EARTHING SYSTEM ASSESSMENT REPORT

Canberra to Woden 132kV Feeder Undergrounding

Evoenergy

December 2020

safearth

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Revision History:

Rev	Date	By	Purpose of Revision
0	1 December 2020	R.M.	Initial Release

Executive Summary

Safearth have conducted an earthing assessment on the proposed undergrounding of a section of Evoenergy's Canberra to Woden 132kV Feeder Undergrounding located in Whitlam, ACT.

The earthing system assessment has included review of the existing earthing design, assessment of the proposed cable route and visual inspection, DC continuity testing, and low-current off frequency injection testing in targeted locations to identify potential issues.

The existing earthing design incorporates Sheath Voltage Limiters (SVLs) at each pit including those at the end of major transposition sections. This effectively removes hazards from EPR at pit locations. EPR hazards remain at UGOHs however these are located in areas that are unlikely to have significant numbers of people passing through.

The cables are transposed with greatest separation between transposition points being 630m. This transposition is sufficient to effectively remove hazards from load current LFI. Fault current induced voltage hazards are significantly mitigated through use of screened cables, however some induced voltage hazards may remain and some specific recommendations for mitigation are made in the body of the report.

Contents

Appendices

1 Introduction

Evoenergy plans to underground a section of the existing 132kV feeder between the Canberra Bulk Supply Point (Canberra BSP) and Woden Zone Substation (Woden ZS). A 5km section overhead line is to be replaced by a 9.1km underground cable section as part of a customer-initiated project to facilitate development in the area.

Preliminary electrical design has been completed by Aurecon and includes two cables per phase arranged in a flat formation, as well as 17 joint bays. In addition, a second 132kV line will, during future works, be installed in parallel to this cable for approximately 5km. Although that will be future work the construction of 11 joint bays for that project will be completed as part of this project.

The proposed cable route travels through what is primarily rural land at present but major development is planned for much of the area. In addition, the route interacts with multiple fences, water pipelines, culverts, and existing overhead electrical network. Concern has been raised regarding risks associated with EPR and induction from the underground cables to these existing and future services, structures and houses.

Safearth has assessed earthing related hazards based on the preliminary electrical design, on site hazard inspections, pre-construction testing and modelling of the feeder. This report presents the findings of that assessment and recommendations regarding earthing installation and requirements for voltage mitigation and required clearances.

The assessment presented here has been carried out against Australian and Evoenergy standards including AS2067:2016, ENA-EG0, AS3835, AS4853 and AS7000.

1.1 Scope of Works

The scope of this document includes details of:

- Safety criteria selection and derivation from applicable standards for the feeder to assess risks associated with 132kV earth faults.
- Earthing system testing methods and outcomes.
- Earthing system modelling methods and outcomes.
- Our expectations regarding the performance of the earthing installation recommendations.
- Recommendations on mitigation of expected risks.

2 Assessment Inputs

2.1 Supplied or Sourced Documents

The following information has been used in the assessment.

Table 2-1 Supplied Documents

Document Description and Comments
Molonglo Valley 132kV Undergrounding Design Report Reference 506062, draft issue – Aurecon. Received from Evoenergy via FTP Transfer
Molonglo HV Clearance Check DL. Received from Evoenergy via FTP Transfer
Overhead Spatial Details. Received from Evoenergy via FTP Transfer
132kV Underground Cables Cable Jointing Pit Plan and Details – Drawing 12057-4-011. Received from Evoenergy via FTP Transfer
132kV Underground Cables Canberra Woden Sections and Details – Drawing 12057-4-012. Received from Evoenergy via FTP Transfer
132kV Underground Cables Canberra Woden – Cable Transposition Plan and Elevation – Drawing 12057-4-014. Received from Evoenergy via FTP Transfer
132kV Underground Cables Canberra Woden – Cross Bonding Schematic Diagram – Drawing 12057-4-015, 022, 023 & 024. Received from Evoenergy via FTP Transfer
132kV Underground Cables Woden – Civic – Cable Transposition Plan and Elevation – Drawing 12057-4-028. Received from Evoenergy via FTP Transfer
132kV Underground Cables Cable Jointing Pit Structural Details – Drawing 12057-4-088. Received from Evoenergy via FTP Transfer
132kV Underground Cables UGOH Details – Drawings 12057-4-030, 056, 064, 065, 069, 074, 089, 090, 092. Received from Evoenergy via FTP Transfer
ACTSD-0851 Pipe Culverts 750-1200 Dia Headwalls – Received by email
SM4607 A Guide to Working within Transmission Line Reservations. Received from Evoenergy via FTP Transfer
SC19-390-005 Rev 0 – Soil Resistivity Test Report – Molonglo Valley. Received from Evoenergy via FTP Transfer
1882-I-01 Rev B WAE – Arboretum Irrigation Plan. Received from Evoenergy via FTP Transfer
132kV Fault Details at Woden Zone Substation – Received by email
DOC211020 – Cable options – Received by email

2.2 System Configuration

To ensure the safety of an earthing system, it is imperative to assess the system under all possible fault scenarios. This includes determining the system response to all cases that will result in an earth potential rise at the site.

The existing 132kV feeder connects Canberra BSP to Woden ZS. The supplied nominal fault level for the line is 31.5kA however this is expected to drop rapidly with increasing distanced to the supply transformers at Canberra BSP, with the single phase to earth fault level at Woden ZS 132kV bus being only 17.4kA. Significantly more fault current will be supplied via Canberra BSP than via Woden ZS. Because the worst case is with all fault current coming from one point of supply our modelling has assumed full supply coming from Canberra BSP.

The design of cable cross-bonding pits specifies sheath voltage limiters (SVLs) at every cross-bonding point, including at the end of major sections. SVLs are sized so that they do not trigger during power system faults, therefore there will be no EPR at any pit with SVLs during a power system fault (other than the extremely unlikely case of a fault directly to the pit structure that somehow bypasses the screen).

Overhead sections and UGOHs will experience EPR for a greater number of faults and will therefore need to be assessed against different negligible risk thresholds.

2.3 Earth Fault Data

The amount of current that will flow during an earth fault is a significant input into any design, review or assessment of an earthing system. An accurate understanding of the earth fault clearing details is also important. Earth fault data and clearing times for the current system configuration was provided by Evoenergy, and these are summarised in the following table.

Table 2-2 Substation Earth Fault Data – Bolted Fault

Variable	Fault Level (kA)	Primary Clearing Time (mS)
Bolted 132kV Fault at Canberra end of feeder	31.5	100
Bolted 132kV Bus Fault at Woden Zone Substation	17.4	80

2.4 Soil Resistivity

To correctly design and analyse earthing systems it is necessary to understand the electrical structure of the local soil. Soil resistivity testing is used to determine electrical characteristics of the soil in which earth grids are buried and upon which structural earthing elements such as buildings are installed.

Soil resistivity values have been taken from Safearth report SC19-390-005. Because the data obviously does not cover the entire cable route conservative interpolation has been used for assessments of locations not directly covered.

The locations of the tests considered are displayed in Figure 2-1, with colour coded results of the resistivity tests are displayed graphically in Figure 2-2.

Figure 2-1
Soil Resistivity Test Locations

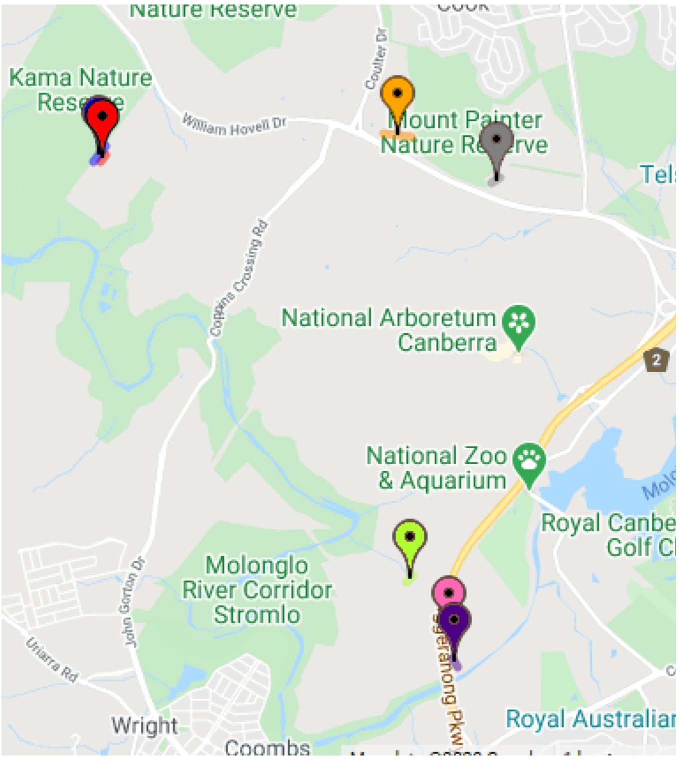
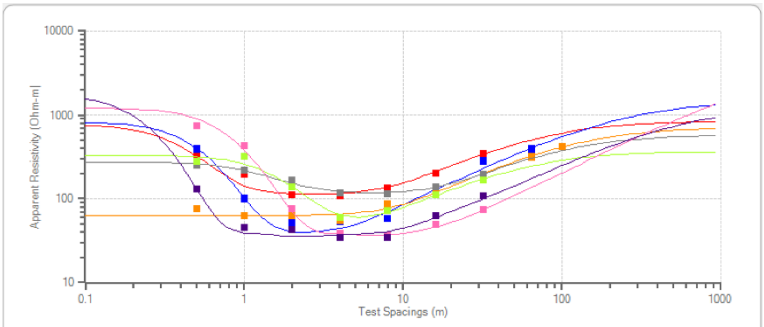


Figure 2-2
Soil Resistivity Test Results



2.5 Fault Rates

Fault rates for the specific asset have not been provided. Typical fault rates for a 132kV overhead line in southern Australia are given by Table A2 of EG-0-2010 as 1 fault per 100km per year, with underground fault rates being much lower. Given the length of the underground and overhead sections Safearth has assumed a fault rate of 0.1 faults per year for the total length of the line.

2.6 Safety Targets

Negligible risk safety targets have been derived from AS2067 based on supplied clearing times with the use of the ARGON tool. For safety targets a surface soil resistivity of 50Ω.m has been assumed. This is lower than any surface soil resistivity measured across the project area and is therefore believed to be conservative. In accordance with Evoenergy policy contact frequency for the Urban interface scenario has been assumed as 135 contacts per year.

Negligible risk threshold voltages have been calculated based on these parameters and are shown in Table 2-3 below.

Table 2-3
132kV Fault Scenario

Surface Soil Resistivity 50 Ω m

Faults / Yr 0.1

Standard Footwear

Clearing Time 0.1s

Parameter	Negligible Risk (1x 10-6)) Threshold Voltage Levels	
	Touch	Hand to Hand
TDMEN (MEN connected Items) 2000 contacts / Yr	626 V	1200 V
TDB (Unconnected Infrastructure – Fences etc) 416 Contacts / Yr	1090 V	1706 V
TDU (HV Infrastructure) 135 contacts / Yr	4,999 V	2846 V

AS/NZS 3835:2006, SAA HB101, and AS/NZS 4853:2012 (Level 2) have been used to develop the third-party coordination safety targets shown in Table 2-4.

Table 2-4: Third Party Asset Coordination Voltage Safety Targets

0.1FPY, 0.1 second clearing time

Fault/Contact Scenario	Overhead Fault
AS3835 EPR	1500 V
AS4853 Operator Gas Valve (5 contacts/5 min) Electrical Footwear	1265 V
AS4853 Pipeline Operator CP Test Location (250 contacts/5 sec) Electrical Footwear	1387 V
AS4853 Pipeline Operator Water Valve (5 contacts/60 min) Electrical Footwear	688 V
AS4853 Public CP Test Location (100 contacts/5 sec) Standard Footwear	5034 V

3 Specific Location Assessments

Specific locations for pre-construction assessment were selected following discussion with Evoenergy staff and are shown in Appendix B. Details of those assessments are presented below.

3.1 Retaining Wall

The retaining wall is constructed from rock contained within wire mesh baskets. The wire mesh consists of individually plastic-coated strands of no more than approximately 2m length and does not present an immediate hazard due to the short section length and the insulating layer. Given the expected long lifetime of the retaining wall and the unknown durability of the coating after prolonged exposure to UV and weather an assessment was carried out to determine worst-case future hazards at the site.

Figure 3-1: Reference Lead Configuration

An injection circuit was set up between two temporary earth grids at 3m horizontal separation from the retaining wall. Voltage relative to the adjacent soil was measured in a continuous 20m cable placed on the first tier of the wall, as shown in Figure 3-1. This measured voltage was then adjusted for local earth potential rise effects and actual wall exposure length and scaled to the worst-case net fault current in the cables.

The location was assessed against Backyard criteria due, for which the negligible risk threshold is 3,605 V, and calculated worst case voltage was 3,255 volts. It should be noted that this test method neglects the effect of connection to the earth of the mesh and is therefore highly conservative. Without full details of the Whitlam development it is also possible that the Backyard assessment level is overly conservative.

✓ Worst case touch voltage on the retaining wall under foreseeable future conditions will be below the relevant negligible risk threshold.

3.2 Pit 3 – Distribution Interaction

Pit 3 has been identified as being close to the newly installed padmount substation S11389.

Figure 3-2: Padmount Substation S11389

Pit 3 is not expected to experience EPR if SVLs are adequately sized. Worst case inductive exposure of LV circuits from this substation is expected to consist of 15m horizontal separation from the close edge of the cable trench for a maximum distance of 165m. With this separation and assuming a conservative shielding factor of 0.3 the worst-case inductive voltage under fault conditions will remain well below the MEN negligible risk threshold.

✓ No further action is required.

3.3 Pit 4 – Distribution Interaction

Pit 4 is located next to McDonagh Crescent, which is likely to have housing on the southern side, within around 30m of the pit. These houses are likely to be supplied from the recently installed padmount substation S11303, which is approximately 330m from the pit. No EPR is expected at Pit 4. Worst case inductive exposure of LV circuits from this substation is expected to consist of minimum 35m horizontal separation from the close edge of the cable trench for a maximum distance of 261m. With this separation and assuming a conservative shielding factor of 0.3 the worst-case inductive voltage under fault conditions will remain well below the MEN negligible risk threshold.

✓ No further action is required.

3.4 Water Main Induction

Approximately 470m of existing water pipeline is to be abandoned, cut and capped as part of the works around the Whitlam development. This water main crosses the planned cable path, with approximately 443m of equivalent parallel exposure. If this pipeline is conductive then the calculated voltage differential between far ends will be approximately 1,000V. The backyard negligible risk voltage threshold is 1,090V. Because several conservative assumptions have been made in the calculation of induced voltage and it is unlikely that the full voltage differential will appear as a voltage relative to the surrounding soil at one end of the pipe this is not expected to be a non-compliance, however it is suggested that this be checked during commissioning testing, and if required the pipeline be located and be cut in additional locations to reduce induced voltage.

> If the pipeline is conductive capped ends should be located during commissioning testing of the feeder to assess the need for additional breaks in the abandoned section.

3.5 Pit 5 – Traffic Signal Interaction

Pit 5 is planned to be approximately 34m from the closest touch point of the traffic signals at the intersection of Coulter Drive and William Hovell Drive, and approximately 132m from pole substation S3685, which is believed to supply these signals. Because no EPR is expected at Pit 5 no further action is required.

✓ No further action is required.

3.6 Pit 9 – Existing 132kV and Pole Sub 8826 Interaction

Pit 9 is planned to be approximately 72m from pole substation S8826 with Pit 18 slightly further away, and approximately 93m from the nearest pole of the Civic-Woden 132kV overhead line (Note that this line will in the future be converted to underground to make use of the additional pits built and assessed as part of the current project, but that conversion will be a separate project and this project will be commissioned while that line remains as overhead).

Because no EPR is expected at Pits 9 and 18 no further action is required.

✓ No further action is required.

3.7 Pit 10 – Interaction with headwall

Pit 10 is to be located approximately 67m from a proposed culvert. Because no EPR is expected at Pit 10 no further action is required.

✓ No further action is required.

3.8 Arboretum Irrigation Systems

There is a large interconnected irrigation system running across the Arboretum, however pipes in this system are non-conductive and so will not present a transfer risk. It is noted that there are conductive draw-wires in place that are used for locating the pipework, however the frequency of access to this draw wire system is extremely low. Nevertheless, it is recommended that Arboretum infrastructure remain at least 3m from the planned cable route in order to minimise disturbance of the soil in the area.

> Clearances maintained to Arboretum irrigation systems should be appropriate to avoid mechanical interference with the cables.

3.9 Pit 14 – Headwall Interaction

Pit 14 is approximately 12m from a planned stormwater headwall, and Pit 24 is only slightly further from the headwall in the other direction. Because no EPR is expected at Pits 14 and 24 no further action is required.

✓ No further action is required.

3.10 Sewer line

The sewer line shown on a services search is understood to be non-conductive and therefore will not present earthing related hazards.

✓ No further action is required.

3.11 Black Mountain Feeder Interaction

The presently planned location of Pit 16 is approximately 49m from the nearest pole of the 11kV Black Mountain feeder. The feeder runs parallel to the proposed cable route for approximately 135m with a horizontal separation of approximately 30m. Worst case induced voltage under fault conditions will be below 200V, which will not significantly affect Black Mountain Feeder.

✓ No further action is required.

3.12 Kangaroo Fence

The UGOH at the southern end of the underground section is close to a long continuous chain mesh kangaroo fence. Under fault conditions there will be a significant voltage rise at the UGOH, with the final magnitude dependent on the achieved earth grid resistance. Continuity testing has shown this fence to have good electrical continuity and so it is likely to see significant voltage rise for a considerable part of its length from this voltage rise at the UGOH.

Figure 3-3: Kangaroo Fence

The fence is, however, in a location where it will be only infrequently accessed, and it is not expected to present touch voltages above the negligible risk threshold for Urban Interface locations.

> Transfer voltages on the fence should be tested during acceptance testing of the UGOH, and isolation sections should be installed in the fence as required.

3.13 Advertising Billboards

Advertising billboards are planned for the corner of John Gorton Drive and William Hovell Drive. These billboards will have a maximum length of approximately 8m and will be approximately 180m from the nearest pit (Pit 4). Because there will be no EPR at cable pits under power system fault conditions there will not be touch voltages above negligible risk thresholds at these billboards due to power system faults.

✓ No further action is required.

4 General Recommendations

The route crosses or parallels many rural fences. It is possible that there will be hazards appearing at those fences that are parallel to the cable route for significant distance (with the critical exposure length being a function of separation from the completed cable). Because of the relatively low cost and simplicity of mitigating hazards on rural fences through appropriate use of isolating sections it is recommended that commissioning testing is used to confirm details of these hazards. This will allow for more exact hazard identification and ensure that mitigation is appropriate.

4.1 SM4607 Construction Guidelines

Construction guidelines are presented in SM4607. These are considered broadly applicable, but it is noted that section 2.2 allows metallic fences or railings below 2.4m height to be up to 3m long. This is likely to present a hazard if these railings are too close to a tower or pit, and it is recommended that within 20m of a tower or pit fences or railings be non-metallic.

Further, that same section (2.2) also permits lighting poles, subject to having an underground power supply and maintaining compliance with AS7000 clause 3.11.2.2. Given that a lighting pole will almost certainly present a transfer voltage hazard and is also likely to be in an area with reasonably high occupation levels it is recommended that this be replaced with a requirement that any power supply within the easement area or within 20m of a pole, tower or pit be subject to an earthing assessment.

4.2 Future Molonglo Development

There are plans for additional development within the area bounded by John Gorton Drive, William Hovell Drive, and the Arboretum. This includes the area through which the new underground 132kV cable section is routed. Due to the use of SVLs at all cable pits there will not be EPR related hazards from this cable within the subsequent development, however there may be LFI related hazards.

Specific recommendations on trigger points on exposure length of continuous conductive structures will be made following commissioning testing, however it is anticipated that specific assessment will be required for conductive structures in accordance with Table 4-1.

Table 4-1: Trigger exposure lengths for specific assessments

0.1FPY, 0.1 second clearing time

Separation from Cable Trench (m)	Assessment Trigger Length (m)
5	200
10	225
15	250
20	275
25	300
30	325
40	350
50	375

5 Conclusions

Work has commenced on the undergrounding of a section of the exiting overhead 132kV transmission line between Canberra BSP and Woden ZS, with conduit already installed around some areas of the Whitlam development.

Free land to the north of the Whitlam development is constrained meaning that several cable pits in that area will be close to the developed zone. In order to avoid EPR related hazards during a fault on the feeder all cable pits have been designed with SVLs, and this is expected to effectively eliminate EPR related hazards at cable pits. EPR related hazards remain at the UGOHs at either end of the undergrounded section and it is recommended that appropriate mitigation for these hazards be determined during commissioning testing.

Inductive hazards are not expected to exceed negligible risk thresholds within the area of development, however it is likely that there will be inductive voltage hazards above applicable negligible risk thresholds on multiple sections of fence with long parallel exposures to the new cable. Given the low cost and complexity of mitigation of these hazards it is suggested that appropriate mitigation be determined during commissioning testing to avoid unnecessary expenditure.

Specific actions are summarised below:

- If the pipeline between pits 3 and 4 is conductive then capped ends should be located during commissioning testing of the feeder to assess the need for additional breaks in the abandoned section.
- Transfer voltages on the kangaroo fence adjacent to Tuggeranong Parkway should be tested during acceptance testing of the southern UGOH, and isolation sections should be installed in the fence as required.
- Farm fences should be tested for touch voltage hazards during commissioning testing. If hazards above negligible risk thresholds are identified they should be mitigated through installation of isolating sections.

6 Bibliography

[1] AS/NZS 2067:2016 'Substations and high voltage installations exceeding 1 kV a.c.'. Standards Australia.

[2] AS/NZS 3000:2007, 'Electrical Installations (known as the Australian/New Zealand Wiring Rules)'. Standards Australia

[3] AS/NZS 3835.1:2006 'Earth Potential Rise - Protection of Telecommunications Network Users, Personnel and Plant - Code of practice'. Standards Australia.

[4] AS/NZS 4853:2012, 'Electrical Hazards on Metallic Pipelines'. Standards Australia.

[5] AS/NZS 60479:2010 'Effects of current on human beings and livestock', Standards Australia.

[6] AS/NZS 7000:2010 'Overhead Line Design – Detailed Procedures'. Standards Australia.

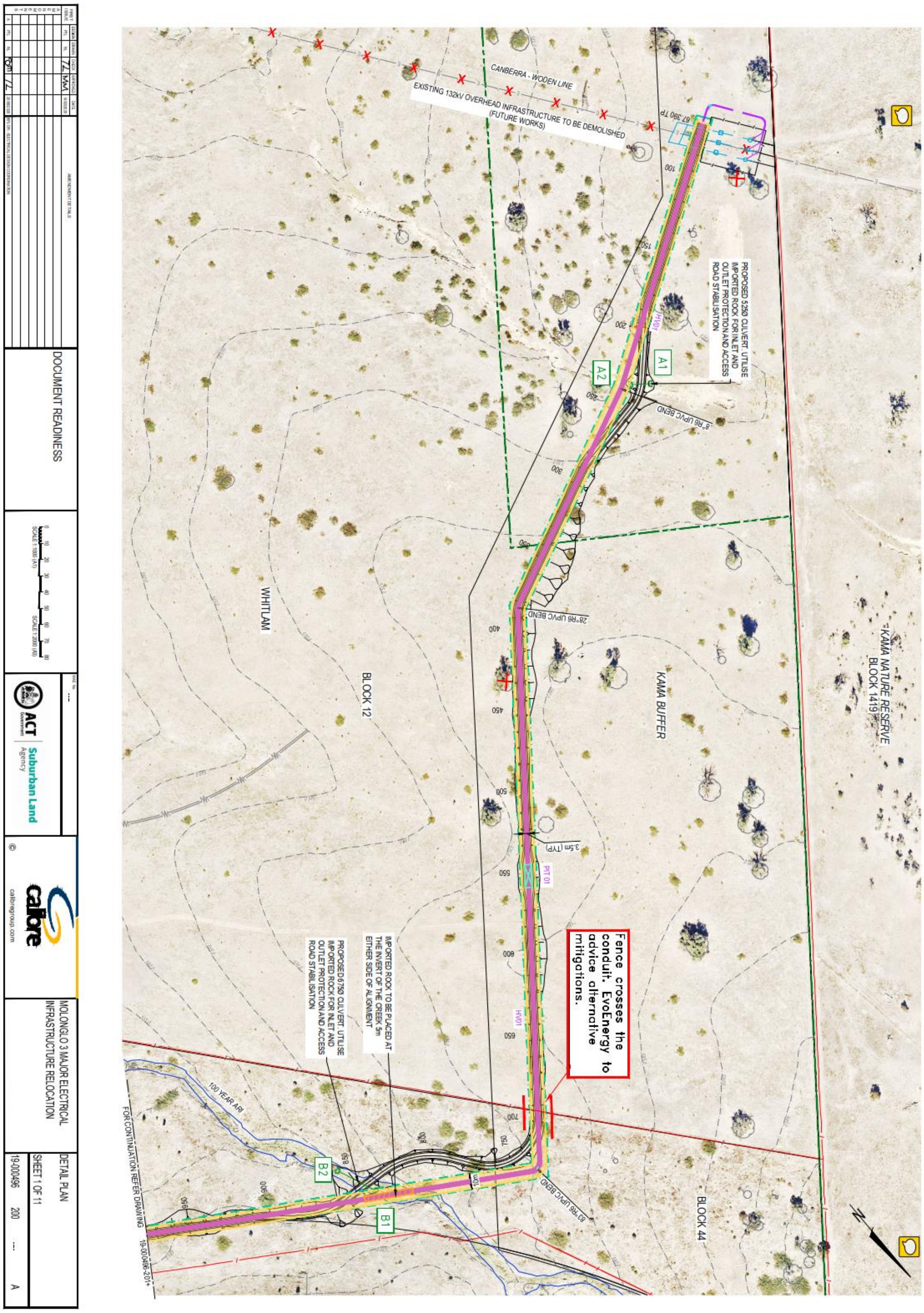
[7] Energy Networks Association, ARGON software, http://www.ena.asn.au/?cat=568

[8] ENA EG-0 'Power System Earthing Guide Part 1: Management Principles.' Energy Networks Association. August 2010.

Appendix A Glossary

Glossary Entry	Definition
ABS	Air break switch
Clearing Time	Time taken for protective devices and circuit breaker to isolate the fault current
Coupling Factor	The magnitude of the current returned on a faulted circuits screens and sheath, or OHEW expressed as a percentage of the fault current magnitude.
ECC	Earth Continuity Conductor – Typically a PVC covered conductor run in parallel to transmission cables, especially where the feeder screens are single point bonded
Earth Grid	A connection to the greater mass of the earth, usually made by burying metallic conductors in the soil
EPR	Earth Potential Rise - The maximum voltage that a station earth grid will attain relative to a distant earthing point assumed to be at the potential of remote earth
Induced Voltage	The voltage on a metallic structure resulting from the electromagnetic or electrostatic effect of a nearby power line.
LFI	The induced voltage created by electromagnetic fields created by normal power system operating frequencies, typically 50 or 60 Hz.
Mesh Voltage	The V_{Mesh} is the touch voltage within a mesh, and the maximum value used for design purposes with a station grid.
MER	MER is an occurrence whereby voltage coupling between earth systems affects the apparent impedance of the combined systems. Soil resistivity structure, system sizes and separation, and current relationship contribute to MER's significance.
OHEW	Overhead earth wire
Shielding Factor	One hundred percent minus the magnitude of the current returned on a faulted cable's screens and sheath expressed as a percentage of the fault current magnitude.
Touch Voltage	Prospective: The open circuit voltage difference between a conductive structure (within 2.4 metres of the ground), and a point on the earth's surface separated by a distance equal to a man's normal horizontal reach (approximately 1 metre). Loaded: The voltage across a body, in a position described as for Prospective but allowing for the voltage drop through the touch voltage circuit caused by current flow in the body
Transfer Voltage	A special case of Touch Voltage where the conductive item touched is connected to a remote point or alternatively is connected to the station grid and is touched at a remote location.
Zero Sequence Current	The fault current flowing through phases and all earth return paths as the result of line(s) to ground faults on the power system ($I_{Fault} = 3I_0$)

Appendix B Specific Assessment Locations


CANBERRA - WODEN LINE
EXISTING 132kV OVERHEAD INFRASTRUCTURE TO BE DEMOLISHED (FUTURE WORKS)
PROPOSED 5/250 CULVERT. UTILISE IMPORTED ROCK FOR INLET AND OUTLET PROTECTION AND ACCESS ROAD STABILISATION
Fence crosses the conduit. EvoEnergy to advice alternative mitigations.
IMPORTED ROCK TO BE PLACED AT THE INVERT OF THE CREEK 5m EITHER SIDE OF ALIGNMENT
PROPOSED 6/250 CULVERT. UTILISE IMPORTED ROCK FOR INLET AND OUTLET PROTECTION AND ACCESS ROAD STABILISATION
100 YEAR ARI
WHITLAM
BLOCK 12
KAMA BUFFER
KAMA NATURE RESERVE BLOCK 1419
BLOCK 44
A1
A2
B1
B2
PIT 01
3.5m (TYP)
DOCUMENT READINESS
ACT Government
Suburban Land Agency
calibregroup.com
MOLONGLO 3 MAJOR ELECTRICAL INFRASTRUCTURE RELOCATION
DETAIL PLAN
SHEET 1 OF 11
19-00496
200
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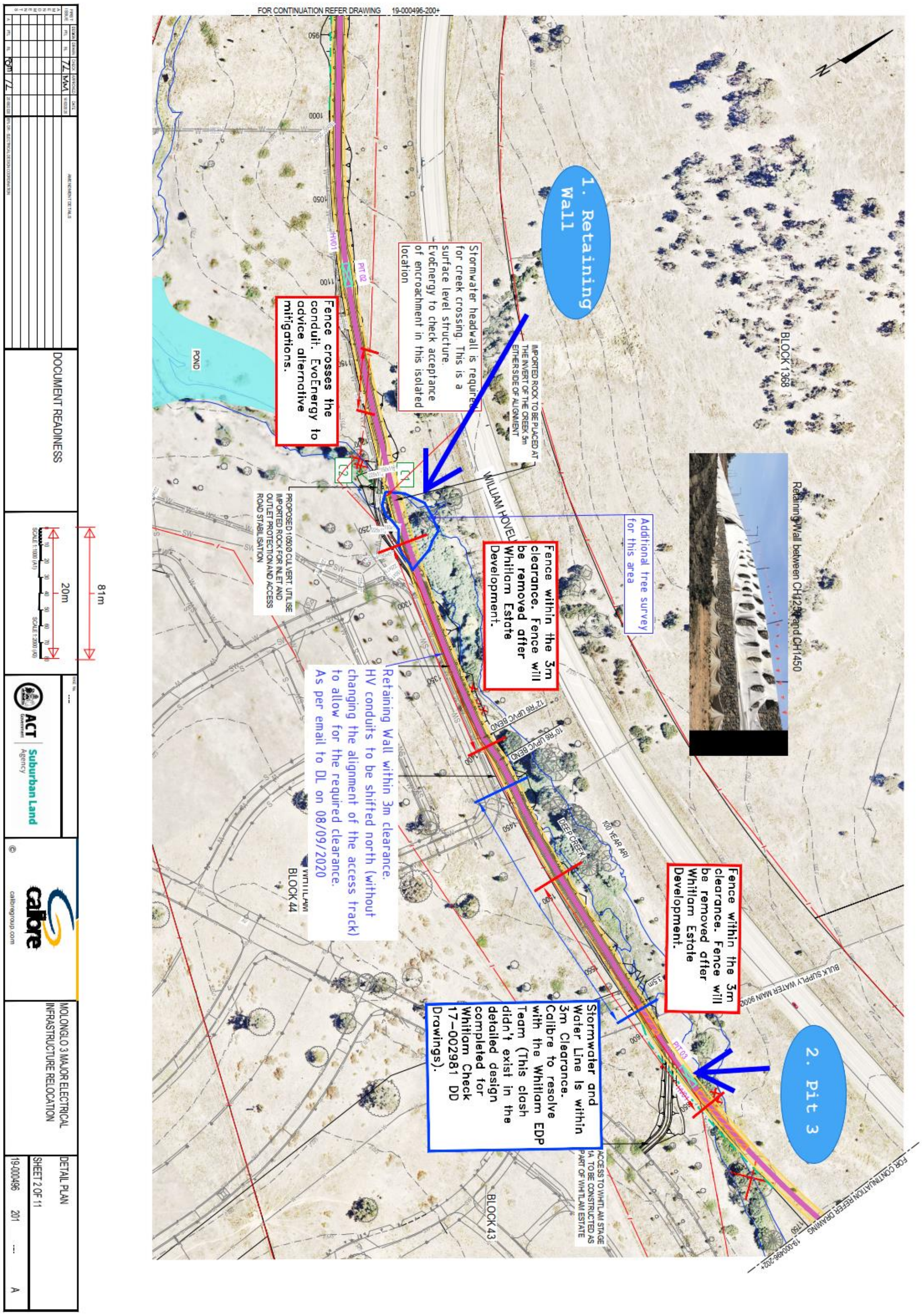
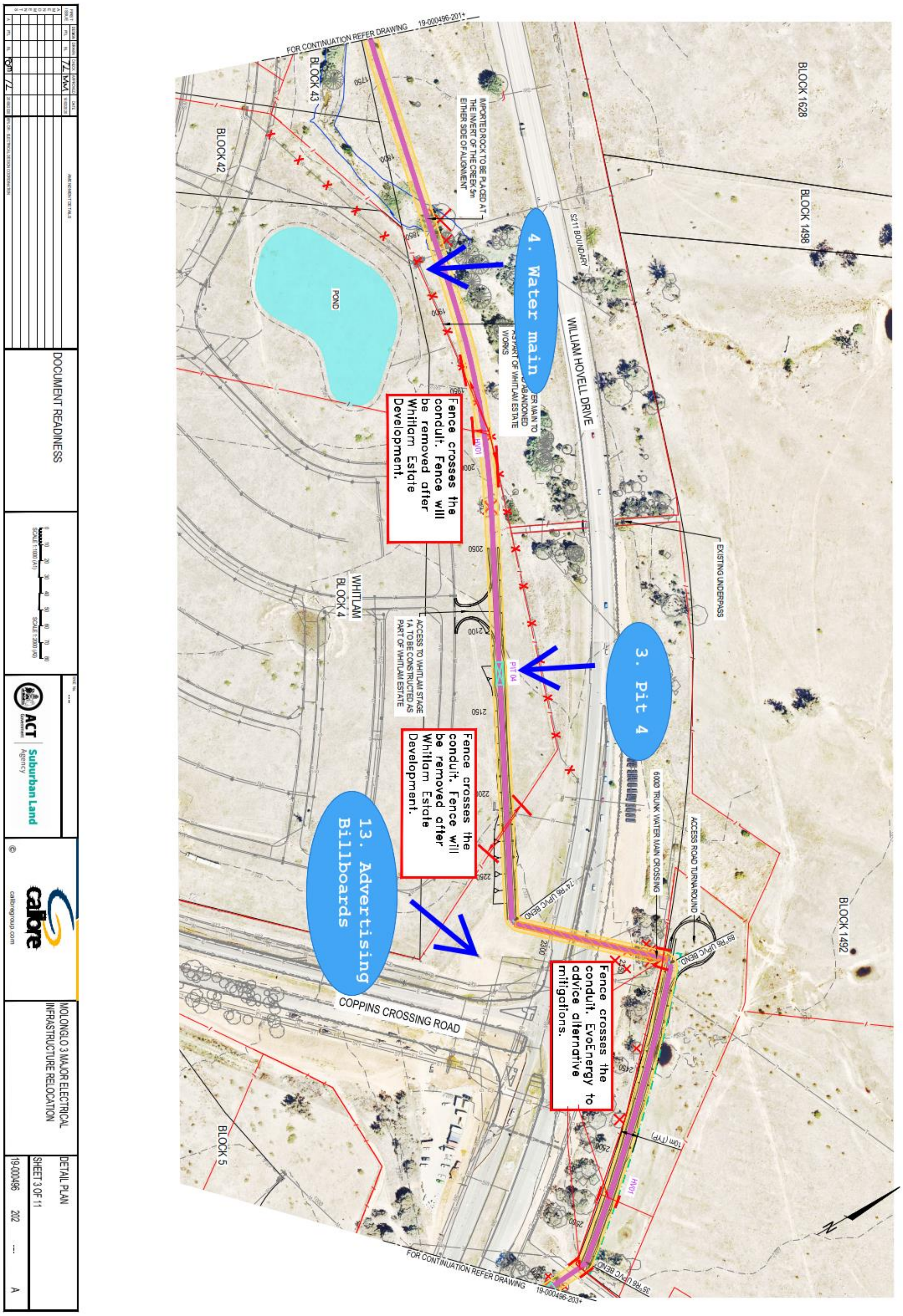
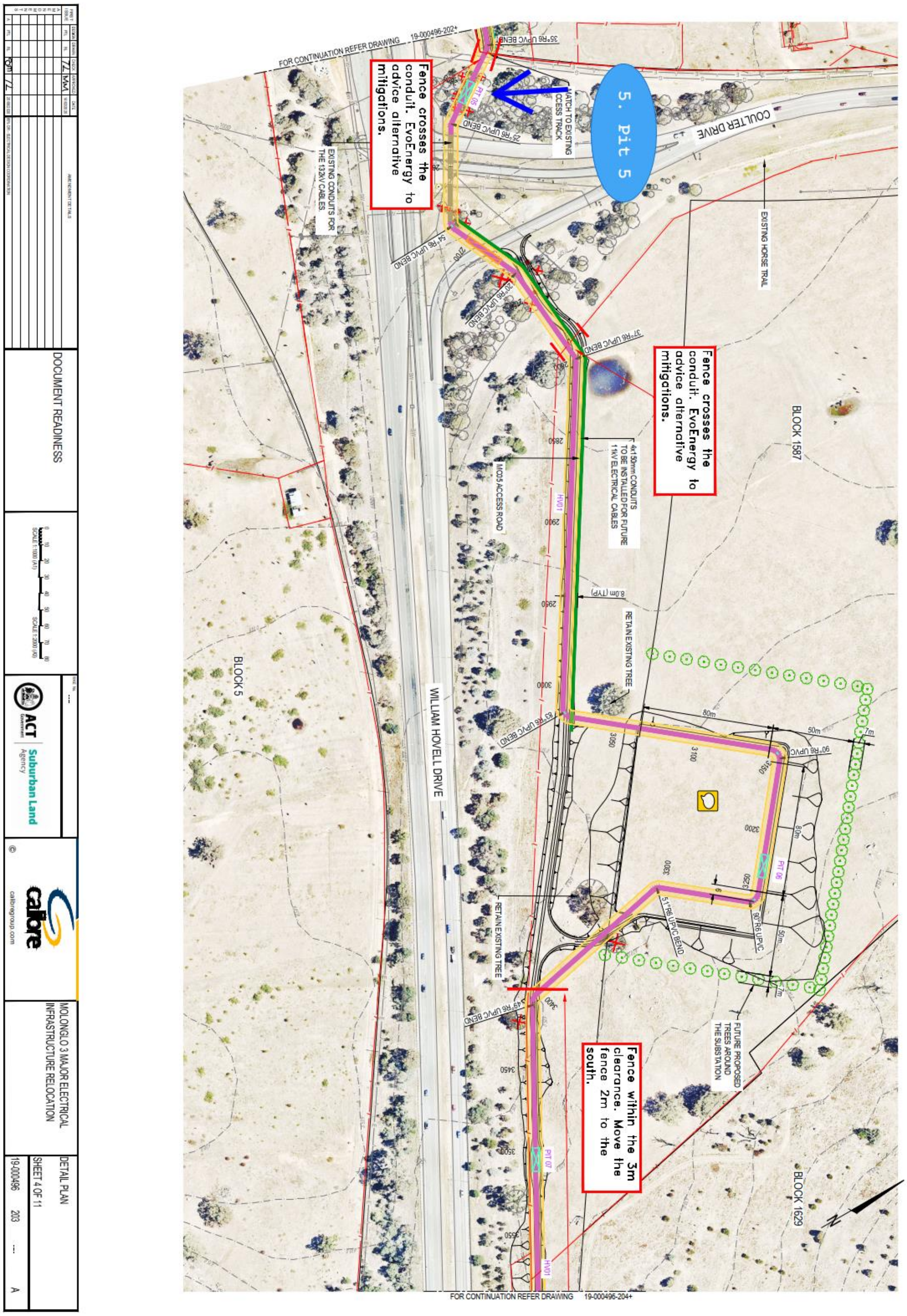


1. Retaining Wall
2. Pit 3
Stormwater headwall is required for creek crossing. This is a surface level structure. EvoEnergy to check acceptance of encroachment in this isolated location
Fence crosses the conduit. EvoEnergy to advice alternative mitigations.
Fence within the 3m clearance. Fence will be removed after Whitlam Estate Development.
Additional tree survey for this area
Retaining Wall within 3m clearance. HV conduits to be shifted north (without changing the alignment of the access track) to allow for the required clearance. As per email to DL on 08/09/2020
Stormwater and Water Line is within 3m Clearance. Calibre to resolve with the Whitlam EDP Team (This clash didn't exist in the detailed design completed for Whitlam Check 17-002981 DD Drawings).
Retaining Wall between CH1250 and CH1450
BLOCK 1368
BLOCK 44
BLOCK 43
WILLIAM HOVELL DRIVE
POND
FOR CONTINUATION REFER DRAWING 19-000496-200+
DOCUMENT READINESS
MOLONGLO 3 MAJOR ELECTRICAL INFRASTRUCTURE RELOCATION
DETAIL PLAN
SHEET 2 OF 11
19-000496
201
A
81m
20m
ACT Government
Suburban Land Agency
calibre
calibregroup.com


4. Water main
3. Pit 4
13. Advertising Billboards
Fence crosses the conduit. Fence will be removed after Whitlam Estate Development.
Fence crosses the conduit. Fence will be removed after Whitlam Estate Development.
Fence crosses the conduit. EvoEnergy to advice alternative mitigations.
WILLIAM HOVELL DRIVE
COPPINS CROSSING ROAD
POND
BLOCK 43
BLOCK 42
BLOCK 1628
BLOCK 1498
BLOCK 1492
BLOCK 5
WHITLAM BLOCK 4
EXISTING UNDERPASS
ACCESS ROAD TURNAROUND
FOR CONTINUATION REFER DRAWING 19-000496-201+
FOR CONTINUATION REFER DRAWING 19-000496-203+
DOCUMENT READINESS
MOLONGLO 3 MAJOR ELECTRICAL INFRASTRUCTURE RELOCATION
DETAIL PLAN
SHEET 3 OF 11
19-000496 202 A
ACT Government
Suburban Land Agency
calibre
calibregroup.com



5. Pit 5
Fence crosses the conduit. EvoEnergy to advice alternative mitigations.
Fence crosses the conduit. EvoEnergy to advice alternative mitigations.
Fence within the 3m clearance. Move the fence 2m to the south.
COULTER DRIVE
WILLIAM HOVELL DRIVE
BLOCK 1587
BLOCK 5
BLOCK 1629
EXISTING HORSE TRAIL
FOR CONTINUATION REFER DRAWING 19-000496-202+
FOR CONTINUATION REFER DRAWING 19-000496-204+
DOCUMENT READINESS
MOLONGLO 3 MAJOR ELECTRICAL INFRASTRUCTURE RELOCATION
DETAIL PLAN
SHEET 4 OF 11
19-000496
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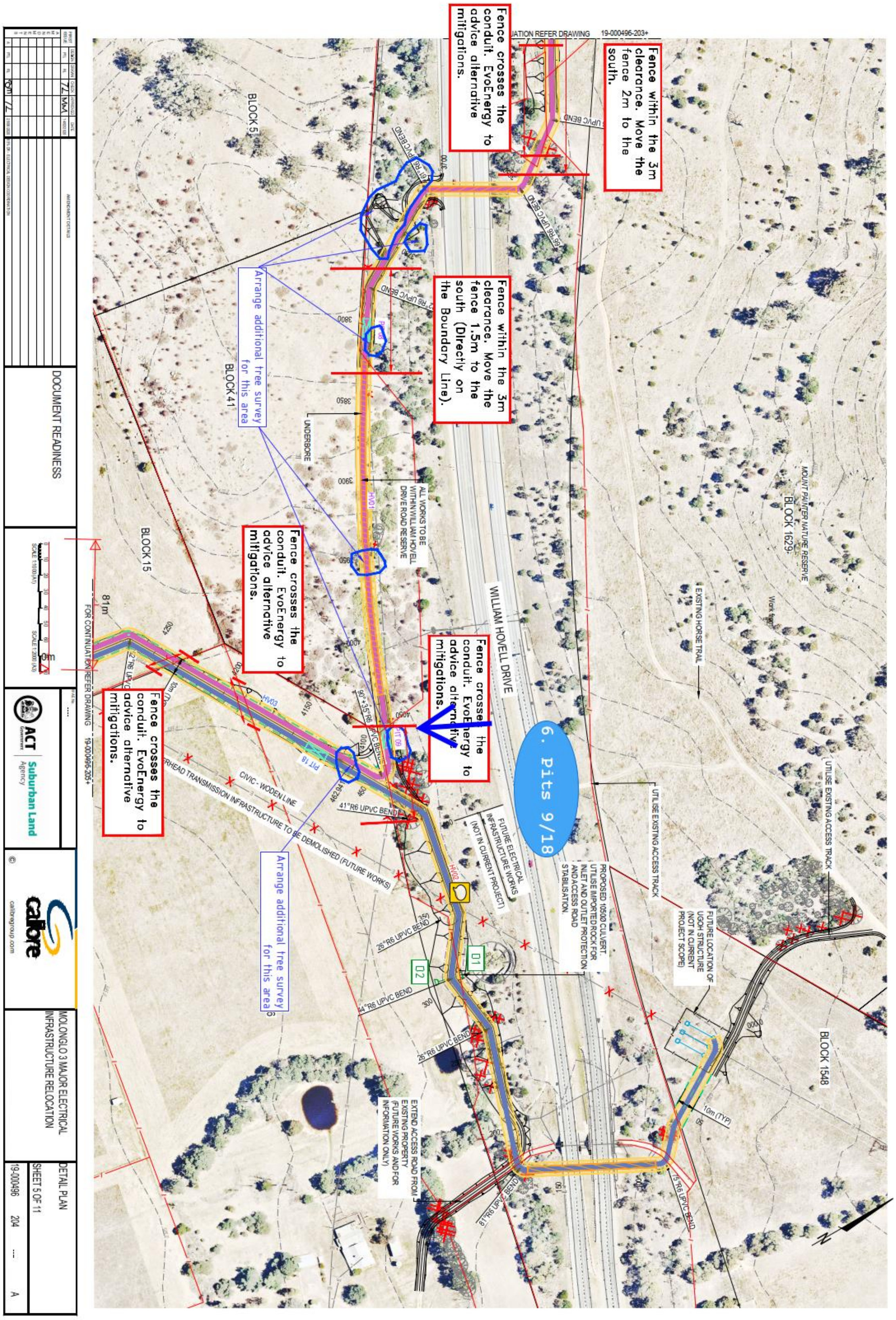
A


Fence within the 3m clearance. Move the fence 2m to the south.
Fence crosses the conduit. EvoEnergy to advice alternative mitigations.
Fence within the 3m clearance. Move the fence 1.5m to the south (Directly on the Boundary Line).
Arrange additional tree survey for this area
Fence crosses the conduit. EvoEnergy to advice alternative mitigations.
Fence crosses the conduit. EvoEnergy to advice alternative mitigations.
Fence crosses the conduit. EvoEnergy to advice alternative mitigations.
Arrange additional tree survey for this area
6. Pits 9/18
WILLIAM HOVELL DRIVE
ALL WORKS TO BE WITHIN WILLIAM HOVELL DRIVE ROAD RESERVE
UNDERBORE
CIVIC - WODEN LINE
MOUNT PAINTER NATURE RESERVE
BLOCK 1629
BLOCK 5
BLOCK 41
BLOCK 15
BLOCK 1548
EXISTING HORSE TRAIL
UTILISE EXISTING ACCESS TRACK
UTILISE EXISTING ACCESS TRACK
DOCUMENT READINESS
MOLONGLO 3 MAJOR ELECTRICAL INFRASTRUCTURE RELOCATION
DETAIL PLAN
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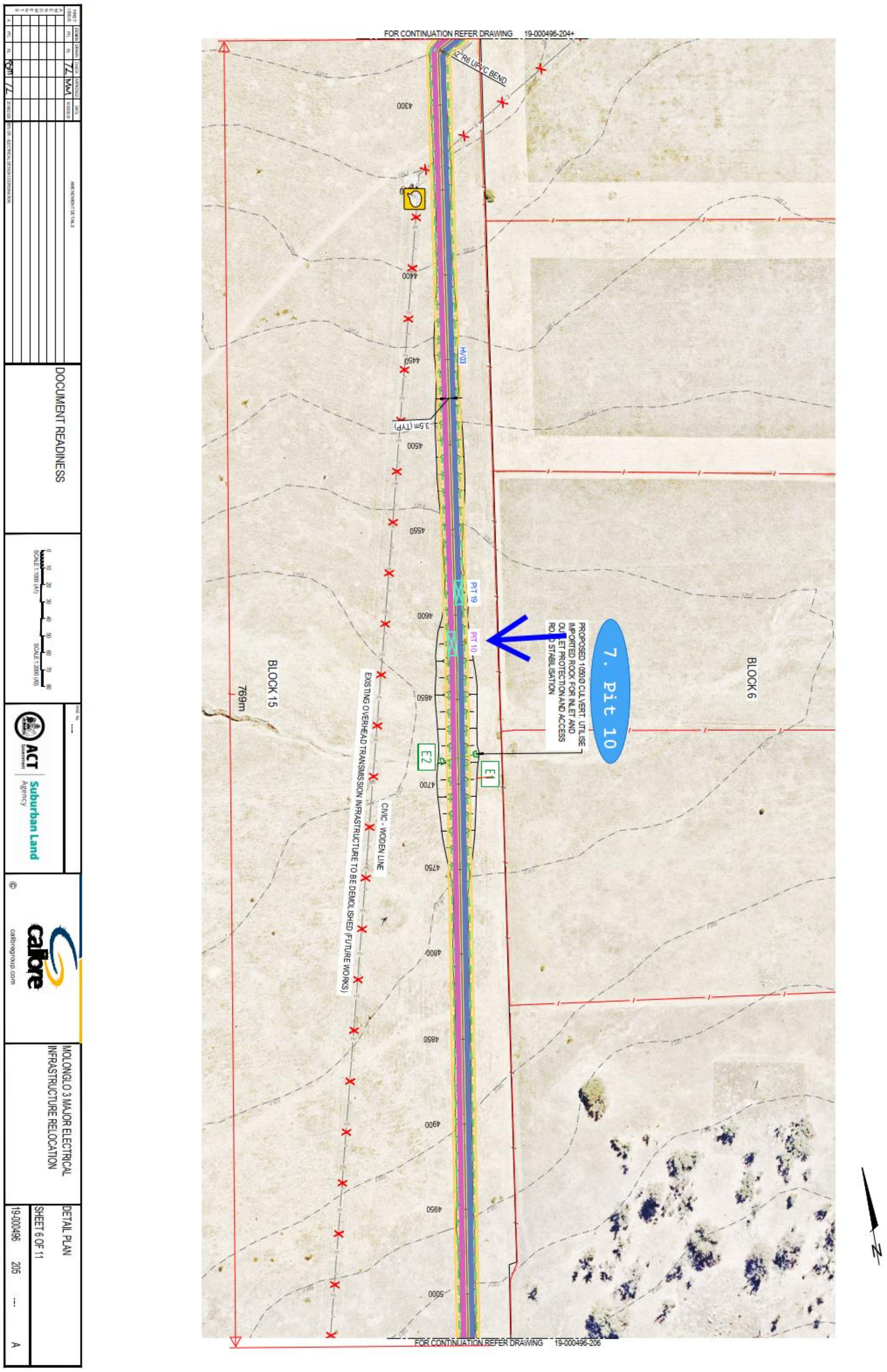
FOR CONTINUATION REFER DRAWING 19-000496-204+
7. Pit 10
PROPOSED 1050Ø CULVERT. UTILISE IMPORTED ROCK FOR INLET AND OUTLET PROTECTION AND ACCESS ROAD STABILISATION
PIT 19
PIT 10
BLOCK 15
BLOCK 6
769m
E1
E2
CIVIC - WODEN LINE
EXISTING OVERHEAD TRANSMISSION INFRASTRUCTURE TO BE DEMOLISHED (FUTURE WORKS)
FOR CONTINUATION REFER DRAWING 19-000496-206
DOCUMENT READINESS
ACT Government
Suburban Land Agency
calibregroup.com
MOLONGLO 3 MAJOR ELECTRICAL INFRASTRUCTURE RELOCATION
DETAIL PLAN
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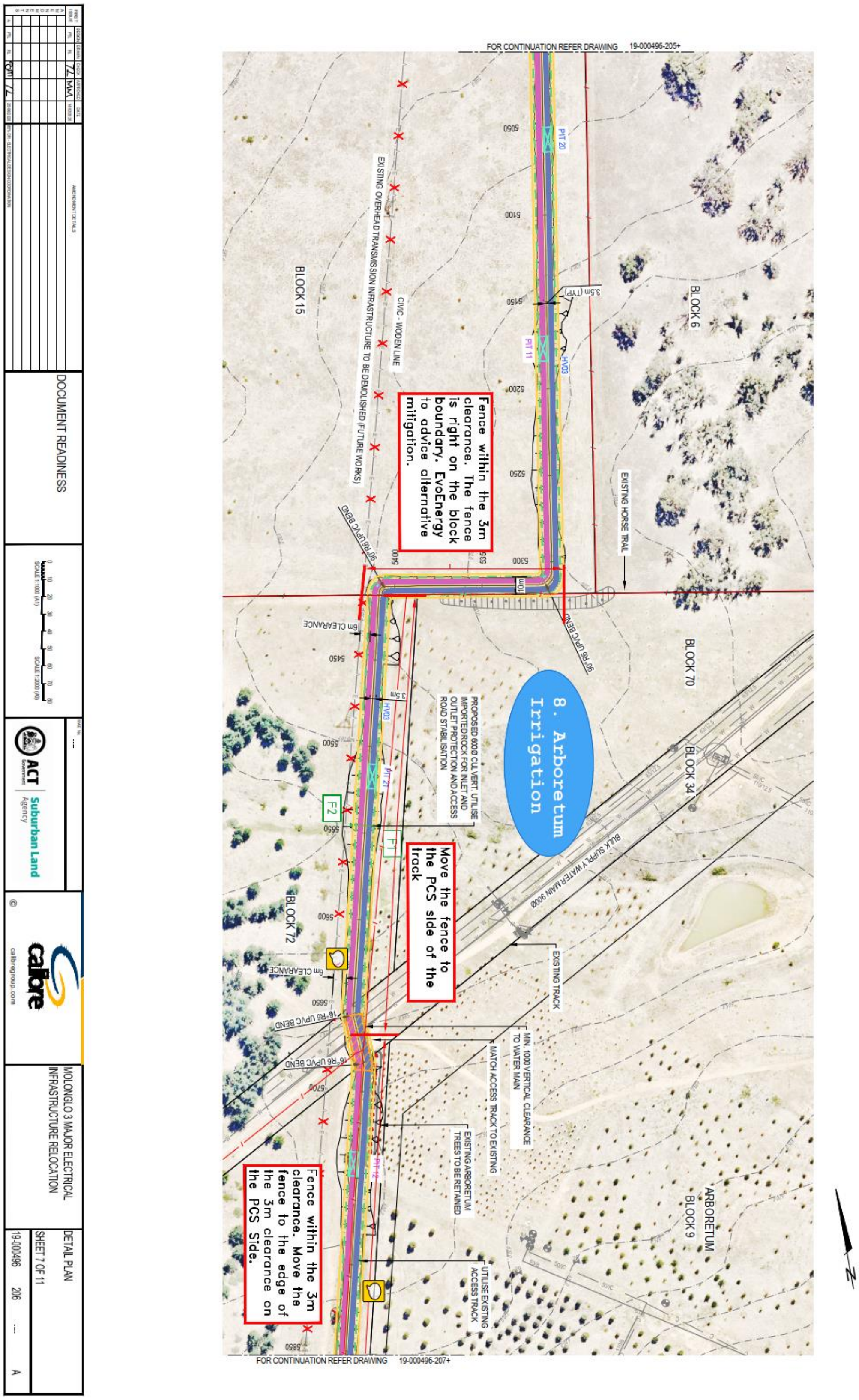
FOR CONTINUATION REFER DRAWING 19-000496-205+
FOR CONTINUATION REFER DRAWING 19-000496-207+
BLOCK 15
BLOCK 6
BLOCK 70
BLOCK 34
BLOCK 72
ARBORETUM BLOCK 9
EXISTING OVERHEAD TRANSMISSION INFRASTRUCTURE TO BE DEMOLISHED (FUTURE WORKS)
CIVIC - WODEN LINE
EXISTING HORSE TRAIL
EXISTING TRACK
BULK SUPPLY WATER MAIN 900Ø
Fence within the 3m clearance. The fence is right on the block boundary. EvoEnergy to advice alternative mitigation.
8. Arboretum Irrigation
Move the fence to the PCS side of the track
Fence within the 3m clearance. Move the fence to the edge of the 3m clearance on the PCS Side.
PROPOSED 600Ø CULVERT. UTILISE IMPORTED ROCK FOR INLET AND OUTLET PROTECTION AND ACCESS ROAD STABILISATION
MIN. 1000 VERTICAL CLEARANCE TO WATER MAIN
MATCH ACCESS TRACK TO EXISTING
EXISTING ARBORETUM TREES TO BE RETAINED
UTILISE EXISTING ACCESS TRACK
F1
F2
DOCUMENT READINESS
Suburban Land Agency
calibregroup.com
MOLONGLO 3 MAJOR ELECTRICAL INFRASTRUCTURE RELOCATION
DETAIL PLAN
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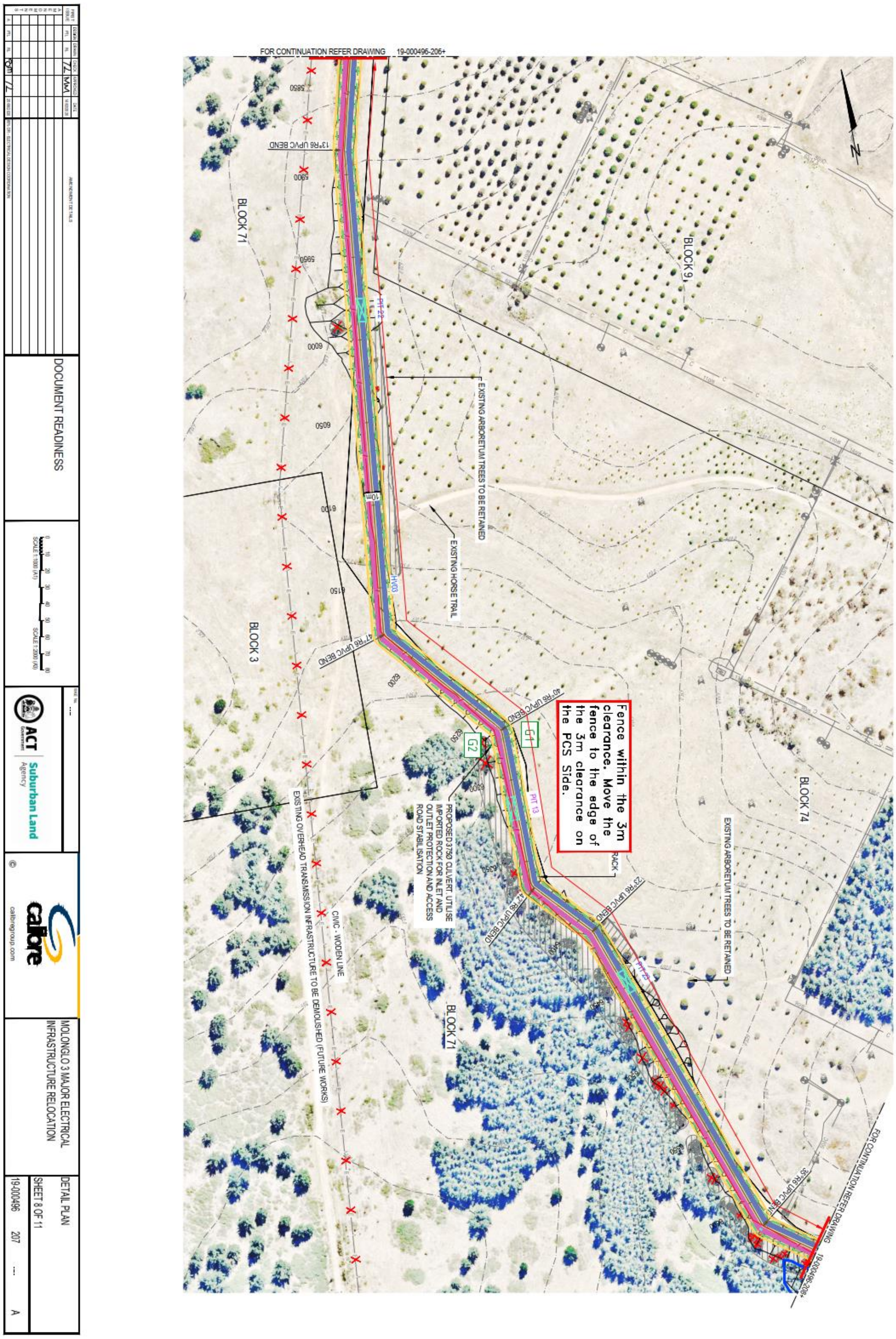
FOR CONTINUATION REFER DRAWING 19-000496-206
13°R6 UPVC BEND
BLOCK 71
BLOCK 9
EXISTING ARBORETUM TREES TO BE RETAINED
EXISTING HORSE TRAIL
BLOCK 3
47°R6 UPVC BEND
40°R6 UPVC BEND
Fence within the 3m clearance. Move the fence to the edge of the 3m clearance on the PCS Side.
G1
G2
PIT 13
PROPOSED 3750 CULVERT. UTILISE IMPORTED ROCK FOR INLET AND OUTLET PROTECTION AND ACCESS ROAD STABILISATION
BLOCK 74
EXISTING ARBORETUM TREES TO BE RETAINED
CIVIC - WODEN LINE
EXISTING OVERHEAD TRANSMISSION INFRASTRUCTURE TO BE DEMOLISHED (FUTURE WORKS)
BLOCK 71
DOCUMENT READINESS
Suburban Land Agency
calibregroup.com
MOLONGLO 3 MAJOR ELECTRICAL INFRASTRUCTURE RELOCATION
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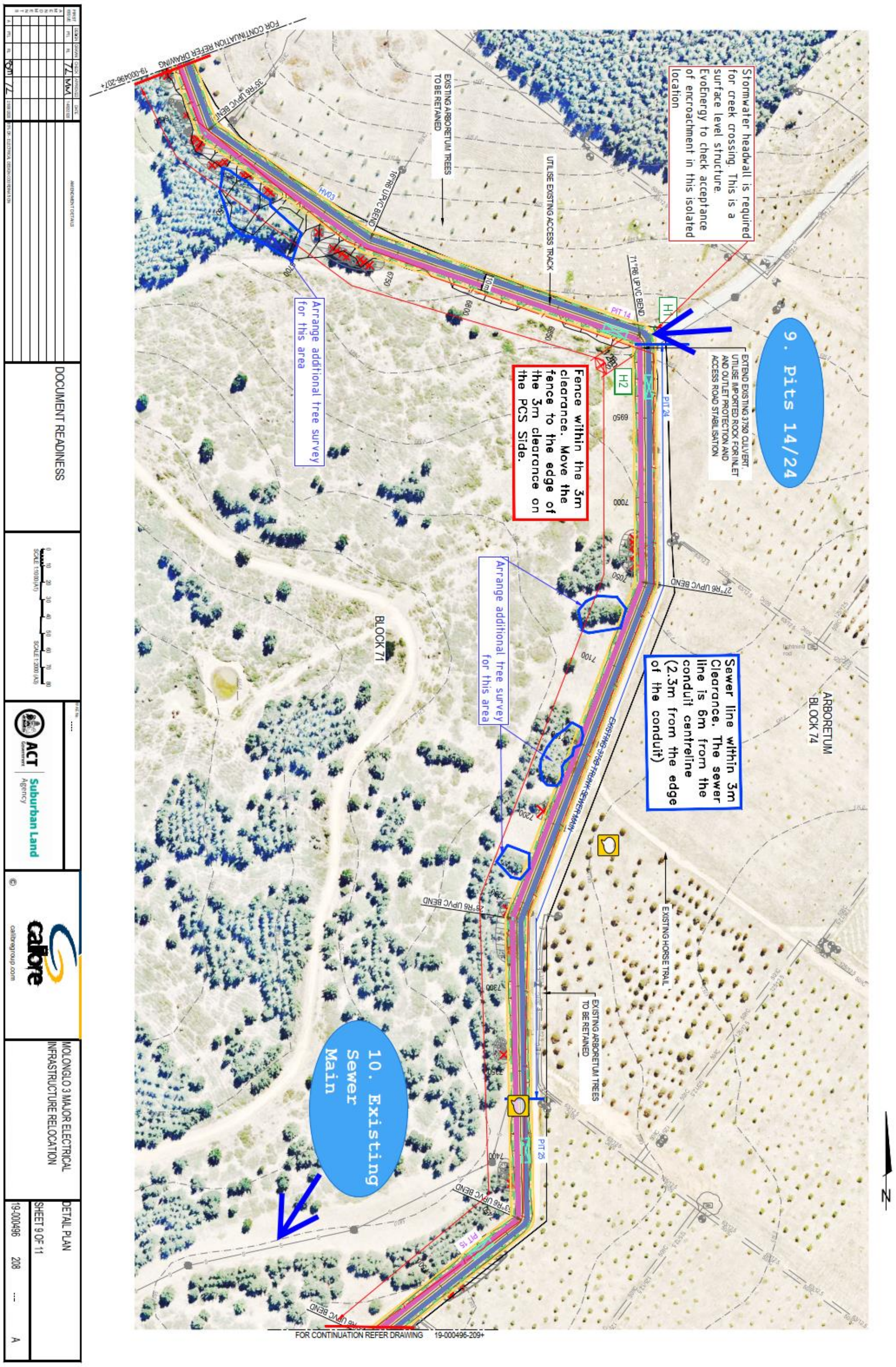

Stormwater headwall is required for creek crossing. This is a surface level structure. EvoEnergy to check acceptance of encroachment in this isolated location
9. Pits 14/24
Fence within the 3m clearance. Move the fence to the edge of the 3m clearance on the PCS Side.
Arrange additional tree survey for this area
Arrange additional tree survey for this area
Sewer line within 3m Clearance. The sewer line is 6m from the conduit centreline (2.3m from the edge of the conduit)
10. Existing Sewer Main
EXISTING ARBORETUM TREES TO BE RETAINED
UTILISE EXISTING ACCESS TRACK
EXISTING HORSE TRAIL
EXISTING ARBORETUM TREES TO BE RETAINED
ARBORETUM BLOCK 74
BLOCK 71
FOR CONTINUATION REFER DRAWING 19-000496-209+
DOCUMENT READINESS
Suburban Land Agency
calibregroup.com
MOLONGLO 3 MAJOR ELECTRICAL INFRASTRUCTURE RELOCATION
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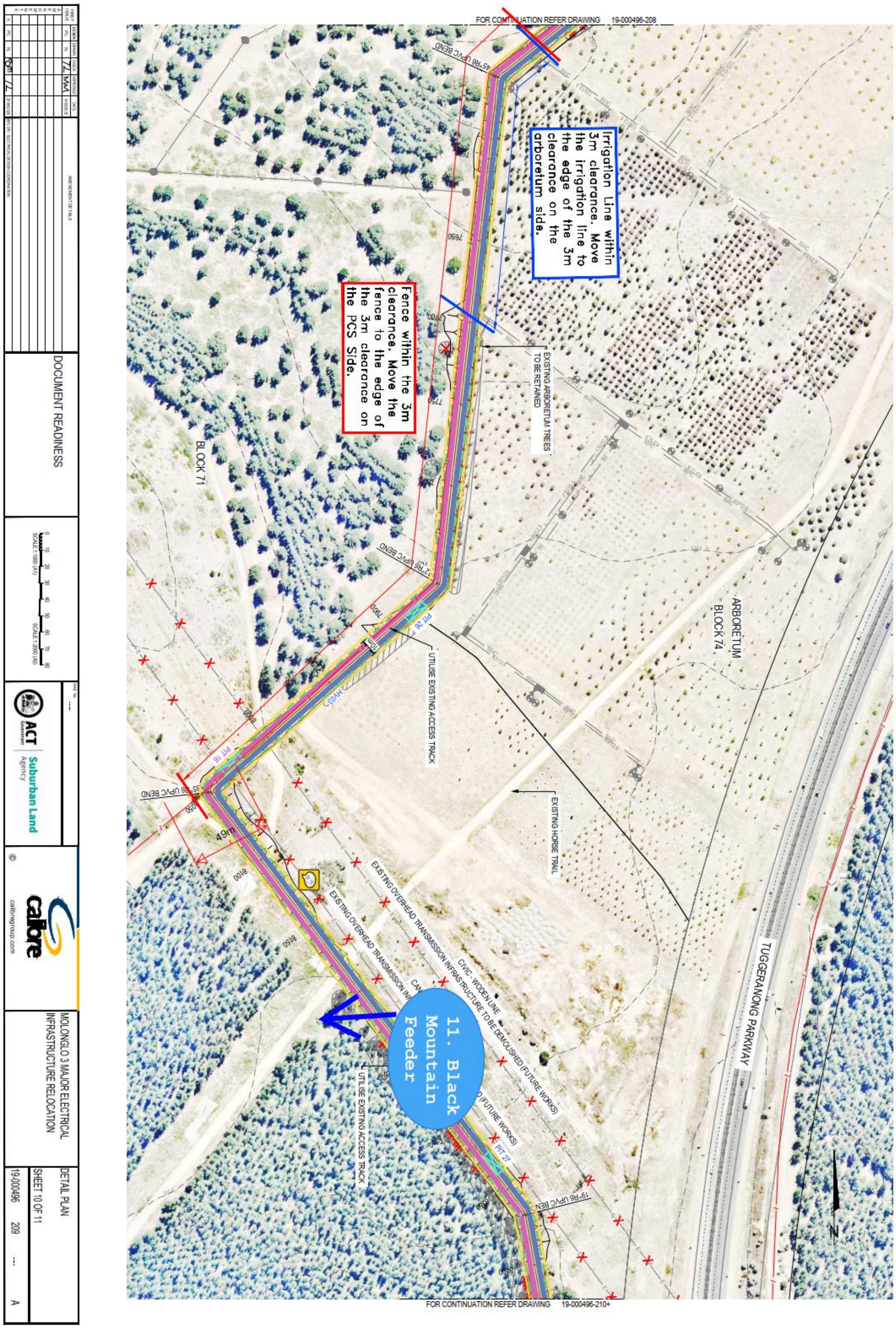

FOR CONTINUATION REFER DRAWING 19-000496-208
Irrigation Line within 3m clearance. Move the irrigation line to the edge of the 3m clearance on the arboretum side.
Fence within the 3m clearance. Move the fence to the edge of the 3m clearance on the PCS Side.
EXISTING ARBORETUM TREES TO BE RETAINED
BLOCK 71
ARBORETUM
BLOCK 74
UTILISE EXISTING ACCESS TRACK
EXISTING HORSE TRAIL
49m
EXISTING OVERHEAD TRANSMISSION INFRASTRUCTURE TO BE DEMOLISHED (FUTURE WORKS)
CIVIC - WODEN LINE
11. Black Mountain Feeder
TUGGERANONG PARKWAY
FOR CONTINUATION REFER DRAWING 19-000496-210
DOCUMENT READINESS
Suburban Land Agency
calibregroup.com
MOLONGLO 3 MAJOR ELECTRICAL INFRASTRUCTURE RELOCATION
DETAIL PLAN
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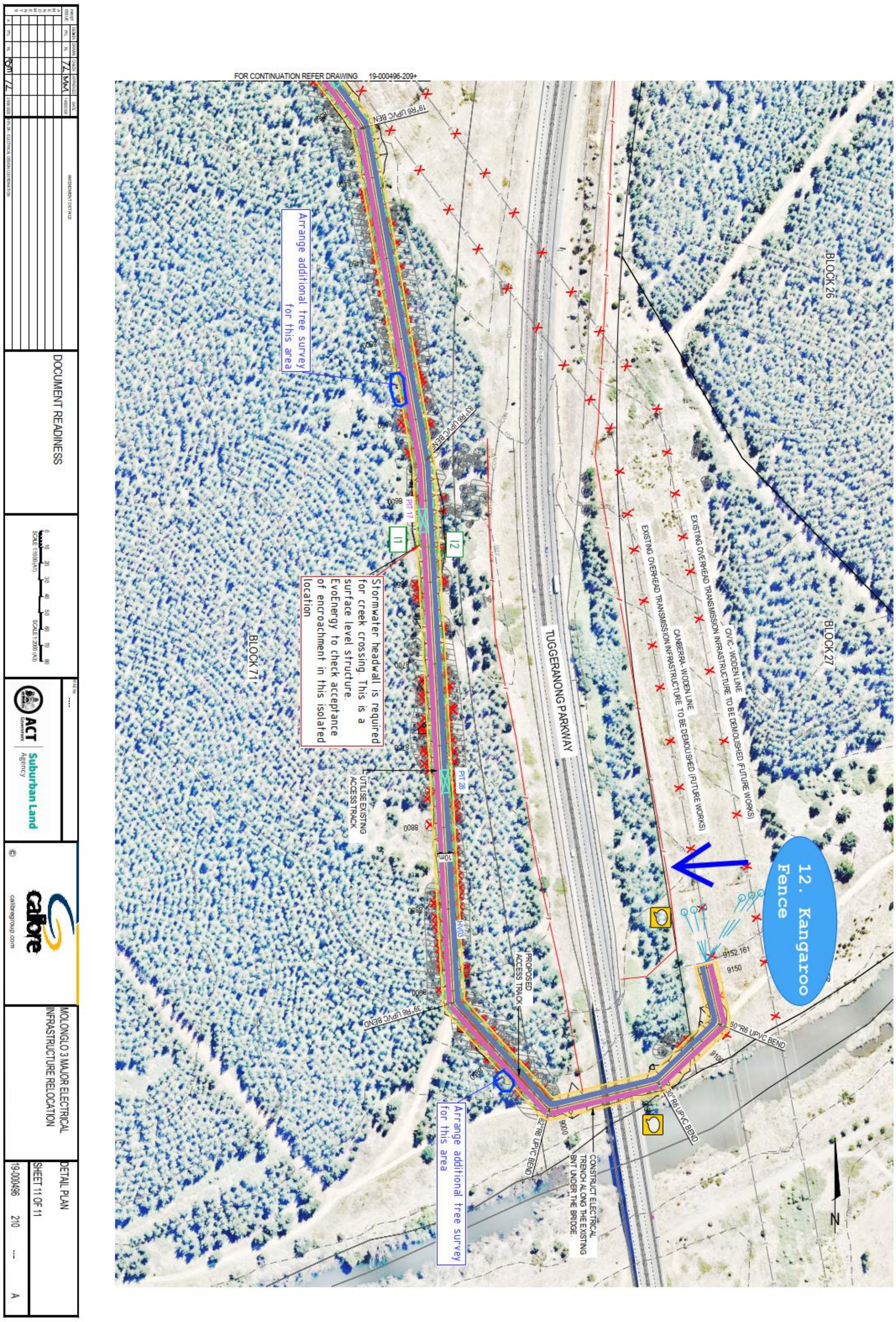
FOR CONTINUATION REFER DRAWING 19-000496-209+
Arrange additional tree survey for this area
Stormwater headwall is required for creek crossing. This is a surface level structure. EvoEnergy to check acceptance of encroachment in this isolated location
BLOCK 71
BLOCK 26
BLOCK 27
TUGGERANONG PARKWAY
EXISTING OVERHEAD TRANSMISSION INFRASTRUCTURE TO BE DEMOLISHED (FUTURE WORKS)
CIVIC - WODEN LINE
CANBERRA - WODEN LINE
UTILISE EXISTING ACCESS TRACK
PROPOSED ACCESS TRACK
12. Kangaroo Fence
Arrange additional tree survey for this area
DOCUMENT READINESS
Suburban Land Agency
calibregroup.com
MOLONGLO 3 MAJOR ELECTRICAL INFRASTRUCTURE RELOCATION
DETAIL PLAN
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