

Appendix H: Drainage Strategy

Byford Rail Extension

Viaduct Drainage Strategy

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1. Introduction

This technical memorandum (memo) provides a summary of the Drainage Strategy for the ‘Viaduct and Train Station’ within the Armadale Project Control Area (PCA) for the Byford Rail Extension (BRE) Project. The memo addresses ‘on-grade’ drainage within the precinct and under viaduct structures and provides an overview of the proposed drainage system from viaduct down to ground level. The drainage design for the viaduct structure interfaces with several other design packages including the linewise ‘Earthworks and Drainage’ package and Armadale Station, each with separate design reports that should be read in conjunction with this memo. Specific details for the design interfaces are documented herein, the Drainage Strategy for the Armadale Station Precinct is included in Appendix A.

The Drainage Strategy addresses the management of stormwater runoff from the viaduct (and on elevated platforms) down to ground level. The ‘on-grade’ drainage network is documented separately as part of the ‘Earthworks and Drainage’ package, though summarised as part of this memo. The viaduct extends from approximate Chainage 28,240 to Chainage 29,775 as seen in Figure 1.0 below.



Figure 1 - Project Locality

1.1 Existing Drainage Infrastructure

Stormwater runoff from the viaduct will be conveyed off the structure and down the proposed column supports and discharged to new drainage infrastructure at ground level. Management of runoff is provided via the on-grade drainage network, either via swale or drainage basin. Runoff will then discharge into either the PTA or City of Armadale (CoA) existing drainage network. Survey data of the project area indicates that PTA drainage assets potentially discharge rail runoff from the rail corridor into the CoA drainage network at select locations in a predevelopment scenario.

Existing drainage infrastructure outside of the rail corridor (CoA assets) are predominately ‘pit and pipe’ infrastructure, typically conveying flow west to follow the natural topography. The drainage network typically runs along kerb lines and/or shoulders of local roads to the west of the rail corridor. Rail corridor drainage is predominantly a network of open earth channels and cross track culverts that

manage stormwater runoff from the formation and within the corridor. Runoff from the rail discharges into the CoA drainage network on the western side of the corridor at select locations, typically aligning with existing transverse culvert outlets.

For further information on existing drainage infrastructure interfaces, refer to the detailed design reports for each relevant design package as per summary below:

- Existing drainage within the rail corridor is detailed in the R30-MET-RPT-CI-155-00002 Drainage Strategy Report for the Linewide Earthworks and Drainage.
- Existing pit and pipe infrastructure at the key road interfaces (Armadale Road, Forrest Road, Church Avenue) are documented in the road design reports, R30-MET-RPT-CI410-00001 and R30-MET-RPT-CI415-00001.
- Existing drainage assets within the Armadale Precinct are detailed within the civil design report for the Armadale Precinct, refer R30-MET-RPT-CI-200-00001 but also documented in the 'Armadale Precinct Drainage Strategy' which is attached as Appendix A.

The treatment of existing drainage assets is detailed separately as part of either the Linewide drainage, roads, or Station Precinct packages. Generally, where possible it is proposed to retain existing drainage assets, with the exception of cross track culverts which are mostly replaced to meet project durability requirements.

2. Design Approach

The project interfaces with multiple regulatory authorities and as such the design is required to comply with several design criteria as listed below. The project design criteria and specifications are principally detailed for 'on-grade' drainage systems. At the time of commencing design, there were no specific drainage requirements within the SWTC for viaduct drainage and no specific PTA specifications. The PTA have subsequently released design requirements for viaduct though the criteria for design is yet to be confirmed and discussion with the PTA is ongoing to develop suitable drainage design criteria for the subsequent design phases.

The drainage strategy below applies to the 'on-grade' drainage systems (i.e. under the viaduct) which manage the stormwater runoff from the viaduct.

2.1 Drainage Design Strategy

The overarching strategy has the following primary objectives:

- Apply Water Sensitive Urban Design (WSUD) Principles where applicable within the 'on-grade' drainage design network.
- Limit post development discharge to predevelopment flow rates, matching existing peak flows at select discharge locations from rail corridor to external local government drainage network.
- Promote use of open channel drainage over use of pit and pipe infrastructure where possible.
- Meet the PTA SWTC requirements.
- Meet the design criteria for viaduct drainage as agreed with the PTA (yet to be formalised, discussions ongoing).
- Meet the PTA Specification 8880-450-090: Design of Drainage for PTA Infrastructure
- Maintain the existing drainage regime within and outside of the rail corridor, including maintaining major event flow paths across the corridor and replicating pre-development hydrology for flood protection of the surrounding environment and rail infrastructure.

2.2 Design Criteria Order of Precedence

The following design criteria and design guidelines have been considered during the development of the Drainage Strategy for the Viaduct and Armadale Train Station. The order in which these are listed below denotes the order of precedence as it applies to the strategy.

Design of Infrastructure on Viaduct:

- Meet compliance with design criteria as agreed with PTA (yet to be formalised, discussions ongoing).

Criteria for design of infrastructure receiving Viaduct Runoff (on-grade drainage network):

- Refer SWTC-BRE-PTAWA-PM_RPT-00007
- 8880-450-090 – Specification: Design of Drainage for PTA Infrastructure
- City of Armadale Stormwater Management Handbook
- A Guide to Water Sensitive Urban Design for Public Transport Infrastructure in Western Australia
- Stormwater Management Manual of Western Australia
- Australian Runoff Quality: A Guide to WSUD
- Adoption Guidelines for Stormwater Biofiltration Systems produced by the CRC for Water Sensitive Cities

Each of the relevant detailed design reports include further information on the adopted design criteria for the drainage systems receiving and managing viaduct runoff. One of the key areas is the Armadale Precinct which has its own drainage strategy, the current draft is attached as Appendix A.

2.3 Managing Viaduct Runoff

Details for conveyance of stormwater runoff on the viaduct structure are still being developed. The preliminary design proposed utilising the viaduct track slab as conveyance for stormwater runoff however alternatives are currently under review and being discussed with the PTA. Ultimately, the viaduct structure will provide some form of conveyance channel, whether that is integrated into the deck structure or conveyed via track slab will be determined through subsequent phases of design. At a high level, runoff is managed on structure and directed towards select outlet locations where it is picked up and discharged to ground via downpipes. Qualitative and quantitative management of stormwater runoff occurs at ground level within the open channels (swales) and/or drainage basins. It should be noted that within the Station Precinct Area there is a lot more hard stand areas beneath the Via-Duct structure therefore the use of Pit and Pipe is sometimes used to convey Via-Duct runoff to open vegetated areas for treatment.

Sketches of the proposed discharge arrangement from structure to ground have been included in Appendix B, accompanied by marked up locations of nominated outlet points from the viaduct structure where downpipes will be required.

2.4 Armadale Precinct

The design within the drainage precinct aims to treat the first flush storm event in bio-retention areas wherever possible and limit the post-development discharge from site to the predevelopment flow rates. The predevelopment condition has been considered as the original unimproved site, i.e., 100% pervious. The provision of WSUD within the drainage design is due to the higher potential of contaminated runoff from vehicles within car park and busway areas. The proposed drainage design for the Armadale Precinct is documented separately in the CI-200 package. Relevant drainage plans have been included in Appendix A for reference.

2.5 Linewide Corridor (Rail)

Drainage within the Linewide Rail Corridor is attenuated by either drainage basins or drain blocks within the open drain channels receiving runoff from the viaduct. This design approach enables controlled discharge of captured runoff at existing outlet locations (from Rail to LGA drainage networks). Treatment of the first flush storm event is achieved via drain block control to retain first flush volumes within the channels (at source). No additional treatment is provided due to the low potential for contamination associated with land use inside the corridor.

The primary objective of the overall Drainage Strategy across the rail, roads and precincts is to maintain the existing drainage regime. This is achieved through retention of existing infrastructure where practicable, maintaining existing flow paths and controlling post-development runoff to pre-development flow rates.

3. Hydrologic Input Data

The Hydrologic input data used for the drainage strategy is consistent across the project. Information on Rainfall Data and IFDs is included in Appendix A and further description of Hydrologic inputs is provided in the Linewide Drainage Strategy Report.

4. Stormwater Design Strategy

The key objective of the design of drainage for the viaduct is to manage runoff within the structure down to the 'on-grade' drainage network in accordance with design criteria as agreed with the PTA (yet to be formalised).

Details of the conveyance from the viaduct structure through downpipes to the on-grade network shall be provided with the ST-170 design package in the subsequent design phase. The nominated outlet locations as shown in Appendix B are required to manage freeboard from the 1% AEP top water levels (TWLs) to top of rail, permitting frequent discharge from structure to ground to prevent build up of flows and limit risk of blocking one primary outlet. Final acceptable freeboard requirements on the structure are yet to be agreed with the PTA however critical freeboard per beam section (Pier to Pier) have been provided refer Appendix C.

The interface between viaduct drainage and 'on-grade' drainage is described in further detail below, as well as other key interfaces and considerations for the viaduct drainage that are key to the drainage strategy.

This section highlights the general strategy for managing stormwater throughout the project but also addresses the drainage design interface with other disciplines and design aspects at key locations, particularly in areas under the viaduct outside of the Armadale Precinct. Such areas are identified as key to the functionality of existing drainage networks and/or flood mitigation.

4.1 Drainage Discharge Locations

The 'on-grade' drainage network within the Armadale Precinct is documented as part of the CI-200 design package. The proposed design includes open drains (swales) and pit and pipe networks and promotes bio-retention areas and basins to achieve qualitative and quantitative management of runoff. These WSUD elements have been designed to limit discharge to predevelopment levels into the existing LGA network. Further details on the precinct drainage design are provided in Section 4.3 below.

The primary discharge point through the Armadale precinct is an existing 900mm dia RCP stormwater pipe (City of Armadale Asset). Runoff is controlled to a pre-development flow rate prior to entering the existing pipe. Water quality is managed through the precinct drainage design (via swales and basins), refer to the Armadale Precinct Drainage Strategy for further details.

Viaduct runoff south of the precinct (south of Church Avenue works) discharges into a new drainage channel under the viaduct which conveys runoff towards an existing rail drainage outlet at Chainage 29,820 (Culvert-02). Treatment of runoff is provided prior to overflowing to the LGA network via a shallow drainage basin under the viaduct. The nominated discharge location is an existing rail discharge point from the PTA network into the LGA drainage network. Attenuation is provided within the drainage channels and shallow drainage basin to ensure the discharge is controlled to pre-development flow rates.

The crest in the vertical profile of the viaduct is close to Forrest Road. Viaduct runoff outlets down to an open channel drainage network on the northern side of Forrest Road and is attenuated through a

combination of open channel drainage controls, a shallow drainage basin and soak wells before overflowing into the existing drainage network along Aragon Court.

Viaduct runoff to the north of Forrest Road discharges to open channel drainage within the rail corridor and passes under Armadale Road via drainage culvert (design to be confirmed). Runoff then flows through a new drainage swale under viaduct and into a shallow drainage basin before overflowing into an existing 1050mm dia RCP pipe downstream of Culvert A-102 (existing PTA Transverse Culvert).

All the above-mentioned discharge points are existing PTA rail discharges into the LGA drainage network. Further details of the stormwater controls for the 'on-grade' drainage network is included in each of the relevant package detailed design reports. An overview of the nominated discharge points is included below in Figure 2.0.

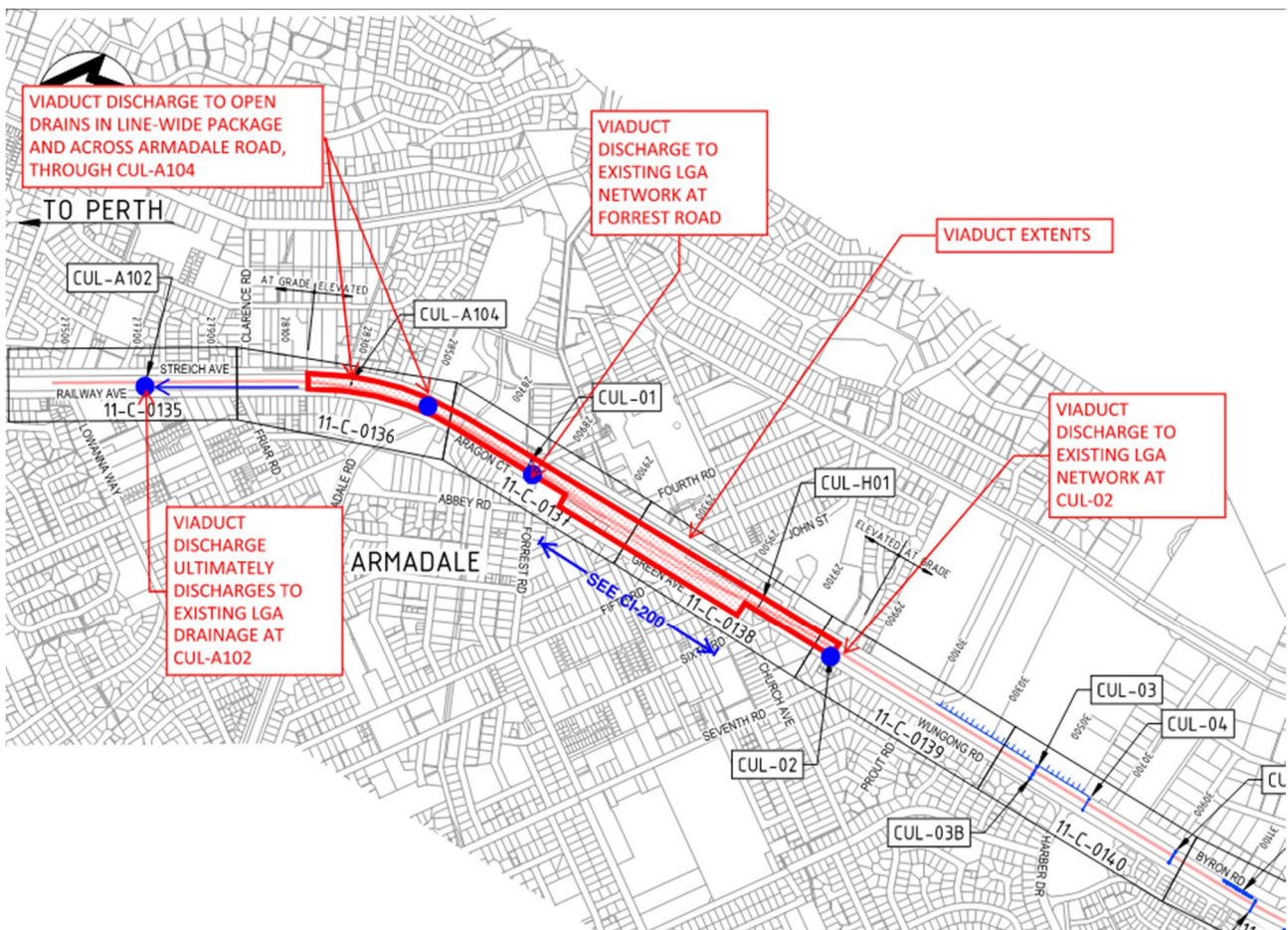


Figure 2 – Discharge Locations

4.2 Viaduct Drainage Overview

The exact details for conveyance of stormwater runoff on the viaduct is still in development and being discussed with the PTA. Runoff will be conveyed and discharged from structure via downpipe at the nominated locations, as shown in the sketch in Appendix B, typically discharging at each column support (with the exception of the Armadale Station Structure). Through the station area it is currently proposed that runoff will be conveyed along the track slab from Pier 26 to Pier 31 and picked up at the southern end of the station structure however this is subject to further discussion with the PTA.

Discharge from the structure will be into an armoured section of swale (open drain), managing scour at the point of discharge.

The open drains convey flow within the rail corridor to existing discharge locations into the CoA drainage network. Treatment of runoff is provided at source within the open drainage channels through

provision of drain blocks or via discharge into shallow landscaped drainage basins under viaduct. The design of drainage basins under viaduct areas is still under development but envisaged as a localised depression which will be intergraded with landscape design. In select locations that are constrained by space or have additional storage requirements, soak well pits may be necessary as supplementary storage with a controlled overflow to the LGA drainage network.

The design of the on-track drainage systems and external hydraulic plumbing is captured as part of the structural design package for the viaduct, design lot reference 'ST-170'. Refer to Appendix C for more detail on track slab drainage and calculations.

The longitudinal grade of the viaduct is taken as the gradient for the runoff flow path as runoff is conveyed along the structure to designated outlet locations. Which at the Reference Design phase is understood to be at every column location. The flow path gradient meets minimum PTA grade requirements of 0.4%.

Further details are to be provided in the structural design lot detailed design report, refer R30-MET-RPT-ST-170-00001.

Stormwater runoff from major events (more than the 1% AEP storm event) will also be conveyed via downpipe down to ground level, details for overflows will be confirmed at the next design stage, providing a relief point for flows exceeding the capacity of the 1% AEP drainage outlet.

An Indicative schematic for the viaduct drainage system from the preliminary design stage is shown below in Figures 3.0 and 4.0.

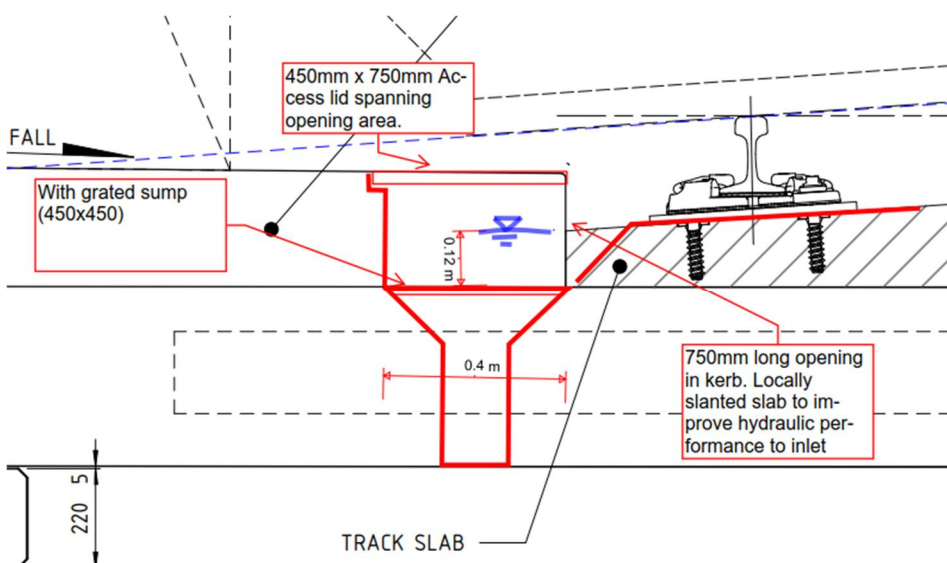


Figure 3 – Typical Viaduct Downpipe Outlet to Ground Level

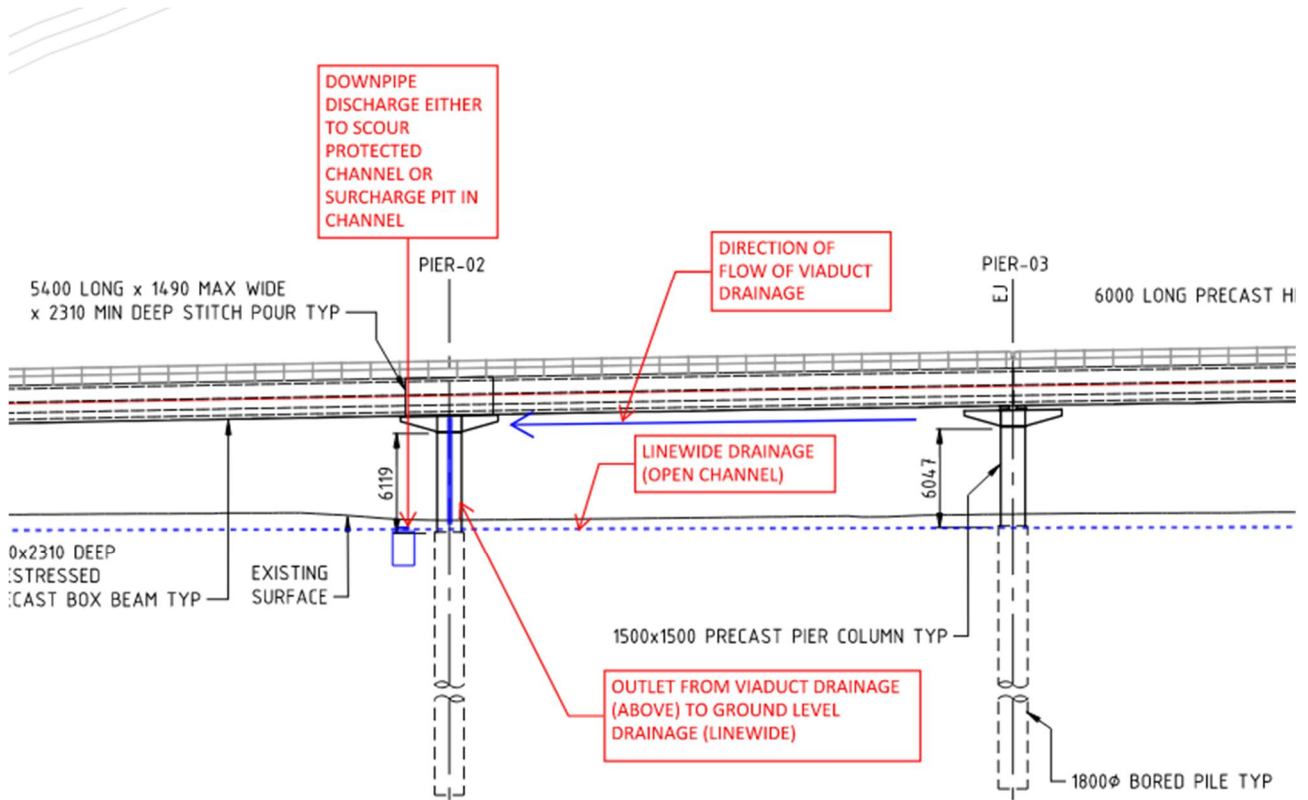


Figure 4 – Viaduct Stormwater Management Profile

The strategy for drainage below the viaduct or ‘on-grade’ varies along the rail alignment but generally follows the principles as set out in Section 2. Four key areas have been identified, each with a slightly different approach to treating and conveying stormwater runoff, depending on spatial, topographical and interface constraints.

These key areas are as summarised below and shown in Figure 6.

1. Area 1 – North of Armadale Road: Section of viaduct north of the Armadale Road upgrades to the viaduct transition to retaining wall at approximate chainage 28,250.
2. Area 2 – Viaduct over Neerigen Brook: This section is split into two sub catchments either side of Neerigen Brook. Runoff north of Neerigen Brook is conveyed across Armadale Road, runoff south of Neerigen Brook is conveyed towards Forrest Road with an overflow to the existing drainage network on Aragon Court. Refer to Figure 5.

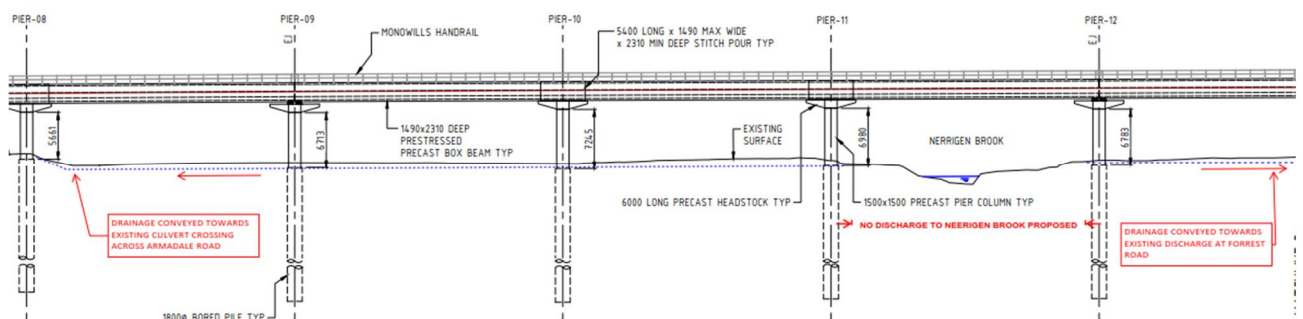


Figure 5 – Neerigen Brook

3. Area 3 – Armadale Precinct: Section of viaduct within the precinct area at Armadale Station, covered separately within the ‘Armadale Precinct Drainage Strategy’ report, summarised subsequently in this memorandum.
4. Area 4 – South of Church Avenue: Section of viaduct south of Church Avenue towards the viaduct transition to retaining wall at approximate chainage 27,775.

The design approach for each of these areas is described in further detail below.

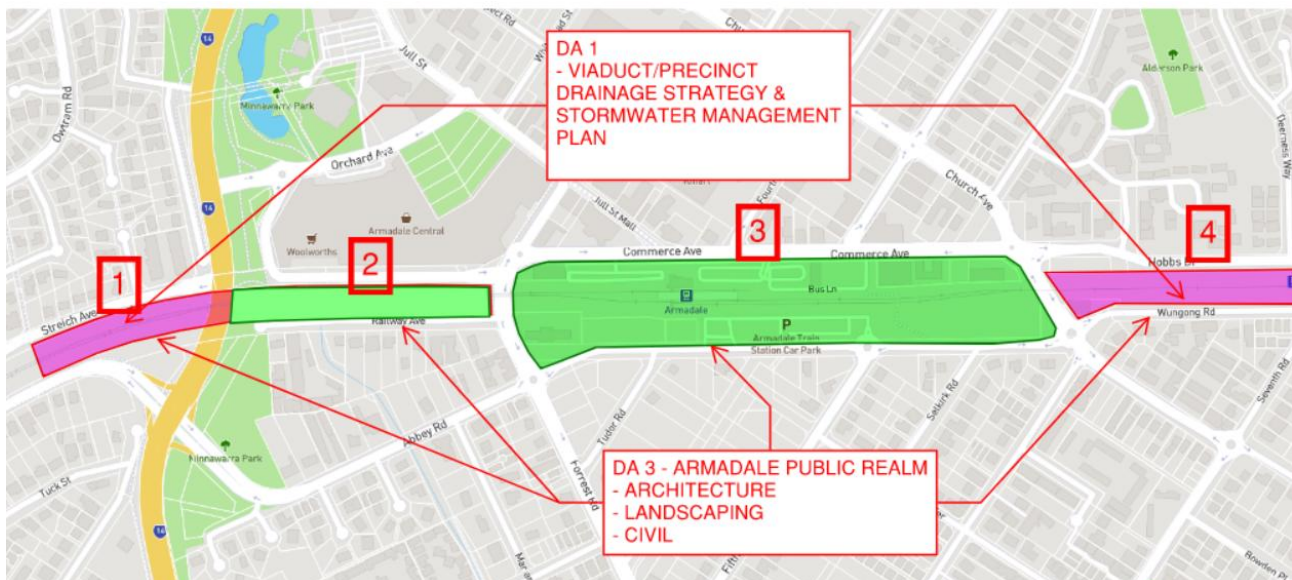


Figure 6 – Armadale Precinct Drainage Catchments

4.2.1 Area 1 – North of Armadale Road

Stormwater runoff from the existing rail is currently managed by an open drain on the eastern side of the corridor. Flow is conveyed across the corridor via an existing transverse culvert (CUL-A104) at approximate chainage 28,270 which then runs north along the western boundary of the corridor before spilling into the CoA drainage network via existing inlet at approximate chainage 27,700.

Culvert A104 also receives overflow from an existing drainage basin to the east of the rail corridor, located at the corner of Frys Lane and Streich Avenue.

The design intent for this section of ‘on-grade’ drainage is to replicate the existing drainage regime by providing open drains (swales) under the viaduct to receive discharge from the viaduct above. The swales will discharge runoff towards a shallow drainage basin positioned under viaduct south of the transition to retaining. Open drains are proposed to run south to north along the column lines on both sides of the viaduct. Drainage blocks will be required to attenuate ‘first flush’ storm events within the drainage channels with the drainage basin providing further storage capacity to control flow rates for larger storm events such as the 10% and 1% AEP storm events.

The key constraint for this area is the interface with the PSP bridge structure which is currently proposed to span over Armadale Road though at the time of preparing this memo we understand the design to be under review. The proposed design at RD phase is a spiral ramp which transitions from an embankment structure to a bridge deck structure at approximate chainage 28,425. The proposed PSP design places constraints on the ability to run open channels continuously on both sides of the viaduct, as a result, some pit and pipe drainage infrastructure is required to negotiate runoff within the channels around embankment earthworks and structures.

Consultation regarding the proposed PSP design for this area is ongoing and the drainage strategy may change depending on the final design solution for the PSP.

4.2.2 Area 2a – Neerigen Brook to Armadale Road

Runoff from the existing rail formation in this area sheets from formation to existing open drains or localised depressions before flowing through existing culverts that cross under Armadale Road and convey flow north towards Area 1.

The rail corridor slopes from east to west through this area, overland flow passing across the corridor from east to west is controlled by the existing rail formation as the rail levels are elevated above the adjacent natural surface level through this area. The rail passes over Neerigen Brook, which is a critical Water Corporation drainage asset which manages upstream catchment flows across the rail corridor (from east to west). The Brook passes under rail, which is supported via bridge structure, elsewhere the rail formation is elevated via raised embankment earthworks and acts as a 'bund' for external flows.

Further details on the Neerigen Brook are included subsequently in Section 4.5.

The bunded formation currently attenuates flows from larger storm events where the Neerigen Brook overtops and is restrained by the bund. It is therefore imperative that the bund be retained to replicate the existing drainage regime and mitigate risk of downstream flooding issues, as a removal of the bund would result in a loss of storage within the corridor and increase downstream flows.

For minor storm events, it is intended to manage stormwater runoff from the viaduct within drainage channels with outlets from the viaduct discharging into rock-lined sections of channels at column locations. The key constraint to design for this area is the undulating nature of the corridor at the proposed location of the drainage channel. The channel may require bunding or need to be integrated into the bund design as the bund is located closer to the eastern boundary than the lower corridor levels on the west. An open channel on the western side of the corridor will not be able to grade back to the existing culvert crossing Armadale Road that is being retained, a new Armadale Road crossing on the western side of the corridor may need to be provided.

The open drains may be integrated with the landscaped design, utilising shallow swales for flow conveyance, through sufficient energy dissipation shall be provided within the hydraulic design of the viaduct outlets to minimise scour and erosion at the point of discharge, which shall be documented as part of the ST-170 design package.

Current options being assessed during detailed design development are for viaduct drainage downpipes to be conveyed towards the east, combining the two outlets into one to enable discharge into an open channel on the higher side of the corridor (i.e. east), though this may result in an increase in discharge flow which may require surcharge pits to be placed within the channel to adequately manage scour and provide treatment of smaller storm events.

4.2.3 Area 2b – Neerigen Brook to Forrest Road

This area still has an interface within Neerigen Brook and therefore has similar constraints regarding removal of the existing bunded formation as highlighted in the above section. The level of the bund eventually grades out towards the existing level crossing through Forrest Road.

Design integration with landscaping shall consider required bund levels to mitigate downstream flood risks.

The proposed drainage design to manage minor storm events replicates the existing drainage regime. Open drains will be provided either side of the viaduct columns to collect stormwater runoff and convey flow towards and localised depression for attenuation. A series of soak wells are proposed within the depression area to provide additional storage and controlled infiltration within the rail corridor. An overflow connection is proposed to the existing CoA drainage network along Aragon Court. Drain blocks are also proposed within the channels upstream of the depression to provide linear storage of runoff.

The existing cross track culvert just north of Forrest Road is to be replaced with a pit and pipe network which drains a trapped low point formed between the relocated PSP and Forrest Road, with pipework connecting into the soakwells in the localised depression within the rail corridor.

4.2.4 Area 3 – Armadale Precinct

Strategy addressed in Section 4.3 below, as well as Appendix A.

4.2.5 Area 4 – South of Church Road

The use of open drains through this section is limited due to the PSP crossing the corridor from east to west. To meet SWTC requirements, runoff from the PSP cannot discharge into the rail corridor drainage. Therefore, the PSP runoff is controlled via kerbing, discharging to grated soakwell pits off the shoulder of the PSP.

A central open drain is provided under the viaduct though the network is supplemented by pit and piped infrastructure where the PSP crosses the corridor as the open drain cannot pass the PSP. Additionally, level constraints on the PSP and downstream drainage overflow limit a conventional culvert crossing of the PSP to enable continuity of the open drain south of the PSP crossing. This results in the pipework being carried across the PSP and under the open channel drain through the viaduct. Captured runoff will discharge into a drainage basin placed between viaduct columns and the retaining wall transition at Chainage 29,775. The basin will have a low-level outlet to discharge into a network which connects into existing CoA drainage at Chainage 29,870. Larger storm events will overtop the basin and flow in a drain between the retaining wall and PSP to discharge at the same location via high flow catchpit.

The drainage basin is currently modelled as a 1m deep conventional drainage basin which is intended to be fenced off with an access point off the PSP to the west. Options to integrate the drainage basin with the landscaping design are currently being assessed, adopting a larger shallow depression for storage which may increase the length of the drainage basin but reduce depth and allow for greater utilisation of the space beneath the viaduct.

4.3 Armadale Precinct Drainage

Runoff within the precinct is broken down into sub-catchments and directed to treatment areas prior to discharge into the existing LGA drainage network. The viaduct runoff will connect to 'at-ground' drainage and discharge either into bio-retention areas or drainage basins. Overflow from the treatment areas will either connect to the existing 900mm dia RCP pipe passing through the precinct from east to west, or existing drainage out on Green Avenue.

An overview of the precinct sub-catchments is shown below in Figure 7.0. The full Armadale Precinct Drainage Strategy is included in Appendix A.

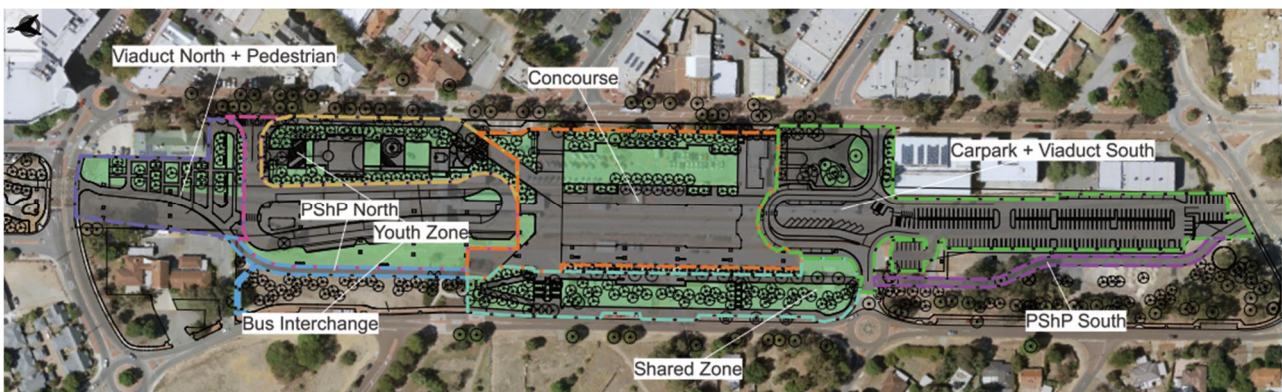


Figure 7 – Armadale Precinct Drainage Catchments

4.4 Interface with Retaining Wall Drainage

Stormwater runoff will be managed by either ACO drains (proposed TD300 with class D grate) or pit and piped drainage network. ACO drains will be used where space is limited due to rail infrastructure such as the MCR. Areas with sufficient space will adopt a pit and pipe network solution.

The design of retaining walls is captured as part of the ST-431 design package, which shall include provision for emergency overflows for major events that exceed the capacity of the retaining wall drainage systems.

Any drainage that forms part of the retaining wall design (i.e., back of wall drains) are not documented as part of this package; these shall be documented as part of the ST-431 design lot.

4.5 Key Waterway Interfaces

4.5.1 Neerigen Brook

The Neerigen Brook is a Water Corporation drainage asset and currently passes through the rail corridor at approx. Chainage 28,630. The existing rail passes over Neerigen Brook via rail bridge and the rail embankment provides attenuation of major event flows through this area.

As the proposed rail design will be on viaduct through this section, no changes are proposed to the existing Neerigen Brook channel for the RD design. The existing embankment shall be retained to limit any impacts to the pre-development flow regime of Neerigen Brook.

No stormwater discharge from the rail corridor is proposed to enter into the Neerigen Brook for the RD design.

Current design strategy seeks to minimise impact on Neerigen Brook. Detailed flood modelling is currently underway to demonstrate impact. Refer to R30-MET-RPT-CI-160-00001 for flood modelling details and results.

4.6 Interface with Roads

The viaduct spans over the following City of Armadale Roads:

- Armadale Road
- Forrest Road
- Church Avenue

Runoff from the viaduct will discharge at column locations either side of the road and into line-wide rail corridor drainage. No discharge into road drainage is proposed.

4.7 Water Sensitive Urban Design

Water sensitive urban design has been considered as part of the development of the line-wide and precinct drainage systems which receive the viaduct runoff. Where possible, the provision of open drainage channels will be integrated with the landscaping design to provide a linear treatment system for stormwater runoff, utilising the undulating nature of the corridor to provide storage in low lying depressions and bioretention areas.

Refer to Appendix A for further details on the WSUD for the Armadale Precinct and refer to the Linewidth Drainage Strategy for water quality considerations for the Linewidth corridor (at-ground) drainage design.

4.8 Calculations

A high-level assessment has been completed to determine flow rates for different storm events along the viaduct structure. The assessment has been completed to review approximate discharge volumes and flow rates into the receiving drainage systems at ground level.

A more detailed analysis of flow on the viaduct structure including depth, width and freeboard along with inlet capacity and redundancy is provided in Appendix C.

The peak flow assessment undertaken for the viaduct runoff being conveyed to within the rail corridor has been compared to pre-development stormwater runoff within the rail corridor to assess storage requirements to attenuate post-development flow rates to a pre-development level.

The storage volumes required are documented as part of the line-wide drainage strategy report. Storage is achieved either within the drainage channel via drain blocks (providing attenuation) or at drainage basins. There is a small catchment at Forrest Road which will manage viaduct runoff via soak wells with high level overflow into the CoA network for events more than the 10% AEP storm event.

The two key interface packages for the viaduct drainage are the Armadale Precinct package (CI-200) and the Linewide Earthworks and Drainage package (CI-155). Drainage calculations for each package consider the viaduct runoff above in the catchment areas for assessment of stormwater runoff in a post-development scenario. Calculations are included separately within the relevant design reports.

Both abovementioned packages provide the necessary controls to limit post-development discharge from the viaduct (and surrounding hardstand areas) to a pre-development level for both the 10% and 1% AEP storm events.

5. Conclusion

The Drainage Strategy for the Viaduct (including precincts) and areas below the viaduct has been developed to be consistent with the overall drainage strategy for the line-wide rail corridor and Armadale Precinct.

Runoff from the viaduct will be conveyed via track slab structure down to new 'at-ground' drainage infrastructure within the line-wide rail corridor or within the Armadale Precinct. The 'at-ground' drainage network receiving viaduct runoff will provide the necessary qualitative and quantitative controls to manage stormwater runoff in accordance with the project SWTC requirements and relevant design standards. Where possible, the 'at-ground' drainage will be in the form of open drains as opposed to pit and piped infrastructure, though the latter may be necessary where design is constrained.

Existing drainage regimes will be maintained across the corridor and within the precinct to mitigate impacts to the existing drainage network and also mitigate flooding risks for the surrounding environment and within the corridor This will be achieved through managing stormwater runoff within the corridor in accordance with design requirements for the project and utilising existing rail corridor discharge locations for controlled release of flow back into the CoA drainage network. All runoff will be sufficiently attenuated to ensure that discharge from the corridor does not exceed pre-development flow rates for both minor and major storm events

Appendix A: Armadale Precinct Drainage Strategy

Refer attached Appendix A.

Byford Rail Extension

Armadale Precinct Drainage Strategy

1. Introduction

The purpose of this memo is to describe the overarching drainage design strategy that feeds into the CI-200 Package – civil design of Armadale Station Precinct. This memo has been updated to align with the latest resubmission of the Reference Design and associated layout changes dated 20th January 2023.

1.1 Project Locality

The site is located at the existing Armadale Station in Armadale, Western Australia.



Figure 1. Project Locality

1.2 Site Layout

The Precinct consists of carparking facilities, a bus interchange and a pedestrian concourse that site close to existing ground level. The Precinct sits underneath the Byford Rail Extension Viaduct. Figure 2 shows the layout of the proposed design.

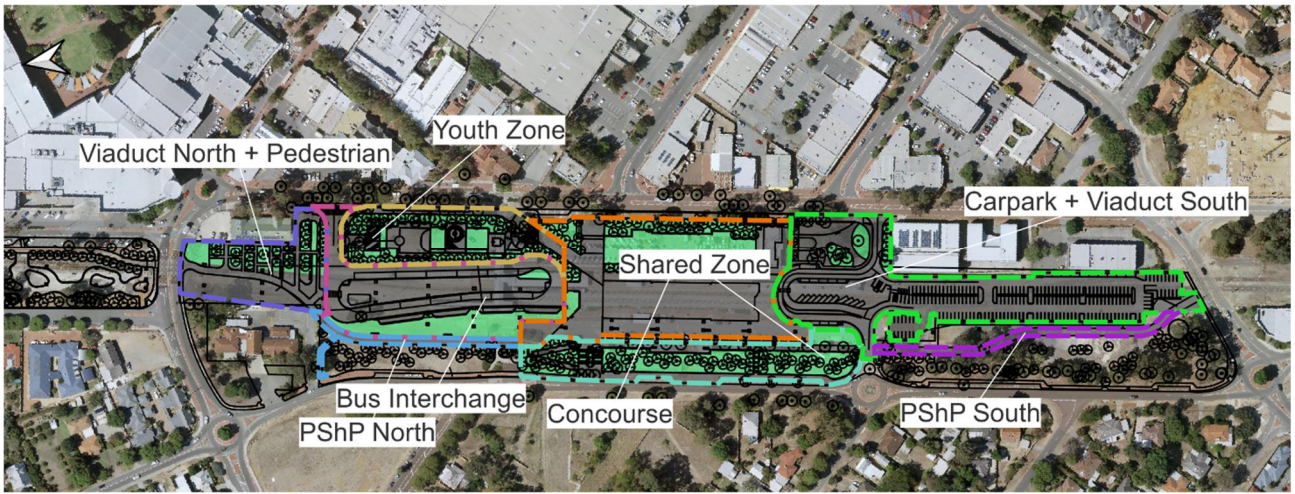


Figure 2. Site Layout

The existing Armadale Station Precinct consists of a station, carpark and bus interchange. The existing stormwater runoff is managed via the use of a traditional pit and pipe network that discharges to a basin and outlets to the City of Armadale drainage network.

1.3 Existing Catchment Plan

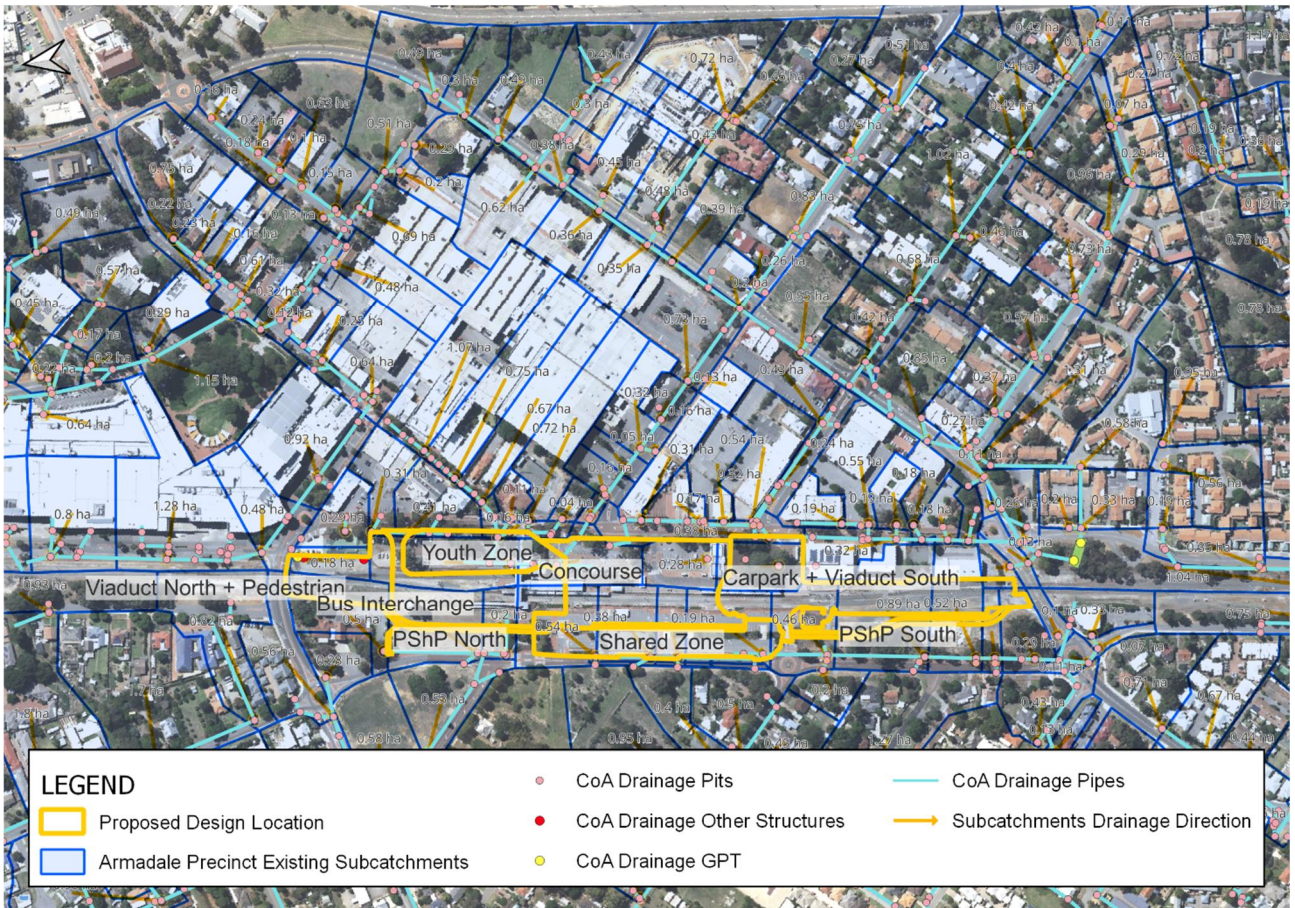


Figure 3. Catchment Plan

2. Design Criteria

2.1 Design Strategy

The overarching drainage strategy has the following primary objectives:

- Apply Water Sensitive Urban Design Principles
- Reduce post development runoff rates to predevelopment conditions
- Meet the SWTC requirements
- Meet the PTA Specification 8880-450-090: Design of Drainage for PTA Infrastructure

The design seeks to treat the first flush in bio-retention areas wherever possible and limit the discharge off-site to the predevelopment discharge rates as determined by hydrologic modelling. The predevelopment condition has been considered as the original unimproved site, i.e. 100% pervious.

2.2 Design Criteria Order of Precedence

The following design criteria and design guidelines have been considered during the development of the Armadale Precinct Drainage Strategy. The order in which these are listed below denotes the order of precedence as it applies to the strategy.

- 1.1.1 SWTC-BRE-PTAWA-PM_RPT-00007
- 1.1.2 8880-450-090 – Specification: Design of Drainage for PTA Infrastructure
- 1.1.3 A Guide to Water Sensitive Urban Design for Public Transport Infrastructure in Western Australia
- 1.1.4 Stormwater Management Manual of Western Australia
- 1.1.5 Australian Runoff Quality: A Guide to WSUD
- 1.1.6 Adoption Guidelines for Stormwater Biofiltration Systems produced by the CRC for Water Sensitive Cities

2.3 SWTC -BRE-PTAWA-PM-RPT-00007

Relevant extracts from the SWTC are reproduced below:

- 1.1.7 2.1.3-10 - The maximum storage depth of bio-retention areas in the station precinct where accessible to public shall be limited to 300mm with 1 in 4 batter slopes.
- 1.1.8 2.1.3-9 - The maximum emptying time for infiltration drainage system within the station precinct and outside the rail reserve shall comply with the Stormwater Management Manual for Western Australia.

AEP	1EY	0.5EY	0.2EY	10%	5%	2%	1%
Maximum Emptying Time in days	0.5	1	1.5	2	2.5	3	3.5

Table 1 – Extract from Stormwater management manual chapter 9 Table 5

- 1.1.9 2.1.3-8 Provision of bio-retention filter media shall comply with the Stormwater Management Manual for Western Australia
 - 1.1.9.1 Typically, filter media consists of a sandy loam with a saturated hydraulic conductivity between 50 and 300 mm/hr
 - 1.1.10 9.2.3-1 All rainwater run-off from roofed and platform paved areas shall be collected and be disposed of onsite via soakwells or via the local area stormwater drainage system where the NOP actions make this possible. Rainwater run-off from bus interchange shelters shall connect to the civil engineers' car park drainage system. Where soil conditions beneath platforms is not considered suitable for onsite disposal, consideration shall be given to drainage lines connecting to the civil engineers 'PERWAY' drainage system.

2.4 8880-450-090 - Specification: Design of Drainage for PTA Infrastructure

Relevant extracts from the Specification are reproduced below:

1.1.11 Table 7 Drainage Annual Exceedance Probabilities for Outside the Rail Reserve

Item	Situation	AEP %
1	Major system check: TWL to property and railway building floor levels with 300mm freeboard	1
2	Stormwater drainage contained in principal shared path (PSP) corridor: PSP crossfall shall be away from the rail reserve. For larger storms and major storm overland flow paths, and where discharge into PTA rail reserve is unavoidable, this shall be communicated with and accepted by the PTA prior to construction.	20
3	Water Corporation main / branch drains.	
4	Kerb overtopping.	20
5	Drainage basins and sumps	10
6	Swales and open drains.	20
7	Gutter flow spread limits.	20
8	Piped system with 150 mm of freeboard from HGL to FSL.	20
9	Groundwater level (dry subgrade).	2
10	Drainage system overflows that might cause erosion or scour.	10
11	Drainage basin backwater onto pavement.	5
12	Swales and open drains backwater onto pavement.	10

Table 2 – Extract from 880-450-090 (Table 7: Drainage Annual Exceedance Probabilities for Outside the Rail Reserve)

- 1.1.12 2.3.5.13 - No part of the carparks shall be flooded, or inundated, during any storm event smaller than the 10% AEP storm event. The depth of stormwater during the 1% AEP event shall not be more than 200 millimetres in any part of the carpark, at any time, and there shall not be any ponding of stormwater for longer than six hours in any part of the carpark during a 1% AEP storm event
- 1.1.13 2.3.5.5 - Stormwater runoff from constructed impervious surfaces generated by the first 15 mm of rainfall from a frequently occurring event shall be retained and/or detained, and treated (if required) at the source as much as practical to meet WSUD requirements
- 1.1.14 2.3.17.5 - Infiltration / detention basins shall be designed to include a stormwater biofilter (where treatment of runoff is required) unless otherwise approved by the PTA. Biofilters shall be designed and installed in accordance with the Adoption Guidelines for Stormwater Biofiltration Systems produced by the CRC for Water Sensitive Cities. Where treatment of runoff is not required, basins/flood storage areas shall be designed with vegetative retention/detention systems noting that the root systems of vegetation help to minimise potential soil clogging and maintain infiltration of runoff.
- 1.1.15 2.3.15.1 - Any discharge into existing drains shall be compensated to reduce peak flows to pre-development flows or limits acceptable to the controlling authorities
- 1.1.16 2.3.15.2 a. - Infiltration into natural surface: If the soil permeability is adequate and no adverse environmental or community effects will result from standing water up to 96 hours, the run-off shall be managed in open drains and swales to infiltrate. Drain blocks at regular intervals and based on hydraulic calculations can be used to maximise infiltration. Excess run-off shall be treated by passing through a vegetated detention basin or approved treatment system. In the sites with potential high-risk pollution (e.g. fuel filling or storage areas, station open carparks, open train and other vehicle depot), first flush runoff should have appropriate treatment before

infiltrating to groundwater or discharging to downstream environment when infiltration is not feasible.

3. Hydrologic Input Data

The Hydrologic input data used in the drainage strategy is described in this section.

3.1 Rainfall

Rainfall data is extracted from the Bureau of Meteorology and is provided as Intensity-Frequency-Durations (IFD).

3.1.1 Intensity Frequency Duration

Rainfall IFDs were extracted from the Bureau of Meteorology Website for the site location. The IFDs have been republished below.

Table 1 IFD Extraction Data and Location

IFD Design Rainfall Depth (mm)				
Issued:	29-Jun-22			
Location Label:				
Requested coordinate:	Latitude	-32.155	Longitude	116.013
Nearest grid cell:	Latitude	32.1625 (S)	Longitude	116.0125 (E)

Table 2 IFD Data

Duration in min	63.20%	50%	20%	10%	5%	2%	1%
1	1.82	2.01	2.64	3.09	3.55	4.19	4.71
2	3.21	3.51	4.51	5.23	5.98	7.01	7.86
3	4.3	4.71	6.07	7.07	8.09	9.52	10.7
4	5.19	5.7	7.39	8.62	9.89	11.7	13.1
5	5.93	6.54	8.52	9.96	11.4	13.5	15.2
10	8.57	9.48	12.5	14.6	16.8	19.9	22.4
15	10.3	11.4	15.1	17.7	20.3	24	26.9
20	11.7	12.9	17	19.9	22.9	27	30.3
25	12.8	14.1	18.5	21.7	25	29.5	33.1
30	13.7	15.2	19.9	23.3	26.7	31.5	35.4
45	16.1	17.7	23	26.9	30.9	36.6	41.1
60	18	19.7	25.5	29.8	34.3	40.6	45.7
90	21	22.9	29.5	34.4	39.6	47.1	53.3
120	23.4	25.5	32.7	38.2	44	52.5	59.7
180	27.2	29.6	37.9	44.3	51.2	61.5	70.4
270	31.7	34.4	44.1	51.6	59.9	72.3	83.1
360	35.3	38.3	49.1	57.5	66.8	81	93.4
540	40.9	44.4	57	66.9	77.8	94.6	109

3.1.2 Pre-burst

Median Pre-burst Rainfall depths were applied to rainfall data to account for ARR Data Hub storm losses.

The conversion from storm Initial losses to burst initial losses is shown in Equation 1.

$$\text{Burst initial loss} = \text{Storm initial losses} - \text{Pre - burst rainfall (for Burst initialloss} \geq 0)$$

Equation 1

The median pre-burst rainfall data is published in Table 3.

Table 3 Median Pre-burst rainfall depths

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	6.4	6.3	6.3	6.3	5.6	5.1
90 (1.5)	7.3	7.5	7.6	7.7	7.9	8
120 (2.0)	3.4	4.7	5.6	6.5	6.5	6.5
180 (3.0)	3.2	3.8	4.3	4.7	5.1	5.4
360 (6.0)	1.9	2.1	2.2	2.3	3.1	3.7
720 (12.0)	0.6	0.7	0.7	0.7	1.9	2.8
1080 (18.0)	0.2	0.2	0.2	0.2	1	1.5
1440 (24.0)	0	0	0	0	0.4	0.7
2160 (36.0)	0	0	0	0	0	0
2880 (48.0)	0	0	0	0	0	0
4320 (72.0)	0	0	0	0	0	0

3.2 Losses

Initial and continuing losses have been extracted from the ARR Data Hub for use in hydrologic modelling. The values are shown in Table 4.

Table 4 Storm Losses

ID	Value
Storm Initial Losses (mm)	26
Storm Continuing Losses (mm/h)	6

4. Storm Water Design Strategy

A high-level assessment was undertaken on the pre and post development scenarios for each developed area in the Armadale Precinct. These areas are as follows:

- 1.1.17 Viaduct North
- 1.1.18 Pedestrian Zone
- 1.1.19 PShP North
- 1.1.20 Youth Zone
- 1.1.21 Bus Interchange
- 1.1.22 Shared Zone
- 1.1.23 PShp South
- 1.1.24 Carpark
- 1.1.25 Viaduct South

4.1 Fraction Impervious

The fraction impervious has been calculated as Total Impervious Area (TIA) via GIS. Impervious areas were assessed using aerial imagery in the existing case and proposed design drawings in the developed case.

Figures 4 to 9 below show the extent of impervious area for each location.

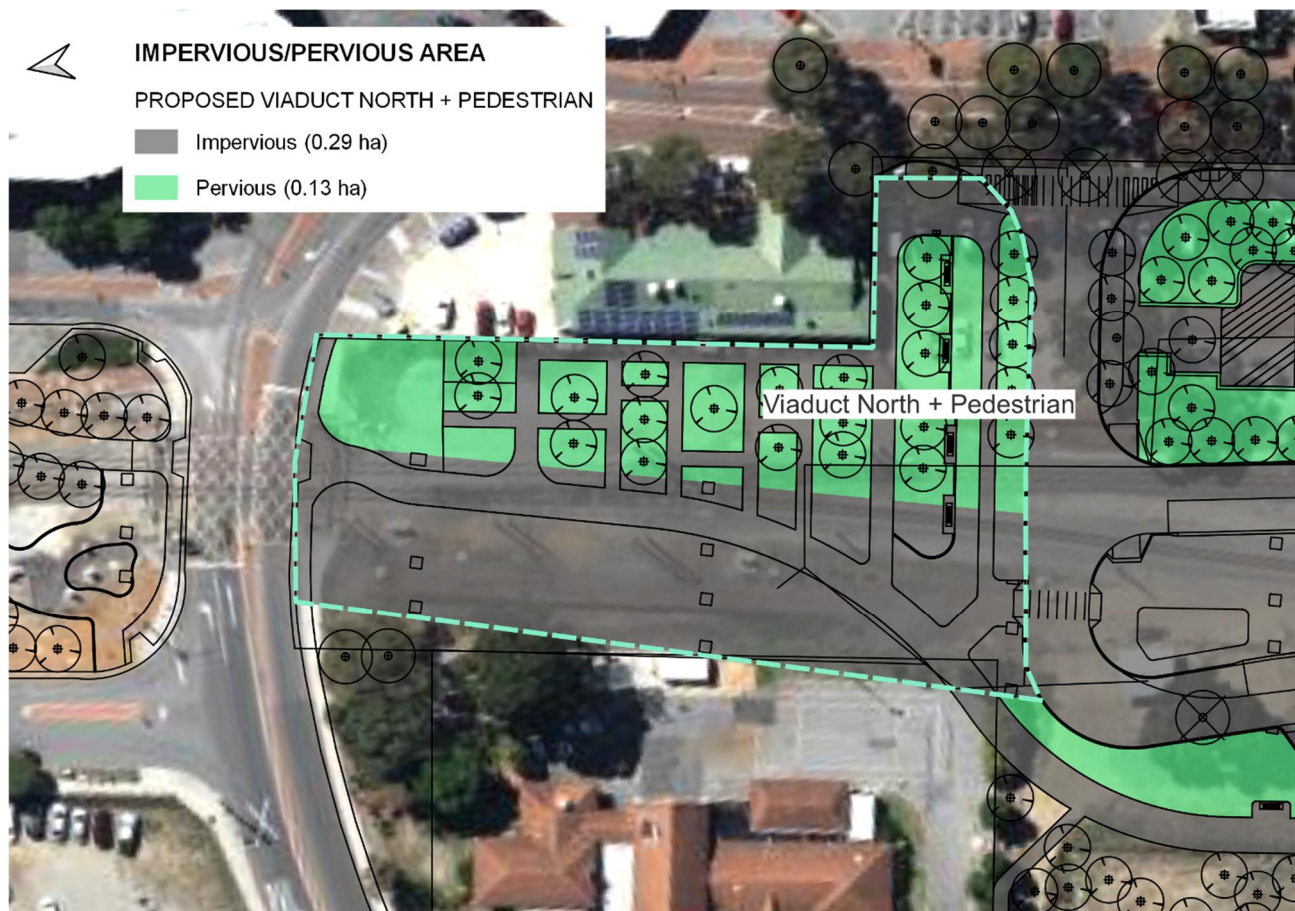


Figure 4. Viaduct North and Pedestrian Zone

Figure 4 above shows the Viaduct North and Pedestrian Zone. The Pedestrian Zone contains pervious areas, shown in green, used to treat and detain the impervious area runoff.

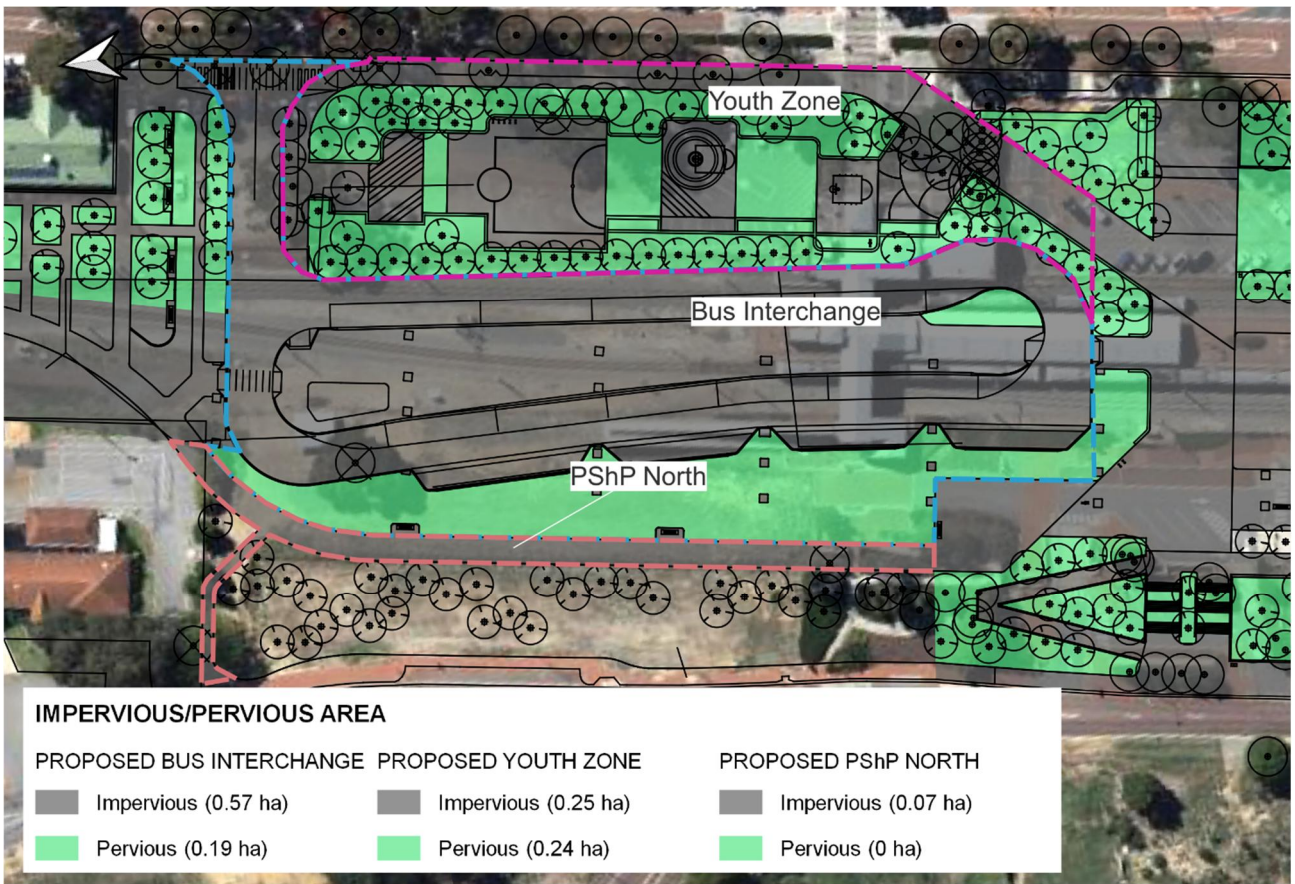


Figure 5. Youth Zone, Bus Interchange and PShP North

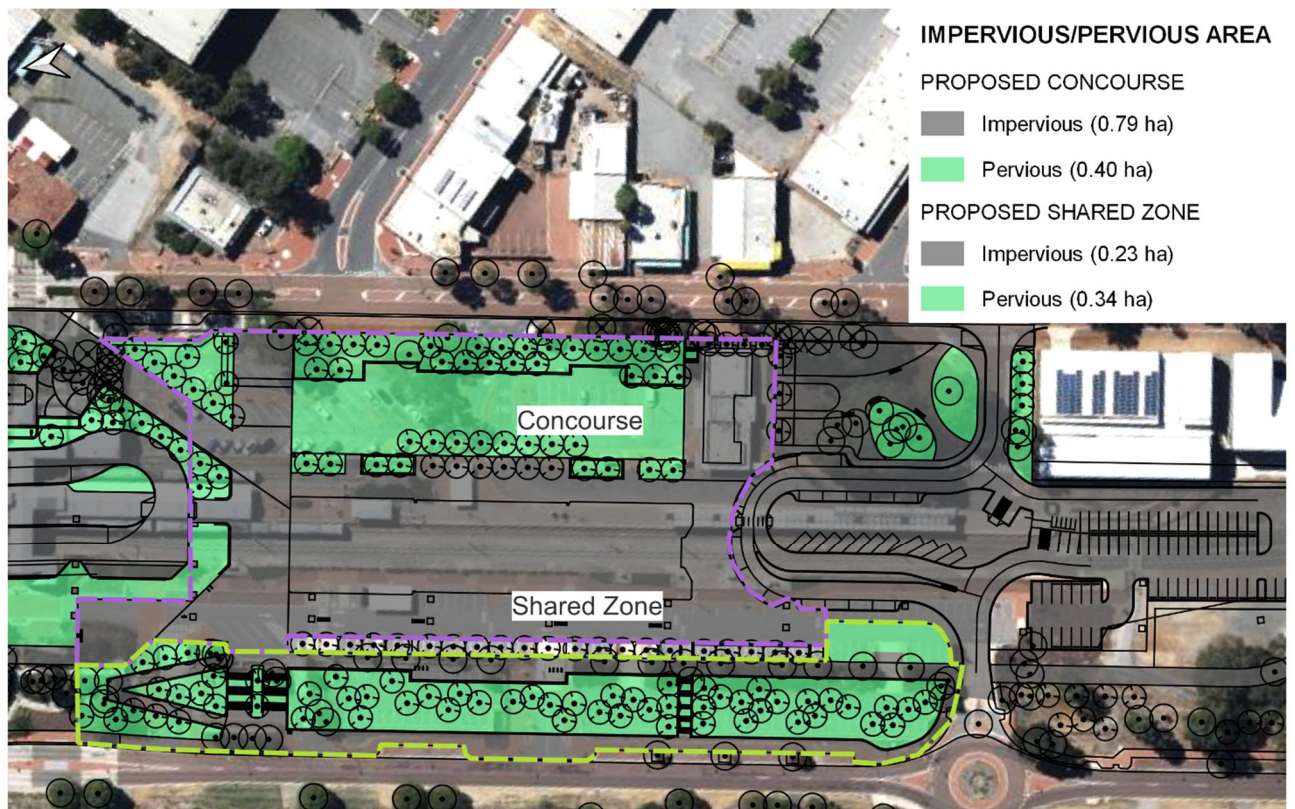


Figure 6. Concourse and Shared Zone

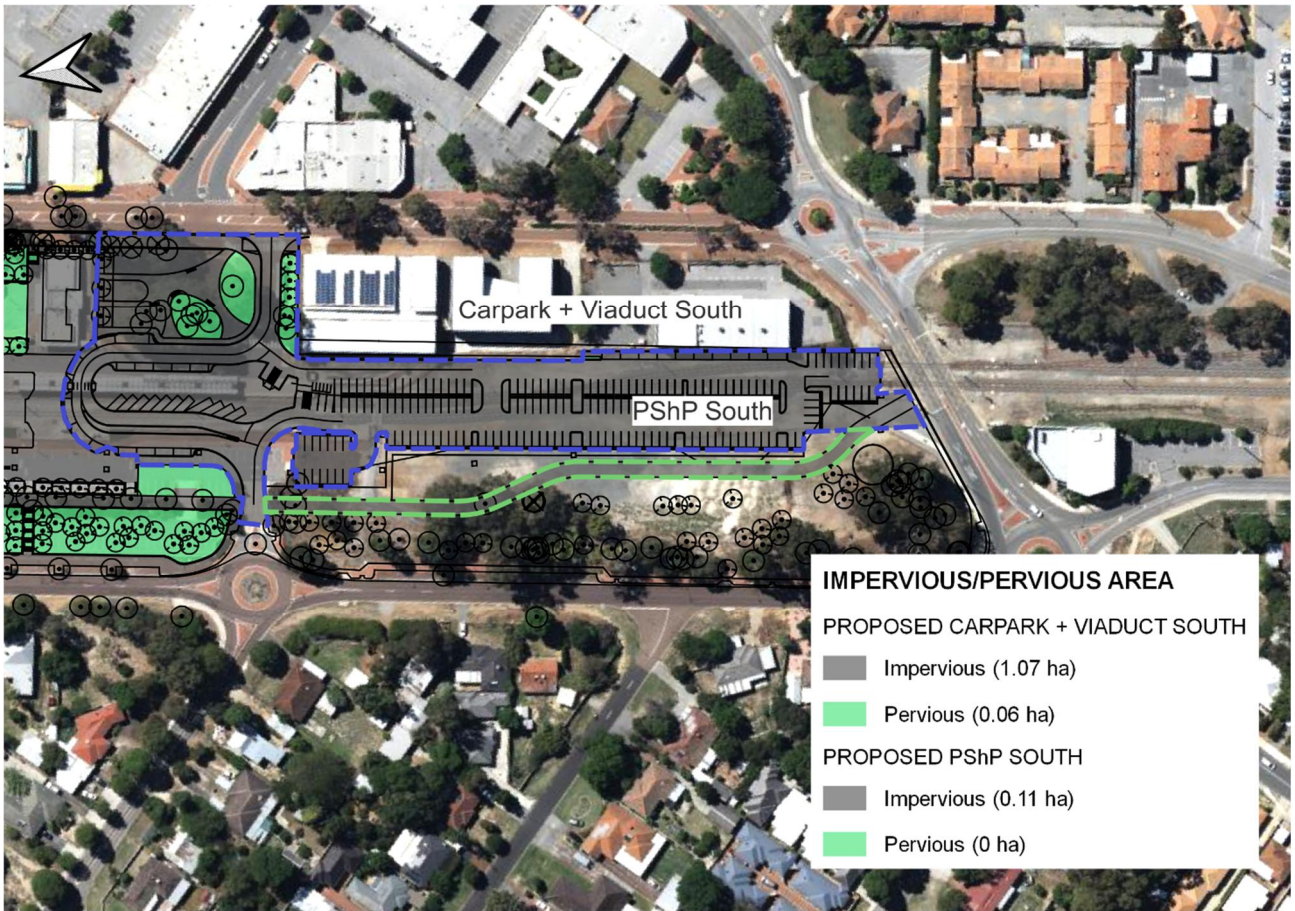


Figure 7. Southeast Carpark and Viaduct South

Runoff from the Viaduct structure is managed via downpipes and brought to ground level. Here it is conveyed via a traditional pit and pipe system.

Table 5 Fraction Impervious Assessment

AREA	PRE-DEVELOPMENT			POST-DEVELOPMENT		
	IMPERVIOUS AREA (ha)	PERVIOUS AREA (ha)	%IMP	IMPERVIOUS AREA (ha)	PERVIOUS AREA (ha)	%IMP
CATCHMENT						
VIADUCT NORTH	0.00	0.39	0%	0.39	0.00	100%
PEDESTRIAN ZONE	0.00	0.492	0%	0.246	0.246	50%
SOUTHEAST CARPARK	0.00	1.144	0%	0.915	0.229	80%
VIADUCT SOUTH						
BUS INTERCHANGE	0.00	0.772	0%	0.664	0.108	86%
PShP NORTH	0.00	0.147	0%	0.147	0.00	100%
PShP SOUTH	0.00	0.150	0%	0.150	0.00	100%
SHARED ZONE	0.00	0.21	0%	0.168	0.042	80%

4.2 Required Storage and Treatment Volumes

The storage volumes required refer to any volume of water detained on site. This can be achieved via above ground storage e.g., detention basins/swales, infiltration, or underground storage.

The required volumes can also be combined to be managed in a larger detention system. The first 15mm of stormwater runoff from impervious areas will be treated in bioretention areas. Table 7 shows the volumes required to treat the first flush.

Table 6 Required Storage Volumes

STORAGE REQUIREMENTS			
Area	Post-Development Detention Storage Volume (m ³)	First Flush Volume (m ³)	Remaining Storage Requirement (m ³)
VIADUCT NORTH	56	48	13
YOUTH ZONE	30	34	-
BUS INTERCHANGE	103	100	3
PShP NORTH	17	22	-
CARPARK	129	137	-
CONCOURSE	98	100	-
SHARED ZONE	30	38	-
PShP SOUTH	18	23	-

4.3 Pre and Post Development Hydraulic Outputs

Pre-development, post-development unmitigated and post-development mitigates critical design flow result output are published in Figures 8 to 14.

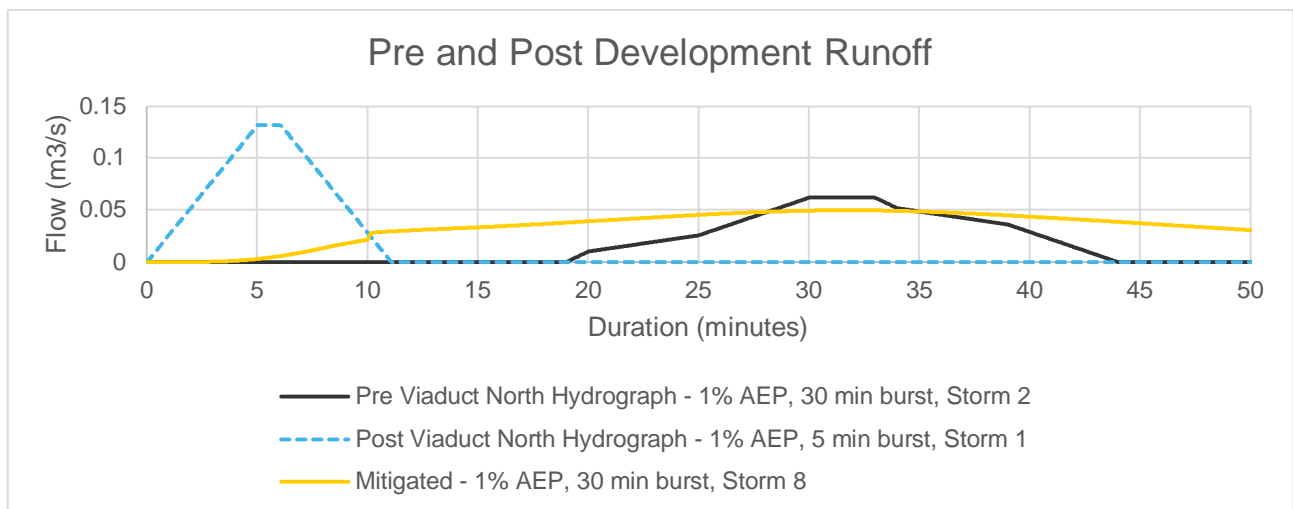


Figure 8 – Pre and Post Development Critical Duration Runoff 1% AEP - VIADUCT NORTH

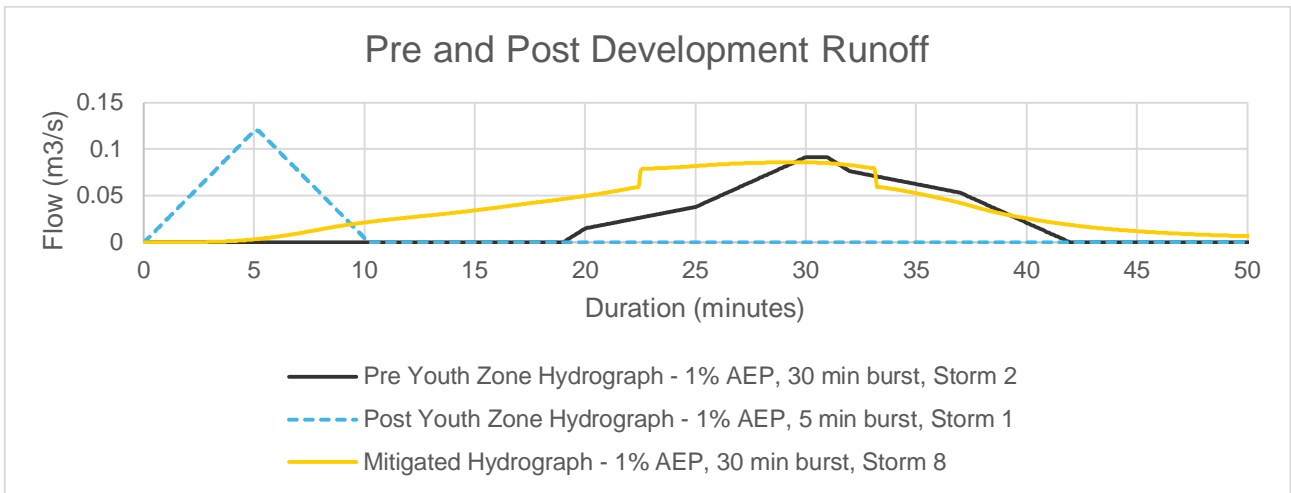


Figure 9 – Pre and Post Development Critical Duration Runoff 1% AEP – YOUTH ZONE

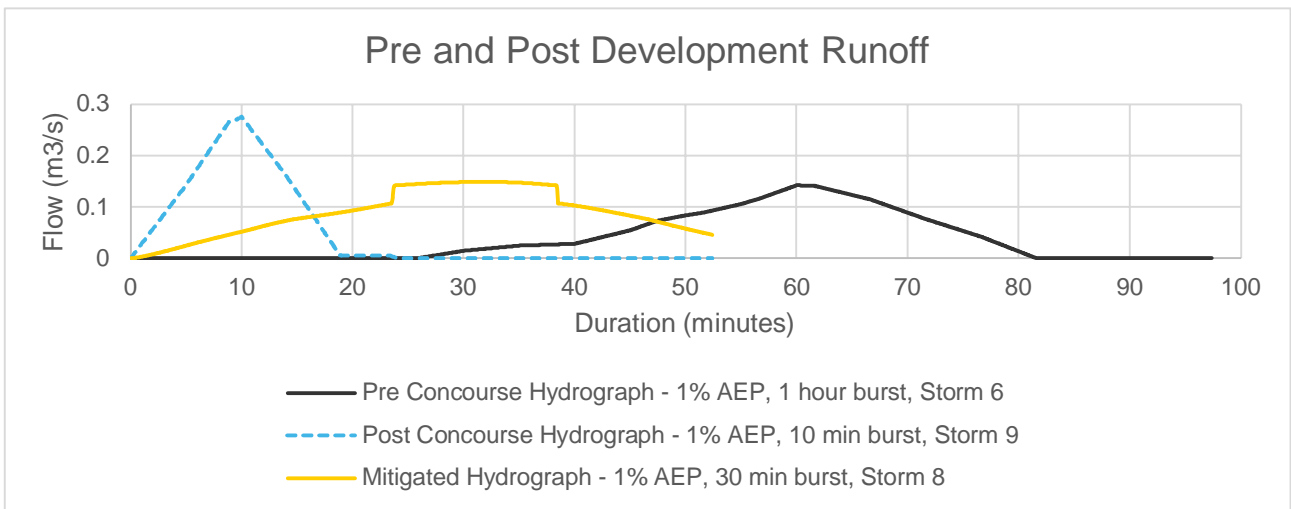


Figure 10 – Pre and Post Development Critical Duration Runoff 1% AEP - CONCOURSE

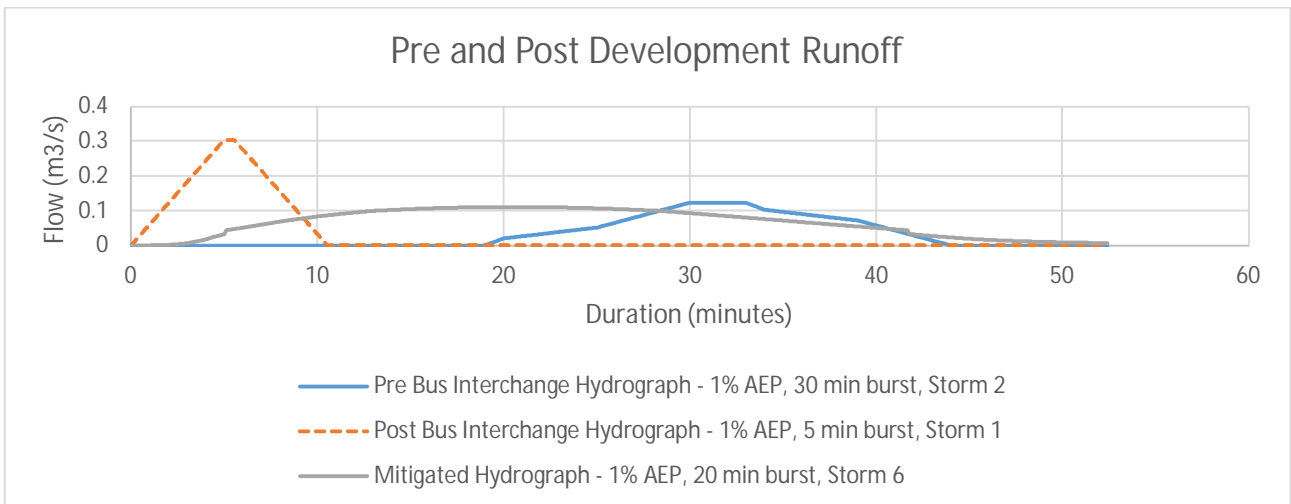


Figure 11 – Pre and Post Development Critical Duration Runoff 1% AEP – BUS INTERCHANGE

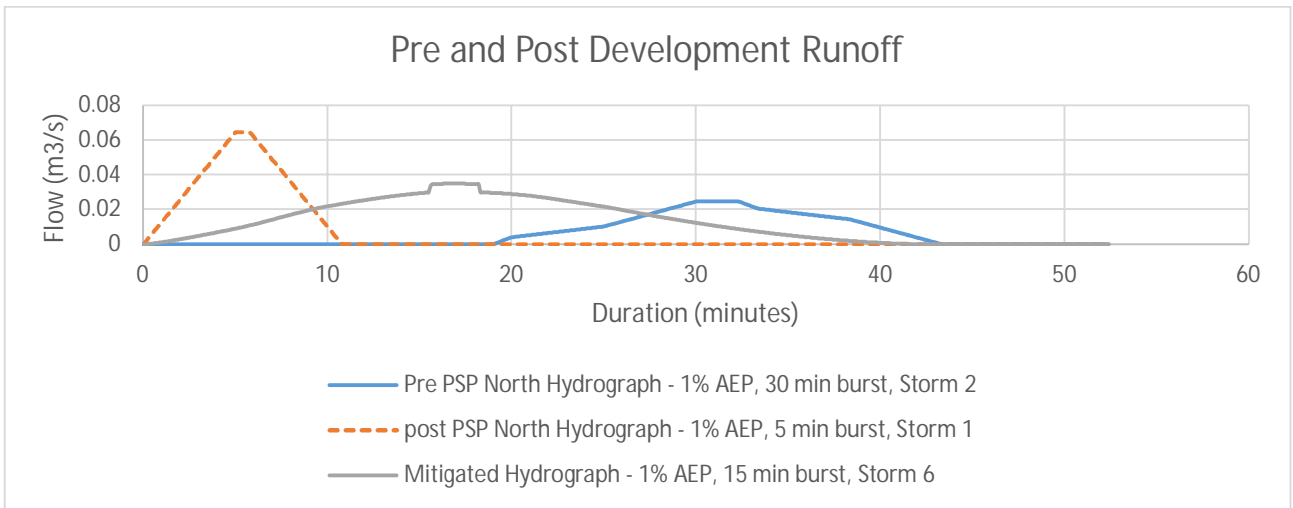


Figure 12 – Pre and Post Development Critical Duration Runoff 1% AEP PHSP NORTH

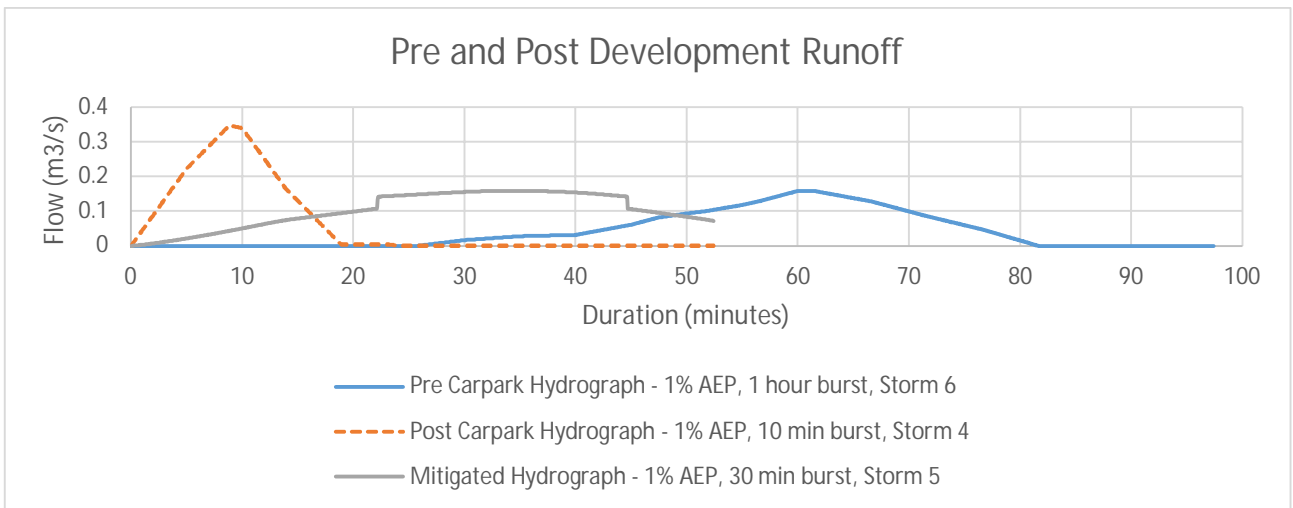


Figure 13 – Pre and Post Development Critical Duration Runoff 1% AEP CARPARK

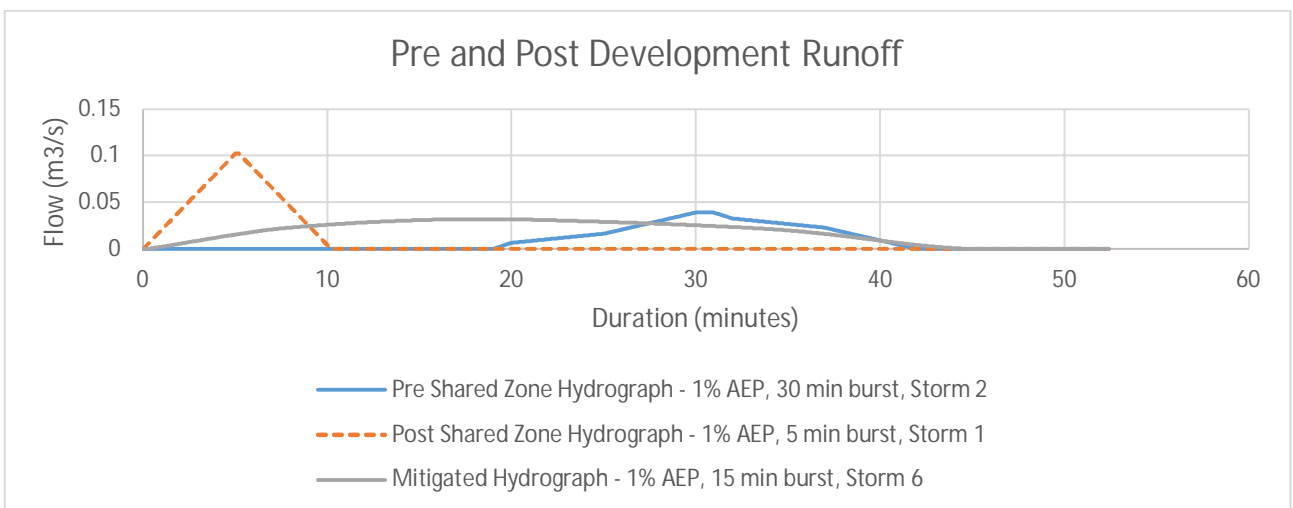


Figure 14 – Pre and Post Development Critical Duration Runoff 1% AEP SHARED ZONE

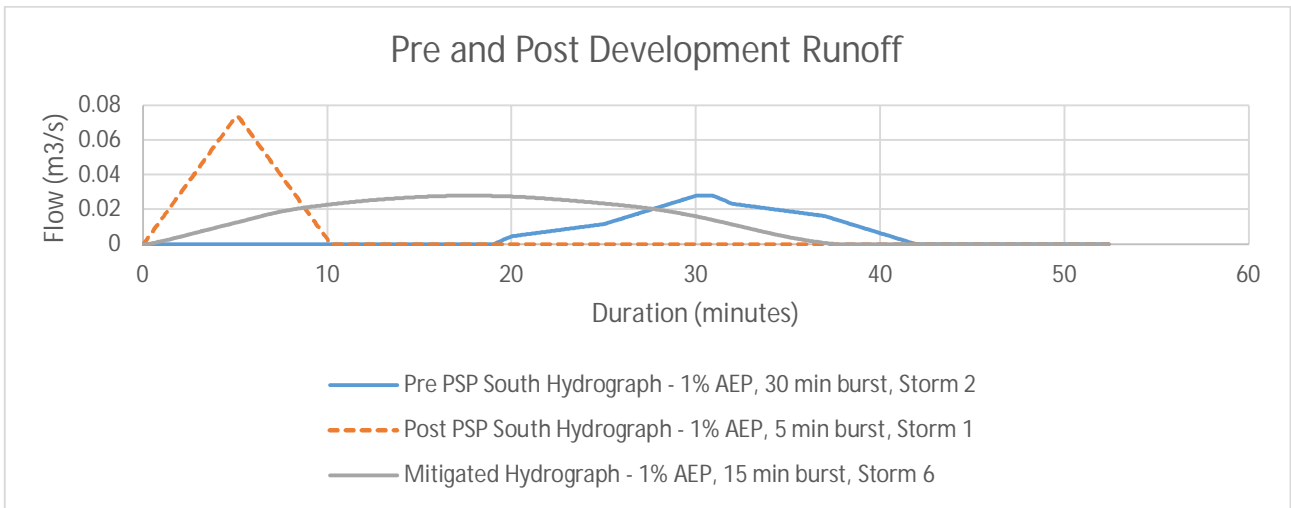
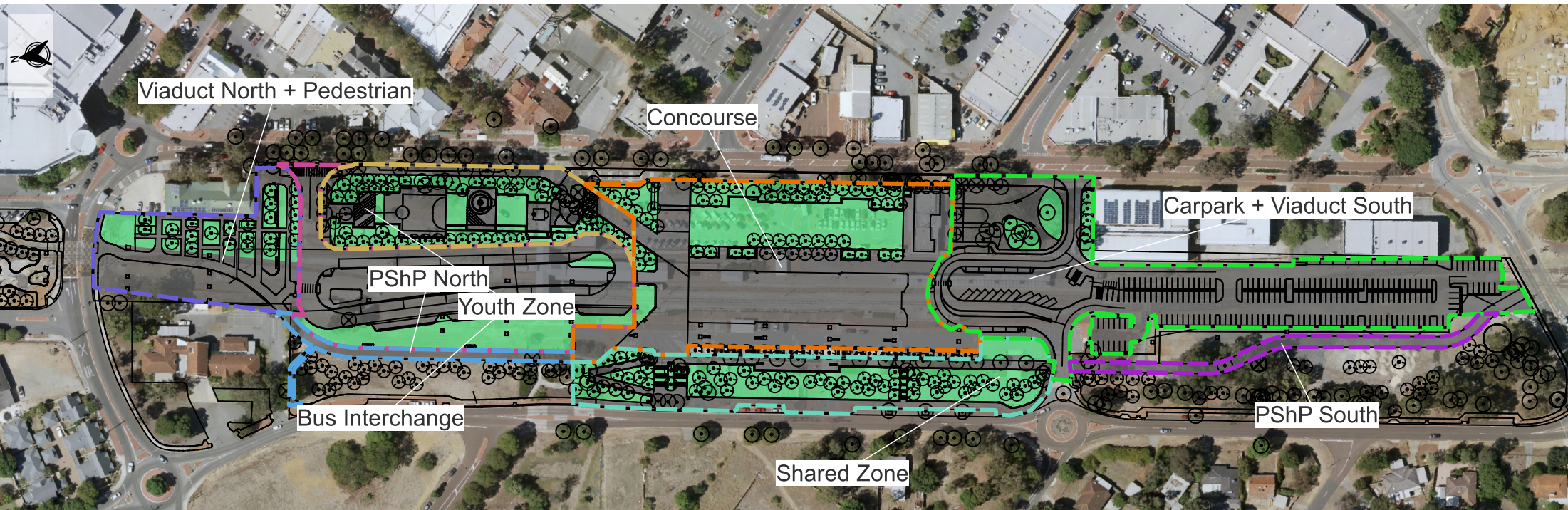


Figure 15 – Pre and Post Development Critical Duration Runoff 1% AEP PHSP SOUTH

5. Conclusion

The overall stormwater strategy applies water sensitive urban design principles and safely conveys water via surface drainage to above ground storage systems. The design maintains pre-development runoff rates by utilising stormwater bio-retention basins.



LEGEND

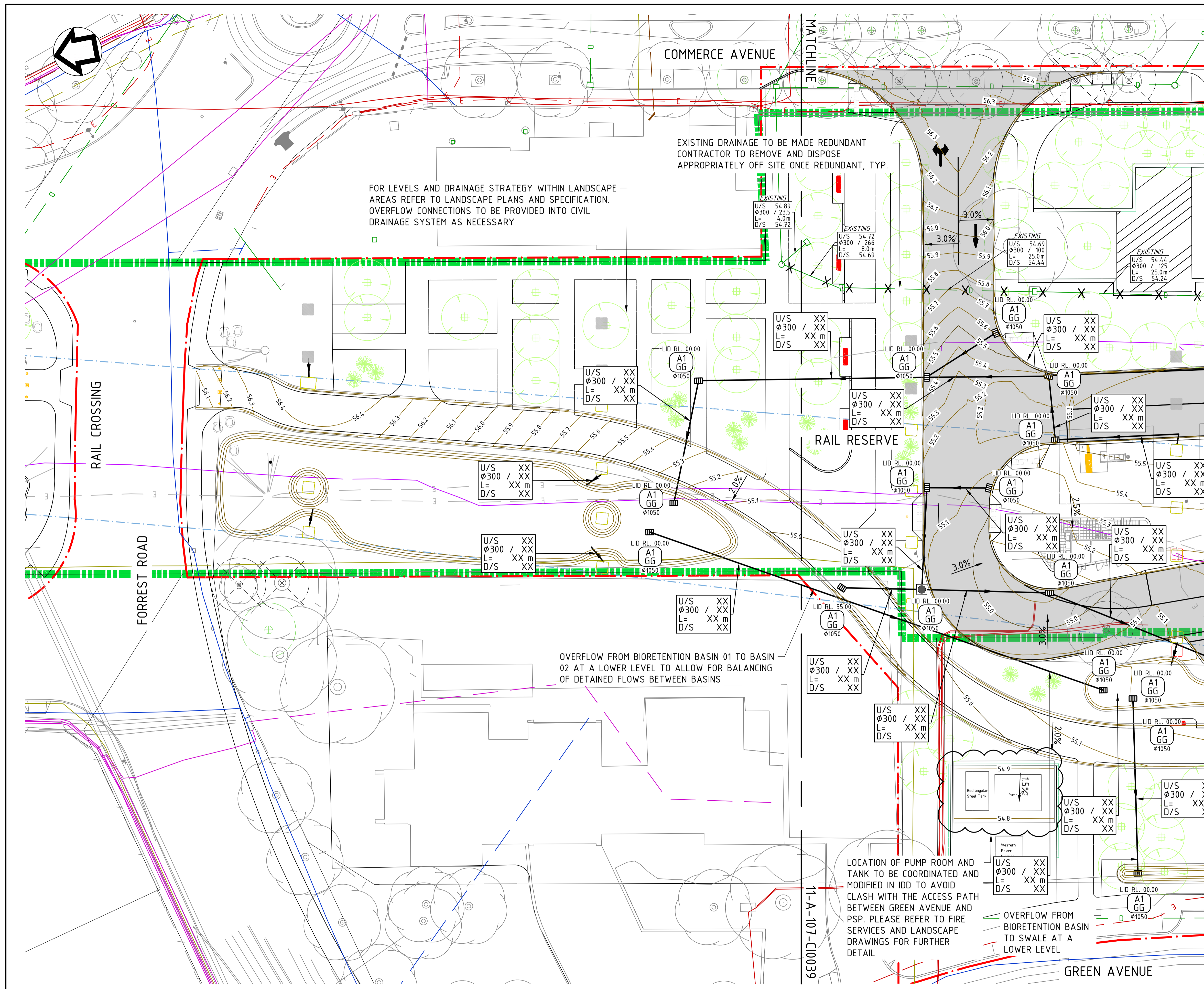
Catchments Armadale Precinct

- Bus Interchange
- Carpark + Viaduct South
- Concourse
- PShP North
- PShP South
- Shared Zone
- Viaduct North + Pedestrian
- Youth Zone

Pervious/Impervious Areas

- Landscaping Design Lines
- Impervious
- Pervious

Name	perm_ha	imperv_ha	area_ha	perc_perm (%)	perc_imp (%)
Bus Interchange	0.19	0.57	0.76	24	76
Carpark + Viaduct South	0.06	1.07	1.13	5	95
Concourse	0.40	0.79	1.19	34	66
PShP North	0.00	0.00	0.07	0	100
PShP South	0.00	0.10	0.10	0	100
Shared Zone	0.34	0.23	0.57	60	40
Viaduct North + Pedestrian	0.13	0.29	0.42	31	69
Youth Zone	0.24	0.25	0.49	50	50



- NOTES**
- FOR DRAINAGE OF HARDSCAPE AREAS AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO LANDSCAPE PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES.
 - FOR DRAINAGE OF BUILDINGS AND ROOF AREAS AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO HYDRAULIC PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES.
 - FOR DRAINAGE OF VIADUCT STRUCTURES AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO VIADUCT STRUCTURE PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES.
 - LOCAL PRECINCT DRAINAGE HAS BEEN COMPLETED IN ACCORDANCE WITH THE WIDER PRECINCT DRAINAGE STRATEGY, AS INCLUDED IN APPENDIX E OF THE ARMADALE PRECINCT CIVIL DESIGN REPORT. REFER TO DESIGN REPORT AND APPENDIX E FOR FURTHER DETAILS ON PRECINCT WIDE STORMWATER DRAINAGE STRATEGY.
 - FLOWS GREATER THAN 100-YR ARI STORM EVENT ARE INTENDED TO BE CONVEYED TO COA DRAINAGE NETWORK VIA AN OUTLET PIT AND PIPE CONNECTION OR VIA OVERLAND FLOW.
 - LOCATION AND SIZES OF ALL BIORETENTIVE BASINS NEED TO BE FURTHER COORDINATED WITH LANDSCAPE IN SUBSEQUENT DESIGN PHASE.
 - VIADUCT DRAINAGE TO BE CONVEYED VIA DOWNPIPES PRECAST INTO PIERS. VIADUCT DRAINAGE OUTLET POINTS SUBJECT TO CONFIRMATION AND COORDINATION WITH CIVIL, VIADUCT AND LANDSCAPE DESIGN.
 - LANDSCAPE/VEGETATIVE STRIPS TO BE DRAINED VIA SUBSOIL. SUBSOIL PLANS TO BE FURTHER DEVELOPED IN SUBSEQUENT DESIGN STAGE IN COORDINATION WITH CIVIL, LANDSCAPE AND HYDRAULICS.
 - CONCOURSE PAVEMENT TO SHEET FLOW INTO VEGETATED LANDSCAPE STRIPS. STRATEGY TO BE FURTHER DEVELOPED IN THE SUBSEQUENT DESIGN STAGE IN COORDINATION WITH LANDSCAPE AND HYDRAULICS.
 - EXISTING RAIL SYSTEM SERVICES TO BE MADE REDUNDANT FOLLOWING INSTALLATION OF THE TEMPORARY MCR AND SHUT DOWN OF RAIL. FOR TREATMENT OF REDUNDANT SERVICES, REFER TO RESPECTIVE DISCIPLINE DESIGN DRAWINGS.
 - EXISTING AND PROPOSED DRAINAGE SUBJECT TO FURTHER INVESTIGATION AND FINALISATION OF DRAINAGE DESIGN IN DETAILED DESIGN.
 - FOR OVERALL TREATMENT OF UTILITY SERVICES, REFER TO UTILITIES PACKAGE UT-040.
 - PROPOSED DRAINAGE INFRASTRUCTURE MAY CLASH WITH EXISTING SERVICES THAT MAY BE MADE REDUNDANT. PRIOR TO INSTALLATION OF DRAINAGE, ENSURE SERVICES ARE ACCURATELY LOCATED AND IDENTIFIED. REDUNDANT SERVICES TO BE REMOVED AS PER PTA REQUIREMENTS.

CAUTION: HIGH PRESSURE GAS IN VICINITY.
CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE PIPELINE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.

CAUTION: FIBRE OPTIC CABLE IN VICINITY.
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REV	DATE	AMENDMENT	DSN	DRN	CHK	APP		
B	08/02/23	RE-ISSUED FOR RD			R.T.	M.B.	F.O.	A.E.
A	05/08/22	ISSUED FOR RD - PTA REVIEW			R.T.	M.B.	Y.K.	A.E.
ORIG SIZE	0 10 20 30 40 50 100mm		This document must not be copied without PTA's written permission, and the contents thereof must not be imparted to a third party nor be used for any unauthorised purpose.					
A1	AT ORIGINAL PLOT SIZE		Contractor No: R30-MET-DWG-CI-200-04000					



REFERENCES

- XRO1GN_CADAstral_BdY_PCG2020
- XRO1GN_SURVEY_PCG2020
- XRO1UT_UTILITIES_PCG2020
- R30-MET-XRF-CI-200-00001
- R30-MET-XRF-CI-200-00002
- R30-MET-XRF-CI-200-00003
- XRO1GN_RAIL_RESERVE_BdY_PCG2020
- LOGO_METCONNX
- R30-UDL-XRF-LA-230-00001
- R30-WWH-XRF-AR-225-00001
- R30-DEA-XRF-ST-170-01001
- XRO1GN_ENVIRONMENTAL_SITES_PCG2020

SCALE

1:250

DATUM

HORIZONTAL: PCG2020
VERTICAL: AHD71

DESIGNED R. THOMPSON

DRAWN M. BLIGH-SHEPPARD

CHECKED F. OTRANTO

APPROVED A. EYRES

DATE 09/02/23

REFERENCE DESIGN

Government of Western Australia
Public Transport Authority

BYFORD RAIL EXTENSION

ARMADALE PRECINCT
CIVIL WORKS
PIT AND PIPE LAYOUT - SHEET 1 OF 5
PTA Drawing No: 11-A-107-CI0038

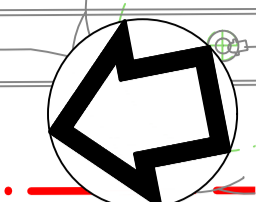
Rev: B

MATCHLINE

FOR LEVELS AND DRAINAGE STRATEGY WITHIN LANDSCAPE AREAS REFER TO LANDSCAPE PLANS AND SPECIFICATIONS. OVERFLOW CONNECTIONS TO BE PROVIDED INTO CIVIL DRAINAGE SYSTEM AS NECESSARY

YOUTH ZONE PAVEMENT TO DRAIN AS SHEET FLOW INTO LANDSCAPE STRIPS VIA WEEP HOLES OR DRAIN BREAKS PRECAST INTO LANDSCAPE WALLS. DETAILS TO BE DEVELOPED FURTHER IN SUBSEQUENT DESIGN STAGE

COMMERCE AVENUE



NOTES

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- CONCOURSE PAVEMENT TO SHEET FLOW INTO VEGETATED LANDSCAPE STRIPS. STRATEGY TO BE FURTHER DEVELOPED IN THE SUBSEQUENT DESIGN STAGE IN COORDINATION WITH LANDSCAPE AND HYDRAULICS.
- EXISTING RAIL SYSTEM SERVICES TO BE MAINTAINED FOLLOWING INSTALLATION OF THE TEMPORARY MCR AND SHUT DOWN OF RAIL. FOR TREATMENT OF REDUNDANT SERVICES, REFER TO RESPECTIVE DISCIPLINE DESIGN DRAWINGS.
- EXISTING AND PROPOSED DRAINAGE SUBJECT TO FURTHER INVESTIGATION AND FINALISATION OF DRAINAGE DESIGN IN DETAILED DESIGN.
- FOR OVERALL TREATMENT OF UTILITY SERVICES, REFER TO UTILITIES PACKAGE UT-040.
- PROPOSED DRAINAGE INFRASTRUCTURE MAY CLASH WITH EXISTING SERVICES THAT MAY BE MADE REDUNDANT. PRIOR TO INSTALLATION OF DRAINAGE, ENSURE SERVICES ARE ACCURATELY LOCATED AND IDENTIFIED. REDUNDANT SERVICES TO BE REMOVED AS PER PTA REQUIREMENTS.

MATCHLINE

PROPOSED COLUMN RELOCATIONS ACCEPTED IN PRINCIPLE BY VIADUCT STRUCTURES DESIGN. TO BE DEVELOPED AND VERIFIED BY VIADUCT STRUCTURAL PACKAGE. DETAILS TO BE CONFIRMED IN SUBSEQUENT DESIGN



CAUTION: HIGH PRESSURE GAS IN VICINITY. CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE PIPELINE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.

CAUTION: FIBRE OPTIC CABLE IN VICINITY. CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE CABLE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.

11-A-107-C10040

11-A-107-C10038

LOCATION OF PUMP ROOM AND TANK TO BE COORDINATED AND MODIFIED IN IDD TO AVOID CLASH WITH THE ACCESS PATH BETWEEN GREEN AVENUE AND PSP. PLEASE REFER TO FIRE SERVICES AND LANDSCAPE DRAWINGS FOR FURTHER DETAIL

OVERFLOW FROM BIORETENTION BASIN TO SWALE AT A LOWER LEVEL

PROPOSED COLUMN RELOCATIONS ACCEPTED IN PRINCIPLE BY VIADUCT STRUCTURES DESIGN. TO BE DEVELOPED AND VERIFIED BY VIADUCT STRUCTURAL PACKAGE. DETAILS TO BE CONFIRMED IN SUBSEQUENT DESIGN

OUTLET TO CITY OF ARMADALE DRAINAGE NETWORK

OVERFLOW FROM SWALE TO CITY OF ARMADALE NETWORK TO MAINTAIN CONNECTION TO EXISTING SYSTEM LIMITED TO PREDEVELOPMENT FLOW RATES

REV	DATE	AMENDMENT	DSN	DRN	CHK	APP
B	08/02/23	RE-ISSUED FOR RD	R.T.	M.B.	F.O.	A.E.
A	05/08/22	ISSUED FOR RD - PTA REVIEW	R.T.	M.B.	Y.K.	A.E.
ORIG SIZE						
A1	AT ORIGINAL PLOT SIZE					



REFERENCES	SCALE
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DATUM	HORIZONTAL: PCG2020 VERTICAL: AHD71

DESIGNED	R. THOMPSON
DRAWN	M. BLIGH-SHEPPARD
CHECKED	F. OTRANTO
APPROVED	A. EYRES
DATE	09/02/23

REFERENCE DESIGN

Government of Western Australia
Public Transport Authority

BYFORD RAIL EXTENSION

ARMADALE PRECINCT
CIVIL WORKS
PIT AND PIPE LAYOUT - SHEET 2 OF 5
PTA Drawing No: 11-A-107-C10039

Rev: B

COMMERCE AVENUE

MATCHLINE

- NOTES
- FOR DRAINAGE OF HARDSCAPE AREAS AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO LANDSCAPE PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES.
 - FOR DRAINAGE OF BUILDINGS AND ROOF AREAS AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO HYDRAULIC PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES.
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EXISTING SER BUILDING

FOR LEVELS AND DRAINAGE STRATEGY WITHIN LANDSCAPE AREAS REFER TO LANDSCAPE PLANS AND SPECIFICATIONS. OVERFLOW CONNECTIONS TO BE PROVIDED INTO CIVIL DRAINAGE SYSTEM AS NECESSARY.

EXISTING TREES TO BE TRANSPLANTED. PLEASE REFER TO LANDSCAPE DRAWINGS FOR DETAILS.

PSP TO GRADE AND DRAIN INTO ADJACENT LANDSCAPE AREA AND BIORETENTION BASIN NEAR GREEN STREET

CAUTION: HIGH PRESSURE GAS IN VICINITY. CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE PIPELINE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.

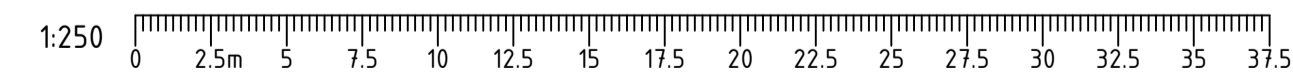
CAUTION: FIBRE OPTIC CABLE IN VICINITY. CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE CABLE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.



MATCHLINE

11-A-107-C10039

11-A-107-C10041



REV	DATE	AMENDMENT	DSN	DRN	CHK	APP
B	08/02/23	RE-ISSUED FOR RD	R.T.	M.B.	F.O.	A.E.
A	05/08/22	ISSUED FOR RD - PTA REVIEW	R.T.	M.B.	Y.K.	A.E.

ORIG SIZE: A1
AT ORIGINAL PLOT SIZE

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REFERENCES
XR01G_CADAstral_BDy_PCG2020
XR01G_SURVEY_PCG2020
XR01UT_UTILITIES_PCG2020
R30-DEA-XRF-ST-170-01001
R30-UDL-XRF-LA-230-00001
_LOGO_METCONNX
R30-MET-XRF-CI-200-00003
XR01G_RAIL_RESERVE_BDy_PCG2020
R30-WWH-XRF-AR-225-00001
R30-MET-XRF-CI-200-00001
R30-MET-XRF-CI-200-00002
XR01G_ENVIRONMENTAL_SITES_PCG2020

SCALE
1:250
DATUM
HORIZONTAL: PCG2020
VERTICAL: AHD71

DESIGNED: R. THOMPSON
DRAWN: M. BLIGH-SHEPPARD
CHECKED: F. OTRANTO
APPROVED: A. EYRES
DATE: 09/02/23

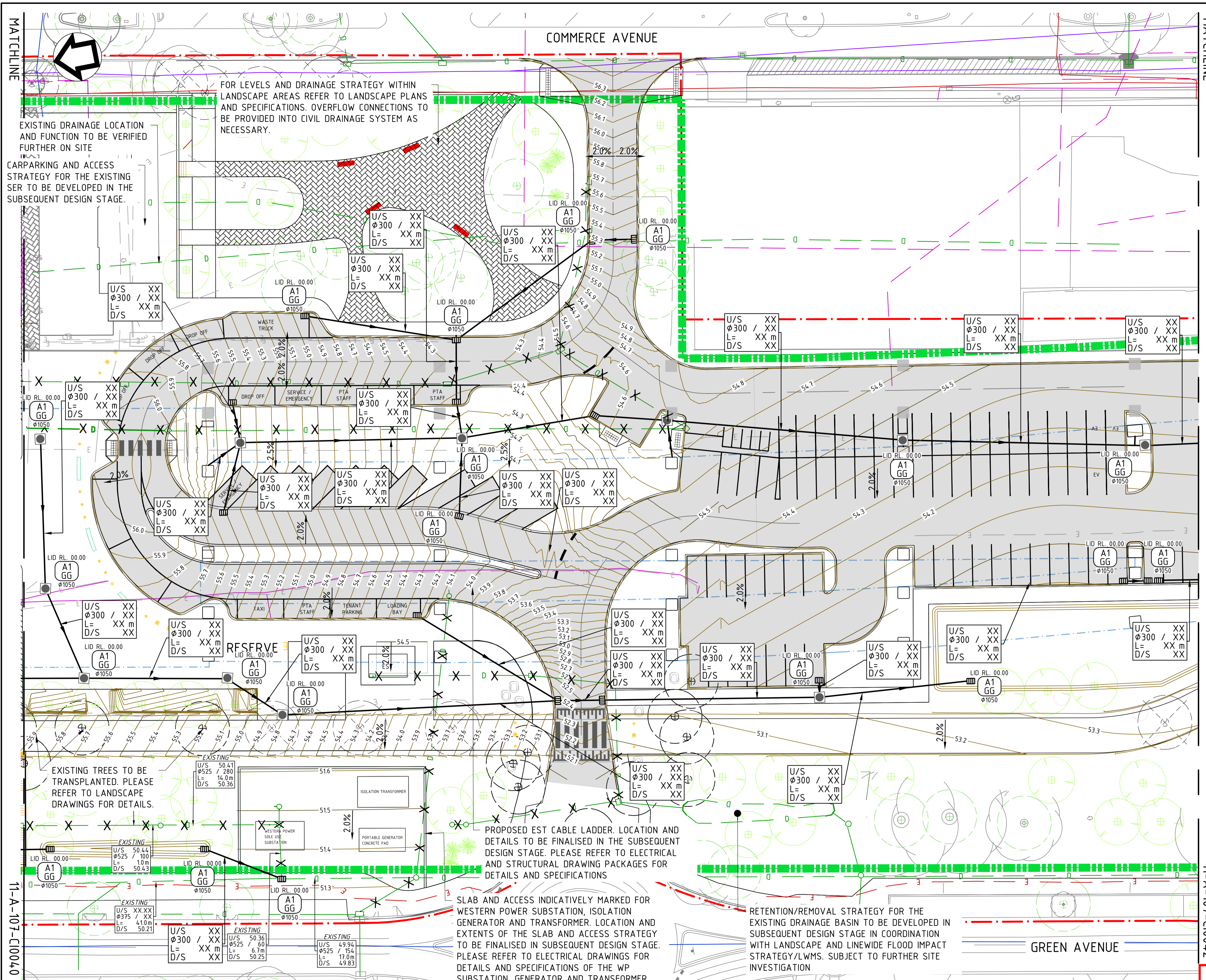
REFERENCE DESIGN

Government of Western Australia
Public Transport Authority

BYFORD RAIL EXTENSION

ARMADALE PRECINCT
CIVIL WORKS
PIT AND PIPE LAYOUT - SHEET 3 OF 5
PTA Drawing No: 11-A-107-C10040

Rev: B



- NOTES**
- FOR DRAINAGE OF HARDSCAPE AREAS AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO LANDSCAPE PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES.
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EXISTING DRAINAGE LOCATION AND FUNCTION TO BE VERIFIED FURTHER ON SITE

CARPARKING AND ACCESS STRATEGY FOR THE EXISTING SER TO BE DEVELOPED IN THE SUBSEQUENT DESIGN STAGE.

FOR LEVELS AND DRAINAGE STRATEGY WITHIN LANDSCAPE AREAS REFER TO LANDSCAPE PLANS AND SPECIFICATIONS. OVERFLOW CONNECTIONS TO BE PROVIDED INTO CIVIL DRAINAGE SYSTEM AS NECESSARY.

EXISTING TREES TO BE TRANSPLANTED. PLEASE REFER TO LANDSCAPE DRAWINGS FOR DETAILS.

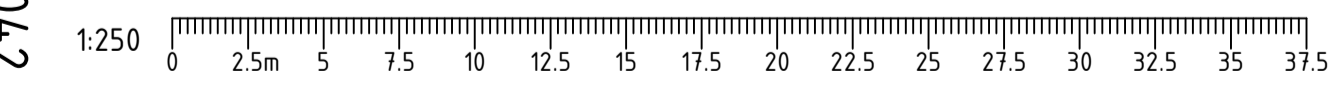
PROPOSED EST CABLE LADDER. LOCATION AND DETAILS TO BE FINALISED IN THE SUBSEQUENT DESIGN STAGE. PLEASE REFER TO ELECTRICAL AND STRUCTURAL DRAWING PACKAGES FOR DETAILS AND SPECIFICATIONS

SLAB AND ACCESS INDICATIVELY MARKED FOR WESTERN POWER SUBSTATION, ISOLATION GENERATOR AND TRANSFORMER. LOCATION AND EXTENTS OF THE SLAB AND ACCESS STRATEGY TO BE FINALISED IN SUBSEQUENT DESIGN STAGE. PLEASE REFER TO ELECTRICAL DRAWINGS FOR DETAILS AND SPECIFICATIONS OF THE WP SUBSTATION, GENERATOR AND TRANSFORMER.

RETENTION/REMOVAL STRATEGY FOR THE EXISTING DRAINAGE BASIN TO BE DEVELOPED IN SUBSEQUENT DESIGN STAGE IN COORDINATION WITH LANDSCAPE AND LINEWIDE FLOOD IMPACT STRATEGY/LWMS. SUBJECT TO FURTHER SITE INVESTIGATION

CAUTION: HIGH PRESSURE GAS IN VICINITY.
CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE PIPELINE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.

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REFERENCE DESIGN

REV	DATE	AMENDMENT	DSN	DRN	CHK	APP
B	08/02/23	RE-ISSUED FOR RD	R.T.	M.B.	F.O.	A.E.
A	05/08/22	ISSUED FOR RD - PTA REVIEW	R.T.	M.B.	Y.K.	A.E.

ORIG SIZE: A1
AT ORIGINAL PLOT SIZE

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REFERENCES

- XRO1GN_CADASTRAL_BDY_PCG2020
- XRO1GN_SURVEY_PCG2020
- XRO1UT_UTILITIES_PCG2020
- XRO1GN_RAIL_RESERVE_BDY_PCG2020
- R30-MET-XRF-CL-200-00001
- R30-MET-XRF-CL-200-00002
- R30-MET-XRF-CL-200-00003
- _LOGO_METCONNX
- R30-UDL-XRF-LA-230-00001
- R30-DEA-XRF-ST-170-01001
- XRO1GN_ENVIRONMENTAL_SITES_PCG2020

SCALE

1:250

DATUM

HORIZONTAL: PCG2020
VERTICAL: AHD71

DESIGNED R. THOMPSON

DRAWN M. BIGH-SHEPPARD

CHECKED F. OTRANTO

APPROVED A. EYRES

DATE 09/02/23

Government of Western Australia
Public Transport Authority

BYFORD RAIL EXTENSION

ARMADALE PRECINCT
CIVIL WORKS
PIT AND PIPE LAYOUT - SHEET 4 OF 5
PTA Drawing No: 11-A-107-C10041

Rev: B

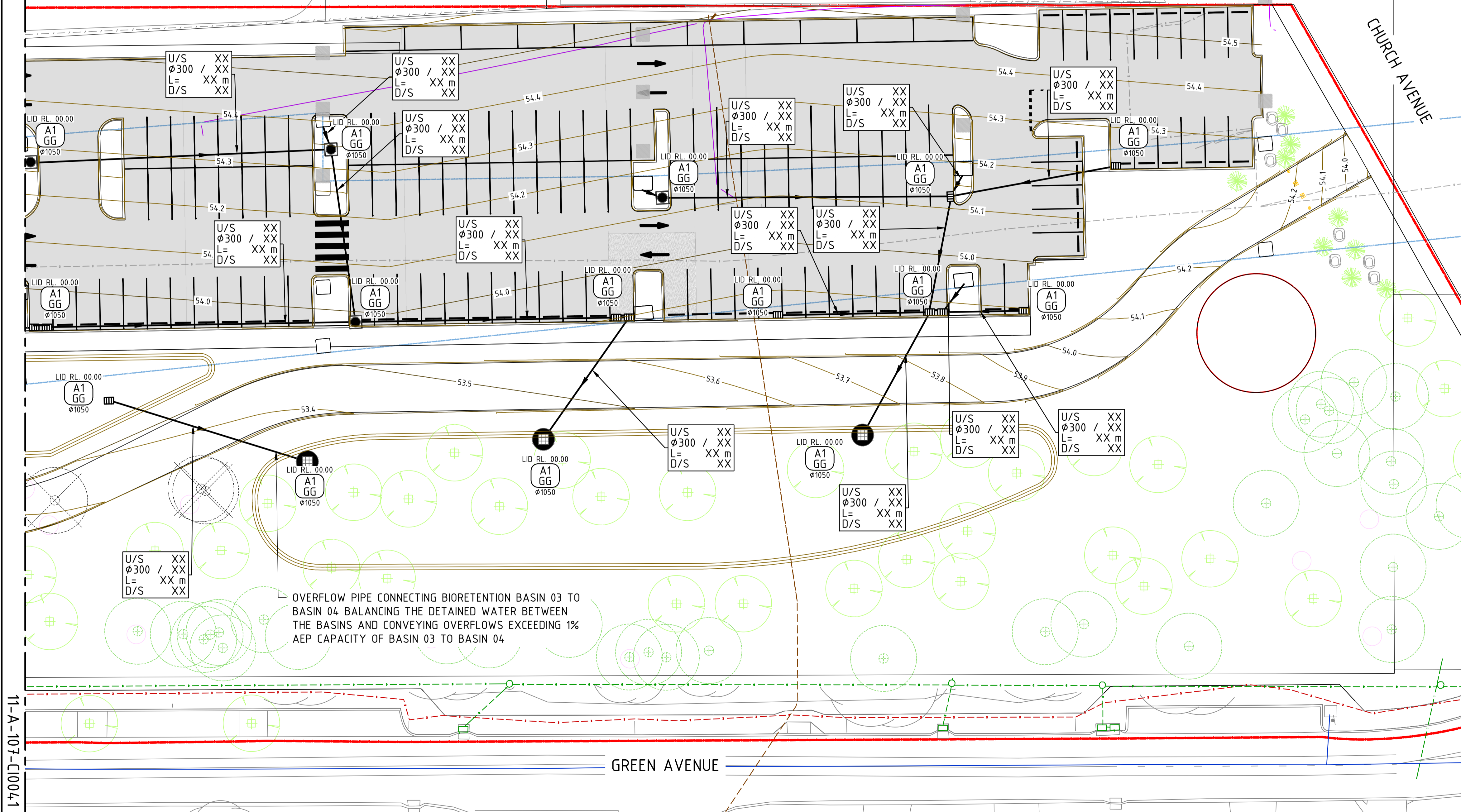
MATCHLINE

COMMERCE AVENUE

CHURCH AVENUE

GREEN AVENUE

- NOTES**
- FOR DRAINAGE OF HARDSCAPE AREAS AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO LANDSCAPE PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES
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 - CONCOURSE PAVEMENT TO SHEET FLOW INTO VEGETATED LANDSCAPE STRIPS. STRATEGY TO BE FURTHER DEVELOPED IN THE SUBSEQUENT DESIGN STAGE IN COORDINATION WITH LANDSCAPE AND HYDRAULICS



OVERFLOW PIPE CONNECTING BIORETENTION BASIN 03 TO BASIN 04 BALANCING THE DETAINED WATER BETWEEN THE BASINS AND CONVEYING OVERFLOWS EXCEEDING 1% AEP CAPACITY OF BASIN 03 TO BASIN 04

CAUTION: HIGH PRESSURE GAS IN VICINITY.
CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE PIPELINE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.



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REFERENCE DESIGN

Government of Western Australia
Public Transport Authority

BYFORD RAIL EXTENSION

ARMADALE PRECINCT
CIVIL WORKS
PIT AND PIPE LAYOUT - SHEET 5 OF 5
PTA Drawing No: 11-A-107-C10042

DESIGNED: R. THOMPSON
DRAWN: M. BLIGH-SHEPPARD
CHECKED: F. OTRANTO
APPROVED: A. EYRES
DATE: 09/02/23

Rev: B

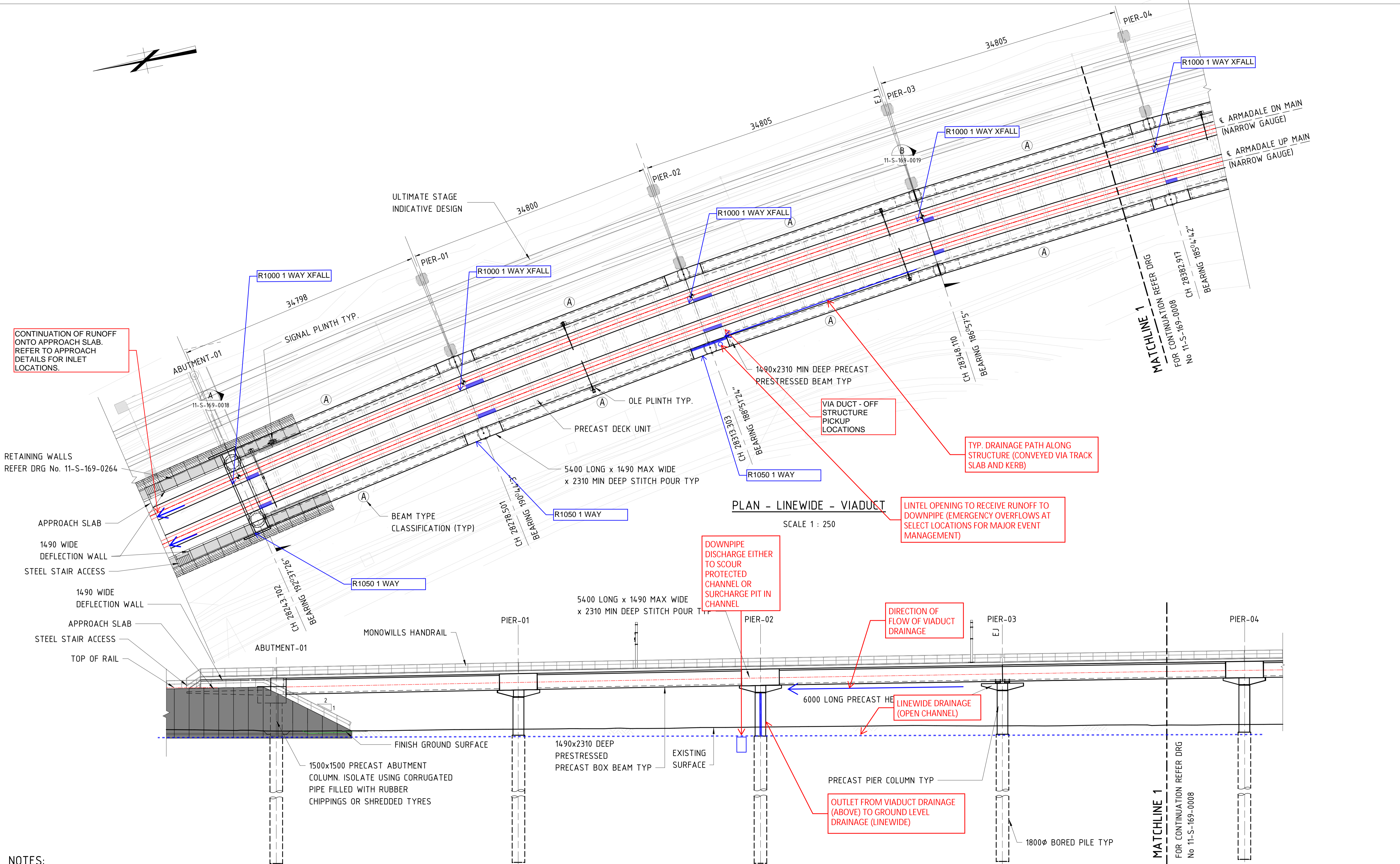
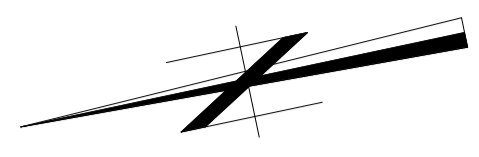
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B	08/02/23	RE-ISSUED FOR RD				
A	05/08/22	ISSUED FOR RD - PTA REVIEW	R.T.	M.B.	F.O.	A.E.
ORIG SIZE	0 10 20 30 40 50 100mm		This document must not be copied without PTA's written permission, and the contents thereof must not be imparted to a third party nor be used for any unauthorised purpose.			
A1	AT ORIGINAL PLOT SIZE		Contractor No: R30-MET-DWG-CI-200-04004			



REFERENCES	SCALE	DESIGNED
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DATUM	HORIZONTAL: PCG2020 VERTICAL: AHD71	DRAWN: M. BLIGH-SHEPPARD CHECKED: F. OTRANTO APPROVED: A. EYRES DATE: 09/02/23

Appendix B: Drainage Strategy Sketches

Refer attached Appendix B.



CONTINUATION OF RUNOFF ONTO APPROACH SLAB. REFER TO APPROACH DETAILS FOR INLET LOCATIONS.

RETAINING WALLS REFER DRG No. 11-S-169-0264

APPROACH SLAB
1490 WIDE DEFLECTION WALL
STEEL STAIR ACCESS
1490 WIDE DEFLECTION WALL
APPROACH SLAB
STEEL STAIR ACCESS
TOP OF RAIL

- NOTES:**
- FOR GENERAL NOTES REFER TO DRG Nos 11-S-169-0004 AND 11-S-169-0005
 - CHAINAGES SHOWN ARE ALONG ARMADALE DOWN TRACK CENTER LINE

PLAN - LINEWIDE - VIADUCT
SCALE 1 : 250

DEVELOPED ELEVATION - LINEWIDE - VIADUCT
SCALE 1 : 250

LINTEL OPENING TO RECEIVE RUNOFF TO DOWNPIPE (EMERGENCY OVERFLOWS AT SELECT LOCATIONS FOR MAJOR EVENT MANAGEMENT)

DOWNPIPE DISCHARGE EITHER TO SCOUR PROTECTED CHANNEL OR SURCHARGE PIT IN CHANNEL

DIRECTION OF FLOW OF VIADUCT DRAINAGE

LINEWIDE DRAINAGE (OPEN CHANNEL)

OUTLET FROM VIADUCT DRAINAGE (ABOVE) TO GROUND LEVEL DRAINAGE (LINEWIDE)

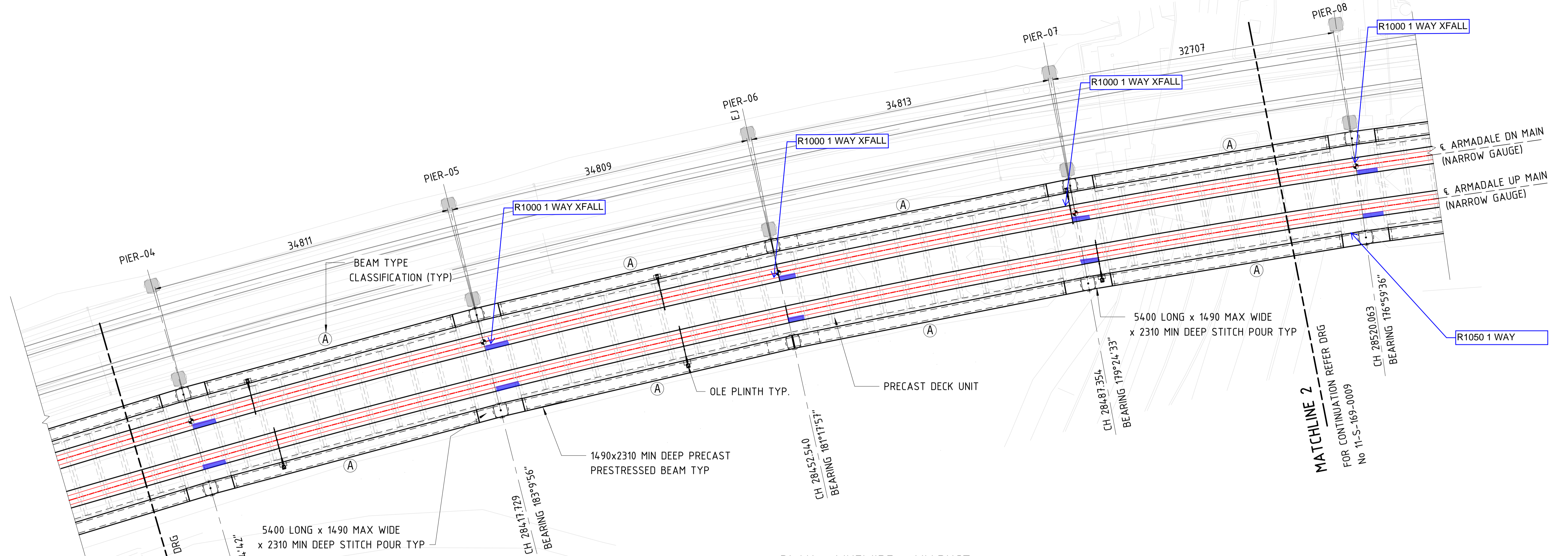
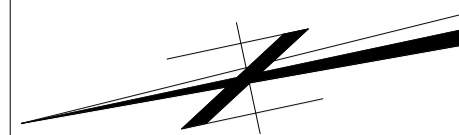
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ISSUED FOR INFORMATION



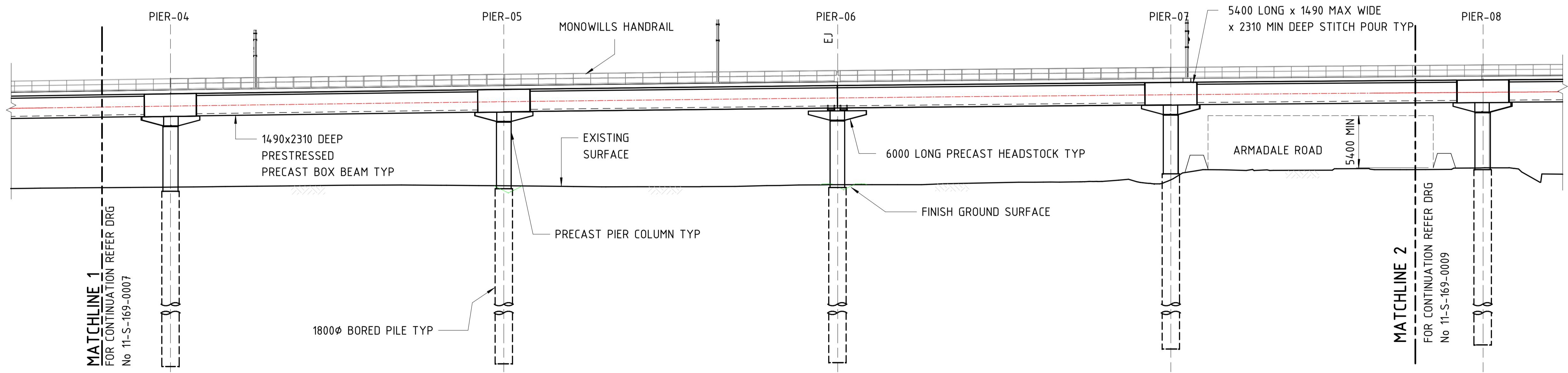
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DATUM	
HORIZONTAL:	PCG2020
VERTICAL:	AHD71

WORK IN PROGRESS	
DESIGNED	L.SCHOOF
DRAWN	T.NGAN
CHECKED	T.FORD
APPROVED	
DATE	

INTERIM DETAILED DESIGN	
BYFORD RAIL EXTENSION	
LINEWIDE VIADUCT	
STRUCTURAL	
GENERAL ARRANGEMENT PLAN & ELEVATION - SHEET 1	
PTA Drawing No:	11-S-169-0007
Rev:	B



PLAN - LINEWIDE - VIADUCT
SCALE 1 : 250



DEVELOPED ELEVATION - LINEWIDE - VIADUCT
SCALE 1 : 250

NOTES:

- FOR GENERAL NOTES REFER TO DRG Nos 11-S-169-0004 AND 11-S-169-0005
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SKETCH ONLY
ISSUED FOR INFORMATION



Contractor No: R30-DEA-DWG-ST-170-01011 | Rev: B

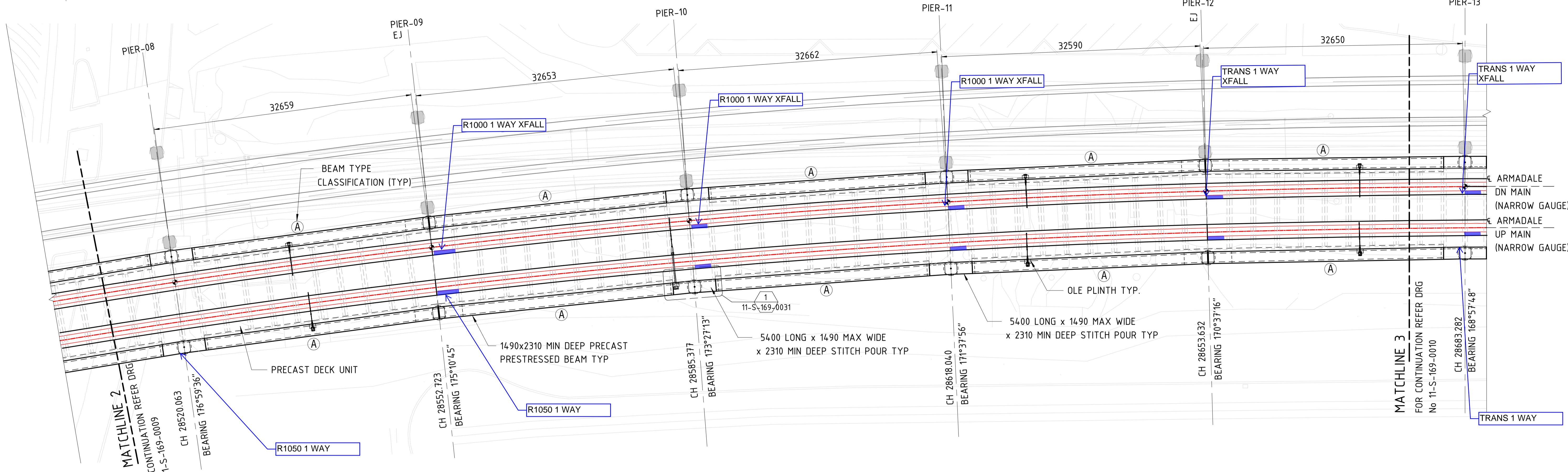
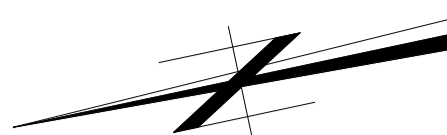
REFERENCES

WORK IN PROGRESS

INTERIM DETAILED DESIGN

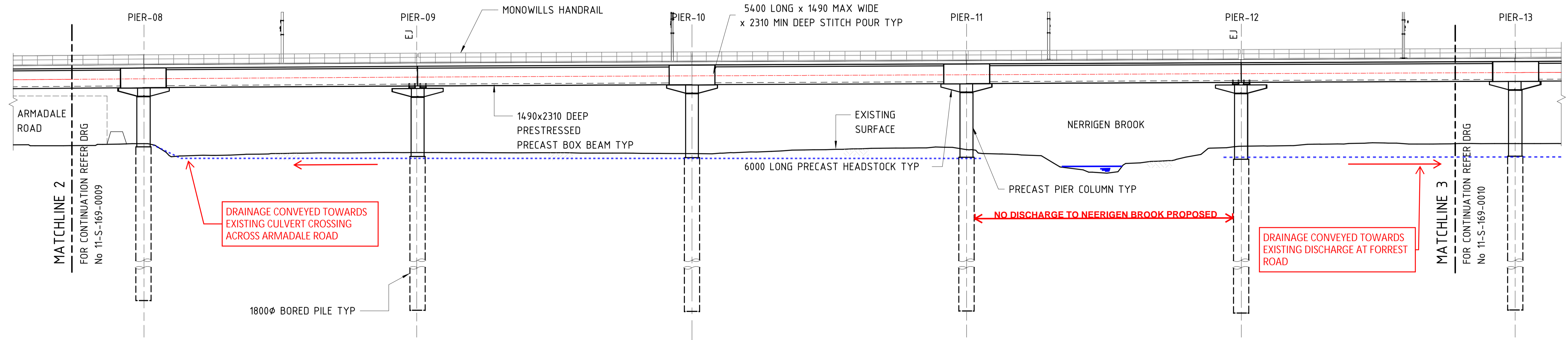
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DESIGNED	L.SCHOOF	
DRAWN	T.NGAN	
CHECKED	T.FORD	
APPROVED		
DATE		
DATUM		
HORIZONTAL:	PCG2020	
VERTICAL:	AHD71	

	BYFORD RAIL EXTENSION
	LINWIDE VIADUCT STRUCTURAL
GENERAL ARRANGEMENT PLAN & ELEVATION - SHEET 2	
PTA Drawing No: 11-S-169-0008	Rev: B



PLAN - LINEWIDE - VIADUCT

SCALE 1 : 250



DEVELOPED ELEVATION - LINEWIDE - VIADUCT

SCALE 1 : 250

NOTES:

- FOR GENERAL NOTES REFER TO DRG Nos 11-S-169-0004 AND 11-S-169-0005
- CHAINAGES SHOWN ARE ALONG ARMADALE DOWN TRACK CENTER LINE

SKETCH ONLY
ISSUED FOR INFORMATION



Contractor No: R30-DEA-DWG-ST-170-01012 Rev: B

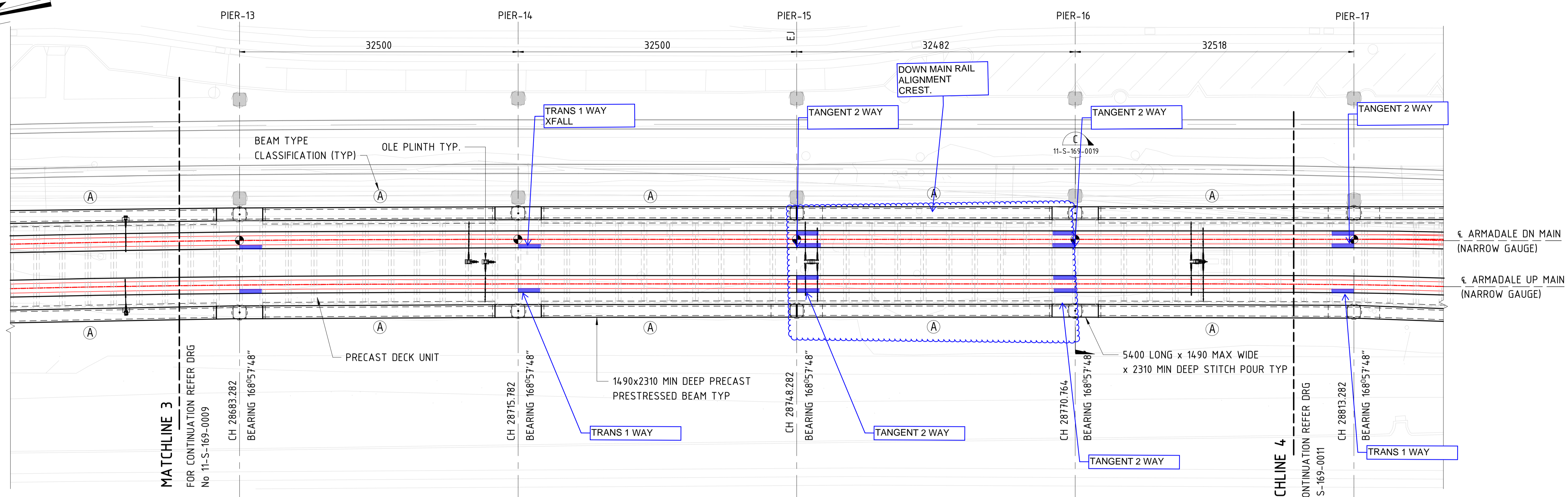
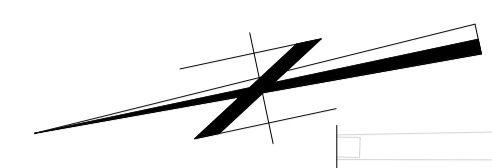
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WORK IN PROGRESS

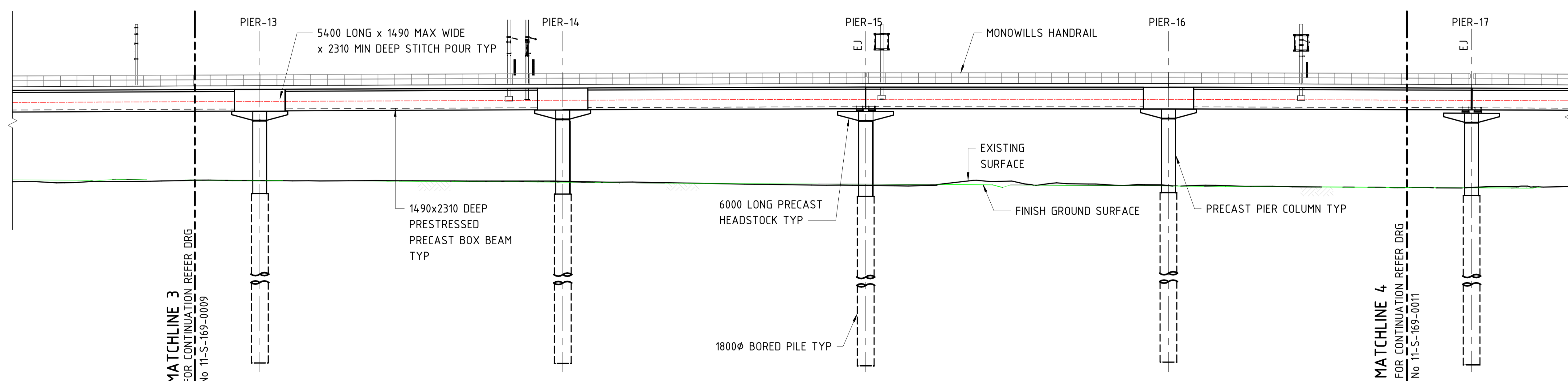
INTERIM DETAILED DESIGN

SCALE	1 : 250 (@ A1)
DESIGNED	L.SCHOOF
DRAWN	T.NGAN
CHECKED	T.FORD
APPROVED	
DATE	

	BYFORD RAIL EXTENSION
LINEWIDE VIADUCT	
STRUCTURAL	
GENERAL ARRANGEMENT PLAN & ELEVATION - SHEET 3	
PTA Drawing No: 11-S-169-0009	Rev: B



PLAN - LINEWIDE - VIADUCT
SCALE 1 : 250



DEVELOPED ELEVATION - LINEWIDE - VIADUCT
SCALE 1 : 250

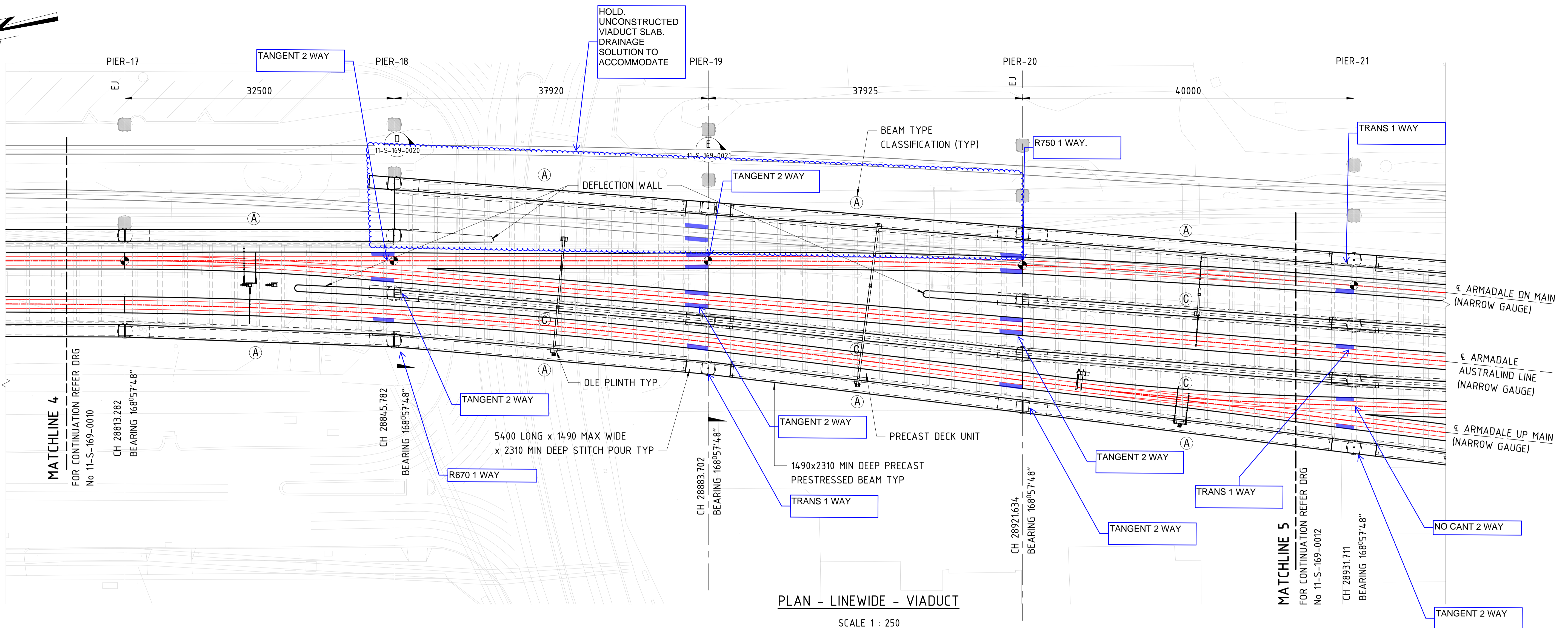
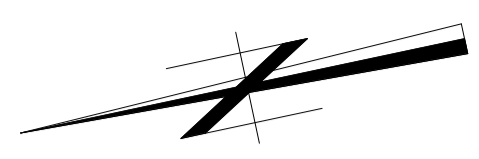
- NOTES:
- FOR GENERAL NOTES REFER TO DRG Nos 11-S-169-0004 AND 11-S-169-0005
 - CHAINAGES SHOWN ARE ALONG ARMADALE DOWN TRACK CENTER LINE

SKETCH ONLY
ISSUED FOR INFORMATION



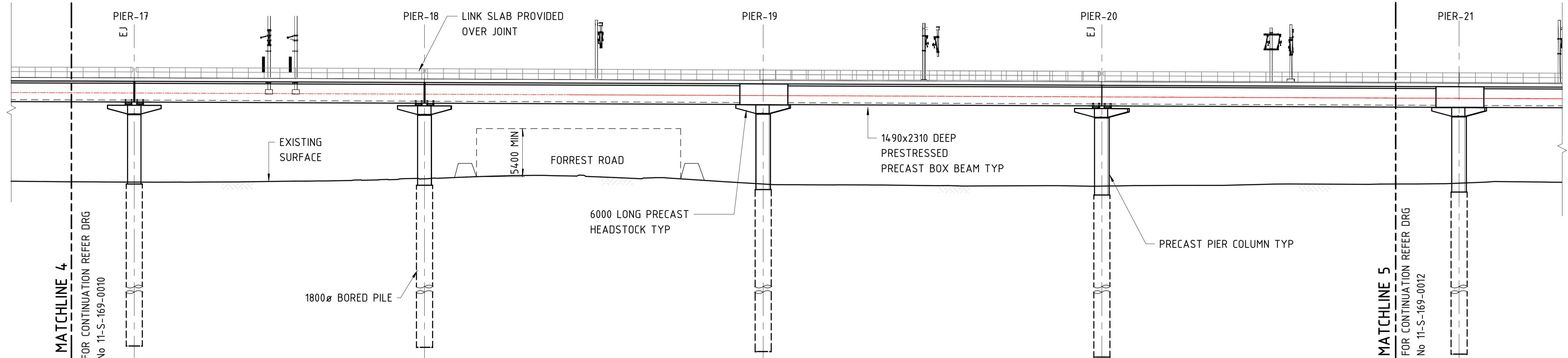
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WORK IN PROGRESS		INTERIM DETAILED DESIGN	
SCALE	DESIGNED	L.SCHOOF	
1 : 250 (@ A1)	DRAWN	T.NGAN	
DATUM	CHECKED	T.FORD	
HORIZONTAL: PCG2020	APPROVED		
VERTICAL: AHD71	DATE		
		BYFORD RAIL EXTENSION	
		LINEWIDE VIADUCT	
		STRUCTURAL	
		GENERAL ARRANGEMENT PLAN & ELEVATION - SHEET 4	
		PTA Drawing No: 11-S-169-0010 Rev: B	



PLAN - LINEWIDE - VIADUCT

SCALE 1 : 250



DEVELOPED ELEVATION - LINEWIDE - VIADUCT

SCALE 1 : 250

- NOTES:
- FOR GENERAL NOTES REFER TO DRG Nos 11-S-169-0004 AND 11-S-169-0005
 - CHAINAGES SHOWN ARE ALONG ARMADALE DOWN TRACK CENTER LINE

SKETCH ONLY
ISSUED FOR INFORMATION

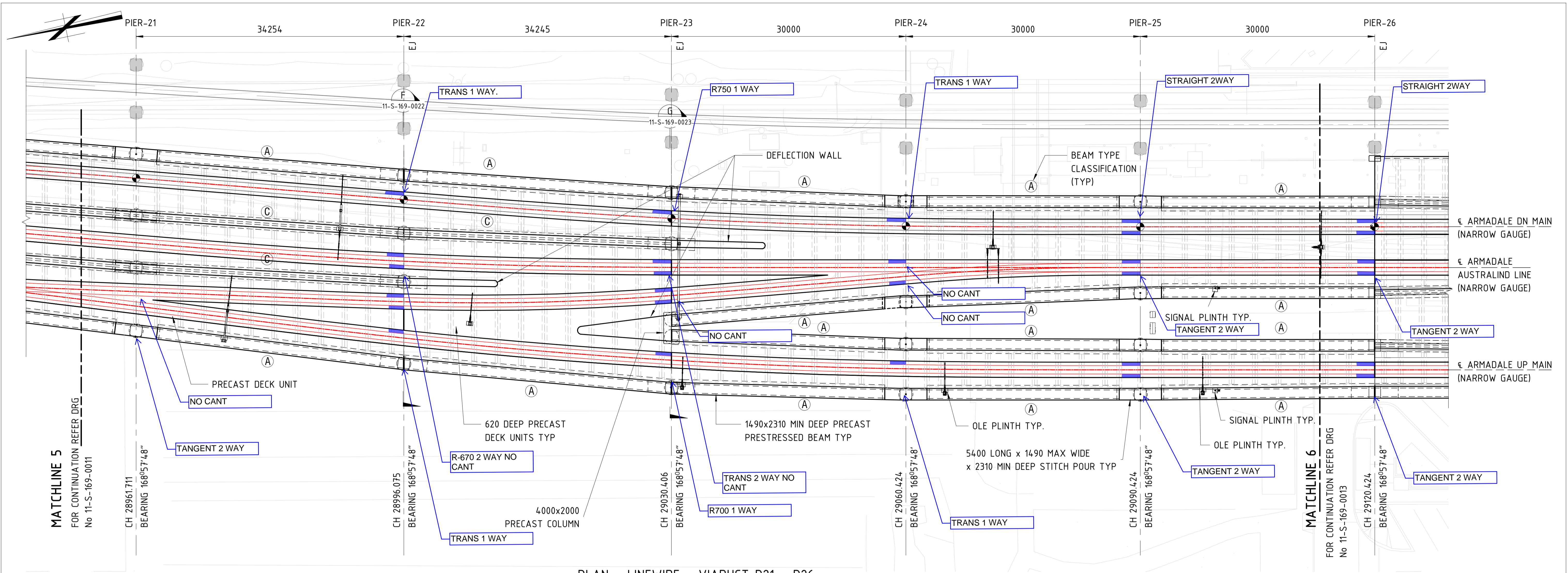


Contractor No: R30-DEA-DWG-ST-170-01014 | Rev. B

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DATUM	
HORIZONTAL:	PCG2020
VERTICAL:	AHD71

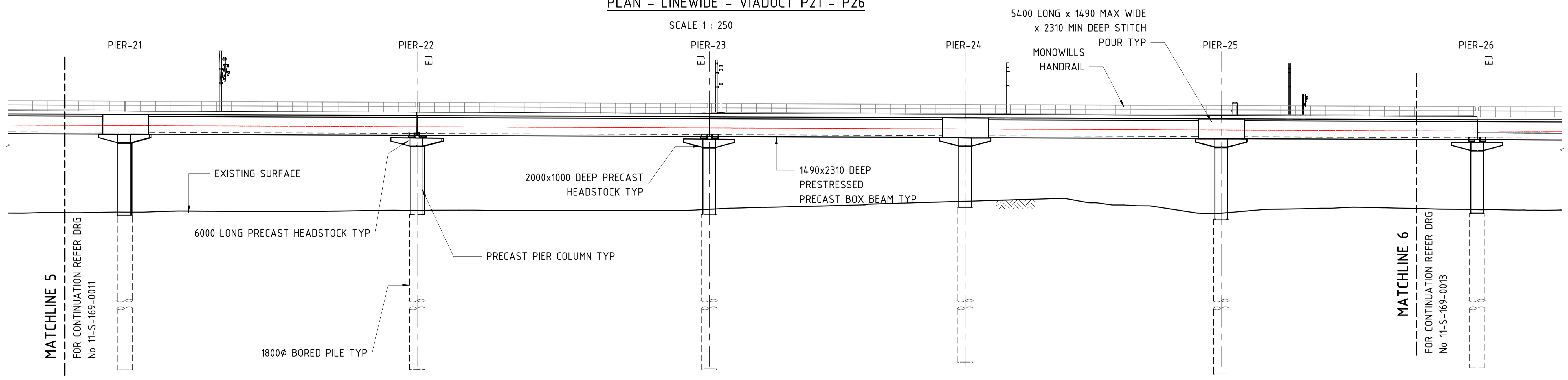
WORK IN PROGRESS	
DESIGNED	L.SCHOOF
DRAWN	T.NGAN
CHECKED	T.FORD
APPROVED	
DATE	

INTERIM DETAILED DESIGN	
Government of Western Australia Public Transport Authority	
BYFORD RAIL EXTENSION	
LINEWIDE VIADUCT STRUCTURAL	
GENERAL ARRANGEMENT PLAN & ELEVATION - SHEET 5	
PTA Drawing No:	11-S-169-0011
Rev:	B



PLAN - LINEWIDE - VIADUCT P21 - P26

SCALE 1 : 250



DEVELOPED ELEVATION - LINEWIDE - VIADUCT

SCALE 1 : 250

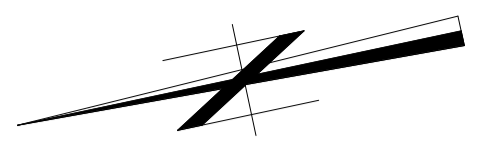
- NOTES:
- FOR GENERAL NOTES REFER TO DRG Nos 11-S-169-0004 AND 11-S-169-0005
 - CHAINAGES SHOWN ARE ALONG ARMADALE DOWN TRACK CENTER LINE

SKETCH ONLY
ISSUED FOR INFORMATION

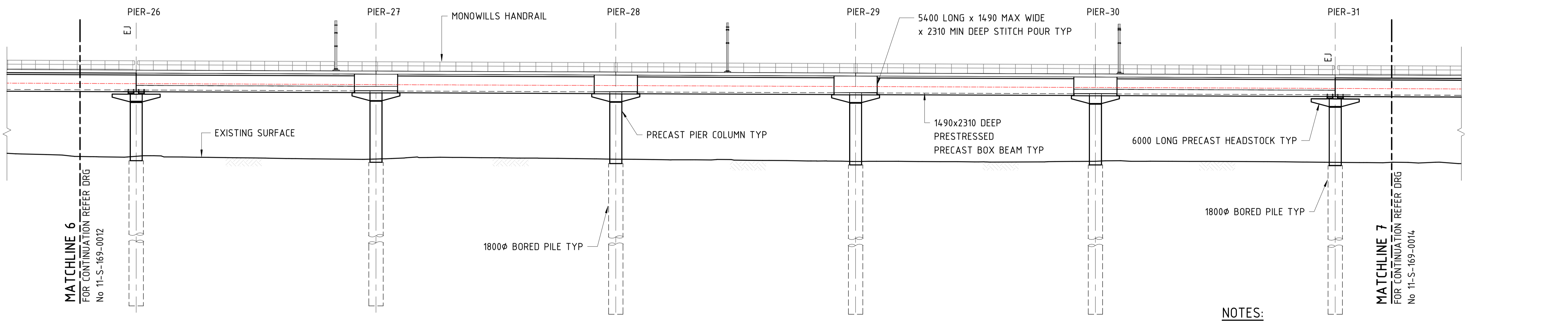
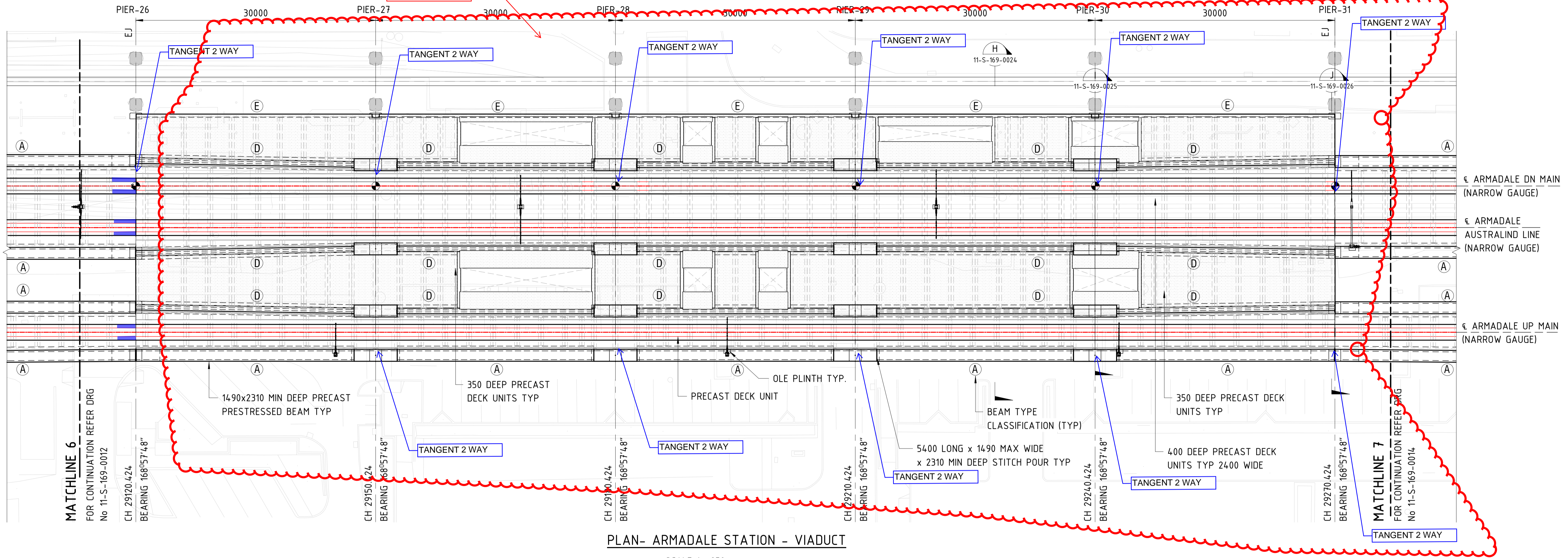


Contractor No: R30-DEA-DWG-ST-170-01015 | Rev: B

REFERENCES	SCALE		DESIGNED		L.SCHOOF
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HORIZONTAL: PCG2020	DATE		CHECKED		T.FORD
	VERTICAL: AHD71		APPROVED		
<p>WORK IN PROGRESS</p>			<p>INTERIM DETAILED DESIGN</p>		
<p>Government of Western Australia Public Transport Authority</p>			<p>BYFORD RAIL EXTENSION</p>		
<p>LINWIDE VIADUCT STRUCTURAL</p>			<p>GENERAL ARRANGEMENT PLAN & ELEVATION - SHEET 6</p>		
<p>PTA Drawing No: 11-S-169-0012</p>			<p>Rev: B</p>		



STATION PRECINCT
AREA INDICATIVE
ONLY, REFER TO
STATION PRECINCT
PACKAGE FOR
DETAILS.

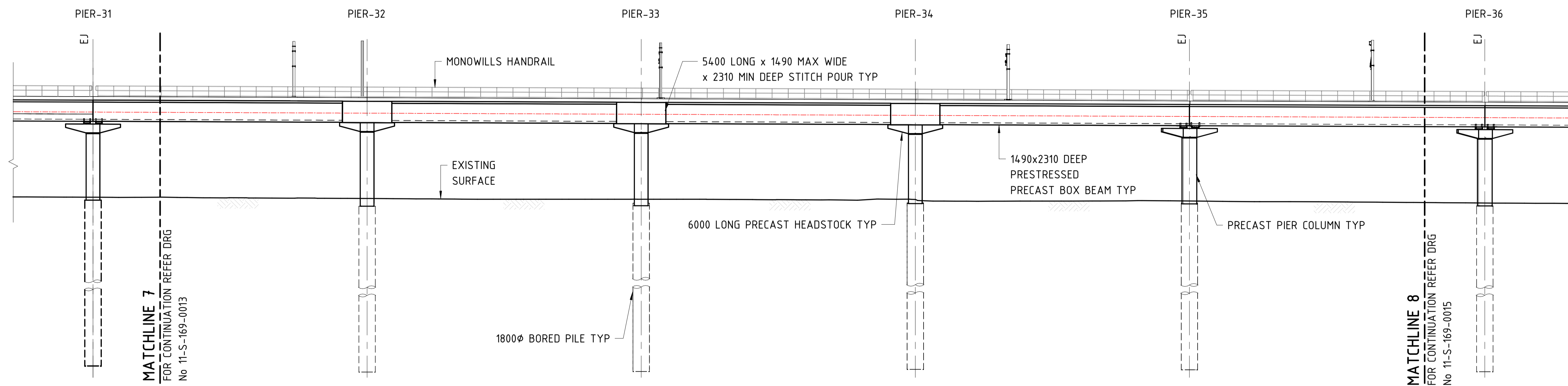
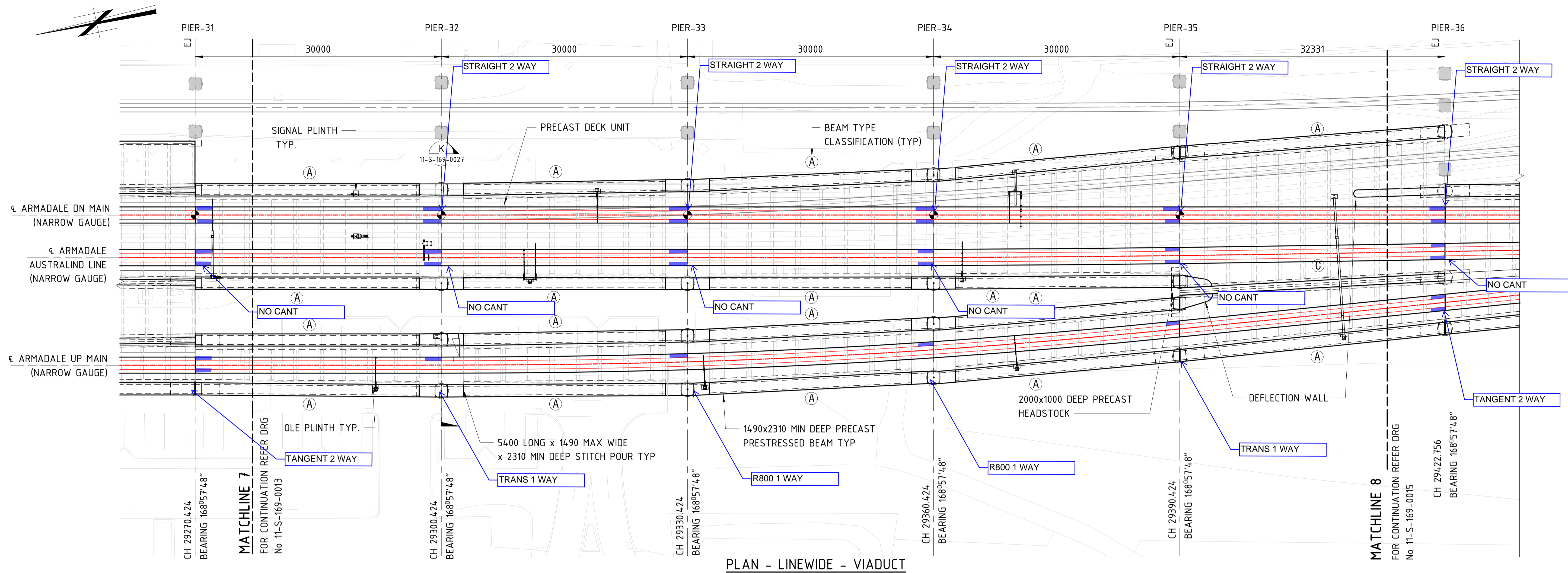


- NOTES:
- FOR GENERAL NOTES REFER TO DRG Nos 11-S-169-0004 AND 11-S-169-0005
 - CHAINAGES SHOWN ARE ALONG ARMADALE DOWN TRACK CENTER LINE

SKETCH ONLY
ISSUED FOR INFORMATION



REFERENCES	WORK IN PROGRESS		INTERIM DETAILED DESIGN	
	SCALE	DESIGNED	L.SCHOOF	
	1 : 250 (@ A1)	DRAWN	T.NGAN	
		CHECKED	T.FORD	
DATUM		APPROVED		
HORIZONTAL:	PCG2020	DATE		
VERTICAL:	AHD71			
			Government of Western Australia Public Transport Authority BYFORD RAIL EXTENSION LINELINE VIADUCT STRUCTURAL GENERAL ARRANGEMENT PLAN & ELEVATION - SHEET 7 PTA Drawing No: 11-S-169-0013 Rev: B	



NOTES:

- FOR GENERAL NOTES REFER TO DRG Nos 11-S-169-0004 AND 11-S-169-0005
- CHAINAGES SHOWN ARE ALONG ARMADALE DOWN TRACK CENTER LINE

SKETCH ONLY
ISSUED FOR INFORMATION



Contractor No: R30-DEA-DWG-ST-170-01017 | Rev. B

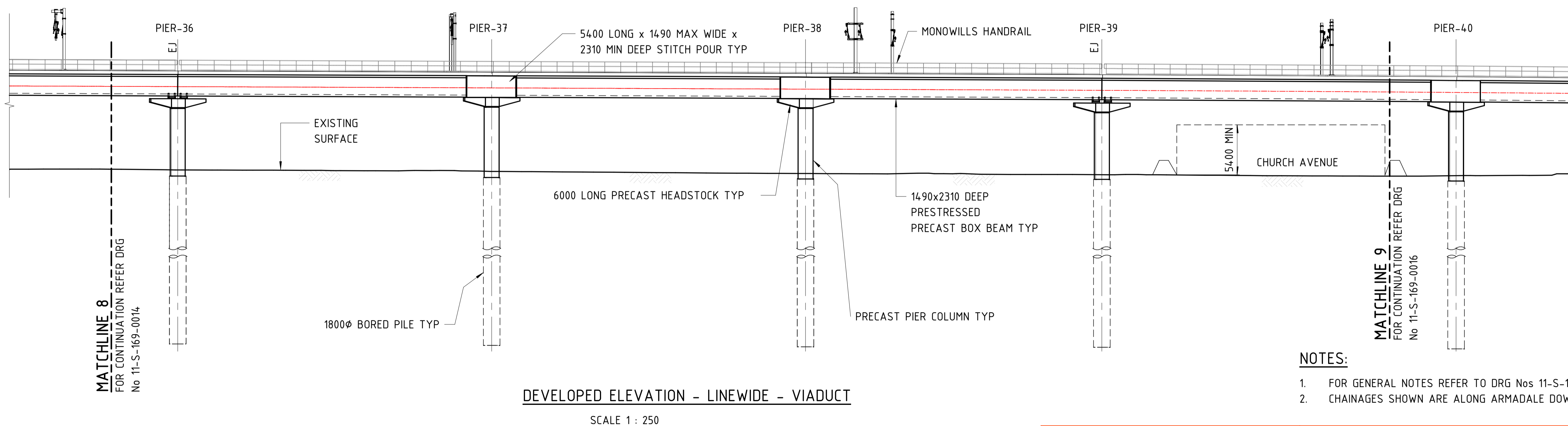
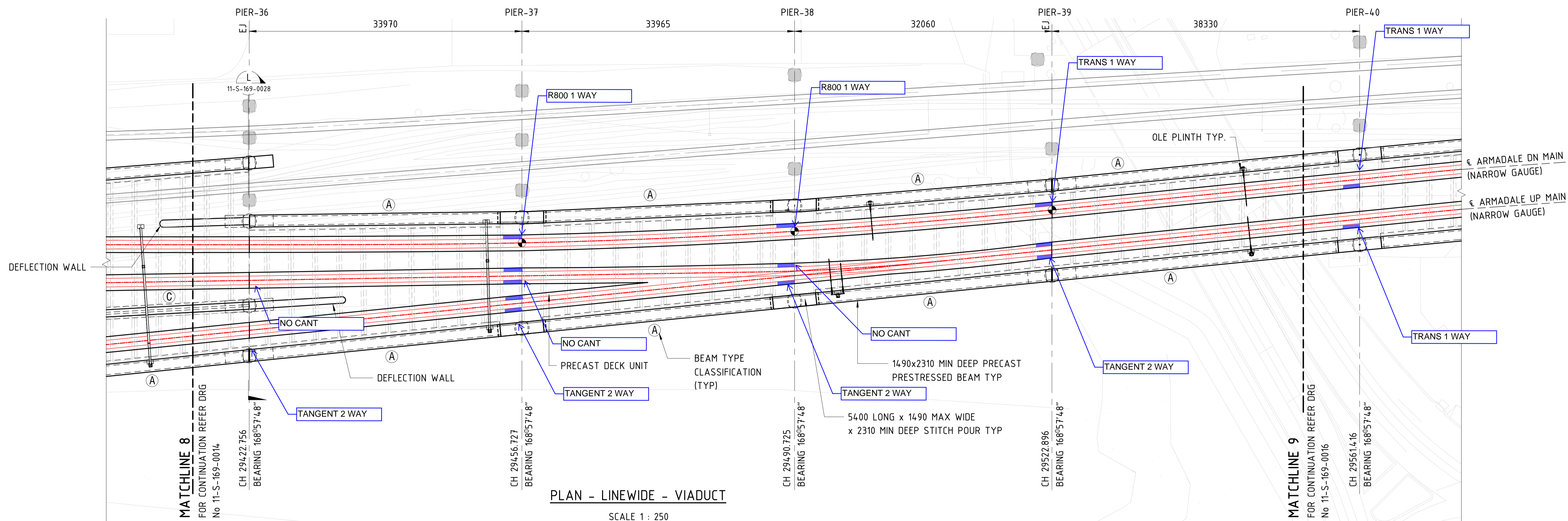
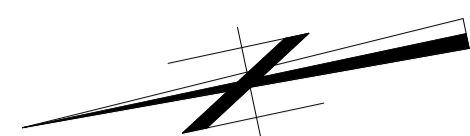
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INTERIM DETAILED DESIGN

SCALE	1 : 250	(@ A1)
DESIGNED	L.SCHOOF	
DRAWN	T.NGAN	
CHECKED	T.FORD	
APPROVED		
DATE		

	BYFORD RAIL EXTENSION
	LINWIDE VIADUCT STRUCTURAL
GENERAL ARRANGEMENT PLAN & ELEVATION - SHEET 8	
PTA Drawing No: 11-S-169-0014	Rev: B



- NOTES:**
- FOR GENERAL NOTES REFER TO DRG Nos 11-S-169-0004 AND 11-S-169-0005
 - CHAINAGES SHOWN ARE ALONG ARMADALE DOWN TRACK CENTER LINE

SKETCH ONLY
ISSUED FOR INFORMATION



Contractor No: R30-DEA-DWG-ST-170-01018 | Rev: B

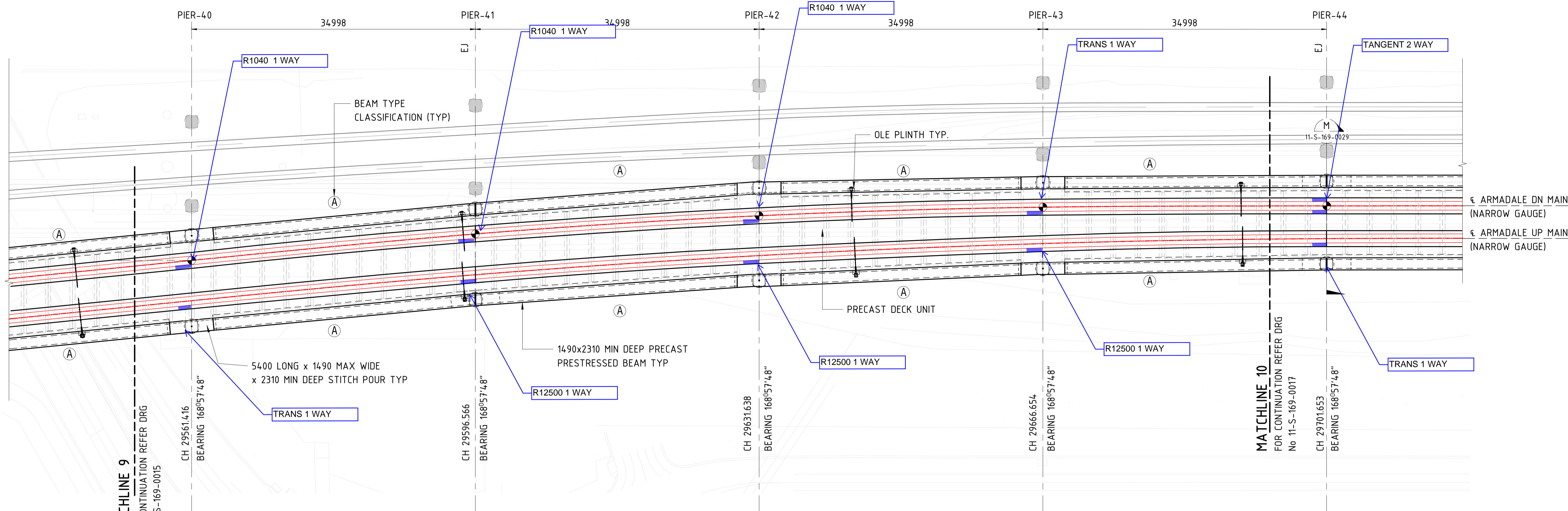
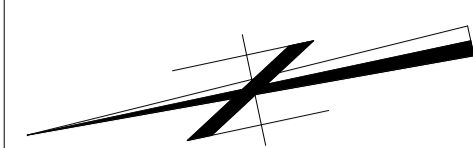
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INTERIM DETAILED DESIGN

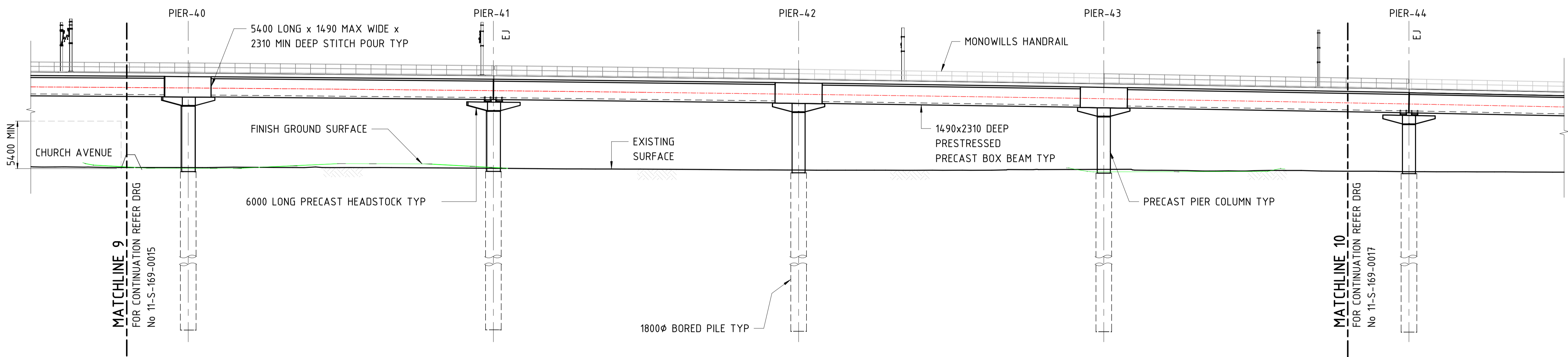
SCALE	1 : 250 (@ A1)
DESIGNED	L.SCHOOF
DRAWN	T.NGAN
CHECKED	T.FORD
DATUM	
HORIZONTAL:	PCG2020
VERTICAL:	AHD71
APPROVED	
DATE	

	BYFORD RAIL EXTENSION
LINEWIDE VIADUCT	
STRUCTURAL	
GENERAL ARRANGEMENT PLAN & ELEVATION - SHEET 9	
PTA Drawing No: 11-S-169-0015	Rev: B



PLAN - LINEWIDE - VIADUCT

SCALE 1 : 250



DEVELOPED ELEVATION - LINEWIDE - VIADUCT

SCALE 1 : 250

- NOTES:
- FOR GENERAL NOTES REFER TO DRG Nos 11-S-169-0004 AND 11-S-169-0005
 - CHAINAGES SHOWN ARE ALONG ARMADALE DOWN TRACK CENTER LINE

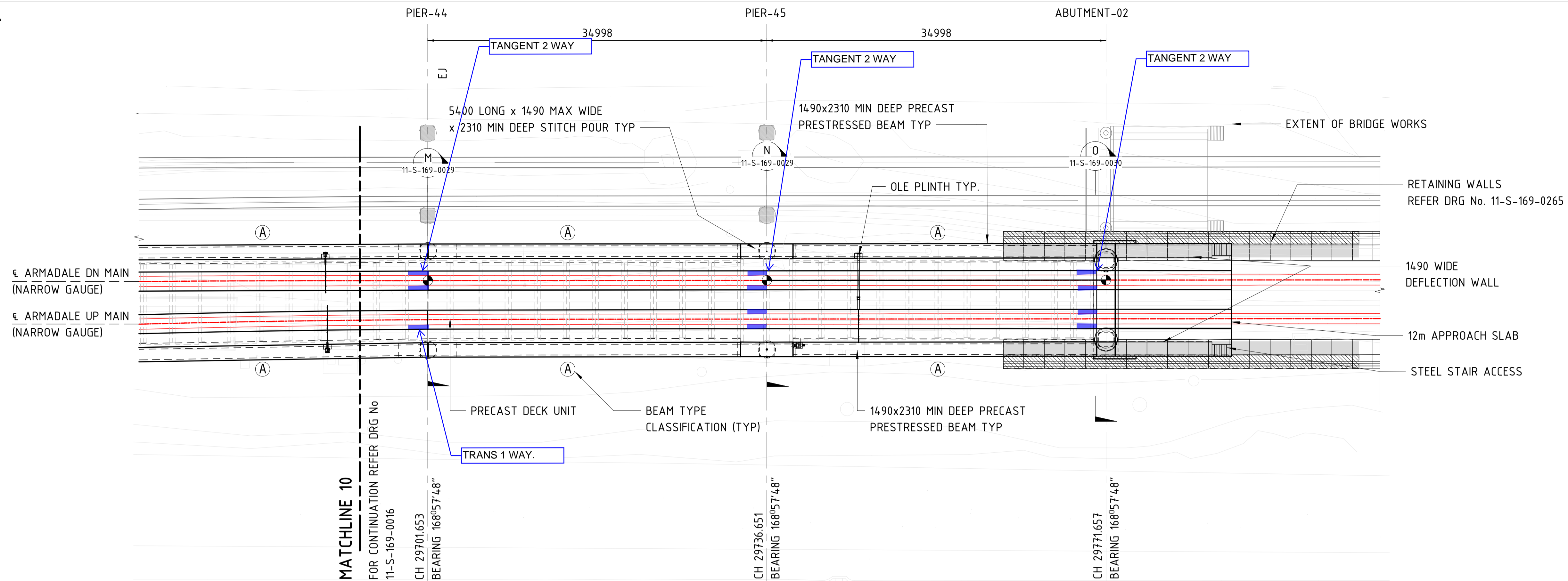
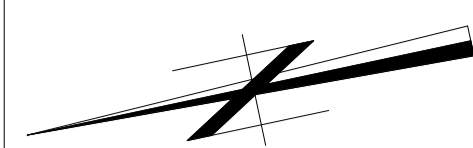
SKETCH ONLY
ISSUED FOR INFORMATION



Contractor No: R30-DEA-DWG-ST-170-01019 | Rev: B

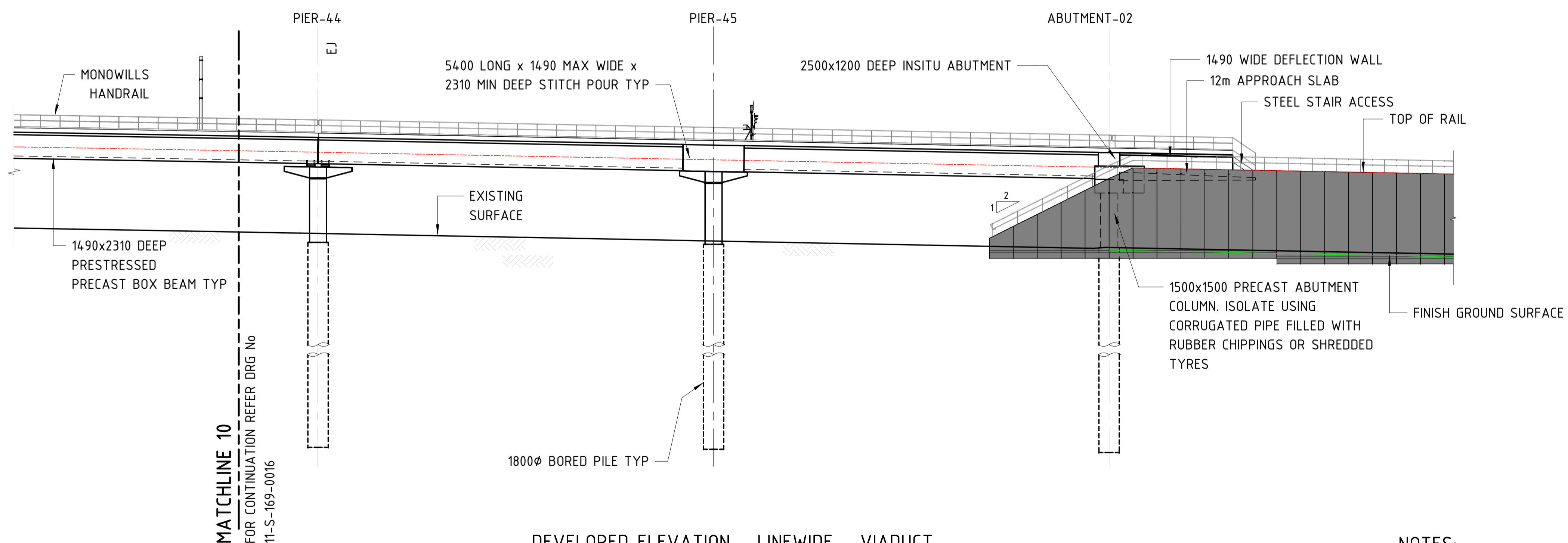
REFERENCES	SCALE	DESIGNED	L.SCHOOF
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DATE	DATUM	CHECKED	T.FORD
	HORIZONTAL: PCG2020	APPROVED	
	VERTICAL: AHD71	DATE	

WORK IN PROGRESS	INTERIM DETAILED DESIGN
BYFORD RAIL EXTENSION	
LINEWIDE VIADUCT	
STRUCTURAL	
GENERAL ARRANGEMENT PLAN & ELEVATION - SHEET 10	
PTA Drawing No: 11-S-169-0016	Rev: B



PLAN - LINEWIDE - VIADUCT

SCALE 1 : 250



DEVELOPED ELEVATION - LINEWIDE - VIADUCT

SCALE 1 : 250

NOTES:

- FOR GENERAL NOTES REFER TO DRG Nos 11-S-169-0004 AND 11-S-169-0005
- CHAINAGES SHOWN ARE ALONG ARMADALE DOWN TRACK CENTER LINE

SKETCH ONLY
ISSUED FOR INFORMATION



Contractor No: R30-DEA-DWG-ST-170-01020 Rev: B

REFERENCES

WORK IN PROGRESS

INTERIM DETAILED DESIGN

SCALE	1 : 250	(@ A1)
DESIGNED	L.SCHOOF	
DRAWN	T.NGAN	
CHECKED	T.FORD	
APPROVED		
DATE		
DATUM		
HORIZONTAL:	PCG2020	
VERTICAL:	AHD71	

	BYFORD RAIL EXTENSION
	LINEWIDE VIADUCT STRUCTURAL
GENERAL ARRANGEMENT PLAN & ELEVATION - SHEET 11	
PTA Drawing No: 11-S-169-0017	Rev: B

BYFORD RAIL EXTENSION (BRE)

LINEWIDE - PERMANENT WAY - EARTHWORKS AND DRAINAGE

DRAWING NUMBER		DRAWING TITLE
PTA	MetCONNX	
GENERAL DRAWINGS		
11-C-04-0051	R30-MET-DWG-CI-155-00001	LINEWIDE - EARTHWORKS AND DRAINAGE - COVER SHEET AND DRAWING INDEX
11-C-04-0055	R30-MET-DWG-CI-155-00010	LINEWIDE - EARTHWORKS AND DRAINAGE - LOCALITY PLAN
TYPICAL CROSS SECTIONS		
11-C-12-0025	R30-MET-DWG-CI-155-00101	LINEWIDE - EARTHWORKS AND DRAINAGE - TYPICAL SECTIONS - SHEET 1
11-C-12-0026	R30-MET-DWG-CI-155-00102	LINEWIDE - EARTHWORKS AND DRAINAGE - TYPICAL SECTIONS - SHEET 2
11-C-12-0027	R30-MET-DWG-CI-155-00103	LINEWIDE - EARTHWORKS AND DRAINAGE - TYPICAL SECTIONS - SHEET 3
11-C-12-0028	R30-MET-DWG-CI-155-00104	LINEWIDE - EARTHWORKS AND DRAINAGE - TYPICAL SECTIONS - SHEET 4
11-C-12-0029	R30-MET-DWG-CI-155-00105	LINEWIDE - EARTHWORKS AND DRAINAGE - TYPICAL SECTIONS - SHEET 5
11-C-12-0030	R30-MET-DWG-CI-155-00106	LINEWIDE - EARTHWORKS AND DRAINAGE - TYPICAL SECTIONS - SHEET 6
11-C-12-0031	R30-MET-DWG-CI-155-00107	LINEWIDE - EARTHWORKS AND DRAINAGE - TYPICAL SECTIONS - SHEET 7
11-C-12-0032	R30-MET-DWG-CI-155-00108	LINEWIDE - EARTHWORKS AND DRAINAGE - TYPICAL SECTIONS - SHEET 8
11-C-12-0033	R30-MET-DWG-CI-155-00109	LINEWIDE - EARTHWORKS AND DRAINAGE - TYPICAL SECTIONS - SHEET 9
11-C-12-0034	R30-MET-DWG-CI-155-00110	LINEWIDE - EARTHWORKS AND DRAINAGE - TYPICAL SECTIONS - SHEET 10
11-C-12-0035	R30-MET-DWG-CI-155-00111	LINEWIDE - EARTHWORKS AND DRAINAGE - TYPICAL SECTIONS - SHEET 11
DETAILED SECTIONS		
11-C-12-0036	R30-MET-DWG-CI-155-00112	LINEWIDE - EARTHWORKS AND DRAINAGE - DETAILED SECTIONS - SHEET 1
11-C-12-0037	R30-MET-DWG-CI-155-00113	LINEWIDE - EARTHWORKS AND DRAINAGE - DETAILED SECTIONS - SHEET 2
11-C-12-0038	R30-MET-DWG-CI-155-00114	LINEWIDE - EARTHWORKS AND DRAINAGE - DETAILED SECTIONS - SHEET 3
11-C-12-0039	R30-MET-DWG-CI-155-00115	LINEWIDE - EARTHWORKS AND DRAINAGE - DETAILED SECTIONS - SHEET 4
GENERAL ARRANGEMENT PLANS		
11-C-15-0135	R30-MET-DWG-CI-155-00201	LINEWIDE - EARTHWORKS AND DRAINAGE - GENERAL ARRANGEMENT PLAN - SHEET 1
11-C-15-0136	R30-MET-DWG-CI-155-00202	LINEWIDE - EARTHWORKS AND DRAINAGE - GENERAL ARRANGEMENT PLAN - SHEET 2
11-C-15-0137	R30-MET-DWG-CI-155-00203	LINEWIDE - EARTHWORKS AND DRAINAGE - GENERAL ARRANGEMENT PLAN - SHEET 3
11-C-15-0138	R30-MET-DWG-CI-155-00204	LINEWIDE - EARTHWORKS AND DRAINAGE - GENERAL ARRANGEMENT PLAN - SHEET 4
11-C-15-0139	R30-MET-DWG-CI-155-00205	LINEWIDE - EARTHWORKS AND DRAINAGE - GENERAL ARRANGEMENT PLAN - SHEET 5
11-C-15-0140	R30-MET-DWG-CI-155-00206	LINEWIDE - EARTHWORKS AND DRAINAGE - GENERAL ARRANGEMENT PLAN - SHEET 6
11-C-15-0141	R30-MET-DWG-CI-155-00207	LINEWIDE - EARTHWORKS AND DRAINAGE - GENERAL ARRANGEMENT PLAN - SHEET 7
11-C-15-0142	R30-MET-DWG-CI-155-00208	LINEWIDE - EARTHWORKS AND DRAINAGE - GENERAL ARRANGEMENT PLAN - SHEET 8
11-C-15-0143	R30-MET-DWG-CI-155-00209	LINEWIDE - EARTHWORKS AND DRAINAGE - GENERAL ARRANGEMENT PLAN - SHEET 9
11-C-15-0144	R30-MET-DWG-CI-155-00210	LINEWIDE - EARTHWORKS AND DRAINAGE - GENERAL ARRANGEMENT PLAN - SHEET 10
11-C-15-0145	R30-MET-DWG-CI-155-00211	LINEWIDE - EARTHWORKS AND DRAINAGE - GENERAL ARRANGEMENT PLAN - SHEET 11
11-C-15-0146	R30-MET-DWG-CI-155-00212	LINEWIDE - EARTHWORKS AND DRAINAGE - GENERAL ARRANGEMENT PLAN - SHEET 12
11-C-15-0147	R30-MET-DWG-CI-155-00213	LINEWIDE - EARTHWORKS AND DRAINAGE - GENERAL ARRANGEMENT PLAN - SHEET 13
11-C-15-0148	R30-MET-DWG-CI-155-00214	LINEWIDE - EARTHWORKS AND DRAINAGE - GENERAL ARRANGEMENT PLAN - SHEET 14
11-C-15-0149	R30-MET-DWG-CI-155-00215	LINEWIDE - EARTHWORKS AND DRAINAGE - GENERAL ARRANGEMENT PLAN - SHEET 15
11-C-15-0150	R30-MET-DWG-CI-155-00216	LINEWIDE - EARTHWORKS AND DRAINAGE - GENERAL ARRANGEMENT PLAN - SHEET 16
DRAINAGE PLANS		
11-C-23-0075	R30-MET-DWG-CI-155-00401	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE PLAN - SHEET 1
11-C-23-0076	R30-MET-DWG-CI-155-00402	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE PLAN - SHEET 2
11-C-23-0077	R30-MET-DWG-CI-155-00403	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE PLAN - SHEET 3
11-C-23-0078	R30-MET-DWG-CI-155-00404	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE PLAN - SHEET 4
11-C-23-0079	R30-MET-DWG-CI-155-00405	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE PLAN - SHEET 5
11-C-23-0080	R30-MET-DWG-CI-155-00406	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE PLAN - SHEET 6
11-C-23-0081	R30-MET-DWG-CI-155-00407	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE PLAN - SHEET 7
11-C-23-0082	R30-MET-DWG-CI-155-00408	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE PLAN - SHEET 8
11-C-23-0083	R30-MET-DWG-CI-155-00409	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE PLAN - SHEET 9
11-C-23-0084	R30-MET-DWG-CI-155-00410	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE PLAN - SHEET 10
11-C-23-0085	R30-MET-DWG-CI-155-00411	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE PLAN - SHEET 11
11-C-23-0086	R30-MET-DWG-CI-155-00412	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE PLAN - SHEET 12

DRAWING NUMBER		DRAWING TITLE
PTA	MetCONNX	
DRAINAGE PLANS		
11-C-23-0087	R30-MET-DWG-CI-155-00413	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE PLAN - SHEET 13
11-C-23-0088	R30-MET-DWG-CI-155-00414	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE PLAN - SHEET 14
11-C-23-0089	R30-MET-DWG-CI-155-00415	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE PLAN - SHEET 15
11-C-23-0090	R30-MET-DWG-CI-155-00416	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE PLAN - SHEET 16
11-C-23-0091	R30-MET-DWG-CI-155-00421	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE BASIN DETAILS - SHEET 1
11-C-23-0092	R30-MET-DWG-CI-155-00422	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE BASIN DETAILS - SHEET 2
11-C-23-0093	R30-MET-DWG-CI-155-00423	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE BASIN DETAILS - SHEET 3
11-C-23-0094	R30-MET-DWG-CI-155-00424	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE BASIN DETAILS - SHEET 4
DRAINAGE PROFILES		
11-C-23-0096	R30-MET-DWG-CI-155-00501	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE CULVERT SECTIONS - SHEET 1
11-C-23-0097	R30-MET-DWG-CI-155-00502	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE CULVERT SECTIONS - SHEET 2
11-C-23-0098	R30-MET-DWG-CI-155-00503	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE CULVERT SECTIONS - SHEET 3
11-C-23-0099	R30-MET-DWG-CI-155-00504	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE CULVERT SECTIONS - SHEET 4
11-C-23-0100	R30-MET-DWG-CI-155-00505	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE CULVERT SECTIONS - SHEET 5
11-C-23-0101	R30-MET-DWG-CI-155-00506	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE CULVERT SECTIONS - SHEET 6
11-C-23-0102	R30-MET-DWG-CI-155-00507	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE CULVERT SECTIONS - SHEET 7
11-C-23-0103	R30-MET-DWG-CI-155-00508	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE CULVERT SECTIONS - SHEET 8
11-C-23-0104	R30-MET-DWG-CI-155-00509	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE CULVERT SECTIONS - SHEET 9
11-C-23-0105	R30-MET-DWG-CI-155-00510	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE CULVERT SECTIONS - SHEET 10
11-C-23-0106	R30-MET-DWG-CI-155-00511	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE CULVERT SECTIONS - SHEET 11
11-C-23-0107	R30-MET-DWG-CI-155-00512	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE CULVERT SECTIONS - SHEET 12
TYPICAL FORMATION DETAILS		
11-C-12-0045	R30-MET-DWG-CI-155-00600	LINEWIDE - EARTHWORKS AND DRAINAGE - TYPICAL DETAILS - SHEET 1
11-C-12-0046	R30-MET-DWG-CI-155-00601	LINEWIDE - EARTHWORKS AND DRAINAGE - TYPICAL DETAILS - SHEET 2
11-C-12-0047	R30-MET-DWG-CI-155-00602	LINEWIDE - EARTHWORKS AND DRAINAGE - TYPICAL DETAILS - SHEET 3
11-C-12-0048	R30-MET-DWG-CI-155-00603	LINEWIDE - EARTHWORKS AND DRAINAGE - TYPICAL DETAILS - SHEET 4
11-C-12-0049	R30-MET-DWG-CI-155-00604	LINEWIDE - EARTHWORKS AND DRAINAGE - TYPICAL DETAILS - SHEET 5
DRAINAGE DETAILS		
11-C-23-0140	R30-MET-DWG-CI-155-00901	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE DETAILS - SHEET 1
11-C-23-0141	R30-MET-DWG-CI-155-00902	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE DETAILS - SHEET 2
DRAINAGE SCHEDULE		
11-C-23-0175	R30-MET-DWG-CI-155-00950	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE CULVERT SCHEDULE
11-C-23-0177	R30-MET-DWG-CI-155-00952	LINEWIDE - EARTHWORKS AND DRAINAGE - DRAINAGE STRUCTURES SCHEDULE

B	15/12/22	ISSUED FOR IDDR - PTA REVIEW	D.G.	J.Y.	N.T.	M.P.
A	22/07/22	ISSUED FOR RD - PTA REVIEW	D.G.	J.Y.	N.T.	M.P.
REV	DATE	AMENDMENT	DSN	DRN	CHK	APP
ORIG SIZE	0 10 20 30 40 50 100mm		This document must not be copied without PTA's written permission, and the contents thereof must not be imparted to a third party nor be used for any unauthorised purpose.			
A1	AT ORIGINAL PLOT SIZE		Contractor No: R30-MET-DWG-CI-155-00001 Rev: B			



REFERENCES	SCALE	DESIGNED	D. GLEASON
	N.T.S.	DRAWN	J. YANG
	DATUM	CHECKED	N. TAITO
	HORIZONTAL: PCG2020	APPROVED	M. PARKER
	VERTICAL: AHD71	DATE	15/12/22

DETAILED DESIGN

BYFORD RAIL EXTENSION	
LINEWIDE EARTHWORKS AND DRAINAGE COVER SHEET AND DRAWING INDEX	
PTA Drawing No:	11-C-04-0051
Rev:	B



NOTE
 1. REFER TO DRG No. 11-C-04-0051 FOR DRAWING INDEX.

LEGEND

- PROPOSED RAIL
- PROPOSED DRAINAGE PIPE
- EXISTING DRAINAGE PIPE
- PROPOSED FAUNA CROSSING
- PROPOSED DRAINAGE BASIN
- 11-C-0135 TO 11-C-0150 PTA DRAWING SUFFIX FOR GENERAL ARRANGEMENTS

KEY PLAN
 N.T.S.



CAUTION: FIBRE OPTIC CABLE IN VICINITY.
 CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE CABLE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.

CAUTION: HIGH PRESSURE GAS IN VICINITY.
 CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE PIPELINE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.

DETAILED DESIGN

BYFORD RAIL EXTENSION

LINEWIDE
EARTHWORKS AND DRAINAGE
LOCALITY PLAN
 PTA Drawing No: **11-C-04-0055** Rev: **B**

REV	DATE	AMENDMENT	DSN	DRN	CHK	APP
B	15/12/22	ISSUED FOR IDOR - PTA REVIEW	D.G.	J.Y.	N.T.	M.P.
A	22/07/22	ISSUED FOR RD - PTA REVIEW	D.G.	J.Y.	N.T.T.	M.P.

ORIG SIZE: **A1**

0 10 20 30 40 50 100mm

AT ORIGINAL PLOT SIZE

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Contractor No: R30-MET-DWG-CI-155-00010 | Rev: B

REFERENCES

R30-MET-XRF-TR-100-00110
 XR01GN_CAD_PCG2020
 R30-MET-XRF-CI-155-00101
 R30-MET-XRF-CI-155-00011
 R30-MET-XRF-CI-155-00012
 R30-MET-XRF-CI-155-00013
 R30-MET-XRF-CI-155-00021
 R30-MET-XRF-CI-155-00003

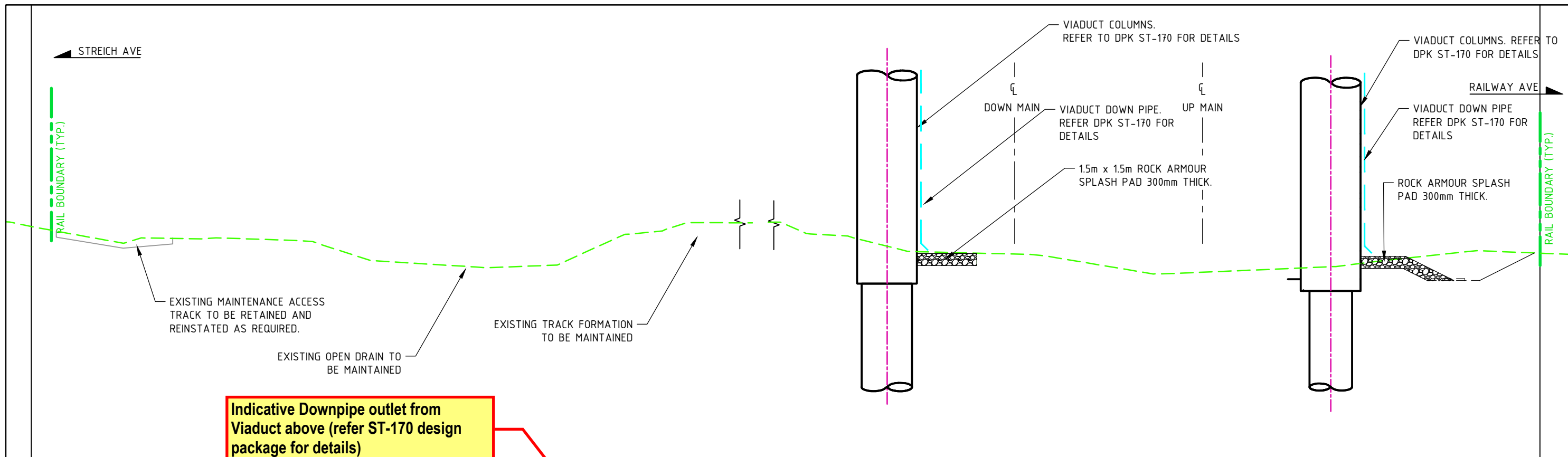
SCALE

N.T.S.

DATUM

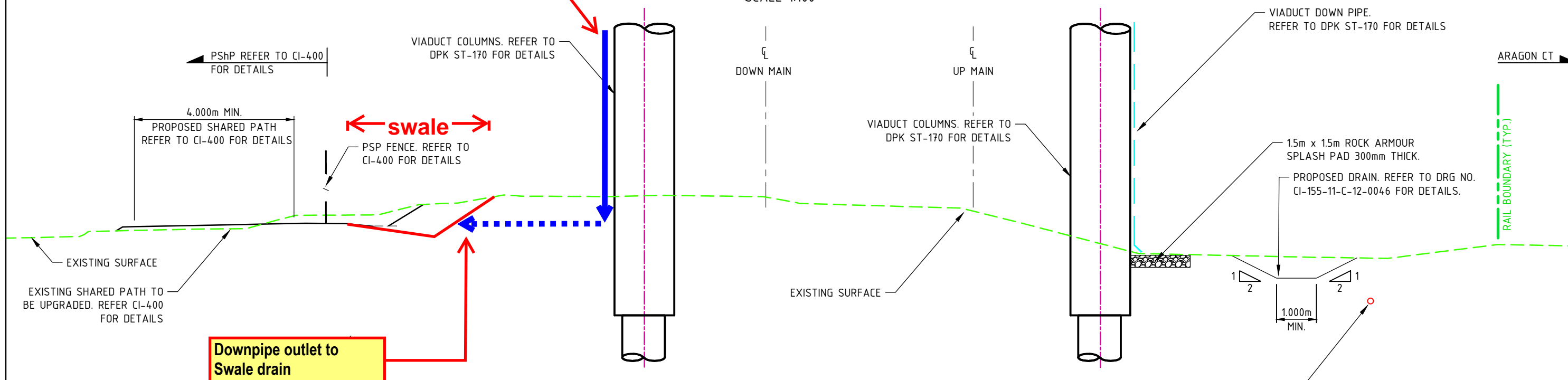
HORIZONTAL: PCG2020
 VERTICAL: AHD71

DESIGNED D. GLEASON
DRAWN J. YANG
CHECKED N. TAITO
APPROVED M. PARKER
DATE 15/12/22



Indicative Downpipe outlet from Viaduct above (refer ST-170 design package for details)

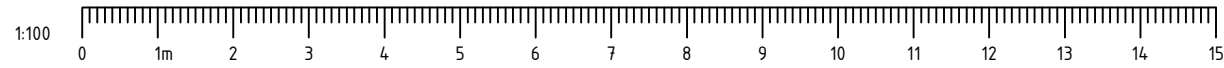
TYPICAL CROSS SECTION - NORTH ARMADALE ROAD (APPROX. CH 28300)
SCALE 1:100



Downpipe outlet to Swale drain

TYPICAL CROSS SECTION - NORTH FORREST ROAD (APPROX. CH 28700)
SCALE 1:100

- NOTES**
- REFER TO DRG NOS. 11-C-15-0135 TO 0150 FOR GENERAL ARRANGEMENT PLANS, LEGEND AND NOTES.
 - ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
 - VIADUCT DOWN PIPE COLLECTION POINT VIA SPLASH PAD OR SOAKWELL. LOCATIONS AND DETAILS TO BE COORDINATED FURTHER WITH LANDSCAPE PLANS WHICH ARE STILL IN DEVELOPMENT WITHIN PRECINCT PACKAGE



**SKETCH ONLY
ISSUED FOR INFORMATION**



Contractor No: R30-MET-DWG-CI-155-00104 Rev: B

REFERENCES	
SCALE	1:100
DATUM	
HORIZONTAL:	PCG2020
VERTICAL:	AHD71
DESIGNED	H. AMIN
DRAWN	P. WILKS
CHECKED	N. TAITO
APPROVED	M. PARKER
DATE	15/12/22

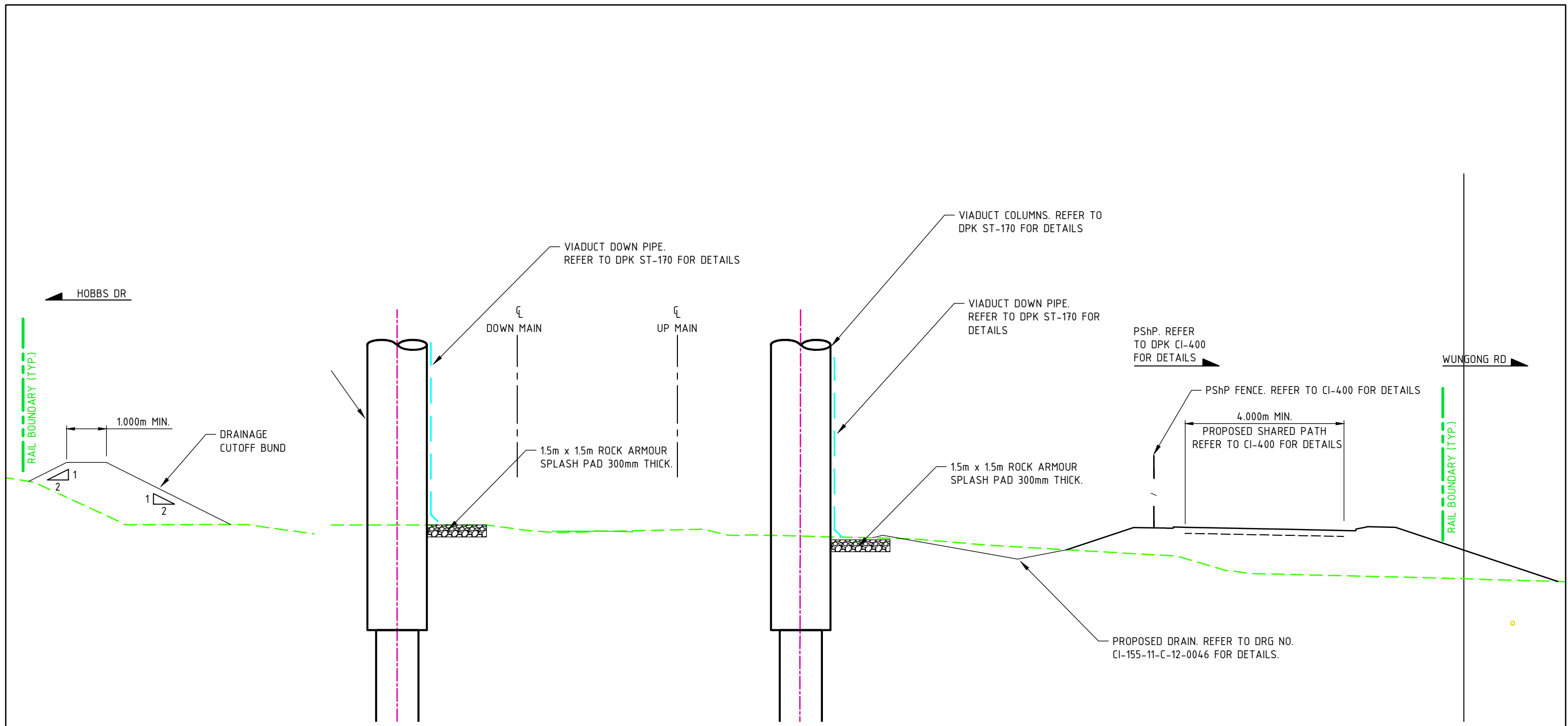
DETAILED DESIGN

Government of Western Australia
Public Transport Authority

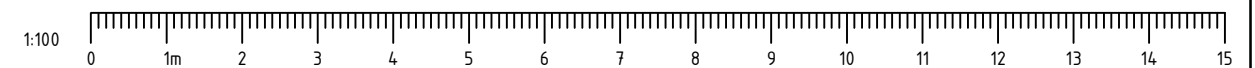
BYFORD RAIL EXTENSION

LINELINE
EARTHWORKS AND DRAINAGE
TYPICAL SECTIONS - SHEET 4

PTA Drawing No: 11-C-12-0028 Rev: B



CAL CROSS SECTION - SOUTH CHURCH AVENUE (APPROX. CH 29)
SCALE 1:100



REV	DATE	AMENDMENT	DSN	DRN	CHK	APP
B	15/12/22	ISSUED FOR IDDR - PTA REVIEW	H.A.	P.W.	N.T.	M.P.
A	22/07/22	ISSUED FOR RD - PTA REVIEW	N.N.	D.U.	H.A.	M.P.



Contractor No: R30-MET-DWG-CI-155-00105 Rev: B

REFERENCES	SCALE 1:100	DESIGNED H. AMIN
	DATUM HORIZONTAL: PCG2020 VERTICAL: AHD71	DRAWN P. WILKS
		CHECKED N. TAITO
		APPROVED M. PARKER
		DATE 15/12/22

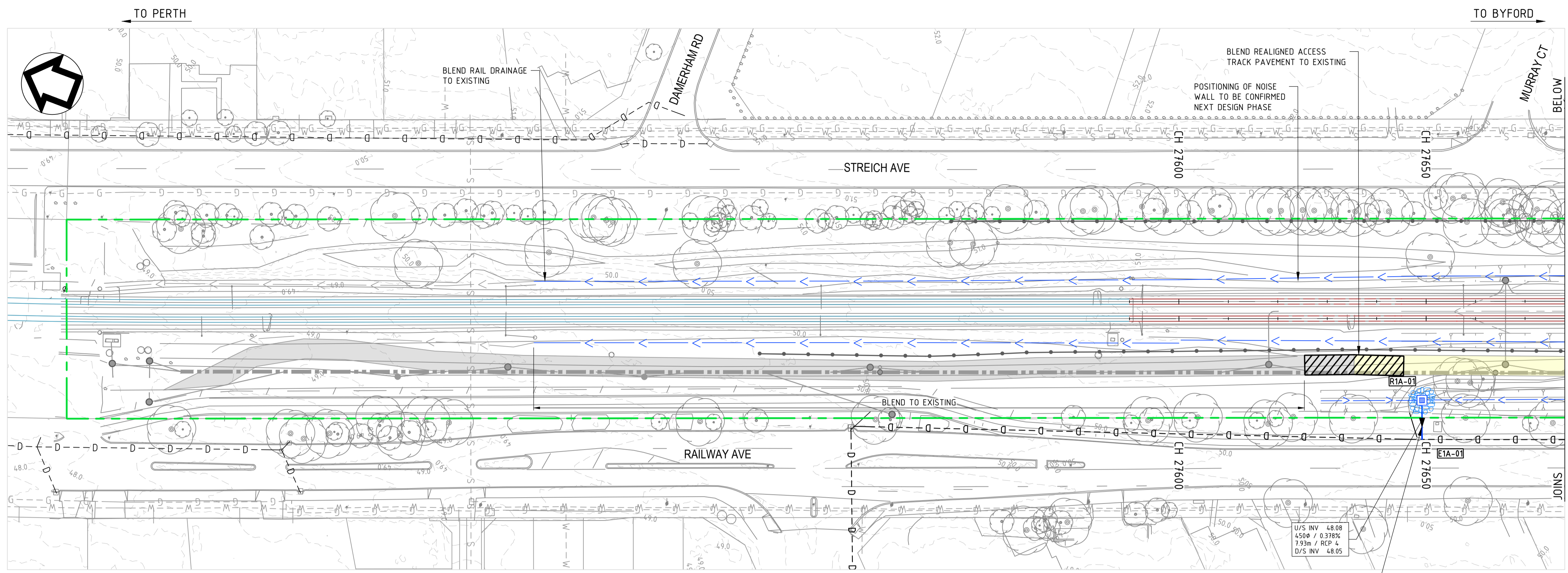
DETAILED DESIGN

Government of Western Australia
Public Transport Authority

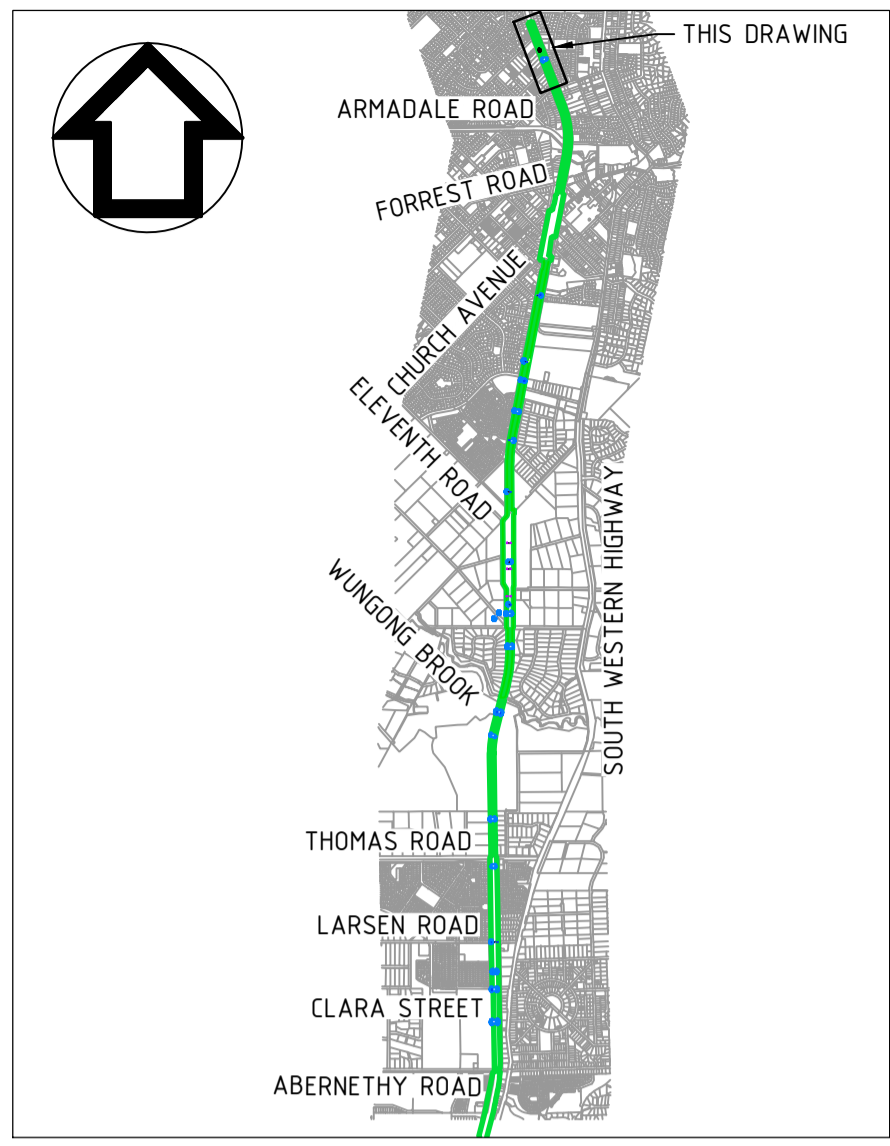
BYFORD RAIL EXTENSION

LINEWIDE
EARTHWORKS AND DRAINAGE
TYPICAL SECTIONS - SHEET 5

PTA Drawing No: 11-C-12-0029 Rev: B



PLAN
SCALE 1:500



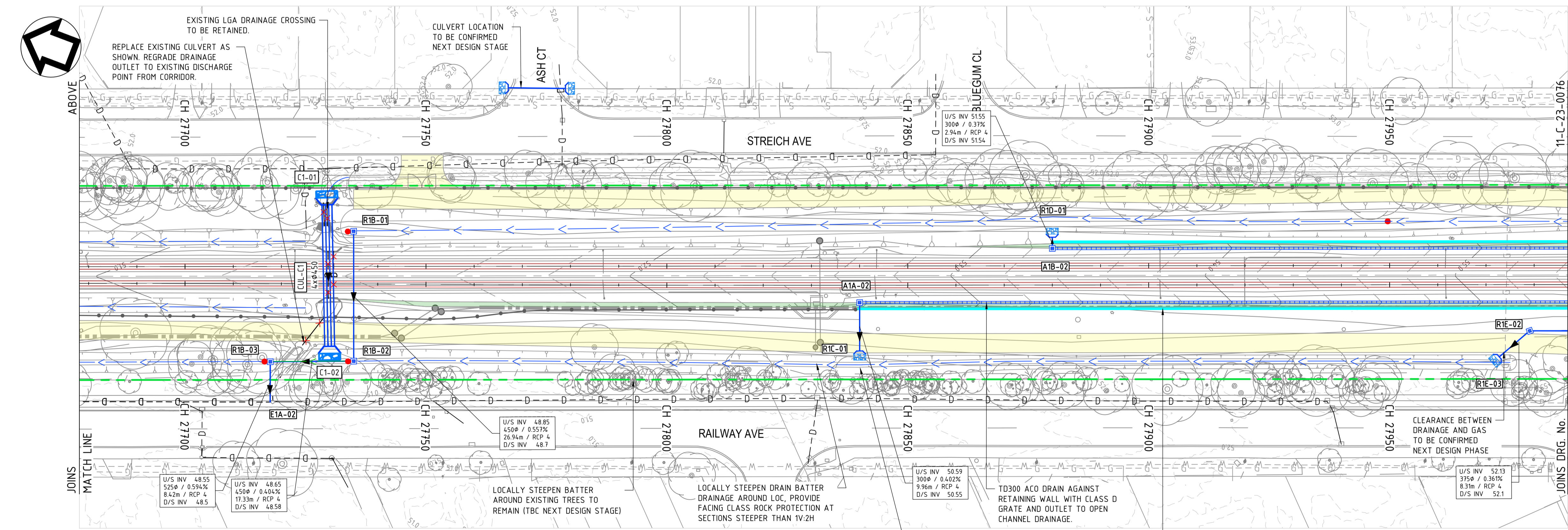
LOCALITY PLAN

NOTES

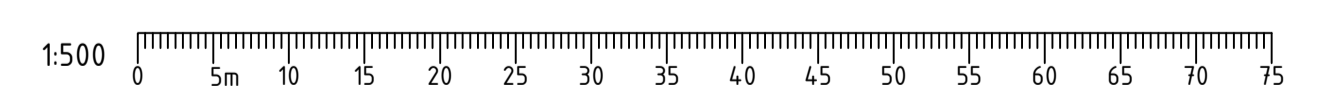
1. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. FURTHER DETAILS OF INTERFACE BETWEEN MCR AND DRAINAGE INFRASTRUCTURE PROVIDED AT NEXT DESIGN STAGE.
3. REFER TO DRAINAGE STRATEGY SKETCH PLANS AND BRE-META-CI-RPT-004.12 FOR STORAGE VOLUMES.
4. CORRIDOR FENCING PROVIDED IN ST-431 DESIGN PACKAGE. TO BE SHOWN AT NEXT DESIGN STAGE.

LEGEND

- PROPOSED RAIL
- PROPOSED PLATFORMS
- PROPOSED MAINTENANCE ACCESS TRACK
- REGRADED MAINTENANCE ACCESS TRACK
- EXISTING MAINTENANCE ACCESS TRACK
- PROPOSED PSP
- EXISTING ROAD CROSSING TO BE REMOVED
- EXISTING TRACKS
- RAIL RESERVE BOUNDARY
- THREATENED ECOLOGICAL COMMUNITY AREA
- BLACK COCKATOO BREEDING TREES
- THREATENED PRIORITY FLORA SITES
- PROPOSED RETAINING WALL
- PROPOSED KERBING
- PROPOSED MCR
- PROPOSED DRAINAGE PIPE - PTA
- PROPOSED DRAINAGE PIPE - LGA
- PROPOSED FAUNA CROSSING
- EXISTING DRAINAGE PIPE
- EXISTING DRAINAGE PIPE - REMOVE
- PROPOSED DRAINAGE CHANNEL
- PROPOSED CUT OFF DRAIN
- PROPOSED CONCRETE CHANNEL
- PROPOSED IG DRAIN
- PROPOSED LGA DRAIN
- EXISTING DRAINAGE CHANNEL
- PROPOSED ACO-DRAIN
- PROPOSED BUND
- PROPOSED ROCK PITCHING
- GULLY PIT
- MANHOLE
- DRAINAGE CATCHPIT
- SOAKWELL
- DRAINAGE BLOCK
- DESIGN CONTOURS (0.2m INTERVAL)
- EXISTING CONTOURS (0.2m INTERVAL)
- EXISTING GAS, SEWER AND WATER
- RELOCATED SEWER, WATER, GAS AND POWER
- HOLD



PLAN
SCALE 1:500



DETAILED DESIGN

REV	DATE	AMENDMENT	DSN	DRN	CHK	APP	
B	15/12/22	ISSUED FOR IDOR - PTA REVIEW		D.G.	J.Y.	N.T.	M.P.
A	22/07/22	ISSUED FOR RD - PTA REVIEW		D.G.	J.Y.	N.T.T.	M.P.

ORIG SIZE: 0 10 20 30 40 50 100mm

AT ORIGINAL PLOT SIZE

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Contractor No: R30-MET-DWG-CI-155-004.01 Rev: B



REFERENCES
<ul style="list-style-type: none"> ST-431 DESIGN PACKAGE ST-170 DESIGN PACKAGE ST-171 DESIGN PACKAGE ST-172 DESIGN PACKAGE ST-173 DESIGN PACKAGE ST-174 DESIGN PACKAGE ST-175 DESIGN PACKAGE ST-176 DESIGN PACKAGE ST-177 DESIGN PACKAGE ST-178 DESIGN PACKAGE ST-179 DESIGN PACKAGE ST-180 DESIGN PACKAGE ST-181 DESIGN PACKAGE ST-182 DESIGN PACKAGE ST-183 DESIGN PACKAGE ST-184 DESIGN PACKAGE ST-185 DESIGN PACKAGE ST-186 DESIGN PACKAGE ST-187 DESIGN PACKAGE ST-188 DESIGN PACKAGE ST-189 DESIGN PACKAGE ST-190 DESIGN PACKAGE ST-191 DESIGN PACKAGE ST-192 DESIGN PACKAGE ST-193 DESIGN PACKAGE ST-194 DESIGN PACKAGE ST-195 DESIGN PACKAGE ST-196 DESIGN PACKAGE ST-197 DESIGN PACKAGE ST-198 DESIGN PACKAGE ST-199 DESIGN PACKAGE ST-200 DESIGN PACKAGE

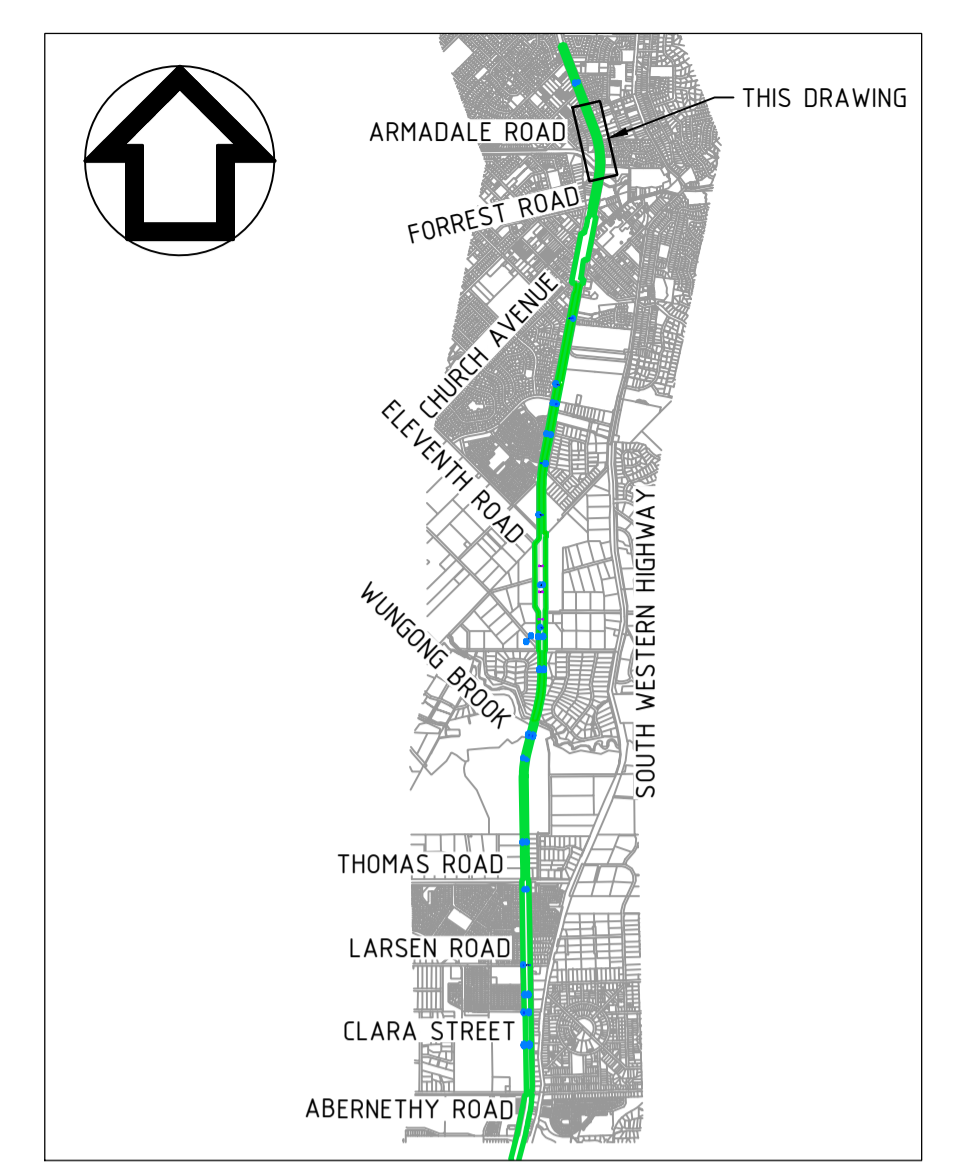
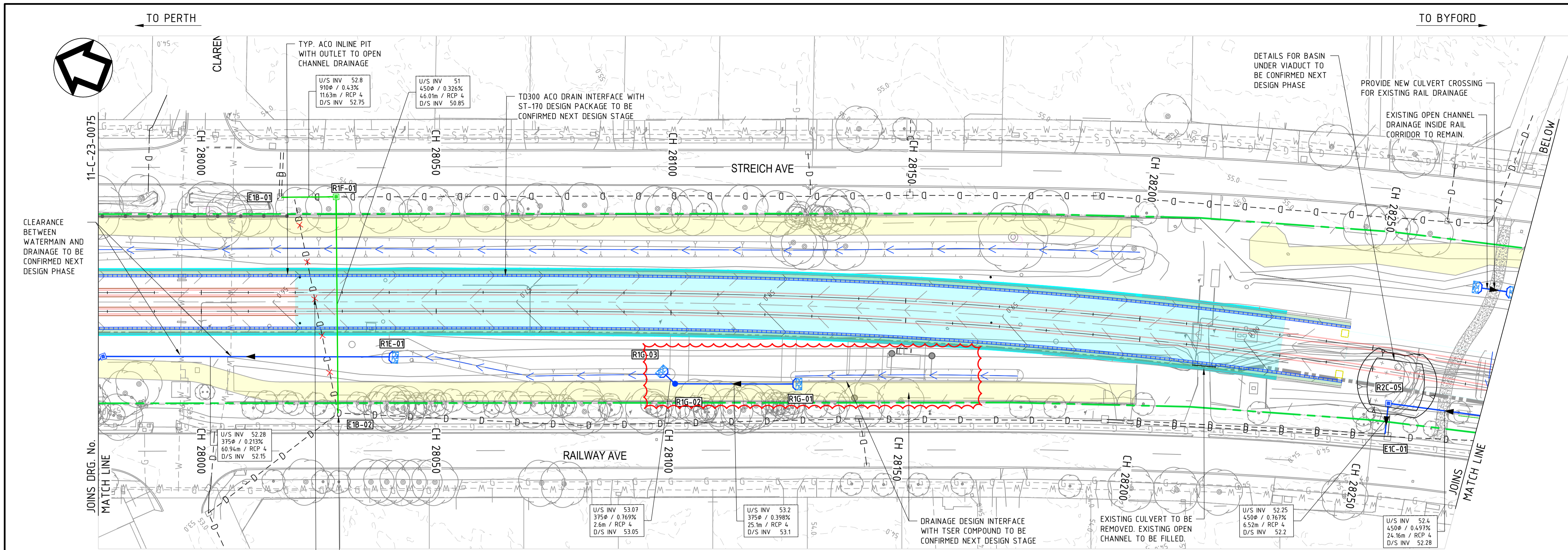
SCALE	DESIGNED
1:500	D. GLEASON
	DRAWN: J. YANG
	CHECKED: N. TAITO
	APPROVED: M. PARKER
	DATE: 15/12/22

Government of Western Australia
Public Transport Authority

BYFORD RAIL EXTENSION

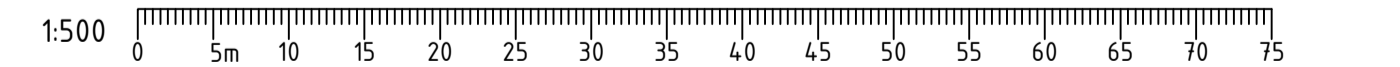
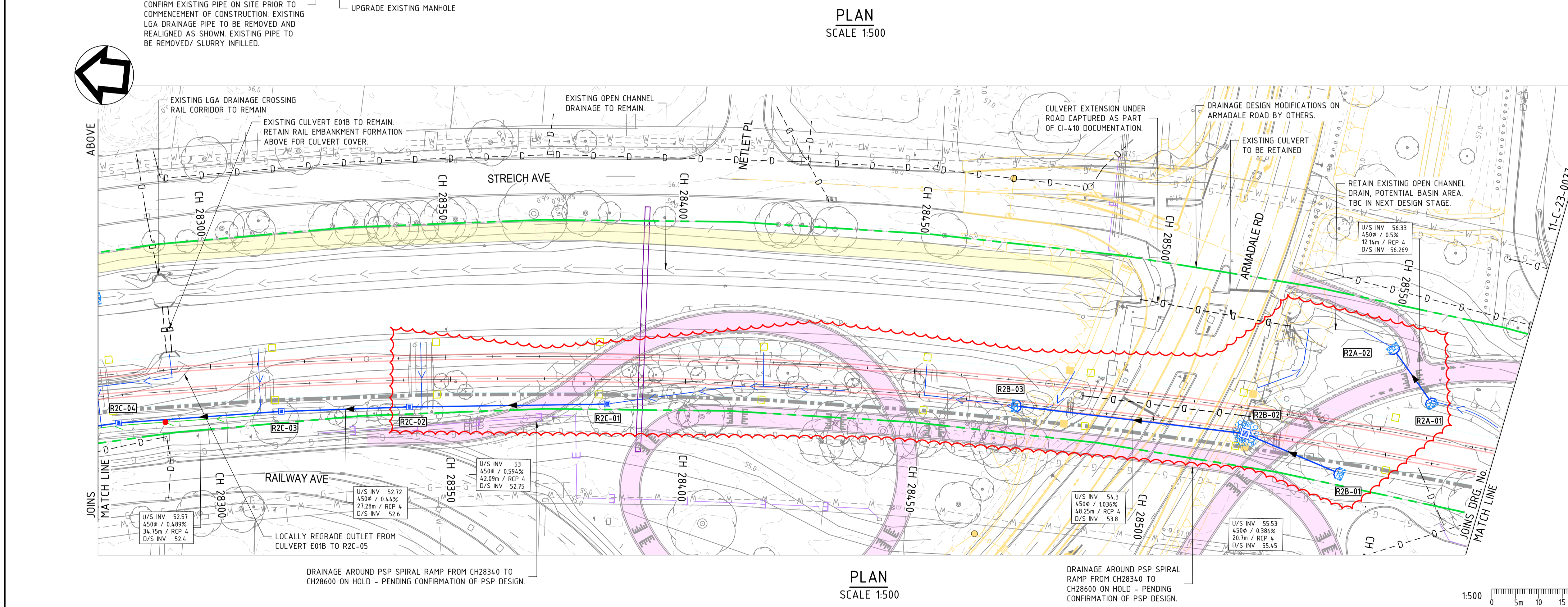
LINEWIDE
EARTHWORKS AND DRAINAGE
DRAINAGE PLAN - SHEET 1

PTA Drawing No: 11-C-23-0075 Rev: B



- NOTES**
- ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
 - FURTHER DETAILS OF INTERFACE BETWEEN MCR AND DRAINAGE INFRASTRUCTURE PROVIDED AT NEXT DESIGN STAGE.
 - REFER TO DRAINAGE STRATEGY SKETCH PLANS AND BRE-META-CI-RPT-004.12 FOR STORAGE VOLUMES.
 - CORRIDOR FENCING PROVIDED IN ST-431 DESIGN PACKAGE. TO BE SHOWN AT NEXT DESIGN STAGE.

- LEGEND**
- PROPOSED RAIL
 - PROPOSED PLATFORMS
 - PROPOSED MAINTENANCE ACCESS TRACK
 - REGRADED MAINTENANCE ACCESS TRACK
 - EXISTING MAINTENANCE ACCESS TRACK
 - PROPOSED PSP
 - EXISTING ROAD CROSSING TO BE REMOVED
 - EXISTING TRACKS
 - RAIL RESERVE BOUNDARY
 - THREATENED ECOLOGICAL COMMUNITY AREA
 - BLACK COCKATOO BREEDING TREES
 - THREATENED PRIORITY FLORA SITES
 - PROPOSED RETAINING WALL
 - PROPOSED KERBING
 - PROPOSED MCR
 - PROPOSED DRAINAGE PIPE - PTA
 - PROPOSED DRAINAGE PIPE - LGA
 - PROPOSED FAUNA CROSSING
 - EXISTING DRAINAGE PIPE
 - EXISTING DRAINAGE PIPE - REMOVE
 - PROPOSED DRAINAGE CHANNEL
 - PROPOSED CUT OFF DRAIN
 - PROPOSED CONCRETE CHANNEL
 - PROPOSED IG DRAIN
 - PROPOSED LGA DRAIN
 - EXISTING DRAINAGE CHANNEL
 - PROPOSED ACO-DRAIN
 - PURPOSED BUND
 - PROPOSED ROCK PITCHING
 - GULLY PIT
 - MANHOLE
 - DRAINAGE CATCHPIT
 - SOAKWELL
 - DRAINAGE BLOCK
 - DESIGN CONTOURS (0.2m INTERVAL)
 - EXISTING CONTOURS (0.2m INTERVAL)
 - EXISTING GAS, SEWER AND WATER
 - RELOCATED SEWER, WATER, GAS AND POWER
 - HOLD



DETAILED DESIGN

Government of Western Australia
Public Transport Authority

BYFORD RAIL EXTENSION

LINEWIDE
EARTHWORKS AND DRAINAGE
DRAINAGE PLAN - SHEET 2

PTA Drawing No: 11-C-23-0076 Rev: B

REV	DATE	AMENDMENT	DSN	DRN	CHK	APP
B	15/12/22	ISSUED FOR IDOR - PTA REVIEW	D.G.	J.Y.	N.T.	M.P.
A	22/07/22	ISSUED FOR RD - PTA REVIEW	D.G.	J.Y.	N.T.T.	M.P.

ORIG SIZE A1

0 10 20 30 40 50 100mm

AT ORIGINAL PLOT SIZE

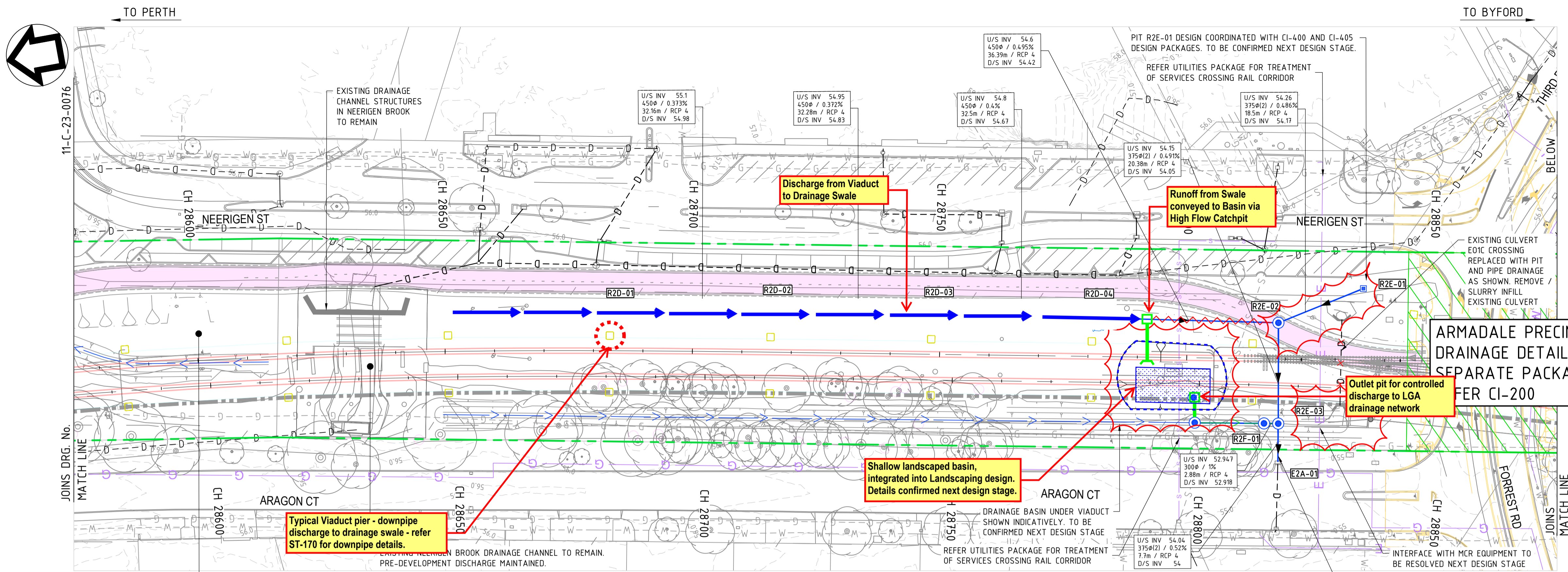
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Contractor No: R30-MET-DWG-CL-155-00402 Rev: B

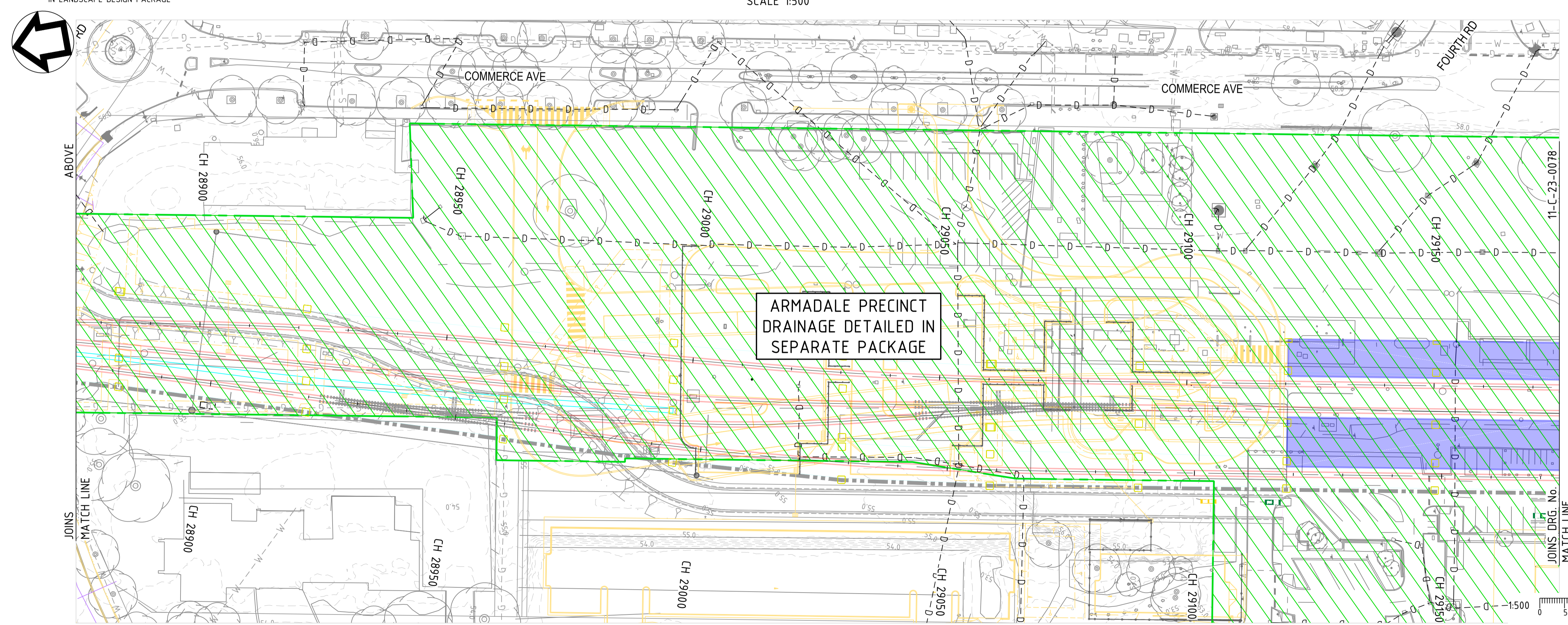
MetCONX

REFERENCES	SCALE	DESIGNED
	1:500	D. GLEASON
		DRAWN J. YANG
		CHECKED N. TAITO
		APPROVED M. PARKER
		DATE 15/12/22

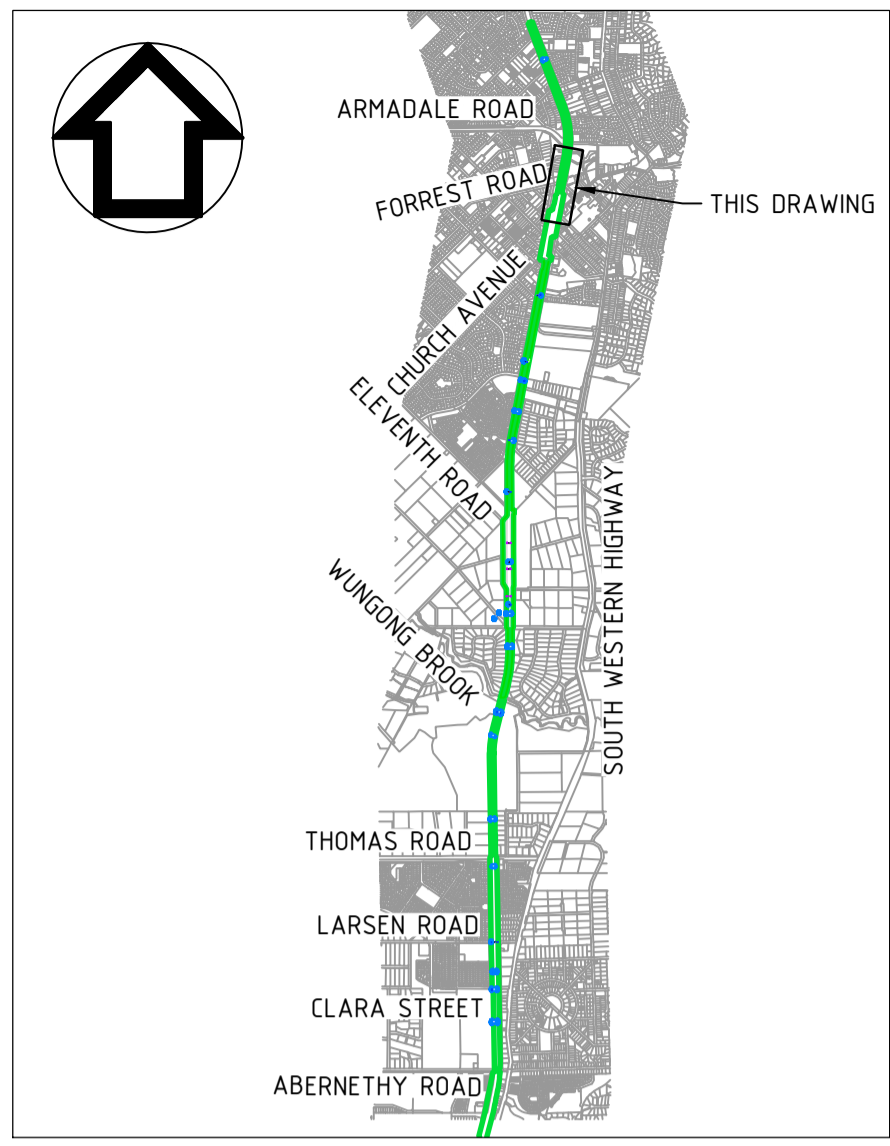
DATUM
HORIZONTAL: PCG2020
VERTICAL: AHD71



PLAN
SCALE 1:500



PLAN
SCALE 1:500



LOCALITY PLAN

NOTES

1. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. FURTHER DETAILS OF INTERFACE BETWEEN MCR AND DRAINAGE INFRASTRUCTURE PROVIDED AT NEXT DESIGN STAGE.
3. REFER TO DRAINAGE STRATEGY SKETCH PLANS AND BRE-META-CI-RPT-004.12 FOR STORAGE VOLUMES.
4. CORRIDOR FENCING PROVIDED IN ST-431 DESIGN PACKAGE. TO BE SHOWN AT NEXT DESIGN STAGE.

LEGEND

- PROPOSED RAIL
- PROPOSED PLATFORMS
- PROPOSED MAINTENANCE ACCESS TRACK
- REGRADED MAINTENANCE ACCESS TRACK
- EXISTING MAINTENANCE ACCESS TRACK
- PROPOSED PSP
- EXISTING ROAD CROSSING TO BE REMOVED
- EXISTING TRACKS
- RAIL RESERVE BOUNDARY
- THREATENED ECOLOGICAL COMMUNITY AREA
- BLACK COCKATOO BREEDING TREES
- THREATENED PRIORITY FLORA SITES
- PROPOSED RETAINING WALL
- PROPOSED KERBING
- PROPOSED MCR
- PROPOSED DRAINAGE PIPE - PTA
- PROPOSED DRAINAGE PIPE - LGA
- PROPOSED FAUNA CROSSING
- EXISTING DRAINAGE PIPE
- EXISTING DRAINAGE PIPE - REMOVE
- PROPOSED DRAINAGE CHANNEL
- PROPOSED CUT OFF DRAIN
- PROPOSED CONCRETE CHANNEL
- PROPOSED IG DRAIN
- PROPOSED LGA DRAIN
- EXISTING DRAINAGE CHANNEL
- PROPOSED ACO-DRAIN
- PURPOSED BUND
- PROPOSED ROCK PITCHING
- GULLY PIT
- MANHOLE
- DRAINAGE CATCHPIT
- SOAKWELL
- DRAINAGE BLOCK
- DESIGN CONTOURS (0.2m INTERVAL)
- EXISTING CONTOURS (0.2m INTERVAL)
- EXISTING GAS, SEWER AND WATER
- RELOCATED SEWER, WATER, GAS AND POWER
- HOLD

DETAILED DESIGN

Government of Western Australia
Public Transport Authority

BYFORD RAIL EXTENSION

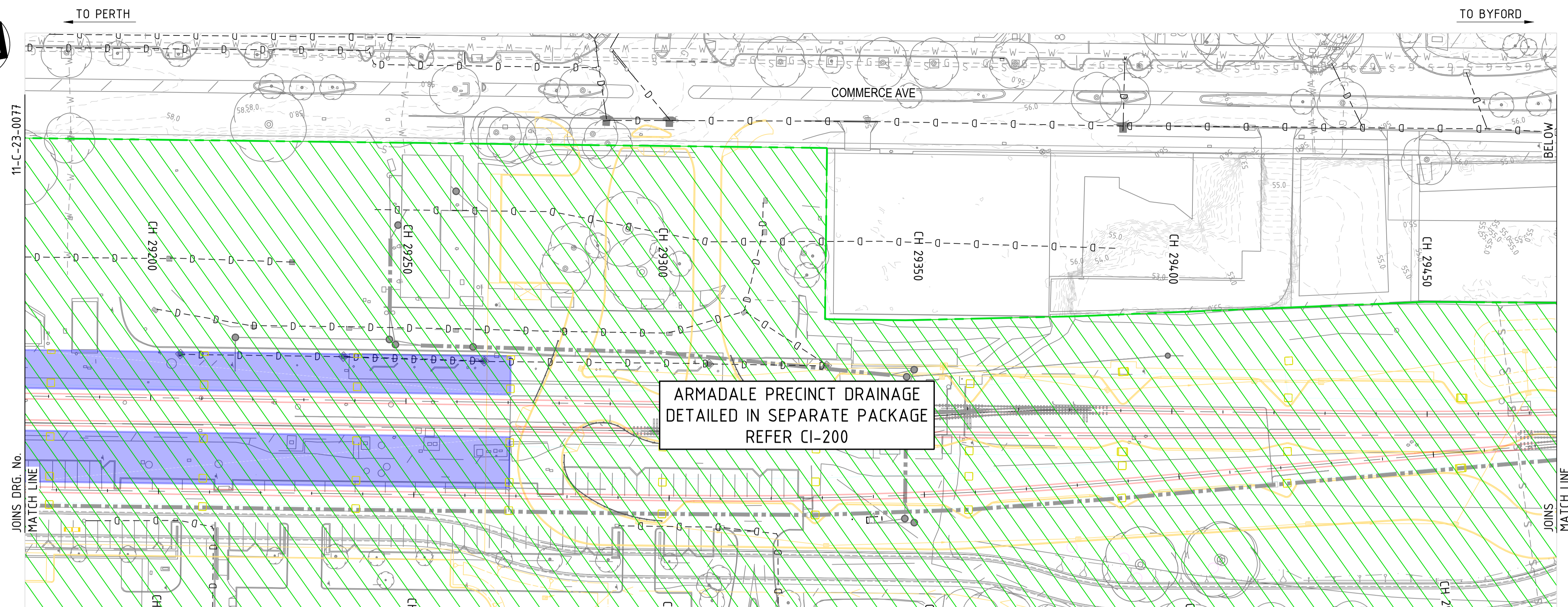
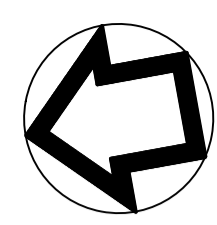
LINEWIDE
EARTHWORKS AND DRAINAGE
DRAINAGE PLAN - SHEET 3

PTA Drawing No: 11-C-23-0077 Rev: B

**SKETCH ONLY
ISSUED FOR INFORMATION**

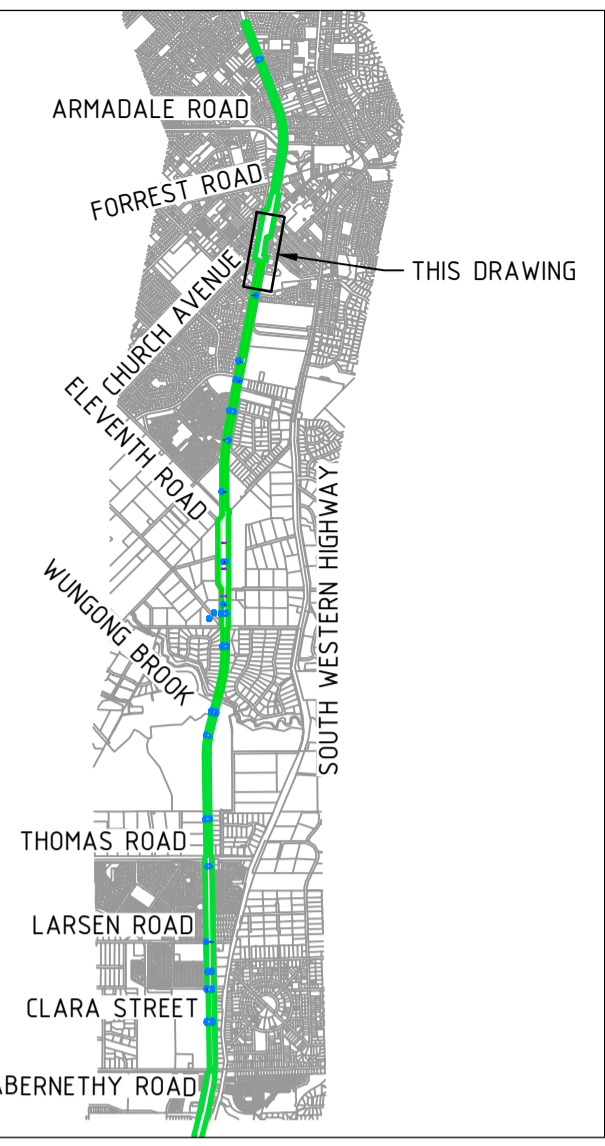
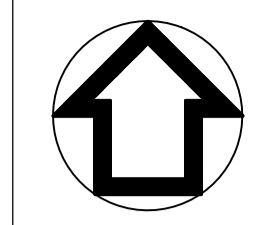


DESIGNED	D. GLEASON
DRAWN	J. YANG
CHECKED	N. TAITO
APPROVED	M. PARKER
DATE	15/12/22



ARMADALE PRECINCT DRAINAGE
DETAILED IN SEPARATE PACKAGE
REFER CI-200

PLAN
SCALE 1:500



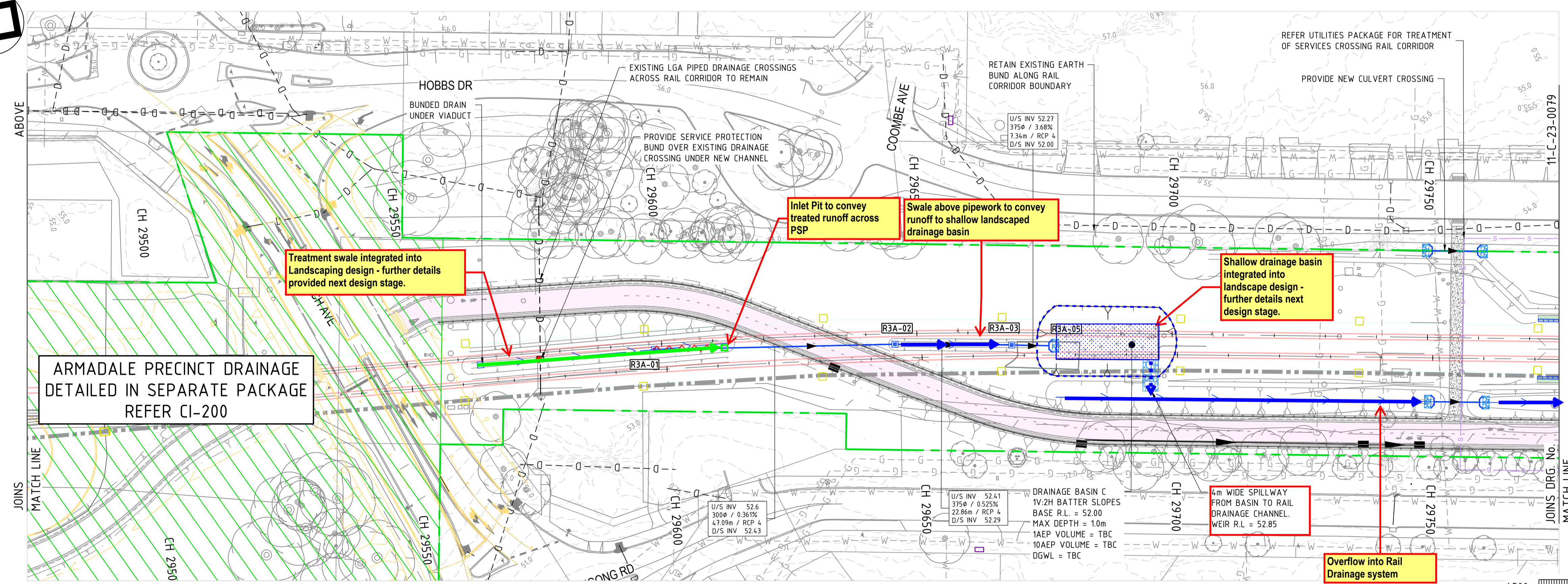
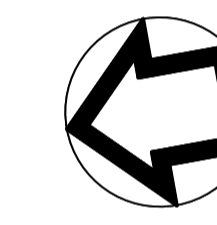
LOCALITY PLAN

NOTES

1. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. FURTHER DETAILS OF INTERFACE BETWEEN MCR AND DRAINAGE INFRASTRUCTURE PROVIDED AT NEXT DESIGN STAGE.
3. REFER TO DRAINAGE STRATEGY SKETCH PLANS AND BRE-META-CI-RPT-004.12 FOR STORAGE VOLUMES.
4. CORRIDOR FENCING PROVIDED IN ST-431 DESIGN PACKAGE. TO BE SHOWN AT NEXT DESIGN STAGE.

LEGEND

- PROPOSED RAIL
- PROPOSED PLATFORMS
- PROPOSED MAINTENANCE ACCESS TRACK
- REGRADED MAINTENANCE ACCESS TRACK
- EXISTING MAINTENANCE ACCESS TRACK
- PROPOSED PSP
- EXISTING ROAD CROSSING TO BE REMOVED
- EXISTING TRACKS
- RAIL RESERVE BOUNDARY
- THREATENED ECOLOGICAL COMMUNITY AREA
- BLACK COCKATOO BREEDING TREES
- THREATENED PRIORITY FLORA SITES
- PROPOSED RETAINING WALL
- PROPOSED KERBING
- PROPOSED MCR
- PROPOSED DRAINAGE PIPE - PTA
- PROPOSED DRAINAGE PIPE - LGA
- PROPOSED FAUNA CROSSING
- EXISTING DRAINAGE PIPE
- EXISTING DRAINAGE PIPE - REMOVE
- PROPOSED DRAINAGE CHANNEL
- PROPOSED CUT OFF DRAIN
- PROPOSED CONCRETE CHANNEL
- PROPOSED IG DRAIN
- PROPOSED LGA DRAIN
- EXISTING DRAINAGE CHANNEL
- PROPOSED ACO-DRAIN
- PROPOSED BUND
- PROPOSED ROCK PITCHING
- GULLY PIT
- MANHOLE
- DRAINAGE CATCHPIT
- SOAKWELL
- DRAINAGE BLOCK
- DESIGN CONTOURS (0.2m INTERVAL)
- EXISTING CONTOURS (0.2m INTERVAL)
- EXISTING GAS, SEWER AND WATER
- RELOCATED SEWER, WATER, GAS AND POWER
- HOLD



ARMADALE PRECINCT DRAINAGE
DETAILED IN SEPARATE PACKAGE
REFER CI-200

PLAN
SCALE 1:500

1:500 0 5m 10 15 20 25 30 35 40 45 50 55 60 65 70 75

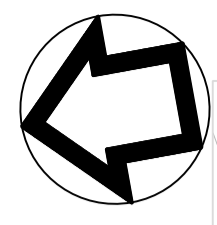
DETAILED DESIGN

**SKETCH ONLY
ISSUED FOR INFORMATION**



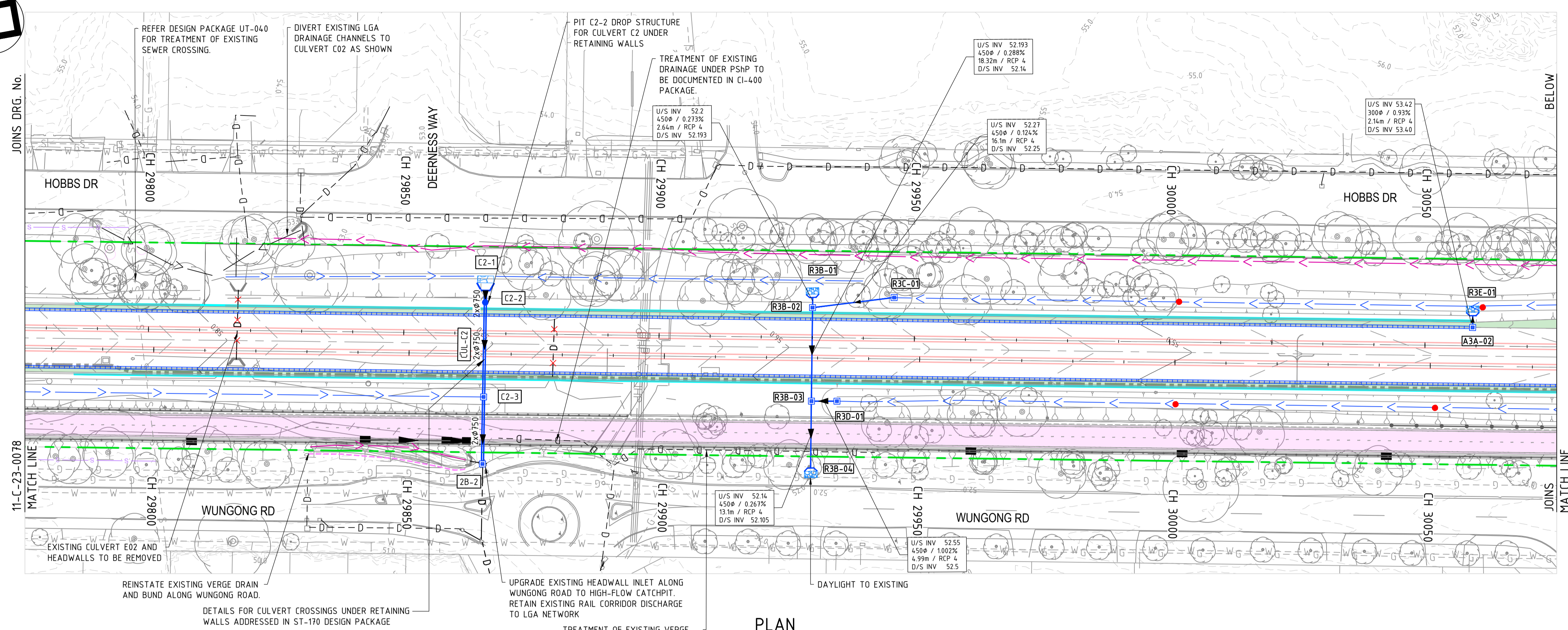
REFERENCES	SCALE	DESIGNED
	1:500	D. GLEASON
	DATUM	DRAWN
	HORIZONTAL: PCG2020	J. YANG
	VERTICAL: AHD71	CHECKED
		N. TAITO
		APPROVED
		M. PARKER
		DATE
		15/12/22

		BYFORD RAIL EXTENSION
LINEWIDE		
EARTHWORKS AND DRAINAGE		
DRAINAGE PLAN - SHEET 4		
PTA Drawing No:	11-C-23-0078	Rev: B

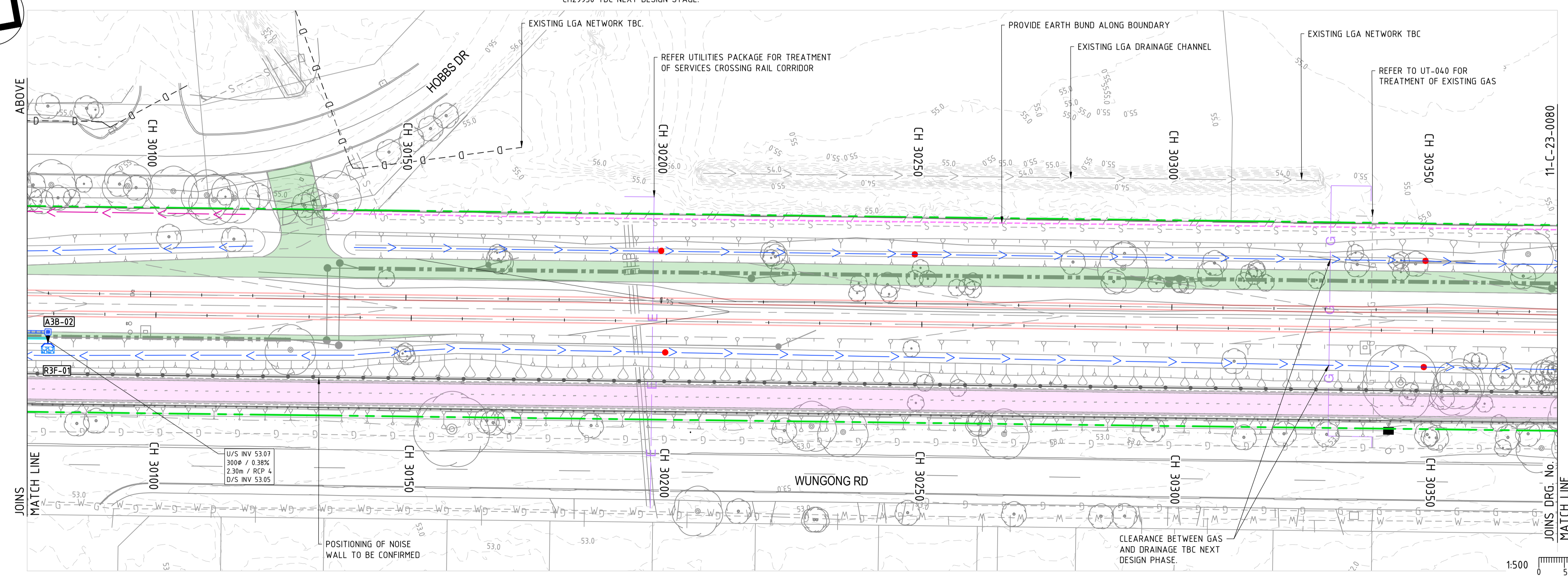
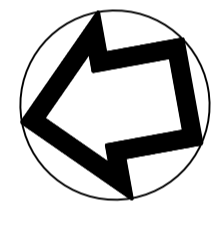


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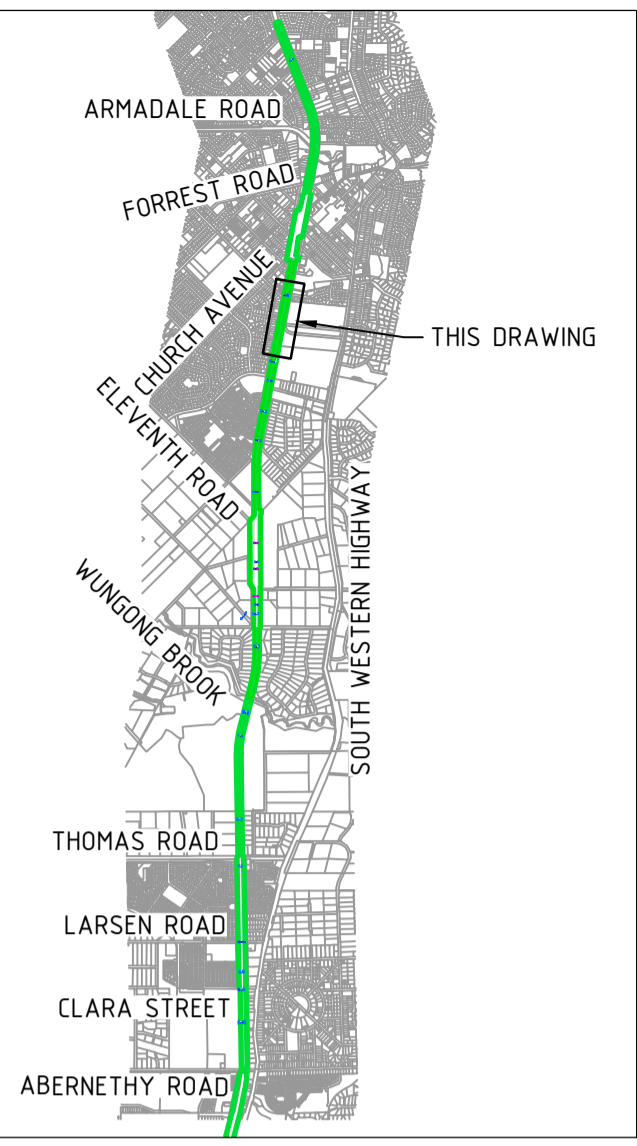
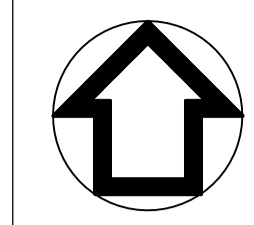
TO BYFORD



PLAN SCALE 1:500



PLAN SCALE 1:500



LOCALITY PLAN

NOTES

1. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. FURTHER DETAILS OF INTERFACE BETWEEN MCR AND DRAINAGE INFRASTRUCTURE PROVIDED AT NEXT DESIGN STAGE.
3. REFER TO DRAINAGE STRATEGY SKETCH PLANS AND BRE-META-CI-RPT-004.12 FOR STORAGE VOLUMES.
4. CORRIDOR FENCING PROVIDED IN ST-431 DESIGN PACKAGE. TO BE SHOWN AT NEXT DESIGN STAGE.

LEGEND

- PROPOSED RAIL
- PROPOSED PLATFORMS
- PROPOSED MAINTENANCE ACCESS TRACK
- REGRADED MAINTENANCE ACCESS TRACK
- EXISTING MAINTENANCE ACCESS TRACK
- PROPOSED PSP
- EXISTING ROAD CROSSING TO BE REMOVED
- EXISTING TRACKS
- RAIL RESERVE BOUNDARY
- THREATENED ECOLOGICAL COMMUNITY AREA
- BLACK COCKATOO BREEDING TREES
- THREATENED PRIORITY FLORA SITES
- PROPOSED RETAINING WALL
- PROPOSED KERBING
- PROPOSED MCR
- PROPOSED DRAINAGE PIPE - PTA
- PROPOSED DRAINAGE PIPE - LGA
- PROPOSED FAUNA CROSSING
- EXISTING DRAINAGE PIPE
- EXISTING DRAINAGE PIPE - REMOVE
- PROPOSED DRAINAGE CHANNEL
- PROPOSED CUT OFF DRAIN
- PROPOSED CONCRETE CHANNEL
- PROPOSED IG DRAIN
- PROPOSED LGA DRAIN
- EXISTING DRAINAGE CHANNEL
- PROPOSED ACO-DRAIN
- PURPOSED BUND
- PROPOSED ROCK PITCHING
- GULLY PIT
- MANHOLE
- DRAINAGE CATCHPIT
- SOAKWELL
- DRAINAGE BLOCK
- DESIGN CONTOURS (0.2m INTERVAL)
- EXISTING CONTOURS (0.2m INTERVAL)
- EXISTING GAS, SEWER AND WATER
- RELOCATED SEWER, WATER, GAS AND POWER
- HOLD

1:500 0 5m 10 15 20 25 30 35 40 45 50 55 60 65 70 75

DETAILED DESIGN

Government of Western Australia
Public Transport Authority

BYFORD RAIL EXTENSION

LINEWIDE
EARTHWORKS AND DRAINAGE
DRAINAGE PLAN - SHEET 5

PTA Drawing No: 11-C-23-0079 Rev: B

REV	DATE	AMENDMENT	DSN	DRN	CHK	APP
B	15/12/22	ISSUED FOR IDOR - PTA REVIEW	D.G.	J.Y.	N.T.	M.P.
A	22/07/22	ISSUED FOR RD - PTA REVIEW	D.G.	J.Y.	N.T.	M.P.

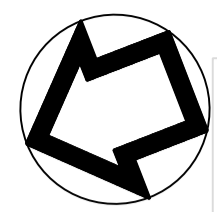
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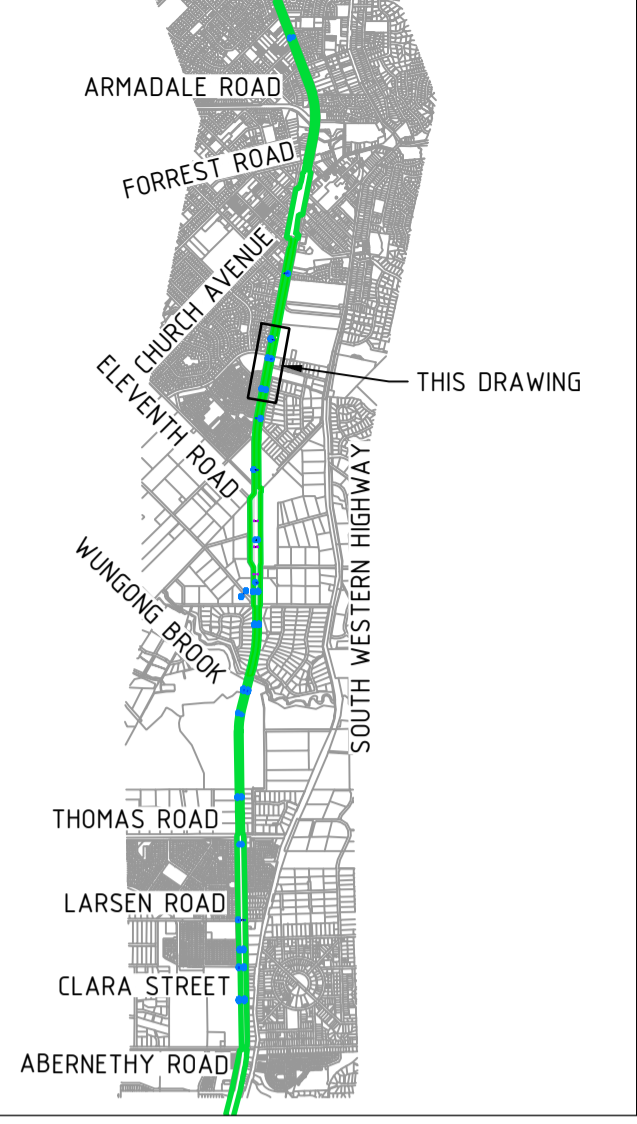
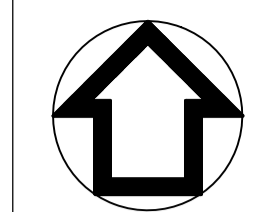
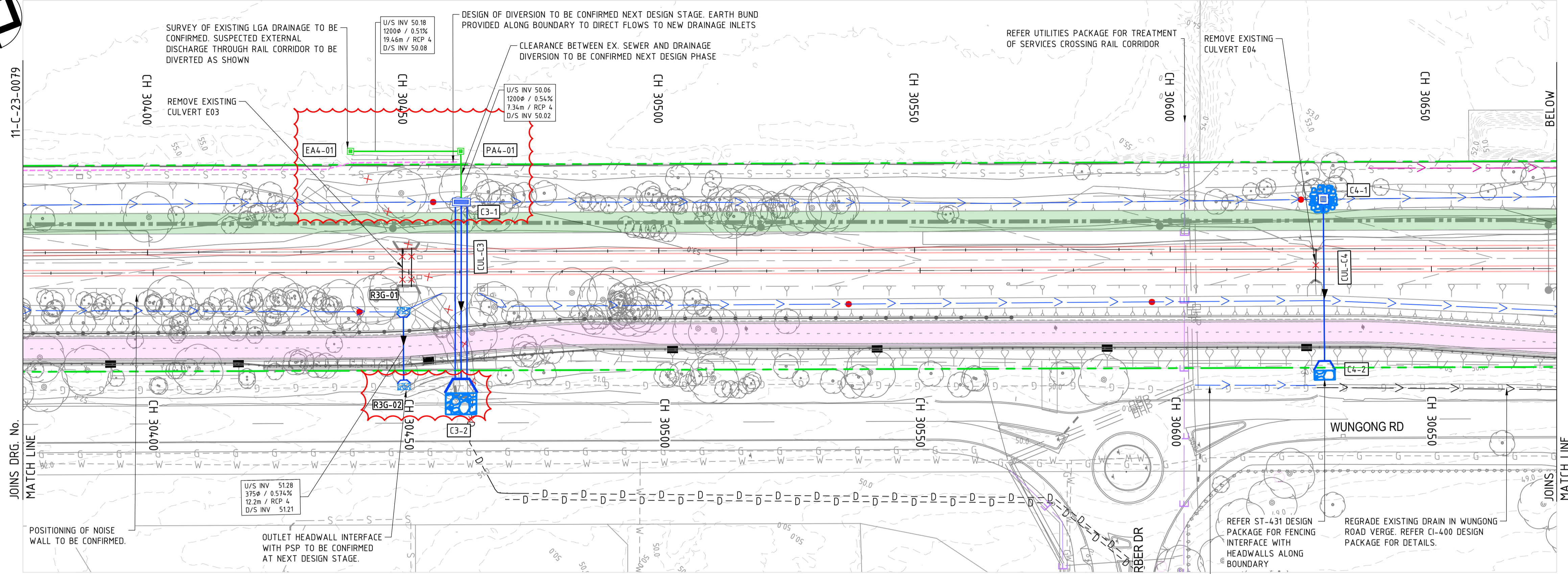
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SCALE	DESIGNED
1:500	D. GLEASON
	DRAWN: J. YANG
	CHECKED: N. TAITO
	APPROVED: M. PARKER
	DATE: 15/12/22



TO PERTH

TO BYFORD

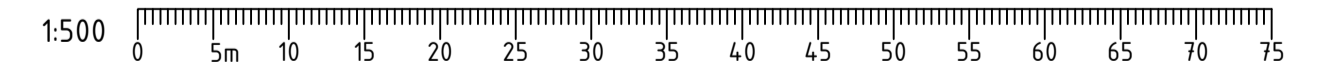
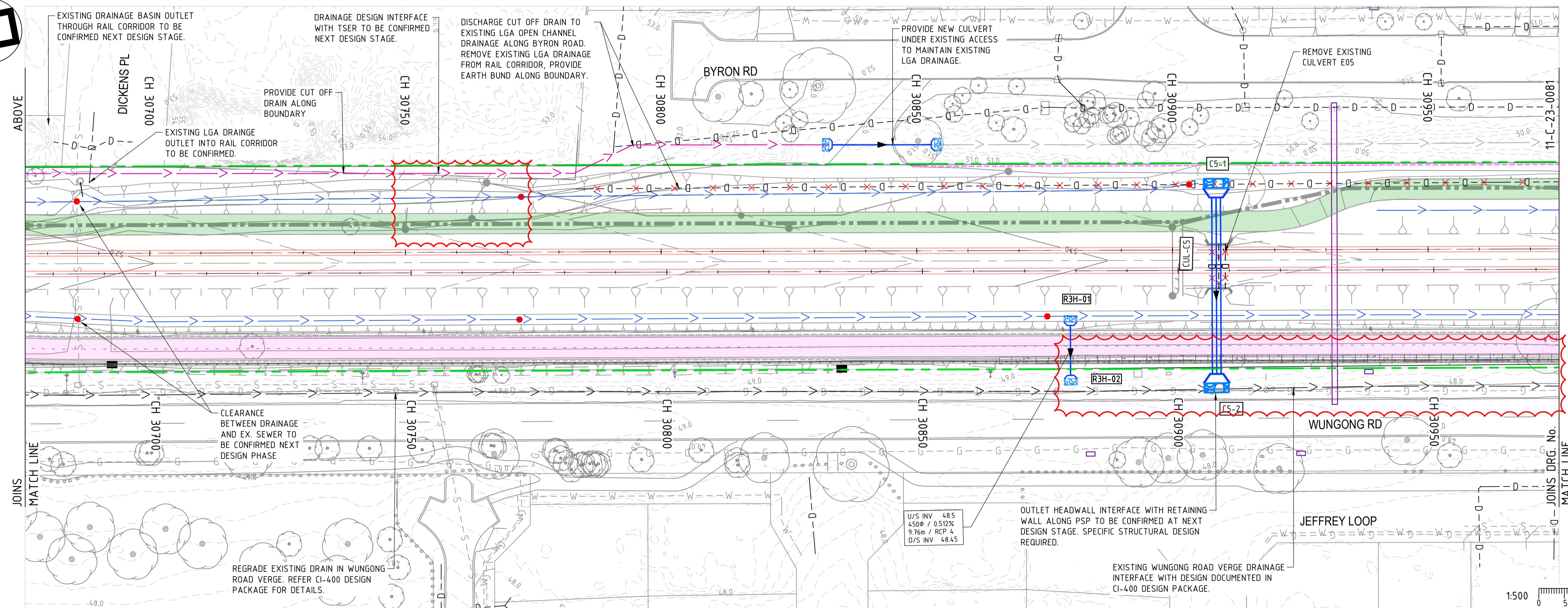
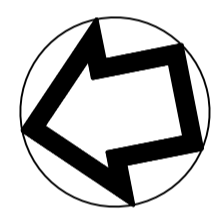


NOTES

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3. REFER TO DRAINAGE STRATEGY SKETCH PLANS AND BRE-META-CL-RPT-004.12 FOR STORAGE VOLUMES.
4. CORRIDOR FENCING PROVIDED IN ST-431 DESIGN PACKAGE. TO BE SHOWN AT NEXT DESIGN STAGE.

LEGEND

- PROPOSED RAIL
- PROPOSED PLATFORMS
- PROPOSED MAINTENANCE ACCESS TRACK
- REGRADED MAINTENANCE ACCESS TRACK
- EXISTING MAINTENANCE ACCESS TRACK
- PROPOSED PSP
- EXISTING ROAD CROSSING TO BE REMOVED
- EXISTING TRACKS
- RAIL RESERVE BOUNDARY
- THREATENED ECOLOGICAL COMMUNITY AREA
- BLACK COCKATOO BREEDING TREES
- THREATENED PRIORITY FLORA SITES
- PROPOSED RETAINING WALL
- PROPOSED KERBING
- PROPOSED MCR
- PROPOSED DRAINAGE PIPE - PTA
- PROPOSED DRAINAGE PIPE - LGA
- PROPOSED FAUNA CROSSING
- EXISTING DRAINAGE PIPE
- EXISTING DRAINAGE PIPE - REMOVE
- PROPOSED DRAINAGE CHANNEL
- PROPOSED CUT OFF DRAIN
- PROPOSED CONCRETE CHANNEL
- PROPOSED IG DRAIN
- PROPOSED LGA DRAIN
- EXISTING DRAINAGE CHANNEL
- PROPOSED ACO-DRAIN
- PURPOSED BUND
- PROPOSED ROCK PITCHING
- GULLY PIT
- MANHOLE
- DRAINAGE CATCHPIT
- SOAKWELL
- DRAINAGE BLOCK
- DESIGN CONTOURS (0.2m INTERVAL)
- EXISTING CONTOURS (0.2m INTERVAL)
- EXISTING GAS, SEWER AND WATER
- RELOCATED SEWER, WATER, GAS AND POWER
- HOLD



REV	DATE	AMENDMENT	DSN	DRN	CHK	APP
B	15/12/22	ISSUED FOR IDOR - PTA REVIEW	D.G.	J.Y.	N.T.	M.P.
A	22/07/22	ISSUED FOR RD - PTA REVIEW	D.G.	J.Y.	N.T.	M.P.

ORIG SIZE: A1
AT ORIGINAL PLOT SIZE

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		DRAWN
		J. YANG
		CHECKED
		N. TAITO
		APPROVED
		M. PARKER
		DATE
		15/12/22

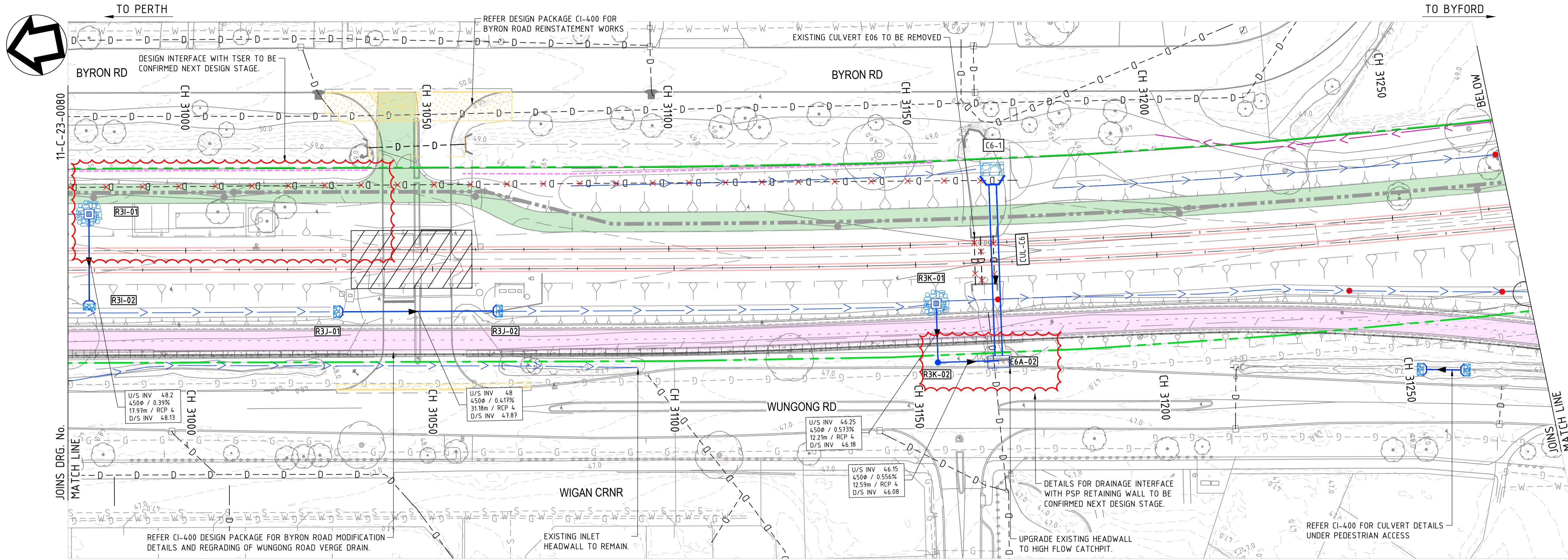
DETAILED DESIGN

Government of Western Australia
Public Transport Authority

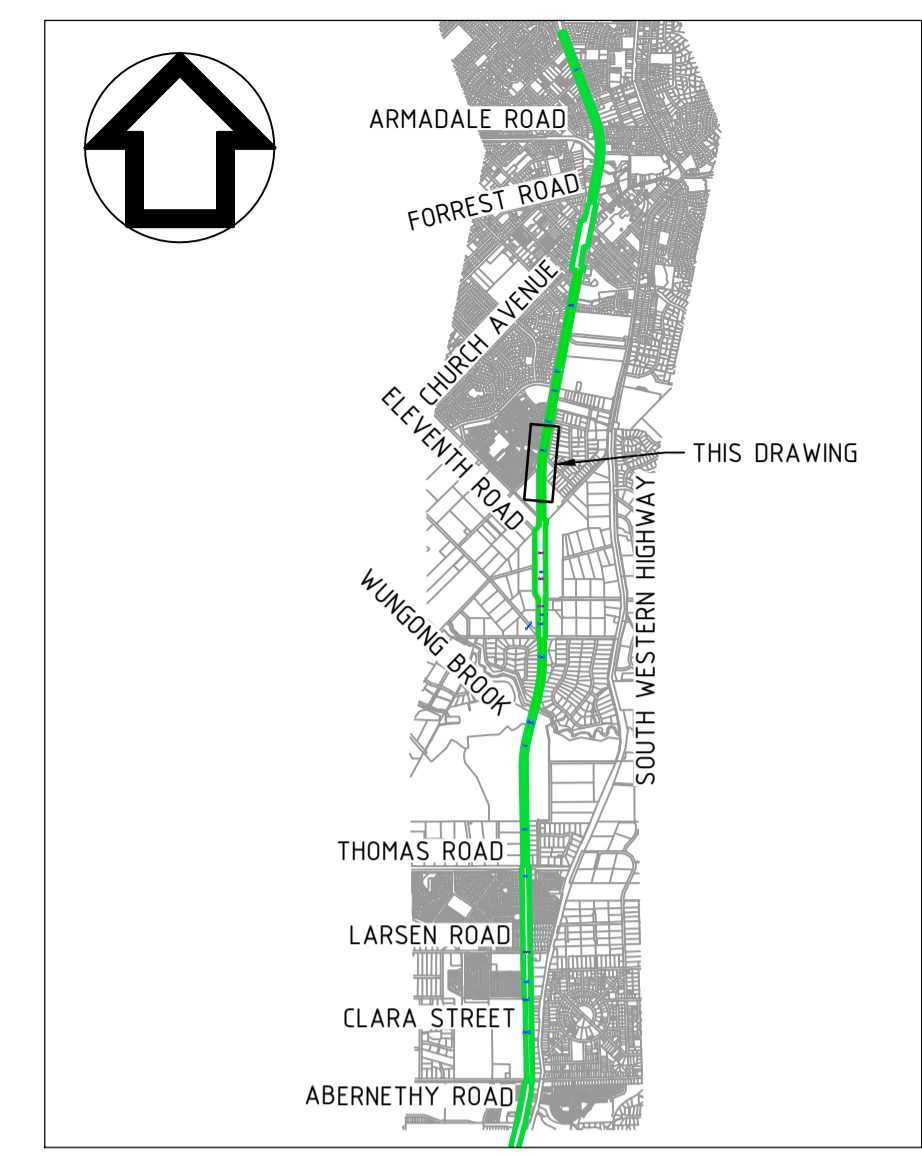
BYFORD RAIL EXTENSION

LINEWIDE
EARTHWORKS AND DRAINAGE
DRAINAGE PLAN - SHEET 6

PTA Drawing No: 11-C-23-0080 Rev: B



PLAN
SCALE 1:500



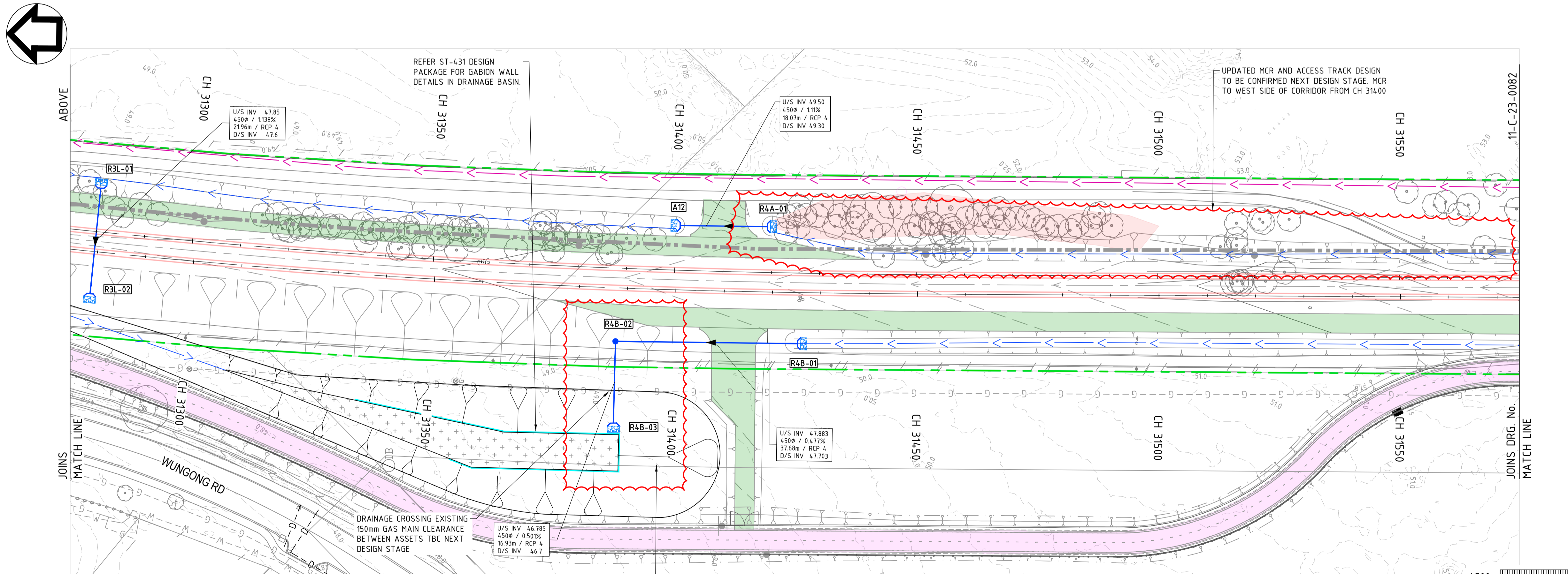
LOCALITY PLAN

NOTES

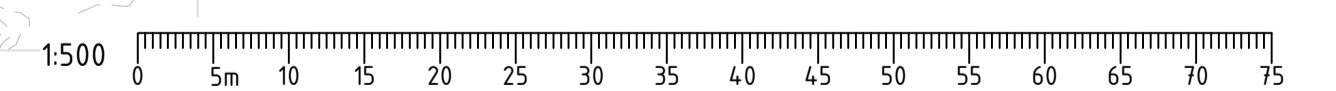
1. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. FURTHER DETAILS OF INTERFACE BETWEEN MCR AND DRAINAGE INFRASTRUCTURE PROVIDED AT NEXT DESIGN STAGE.
3. REFER TO DRAINAGE STRATEGY SKETCH PLANS AND BRE-META-CL-RPT-004.12 FOR STORAGE VOLUMES.
4. CORRIDOR FENCING PROVIDED IN ST-431 DESIGN PACKAGE. TO BE SHOWN AT NEXT DESIGN STAGE.

LEGEND

- PROPOSED RAIL
- PROPOSED PLATFORMS
- PROPOSED MAINTENANCE ACCESS TRACK
- REGRADED MAINTENANCE ACCESS TRACK
- EXISTING MAINTENANCE ACCESS TRACK
- PROPOSED PSP
- EXISTING ROAD CROSSING TO BE REMOVED
- EXISTING TRACKS
- RAIL RESERVE BOUNDARY
- THREATENED ECOLOGICAL COMMUNITY AREA
- BLACK COCKATOO BREEDING TREES
- THREATENED PRIORITY FLORA SITES
- PROPOSED RETAINING WALL
- PROPOSED KERBING
- PROPOSED MCR
- PROPOSED DRAINAGE PIPE - PTA
- PROPOSED DRAINAGE PIPE - LGA
- PROPOSED FAUNA CROSSING
- EXISTING DRAINAGE PIPE
- EXISTING DRAINAGE PIPE - REMOVE
- PROPOSED DRAINAGE CHANNEL
- PROPOSED CUT OFF DRAIN
- PROPOSED CONCRETE CHANNEL
- PROPOSED IG DRAIN
- PROPOSED LGA DRAIN
- EXISTING DRAINAGE CHANNEL
- PROPOSED ACO-DRAIN
- PURPOSED BUND
- PROPOSED ROCK PITCHING
- GULLY PIT
- MANHOLE
- DRAINAGE CATCHPIT
- SOAKWELL
- DRAINAGE BLOCK
- DESIGN CONTOURS (0.2m INTERVAL)
- EXISTING CONTOURS (0.2m INTERVAL)
- EXISTING GAS, SEWER AND WATER
- RELOCATED SEWER, WATER, GAS AND POWER
- HOLD



PLAN
SCALE 1:500



DETAILED DESIGN

Government of Western Australia
Public Transport Authority

BYFORD RAIL EXTENSION

LINEWIDE
EARTHWORKS AND DRAINAGE
DRAINAGE PLAN - SHEET 7

PTA Drawing No: 11-C-23-0081 Rev: B

REV	DATE	AMENDMENT	DSN	DRN	CHK	APP
B	15/12/22	ISSUED FOR IDOR - PTA REVIEW	D.G.	J.Y.	N.T.	M.P.
A	22/07/22	ISSUED FOR RD - PTA REVIEW	D.G.	J.Y.	N.T.	M.P.

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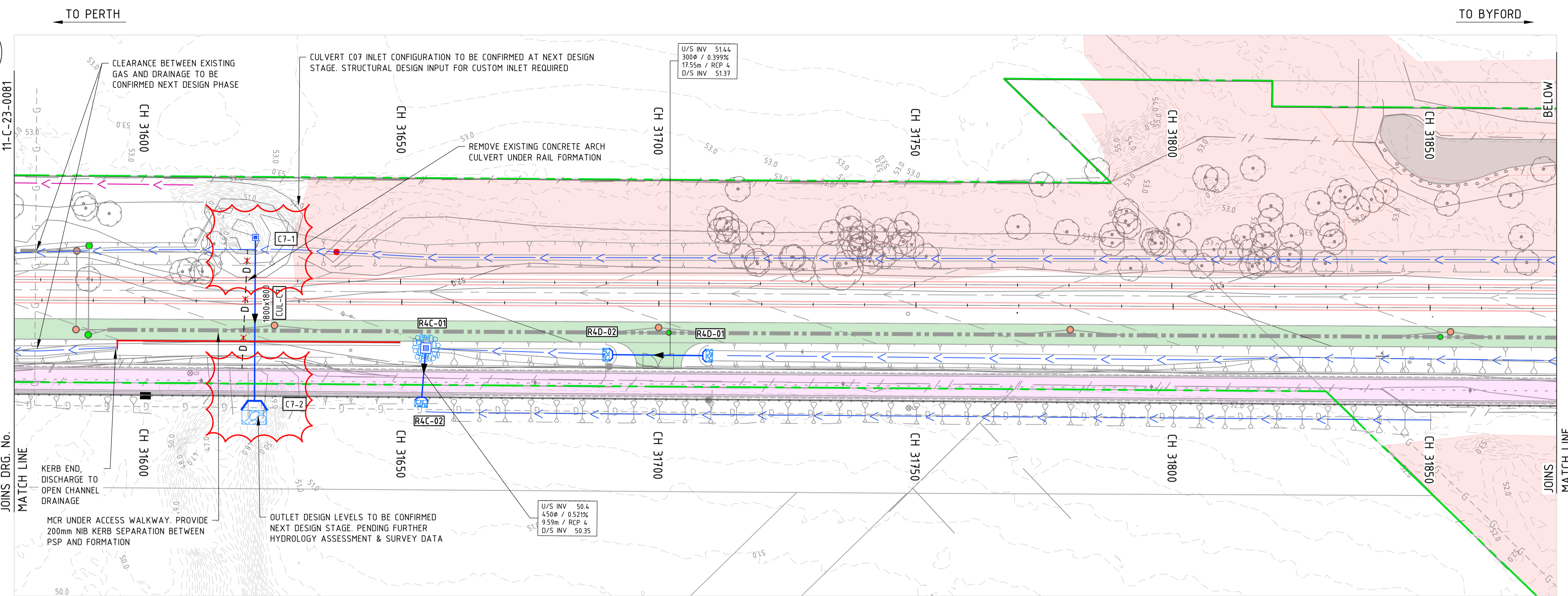
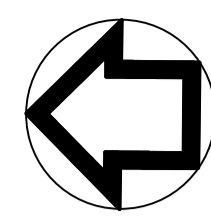
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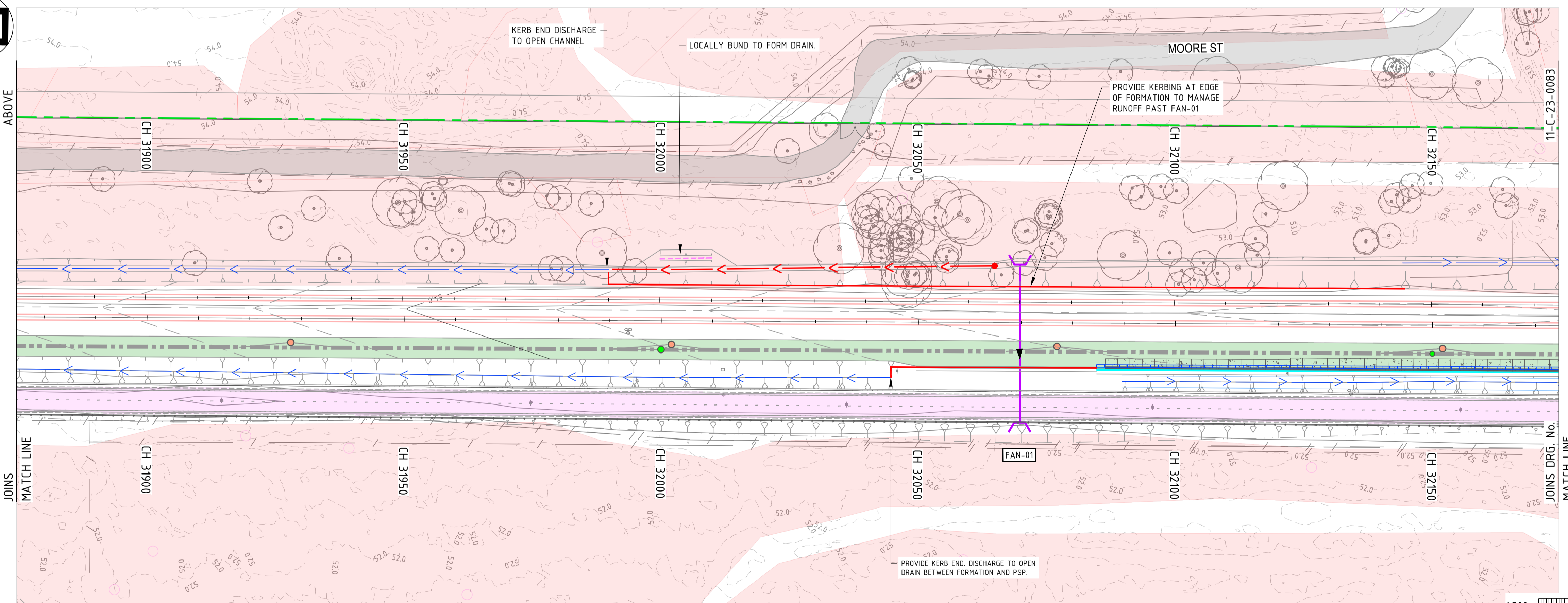
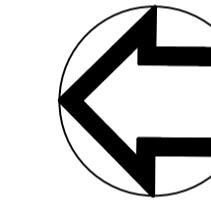
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Contractor No: R30-MET-DWG-CL-155-004071 Rev: B

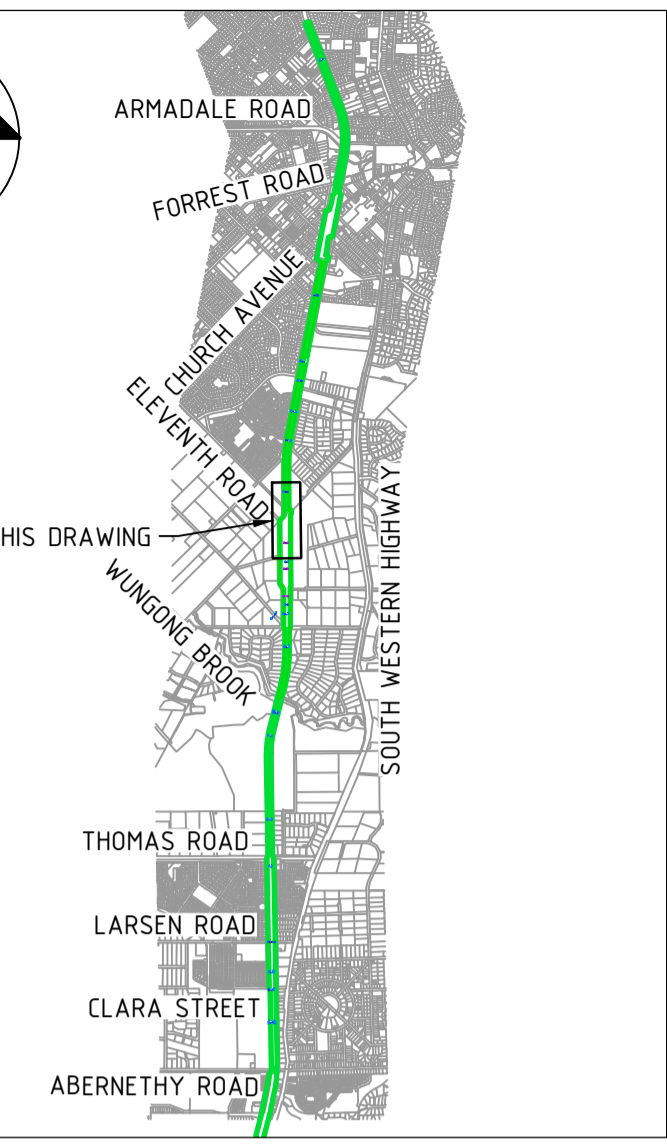
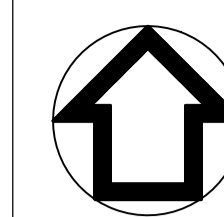
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	DATUM	DRAWN
	HORIZONTAL: PCG2020	J. YANG
	VERTICAL: AHD71	CHECKED
		N. TAITO
		APPROVED
		M. PARKER
		DATE
		15/12/22



PLAN
SCALE 1:500



PLAN
SCALE 1:500



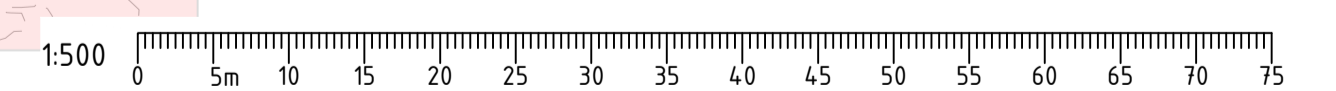
LOCALITY PLAN

NOTES

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2. FURTHER DETAILS OF INTERFACE BETWEEN MCR AND DRAINAGE INFRASTRUCTURE PROVIDED AT NEXT DESIGN STAGE.
3. REFER TO DRAINAGE STRATEGY SKETCH PLANS AND BRE-META-CL-RPT-004.12 FOR STORAGE VOLUMES.
4. CORRIDOR FENCING PROVIDED IN ST-431 DESIGN PACKAGE. TO BE SHOWN AT NEXT DESIGN STAGE.

LEGEND

- PROPOSED RAIL
- PROPOSED PLATFORMS
- PROPOSED MAINTENANCE ACCESS TRACK
- REGRADED MAINTENANCE ACCESS TRACK
- EXISTING MAINTENANCE ACCESS TRACK
- PROPOSED PSP
- EXISTING ROAD CROSSING TO BE REMOVED
- EXISTING TRACKS
- RAIL RESERVE BOUNDARY
- THREATENED ECOLOGICAL COMMUNITY AREA
- BLACK COCKATOO BREEDING TREES
- THREATENED PRIORITY FLORA SITES
- PROPOSED RETAINING WALL
- PROPOSED KERBING
- PROPOSED MCR
- PROPOSED DRAINAGE PIPE - PTA
- PROPOSED DRAINAGE PIPE - LGA
- PROPOSED FAUNA CROSSING
- EXISTING DRAINAGE PIPE
- EXISTING DRAINAGE PIPE - REMOVE
- PROPOSED DRAINAGE CHANNEL
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- DRAINAGE CATCHPIT
- SOAKWELL
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- DESIGN CONTOURS (0.2m INTERVAL)
- EXISTING CONTOURS (0.2m INTERVAL)
- EXISTING GAS, SEWER AND WATER
- RELOCATED SEWER, WATER, GAS AND POWER
- HOLD



DETAILED DESIGN

REV	DATE	AMENDMENT	DSN	DRN	CHK	APP
B	15/12/22	ISSUED FOR IDDR - PTA REVIEW	D.G.	J.Y.	N.T.	M.P.
A	22/07/22	ISSUED FOR RD - PTA REVIEW	D.G.	J.Y.	N.T.	M.P.

ORIG SIZE: A1
AT ORIGINAL PLOT SIZE

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Contractor No: R30-MET-DWG-CL-155-00408 Rev: B

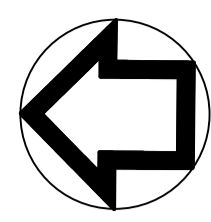
REFERENCES	SCALE	DESIGNED
	1:500	D. GLEASON
		DRAWN: J. YANG
		CHECKED: N. TAITO
		APPROVED: M. PARKER
		DATE: 15/12/22

Government of Western Australia
Public Transport Authority

BYFORD RAIL EXTENSION

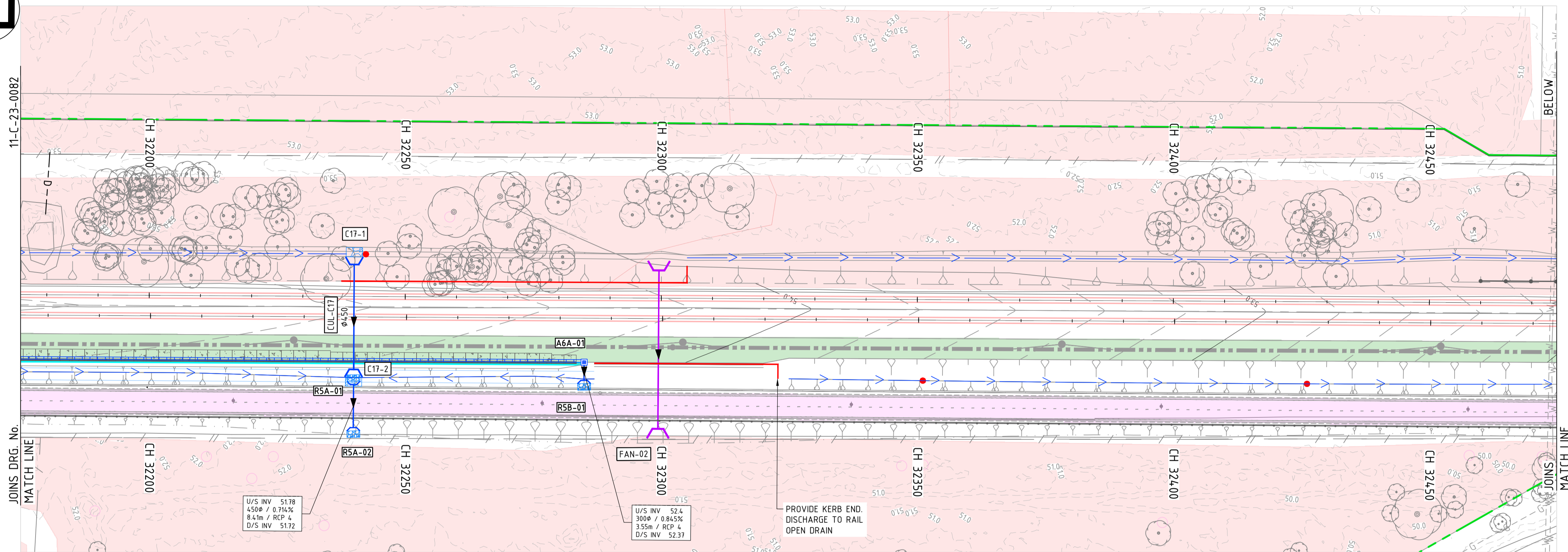
LINEWIDE
EARTHWORKS AND DRAINAGE
DRAINAGE PLAN - SHEET 8

PTA Drawing No: 11-C-23-0082 Rev: B

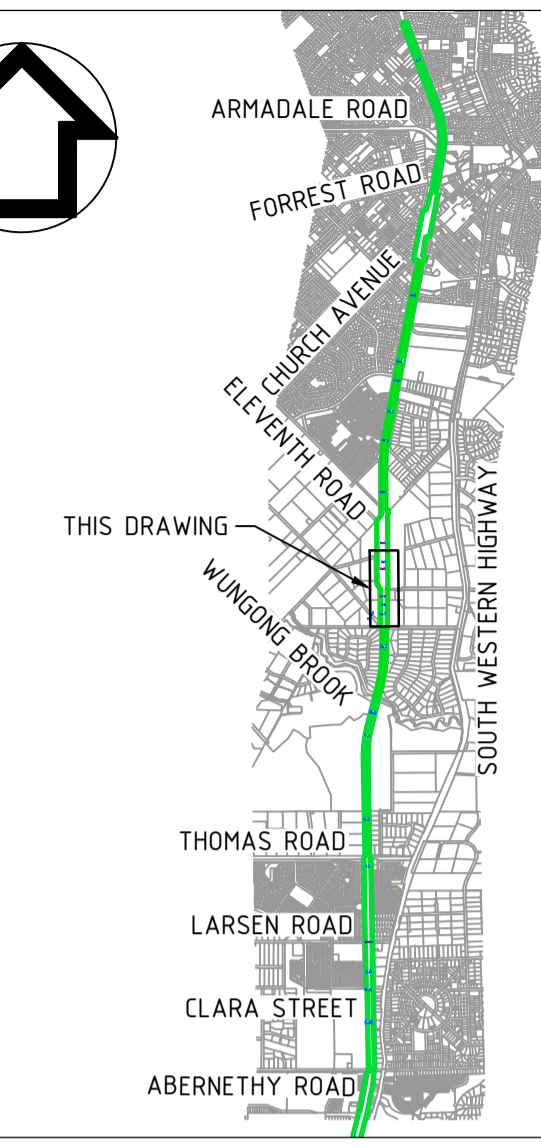
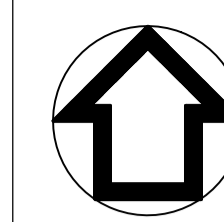


TO PERTH

TO BYFORD



PLAN
SCALE 1:500



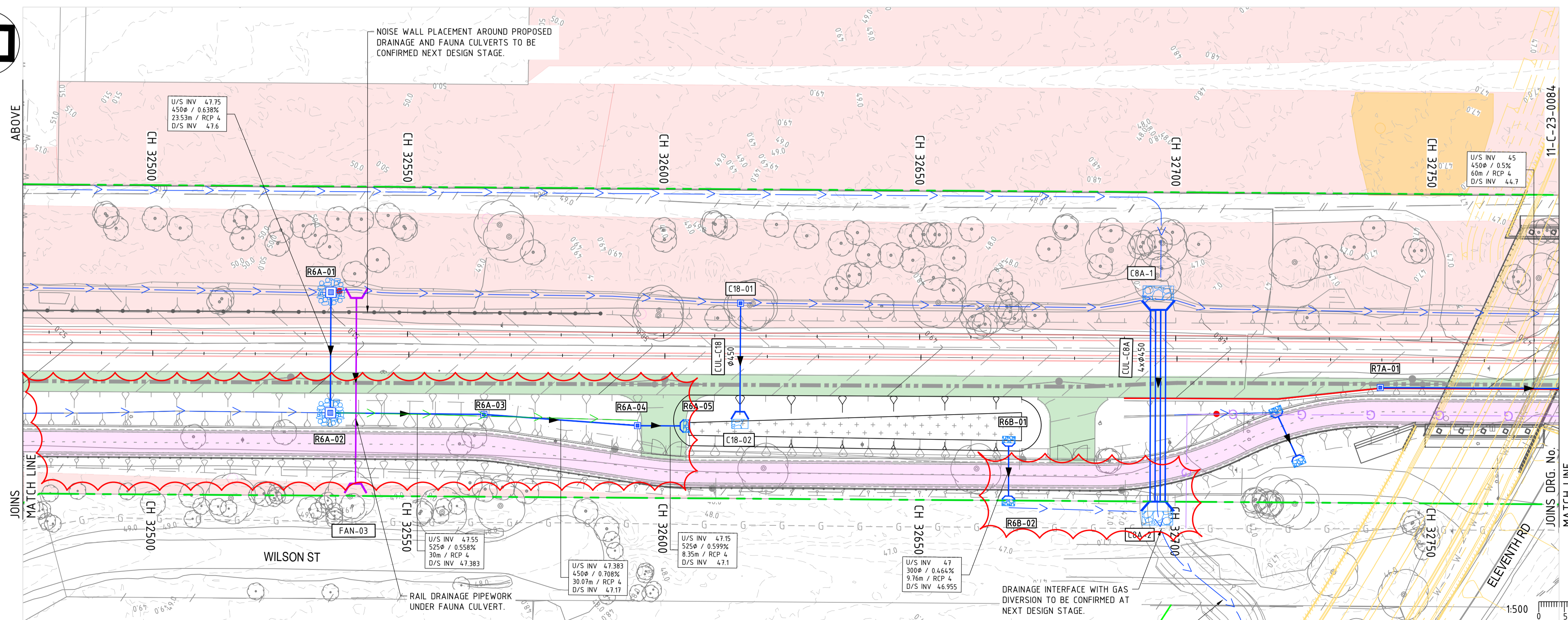
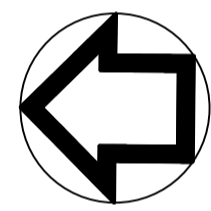
LOCALITY PLAN

NOTES

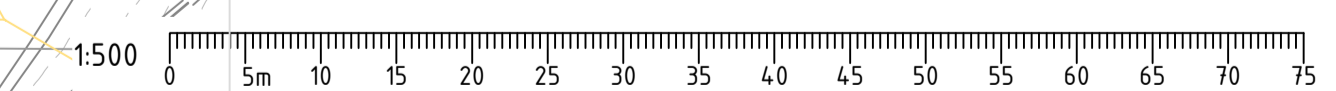
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3. REFER TO DRAINAGE STRATEGY SKETCH PLANS AND BRE-META-CI-RPT-004.12 FOR STORAGE VOLUMES.
4. CORRIDOR FENCING PROVIDED IN ST-431 DESIGN PACKAGE. TO BE SHOWN AT NEXT DESIGN STAGE.

LEGEND

- PROPOSED RAIL
- PROPOSED PLATFORMS
- PROPOSED MAINTENANCE ACCESS TRACK
- REGRADED MAINTENANCE ACCESS TRACK
- EXISTING MAINTENANCE ACCESS TRACK
- PROPOSED PSP
- EXISTING ROAD CROSSING TO BE REMOVED
- EXISTING TRACKS
- RAIL RESERVE BOUNDARY
- THREATENED ECOLOGICAL COMMUNITY AREA
- BLACK COCKATOO BREEDING TREES
- THREATENED PRIORITY FLORA SITES
- PROPOSED RETAINING WALL
- PROPOSED KERBING
- PROPOSED MCR
- PROPOSED DRAINAGE PIPE - PTA
- PROPOSED DRAINAGE PIPE - LGA
- PROPOSED FAUNA CROSSING
- EXISTING DRAINAGE PIPE
- EXISTING DRAINAGE PIPE - REMOVE
- PROPOSED DRAINAGE CHANNEL
- PROPOSED CUT OFF DRAIN
- PROPOSED CONCRETE CHANNEL
- PROPOSED IG DRAIN
- PROPOSED LGA DRAIN
- EXISTING DRAINAGE CHANNEL
- PROPOSED ACO-DRAIN
- PURPOSED BUND
- PROPOSED ROCK PITCHING
- GULLY PIT
- MANHOLE
- DRAINAGE CATCHPIT
- SOAKWELL
- DRAINAGE BLOCK
- DESIGN CONTOURS (0.2m INTERVAL)
- EXISTING CONTOURS (0.2m INTERVAL)
- EXISTING GAS, SEWER AND WATER
- RELOCATED SEWER, WATER, GAS AND POWER
- HOLD



PLAN
SCALE 1:500



REFER CI-400 DESIGN PACKAGE FOR DRAIN DIVERSION TO CULVERTS ACROSS ELEVENTH ROAD.

DETAILED DESIGN

REV	DATE	AMENDMENT	DSN	DRN	CHK	APP	
B	15/12/22	ISSUED FOR IDOR - PTA REVIEW		D.G.	J.Y.	N.T.	M.P.
A	22/07/22	ISSUED FOR RD - PTA REVIEW		D.G.	J.Y.	N.T.	M.P.

MetCONX

Contractor No: R30-MET-DWG-CI-155-004-09 Rev: B

REFERENCES	SCALE	DESIGNED
	1:500	D. GLEASON
		DRAWN: J. YANG
		CHECKED: N. TAITO
		APPROVED: M. PARKER
		DATE: 15/12/22

Government of Western Australia
Public Transport Authority

BYFORD RAIL EXTENSION

LINEWIDE
EARTHWORKS AND DRAINAGE
DRAINAGE PLAN - SHEET 9

PTA Drawing No: 11-C-23-0083 Rev: B

Appendix C: Via-Duct – Track Drainage Details and Calcs

Refer attached Appendix C.

Byford Rail Extension

Drainage Details and Calculations

1. Proposed Drainage Design

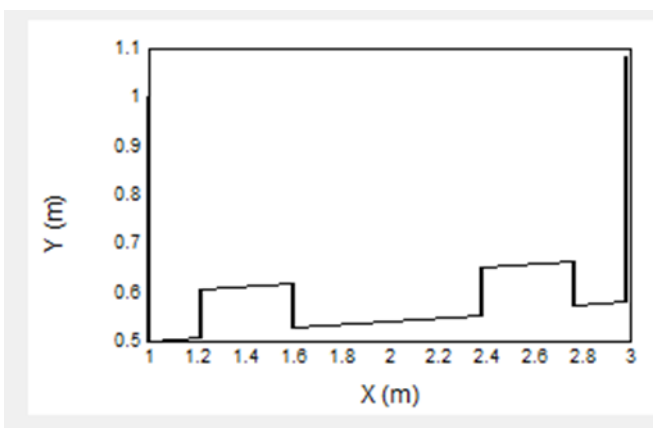
The proposed drainage strategy for structure is to convey runoff along the track slab followed by a pickup of flows off the track via kerb opening and grated inlet at every pier location excluding the Station area.

Inlet locations will dependent track xfall, some area will have inlets at both kerb locations where there is two way crossfall or on one kerb only where there is oneway crossfall. Inlets and subsequent plumbing will be sized to cater for 1% AEP peak flow ensuring no bypass past the pier. The inlet as a minimum will incorporate a sump to increase head drive and improve inlet hydraulics and grate which will be checked with an allowance for 50% blockage.

Conveyance on the track slab has calculated for the worst case scenario for each beam section using DRAINS with the key model assumptions below;

- i) Hydrology = ILSAX (AR&R 2016 rainfall data)
- ii) Channel flow methodology = Manning's (n = 0.012)
- iii) The catchment is assessed as 100% impervious only with 1mm initial loss.
- iv) No bypass occurs between inlets, 100% capture rate assumed.

Channel profiles have been created for the different x-section profiles with different inputs, i.e 1-way cant with varying xfall from 10% to 2%, 2-way cant x-fall is limited to 1%. An allowance for rail block outs has also been made when assessing channel flow depths, refer figure below.



Profile example with oneway 5% Cant.

1.1 Calculated Flow Depths and Freeboard

The attached table provides a break down of pier to pier sections with the following corresponding data;

- i) Track vertical and horizontal geometry
- ii) Track cant
- iii) Beam length and critical catchment width.
- iv) 1% AEP critical peak flow, depth and available freeboard.

Note freeboard is based on Top of Rail to top of track slab being 235mm.

The worst case scenario occurs where cant is the steepest @ 10% between pier 0 to 11 where flow depth against the RHS kerb edge is 63mm with available freeboard of 172mm. A similar worst case occurs between pier 20 and 22 where turnouts are occurring with 3% cant and near flat grades of 0.4%.

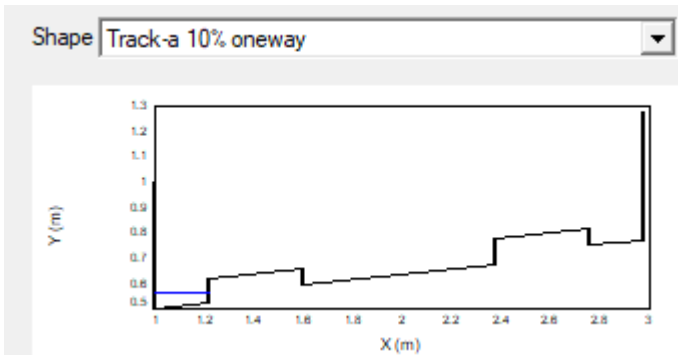


Figure 1: 1% AEP Critical Section Flow Depth

A further assessment on corresponding flow depths for the lower events is tabled below for the above worst case sections.

Table 1: Flow Depth and Free Board for Lower Storm Events

1% AEP l/s	Depth (mm)	FB (mm)	10% AEP l/s	Depth (mm)	FB (mm)	20% AEP l/s	Depth (mm)	FB (mm)	50% AEP l/s	Depth (mm)	FB (mm)	1 EY l/s	Depth (mm)	FB (mm)
13	63	172	8	43	192	7	40	195	5	40	195	5	33	202

1.2 Sensitivity Assessment

A sensitivity assessment was conducted to assess the depth sensitivity on larger storm/flow events for the above critical section. Refer Table 2 below.

Table 2: Rare event sensitivity analysis

Rare Design Rainfall Checks - 10% Cant @ 2% Grade						
%AEP	1.0%	0.50%	0.20%	0.10%	0.05%	
~ 1/ Yr	100	200	500	1000	2000	
Q (l/s)	13	16	19	21	24	
Flow Depth (mm)	63	69	77	83	88	
Freeboard (mm)	172	166	158	152	147	

Assuming a kerb height of 120mm it can be shown that flows are still contained on the track slab.

1.3 Armadale Station Case

It is currently proposed that flow is conveyed via multiple pier to pier sections (Pier 26 to 32) before discharge to an inlet. In this scenario the flow depth is 69mm (166mm FB)

Table 3: Flow depth over 6 sections

Notes	Pier		Geometry							Tracks	T.Slab Section	Track Cant	1% AEP l/s	Depth (mm)	FB (mm)
	Start	End	Horiz	Vert	Length (m)	Tot. Width (m)	Crit. Width (m)	Area (m ²)							
Station (6 Sections)	26	32	Tangent	-0.4%	30	31.1	5.1	1051	Quad	2way	1%	50	69	166	

A sensitivity check on the 1in2000 event has a flow depth of 97mm see Fig 3 below

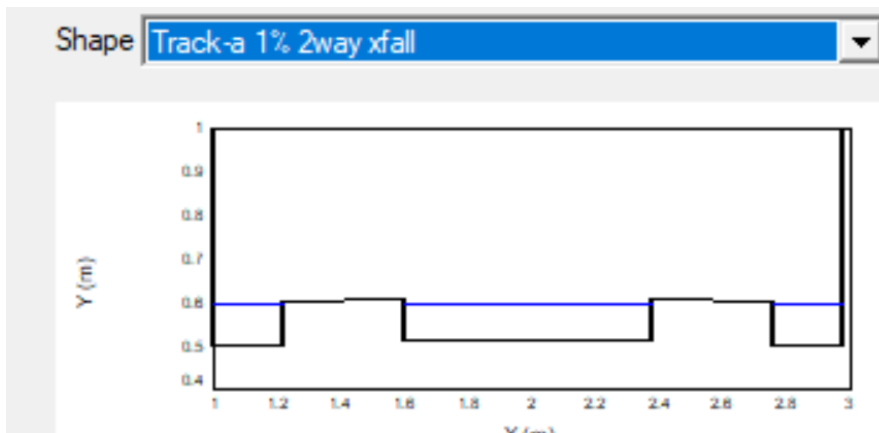


Figure 2: 1in2000yr Station Case.

1.4 Inlet design

The current proposal is to utilise a sump inlet to increase inlet capacity by increasing head and increasing blockage redundancy. To ensure 100% capture to prevent bypass to the downstream section. Fig.4 shows a proposed detail. Further detail around the inlet opening to be worked through with structures.

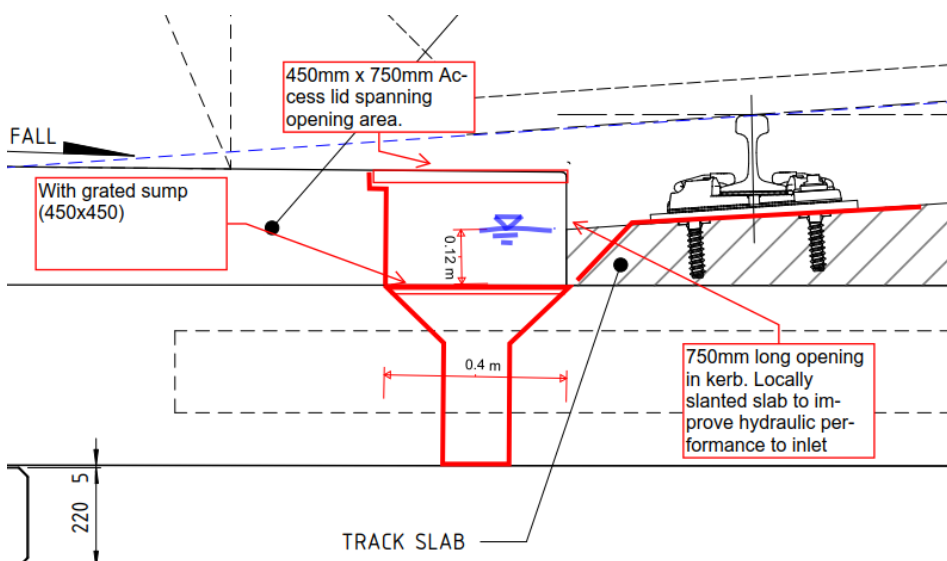


Figure 3: Inlet with Sump detail

The data below shows the hydraulic performance of the inlet arrangement based on Section 4.4.5.4 of HEC22 FHWA. With a 50% blockage factor applied to the inlet capacity, the system still allows for ~ 44l/s operating at 120mm head which is off the track slab. This provides over 2x redundancy capacity to the inlet system ensuring this is not a constriction point.

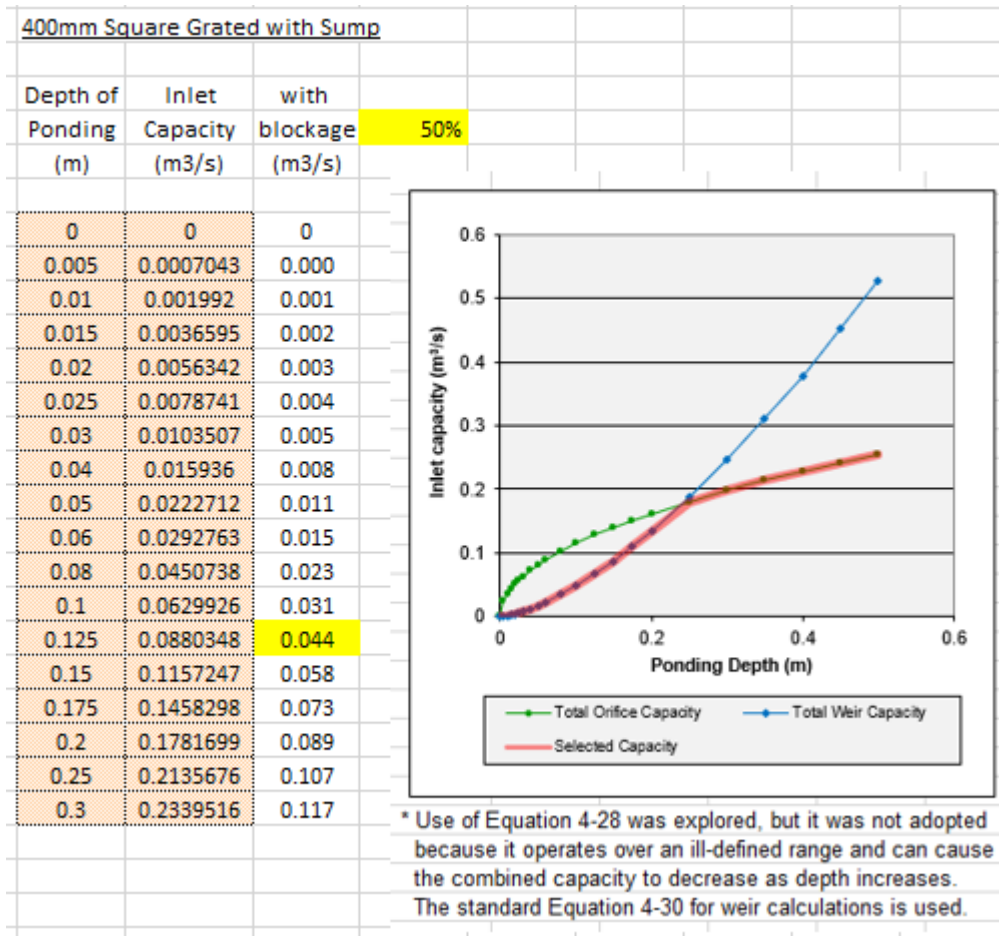


Figure 4: Inlet Hydraulic capacity with blockage

1.5 Maintenance and Operations

As the inlet is grated, cleaning of the grate will be from the via-duct via the access lid involving cleaning debris from the inlet grate. Blockage within the pipe system network is unlikely however blockages at the inlet (ontop of viaduct structure) and outlet (at ground level of piers) will be the most common points.

ATTACHMENTS

- i) ViaDuct - Conveyance Calculations
- ii) ViaDuct – Inlet locations.

Via-Duct Tack Slab - Critical runoff and depth checks																
Rainfall Data	AR&R 2016															
Hydrology Method	ILSAX (AR&R2019)															
Climate change	1.18															
Top of rail to Track Slab	235 mm															
ToR to Deck Plank	387 mm															
Geometry																
Notes	Pier Start	End	Horiz	Vert	Length (m)	Tot. Width (m)	Crit. Width (m)	Area (m2)	Tracks	T.Slab Section	Track Cant	1% AEP l/s	Depth (mm)	FB (mm)		
North Abutment	0	1	RH R1000	2.0%	35	13.0	8.0	280	Twin	1way	10%	13.0	63	172		
	1	2	RH R1000	2.0%	35	13.0	8.0	280	Twin	1way	10%	13.0	63	172		
	2	3	RH R1000	2.0%	35	13.0	8.0	280	Twin	1way	10%	13.0	63	172		
	3	4	RH R1000	2.0%	35	13.0	8.0	280	Twin	1way	10%	13.0	63	172		
	4	5	RH R1000	2.0%	35	13.0	8.0	280	Twin	1way	10%	13.0	63	172		
	5	6	RH R1000	2.0%	35	13.0	8.0	280	Twin	1way	10%	13.0	63	172		
	6	7	RH R1000	2.0%	35	13.0	8.0	280	Twin	1way	10%	13.0	63	172		
	7	8	RH R1000	2.0%	33	13.0	8.0	264	Twin	1way	10%	12.0	60	175		
	8	9	RH R1000	2.0%	33	13.0	8.0	264	Twin	1way	10%	12.0	60	175		
	9	10	RH R1000	2.0%	33	13.0	8.0	264	Twin	1way	10%	12.0	60	175		
	10	11	RH R1000	2.0%	33	13.0	8.0	264	Twin	1way	10%	12.0	60	175		
	11	12	Trans	2.0%	33	13.0	8.0	264	Twin	1way	10%	12.0	60	175		
	12	13	Trans	2.0%	33	13.0	8.0	264	Twin	1way	10%	12.0	60	175		
Crest (CHA 28761)	13	14	Trans	2.0%	33	13.0	8.0	264	Twin	1way	10%	12.0	60	175		
	14	15	Tangent	2.0%	33	13.0	8.0	264	Twin	1way	10%	12.0	60	175		
	15	16	Tangent	-0.4%	33	13.0	8.0	264	Twin	2way	1%	12.0	23	212		
	16	17	Tangent	-0.4%	33	13.0	8.0	264	Twin	2way	1%	12.0	23	212		
Forrest Rd	17	18	Tangent	-0.4%	38	13.0	6.0	230	Twin	2way	1%	11.0	22	213		
	18	19	Tangent	-0.4%	38	20.5	6.5	247	Twin	2way	1%	12.0	33	202		
	19	20	Tangent	-0.4%	38	21	6.5	262	Triple	2way	1%	12.0	33	202		
	20	21	Tangent	-0.4%	40	22.3	6.5	260	Triple	1way	3%	12.0	61	174		
	21	22	Tangent	-0.4%	34	24.5	8.0	290	Triple	1way	3%	14.0	63	172		
	22	23	Tangent	-0.4%	34	26.0	8.0	266	Triple	1way	2%	13.0	50	185		
	23	24	Tangent	-0.4%	30	26.6	8.0	270	Quad	2way	1%	13.0	34	201		
	24	25	Trans	-0.4%	30	22.0	8.0	238	Quad	2way	1%	11.0	32	203		
	25	26	Trans/Tangent	-0.4%	30	21.0	8.0	225	Quad	2way	1%	11.0	31	204		
	Station	26	27	Tangent	-0.4%	30	31.1	5.1	165	Quad	2way	1%	8.0	27	208	
	Station	27	28	Tangent	-0.4%	30	31.1	5.1	165	Quad	2way	1%	8.0	27	208	
	Station	28	29	Tangent	-0.4%	30	31.1	5.1	165	Quad	2way	1%	8.0	27	208	
	Station	29	30	Tangent	-0.4%	30	31.1	5.1	165	Quad	2way	1%	8.0	27	208	
	Station	30	31	Tangent	-0.4%	30	31.1	5.1	165	Quad	2way	1%	8.0	27	208	
		31	32	Tangent	-0.4%	30	21.5	8.0	226	Quad	2way	1%	11.0	32	203	
32		33	Tangent/Trans/L800	-0.4%	30	22.0	7.6	229	Quad	2way	2%	11.0	32	203		
33		34	L800	-0.4%	30	22.0	8.0	239	Quad	2way	2%	11.0	32	203		
34		35	L800/Trans	-0.4%	30	26.0	8.0	237	Quad	2way	1%	11.0	32	203		
35		36	Trans	-0.4%	32	25.5	8.0	249	Quad	2way	1%	12.0	33	202		
36		37	Tangent	-0.4%	34	25.0	7.5	215	Triple	2way	1%	10.0	30	205		
37		38	L800	-0.4%	34	15.9	6.0	214	Triple	2way	2%	10.0	30	205		
38		39	Tangent	-0.4%	32	13.5	7.0	210	Triple	2way	1%	10.0	30	205		
Church St		39	40	LH R1250	-0.4%	38	11.7	6.0	228	Twin	1way	3%	11.0	59	176	
		VIP	40	41	LH R1250	-2.0%	35	11.7	6.0	210	Twin	1way	3%	10.0	45	190
	41	42	LH R1250	-2.0%	35	11.7	6.0	210	Twin	1way	3%	10.0	45	190		
	42	43	LH R1250	-2.0%	35	11.7	6.0	210	Twin	1way	3%	10.0	45	190		
	43	44	Trans	-2.0%	35	11.7	6.0	210	Twin	2way	1%	0.0	21	214		
South Abutment	44	45	Tangent	-2.0%	35	11.7	6.0	210	Twin	2way	1%	0.0	21	214		
	45	46	Tangent	-2.0%	35	11.7	6.0	210	Twin	2way	1%	0.0	21	214		
Station (6 Sections)	26	32	Tangent	-0.4%	30	31.1	5.1	1051	Quad	2way	1%	50.0	69	166		
Assessment with 6% Cant	0	15	RH R1000	2.0%	35	13.0	8.0	280	Twin	1way	6%	13.0	55	180		
Assessment with 5% Cant	0	15	RH R1000	2.0%	35	13.0	8.0	280	Twin	1way	6%	13.0	55	180		
Notes																
1 Assumes track slab is longitudinally continuous																
2 Mannings - Flow depth calculation method																
3 Roughness coefficient (n=0.012)																
4 Depth = Flow depth on track slab without channel provision																
5 Depth of 1% AEP flow through station area (Pier 26 to 32) = 70mm (165mm FB)																