



ENGINEERING AND SERVICING REPORT NORTH ELLENBROOK DISTRICT STRUCTURE PLAN September 2022

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1. EXECUTIVE SUMMARY

This report has been prepared by Cossill & Webley Pty Ltd (CW) for the North Ellenbrook District Structure Plan (NE DSP). It summarises the results of a review of the civil engineering aspects which have informed and support the delivery of the structure plan and are related to the future servicing of the developed land.

This report provides details on each major infrastructure type and a servicing strategy for the implementation required for the development of the DSP area.

The engineering review has covered siteworks, roadworks, stormwater drainage, sewerage, water supply and utility services.

The investigation has found the land is capable of supporting development in accordance with the proposed District Structure Plan with a logical progressive extension of infrastructure and base capacity.

The existing ground conditions and past land uses will not limit the proposed urban development.

Road access to the development will initially be via the existing Maralla Road to the south, which connects to Dunnett Drive to the south and Railway parade to the east. Ultimately an interchange could be constructed from Tonkin Highway on the western boundary of the DSP area to service the DSP area as well as future urban areas west of Tonkin Highway.

Sewer infrastructure will be provided via a gravity network internal to the DSP area and provision of a new Waste Water Pumping Station (WWPS). The ultimate outfall for the internal DSP area is still to be confirmed.

Water supply will be provided from the Ellenbrook reservoir via a connection to the existing water reticulation network.

Initial power supply can be provided by connection to the existing high voltage HV infrastructure in Maralla Road and Sawpit Road.

Telecommunications and gas are available from existing services in Maralla Road. We understand there is capacity in the existing network to service the proposed development.

The investigations and preparation of this report is largely based on preliminary advice from the various service authorities. The information is current as of November 2019 and is subject to change as development proceeds in the Perth north-east corridor resulting in the extension of service infrastructure and the creation of new capacity.

2. INTRODUCTION

This report has been prepared by Cossill & Webley Pty Ltd (CW) for the North Ellenbrook District Structure Plan (NE DSP). It summarises the results of a review of the civil engineering issues which have influenced the form of the structure plan and which are related to the future servicing of the developed land.

The preparation of the North Ellenbrook District Structure Plan (NE DSP) has been carried out by a team of consultants, led by CLE on behalf of Lend Lease and covers an area of approximately 499 hectares.

The North Ellenbrook DSP area is identified by the red boundary presented below in Figure 1

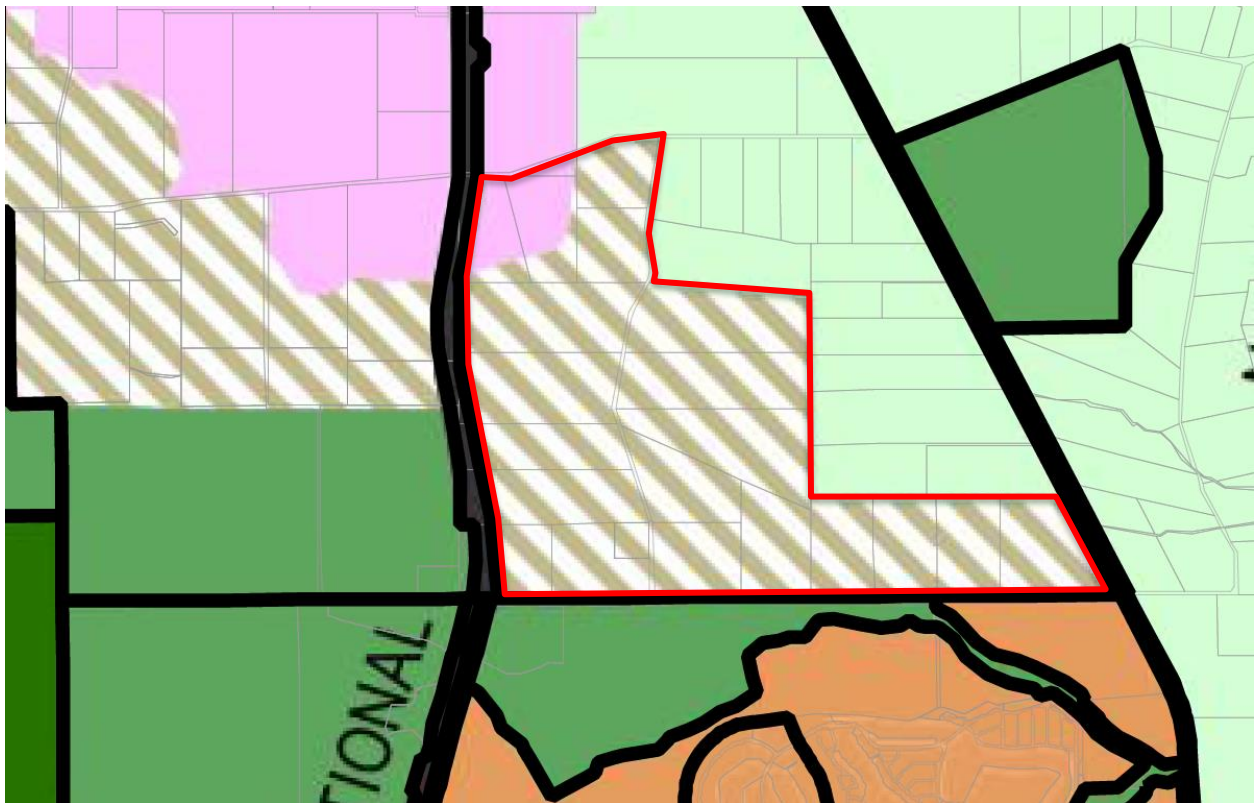


Figure 1 - Site Plan (WAPC Sub Regional Framework 2018)

3. SITE DESCRIPTION

The NE DSP is situated within the City of Swan, approximately 28 kilometres north-east of the Perth city centre. The Site is bound by Maralla Road to the south, existing rural properties to the east, and Warbrook Road to the north. The Perth-Darwin National Highway (Northlink Project) is currently under construction to the west of the NE DSP area. The majority of the Site (approximately 80%) has been cleared historically, with the remaining 20% of the Site covered with vegetation, which consists of a mixture of shrubs and low lying bushes as well as trees ranging from small to medium height. *Figure 2* below refers.

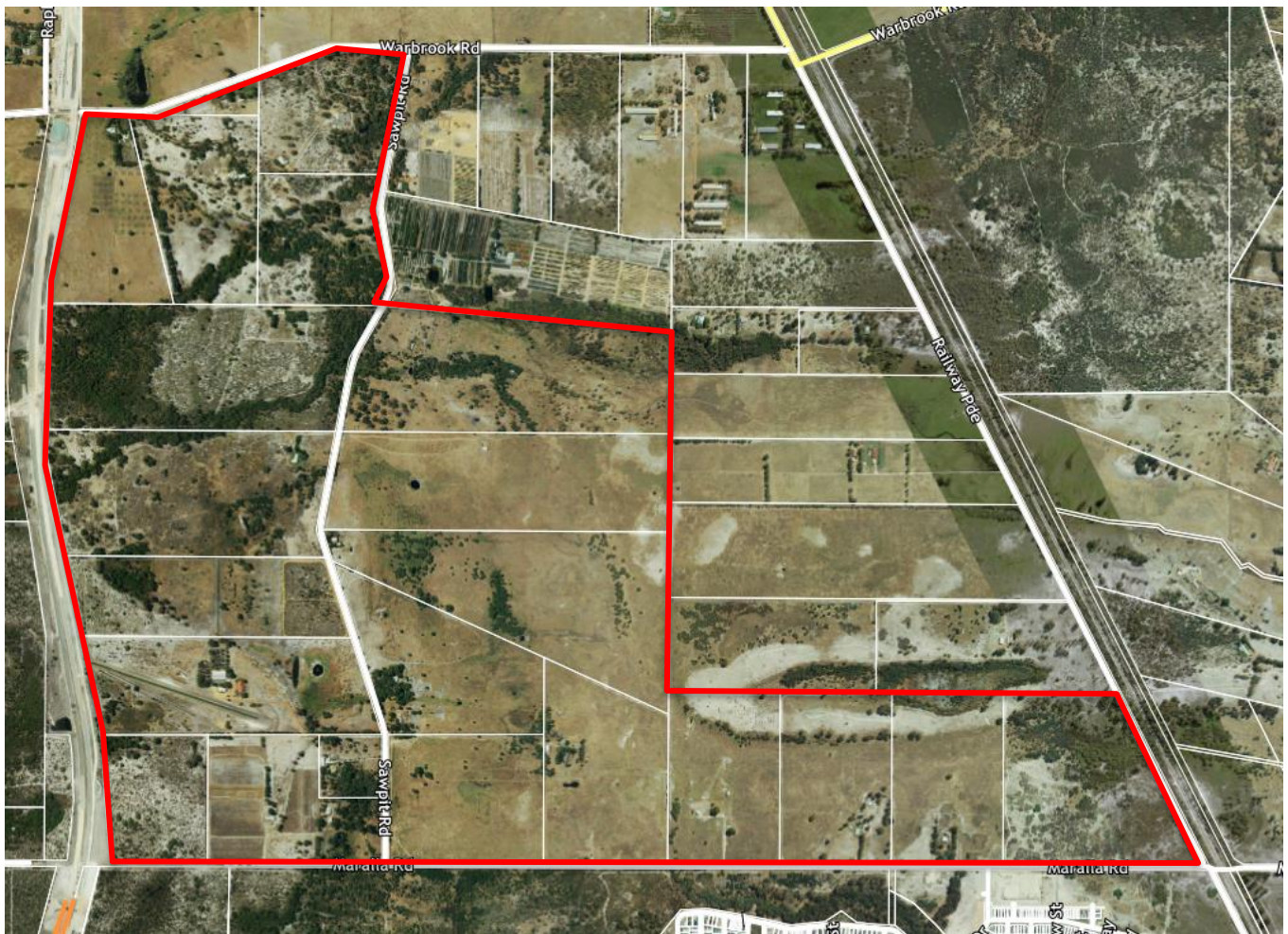


Figure 2 – Aerial Photography (Eagleview 2019)

3.2 Existing Topography

Based on aerial contour data obtained from the City of Swan, the Site generally grades from west to east, ranging in elevation from RL59m AHD in the south-western corner through to RL27m AHD in the south-eastern corner. Existing natural surface contours are presented in Figure 4 below:

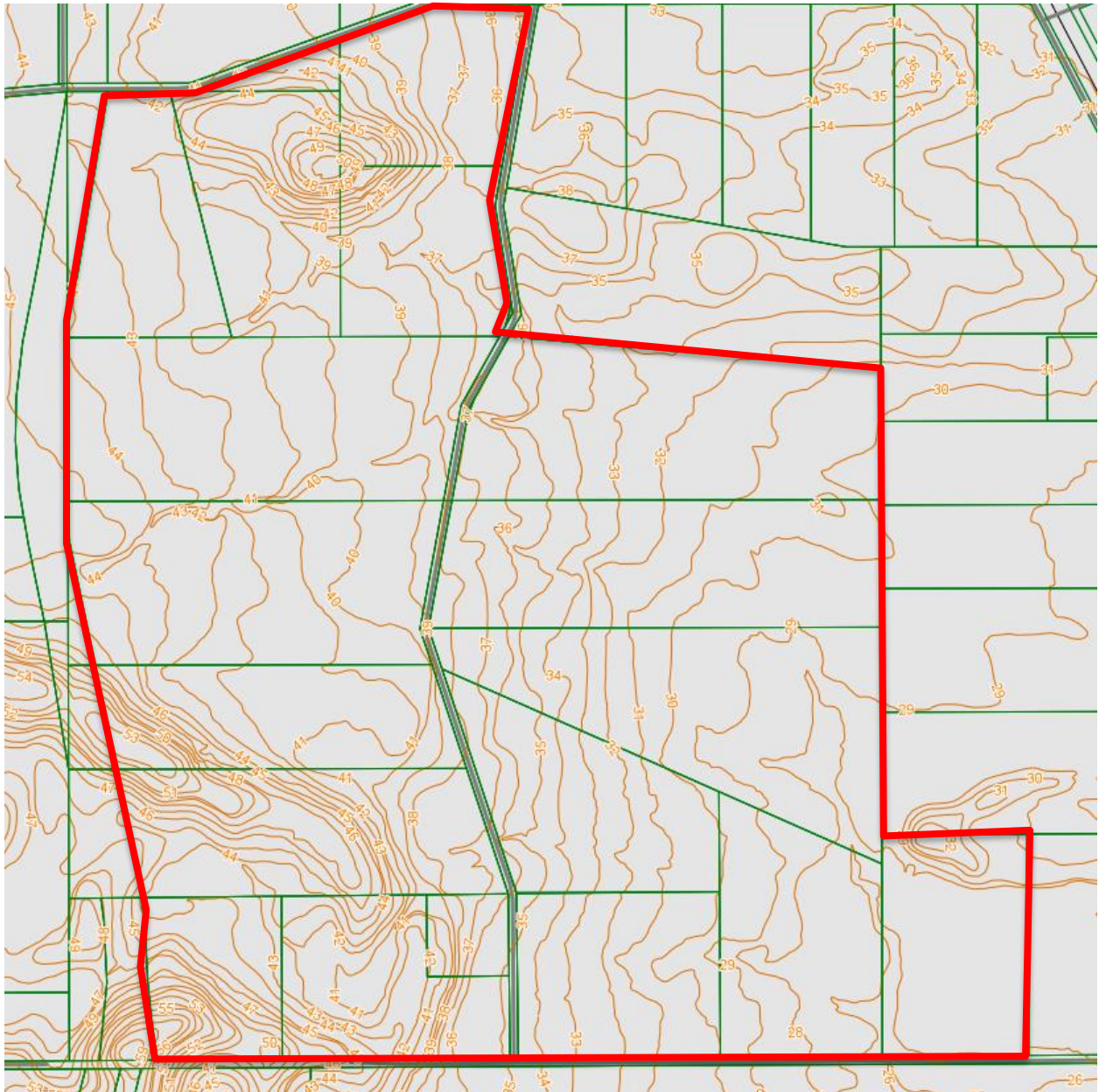


Figure 4 – Site Contours (City of Swan Intramaps, 2019)

Significant topographical features of the Site include three elevated ridges to the west located in the south-western corner, mid-way along the western boundary, and in the northern portion west of Sawpit Road. Sawpit Gully runs from west to east between the two northern-most ridge formations.

3.3 Geology and Landform

The Geological Survey of Western Australia Perth Metropolitan Region soils map for Muchea (part 2034 I & 2134 IV) indicates the majority of the Site is characterised by Bassendean Sand and Sand over Pebbly Silt (Guildford Formation). Figure 5 below refers.

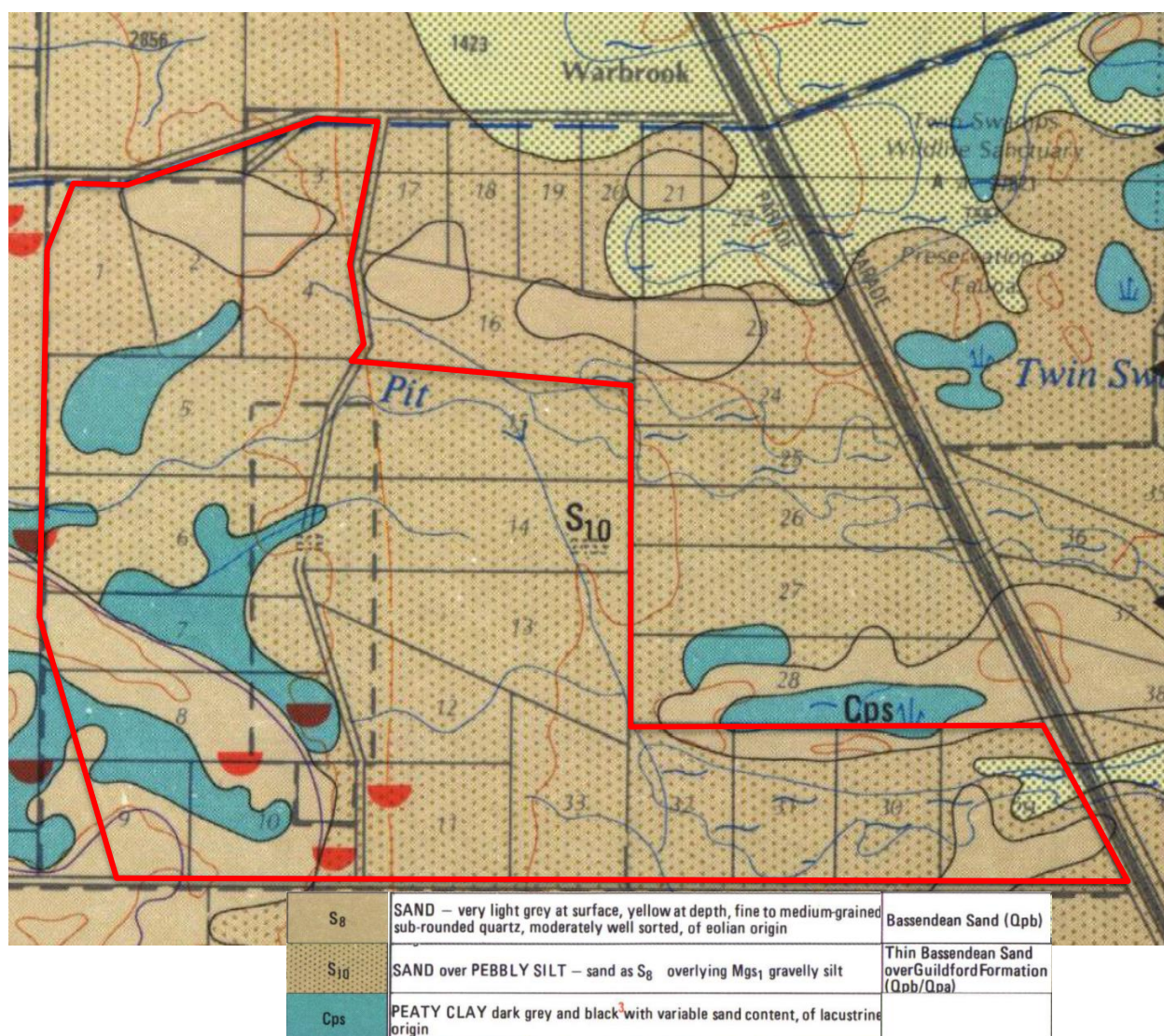


Figure 5 - Geotechnical Information (Geological Survey of WA)

Bassendean sand is free draining and suitable for development. Pebbly Silt is generally consistent with a water table close to the surface, and may require additional free draining sand and subsurface drainage for development.

Sections of Peaty Clay are indicated within the western portion of the Site, and may require removal or remediation prior to development.

Based on our experience on similar projects within the area, the Site is well suited for future urban development in terms of topography and soils and will provide a suitable foundation for roads, infrastructure and residential development.

3.4 Bush Forever

There is a Bush Forever site located within the proposed NE DSP area as identified in Figure 6 below.

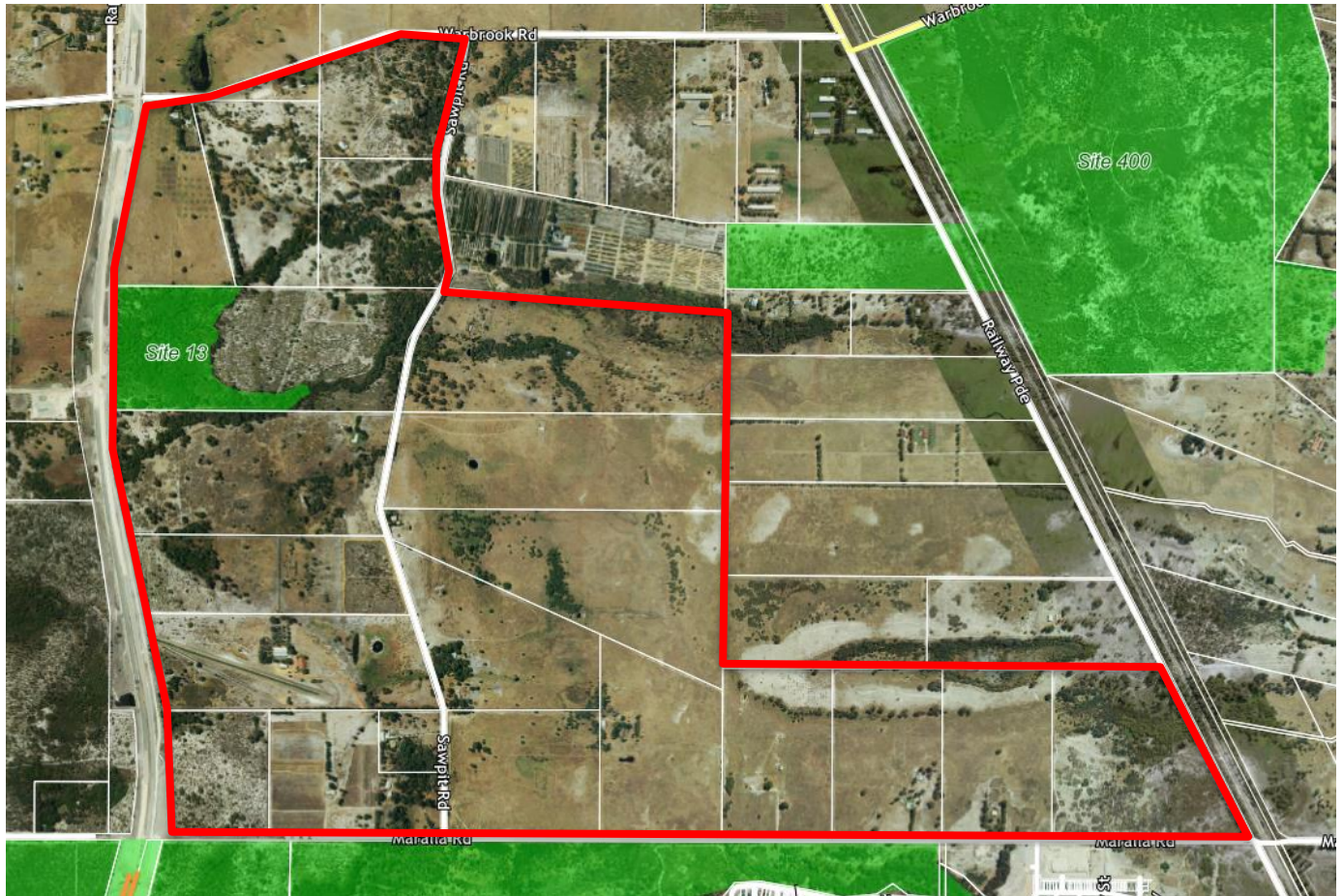


Figure 6: Bush Forever Areas (MNG Access, 2019)

There are also two Bush Forever sites located adjacent but external to the Site, one south of Maralla Road and north-east of the Site.

3.5 Bushfire Prone Areas

A large portion of the Site is mapped as “Bushfire Prone Area” as depicted below in Figure 7.

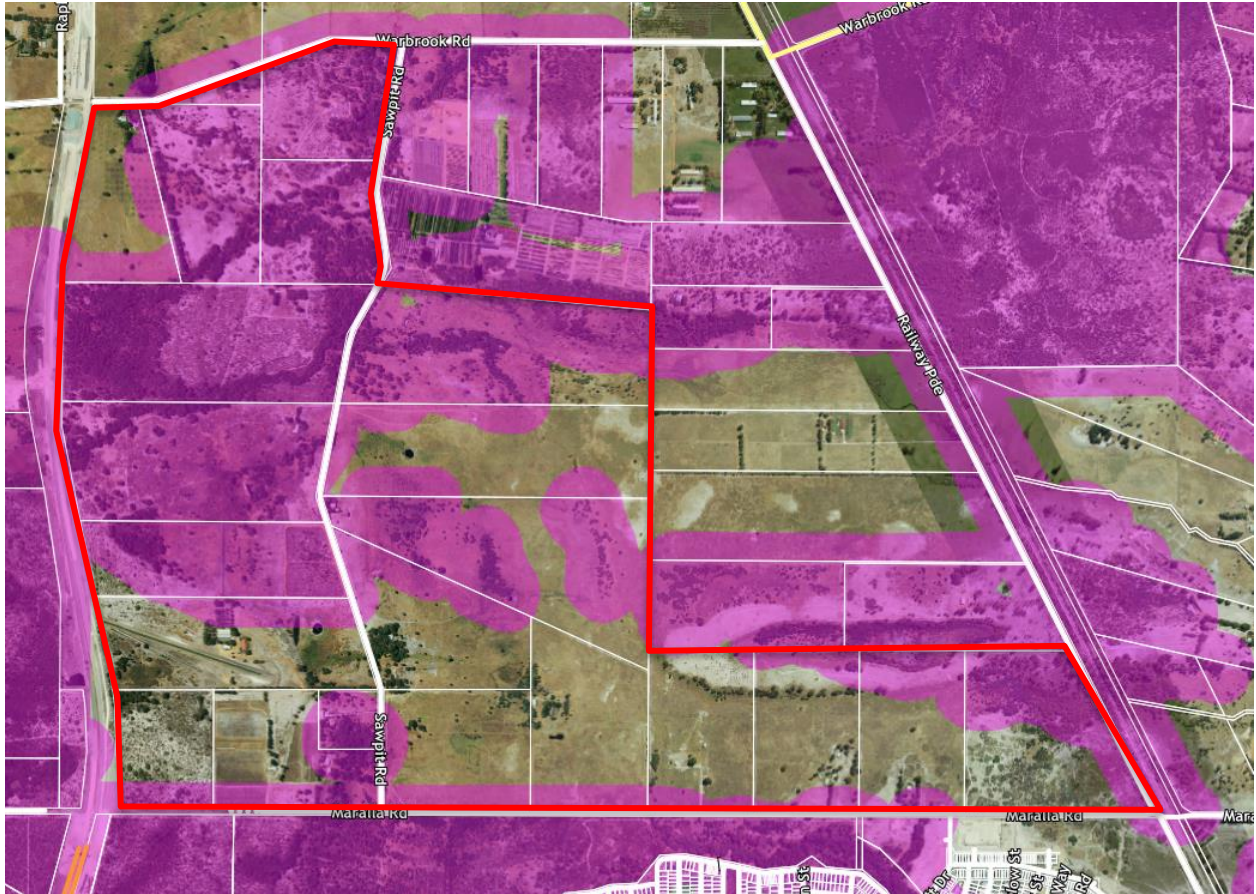


Figure 7: Bushfire Prone Areas (MNG Access, 2019)

It is possible through managed clearing and other such management that the Bushfire Prone Areas indicated on the mapping above could be reduced. The presence of Bush Forever, as well as the inability to clear adjoining properties will however provide an ongoing Bushfire Prone Area, and potential Bushfire Attack level (BAL) considerations for development.

3.6 Wetlands

A large portion of the site is classified as Multiple Use wetlands as depicted below in Figure 8.

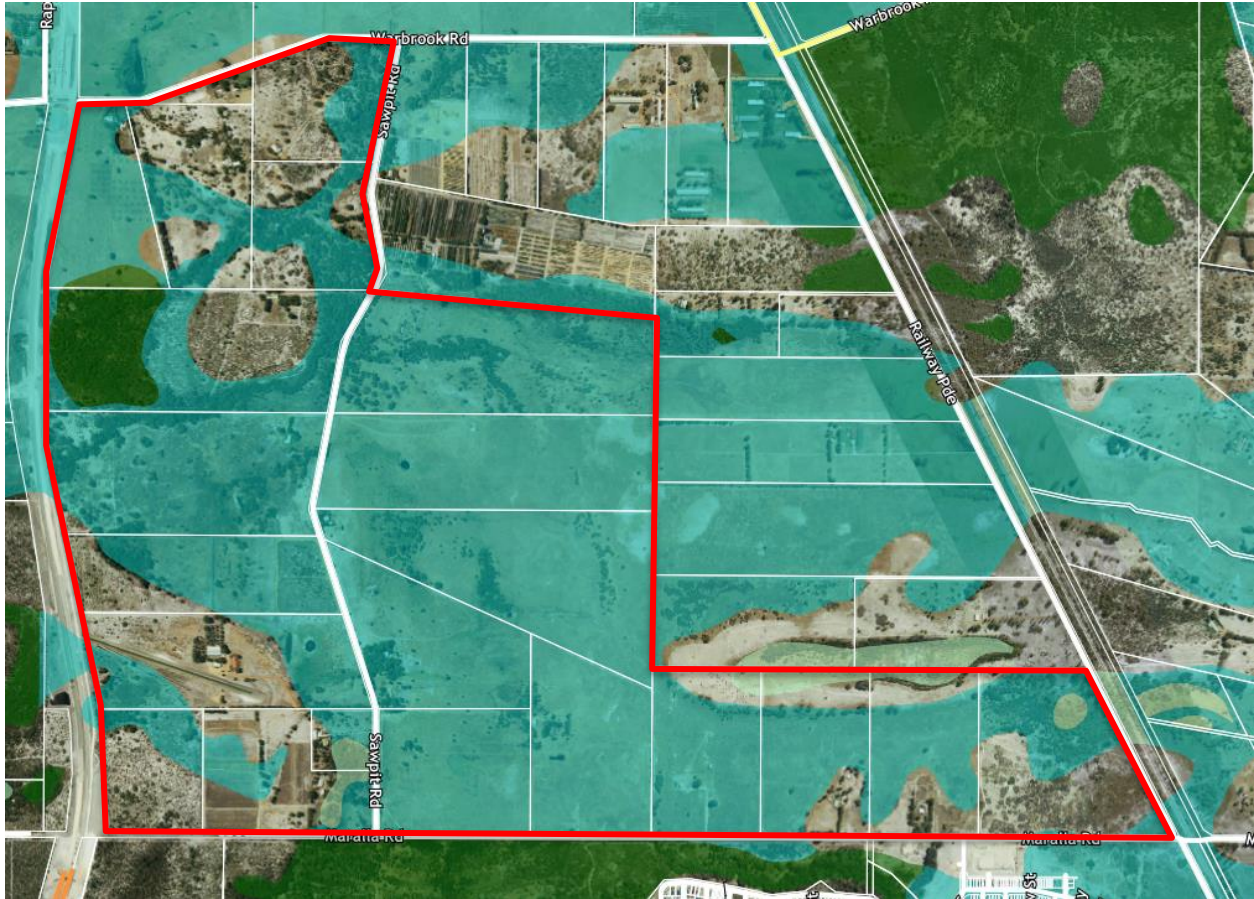


Figure 8: Geomorphic Wetland Mapping (DoW, 2019)

A Conservation Category Wetland (CCW) is present within Bush Forever located on the mid-point of the western boundary of the DSP area. There is also a Resource Enhancement Wetland located north-west of the intersection of Sawpit and Maralla Roads, as well along the northern boundary of the eastern part of the DSP area. The presence of these wetlands, and their associated buffers will be considered as part of any potential development within the DSP area.

3.7 Groundwater

The Department of Water's (DoW) Maximum groundwater levels contained in their Groundwater Atlas for Perth only extend to the western extremities of the Site, as depicted in magenta in Figure 9 below. Where maximum groundwater contours do not exist, the DoW typically adopts a maximum level of 2m above the minimum groundwater levels, which are shown in purple in Figure 9.

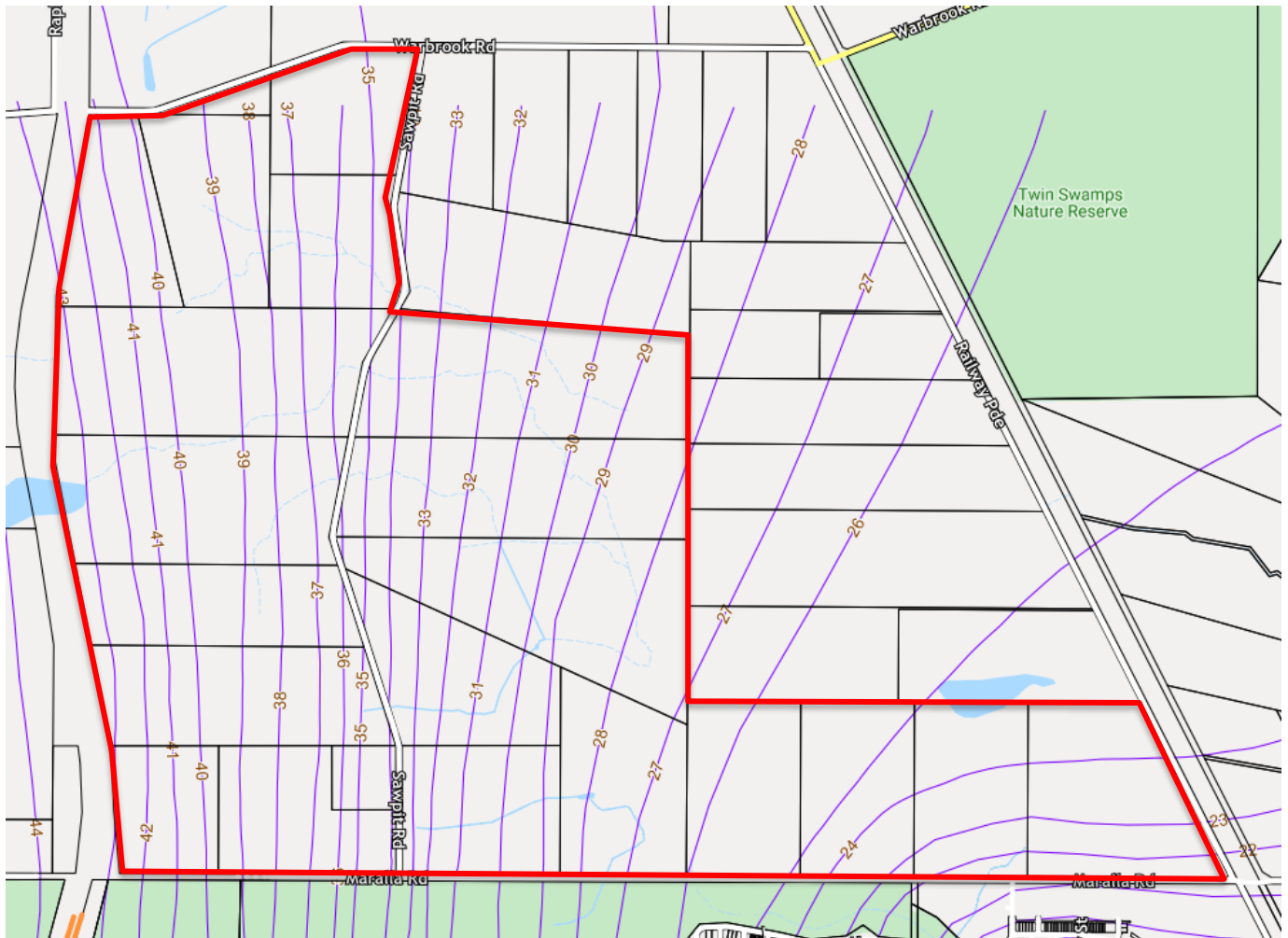


Figure 9: Average Minimum Groundwater Contours (DoW, 2019)

Based on the maximum levels available, and extrapolation from the minimum levels, maximum groundwater levels vary across the Site from approximately RL45m AHD at the western boundary to RL22m AHD at the south eastern corner of the Site.

These regional groundwater contour levels suggest that there are areas of the site where a separation of less than 2 metres exists between existing natural surface and maximum groundwater levels, which may be insufficient for the effective disposal of stormwater drainage through soakwells or drainage swales.

Separation to prevailing groundwater for urban development can be managed in a number of ways, including the incorporation of subsoil drainage and/or the importation of clean fill.

4. SITEWORKS & EARTHWORKS

4.1 Typical Earthwork Strategy

Siteworks for urban development typically comprise the clearing of existing vegetation and, where necessary, the earthworking of existing ground to facilitate future development.

In Perth it is often the case that the extent of siteworks is dictated by the density and nature of development and by the finished ground shape required for building houses. Increased densities and decreasing lot sizes has led to a current trend for the development areas to be fully earthworked to create level lots which are terraced utilising inter-allotment retaining walls.

This approach provides a number of positive outcomes:

- It reduces house building costs.
- It rationalises retaining wall layouts and designs consistent with Local Authority specifications.
- It enables lots to be terraced up natural slopes to maintain elevation and views.

Finished lot levels for the development will likely be dictated or controlled by the following design considerations/factors:

- Desired Geotechnical Site Classification
- Thickness of sand layer over clays/silt/peat (where applicable)
- Separation from groundwater table
- Sewer control levels
- Hydraulic grade line of drainage system
- Existing neighbouring road or lot levels
- Retention of existing vegetation.
- Planning layout

It is likely that a combination of the above constraints will control design levels, and different area of the Site will likely be influenced by different factors.

A preliminary earthworks strategy will be prepared for the Site which will provide an indication of the conceptual design levels required to support any future development. Based on the information available to date, it is anticipated that where sand material is available in higher levels of the Site, this could be utilised to fill lower levels of the Site in order to ensure lower lying levels address the above design criteria. Based on a review of the topographical and hydrological data available, it is anticipated that importation of clean sand fill material may be required for the Site.

It is preferable to minimise the importation of clean fill sand to the Site, not only to reduce costs (imported fill can typically equate to around 30% of development costs), but also to ensure the most appropriate use of basic raw materials. Considerations that will be investigated to minimise the need to import clean fill sand include the following:

- Reviewing the potential of providing a subsoil network below the prevailing groundwater level – by establishing a subsoil network below the AAMGL and creating a controlled groundwater level, this has the net effect of reducing the volume of imported material brought to a development to maintain clearance from groundwater, and also has the potential of assisting with irrigation.;

- Adopting a planning layout which is sympathetic to existing natural contours (including waterways), to ensure that stormwater drainage design is optimised such that required development levels do not require excessive filling over the existing topography.
- Optimising the location of any critical sewer infrastructure (such as Waste Water Pumping Stations), to ensure that sewer controls minimise the need to fill areas of the development.

The above controls will be reviewed in detail as part of the design process to ensure that the volume of imported fill necessary for development is minimised.

5. DRAINAGE STRATEGY

5.1 Integrated Urban Water Management

The North Ellenbrook District Water Management Strategy (DWMS) is being prepared by RPS as a separate document. This provides a basis for ongoing development to ensure that appropriate allowances are made for total water management including the minimisation of scheme water use and the maximisation of recharge of stormwater runoff.

Stormwater drainage management is proposed by adopting a Water Sensitive Urban Design (WSUD) approach. Objectives of WSUD include:

- Detention of stormwater rather than rapid conveyance;
- Use of stormwater to conserve potable water;
- Use of vegetation for filtering purposes; and
- Water efficient landscaping.

For the NE DSP, the main WSUD practices which should be incorporated into the ongoing implementation of the site as follows:

1.5.1 Stormwater Management

Stormwater recharge of the shallow aquifer should be maximised through the adoption of 'Best Management Practices', which promote the dispersion and infiltration of runoff. These include the use of porous paving for roads and car parks, the diversion of runoff into road medians and road-side swales, drainage soakwells to infiltrate runoff from buildings and private open space areas and the disposal of road runoff into infiltration basins within areas of public open space POS.

1.5.2 Water Quality Management

The maximisation of the quality of recharge water through the adoption of "Best Management Practices", which promote the disposal of runoff via water pollution control facilities (including vegetated swales and basins, detention storage and gross pollutant traps) and the implementation of non-structural source controls (including urban design, street sweeping, community education, low fertiliser landscaping regimes, etc.).



5.2 Stormwater Collection and Management

It is anticipated that runoff within future residential allotments will be contained on-site. Stormwater disposal will be via soakwells or other infiltration facilities which form part of the building and private open space development.

Drainage from public roads and lanes can be managed in a number of ways depending on the nature of the adjacent land uses, the extent of traffic and pedestrians and the objectives for drainage management.

Infiltration could also be via swales within or adjacent to road reserves, via gully pits with permeable bases, slotted drainage pipes, porous road pavements or under road storages subject to the City of Swan approval.

Runoff from storms up to 1 in 5 years ARI would be conveyed via an underground pipe system to low point infiltration basins consistent with the requirements of the City of Swan.

Roads and POS will be designed to cater for the surface overflow for more severe storms with building pads constructed at least 300 millimetres above the 1 in 100 year ARI flood or storage level at any location.

The dispersion of stormwater disposal will maximise the area of recharge down through the soil profile to the shallow aquifer, thereby, maximising the potential for nutrient stripping and water quality improvements.

6. ROADWORKS & FOOTPATHS

6.1 Traffic and Transportation

An assessment of the traffic and transport planning for the NE DSP has been undertaken by GHD.

The results of this assessment include a recommended hierarchy for the roads within the NE DSP and the future subdivision development together with recommendations for public transport services, pedestrian and cyclist facilities.

In all cases the engineering review has taken account of the recommendations outlined in the GHD report and they will be incorporated into future detailed subdivision planning and design.

6.2 Regional Roads

The Perth-Darwin National Highway Road (Northlink WA) is the most significant regional road adjacent to the NE DSP area, and forms the western boundary of the DSP area. Northlink WA is currently under construction for the section adjacent to the Site, and is anticipated to be completed and operational prior to the commencement of any development within the DSP area. The current scope of design and construction of Northlink WA, does not include any interchange from Northlink to connect to the proposed development.

As part of an investigation completed by GHD on behalf of the proponent, a proposed new interchange is included in the DSP to provide a direct connection to the Site from Northlink. Following initial enquiry with Main Roads WA (MRWA), GHD completed a review of potential new intersection locations onto Northlink which took into consideration the advice received from MRWA, as well as collaboration with the proponents of the development of the land to the west of Northlink, to determine the proposed location of the interchange as indicated in the NE DSP. The separate report prepared by GHD and included in the DSP document provides further detail in this regard.

Access to the Site is currently via Maralla Road along the southern boundary, and Sawpit Gully which traverses the Site from south to north. Both of these existing roads are proposed to be retained on their current alignment in the NE DSP, however the development of the Site will increase traffic flows, and hence these existing roads will be required to be upgraded from their current rural standard. The traffic report prepared by GHD proposes an upgrade of Maralla Road and Sawpit Roads to a Neighbourhood Connector standard in accordance with Liveable Neighbourhoods requirements.

6.3 Development Roads

The NE DSP comprises a network of development roads including Neighbourhood Connectors running north to south and west to east, and local access roads and laneways. The NE DSP proposes an urban design hierarchy for the development roads, which is an expansion of the traffic hierarchy, to better reflect the intended functions of the roads and their corresponding streetscape characters.

In all cases the road cross-sections will be designed to cater for utility services, on standard verge alignments, street trees, parking embayments where appropriate, off-street and on-street cycling lanes in accordance with the overall pedestrian and cycling network.

The engineering design of roads will be carried out to comply with the Department of Planning's Liveable Neighbourhoods recommendations for design speeds and sight distances and with the requirements of the City of Swan. Roadworks will generally consist of kerbed and asphalted pavements.

In particular, it is proposed that the development roads be designed to suit lower vehicle operating speeds to ensure safer operation and improved pedestrian movement. The lower speeds on local roads will also support initiatives to adopt smaller street truncations and associated intersection curve radii where suitable.

6.4 Footpaths

Footpaths will be provided in accordance with *Liveable Neighbourhoods* and the City of Swan standards and will consist of one path in every road, and dual use paths in Neighbourhood Connector roads as outlined in the GHD Traffic Report accompanying the DSP.

6.5 Public Transport

The State Government's METRONET programme includes the Morley- Ellenbrook project, which proposes a new 21km rail line extension from the existing rail network in Morley through to Ellenbrook's Town Centre. There are no known plans to extend the rail further north at this stage.

There are currently bus services servicing Ellenbrook, which includes a terminal on Banrock Drive immediately south of the NE DSP area. GHD's Transport Assessment advises that the Public Transport Authority (PTA) is likely to develop additional bus services as the broader DSP area is occupied by residents and demand justifies the service, with the primary route likely to enter the DSP area via Sawpit Road.

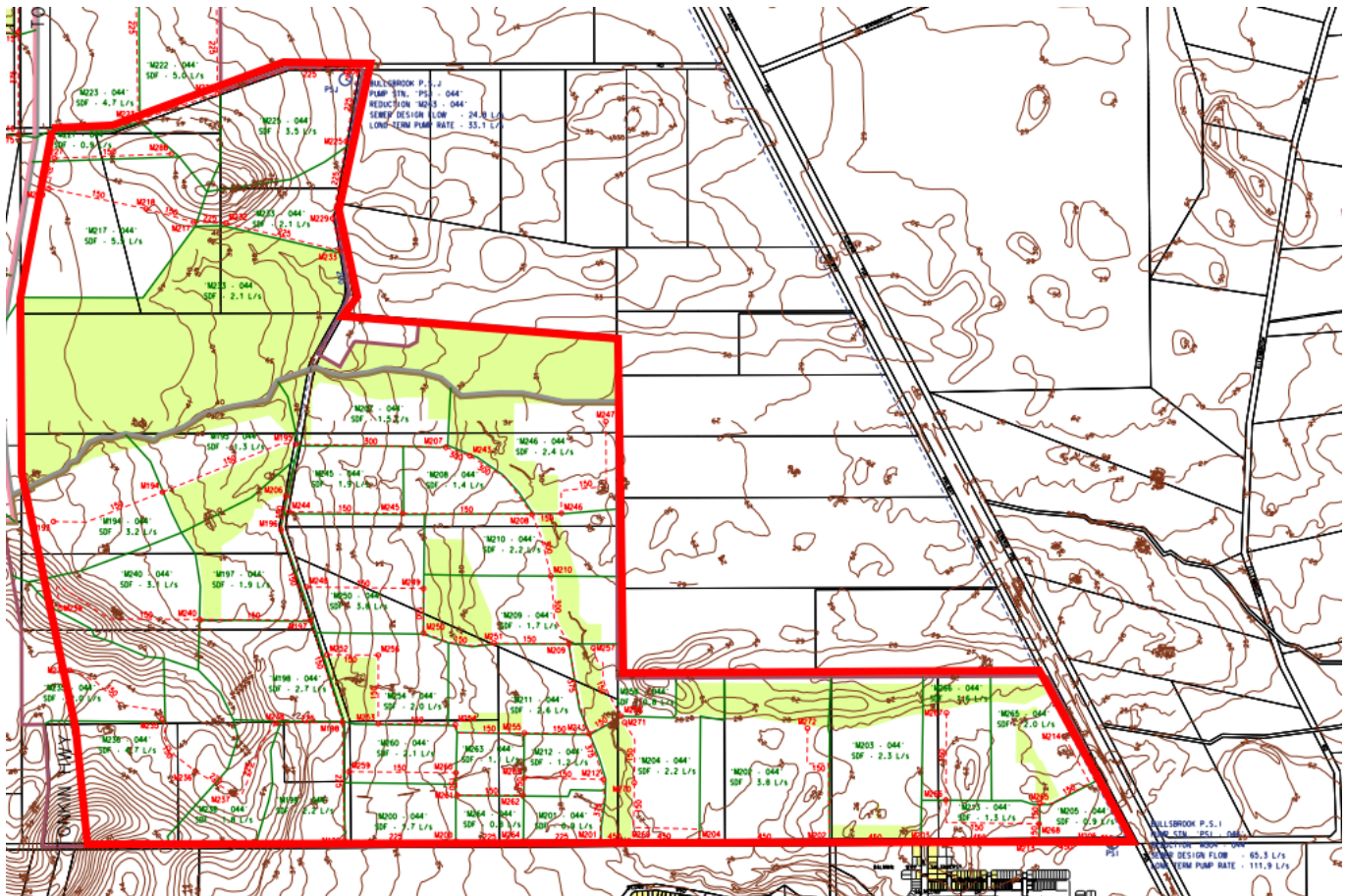
6.6 Noise Attenuation

The western boundary of the NE DSP area abuts Northlink WA, and hence in accordance with State Planning Policy 5.4 "Noise Considerations", an acoustic consultant will be engaged to prepare an Acoustic Report to assess the requirements for the site for transportation noise from the road.

Some noise mitigation strategies will be required for these interfaces and could consist of noise bunds, noise walls, facade protection and/or in-house acoustic mitigation techniques.

7. WASTEWATER

The subject land is located within the Water Corporation licensed area for operating sewerage services. The Water Corporation has advised that the Site falls within their revised Bullsbrook Sewer District, which considers the area identified for potential urban development as part of the 2018 Sub-Regional Framework Planning. The DSP area relative to the Water Corporation's Sewer Planning is shown in Figure 10 below.



The majority of the Site is proposed to grade south via a reticulated gravity sewer network to a future Waste Water Pumping Station (WWPS) located in the south-east of the DSP area. This WWPS would then pump north to a future DN1050 Collector Sewer located approximately at the intersection of Stock Road and Railway Parade. This collector sewer would then gravitate east to a future district level WWPS located on Stock Road. This district level WWPS would then pump flows west to the Carabooda sewer district.

Northern extremities of the DSP area are proposed to be serviced by a Type 40 WWPS located near the intersection of Sawpit Road and Warbrook Road. Flows from this WWPS would be pumped south to the proposed gravity sewer network referred to above.

In the ultimate sense, development of the DSP area is contingent upon the construction of a reasonable level of higher-order wastewater infrastructure. The Water Corporation recognises this, and has suggested that in order to allow for the development of the North Ellenbrook East (and West) DSP areas, that an outfall could be provided for the DSP areas by constructing the proposed DN900 Collector sewer north from Ghangara Road along Drumpellier Drive to a high point that will be high enough to accept pumped flows from the North Ellenbrook DSP areas. The Water Corporation has advised that funding for these works is not currently included on their Capital Investment Program (CIP).

8. WATER RETICULATION

The subject land is located within the Water Corporation's licensed area for provision of a potable water supply service. The Water Corporation has advised that there is currently no Water Planning for residential development of the land north of Maralla Road.

It is noted that the Water Corporation has a water storage tank (Ellenbrook Reservoir) to the west of Tonkin Highway which is fed by the Gngangara groundwater bore scheme to supply the reservoir. Figure 11 below refers.



Figure 10: Existing Water Reservoir Location (MNG, 2022)

Notwithstanding that there is currently no Water Corporation planning for the DSP area, given the proximity of the Ellenbrook Reservoir to the subject land and the capacity of the supply and storage of the existing facility, the Water Corporation has advised that the subject land could be likely be serviced from the existing reservoir, subject to timing and rate of demand.

There are currently no plans to supply of the land north of Maralla Road from the reservoir, so securing a route and determining the appropriate size of trunk main to service the development would be required. The Water Corporation has advised that capital funding of the distribution main and associated works is not currently in their CIP.

9. GAS SUPPLY

Atco Gas have advised that the existing adjacent high pressure gas network to the south of Maralla Road in Ellenbrook will have capacity for development in the NE DSP area. Therefore we do not anticipate there will be any gas supply capacity issues. Some extension from the existing network will be required to bring gas to the Site.

Gas reticulation will be supplied and funded by Atco Gas and installed by the Contractor concurrent with other service installation.

10. ELECTRICAL POWER SUPPLY

10.1 Power Network

There is existing 22kV high voltage overhead power lines in both Maralla Road (northern verge) and Sawpit Road (eastern verge) as depicted in blue below in Figure 11.

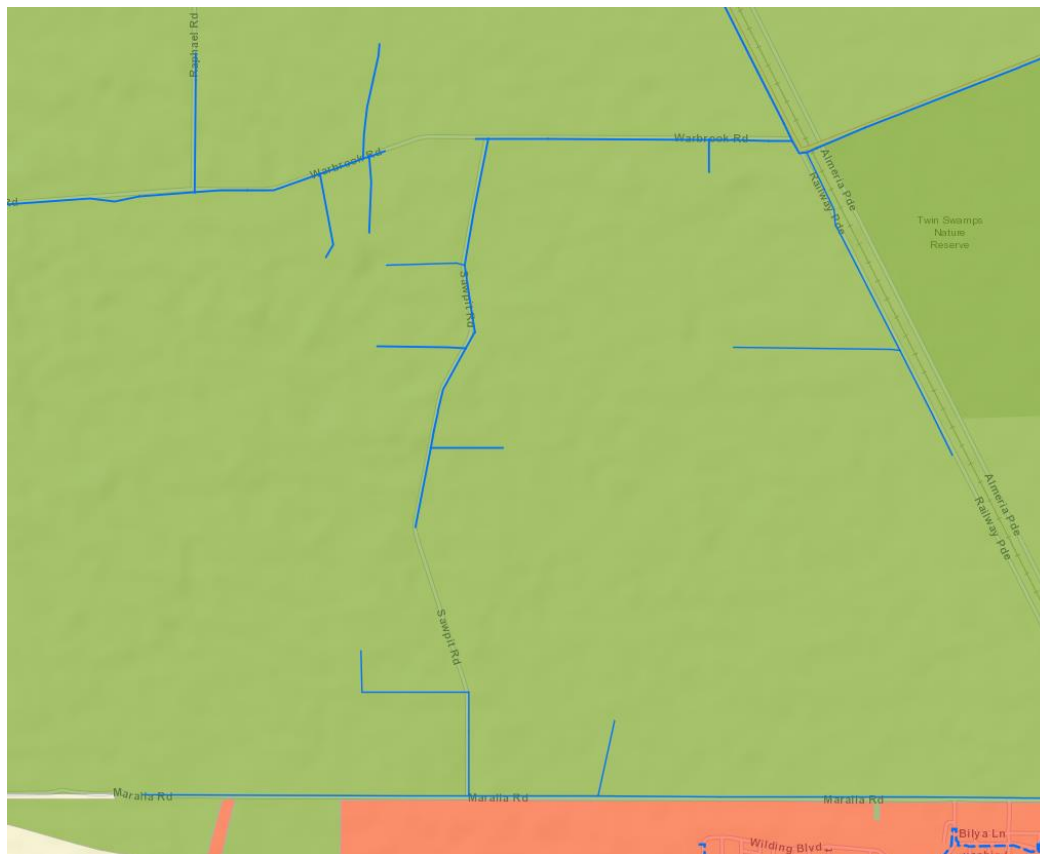


Figure 11: Existing Overhead Powerlines (Western Power, 2019)

The Western Power Network Capacity Mapping Tool indicates a forecast capacity in the DSP area of 25 – 30MVA through to 2026.

It is anticipated that the local network will be incrementally extended from the existing 22kV HV feeds in Maralla Road and Sawpit Road into the Site. A series of HV feeds, switch stations and transformers will be required throughout the DSP area to meet individual site requirements.

Additional reinforcement of the power network by the developer may be required, however, further details of the proposed load within the development are required to confirm this. This will occur as part of ongoing discussions that take place with Western Power as planning for the Site progresses.

11. TELECOMMUNICATIONS

The Site is within NBN's fixed line footprint, and hence can be serviced with optic fibre under their roll-out scheme for greenfield developments.

Through the NBN, the ownership issues of delivering the wholesale fibre to the home system have been transferred to the Government with more than 100 retail service providers offering services over the network. There are other private telecommunication providers that can also offer similar services.

Developers of new residential estates have the option to pay NBN or an alternative service provider for provision of a high speed broadband network. In either case the developer will install pit and pipe infrastructure that can accommodate a future high speed broadband network.

The current design practice for road reserves, pavement and verge provisions will make adequate allowance for services including broadband in accordance with the agreed Utilities Service Providers handbook. There will be some local land requirements for equipment sites, similar to current provisions which will be accommodated at detailed subdivision stage.

12. STAGING

The staging of subdivision and development will be heavily influenced by market forces. Whilst development staging is still to be refined, the following provides the basis for future decision-making:

- Land in the southern portion of the site adjacent Maralla Road is likely to be developed first, as that area is closest to available utilities. It is also located adjacent to the lowest point of the existing Sawpit Gully for drainage, and lower areas of the Site where a Sewer Pump Station will need to be located;
- Subsequent staging will need to consider drainage and sewer catchments, providing connectivity through key access streets and the supply of neighbourhood amenity;
- Subdivision is expected to occur in 30-50 lot stages constructed towards the north and then progressively extending towards the eastern side of the Site.

13. CONCLUSION

There are no engineering impediments to the development, and co-ordination and co-operation with the relevant Service Authorities will be undertaken as the development progresses.