NATIVE VEGETATION CLEARING PERMIT APPLICATION SUPPORTING DOCUMENT

SOUTHERN LINK ROAD (STAGE 3) CANNINGTON CITY OF CANNING

ENDPLAN ENVIRONMENTAL

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Native Vegetation Clearing Permit Supporting Document
Southern Link Road (Stage 3) Cannington
City of Canning

Our Reference:

ECO202_06_V3

STATEMENT OF LIMITATIONS:

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1. INTRODUCTION

The City of Canning (the City) is proposing to construct and operate 0.45 km of the Southern Link Road Stage 3 (SLR Stage 3), located within the Canning City Centre to provide a direct connection between Liege and Gerard Streets.

The SLR Stage 3 application area comprises 1.15 ha, although 0.74 ha is already entirely cleared or in Completely Degraded condition and not considered as native vegetation. To enable the proposed construction to proceed, clearing of 0.41 ha of native vegetation will be required (0.34 ha in Degraded condition; 0.07 ha in Very Good condition). Of this 0.16 ha is designated as the *Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain* Threatened Ecological Community (TEC) inclusive of all vegetation condition ratings (Completely Degraded – Very Good) [1].

Approximately 1,785.84 m^2 of the proposed SLR Stage 3 alignment will be constructed on the eastern boundary of Cannington Swamp, a Conservation category wetland (CCW) (also known as Cannington Swamp and Grose Avenue/Lake Street Wetland). Cannington Swamp is largely considered to represent the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) endangered *Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain* Threatened Ecological Community (TEC), and is also listed as endangered under the Western Australian *Biodiversity Conservation Act 2016* (BC Act). In addition, a critically endangered short-tongued native bee (*Leioproctus douglasiellus*) has previously been recorded from the TEC, and another short-tongued native bee (*Neopasiphae simplicior*) was considered likely to occur on-site. However, neither species was recorded during a targeted bee survey conducted during the 2018-2019 flight period of these species (Prendergast 2019).

The City referred the proposal to the Environmental Protection Authority (EPA) under s. 38 of the *Environmental Protection Act 1986* (EP Act) and in February 2022 the EPA advised the City that the likely environmental effects of the proposal are not so significant as to warrant formal assessment due to the minimal clearing of TEC and wetland area being impacted, and the management and mitigation of potential impacts could be managed via a clearing permit.

Clearing of native vegetation for the purpose of constructing the proposed SLR Stage 3 will therefore require a permit to clear native vegetation under Schedule 2 of the *Environmental Protection [Clearing of Native Vegetation] Regulation 2004* (Clearing Regulations) issued by the Department of Water and Environmental Regulation (DWER).

This document has been prepared to support the granting of a Native Vegetation Clearing Permit (NVCP) for the project under Part V Division 2 (Clearing) of the EP Act and includes the following information:

- An overview of the existing environmental conditions of the site.
- An evaluation of potential impacts of the proposed native vegetation clearing.
- An evaluation of compliance of the proposed clearing against the ten clearing principles listed under Schedule 5 of the EP Act, and
- Environmental approvals and management requirements.

This supporting document has been prepared as part of the NVCP application and should be read in conjunction with the attached NVCP application form.

[1] As mapped by Keighery and Hyder-Griffiths (2004).

1.1 Project Location and Ownership

The proposed SLR Stage 3 is located approximately 10 km south-east of the Perth Central Business District (CBD) (**Figure 1**). Zoned "Central City Area" under the Metropolitan Region Scheme (MRS) and "Centre" under the City of Canning Local Planning Scheme No. 42 (Department of Planning, Lands and Heritage 2020) this zoning allows the City to develop a City Centre Activity Centre Plan that has resulted in detailed planning of the zone.

For the purpose of this application, the 'application area ' encompasses the 26 m wide alignment required to construct the proposed SLR Stage 3 linking Liege Street in the south to Gerard Street in the north and includes the associated infrastructure: dual carriageway, dual-use path, utility modifications, local road modifications, culverts, slotted subsoil pipe, lighting, fencing, landscaping, barriers and signage[2].

The proposed SLR Stage 3 application area comprises an overall area of approximately 11,473.81 m^2 of which a 1,785.84 m^2 portion will be constructed on the eastern boundary of Cannington Swamp, a Conservation category wetland (CCW) (also known as Cannington Swamp and Grose Avenue/Lake Street Wetland) (**Figure 2**).

Table 1: Legal Description of the Application Area

Lot No.	Deposited Plan	Volume	Folio	Registered proprietor
201	P415006	2967	474	Western Power
5	P225925	1174	469	
5	P000593	1174	469	
271-277 inclusive	P002209	52 1133 1413 1164 1302 1158	74A 593 330 93 933 336	
264-270 inclusive	P002209	1296 1133 1413 1164 125 1116	933 593 329 193 87A 789	

Source: City of Canning 2022

Currently, the bulk of the Cannington Swamp is owned by Western Power under Freehold. Western Power has provided the City with a *Letter of Authority to Access and Clear Native Vegetation* on Western Power owned land. The Letter of Authority is included as **Appendix 1**.

There are no conservation reserves associated with the application area.

[2] Extents within this document have been calculated using road data provided by the City of Canning on 22 June 2020, as indicated on City of Canning drawing File No. CAD2420 Plan R242 Revision F (Porter Consulting Engineers 2020).

1.2 Project Justification

The first Structure Plan approved by the City and the Western Australian Planning Commission (WAPC) was the Canning Regional Centre Structure Plan approved by the WAPC on 14 February 1995. This plan identified an alignment for the Southern Link Road which represented a direct link between the Liege Street and the Gerard Street Bridge as shown on **Plate 1**.

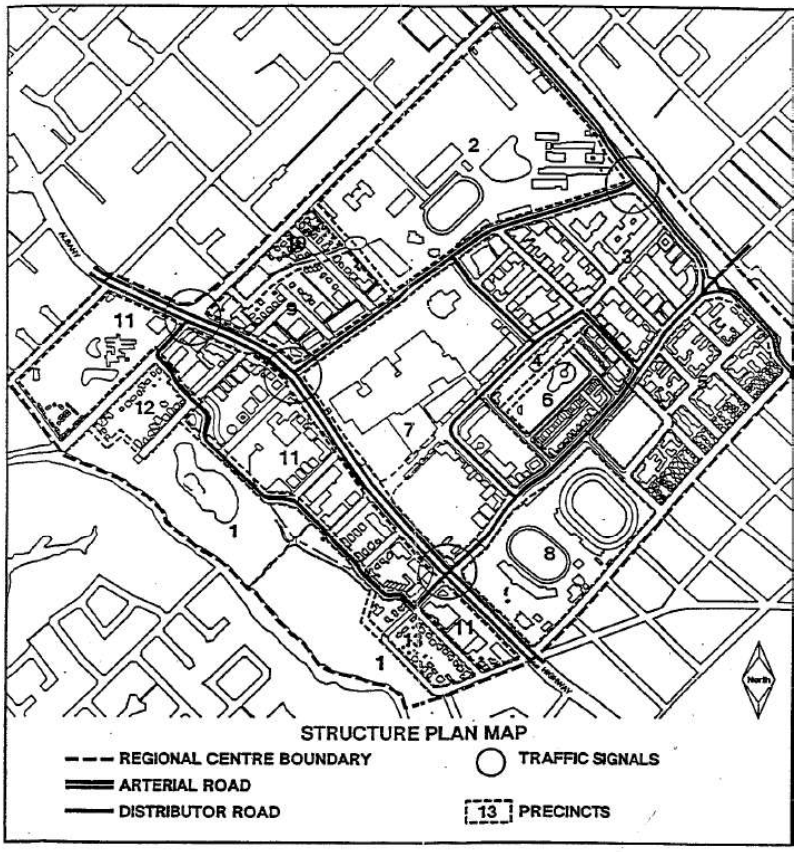

PLATE 1: Canning Regional Centre Structure Plan (1995)

The City reviewed the Canning Regional Centre Structure Plan and adopted the Canning City Centre Structure Plan as a Local Planning Policy on 15 October 2013. This plan was accompanied by environmental studies and identified a change to the alignment of the Southern Link Road from a straight line to a curved design to reduce the impact on the TEC by going through mainly Degraded to Completely Degraded vegetation. The 2013 realignment is shown on **Plate 2** (over the page).

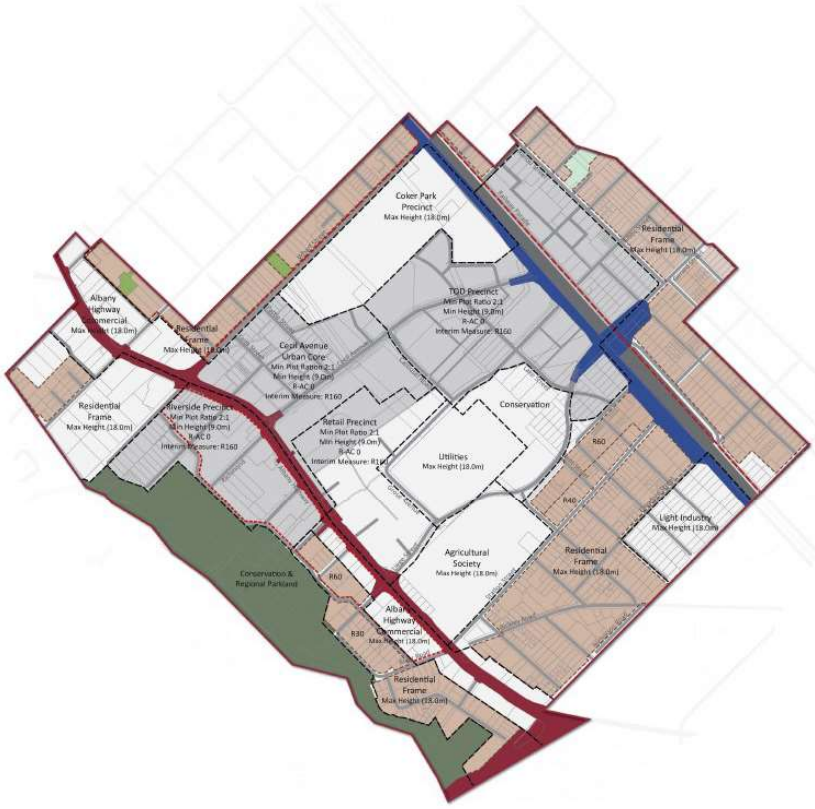

PLATE 2: Realignment of the Southern Link Road (2013)

Council subsequently adopted the Canning Activity Centre Plan, which was endorsed by the WAPC on 24 October 2017, with Amendment 1 to this document approved by the WAPC on 4 May 2021. The document maintains the Southern Link Road alignment from the 2013 plan and identifies the conservation precinct adding another level of protection and recognition of its environmental status (area shaded dark green below).

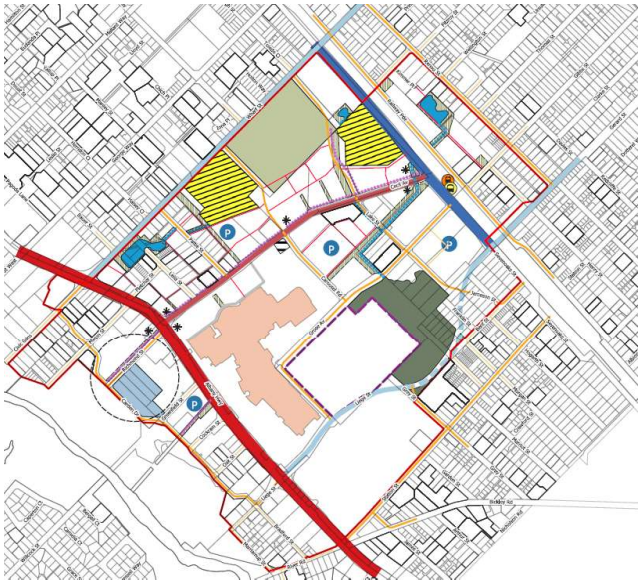

PLATE 3: Canning Activity Centre Plan (2017)

The Canning Activity Centre Plan (CACP) (City of Canning 2021) has been prepared to guide the strategic development of the Canning City Centre (CCC) as a Strategic Metropolitan Regional Centre under State Planning Policy 4.2 - Activity Centres for Perth and Peel (Western Australian Planning Commission, 2010). Referred to as the Cannington Strategic Metropolitan Centre in SPP 4.2, the CACP is identified as a 'Major Growth Area by 2031' with the Cannington Train Station identified as being a major transit-oriented development location. It is anticipated that by 2031, the CCC will house up to an additional 25,000 residents, with the CACP showing the indicative alignment of the full length of the Southern Link Road (SLR) providing for traffic connectivity and access to and from the CCC area (**Figure 2**).

The SLR is part of a suite of local and regional road upgrades recommended in the City's Integrated Transport Strategy (July 2015) in order to improve access to the CCC and the permeability of the transport network. The SLR is therefore one of the proposed key upgrades to the local road network as it will ultimately provide a direct north-south connection between Orrong Road and Albany Highway, both classified as Primary Regional Roads within the MRS (Western Australian Planning Commission, 1985). Stage 2 of the SLR was constructed in 2019 and the proposed construction of the 0.45 km length of the proposed SLR Stage 3 has been identified by the City as a key component of the development of the CCC (City of Canning 2021).

When constructed, the proposed SLR Stage 3 will provide a strong north-south link between Albany Highway and Gerard Street. In the future, it is proposed that the northern section of Gerard Street will be extended to Welshpool Road in order to connect to McDowell Street (subject to further studies and approvals), thereby providing an alternative north-south road link over the railway line resulting in reduced traffic volumes and delays at the Wharf Street and William Street level crossings (Cardno (WA) Pty Ltd. 2020).

There are currently only a limited number of east-west connections within the CCC. The major east-west connections are Albany Highway and Sevenoaks Street, although it is noted that the Sevenoaks Street connection to the east, through the City of Gosnells, has not yet been constructed (Cardno (WA) Pty Ltd. 2020). To the west, the minor east-west connections include:

- Pattie Street
- Carousel Road Extension (not yet constructed)
- Lake Street Extension (not yet constructed).

The importance of the proposed SLR Stage 3 traffic link is demonstrated in the Movement Access and Parking Strategy (Jacobs 2015) and the Road Benefit Investigation Southern Link Road (**Appendix 2**) (Cardno (WA) Pty Ltd. 2020). It is estimated that the network benefits resulting from the proposed construction of the proposed SLR Stage 3 include carrying 13,900 vehicles per day in 2021 and 20,600 vehicles per day in 2031 respectively (Cardno (WA) Pty Ltd. 2020).

In response to the EPA's request for further information regarding why the 'improved access' potentially achieved by the proposal cannot be achieved by modifying existing local roads bordering the Cannington Swamp, the City provided a Technical Memorandum (**Appendix 3**).

As shown in **Plate 4** (over the page), road classifications for the nearby street network are defined in the Main Roads Functional Hierarchy as follows:

- Primary Distributors (light blue): Form the regional and inter-regional grid of MRWA traffic routes and carry large volumes of fast-moving traffic. Some are strategic freight routes, and all are National or State Road.
- Distributor B (dark blue): preform a similar function to District Distributor A but with reduced capacity due to flow restrictions from access to and roadside parking alongside adjoining property. These are often older roads with traffic demand in excess of that originally intended. District Distributor A and B roads run between land-use cells and not through them, forming a grid that would ideally be around 1.5 km apart. They are managed by Local Government.
- Local Distributors (orange): Carry traffic within a cell and link District Distributors at the boundary to access roads. The route of the Local Distributor discourages through traffic so that the cell formed by the grid of District Distributors only carries traffic belonging to or serving the area. These roads should accommodate buses but discourage trucks. They are managed by Local Government.
- Access Roads (grey): Provide access to abutting properties with amenity, safety and aesthetic aspects having priority over the vehicle movement function. These roads are bicycle and pedestrian friendly. They are managed by Local Government.

ROAD HEIRARCHY

PLATE 4: Road Hierarchy in the Vicinity of Southern Link Road (Stage 3). (Source: Cardno 2020)

The City has considered a range of possible road extensions for the proposed SLR Stage 3 however it is apparent that the surrounding road network would be unable to uphold the pressures and high volumes of vehicles predicted by 2031.The proposed SLR Stage 3 is a crucial part to improving the connectivity within the CCC and ensuring that vehicles can easily and safely access Albany Highway and Sevenoaks Street. In addition to the above, the proposed Stage 3 road extension is considered as an Integrator Arterial under the draft *Liveable Neighbourhoods* (Department of Planning 2015), with geometry and function resembling an Integrator B type road. Integrator B roads carry a volume range of 15,000 vehicles per day.

Roads within the close proximity of the proposed SLR Stage 3 include Bent Street and Grey Street, both of which are considered Access Streets type D, are only intended to carry local and residential traffic up to a maximum of 1,000 vehicles per day. Future traffic volumes anticipated within the immediate locality suggest that these streets would not be able to accommodate the excessive number of vehicles travelling throughout the area. There are a number of plans in various documents that show Wilson Street (between Grey Street and Bent Street) located adjacent to the proposed SLR Stage 3. This road reserve was privately owned and was amalgamated and developed with adjacent land holdings in 2014.

The location of the proposed SLR Stage 3 road extension is surrounded by a range of road classifications further described in **Appendix 2** (refer to Table 5-1; Cardno 2020). Each of these roads have been considered for potential links forming the proposed SLR Stage 3.

The City has considered a range of possible road extensions for the proposed SLR Stage 3 however, it is apparent that the surrounding road network would be unable to uphold the pressures and high volumes of vehicles predicted by 2031. Adjacent roads are either considered to be too far from the CCC to efficiently provide the level of accessibility and connectivity required for an arterial integrator road, are to a standard that is not suitable to carry regional traffic volumes, or do not have appropriate connectivity to Albany Highway.

The City recognises that the 'Conservation Precinct' is an important environmental asset that is not suitable for any additional uses or development and that the proposed alignment of the SLR Stage 3 (**Figure 3**) will form a barrier to unauthorised public access, further urban development and stormwater run-off into the TEC/CCW.

Inside the TEC boundary, no development (other than for the purpose of enhancing the asset) will be allowed. If supported with approval from the relevant authorities, the TEC will be made accessible to the community through sensitive planning and the location of paths, low-key fences (to restrict and limit pedestrian access), educational signage and boardwalks.

Development outside of the TEC boundary is subject to approval by the relevant authorities. In respect to the potential development in and around the Western Power Cannington Terminal Substation, referred to in the CACP as the 'Utilities Precinct', strict limits have been placed on this Precinct. A 30 m buffer to urban development is required to be retained around the whole of the substation infrastructure area. The CACP has recommended that Western Power explore innovative methods for reducing the visual impact of the Terminal Substation to support the creation of the CCC. As the substation does not occupy the entire Western Power landholding, there is opportunity for future developments facing Grose Avenue but outside of 'Conservation Precinct' (City of Canning 2021).

1.3 Alternative Project Options

Since 2014, the Proponent has engaged consultants to conduct environmental and hydrological investigations (**Appendices 5 - 8**) of Cannington Swamp to determine the potential impact of constructing SLR Stages 2 and 3 (Natural Area Consulting Management Services 2016; Urbaqua 2018a, 2018b and 2019; Ecoscape (Australia) Pty Ltd 2019, Prendergast 2019).

In order to reduce the application area and its potential impact on the TEC/CCW, the City's engineers developed three construction options[3]:

- **Option 1: using a vertical retaining wall along the boundary line**
  This option has the least ground footprint within the TEC area and would require the least clearing also. As the wall is a vertical option it will have nil impact to stormwater movements and the potential for scour on the outer edges of the treatment with the road reserve side of the geometry draining back within the road. This feature will provide nothing in the way of landscape buffering between the road reserve and the TEC, however, the addition of a fence line will act as a "Trash Screen" and also preventing pedestrians from falling down the embankment. This option will limit the movement of fauna between the Road Reserve to the TEC due to the presence of the fence.
- **Option 2: 1:4 batter bottom line offset 4 m from the boundary line**
  While this option will have the greatest ground footprint impact by area of the three options, it will have the most natural appearance and provide the opportunity to remove the requirement for a fence line and introduce vegetation to the batter to stabilize the batter and control potential scour. With the embankment height varying across the length of the alignment, the impact of this batter will vary with regards to the footprint. However, if incorporated into an outer edge revegetation/restoration, its impact may be minimised due to the reduced compaction effort required during construction.
- **Option 3: 1:2 cobbled batter line offset 2 m from the boundary line**
  From a footprint perspective this option presents the second least impact of the three options. This option would require engineering stabilisation of the batter via rock or concreting, similar to the treatment which exists closer to the Gerard Street Bridge. This option will require more construction compaction effort to the fringe to ensure the batter segments are embedded and the "armour" does not fail. There is also greater potential for scour to the edge of the batter due to stormwater potentially discharging down the face of the wall. This treatment will offer consistency in appearance to the surrounding treatment and again include a fence line to act as a "trash screen "preventing the movement of waste into the reserve and preventing pedestrians from falling down the embankment. This option will also limit the movement of fauna between the road reserve to the TEC due to the presence of the fence.

All three options have been provided by the City to the DBCA for their consideration and the DBCA's preference was for Option 2 to be adopted as the preferred construction method.

A cross-section of Option 2 is and its impact on the TEC is shown in **Appendix 4**.

[3] Each of these options assumes an estimated backfill to 1 m maximum.

2. CLEARING OF NATIVE VEGETATION

2.1 Measures to Avoid and Minimise Clearing

The current alignment of the proposed SLR Stage 3 comprising 0.45 km of road is shown in **Figure 2**. Given the inherent safety aspects of the engineering design for the proposed SLR Stage 3, the road alignment has been optimised as far as practicable and the opportunity to reduce disturbance further is not available.

2.1.1 Impact Avoidance through Project Design

Originally the SLR alignment was a straight line, however based on flora, fauna and hydrological studies, was subsequently revised to a narrower curved design to maximise the use of degraded habitat thereby minimising the removal of native vegetation that is in Very Good condition.

In terms of avoiding environmental impacts, the revised alignment has resulted in:

- Reducing the impact of clearing to 0.41 ha of native vegetation (0.34 ha in Degraded condition; 0.07 ha in Very Good condition) of which 0.16 ha in total is designated as the *Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain* TEC.
- Avoiding impacting conservation significant flora.
- Introducing vegetation to the batter as a means of controlling scour as well as stabilizing the batter.
- Minimising the impact of the batter due to the reduced compaction effort required during construction.

2.1.2 Impact Avoidance Through Environmental Management

As part of the Canning City Centre Local Drainage Plan (Urbaqua 2016a), hydrologic and hydraulic analysis of the existing and potential future land uses (based on full proposed development) of Cockram Street main drain catchments was undertaken in order to develop an understanding of flood risk and required drainage upgrades within the structure planning areas. A variety of system upgrades proposed in order to achieve the objective above.

In relation to hydrological impacts, planning controls will be implemented to ensure future developments are in accordance with these upgrades, the capacity of the main drains is sufficient and the Cannington TEC is protected.

Key outcomes that must be sought through development controls (**Appendix 5**) are:

- Where practicable, construction should not be undertaken during late summer or autumn to prevent risk of fire during this time which could cause significant damage to swamp.
- Developments should provide for management of stormwater on-site to assist with water quality management.
- Developments should not have any hydrologic or stormwater interactions with the Cannington Swamp (and associated TEC).
- Developments should provide shade modelling to demonstrate minimal or no overshadowing impacts on the TEC.
- Provision of infrastructure that will provide standard levels of service during minor floods.
- Protection of development from predicted flood levels during major events.
- Relevant contribution toward upgrade of local and arterial drainage systems.

In order to consider the short-term risks presented by construction activity within the Cannington Swamp and TEC boundary, prior to the commencement of vegetation clearing, the City will prepare a Construction Environmental Management Plan (CEMP) to describe how the impacts of activities related to the clearing and construction phases of the project will be managed to reduce potential direct and indirect impacts on the environment.

The following strategies are recommended for consideration in developing an appropriate construction environmental management plan:

- The proposed road alignment must be fenced to ensure all the construction traffic is restricted only within the road footprint with no disturbance to the wetland.
- Where practicable, construction should be undertaken during periods of low groundwater to avoid requirements for any dewatering and to avoid dispersal of sediment and construction materials into the wetland.
- Sediment fencing should be provided along the edge of the construction area to provide protection from wind and water borne sediment and construction materials.
- Temporary stockpiles should be located outside the wetland boundaries and contained by sediment fencing.

The CEMP will include, but not be restricted to, the following:

(i) measures to avoid and mitigate impacts during construction, including:
  - the proposed road alignment must be fenced to ensure all construction traffic is restricted to only within the road footprint with no disturbance to the wetland
  - clearing and access control
  - construction should be undertaken during periods of low groundwater if practicable to avoid requirements for any dewatering
  - managing dewatering rates to minimise drawdown and prevent incursion of ASS into the surface water
  - topsoil management
  - sediment and dust control
  - hygiene requirements to prevent the introduction or spread of *P. cinnamomi* Dieback
  - hydrocarbon storage
  - waste and fire management

(i) performance indicators that measure the effectiveness of avoidance and mitigation measures

(ii) contingency measures that will be undertaken if performance targets are not met

(iii) roles and responsibilities of personnel associated with implementing mitigation measures.

2.2 Impact Mitigation through Provision of Offsets

1. The City is negotiating with DWER and Western Power to ensure that the TEC/CCW is under appropriate ownership and management to protect conservation values.

2. To mitigate residual impacts of the proposed clearing on the TEC, the City will prepare an Environmental Management Plan (EMP) for the area of TEC outside of the application area. The EMP will be prepared in keeping with the document *Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans* (Environmental Protection Authority 2020a) and when approved by the DWER, the EMP will be implemented by the City, subject to appropriate management arrangements being agreed and implemented.

The EMP will be prepared in consultation with the DBCA and include, but not be restricted to, the following:

(i) management measures to:
- protect existing native vegetation within the wetland
- rehabilitate degraded areas within the wetland
- prevent the introduction of Dieback
- enhance wetland and fauna habitat values
- control the introduction and spread of weeds
- control vehicle and pedestrian access
- implement development planning controls for drainage and water quality management.

(ii) performance indicators that measure the effectiveness of avoidance and mitigation measures

(iii) contingency measures that will be undertaken if performance targets are not met

(iv) roles and responsibilities of personnel associated with implementing management measures.

3. Revegetation of the proposed road fill batters and streetscapes will be undertaken with local native plant species to ensure minimal impact to the wetland biodiversity values and assist in maintaining groundwater flow through the site.

3 PHYSICAL ENVIRONMENT

3.1 Climate

The Köppen-Geiger climate classification identifies the application area as having a temperate climate with hot summers (Class Csa) (Peel, Finlayson and McMahon 2007). This classification is considered to represent a Mediterranean climate where average summer maximum temperatures exceed 22°C during at least one month and the wettest winter month has at least three times the rainfall of the driest month, which is below 40 mm.

The closest Bureau of Meteorology (BoM) station with long-term records for rainfall is Perth Airport Station No. 9021[4] located approximately 7.5 km north-east of the application area; rainfall records have been kept since 1944 (BoM 2022). The mean annual rainfall is 760.9 mm with rainfall predominantly received between May and August. Mean maximum temperatures range from 32.0 °C (February) to 18.6 °C (August) and mean minimum temperatures ranging from 17.6 °C (February) to 8.1 °C (July/August).

Winds are variable in winter with a north-easterly predominance commonly up to 30 kph. On summer mornings winds are commonly from the east with south-westerly afternoon sea breezes that are frequently strong and in excess of 30 kph (BOM 2022).

3.2 Geology

Regional environmental geology defines the materials as S10, thin Bassendean Sand over Sandy Clay to Clayey Sand of the Guildford Formation of eolian origin (Jordan 1986). Site-specific soil investigations (Parsons Brinkerhoff Australia Pty Ltd 2005) indicate the wetland soil profile as ranging from Sandy Clay (depth of 0-5.5 m), Limestone Gravel (depth of 1.5-4.5 m), Chalky Clay (depth of 3.5-4.5 m), Interlayered Sand and Sandy Clay (depth of 3-12 m), Black Clay (depth of 12-13 m) and Sand with calcareous Gravel and Shells (depth of 13-15 m).

3.3 Hydrology

The application area is located in the City of Canning subarea of the Perth groundwater area which consists of three aquifers (Urbaqua 2020). In descending order of depth from the natural surface they are:

- Perth-Superficial Swan Aquifer
- Leederville Aquifer
- Yarragadee North Aquifer.

The Perth Groundwater Atlas (Government of Western Australia & DWER 2018) indicates that the Maximum Groundwater Level (MGL) is approximately between 4 and 5 m AHD at and around the application area.

Cannington Swamp is located within a Water Corporation drainage catchment (Cockram Street Main Drain) which ultimately discharges into the Liege Street constructed wetlands. The wetland becomes

[4] Climate statistics for Australian locations (bom.gov.au)

inundated during the winter months and early spring. The drainage system underlying the wetland is comprised of an underground pipe network which may surcharge via raised manholes during major storm events (**Appendix 5**). Approximately 0.16 ha of the application area is located on or adjacent to the eastern boundary of Cannington Swamp; a 5.71 ha conservation category wetland.

A hydrological study has been undertaken to assess the existing condition of the TEC and supporting wetland, and to determine the potential impacts of construction of the proposed road and other infrastructure (**Appendix 5**). The interaction between the surrounding drainage system and catchment is limited to high level infrequent events and the TEC is therefore predominantly supported by locally shallow groundwater and direct rainfall onto the site.

3.3.1 Groundwater

As part of the Cannington Swamp Hydrological Study, a groundwater monitoring program was undertaken between July 2017 and June 2018. Monitoring included monthly measurement of groundwater levels from four existing bores and four newly installed bores (**Appendix 5**).

Monthly groundwater levels and depths to groundwater recorded were recorded at each of the monitoring bores across the Cannington Swamp from July 2017-June 2018. Spatial analysis of maximum recorded groundwater levels (2005-2017) indicates the presence of slight mounding in the local groundwater system coinciding with the TEC area which is most likely reflective of local seasonal recharge patterns. The gradient of groundwater associated with this mounding is approximately 1:200. The Perth Groundwater Atlas (Government of Western Australia & DWER 2018) indicates that the long-term Maximum Groundwater Level (MGL) is approximately between 4 and 5 m AHD across the Cannington Swamp. The regional groundwater gradient indicated by these contours is quite flat (approximately 1:700) and sloped to the west indicating that groundwater in the area flows slowly towards the Canning River.

Groundwater samples taken from each bore located on-site in July and October 2017 for water quality analysis as per Australian Standards (AS/NZS 5667.4:1998 and AS/NZS 5667.11.1998) show:

- pH levels were typically recorded within the guideline range for the wetlands (ANZECC and ARMCANZ 2000) with levels slightly below 7 only at Bores CS-U1 and CS-U6.
- The superficial groundwater at the site is considered as Fresh with the average salinity of 3.68mg/L.
- Nitrogen levels in groundwater were found to be relatively low across the site, elevated total nitrogen concentrations were identified at CS-U1 and CW1(S) (north and north-west of the site).
- Total Phosphorus and Ammonia levels exceeded the wetland criteria in all bores.

3.3.2 Surface Water

In order to provide technical analysis that quantifies infrastructure flooding issues and assist with the Canning City Centre Activity Centre Plan, a Local Drainage Plan has been prepared (Urbaqua 2016). The study indicates that the Cannington Swamp is located within a Water Corporation drainage catchment named as Cockram Street Main Drain which ultimately discharges to the Liege Street constructed wetlands.

Cannington Swamp is bounded on all sides by roads, which are typically constructed on fill to sit at approximately 0.5 m above the natural surface level. Subcatchment delineation for the wetland site, based on LiDAR information, demonstrates that the site is internally draining with virtually no external catchment except for portions of the Western Power site. The drainage system underlying the wetland is comprised of an underground pipe network which may surcharge via raised manholes during major

storm events (>20% AEP). However, this surcharge is not expected to have a significant impact on overall hydrology of the wetland as it occurs only during large storm events and therefore has no influence on the annual hydrological cycle of the wetland (Urbaqua 2016). With virtually no upstream catchment, surface water inflow to the wetland occurs via direct rainfall recharge and outflow is via infiltration, evaporation and evapotranspiration.

3.4 Surrounding Landuse

Land uses surrounding Cannington Swamp include:

- North: Carousel Shopping Centre and carparking facilities.
- East: vacant land and medium density residential development alongside Wilson Street and Bent Street and a disused telecommunications tower.
- South: Greyhounds WA Cannington Racetrack.
- West: Western Power Cannington Terminal Substation facility.

A number of Western Power transmission lines connect to the Cannington Terminal Substation facility in multiple directions crossing Cannington Swamp. The telecommunications tower is currently located inside Western Power's landholding and the requirement to demolish (and possibly relocate) the towers and power lines has been included in the City's project budget.

4 BIOLOGICAL ENVIRONMENT

4.1 Biogeographic Region

The application area is located in the Interim Biogeographical Regionalisation of Australia (IBRA) descriptions identify the proposal as being located within the Swan Coastal Plain 2 - Perth Coastal Plain (Mitchell *et al*. 2002).

4.2 Pre-European Vegetation

The vegetation complex located at the application area is the Guildford Complex (WALGA 2015). This is described as being a mixture of open-forest to tall open-forest of Marri (*Corymbia calophylla*), Wandoo (*Eucalyptus wandoo*) and Jarrah (*Eucalyptus marginata*) in dry areas, with Flooded Gum (*Eucalyptus rudis*) and Swamp Paperbark (*Melaleuca rhaphiophylla*) in wetter areas with much of the vegetation cleared since European settlement (Heddle, Loneragan and Havel 1980).

According to the Government of Western Australian (2019), the pre-European extent of the Guildford Complex was 90,513.13 ha, of which 6,607.91 ha or 5.09% remained in 2018. Within the City of Canning, the extent of Guildford Complex vegetation was 305.22 ha, of which 4.66 ha or 1.53% remains, representing 0.34% of the pre-European extent of the vegetation complex within Western Australia (Government of Western Australia 2019).

4.3 Ecological Surveys

Ecological surveys of the application area were undertaken in spring 2015[5] [6](Natural Area Holdings PL 2016: **Appendix 6**), spring 2018[7] [8](Ecoscape (Australia) PL 2019: **Appendix 7**) and spring/summer 2018/2019[9] (Prendergast 2019: **Appendix 8**). All surveys were planned and conducted in accordance with the EPA's guidance that were current at the time of survey (Environmental Protection Authority 2004a and b, 2016a-d, 2018). The *Environmental Factor Guidelines* were considered when identifying the flora and vegetation values within the application area and the issues identified in the *Guidelines* have been considered in relation to the potential impacts that the proposal may have on flora, vegetation, fauna and inland waters.

Prior to undertaking field surveys, desktop assessments were conducted to identify the potential and possible occurrence of Threatened Ecological Communities (TECs), Priority Ecological communities (PECs) and Threatened and Priority flora and fauna species listed under the EPBC Act and BC Act, and by the DBCA. The assessment utilised *FloraBase* (Western Australian Herbarium [WAH] 1998-2022), Australian Government EPBC Act *Protected Matters Search Tool* (PMST), *NatureMap* (Department of

[5] *Guidance Statement 51 – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (Environmental Protection Authority, 2004a)
[6] *Guidance statement 56 – Terrestrial Fauna Surveys for Environmental Impact in Western Australia* (Environmental Protection Authority, 2004b).
[7] *Environmental Factor Guideline: Flora and Vegetation* (Environmental Protection Authority, 2016a).
[8] *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment* (Environmental Protection Authority, 2016c)
[9] *Environmental Factor Guideline: Terrestrial Fauna*. (Environmental Protection Authority. 2016b)

Biodiversity, Conservation and Attractions [DBCA] (2007-2022), Department of Agriculture, Water and the Environment [DAWE], and DBCA databases and available literature.

4.4 Flora and Vegetation

4.4.1 Flora

Targeted searches were conducted in areas of habitat suitable for Threatened Flora (TF) and Priority Flora (PF) that were identified during the desktop assessment as having the potential to occur.

During the 2018 Spring survey, seven floristic quadrats were recorded from within the area of, and near the application area. Fifty-four vascular flora species comprising 25 genera were recorded, including 18 introduced species (weeds) none of which were Declared Pest plants or *Weeds of National Significance* (Australian Government 2019). The most commonly represented families were Poaceae (11 taxa – predominantly weed species), Cyperaceae (six taxa) and Myrtaceae (five). The full list of species, presented as a site-by-species table, and quadrat datasheets are included in **Appendix 7**.

No TF listed under the Commonwealth EPBC Act or Western Australian BC Act were recorded within the application area.

Two P4 PF species were recorded: *Aponogeton hexatepalus* (recorded opportunistically) and *Schoenus natans* (recorded from three quadrats and opportunistically, including one quadrat corresponding with the application area). Their locations are shown on **Figure 5**. *Schoenus natans* was observed to form mats under much of the *Melaleuca lateritia* mid shrubland vegetation type.

4.4.2 Vegetation Type

The 2015 survey identified nine vegetation types within the extent of the TEC/CCW, with *Melaleuca lateritia* Heathland covering the majority of the survey site. Approximately half of the application area was identified as being degraded with little to no native species present (**Appendix 6**).

The majority of the area within the application area was re-surveyed in spring 2018, although a small portion of native vegetation was not included (vegetation type *Leptocarpus* (*Meeboldina*) Sedgeland).

Table 2 (over the page) identifies the three vegetation types from the 2018 survey and the 2015 *Leptocarpus* Sedgeland vegetation type that are located within the application area, their description and the area (ha) and percentage of the vegetation type found within the application area.

The location and extent of each of the 2018 survey vegetation type and its condition within the application area is shown in **Figure 5**.

TABLE 2: Vegetation Types within the Application Area

Vegetation Type	Description
MlMS: *Melaleuca lateritia* mid shrubland (from Ecoscape 2019) **Application Area**: 0.11 ha (9.41%)	*Melaleuca lateritia*, *Astartea affinis* and *Viminaria juncea* mid shrubland over *Leptocarpus canus* and *Watsonia meriana* mid rushland/Forbland Other characteristic native species include: *Cassytha racemosa* forma *racemosa, Eutaxia virgata, Goodenia pulchella* subsp. Coastal Plain B (L.W. Sage 2336), *Gratiola pubescens, Isolepis cernua* var. *setiformis, Lachnagrostis filiformis, Schoenus natans, Schoenus tenellus, Stylidium divaricatum, Stylidium roseoalatum*
VjTS: *Viminaria juncea* tall shrubland (from Ecoscape 2019) **Application Area**: 0.26 ha (22.97%)	*Viminaria juncea* tall shrubland over *Watsonia meriana* mid dense forbland Other characteristic native species include: *Chorizandra enodis, Gompholobium marginatum, Haemodorum simplex, Lepidosperma costale, Melaleuca lateritia, Opercularia vaginata, Patersonia occidentalis, Xanthorrhoea brunonis*
VjMrLW: *Viminaria juncea* and *Melaleuca rhaphiophylla* low woodland (from Ecoscape 2019) **Application Area**: 0.01 ha (1.28%)	*Viminaria juncea* and *Melaleuca rhaphiophylla* low woodland over *Watsonia meriana*, *Paspalum dilatatum* and *Lepidosperma costale* mid dense forbland/grassland/sedgeland Other characteristic native species include: *Astartea scoparia, Leptocarpus canus, Lomandra suaveolens, Patersonia occidentalis, Xanthorrhoea brunonis*
***Leptocarpus* (*Meeboldina*) Sedgeland** (from Natural Area Consulting Management Services 2016) **Application Area**: 0.04 ha (3.38%)	*Meeboldina cana* (now *Leptocarpus canus*) and *M. coangustata* (now *L. coangustatus*) Sedgeland with sparse *Hakea sulcata* shrubs and *Melaleuca rhaphiophylla* trees, and an understorey of weedy herbs and grasses

Source: Ecoscape (Australia) Pty Ltd 2019

4.4.3 Vegetation Type

On the basis of DBCA's 2004 assessment of Cannington Swamp (Keighery and Hyder-Griffiths 2004), 0.16 ha of the application area is considered to represent the EPBC-listed endangered *Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain* Threatened Ecological Community (TEC) and its State equivalent.

The EPBC-listed endangered Muchea Limestone TEC has 16 known occurrences, including the Cannington Swamp (DotEE 2017). The indicatively mapped distribution (Environment Australia 2003), now outdated, indicates that the bulk of the community occurs north of Perth at *The Vines* (Upper Swan), Bullsbrook, Muchea and Beermullah. As such, the wetland is a geographical outlier. The range of the TEC, when including this wetland, is approximately 95 km north to south.

4.4.4 Vegetation Condition

The vegetation condition within the application area ranges from Very Good to Completely Degraded.

The condition of the area considered by Keighery and Hyder-Griffiths (2004) to represent the Muchea Limestone TEC ranges from Very Good to Completely Degraded (**Figure 5**). The southern portion of the TEC, which is in Degraded condition due to the extensive weed cover, largely *Watsonia meriana*, and lack of native species, occupied 77.39% of the TEC portion within the application area.

Areas included in the application area that were included in the overall 2018 survey area that did not have native vegetation (assessed as Completely Degraded, 'not native vegetation', 'rehab – Geraldton Wax' and 'not assessed' as it was not close to the mapped TEC) occupied 0.74 ha; 64.32% of the total intersecting area.

The vegetation condition within the application area and within the TEC ranges from Very Good to Completely Degraded as shown in the **Table 3**.

TABLE 3: TEC Vegetation Condition within the Application Area

TEC Vegetation Condition	Area (ha)	Area (m^2)	% of CS	% of DE
Completely Degraded	0.01	82.02	0.14	0.71
Degraded	0.12	1,248.88	2.19	10.88
Very Good	0.03	282.85	0.50	2.47
TOTAL	**0.16**	**1,613.75**	**2.83**	**14.06**

Vegetation condition extents are shown on **Figure 5**.

4.5 Terrestrial Fauna

4.5.1 Methodology

A level 2 fauna survey of the CCW and application area was conducted from 16 –26 November 2015 (**Appendix 6**), traps were installed left *in situ* for the entire period. A night survey for nocturnal fauna species was undertaken on 17 December 2015.

A review of the DBCA Threatened and Priority Fauna Database, *NatureMap* (DPaW 2007-2022) the *Protected Matters Search Tool* (PMST; DoE 2015) reports identified the potential for 18 conservation significant species listed under the BC Act (at the time, WC Act) and/or the EPBC Act to be present in the survey area. Native bee species *Leioproctus* (*Andrenopsis*) *douglasiellus* and *Neopasiphae simplicior* are listed the EPBC Act list of threatened species (DAWE 2020a; 2020b, both accessed July 2020).

The 2015 fauna survey confirmed the presence of three mammals, 15 birds, five reptiles, four amphibians and 42 invertebrates within the site. The number of birds and mammals compared to those listed *on NatureMap* are both low. The low numbers of birds, mammals and reptiles could be explained by the:

- wet nature of the site, as the majority is inundated for most of the winter months and the start of Spring
- small size of the site
- site's isolation from other vegetated areas
- degraded nature of the area and human disturbances.

The 2015 fauna survey area was assessed as containing good quality fauna habitat where the TEC is present, with areas of thick heath and understory vegetation present for invertebrates and numerous flowering shrub species for birds such as Honeyeaters, and wetland habitat suitable for amphibians. The wetter areas were assessed as being unlikely to be impacted by the proposal as it will not extend into those portions of the site.

4.5.2 Fauna assemblage

During the 2015 fauna survey, three mammal species were recorded on the basis of observations of animals, track, scats and/or diggings. The introduced European Red Fox (*Vulpes vulpes*) and Domestic Dog (*Canis lupus familiaris*) were the only mammal species observed during fauna activities. Signs of the introduced European Rabbit (*Oryctolagus cuniculus*) were also observed throughout the site. Fifteen bird species were observed (three were introduced species), five reptile species and four frog species were also recorded.

4.5.3 Conservation listed species

Historically, Cannington is known to be habitat for the only two native bee species in Australia that are listed as threatened on the EPBC Act list of threatened species. *Leioproctus* (*Andrenopsis*) *douglasiellus* (Colletidae) has previously been collected from Cannington Swamp and *Neopasiphae simplicior* (Colletidae) is known to historically occur within the vicinity. According to the Threatened Species Scientific Committee (DSEWPaC 2013), *Leioproctus (Andrenopsis) douglasiellus* is closely associated with the presence of flora species *Goodenia filiformis* (Thread-leaved Goodenia) and *Anthotium junciforme*, neither flora species were recorded at the site during the 2015 fauna survey.

These bees are listed as:

- critically endangered and threatened with extinction under the EPBC Act (DAWE 2020a; 2020b, both accessed July 2020; DSEWPaC 2013; DEWHA 2008; TSSC 2009; 2013)
- endangered under the BC Act, as listed on the DBCA's Threatened and Priority Fauna List (DBCA 2019)
- endangered (as per IUCN Redlist Criteria) by the Western Australian Government (TSSC 2009).

A targeted native bee survey was conducted at the CCW with the two listed species being the focus of the survey. Seven surveys were conducted from late November 2018 to the end of February 2019. Despite the host plant being present and flowering during the survey, and recording a diverse assemblage of native bees, **no observations** of either of the two target threatened species were made (**Appendix 8**).

The survey did, however, identify 47 species and morphospecies of native bees, ranging from 4-32 species per survey. The survey effort and high species yields indicate that the survey effort was sufficient to identify if the target bees were present over the months that surveys were conducted.

Given that the whole of Cannington Swamp was comprehensively surveyed, the survey results indicate that *Leioproctus douglasiellus* was not present at the time of surveying. The cause of the absence of *Leioproctus douglasiellus* is unclear, especially as its host plant was flowering during the survey, however, it may be that the population was already reduced such that negative effects of small population size have resulted in the extirpation of *Leioproctus douglasiellus* since it was last recorded at this site (last record unknown). The site is highly isolated, being surrounded by an electricity substation, shopping centre, greyhound track, parking and residential development that appears to have little in the way of native vegetation that could serve to connect the Cannington Claypan population with any other populations in the region.

The absence of *Neopasiphae simplicior* can be taken as more conclusive evidence that this bee does not occur at the site, given that its entire flight season was covered. It has not been recorded in the vicinity for over 60 years and may never have occurred at the site as the holotype collection record from 'Cannington' is too broad to precisely identify the location (geocode precision 4, indicating location accuracy of 10-50 km).

5. APPLICATION OF THE TEN CLEARING PRINCIPLES

The 2015 and 2018 flora and vegetation surveys were conducted during Spring which is within the optimal period for a primary survey within the bioregion (EPA 2016c). The Level 2 fauna survey was conducted concurrently with the 2015 flora and vegetation survey. Seven targeted surveys for two listed native bee species were conducted between November 2018 and February 2019; timed to coincide with the documented activity time of the target bee species.

An assessment of the proposed clearing of **0.41 ha** of native vegetation from within the **1.15 ha** application area against the Ten Clearing Principles outlined in Schedule 5 of the EP Act is provided in **Sections 5.1 – 5.10**.

A summary of the assessment is shown in **Table 4** below.

Table 4: Summary of Assessment Against the Ten Clearing Principles

Clearing principle	Unlikely to be at variance	May be at variance	Likely to be at variance
Principle (a) Native vegetation should not be cleared if it comprises a high level of biological diversity (refer to **Section 5.1**)		X	
Principle (b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia (refer to **Section 5.2**)	X		
Principle (c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora (refer to **Section 5.3**)	X		
Principle (d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community (refer to **Section 5.4**)			X
Principle (e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared (refer to **Section 5.5**)			X
Principle (f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland (refer to **Section 5.6**)		X	
Principle (g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation (refer to **Section 5.7**)	X		
Principle (h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area (refer to **Section 5.8**)		X	
Principle (i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water (refer to **Section 5.9**)	X		
Principle (j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding (refer to **Section 5.10**)	X		

5.1 Principle (a)

Native vegetation should not be cleared if it comprises a high level of biological diversity.

5.1.1 Assessment

During the 2018 Spring survey, seven floristic quadrats were recorded from within the wetland area and near the application area. Fifty-four vascular flora species comprising 25 genera were recorded, including 18 introduced species (i.e., approximately 33% of the total number of species) none of which were Declared Pest plants or *Weeds of National Significance* (Australian Government 2019). The most commonly represented families were Poaceae (11 taxa – predominantly weed species), Cyperaceae (six taxa) and Myrtaceae (five). The full list of species, presented as a site by species table, and quadrat datasheets are included in **Appendix 7**.

No TF pursuant to the BC Act or the EPBC Act were recorded. Two PF species (Priority 4) were recorded: *Aponogeton hexatepalus* (recorded opportunistically) and *Schoenus natans* (recorded from three quadrats and opportunistically, including one quadrat corresponding with the application area).

The 2015 survey identified nine vegetation types within the extent of the TEC/CCW, with *Melaleuca lateritia* Heathland covering the majority of the 2015 survey site. In 2015, approximately half of the application area was identified as being degraded with little to no native species present. The majority of the area within the application area was re-surveyed in Spring 2018, although a small portion of native vegetation was not included (vegetation type *Leptocarpus* (*Meeboldina*) Sedgeland).

Within the application area, three vegetation types were mapped during the 2018 survey and the 2015 *Leptocarpus* Sedgeland was also recorded.

During the 2015 Level 2 fauna survey, three mammals, 15 birds, five reptiles, four amphibians and 42 invertebrates were recorded from within the 12.4 ha survey site[10]. Compared to the number of mammal and reptile species listed on *NatureMap* as being recorded in the search area (i.e., 125 vertebrate species) the numbers trapped or observed within the survey site were considered to be low.

5.1.2 Conclusion

The flora and fauna diversity in the proposed area of clearing is not similar to the surrounding area which has been predominantly cleared for urban residential development. However, as the application area proposed to be cleared is part of the *Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain* TEC, the impact of clearing the application area may be considered to be at variance to the clearing principle in that it would be clearing an ecological community that represents a unique ecological assemblage of organisms within the State that are under various threats from human activity.

The proposed clearing of 0.41 ha of native vegetation within the 1.15 ha application area <u>may</u> <u>be at variance</u> with this Principle.

[10] The survey site included portions of the Western Power substation between Grose Avenue, and undeveloped land around Grey and Lake Streets, and covers approximately **12.4 ha**.

5.2 Principle (b)

Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.

5.2.1 Assessment

The 2015 fauna survey area was assessed as containing good quality fauna habitat where the TEC is present, with areas of thick heath and understorey vegetation present for invertebrates and numerous flowering shrub species for birds, and wetland habitat suitable for amphibians. The wetter areas were assessed as being unlikely to be impacted by the proposal as it will not extend into those portions of the site.

During the 2015 fauna survey, three mammal species were recorded on the basis of observations of animals, track, scats and/or diggings; all introduced species. Fifteen bird species were observed (three were introduced species), five reptile species and four frog species were also recorded.

On the basis of desktop analysis, two short-tongued native bee species (*Leioproctus douglasiellus* and *Neopasiphae simplicior*) have been identified as occurring, or potentially occurring, within the wetland. *Leioproctus douglasiellus* is listed as critically endangered under the EPBC Act and Schedule 1 (fauna that is rare or likely to become extinct) under the BC Act. As of 2013, it was thought to occur in three locations within the Perth metropolitan area ranging from Cannington to Forrestdale, with an extent of occurrence of 24.3 km^2 and area of occupancy of 0.2 km^2. It has been collected on two plant species: *Goodenia filiformis*[11] and *Anthotium junciforme*, both previously listed as PF species.

Leioproctus douglasiellus was reported as having been recently been found 'near Carousel in Cannington' during a Department of Environment and Conservation survey (Swan Catchment Council 2007). The vegetation was described as *areas of heath on flowering Goodenia filiformis and G. pulchella (perennial herbs, yellow flowers), Lobelia tenuior (annual herb, blue flowers) and Anthotium junciforme (perennial herb, blue/violet flowers)*.

Neopasiphae simplicior is listed as critically endangered under the EPBC Act and Schedule 1 (fauna that is rare or likely to become extinct) under the Western Australian the BC Act. As of 2009 it was known from a single location at Forrestdale Lake, with an extent of occurrence and area of occupancy estimated at 1 km^2. The species has only been collected at flowers of Thread-leaved Goodenia (*Goodenia filiformis*[11]), a perennial herb; Slender Lobelia (*Lobelia tenuior*), an annual herb; *Angianthus preissianus* (males only), an annual herb; and *Velleia* sp (now *Goodenia* spp. – Shepherd *et al.* 2020).

Neopasiphae simplicior was first described in 1954 at 'Cannington' from a single male specimen (Houston 2000). The location accuracy attributed to this record is 10-50 km (Geocode precision 4) thus may not have been from this wetland.

A targeted native bee survey was conducted at the CCW with the two listed species being the focus of the survey. Seven surveys were conducted from late November 2018 to the end of February 2019. Despite the host plant being present and flowering during the survey, and recording a diverse assemblage of native bees, **no observations** of either of the two target threatened species were made.

[11] *Goodenia filiformis* only occurs in far southern parts of Western Australia (Western Australian Herbarium 1998-2019, accessed 5 March 2019) and appears to have been erroneously listed for both bee species. The relevant host species are known to be *G. pulchella* and *G. micrantha* (K. Prendergast *pers. comm*.).

The survey did, however, identify 47 species and morphospecies of native bees, ranging from 4-32 species per survey. The survey effort and high species yields indicate that the survey effort was sufficient to identify if the target bees were present over the months that surveys were conducted.

Given that the whole of Cannington Swamp was comprehensively surveyed, the survey results indicate that *Leioproctus douglasiellus* was not present at the time of surveying. The cause of the absence of *Leioproctus douglasiellus* is unclear especially as its host plant was flowering during the survey, however, it may be that the population was already reduced such that negative effects of small population size have resulted in the extirpation of *Leioproctus douglasiellus* since it was last recorded at this site (last record unknown). The site is highly isolated, being surrounded by an electricity substation, shopping centre, greyhound track, parking and residential development that appears to have little in the way of native vegetation that could serve to connect the Cannington Claypan population with any other populations in the region.

The absence of *Neopasiphae simplicior* can be taken as more conclusive evidence that this bee does not occur at the site, given that its entire flight season was covered. It has not been recorded in the vicinity for over 60 years and may never have occurred at the site as the holotype collection record locational accuracy is broad (i.e., within 10-50 km).

5.2.2 Conclusion

The 2015 fauna survey confirmed the presence of three mammals, 15 birds, five reptiles, four amphibians and 42 invertebrates within the site. The number of birds and mammals compared to those listed on the 2015 desktop search of *NatureMap* (i.e., potential 125 species occurring onsite) are both considered to be low.

Historically known to be habitat for the only two native bee species in Australia that are listed as threatened on the EPBC Act list of threatened species, the results of the targeted survey of the whole of Cannington Swamp in 2018-2019, indicate that *Leioproctus douglasiellus* was not present at the time of surveying. The cause of the absence of *Leioproctus douglasiellus* is unclear especially as its host plant was flowering during the survey, however, it may be that the population was already reduced such that negative effects of small population size have resulted in the extirpation of *Leioproctus douglasiellus* since it was last recorded at this site (last record unknown). The site is highly isolated, being surrounded by an electricity substation, shopping centre, greyhound track, parking and residential development that appears to have little in the way of native vegetation that could serve to connect the Cannington Claypan population with any other populations in the region.

The absence of *Neopasiphae simplicior* can be taken as more conclusive evidence that this bee does not occur at the site, given that its entire flight season was covered. It has not been recorded in the vicinity for over 60 years and may never have occurred at the site as the holotype collection record from 'Cannington' is too broad to precisely identify the location (geocode precision 4, indicating location accuracy of 10-50 km).

The proposed clearing of 0.41 ha of native vegetation within the 1.15 ha application area is <u>unlikely to be at variance</u> with this Principle.

5.3 Principle (c)

Native vegetation should not be cleared if it includes, or is necessary for, the continued existence of rare flora.

5.3.1 Assessment

During the 2015 and 2018 surveys, targeted searches were conducted in areas of habitat suitable for TF and PF identified during the desktop assessments, to determine the presence of any TF or PF species and/or ecological communities listed under the BC Act and/or the EPBC Act.

During the 2015 survey, the TF species *Eremophila glabra* subsp. *chlorella,* and the PF species *Ornduffia submersa* (Priority 4) were observed. None of these species were located within the application area (refer to Figure 8 in **Appendix 6).**

During the 2018 survey, no TF species were observed within the application area. Two PF species, both P4, were recorded: *Aponogeton hexatepalus* (recorded opportunistically) and *Schoenus natans* (recorded from three quadrats and opportunistically), including one quadrat corresponding with the application area.

5.3.2 Conclusion

No TF flora species listed for protection under the EPBC Act or BC Act have been recorded from the application area. One P4 species, *Schoenus natans*, was recorded within the application area. Priority 4 species are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands[12]. Near Threatened species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. Species that have been removed from the list of threatened species or lists of conservation dependent or other specially protected species, during the past five years for reasons other than taxonomy, or other species in need of monitoring.

The proposed clearing of 0.41 ha of native vegetation within the 1.15 ha application area is <u>unlikely to be at variance</u> with this Principle.

5.4 Principle (d)

Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.

5.4.1 Assessment

On the basis of DBCA's 2004 assessment of Cannington Swamp, approximately 0.16 ha of the application area has been considered to represent the Muchea Limestone TEC (refer to **Appendix 7**).

In 2005, Parsons Brinckerhoff drilled and assessed 19 bore holes (Woodman Environmental Consulting Pty Ltd 2005) and did not identify the requisite TEC soil conditions of Muchea Limestone and/or

[12] Conservation Codes for Western Australian Flora and Fauna (dpaw.wa.gov.au)

significant ironstone. However, some transported limestone was recorded thus limestone considered as Plains limestone may occur, thus not entirely precluding the Muchea Limestone TEC from occurring (based on soil type requirements).

Comparison of the flora species of the site during the 2015 and 2018 surveys with those listed in the *Interim Recovery Plan* for the Muchea Limestone TEC (English & Blyth 2000) identified only three species in common (four if the identification of *Melaleuca lateriflora* in the *Interim Recovery Plan* should be *Melaleuca lateritia*): *Acacia saligna* (from one 2018 quadrat), *Casuarina obesa* (from one 2015 quadrat), *Melaleuca rhaphiophylla* (from two 2018 quadrats and one each from 2018 and 2015) and *Melaleuca lateritia* (five from 2018 and three from 2015).

None of the above species are particularly associated with limestone soils (WAH 1998-2022). Additionally, the species recorded during the 2015 and 2018 surveys show a greater affinity with the Clay Pans TEC, with 23 species in common with the *Clay pans with shrubs* PEC component of the Clay Pans TEC.

The EPBC-listed and BC Act endangered Muchea Limestone TEC has 16 known occurrences, including the Cannington Swamp (DotEE 2017). The indicatively mapped distribution (Environment Australia 2003), now outdated, indicates that the bulk of the community occurs north of Perth at *The Vines* in Upper Swan, Bullsbrook, Muchea and Beermullah.

5.4.2 Conclusion

The proposed clearing of native vegetation from within the application area will result in the loss of **0.16 ha** of the Muchea Limestone EPBC-listed TEC and its DBCA TEC equivalent.

The proposed clearing of 0.41 ha of native vegetation within the 1.15 ha application area <u>is at variance</u> with this Principle.

5.5 Principle (e)

Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

5.5.1 Assessment

The application area is located in the Swan Coastal Plain 2 - Perth Coastal Plain IBRA region in the (DPIRD 2022).

The vegetation complex is the Guildford Complex being a mixture of open-forest to tall open-forest of Marri (*Corymbia calophylla*), Wandoo (*Eucalyptus wandoo*) and Jarrah (*Eucalyptus marginata*) in dry areas, with Flooded Gum (*Eucalyptus rudis*) and Swamp Paperbark (*Melaleuca rhaphiophylla*) in wetter areas with much of the vegetation cleared since European settlement.

The pre-European extent of the Guildford Complex was 90,513.13 ha, of which 6,607.91 ha or 5.09% remained in 2018. Within the City of Canning, the extent of Guildford Complex vegetation was 305.22 ha, of which 4.66 ha or 1.53% remains, representing 0.34% of the pre-European extent of the vegetation complex within Western Australia (Government of Western Australia 2019).

5.5.2 Conclusion

There is currently less than 10 % of the pre-European Guildford Complex remaining at all State, region, sub-region and City of Canning scales.

The proposed clearing of 0.41 ha of native vegetation within the 1.15 ha application area is at variance with this Principle.

5.6 Principle (f)

Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

5.6.1 Assessment

Cannington Swamp is a seasonal wetland that becomes inundated during the winter months and early spring. The majority of the site is classified as a Conservation Category wetland (6.71 ha), which is considered environmentally significant and has restrictions on land use and management practices within the area. Approximately 0.44 ha of the wetland occurs within the application area. The north-east portion of the application area is classified as multiple use wetland and a small portion on the north-west side is no longer considered a wetland (**Figure 4**).

Cannington Swamp is bounded on all sides by roads, which are typically constructed on fill to sit at approximately 0.5m above the natural surface level. Subcatchment delineation for the wetland site, based on LiDAR information, demonstrates that the site is internally draining with virtually no external catchment except for portions of the Western Power site. The drainage system underlying the wetland is comprised of an underground pipe network which may surcharge via raised manholes during major storm events (>20% AEP). However, this surcharge is not expected to have a significant impact on overall hydrology of the wetland as it occurs only during large storm events and therefore has no influence on the annual hydrological cycle of the wetland (Urbaqua 2016). With virtually no upstream catchment, surface water inflow to the wetland occurs via direct rainfall recharge and outflow is via infiltration, evaporation and evapotranspiration.

As part of the Cannington Swamp Hydrological Study, a groundwater monitoring program was undertaken between July 2017 and June 2018 to assess the existing condition of the TEC and supporting wetland, and to determine the potential impacts of construction of the proposed SLR Stage 3 and other infrastructure on the wetland (**Appendix 5**). Monitoring included monthly measurement of groundwater levels from four existing bores and four newly installed bores (**Figure 6**).

Spatial analysis of maximum recorded groundwater levels (2005-2017) indicates the presence of slight mounding in the local groundwater system coinciding with the TEC area which is most likely reflective of local seasonal recharge patterns. The gradient of groundwater associated with this mounding is approximately 1:200.

The Perth Groundwater Atlas (Government of Western Australia & DWER 2018) indicates that the long-term Maximum Groundwater Level (MGL) is approximately between 4 and 5 m AHD across Cannington Swamp. The regional groundwater gradient indicated by these contours is quite flat (approximately 1:700) and sloped to the west indicating that groundwater in the area flows slowly towards the Canning River.

5.6.2 Conclusion

Consistent with the existing conditions, there will be no upstream catchment discharging to the wetland. Runoff from the proposed roadway will be directed to the existing drainage systems within the Cockram Street Main Drain catchment. The wetland area and storage capacity will be decreased slightly as a result of the road construction but importantly, the depth and duration of inundation will not be substantially changed. The finished level of any construction within the application area is expected to be above and have sufficient clearance from the local Maximum Groundwater Level (MGL).

The proposed clearing of 0.41 ha of native vegetation within the 1.15 ha application area may be at variance with this Principle.

5.7 Principle (g)

Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

5.7.1 Assessment

Regional environmental geology defines the materials as S10, thin Bassendean Sand over Sandy Clay to Clayey Sand of the Guildford Formation of eolian origin (Jordan 1986). Site-specific soil investigations (Parsons Brinkerhoff Australia Pty Ltd 2005) indicate the wetland soil profile as ranging from Sandy Clay (depth of 0-5.5 m), Limestone Gravel (depth of 1.5-4.5 m), Chalky Clay (depth of 3.5-4.5 m), Interlayered Sand and Sandy Clay (depth of 3-12 m), Black Clay (depth of 12-13 m) and Sand with calcareous Gravel and Shells (depth of 13-15 m).

The hydrological modelling results indicate that post-development flow rates from the proposed road are relatively small and are not expected to cause substantial erosion effects. Underground pipes can be designed to convey runoff from up to the 20% AEP event downstream to provide for appropriate serviceability. Extreme flooding events (up to the 1% AEP event) that exceed the capacity of pipes will be directed through overland flow on the road.

Potential impacts that may occur as a result of clearing of the application area to the terrestrial environmental quality includes erosion of soils from earthworks and dewatering that may result in the exposure of Acid Sulfate Soils (ASS). The proposed CEMP will incorporate ASS management measures to mitigate any potential impact.

5.7.2 Conclusion

The application area may be susceptible to erosion and waterlogging during heavy rainfall events as there is minimal gradient. Given the small-scale nature of the application area (1.15 ha) and implementing best practice management, erosion and waterlogging can be minimised. Impacts are expected to be temporary (during construction) and appropriate application of management measures identified in the CEMP will ensure that potential dust sources are managed appropriately.

The proposed clearing of 0.41 ha of native vegetation within the 1.15 ha application area is unlikely to be at variance with this Principle.

5.8 Principle (h)

Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

5.8.1 Assessment

A 1,785.84 m^2 portion of the application area will be constructed on the eastern boundary of Cannington Swamp, a Conservation category wetland (also known as Cannington Swamp and Grose Avenue/Lake Street Wetland).

The construction of the proposed SLR Stage 3 will result in the removal of TEC/CCW vegetation surveyed to be in the following conditions: Very Good: 282.85 m^2; Degraded: 1,248.88 m^2; Completely Degraded: 82.02 m^2.

5.8.2 Conclusion

The removal of native vegetation from within the application area includes a 1,785.84 m^2 portion of the TEC/CCW vegetation the majority of which is in a Degraded to Completely Degraded condition.

The proposed clearing of 0.41 ha of native vegetation within the 1.15 ha application area <u>is</u> at variance with this Principle.

5.9 Principle (i)

Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

5.9.1 Assessment

A hydrological study has been undertaken to assess the existing condition of the TEC and supporting wetland, and to determine the potential impacts of construction of the proposed road and other infrastructure (**Appendix 5**). The interaction between the surrounding drainage system and catchment was found to be limited to high level infrequent events and the TEC is therefore predominantly supported by locally shallow groundwater and direct rainfall onto the site.

A groundwater monitoring program undertaken between July 2017 and June 2018 included monthly measurement of groundwater levels from four existing bores and four newly installed bores (Error! Reference source not found.).

Spatial analysis of maximum recorded groundwater levels (2005-2017) indicates the presence of slight mounding in the local groundwater system coinciding with the TEC area which is most likely reflective of local seasonal recharge patterns. The gradient of groundwater associated with this mounding is approximately 1:200. The Perth Groundwater Atlas (Government of Western Australia & DWER 2018) indicates that the long-term Maximum Groundwater Level (MGL) is approximately between 4 and 5 m AHD across the Cannington Swamp. The regional groundwater gradient indicated by these contours is quite flat (approximately 1:700) and sloped to the west indicating that groundwater in the area flows slowly towards the Canning River.

Groundwater quality testing was undertaken from all the bores within the superficial aquifer onsite in July and October 2017. The results show that pH levels were typically recorded within the guideline

range for the wetlands (ANZECC & ARMCANZ, 2000) with levels slightly below 7 only at Bores CS-U1 and CS-U6. The superficial groundwater at the site is considered as Fresh with the average salinity of 3.68mg/L. Nitrogen levels in groundwater were found to be relatively low across the site, elevated total nitrogen concentrations were identified at CS-U1 and CW1(S) (north and north-west of the site). Total Phosphorus and Ammonia levels exceeded the wetland criteria in all bores.

5.9.2 Conclusion

The removal of vegetation from within the application area to enable construction of the proposed SLR Stage 3 may have the potential to impact the quality of groundwater, however, the proposed treatment of infiltrated runoff generated within the application area will minimise the export of pollutants to groundwater.

The proposed clearing of 0.41 ha of native vegetation within the 1.15 ha application area is <u>unlikely to be at variance</u> with this Principle.

5.10 Principle (j)

Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.

5.10.1 Assessment

Hydrological modelling results indicate that post-development flow rates from the application area are relatively small and are not expected to cause substantial erosion effects. Underground pipes will be designed to convey runoff from up to the 20% AEP event downstream to provide for appropriate serviceability. Extreme flooding events (up to the 1% AEP event) that exceed the capacity of pipes will be directed through overland flow on the proposed SLR Stage 3 roadway.

Consistent with the existing conditions, there will be no upstream catchment discharging to the wetland. Runoff from the application area will be directed to the existing drainage systems within the Cockram Street Main Drain catchment. The wetland area and storage capacity will be decreased slightly as a result of the proposed road construction but importantly, the depth and duration of inundation will not be changed substantially. The finished level of any construction within the application area is expected to be above and have sufficient clearance from the local Maximum Groundwater Level (MGL).

5.10.2 Conclusion

The removal of vegetation from which the application area has the potential to change the local water balance reducing local recharge and impacting on groundwater levels. On-site infiltration of small rainfall events consistent with the requirements of DWER and the City of Canning will be engineered for to prevent this impact.

The proposed clearing of 0.41 ha of native vegetation within the 1.15 ha application area is <u>unlikely to be at variance</u> with this Principle.

6 SUMMARY AND CONCLUSION

Desktop reviews of published Western Australian and Commonwealth databases pertaining to the application area were conducted prior to field surveys being conducted in Spring 2015 and 2018. The desktop review included data and information relating to TF, PF and TECs, Threatened and Migratory fauna species, ESAs and groundwater dependent ecosystems.

As Cannington Swamp is historically known or considered likely to be habitat for the only two native bee species in Australia listed as threatened on the EPBC Act list of threatened species, *Leioproctus* (*Andrenopsis*) *douglasiellus* (Colletidae) and *Neopasiphae simplicior* (Colletidae), seven targeted surveys were undertaken from late November 2018 to late February 2019.

Groundwater monitoring undertaken between July 2017 and June 2018, included monthly measurement of groundwater levels from four existing and four newly installed bores. To provide technical analysis that quantifies potential infrastructure flooding issues, a Local Drainage Plan has been prepared for the Canning City Centre Activity Centre Plan that includes the application area.

The findings of the environmental assessments include:

- The pre-European extent of the Guildford Complex intersecting the application area has 1.53 % of its original extent remaining at local government area scale.
- The application area is included in the mapped extent of the EPBC-listed endangered *Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain* TEC and its Western Australian equivalent.
- No TF species were found to occur within the application area; one PF species, *Schoenus natans* (P4), was observed on the edge of the application area.
- Despite the host plant being present and flowering during the targeted native bee survey, and recording a diverse assemblage of native bees, no observations of either of the two targeted threatened species (*Leioproctus douglasiellus* and *Neopasiphae simplicior*) were made.

Approximately 0.41 ha of native vegetation within the 1.15 ha application area is proposed to be cleared to enable the construction of the proposed SLR Stage 3.

A 0.17 ha portion of the application area is located on the eastern boundary of Cannington Swamp, a CCW. A flora and vegetation survey conducted in Spring 2018 found the vegetation within the application area to be in the following conditions: Very Good: 282.85 m^2; Degraded: 1,248.88 m^2; Completely Degraded: 82.02 m^2.

As discussed in **Section 5**, it is concluded that the proposed clearing of **0.41 ha** of native vegetation from within the **1.15 ha** application area includes approximately **0.16** of *Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain* TEC and is likely to be at variance with Clearing Principles (d), (e) and (h).

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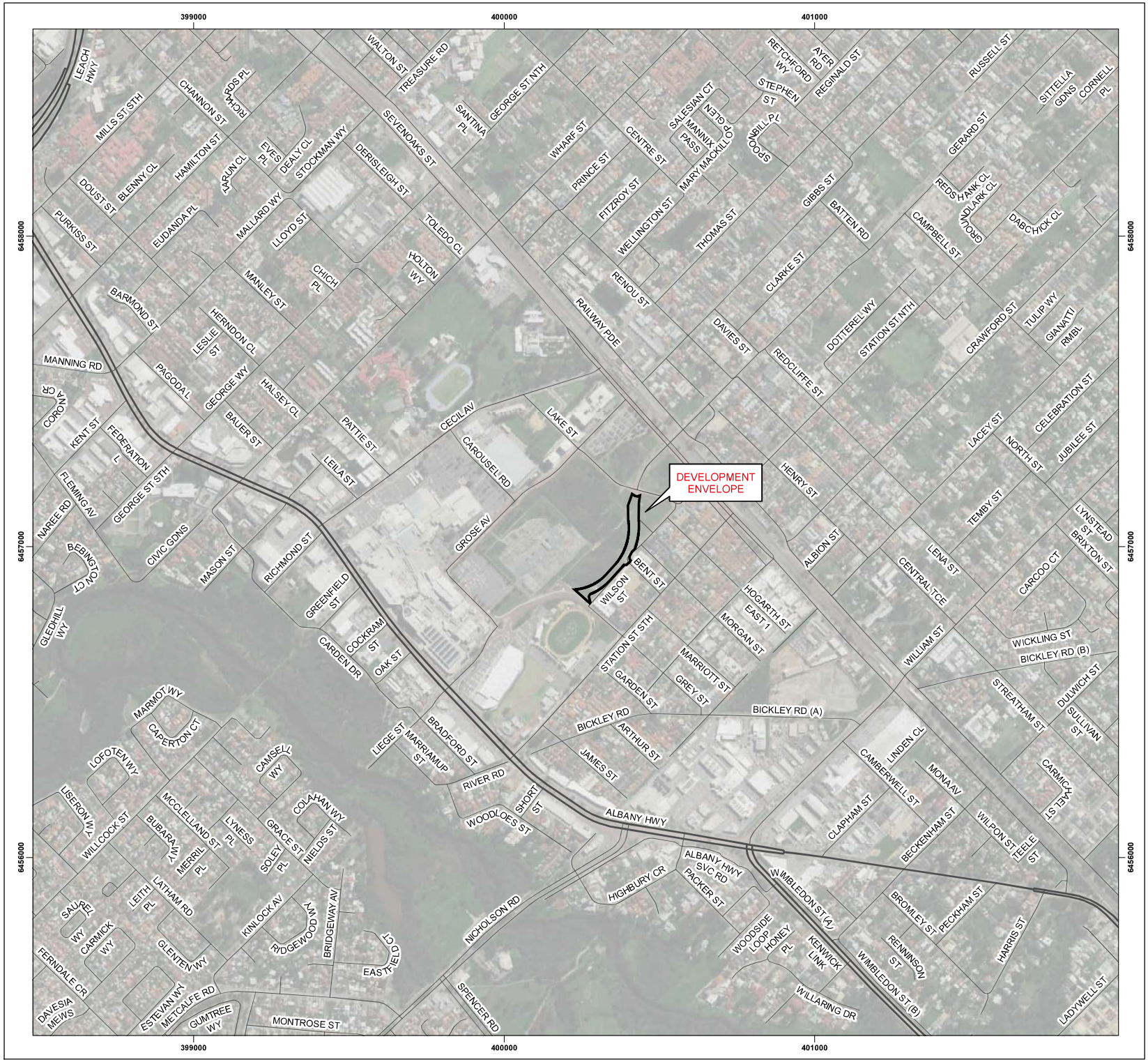
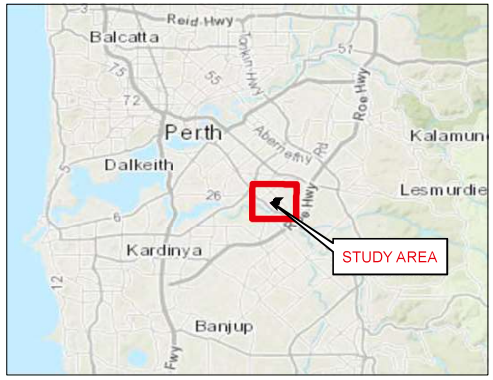
FIGURES

NATIVE VEGETATION CLEARING PERMIT SUPPORTING DOCUMENT
SOUTHERN LINK ROAD (STAGE 3) CANNINGTON
CITY OF CANNING



LEGEND

Southern Link Road Development Envelope S429-I Rev B



DATA SOURCES
SOURCE DATA:
AERIAL: ESRI BASEMAP (2020)
SERVICE LAYERS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY
SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

ecoscape

SOUTHERN LINK ROAD (STAGE 3)
NVCP APPLICATION
CITY OF CANNING
REGIONAL LOCATION

City of CANNING

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

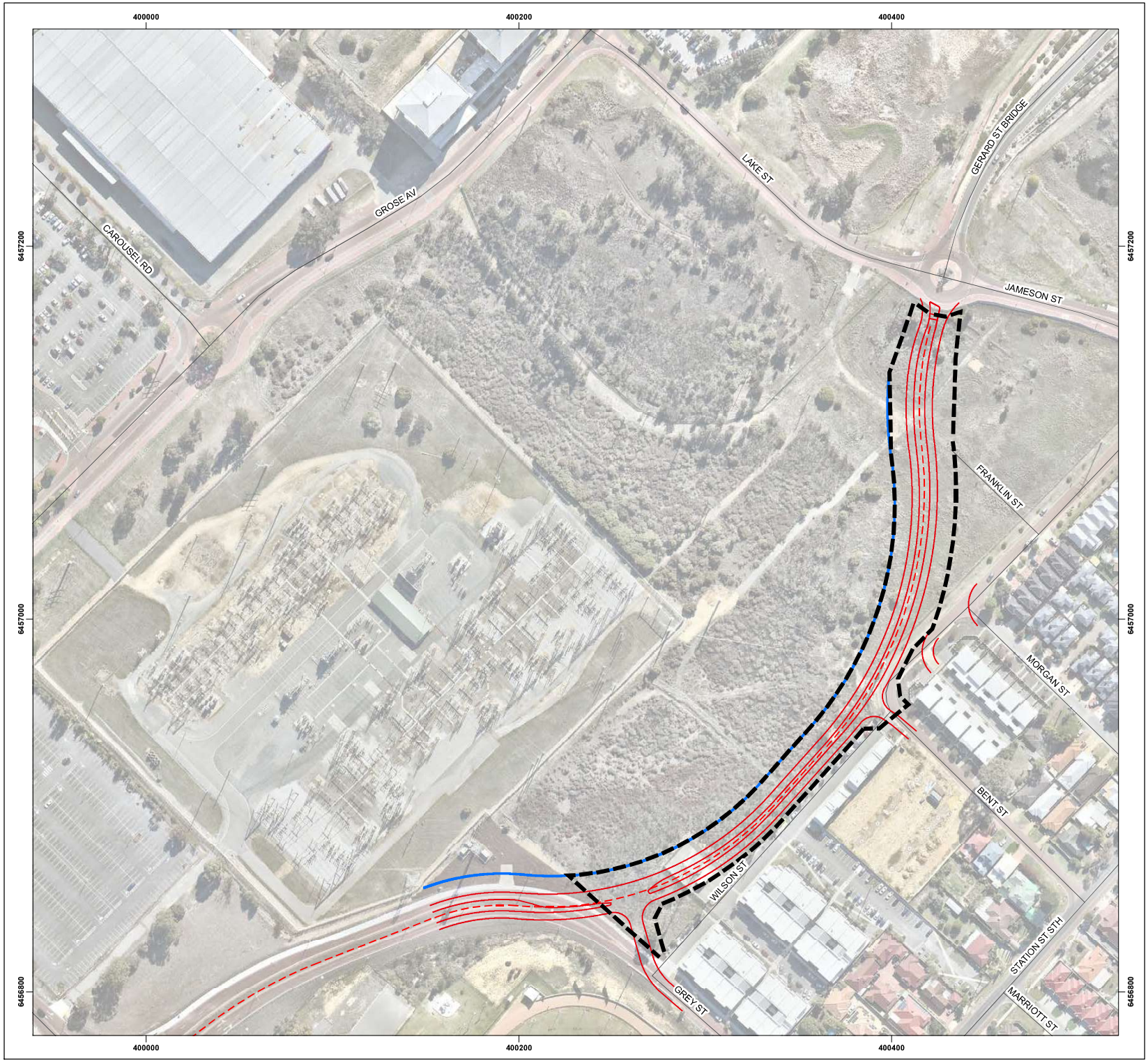
SCALE: 1:12,000 @ A3

0 200 400 m

PROJECT NO: 4267-18

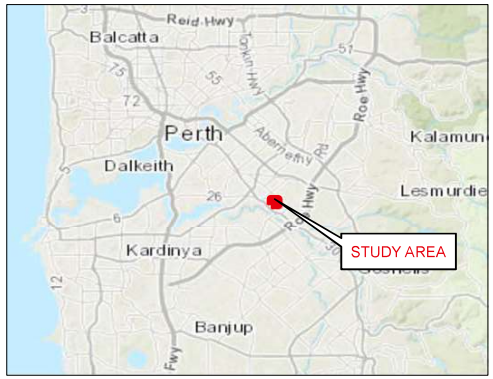
REV	AUTHOR	APPROVED	DATE
0	SS	NW	18/05/2022

FIGURE 01



LEGEND

- Southern Link Road Application Area S429-I Rev B
- Batter
- Ultimate Centrelines
- Ultimate Dgn Kerb



DATA SOURCES
SOURCE DATA:
AERIAL: NEARMAP (2020)
SERVICE LAYERS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

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SOUTHERN LINK ROAD (STAGE 3)
NVCP APPLICATION
CITY OF CANNING

APPLICATION AREA AND ROAD ALIGNMENT

City of CANNING

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:2,000 @ A3

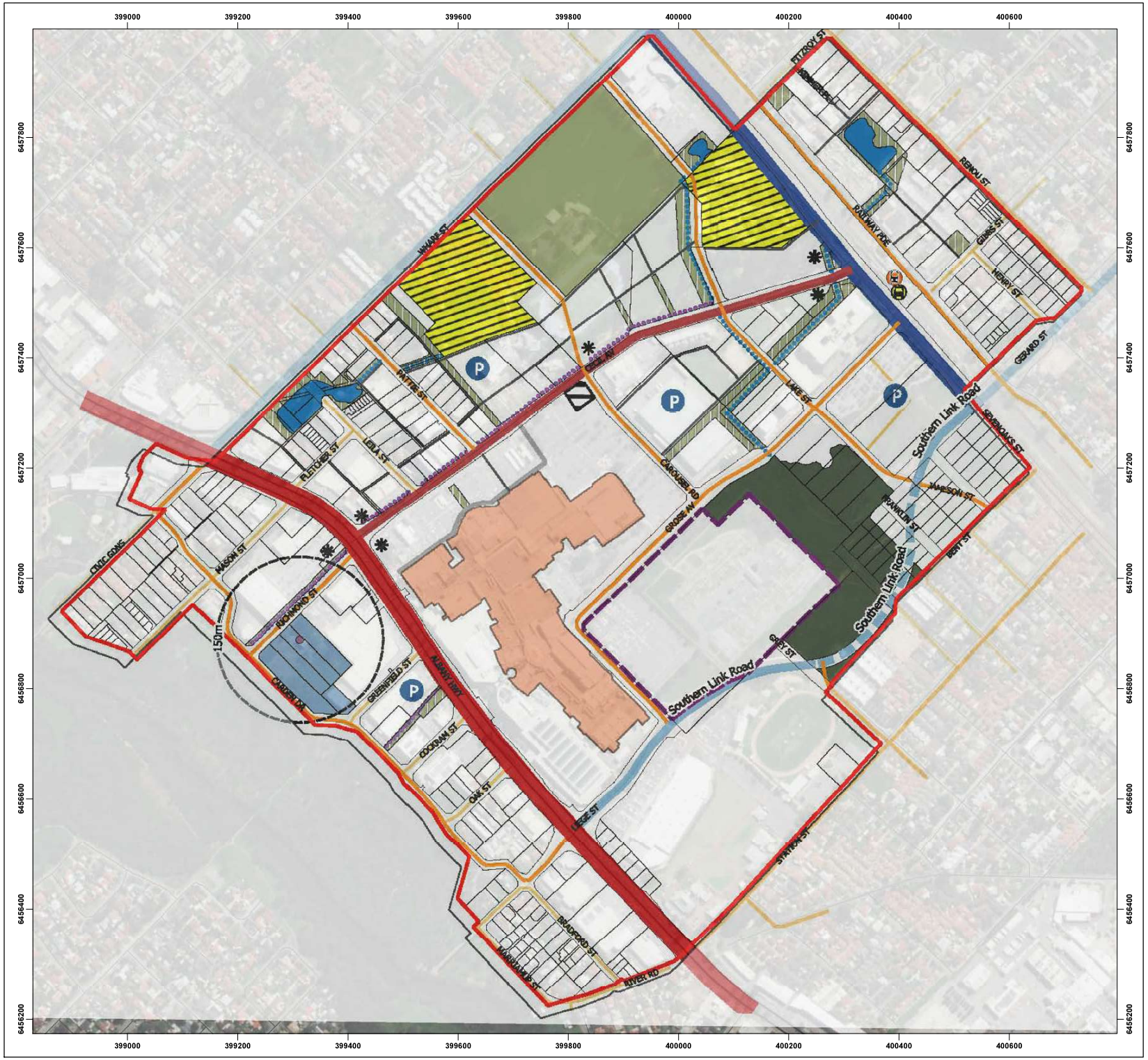
N

0 40 80 m

PROJECT NO: 4267-18

REV	AUTHOR	APPROVED	DATE
0	SS	NW	18/05/2022

FIGURE 02



LEGEND

- City Centre Boundary
- Landmark Buildings
- Building Outline
- Indicative Shared Parking Locations
- Western Power Substation Buffer

Train Station and Bus Interchange (Subject to Upgrade and Planning)

- Bus Interchange
- Cannington Train Station

Water Corporation Pump Station Buffer

- 150m
- Water Corporation Pump Station

Roads

- Integrated Arterial A
- Main Street
- Neighbourhood Connector
- Access Street
- Laneway (Indicative)
- Future Intergrated Arterial B
- Future Integrated Arterial B (Indicative Alignment Only)
- Primary Distributor
- Indicative Access Lane

Reserves

- Water Corporation
- Public School

Urban Streams

- Urban Stream
- Water Sensitive Urban Design Treatment

Public Open Space

- Public Open Space
- Public Open Space - Indicative (New)
- Regional Open Space
- Cecil Square
- Waterbody

ecoscape

SOUTHERN LINK ROAD (STAGE 3) NVCP APPLICATION CITY OF CANNING

CANNING CITY CENTRE ACTIVITY CENTRE PLAN

DATA SOURCES
SOURCE DATA: CANNING CITY CENTRE OUTLINE MAP (CITY OF CANNING 2017)
AERIAL: ESRI BASEMAP (2020)
SERVICE LAYERS SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY
SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

City of CANNING

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:6,750 @ A3

0 125 250 m

PROJECT NO: 4267-18

REV	AUTHOR	APPROVED	DATE
0	SS	NW	18/05/2022

FIGURE 03

LEGEND

- Southern Link Road Application Area S429-I Rev B
- Carousel Swamp (DBCA)

DATA SOURCES
SOURCE DATA: DEVELOPMENT ENVELOPE (CITY OF CANNING 27/07/2020)
AERIAL: NEARMAP (2020)
SERVICE LAYERS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

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SOUTHERN LINK ROAD (STAGE 3)
NVCP APPLICATION
CITY OF CANNING
CAROUSEL SWAMP

City of CANNING

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:2,000 @ A3

0 40 80 m

PROJECT NO: 4267-18

REV	AUTHOR	APPROVED	DATE
0	SS	NW	18/05/2022

FIGURE 04

LEGEND

- Southern Link Road Development Envelope S429-I Rev B
- Carousel Swamp (DBCA)

Vegetation Condition

- Very Good
- Degraded
- Completely Degraded

Vegetation Type

- MIMS: *Melaleuca lateritia* mid shrubland
- VjMrLw: *Viminaria juncea* and *Melaleuca rhaphiopylla* low woodland
- VjTS: *Viminaria juncea* tall shrubland
- *Leptocarpus* (fomerly *Meeboldina*) Sedgeland

DATA SOURCES

SOURCE DATA: DEVELOPMENT ENVELOPE (CITY OF CANNING 27/07/2020), VEGETATION CONDITION (NATURAL AREA CONSULTING MANAGEMENT SERVICES, 2016 AND ECOSCAPE, 2018), VEGETATION TYPE (NATURAL AREA CONSULTING MANAGEMENT SERVICES, 2016 AND ECOSCAPE, 2018).
AERIAL: NEARMAP (2020)
SERVICE LAYERS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

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SOUTHERN LINK ROAD (STAGE 3) NVCP APPLICATION CITY OF CANNING

VEGETATION TYPE AND CONDITION

City of CANNING

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:2,000 @ A3

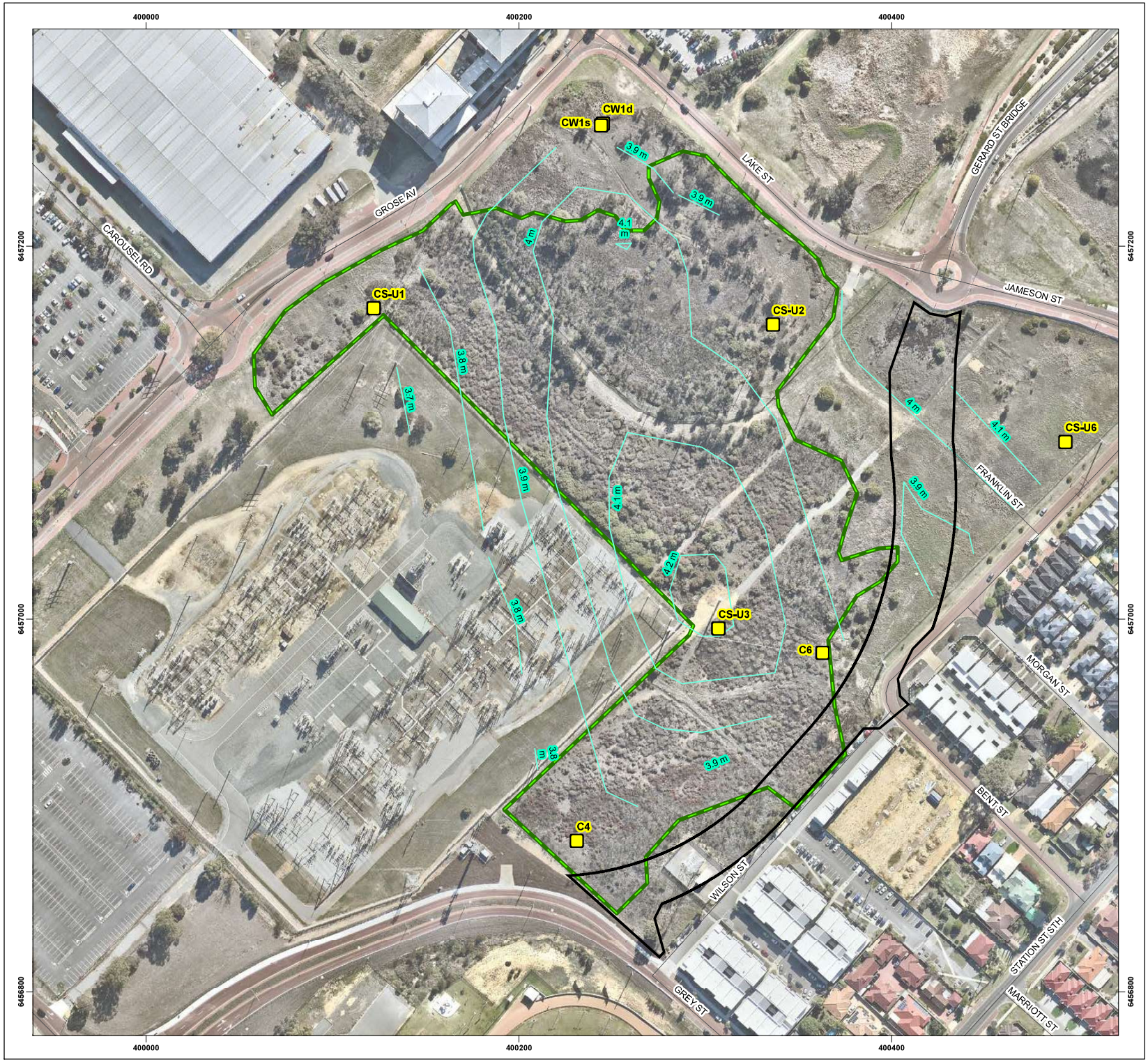
N

0 40 80 m

PROJECT NO: 4267-18

REV	AUTHOR	APPROVED	DATE
0	SS	NW	18/05/2022

FIGURE 05



LEGEND

- Sampling Bore Locations
- MGL Generated Contours
- Southern Link Road Development Envelope S429-I Rev B
- Carousel Swamp (DBCA)

DATA SOURCES
SOURCE DATA: DEVELOPMENT ENVELOPE (CITY OF CANNING 27/07/2020), HYDROLOGICAL DATA (URBAQUA, 2019)
AERIAL: NEARMAP (2020)
SERVICE LAYERS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

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SOUTHERN LINK ROAD (STAGE 3)
NVCP APPLICATION
CITY OF CANNING

GROUNDWATER LEVELS AND BORE LOCATIONS

City of CANNING

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:2,000 @ A3

N

0 40 80 m

PROJECT NO: 4267-18

REV	AUTHOR	APPROVED	DATE
0	SS	NW	18/05/2022

FIGURE 06