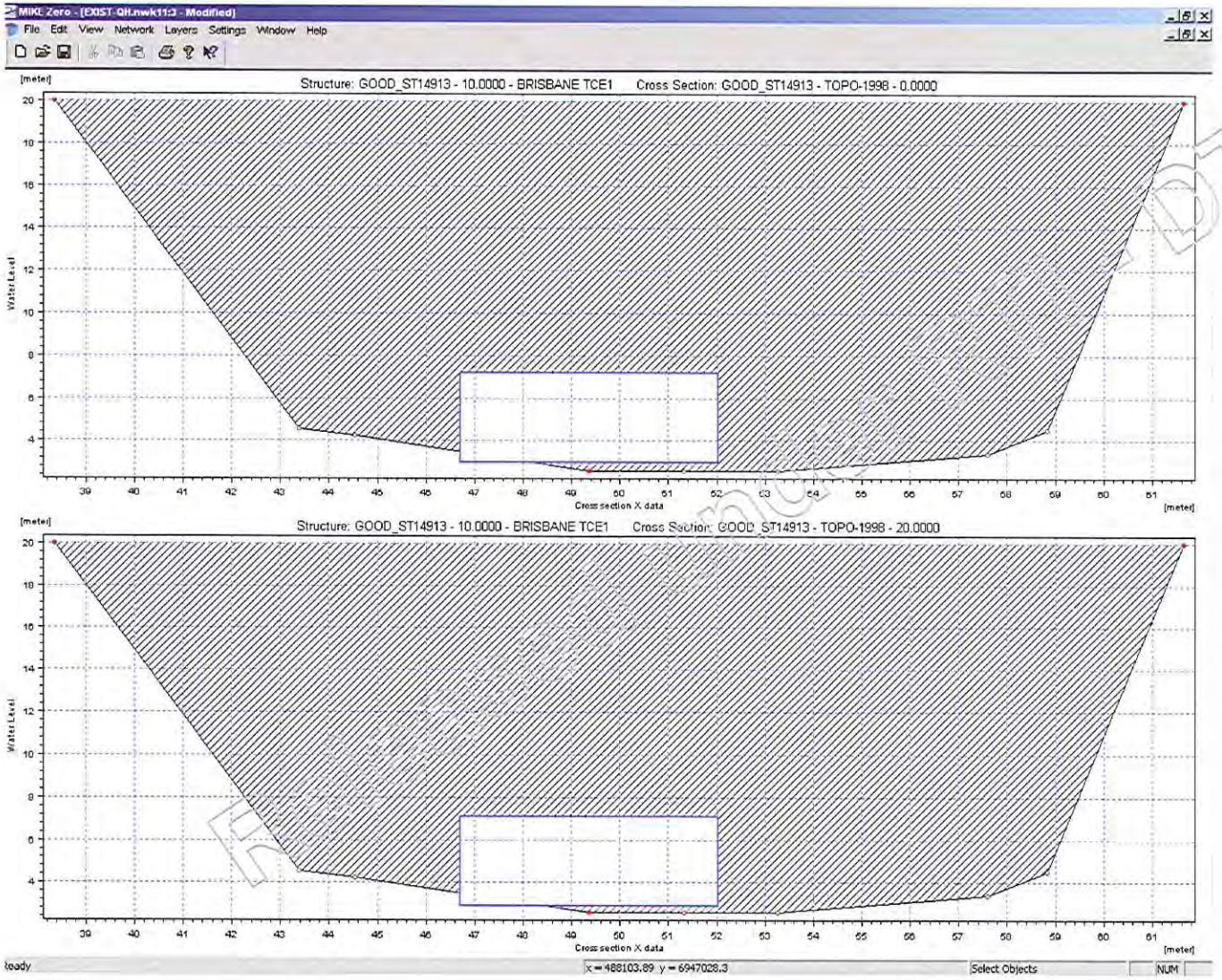


Bris terrace – culvert



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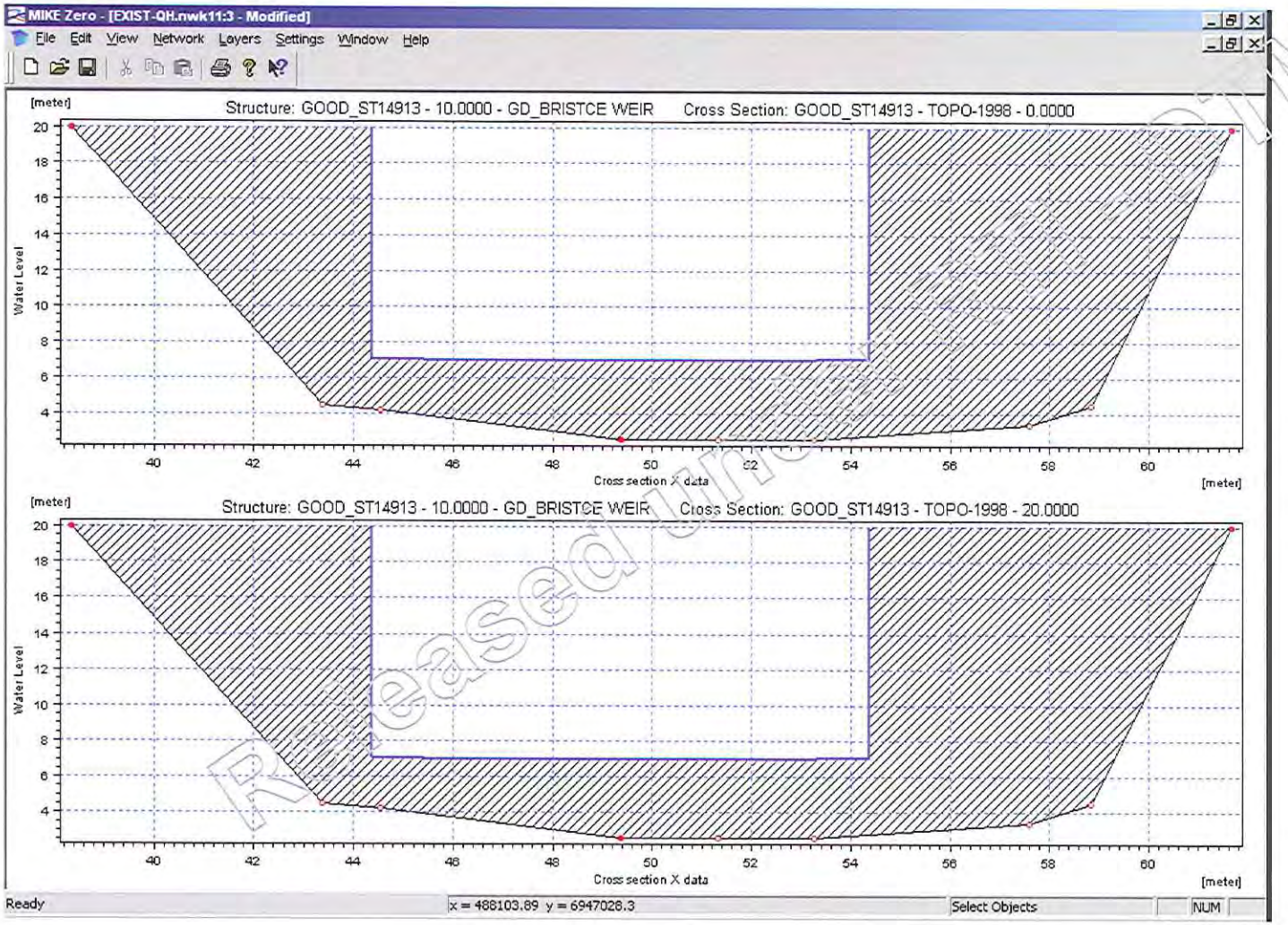
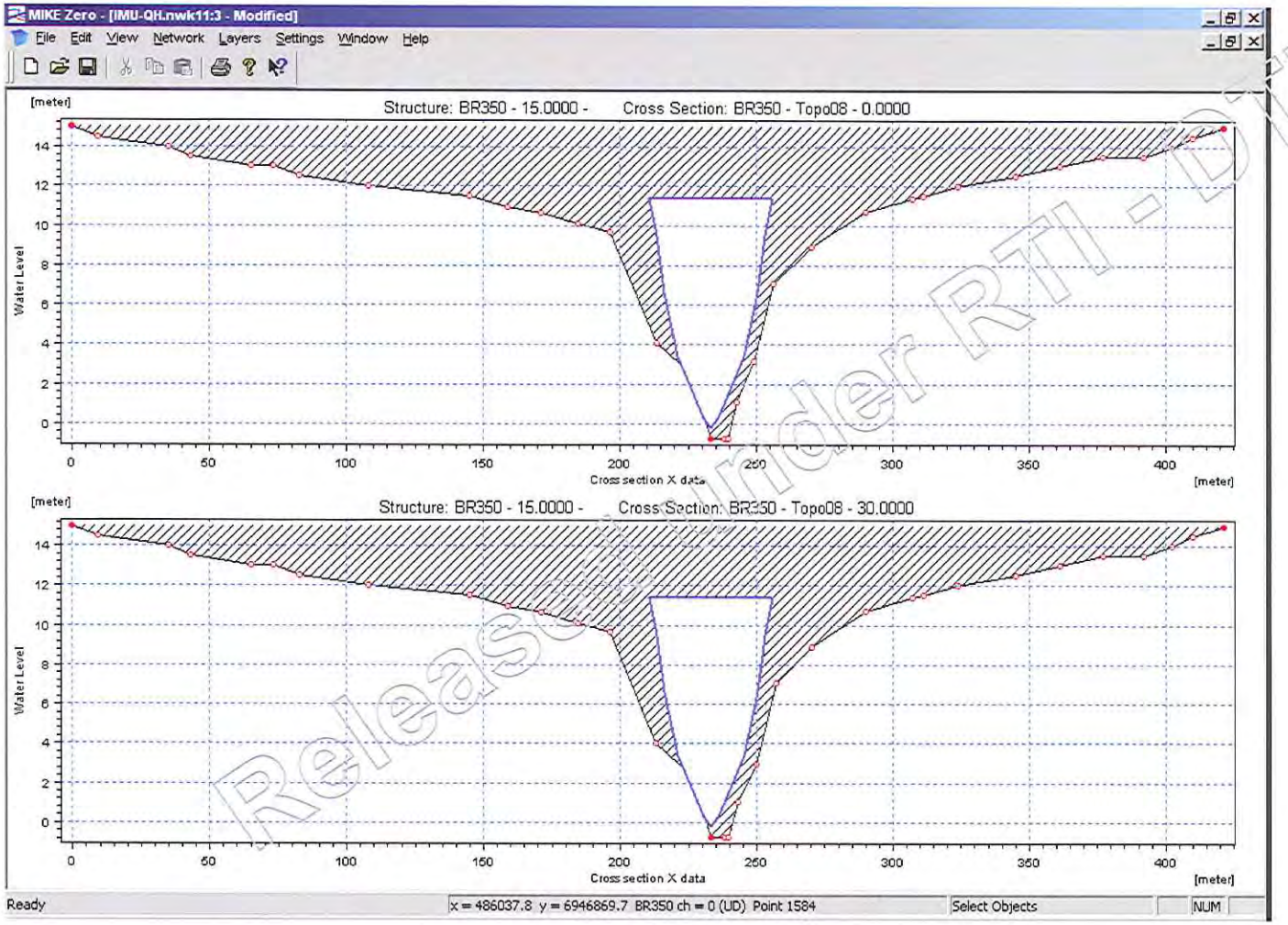
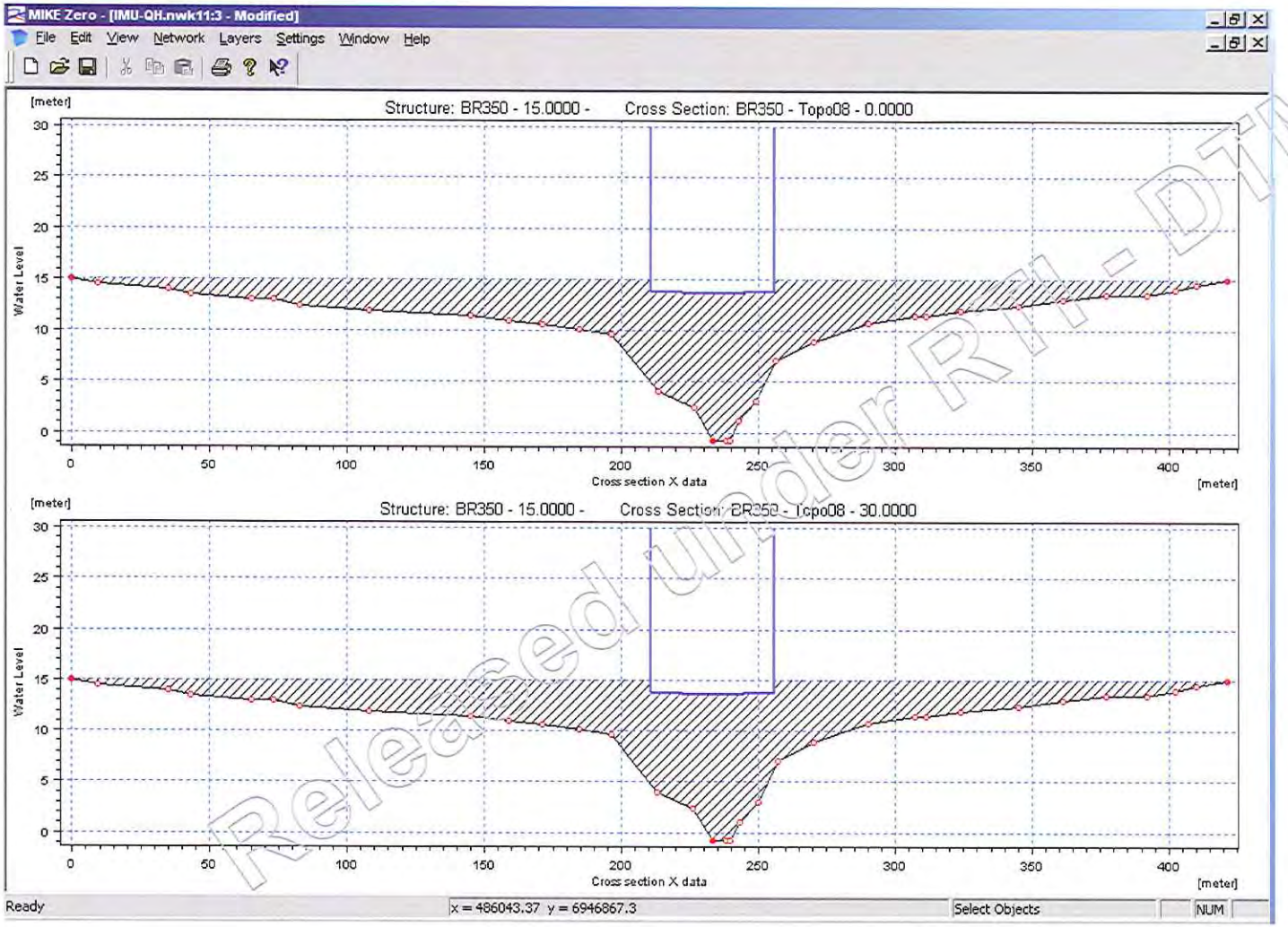


IMU Regional Q100 Six Mile Creek MIKE11 input

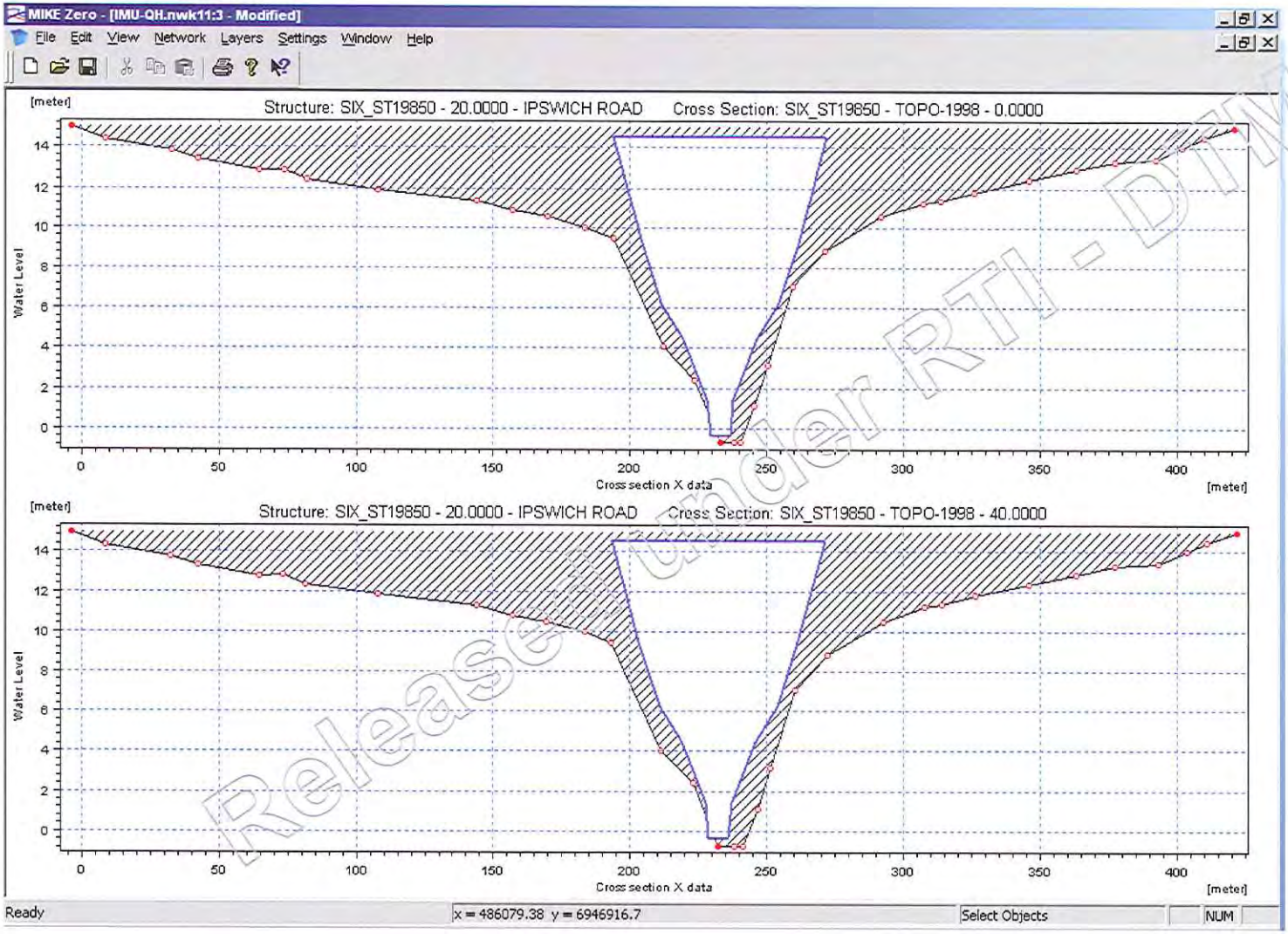
Southern service road – culvert



Southern Service Road – weir



Motorway – Culvert



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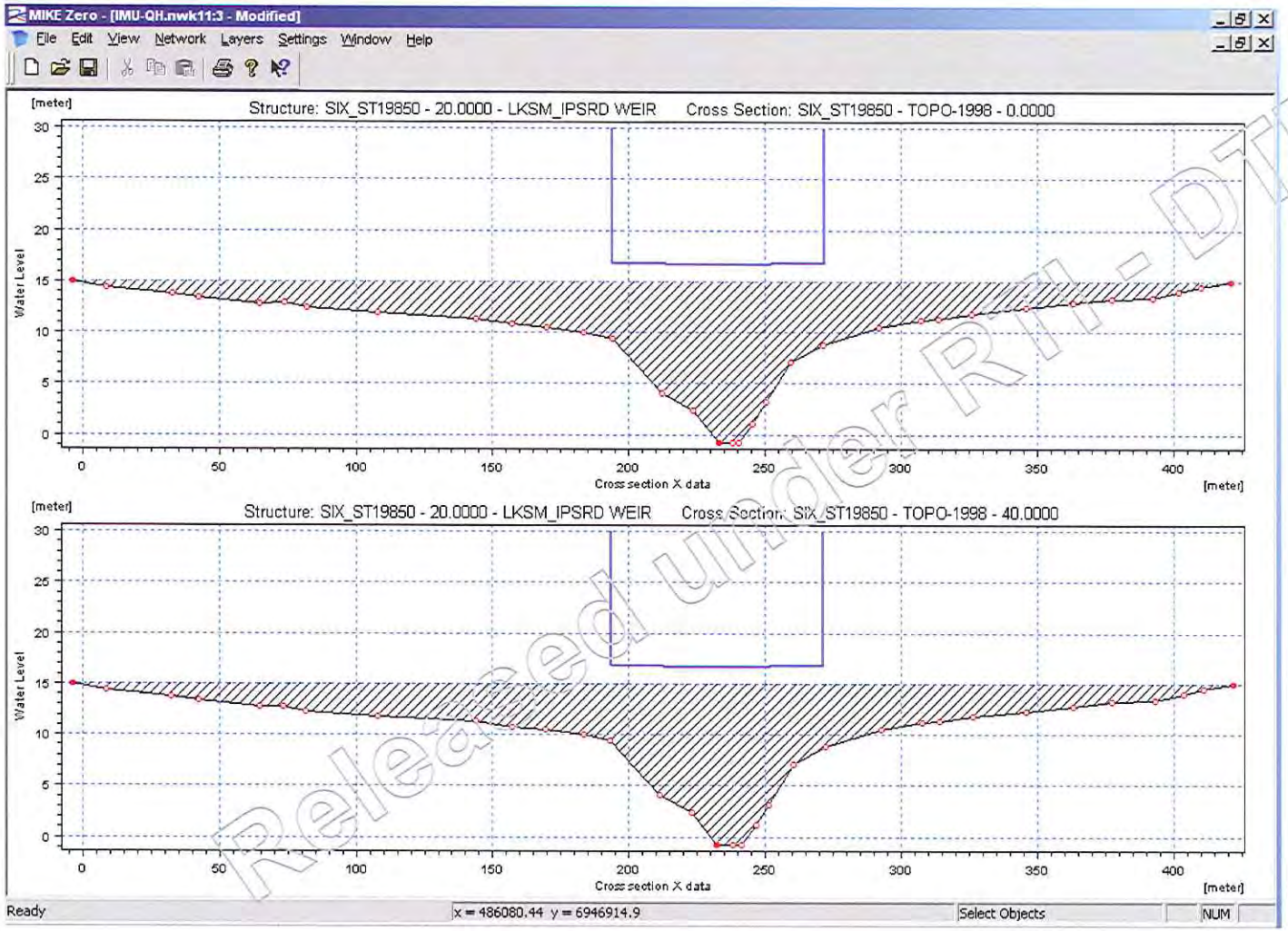

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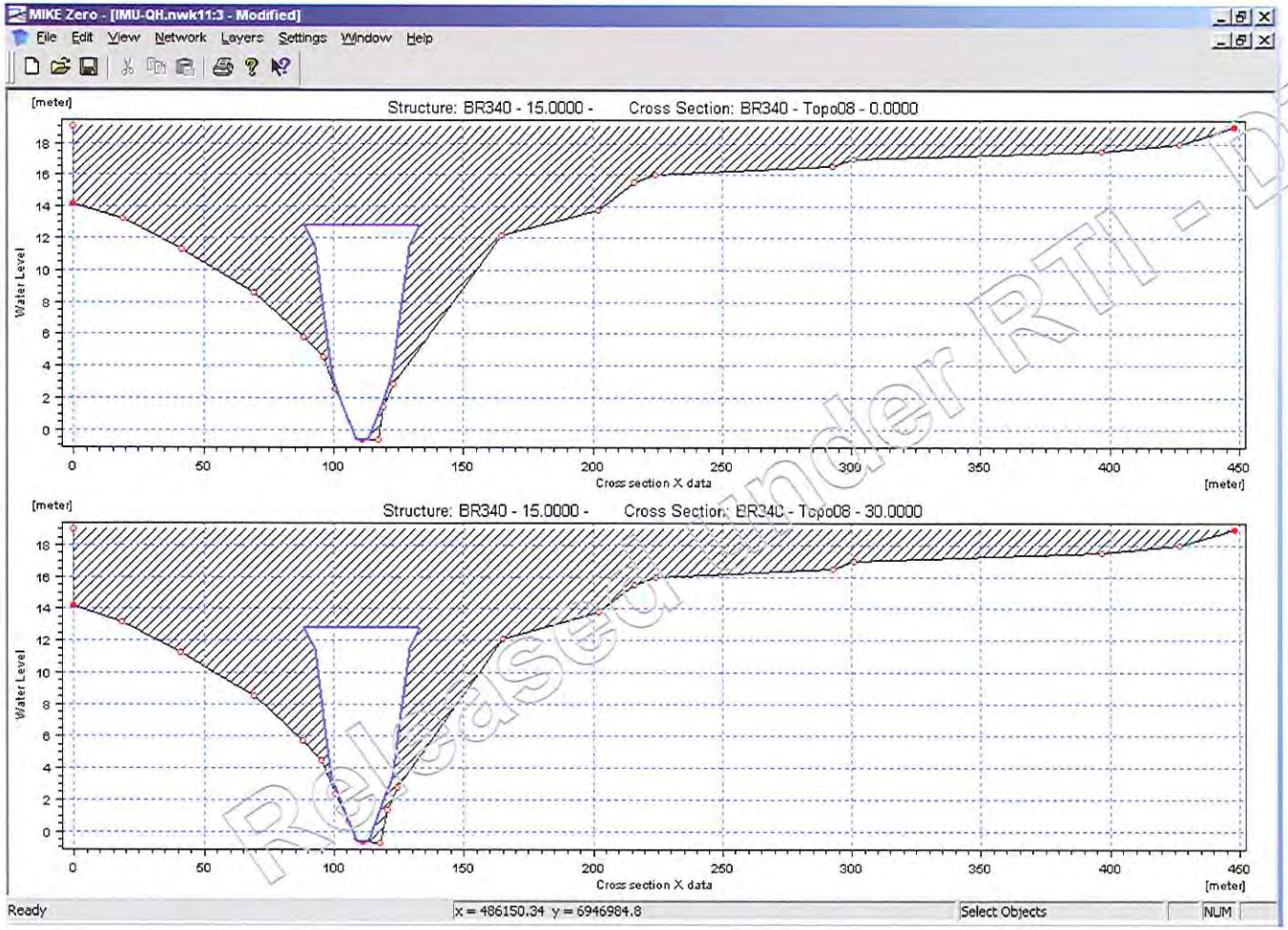

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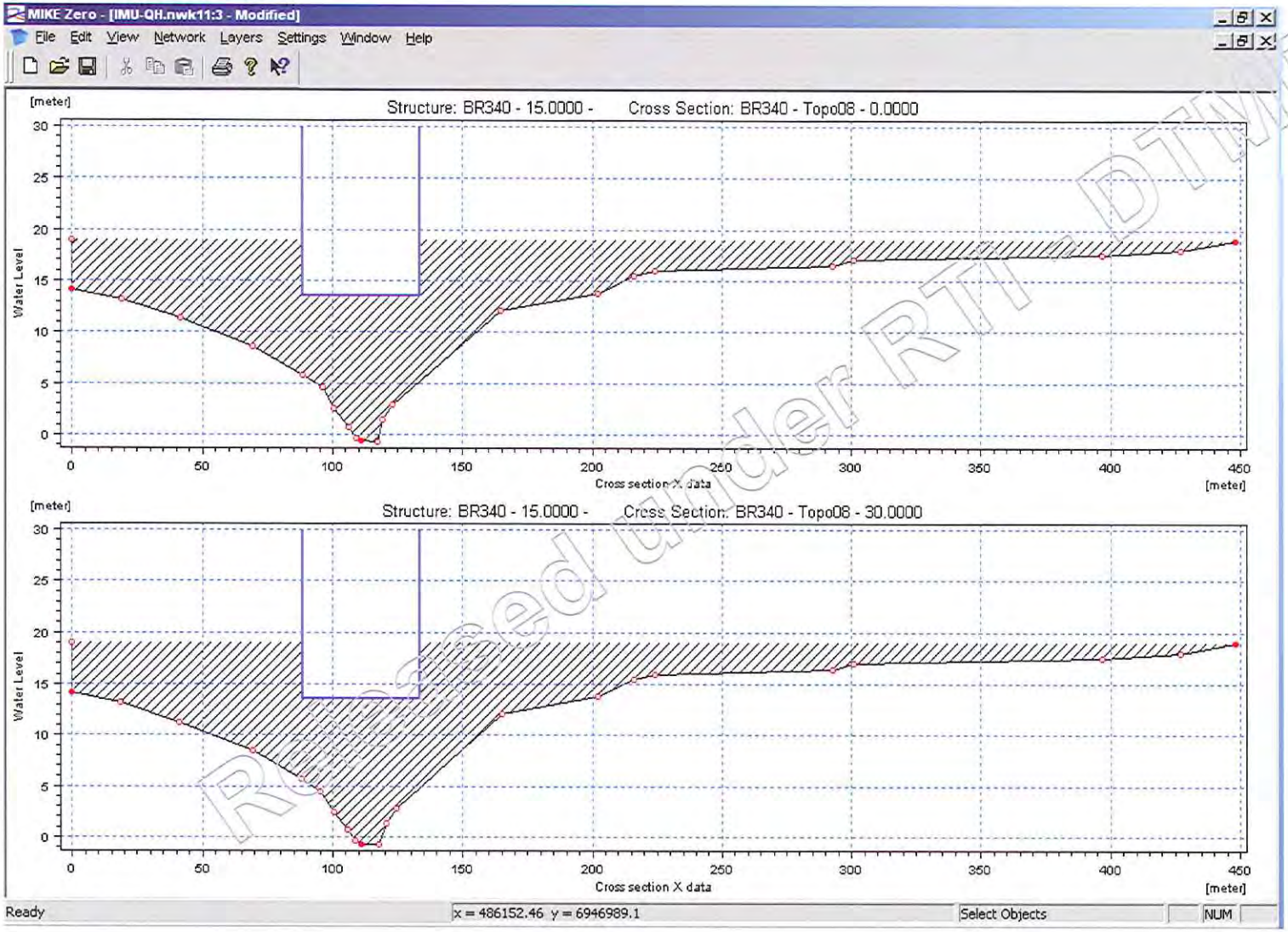

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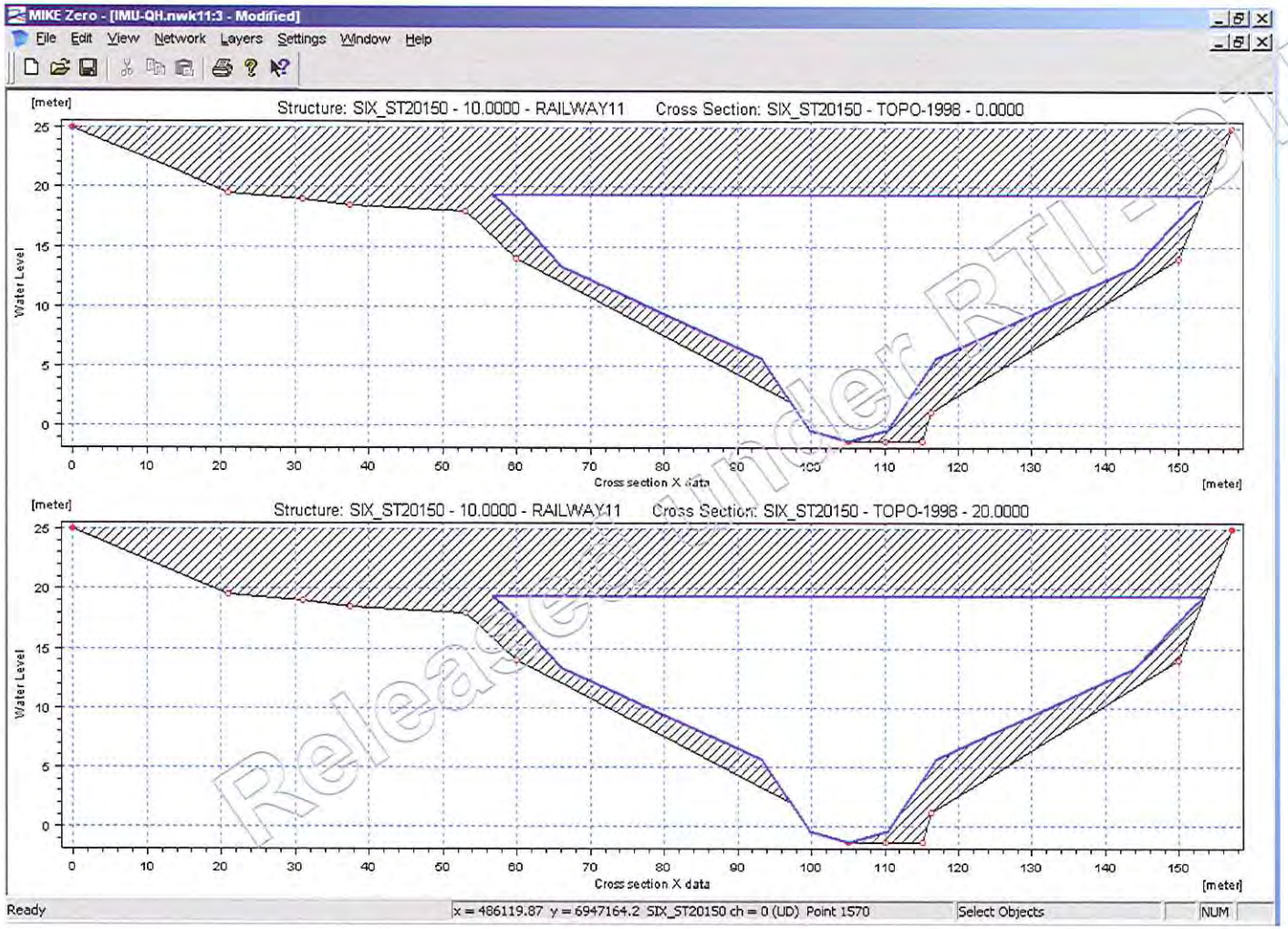

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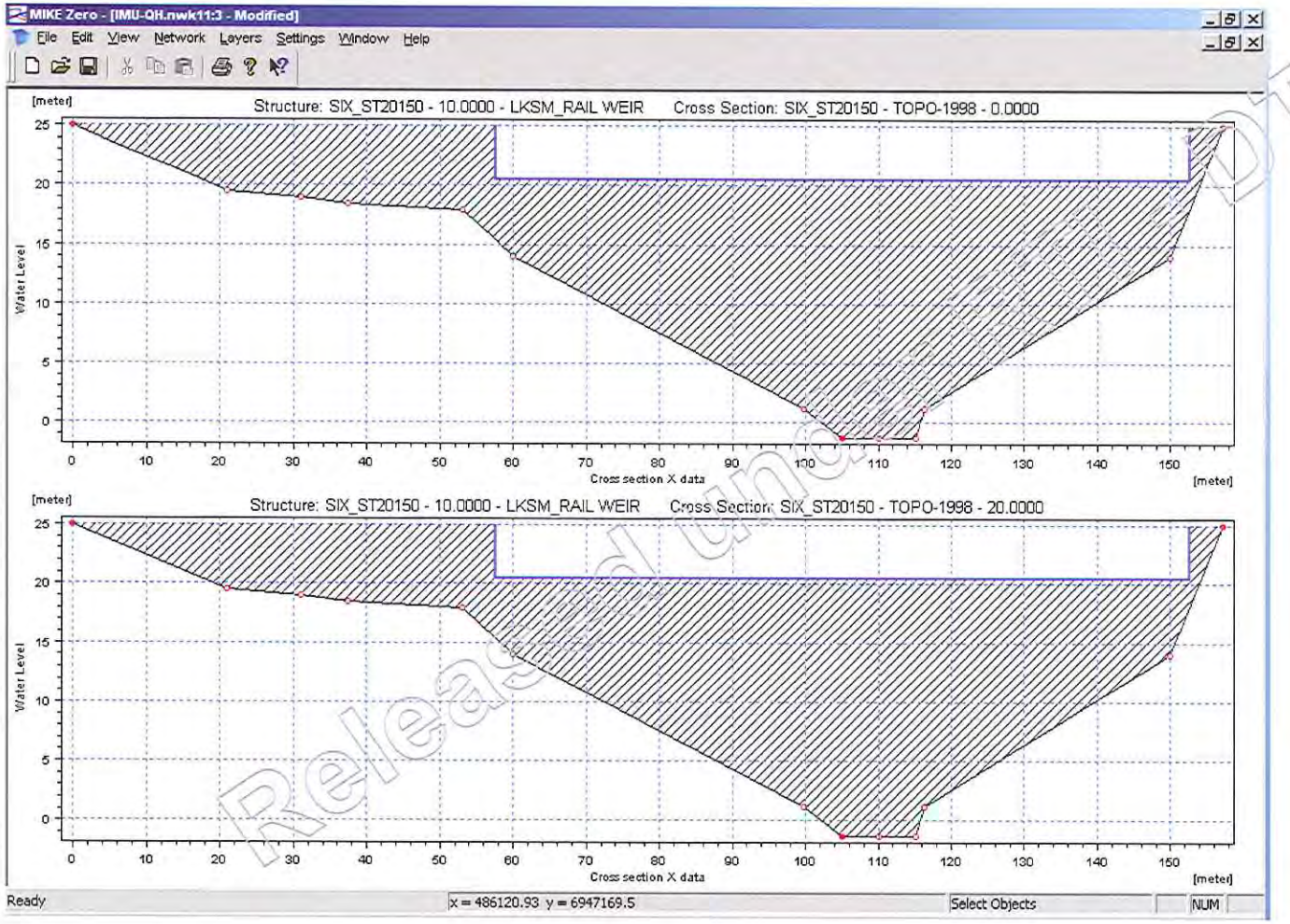
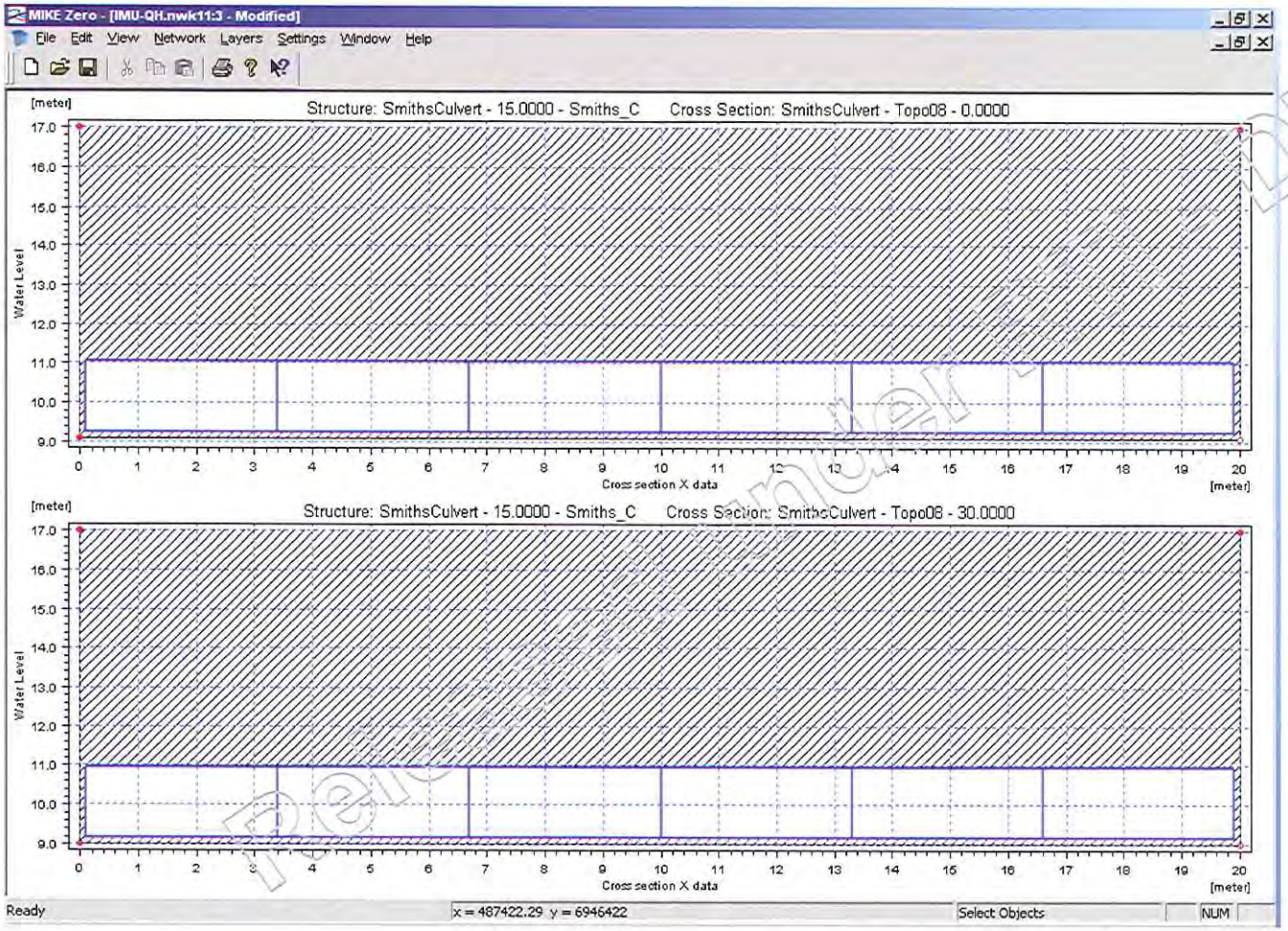
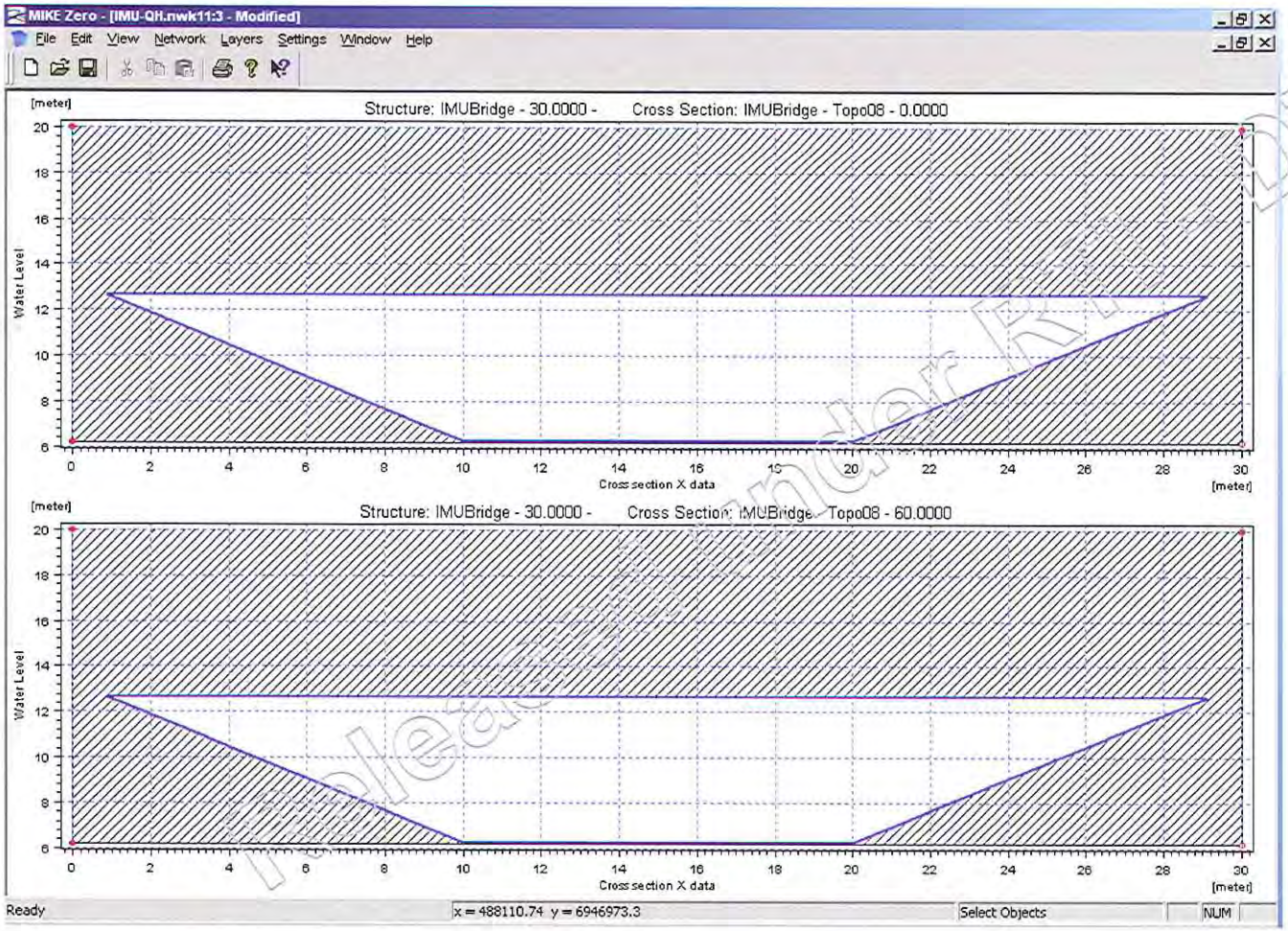


IMU Regional Q100 Goodna Creek MIKE11 input

Smiths Road – culvert

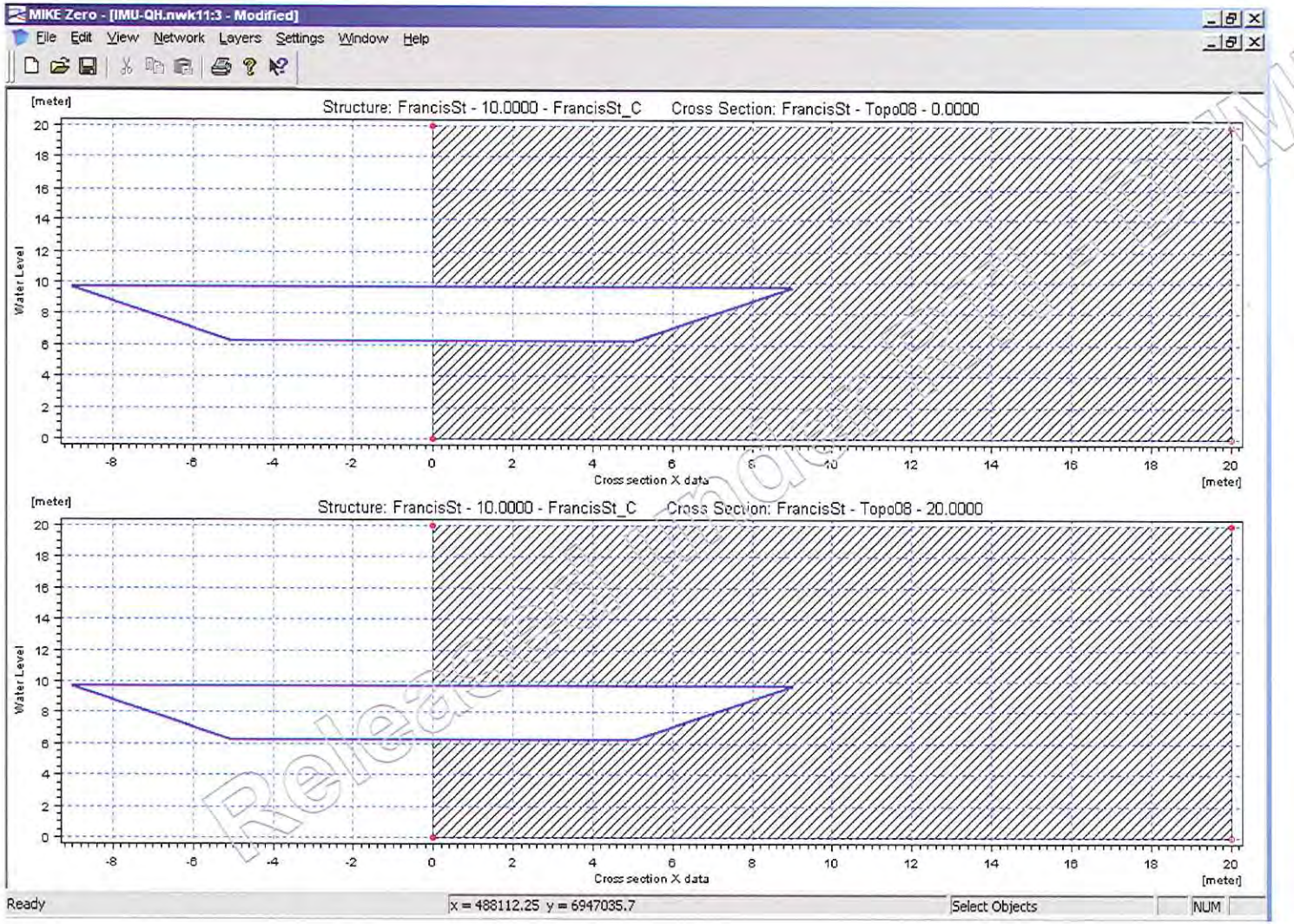


IMU bridge



IMU - Weir

Francis Street – culvert



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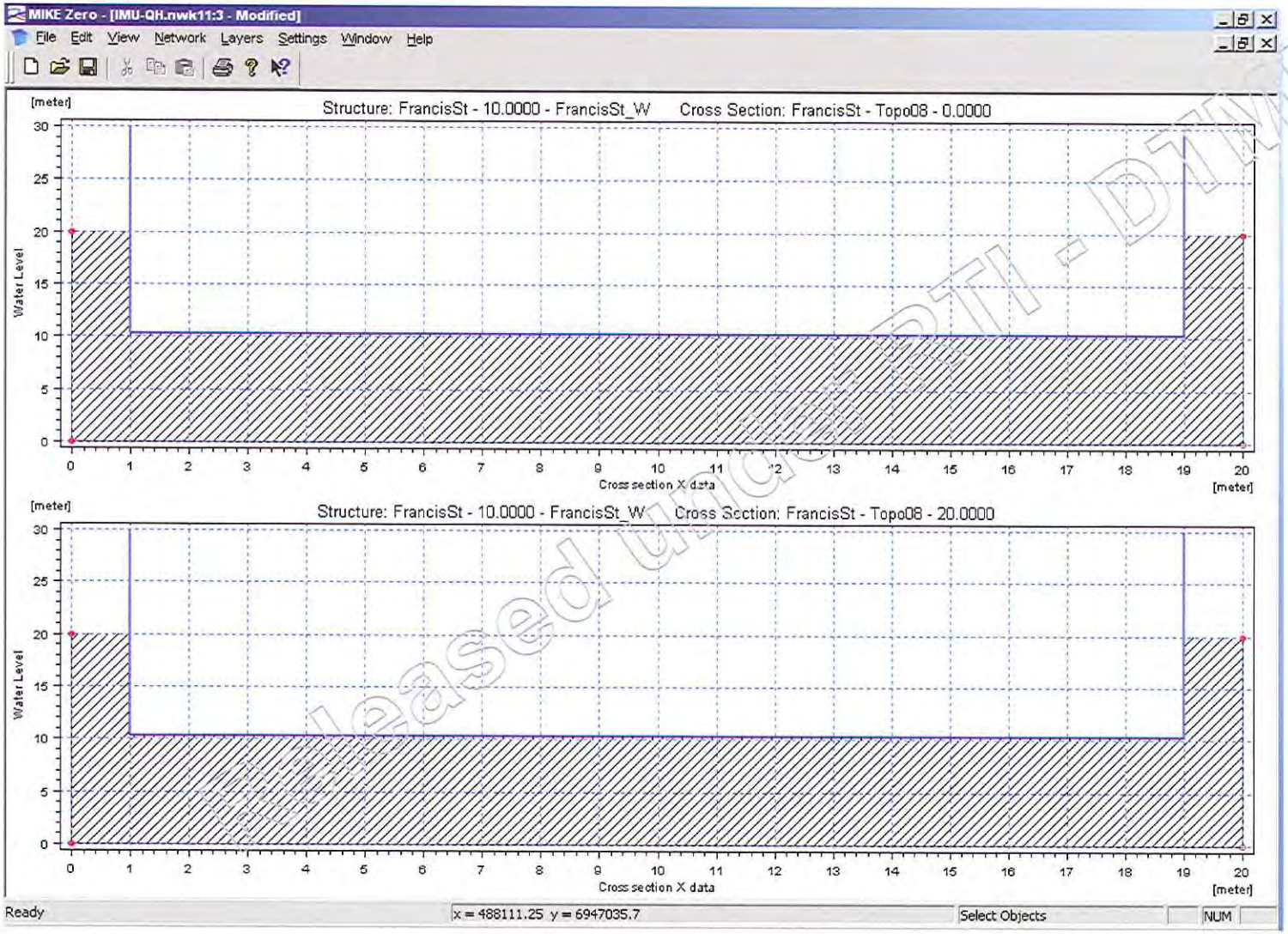

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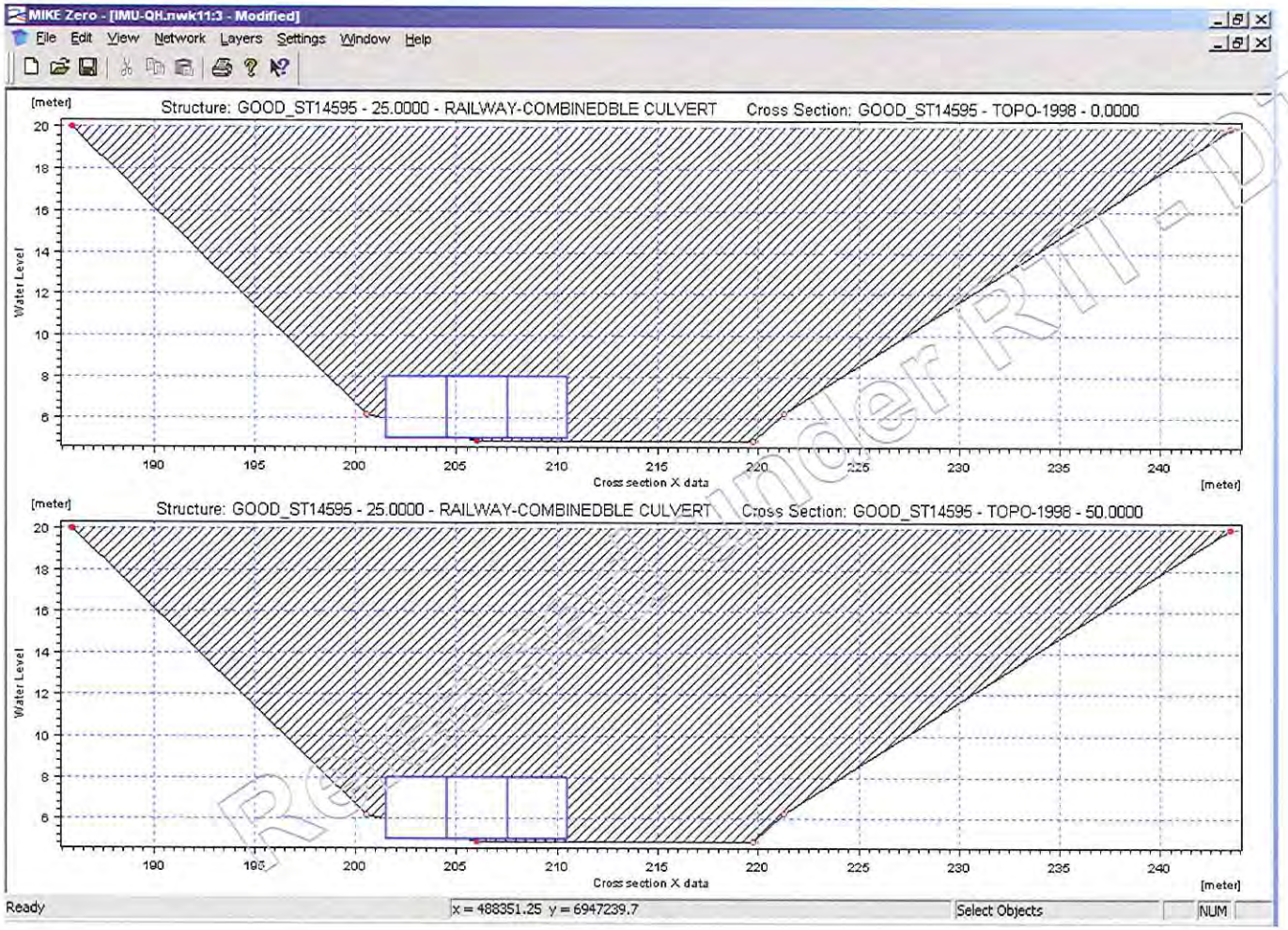

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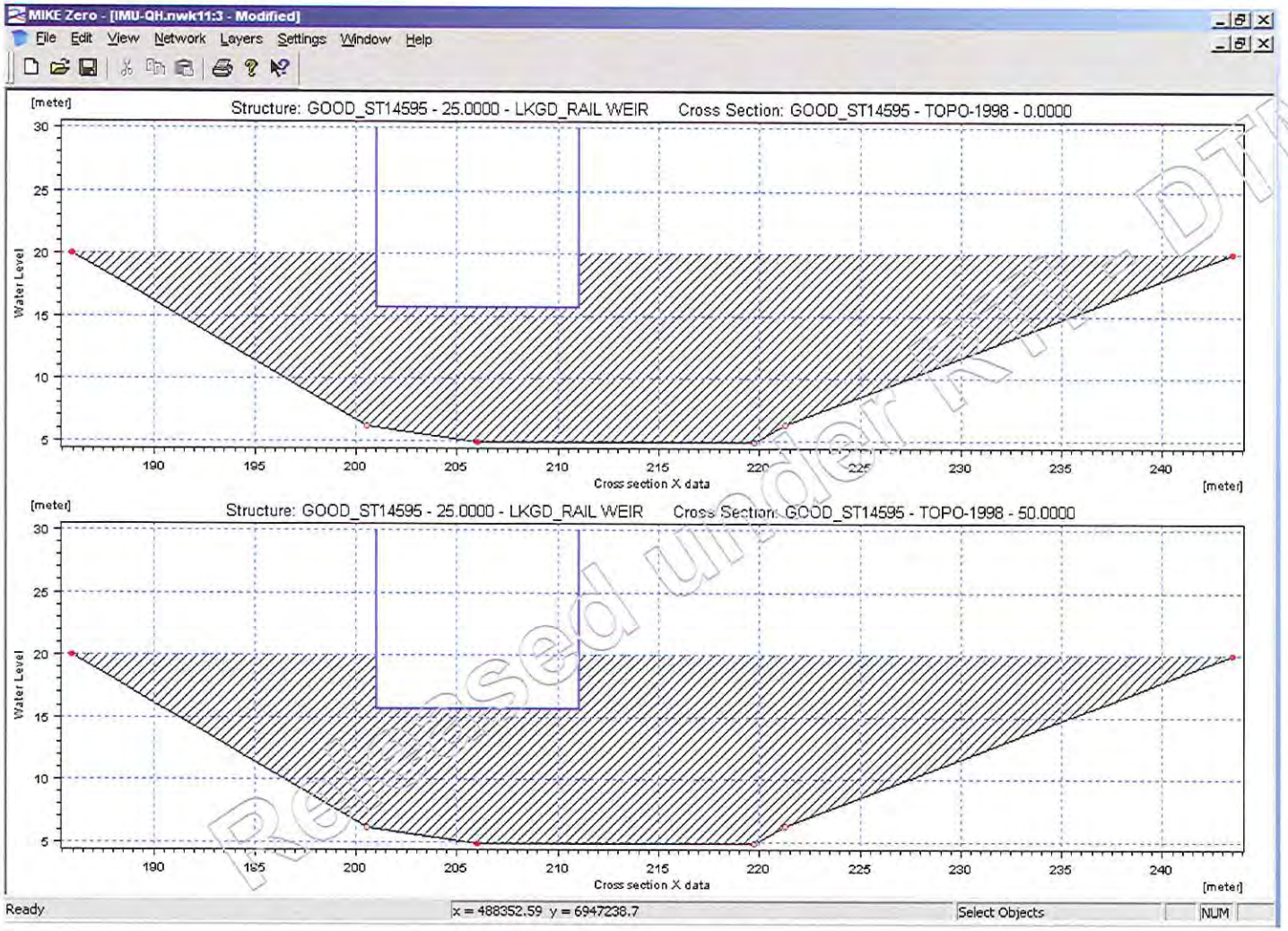
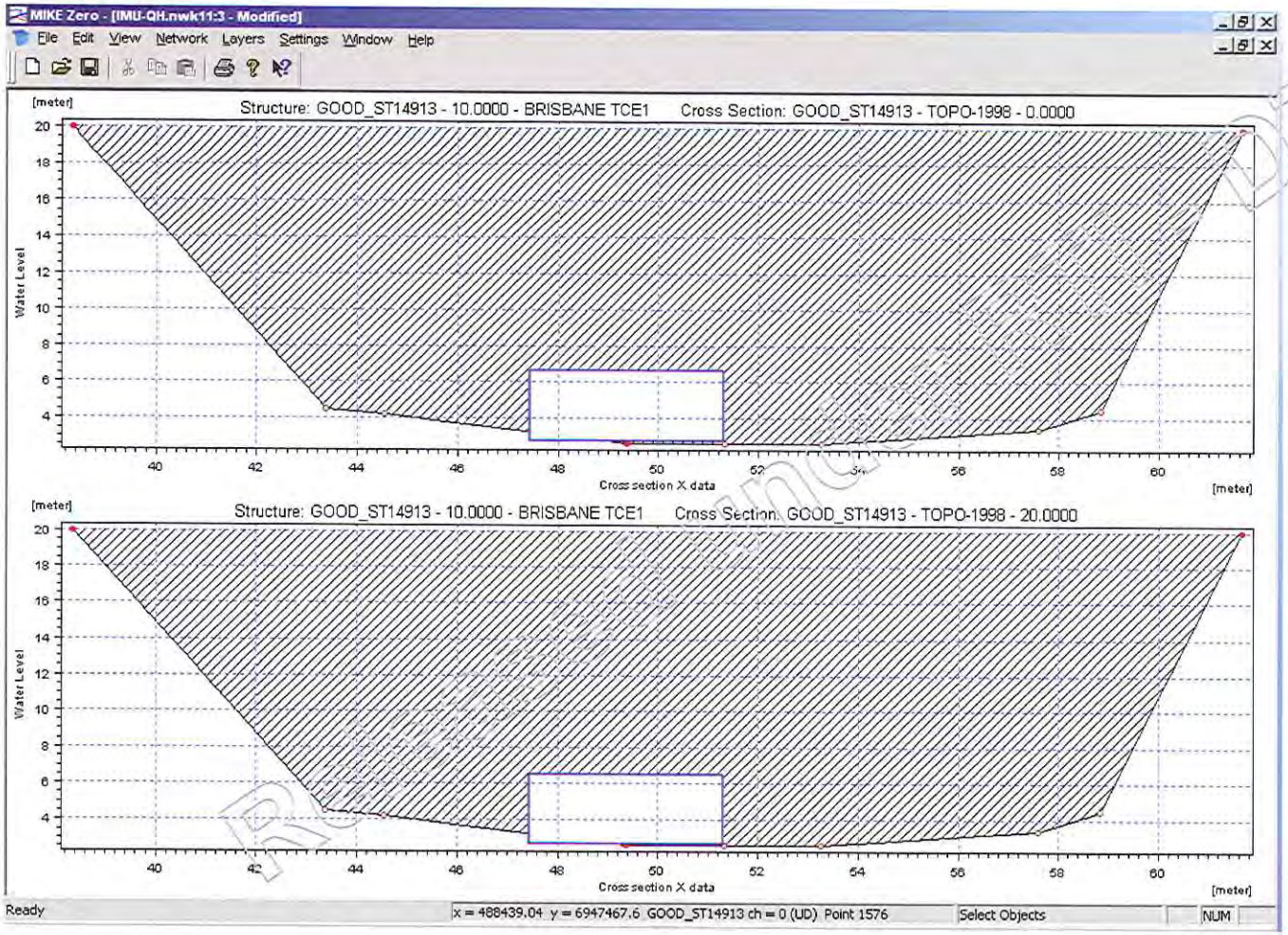
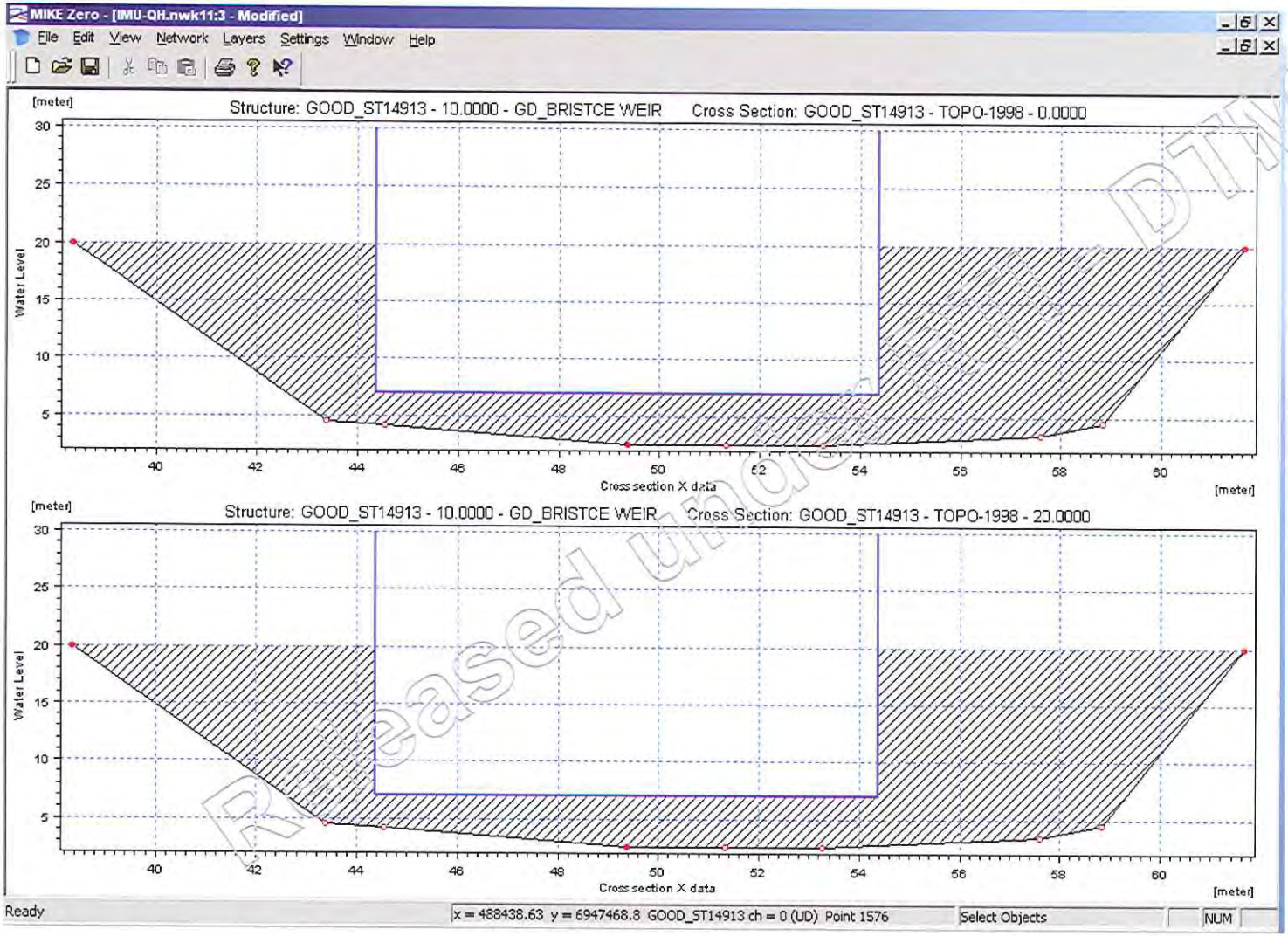


Bris Terrace – culvert



Bris Terrace Weir



OriginAlliance

Connecting Dinmore to Goodna

Ipswich Motorway Upgrade

Dinmore to Goodna

Final Design Report
Transverse Drainage - Zone 2
Other Culverts

Report No.: D2G-BASD-RERODR206-R-1000
Date: 30 September 2010

Job title	**IPSWICH MOTORWAY UPGRADE** **Dinmore to Goodna**	**DMR No.148/17A/59**
Document title	Final Design Report Transverse Drainage - Zone 2 Other Culverts	File reference
Document ref	D2G-BASD-RERODR206-R-1000	

File name:P:\10-DESIGN MANAGEMENT\10.01-Submission Control\DC\DCs To Issue\RERODR206 - Transverse Drainage - Other Culverts - IFC\IFC\Report Parts\Report\RERODR206-R-1000.doc

Revision	Revision Date	Details	Authorised			
			Prepared by	Checked by:	Verified by:	Approved by:
01	29/10/09	85% Design	Not Relevant			
02A	08/12/09	100%Final Design–AV Approval				
02	21/01/10	100%Final Design				
03A	18/3/10	100%Final Design-AV Approval				
03	14/4/10	100% Final Design (Hold Cloud Removal)				
04A	12/5/10	100%Final Design-AV Approval (Hold Cloud Removal)				
04	24/5/10	100% Final Design (Hold Cloud Removal)				
05A	7/9/10	100% Final Design -AV Approval (Design Amendment)				
05	30/9/10	100% Final Design - (Design Amendment)				

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1 Introduction

1.1 Background

The Ipswich Motorway Upgrade – Dinmore to Goodna involves the upgrade of 8km of extremely constrained urban motorway from four lanes to a minimum of six lanes and also includes two motorway to motorway interchanges. This is one of the largest roads projects ever undertaken in Queensland.

The Ipswich Motorway Upgrade – Dinmore to Goodna is being delivered through an Alliance framework by the Department of Main Roads. The Origin Alliance has been formed to meet the unique challenges of this project.

1.2 Scope of this Report

This report has been compiled to outline design development during the Final Design (100%) stage of the Project Delivery phase.

This report focuses on the transverse drainage for Francis Street in Zone 2 and the culvert at the intersection of Collingwood Drive and Smiths Road. The transverse drainage design for the other culverts on Smiths Road is contained in a separate report (D2G-BASD-RERO207-R-1000) and the mainline transverse drainage is contained in a separate report (D2G-BASD-RERO205-R-1000).

The local flood model results were used to determine tail water levels, where applicable, and are contained in the Goodna Creek local flood model document D2G-BASD-REFHKS100-R-1000

1.3 Description of this Package

This package is being reissued to document a design change at C-FS950. For further information on the design, refer to Section 4 of this report.

This design lot includes the transverse drainage infrastructure required for the intersection of Collingwood Drive and Smiths Road and Francis Street between CH 0 and CH 1300 (Zone 2). Transverse drainage is provided at existing watercourses and gullies to prevent localised flooding of upstream areas and inundation of the road.

This package includes the construction of new culverts in locations where culverts did not previously exist and the upgrade of existing culverts. The culvert locations are presented in Table 1-1.

Table 1-1 Proposed transverse culverts

Culvert	Crossing
C-SR100	Collingwood Drive/ Mine Street
C-FS620	Francis Street
C-FS750	Francis Street
C-FS950	Francis Street

1.3.1 Design Documentation

This package consists of the following design documentation:

- Detailed design report (this report)
- Appendix A – Design drawings
- Appendix B – Technical Standards and Specifications
- Appendix C – Reference drawings
- Appendix D – Reference documents
- Appendix E – Environmental Requirements Checklist
- Appendix F – IV Comments and Closeouts
- Appendix G – DMR Comments and Closeouts
- Appendix H – Third Party Comments and Closeouts
- Appendix I – Community Requirements checklist
- Appendix J – Value Engineering Outputs
- Appendix K – SIDR Outputs
- Appendix L – XP-SWMM Outputs
- Appendix M – Pipe Class Outputs
- Appendix N – Sub-catchment land use break-up

2 Reference Documents

This design report should be read in conjunction with the reference documents detailed in Table 2-1.

Table 2-1 History of Package Development

Stage	Document Title	Document Reference
15%	Concept design report – 15% transverse drainage – Zone 2	D2G-BASD-RERODR200-R-1000
85%	Detailed design report – 85% transverse drainage – Zone 2 – Other Culverts	D2G-BASD-RERODR206-R-1000
100%	Final design report – 100% transverse drainage – Zone 2 – Other Culverts	D2G-BASD-RERODR206-R-1000
100% - Post IFC Review	Final design report – 100% transverse drainage – Zone 2 – Other Culverts FS-950 revised	D2G-BASD-RERODR206-R-1000

Refer to Appendix C for the list of reference drawings.

Refer to SWTC (Scope of Works and Technical Criteria) - Appendix 16 for the list of general Reference Documents. Refer to Appendix D of this submission for any additional reference documents.

3 Compliance with the SWTC

3.1 General

Except where detailed below, it is expected all aspects of the Final Design (100%) stage of the transverse drainage design will fully comply with the requirements of the SWTC with design development.

3.2 Proposed SWTC Non-Compliances

There are no non-compliances at this stage of design.

Table 3-1 Schedule of non-compliances

Non-Conformance No.	Description	DMR Correspondence Reference
NIL		

3.3 Non-Compliances closed-out since previous Design Lot Stage Submission

The following non-compliances have been closed out since the previous stage of design (85% Detailed Design).

Table 3-2 Schedule of closed-out non-compliances

Non-Conformance No.	Description	DMR Correspondence Reference of Acceptance
RERODR206 – 1	Afflux downstream of C-FS950	RFI 0446
RERODR206 – 2	Afflux and modelling approach of C-FS950	RFI 0674

3.3.1 RERODR206 – 1 Afflux at Downstream of C-FS950

The area between the outlet of culvert C-FS950 and the inlet of the existing culvert at McAuliffe Street (CH 950) results in minor afflux at the culvert inlet for the 20 year ARI, 100 year ARI and PMF events. The issue has been raised in RFI-446. This has been closed out.

3.3.2 RERODR206 – 2 Afflux and modelling approach C-FS950

Due to the sensitive nature of C-FS950 and the range of events modelled the blockages factors and affluxes have been raised with the appropriate stakeholders to accept the modelling approach and conditions used. The issue has been raised in RFI-674 and has been closed out.

4 Design Description

4.1 Performance Criteria

The requirements of the Project Brief and SWTC have been summarised into the Design Criteria Report. This report forms the principal reference for the design team and has been submitted separately (D2G-BASD-DGRODR101-R-1000).

4.2 Technical Details

The following section discusses the Detail Design undertaken for Zone 2 Other Culverts C-SR100, C-FS620, C-FS750 and C-FS950.

4.2.1 General

The transverse drainage system has been designed to ensure an acceptable level of flood immunity for the proposed motorway and service roads and to ensure that the works do not have unacceptable impact on the hydraulic regime of the area. This is achieved by including adequately sized and located culverts, water diversions and other works in the design.

The design brief (Scope of Works and Technical Criteria – SWTC) requires that the Ipswich City Council controlled service roads and ramps must be designed so that the lowest point of each carriageway's pavement surface is protected from flooding and is 100 mm above the 20 year Average Recurrence Interval (ARI) flood level for cross drainage. This includes all locations where the works intercept runoff, floodplains, watercourses, depressions or drainage lines. The cross drainage structures have therefore been designed to convey the peak flows from the 20 year ARI storm event as a minimum.

This report only includes details for service road culvert crossings listed above.

The design relies on various data supplied from a number of sources as identified below:

- Field survey of existing structures and channels including Queensland Rail culverts (Alliance/DMR surveyors).
- Existing level of catchment development (taken from recent aerial photography).
- Future development conditions (based on Ipswich City Council planning scheme land uses).
- Current road design
- Local Goodna Creek flood model, for tailwater levels, where appropriate.

4.2.2 Existing Transverse Drainage

The details of the existing culverts are as follows:

Table 4-1 Existing Transverse Culverts on Service Roads

Culvert ID Chainage.	US IL (m)	DS IL (m)	Grade (%)	Culvert Size (mm Dia)	Existing Culvert Length (m)
Mine Street/Collingwood Drive, (Ch. 100 on Smiths Street)	11.53	11.35	0.5	2x 1500W x 900H RCBC	38.0
Existing Motorway (Francis Street at Ch. 620)	11.30	10.91	1.1	2 x 600 RCP	36.0
CH 16150 – Chalk St	9.47	9.38	0.51	1x1050 RCP	17.4
Existing McAuliffe Road (Francis Street at Ch. 950)	8.60	8.24	3.2	1x1050 RCP	11.2

4.2.3 Design Methodology

Generally, the proposed service road transverse culverts in Zone 2 have been sized to ensure peak water levels upstream and downstream of the structures do not exceed existing flood levels by more than 10 mm. The culverts also provide flood immunity to the service roads for the 20 year Average Recurrence Interval (ARI) storm for the local catchment. Two scenarios were considered as follows:

Base scenario – The hydrology of, and hydraulic calculations for the existing culverts were undertaken to estimate the existing 20 year ARI, 100 year ARI and PMF water levels and velocities upstream and downstream of the culverts. In this scenario, sub-catchment characteristics were assumed to be fully developed. A typical blockage factor of 20% was included in the analysis.

Upgrade scenario – The hydrology of, and hydraulic calculations for the upgraded service roads and culverts were undertaken to estimate the water levels and velocities upstream and downstream of each culvert for the 20 year ARI and 100 year ARI. The Probable Maximum Flood (PMF) event was modelled at culvert C-FS950 as requested by ICC to ensure that the proposed works do not adversely impact neighbouring residents. Sub-catchment characteristics were assumed to be fully developed. A minimum of 20% and maximum of 50% blockage is included in the analysis, depending on the inlet type.

Baseline and upgrade scenario flow hydrographs were estimated using the XP-RAFTS computer program. The hydraulic calculations for the culverts have been carried out using the XP-SWMM program. XP-SWMM uses the inflow hydrographs generated in XP-RAFTS and exported as an interface file. Outputs from XP-RAFTS were compared with the Rational Method for selected events to verify design flows.

The dimensions used for the design, including inlet and outlet levels and downstream channel properties were based on field survey where it was available. The tailwater levels for the culverts were based on the 20 year and 100 year Goodna Creek flood levels respectively.

Hydrology – XP-RAFTS & Rational Method

Hydrology describes the estimation of stormwater runoff volumes that are expected to traverse the service roads. This analysis only considers the flows from local catchments, not regional flows or flooding from major waterways.

The XP-RAFTS hydrological model was chosen to estimate design hydrographs as it is capable of representing a range of physical characteristics that influence runoff behaviour, such as rainfall patterns, catchment shape, catchment slope, drainage features, channel and floodplain storage, and variations in catchment land use. The XP-RAFTS model converts rainfall to runoff by applying rainfall losses to both the impervious and pervious catchments within the model to produce effective rainfall hyetographs. An initial and continuing loss model was adopted for this study, based on regional values recommended in Australian Rainfall and Runoff 2001 (AR&R). Standard temporal patterns and Intensity Frequency Duration (IFD) parameters were derived for the catchments using Volume 2 of AR&R. Detailed IFD data were generated for the entire project to ensure consistency as summarised in Table 4-2.

Table 4-2 Design Event – Intensity Frequency Duration Information

Parameter	Values
2 Year A.R.I. - 1 hour duration	46.27 mm/hr
2 Year A.R.I. - 12 hour duration	7.40 mm/hr
2 Year A.R.I. - 72 hour duration	2.20 mm/hr
50 Year A.R.I. - 1 hour duration	95.16 mm/hr
50 Year A.R.I. - 12 hour duration	15.41 mm/hr
50 Year A.R.I. - 72 hour duration	4.62 mm/hr
Geographic Factor F2	4.35
Geographic Factor F50	17.25
Location Skew	0.16
Temporal Pattern	Zone 3

The catchment areas were determined from the survey design models in the 12d earthworks and surveying computer package. This topographical information is based on aerial survey, detailed field survey and 1m contours obtained from Ipswich City Council (ICC) GIS information. Relevant percent imperviousness, Manning's roughness coefficients and catchment slopes were determined from the 12d model aerial photographs of the catchment and ICC development planning maps.

XP-RAFTS consider pervious and impervious sub areas separately. Each sub catchment has been divided into a pervious sub-area and an impervious sub-area. The pervious and impervious sub areas were estimated based on the land use. An Excel spreadsheet was developed to break-up the catchment and determine input data for the XP-RAFTS model.

The land use for the base and upgrade scenarios was based on ultimate catchment development in accordance with the ICC development planning maps. This yields conservatively high flows for the purposes of design. XP-RAFTS estimates runoff from the sub-catchments from the fraction impervious and the Manning's coefficients for each sub-catchment. The fraction impervious values were adopted from the XP-RAFTS Manual for the various land uses and the adopted fraction impervious and roughness coefficients are presented in Table 4-3.

Table 4-3 Fraction Impervious and Roughness coefficients

Land use Category	Fraction Impervious	Roughness 'n'(pervious)
Rural	0.1	0.07
Rural Residence	0.2	0.05
Commercial	0.9	0.03
Roads and Driveway	1	0.015
Urban	0.6	0.025
Open Space	0	0.04

Each sub-catchment has different loss parameters to account for the various level of imperviousness. The adopted loss parameters are based on recommended regional values from AR&R as summarised in Table 4-4.

Table 4-4 Rainfall Infiltration Losses

Loss rates	Pervious areas	Impervious areas	Reference
Initial losses (mm)	25	1.5	XP-RAFTS Reference/ AR&R Book 2 Sec. 3
Continuing losses (mm/hr)	2.5	0	XP-RAFTS Reference/ AR&R Book 2 Sec. 3

The XP-RAFTS model was run for a range of durations from 10 to 180 minutes for the 20 year ARI and 100 year ARI to determine peak flow rates for each individual culvert. As there is no recorded streamflow data to calibrate the models, the results were compared against peak flows estimated by the Rational Method. This was done to provide confidence in the results only, not to calibrate the models against the Rational Method estimates.

Design coefficients of runoff for the Rational Method calculations for different design average recurrence intervals were determined using Tables 3.7 and 3.8 on page 3-28 from the Road Drainage Design Manual (RDDM) – June 2002. The time of concentration was determined using standard inlet times and an estimate of pipe or channel flow assuming average flow velocities as presented in Section 3.5.3 of the RDDM.

The PMP estimates were derived in accordance with the Bureau of Meteorology's (BOM) guidelines, 'The estimation of Probable Maximum Precipitation in Australia: Generalised Short –Duration Method (June 2003), known as GSDM, for both base and ultimate scenarios. The Probable Maximum Flood (PMF) was estimated using XP-RAFTS model and XP-SWMM model.

Culvert Hydraulics – SWMM

The culverts are designed to ensure flood immunity of the service roads in a 20 year ARI event and to ensure that flood levels do not adversely impact on the adjoining properties and drainage systems upstream or downstream of the roads in a 100 year ARI event. This was done by determining flood levels for peak flows and velocities for each upgrade culvert structure and comparing results against the base scenario.

Hydraulics

The culvert and channel hydraulics were analysed using XP-SWMM. XP-SWMM is a one-dimensional unsteady state hydraulic model that can determine flood levels and velocities of stormwater systems (both underground pipe systems and overland flow paths) including detention basins and flood storages.

The model performs both inlet and outlet hydraulic calculations for culverts as explained below:

Inlet Control - For inlet control, the required headwater is calculated by assuming that the culvert inlet controls the upstream water level. Therefore, the inlet control capacity depends primarily on the geometry of the culvert entrance.

Outlet Control - For outlet control flow, the required headwater is calculated considering several conditions within the culvert and the downstream tailwater. For culverts flowing full, the total energy loss through the culvert is computed as the sum of friction losses, entrance losses, and exit losses. Friction losses are based on the Manning's equation. Entrance losses are calculated as a coefficient times the velocity head in the culvert at the upstream end. Exit losses are calculated as a coefficient times the change in velocity head from just inside the culvert (at the downstream end) to outside the culvert. The culvert entrance and exit losses are normally taken to be 0.5 and 1.0 respectively.

Blockage

The RDDM (Road Drainage Design Manual) indicates that the likelihood of blockage should be considered when designing culverts. Blockage can occur through a build up siltation or vegetation. Where blockage is considered to be likely due to the catchment containing significant woody riparian vegetation, larger culvert sizes may be required.

The culverts were modelled with blockage to determine impacts on existing flood levels for both the base and upgrade cases to ensure consistency between the scenarios. The blockage factor varied based on the catchment characteristics, sensitivity to blockage and requirement for an inlet screen. Where an inlet screen was not required a typical value of 20% was adopted and was applied at the base of the culverts.

Where an inlet screen is required the screen has been designed in accordance with QUDM guidance and a 50% blockage applied. It should be noted that the screen waterway area is required to be a minimum of 3 times the protected culverts waterway area. In effect a 50% blockage of the screen is unlikely to have a significant impact on the ability of the culvert arrangement to achieve its design capacity (i.e. 150% waterway area still available). For purposes of modelling, a blockage value of 20% was applied at the base of any culverts with an inlet screen to simulate sediment build-up.

Upgrade culvert C-FS950 represents a special case in that a suitable overland flow path will not be feasible for the upstream catchment as a result of the Francis Street/ Monash Road railway overpass embankment. The culverts have therefore been designed to cater for the PMF.

Tailwater

Modelling undertaken for Goodna Creek (refer report D2G-BASD-RERHK100-R-1000) was utilised to determine the tailwater levels in the 20 year and 100 year events. The adopted tailwater levels for the culverts C-SR100, C16150 and C-FS950 are given in the respective report sections.

Time-stage boundary conditions are used at the Goodna Creek nodes. This time-stage information for Q20 and Q100 flows for 60min durations were obtained from the dynamic HEC-RAS model, which was developed for Goodna Creek flood studies. The tailwater for the PMF scenario has been set at the 100 year flood level. Use of the PMF tailwater level would fully inundate the culverts and their upstream catchments.

Model Scenarios

Two model scenarios were developed in XP-SWMM:

- Base culvert case (ultimate development) – allowance for blockage
- Upgrade culvert case with the proposed IM upgrading case (ultimate development) – allowance for blockage

Water level, flow rate and velocity results were compared for both cases to confirm that the proposed culvert does not adversely impact adjacent property owners upstream and downstream. A description of the model for each culvert is provided below.

4.2.4 Upgrade Culvert C-SR100

The urban stormwater drainage system from the northern side of the Ipswich Motorway crosses the motorway through a series of pipes running adjacent to Mine Street. Stormwater discharges from Redbank Plaza and nearby catchments are added to these flows before discharging to Goodna Creek.

The two existing 1500W x 900H box culverts, crossing Mine Street and Collingwood Drive will be replaced as part of the road works proposed at the intersection of Mine Street and Smiths Road. The culverts are required to provide 20 year ARI immunity.

The upgrade of the motorway culverts and the models are discussed in the Zone 3 Transverse Drainage report (D2G-BASD-RIRODR300-R-1000). A summary of the information is provided below.

Hydrology –XP SWMM

The majority of the catchment is zoned as Major Centres, Residential Medium Density and Residential Low Density according to Ipswich City Council's PD (Planning & Development) Online. The catchment also includes some percentage of open space, road and commercial areas.

The total catchment area contributing to this culvert is 25.7 ha in the base case. The catchment area in the upgrade case is 0.9ha less than the base case due to the proposed motorway upgrading and culvert realignment. Runoff from the sub catchment C16500I1 with an area of 8.4 ha is collected at roadside gully pits and flows through a 2x 900 mm diameter RCP to the existing culvert outlet. Similarly, the runoff from the sub catchment C16500H1 with an area of 2.3 ha is collected at roadside gully pits and flows through a 750 mm diameter RCP to the existing culvert outlet. The upgrade of these two pipes are considered in the longitudinal drainage of the Mine Street and Collingwood Streets. The catchment plans are shown in Appendix A, D2G-BASD-RERODR203-K-2467 and 2468.

Refer to Zone 3 Transverse Drainage report (D2G-BASD-RIRODR300-R-1000) for the breakdown of catchment landuse for each sub-catchment for the base and upgrade case. The catchment break-up for the base case and ultimate case are shown on drawings K-2467 and K-2468.

Currently all flow from the catchment is diverted to the culvert in the upgrade case, an additional culvert outlet is provided just downstream of the Mine Street underpass. This results in less flow reporting to C-SR100. Both culverts have been modelled in one system to determine flow hydrographs at each culvert outlet.

The existing culvert network under the Redbank Plaza carpark will remain unchanged with no upgrade required. Culvert C-SR100 will be realigned and extended to suit the upgraded road alignment as the existing discharge location will be in the middle of the proposed Mine Street/Smiths Road Intersection.

The 20 year ARI storm event was run in XP-SWMM for storm durations ranging from 10 minutes to 2 hours. Table 4-5 shows the peak flow for each storm duration. The duration of 25 minute storm produced the largest outflow of 9.36 m^3/s for base case and 60 min produced 7.57 m^3/s for ultimate case at the culvert inlet.

The 100 year ARI storm event was run in XP-SWMM for storm durations ranging from 10 minutes to 2 hours. Table 4-5 shows the peak flow for each storm duration. The duration of 60 minute storm produced the largest outflow of 9.51 m^3/s for base case and 25 min produced 8.42 m^3/s for ultimate case at the culvert inlet. Peak flows have decreased in the ultimate case due to the upstream bypass just downstream of the Mine Street underpass.

Table 4-5 Peak flows at the culvert inlet – Base and Ultimate Scenarios – 20 and 100 year ARI

Storm Duration	Base Model		Ultimate Model	
	20 year ARI Flows (m^3/s)	100 year ARI Flows (m^3/s)	20 year ARI Flows (m^3/s)	100 year ARI Flows (m^3/s)
10 min	8.37	9.41	5.32	7.85
15 min	9.05	9.49	7.30	7.99
20 min	9.03	9.48	7.16	8.28
25 min	**9.36**	9.51	**7.22**	**8.42**
30 min	9.20	9.50	**7.00**	**8.41**
45 min	8.44	9.46	6.62	8.00
60 min	9.25	**9.51**	**7.57**	8.26
1.5 hr	8.35	9.25	5.63	7.88
2 hr	8.92	8.92	5.07	6.32

It is found that the 20year 25min flow is 9.36m^3/s and the 100year 60min flow is 9.51m^3/s through the existing box culverts. There is not much increase in the 100 year flows through the box culvert. And this reduction is due to diversion upstream.

The existing system comprises 800mm longitudinal RCP plus 2x1500x900 transverse RCBC plus flow overtopping Mine Street in 20 and 100 year ARI events. The bypass flows along the existing link pc16500H1 (800mm RCP+ Overland flow) are given in the Table below:

Table 4-6 Peak flows (existing scenario) along the link pc 16500H1

Flows (m^3/s)	20 year ARI 25min	100 year ARI 60min
Pipe flow	1.44	1.45
Overland flow (road) across Mine street and Collingwood drive	1.33	4.84
Total flow	**2.77**	**6.29**

This indicates that most of the existing flows bypass the culvert by overtopping the road. Increase in flow from 20 year ARI event to 100 year ARI event is accommodated by increasing overtopping flows only and the flows in RCP and RCBC are not increased. The proposed system includes a diversion upstream such that flows do not overtop Mine Street in both events.

Hydrology – Rational Method

The stormwater runoff results from XP-SWMM were compared against peak flows estimated by the Rational Method. The 20 year ARI flow was estimated using the fully developed catchment runoff coefficients, intensity of rainfall and the catchment area.

The area of the catchment is 25.7 ha (upstream of the culvert). A fraction impervious was derived for each sub-catchment, with an average of 0.70 for the total upstream (fully developed) catchment.

The time of concentration for the catchment was estimated using a standard inlet time and average flow velocity for the pipe flow path. A standard inlet time of 13 minutes was adopted based on the upstream sub-catchment slope. The pipe flow time was found to be 4.9 minutes using the average flow velocity of 3.0 m/s for the pipe length of 874m. Consequently, the total time of concentration was estimated to be 18 minutes.

The Rational Method estimate for peak flow for the 20 year ARI event is $9.1m^3/s$, which is slightly lower than the XP-SWMM peak flow of $9.4m^3/s$.

There is a fair comparison between XP-SWMM and Rational Method giving confidence in the XP-SWMM hydrology. The XP-SWMM peak flow is considered conservative as it is greater than the Rational Method peak flow. The assumptions used in the Rational Method analysis (e.g. standard inlet time used in the estimation of the time of concentration, fraction impervious and flow velocity used in the pipe flow etc.) would contribute to the discrepancy.

Hydraulics – SWMM

The hydraulics of the entire system was modelled using XP-SWMM. The Base model starts at Brisbane Road north of the motorway. The culvert network crosses the motorway main alignment, Redbank Plaza car park area, Mine Street and Collingwood Drive before discharging into Goodna Creek on the south-east corner of Redbank Plaza approximately 180m south of the motorway.

A new outlet has been designed upstream of Redbank Plaza, which discharges flows in excess of the downstream network capacity so that no upgrades are required to the pipe network under Redbank Plaza. However, two box culverts are required to pass the design flows across Mine Street in order to provide 20 year ARI immunity.

The construction of a new access chamber within the road reserve is required at a location 10m away from an existing manhole. The existing pipe culverts will be retained between the manholes.

A time-stage boundary condition was used at culvert outlet at Goodna Creek. This time-stage information for Q20 and Q100 flows was obtained from the HEC-RAS model developed for Goodna Creek flood studies. The time-stage information is given in the following table:

Table 4-7 The tailwater elevations at Goodna Creek

Time (hrs)	Base Case Stage (m)- Q20	Ultimate Case Stage (m)-Q20	Base Case Stage (m)-Q100	Ultimate Case Stage (m)-Q100
0	11.06	10.56	11.06	10.56
0.5	11.07	10.64	11.20	10.98
1.0	11.53	11.26	11.73	11.55
1.5	11.92	11.70	12.15	12.15
2.0	12.01	11.89	12.52	12.84
2.5	11.81	11.56	12.27	12.47
3.0	11.57	11.31	11.76	11.68
3.5	11.39	11.15	11.45	11.17
4.0	11.05	10.74	11.07	10.68
4.5	10.75	10.37	10.79	10.34

The upstream inlet gully pits were modelled as an orifice/weir with a blockage factor of 50% and the road culverts were modelled without any blockage.

For detailed SWMM outputs, refer to the Zone 3 report mentioned above.

Results

The adopted culvert solution is presented below:

- 2x 1800W x 900H RCBCs

Table 4-8 Results for existing and proposed culverts at C-SR100 – 20 year ARI

Location	Scenario	Flow (m^3/s)	Velocity (m/s)	Road Formation Level (m)	Water Level (m)	Ground Level (m)	Afflux (m)
C16500A7	Existing	9.36	3.44	15.0[1]	14.287	11.53	-0.919
(RB Plaza Manhole)	Proposed	-	-	15.0[1]	13.368	11.53	
C-SR100A	Existing	-	-	-	-	-	
(Inlet Manhole)	Proposed	7.57	2.33	13.2	12.691	11.50	
C-SR100B	Existing	9.36	-	-	12.141	11.04	-0.120
(Outlet)	Proposed	7.57	-	-	12.021	11.00	

Note: 1- refers to the Redbank Plaza Car Park Level

Table 4-9 Results for existing and proposed culverts at C-SR100 – 100 year ARI

Location	Scenario	Flow (m^3/s)	Velocity (m/s)	Road Formation Level (m)	Water Level (m)	Ground Level (m)	Afflux (m)
C16500A7	Existing	9.51	3.48	15.0[1]	14.346	11.53	-0.400
(RB Plaza Manhole)	Proposed	-	-	15.0[1]	13.746	11.53	
C-SR100A	Existing	-	-	-	-	-	
(Inlet Manhole)	Proposed	8.45	2.60	13.2	12.904	11.50	
C-SR100B	Existing	9.51	-	-	12.207/12.522*	11.04	-0.139
(Culvert outlet)	Proposed	8.45	-	-	12.068/12.846*	11.00	

Note: 1- refers to the Redbank Plaza Car Park Level

* afflux caused by increase in Goodna Creek water level

The peak water levels in Goodna Creek do not coincide with peak flows in local drainage

Discussion

The upgraded culverts are required to discharge stormwater flows to the southern side of Smiths Road. Stormwater flows originate from the urban areas north of the motorway and the properties west of Mine Street including Redbank Plaza.

The culvert upgrade at C-SR100 requires two 1800W x 900H RCBCs. As this is a local road, the culverts are sized for 20 year ARI design flows so that the upstream flows can be discharged to Goodna Creek without causing afflux or allowing runoff to overtop the road.

A 200m long 5m wide vegetated channel is required to convey the flows from the culvert outlet to Goodna Creek.

The estimated water levels before and after the motorway upgrade have been compared at the existing manhole no.C16500A7, which is located in the Redbank Plaza compound. A water level reduction of 919 mm for the 20 year ARI design event is estimated. A reduction in upstream flood level is preferred to ensure that the road upgrade has no impact on upstream properties.

At the proposed culvert inlet location C-SR100A, the predicted water level is 12.691m, which is lower than the foot path finished level of 13.05m.

Scour protection will be required downstream of the proposed culvert based on the expected outlet velocity (Section 4.2.13).

The ultimate model was run with the 100 year ARI flow and it was found that the transverse flows do not overtop Mine Street/Collingwood Drive as flows are reduced because of the diversion upstream at the new proposed drain parallel to the motorway.

The intersection of Smiths Road and Collingwood Drive is underlain by mine workings associated with the new Redbank colliery; refer to new Redbank interpretive report for a discussion on foundation treatment details.

At this stage (100% final detailed design) the hydraulic calculations for the culverts provides an acceptable design.

4.2.5 Upgrade Culvert C-FS620 and C16150

The existing culvert consists of twin 600 mm diameter RCPs 36 m long crossing the existing Ipswich Motorway (IM), and a 1050 mm diameter 17m long RCP crossing Chalk Street. The runoff from the catchment on the northern side of the motorway flows into a detention basin located upstream of the IM, which is currently designated as a recreation area, before entering the culverts.

A new local road configuration connecting the Brisbane Terrace/ Bridge Street roundabout with the Francis Street upgrade requires the existing two culverts to be replaced by new culverts known as C-FS620 and C16150. Culvert C-FS620 will cross Francis Street (formally IM) and discharge to a 3m wide open channel that connects to the proposed IMU culvert C16150. Culvert C-FS620 will be designed to provide a 20 year level of immunity to the local road while culvert C16150, which crosses the motorway, is required to provide a 100 year level of immunity. The details of culvert C16150 are contained within Detailed Design Report, Transverse Drainage – Zone 2, Early Works Culverts (D2G-BASD-RERO205-R-1000).

Culvert C-FS620 was deemed to be a Class B culvert, according to QUDM, because it is close to a park and residential areas. It is therefore provided with an inlet screen.

Hydrology – XP-RAFTS

Two hydrology models were developed for the design. The first is the base scenario with the existing motorway and culverts with the assumed ultimate catchment development. The second model included the upgraded Ipswich Motorway and proposed culverts with the ultimate catchment development.

The majority of the extensive upstream catchment is zoned as *Residential Low Density* and *Recreation* according to Ipswich City Council's *PD (Planning & Development) Online*. XP-RAFTS was used to generate catchment flows upstream of the culverts. The sub-catchment characteristics are provided in Table 4-11, and were assumed to be fully developed. The catchment breakup is shown in Appendix A, Sketch no. D2G-BASD-RERODR200-K-2452 and the sub-catchment land-use break up are shown on Appendix N.

Table 4-10 C-FS620/ C16150 sub-catchment characteristics – Base Scenario

Sub-catchment	Sub-catchment Number	Total Area [ha]	Catchment Slope [%]	Init/Cont Rainfall Loss	Catchment Mannings 'n'	Percentage Impervious [%]
C16150/a	1	0.00	3.1	IL25CL2.5	0.02	0
	2	0.78	3.1	IL1.5CL0	0.015	100
C16150/b	1	2.03	4.6	IL25CL2.5	0.036	0
	2	0.41	4.6	IL1.5CL0	0.015	100
C16150/c	1	1.00	4.0	IL25CL2.5	0.032	0
	2	0.60	4.0	IL1.5CL0	0.015	100
C16150/rd1	1	0.00	1.6	IL25CL2.5	0.02	0
	2	0.30	1.6	IL1.5CL0	0.015	100
C16150/rd2	1	0.00	0.9	IL25CL2.5	0.02	0
	2	0.11	0.9	IL1.5CL0	0.015	100
C16150/g1	1	0.43	2.5	IL25CL2.5	0.031	0
	2	0.33	2.5	IL1.5CL0	0.015	100

Sub-catchment	Sub-catchment Number	Total Area [ha]	Catchment Slope [%]	Init/Cont Rainfall Loss	Catchment Mannings 'n'	Percentage Impervious [%]
C16150/g2	1	0.77	2.8	IL25CL2.5	0.033	0
	2	0.40	2.8	IL1.5CL0	0.015	100
C16150/rd3	1	0.00	1.8	IL25CL2.5	0.02	0
	2	0.29	1.8	IL1.5CL0	0.015	100
Total		**7.45**				**43%**

The total catchment area contributing to the existing Ipswich Motorway culvert is 5.12 ha (Sub-catchment C16150/a + C16150/b + C16150/c + C16150/rd1). The sub-catchments have a typical slope of 5% and the road has a slope of approximately 1%. Flow from this area then passes through to the Chalk Street culvert with the addition of road areas (sub catchments C16150/rd2, C16150/g1 and C16150/g2). The sub catchment C16150/rd3 is added at the culvert outlet to give a total catchment area of 7.45 ha.

The 20 year and 100 year ARI storm events were run in XP-RAFTS for storm durations ranging from 10 minutes to 6 hours. Table 4-12 shows the peak flow for each storm duration. The 60 minute duration storm produced the largest outflow of 2.0 m^3/s and 3.1 m^3/s for the 20 year and 100 year ARI storms respectively.

Table 4-11 Peak flows at the culvert inlets – Base Scenario- 20 year and 100 year ARI

Storm Duration	20 year ARI Flow at Culvert Inlet (m^3/s)	100 year ARI Flow at Culvert Inlet (m^3/s)
10 min	1.3	1.8
15 min	1.5	2.2
20 min	1.5	2.4
25 min	1.9	2.7
30 min	1.8	2.6
45 min	1.4	2.3
60 min	**2.0**	**3.1**
1.5 hr	1.9	2.5
2 hr	1.5	2.2
3 hr	1.4	1.8
6 hr	0.9	1.2

The upgrade scenario sub-catchment characteristics are provided in Table 4-13, and the catchment break-up is shown in Appendix A, Sketch no. D2G-BASD-RERODR200-K-2455. The land-use break up within each sub-catchment is detailed in Appendix N.

Table 4-12 C-FS620/ C16150 sub-catchment characteristics – Upgrade Scenario

Sub-catchment	Sub-catchment Number	Total Area [ha]	Catchment Slope [%]	Init/Cont Rainfall Loss	Catchment Mannings 'n'	Percentage Impervious [%]
C16150/a	1	0.00	3.1	IL25CL2.5	0.02	0
	2	0.78	3.1	IL1.5CL0	0.015	100
C16150/b	1	1.72	4.6	IL25CL2.5	0.036	0
	2	0.35	4.6	IL1.5CL0	0.015	100
C16150/r71	1	0.00	1.0	IL25CL2.5	0.02	0
	2	0.22	1.0	IL1.5CL0	0.015	100
C16150/r72	1	0.00	1.0	IL25CL2.5	0.02	0
	2	0.27	1.0	IL1.5CL0	0.015	100
C16150/h	1	1.89	2.1	IL25CL2.5	0.04	0
	2	0.00	2.1	IL1.5CL0	0.015	100
C16150/z	1	0.10	4.2	IL25CL2.5	0.028	0
	2	0.15	4.2	IL1.5CL0	0.015	100
Total		**5.47**				**32%**

The total catchment area draining to C-FS620 and subsequently C16150 is reduced to 5.47 ha in the upgrade scenario. Sub catchment C16150/c now discharges to culvert C-FS750 to the west. Culvert C-FS750 is discussed in Section 4.2.6. The breakdown for each upgrade culvert is as follows:

- C-FS620 (sub-catchments C16150/a and C16150/b) – 2.85 ha
- C16150 (sub-catchments C16150/a, C16150/b, C16150/r71, C16150/r72 and C1610/h) – 5.22 ha

The 20 and 100 year ARI storm events were run in XP-RAFTS for storm durations ranging from 10 minutes to 6 hours. Table 4-14 shows the peak flow for each storm duration for each culvert inlet. The 60 minute duration storm produced the largest outflow for the culverts.

Table 4-13 Peak flows at the culvert inlet – Upgrade Scenario-20 and 100 year ARI

Storm Duration	20 year ARI Flow at Culvert Inlet (m^3/s)	100 year ARI Flow at Culvert Inlet (m^3/s)
10 min	0.8	1.1
15 min	1.0	1.4
20 min	0.9	1.5
25 min	1.2	1.7
30 min	1.1	1.6
45 min	0.8	1.4
60 min	**1.3**	**1.9**
1.5 hr	1.1	1.6
2 hr	0.9	1.3
3 hr	0.8	1.0
6 hr	0.6	0.7

Hydrology – Rational Method

The stormwater runoff results from XP-RAFTS were compared against peak flows estimated by the Rational Method. The 100 year ARI flow was estimated using the fully developed catchment runoff coefficients, intensity of rainfall and the catchment area. The area of the catchment (ultimate case) draining to the culvert inlet is 2.85 ha. A fraction of imperviousness was derived for each sub-catchment, with of average of 0.6 for the total upstream (fully developed) catchment.

The time of concentration for the catchment was estimated using the standard inlet time and an estimated pipe flow time. A standard inlet time of 13 minutes was used based on the headwater sub-catchment slope. The pipe flow time was found to be 2.0 minutes using an average flow velocity of 2 m/s for the pipe/surface flow length of 250 m. Consequently, the total time of concentration was estimated to be 15 minutes.

The Rational Method estimate peak flow for the 20 year ARI is 1.1m^3/s, which is slightly lower than the XP-RAFTS peak flow of 1.3 m^3/s in the existing scenario. Given that the Rational Method does not account for any storage on a catchment, a higher value would be expected. The XP-RAFTS estimate is considered suitable for design purposes.

Hydraulics – XP-SWMM

Culvert hydraulics was modelled using XP-SWMM. The model includes the sub-catchment upstream of the existing culvert and extends downstream to Goodna Creek.

Under existing conditions there is detention storage upstream of the existing motorway which has been formed by the motorway embankment crossing a natural depression. The storage is located at the inlet of the existing culvert/culvert C-FS-620 and the stage/discharge relationship for the existing and upgrade scenarios are given in the Tables 4-15 and 4-16. The motorway upgrade reduces the storage because of the construction of the local access road.

Table 4-14 Stage-storage relationships for detention storage in Base Scenario

Detention basin upstream of existing motorway			
Contour Level (m AHD)	**Water Depth (m)**	**Area (ha)**	**Cumulative Volume (m^3)**
11.3	0.0	0.000	0
12.0	0.7	0.003	10
13.0	1.7	0.050	280
14.0	2.7	0.320	2130

Table 4-15 Stage storage relationships for detention storage in the upgrade scenario

Detention basin upstream of existing motorway			
Contour Level (m AHD)	**Water Depth (m)**	**Area (ha)**	**Cumulative Volume (m^3)**
12.3	0.0	0.000	0
13.0	0.7	0.009	30
14.0	1.7	0.131	730
15.0	2.7	0.356	4960

Blockage factors of 20% were adopted for upstream culverts in the base and upgrade scenarios and a blockage factor of 10% was adopted for the upgrade culvert C16150 given its location downstream of culvert C-FS620. An additional entrance loss factor of 1.0 was applied to estimate approximately the partially blocked screen hydraulic losses.

A time-stage boundary condition was used for the tailwater at Goodna Creek. This time-stage information for 20 year ARI 100 year ARI flows was obtained from the HEC-RAS model developed for Goodna Creek. The time-stage information is given in the following table:

Table 4-16 Tailwater elevations at Goodna Creek

Time (hrs)	Base Case Stage (m)- Q20	Ultimate Case Stage (m)-Q20	Base Case Stage (m)-Q100	Ultimate Case Stage (m)-Q100
0	9.30	9.29	9.30	9.29
0.5	9.29	9.28	9.33	9.32
1.0	9.42	9.42	9.54	9.54
1.5	9.59	9.59	9.85	10.06
2.0	9.81	10.07	10.81	11.25
2.5	9.69	10.00	11.37	11.73
3.0	9.54	9.58	10.74	11.19
3.5	9.46	9.46	9.53	10.1
4.0	9.35	9.35	9.35	9.35
4.5	9.28	9.28	9.27	9.27

Results

The adopted upgrade culvert solution is presented below:

- C-FS620 – 2x 750 mm diameter RCP (Francis Street)
- C16150 – 2x 1200 mm diameter RCP (Main Line)
- Localised regrading (approximately 1m depth) will be required to form the upgrade culvert inlet area. Refer Drawing No.D-1034 for details.

Flow, water level and velocity results from the XP-SWMM hydraulic model for the base case and upgraded case are summarized in Table 4-18 and Table 4-19. The model output is contained in Appendix L.

Table 4-17 Results for existing and proposed culverts at C-FS620 – 20 year ARI

Location	Scenario	Flow (m^3/s)	Velocity (m/s)	Road Formation Level (mAHD)	Water Level (mAHD)	Ground Level (mAHD)	Afflux (m)
C-FS620A (Francis St. culvert Inlet)	Base	1.32	2.88	15.20	13.020	11.28	-0.004
	Upgrade	1.07	2.06	15.50	13.016	12.25	
C16150B (IMU Culvert outlet)	Base (Chalk Street)	1.60	NA	11.00	10.10	9.38	-
	Upgrade (IMU)	1.43	NA	16.00 (IMU road level)	9.81	8.83	

Table 4-18 Results for existing and proposed culverts at C-FS620 – 100 year ARI

Location	Scenario	Flow (m^3/s)	Velocity (m/s)	Road Formation Level (mAHD)	Water Level (mAHD)	Ground Level (mAHD)	Afflux (m)
C-FS620A (Francis St. culvert Inlet)	Base	1.56	3.38	15.20	13.651	11.28	-0.317
	Upgrade	1.39	2.22	15.50	13.334	12.25	
C16150B (IMU Culvert outlet)	Base (Chalk Street)	2.00	NA	11.00	10.190/10.370*	9.38	-
	Upgrade (IMU)	2.15	NA	16.00 (IMU road level)	9.320/11.730*	8.83	

* afflux caused by increase in Goodna Creek water level

The peak water levels in Goodna Creek do not coincide with peak flows in local drainage

The flows in the upgrade case were slightly higher than the base case because of the modified retention basin storage.

The upstream side of the culvert arrangement will incorporate inlet screen fitted to the concrete headwall. Details of the screens are provided on the drawing nos. D-2115 & D-2116.

Discussion

New twin 750 mm diameter RCPs will replace the existing twin 600 mm diameter RCPs under the existing motorway (and become Francis Street culverts). The existing culverts under Chalk Street will be replaced with twin 1200 mm diameter RCPs (and become the IMU culverts).

The afflux at the upstream end of the proposed culvert system (Francis Street culvert) was checked and a flood level decrease of 4 mm and 317mm for the 20 year and 100 year ARI event are predicted. The predicted ultimate 100 year flood level is 13.33 m at the Francis Street culvert inlet with the ground level (lowest level) at the nearest housing area at 16.00 m. The properties upstream of the culvert will not be affected by the 100 year ARI.

In flood events larger than the 100 year ARI event, it is expected that upstream floodwaters will breach over Francis Street to the southeast of the proposed culvert and flow east towards Goodna Creek. The lowest road level of Francis Street is 15.5m and it is not expected to impact the upstream properties which are above 16.0m.

At this stage (100% final design) the hydraulic calculations for the culverts provides an acceptable design.

A safety analysis was performed in accordance with QUDM to determine the need for safety screens or fencing at the culvert inlet. An inlet screen has been incorporated into this design.

Scour protection and pipe loading and bedding calculations have been included in sections 4.2.13 and 4.2.10 respectively.

4.2.6 Upgrade Culvert C-FS750

The proposed alignment of the Francis Street upgrade commences at Francis Street /Brisbane Road junction crosses the QR railway line via an overpass and joins the existing Monash Road at the Monash Road-Brisbane Terrace junction.

The existing service road (McAuliffe Street), which is providing access to the existing Ipswich sewerage pumping station and Pan Pacific Peace Gardens, is being maintained with a new junction at Francis Street. The geometry of the proposed Francis Street upgrade requires two new culverts (C-FS750 and C-FS950) to drain the upstream catchments from the western side of Francis Street to Goodna Creek. Culverts are required to provide 20 year ARI immunity to Francis Street. The details of culvert C-FS750 is provided in this section. The other two culverts are discussed in Sections 4.2.7 and 4.2.8.

At present, the runoff from this catchment drains towards Goodna Creek along the road side drain between the Ipswich Motorway and Bridge Street.

Hydrology – RAFTS

Base and upgrade hydrological models were developed for the design, which assume a fully developed catchment.

The majority of the extensive upstream catchment is zoned as road reserve/recreation according to Ipswich City Council's PD (Planning & Development) Online. XP-RAFTS was used to generate catchment flows upstream of the culverts. The base scenario sub-catchment characteristics are provided in Table 4-20, and the catchment break-up is shown in Appendix A, D2G-BASD-RERODR203-K-2465. The land-use break up within each sub-catchment is detailed in Appendix O.

Table 4-19 C-FS750 sub-catchment characteristics – Base Scenario

Sub-catchment	Sub-catchment Number	Total Area [ha]	Catchment Slope [%]	Init/Cont Rainfall Loss	Catchment Mannings 'n'	Percentage Impervious [%]
FS750/a	1	0.41	3.9	IL25CL2.5	0.032	0
	2	0.27	3.9	IL1.5CL0	0.02	100
FS750/b	1	0.92	3.9	IL25CL2.5	0.031	0
	2	0.59	3.9	IL1.5CL0	0.02	100
Total		**2.19**				**40%**

Under existing conditions, only the sub catchment FS750/a with an area of 0.7 ha and 40% imperviousness drains to the outlet channel. Catchment FS750/b currently discharges via a 1050 mm diameter culvert towards the existing motorway culvert with overland flow towards catchment FS750/a. This overland flow has been included in the modelling, but no flows were observed in both 20 and 100 year ARI flow scenarios.

The 20 and 100 year ARI design event was run in XP-RAFTS for storm durations ranging from 10 minutes to 6 hours. Table 4-21 shows the peak flow for each storm duration. The 60 minute duration storm produced the largest outflow of 0.32 m^3/s at the inlet location. No overland flow from catchment FS750/b drains to the culvert in the 20 year or 100 year ARI event.

Table 4-20 Peak flows at the culvert inlet – Base Scenario- 20/ 100 year ARI

Storm Duration	20 year ARI Inlet Flows (m^3/s)	100 year ARI Inlet Flows (m^3/s)
10 min	0.16	NM
15 min	0.21	NM
20 min	0.23	0.43
25 min	0.30	0.43
30 min	0.28	0.41
45 min	0.22	0.35
60 min	**0.32**	**0.47**
90 min	0.28	0.36
120 min	0.24	NM
180 min	0.20	NM
360 min	0.13	NM

Note: NM- not modelled

The ultimate scenario sub-catchment characteristics are provided in Table 4-22, and the catchment break-up is shown in Appendix A, D2G-BASD-RERODR203-K-2466.

Table 4-21 C-FS750 sub-catchment characteristics – Ultimate Scenario

Sub-catchment	Sub-catchment Number	Total Area [ha]	Catchment Slope [%]	Init/Cont Rainfall Loss	Catchment Mannings 'n'	Percentage Impervious [%]
FS750/a	1	2.03	3.4	IL25CL2.5	0.035	0
	2	0.52	3.4	IL1.5CL0	0.02	100
FS750/rd	1	0.0	2.7	IL25CL2.5	0.020	0
	2	0.43	2.7	IL1.5CL0	0.02	100
Total		**2.98**				**32%**

The 20 year and 100 year ARI storm event was run in XP-RAFTS for storm durations ranging from 10 minutes to 6 hours. Table 4-23 shows the peak flow for each storm duration. The 60 minute duration storm produced the largest outflow of 0.98 m^3/s and 1.55 m^3/s at the culvert inlet for the 20 and 100 year flood events respectively.

Table 4-22 Peak flows at the culvert inlet – Upgrade Scenario-20 year/ 100 year ARI

Storm Duration	20 year ARI Flow at Culvert Inlet (m^3/s)	100 year ARI Flow at Culvert Inlet (m^3/s)
10 min	0.58	NM
15 min	0.71	NM
20 min	0.69	1.16
25 min	0.91	1.35
30 min	0.84	1.28
45 min	0.78	1.15
60 min	**0.98**	**1.55**
90 min	0.93	1.36
120 min	0.78	1.11
180 min	0.79	1.00
360 min	0.46	NM

Note: NM- not modelled

Hydrology – Rational Method

The stormwater runoff results from XP-RAFTS were compared against peak flows estimated by the Rational Method. The 20 year ARI flow was estimated using the fully developed catchment runoff coefficients, intensity of rainfall and the catchment area.

The area of the catchment is 2.98 ha (ultimate case upstream of the basin). A fraction impervious was derived for sub-catchment, with an average of 32% for the total upstream (fully developed) catchment.

The time of concentration for the catchment was estimated using a standard inlet time and average flow velocity for the channel flow path method. A standard inlet time of 13 minutes was used based on the upstream sub-catchment slope. The pipe flow time was found to be 3 minutes using the average flow velocity of 2 m/s for the surface flow length of 330 m. Consequently, the total time of concentration was estimated to be 16 minutes.

The Rational Method estimate for peak flow for the 20 year ARI event is $1.1m^3/s$, which is higher than the XP-RAFTS peak flow of $0.98m^3/s$. Given that the Rational Method does not account for any storage on a catchment, a higher value would be expected. The XP-RAFTS estimate is considered suitable for design purposes.

Hydraulics - SWMM

Culvert hydraulics were modelled using XP-SWMM. The model extends from approximately 300m upstream of the culvert and includes a section of the existing natural channel.

The proposed culvert C-FS750 was added into the upgrade scenario. Blockage factors of 20% were adopted for the culverts to account for siltation. As the culvert inlet is depressed an additional field inlet structure (Type 2 double gully inlet pit) to the culvert was modelled with a 50% blockage factor. The inlet pit has been designed in accordance with QUDM guidance (QUDM Section 7.05.4) and a blockage factor of 50% of the clear opening area was used.

The culvert discharges into a new vegetated channel located along the base of the Francis Street embankment, which directs the outflows towards Goodna Creek.

Results

Table 4-24 and Table 4-25 present the results of the XP-SWMM hydraulic model.

The adopted culvert solution is presented below:

- 1x 900mm diameter RCP
- Type 1 double field inlet

Model output is contained in Appendix N.

Table 4-23 Results for existing and proposed culverts-20 year ARI

Location	Scenario	Flow (m^3/s)	Velocity (m/s)	Road Formation Level (mAHD)	Water Level (mAHD)	Ground Level (mAHD)	Afflux (m)
C-FS750A (Culvert inlet)	Base	0.28	0.84	-	13.339	13.0	-0.595
	Upgrade	0.89	1.79	13.30	12.744	12.50(ground) 11.00(invert)	
C-FS750B (Culvert outlet)	Base	0.28	0.84		13.339	12.9	-2.109
	Upgrade	0.88	0.84	13.30	11.23	10.75	

Table 4-24 Results for existing and proposed culverts-100 year ARI

Location	Scenario	Flow (m^3/s)	Velocity (m/s)	Road Formation Level (mAHD)	Water Level (mAHD)	Ground Level (mAHD)	Afflux (m)
C-FS750A (Culvert inlet)	Base	0.42	0.94	-	13.393	13.0	-0.445
	Upgrade (culvert)	1.26	2.48	13.30	13.509	12.50(ground) 11.00(invert)	
C-FS750B (Culvert outlet)	Base	0.42	0.94		13.393	12.9	-2.053
	Upgrade	1.25	0.94	13.30	11.324	10.75	

Discussion

A culvert is required to discharge stormwater flows to the southern side of Francis Street at this location. The culvert flows originate from the open areas north of the existing motorway and the urban development areas south of the railway line.

The culvert upgrade at this location requires one 900mm diameter RCP. As this is a local road, the culvert is designed for 20 year ARI flows so that the upstream flood levels are unaffected and the roadway is immune from over topping. A type 1 double field inlet was proposed at the culvert inlet as no space was available for a conventional culvert inlet.

The base and upgrade flood levels been compared upstream of the culvert C-FS 750A inlet. Flood level reduction of 595 mm has been predicted for the 20 year ARI design event with 556 mm freeboard to the road carriageway. This reduction in upstream flood level ensures that there is no impact on upstream properties. The proposed culvert invert level is 2.7m below the original ground level of 13.7m, which is the reason for the large water level reduction.

As a further check on flood impacts, the ultimate model was run with the 100 year ARI flow and no impacts on the upstream properties or overtopping of the carriageway are predicted.

In flood events larger than the 100 year ARI event (or if the culvert is fully blocked), it is expected that upstream floodwaters will breach over Francis Street to the southeast of the proposed culvert and flow east towards Goodna Creek. The lowest road level of Francis Street is 13.30 m at this location and it is not expected to impact the upstream properties which are above 14.60 m.

Scour protection will be required downstream of the proposed culvert as discussed in section 4.2.13.

At this stage (100% final design) the hydraulic calculations for the culverts provides an acceptable design.

4.2.7 Upgrade Culvert C-FS950

A 25 ha catchment contributes flows to the proposed culvert C-FS950. This includes a portion of the QR workshops, Brisbane Terrace, the QR railway corridor and a residential area at the lower end.

An existing 1050mm diameter RCP conveys flows under Brisbane Terrace. In addition, 3 x 300mm diameter RCP stormwater pipes convey runoff from an open area adjacent to Brisbane Terrace.

Flows pass beneath the QR through a single 18m long 1050mm diameter RCP. Additional QR sub-catchments contribute to the flow at the upstream and the downstream side of this culvert. A natural channel then conveys flows to the McAuliffe Street culvert. Runoff from nearby residential areas is discharged via a pipe in the vicinity of the existing culvert inlet.

The existing culvert across McAuliffe Street consists of a single 1050 mm diameter RCP, approximately 11 m long. The existing culvert collects runoff from the entire catchment west of McAuliffe Street and discharges into a pond to the east within the Pan Pacific Peace Gardens. This pond level is controlled via a spillway that discharge flows to Goodna Creek approximately 150m away.

When the headwater level exceeds approximately 17.0m, flows in excess of the QR culvert capacity can spill to a channel/ overland flow path along the northern side of the railway embankment. This diversion of flows can reduce the impact of flooding on downstream properties for large flood events. However in extreme and rare events, it is expected that a portion of flows will overtop the QR rail embankment and flow towards the culverts at McAuliffe Street.

The Monash Road upgrade, which incorporates an overpass crossing the QR track, will result in a significant road embankment being constructed, a short distance upstream of the retained McAuliffe street roadway. The embankment will remove the existing overland flow path for the catchment. The provision of the upgrade requires a new culvert to be constructed at this location.

A meeting was held with ICC to discuss the impact of the embankment on local flood risk (Refer IMU Drainage-ICC, meeting minutes dated 21st September 09). The outcome of the meeting was a request from ICC to:

- Specifically consider a 50% blockage of the culvert in a 100 year flood event;
- Provide a positive overflow, such as a channel, for an emergency bypass should the culvert become excessively blocked.

This approach differed from that specified in the Drainage Design Criteria Report (DGRODR101) and the approach used on all other culverts through out the corridor, which was a 50% screen blockage and a 20% culvert blockage. However as requested by ICC a conservative 50% blockage factor was adopted for the proposed culvert for the 100 year flood event. It was found that the provision of a new 'non-structural' flood relief point was not feasible because of the upgrade embankment road levels, so a 'structural' solution using oversized culverts was required. In order to assess the worse case impacts, the upgrade design for this culvert includes an extreme event assessment using the Probable Maximum Flood (PMF).

Culvert C-FS950 was deemed to be a Class B culvert, according to QUDM, because it is close to a park and residential areas. It is therefore provided with an inlet screen.

Hydrology - RAFTS

Base and upgrade hydrological models were developed for the design, and assume a fully developed catchment.

The majority of the large upstream catchment is zoned as a mixture of residential/business/industrial uses according to Ipswich City Council's PD (Planning & Development) Online. XP-RAFTS was used to generate catchment flows upstream of the culverts. The base scenario sub-catchment characteristics are provided in Table 4-25, and the catchment break-up is shown in Appendix A, D2G-BASD-RERODR203-K-2465. The land-use break up within each sub-catchment is detailed in Appendix O.

Table 4-25 C-FS950 sub-catchment characteristics – Base Scenario

Sub-catchment	Sub-catchment Number	Total Area [ha]	Catchment Slope [%]	Init/Cont Rainfall Loss	Catchment Mannings 'n'	Percentage Impervious [%]
C-FS950/a	1	0.86	6.2	IL25CL2.5	0.028	0
	2	0.85	6.2	IL1.5CL0	0.015	100
C-FS950/b	1	1.07	4.4	IL25CL2.5	0.025	0
	2	1.61	4.4	IL1.5CL0	0.015	100
C-FS950/qr1	1	0.001	1.6	IL25CL2.5	0.020	0
	2	0.46	1.6	IL1.5CL0	0.015	100
C-FS950/qr2	1	0.03	2.8	IL25CL2.5	0.022	0
	2	1.3	2.8	IL1.5CL0	0.015	100
C-FS950/d	1	0.14	4.3	IL25CL2.5	0.03	0
	2	1.28	4.3	IL1.5CL0	0.015	100
C-FS950/e	1	0.36	1.7	IL25CL2.5	0.029	0
	2	0.41	1.7	IL1.5CL0	0.015	100
C-FS950/f	1	0.75	2	IL25CL2.5	0.04	0

Sub-catchment	Sub-catchment Number	Total Area [ha]	Catchment Slope [%]	Init/Cont Rainfall Loss	Catchment Mannings 'n'	Percentage Impervious [%]
	2	0.001	2	IL1.5CL0	0.015	100
C-FS950/g	1	4.74	0.5	IL25CL2.5	0.025	0
	2	7.12	0.5	IL1.5CL0	0.015	100
C-FS950/h	1	1.63	4.2	IL25CL2.5	0.025	0
	2	2.45	4.2	IL1.5CL0	0.015	100
Total		**25.06**				**58%**

Under existing conditions, the total catchment is approximately 25 ha with 58% imperviousness. The sub-catchments slope varies between 0.5 % and 7 %.

The 20, 100 year ARI and PMF design event were run in XP-RAFTS for storm durations ranging from 10 minutes to 6 hours. Table 4-27 shows the peak flow for each storm duration. The 25 minute duration storm produced the largest flow of 6.9 m^3/s in the 20 year ARI event and the 60min duration storm produced the largest flow of 10.9 m^3/s in the 100 year event.

The PMP estimates were derived in accordance with Bureau of Meteorology's (BOM) guidelines, 'The estimation of Probable Maximum Precipitation in Australia: Generalised Short –Duration Method (June 2003)', known as GSDM, for both base and ultimate scenarios. As the catchment is less than a square kilometre, the PMP values were interpolated and estimated. The following values were used to calculate the PMP rainfall estimates:

- Rainfall duration: checked for 15 min – 360 mins
- The PMF Initial Rainfall Depth (IRD) from the Depth Duration-Area (DDA) curve in Figure 4 (refer GSDM document): 555mm (smooth terrain)
- Elevation Adjustment Factor (EAF): 1.00
- Moisture Adjustment Factor (MAF): 0.85

PMP was estimated by the following relationship:

PMP = Initial Rainfall Depth x MAF x EAF

The value of PMP for 45 minute duration event was estimated as 519mm. This rainfall was used in XP-RAFTS for both base and ultimate scenarios. The following loss values were used in XP-RAFTS model:

Loss rates	Pervious areas	Impervious areas
Initial losses (mm)	0	0
Continuing losses (mm/hr)	0	0

The PMF rainfall was then run to generate the water levels and flows both base and ultimate XP-SWMM models.

Table 4-26 Peak flows at the culvert inlet – Base Scenario - 20 year, 100 year ARI and PMF

Storm Duration	20 year ARI Inlet Flows (m^3/s)	100 year ARI Inlet Flows (m^3/s)	PMF Inlet Flows (m^3/s)
10 min	5.5	NM	NM

Storm Duration	20 year ARI Inlet Flows (m^3/s)	100 year ARI Inlet Flows (m^3/s)	PMF Inlet Flows (m^3/s)
15 min	6.2	NM	64.3
20 min	6.3	9.4	NM
25 min	**6.9**	9.4	NM
30 min	6.7	8.8	62.6
45 min	6.1	8.6	**58.3**
60 min	6.8	**10.9**	41.7
90 min	6.0	7.9	33.1
120 min	5.6	6.5	28.3
180 min	5.3	6.0	41.8
360 min	4.0	NM	26.5

Note: NM- not modelled

The ultimate scenario sub-catchment characteristics are provided in Table 4-28, and the catchment break-up is shown in Appendix A, D2G-BASD-RERODR203-K-2466.

Table 4-27 C-FS950 sub-catchment characteristics – Ultimate Scenario

Sub-catchment	Sub-catchment Number	Total Area [ha]	Catchment Slope [%]	Init/Cont Rainfall Loss	Catchment Mannings 'n'	Percentage Impervious [%]
C-FS950/a	1	0.71	6.2	IL25CL2.5	0.028	0
	2	0.63	6.2	IL1.5CL0	0.015	100
C-FS950/b	1	0.89	4.4	IL25CL2.5	0.025	0
	2	1.34	4.4	IL1.5CL0	0.015	100
C-FS950/d	1	0.14	4.3	IL25CL2.5	0.03	0
	2	1.28	4.3	IL1.5CL0	0.015	100
C-FS950/qr1	1	0.01	1.6	IL25CL2.5	0.020	0
	2	0.46	1.6	IL1.5CL0	0.015	100
C-FS950/qr2	1	0.03	2.8	IL25CL2.5	0.022	0
	2	1.3	2.8	IL1.5CL0	0.015	100
C-FS950/e	1	0.36	1.7	IL25CL2.5	0.029	0
	2	0.41	1.7	IL1.5CL0	0.015	100
C-FS950/f	1	0.75	2	IL25CL2.5	0.04	0
	2	0.001	2	IL1.5CL0	0.015	100
C-FS950/g	1	4.74	0.5	IL25CL2.5	0.025	0
	2	7.12	0.5	IL1.5CL0	0.015	100
C-FS950/h	1	1.63	4.2	IL25CL2.5	0.025	0
	2	2.45	4.2	IL1.5CL0	0.015	100
C-FS950/i	1	0.86	4.8	IL25CL2.5	0.04	0
	2	0.001	4.8	IL1.5CL0	0.015	100
Total		**25.1**				**59%**

Under ultimate conditions, the total catchment is approximately 25 ha with 59% imperviousness. The sub-catchments slope varies between 0.5 % and 7 %. A minor reduction in catchment area results from the separate collection and discharge of the road upgrade drainage.

The 20 year and 100 year ARI storm events were run in XP-RAFTS for storm durations ranging from 10 minutes to 6 hours. Table 4-29 shows the peak flow for each storm duration. The 60 minute duration storm produced the largest outflow of 6.6 m^3/s and 10.5 m^3/s for the 20 and 100 year events respectively.

Table 4-28 Peak flows at the culvert inlet – Upgrade Scenario- 20 year, 100 year ARI and PMF

Storm Duration	20 year ARI Flow at Culvert Inlet (m^3/s)	100 year ARI Flow at Culvert Inlet (m^3/s)	PMF Inlet Flows (m^3/s)
10 min	5.3	NM	NM
15 min	5.8	NM	63.1
20 min	6.1	9.0	NM
25 min	6.6	9.4	NM
30 min	6.3	8.8	61.5
45 min	5.9	8.7	**57.2**
60 min	**6.6**	**10.5**	41.2
90 min	5.9	7.9	32.4
120 min	5.6	6.5	27.9
180 min	5.3	6.0	41.1
360 min	3.9	NM	26.1

Note: NM- not modelled

Hydrology – Rational Method

The stormwater runoff results from XP-RAFTS were compared against peak flows estimated by the Rational Method. The 20 year ARI flow was estimated using the fully developed catchment runoff coefficients, intensity of rainfall and the catchment area

The area of the catchment is 25.0 ha (upstream of the basin). A fraction impervious was derived for each sub-catchment, with an average of 62% for the total upstream (fully developed) catchment.

The time of concentration for the catchment was estimated using a standard inlet time and average flow velocity for the channel flow path method. A standard inlet time of 15 minutes was used based on the upstream sub-catchment slope. The assumed pipe/channel flow time was found to be 7 minutes using the average flow velocity of 2 m/s for the surface flow length of 820 m. Consequently, the total time of concentration was estimated to be 22 minutes.

The Rational Method estimate for peak flow for the 20 year ARI event is 7.7 m^3/s, which is higher than the XP-RAFTS peak flow of 6.6 m^3/s. Given that the Rational Method does not account for any storage on a catchment, a higher value would be expected. The XP-RAFTS estimate is considered suitable for design purposes.

Hydraulics – SWMM

Culvert hydraulics was modelled using XP-SWMM. The model extends from the Queensland Railway yard at Redbank, which is located north of Brisbane Terrace, to the artificial lakes located at the western side of the Pan Pacific Peace Garden.

The existing stormwater network was incorporated into the base scenario. The proposed culvert arrangement was added into the ultimate scenario.

A blockage factor of 20% was adopted for all crossing culverts in the base and ultimate scenarios with the exception of the new culvert arrangement (C-FS950) which was assumed to be 50% up to the 100 year ARI storm event. This was done based on advice from ICC to ensure that the adjacent town houses are protected.

It should be noted that the inlet of culvert C-FS950 will incorporate an inlet screen designed in accordance with QUDM. This inlet screen has a clear screen waterway area approximately three times that of the proposed culverts. In the unlikely event of a 50% blockage of this screen, the full culvert waterway area (i.e. 150%) will still be available. For purposes of modelling, a blockage value of 50% was applied at the base of the culverts up to the 100 year event and a blockage value of 20% for the PMF event, to simulate debris or sediment build-up. An additional screen loss was calculated for the partially blocked screen hydraulic losses using the method provided in QUDM.

A time-stage boundary condition was used for the tailwater at the Goodna Creek. This time-stage information for Q20 and Q100 flows for 60min durations was obtained from the HEC-RAS model developed for Goodna Creek. The time-stage information is given in the following table:

Table 4-29 Tail water elevations at Goodna Creek

Time (hrs)	Base Case Stage (m)- Q20	Ultimate Case Stage (m)-Q20	Base Case Stage (m)-Q100	Ultimate Case Stage (m)-Q100
0	7.01	7.01	7.01	7.01
0.5	6.99	6.98	7.06	7.04
1.0	7.40	7.36	7.60	7.53
1.5	7.80	7.75	8.35	8.19
2.0	8.52	8.37	9.52	9.38
2.5	8.77	8.83	10.23	10.37
3.0	8.43	8.56	10.06	10.33
3.5	8.03	8.12	9.09	9.55
4.0	7.58	7.68	7.96	8.33
4.5	7.08	7.14	7.14	7.39

The tailwater for the PMF scenario has been set at the 100 year ARI scenario levels.

Results

Table 4-31, Table 4-32 and Table 4-33 present the results of the XP-SWMM hydraulic model.

The adopted culvert solution is presented below:

- 5x 2100mm diameter RCPs

Localised regrading (approximately 1m depth) will be required to form the upgraded culvert inlet area. Refer Drawing No.D-1034 for details. The proposed works include scour protection at the upstream side of McAuliffe Street but not an upgrade of the McAuliffe Street roadway or culverts. Model output is summarised in Appendix N.

Table 4-30 Results for existing and upgrade culverts- 20year ARI

Location	Scenario	Flow (m^3/s)	Velocity (m/s)	Road Formation Level (mAHD)	Water Level (mAHD)	Ground Level (mAHD)	Afflux (m)	d V product (m^2/s)
C-FS950A (Proposed culvert inlet)	Base	5.48	1.06	-	10.610	10.50	0.096	-
	Upgrade	5.51	1.81	13.7 (low spot)	10.706*	9.40		-
C-FS950C (Existing culvert inlet)	Base (Culvert)	1.89	2.83	10.2		8.60	0.014	-
	Base (Road)	3.39	-	10.2	10.364	8.60		0.11
	Upgrade (Culvert)	1.91	2.85	10. 2		8.60		-
	Upgrade (Road)	3.85	-	10.2	10.378	8.60		0.12

* Incorporating 5mm of Headloss.

The above results for the upgraded scenario are based on a 50% screen blockage and 50% culvert blockage for the proposed new culverts.

A more typical arrangement of 50% screen blockage and 20% culvert blockage would result in an upstream flood level of approximately 10.400m. This would result in no afflux and a lowering of flood levels by approximately 200mm from existing flood levels.

The culvert arrangement provides 20 year flood immunity to the upgraded carriageway. An increase of 14mm in flow depths passing over the McAuliffe Street roadway occurs as a result of the change in flow conveyance. This flow depth increase is localised to the road only and does not affect adjacent properties.

Table 4-31 Results for existing and proposed culverts- 100 year ARI

Location	Scenario	Flow (m^3/s)	Velocity (m/s)	Road Formation Level (mAHD)	Water Level (mAHD)	Ground Level (mAHD)	Afflux (m)	d V product (m^2/s)
C-FS950A (Proposed culvert inlet)	Base	6.51	1.14	-	10.622	10.50	0.127	-
	Upgrade	7.1	1.99	13.7 (low spot)	10.749*	9.40		-
C-FS950C (Existing culvert inlet)	Base (Culvert)	1.93	2.90	10.2		8.60	0.042	-
	Base (Road)	4.93	-	10.2	10.410	8.60		0.15
	Upgrade (Culvert)	1.95	2.92	10.2		8.60		-
	Upgrade (Road)	5.52	-	10.2	10.452	8.60		0.20

Note: levels don't include backwater from Goodna Creek

* Incorporating 5mm of Headloss.

The above results for the upgraded scenario are based on a 50% screen blockage and 50% culvert blockage for the proposed new culverts.

The lowest surveyed floor level of the adjacent townhouses is approximately 12.2m and the predicted flood level of 10.749m will not inundate the structure floor levels. This increase in flood level does not extend upstream to the QR culverts, and their capacity will not be impacted by the predicted afflux if the screen and culverts are blocked to 50% of their respective surface areas. The predicted small downstream afflux is a product of the new culvert arrangement that is designed for the PMF and the 100 year ARI event with 50% blockage. This flow depth increase is localised to the road only and does not affect properties.

If the culvert inlet screen was 50% blocked and the culvert was 20% blocked as per all other IMU culvert designs, there would be no afflux and the resultant water level at the culvert inlet would be 10.454mm, a reduction in flood levels.

The peak 100 year flood and PMF flood levels in Goodna Creek are 10.453m and 10.556m respectively. These floodwaters will act as "backwater" to McAuliffe Street and inundate the road. The levels in Table 4-24 are based on local flows only and do not include any backwater effect from Goodna Creek. Therefore, the predicted 100 year flood level of McAuliffe Street may be slightly higher (1mm) than the documented flood level, however the road will still be trafficable and the flood depth will be lower than 300mm.

Table 4-32 Results for existing and proposed culverts- PMF flows

Location	Scenario	Flow (m^3/s)	Velocity (m/s)	Road Formation Level (mAHD)	Water Level (mAHD)	Ground Level (mAHD)	Afflux (m)	d V product (m^2/s)
C-FS950A (Proposed culvert inlet)	Base	39.24	2.66	-	11.131	10.50	0.473	-
	Upgrade	35.70	2.56	13.7 (low spot)	11.604*	9.20		-
C-FS950C (Existing culvert inlet)	Base (Culvert)	2.43	3.58	10.2		8.60	-0.221	-
	Base (Road)	36.86	-	10.2	11.003	8.60		0.58
	Upgrade (Culvert)	2.26	3.35	10.2		8.60		-
	Upgrade (Road)	35.53	-	10.2	10.782	8.60		0.56

Note: levels don't include backwater from Goodna Creek

* Incorporating 60mm of Headloss.

The above results for the upgraded scenario are based on a 50% screen blockage and 20% culvert blockage for the proposed new culverts.

The culvert arrangement provides PMF flood immunity to the upgraded carriageway and results in an increased water level of 473 mm upstream of the upgraded road embankment. This raises water levels to 11.604m AHD which will not result in flooding of existing property which has floor levels at 12.20 m or higher. The screen loss / blockage is approximately 60mm which is low due to the area of

the screen which is approximately 65m^2. The lowest section of the driveway access is believed to be approximately 11.4m, therefore the access would be inundated in a PMF, however it would still be trafficable. Downstream flood levels are expected to decrease slightly due to the increased storage upstream of the new road embankment.

The upstream side of the culvert arrangement will incorporate inlet screen fitted to the concrete headwall. Details of the screens are provided on the drawing no. D-2115 & D-2116.

Discussion

A new 5x2100 mm diameter RCP culvert arrangement is proposed at this location. The discharge from this arrangement will pass through the existing McAuliffe Street culvert and over the roadway which will remain unchanged, except for additional scour protection.

The afflux at the upstream end of the proposed culvert system (location C-FS950A) was checked and a water level increase of 96mm for the 20 year ARI and an increase of 127mm for the 100 year ARI event was predicted. This was based on the conservative assumption that the inlet screen and culverts would both have 50% blockage. The predicted ultimate 100 year flood level is 10.749 m at the culvert inlet and provides over 1.45m freeboard to the ground level (lowest level) at the nearest housing area located at 12.20 m. The properties adjacent to the culvert and the QR culvert will not be affected by the 100 year ARI flood event. The land immediately upstream of the culvert between Monash Road and the Queensland Rail embankment is owned by DTMR.

The predicted flood level in the PMF event of 11.604 m represents an increase in water level of 473mm. At this level no flooding of the existing property structure floor levels are expected.

The depth x velocity (dv product) value for the McAuliffe Street overtopping flow was calculated for the 20 year and 100year ARI events. The width of the overtopping part of the road was taken as 32m. It was found that the estimated value for ultimate case of 0.12 m^2/s for 20 year ARI is slightly higher than the existing value of 0.11 m^2/s. The 100 year ARI depth by velocity product was estimated as 0.2m^2/s. Both satisfy the QUDM allowable depth by velocity product of 0.4m^2/s.

At this stage (100% final design) the hydraulic calculations for the culverts provides an acceptable design.

A safety analysis was performed in accordance with QUDM to determine the need for safety screens or fencing at the culvert inlet. An inlet screen has been incorporated into this design.

Scour protection and pipe loading and bedding calculations have been included in sections 4.2.13 and 4.2.10 respectively.

4.2.8 Upgrade Culvert C-FS1250

Culvert C-FS1250, was included in the previous submission of this design package. As a result of design development and scope resolution regarding the limit of works in the vicinity of Brisbane Terrence and Francis Street the culvert has been removed from the scope of this package.

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4.2.9 Zone 2 Service Roads Culvert Summary

Table 4-32 and Table 4-33 present a summary of the water levels, velocities and afflux that occur at the upgrade culverts which form part of this design lot.

Table 4-32 Transverse drainage Zone 2- Other Culverts summary

Culvert	Description	Culverts	Road Level (m)	20 year ARI Water Level (m)	20 year ARI Free Board (m)	Upstream culvert invert (m AHD)	Downstream culvert invert (m AHD)	Culvert Length (m)	Blockage factor	20/100 year Downstream Tailwater Level
C-SR100	Culverts at Mine Street and Collingwood Drive intersection	2 x 1800Wx900H RCBC	13.2	12.69	0.5	11.50	11.00	42.0	0%	Goodna Creek
C-FS620	Culvert at Francis Street CH 620	2 x 750 RCP	15.2	13.01	2.2	12.25	11.00	48.8	20%	Goodna Creek
C-FS750	Culvert at Francis Street CH 750	1x 900 RCP	13.3	12.74	0.6	11.00	10.75	37.20	20%	Free Discharge
C-FS950	Culvert at Francis Street CH 950	5 x 2100 RCP	18.8	10.70	8.3	9.40	8.70	48.8	20-50%	Goodna Creek

Table 4-33 Comparison of the 20 year peak water levels, velocities and afflux

Culvert	20 year ARI, water level U/S of culvert (m AHD)		Channel Velocity D/S of culvert (m/s)		Afflux (mm)		Remarks
	Base	Upgrade	Base	Upgrade	U/S of culvert	D/S of culvert	
C-SR100	14.287	13.368	0.84	1.61	-919	Goodna Ck	Refer section 4.2.4
C-FS620	13.020	13.016	NA	NA	-004	Goodna Ck	Refer section 4.2.5
C-FS750	13.339	12.744	0.84	0.84	-595	N/A	Refer section 4.2.6
C-FS950	10.610	10.706	NA	NA	+96	+14	Refer section 4.2.7

4.2.10 Structural Adequacy Analysis

The transverse culvert structures have been designed to accommodate the relevant design fill loads and traffic loading during operation and construction.

The design criteria stipulated by the DMR PSTS25 which is based on AS 5100 – 2004 has been applied to the design of the culverts. The relevant criteria for structural design of culverts is summarised below:

- Accommodate finished surface level of fill material
- W80, A160, SM1600 and HLP 400 vehicular loadings
- Live load surcharge
- Construction loads
- Earth pressure
- Be designed for ease of maintenance
- Be structurally safe at all times
- Not suffer any loss of performance due to uniform and/ or differential settlement.

The software program PipeClassV1.2 developed by Concrete Pipe Association of Australasia was used to determine the pipe class of each pipe culvert. The program includes standard classifications and bedding types as set out in the Concrete Pipe Selection and Installation Guide.

The construction loads were selected from the Pipe Class library and are summarized in Table 4-34.

Table 4-33 Construction loads from Pipe Class Library

Vehicle	Description	Vehicle Load
CPAAVR-10T	Smooth drum vibratory roller	19.5 tons
CAT 140H	Motor grader	17 tons
CATD 300E	Articulated truck	50 tons
CAT621F	Scraper	54 tons
CAT 815F	Soil compactor	21 tons

The design assumed an average pavement thickness of 0.6m that has been applied as a surcharge load at the top of the embankment fill. The embankment fill properties were assumed to be:

- Density – 20 kN/m^3
- Angle of internal friction (Phi) – 30 deg
- Cohesion (c) – 5 kPa
- Ku – 0.1924

Bedding Type H2 has been adopted for all culverts with the exception of C-FS950 which will be bedding type HS3. The construction team have indicated that all culverts will be laid in a trench (possitive projection) i.e. the embankment fill will be compacted to an appropriate level and then trenched rather than the pipe laid and embankment filled around the pipe.

The summary of the analysis are shown in the following Table 4-35:

Table 4-34 Type of pipe class required for transverse culverts

Culvert ID	Pipe diameter (mm)	Type of bedding	Class of pipes	Comment
C-SR100	2 x 1800W x 900H RCBC	-	-	Supplier to design
C-FS620	2 x 750 RCP	H2	Class 3	
C-FS750	1 x 900 RCP	H2	Class 3	
C-FS950	5 x 2100 RCP	HS3-modified	Class 4	Stabilised sand bedding and backfill

The details of the model analyses are included in Appendix M.

4.2.11 Environmentally Friendly Culverts

There are no specific fauna-friendly requirements for the culverts detailed in this submission.

4.2.12 Bridge Crossings

There are no water way bridge crossings in this design package.

4.2.13 Scour Protection at Culvert outlets

Scour protection has been designed for the 50 year ARI design event where required. The need for scour protection depends on the culvert outlet velocity and the erosion potential of the downstream environment.

The flow through a culvert can either be inlet or outlet controlled. For inlet control the water surface profile converges toward normal depth. Therefore, normal depth is used to define the flow area at the outlet and determine the outlet velocity.

In outlet control, the flow area is defined by the geometry of the outlet and tailwater depth.

The design has included an assessment of the downstream tailwater level, culvert normal depth and critical depth. The adopted outlet velocity is based on the following:

- Tailwater level greater than the culvert obvert – adopt culvert full flow and velocity
- Tailwater level less than obvert but greater than normal depth – adopt tailwater level and calculate part full velocity based on tailwater level
- Tailwater level less than normal depth and normal depth is less than critical depth – adopt normal depth and calculate part full velocity based on normal depth
- Tailwater level less than critical depth and flow in the culvert is supercritical – adopt critical depth and calculate part full velocity based on critical depth.

The selection of scour protection type is outlined in Table 4–36.

Table 4-36 Scour protection selection based on outlet velocity

Outlet Velocity Range	Scour Protection Type
Less than 1.5 m/s	No protection required
Between 1.5 to 3.5 m/s	Either rock pad or steel wire mattress
Between 3.5 to 5.0 m/s	Steel wire mattress
Greater than 5.0 m/s	Type A Energy Dissipater as specified in Section 8 of the Road Design Guide (RTA)

The design of rock pads is based on page 8-24 QUDM Volume 1 second edition 2007.

The Table 4-37 shows the type of scour protection required for the culverts.

Table 4-37 Type of scour protection required for transverse culverts

Culvert ID	Q50-Outlet velocity (m/s)	Mattress/ Apron Length (m)*	Mattress/ Apron Width (m)	Rock size, d_{50} (mm)	Thickness (mm)	Comment
C-SR100B	2.9	32.0	14.0	300	600	Rock Protection
C-FS620A	3.8	12.0	10.0	-	170	Steel wire Mattress
C-FS750B	2.4	2.2	5.4	-	170	Steel wire Mattress
C-FS950A	2.8	6.0	10.6	-	170	Steel wire Mattress
C-FS950B	2.8	13.0	10.6	-	170	Steel wire Mattress
C-FS950D	-	4.0	35	-	170	Steel wire Mattress

*The length of the culvert outlet apron has been subtracted.

4.2.14 Open Channels and Waterway Diversions

A channel is required at the SR100 pipe culvert outlet in order to discharge flows into Goodna Creek. This new channel replaces the existing outlet channel due to the alignment changes. The proposed channel will be 200m long 5m wide trapezoidal vegetated channel and designed for 20 year ARI event flows.

A 5m long concrete channel will be constructed to protect the 900mm diameter existing sewer line, which crosses the channel with shallow cover.

A trapezoidal channel, 3m wide 1m deep with 1:2 batters, was designed between the outlet of the culvert C-620 and the inlet of the culvert C16150. This channel is shown on the drawing number RERODR203-D 1034. The proposed channel will be approximately 27m long and designed for 100 year ARI event flows.

A channel is required at the C-FS750 outlet in order to discharge flows into Goodna Creek. This new channel replaces the existing channel due to the alignment changes. The proposed channel will be 250m long trapezoidal vegetated channel and designed for 20 year ARI event flows.

4.3 Design Changes

4.3.1 Changes between Reference Design and Concept Design

The Origin Alliance has undertaken a Due Diligence Review of the reference design.

As part of the design development of the Concept Design a Value Engineering review has also been undertaken. Outputs of this review are included in Appendix J.

The reference design did not include any drainage infrastructure therefore no assessment of differences can be made.

4.3.2 Changes between Concept Design and Detailed Design

Table 4-38 Changes between Concept Design and Detail Design

Culvert ID	Design Element	Description of Adjustment	Reason for Adjustment	Supporting Information
C-SR100	Culvert	Culvert has been redesigned. Pipe culverts changed to box culverts.	Change of Smith Street horizontal road alignment.	Appendix A
C-FS620	Culvert Replaced	Culvert has been redesigned.	Change of horizontal and vertical alignment of the road.	Appendix A
C-FS750	New Culvert	A new culvert has been introduced	New Road Alignment	Appendix A
C-FS950	New Culvert	A new culvert has been introduced	New Road Alignment	Appendix A

4.3.3 Changes between Detailed Design and Final Design

Table 4-39 Changes between Detail Design and Final Design

Culvert ID	Design Element	Description of Adjustment	Reason for Adjustment	Supporting Information
Nil				

4.3.4 Changes between Final Design and This Submission

Table 4-40 Changes between Detail Design and Final Design

Culvert ID	Design Element	Description of Adjustment	Reason for Adjustment	Supporting Information
C-FS950	Culvert	Additional 2 cells added to culvert	Review of high flow bypass upstream based on extreme events	This report

4.4 Items for Resolution

There are no items for resolution at the current stage of this design package.

4.5 Verification and Reviews

4.5.1 Internal Design Verification

Comments from the Internal Verifier and designer's responses have been closed out.

4.5.2 Independent Verifier

Independent verifier comments have been received and addressed in Appendix F.

4.5.3 DMR Reviews

DMR comments have been received and addressed in Appendix G.

4.5.4 Third Party Reviews

There were no third party comments received.

4.6 Design Drawings

Refer to Appendix A for the design drawings that apply to this design lot.

4.7 Technical Standards and Specifications

Refer to Appendix B for the list of Technical Standards and Specifications that apply to of this design lot.

5 Safety in Design

Safety in Design is an integral part of the Origin Alliance Risk Management process.

5.1 Safety in Design and Constructability Review (SIDR)

The purpose of the SIDR is to identify any significant construction, operation, maintenance and demolition risks inherent in the design of the project as a workplace that may prove significant. Specifically, the identification and understanding of these risks early in the project allows risk controls to be established to ensure that, if the risks cannot be eliminated by design, they are mitigated and managed in the design process so that they are as low as practicable. Risks identified are to be documented in the design report at the conclusion of the detailed design.

A Global SIDR on the Concept Design has been undertaken and forms a separate design submission. (Report ref D2G-DPSM-R-0001)

During the Detailed Design, a SIDR for this package has been convened as part of Zone 2/3 SIDR Workshop on 21/05/09. Outputs of the SIDR including identified risks as well as mitigation status, if any, are included in Appendix K.

The SIDR, as mentioned above, has been updated to clearly identify the following:

- design mitigation measures applied for the hazards as identified in the original SIDR workshop
- residual risks following design mitigation for the hazards as identified in the original SIDR workshop
- responsible group for mitigation and recipient group for transfer of residual risk
- any additional hazards, control and mitigations for items that were identified through design that may not have been captured in the original SIDR workshop

Details of the revised SIDR for this particular design lot are attached in Appendix K.

A Global SIDR focussed on the operation and maintenance phase of the project was held on 24/3/10. The outputs of this review are reported separately; however key aspects have been considered in the design.

5.2 Design to Facilitate Safe Use

5.2.1 Normal Use – Road Safety Audits

A Road Safety Audit (RSA) of the project has been undertaken on the Concept Design and has been submitted separately. Refer to report number 2108208A-RPT007-A.

The RSA of the Detailed Design for Zone 2 has been undertaken. Refer to Road Safety Audit Ipswich Motorway Upgrade – Dinmore to Goodna: Zone 2 – 85%, 2108208A-RPT015. The audit findings have been addressed and closed out. This will be the subject of a separate design submission.

5.2.2 Emergency Use

Origin Alliance facilitates a forum with emergency services personnel to obtain input to the safe emergency use of the facility.

An Emergency Response Management Plan (Report Ref D2G-MPPL-V-016) has been developed by the Alliance in consultation with emergency services and DMR and is the subject of a separate submission.

A summary of specific features incorporated into this design package to facilitate safe emergency use is detailed in Table 5-1 below.

Table 5-1 Summary of specific features addressing Design for Safe Maintenance

Elements	Design Response
Culvert/Gully Inlets	The design allows for blockage factor to reduce maintenance frequencies. The design uses dome top grates for field inlets to identify during maintenance and perform better with debris. Vehicle access to major culvert headwalls is provided where practical.
Culvert Outlets	Vehicle access provided for inspection and rehabilitation of downstream scour protection where practical
Pipe Inlet and Outlet channels	The design uses low velocities in channels to prevent scour and regular maintenance. Flatter side slopes have been used where possible to assist with maintenance activities.

5.2.3 Design for Safe Maintenance

Origin Alliance facilitates a forum with DMR maintenance personnel to obtain input to the design process to ensure the design is safe for maintenance. This review and input occurs as part of the design development process in formal and informal meetings etc. and at staged reviews of major design submissions at Concept Design and Detailed Design.

The principal method adopted by the design to address safety during maintenance is to reduce or eliminate maintenance requirements.

Details addressing specific issues relating to the operation and maintenance aspects of the design are addressed in the revised SIDR contained in Appendix K.

6 Design Integration

The detailed design involves the integration of requirements from all relevant design disciplines and is the subject of 'spatial fit' and other interface checks as each design lot develops.

A summary of the key disciplines that have impacted on this design package are provided below.

6.1 Roadworks and Alignment

Cross drainage structures have been designed to convey stormwater flows within waterways that traverse the proposed motorway and service roads. The culverts have been designed to provide immunity for the motorway from the 100 year ARI event and the service roads have been designed to have 20 year ARI immunity. The culverts along the service roads have been designed to these design criteria. The culverts are designed with minimum cover requirements that exceed the nominated pavement depths.

Table 6-1 Roadworks and alignment design integration summary

Element	Description
Flooding	The regional flood model includes the road alignment, bridge structures and local roads for the motorway upgrade. Flood modelling was run for the 20 year and 100 year ARI events. The road alignment has been designed to consider the required flood immunity of the pavement, and ongoing development of the alignment will be undertaken as design progresses to ensure required immunities are met.

6.2 Geotechnical

Table 6-2 Geotechnical design integration summary

Element	Description
Earthworks	N/A
Mines	The intersection of Smiths Road and Collingwood Drive is underlain by mine workings associated with the new Redbank colliery; refer to New Redbank Mine Subsidence Report: D2G-BASD-DGMSIR102-R-1001 for further details on the treatment.

6.2.1 Design Assumptions

The minimum allowable bearing capacity of the culvert foundations has been calculated to be 150kPa for all culverts except culvert C-FS950 which requires minimum 250kPa.

6.2.2 Design Details

General

The primary geotechnical issue with respect to construction of the culvert structures is the potential impact of foundation settlement on the serviceability of the structure. The foundation settlements underneath the pipe culverts in Zone 2 will be managed by removing any compressible soil layers present at or near the ground surface and beneath the invert level of the culvert and designing the culvert grade to suit the conditions.

Geotechnical Models

The geotechnical models used for the assessment of foundation settlements at culvert locations were derived from the boreholes/test pits listed in Table 6-3, and their locations are shown on Geotechnical Investigation Plans (refer to Package No. DGGOKS100).

The settlement calculations apply only to the soil layers beneath the invert levels of the culverts. The settlements of the soil layers above the proposed culvert invert level are ignored. Where the proposed invert level of the culvert is higher than the nearest borehole collar level, the soil layer between the levels are interpolated accordingly.

Design Outputs

The results of the assessment of foundation treatments for the culverts are presented in Table 6-3. The table includes the culvert locations, subsoil profiles interpreted from representative boreholes/ test pits, the estimated total settlements of the culverts over 100 years in associating with the recommended foundation treatments.

For culvert C-FS620, the subsoil profile is based on TP049 and a remote borehole IMU225 for the indication of the rock level.

Except for culvert C-FS950, the total residual settlements of the culverts without foundation treatments are estimated to be less than 50mm, therefore, at this stage the culverts can be installed prior to construction of the embankment fill.

The subsoil profile at culvert C-FS950 location is based on borehole.IMU229E. It is estimated that the total settlement of culvert C-FS950 under 10.3m fill height is 81mm including 64mm of primary settlement. In order to reduce the primary settlement, construction of the fill to 5m and preloading for one month are required to allow the ground to settle 31mm, and then cut back to invert level and construct the culvert, As a result, the total residual settlements of the culvert over 100 years can be reduced to 50mm.

Unless otherwise specified, any material worse (softer) than stiff clay or medium dense sands on the top of the foundation shall be removed and be replaced with engineered fill compacted to a compaction ratio of 97% to ensure that the minimum required bearing capacity is achieved.

Other Issues

The founding material will be inspected on site by an experienced geotechnical engineer or engineering geologist to confirm the bearing capacity of the foundation material at each culvert location.

Table 6-3 Summary of Foundation Treatments for Culvert Locations

Culvert No.	Approx Station (km)	Available Boreholes and Test-pits in the Vicinity of Culvert Locations	Represent-ative Boreholes and Test-pits	Subsurface Profile Interpreted beneath Culvert Invert Levels	Maximum Embankment Fill Height at Culvert Locations (m)	Primary Settlement with Foundation Treatment (mm)	Total Residual Settlement with Foundation Treatment (mm)	Recommendation for Foundation Treatments
C-SR100	0-80 (MCS0)	TP236, TP321 MWRB345, MWRB347B, MWRB347C	MWRB345 + TP321	3.5m stiff to very stiff clay underlain by 9.0m hard clay and 2.0m dense gravel on top of rock	2.7	23	30	No treatment.
C-FS620	610-620 (MCR0)	TP049, TP050, TP220, TP313,, IMU316A	TP220 + IMU316A	4.3m stiff to hard clay underlain by rock	3.8	16	28	Remove all unsuitable materials estimated to be up to 0.3m firm silt.
C-FS750	800-810 (MCR0)	IMU228D, IMU316A	IMU228D	8.5m very stiff to hard clay underlain by rock	2.0	9	9	No treatment.
C-FS950	950-960 (MCR0)	TP216, TP702, IMU228C, IMU228D, IMU229D, IMU229E	IMU229E	5.7m stiff to hard clay underlain by rock	10.3	33	50	Preload 5m fill for 1 month, and then cut and place the culvert before the embankment construction to FSL.

Note:

The settlements are estimated based on the highest embankment height at culvert's locations to estimate the maximum settlements.

Unsuitable materials such as loose sand, soft or firm clay must be replaced by compacted engineering fill after inspection by an experienced engineering geologist / geotechnical engineer.

6.3 Structures

6.3.1 Bridges

There are no bridges that can impact on the areas where the upgrade culverts are proposed.

6.3.2 Retaining Walls

There are no retaining wall clashes with the other culverts in Zone 2.

6.3.3 Other

The clashes between transverse drainage and the following structural items have been addressed in this detailed design:

- Gantries
- Signs
- Noise Barriers
- There are no clashes between transverse culverts and the above structural elements.

6.4 Intelligent Transport Systems (ITS)

There are no ITS clashes with the Zone 2 –Other culverts.

6.5 Temporary Traffic Management (TTM)

Drainage for temporary traffic configurations will be detailed in the separate TTM design lots. To facilitate operation of the permanent drainage in temporary stages of construction transverse crossings have been located at cut-to-fill lines wherever possible.

6.6 Environment

This package is compliant with applicable Environmental and Approvals requirements identified in the Environmental Requirements Checklist as evidenced in Appendix E, where authorisations for derivations are referenced or explained. All Environmental requirements are to be summarised in the Environmental Design Report (EDR).

The environmentally sensitive areas that have been identified relevant to transverse drainage in Zone 2 are summarised in Table 6-4.

6.6.1 Approvals

All environment and current approval requirements have been identified and summarised on the Environmental Requirements Checklist included in Appendix E. Future approval requirements will result from:

- The removal of soil from lots listed under the Department of Environment and Resource Management (DERM) Environment Management Register is subject to approvals under the *Environmental Protection Act 1994*; and
- Vegetation Clearing Permits: Approval is required under the *Vegetation Management Act 1999* and the *Nature Conservation Act 1992* (NC Act 1992) for vegetation removal on state and freehold land respectively. The Permit under the NC Act 1992 has been received from DERM; permit number WICL05811509.

The environmental requirements relating to this design lot are detailed in Table 6-4 below and Appendix E

Table 6-4 Zone 2 Transverse Drainage Design Brief Environmental Input

Name	Chainage	Description	Comments	Category	Design Requirement (Environmental Requirements Checklist)
SR100	100	Culvert	Goupong Park	Indigenous heritage	To be managed during the construction phase in accordance with the Cultural Heritage Management Plan (D2G-MPPL-V-012).
C-FS620/ C16150	620/ 16175	Culvert	Cultural heritage monitoring area	Indigenous heritage	To be managed during the construction phase in accordance with the Cultural Heritage Management Plan (D2G-MPPL-V-012).
			UXO	No-go zone	UXO high risk area subject to investigation and removal of ordinances prior to works commencing. High risk area is soft ground in and around the creek and drainage lines. This area is known to be impacted by a mortar range.
		Open channel swale	UXO	No-go zone	UXO high risk area subject to investigation and removal of ordinances prior to works commencing. High risk area is soft ground in and around the creek and drainage lines. This area is known to be impacted by a mortar range.
			Discharging to Goodna Creek	Flora, fauna and ecology	Disturbance to the bed or banks of Goodna Creek will be subject to approvals. Surface flows that are concentrated by an open channel or conduit should be controlled prior to discharge on a downstream system or owner. Concentrated flows should be dissipated by the use of detention and energy dissipaters. Swales and drainage channels longitudinal alignments to gently meander reflecting natural landform and to be of a more naturalised appearance with maximum side slope of 1:3. All outlets of the surface drainage system must incorporate energy dissipation, erosion and sediment

Name	Chainage	Description	Comments	Category	Design Requirement (Environmental Requirements Checklist)
					control. Water discharged must comply with water quality provisions of the Environmental Protection (Water) Policy 1997, as well as ANZECC and/or locally relevant water quality guidelines.
		Sed basin and bio-retention basin	UXO	No-go zone	UXO high risk area subject to investigation and removal of ordinances prior to works commencing. High risk area is soft ground in and around the creek and drainage lines. This area is known to be impacted by a mortar range.
			Goodna Creek	Flora, fauna and ecology	Disturbance to the bed or banks of Goodna Creek will be subject to approvals. All outlets of the surface drainage system must incorporate energy dissipation, erosion and sediment control. Incorporate a filtration system into the drainage design in order to minimise pollutants entering Goodna Creek. Stormwater Quality Management Achieve the following reductions in total pollutant load: 90% reduction in gross pollutants; 80% reduction in TSS; 60% reduction in Total Phosphorous; 45% reduction in Total Nitrogen.
			Sensitive vegetation	Flora, fauna and ecology	Avoid disturbance to sensitive vegetation. Investigate potential to integrate into existing wetland system.
C-FS750	750	Culvert	No environmental constraints		
C-FS950	950	Culvert	Pan Pacific Peace Gardens	Public area sensitive receptor	Potential impacts associated with construction will be managed during the construction phase in accordance with the Construction Environmental Management Plan (D2G-MPPL-V-017).
				Sensitive vegetation	Minimise the removal of existing native vegetation to the extent necessary only for construction and permanent design footprint (clearing is subject to a statutory approval which may detail additional controls to be applied).

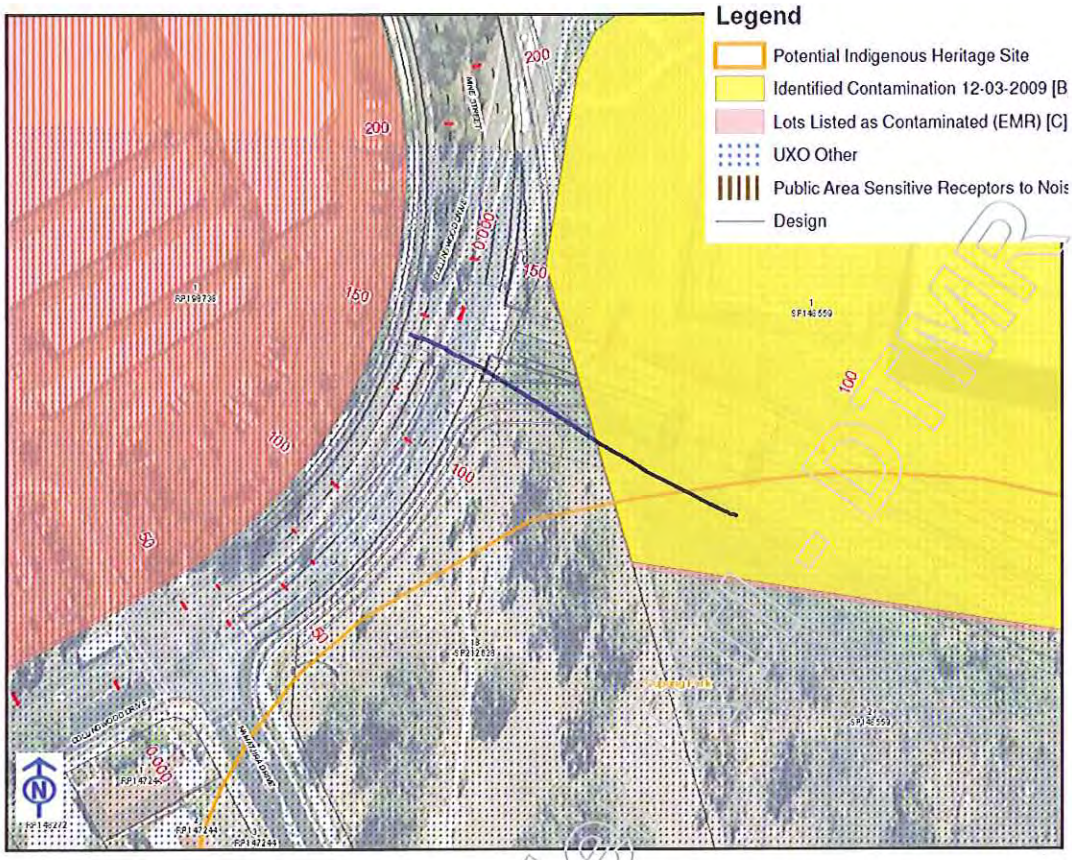

Figure 6-1 C-SR100

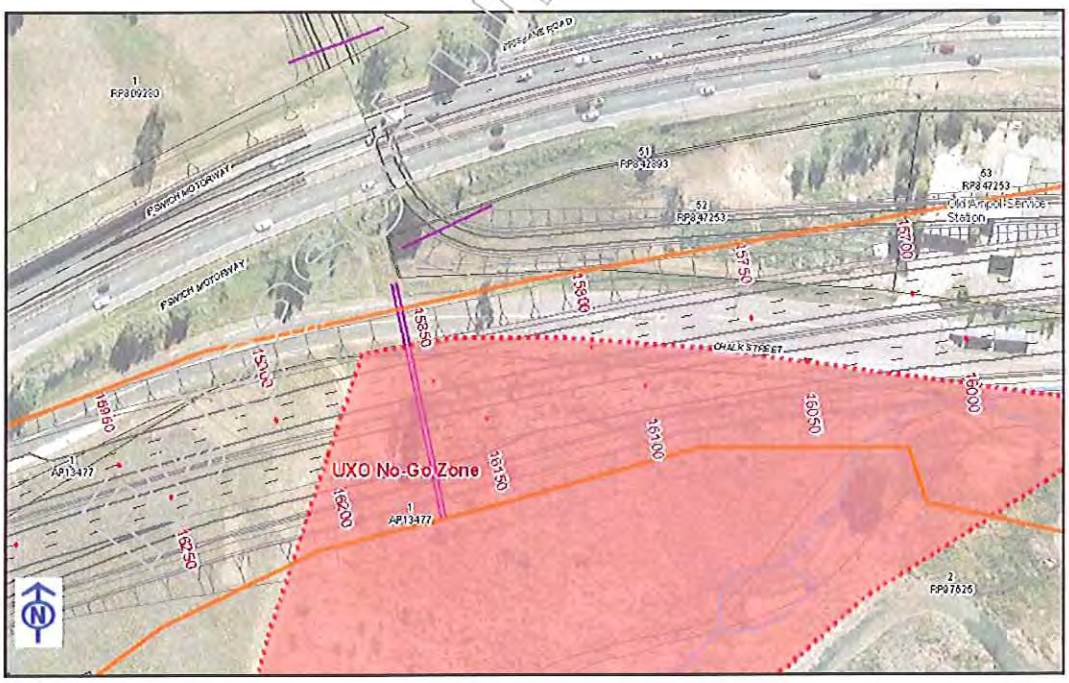

Figure 6-2 C-FS620/ C16150

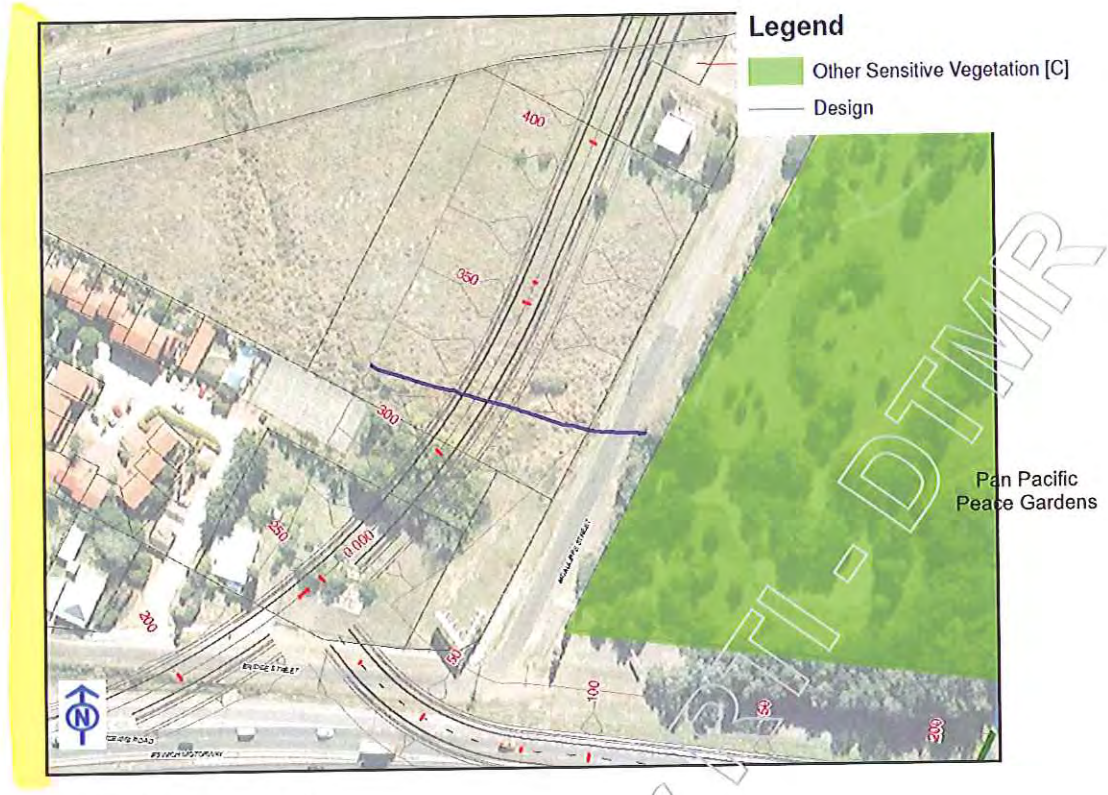

Figure 6-3 C-FS950

6.7 Urban and Landscape Design

Landscape and Urban Design treatments have taken into account the locations of transverse drainage pipes and swales. No conflicts currently exist between drainage and landscape requirements.

6.8 Community

Community requirements have been identified and summarised on the Community Requirements Checklist included in Appendix I.

6.9 Public Utilities

The proposed longitudinal drainage has been reviewed against the existing services and proposed service locations. Near the proposed Collingwood Drive and Smiths Road intersection, the proposed culvert structures (C-SR100) are in conflict with the existing water supply and sewerage pipes and the valve chambers. PUP will be relocated prior to construction so there will be no clashes with proposed transverse drainage. At time of submission, only the horizontal alignment of PUP was available.

There are existing overhead electricity & Optus services, underground Telstra optic fibre mains in the locality of the proposed culverts. The Telstra, Optus and electricity services will remain in place until such time as the bulk earthworks are complete for the northern service road and at such time these services will be relocated to the new service road verge area. The construction staging and design of the proposed culverts should include consideration of the existing Telstra, Optus and ENERGEX services that will be in conflict with the proposed culvert at certain stages during construction.

6.10 Queensland Rail

The drainage line crossing QR is passing through the QR culvert and reaches the proposed culvert C-FS950. The upstream catchment area at the QR culvert has not changed. As such, there will not be any increase in the flow through the QR culvert and the flow in the railway channel.

7 Durability Considerations

7.1 General

A comprehensive sampling programme and durability assessment is currently being finalised to ensure that the proposed design, technical and construction standards are adequate to meet the durability standards outlined in the SWTC and to meet the minimum design life for the various asset types associated with this project. A summary of the assessment for drainage associated structures at C-SR100, C-FS620, C-FS750 and C-FS950 is detailed below:

Based on sampling undertaken in borehole and test pits adjacent to these structures the following is noted.

For structure C-SR100 relevant sampling from boreholes IMU236B and IMU269B show pH levels in excess of 6.9 and critical values for sulphate of 110ppm and chloride of 790ppm.

For structures CFS620, relevant sampling from test pits TP218C and TP220 shows pH levels in excess of 7.6 and critical values for sulphate of 46ppm and chloride of 720ppm.

For structure CFS750, relevant sampling from test pits TP215 and TP216 show pH levels in excess of 7.4 and critical values for sulphate of 55ppm and chloride of 1400ppm.

For structure CFS950, relevant sampling from test pits TP702 and TP216 show pH levels in excess of 8.0 and critical values for sulphate of 27ppm and chloride of 1400ppm.

The critical values from these samples show the soils to be non-aggressive and are all well below the concentrations which are considered detrimental to concrete and reinforcing steel. These results have been reviewed and discussed with our specialist consultant Mahaffey.

In accordance with Clause 7.6.2 of the SWTC, a minimum exposure classification of B2 is required. As the environment is not deemed to be tidal or saline, no special measures are required and this minimum required exposed classification is adequate for these drainage structures.

The durability design for all works is covered by a separate design durability report D2G-BASD-DGDUKS100-R-1000. The test sample results and further discussion are included in this report.

8 Items on HOLD

Formal review of the design lot is to occur on all drawings included in this design package.

HOLD clouds have been used to identify those areas of the Drawings awaiting further design development or PSTR revisions. The HOLD clouds for review are outlined in Table 8-1.

8.1 Holds Closed

Table 8-1 lists the HOLDS Closed.

Table 8-1 Summary of HOLDS Closed

HOLD No.	Description	Package where Hold Cloud were Removed
HOLD 1	Longitudinal drainage (works not part of this design submission) Hold cloud released with IFC issue of Longitudinal Drainage	RERODR201
HOLD 3	Safety Screens on culverts C-FS620 and C-FS950	RERODR206
HOLD 7	Culvert C-SR100A-inlet structure	RERODR206
HOLD 4	Francis Street / Monash Road & Brisbane Terrace Intersection, Culvert C1250 – removed from scope.	RERODR206
HOLD 10	Francis Street / Brisbane Road Intersection	RERODR201

8.2 Holds for Review, Verification and Certification

Not applicable at this stage.

8.3 Holds Not for Verification and Certification

The items listed in Table 8-2 are on HOLD and are not for Verification and Certification. These HOLDS should be considered in the integrated design and can be reviewed and commented on, but they are not subject to the IV certification at this stage, as they do not necessarily comply with the PSTR as it currently stands. Subsequent design submissions will be presented to remove these HOLDS.

Table 8-2 Summary of HOLDS not for review, verification and certification

HOLD No.	Description	Package where Hold Cloud will be Removed
HOLD 9	Limit of Works at Francis Street	RERODR201

Appendix A – Relevant Design Drawings (Transmittal Number TC 342)

Appendix B – Technical Standards and Specifications

List of Specifications applying to this design lot

Number	Description	Version	Tick if Applicable to this Package
Project Specific Technical Specifications			
PSTS01	Introduction to Technical Standards	Aug 09	☒
PSTS02	Provision for Traffic	Aug 09	☐
PSTS03	Drainage, Retaining Structures and Protective Treatments	Aug 09	☒
PSTS04	General Earthworks	Aug 09	☒
PSTS05	Unbound Pavements	Aug 09	☐
PSTS06	Reinforced Soil Walls	Aug 09	☐
PSTS07A	In Situ Stabilised Sub-grades Using Quicklime or Hydrated Lime	Aug 09	☐
PSTS07B	In Situ Stabilised Pavements Using Cement or Cementitious Blends	Aug 09	☐
PSTS07C	In Situ Stabilised Pavements Using Foamed Bitumen	Aug 09	☐
PSTS08	Plant-Mixed Stabilised Pavements	Aug 09	☐
PSTS11	Sprayed Bituminous Surfacing (Excluding Emulsions)	Aug 09	☐
PSTS14	Road Furniture	Aug 09	☐
PSTS15	Noise Barriers	Aug 09	☐
PSTS16	Landscape and Revegetation Works	Aug 09	☒
PSTS17	Bitumen	Aug 09	☐
PSTS18	Polymer Modified Binder	Aug 09	☐
PSTS19	Bitumen Cutter Oil and Flux Oil	Aug 09	☐
PSTS20	Cutback Bitumen	Aug 09	☐
PSTS21	Bituminous Emulsion	Aug 09	☐
PSTS22	Supply of Cover Aggregate	Aug 09	☐
PSTS23	Supply and Delivery of Quicklime and Hydrated Lime for Road Stabilisation	Aug 09	☐
PSTS24	Manufacture of Precast Concrete Culverts	Aug 09	☒
PSTS25	Manufacture of Precast Concrete Pipes	Aug 09	☒
PSTS26	Manufacture of Fibre Reinforced Concrete Drainage Pipes	Aug 09	☒
PSTS27	Geotextiles (Separation and Filtration)	Aug 09	☒
PSTS30	Dense Graded Asphalt Pavements	Aug 09	☐
PSTS31	Heavy Duty Asphalt	Aug 09	☐
PSTS34	Open Graded Asphalt Surfacing	Aug 09	☐
PSTS38	Pavement Drains	Aug 09	☐
PSTS39	Lean Mix Sub-base for Pavements	Aug 09	☐
PSTS40	Concrete Base in Pavements – Jointed Un-reinforced, Jointed Reinforced, Concrete Reinforced and Steel Fibre Reinforced Pavements.	Aug 09	☐
PSTS42	Supply of Wax Emulsion Curing Compound for Concrete	Aug 09	☐
PSTS45	Pavement Marking	Aug 09	☐
PSTS45A	Audio Tactile Line Marking	Aug 09	☐
PSTS50	Specific Quality System Requirements	Aug 09	☐
PSTS51	Environmental Management	Aug 09	☐
PSTS57	Geotextiles for Paving Application	Aug 09	☐
PSTS61	Mounting Structures for ITS Devices	Aug 09	☐
PSTS62	Bridge Substructures	Aug 09	☐
PSTS63	Cast-In-Place Piles	Aug 09	☐
PSTS65	Precast Prestressed Concrete Piles	Aug 09	☐
PSTS67	Bitumen Slip Layer on Piles	Aug 09	☐
PSTS68	Dynamic Testing of Piles	Aug 09	☐
PSTS70	Concrete	Aug 09	☒
PSTS71	Reinforcing Steel	Aug 09	☒
PSTS71A	Stainless Steel Reinforcing	Aug 09	☐
PSTS72	Manufacture of Precast Concrete Elements	Aug 09	☒
PSTS73	Manufacture of Prestressed Concrete Members and Stressing Units	Aug 09	☐
PSTS74	Supply and Erection of Prestressed Concrete Deck and Kerb Units	Aug 09	☐
PSTS75	Supply and Erection of Prestressed Concrete Girders	Aug 09	☐
PSTS76	Supply and Erection of Steel Girders (Yet to be supplied)	Aug 09	☐
PSTS78	Fabrication of Structural Steelwork	Aug 09	☐
PSTS79	Fabrication of Aluminium Components	Aug 09	☐
PSTS80	Supply and Erection of Bridge Barrier	Aug 09	☐

Number	Description	Version	Tick if Applicable to this Package
PSTS81	Bridge Bearings	Aug 09	☐
PSTS82	Bridge Deck Expansion Joints	Aug 09	☐
PSTS83	Anti-Graffiti Protection	Aug 09	☐
PSTS84	Deck Wearing Surface	Aug 09	☐
PSTS84A	Cold Milling Bridge Deck Wearing Surface	Aug 09	☐
PSTS85A	Repainting Existing Steel Bridges and New Steel Bridges – Zinc Metal Systems	Aug 09	☐
PSTS86	Preparation for Bridge Widening	Aug 09	☐
PSTS88	Painting New Work	Aug 09	☐
PSTS89	Post Tensioned Concrete	Aug 09	☐
PSTS90	Modular Bridge Expansion Joints	Aug 09	☐
PSTS91	Ducts and Pits	Aug 09	☐
PSTS92	Traffic Signal and Road Lighting Footings	Aug 09	☐
PSTS93	Traffic Signals	Aug 09	☐
PSTS94	Road Lighting	Aug 09	☐
PSTS95	Switchboards and Cables Layer,	Aug 09	☐
PSTS101	Checking Subgrade, Capping Layer, Drainage Layer, Controlled Subgrade, Working Platform, Temporary Pavement, Verge	Aug 09	☐
PSTS101B	Temporary Pavements	Aug 09	☐
PSTS201	General Equipment Requirements	Aug 09	☐
PSTS202	Provision of Variable Message Signs	Aug 09	☐
PSTS203	Provision of Weigh-in-Motion System	Aug 09	☐
PSTS204	Provision of Vehicle Loop Detectors	Aug 09	☐
PSTS206	Provision of Variable Speed Limit and Lane Control Signs	Aug 09	☐
PSTS210	Provision of Mains Power	Aug 09	☐
PSTS221	Provision of Help Telephones	Aug 09	☐
PSTS225	Provision of Imaging Equipment	Aug 09	☐
PSTS226	Provision of Telecommunications Field Cabinets	Aug 09	☐
PSTS227	Provision of Changeable Message Signs	Aug 09	☐
PSTS228	Provision of Electronic Switchboards	Aug 09	☐
PSTS231	Provision of Road Weather Monitors	Aug 09	☐
PSTS232	Provision of Field Processors	Aug 09	☐
PSTS234	Provision of Telecommunications Cables	Aug 09	☐
PSTS239	Provision of Mounting Structures for ITS Devices	Aug 09	☐
PSTS245	Principal's Telecommunications Network	Aug 09	☐
PSTS248	Provision of Travel Time Signs	Aug 09	☐
PSTS250	Provision of Automatic Number Plate Recognition System	Aug 09	☐
PSTS251	Provision of Traffic Counter/Classifier	Aug 09	☐
	Project Specific Supplementary Specifications		
MRS 11.91	Ducts and Pits	Aug 09	☐
MRS 11.92	Traffic Signal and Road Lighting Footing	Aug 09	☐
MRS 11.94	Road Lighting	Aug 09	☐
MRS 11.95	Switchboards and Cables	Aug 09	☐
ITS 10	Mains Power Supply	Aug 09	☐
	Miscellaneous Specifications		
MCE-SR-002	Requirements for Work in or about QR Property	Aug 09	☐
MCE-SR-003	Requirements for Work adjacent to Overhead Line Equipment	Aug 09	☐
R57	Design of Reinforced Soil Walls	Aug 09	☐
MDSS 987	Hot-Mixed Asphalt Pavement – Bikeway	Aug 09	☐
MCE-SR-0015	Queensland Railways - Track Clearances (Draft)	Aug 09	☐

Appendix C – Reference Drawings

List of DMR Reference Drawings applying to this design lot.

Author	Drawing number	Description	Revision	Tick if Applicable to this package
DMR	881	Cane Railway Crossings – Asphalt Paved and Concrete	Rev B 9/00	☐
DMR	1033	Kerb and Channel – Kerbs, Channels and Ramped Vehicular Crossing	Rev J 10/05	☒
DMR	1043	Reinforcing Steel – Standard Bar Shapes Drawing 1 of 2 and Drawing 2 of 2	Rev M 9/06	☒
DMR	1044	Reinforcing Steel – Standard Hook, Lap and Bend Details and General Steel Reinforcement Information	Rev J 9/06	☒
DMR	1045	Revegetation – Treatment of Cut Batters	Rev D 10/03	☒
DMR	1063	Standard Date Plate – General Arrangement	Rev F 1/04	☐
DMR	1116	Subsoil Drains – Outlets and Cleanouts	Rev F 9/02	☒
DMR	1117	Drainage Structures – Abutment Protection	Rev G 8/02	☒
DMR	1131	R C Slab Deck Culvert - 2500 Span – Construction of Foundations, Aprons, Walls and Wings	Rev F 11/05	☒
DMR	1132	R C Slab Deck Culvert - 2500 Span – Construction of Reinforced Concrete decks and Kerbs	Rev F 5/06	☒
DMR	1145	Standard P.V.C. Scupper – Details for Cast In Situ Deck	Rev D 8/02	☒
DMR	1148	R C Slab Deck Culvert - 2500 Span – Steel Schedule for Reinforced Concrete Deck, Foundations, Aprons, Walls and Wings	Rev F 3/02	☒
DMR	1149	Traffic Signals/Road Lighting/ITS – Ducts for Underground Electrical and Communications Conduit	Rev G 1/07	☐
DMR	1170	Flood Depth Indicators – Installation	Rev B 10/00	☐
DMR	1172	Retaining Structures – Bridge Approach Relieving Slab	Rev H 9/06	☐
DMR	1174	R C Box Culverts – Construction of End Structures H = 150 – 600	Rev F 2/04	☒
DMR	1178	Diversion of Water – Diversion of water from Roadway and Table Drains	Rev E 10/03	☒
DMR	1179	R C Slab Deck Culvert - 2500 Span – Construction of Base, Aprons, Walls and Wings	Rev D 6/02	☒
DMR	1284	R C Slab Deck Culvert - 2500 Span – Steel Schedule for Reinforced Concrete Deck, Foundations, Aprons, Walls and Wings	Rev C 3/02	☒
DMR	1290	Traffic Signals – Lamp State Coding Philips PTF Traffic Controllers	Rev D 7/02	☐
DMR	1291	Sign – Guide Sign – Finger Board, Geographical Feature and Street Name Signs Extrusion Detail	Rev C 9/90	☐
DMR	1292	Sign – Roadworks Sign Support Y Stand	Rev D 12/92	☐
DMR	1294	Sign – Roadwork Delineators	Rev B 12/92	☐
DMR	1295	Sign – Fingerboard, Geographical Feature and Street Name Signs and Bracket Details	Rev C 9/90	☐
DMR	1301	Sign – Roadworks Sign Details and Assembly of Crossbars and Supports	Rev D 12/92	☐
DMR	1303	R C Box Culverts & Slab Link Box Culverts – Construction of Reinforced Concrete Wingwalls and Headwalls	Rev F 4/06	☒
DMR	1304	Pipe Culverts - Construction of Reinforced Concrete Wingwalls and Aprons for Pipe Diameter up to 2400	Rev F 11/05	☒