Cardno
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WARRINGAH MALL, BROOKVALE

STORMWATER MANAGEMENT PLAN & STORMWATER REPORT FOR SECTION 96 APPLICATION

Nov 2014
Job No. W4548

WESTFIELD DESIGN
AND CONSTRUCTION

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WARRINGAH MALL, BROOKVALE

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1. INTRODUCTION

This report has been prepared to support the Section 96 Application (DA2008/1742) for drainage augmentation works at Warringah Mall, Brookvale and in particular for the modification of the Condamine Street box culverts. It is to be read with the following reports and plans:

- Concept Drainage Augmentation Works, Drawings W4548-100 Series for DA & W4548-400 for Section 96 by Cardno (NSW/ACT);
- Concept Drainage Augmentation Works, Stage 1 Expansion Works, Drawings W4548-200 Series for DA & W4548-300 Series for Section 96 by Cardno (NSW/ACT);
- Warringah Mall Flood Impact Assessment, Final Report, December 2008 by Cardno Willing (NSW);
- Cardno letter dated 5 Nov 2014 Stormwater Management Deferred Commencement Condition No.1 DA2008/1742 at Warringah Mall – Section 96 Application.

For an overview of the site, background information, existing and proposed conditions and details of flood modelling works refer to the report 'Warringah Mall Flood Impact Assessment, Final Report, December 2008' by Cardno Willing (NSW).

This report presents a brief overview of the assumptions made in preparing the design plans as listed above. It presents additional detail not presented in the Cardno Willing report and generally relates to services and utilities and constructability of the proposed works.

2. EXISTING SITE INFORMATION

Details of existing site drainage, levels and features have been taken from a number of sources including:

- A number of field surveys provided by Westfield
- Stormwater Condition Survey by Hyder Consulting
- Dial before You Dig Inquiry for existing services and utilities

Base survey data was imported into a 12D computer model to represent the site in 3-dimensions.

Data was also entered into the model to represent the existing utilities and stormwater pipes and culverts in 3-dimensions. Where levels of existing utilities were not known, the service was set to an assumed constant depth below the existing surveyed ground surface. This assumed constant depth is consistent with each utility authority's minimum cover requirements.

The location and level of all services that cross or run parallel to the proposed works should be verified by potholing on site prior to the commencement of construction works.

The above 12D model formed the basis for the concept drainage augmentation work plan sets as detailed in Section 1.

3. CONCEPT DRAINAGE AUGMENTATION WORKS

The flood modelling undertaken by Cardno Willing (NSW) ran a number of scenarios to assess flood impacts on the Warringah Mall site.

Augmentation works as determined by the Cardno Willing (NSW) flood modelling were entered in 3-dimensions into the 12D model to represent the proposed works to be carried out on site.

The proposed works include:

- new and upgraded pipes and culverts
- pavement regrading
- construction of high capacity inlet grates
- augmentation to the existing Brookvale Creek parapet wall
- lowering of the two central culverts under Condamine Street
- lowering of the existing apron slab upstream of the gross pollutant trap (GPT) downstream of Condamine Street.

Four plan sets have been prepared:

The W4548-100 series plans for DA 2008/1742 and W4548-400 series for S96 present the proposed drainage augmentation plans for the whole of the site in relation to existing site features.

The W4548-200 series plans for DA 2008/1741 and W4548-300 for S96 represent drainage augmentation works proposed to facilitate Stage 1 of the mall expansion. Works proposed under the W4548-200 & 300 series plans set are consistent with the wider augmentation works shown in the W4548-100 & 400 series plans.

The following Sections present a brief discussion on the assumptions made in preparing the above designs for the augmentation works.

3.1 Brookvale Creek Parapet Wall Augmentation and Associated Works

Brookvale Creek runs from Allenby Basin to the north of Warringah Mall to the northern boundary of the site as an open channel. At the northern boundary of the site the creek discharges into reinforced concrete box culverts (RCBCs) that pass under the site and discharge at the existing GPT downstream of Condamine Street.

Flows in excess of the culvert capacity at the northern boundary of the site pond behind an existing concrete parapet wall before overtopping an overflow weir and discharging into existing overflow culverts located under the Woolworths loading dock access road. These overflow culverts, as noted above, then discharge to an open channel to the south-west of the Cross Street roundabout.

Flows in excess of the overflow culvert's capacity overtop the parapet wall and spill over the access road and into an open channel. From this open channel the flows discharge back into the main culverts under the mall via culverts and pipes (see Stormwater Condition Report by Hyder).

To minimise existing upstream impacts it is proposed to lower the parapet wall and overflow weir levels associated with the overflow culverts. The overflow weir will be lowered from its existing level of RL11.50 to RL10.50. This lowered level is the similar to the adjoining existing surface level upstream of the parapet wall and will result in the overflow culverts conveying flows during more frequent storm events.

The main parapet wall will be lowered from RL12.0 to RL11.1. It is expected that flows will pond to RL11.1 and spill over the access road in events equal to or greater than the 5% AEP (20-year ARI) design storm event.

Flood barriers will be installed on the access road to prevent any flows that overtop the lowered parapet from discharging west toward to Woolworths loading dock. The type of flood barrier will be determined at the detailed design stage.

In conjunction with the flood barrier, traffic boom gates will be installed at the Cross Street roundabout and near the Woolworths loading dock to prevent vehicles from passing through the water that spills over the lowered parapet. These boom gates will be linked to flood levels within Brookvale Creek.

For additional discussion of work in this area refer to the Flood Impact Assessment report by Cardno Willing (NSW). The above works are proposed to be undertaken prior to the Stage 1 Expansion.

3.2 Starfish Car Park Regrading and Associated Works

The existing Starfish car park is currently subject to inundation during relatively frequent storm events. It is proposed to regrade the access road immediately to the west of the car park to ensure no flows pass through the car park during the design 1% AEP (100-year ARI) storm event.

It is proposed to regrade the access road from a standard cross fall (falling from the centre median to the kerb and gutter) to fall from the kerb and gutter toward the median. It is proposed to replace part of the median with a high capacity inlet grate (approximately 12m x 2m including allowance for 50% blockage) to capture the 1% AEP (100-year ARI) storm flows and ensure no flows enter the car park during this storm event. The high capacity inlet will discharge to the nearby existing 1050mm diameter stormwater pipe.

The proposed regrading works will tie in with existing levels to the north and south of the car park.

The existing Optus telecommunication services that traverses the access road needs to be located and levelled prior to construction to confirm any impacts upon the service. It is expected that any reduction in cover would be minimal, in the order of 50mm (subject to confirmation of service location).

Associated with this regrading and high capacity inlet is the construction of local raised thresholds/speed humps to ensure water is directed to the proposed high capacity inlet. The thresholds will be located near the access road's intersection with Old Pittwater Road and near the crest of the access road that runs in an east-west direction between the Starfish car park and Myer.

For additional discussion of work in this area refer to the Flood Impact Assessment report by Cardno Willing (NSW). The above works are proposed to be undertaken prior to the Stage 1 Expansion.

3.3 Cross Street Roundabout Regrading Works

The existing Cross Street roundabout will be partially regraded to direct flows to proposed grated inlets around the south-east kerb. These grates will discharge into the adjoining existing open channel to the south-east of the roundabout.

The proposed grates have been sized at 12m x 0.45m and allow for 50% blockage.

For additional discussion of work in this area refer to the Flood Impact Assessment report by Cardno Willing (NSW). The above works are proposed to be undertaken prior to the Stage 1 Expansion.

3.4 Re-Configuration of the Stormwater Culvert DA Layout Through Bing Lee

Subsequent to the modelling assessments to optimise the layout of Chambers B4 and B6 further consideration was given to the interaction of the proposed works with other services, the feasibility of relocating services at the southern end of Green Street, traffic management during construction, construction sequencing and potential hydraulic impacts during construction.

This led to further consideration of the proposed construction of two additional culverts under Condamine Street and the merit of separating the alignment of the new stormwater culverts from the existing culverts realigning the additional stormwater culverts through the Bing Lee site between Chambers B4 and B6.

For additional discussion of work in this area refer to Cardno letter dated 5 Nov 2014 Stormwater Management Deferred Commencement Condition No.1 DA2008/1742 at Warringah Mall – Section 96 Application.

3.5 Cross and Green Street Car Park

The existing on-grade car park on the corner of Cross and Green Streets will be upgraded to a multi-storey car park as part of the Stage 1 Expansion. The existing car park will form the ground level of the proposed multi-storey structure.

It is proposed to construct twin 3.6m (W) x 1.5m (H) reinforced concrete box culverts (RCBCs) along the southern boundary of Cross Street and the western boundary of Green Street. The culverts will drain the existing open channel to the south-east of the Cross Street roundabout. Culverts will be oriented parallel to the proposed multi-storey car park with the outside face of the inner culvert (furthest from the boundary) located vertically in line with the vehicle ramps above.

The top of the proposed culverts will be slightly above existing ground level in some locations. To ensure a minimum 300mm of topsoil is provided over the culverts for landscaping purposes, it is proposed to construct a low retaining wall along the boundary to retain this additional soil.

Chamber B4 has been modified to a curved in-situ structure to streamline flows and avoid construction sequencing and staging difficulties with the existing culverts at the Green Street roundabout.

Chamber B4 is just upstream of the limit of the drainage augmentation works associated with the Stage 1 Expansion works. During the Stage 1 Expansion works the end of the culvert will be blocked and a temporary connection to the existing culverts will be via 1350dia RCP. During future expansion works, proposed twin 3.6m (W) x 1.5m (H) culverts will be constructed to the north of the existing 3.3m (W) x 1.5m (H) culvert that ultimately discharges to the existing GPT south of Condamine Street.

A high capacity inlet grate is proposed to be constructed over the proposed culverts at the low point in Green Street. These grates have been orientated so that the perimeter of the grate parallel to Green Street is maximised. At this grate location the low retaining wall will return across the top of the culverts to retain the 300mm topsoil. The nominal grate area is proposed to be 10m x 7.2m and allows for 50% blockage.

Existing local drainage within the existing car park (the existing local drainage will be redesigned and constructed along with the Stage 1 expansion works) is generally proposed to remain, however, minor adjustment works may be required to suit the proposed culvert arrangement.

For additional discussion of work in this area refer to the Flood Impact Assessment report by Cardno Willing (NSW). The above works are proposed to be undertaken prior to the Stage 1 Expansion.

3.6 Dale Street Roundabout Regrading

Under existing conditions, Dale Street is subject to high overland flows due to the convergence of several large upstream catchments (refer Flood Impact Assessment Report for more information). The existing Dale Street roundabout is proposed to be regraded and a high capacity inlet grate constructed to collect and discharge these overland flows.

It is proposed to regrade the existing roundabout so that it falls toward the centre island. The existing raised island will be reconstructed level with the adjoining pavement and delineated by line marking and bollards. The regrading works will tie in with existing kerb levels around the perimeter of the roundabout.

The proposed high capacity grate Chamber B6 will be constructed within the regraded island and has been calculated at 10.5m x 1.8m allowing for 50% blockage. The grate will discharge into two new 3.3m (W) x 1.8m (H) culverts and an extension of an existing 4.2m (W) x 1.8m (H) culvert.

In conjunction with this work the existing junction chamber to the north-west of the roundabout will be reconstructed and enlarged to mix flows from the proposed twin 3.6m (W) x 1.5m (H) culverts and existing 3.3m (W) x 1.5m (H) culvert.

The proposed culverts in this area pass over an existing 1200mm sewer carrier. The culverts will need to be piered to ensure that the culvert loads are transferred below the sewer. All works within the existing sewer easement will need to be approved by Sydney Water Corporation (SWC). It is proposed to divert the 1200mm diameter sewer within an easement 5.5m wide easement parallel with Pittwater Road but these works are subject to budgetary constraints and approvals by SWC.

An existing 1350mm diameter stormwater pipe crosses Pittwater Road and passes under the existing car park to the east of the Dale Street roundabout. Flows in the 1350mm diameter pipe crossing Pittwater Road will be redirected to a new pipe adjacent to the boundary discharging into one of the proposed twin 3.3m (W) x 1.8m (H) culvert. A small length of the existing 1350mm diameter pipe that carries part of the car park's local drainage will be retained and connected into one of the proposed twin 3.3m (W) x 1.8m (H) culvert.

For additional discussion of work in this area refer to the Flood Impact Assessment report by Cardno Willing (NSW).

3.7 Pittwater Road Bus Stop, Electrical Substation and Building Demolition Works

Existing bus stops are located on Pittwater Road. These bus stops serve as the main point of entry from the public transport system into the Mall. The bus stops are surrounded by a number of large, established trees and vegetation.

Along Pittwater Road there is an allowance for future road widening of 4.0m. From this edge it is proposed to construct a 1200mm diameter sewer within an easement 5.5m wide. It is proposed to construct the twin 3.3m (W) x 1.8m (H) culverts approximately 6.0m off the edge of the proposed sewer easement which will enable the existing bus stops and surrounding significant trees and vegetation to be retained. In summary, the proposed twin culverts will be constructed 15.5m from the existing road reserve boundary. The culvert construction will require the partial demolition and reconstruction of the existing covered walkway that runs from the bus stops to the Mall entrance.

The culvert alignment has been straightened for hydraulic efficiency and also it is parallel with Pittwater Road/Condamine Street to avoid the high voltage substation that exists between the access road and pedestrian path. The substation is fed by underground high voltage cables that connect to the electricity grid in Pittwater Road. It is understood that Hyder will be detailing all HV relocations including relocation of this substation to suit the proposed building works.

To the south of the access road the proposed culverts encroach on the building footprint of the HCF building and Godfathers Restaurant. Full demolition of the both buildings will be required to allow construction of the proposed twin 3.3m (W) x 1.8m (H) culverts parallel to Pittwater Road/Condamine Street.

For additional discussion of work in this area refer to the Flood Impact Assessment report by Cardno Willing (NSW).

3.8 Condamine Street Culverts & Chamber C6

The proposed construction of two additional culverts under Condamine Street poses major challenges in terms of traffic management and construction sequencing. Consequently consideration has been given to a modification of the proposed works in the vicinity of Condamine Street to allow the hydraulic capacity of the Condamine Street culverts to be increased without disrupting Condamine Street.

It is proposed to reconstruct Chamber C6 and lower the invert level of the two central box culverts by 1.0m together with the lowering of the apron slab at the outlet also by 1.0m.

Due to the lowering of the culverts and the sewer diversion works, the reconstruction of Chamber C6 is required.

The existing gross pollutant trap (GPT) to the south of Condamine Street which treats flows from the existing culverts will not be impacted by the works.

The proposed culvert lowering that cross Condamine Street will need to be constructed in accordance with the RMS' requirements for works within their road reserve. Preliminary construction methodology and suggested construction staging drawings have been prepared; refer to Appendix B and separate Structural Report by Cardno for details.

The augmentation works to the Condamine Street are proposed to include:

- the reconstruction of Chamber C6
- the lowering of the invert level of the two central culverts by 1.0m
- the lowering of existing concrete apron slab for the two central culverts by 1.0m

All proposed works will make a smooth connection with existing levels.

Suggested construction staging drawings are provided in Appendix B of this report.

For additional discussion of work in this area refer to the Flood Impact Assessment report by Cardno Willing (NSW).

4. CONCLUSION

The existing Warringah Mall site is currently subject to relatively frequent stormwater inundation.

The proposed works will be staged with the first stage undertaken to facilitate Stage 1 of the proposed Mall expansion works.

Significant works that will be undertaken as part of the proposed works include:

- Augmentation to the existing parapet wall on the Woolworths loading dock road;
- Regrading works at the Starfish car park;
- Regrading of the Cross Street roundabout;
- Installation of culverts around the proposed Cross Street and Green Street adjacent to Palm Tree car park;
- Construction of culverts through Bing Lee between Chamber B4 & B6;
- Regrading and reconstruction of the Dale Street car park;
- Construction of culverts along Pittwater Road and Condamine Street;
- Lowering of culverts under Condamine Street;
- Lowering of the existing apron slab between Condamine Street outlet and the gross pollutant trap (GPT).

The proposed works will allow the existing bus stops and significant vegetation along Pittwater Road to remain.

The works will require the full demolition of the existing Bing Lee, HCF and Godfathers building to facilitate the culvert construction.

The proposed works will increase the capacity of the underground stormwater network and reduce the volume and hazard of overland flows during infrequent storm events. This results in an overall improvement to public safety both within and outside of the Mall.

5. REFERENCES

- Cardno (NSW/ACT), *Concept Drainage Augmentation Works*, Drawings W4548-100 Series

- Cardno (NSW/ACT), *Concept Drainage Augmentation Works, Stage 1 Expansion Works*, Drawings W4548-200 Series

- Cardno Willing (NSW), *Warringah Mall Flood Impact Assessment*, Final Report, December 2008, Job W4548

- Hyder Consulting, *Warringah Mall Stormwater Condition Report,* Project Code NS00376, noted as Preliminary Only

- Cardno (NSW/ACT), *Concept Drainage Augmentation Works*, Stage 1 Expansion Works, Section 96 Application Drawings W4548-300 Series

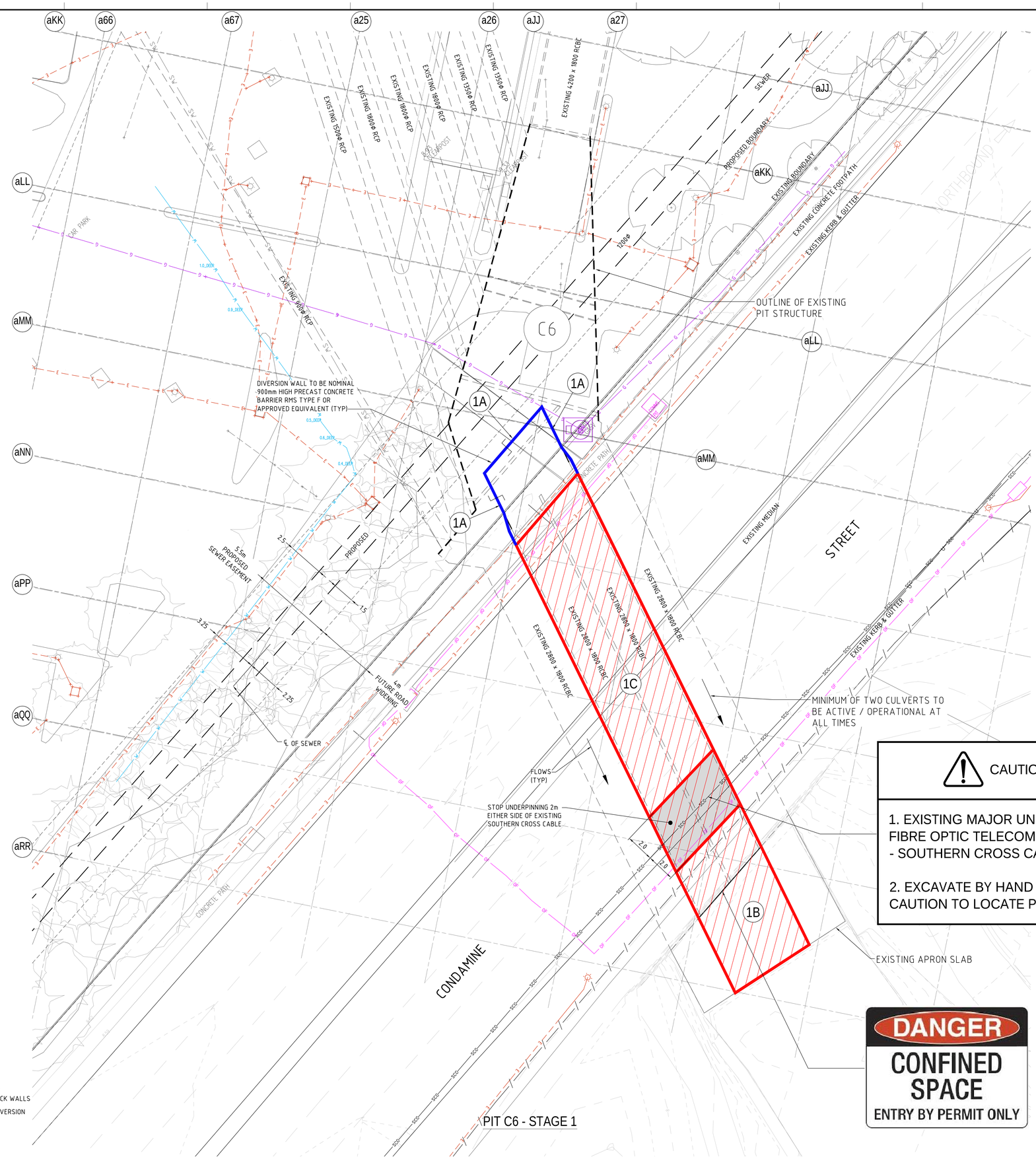
- Cardno (NSW/ACT), *Concept Drainage Augmentation Works, Section 96 Application*, Drawings W4548-400 Series

APPENDIX A – PHOTO MONTAGE CONDAMINE STREET CULVERTS

WARRINGAH MALL
CONDAMINE STREET, BROOKVALE
DA 2008/1742

×LOWER INVERT OF CULVERTS BY 1.00m

APPENDIX B – CONDAMINE STREET CULVERTS & CHAMBER C6 CONSTRUCTION STAGING DRAWINGS



PIT C6 - STAGE 1 CONSTRUCTION SEQUENCE

1A - CONSTRUCT DIVERSION WALLS - ACCESS AREA THROUGH DOWNSTREAM OUTLET.

NOTE:
THIS IS A CONFINED SPACE. ANY PERSON ENTERING THE CULVERTS MUST HAVE CONFINED SPACE TRAINING. CONTRACTOR IS REQUIRED TO MONITOR WEATHER CONDITIONS CLOSELY AND AVOID ENTRY / CONSTRUCTION WITHIN PIT IF RAIN IS PREDICTED.

1B - LOWER APRON SLAB AS PER DWG CAR-060141

1C - LOWER BASE SLAB AS PER CARDNO DWG CAR-060140 & CAR-060141

⚠ CAUTION DANGER

1. EXISTING MAJOR UNDERGROUND OPTUS FIBRE OPTIC TELECOMMUNICATIONS CABLE - SOUTHERN CROSS CABLES.

2. EXCAVATE BY HAND WITH EXTREME CAUTION TO LOCATE PRIOR TO ANY WORKS

DANGER
CONFINED SPACE
ENTRY BY PERMIT ONLY

LEGEND

EXISTING

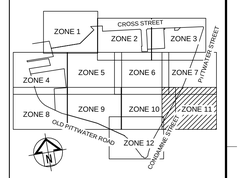
- BOX CULVERT (2800 x 1800 RCBC)
- STORMWATER DRAINAGE PIPE (EXISTING 1500ø)
- BOUNDARY
- ELECTRICITY (HIGH VOLTAGE) (E)
- ELECTRICITY (LOW VOLTAGE) (E)
- GAS (G)
- WATER (W)
- OPTIC FIBER (OF)
- SEWER (S)
- STORMWATER DRAINAGE (SWD)
- SOUTHERN CROSS CONDUIT (SCO)
- TELSTRA (T)
- FIRE SERVICES (F)
- UNKNOWN SERVICES
- EXISTING SUBSOIL DRAIN
- FENCE

PROPOSED

- BOX CULVERT
- STORMWATER DRAINAGE PIPE
- SEWER (PROPOSED ø SEWER)
- LONGITUDINAL SECTION REFERENCE (A1)
- STORMWATER DRAINAGE
- ELECTRICITY (HIGH VOLTAGE)
- ELECTRICITY PIT
- SUBSOIL DRAIN (SS)
- SHORING WALL
- PROPOSED CONCRETE WALL
- TEMPORARY DIVERSION BLOCK WALLS
- DEMOLISHED TEMPORARY DIVERSION BLOCK WALLS
- EXTENT OF WORKS

Rev	Date	By	Chk	Description
1	31/10/14	GV	DNA	ISSUED FOR CONSTRUCTION

Key Plan



General Note

ALL DIMENSIONS TO BE CHECKED ON SITE. WRITTEN DIMENSIONS ONLY TO BE USED. REFER TO ALL DETAIL DRAWINGS, STRUCTURAL, MECHANICAL & SERVICES DRAWINGS BEFORE COMMENCING WORK. REFER ANY DISCREPANCIES TO THE ARCHITECT. DO NOT SCALE FROM DRAWINGS.

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Title
WARRINGAH STORMWATER AUGMENTATION CULVERT STAGE 2

SUGGESTED CONSTRUCTION STAGING - PIT C6 STAGE 1

Drawing Scale	Scale Bar 1:1	
1:100	0 1 2 3 4 5	
Drawn By	CAD Filename	Plot Date
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Project No.	Drawing No.	Revision
D11753	CAR-110130	1

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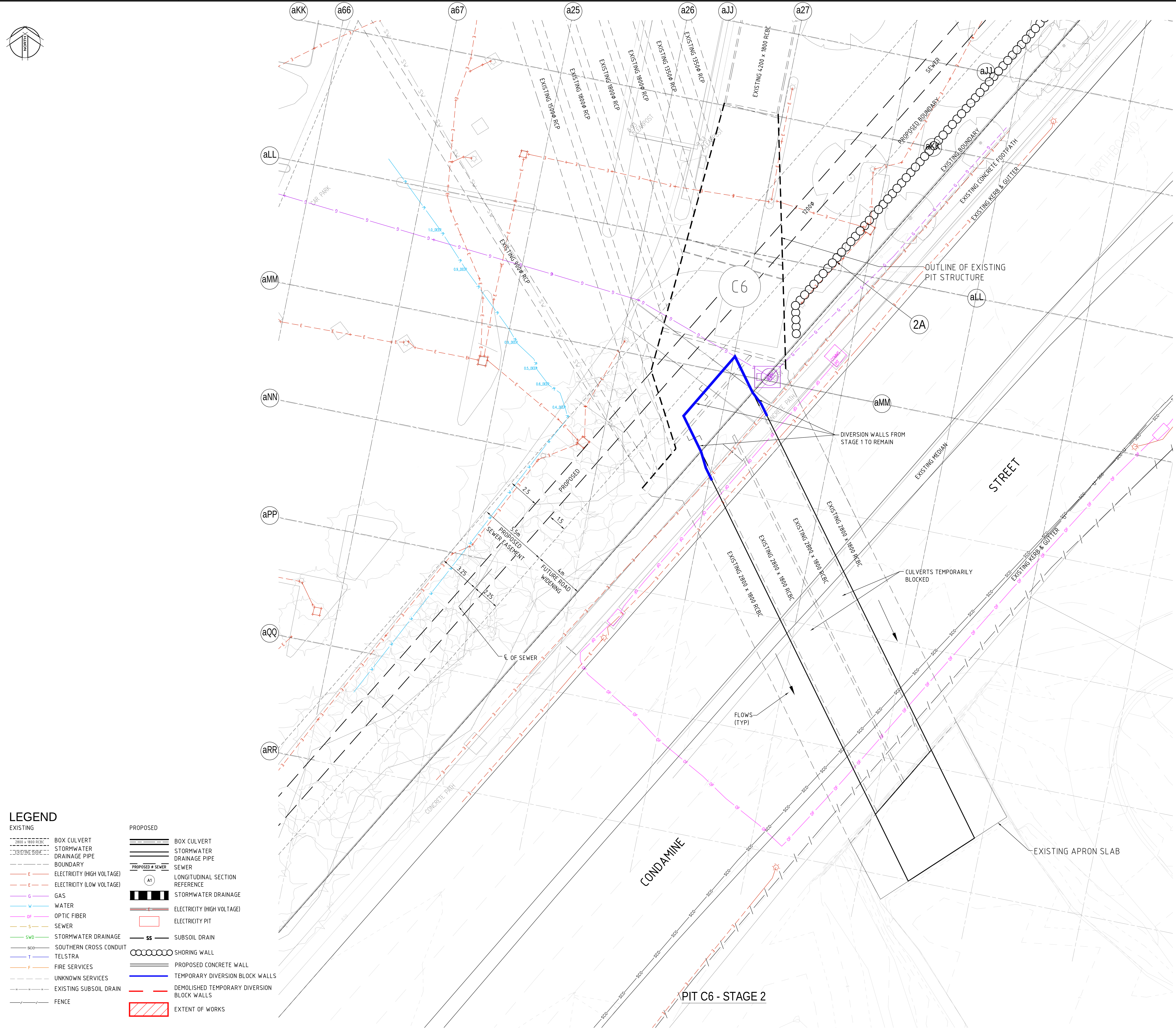


PIT C6 - STAGE 2

LEGEND

EXISTING		PROPOSED	
2800 x 1800 RCBC	BOX CULVERT		BOX CULVERT
750Ø RCP	STORMWATER DRAINAGE PIPE		STORMWATER DRAINAGE PIPE
	BOUNDARY	PROPOSED Ø SEWER	SEWER
E	ELECTRICITY (HIGH VOLTAGE)	A1	LONGITUDINAL SECTION REFERENCE
E	ELECTRICITY (LOW VOLTAGE)		STORMWATER DRAINAGE
G	GAS	E	ELECTRICITY (HIGH VOLTAGE)
W	WATER		ELECTRICITY PIT
OF	OPTIC FIBER	SS	SUBSOIL DRAIN
S	SEWER		SHORING WALL
SWD	STORMWATER DRAINAGE		PROPOSED CONCRETE WALL
SCO	SOUTHERN CROSS CONDUIT		TEMPORARY DIVERSION BLOCK WALLS
T	TELSTRA		DEMOLISHED TEMPORARY DIVERSION BLOCK WALLS
F	FIRE SERVICES		EXTENT OF WORKS
	UNKNOWN SERVICES		
	EXISTING SUBSOIL DRAIN		
	FENCE		

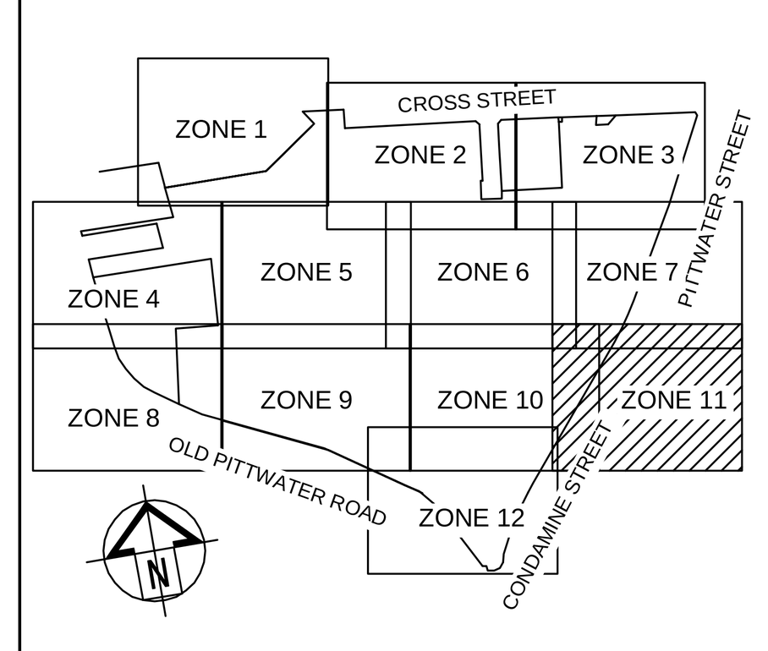
PIT C6 - STAGE 2 CONSTRUCTION SEQUENCE

2A - CONSTRUCT SECANT PILE WALL

NOTE:
2A CAN BE CONCURRENT WITH STAGE 1

Rev	Date	By	Chk	Description
1	31/10/14	GV	DNA	ISSUED FOR CONSTRUCTION

Key Plan



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Title
WARRINGAH STORMWATER AUGMENTATION CULVERT STAGE 2

SUGGESTED CONSTRUCTION STAGING - PIT C6 STAGE 2

Drawing Scale	Scale Bar 1:1	
1:100	0 1 2 3 4 5	
Drawn By	**CAD Filename**	**Plot Date**
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Project No.	**Drawing No.**	**Revision**
D11753	CAR-110131	1

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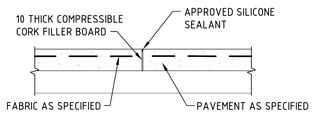

EXPANSION JOINT (EJ)
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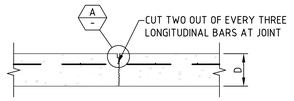
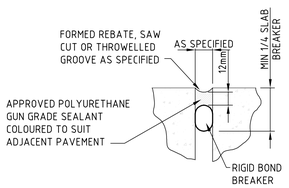
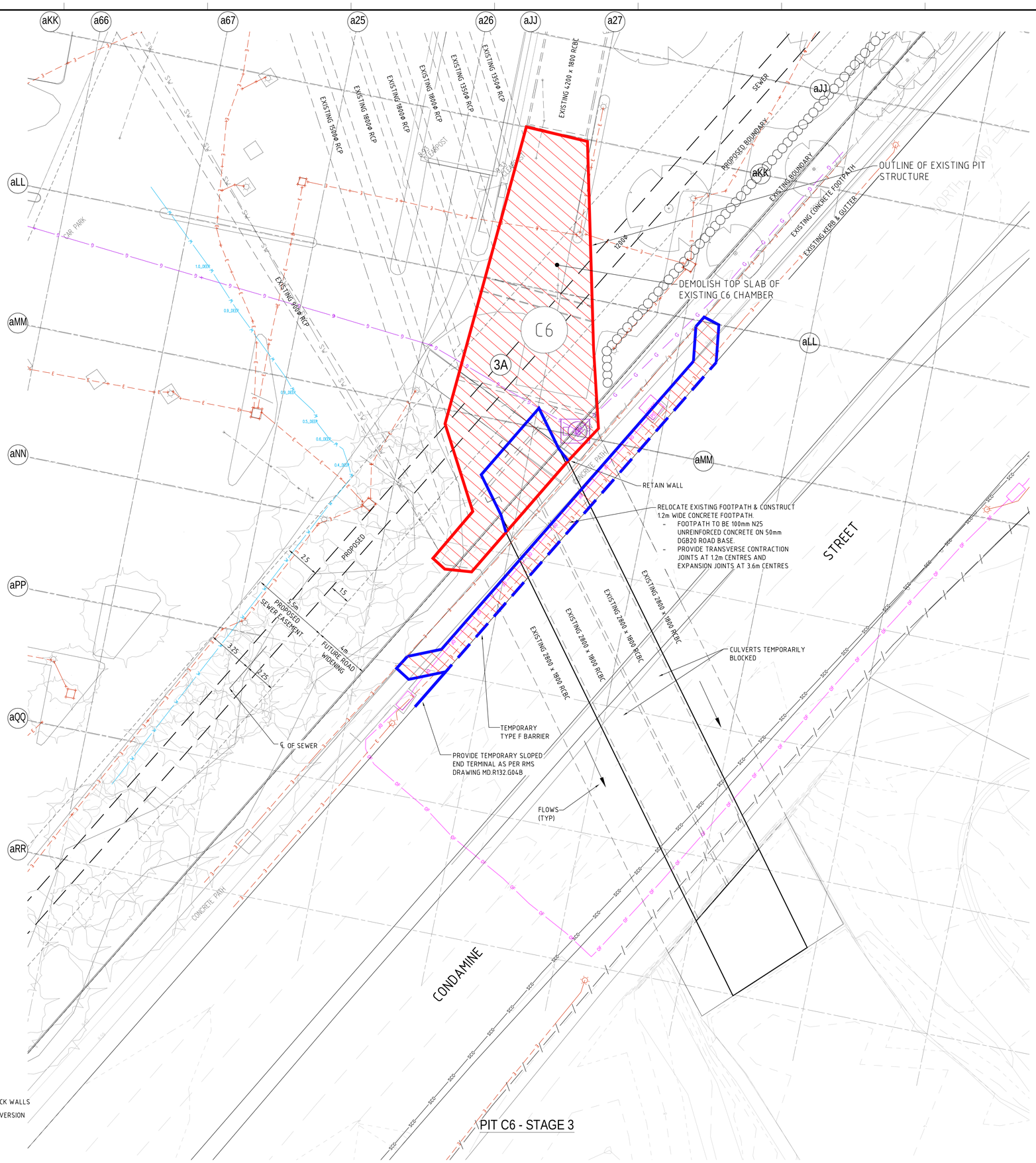


TRANSVERSE CONTRACTION JOINT (TCJ)
SCALE 1:10



DETAIL A
N.T.S.



LEGEND

EXISTING

- BOX CULVERT (2800 x 1800 RCBC)
- STORMWATER DRAINAGE PIPE (EXISTING 1500ø RCP)
- BOUNDARY
- ELECTRICITY (HIGH VOLTAGE) (E)
- ELECTRICITY (LOW VOLTAGE) (E)
- GAS (G)
- WATER (W)
- OPTIC FIBER (OF)
- SEWER (S)
- STORMWATER DRAINAGE (SWD)
- SOUTHERN CROSS CONDUIT (SCO)
- TELSTRA (T)
- FIRE SERVICES (F)
- UNKNOWN SERVICES
- EXISTING SUBSOIL DRAIN
- FENCE

PROPOSED

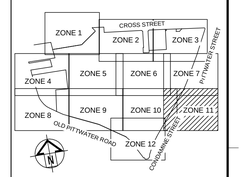
- BOX CULVERT
- STORMWATER DRAINAGE PIPE
- SEWER (PROPOSED ø SEWER)
- LONGITUDINAL SECTION REFERENCE (A1)
- STORMWATER DRAINAGE
- ELECTRICITY (HIGH VOLTAGE)
- ELECTRICITY PIT
- SUBSOIL DRAIN (SS)
- SHORING WALL
- PROPOSED CONCRETE WALL
- TEMPORARY DIVERSION BLOCK WALLS
- DEMOLISHED TEMPORARY DIVERSION BLOCK WALLS
- EXTENT OF WORKS

PIT C6 - STAGE 3 CONSTRUCTION SEQUENCE

3A - CAREFULLY DEMOLISH TOP SLAB OF EXISTING C6 CHAMBER

Rev	Date	By	Chk	Description
1	31/10/14	GV	DNA	ISSUED FOR CONSTRUCTION

Key Plan



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GPO Box 4004 Sydney NSW 2001

Title
WARRINGAH STORMWATER AUGMENTATION
CULVERT STAGE 2

SUGGESTED CONSTRUCTION STAGING - PIT C6 STAGE 3

Drawing Scale	Scale Bar 1:1	
1:100	0 2 4 6 8 10	
Drawn By: GV	CAD Filename: CAR-110132[A].DWG	Plot Date: 31/10/2014 10:13am
Project No.: D11753	Drawing No.: CAR-110132	Revision: 1

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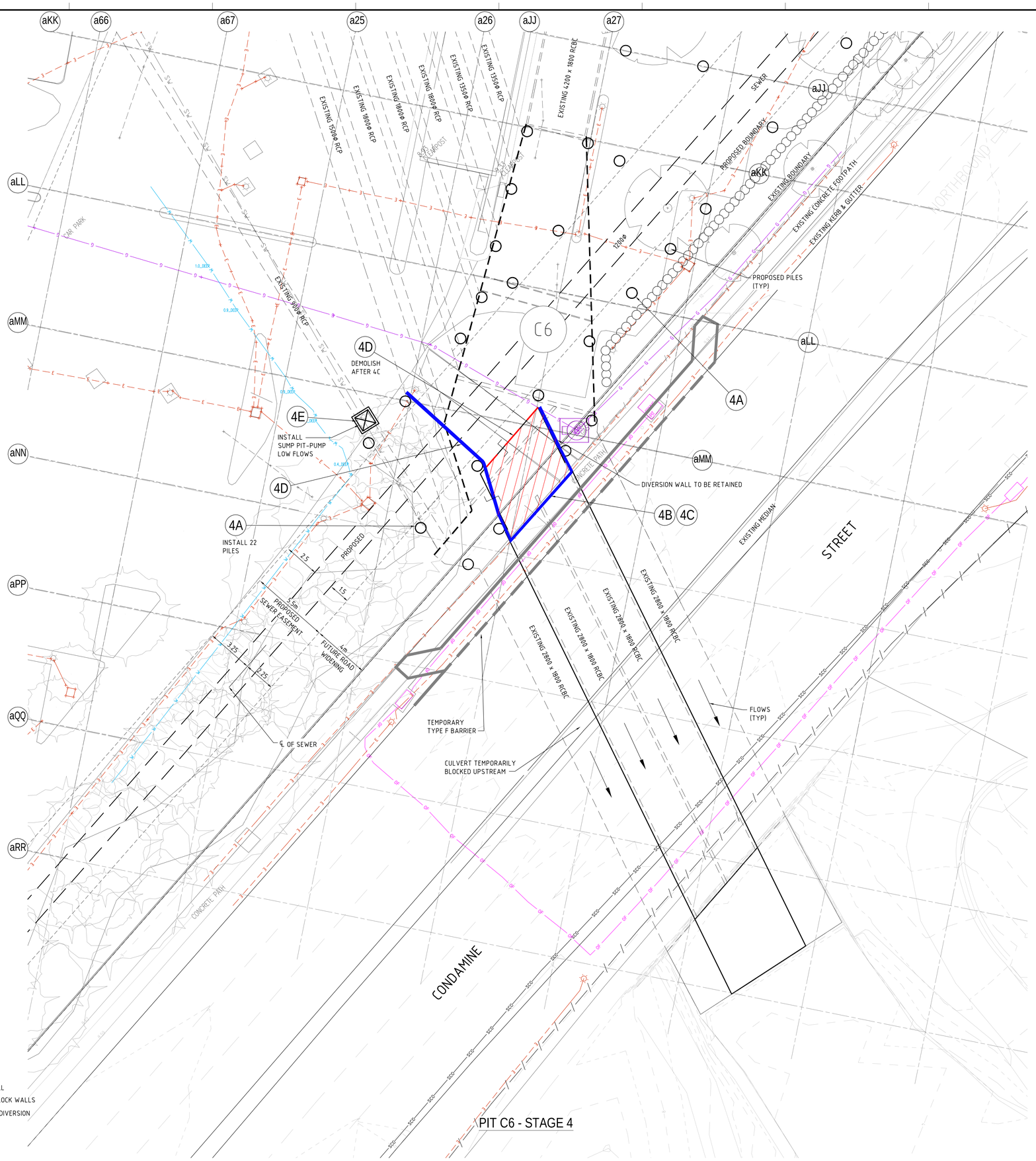


LEGEND

EXISTING		PROPOSED	
2800 x 1800 RCBC	BOX CULVERT		BOX CULVERT
EXISTING 1500ø	STORMWATER DRAINAGE PIPE		STORMWATER DRAINAGE PIPE
	BOUNDARY	PROPOSED ø SEWER	SEWER
E	ELECTRICITY (HIGH VOLTAGE)	A1	LONGITUDINAL SECTION REFERENCE
E	ELECTRICITY (LOW VOLTAGE)		STORMWATER DRAINAGE
G	GAS	E	ELECTRICITY (HIGH VOLTAGE)
W	WATER		ELECTRICITY PIT
OF	OPTIC FIBER	SS	SUBSOIL DRAIN
S	SEWER		SHORING WALL
SWD	STORMWATER DRAINAGE		PROPOSED CONCRETE WALL
SCO	SOUTHERN CROSS CONDUIT		TEMPORARY DIVERSION BLOCK WALLS
T	TELSTRA		DEMOLISHED TEMPORARY DIVERSION BLOCK WALLS
F	FIRE SERVICES		EXTENT OF WORKS
	UNKNOWN SERVICES		
	EXISTING SUBSOIL DRAIN		
	FENCE		

PIT C6 - STAGE 4 CONSTRUCTION SEQUENCE

4A - PROPOSED PILES OVER SEWER

4B - DEMOLISH BASE SLAB

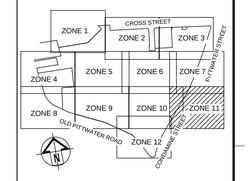
4C - CONSTRUCT REMAINING SECTION OF CULVERT BASE SLAB

4D - DEMOLISH DIVERSION WALL FROM PREVIOUS STAGE THEN CONSTRUCT NEW WALLS TO ENSURE A MINMUM OF 2 CULVERTS IN SERVICE AT ALL TIMES

4E - CONSTRUCT SUMP PIT

No	Date	By	Chk	Description
1	31/10/14	GV	DNA	ISSUED FOR CONSTRUCTION

Key Plan



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Title
WARRINGAH STORMWATER AUGMENTATION
CULVERT STAGE 2

SUGGESTED CONSTRUCTION STAGING - PIT C6 STAGE 4

Drawing Scale	Scale Bar 1:1	
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Project No.	Drawing No.	Revision
D11753	CAR-110133	1

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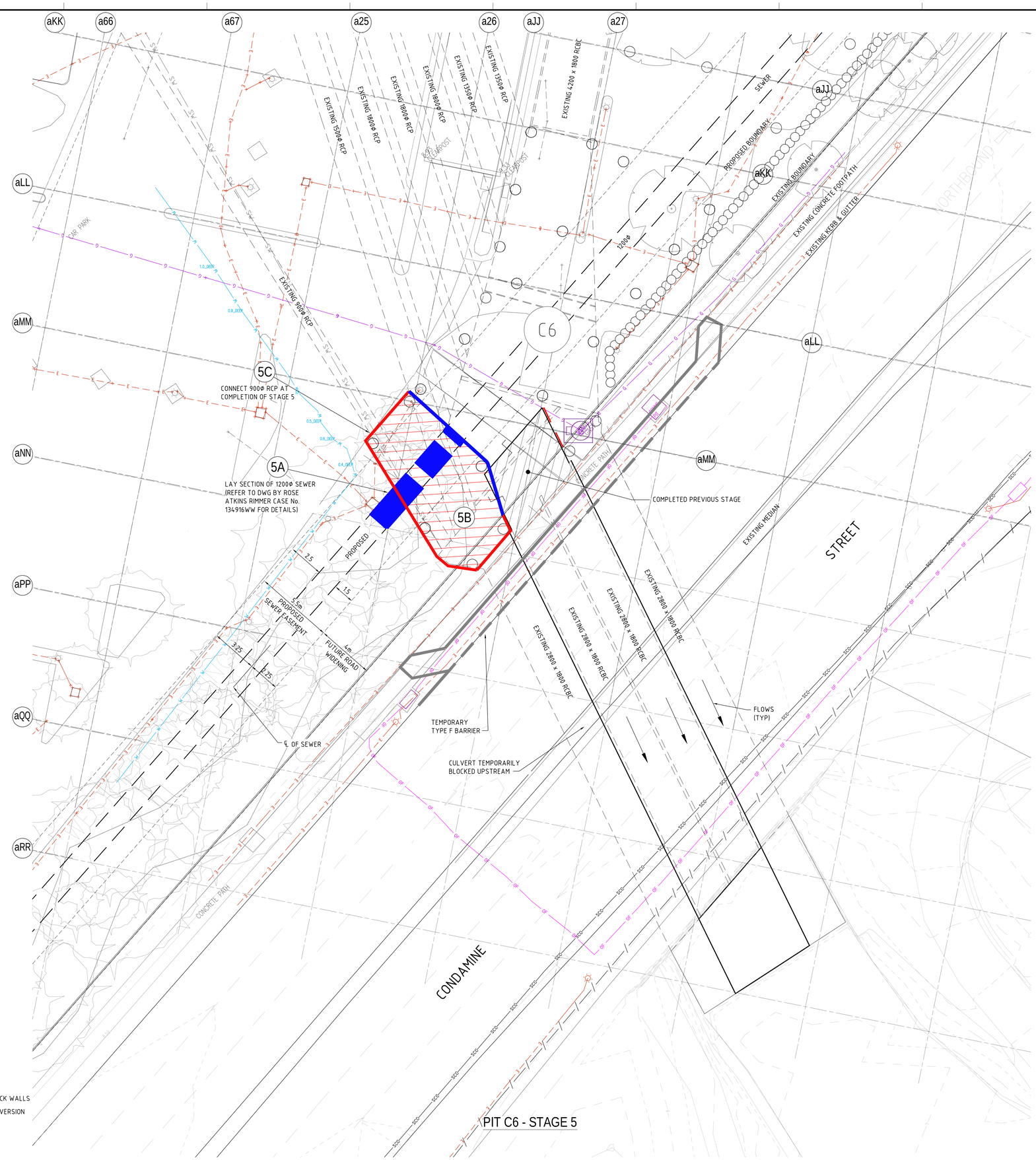


LEGEND

EXISTING		PROPOSED	
2800 x 1800 RCBC	BOX CULVERT		BOX CULVERT
EXISTING 1500ϕ	STORMWATER DRAINAGE PIPE		STORMWATER DRAINAGE PIPE
	BOUNDARY	PROPOSED ϕ SEWER	SEWER
E	ELECTRICITY (HIGH VOLTAGE)	A1	LONGITUDINAL SECTION REFERENCE
E	ELECTRICITY (LOW VOLTAGE)		STORMWATER DRAINAGE
G	GAS	E	ELECTRICITY (HIGH VOLTAGE)
W	WATER		ELECTRICITY PIT
OF	OPTIC FIBER	SS	SUBSOIL DRAIN
S	SEWER		SHORING WALL
SWD	STORMWATER DRAINAGE		PROPOSED CONCRETE WALL
SCO	SOUTHERN CROSS CONDUIT		TEMPORARY DIVERSION BLOCK WALLS
T	TELSTRA		DEMOLISHED TEMPORARY DIVERSION BLOCK WALLS
F	FIRE SERVICES		EXTENT OF WORKS
	UNKNOWN SERVICES		
	EXISTING SUBSOIL DRAIN		
	FENCE		

PIT C6 - STAGE 5 CONSTRUCTION SEQUENCE

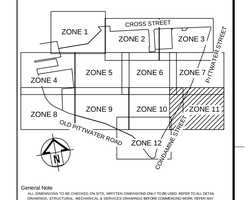
5A - INSTALL SEWER PILES AND LAY ϕ1200 SEWER

5B - DEMOLISH REDUNDANT BASE SLAB AND CONSTRUCT BASE SLAB, WALLS AND COLUMNS

5C - CONNECT EXISTING ϕ900 RCP

Rev	Date	By	Chk	Description
1	31/10/14	GV	DNA	ISSUED FOR CONSTRUCTION

Key Plan



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Title

WARRINGAH STORMWATER AUGMENTATION
CULVERT STAGE 2

SUGGESTED CONSTRUCTION STAGING - PIT C6 STAGE 5

Drawing Scale	Scale Bar 1:1	
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Drawn By	CAD Filename	Plot Date
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Project No.	Drawing No.	Revision
D11753	CAR-110134	1

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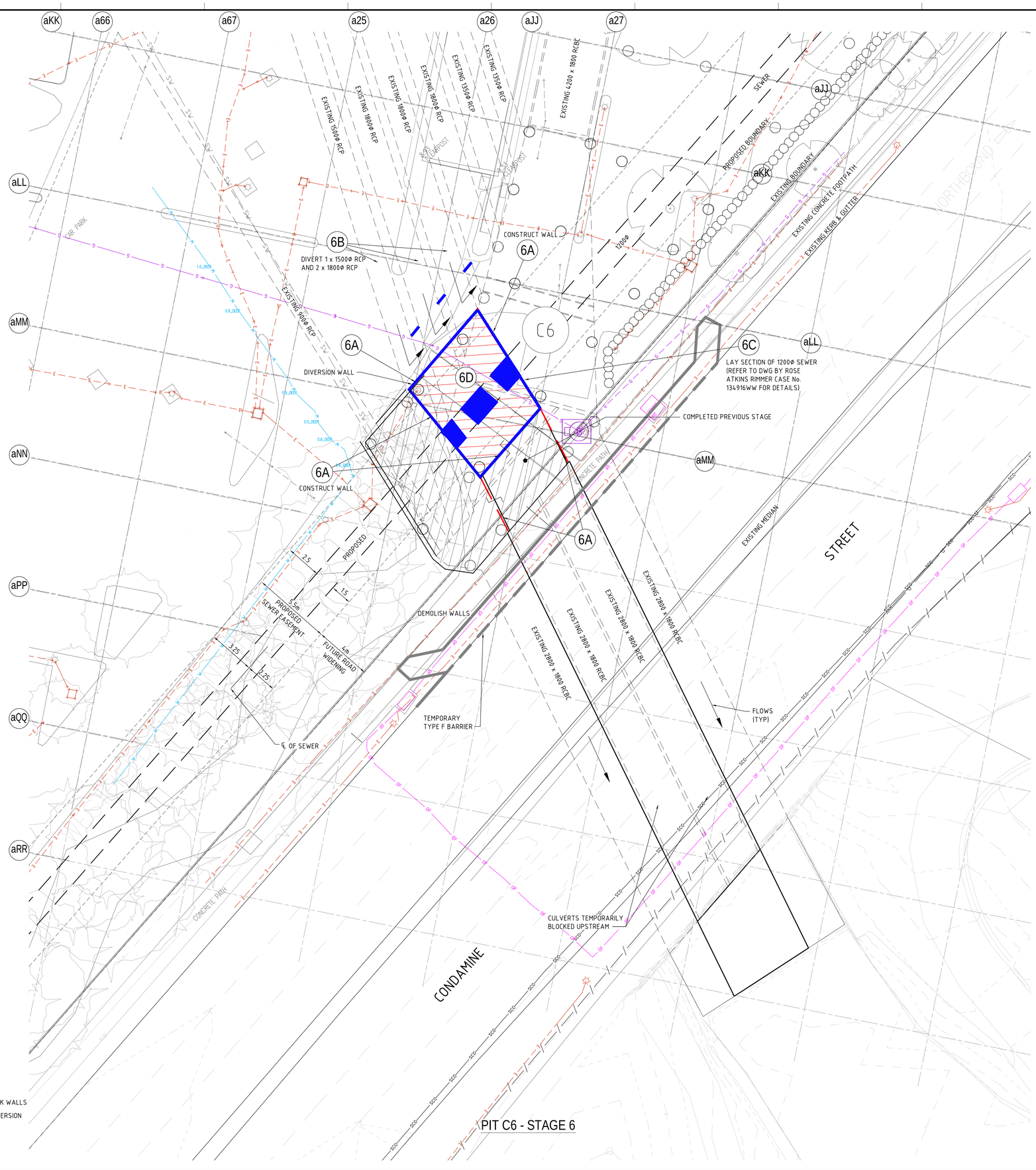


LEGEND

EXISTING

- BOX CULVERT (2800 x 1800 RCBC)
- STORMWATER DRAINAGE PIPE (EXISTING 1500ø)
- BOUNDARY
- ELECTRICITY (HIGH VOLTAGE) (E)
- ELECTRICITY (LOW VOLTAGE) (E)
- GAS (G)
- WATER (W)
- OPTIC FIBER (OF)
- SEWER (S)
- STORMWATER DRAINAGE (SWD)
- SOUTHERN CROSS CONDUIT (SCO)
- TELSTRA (T)
- FIRE SERVICES (F)
- UNKNOWN SERVICES
- EXISTING SUBSOIL DRAIN
- FENCE

PROPOSED

- BOX CULVERT
- STORMWATER DRAINAGE PIPE
- SEWER (PROPOSED ø SEWER)
- LONGITUDINAL SECTION REFERENCE (A1)
- STORMWATER DRAINAGE
- ELECTRICITY (HIGH VOLTAGE)
- ELECTRICITY PIT
- SUBSOIL DRAIN (SS)
- SHORING WALL
- PROPOSED CONCRETE WALL
- TEMPORARY DIVERSION BLOCK WALLS
- DEMOLISHED TEMPORARY DIVERSION BLOCK WALLS
- EXTENT OF WORKS

PIT C6 - STAGE 6 CONSTRUCTION SEQUENCE

6A - CONSTRUCT AND DEMOLISH DIVERSION WALLS AS NOTED

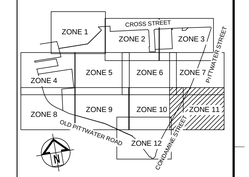
6B - DIVERT 1 x ø1500 AND 2 x ø1800 RCP TO EXISTING CHAMBER

6C - INSTALL PILES FOR SEWER AND LAY ø1200 SEWER

6D - DEMOLISH REDUNDANT BASE SLAB AND CONSTRUCT BASE SLAB AND WALLS

Rev	Date	By	Chk	Description
1	31/10/14	GV	DNA	ISSUED FOR CONSTRUCTION

Key Plan



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GPO Box 4004 Sydney NSW 2001

Title

WARRINGAH STORMWATER AUGMENTATION
CULVERT STAGE 2

SUGGESTED CONSTRUCTION STAGING - PIT C6 STAGE 6

Drawing Scale	Scale Bar 1:1	
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Drawn By: GV	CAD Filename: CAR-110135[A].DWG	Plot Date: 31/10/2014 8:58am
Project No.: D11753	Drawing No.: CAR-110135	Revision: 1

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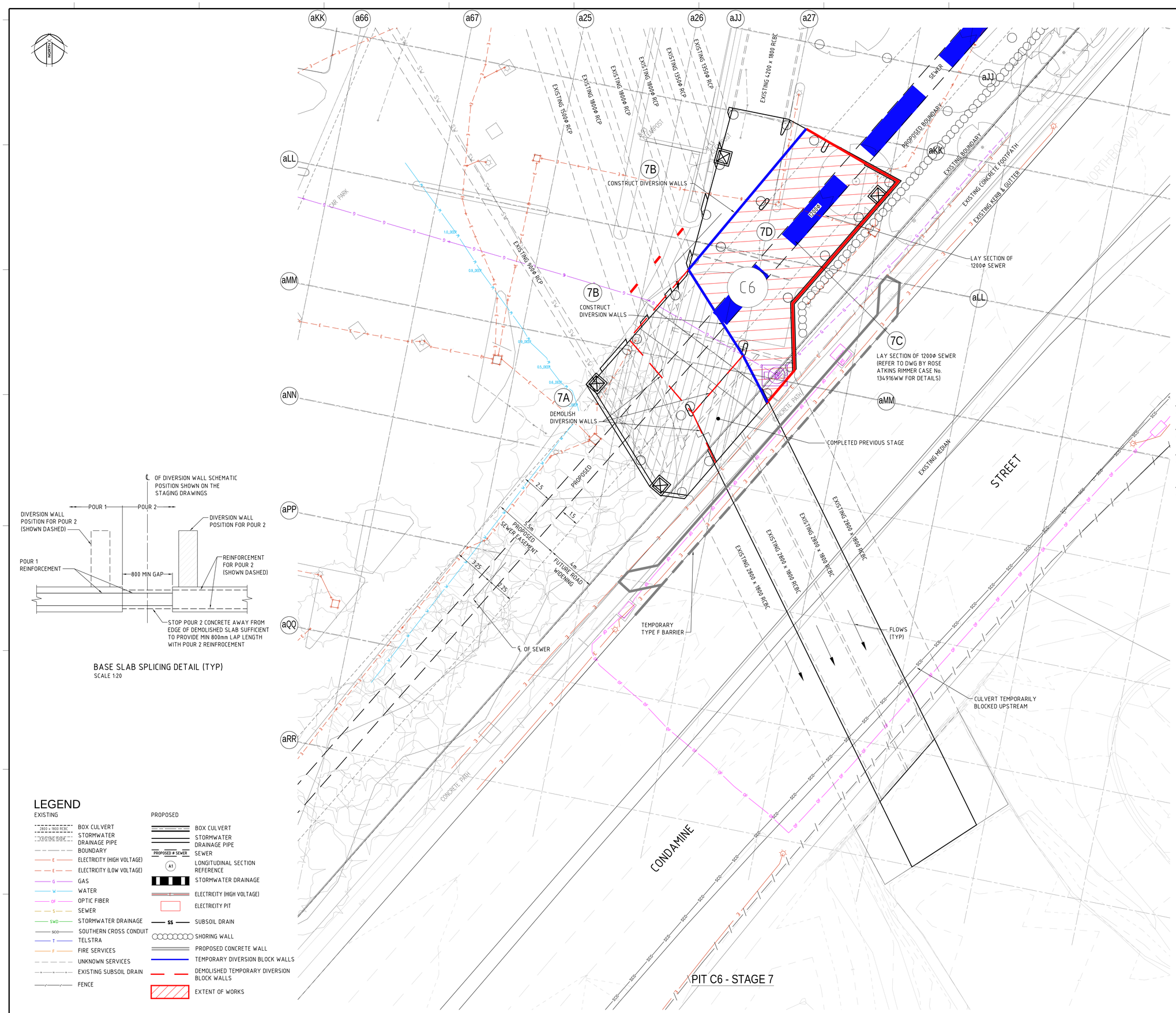


BASE SLAB SPLICING DETAIL (TYP)
SCALE 1:20

LEGEND

EXISTING		PROPOSED	
2800 x 1800 RCBC	BOX CULVERT		BOX CULVERT
EXISTING 600ø RCP	STORMWATER DRAINAGE PIPE		STORMWATER DRAINAGE PIPE
	BOUNDARY	PROPOSED ø SEWER	SEWER
E	ELECTRICITY (HIGH VOLTAGE)	A1	LONGITUDINAL SECTION REFERENCE
E	ELECTRICITY (LOW VOLTAGE)		STORMWATER DRAINAGE
G	GAS		ELECTRICITY (HIGH VOLTAGE)
W	WATER		ELECTRICITY PIT
OF	OPTIC FIBER	SS	SUBSOIL DRAIN
S	SEWER		SHORING WALL
SWD	STORMWATER DRAINAGE		PROPOSED CONCRETE WALL
SCO	SOUTHERN CROSS CONDUIT		TEMPORARY DIVERSION BLOCK WALLS
T	TELSTRA		DEMOLISHED TEMPORARY DIVERSION BLOCK WALLS
F	FIRE SERVICES		EXTENT OF WORKS
	UNKNOWN SERVICES		
	EXISTING SUBSOIL DRAIN		
	FENCE		

PIT C6 - STAGE 7 CONSTRUCTION SEQUENCE

7A - DEMOLISH DIVERSION WALLS

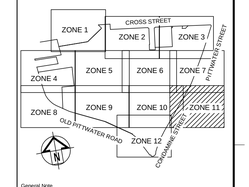
7B - CONSTRUCT DIVERSION WALLS

7C - INSTALL PILES FOR SEWER AND LAY Φ1200 SEWER AND DIVERT FLOWS

7D - DEMOLISH REDUNDANT BASE SLAB AND CONSTRUCT BASE SLAB, WALLS, PIERS AND COLUMNS

Rev	Date	By	Chk	Description
1	31/10/14	GV	DNA	ISSUED FOR CONSTRUCTION

Key Plan



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Title
WARRINGAH STORMWATER AUGMENTATION
CULVERT STAGE 2

SUGGESTED CONSTRUCTION STAGING - PIT C6 STAGE 7

Drawing Scale	Scale Bar 1:1	
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Drawn By	CAD Filename	Plot Date
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Project No.	Drawing No.	Revision
D11753	CAR-110136	1

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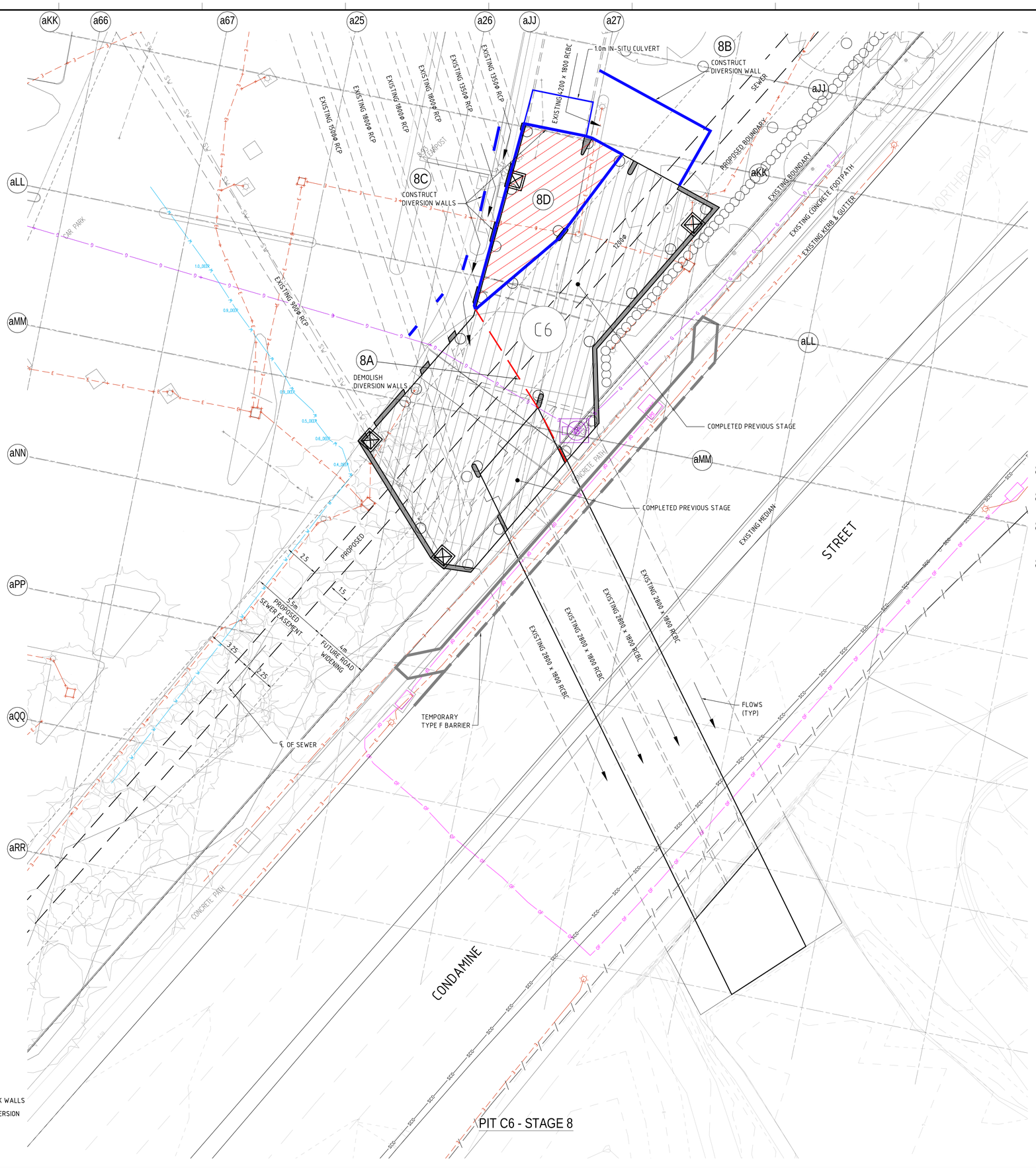


LEGEND

EXISTING

- BOX CULVERT (2800 x 1800 RCBC)
- STORMWATER DRAINAGE PIPE (1350ø RCP)
- BOUNDARY
- ELECTRICITY (HIGH VOLTAGE)
- ELECTRICITY (LOW VOLTAGE)
- GAS
- WATER
- OPTIC FIBER
- SEWER
- STORMWATER DRAINAGE
- SOUTHERN CROSS CONDUIT
- TELSTRA
- FIRE SERVICES
- UNKNOWN SERVICES
- EXISTING SUBSOIL DRAIN
- FENCE

PROPOSED

- BOX CULVERT
- STORMWATER DRAINAGE PIPE
- SEWER (PROPOSED ø SEWER)
- LONGITUDINAL SECTION REFERENCE (A1)
- STORMWATER DRAINAGE
- ELECTRICITY (HIGH VOLTAGE)
- ELECTRICITY PIT
- SUBSOIL DRAIN (SS)
- SHORING WALL
- PROPOSED CONCRETE WALL
- TEMPORARY DIVERSION BLOCK WALLS
- DEMOLISHED TEMPORARY DIVERSION BLOCK WALLS
- EXTENT OF WORKS

PIT C6 - STAGE 8 CONSTRUCTION SEQUENCE

8A - DEMOLISH DIVERSION WALLS FROM PREVIOUS STAGE

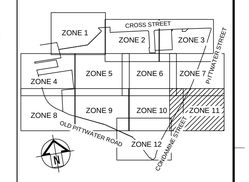
8B - CONSTRUCT DIVERSION WALLS FOR 4200 x 1800 CULVERT

8C - CONSTRUCT DIVERSION WALLS FOR 2 x ø1350 AND 1 x ø1800 RCP

8D - DEMOLISH REDUNDANT BASE SLAB AND CONSTRUCT BASE SLAB AND WALLS

Rev	Date	By	Chk	Description
1	31/10/14	GV	DNA	ISSUED FOR CONSTRUCTION

Key Plan



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Title:
WARRINGAH STORMWATER AUGMENTATION
CULVERT STAGE 2

SUGGESTED CONSTRUCTION STAGING - PIT C6 STAGE 8

Drawing Scale	Scale Bar 1:1	
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Drawn By	CAD Filename	Plot Date
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Project No.	Drawing No.	Revision
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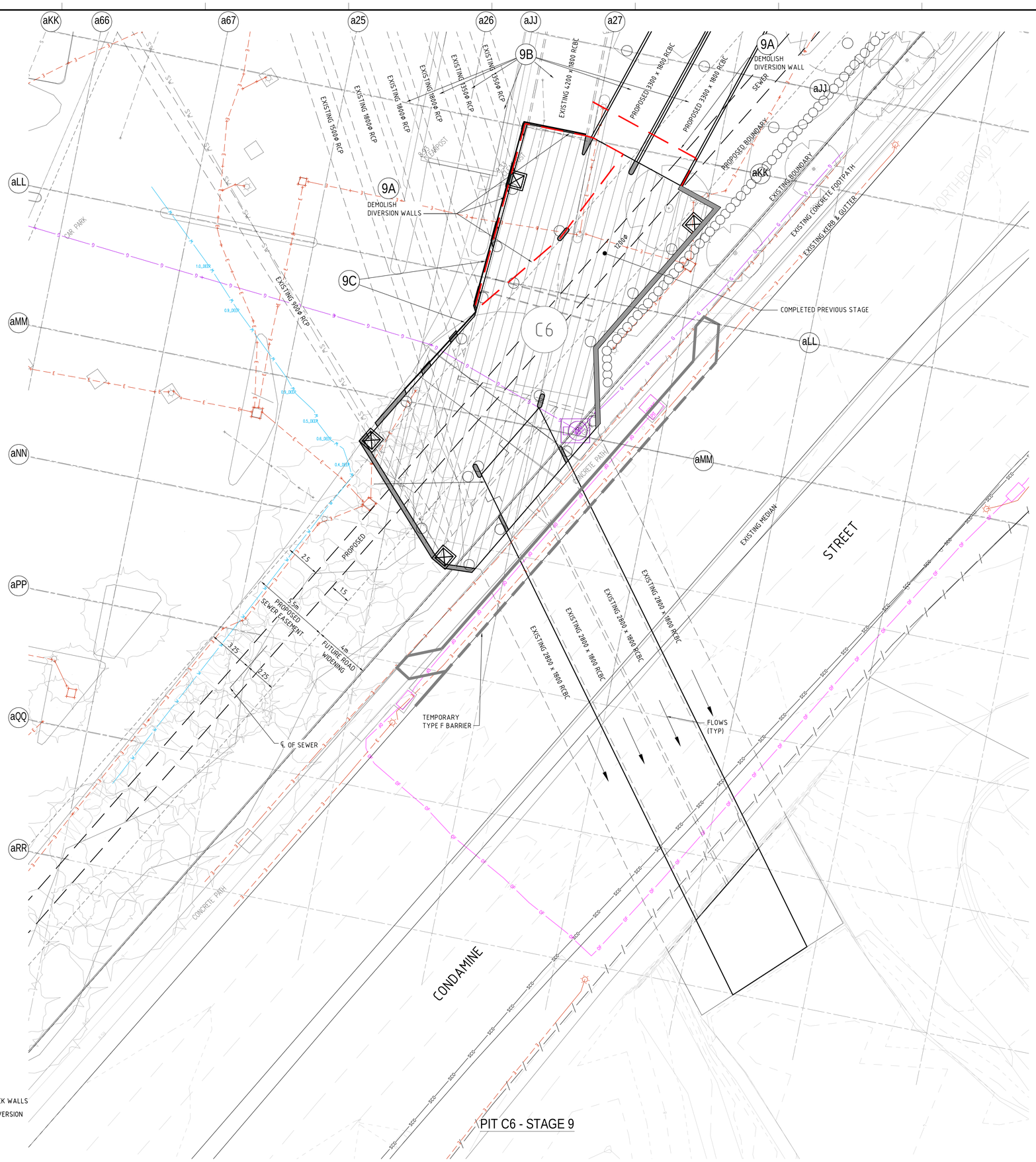


LEGEND

EXISTING		PROPOSED	
2800 x 1800 RCBC	BOX CULVERT		BOX CULVERT
EXISTING 1500ø	STORMWATER DRAINAGE PIPE		STORMWATER DRAINAGE PIPE
	BOUNDARY	PROPOSED ø SEWER	SEWER
E	ELECTRICITY (HIGH VOLTAGE)	A1	LONGITUDINAL SECTION REFERENCE
E	ELECTRICITY (LOW VOLTAGE)		STORMWATER DRAINAGE
G	GAS	E	ELECTRICITY (HIGH VOLTAGE)
W	WATER		ELECTRICITY PIT
OF	OPTIC FIBER	SS	SUBSOIL DRAIN
S	SEWER		SHORING WALL
SWD	STORMWATER DRAINAGE		PROPOSED CONCRETE WALL
SCO	SOUTHERN CROSS CONDUIT		TEMPORARY DIVERSION BLOCK WALLS
T	TELSTRA		DEMOLISHED TEMPORARY DIVERSION BLOCK WALLS
F	FIRE SERVICES		EXTENT OF WORKS
	UNKNOWN SERVICES		
SS	EXISTING SUBSOIL DRAIN		
	FENCE		

PIT C6 - STAGE 9
CONSTRUCTION SEQUENCE

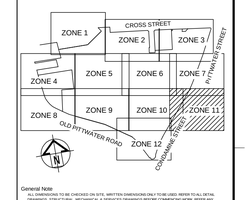
9A - DEMOLISH DIVERSION WALLS

9B - CONNECT REMAINING PIPES AND CULVERTS
- 2 x ø1350 RCP
- 2 x ø1800 RCP
- 2 x 3300 x 1800 RCBC
- 4200 x 1800 RCBC

9C - CONSTRUCT NEW WALLS AT GRID 27 AND 26 WEST SIDE

Rev	Date	By	Chk	Description
1	31/10/14	GV	DNA	ISSUED FOR CONSTRUCTION

Key Plan



General Note

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Title
WARRINGAH STORMWATER AUGMENTATION CULVERT STAGE 2

SUGGESTED CONSTRUCTION STAGING - PIT C6 STAGE 9

Drawing Scale	Scale Bar 1:1	
1:100	0 1 2 3 4 5	
Drawn By	CAD Filename	Plot Date
GV	CAR-110138[A].DWG	31/10/2014 9:15am
Project No.	Drawing No.	Revision
D11753	CAR-110138	1

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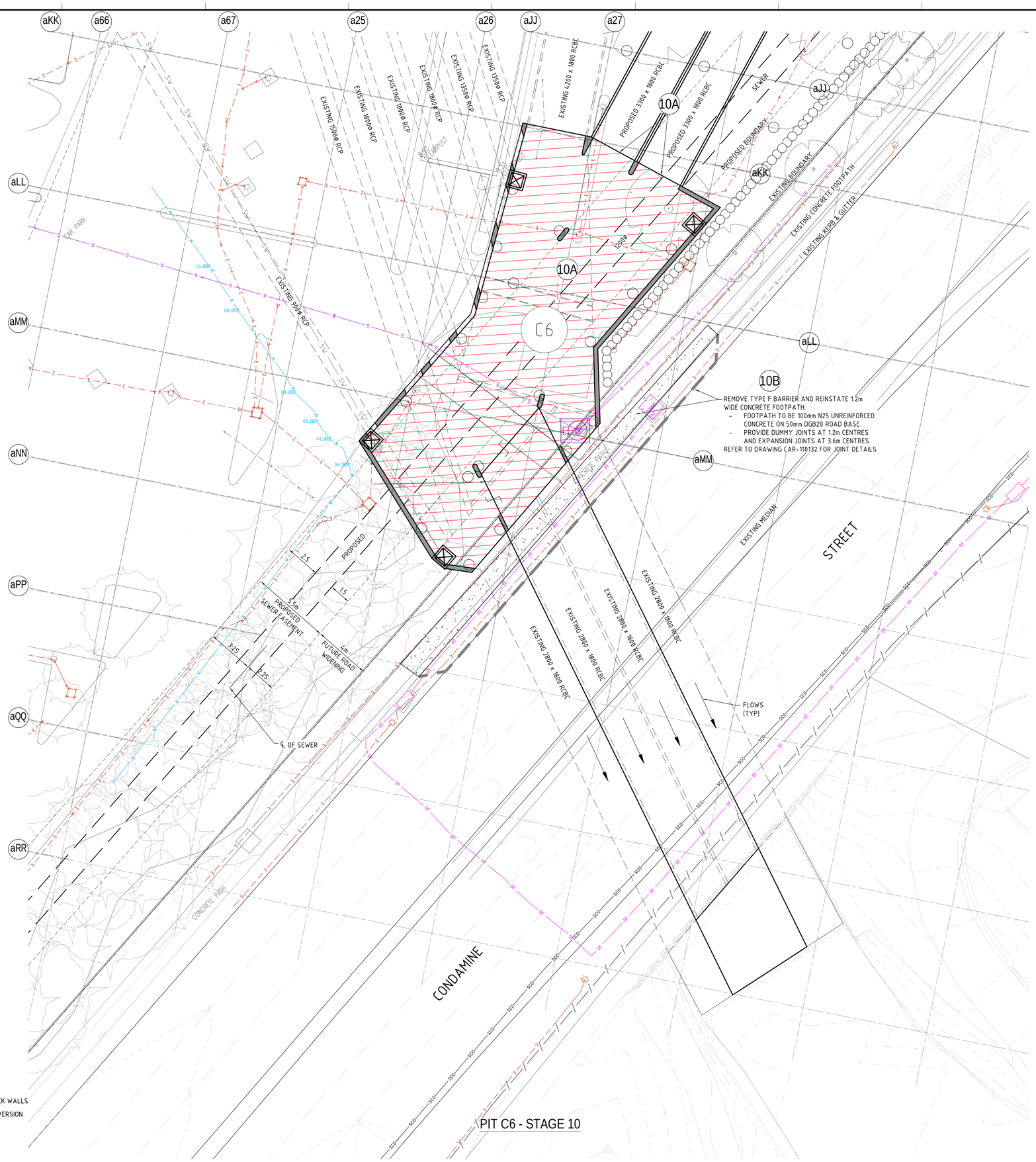


LEGEND

EXISTING

- BOX CULVERT
- STORMWATER DRAINAGE PIPE
- BOUNDARY
- ELECTRICITY (HIGH VOLTAGE)
- ELECTRICITY (LOW VOLTAGE)
- GAS
- WATER
- OPTIC FIBER
- SEWER
- STORMWATER DRAINAGE
- SOUTHERN CROSS CONDUIT
- TELSTRA
- FIRE SERVICES
- UNKNOWN SERVICES
- EXISTING SUBSOIL DRAIN
- FENCE

PROPOSED

- BOX CULVERT
- STORMWATER DRAINAGE PIPE
- SEWER
- LONGITUDINAL SECTION REFERENCE
- STORMWATER DRAINAGE
- ELECTRICITY (HIGH VOLTAGE)
- ELECTRICITY PIT
- SUBSOIL DRAIN
- SHORING WALL
- PROPOSED CONCRETE WALL
- TEMPORARY DIVERSION BLOCK WALLS
- DEMOLISHED TEMPORARY DIVERSION BLOCK WALLS
- EXTENT OF WORKS

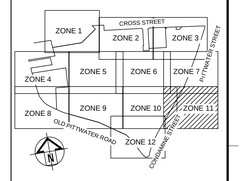
PIT C6 - STAGE 10 CONSTRUCTION SEQUENCE

10A - CONSTRUCT ROOF SLAB

10B - REMOVE TEMPORARY TYPE F BARRIER AND REINSTATE CONCRETE FOOTPATH AND TURF VERGE AREA.

No	Date	By	Chk	Description
1	31/10/14	GV	DNA	ISSUED FOR CONSTRUCTION

Key Plan



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WARRINGAH STORMWATER AUGMENTATION CULVERT STAGE 2

SUGGESTED CONSTRUCTION STAGING - PIT C6 STAGE 10

Drawing Scale	Scale Bar 1:1	
1:100	0 1 2 3 4 5	
Drawn By: GV	CAD Filename: CAR-110139[A].DWG	Plot Date: 31/10/2014 9:20am
Project No.: D11753	Drawing No.: CAR-110139	Revision: 1

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