Given the above, it is considered that there would be no significant residual impacts associated with the proposal and the proposal able to meet EPA's objective to protect terrestrial fauna so that biological diversity and ecological integrity are maintained.

4.4 Inland Waters

4.4.1 Environmental Protection Authority objective

To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.

4.4.2 Policy and guidance

Relevant guidance documents for inland waters are listed below:

- *Statement of Environmental Principles, Factors and Objectives* (EPA 2019b)
- *Environmental Factor Guideline Inland Waters* (EPA 2018a)
- *State Planning Policy 2.9: Water Resources* (WAPC 2006)
- *Better Urban Water Management* (WAPC 2008)
- *Decision Process for Stormwater Management in Western Australia* (DWER 2017)
- *Australian Runoff Quality: A guide to Water Sensitive Urban Design* (Engineers Australia 2006)
- *Stormwater Management Manual for Western Australia* (DoW 2007).

4.4.3 Receiving environment

The physiography across the site and broader area is characterised by a colluvial slope in the east (i.e. the Piedmont Zone) that is a foothill of the Darling Plateau located further to the east, and the Pinjarra Plain in the west, an alluvial plain composed of clayey alluvium that has been transported from the Darling Plateau (Gozzard 2011). Consistent with this physiography, land to the east of the site rises towards the Darling Plateau (with the exception of the existing rail corridor which is up to 3 m below the adjacent land) and land to the west of the site grades more gently towards the Swan River. Existing topographic contours across the site range from 25 m Australian height datum (AHD) in the east to 19 m AHD in the south west and the site has an average grade of 4 %.

Surface geology across the site has been mapped by the Geological Survey of Western Australia (Gozzard 1986). The site comprises of medium-grained yellow sands (S12) of the Yoganup Formation in the east and pebbly silty sand overlying clay (Mgs1) consistent with the Guildford Formation in the west. Geotechnical investigations describe soils beneath the site as topsoil overlying highly permeable sand with the exception of a small area in the north that is described as topsoil and fill overlying sand underlain by slightly gravelly clayey sand (Douglas Partners 2014). To the west of the site and Farrall Road the soil is mostly described as topsoil overlying sand and clayey sand, that is underlain by sandy clayey gravelly materials (Douglas Partners 2014)

There is one surface water feature, Blackadder Creek, that enters the site from developed urban areas to the east and discharges westward beneath Farrall Road. West of the site, Blackadder Creek flows through existing developed areas prior to discharging into the Swan River.

Based on the *Geomorphic Wetland Database – Swan Coastal Plain* mapping (DBCA 2019), a multiple use wetland (MUW) (UFI 15136) is located in the south-western corner of the site, within Bush Forever Site 309 (DBCA 2019). This MUW is part of a large palusplain wetland of the Swan River consanguineous suite which extends over 300 ha (DBCA 2019).

To understand the inland waters considerations within the site, a number of technical assessments have been completed to support the planning approval process including:

- *Biophysical Assessment of Blackadder Creek and Woodbridge Creek (Emerge Associates 2015a)*
- *Local Water Management Strategy* (Emerge Associates 2015d)
- *Report on Geotechnical and Preliminary Acid Sulphate Soil Investigation* (Douglas Partners 2014)
- *West Stratton Groundwater and Surface Water Monitoring* (GHD 2008)
- *Report on West Stratton Local Water Management Strategy* (GHD 2010)
- *Technical Memorandum. Environmental Factor: Inland Waters* (Emerge Associates 2019) (**Appendix E**).

4.4.3.1 Surface water features

Blackadder Creek enters and discharges from the site at its northern corner and enters the site via two culverts beneath the railway line and discharges under Farrall Road. The creekline is ephemeral and flows in response to rainfall events and vegetation within Blackadder Creek is in 'degraded' condition. The length of the waterway contained within site boundary is less than 10 metres.

4.4.3.2 Surface runoff and infiltration

Geotechnical investigations completed across the wider Movida development describe soils within the site as sand with high measured permeability rates. Given the high permeability of the sands, little or no stormwater runoff is expected to occur following small rainfall events (e.g. the first 15 mm of rainfall) (Douglas Partners 2014).

Hydraulic and hydrological models of the LSP area and upstream catchments were prepared to establish pre-development peak flows entering and exiting the LSP area as described within the *Local Water Management Strategy* (LWMS) **Appendix K** (Emerge Associates 2015d) . As part of this process, a 2D model was established based on detailed topographical data (from Light Detection and Ranging (LiDAR)) to identify surface flows and pockets of storage. The associated modelling results shown in **Figure 8** demonstrate that there are no flow paths or ponding across the majority of the site associated with a major rainfall event. There would be flow within Blackadder Creek and some minor ponding on the eastern side of Farrall Road, which is a surface barrier to flows. Consequently, in an average rainfall year it is anticipated that rainfall on the site will infiltrate and either be intercepted by vegetation or recharge the underlying groundwater.

Water moving from outside the site (from the east) is intercepted by the presence of the railway line on the site's eastern boundary. The railway sits one to two metres below the surface level of the site and as such, the railway is a barrier to overland flow that might have progressed into the site.

4.4.3.3 Surface water quality

GHD (2010) conducted surface water quality monitoring on three occasions between October 2007 and September 2008 across the LSP area, including two monitoring locations within Blackadder Creek (one upstream of the site and one downstream) and one within the tributary downstream of Roe Highway. Emerge Associates conducted additional surface water quality monitoring between May 2015 and August 2016 (Emerge Associates 2016).

Surface water quality within Blackadder Creek measured upstream of the site was found to have nutrients (total nitrogen (TN) and total phosphorus (TP)) generally below the guideline values set by the Healthy Rivers Action Plan (HRAP) (SRT 2009). The HRAP was prepared by the Swan River Trust to improve water quality in the Swan and Canning Rivers and provides a long-term and short-term target for nutrient reduction.

4.4.3.4 Groundwater

Minimum groundwater levels across the site shown in the *Perth Groundwater Map* range from approximately 10.75 m AHD to 11.5 m AHD with groundwater flowing in a westerly direction (DWER 2019) as shown in **Figure 9.** Depth to groundwater ranges from approximately 8.5 m to 13.5 m below the natural surface.

A number of technical investigations have been undertaken to understand groundwater levels within the site including:

- Monthly groundwater monitoring was carried out by GHD (2010) between October 2007 and September 2008.
- Monthly groundwater level monitoring was undertaken by Emerge Associates between July and November 2015.

It is expected that groundwater beneath the site is generally perched within sands above clayey sand and consequently rainfall (that infiltrates through sands) would perch above the underlying sandy clay and flow laterally from east to west (Douglas Partners 2014).

GHD (2010) conducted groundwater quality monitoring on six occasions between October 2007 and September 2008 including sampling of physio-chemical parameters in situ and laboratory analysis of nutrient and salt concentrations. Water quality was measured downstream of the site and groundwater quality at this location (GW10) is summarised in **Appendix E.** TN and TP were found to generally exceed the HRAP long-term target (based upon a number of monitoring events) and TP also exceeded the HRAP short-term target (SRT 2009). These groundwater quality TN and TP exceedences are not unexpected given the historic agricultural land uses within the site and within the upstream groundwater catchment which are likely to persist over a longer time scale when compared with surface water quality.

4.4.3.5 Wetlands

The MUW located in the south-western corner of the site is within Bush Forever Site 309 (DBCA 2019). As documented within the original referral to the EPA, the vegetation within Bush Forever site 309 is in 'excellent' condition and on this basis, the wetland within the Bush Forever site boundary is considered by Emerge to be representative of a CCW. CCWs support a high level of environmental values and are the highest priority wetlands. In accordance with *State Planning Policy 2.9 Water Resources* (WAPC 2006) and *Guidance Statement 33 - Environmental Guidance for Planning and Development* ((EPA 2008) , the management objective for CCWs are the preservation, conservation and protection of wetlands environmental attributes, functions and values.

The existing upstream contributing groundwater and surface water catchments for the wetland has been determined and is shown in **Figure 10.** This means that the majority of the site (i.e. to the north) is not within the upstream catchment of the wetland. These catchments have been determined using available topographic contours, the City of Swan intramaps that illustrates the upstream drainage network, and the location of the existing railway line (given it is a barrier to overland flow).

4.4.4 Potential impacts

There are a number of impacts potentially associated with the proposal including:

- Direct impacts
  - Modification of a wetland ecosystem through removal of vegetation or landform modification
  - Alteration of the hydrogeological regime that sustains the wetland
- Indirect impacts
  - Abstraction of groundwater that impacts other groundwater users
  - Impacts to water quality.
  - Cumulative impacts associated with other proposals.

These impacts are discussed further below. A conceptual box model provided in **Plate 13**, summarises the hydrogeological regime of the wetland for both the pre and post development scenarios detailing hydrological inputs and outputs.

4.4.5 Assessment of impacts

4.4.5.1 Modification of wetland ecosystem

The implementation of the proposal will retain the entirety of the wetland in 'excellent' condition vegetation inclusive of landform and vegetation within the southern POS as shown on the proposal plan (**Appendix B**). There will be no filling of the wetland associated with the proposal. Approximately 460 m^2 (0.046 ha) of wetland dependent vegetation will be cleared due to the realignment of Farrall Road, however this vegetation is in 'degraded' condition, is not considered representative of a CCW and is not significant. Construction works associated with the proposed realignment of Farrall Road and the proposed roundabout will be confined to the road reserve and will not extend into the wetland.

4.4.5.2 Alteration of the hydrogeological regime that sustains the wetland

A conceptual water balance (**Appendix L**) has been completed to describe and quantify how the existing environment relates to the hydrogeological regime of the wetland within the southern POS and assess whether implementation of the proposal would impact on the hydrogeological regime of the wetland. The box model for the post-development water balance is provided as **Plate 13**. Given the limited surface water run-off from the site, plus the presence of groundwater within a perched clay layer, the conceptual water balance has inferred that the wetland is an ecosystem dependent on the subsurface presence of groundwater (Eamus and Froend 2006; Serov and Kuginis 2017).

The various components of the conceptual water balance are described below, with additional detail contained in **Appendix E**.

Direct rainfall

460 m^2 of wetland dependent vegetation (outside of the Bush Forever Site) will be removed as part of the implementation of the proposal reducing the volume of direct rainfall onto the wetland by 2.6 %. This wetland vegetation is not representative of the potential CCW that occurs within the site would have limited hydrological interaction with the wetland, given groundwater flows to the west.

Surface water

The existing surface water catchment for the wetland is located immediately east of the wetland within the site, based on topographic contours and the location of the existing railway line (which acts as a barrier to overland flow). As outlined above in **Section 4.4.3.2** in the pre-development environment there is not expected to be any runoff from this catchment entering the wetland during the frequent/small rainfall events or major rainfall events.

Any outflows from the wetland to the west are expected to be constrained by Farrall Road as there is only a small culvert adjacent to the wetland to convey surface water flows under the road.

Within the upstream surface water catchment of the wetland, the proposal includes the southern POS area, road reserves and some development. Surface water inflows will not be increased or decreased in the post-development scenario based upon the following:

- Existing topographic contours (and therefore the existing sand profile) will be maintained within both landscaped areas and conservation POS.
- Vegetation within the southern POS area will be largely retained and rehabilitated (e.g. through revegetation as outlined in **Appendix J**) to ensure vegetation cover is maintained and infiltration continues to occur.
- Landscape treatments within the southern POS will ensure that vegetation cover and infiltration capacity is maintained. These will be outlined in the future UWMP for the site, approved by the City of Swan and implemented as part of subdivision.
- Residential lots will be connected to soakwells to maximise local infiltration. Runoff beyond the capacity of soakwells and infiltration within pervious gardens will overland flow towards the adjacent road reserve, however this would occur infrequently and only in response to major rainfall events.

- Water sensitive urban design (WSUD) measures (e.g. bio-retention areas, swales etc.) are proposed to be located within road verges and/or the landscaped areas to treat and infiltrate the small rainfall event at source, as currently occurs.
- Conveyance of runoff (up to the 1 % AEP rainfall event) from road reserves and residential lots will be directed towards the west within a piped drainage network into the existing Movida Estate drainage network. This approach will ensure post development stormwater runoff does not enter the wetland consistent with the pre-development hydrology.

Based on the proposal and design approaches noted above the risk of modifying the surface flow component of the hydrogeological regime is considered low.

Evapotranspiration

Evapotranspiration is the term used to describe the part of the water cycle which removes liquid water from an area with vegetation and into the atmosphere by the processes of both transpiration and evaporation (BoM 2019b). Evapotranspiration can impact on recharge of underlying groundwater. Within the proposal, evapotranspiration within the wetland is expected to remain consistent, as existing vegetation will be retained.

Within the groundwater catchment of the wetland located within the site (immediately east of the wetland), evapotranspiration will increase within revegetated areas (FCT 20c TEC and buffer area) and slightly decrease within the proposed residential development. However, any changes to evapotranspiration facilitated by implementation of the proposal are considered minor, given that the majority of the groundwater catchment is expected to remain the same (**Figure 10**) as land uses upstream of the site are not predicted to change.

Groundwater through-flow

Groundwater beneath the site currently flows from east to west. Based upon the available groundwater information for the site, depth to groundwater within the wetland ranges from approximately 1.6 m to 2.25 m below the existing ground surface, and depth to groundwater within the vegetation immediately east of the wetland ranges from approximately 2.25 m to 5.5 m below the existing ground surface.

A number of measures are proposed to minimise changes to groundwater flow toward the wetland. These measures focus on avoiding the intersection, diversion and abstraction of groundwater upstream of the wetland, and include:

- Groundwater production bores for any landscape irrigation will not be installed within the superficial aquifer, as the groundwater licences secured for Movida Estate are for the confined Perth- Leederville aquifer.
- Existing ground levels will be maintained within both landscaped areas and conservation POS.

The current production bore for long-term irrigation is licenced for the deeper Leederville aquifer, which will not impact upon the wetland. This bore is located west of Farrall Road and given the perched clay layer drawdown from the bore extraction would not interact with surface water features.

Abstraction from the superficial aquifer has the potential to impact groundwater levels beneath the wetland area. The extent of the impact is mostly dependent on the location and operation of the production bore. The existing production bore is used for temporary construction and dust suppression purposes and accesses the superficial aquifer under GWL 181629. This production bore is located approximately 290 m north-west of the wetland area (**Figure 9**) and groundwater pumping is restricted to construction operating hours on weekdays. It is relevant to note that the construction bore is only in operation during earthworks and civil construction, which is conducted on a staged basis generally over a period of 12 weeks and may involve 1-2 stages per year (depending on market conditions).

Calculations undertaken by Emerge Associates (**Appendix E**) indicate that the maximum magnitude of drawdown experienced at the northern extent of the wetland (292 m away from the production bore) was 2.12 m. This magnitude of drawdown may have lowered the groundwater table to below the root zones of some plant species. However, measured groundwater recovery data from monitoring bores within the site demonstrates that groundwater levels near the wetland were able to recover to within 80 % of the standing water level within 12 hours from the cessation of pumping. This rapid recovery suggests the wetland will not experience adverse impacts as a result of taking water from the production bore for temporary construction and dust suppression purposes. As outlined above, groundwater abstraction will only be required while the site (and wider Movida Estate) is being developed (likely to be the next 5 years) and only during earthworks and civil construction, typically over a period of 12 weeks at a time, during construction hours and on weekdays only.

The groundwater production bore has been operated (during construction) since 2016 and since this time the wetland vegetation has been monitored for any visible signs of vegetation decline and stress referencing the baseline survey data from 2015 (Emerge Associates 2015c). There has been no observable impact to vegetation observed from operation of the production bore over the past three years and wetland vegetation will continue to be monitored, particularly for any construction in summer, when the wetland is more vulnerable to water stress.

No additional groundwater production bores are anticipated to be required for earthworks and civil construction purposes across the proponent's development. However, if current bore is decommissioned and another is required, this bore will be located west of the current bore, within the Blackadder Creek POS area, further away from the wetland. As such, it is considered that there is not likely to be a significant impact to the wetland from the intermittent use of the superficial groundwater production bore.

In order to limit impacts to groundwater beneath the wetland, the following measures will be implemented by the proponent:

- Future groundwater production bores for construction (if required) will be located westwards of the current production bore.
- Pumping will be restricted to construction operating hours on weekdays to enable recovery of groundwater levels overnight.

Based on the proposal and design approaches noted above the risk of modifying the groundwater through-flow component of the hydrogeological regime is considered low.

Recharge to groundwater

No changes to evaporation, evapotranspiration or recharge are anticipated to occur across the wetland given the vegetation is being retained. However, the proposal has the potential to alter recharge within the upstream groundwater recharge catchment area (of the wetland) as implementation of the proposal will modify the land uses in this area including revegetation, landscaping, residential lot/s and road reserve.

As detailed in **Appendix E**, **Appendix L** and **Plate 13**, recharge from the upstream groundwater recharge area due to the proposal (i.e. development within Lot 102) is anticipated to increase from 4,570 m^3 to 4,645 m^3 (a 1.6 % increase) once the proposal has been implemented. Spread across the upstream groundwater recharge catchment area within the site boundary (2.15 ha) represents a rise of approximately 3.5 mm. This is not considered a significant change especially as the majority of the 24.9 ha upstream groundwater recharge catchment could recharge in the order of 85,000 m^3 assuming an average annual recharge rate of 50 % (DoW 2009). When considering the entire groundwater recharge catchment, the potential change to groundwater recharge would be an increase of 0.08 %, and on this basis, it is concluded that groundwater recharge will not be modified by the proposal.

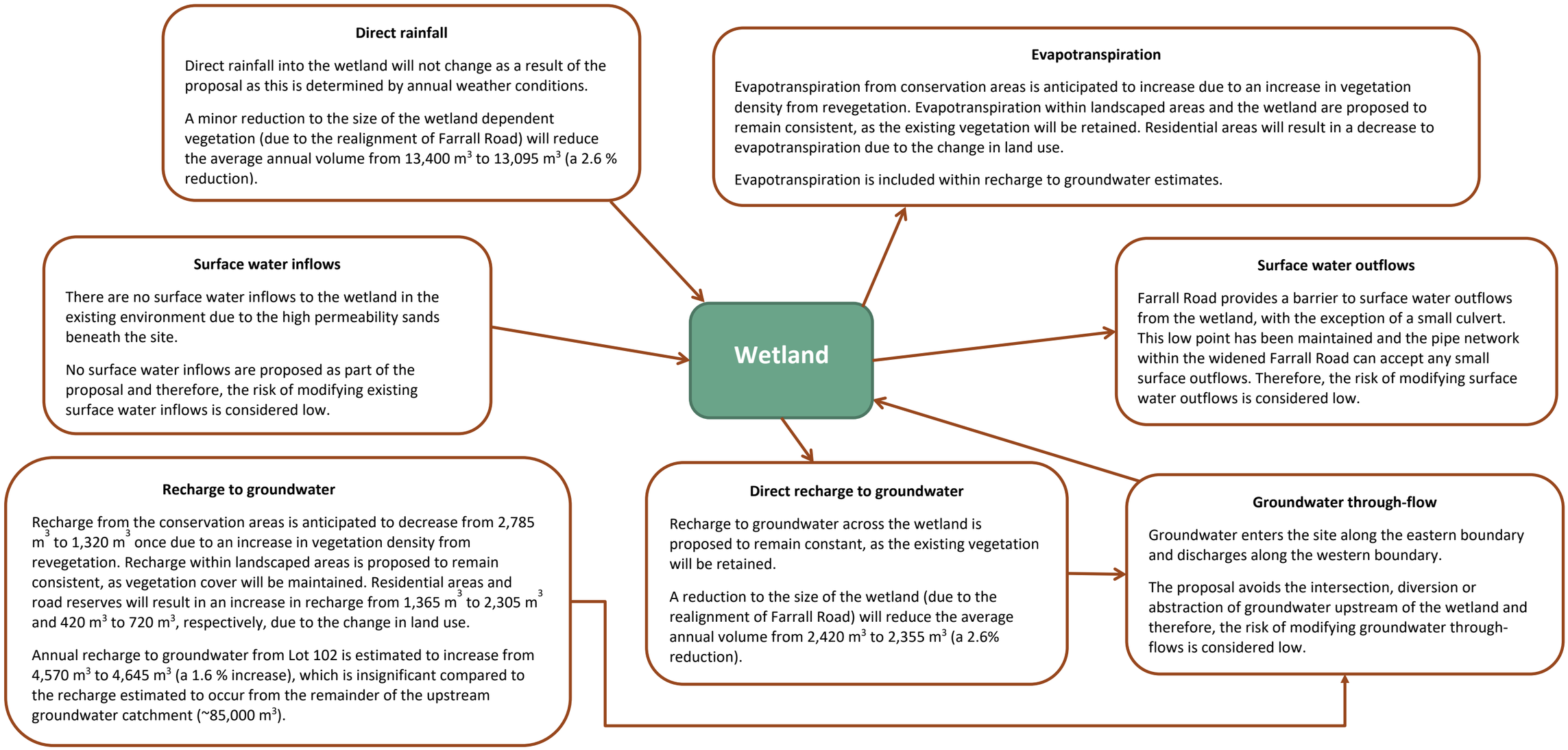

Plate 13 Conceptual box model showing impacts from the proposal on the wetland within the site

4.4.5.3 Abstraction of groundwater that impacts other groundwater users

Implementation of the proposal will require abstraction of the groundwater for the purposes of dust suppression and civil construction, and irrigation of POS. The site is located within a proclaimed groundwater area pursuant to the *Rights in Water and Irrigation Act 1914*, which regulates water use within areas of high demand. Groundwater licencing is regulated by DWER in accordance with the *Rights in Water and Irrigation Act 1914* and DWER's assessment process for the granting of licences ensures the proposed take and use of water is unlikely to have a detrimental effect on another person.

There are potentially several other groundwater users in the local area, including unlicensed private bores (garden bores) as well as licenced bores within the superficial aquifer and the deeper Leederville aquifer.

A temporary groundwater licence (GWL 181629) for the superficial aquifer has been secured for dust suppression and civil construction, which will not be required once civil construction has been completed across the site. Temporary (GWL 201397) and longer-term (GWL 182854) licences from the Leederville aquifer have been secured for the establishment and ongoing irrigation of landscaped areas within POS, respectively. The proponent will need to comply with the statutory requirements and conditions of these licences.

Given the licensing process that has been completed in accordance with the *Rights in Water and Irrigation Act 1914* and ongoing reporting requirements, it is expected that no significant impact to other groundwater users would result.

4.4.5.4 Impacts to water quality

Impacts to water quality impacts associated with the proposal may occur during construction, development and then ongoing residential use. The key pollutants may include sediments, hydrocarbons or nutrients from household gardens which may infiltrate through the soil or be conveyed within stormwater along road reserves and through the piped drainage network.

Infiltration through sandy soils will naturally filter particles such that only fine colloidal material and dissolved nutrients would reach the underlying groundwater (Engineers Australia 2006). However, a piped drainage network can convey all pollutants towards the downstream discharge location (Engineers Australia 2006). It is relevant to note that the site contains only local roads, which would not produce high traffic volumes.

The generation of pollutants within the site will be minimised by the following design and ongoing management measures:

- Design:
    - Minimising road reserves within the upstream surface water catchment to reduce pollutants from vehicles.
    - Maximising the area of retained vegetation within southern POS areas to reduce the conveyance of pollutants.
    - Minimising the area of residential development within the upstream groundwater recharge catchment to the wetland to minimise impacts from household gardens.

- Avoiding the use of turf within the southern POS area to avoid the application and subsequent leaching of fertiliser.

- Stormwater management measures:
  - Information on fertiliser application to be provided to residents at point of sale.
  - Retention of the small rainfall event within the lot at source (i.e. within soakwells and infiltration within pervious area), to minimise the conveyance of pollutants from lots.
  - Treatment of the small rainfall event that falls on road reserves (i.e. appropriately designed WSUD measures), to minimise conveyance of pollutants from road reserves.
  - Implementation of construction management strategies that address dust, erosion and sediment, and stormwater runoff etc.
- Revegetation measures including:
  - Where conservation POS areas is revegetated a slow nitrogen release, low phosphorus fertiliser will be applied at time of planting and no fertiliser will be applied thereafter.
- Other measures:
  - Within the landscaped areas, a slow nitrogen release, low phosphorus fertiliser will be applied at time of planting and no fertiliser will be applied to shrubs/trees thereafter.
  - Front landscaping packages installed by the developer (as part of an opt-in landscaping bonus) will require that turf areas are minimised and waterwise species utilised within garden beds in order to minimise fertiliser application within lots.

The stormwater management measures described above will be outlined in an UWMP which will be prepared as a condition of subdivision, while the revegetation measures are outlined in the RVMP (**Appendix J**).

4.4.5.5 Consideration of cumulative impacts

As outlined in **Section 4.2.5.9**, cumulative impacts consider the environmental impact associated with other proposals that are known to, or highly likely to occur in the future and may contribute to cumulative impacts at a local or regional scale. When considering cumulative impacts on inland waters, potential impacts from the upstream surface and groundwater catchments of the southern wetland have been considered.

In terms of cumulative impacts on the southern wetland any local or regional surface water impacts are limited and are constrained by the presence of the railway line to the east, which severs any potential surface water connection from upstream outside of the site. An uncreated road reserve and lot exists immediately south of the site, and these are proposed to be developed for urban development and are included within the approved Movida Estate LSP (**Appendix A**). The urban development of this area could have impact upon the wetland area; however, any impacts would be similar to that incurred by the proposal which are considered unlikely to be significant. This area contributes minimally to the upstream surface (1.6 %) and groundwater catchment (15 %) of the wetland (**Figure 10**).

This road reserve and the area south of Bush Forever Site 309 were included within the LWMS (**Appendix K**) prepared to support the Movida Estate LSP and future subdivision and development of this land would be required to demonstrate that the pre-development hydrology to the wetland is maintained in line with water sensitive urban design principles. This would include the requirement to retain the small rainfall event within residential lots at source to minimise the conveyance of

pollutants from lots and treat the small rainfall event that falls onto road reserves to minimise the conveyance of pollutants from road reserves. These design and management measures would be incorporated into an UWMP prepared as a condition of subdivision consistent with the approved LWMS (**Appendix K**). The UWMP would be prepared on advice of the DBCA to the satisfaction of the City of Swan. Therefore, there are considered to be no cumulative surface water impacts at a regional or local level associated with the proposal.

The water balance has determined that the hydrology of the wetland is driven by groundwater, with the groundwater upstream catchment shown in **Figure 10.** The upstream groundwater catchment consists of urban developed areas of Swan View, plus the Midland Cemetery. The urban areas of Swan View are largely developed (i.e. built out) and on this basis there are not anticipated to be any additional impacts from future proposals which would affect groundwater flow or quality through to the wetland.

The Midland Cemetery is also located within the assumed groundwater catchment of the wetland and is an active cemetery with 100 internments over 2017/2018 and 104 over 2018/2019 (Metropolitan Cemeteries Board 2018, 2019). While the decomposition of human remains can cause groundwater contamination, the likelihood that this would be impacting upon the wetland within the site is considered low. The cemetery has been present within the location for over 100 years and therefore the ongoing use of the cemetery is not considered a significantly increased risk to that which currently exists.

In term of other cumulative wetland impacts and as outlined in **Section 4.2.5.1**, the wetland is representative of a CCW, however is currently mapped as a multiple use wetland. The wetland is a palusplain wetland and is part of the Swan River consanguineous suite. In accordance with DBCA data provided in *A methodology for the evaluation of wetlands on the Swan Coastal Plain, Western Australia* (DBCA 2017), 3.8 % of palusplain wetlands are assigned conservation category across the Swan Coastal Plain, while Swan River wetlands comprised 10,224 ha as of 2016, of which 15.7 % is classified as CCW (DBCA 2017). In addition, there is only 7.1 % of Swan River palusplain which are assigned conservation category. The inclusion of 1.7 ha of wetland into conservation management, as part of this proposal (and re-evaluation to conservation management category) will increase the amount of conservation category Swan River palusplain remaining on the Swan Coastal Plain.

Overall, it is considered that there are no significant local, regional or cumulative impacts associated with the implementation of the proposal that will affect with Inland waters.

4.4.6 Mitigation

4.4.6.1 Avoid

The proposal avoids the clearing and modification of the wetland representative of a CCW associated with Bush Forever Site 309. A small area of degraded wetland dependent vegetation immediately north of the wetland (but outside of Bush Forever Site 309) will be removed as part of the proposal for the realignment of Farrall Road and is required to reduce traffic speeds and provide a larger road reserve to account for increased road traffic in the future.

The landscaped portion of the southern POS (**Figure 6**) will be simple with minimal infrastructure. The primary aim is to protect and enhance the existing site through revegetation, while managing access with limestone paths and conservation fencing.

The design of the southern POS will include the following elements to avoid impacts to the wetland:

- Existing topographic contours (and therefore the existing sand profile) will be maintained across the entire southern POS.
- Landscape treatments within the southern POS will ensure that vegetation cover and infiltration capacity is maintained.
- Landscape species will be subject to approval by the City of Swan and will not include known invasive species.
- No turf is proposed.
- No irrigation will be provided.
- The site is expected to be used for passive recreation.
- Conservation fencing (to the City of Swan specifications) will be included around the boundary of the conservation area to separate the landscaped portion of the southern POS and restrict access to the conservation areas.
- Crushed limestone paths on existing tracks will be provided through the POS (outside of the fenced conservation areas) to provide pedestrian access and enable fire appliance access.
- Bin/s will be provided to reduce rubbish impacts from public usage.
- Signage will be provided to notify the public of the conservation POS areas.

In addition, groundwater production bores for the purposes of irrigation will not be installed within the superficial aquifer to avoid potential hydrological impacts to the wetland due to drawdown.

4.4.6.2 Minimise

Construction work adjacent to the wetland, such as the construction of a roundabout and the realignment of Farrall Road will be minimised through the preparation of a CEMP and specific management-based provisions to address the wetland (and inland waters) that will be included within the CEMP are outlined in **Table 29.**

The implementation of the proposal will minimise the generation of pollutants towards the wetland from within the site by:

- Maximising the area of retained vegetation within conservation POS areas.
- Minimising the area of residential development or road reserves within the upstream groundwater recharge catchment to the wetland.
- Not utilising turf within the landscaped area (or any part of the southern POS).

Impacts associated with the proposal will also be minimised through the planned revegetated buffer on the eastern side of the wetland. The majority of this buffer will be intensively revegetated, as outlined in the attached RVMP (**Appendix J**).

Ongoing management of the landscaped area of the southern POS (**Figure 6**) will be undertaken by the proponent prior to handover (over 5 to 7 years) and will include rubbish removal, weed control, maintenance of signage and fencing. This will reduce impacts to the surrounding conservation POS

areas, including the wetland. Following handover, these routine maintenance tasks will be completed by the City of Swan in accordance with standard POS management.

An LWMS (Emerge Associates 2015d) prepared for the LSP sets the framework for water management over the site, proposing treatment and retention of small event runoff close to source. The implementation of the proposal will include additional design measures to minimise impacts including:

- No grading of clayey soils will occur within the site to maintain the hydrogeological regime that sustains the wetland.
- Final earthworks contours will ensure the depth of cut does not intersect/divert regional groundwater and therefore maintains the existing hydrogeological regime.
- Existing topographic contours will be maintained within both landscaped and conservation POS areas to ensure the existing highly permeable sand profile is maintained.
- The small rainfall event will be treated within lots and road reserves to maintain the hydrogeological regime that sustains the wetland and ensure pollutants generated within the site are appropriately treated.
- Conveyance of minor and major event runoff (up to the 1 % AEP rainfall event) from road reserves and residential lots towards the west into the existing Movida Estate drainage network to avoid runoff being directed into the wetland.
- Landscape designs within the landscaped portion of the southern POS will ensure the vegetation cover and infiltration capacity of the underlying soils is retained to maintain the hydrogeological regime that sustains the wetland.
- Retaining the small rainfall event within the lot to minimise the conveyance of pollutants from lots onto the road reserve or piped drainage network.
- Stormwater runoff from the small rainfall event conveyed along road reserves is treated with WSUD measures.
- An appropriate management and maintenance schedule to ensure WSUD functions are maintained.

These measures will be documented in an UWMP prepared as a condition of subdivision, consistent with the principles and objectives of the approved LWMS (Emerge Associates 2015d).

Impacts associated with the development the site will be managed to minimise impacts to the wetland. Management-based provisions to minimise impacts to the wetland and inland waters are outlined in **Table 29** and will be documented in a CEMP to be prepared to support subdivision or a development application.

Table 29: Management provisions to be included within the CEMP for Inland waters.

Management Targets	Management Actions	Monitoring	Reporting
No clearing of vegetation outside of the disturbance footprint during civil construction.	Demarcate the southern POS area through temporary fencing to prevent clearing beyond the disturbance footprint	Daily inspection during clearing of clearing areas and temporary fencing to confirm no clearing beyond the disturbance footprint.	Report unauthorised clearing to DWER.
No disturbance to wetland vegetation within southern POS during and attributable to construction.	Provide site inductions to personnel that include information on the importance of wetland vegetation and weed management and hygiene practices	Daily inspection for evidence of unauthorised access into the southern POS (beyond the disturbance footprint). e.g. observations of vehicles or machinery, damage to fencing	Report unauthorised access or disturbance to wetland vegetation within the development envelope. Reporting to be provided to EPA.
No significant impact upon wetland water levels from production bore pumping during construction.	Pumping of the production bore proposed will be restricted to construction operating hours on weekdays to enable recovery of water levels overnight. Monitoring of levels at associated monitoring bores to be completed to provide site specific advice regarding the pumping regime.	A monitoring program consistent with that documented in the UWMP to measure groundwater levels adjacent to the wetland so that any impacts can be noted and modifications to operations made. Vegetation condition monitoring to be conducted if pumping is required during summer months using existing baseline data.	Groundwater monitoring report to be provided to DWER.
No observable dust, erosion or sediment leaving site during construction.	Implement drainage controls to prevent offsite discharge of runoff. Implement sediment control measures to prevent offsite sedimentation.	Daily observation of drainage and sediment control structures to check operation.	Report any significant discharges to City of Swan.

4.4.6.3 Rehabilitate

The wetland vegetation will be appropriately managed and improved (e.g. through revegetation and weed control), ensuring that vegetation cover is maintained and infiltration continues to occur, which sustains the hydrogeological regime associated with the wetland. In addition, the wetland buffer area will be revegetated and landscaped to minimise impacts associated with the proposal.

This revegetation will be completed in accordance with RVMP (**Appendix J**) to be implemented as a condition of subdivision. The requirement to implement the RVMP as a condition of subdivision is reflected in the LSP.

4.4.7 Predicted outcome

The design of the proposal has aimed to avoid impacts to inland waters by retaining the potential CCW, establishing a vegetated buffer (through the implementation of the RVMP) and maintaining pre-development hydrology (through the implementation of an UWMP and CEMP). will have minor impacts upon the wetland associated with Bush Forever Site 309, however the proposal has largely

Given the above, it is considered that the proposal can meet EPA's objective to protect inland waters to maintain hydrological regimes and quality of groundwater and surface water so that environmental values are protected.

5 Other Environmental Factors or Matters

Based on a review of the DPLH 'Aboriginal Heritage Inquiry System' online database, there are multiple registered Indigenous heritage sites within or immediately adjacent to the site. These Aboriginal Heritage sites within the site are detailed in **Table 30** below.

Table 30: Aboriginal Heritage Sites within the site.

Site ID	Site Name	Site Type
DAA 3492	Green Bullfrog Dreaming	Artefacts/Scatter, Mythological, Skeletal Material/Burial
DAA 3720	Blackadder and Woodbridge Creek	Mythological

Both these Aboriginal Heritage sites cover a large area (beyond the proposal site) and these indigenous heritage sites were investigated as part of the LSP process. Ethnographic consultation with relevant traditional owners was completed in 2014 to support a Section 18 application lodged under the *Aboriginal Heritage Act 1972* in 2015. Section 18 consent for the proposed development was received from the Department of Aboriginal Affairs on 18 September 2015.

Consistent with the Section 18 consent, the proponent will provide a report detailing the extent to which the construction has impacted on the sites and report on results from any monitoring of ground disturbing works.

6 State Environmental Offsets

Environmental offsets are actions that provide environmental benefits which counterbalance the significant residual impacts associated with a proposal (Government of WA 2014). Under the *WA Environmental Offsets Guidelines* (Government of WA 2014), offsets are undertaken outside of the development envelope and are considered separate to mitigation actions which occur on-site to reduce the direct impact of a proposal.

Environmental offsets associated with Matters of National Environmental Significance (MNES) and the EPBC Act are also discussed in **Section 7.4**.

6.1 Avoidance

The site was zoned 'urban' under the MRS prior to 1996 and has been identified in the prevailing policy frameworks as a key short term urban development area (WAPC 2018). Through the planning design process, the proponent has aimed to avoid impacts to significant environmental assets. This includes the wetland, Bush Forever Site 309 and the majority of FCT 20c TEC. These areas are located in the southern portion of the site and will be retained within POS, transferred to the Crown free of cost and managed for conservation initially by the proponent and then following handover by the City of Swan.

The retention of the southern POS area has also provided for the retention of the highest quality fauna habitat (Harewood 2018; Invertebrate Solutions 2019), four potential habitat trees and six individuals of *Isopogon drummondii*.

It is not possible to avoid all impacts to environmental values over the site and the implementation of the proposal will result in the clearing of 0.2 ha of FCT 20c TEC, 2.74 ha of vegetation in the Forrestfield complex (inclusive of 0.2 ha of FCT 20c TEC). The areas of FCT 20c TEC proposed to be cleared are small and fragmented and considered unlikely to be viable over the long term given persistent threats and edge effects (van Etten 2019). As such, even if impacts to these areas were avoided it is unlikely that FCT 20c TEC would persist in the long term.

The implementation of the proposal will also result in the clearing of 0.2 ha of 'quality' black cockatoo habitat (Harewood 2018). However the southern POS will retain some habitat for black cockatoos through Banksia woodland (incorporating FCT 20cTEC) providing foraging habitat for Carnaby's black cockatoo species, plus some Marri and Jarrah trees providing low quality foraging habitat for Baudin's and Forest red-tailed black cockatoo. One habitat tree (Jarrah) will be retained in the southern POS which may provide roosting habitat for Baudin's and Forest red-tailed black cockatoos species (DSEWPaC 2012b).

6.2 Minimisation

The impacts to the southern occurrence of FCT 20c TEC will be minimised through the establishment of a vegetated buffer as part of the southern POS. The extent of this buffer area was based on the outcomes of the independent TEC assessment with the aim being to improve the viability and resilience of the retained FCT 20c TEC patch. The vegetated buffer will seek to reduce edge effects

and threats (weed, fire) to the retained vegetation. A buffer will also be provided from development to the potential CCW within the southern POS area to minimise impacts of the proposal.

The environment has the potential to be impacted through the construction and development process through:

- Clearing of native vegetation
- Vehicle and machinery movement and use
- Earthworks
- Sediment, dust and run-off
- Use and storage of chemicals

The impacts of construction will be minimised through specific management based procedures as outlined in **Section 4** and **Table 31**. These will be included within a CEMP prepared in line with *Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans* (EPA 2018b) and prepared as a condition of subdivision or development application approval.

Throughout construction and in accordance with the CEMP, the proponent and engaged contractors will keep records and make reports on the following:

- Unauthorised clearing
- Death or injury to any megafauna (e.g. kangaroos, quenda).
- Pre-clearing vertebrate fauna trapping and translocation information
- Increase in presence and abundance of weed species or dieback occurrence (this will also be formally documented through the rehabilitation of the southern POS area as detailed in **Section 4.2.6.3** and **Section 6.3**).
- Groundwater levels and abstraction volumes
- Significant sediment or dust

Consistent with EPA guidance on environmental management plans (EPA 2018b), the CEMP will also include an adaptive management program, such that management actions will be adjusted if management targets are not met. The development and construction of the site is likely to occur in stages which provides an opportunity to review the management plan and make adjustments as required. These adjustments may include actions such as:

- Providing additional information to contractors or altering site procedures
- Actively managing threats or impacts (weeds, dust, sediment, pests).

Table 31: Management provisions to be included within the CEMP for key environmental factors.

Environmental Factor	Management Targets	Management Actions	Monitoring	Reporting
Flora and vegetation	No clearing of vegetation outside of the disturbance footprint during civil construction. Clearing of native vegetation within the development envelope will not exceed 2.74 ha and not include more than 0.2 ha of FCT 20c TEC attributable to civil construction.	Demarcate the southern POS area through temporary fencing to prevent clearing beyond the disturbance footprint	Daily inspection during clearing of clearing areas and temporary fencing to confirm no clearing beyond the disturbance footprint.	Report unauthorised clearing to DWER as soon as practicable.
	No introduction of new weed species into the development envelope during and attributable to construction. No disturbance to retained vegetation within southern POS during and attributable to construction.	Provide site inductions to personnel that include information on the importance of retained vegetation and weed management and hygiene practices	Daily inspection for evidence of unauthorised access into the southern POS (beyond the disturbance footprint). e.g. observations of vehicles or machinery, damage to fencing Monthly visual inspections for weeds along the clearing edge, adjacent to native vegetation, commencing at the commencement of clearing activities, and to continue for the duration of construction	Report increase in weed species, density and/or numbers from pre-construction monitoring observations within the development envelope. Reporting to be provided to EPA.
	Phytophthora dieback is not introduced to vegetation surrounding the development envelope attributable to construction activities as observed within three years from the commencement of construction	All vehicles and machinery to be inspected and free of weeds and soil prior to entering the development envelope.	Yearly visual monitoring within southern POS area for potential dieback for three years. If visual monitoring suggests dieback, confirm presence of the disease with laboratory analysis.	Report occurrence of dieback. Maintain records of vehicle and machinery inspections during construction.
	No fires onsite attributable to construction.	All machinery and vehicles undertaking native vegetation clearing are fitted with a fire extinguisher or that one is present within 15 m of equipment. Prohibit vegetation clearing when fire danger is Extreme or Catastrophic.	Daily inspection of cleared areas for smoking/smouldering vegetation.	Report uncontrollable fires to DFES Maintain records of minor fires to enable review of procedures if required.
	Maximise retention of intact plant material from the site within rehabilitation areas.	Transferrable material (such as grass trees, zamia palms and large wood) will be translocated into the southern POS or temporary storage areas. Direct vegetation transfer from cleared areas of FCT 20c TEC will be directly transferred to an identified receiving site within the southern POS. If direct transfer is not possible, topsoil will be stockpiled in a temporary storage area.	Direct vegetation transfer of FCT 20c TEC to be visually monitored by an ecologist to confirm transfer protocol.	Document direct vegetation transfer including date, volume, location of transfer and recipient sites. Report on direct vegetation transfer to be provided to EPA.
	Minimise impact from construction dust on retained vegetation.	• Water application during construction to minimise potential impacts to vegetation from dust at source.	Daily inspection of retained vegetation for visible dust during construction.	Maintain records of water application and visible dust and provide data to EPA following construction.

Table 31: Management provisions to be included within the CEMP for key environmental factors (continued).

Environmental Factor	Management Targets	Management Actions	Monitoring	Reporting
Fauna	No avoidable deaths of conservation fauna during vegetation clearing for construction.	Undertake clearing in one direction to allow fauna to escape machinery. Require that within seven days prior to clearing of native vegetation, a qualified fauna expert undertakes a trapping and relocation program for conservation significant vertebrate fauna in accordance with a licence to take fauna for education or public purpose issued under Section 15 of the WC Act by DBCA. Conduct vertebrate fauna trapping and relocation in accordance with DBCA's Standard Operating Procedures (SOPs) or permit conditions. Require that fauna spotters are present during clearing of native vegetation to supervise dispersal/ relocation of any remnant fauna, and identification of any potential injured fauna. Select fauna individuals injured during fauna habitat clearing will be rehabilitated by a wildlife carer. Require that all personnel complete a site induction that will cover fauna values within and adjacent to the development envelope. Implement traffic management procedures to minimise the likelihood of fauna interactions with vehicles.	Daily inspection for conservation significant fauna during vegetation clearing. Record known injuries or deaths of conservation significant fauna species.	Prepare a report on the trapping program outlining methods and results, including number and species of any fauna caught and where they were released. Report should also include records of other fauna interactions (captures, strikes, injuries, fatalities etc…). Report provided to DBCA as per fauna licence conditions.
	No disturbance of active Black Cockatoo nests (if found) during and attributable to construction.	An appropriately qualified person to inspect potential black cockatoo habitat trees no more than 7 days prior to vegetation clearing during July to December. If black cockatoo breeding activity is identified, demarcate trees with active nest and apply a 10 m buffer around the tree with temporary fencing. Postpone clearing of active nests until DBCA advises it is suitable to continue.	Monthly visual observations of marked breeding tree hollows (if found) for signs of disturbance and breeding activity Conduct walkover inspection of applied 10 m buffers around marked breeding trees for signs of disturbance, such as temporary fence moved, prematurely vacated nests, broken eggs, and dead fledglings	Prepare a report which outlines: -Results of the potential breeding tree assessment, including the qualifications of the inspector -Number of trees with active nests (if any) -Outcome e.g. clearing postponed if found and area avoided until fledglings left the nest -Any signs of disturbance to active nests
Inland waters	No clearing of vegetation outside of the disturbance footprint during civil construction.	Demarcate the southern POS area through temporary fencing to prevent clearing beyond the disturbance footprint	Daily inspection during clearing of clearing areas and temporary fencing to confirm no clearing beyond the disturbance footprint.	Report unauthorised clearing to DWER.
	No disturbance to wetland vegetation within southern POS during and attributable to construction.	Provide site inductions to personnel that include information on the importance of wetland vegetation and weed management and hygiene practices	Daily inspection for evidence of unauthorised access into the southern POS (beyond the disturbance footprint). e.g. observations of vehicles or machinery, damage to fencing	Report unauthorised access or disturbance to wetland vegetation within the development envelope. Reporting to be provided to EPA.
	No significant impact upon wetland water levels from production bore pumping during construction.	Pumping of any future production bore proposed will need to be restricted to construction operating hours on weekdays to enable recovery of water levels overnight. Pump testing of the production bore and monitoring of levels at associated monitoring bores to be completed to provide site specific advice regarding the pumping regime.	A monitoring program consistent with that documented in the UWMP to measure groundwater levels adjacent to the wetland and any future production bore so that any impacts can be noted and modifications to operations made.	Groundwater monitoring report to be provided to DWER.
	No observable dust, erosion or sediment leaving site during construction.	Implement drainage controls to prevent offsite discharge of runoff. Implement sediment control measures to prevent offsite sedimentation.	Daily observation of drainage and sediment control structures to check operation.	Report any significant discharges to City of Swan.

In relation to stormwater management and water sensitive urban design, a number of design and management measures have been incorporated into the proposal to minimise any hydrological impacts. These include:

- No grading of clayey soils will occur within the site to maintain the hydrogeological regime that sustains the wetland.
- Final earthworks contours for development will ensure the depth of cut does not intersect/divert regional groundwater and therefore maintains the existing hydrogeological regime.
- Existing ground levels will be maintained within both landscaped and conservation POS areas to ensure the existing highly permeable sand profile is maintained.
- Minor rainfall events will be treated within lots and road reserves to maintain the hydrogeological regime that sustains the wetland and ensure pollutants generated within the site are appropriately treated.
- Conveyance of minor and major event runoff (up to the 1 % AEP rainfall event) from road reserves and residential lots towards the west into the existing Movida Estate drainage network to avoid runoff being directed into the wetland to maintain the current hydrological regime.
- Landscape designs within the landscaped portion of the southern POS will ensure the vegetation cover and infiltration capacity of the underlying soils is retained to maintain the hydrogeological regime that sustains the wetland.
- Retaining the minor rainfall event within the lot to minimise the conveyance of pollutants from lots onto the road reserve or piped drainage network.
- Stormwater runoff from the minor rainfall event conveyed along road reserves with appropriate treatment.
- Development of an appropriate management and maintenance schedule to ensure water sensitive urban design functions are maintained.
- There will be no irrigation bores located within the southern POS area.
- Future production bores for construction (if required) will be located westwards of the current construction bore.
- Pumping from the superficial groundwater bore will be restricted to construction operating hours on weekdays to enable recovery of water levels overnight.

These measures will be documented in an UWMP prepared as a condition of subdivision in accordance with standard urban development and implemented as part of residential development.

Following development, the best outcome to protect environmental assets is to provide secure tenure in the long term with an appropriate conservation land manager. The implementation of the proposal will enable the southern POS area to be transferred over to the Crown free of cost with the CoS as the management authority. At a City of Swan Council Meeting (5th June 2019), the City of Swan agreed to accept the management of the southern POS area and make provision for the long term maintenance of this area (**Appendix I**). The CoS has extensive experience in the management of conservation reserves and has identified protection of the Forrestfield complex as a priority within the local government's *Local Biodiversity Strategy* (City of Swan 2015).

6.3 Rehabilitation

Rehabilitation is proposed to be undertaken within the southern POS area. Rehabilitation will be undertaken as outlined in the RVMP attached as **Appendix J**. Rehabilitation is focused on protection (buffering) of the retained portion of FCT 20c TEC and increasing the extent of FCT 20c TEC in the long term as well as improving the resilience and values of the wetland within Bush Forever Site 309 and the FCT 20c TEC.

The goals of the rehabilitation, as outlined in the RVMP (**Appendix J**) include the following:

1. Restore approximately 5,278 m^2 of FCT 20c vegetation in 'degraded' or 'completely degraded' condition[1], such that a vegetation condition rating of 'good' or better is achieved.
2. Manage approximately 4,565 m^2 of FCT 20c vegetation in 'very good' or better condition to maintain its existing condition and restore any 'degraded' portions to 'good' or better condition.
3. Manage approximately 17,036 m^2 FCT 11 vegetation associated with Bush Forever Site 309 to maintain its existing condition and restore any 'degraded' portions to 'good' or better condition.

Revegetation of the FCT 20c TEC buffer area will require intensive management over a number of years, with implementation works outlined the RVMP occurring over three years, with additional ongoing maintenance works conducted by the proponent until handover of the POS area to the City of Swan. The proponent will retain the ongoing maintenance and management responsibilities for the life of the Movida estate development (expected to be at least five to seven years in total). The RVMP details the management approach for the proposed rehabilitation and uses best practice ecological restoration principles to provide the greatest chance of success. Where appropriate methods have been adopted as recommended in recently published expert scientific guidance *Banksia Woodlands A restoration Guide for the Swan Coastal Plain* (Stevens *et al.* 2016).

A total of 0.34 ha of vegetation within the site will be subject to 'Intensive' management actions, and 0.64 ha 'Targeted' as outlined in **Table 20**. Targeted management includes mapped areas of the FCT 20c TEC (**Figure 3**) and additional buffer areas, with a focus on targeted weed control and some infill planting. Intensive management actions will include:

- Landform preparation (including scalping and weed control)
- The introduction of native vegetation through a variety of methods, including vegetation direct transfer, topsoil/mulch application, direct seeding and tubestock planting.

To reduce potential impacts from dieback and other pathogens, best practice management measures for hygiene will be adopted across the rehabilitation site. Fencing and other access control measures will also be implemented across the rehabilitation site.

Rehabilitation will also improve vegetation within the Forrestfield vegetation complex which has less than 10 % of its pre-European extent remaining. In addition, fauna habitat values within the conservation POS area will be improved through weed removal and provision of additional fauna habitat (for example hollow logs or additional habitat trees).

Monitoring will be conducted a minimum of two times per year during the implementation phase. This will include an assessment of vegetation condition (using the Banksia woodlands conservation advice (DoEE 2016), with reference to definitions in Keighery (1994) and Casson *et al.* (2009)), native plant density measurement and photo-point monitoring.

As outlined in the goals above, it is the intention that the RVMP leads to the re-establishment of an area of 0.98 ha of vegetation in 'good' or better condition that is representative of FCT 20c TEC. The re-establishment of this area will effectively create a larger consolidated area of the TEC, adjacent to other areas of native vegetation and reducing currently degrading threats and reducing edge effects. The area of TEC will be 32 % greater than what currently exists onsite with ongoing management and retention for conservation in the long term. Without implementation of the proposal, the small discrete TEC patches are likely to continue to degrade over time, given their size, isolation and degraded surroundings.

Further information on rehabilitation is outlined in **Section 4.2.6.3** and **Section 6.3** and **Appendix J**.

6.4 Residual environmental impacts

Offsets are only to be considered where it is determined after avoidance, minimisation and rehabilitation, a significant residual impact is still likely to occur. The residual impact significance model from the *WA Environmental Offsets Guidelines* (Government of WA 2014) identifies four levels of significance for residual impacts.

- *Unacceptable impacts* – those impacts which are environmentally unacceptable or where no offset can be applied to reduce the impact. Offsets are not appropriate in all circumstances, as some environmental values cannot be offset.
- *Significant impacts requiring an offset* – any significant residual impact of this nature will require an offset. These generally relate to any impacts to species, ecosystems, or reserve areas protected by statute or where the cumulative impact is already determined to be at a critical level.
- *Potentially significant impact which may require an offset* – the residual impact may be significant depending on the context and extent of the impact. These relate to impacts that are likely to result in a species or ecosystem requiring protection under statute or increasing the cumulative impact to a critical level. Whether these impacts require an offset will be determined by the decision-maker based on information provided by the proponent or applicant and expert judgement.
- *Impacts which are not significant* – impacts which do not trigger the above categories are not expected to have a significant impact on the environment and therefore do not require an offset.

The completed Residual Impact Significance Model for all direct and indirect impacts associated with the proposal for Lot 102 Farrall Road is provided in **Table 32** and an explanation of the information and values for each environmental factor outlined below.

6.4.1 Rare flora

No species declared as rare flora under the BC Act or listed as threatened under the EPBC Act are present within the site and as such there is not considered to be any impacts to rare flora as part of the proposal.

6.4.2 Threatened Ecological Communities

The site contains three separate patches of FCT 20c TEC of which 0.2 ha (over two patches) will be cleared as part of the proposal. These two northern patches are small (0.15 ha and 0.05 ha), surrounded by degraded vegetation and separated from the larger, more intact patch by approximately 200 m.

The localised residual impact of the proposed action is the loss of two patches of FCT 20c totalling an area of 0.2 ha, and representing 0.15 % of the total known AOO of the TEC. While the loss represents 27 % over all FCT 20c TEC patches within the site, there will be minimal loss at a broader scale when considering the extent of the AOO remaining and only 0.28 % impacted based upon the known extent within 20 km of the site. Conversely, the proposed rehabilitation and management of the remaining patch of the TEC will lead to Farrell06 (0.54 ha) being increased to 0.98 ha and therefore, represents an overall increase of 32 % of FCT 20c within the site. At a broader scale, this represents an increase of 0.18 % of the total known AOO of the TEC.

The northern patches of FCT 20c TEC would likely be unviable over the long term, given persistent threats, edge effects, lack of connectivity to other intact FCT 20c TEC remnants (van Etten 2019). Without the control of weeds, the patches are likely to transition to a grassy weed dominated open woodland/shrubland ecosystem which would be structurally and functionally different from that of FCT 20c TEC and similar to that which exists over the majority of the site (van Etten 2019).

It would require significant expenditure of resources to adequately rehabilitate these two patches to the extent that it provides a substantial conservation benefit for the TEC at a local and regional scale. On this basis, it is considered that the implementation of the proposal is unlikely to have any significant residual impacts upon flora and vegetation, given the degraded and declining condition of these patches, which would cease to exist under the current management approach (the 'do nothing' situation).

Furthermore, the *WA Environmental Offsets Guidelines* (Government of WA 2014) states that 'mitigation includes the effect of onsite rehabilitation in rectifying the impact of a project once complete'. As part of the proposal, rehabilitation of FCT 20c TEC will occur as part of implementation of the proposal and it is the intention that 0.98 ha of banksia woodland similar to FCT 20c TEC will be created, including the retention of 0.54 ha currently in 'good' condition.

Resource investment is better directed to improving the quality and resilience (and eventually extent) of FCT 20c TEC in the southern portion of the site, which is larger and of better vegetation quality. Rehabilitation and revegetation of this southern patch is considered to have a greater chance of rehabilitation success (van Etten 2019) and represents an opportunity for the extent of FCT 20c TEC to be increased, providing a beneficial conservation outcome. The proponent will implement the revegetation and manage the site for the life of the Movida estate development (expected to be five to seven years) to achieve this during implementation of the proposal. The proposal also provides an

opportunity to transfer the land to an experienced conservation land manager (City of Swan) for retention and conservation in the long term (**Appendix I**).

Considering the current state of the existing patches of FCT 20c TEC and the proposed rehabilitation as part implementation of the proposal (consistent with the WA offset guideline), it is considered that the proposal avoids a significant residual impact and as such no offsite offsets are required and the proposal can meet the EPA's objectives for flora and vegetation as part of implementation of the proposal.

The site also contains the FCT 21c Priority 3 PEC in 'degraded' condition. The PEC is not an ecological community that is formally recognised as being threatened (through legislation) and is generally considered a 'poorly-known community'. Given this vegetation is degraded, it is considered that it is unlikely to be representative of the PEC and therefore no significant impacts on this PEC will occur.

6.4.3 Remnant vegetation

The implementation of the proposal will result in the clearing of 2.74 ha of native vegetation in 'good' or 'degraded' condition. Given the proposal is located within the Guildford Complex and Forrestfield Complex[6] (both of which have been significantly cleared), the vegetation could be considered significant remnant vegetation. However, reviewing the local and regional impacts on these vegetation complexes, the site is represents less than 1 % of the remaining extent of Forrestfield Complex over the Swan Coastal Plain and less than 1% of the remaining extent within the City of Swan. Furthermore, given the majority of this vegetation 2.54 ha is in 'degraded' condition it is arguable whether this portion is representative of the complex, given the change to vegetation composition and structure.

On this basis the impact on remnant vegetation (vegetation complexes) is not considered significant.

6.4.4 Wetlands and waterways

The implementation of the proposal will result in the clearing of 0.046 ha of wetland dependent vegetation located within the southern portion of the site. This vegetation is in 'degraded' condition, adjacent to Farrall Road, is outside of Bush Forever Site No. 309 and would not be classified as part of the CCW. The full extent of the potential CCW will be retained, rehabilitated and protected.

The proposal may also have indirect impacts to a wetland during construction and development, which as outlined in **Section 4.4.5** will be managed through the preparation and implementation of an UWMP as a condition of any future subdivision. The UWMP will be prepared on advice of DBCA to the satisfaction of the City of Swan. As such, these impacts are not considered to be significant.

[6] While regional Heddle *et al.* 1980 mapping shows the site mapped in the Guildford complex, it is considered transitional between the Guildford and Forrestfield vegetation complexes. Based upon detailed site visits and the vegetation present (including FCT 20c TEC) that majority of the site is considered representative of the Forrestfield complex. **Figure 3** provides an inferred boundary of Guildford and Forrestfield vegetation complexes based upon the vegetation survey information.

6.4.5 Conservation areas

The proposal provides for the retention of all vegetation associated with Bush Forever Site 309 and a wetland representative of a CCW. Specific management actions and procedures as outlined in **Section 4.4.5** and **4.2.5** will minimise any indirect impacts to the wetland. These measures will be documented in a CEMP and UWMP prepared as a condition of any future subdivision or development application approval. Impacts to the wetland will also be minimised through the provision of a revegetated buffer and additional revegetation as outlined in **Appendix J.**

6.4.6 High biological diversity

The proposal is not located within one of Australia's nationally recognised biodiversity hotspots (DoEE 2019) nor does it not support habitat for any listed migratory species under the *Japan-Australia Migratory Bird Agreement, China-Australia Migratory Bird Agreement, Republic of Korea-Australia Migratory Bird Agreement.*

However, the site is part of one of the international biodiversity hotspots (Southwest Australia), recognized by Conservation International (Conservation International 2020). The international biodiversity hotspot criteria include at least 1,500 vascular plants as endemics and 30% or less of the original native vegetation.

FCT 20c TEC is a biodiverse ecological community as noted for plant communities that occur on the Forrestfield Land Unit of the Ridge Hill Shelf (Keighery and Keighery 1993). While the proposal impacts upon an ecological community with high biological diversity within an international biodiversity hotspot, the impact is not considered significant as:

- The vegetation impacted by the proposal is generally in 'degraded' to 'completely degraded' condition and therefore does not comprise high biological diversity.
- The area of 0.2 ha of FCT 20c TEC in 'good' condition proposed to cleared as part of the proposal is small (spread over two patches) and is not representative of high diversity as it has reduced diversity when compared with the average species richness of FCT 20c TEC (Gibson *et al.* 1994).

6.4.7 Habitat for fauna

The implementation of the proposal will involve the development of 5.08 ha of the site plus a small area of the southern POS of 0.58 ha, which combined contains 2.74 ha of native vegetation that will be cleared as well as scattered native trees. The majority of fauna habitat proposed to be cleared is 'degraded' native vegetation (2.55 ha) and provides limited habitat values for significant species.

When considering local and regional impacts, the site provides less than 0.5 % (**Table 25**) of the available native vegetation within 20 km of the site and 0.00041 % on the Swan Coastal Plain. When considering cumulative impacts from development in the short, medium and long term (DPLH 2017) the site (and other impacts) will result in clearing of 1.23 % of native vegetation on the Swan Coastal Plain (**Table 27**). These is not considered a significant impact on native fauna habitat.

The proposal will result in the clearing of potential habitat for conservation significant species being:

- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris)*

- Forest red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*)
- Baudin's Black Cockatoo (*Calyptorhynchus baudinii*)

This includes 2.74 ha of banksia and marri woodland and 11 potential habitat trees. In determining the potential significance of this impact, it is relevant to consider the following:

- the scale of the impact and the extensive amount of high quality foraging (and roosting) habitat within 6 km of the site (~3,037 ha (DEC 2011)) which would provide a significant resource for black cockatoos.
- The potential habitat trees do not support suitable hollows for nesting black cockatoos and no evidence of breeding or roosting. These trees are scattered around the site (**Figure 7**) and are not in proximity to large areas of quality foraging habitat which reduces their potential value as black cockatoo habitat trees.
- Only 0.2 ha of this habitat would be considered 'quality' foraging habitat based upon the areas of Marri woodland within the site (Harewood 2018) (**Figure 7**) which is below the one hectare threshold provided in the *EPBC Act referral guidelines for three threatened black cockatoo species* (DSEWPaC 2012b) .

As discussed in **Section 4.3.5**, It was concluded there were no conservation significant SRE species that would be significantly implemented by the proposal.

6.5 Determination of offsets

As outlined above in the Residual Impact Significance Model (**Table 32**), there are no significant residual impacts associated with the proposal and therefore offsets are not required. The avoidance of significant residual impacts is achieved through:

- Retention of the highest-quality native vegetation and fauna habitat.
- Revegetation of the wetland, a wetland buffer and FCT 20c TEC to increase the area of the TEC to 0.98 ha.
- Preparation and implementation of a CEMP as a condition of subdivision or a development application to minimise impacts during construction and development.
- Preparation and implementation of an UWMP as a condition of subdivision to minimise hydrological impacts of construction and development.

It is relevant to note that there are differences in the state and Commonwealth offset policy and guidelines. In accordance with the WA offset guideline (Government of WA 2014), the rehabilitation proposed cannot be considered to be an offset as rehabilitation forms part of mitigation to reduce the significance of the impact. Application of the federal offsets assessment guide and policy (which does not require offsets to be off-site) (DSEWPaC 2012a), states that the the proposed protection of retained vegetation and revegetation offsets will offset 187.9 % of the residual impact. This is outlined further in **Section 7.4** and the WA Offset Template is provided below as **Table 33**.

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Table 32: Residual Impact Significance Model.

Part IV Environmental Factors	Vegetation and Flora			Terrestrial Fauna			
Part V Clearing Principles	**Rare Flora**	**Threatened Ecological Communities**	**Remnant Vegetation**	**Wetlands and Waterways**	**Conservation Areas**	**High Biological Diversity**	**Habitat for Fauna**
Residual Impact that is environmental unacceptable and cannot be offset							
Significant residual impact that will require an offset							
Significant residual impacts that may require an offset							
Residual impacts that are not significant	No species declared as rare flora under the BC Act or listed as threatened under the EPBC Act. Clearing of 8 Priority 3 *Isopogon drummondii*	Clearing of 0.2 ha of FCT 20c TEC	Clearing of areas (2.74ha) of vegetation in 'good' or 'degraded' condition representative of the Forrestfield Complex. The majority of this vegetation is in Degraded condition (2.5 ha). Clearing of 0.85 ha of FCT 21c Priority 3 PEC	Clearing of 0.05 ha of wetland dependent vegetation in 'degraded' condition.	Impacts to the Bush Forever site.	While in an international biodiversity hotspot, vegetation is largely degraded and does not comprise high biological diversity. Areas of FCT 20c TEC proposed to be cleared also contain reduce biodiversity when compared to the average.	Clearing of 0.2 ha of quality foraging habitat for Baudin's black cockatoo and Forest red-tailed black cockatoo. Clearing of 2.54 ha of low quality foraging habitat for Carnaby's black cockatoo being banksia woodland in 'good-degraded' condition. Clearing of 11 potential habitat trees providing scattered low-quality potential breeding and roosting habitat for all three black cockatoo species. The implementation of the proposal will result in the removal of 2.74 ha of native vegetation which would provide habitat values for native fauna, including the Peregrine Falcon (an 'other specially protected fauna') under the BC Act.

Table 33: WA offset template

Environmental Factor	Existing environment/impact	Mitigation			Residual impact	Offset Calculation methodology				
		Avoid and minimise	Rehabilitation Type	Likely rehabilitation success		Type	Risk	Likely offset success	Time lag	Offset quantification
Flora and vegetation	14 Priority 3 individuals *Isopogon drummondii*	6 individuals avoided (retained). Impacts to these individuals to be minimized during construction through the use of a CEMP.			No. Given this is a priority 3 species and not under imminent threat.					
	0.74 ha of FCT 20c TEC (spread over 3 patches)	0.54 ha of FCT 20c TEC avoided. Impacts to retained TEC area be minimized during construction through the use of a CEMP.	Onsite rehabilitation and additional re-establishment of TEC habitat. Rehabilitation to involve topsoil transfer from cleared areas of TEC to maximise success and retention of biological material. 0.44 ha of TEC in 'good' or better condition will be created. This will result in a total of 0.98 ha of TEC in a consolidated patch in 'good' or better condition.	*Can the environmental values be rehabilitated/evidence* Rehabilitation will involve re-establishment of TEC, which used to persist over the site and has been significantly degraded. The soils and hydrology of the site can support have not been significantly altered and would be capable of supporting this community. Rehabilitation will be guided by RVMP. The RVMP has been designed with attention to the six principles outlined in The National Standards for the Practice of Ecological Restoration in Australia (Standards Reference Group SERA 2017), which is listed in the TEC conservation advice (REF) as underpinning any restoration of the TEC. The restoration actions in the conservation advice have been incorporated into the RVMP. *Operator experience in undertaking rehabilitation*. The selected operator will need to demonstrate success in rehabilitation and TEC experience and local experience will be favourable. An operator will be appointed based upon their demonstrated experience and understanding of the objectives in the RVMP. *Type of vegetation being rehabilitated.* Banksia woodland – Shrubland and woodlands of the eastern Swan Coastal Plain (FCT 20c) *Time lag* Some values of the TEC will be expected to return in 3 years (structural species, species that can be propagated, reduction in weed cover). The transfer of topsoil and direct transfer of vegetation will reduce time taken to restore biodiversity values (including native vegetation, soil biota and native vegetation seedbank) and recalcitrant species that would otherwise be impossible to re-establish.	No. Given the retention of 0.54 ha onsite and the additional revegetation of 0.44 ha, it is considered that the impact is not significant.				

Table 33: WA offset template (continued).

Environmental Factor	Existing environment/impact	Mitigation			Residual impact	Offset Calculation methodology				
		Avoid and minimise	Rehabilitation Type	Likely rehabilitation success		Type	Risk	Likely offset success	Time lag	Offset quantification
Flora and vegetation (continued)	(continued from above)	(continued from above)	(continued from above)	These are expected to provide an immediate benefit to the 'degraded' and 'completely degraded' areas of vegetation being rehabilitated. *Credibility of the rehabilitation proposed (evidence of demonstrated success).* Emerge are not aware of any demonstrated rehabilitation of FCT20c TEC. However, Emerge are experienced in writing and implementing restoration plans, have followed the rehabilitation actions within the recovery plan and have used site-specific information to inform the plan. Given FCT 20c TEC is a banksia woodland, the RVMP has been developed using the outcomes and learnings from the *Banksia Woodland Restoration Project and Banksia Woodlands: A restoration guide for the Swan Coastal Plain* ((Stevens *et al.* 2016)). Furthermore, methods such as direct vegetation transfer represent a high level of effort and demonstrate commitment to achieving the best outcomes possible given current knowledge and tools in the field of restoration ecology.	(continued from above)						
	3.4 ha of native vegetation (in 'excellent' to 'degraded' condition) representative of the Forrestfield complex.	0.68 of native vegetation retained in 'excellent' to 'degraded' condition.			No. Given the majority of the vegetation (2.54 ha) is in 'degraded' condition it is not considered representative of the Forrestfield complex. The removal of 0.2 ha in 'good' condition is not considered a significant impact as this is less than 1% of what is remaining.					
	1.8 ha of native vegetation (in 'excellent' to 'degraded' condition) representative of the Guildford complex.	1.8 ha of native vegetation retained in 'excellent' to 'degraded' condition.			No.					
	1.7 ha of wetland vegetation generally in 'Excellent' condition	Majority of wetland vegetation retained, 0.046 ha cleared in 'degraded' condition and outside of Bush Forever site. Impact to wetland vegetation to be minimized during construction through the use of a CEMP.			No. Minor removal of wetland vegetation (0.046ha), which is largely separated from the main body of wetland and not representative of a CCW.					

Table 33: WA offset template (continued).

Environmental Factor	Existing environment/impact	Mitigation			Residual impact	Offset Calculation methodology				
		Avoid and minimise	Rehabilitation Type	Likely rehabilitation success		Type	Risk	Likely offset success	Time lag	Offset quantification
Flora and vegetation (continued)	0.85 ha of plant community Bima, classified as FCT 21c, a Priority 3 PEC. The plant community is in 'degraded' condition.				No. Given this is a priority 3 ecological community, it is not protected by statue. The plant community is in 'degraded' condition and does not contain any rare or endangered flora. The impact is not considered to be significant.					
Wetlands and Waterways (Inland Waters)	Wetland (Bush Forever Site 309)	No change to hydrological regime for wetland.			No.					
	Blackadder Creek	No change to hydrological regime for Blackadder Creek.			No.					
Habitat for Fauna	Clearing of vegetation for fauna habitat	Vegetation incorporating greatest fauna habitat value has been retained. Impacts to fauna to be minimized during construction through the use of a CEMP.	Some benefits through the proposed revegetation of FCT 20c TEC onsite.		No.					
	3.4 ha of potential low-quality foraging habitat for Carnaby's black cockatoo species comprising banksia woodland.	Some banksia woodland area (0.85 ha) will be retained for conservation in POS.	Onsite rehabilitation and will improve the quality of the existing banksia woodland within POS. An additional 0.13 ha of banksia woodland in 'good' or better condition will be created.	*Can the environmental values be rehabilitated/evidence* Banksia woodland can be revegetated and restoration has been achieved on the Swan Coastal Plain, including work undertaken by DPaW as part of the Banksia Woodland Restoration Project *Operator experience in undertaking rehabilitation.* The selected operator will need to demonstrate success in rehabilitation. *Type of vegetation being rehabilitated?* Banksia woodland (Shrubland and woodlands of the eastern Swan Coastal Plain (FCT 20c)) *Time lag* Some Banksia woodland values are expected to be recreated in 3 years; however other values will take longer to return. Banksia trees take many years to reach maturity.	No. Rehabilitation will lead to a consolidated area of FCT 20c TEC which is in 'good' or better condition. This area will be retained for conservation in the long term.				

Table 33: WA offset template (continued).

Environmental Factor	Existing environment/impact	Mitigation			Residual impact	Offset Calculation methodology				
		Avoid and minimise	Rehabilitation Type	Likely rehabilitation success		Type	Risk	Likely offset success	Time lag	Offset quantification
Habitat for Fauna (continued)	(continued from above)	(continued from above)	(continued from above)	*Credibility of the rehabilitation proposed (evidence of demonstrated success)* Banksia woodland has been successfully rehabilitated with increased success through topsoil spreading. DPaW (now DBCA) have extensive experience in banksia woodland rehabilitation through the Banksia Woodland Restoration Project and the outcomes of this have been incorporated into the RVMP.	(continued from above)					
	0.2 ha of quality foraging habitat for Baudin's and Forest red-tailed black cockatoo comprising Marri woodland.	Some Marri will be retained in the southern portion of the site within the Mp wetland community.			No.					
	7 potential habitat trees providing potential roosting habitat for Baudin's black cockatoo and Forest red-tailed black cockatoo comprising Marri and Jarrah.	One habitat tree (jarrah) will be retained within the southern POS.	Additional habitat tress (*Eucalyptus marginata)* and will be incorporated into revegetation within conservation area.	*Can the environmental values be rehabilitated/evidence* Habitat trees can be revegetated. *Operator experience in undertaking rehabilitation.* The selected operator will need to demonstrate success in rehabilitation. *Type of vegetation being rehabilitated*? Eucalyptus habitat trees as part of banksia woodland vegetation. *Time lag* Some habitat tree values will be created immediately, however roosting and/or breeding trees are likely to take a number of years, particularly breeding habitat which requires hollows that only form after the tree is 150 years. *Credibility of the rehabilitation proposed (evidence of demonstrated success* Habitat trees will be revegetated through direct planting and monitored for success.	No. Trees did not demonstrate evidence of breeding or roosting and are fragmented across the site.					
	5 potential habitat trees providing potential roosting habitat for Carnaby's black cockatoo comprising Marri.	Some Marri will be retained in the southern portion of the site within the Mp wetland community but no habitat trees.			No. Trees did not demonstrate evidence of breeding or roosting and are fragmented across the site.					

6.6 State Offset Policy Principles

There are no significant residual impacts are associated with the proposal. However, the State Offset Policy Principles are addressed in have not been addressed in **Table 34**. Consideration of the Commonwealth offset policy is outlined in **Section 7** below.

Table 34 Assessment against State Offset Policy Principles

Offset Policy Principles	Application to this proposal
Environmental offsets will only be considered after avoidance and mitigation options have been pursued.	Environmental offsets address significant residual impacts. The proposal has used avoidance and mitigation (including rehabilitation) to avoid the need for environmental offsets.
Environmental offsets are not appropriate for all projects.	For the proposal onsite avoidance and mitigation are considered the most appropriate mechanisms to reduce significant impacts.
Environmental offsets will be cost-effective as well as relevant and proportionate to the significance of the environmental value being impacted.	While the proposal does not require offsets, the onsite mitigation, primarily through rehabilitation is considered a cost-effective approach to reduce impacts.
Environmental offsets will be based on sound environmental information and knowledge.	While the proposal does not require offsets, the onsite mitigation will be based upon sound environmental information and knowledge. Contingency measures (such as an increased implementation timeframe) will be incorporated to reduce the risks associated with onsite mitigation.
Environmental offsets will be applied within a framework of adaptive management.	While the proposal does not require offsets, the proposed mitigation measures, including rehabilitation will implement a framework of adaptive management, including monitoring, evaluation and reporting of the proposed rehabilitation.
Environmental offsets will be focused no longer term strategic outcomes.	The proposed avoidance and mitigation measures implemented as part of the proposal will deliver long term strategic environmental outcomes, including an increase in the number of occurrences of FCT 20c TEC under conservation management with the FCT 20c TEC recovery plan (DEC 2006, 2012).

7 Matters of National Environmental Significance

Approval under the EPBC Act is required if a proposal is likely to have a significant impact on matters of national significance (MNES), as defined in the EPBC Act.

The proposal was referred to the DoEE (now DAWE) under the EPBC Act and received a 'Controlled Action' decision (EPBC 2017/8066) due to the expected impacts to MNES listed under Section 18 and 18A. The proposal was also authorised to be assessed under the part IV of the EP Act and is being assessed as an accredited assessment under section 87 of the EPBC Act.

As outlined in a letter to the proponent dated 2 July 2018, the relevant MNES for this proposal is:

- *Shrublands and Woodlands of the eastern Swan Coastal Plain* (FCT 20c TEC).

Evaluation of *Shrublands and Woodlands of the eastern Swan Coastal Plain* (FCT 20c TEC) was considered against the significant impact criteria for critically endangered ecological communities as set out in the *Significant Impact Guidelines 1.1 for Matters of National Environmental Significance* (DotE 2013).

The information in this section has been authored by Strategen-JBS&G, who submitted the EPBC Act referral for the proposal. Given the accredited assessment process, EPBC Act considerations have been included within this document to provide a single assessment package, and address the following information, which was requested by the DoEE (now DAWE):

- Confirmation of the total proposed cleared area of 'critical habitat' for the Shrublands and Woodlands of the eastern Swan Coastal Plain.
- Potential indirect impacts to larger areas of the ecological community immediately surrounding or adjacent to the proposed action.
- Consideration of direct and indirect impacts within the local, regional, state and national scale and the precautionary principle.
- Overall conclusion as to the environmental acceptability of the proposal, including consideration with the requirements of the EPBC Act, justification for undertaking the proposal in the manner proposed, and discussion of residual impacts and any offsets and compensatory measures proposed or required for significant residual impacts on MNES and the relative degree of compensation and acceptability.
- Demonstrate that the action is consistent with any relevant recovery plan or threat abatement plan, including:
    - *Eastern Shrublands and Woodlands (Swan Coastal Plain Community 20c) Interim Recovery Plan 2000-2003. Interim Recovery Plan No. 58*. (English and Blyth 2000).
    - *Threat abatement plan for disease in natural ecosystems caused by Phytophthora cinnamomi* (DoE 2018).
    - *Threat abatement plan for competition and land degradation by rabbits* (DoE 2016).
- Demonstrate that the action has had regard to *Approved Conservation Advice for Shrublands and Woodlands of the eastern Swan Coastal Plain* (DoEE 2017).
- Details of any offset(s) intended to compensate for residual significant impacts.
- Demonstrate how any proposed offset is consistent with the EPBC Act Environmental Offsets Policy (October 2012) (DSEWPaC 2012a) and justification for the values used.

- Details on the social and economic costs and/or benefits of undertaking the proposed action.

7.1 Shrublands and Woodlands of the eastern Swan Coastal Plain

The *Approved Conservation Advice for Shrublands and Woodlands of the eastern Swan Coastal Plain* (DoEE 2017) identifies habitat that is critical for the survival of the TEC as:

- The area of occupancy of known occurrences
- The sandy to gravelly soils on the eastern Swan Coastal Plain and foothills of the Darling Scarp on which the community occurs
- Areas of similar habitat within 200 m of known occurrences
- Remnant vegetation that surrounds or links several occurrences.

Due to the 'Critically Endangered' conservation status applied in Western Australia, no condition threshold has been applied to the nationally-listed TEC and all areas meeting the description of the TEC are considered to be critical to its survival.

According to information obtained from the DBCA, the known Area of Occupancy (AOO) of FCT 20c is approximately 129 ha, of which 90 % is located within Talbot Road Reserve in Midvale, and the former Bushmead Rifle Range site in Helena Valley. These areas are relatively well protected and managed through tenure and covenant arrangements between private landowners and DBCA. A further two discrete occurrences of FCT 20c occur at Clifford Road in Maddington and Stirling Crescent in Hazelmere, both of which are under Main Roads jurisdiction and are not formally managed or protected. The occurrence of FCT 20c at the site represents a fifth discrete occurrence of the TEC, although Talbot Road Reserve occurs within 1 km of the site.

Extensive surveys have been conducted over Lot 102 by (Emerge Associates 2015a, c, d, 2017), Tauss & Associates (2016), van Etten (2019) to delineate the likely extent of FCT 20c TEC and its condition. van Etten (2019) considers that the site contains three remnant patches which are representative of FCT 20c TEC as outlined in **Section 4.2.3.2**.

Patches of FCT 20c occurring within Lot 102 are varying in condition as detailed in **Table 12** and shown in **Figure 3.** The southern remnant patch of FCT 20c (Farrell06) comprises an area of 0.54 ha, of which 0.07 ha is in 'very good' condition and 0.22 ha is in 'good' condition. Farrell03 and Farrell04 were also mapped to be mostly in 'good' condition by Tauss & Associates (2016), however, later observations made by van Etten (2019) have concluded that these two patches contain areas which are degraded to some degree. The larger of these two northern patches (0.15 ha, Farrell04) is considered by van Etten (2019) to be in a 'degraded' condition, while the general condition rating of 'good' is supported for the smaller patch (0.05 ha, Farrell03).

The two patches of FCT 20c are of small size, surrounded by heavily degraded vegetation, and isolated from intact FCT 20c in better condition to the south of Lot 102 by approximately 200m. As outlined in **Section 4.2.7**, retaining these two patches would not result in beneficial conservation outcomes for the TEC, and van Etten (2019) asserts that resource investment to protect and restore them would be considerably large and would have greater challenges associated with achieving an adequate level of restoration to be of benefit to the TEC. Furthermore, the extent and viability of these two patches is expected to decline with or without mitigation measures due to:

- Lack of connectivity with the larger and better quality FCT 20c remnant located in the southern portion of Lot 102
- 'Degraded' vegetation surrounding the two patches
- Historic fly-tipping activities
- Reduced resilience to persist in a highly constrained environment from the development of Lot 102.

The future development of Lot 102 will result in the clearing of the two patches (0.2 ha) of FCT 20c for development and retention and rehabilitation of the southern patch of FCT 20c.

Whilst future development of Lot 102 will lead to the unavoidable clearing of 0.2 ha of FCT 20c it also provides the following opportunities:

- Improving the extent and resilience of the remaining patch of FCT 20c TEC to 0.98 ha as a result of the proposed rehabilitation and revegetation management measures (further detail is provided in **Section 7.3.2**, **Section 4.2.6.3** and **Section 6.3**)
- The protection, conservation and ongoing management of the remaining patch of FCT 20c TEC into perpetuity through its future reservation, being ceded to Crown free of cost and handed over to the City of Swan for future management over the POS area.

7.2 Relevant policies and guidance documents

A series of policy and guidance documents have been produced which are relevant to FCT 20c TEC, as discussed below.

7.2.1 Approved conservation advice and interim recovery plan

The *Approved Conservation Advice for Shrublands and Woodlands of the eastern Swan Coastal Plain* (DoEE 2017) and *Eastern Shrublands and Woodlands (Swan Coastal Plain Community 20c) Interim Recovery Plan 2000 – 2003* (English and Blyth 2000) align in their conservation objectives for FCT 20c and as such are discussed collectively. The primary conservation objective for FCT 20c, as stated within the approved conservation advice, is to:

"…mitigate the risk of extinction (or collapse) of the… ecological community, and help recover its biodiversity and function, through: protecting it as a matter of national environmental significance under national environment *law, particularly to avoid further loss; and by guiding implementation of management and recovery through the recommended priority conservation and research actions…"* (DoEE 2017)

To achieve this objective, broad conservation priorities and actions are set out within the approved conservation advice and interim recovery plan, including:

- Preventing vegetation clearance and direct habitat damage
- Preventing weeds and feral animals
- Preventing dieback and other diseases
- Managing groundwater abstraction and groundwater monitoring
- Determining appropriate fire regimes
- Preventing grazing damage

- Restoration activities
- Control invasive species and diseases
- Maintain a recovery team
- Education, information and local regulation
- Incentives and support
- Research and monitoring.

7.2.2 Threat abatement plans

A summary of the objectives of the relevant threat abatement plans is presented below in **Table 35**

It is understood that a formal dieback assessment has not been undertaken for the site but dieback management and hygiene is recommended as part of future management of the site (see **Section 7.3.2**).

The independent advice provided by van Etten (2019) indicates that rabbits are currently not considered a threat to FCT 20c at the site but will be given consideration within the proposed management and mitigation measures (see **Section 7.3.2**).

Table 35: Threat abatement plans relevant to Shrublands and Woodlands of the Eastern Coastal Plain FCT 20c.

Threat abatement plan	Plan objectives
Threat abatement plan for disease in natural ecosystems caused by Phytophthora cinnamomi (DoE 2018)	• Identify and prioritise for protection biodiversity assets that are, or may be, impacted by Phytophthora • Reduce the spread and mitigate the impacts of Phytophthora • Inform and engage the community by promoting information about Phytophthora, its impacts on biodiversity and actions to mitigate these impacts • Encourage research on Phytophthora species and options to manage infestations and protect biodiversity assets
Threat abatement plan for competition and land degradation by rabbits (DoE 2016)	• Strategically manage rabbits at the landscape scale and suppress rabbit populations to densities below threshold levels in identified priority areas • Improve knowledge and understanding of the impact of rabbits and their interactions with other species and ecological processes • Improve the effectiveness of rabbit control programs • Increase engagement of, and awareness by, the community of the environmental impacts of rabbits and the need for integrated control

7.3 Potential impacts and proposed management and mitigation measures

7.3.1 Potential impacts

The proposed action will involve the removal of two patches of 0.05 ha and 0.15 ha of FCT 20c TEC along the eastern boundary of the site. As per the approved conservation advice, all occurrences of FCT 20c are considered 'critical habitat', and therefore the total number of hectares of FCT 20c 'critical habitat' to be cleared is 0.2 ha. This represents a loss of 27 % of FCT 20c patches within Lot 102 which is significant at the local scale, however in terms of the overall TEC distribution, it

represents a minor loss of 0.15 % of the total AOO (or 0.18 % if Farrell03 is included). Given the occurrence of FCT 20c TEC in the broader region, clearing of the two patches will not result in direct, indirect or cumulative impacts to the TEC at a regional scale, nor will it cause irreversible damage to the TEC. The independent assessment conducted by van Etten (2019) concludes that attempting to restore the 0.2 ha area of FCT 20c to be cleared would require a significant investment of resources and priority should the given to the protection and retention of the largest, most intact remnant.

An evaluation against the Significant Impact Criteria set out in the *Matters of National Environmental Significance – Significant impact guidelines 1.1* (DotE 2013) is provided in **Table 36**.

Table 36: Significant impact criteria and impact of the proposed action on FCT 20c TEC.

Significant impact criteria	Impact
Will the action reduce the extent of the ecological community?	Likely. The proposed action will result in the clearing of 0.2 ha of FCT 20c 'critical habitat'. This consists of two remnant patches of 0.05 ha and 0.15 ha in size, along the eastern boundary of the site and represents only 0.15 % of the total known Area of Occupancy of the TEC. The two patches proposed for clearing are isolated, surrounded by degraded vegetation, and have been subject to fly-tipping activities in the past. As a result, the extent and viability of these two patches is expected to decline with or without mitigation measures due to: • lack of connectivity with the larger and better quality FCT 20c remnant located in the southern portion of Lot 102 • 'degraded' vegetation surrounding the two patches will be cleared • historic fly-tipping activities • reduced resilience to persist in a highly constrained environment from the development of Lot 102. A total of 129.13 ha of FCT 20c remains within known occurrences in Talbot Road Reserve and Bushmead Rifle Range, and discrete occurrences between Stratton and Maddington in Western Australia within a distance of 20 km. FCT 20c is represented and protected within a number of conservation reserves within 5 km of the proposal area, including: • Bush Forever Site 306 Talbot Road Bushland in Stratton/Swan view, comprising 95.2 ha • Bush Forever Site 481 Stirling Crescent Bushland in Hazelmere, comprising 31.5 ha • Bush Forever Site 213 Bushmead Bushland, comprising 126.4 ha Clearance and detrimental modification of FCT 20c will be minimised through retention and rehabilitation of the largest (0.54 ha) remnant FCT 20c TEC within the southern portion of Lot 102. Revegetation will utilise species associated with FCT 20c TEC to promote the most beneficial outcome for the TEC. It is anticipated that this will result in an increase in the extent, condition and landscape scale connectivity of FCT 20c TEC. Without the implementation of these management measures, it is considered likely that the condition and extent of the southern patch of TEC will also decline. The proposed development therefore provides an opportunity to improve the condition of the remaining patch of TEC within the site, and it is anticipated that the rehabilitation and revegetation management measures will result in an increase in the extent and viability of the TEC remaining in the site. On this basis, the proposed action will initially reduce the extent of the ecological community. However, the residual impact to the isolated patches of FCT 20c (0.2 ha) are considered to be unavoidable given their small size, being mostly degraded and isolated from the larger intact southern area of FCT 20c and therefore, not expected to be viable in the long term with or without mitigation measures. Furthermore, the proposed development of Lot 102 provides an opportunity to improve the condition as well as increase the extent of the remaining patch of TEC within the site.

Table 36: Significant impact criteria and impact of the proposed action on FCT 20c TEC (continued).

Significant impact criteria	Impact
Will the action fragment or increase fragmentation of an ecological community?	Highly unlikely. The two patches of FCT 20c TEC proposed for clearing total an area of 0.2 ha and are fragmented and isolated from a larger, intact remnant in the southern portion of the site, which will be retained in POS as part of the development of the site. Given the close proximity to Talbot Bushland, geneflow is still expected to occur with the southern patch of FCT 20c TEC to be retained (van Etten 2019). The two patches of FCT 20c to be cleared are not expected to have the resilience to persist in increasingly constrained surrounds due to their small size, condition and lack of connectivity to the larger remnant located in the south of Lot 102. Therefore, it is not expected that clearing these two patches will affect the connectivity of the ecological community or cause further fragmentation. FCT 20c TEC is represented and protected within a number of conservation reserves within 5 km of the proposal area, including: • Bush Forever Site 306 Talbot Road Bushland in Stratton/Swan view, comprising 95.2 ha • Bush Forever Site 481 Stirling Crescent Bushland in Hazelmere, comprising 31.5 ha • Bush Forever Site 213 Bushmead Bushland, comprising 126.4 ha A total of 129.13 ha remaining in six occurrences of FCT 20c occur from Stratton to Maddington in Western Australia within a distance of 20 km. On this basis, the proposed action will not further fragment the ecological community.
Will the action adversely affect habitat critical to the survival of the ecological community?	Highly unlikely. FCT 20c is represented and protected within a number of conservation reserves within 5 km of the proposal area, including: • Bush Forever Site 306 Talbot Road Bushland in Stratton/Swan view, comprising 95.2 ha • Bush Forever Site 481 Stirling Crescent Bushland in Hazelmere, comprising 31.5 ha • Bush Forever Site 213 Bushmead Bushland, comprising 126.4 ha A total of 129.13 ha remaining in six occurrences of FCT 20c occur from Stratton to Maddington in Western Australia within a distance of 20 km. The proposed clearing of up to 0.2 ha of FCT 20c represents approximately 0.15 % of the total AOO and the clearing represents a local impact only. Measures such as provision of conservation fencing will be implemented to restrict access into the area of FCT 20c TEC to be retained in the southern portion of the site, to prevent potential impacts resulting from human presence. Any access provided will be restricted to pathways created upon existing tracks. On this basis, the proposed action will not adversely affect habitat critical to the survival of the ecological community.

Table 36: Significant impact criteria and impact of the proposed action on FCT 20c TEC (continued).

Significant impact criteria	Impact
Will the action modify or destroy abiotic factors necessary for the ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns?	Highly unlikely. The impacts of clearing are confined to the removal of up to 0.2 ha of FCT 20c on the eastern boundary of the site, and will not represent a threat to the survival of the large, intact remnant patch of FCT 20c being retained in the southern portion of the site. While Acid Sulfate Soils (ASS) do not represent a risk over the majority of the site, there is a 'moderate to low' risk of ASS occurring within 3 m of the natural soil surface in the east of the site. This will require consideration where excavation is required for services, such as sewers, and will be addressed within an ASS Management Plan if required. As outlined in **Section 4.4**, groundwater levels will not be significantly impacted by implementation of the proposal. An Urban Water Management Plan (UWMP) will be prepared for each subdivision stage within the development, which will address groundwater and surface water management measures in line with the relevant State Planning Policies and Guidelines. The UWMP will focus on maintaining groundwater quality by reducing total nutrient loads into groundwater originating from the proposed development. Stormwater storage areas will be designed to ensure that pre-development flow rates leaving the site are maintained. On this basis, the proposed action will not result in the modification or destruction of abiotic factors necessary for the survival of the ecological community.
Will the action cause substantial change in the species composition of an occurrence of an ecological community, including causing decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting?	Highly unlikely. While the proposed action will clear up to 0.2 ha of FCT 20c TEC, areas of FCT 20c TEC are available within large conservation reserves surrounding the site. The two patches to be cleared are small and are surrounded by vegetation in a 'degraded' condition and are situated approximately 230 m from the large intact remnant proposed for retention. Revegetation surrounding the intact remnant will utilise species associated with FCT 20c TEC to present the most beneficial outcome for the TEC. Other native species occurring within Lot 102 will also be used in revegetation. This will result in an increase in the remaining extent and condition of FCT 20c TEC. On this basis, the proposed action will not cause a substantial change in the species composition of the ecological community.

Table 36: Significant impact criteria and impact of the proposed action on FCT 20c TEC (continued).

Significant impact criteria	Impact
Will the action cause a substantial reduction in the quality or integrity of the ecological community, including:	Highly unlikely. The clearing of 0.2 ha of FCT 20c will not cause a substantial reduction in quality or integrity of an occurrence of the ecological community. The proposal proposes to retain the largest, intact remnant of FCT 20c TEC in 'good' and 'very good' condition within conservation POS, and rehabilitate 'degraded' vegetation surrounding this vegetation, so as to increase the remaining extent, condition and landscape scale connectivity of FCT 20c TEC.
- assisting invasive species, that are harmful to the listed ecological community, to become established - causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community?	A total of 28 weed species were observed during the Tauss & Associates (2016) winter flora and vegetation survey with Floristic Community Type Analysis. A total of 75.9 % (6.30 ha) of the vegetation within the site is in a 'degraded' to 'completely degraded' condition, and therefore, the removal of 0.2 ha of vegetation will not affect the establishment of weed species. Weed management and hygiene measures will be incorporated into the CEMP and RVMP. On this basis, the proposed action will not cause a substantial reduction in the quality or integrity of the ecological community.
Will the action interfere with the recovery of the ecological community?	Unlikely. The removal of 0.2 ha of FCT 20c TEC is not expected to significantly reduce the extent of FCT 20c TEC overall, as the patches to be cleared are highly fragmented, surrounded by vegetation in a 'degraded' condition, and subject to existing pressures and degradation from fly-tipping activities. Revegetation and rehabilitation measures are proposed to be implemented to improve the condition of the remnant patch of FCT 20c TEC which is consistent with the suggested priorities and actions outlined in the approved Conservation Advice (Commonwealth of Australia 2017) and Interim Recovery Plan (English and Blyth 2000) for the TEC. The two patches of FCT 20c TEC proposed to be cleared would be unlikely to persist with or without mitigation measures. The proposed action is not expected to interfere with the recovery of the TEC, given the amount of FCT 20c TEC retained in formally managed conservation reserves in the wider region.

7.3.2 Proposed management and mitigation measures

Management and mitigation measures as outlined within the RVMP and to be included within a CEMP for the site will have regard for the relevant Approved Conservation Advice, Interim Recovery Plan and Threat Abatement Plans discussed within **Section 7.2.2** by ensuring that:

- Vegetation clearing is managed and vegetation to be retained is clearly demarcated to prevent accidental clearing.
- Fencing is erected around areas of vegetation to be retained to prevent unauthorised access.
- Hygiene practices are implemented to ensure that weeds and pathogens such as dieback are not introduced to the site or spread within it.
- Weed control measures are implemented, such as manual removal and herbicide application
- Infill planting and intensive revegetation measures are implemented to increase the viability and extent of the large southern patch of FCT 20c TEC.

Key management and mitigation measures are focussed towards rehabilitation and revegetation of the southern patch of FCT 20c TEC to be retained, as this is considered to be the most environmentally and financially viable option to ensure that a beneficial conservation outcome is achieved for the TEC (van Etten 2019).

A formal dieback assessment has not been undertaken for the site, however specific hygiene practices and procedures management will be implemented within the CEMP in line with the requirements of the Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (DoE 2018) to ensure that dieback is not introduced or spread within the site.

While rabbits have not been identified as a threat to FCT 20c at the site, the RVMP will have regard for the *Threat abatement plan for competition and land degradation by rabbits* (DoE 2016) by ensuring that rabbit populations are monitored at the site. Appropriate management and mitigation measures will be implemented should this monitoring indicate that rabbit populations begin to pose a threat to the TEC at the site.

Management efforts will be focused towards the retained vegetation and buffer areas within the southern POS to provide a positive conservation outcome for FCT 20c TEC, Bush Forever site and the potential CCW. This management approach aligns with generally accepted biodiversity management principles and is supported by the independent TEC assessment which has been undertaken at the site (van Etten 2019).

The independent TEC assessment determined that retaining the southern patch of TEC would provide the greatest conservation benefit, as this area would be less susceptible to edge effects from the surrounding development given the smaller edge-to-area ratio. Infill planting proposed within the vegetation buffer area (Targeted management zone; see **Table 37**) will act to protect the TEC from weed invasion, while also having potential to improve the quality of water runoff/drainage and increase available habitat. Retention and revegetation/rehabilitation of this larger, intact patch of TEC is regarded as more environmentally and financially viable and sustainable, with a greater chance of rehabilitation success. The proposed management and mitigation measures are intended to maintain or increase the extent, quality and ecological function of FCT 20c.

A CEMP will be prepared to support future construction and subdivision of the site and will outline specific flora and vegetation management actions. Broad management actions to be implemented by the proponent include, but are not limited to:

- Implementation of the RVMP attached as **Appendix J**.
- Fencing will be erected around the areas of retained native vegetation to restrict clearing and unauthorised access.
- Access will be restricted to pathways created upon existing tracks.
- Access will not be permitted to the conservation areas of the TEC and these areas will be fenced with conservation fencing.
- Staff inductions will include information on retained vegetation areas and key fauna species.
- Dust and sediment will be managed to reduce impacts to retained vegetation.
- Hygiene practices are implemented to ensure that weeds and pathogens such as dieback are not introduced to the site or spread within it.
- Clearing activities will not occur if fire danger is Extreme or Catastrophic.

The RVMP identifies management zones within the southern portion of the site, to which levels of management intensity have been assigned based on the nature of management actions required to achieve conservation objectives. These management zones are outlined in **Table 20**, **Table 37** and **Figure 6**.

Table 37 : Management zones within Lot 102 and proposed management actions.

Management zone intensity	Area	Management actions
Low	0.46 ha	Refuse removal, chemical weed control supplemented with manual weed control if practical.
Targeted	0.18 ha	Infill planting with tubestock to increase understorey diversity and cover.
Intensive	0.34 ha	Broad spectrum herbicide application, scalping, translocation/direct vegetation transfer, direct seeding, tubestock planting.

7.3.3 Residual impact

The localised residual impact of the proposed action is the loss of two patches of FCT 20c totalling an area of 0.2 ha, and representing 0.15 % of the total known AOO of the TEC. While this loss is significant at the local scale (i.e. representing a loss of 27 % over all FCT 20c patches within Lot 102), there will be minimal loss at a broader scale when considering the extent of the AOO remaining. Conversely, the proposed rehabilitation and management of the remaining patch of the TEC will lead to its current extent (0.54 ha) being increased to 0.98 ha and therefore, represents an overall increase of 32 % of FCT 20c within the site. At a broader scale, this represents an increase of 0.18 % of the total known AOO of the TEC.

The loss of these two patches is considered unavoidable, in the sense that, as noted in the independent TEC assessment, these two patches are unlikely to persist under the constrained conditions of a post-development environment with or without management and mitigation measures (van Etten 2019). Management or rehabilitation of these two patches is not regarded as an environmentally or financially viable option when compared to the opportunity to rehabilitate and improve the condition and extent of the larger southern patch of FCT 20c.

7.4 MNES Environmental Offsets

Whilst, application of the WA Environmental Offsets and the Residual Impact Significance Model has determined that offsite offsets are not required as a result of the proposed onsite retention and revegetation at a State level, the Federal *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy (DSEWPaC 2012a)* requires the proponent to directly offset the potential residual impacts to FCT 20c TEC. The types of offsets proposed for the site are in the form of protection of retained vegetation and revegetation, which are considered to be forms of suitable offsets under the Federal offset policy.

Noting that there are limited and few known occurrences of FCT 20c TEC remaining, these forms of offsets are justified by a combination of recommendations of the independent TEC assessment (van Etten 2019), and the extent of known occurrences of the TEC which are already under public ownership or reserved for conservation providing no opportunities for offsite offset acquisition. As such, onsite offset is considered to be the most appropriate response which focuses on the reservation, protection and improvement to the best existing patch. Offset calculations have been undertaken for each of the proposed onsite offsets in **Section 7.4.2.**

To ensure the success of the revegetation program the following approach will be implemented:

- Tubestock installation and monitoring will be implemented over 5 to 7 years, which is in excess of typical revegetation projects.
- Ongoing weed and pest control will be implemented by the proponent over this time.
- The proponent will work collaboratively with DBCA and the City of Swan to determine the completion criteria for the revegetation.
- Urban development of the remaining area of the site through implementation of the proposal will reduce the weed seed load in the area, reducing the extent of this threat.

There is a high level of confidence with the proposed revegetation program. However, should there be any issues with the revegetation program, or part of, the following could be adopted:

- In liaison with DBCA develop a suitable alternative offset package and investigate options to:
  - undertake rehabilitation of known occurrences of the TEC
  - fund improvement works of known occurrences of the TEC.

7.4.1 Protection of retained vegetation

The proposal will retain 0.54 ha of FCT 20c in 'very good' to 'good' condition within the southern POS area. In total, 0.98 ha of vegetation within the site will be managed with a combination of 'Low', 'Targeted' and 'Intensive' revegetation management actions, with the objective being to improve the quality and extent of FCT 20c TEC to be retained. It is anticipated that as a condition of subdivision, the POS area will be required to be reserved for recreation and vested in the Crown, free of cost, under Section 152 of the *Planning and Development Act 2005*.

Furthermore, the southern POS area will be handed over to the City of Swan for future management to ensure its ongoing protection. This was agreed by the City of Swan Council in June 2019 as outlined in **Appendix I**. While the retention of the southern occurrence of FCT 20c TEC is considered 'avoidance' under the mitigation hierarchy, the improvement to the quality and extent of FCT 20c

TEC in this location plus the reservation and ceding are considered an offset to the impacts of the proposal in accordance with the EPBC Act Offset Policy (DSEWPaC 2012a).

7.4.2 Revegetation

A total of 0.54 ha of vegetation within the site will be subject to 'Targeted' and 'Intensive' management actions, as outlined in **Table 37**. The level of management assigned to each zone is reflective of the existing environmental values of the areas planned for revegetation. These measures will ensure that a buffer area is created to protect the remnant FCT 20c by reducing the impact of edge effects and susceptibility to weed invasion.

The revegetation site is considered capable of supporting the FCT 20c TEC for the following reasons:

- The revegetation site would have historically contained the FCT 20c TEC as would much of the eastern half of Lot 102.
- Remnants of the FCT 20c TEC occur immediately to the north and south of the revegetation site within Lot 102 (including retained vegetation immediately adjacent to the revegetation site (Farrell06) and the small isolated patches of FCT 20c TEC that are north of the southern POS (Farrell03 and Farrell 04).
- The revegetation site is located on the same landform, same soil type, and is subject to the same hydrological conditions and has the same positional aspect as the remnants of the FCT 20c TEC that occur immediately to the north and south within Lot 102.
- There have been no significant changes to landform, soils or hydrology over time within the revegetation site relative to the locations that contain remnants of the FCT 20c TEC immediately to the north and south within Lot 102.
- Intensive management is proposed by the proponent over a period of 5 to 7 years (as outlined in **Appendix J**) , which increases the likelihood of revegetation success.
- Assuming management occurs as proposed, there are no factors or threats associated with the revegetation site that would preclude the future restoration of the FCT 20c TEC or that the FCT 20c TEC could be re-established.

7.4.2.1 Targeted revegetation

Targeted revegetation actions will include infill planting with tubestock to increase understorey diversity and cover. Areas of FCT 20c TEC are present within the 'Targeted' management zone, which have low understory density and cover, but have canopy or larger shrub layer species such as *Banksia attenuata, B. menziesii, Adenanthos cygnorum* and *Allocasuarina fraseriana*. As there is known floristic variation within the FCT 20c floristic group, species selection for revegetation should include those which are already present within the site within remnant FCT 20c patches so as not to introduce new species. Species planted within the 'Targeted' management zone will be those which are associated with FCT 20c TEC at the site and will promote an overall composition which aligns with the species composition of the TEC.

7.4.2.2 Intensive revegetation

Intensive revegetation management actions will include broad spectrum herbicide application, scalping, translocation/direct vegetation transfer, direct seeding and tubestock planting. Currently the 'Intensive' management zone contains very few native species and has an abundant coverage of

*_Erharta calycina_* (perennial veldt grass) and other invasive weed species. Soil material from the area of FCT 20c TEC to be cleared will be transferred to the revegetation zones, which will promote the establishment of stored seed, invertebrate, microbial and mycorrhizal fungi components, resulting in superior restoration outcomes. Where possible, herbs and shrubs from the area proposed to be cleared will also be transferred.

7.4.2.3 Revegetation management

The RVMP (**Appendix J**) includes a range of methods for site preparation and plant establishment. Some of these methods are routine such as scalping and chemical weed control, topsoil respreading and tubestock propagation and planting. Some methods such as translocation and vegetation direct transfer are more innovative and aimed at achieving the best possible outcomes (that is salvaging the most biological material possible) and are considered worth pursuing. Furthermore, excluding vegetation direct transfer will preclude the opportunity to relocate a wide range of species not available through propagation as well as existing soil biota (microorganisms and soil animals).

As weed species already occur within the revegetation site, ongoing management including weed control using chemical weed management options is proposed within the revegetation site and all adjacent areas of the POS into the future.

As all the soil biota, plants and fauna occurring in Lot 102 are connected and part of the same bushland remnant the same weeds occur within the native vegetation located in the POS area as well as the revegetation site. Therefore weed control will be required irrespective of whether any topsoil or vegetation material is translocated. Given that weed control is proposed over an extended period of time, the risk associated with the spread of weeds and their seed bank is considered to be low.

Chemical weed control is generally accepted as an appropriate option for limiting the establishment of weed species. The spread of herbicide is inherent in chemical weed management approach. The human and environmental risk associated with the use of herbicides is acknowledged. The RVMP only proposes that herbicide be used where necessary, as part of integrated weed management strategy and always according to the manufacturer's instructions and the guidance set out in Australian Pesticides and Veterinary Medicines Authority (APVMA) Permit No. 13333. Therefore, to ensure the restoration outcomes are successful chemical weed control has been incorporated into the RVMP, in particular at the initial stages of restoration.

7.4.3 Offset calculations

The DAWE offset calculator was utilised to provide an offset assessment guide (parameters) associated with the clearing of 0.2 ha of FCT 20c TEC within the site and the proposed offsets (protection of retained vegetation and revegetation). Offset calculator values used for the proposed offsets are included in **Table 38** (protection of retained vegetation) and ***Table* 39** (revegetation). The offset assessment guide for both protection of retained vegetation and revegetation is provided in **Appendix M.**

The following provides a description and the basis of the offset parameters outlined in **Table 38** and **Table 39.**

- **Area of impact** – The area of habitat/community impacted

- **Quality of impacted area** - The quality score for area of habitat/community being impacted - a measure of how well a particular site supports a particular threatened species or ecological community and contributes to its ongoing viability
- **Time over which loss is averted** - This describes the timeframe over which changes in the level of risk to the proposed mitigation site can be considered and quantified
- **Time until ecological benefit** - This describes the estimated time (in years) that it will take for the main benefit of the quality (habitat/community) improvement of the proposed offset to be realised
- **Start quality** - The quality score for the area of habitat/community proposed as an offset - a measure of how well a particular site supports a particular threatened species or ecological community and contributes to its ongoing viability
- **Future quality without offset** - The predicted future quality score (habitat/community) of the proposed offset without the offset
- **Future quality with offset** - The predicted future quality score (habitat/community) of the proposed offset with the offset
- **Risk of loss (%) without offset** - This describes the chance that the habitat/community on the proposed offset will be completely lost (i.e. no longer hold any value for the protected matter of concern) over the foreseeable future without an offset
- **Risk of loss (%) with offset** - This describes the chance that the habitat/community on the proposed offset will be completely lost (i.e. no longer hold any value for the protected matter of concern) over the foreseeable future with an offset
- **Confidence in result** - The level of certainty about the successful achievement of the proposed change in quality (habitat/community) or value (features/individuals)

Table 38 : Protection of retained vegetation offset calculations.

Offset parameter	Values used in calculator	Justification of value
Area of impact (ha)	0.2	0.2 ha of FCT 20c is proposed to be cleared
Quality of impacted area	5	The independent TEC assessment determined that 0.15 ha of the 0.2 ha of FCT 20c proposed to be cleared is in 'degraded' condition, and the remaining 0.05 ha is considered to be in 'good' condition.
Time over which loss is averted	20	The offset area to be retained will be reserved for recreation and vested in the Crown under Section 152 of the *Planning and Development Act 2005,* and handed over to the CoS for future management and conservation.
Time until ecological benefit	1	Ecological benefit would be realised immediately as a direct offset would be provided.
Start quality (retention area)	7	As per the independent TEC assessment conducted by van Etten (2019), the proposed area for retention is considered to be in 'very good' to 'good' condition.

Table 38 : Protection of retained vegetation offset calculations.(continued)

Offset parameter	Values used in calculator	Justification of value
Future quality without offset	3	Given the patch of TEC is small in area and the long-term viability of this vegetation will be comprised as a result of pressures arising from development of the surrounding area, quality of the offset site is likely to decline significantly without any protection and ongoing management measures. As noted in the independent TEC assessment (van Etten 2019) and **Section 4.2.3.2**, the long-term viability of the TEC will decline irrespective of the proposed development. All patches of FCT 20c within Lot 102 are currently subject to a degree of grassy weed invasion and are likely to transition into a grass-dominated open woodland/shrubland ecosystem. This transition would result in compositional, structural and functional changes such that the patches are no longer identifiable as FCT 20c or are unable to recover from the extent of degradation without substantial intervention.
Future quality with offset	7	The offset area to be retained will also be subject to rehabilitation and revegetation measures to improve the quality of the offset site to a 'good' or better condition. Ongoing management of the offset site will reduce the impacts of weed invasion and reduce the impacts of edge effects resulting from development of the surrounding area.
Risk of loss (%) without offset	10	The site is zoned 'Urban' under the (MRS) and 'Residential Development' under the City of Swan Local Planning Scheme No. 17 and has been identified by the State Government as an important infill site in the eastern corridor as key short-term urban development area. Considering that the site is situated in an area that has been identified for priority development in the short term (i.e. within the next 10 years), it is considered that there is a heightened risk of loss in the absence of the offset to provide a form of protection. Additionally, although the condition of the patch of FCT 20c to be retained has been classified as 'very good' to 'good' this patch is small in area and the long term viability of this vegetation will be comprised as a result of pressures arising from the development of the surrounding area and therefore, likely to result in a significant decline in condition. Measures proposed within the RVMP will ensure that the retention area is managed to prevent a decline in the condition and ecological function of the patch of FCT 20c to be retained.
Risk of loss (%) with offset	5	The offset area to be retained will be reserved and vested in the Crown for future conservation.
Confidence in result (habitat quality)	90	Protection mechanisms, once established, will provide a higher level of certainty that the offset will be conserved. Furthermore, implementation of the CEMP and RVMP will lead to the desired conservation outcomes being achieved. Additionally, the proponent has committed to 5 to 7 years of management prior to handover to the CoS for future management, which exceeds the standard commitment of 3 years/2 summers.

Using the values indicated in offset calculator, the output from the offset calculations indicate that 168.38 % of the residual impact will be offset by the proposed protection of retained vegetation.

Table 39: Revegetation offset calculations.

Offset parameter	Values used in calculator	Justification of value
Area of impact (ha)	0.2	0.2 ha of FCT 20c is proposed to be cleared
Quality of impacted area	5	The independent TEC assessment determined that 0.15 ha of the 0.2 ha of FCT 20c proposed to be cleared is in 'degraded' condition, and the remaining 0.05 ha is considered to be in 'good' condition.
Time over which loss is averted	20	The offset area is anticipated to be reserved for recreation and vested in the Crown under Section 152 of the *Planning and Development Act 2005,* and handed over to the CoS for future management.
Time until ecological benefit	10	Time until ecological benefit is estimated at 10 years. This is an allowance for planted vegetation to become established and monitored for success.
Start quality (revegetation area)	5	The proposed revegetation area around the retained patch of TEC, is poor to degraded condition.
Future quality without offset	2	Given the area proposed to be revegetation is in poor to degraded condition, the quality of the revegetation area is expected to decline further without revegetation and management measures due to increasing pressures resulting from development of the surrounding area.
Future quality with offset	7	Revegetation/rehabilitation of the TEC is expected to result in an improvement of condition to 'good' or better. Ongoing management of the TEC will reduce the impacts of weed invasion and reduce the impacts of edge effects resulting from development of the surrounding area.
Risk of loss (%) without offset	10	The site is zoned 'Urban' under the MRS and 'Residential Development' under the City of Swan Local Planning Scheme No. 17 and has been identified by the State Government as an important infill site in the eastern corridor as key short-term urban development area. Considering that the site is situated in an area that has been identified for priority development in the short term (i.e. within the next 10 years), it is considered that there is a heightened risk of loss in the absence of the offset to provide a form of protection. Additionally, development of the surrounding area without revegetation/rehabilitation of the TEC, would result in the TEC becoming more susceptible to degrading factors such as weed invasion and edge effects.
Risk of loss (%) with offset	5	Protection of the TEC will ensure that the risk of loss is minimised as much as possible. The TEC will be fenced and actively managed on an ongoing basis. The proponent will be responsible for actions relating to conditions imposed as part of subdivision approval. Ongoing management measures will include weed control, rabbit control (if required) and maintenance of fencing. The proponent has committed to 5 to 7 years of management prior to handover to the CoS for future management, which exceeds the standard commitment of 3 years/2 summers.
Confidence in result (habitat quality)	90	Protection mechanisms, once established, will provide a higher level of certainty that the offset will be conserved. Furthermore, implementation of the CEMP and RVMP will lead to the desired conservation outcomes being achieved. Additionally, the proponent has committed to 5-7 years of management prior to handover to the CoS for future management, which exceeds the standard commitment of 3 years/2 summers.

Using the values indicated in **Table 15** the output from the offset calculations indicate that 96.02 % of the residual impact will be offset by the proposed revegetation.

In total, the proposed protection of retained vegetation and revegetation offsets will offset 264.4 % of the residual impact.

7.5 Environmental acceptability and outcomes

7.5.1 Precautionary principle and principles of ecologically sustainable development

In the application of the precautionary principle, there has been careful evaluation to avoid, where practicable, serious or irreversible damage to the environment by use of the existing environmental data during design which has also been supplemented with additional studies, in particular the independent TEC assessment undertaken by van Etten (2019). This has resulted in the future development being designed to ensure impacts are avoided and minimised based on the key environmental values of FCT 20c, namely the southern patch of the TEC being prioritised for conservation and rehabilitation/revegetation.

In relation to the principles of ecologically sustainable development, such as intergenerational equity, the proposed development has been designed to ensure there are no significant residual impacts on the health, diversity or productivity of the environment. Furthermore, implementation of the RVMP and the reservation and conservation of the FCT 20c TEC will ensure that the health, diversity and productivity of the environment will be enhanced for the benefit of future generations.

With regard to conservation of biological diversity and ecological integration, this has been a primary consideration of the development design. The technical studies for the TEC have been used to identify and confirm the extent and condition of the TEC within the site and as a result, the proposed action (including implementation of the RVMP) will not substantially reduce the extent of the TEC at local and regional scales.

In terms of improved valuation, pricing and incentive mechanisms, the environmental constraints and management costs have been considered in the development design of the proposed action.

7.5.2 Residual impacts, avoidance, mitigation and offsets

The residual impact of the proposed action is the loss of 0.2 ha of FCT 20c comprising two patches, which represents loss of 27 % over all patches of FCT 20c TEC over the site is considered to be small but significant at a local scale. While this loss is significant at the local scale, there will be minimal loss at a broader scale when considering the extent of the AOO remaining (i.e. representing a loss of 0.15 %).

The two patches proposed for clearing are unlikely to persist with or without management and mitigation measures, given that they are:

- of linear configuration with a high edge-to-area ratio and therefore highly susceptible to edge effects
- surrounded by degraded vegetation which does not serve as a protective buffer and will be cleared for development of the site

- isolated from a larger, intact remnant patch of FCT 20c which is in better condition and there is no connectivity.

The current extent of weed invasion is indicative that, without substantial intervention, the patches would transition to an open woodland/shrubland ecosystem which would differ significantly from the structural, compositional and structural characteristics of FCT 20c TEC, such that they would no longer be considered representative of the TEC. Considering that these patches are unlikely to persist with or without mitigation measures, their loss has been determined to be unavoidable regardless of whether the proposed action occurs or not. The independent TEC assessment (van Etten 2019) maintains that it would require significant expenditure of resources to adequately rehabilitate these two matches to the extent that it provides substantial conservation benefit for the TEC at a local and regional scale. Management measures will instead be focussed on the intact remnant of FCT 20c in the southern portion of the site which in better condition than the patches proposed to be cleared. Rehabilitation and revegetation of this southern patch is considered to have a greater chance of rehabilitation success (van Etten 2019) and represents an opportunity for the extent of FCT 20c TEC to be increased, providing a beneficial conservation outcome.

The proposed management, mitigation and offsets will have regard for the approved conservation advice, interim recovery plan and threat abatement plans, implementing a number of measures which are in alignment with the conservation objectives outlined within these documents. These include:

- removal of threats such as clearing, weeds, fire and grazing
- restoration of Farrall06 with a buffer, managing access, weed prevention and feral animal incursion
- increasing public awareness and community education in relation to the TEC
- increasing the number of occurrences managed for conservation over the next 10 years, as stated within the conservation advice
- maintaining or improving the condition of representative areas of the TEC over the next 10 years, as stated within the conservation advice.

The proposed development is also expected to contribute to a number of the 'criteria for success' outlined within the interim recovery plan (English and Blyth 2000), including:

- *An increase in the area, and number of occurrences, of this community under conservation management.*
- *Maintenance in terms of diversity and basic composition of native species (as described in Gibson et al. 1994 and DEP 1996) as well as hydrological and biological processes, taking account of natural change of the community over time.*
- *Improvement in terms of reduction of numbers of exotic species (as described in Gibson et al. 1994 and DEP 1996) and of other threatening processes as defined above.*

Whilst, future development of Lot 102 will lead to the unavoidable clearing of 0.2 ha of FCT 20c it also provides the following environmental opportunities and outcomes:

- the extent and resilience of the remaining patch of FCT 20c TEC being increased to 0.98 ha as a result of the proposed rehabilitation and revegetation management measures

- protection, conservation and ongoing management of the remaining southern patch of FCT 20c TEC into perpetuity through its future reservation, being ceded to the Crown free of cost and handed over to the CoS for future management over the POS area.

The measures proposed to be implemented as a result of future development will ultimately lead to the extent and viability of the remaining patch of TEC being increased and enhanced. This is in contrast to the current conditions over the site which would lead to the likely ongoing degradation of the southern patch of TEC over time and thereby demonstrating the proposal's environmental acceptability and net positive environmental outcome.

7.6 Social and economic costs and benefits

The proposed development is expected to provide economic and social benefits to the Western Australian community and economy.

The project area is zoned 'urban' under the MRS and 'residential development' under CoS LPS No. 17. The project area is captured within the approved LSP No. 42 in CoS, which allows for the creation of between 1200 – 1300 homes across the LSP area, providing a range of housing types for various demographics of future residents.

The existing local street network will be upgraded and new road networks will support the efficient movement of traffic, pedestrians and cyclists throughout and around the site. Extensive public open space networks proposed within the LSP provide for the establishment of a nature play network, as well as the retention of the Farrall Road Bush Forever Site, and enhancement of Blackadder and Woodbridge Creeks for conservation. These initiatives will benefit the local community within and surrounding the site.

Economic benefits shall be contributed through construction activities, which will result in residential employment and local contracting services.

8 Holistic impact assessment

The key environmental factors relevant to the proposal are:

- Flora and vegetation
- Fauna
- Inland waters.

These factors are addressed separately in **Sections 4.2** to **4.4** and **Table 40** provides a summary of the potential impacts, proposed mitigation and outcomes. The proponent acknowledges there are linkages between environmental factors and these linkages require consideration to meet the EPA's objectives. These linkages and the proposed mitigation for these factors are summarised below.

Flora and vegetation is linked to fauna given that vegetation is a key component of fauna habitat and the pollination and dispersal of flora and vegetation by fauna. These factors will be managed through:

- The retention of the highest quality fauna habitat within the site, which contains both wetland and dryland habitats, including four potential habitat trees for black cockatoo species.
- Further improvement of this habitat through revegetation, weed control, protection and ongoing management.
    - Revegetation will be conducted in accordance with the RVMP to be implemented as a condition of subdivision or development application.
- The management of the construction contractor to minimise the risk of weed invasion and plant disease, which can have secondary impacts on fauna. This will include soil handling and hygiene procedures. These mitigation measures will be outlined within a CEMP to be prepared as a condition or subdivision or development application.

Inland waters are linked to flora and vegetation and fauna by providing hydrological conditions which support flora, vegetation and fauna species. Likewise, flora and vegetation contribute to the water cycle through evapotranspiration and absorption and can influence. The interaction between these factors will be supported through:

- The retention of the wetland within southern POS supporting wetland dependent flora and vegetation and fauna habitat.
- Further improvement of the wetland vegetation and habitat through revegetation, weed control, protection and ongoing management.
    - Revegetation will be conducted in accordance with the RVMP to be implemented as a condition of subdivision or development application.
- Management of hydrological impacts, including water quality impacts from the proposal through the preparation of an UWMP as a condition of subdivision.

Table 40: Summary of potential impacts, proposed mitigation and outcomes for key environmental factors

Flora and Vegetation	
EPA Objective	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.
Policy and Guidance	*Environmental Factor Guideline: Flora and Vegetation* (EPA 2016b). *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016c)

Potential impacts	• Removal of native vegetation over the site, of which:
	  ○ 2.42 ha is in 'completely degraded' condition and was not recorded as part of a plant community. This area contains sparse native and planted exotic trees over a closed grassland of pasture weeds.
	  ○ 2.55 ha is in 'degraded' condition with 0.85 ha of this recorded as FCT 21c Priority 3 Priority Ecological Community (PEC) 'low lying *Banksia attenuata* woodlands or shrublands'
	  ○ 0.2 ha is in 'good' condition and representative of FCT 20c TEC 'shrublands and woodlands of eastern Swan Coastal Plain'.
	• Removal of 0.046 ha of the wetland dependent vegetation located in the southern portion of the site.
	• Removal of 8 out of 14 individuals of *Isopogon drummondii,* a Priority 3 flora species.
	• Indirect impacts:
	  ○ Fragmentation or isolation of populations and occurrences.
	  ○ Impacts on habitat that supports the flora and vegetation.
	  ○ Introduction and spread of weed/disease and fire impacts.
	  ○ Increased recreational use and rubbish dumping facilitated by residential development through improved access and increased population.

Mitigation	**Avoid** • The implementation of the proposal will avoid impact on the largest, most intact patch of FCT 20c TEC (0.54 ha) and the wetland area (situated within Bush Forever Site No. 209). These areas will be retained with undisturbed native vegetation within the southern POS area handed over to the City of Swan and managed for conservation in the long term. • The proposal has also avoided impact to 6 of the 14 individuals of *Isopogon drummondii,* a Priority 3 flora species.
	Minimise • The implementation of the proposal will minimise impacts to the TEC and wetland through the establishment of a vegetated buffer to development, which will be revegetated and appropriately landscaped. • Clearing and construction within the site will be appropriately managed to minimise impacts from weeds, disease, fire and rubbish dumping during construction. Construction management will be directed through the preparation and implementation of a Construction Environmental Management Plan (CEMP) prepared as either a condition of subdivision or development application.

	Rehabilitate
	• A Rehabilitation and Vegetation Management Plan (RVMP) will be implemented as a condition of subdivision (as required by the LSP). A copy of the RVMP is provided in **Appendix J**.
	• The RVMP establishes the following goals:
	  ○ Restore approximately 5,278 m^2 of FCT 20c vegetation in 'degraded' or 'completely degraded' condition[7], such that a vegetation condition rating of 'good' or better is achieved.
	  ○ Manage approximately 4,565 m^2 of FCT 20c vegetation in 'very good' or better condition to maintain its existing condition and restore any 'degraded' portions to 'good' or better condition.

[7] As defined by Keighery (1994) and banksia woodland TEC condition scale (TSSC 2016).

Table 40: Summary of potential impacts, proposed mitigation and outcomes for key environmental factors (continued).

Flora and Vegetation	
Mitigation (continued)	○ Manage approximately 17,036 m^2 FCT 11 vegetation associated with Bush Forever Site 309 to maintain its existing condition and restore any 'degraded' portions to 'good' or better condition. • The implementation of the RVMP will result in the re-establishment of 0.98 ha of native vegetation in 'good' or better condition, generally representative of FCT 20c TEC. • The implementation of the RVMP will improve the resilience of the native vegetation, reducing fragmentation and isolation of populations and reducing indirect impacts from weeds, disease and fire within the southern POS area. • The implementation of the RVMP will also improve fauna habitat within the southern POS area.
Residual impact and significance	The proposal will result in the loss of 0.2 ha of FCT 20c TEC in 'good' condition (occurring as two separate patches). According to the *WA Environmental Offsets Guidelines* (Government of WA 2014), the clearing of any TEC may be considered a significant residual impact that may require an offset. However, the FCT 20c TEC patches proposed to be cleared as part of this proposal are small (0.15 ha and 0.05 ha), already fragmented and surrounded by vegetation in 'degraded' condition. Without active, intensive and ongoing management these patches are unlikely to persist in the future as acknowledged by an independent assessment of the TEC over the site (van Etten 2019). It is therefore considered that given the questionable viability of these patches and the proposed rehabilitation that the proposal avoids a significant residual impact, consistent with the *WA Environmental Offsets Guidelines* (Government of WA 2014), whereby revegetation and rehabilitation are considered as part of mitigation and therefore additional offsite offsets are not required. The proposal will also avoid indirect impacts through the management of construction and development. Specific measures to minimise impacts to flora and vegetation will be incorporated into the UWMP, CEMP and RVMP.
Fauna	
EPA Objective	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.
Policy and Guidance	*Environmental Factor Guideline – Terrestrial Fauna* (EPA 2016a). *Technical Guidance – Sampling methods for terrestrial vertebrate fauna* (EPA 2016e). *Technical Guidance – Terrestrial fauna surveys* (EPA 2016d). *Technical Guidance – Sampling of short range endemic fauna* (EPA 2009). *EPBC Act Referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo, Baudin's cockatoo and Forest red-tailed black cockatoo.* (DSEWPaC 2012b).
Potential impacts	• Removal, fragmentation and modification of habitat through the clearing of land including: ○ Removal of 2.74 ha of vegetation providing habitat for black cockatoos and other fauna, including 0.2 ha of marri woodland comprising quality foraging habitat for Baudin's black cockatoo and Forest red-tailed black cockatoo. ○ Removal of 11 trees with a diameter at breast height $\geq$ 50 cm providing potential breeding and roosting habitat for black cockatoo species (Baudin's black cockatoo, Carnaby's black cockatoo and Forest red-tailed black cockatoo). • Mortality or displacement of individuals or populations through the clearing and disturbance of land. • Indirect impacts ○ Introduction or promotion of weeds, introduced fauna or pests and disease as part of residential development construction. ○ Disruption of the dispersal of individuals required to colonise new areas inhibiting maintenance of genetic diversity between populations.

Table 40: Summary of potential impacts, proposed mitigation and outcomes for key environmental factors (continued).

Fauna	
Mitigation	**Avoid** The implementation of the proposal avoids an impact on the highest value fauna habitat within the site, providing for the long-term retention of the wetland and the adjacent banksia woodland within the southern POS. The implementation of the proposal will also provide for the retention of four potential roosting and breeding trees for black cockatoo species.
	Minimise • Impacts to fauna during construction and development will be managed including fencing, vertebrate fauna trapping and clearing management protocols. Construction management will be directed through the preparation and implementation of a CEMP. • The implementation of the CEMP will also reduce impacts from weeds, introduced fauna or pests and disease during construction.
	Rehabilitate The RVMP will aim to minimise impacts to fauna habitat through the improvement of habitat and pest control if required.
Residual impact and significance	The proposal will result in the clearing of 2.74 ha of black cockatoo habitat and 11 potential roosting and breeding trees for black cockatoos. According to the *WA Environmental Offsets Guidelines* (Government of WA 2014) this residual impact is considered to be significant because habitat for a species listed under the *Biodiversity Conservation Act 2016* and *Environment Protection Biodiversity Conservation Act 1999* with a classification of endangered (IUCN criteria) will be impacted. However, it is considered that the proposal would not result in a significant residual impact to fauna and offsite offsets are not required. This is because of the 2.74 ha of black cockatoo habitat to be cleared only 0.2 ha of vegetation would be considered to be quality habitat (for Baudin's black cockatoo and Forest red-tailed black cockatoo). Furthermore, no evidence of roosting was recorded within the site and the potential habitat trees do not contain suitable hollows for breeding. Finally, there are large areas of quality foraging and roosting habitat within the local area including Talbot Nature Reserve and John Forrest National Park. In addition, The implementation of the proposal will also minimise indirect impact to fauna during the construction and development process through various management measures and site operations. These will be captured through the CEMP, UWMP and RVMP to be prepared prior to subdivision or development.
Inland Waters	
EPA Objective	To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.
Policy and Guidance	*Statement of Environmental Principles, Factors and Objectives* (EPA 2019b) *Environmental Factor Guideline Inland Waters* (EPA 2018a). *State Planning Policy 2.9: Water Resources* (WAPC 2006) *Better Urban Water Management* (WAPC 2008) *Decision Process for Stormwater Management in Western Australia* (DWER 2017) *Stormwater Management Manual for Western Australia* (DoW 2007).

Potential impacts	• Modification of a wetland ecosystem through removal of vegetation or landform modification.
	• Alteration of the hydrogeological regime that sustains the wetland ecosystem.
	• Indirect impacts
	  ○ Abstraction of groundwater that impacts other groundwater users.
	  ○ Impacts to water quality.

Table 40: Summary of potential impacts, proposed mitigation and outcomes for key environmental factors (continued).

Inland Waters	
Mitigation	**Avoid** The implementation of the proposal will avoid impacting the wetland through the retention of the potential CCW wetland feature within the southern POS area. The proposal also avoids hydrological impacts by locating the future road reserve and residential development outside of the upstream surface water and groundwater recharge catchment of the wetland.
	Minimise • Impacts to the potential CCW wetland will be minimised by maintaining existing contours and vegetation cover within the upstream surface water and groundwater recharge catchment of the wetland. • The current hydrological regime will be maintained through the implementation of an UWMP (prepared as a condition of subdivision, on advice of DBCA and approved by the City of Swan) and water sensitive urban design measures (WSUD) to maximise infiltration at source. • Impacts associated with development will also be minimised through the preparation and implementation of a CEMP which will detail management actions to address dust, erosion, sediment and stormwater runoff during construction. • Groundwater licences will be acquired in accordance with the *Rights in Water and Irrigation Act 1914* and all licence conditions will be satisfied in order to minimise impacts to other groundwater users.
	Rehabilitate The RVMP will include revegetation and maintenance works for the wetland and associated buffer to ensure that vegetation cover is maintained and infiltration continues to occur, which sustains the hydrogeological regime associated with the wetland
Residual impact and significance	There are not considered to be any direct impacts to the wetland as a result of the proposal however indirect impacts will be mitigated and managed through the construction and development process. Specific design measures and management will be incorporated into the UWMP, CEMP and RVMP to minimise impacts to the inland waters environmental factor. As such, there is not considered to be any significant residual impact.

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Figures

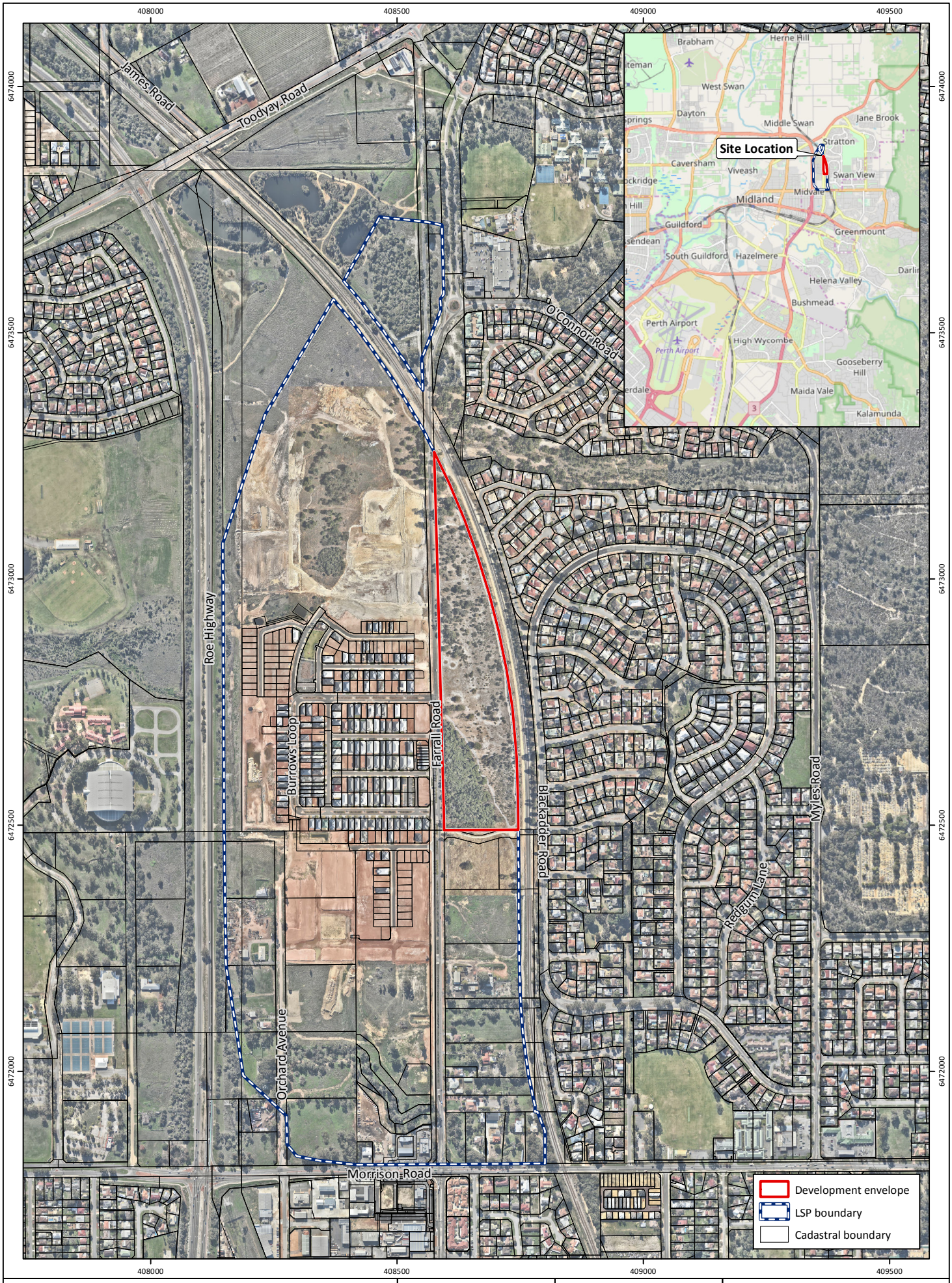

Figure 1: Site Location

Project: Supplementary Environmental Report
Lot 102 Farrall Road, Midvale

Client: Peet Stratton Pty Ltd

Plan Number: EP16-009(21)--F108a

Drawn:	KNM
Date:	11/10/2019
Checked:	CKK
Approved:	CKK
Date:	11/10/2019

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Metres

Scale: 1:10,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

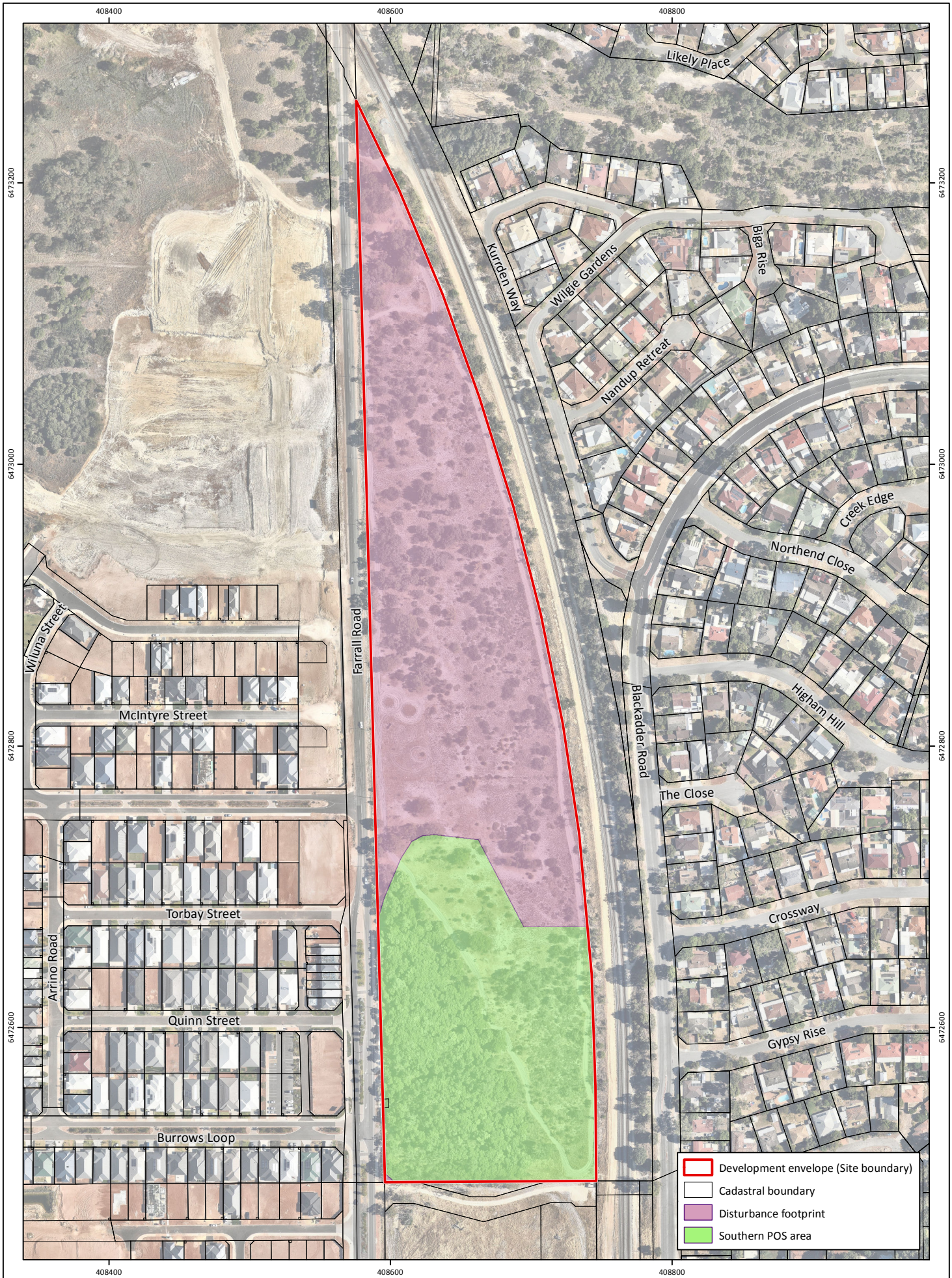

Figure 2: The Proposal

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Client:	Peet Stratton Pty Ltd

Plan Number:
EP16-009(21)--F134

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Date:	11/10/2019
Checked:	CKK
Approved:	CKK
Date:	11/10/2019

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Metres

Scale: 1:3,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

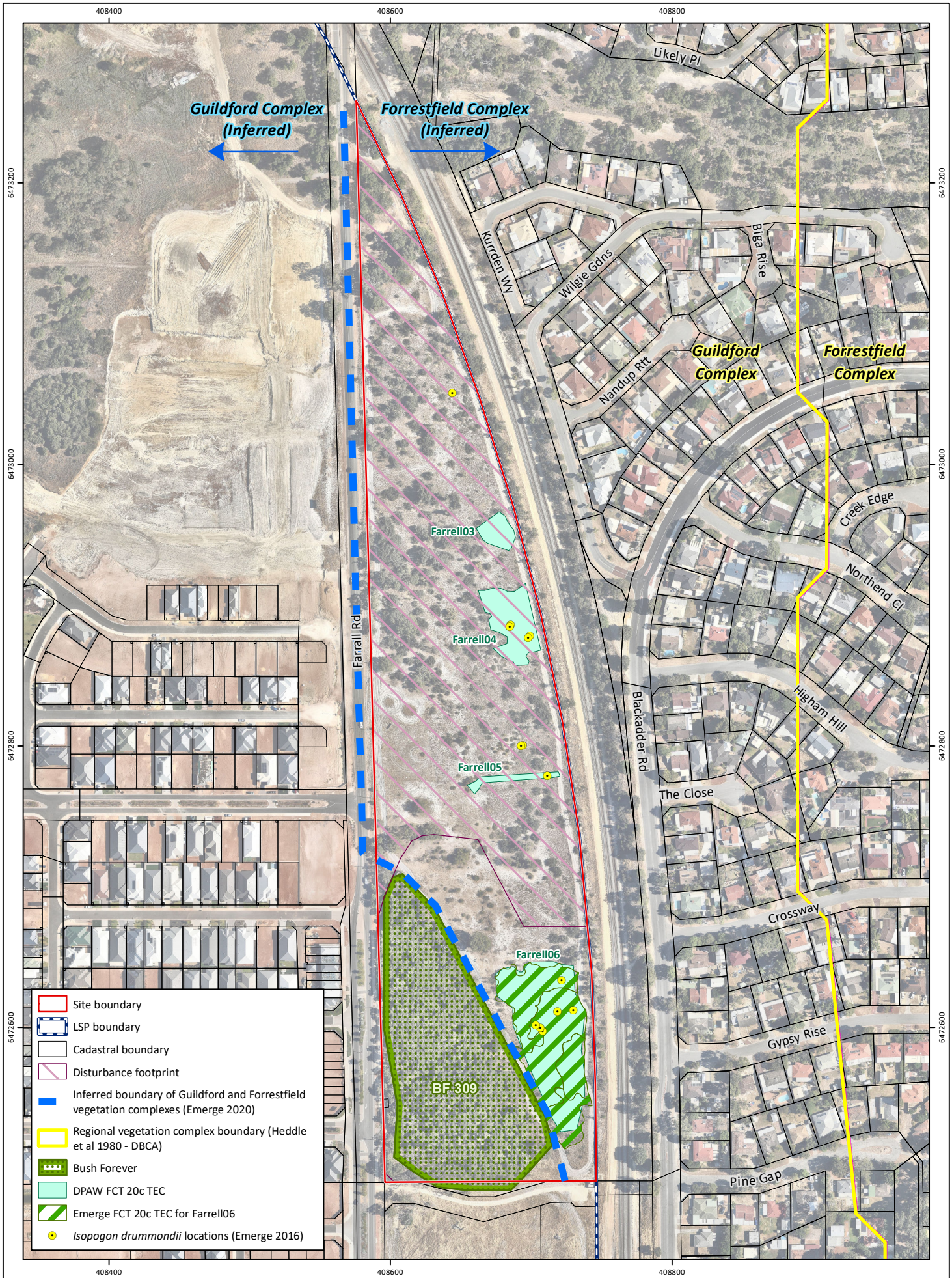

Figure 3: Significant Flora and Vegetation Values

Project:	Supplementary Environmental Report Lot 102 Farrall Road, Midvale
Client:	Peet Stratton Pty Ltd

Plan Number: EP16-009(21)--F110b

Drawn:	AFF
Date:	25/02/2020
Checked:	CKK
Approved:	TAA
Date:	26/02/2020

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Metres

Scale: 1:3,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

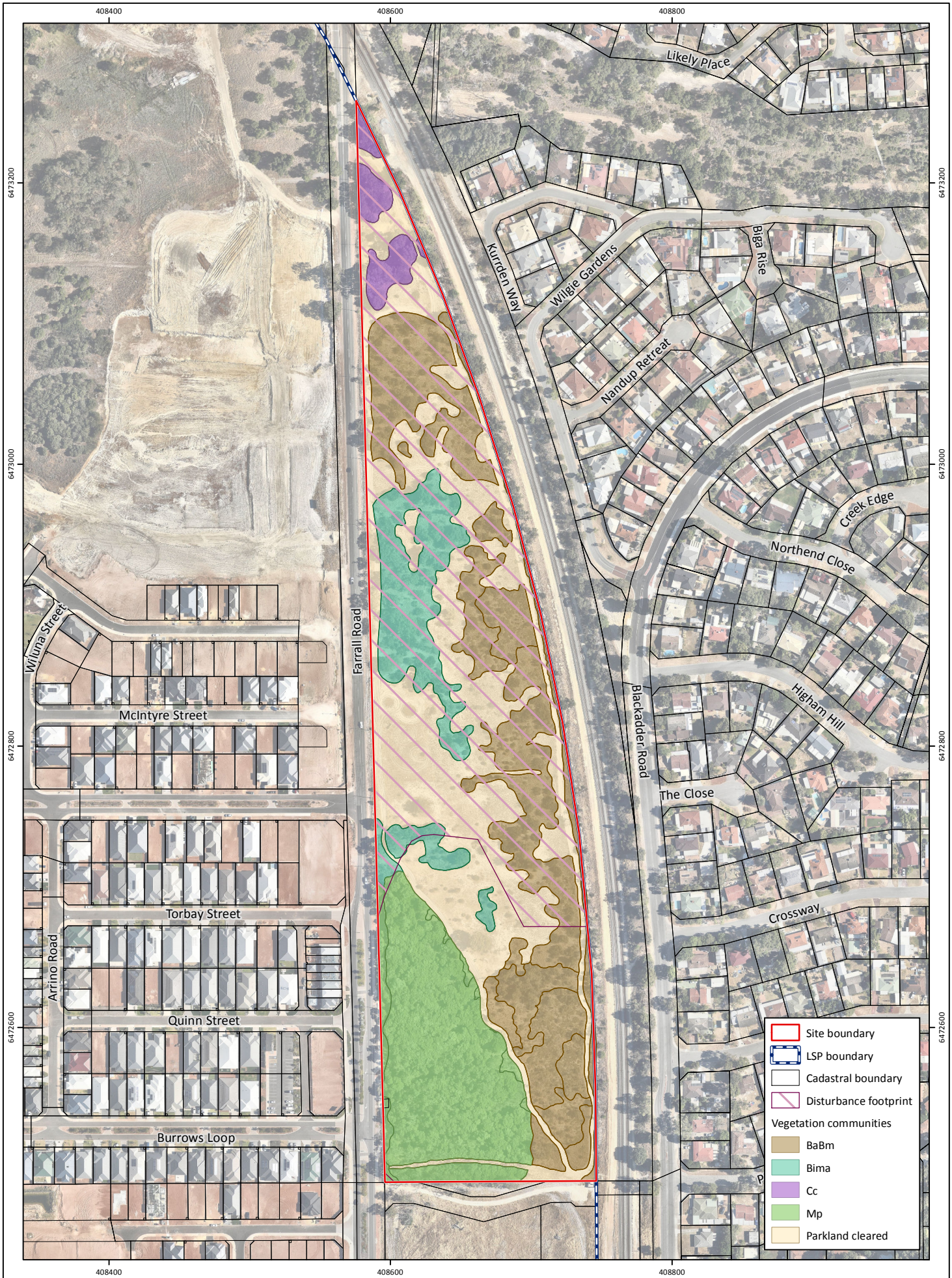

Figure 4: Plant Communities

Project:	Supplementary Environmental Report Lot 102 Farrall Road, Midvale
Client:	Peet Stratton Pty Ltd

Plan Number:
EP16-009(21)--F109a

Drawn:	KNM
Date:	21/10/2019
Checked:	CKK
Approved:	JDH
Date:	21/10/2019

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Metres

Scale: 1:3,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

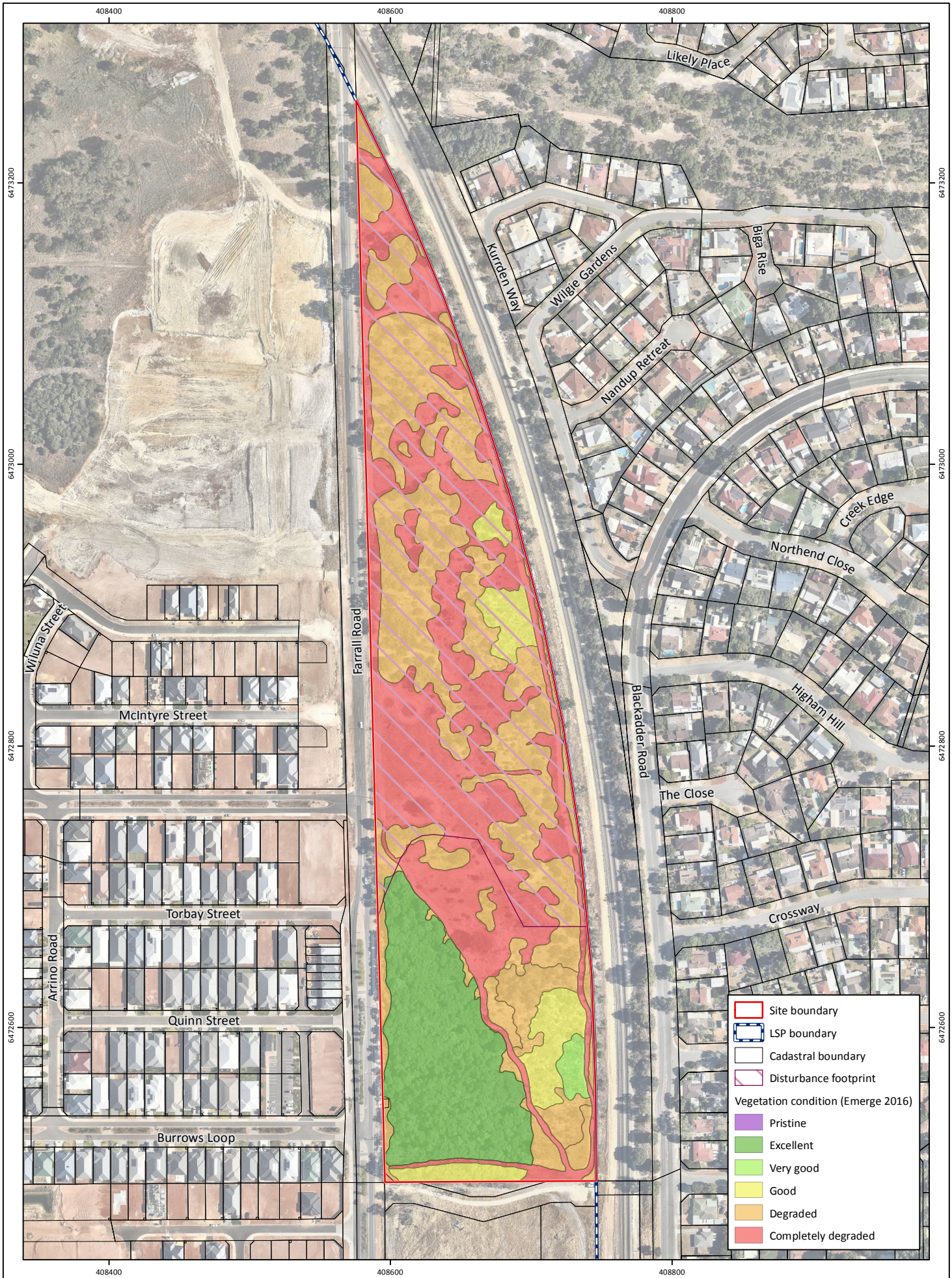

Figure 5: Vegetation Condition

Project:	Supplementary Environmental Report Lot 102 Farrall Road, Midvale
Client:	Peet Stratton Pty Ltd

Plan Number:
EP16-009(21)--F123a

Drawn:	KNM
Date:	21/10/2019
Checked:	CKK
Approved:	JDH
Date:	21/10/2019

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Metres

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GDA 1994 MGA Zone 50

emerge ASSOCIATES

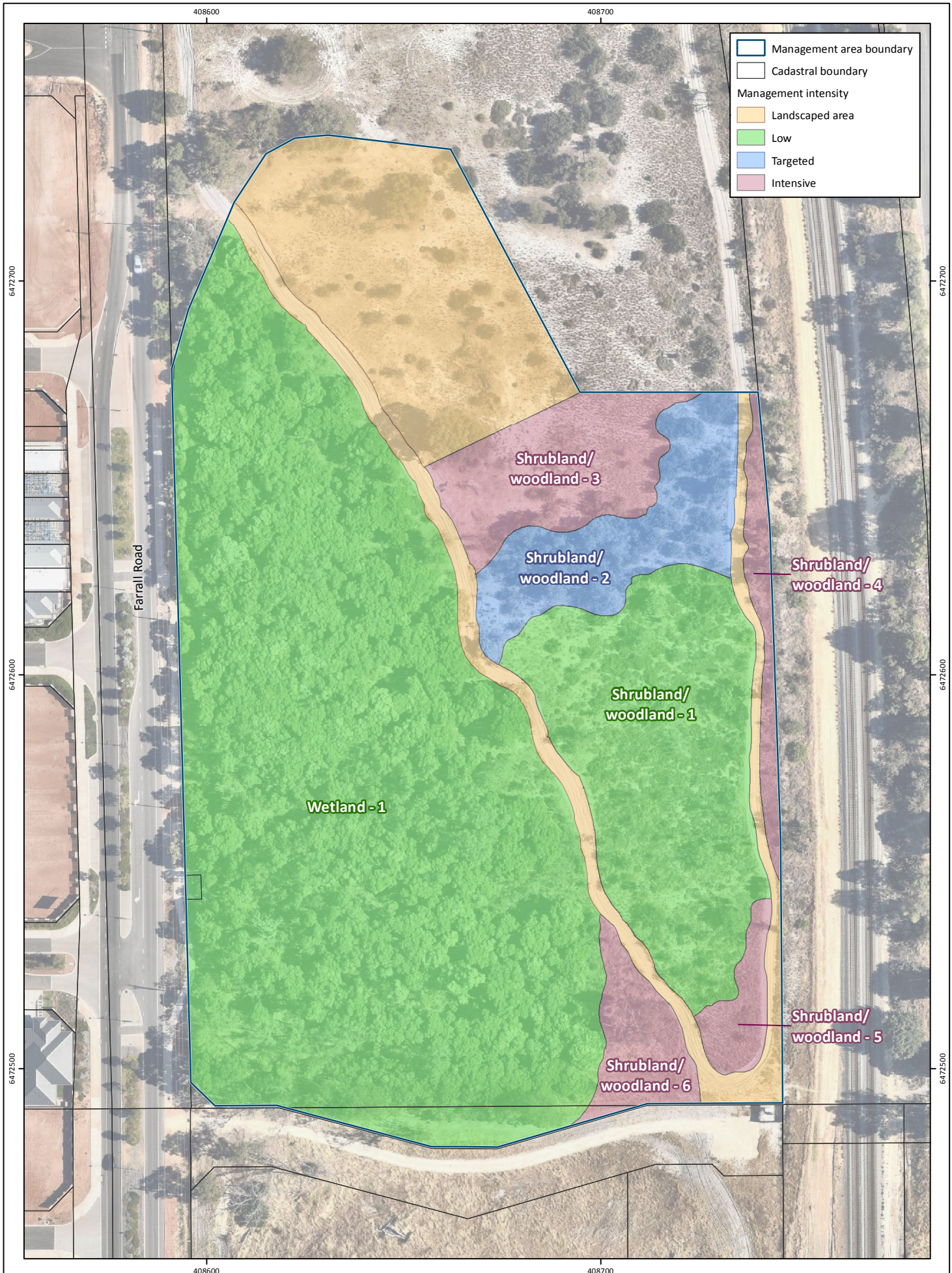

Figure 6: **Proposed Southern Public Open Space Management**

Project: Supplementary Environmental Report
Lot 102 Farrall Road, Midvale

Client: Peet Stratton Pty Ltd

Plan Number: EP16-009(21)--F122a

Drawn:	KNM
Date:	08/04/2019
Checked:	CKK
Approved:	JDH
Date:	08/04/2019

N

0 10 20 30
Metres

Scale: 1:1,250@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

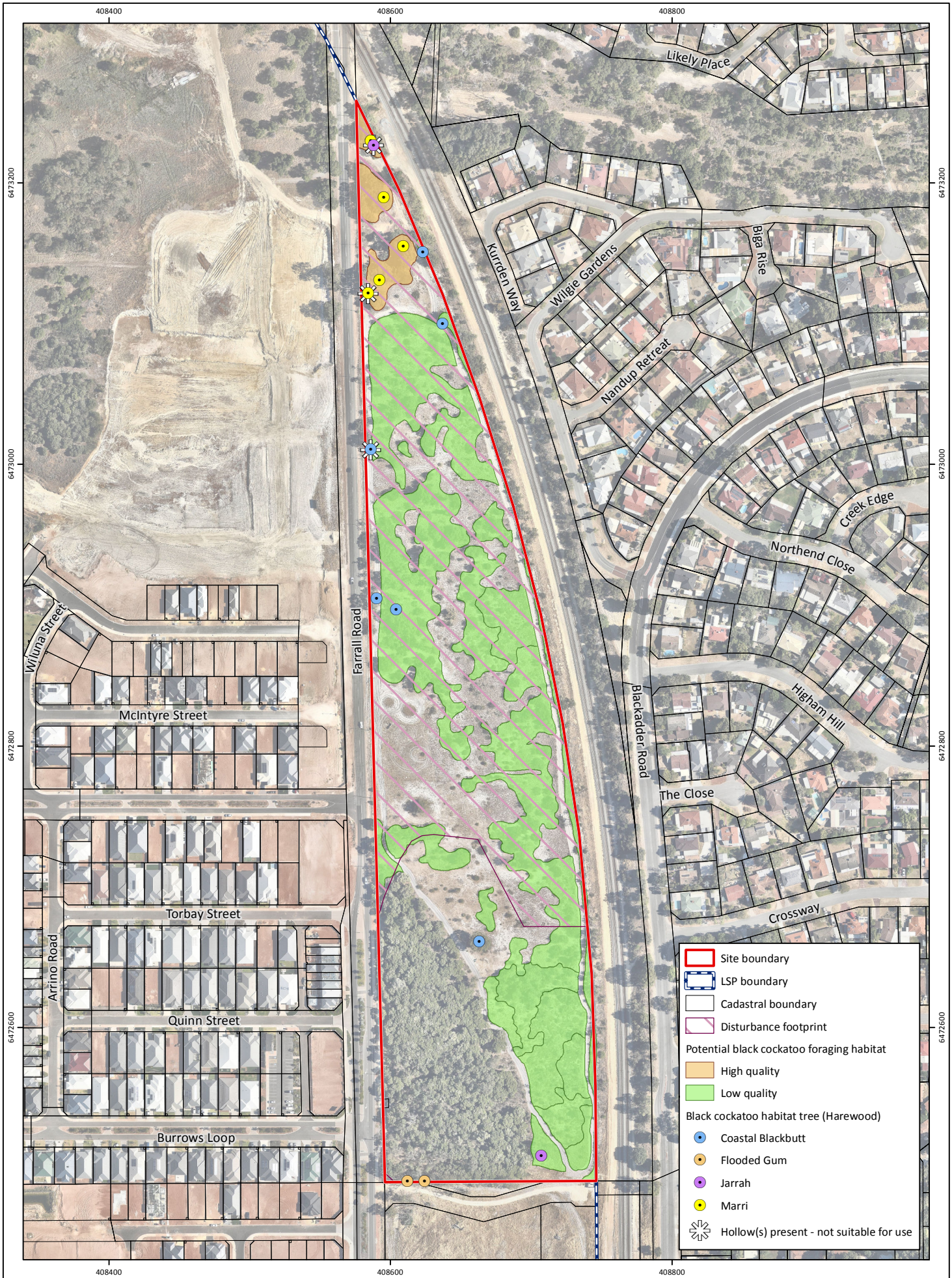

Figure 7: **Black Cockatoo Habitat Values**

Project: Supplementary Environmental Report
Lot 102 Farrall Road, Midvale

Client: Peet Stratton Pty Ltd

Plan Number: EP16-009(21)--F118b

Drawn:	KNM
Date:	21/10/2019
Checked:	CKK
Approved:	JDH
Date:	21/10/2019

N

0 40 80
Metres

Scale: 1:3,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

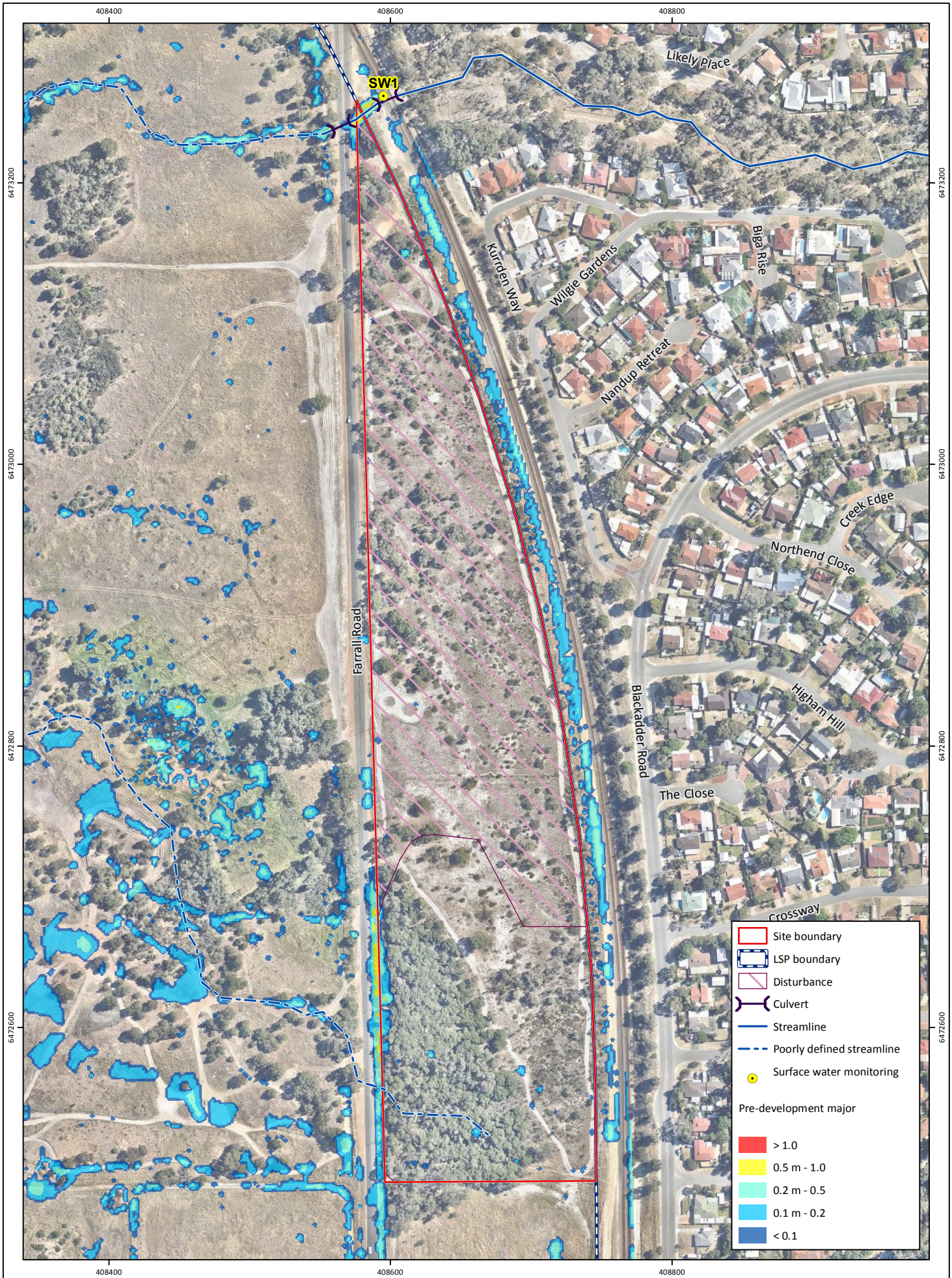

Figure 8: **Pre-development Surface Water**

Project: Supplementary Environmental Report
Lot 102 Farrall Road, Midvale

Client: Peet Stratton Pty Ltd

Plan Number: EP16-009(21)--F128a

Drawn:	KNM
Date:	21/10/2019
Checked:	CKK
Approved:	JDH
Date:	21/10/2019

N

0 40 80
Metres

Scale: 1:3,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

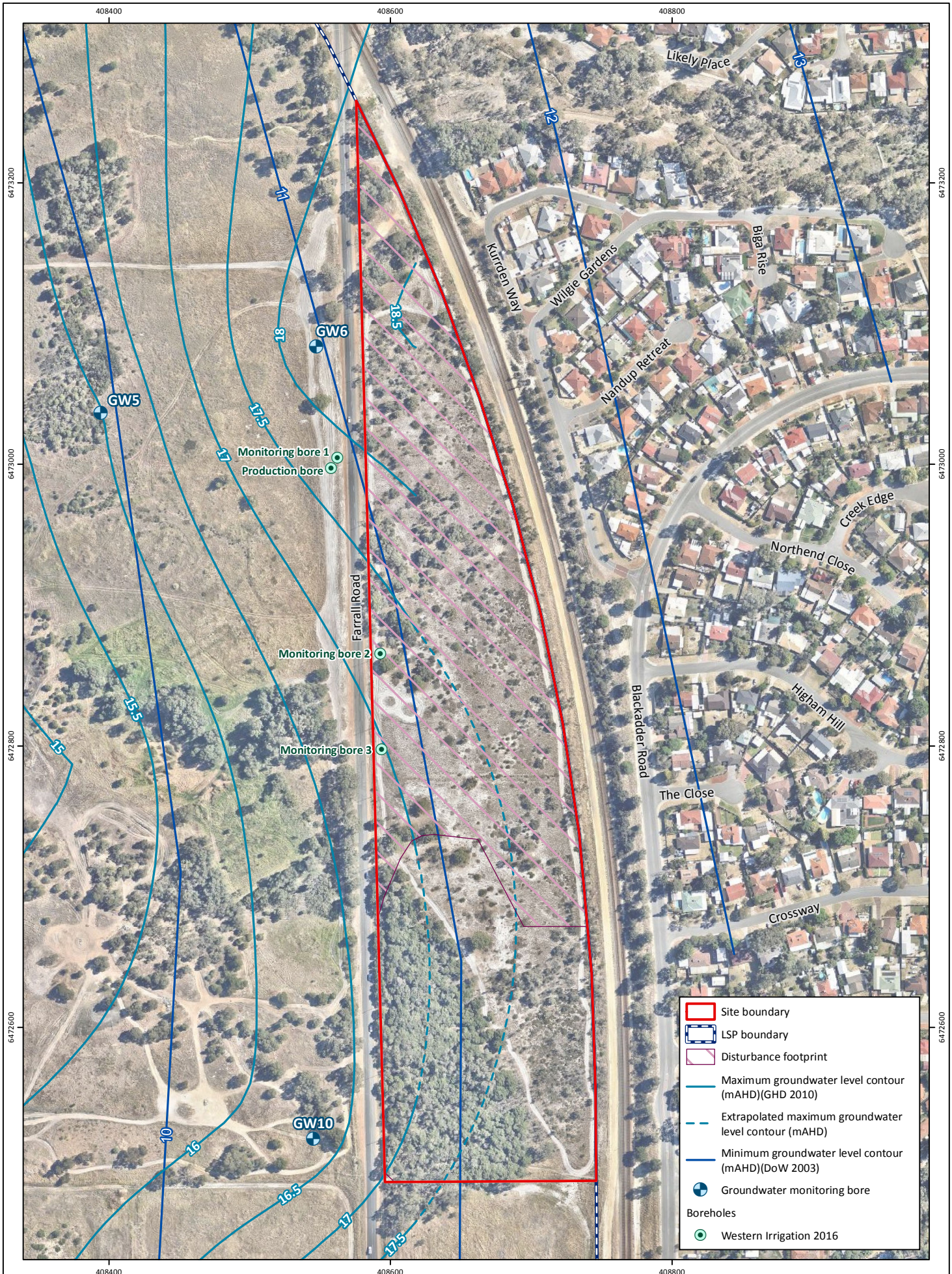

Figure 9: **Pre-development Groundwater**

Project: Supplementary Environmental Report
Lot 102 Farrall Road, Midvale

Client: Peet Stratton Pty Ltd

Plan Number: EP16-009(21)--F129a

Drawn:	KNM
Date:	21/10/2019
Checked:	CKK
Approved:	JDH
Date:	21/10/2019

N

0 40 80
Metres

Scale: 1:3,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

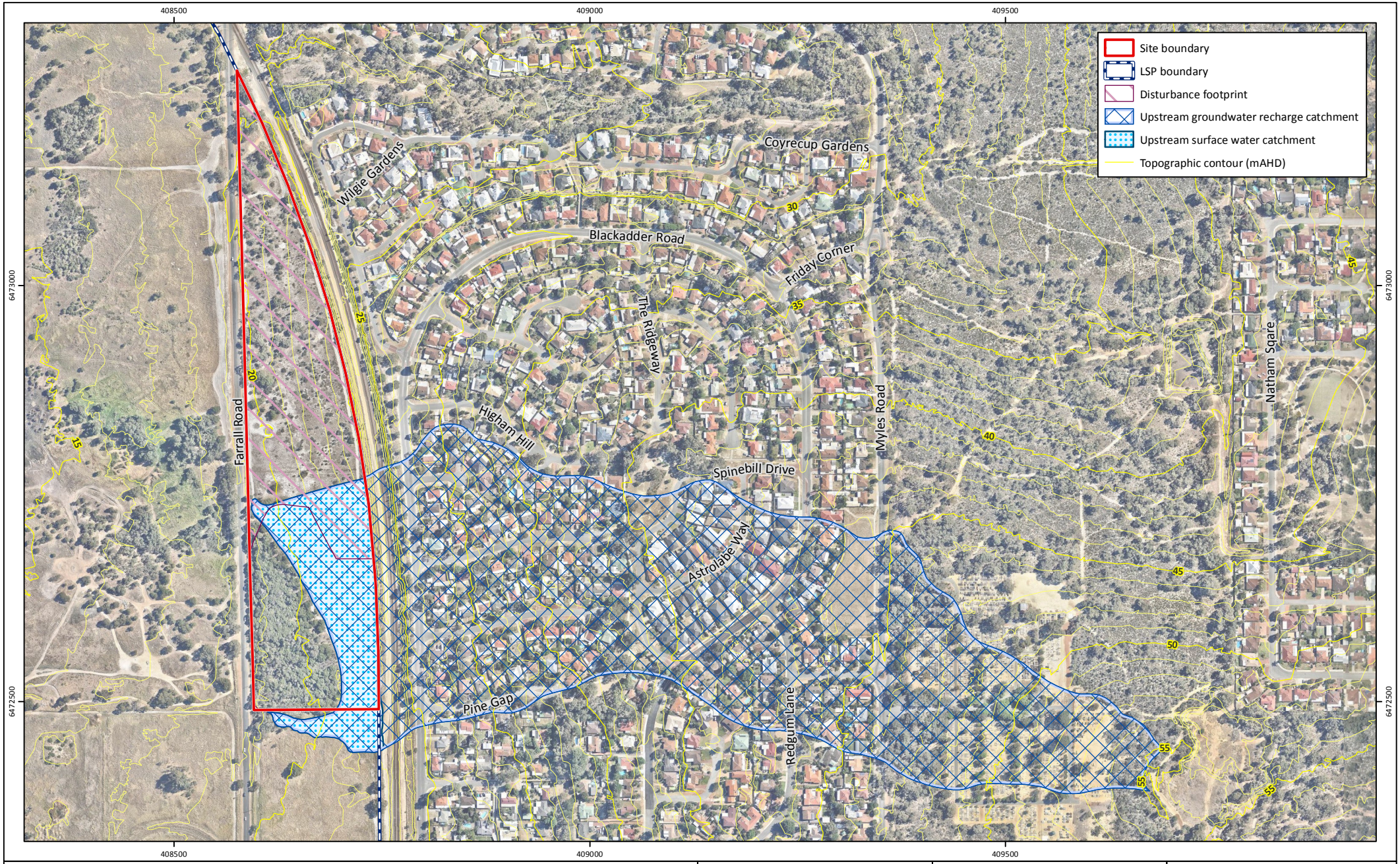

Figure 10: Wetland Upstream Hydrological CatchmentsWetland Upstream Hydrological Catchments

Project:	Supplementary Environmental Report Lot 102 Farrall Road, Midvale
Client:	Peet Stratton Pty Ltd

Plan Number:
EP16-009(21)--F137

Drawn:	KNM
Date:	21/10/2019
Checked:	CKK
Approved:	JDH
Date:	21/10/2019

N

0 100 200
Metres

Scale: 1:6,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES