



# **Marrara Gardens**

**Marrara, Northern Territory**

## **Engineering Services Report & Stormwater Management Plan**

**Gema NT Pty Ltd**

8 March 2022

**Document Verification**

Job Title           **MARRARA GARDENS**

Job Number        23884.002

Document Title    Engineering Services Report & Stormwater Management Plan

**Document Control**

Date	Document	Revision No.	Author	Reviewer
25.02.2022	Engineering Services Report & Stormwater Management Plan	00	J. Lanyon	S. Warner
08.03.2022	Engineering Services Report & Stormwater Management Plan - Amendments	01	J. Lanyon	S. Warner

**Approval for Issue**

Name	Signature	Date
Jonathan Lanyon		8 March 2022
Sam Warner		8 March 2022

**© Document copyright of ADG Engineers (Aust) Pty Ltd**

This document is and shall remain in the property of ADG. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

To the extent permitted by law, ADG expressly disclaims and excludes liability for any loss, damage, cost or expenses suffered by any third party relating to or resulting from the use of, or reliance on, any information contained in this report. ADG does not admit that any action, liability, or claim exist or be available to any third party.

## CONTENTS

<b>1</b>	<b>INTRODUCTION</b>	<b>4</b>
1.1	Background	4
1.2	Property Details	4
1.3	Existing Site Condition	5
1.4	Available Information	5
<b>2</b>	<b>BULK EARTHWORKS</b>	<b>7</b>
<b>3</b>	<b>ROADWORKS &amp; ACCESS</b>	<b>8</b>
3.1	Internal Roadwork Network	8
3.2	Intersections	8
3.3	Cul-de-sacs	9
3.4	Temporary Turn Arouds	9
3.5	Footpaths	9
<b>4</b>	<b>STORMWATER DRAINAGE</b>	<b>10</b>
4.1	Existing infrastructure	10
4.2	Lawful point of discharge (LPD)	10
4.3	Stormwater Quantity Assessment	10
4.3.1	Objective	10
4.3.2	Design Storm Events	10
4.3.3	Peak Flow Estimation	10
4.3.4	Pre-Development Hydrology	11
4.3.5	Post-Development Hydrology	11
4.3.6	Stormwater Detention Analysis	12
4.3.7	Drainage Easement	12
<b>5</b>	<b>WATER &amp; SEWER</b>	<b>13</b>
5.1	Demand	13
5.2	Sewer	13
5.2.1	Existing Infrastructure	13
5.2.2	Proposed Infrastructure	14
5.3	Water	14
5.3.1	Existing Infrastructure	14
5.3.2	Proposed Infrastructure	14
<b>6</b>	<b>POWER &amp; TELECOMMUNICATIONS</b>	<b>15</b>
6.1	Existing Infrastructure	15
6.2	Proposed Infrastructure	15
<b>7</b>	<b>CONCLUSION</b>	<b>16</b>

## TABLE OF FIGURES

Figure 1 - Marrara Gardens Overall Yield Plan with Sub-Staging	4
Figure 2 - Existing Site Condition (NearMap February 2022)	5
Figure 2 - Rapid Creek Catchment and Mitigation Options (reference Figure 14 from Impact of Airport Development on Rapid Creek report by Jacobs dated February 2016)	12

## TABLE OF TABLES

Table 1 - Stage 1 Property Details	5
Table 1 - Road Reserve Widths	8
Table 2 - Design Traffic	8
Table 3 - Pre-development Catchment Details	11
Table 4 - Post-development Catchment Details	11
Table 6 - Pre-Development EP	13
Table 7 - Post Development EP	13

## APPENDICES

Appendix A Stage 1 Subdivision Layout Plan
Appendix B Bulk Earthworks Layout Plan
Appendix C Stage 1 Functional Layout Plan
Appendix D Turn Path Analysis
Appendix E Traffic Assessment
Appendix F Power Water Existing Services Plan



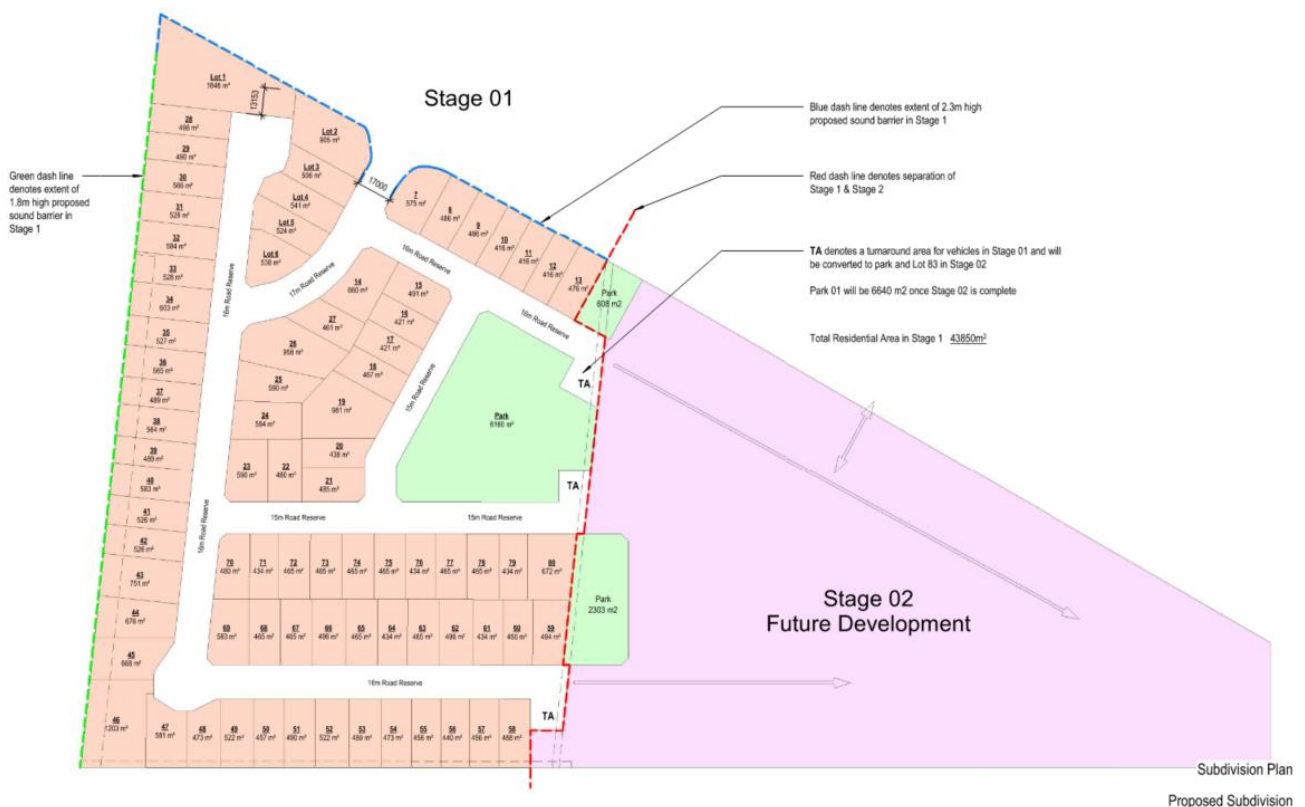
# 1 INTRODUCTION

## 1.1 Background

ADG Engineers (Aust.) Pty Ltd was engaged by Gema NT Pty Ltd to prepare an Engineering Services Report and Stormwater Management Plan for Stage 1 of the Marrara Gardens subdivision. Marrara Gardens is a multi-staged subdivision located on the southern side of McMillans Road in Marrara, Northern Territory. The development covers approximately 11.6 hectares and is broken into two (2) stages as shown in **Figure 1**. Each stage shall be constructed in multiple substages. This report supports the development application for Stage 1 and thus focuses on the development of Stage 1 only. Stage 1 is 6.7 hectares, located on the western boundary of the Marrara Gardens subdivision and comprises of the following:

- 80 residential allotments;
- 6 internal roads; and
- 1 Public Open Space allotments.

Refer to **Appendix A** for the Stage 1 subdivision layout plan. Stage 2 is to be completed at a future date under a separate development application.



**Figure 1 - Marrara Gardens Overall Yield Plan with Sub-Staging**

## 1.2 Property Details

The property details of the proposed development are summarised in **Table 1**.

**Table 1 - Stage 1 Property Details**

<b>Street Address</b>	440 – 450 McMillans Road, Marrara NT
<b>Parcel Number</b>	1841 and 1842 Hundred of Bagot
<b>Site Area</b>	67,700m <sup>2</sup>

### 1.3 Existing Site Condition

The existing site is a caravan park comprising of internal sealed roads hardstand areas for caravan parking, cabins, grassed/landscaped areas, administration buildings and common facilities including a pool and toilet blocks. The existing condition of the site is shown in **Figure 2**.



**Figure 2 - Existing Site Condition (NearMap February 2022)**

### 1.4 Available Information

The following information was available and used in the development of this report and the preliminary engineering drawings for the proposed development:

- Northern Territory Subdivision Development Guidelines

- City of Darwin variation to the Subdivision Development Guidelines
- Subdivision Layout prepared by Cunnington Rosse Town Planning & Consulting as shown on the Concept Design plan dated 11<sup>th</sup> February 2022
- Geotechnical Investigation report prepared by WANT Geotechnics dated 1<sup>st</sup> February 2022
- Internal Road Network Assessment prepared by SJ Traffic dated 13<sup>th</sup> December 2021
- Stage 1 Intersection advice email from SJ Traffic dated 21<sup>st</sup> December 2021
- Rapid Creek Flood Study by Jacobs dated 24<sup>th</sup> March 2020
- Impact of Airport Development on Rapid Creek report by Jacobs dated 19<sup>th</sup> February 2016

## 2 BULK EARTHWORKS

A conceptual bulk earthworks design has been developed for Stage 1 and shall be refined during the detailed design of the stage. The earthworks strategy for the development was to follow the natural contours of the land with the intention of minimising the extent of cutting in rock while aiming to minimise the requirement for fill to be imported for the overall Marrara Gardens development. The conceptual earthworks design has been developed in accordance with the Northern Territory Subdivision Development Guidelines and ensures all allotments are graded to fall towards the road reserve along the allotment frontage.

The requirement for retaining walls has been minimised as part of the design, with batters the preferred option in lieu of retaining walls. Batters have been designed in accordance with the Geotechnical Investigations report prepared by WANT Geotechnics dated 1<sup>st</sup> February 2022. Batters along the side and rear boundaries of allotments have been limited to a maximum height and slope of 1.5m and 1:2 respectively for design purposes. Batters on the frontage of allotments have been designed to have a maximum height and slope of 0.5m and 1:6 respectively. Batters within public open space have been designed to have a desirable maximum slope of 1:6 with an absolute maximum slope of 1:4. All disturbed areas shall be stabilised upon completion of the bulk earthworks activities. Refer to **Appendix B** for the conceptual bulk earthworks plans.

## 3 ROADWORKS & ACCESS

### 3.1 Internal Roadwork Network

The proposed internal road network for Stage 1 consists of a combination of access streets and minor roads. The internal road network is shown on the Functional Layout Plan in **Appendix C**. Access to Stage 1 is provided via connection to McMillans Road located to the north of the Marrara Gardens subdivision. Additional connections to the stage will be made as part of the future Stage 2 development and will be designed and assessed as part of the Stage 2 development application.

The hierarchy of the internal road network has been assigned based on the Internal Road Network Assessment prepared by SJ Traffic and the NT Subdivision Development Guidelines Section 4. Whilst the Internal Road Network Assessment denotes that only minor roads are required through the stage based on the proposed traffic volumes, road segments 1, 2, 3, 6, 7 and 11 as denoted in the Internal Road Network Assessment have all been increased to be equal to that of a access street with a road reserve width of 16m. Road segments 4 and 17 have also been increased to a width of 17m where the additional 1m has been taken up in the verge width. The increased road reserve and carriage way has been requested by the Client for amenity reasons. Refer to **Appendix E** for the Internal Road Network Assessment.

Based on the information provided within the Internal Road Network Assessments and Table 6 of the Subdivision Development Guidelines, the road reserve widths in **Table 2** are proposed.

**Table 2 - Road Reserve Widths**

Road Class	Road Reserve Width (m)	Roadway Width (m)	Verge Width (m)	Typ. Max. no. of allotments
Minor Road	15.0	6.0	2 x 4.5m	30
Local Access	16.0	7.0	2 x 4.5m	60
Local Access (Extended)	17.0	7.0	2 x 5.0m	60

The geometric design of all roads within the development shall be in accordance with the NT Subdivision Development Guidelines and the Austroads Guide to Road Design Part 3: Geometric Design and Austroads Guide to Road Design Part 4A: Signalised and Unsignalised Intersections. All roads within Stage 1 shall be urban roads with an asphalt surface, two-way cross fall, and kerbing on both sides.

The structural design of the road pavements shall be developed in accordance with the NT Subdivision Development Guidelines and the Austroads Guide to Road Design Part 2: Pavement Structural Design. The pavement designs shall be carried out based on the minimum design traffic as specified below in **Table 3**. The road network shall be flexible pavement with unbound granular base material and asphalt surfacing.

**Table 3 - Design Traffic**

Road Class	Residential Design Traffic (ESA)	Industrial Design Traffic (ESA)
Minor Road	8.0 x 10 <sup>3</sup>	6.0 x 10 <sup>4</sup>
Local Access	5.0 x 10 <sup>4</sup>	8.0 x 10 <sup>5</sup>

### 3.2 Intersections

As part of the Marrara Gardens development, the existing intersection which currently exists from the KOA & Malak Caravan Park onto McMillans is proposed to be maintained for Stage 1 of the development. The use of the existing intersection to service the development of Stage 1 is supported by the traffic assessment



completed. Refer to **Appendix E** for further details regarding the use of the existing intersection to support the proposed development.

The existing intersection was designed with high speed approach angles and wider lanes to accommodate the turning movements of vehicles towing large caravans. It is proposed to modify the existing intersection to tighten up kerb radii at the intersection to promote vehicles to slow down on approach to the intersection. Minimum lane widths of 3.5m shall be maintained at the intersection and a turn path analysis of the tightened intersection has been completed to ensure the intersection sufficiently caters for the design vehicle (service vehicle, 8.8m) and the check vehicle (single unit truck/bus, 12.5m) in accordance with the Subdivision Development Guidelines. Refer to the Functional Layout Plan in **Appendix C** for the layout of the proposed intersection.

### 3.3 Cul-de-sacs

Stage 1 of the Marrara Gardens subdivision has a single cul-de-sac to the north of the development. The cul-de-sac has been designed in accordance with Section 4.6.2 of the NT Subdivision Guidelines with a minimum 10m radii from kerb to kerb to facilitate the turning of a garbage truck. Details of the cul-de sac is shown on the Functional Layout Plan in **Appendix C**. A turning path analysis of the cul-de-sac has been completed to confirm the proposed cul-de-sac caters for the design vehicle (service vehicle, 8.8m) in accordance with the Subdivision Development Guidelines. Refer to **Appendix D** for the turn path analysis.

### 3.4 Temporary Turn Arouds

For Stage 1 of the Marrara Gardens subdivision, three (3) temporary turn arouds will be required to facilitate the turnaround of a garbage truck and traffic at the stub roads for Roads 2, 3 and 4 as per the Functional Layout Plan in **Appendix C**. Given that these are temporary turn arouds that will be terminated following the construction of Stage 2, cul-de-sacs have not been considered for the design. A turning path analysis of the temporary turnarounds has been completed to confirm the proposed turnarounds can adequately cater for the design vehicle (service vehicle, 8.8m) in accordance with the Subdivision Development Guidelines. Refer to **Appendix D** for the turn path analysis. The temporary turnarounds shall be sealed with a single coat seal.

### 3.5 Footpaths

The footpaths proposed for the Marrara Gardens are proposed to be designed in accordance with the NT Subdivision Guidelines Table 7 and City of Darwin's variation to the Subdivision Guidelines. For Minor Roads and Local Access roads, a single 1.5m wide footpath is required on one side of the road whilst for the shared path around the park and the pathway between McMillans Road and the park is proposed to be 2.5m wide. Due to the current footpath arrangement on McMillans Road two paths have been proposed at the entrance to Road 1 of the Marrara Gardens development to link these two paths into the development accordingly. The proposed footpath layout is shown in the Functional Layout Plan in **Appendix C**.

## 4 STORMWATER DRAINAGE

### 4.1 Existing infrastructure

The City of Darwin's (CoD) Stormwater Utilities Map identifies two (2) open unlined drains adjacent to the development that are currently located in the Commonwealth Government land (Department of Defence). This existing drain discharges to the Rapid Creek catchment further west of the Marrara Gardens development area.

The existing caravan park contains a series of kerbs and grated inlet pits which discharge to the existing open drain to the south of the property. In addition to the internal drainage for the existing site, there are two (2) drainage easements located within the site. A drainage easement along the western boundary of Stage 1 contains an underground pipe network which conveys runoff from the adjacent development to the existing open drain located to the south of the development site. A drainage easement along the eastern boundary of Stage 1 contains an underground drainage network which conveys flows from McMillans road and discharges to the existing open drain located to the south of the development site.

There are three (3) existing headwalls located along the southern boundary of Stage 1, which discharge to existing open drain. The existing headwalls associated with the drainage easements shall be maintained. The existing headwall which discharges runoff from the existing development on this site shall be modified to accommodate the proposed development. All existing drainage infrastructure within the caravan park is proposed to be demolished as part of the development.

### 4.2 Lawful point of discharge (LPD)

The existing drainage within the development area discharges to the south of the site through several headwalls into the Commonwealth Government's (Department of Defence) open drain before ultimately discharging to Rapid Creek. It is proposed to maintain the existing drain to the south of the development as the LPD.

### 4.3 Stormwater Quantity Assessment

#### 4.3.1 Objective

The aim of the stormwater quantity assessment is to ensure that the development shall impose no adverse effects on downstream properties or receiving water bodies and that the conveyance of flows will be in a safe manner with minimal risk of human endangerment.

#### 4.3.2 Design Storm Events

Based on Table 19 of the Northern Territory Subdivision Development Guidelines the major and minor storm events for the development are defined as:

- Minor Event: 50% Annual Exceedance Probability (AEP)
  - Surface drainage infrastructure sized for a 50% AEP storm event through to point of discharge.
- Major Event: 1% AEP
  - Roadways and drainage easements to convey overland flows safely to LPD.
  - Surface drainage flows shall not present a hazard to people or cause significant damage to property.

#### 4.3.3 Peak Flow Estimation

The peak flow rate for the site has been obtained using the Rational Method in accordance with ARR and the Queensland Urban Drainage Manual (QUDM). It is noted that QUDM, as the name implies, is a Queensland

guideline, however, is considered by industry as a national guideline for the estimation and control for stormwater runoff. Summaries of the hydrology calculations are covered in **Section 4.4.3** and **Section 4.4.4** of this report for the pre and post development scenarios respectively.

$$Q = (2.78 \times 10^{-3}) C_y I_y A$$

$Q$  = Peak flow rate (m<sup>3</sup>/s) for average recurrence interval

$C_y$  = Co-efficient of runoff for ARI of  $y$  years (dimensionless)

$A$  = Catchment area (ha)

$I_y$  = Average rainfall intensity (mm/hr) for a design duration of  $t$  hours and an ARI of  $y$  years

#### 4.3.4 Pre-Development Hydrology

The hydrology of the pre-developed catchment has been assessed using the Rational Method. Stage 1 of the Marrara Gardens development is approximately 6.7ha. The existing site prior to development consists of grassed areas, road network, car parking spaces, cabins and buildings.

The Coefficient of discharge ( $C_{10}$ ) value for the catchment was derived from QUDM 2017 Table 4.5.3 and Table 4.5.4.  $F_y$  frequency factors were applied to determine runoff coefficients for various average recurrence interval (ARI) storm events in accordance with QUDM 2017 Table 4.5.2.

The Fraction Impervious used to determine the Coefficient of Discharge ( $C_{10}$ ) was calculated manually by summing the total impervious area and dividing by the total site area as per the equation. The total fraction impervious was determined based off survey and ariel data. The total fraction impervious was calculated to be 50% for the existing condition on site.

QUDM 2017 Section 4.6 was applied to determine a time of concentration of 15 minutes was applied for the entire site. Rational Method calculations were performed, the results of which summarised in **Table 4**.

**Table 4 - Pre-development Catchment Details**

Area (m <sup>2</sup> )	% Impervious	$C_{10\%}$	$C_{50\%}$	$C_{1\%}$	Time of Concentration (t <sub>c</sub> )	$Q_{50\% \text{ AEP}}$ (m <sup>3</sup> /s)	$Q_{1\% \text{ AEP}}$ (m <sup>3</sup> /s)
67,000	50%	0.80	0.68	0.96	15	1.57	4.24

#### 4.3.5 Post-Development Hydrology

A similar approach to the pre-development hydrology was applied for the post-development hydrology. The fraction impervious and time of concentration we calculated and updated to reflect the condition of the site post development of the proposed subdivision. A summary of the peak discharges for the minor and major storm events is provided in **Table 5**.

**Table 5 - Post-development Catchment Details**

Area (m <sup>2</sup> )	% Impervious	$C_{10\%}$	$C_{50\%}$	$C_{1\%}$	Time of Concentration (t <sub>c</sub> )	$Q_{50\% \text{ AEP}}$ (m <sup>3</sup> /s)	$Q_{1\% \text{ AEP}}$ (m <sup>3</sup> /s)
67,000	70%	0.84	0.71	1.00	15	1.65	4.42



### 4.3.6 Stormwater Detention Analysis

Comparison of the estimated peak flows for Stage 1 of the Marrara Gardens pre and post development identifies that there is an increase in the volume of stormwater runoff due to the subdivision. For the minor and major storm events, an increase in runoff of 0.08m<sup>3</sup>/s (80L/s) and 0.18m<sup>3</sup>/s (180L/s) respectively has been estimated. All stormwater runoff generated within Stage 1 shall discharge to the south of the site into the existing drain owned by the Commonwealth Government (Department of Defence) that ultimately discharges into Rapid Creek.

Extensive flood studies of the Rapid Creek catchment area have been completed (by others) to quantify the flooding within Rapid Creek. The Rapid Creek catchment area contains flow attenuation devices which control the flow of stormwater and flood waters within Rapid Creek. The proposed Marrara Gardens development is located upstream of the existing Rapid Creek Triangle Detention Basin and Rapid Creek Flow Control Weir and is within the contributing catchment for these devices. This is confirmed in the Rapid Creek Flood Study by Jacobs dated 24 March 2020 and the Impact of Airport Development on Rapid Creek report by Jacobs dated 19 February 2016, and is shown in **Figure 3**. As there are regional flood mitigation devices downstream and the development of the proposed site has been catered for in the sizing of these devices, no on site detention or mitigation of flows are proposed.

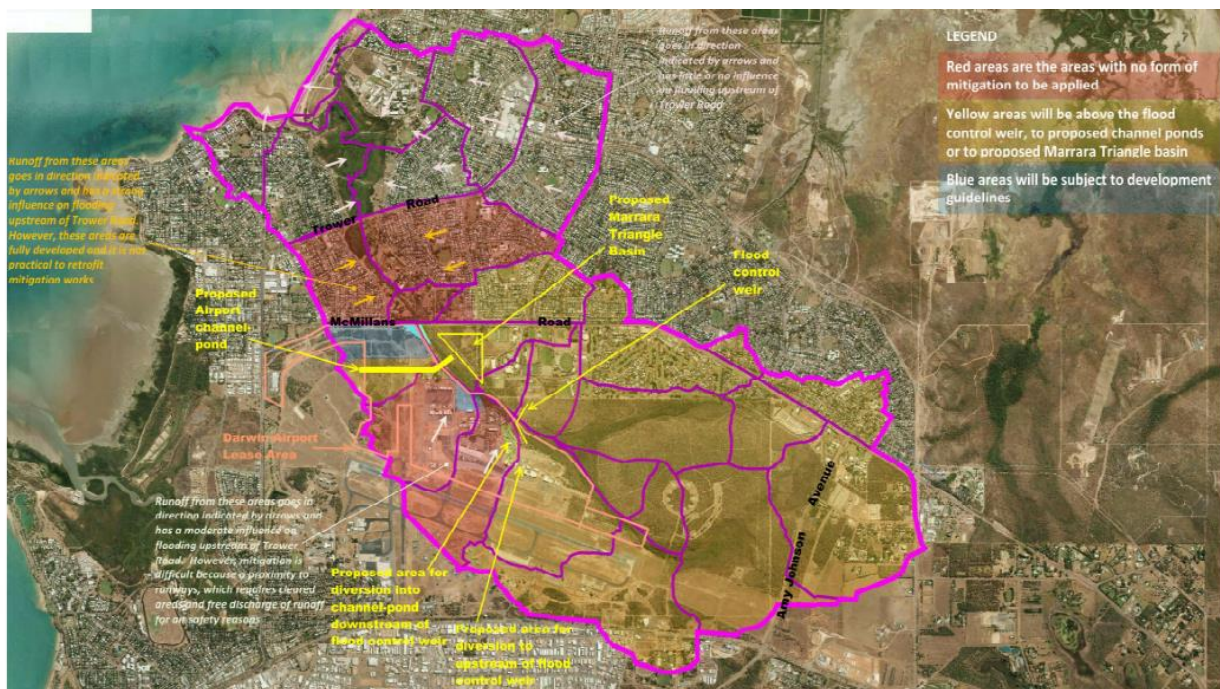


Figure 3 - Rapid Creek Catchment and Mitigation Options (reference Figure 14 from Impact of Airport Development on Rapid Creek report by Jacobs dated February 2016)

### 4.3.7 Drainage Easement

As discussed in **Section 4.1** of this report, there are two (2) existing easements within the development site. These easements, including the underground infrastructure within them shall be maintained as part of the proposed development.

As part of Stage 1 of the Marrara Gardens development, a third and new drainage easement is proposed to convey flows from the internal road network, through an allotment along the southern boundary to the Lawful Point of Discharge adjacent the southern boundary. Details of the easement, including width and location, shall be confirmed as part of the detailed design. It is intended to pipe the major storm event through the easement to minimise the width of the easement and restrict the impact on developable area within the allotment. The proposed location of the easement is shown on the Functional Layout Plan in **Appendix C**.

## 5 WATER & SEWER

### 5.1 Demand

The number of equivalent persons (EP) was used to calculate the demand rates of the proposed water and sewerage reticulations. The proposed EP for the development was based on the current lot arrangement and applying the EP rates as outlined in the Power Water Corporation (PWC) NT Supplement to WSA Codes (2002). The pre-development EP for the site was determined by applying 2.0 EP per site and 20EP/ha of office space as per PWC standards.

**Table 6 - Pre-Development EP**

Development Type	Quantity	Unit	EP multiplier	Total EP
Caravan Park	191	Lot	2.0/lot	382
Office	0.0064	ha	20.0/ha	0.13
<b>Total EP</b>				<b>382.13</b>

The EP for the proposed development of Stage 1 has been determined using 3.5 EP per Single Dwelling (SD) allotment and 20 EP/ha for Public Open Spaces as per PWC standards.

**Table 7 - Post Development EP**

Development Type	Quantity	Unit	EP multiplier	Total EP
Single Dwelling	82	Lots	3.5EP/lot	287
Public Open Space	0.6	ha	20.0/ha	12.32
<b>Total EP</b>				<b>299.32</b>

Comparing the pre-development demand (**Table 6**) against the post-development demand (**Table 7**), there is a decrease in the demand generated from the site post development of the subdivision. This is expected as a caravan park typically generates more loading on a water and sewer network than a residential subdivision. Given the reduction in demand from the site, no water or sewer headworks are proposed for the site to cater for the proposed development.

### 5.2 Sewer

#### 5.2.1 Existing Infrastructure

Review of PWC ArcGIS data and detailed survey has identified the following existing sewer infrastructure within the vicinity of the proposed development:

- A reticulation main located within an easement within the site, along the southern boundary. This main is a DN150 PVC main and upsizes to a DN225 AC main prior to connecting to the trunk main to the south. There are three (3) access chambers within the site along this main.

- › A DN375 VC trunk main along southern boundary located outside of the development boundary. There are multiple access chambers along this main along the boundary.

The PWC sewer network services are shown on the existing services plan in **Appendix F**.

### 5.2.2 Proposed Infrastructure

To facilitate the construction of the proposed subdivision an internal sewer reticulation network is proposed to collect and convey flows to the existing trunk main located adjacent to the southern boundary of the site. The internal sewer reticulation mains and allotment connections shall be designed in accordance with the WSAA Sewerage Code of Australia and NT Supplement to the WSAA Sewerage Code. Upon completion of construction the internal reticulation network will become a PWC asset.

The existing sewer main located within the site along the southern boundary shall be maintained as part of the development of Stage 1. The existing main is the current discharge point for the existing caravan park located to the west of Stage 1. The existing structures within the easement will need to be modified to suit the new surface levels within the development of Stage 1. As this is an existing main and is a live asset, these works will need to be completed by PWC at the developer's expense.

The internal sewer network shall discharge to the existing trunk main located to the south of the development. A new easement within one of the allotments on the southern boundary will need to be created as part of the development to facilitate this connection. It is proposed to connect to the existing access chamber within the easement along the southern boundary of the site. The existing gas trap and chamber shall be maintained subject to inspection of the condition of existing assets. Refer to the Functional Layout Plan in **Appendix C** for the proposed layout of the internal sewer network and the connection point. The details of the connection shall be designed as part of the detailed design.

## 5.3 Water

### 5.3.1 Existing Infrastructure

Review of PWC ArcGIS data and detailed survey has identified the following existing water infrastructure within the vicinity of the proposed development:

- › A DN150 AC water main adjacent the sites McMillans Road frontage
- › A DN675 MSCL trunk water main located centrally within McMillans Road
- › A DN100 water connection and meter off the DN150 main which services the site (Stage 1 development only – Stage 2 is serviced by a separate water connection and meter)

The PWC water network services are shown on the existing services plan in **Appendix F**.

### 5.3.2 Proposed Infrastructure

To facilitate the construction of the proposed subdivision an internal water reticulation network is proposed to supply each allotment with a water service. The reticulation main is proposed to connect to the existing DN150 main along the McMillans Road frontage. The internal water reticulation mains and allotment connections shall be designed in accordance with the WSAA Sewerage Code of Australia and NT Supplement to the WSAA Sewerage Code. Upon completion of construction the internal reticulation network will become a PWC asset.

The existing DN100 water meter and connection to the site shall be removed as part of the proposed subdivision. Temporary dead ends on the internal water network shall be constructed to facilitate the future connection of Stage 2. The internal water network is proposed to be a DN150 PVC reticulation main. Refer to the Functional Layout Plan in **Appendix C** for the proposed layout of the internal water network and the connection point. The details of the proposed network shall be confirmed as part of the detailed design.

## 6 POWER & TELECOMMUNICATIONS

### 6.1 Existing Infrastructure

The PWC ArcGIS has denoted a series of infrastructure in the development area. There is existing 11kV overhead High Voltage (HV) power to the north of the site along McMillans Road. Stage 1 currently contains a single electrical substation on the site of unknown size. The existing Power Water services are shown on the existing services plan in **Appendix F**.

Dial Before You Dig (DBYD) has identified existing NBN infrastructure to the western and southern boundary of the development which can be utilised for the proposed subdivision.

### 6.2 Proposed Infrastructure

The design of the power and telecommunication networks shall be undertaken by an approved electrical designer in accordance with the Power and Water Corporation requirements. The design of the street lighting shall be undertaken in accordance with the NT Subdivision Development Guidelines and City of Darwin's requirements. The Marrara Gardens area falls within the current NBN Co fibre footprint hence NBN reticulation is to be installed throughout the proposed subdivision. The required telecommunications infrastructure for the Marrara Gardens shall be provided in accordance with NBN Co standards.

The details of the power and communications network shall be provided as part of the detailed design of the subdivision.

## 7 CONCLUSION

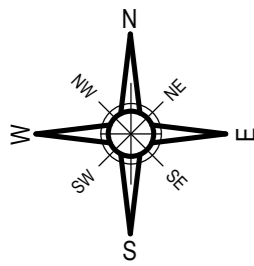
ADG Engineers have undertaken an engineering services assessment for Stage 1 of the proposed Marrara Gardens subdivision. Stage 1 can be adequately serviced by all essential infrastructure through the installation of new infrastructure and connection to existing infrastructure. No onsite stormwater detention measures are proposed for the development as regional mitigation is provided downstream. The works discussed within this report are subject to detailed design and authority approval. The design of all infrastructure shall be completed in accordance with all relevant authority guidelines/standards. Detailed engineering documentation shall be submitted to and approved all relevant authorities prior to commencement of works onsite.

# Appendix A

## Stage 1 Subdivision Layout Plan







Blue dash line denotes extent of 2.3m high proposed sound barrier in Stage 1

Red dash line denotes separation of Stage 1 & Stage 2

TA denotes a turnaround area for vehicles in Stage 01 and will be converted to park and Lot 83 in Stage 02

Park 01 will be 6640 m<sup>2</sup> once Stage 02 is complete

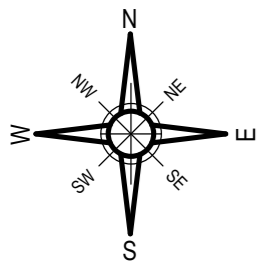
**Subdivision Plan - Stage 1**  
1:1500 @ A3

**Stage 1 Subdivision Plan**  
1:1500@ A3

Stage 1 - Subdivision Plan  
Proposed Subdivision







10m  
22.5m  
**Lot Type 1 - 300m<sup>2</sup> - 449m<sup>2</sup>**  
(Lots 10, 11, 12, 16, 17, 20, 56, 61, 64, 71, 76, 79)

11m  
22.5m  
**Lot Type 2 - 450m<sup>2</sup> - 599m<sup>2</sup>**  
(Lots 3, 4, 5, 8, 9, 13, 18, 22, 24, 25, 27, 28, 29, 30, 31, 32, 33, 35, 36, 37, 38, 39, 40, 41, 42, 47, 48, 49, 50, 51, 52, 53, 54, 55, 57, 58, 59, 60, 62, 63, 65, 66, 67, 68, 72, 73, 74, 75, 77, 78)

12m  
22.5m  
**Lot Type 2a - 450m<sup>2</sup> - 599m<sup>2</sup> - (Corner Lots)**  
(Lots 6, 7, 15, 21, 23, 69, 70)

20m  
24.5m  
**Lot Type 3 - 600m<sup>2</sup> +**  
(Lots 1, 2, 19, 26, 34, 43, 44, 45, 46, 80)

21m  
24.5m  
**Lot Type 3a - 600m<sup>2</sup> + (Corner Lots)**  
(Lots 14)

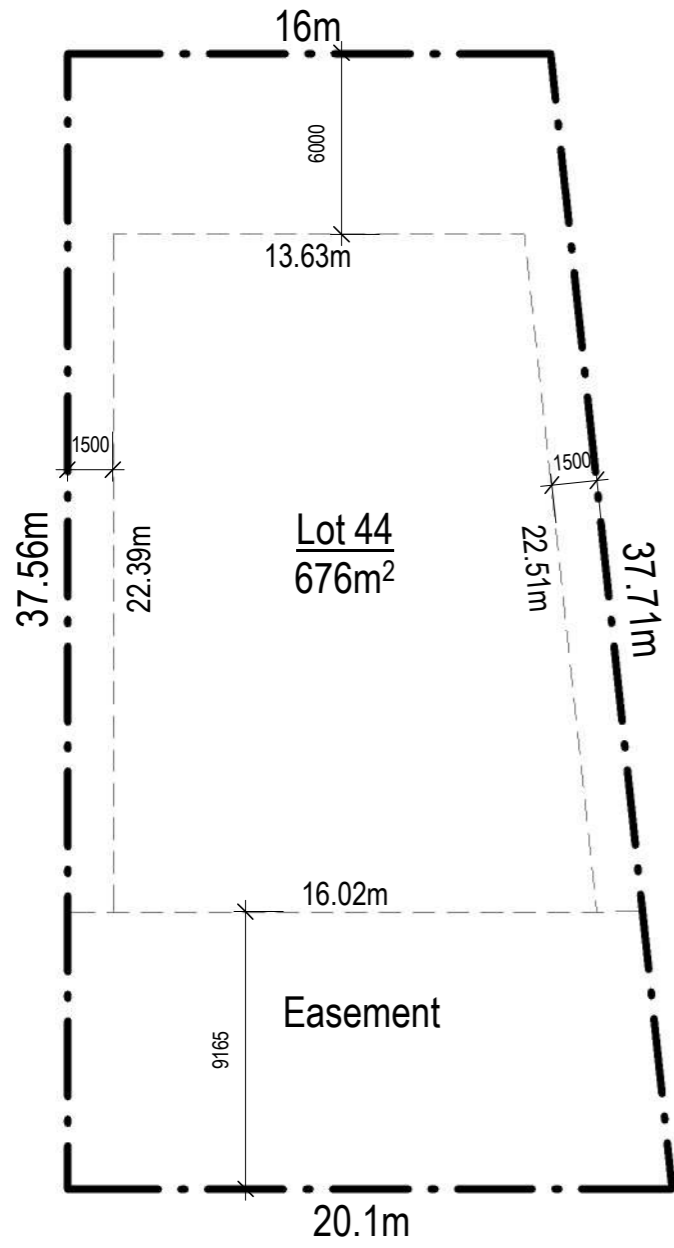


**Stage 1 - Building Envelope Plan**  
1:1500 @ A3

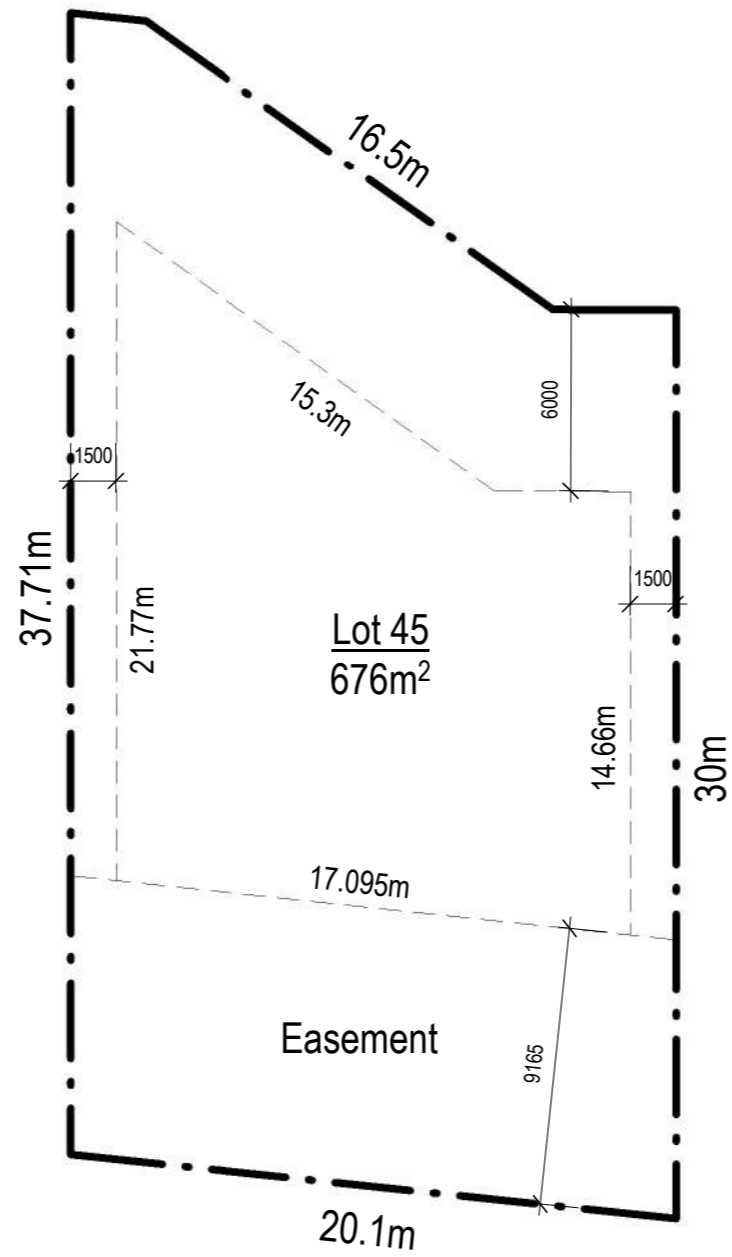
Stage 1 - Building Envelope Plan  
Proposed Subdivision

Mobile: 0427 796 140  
Email: brad@crtpc.com.au  
www.cunningtonrossetownplanning.com.au

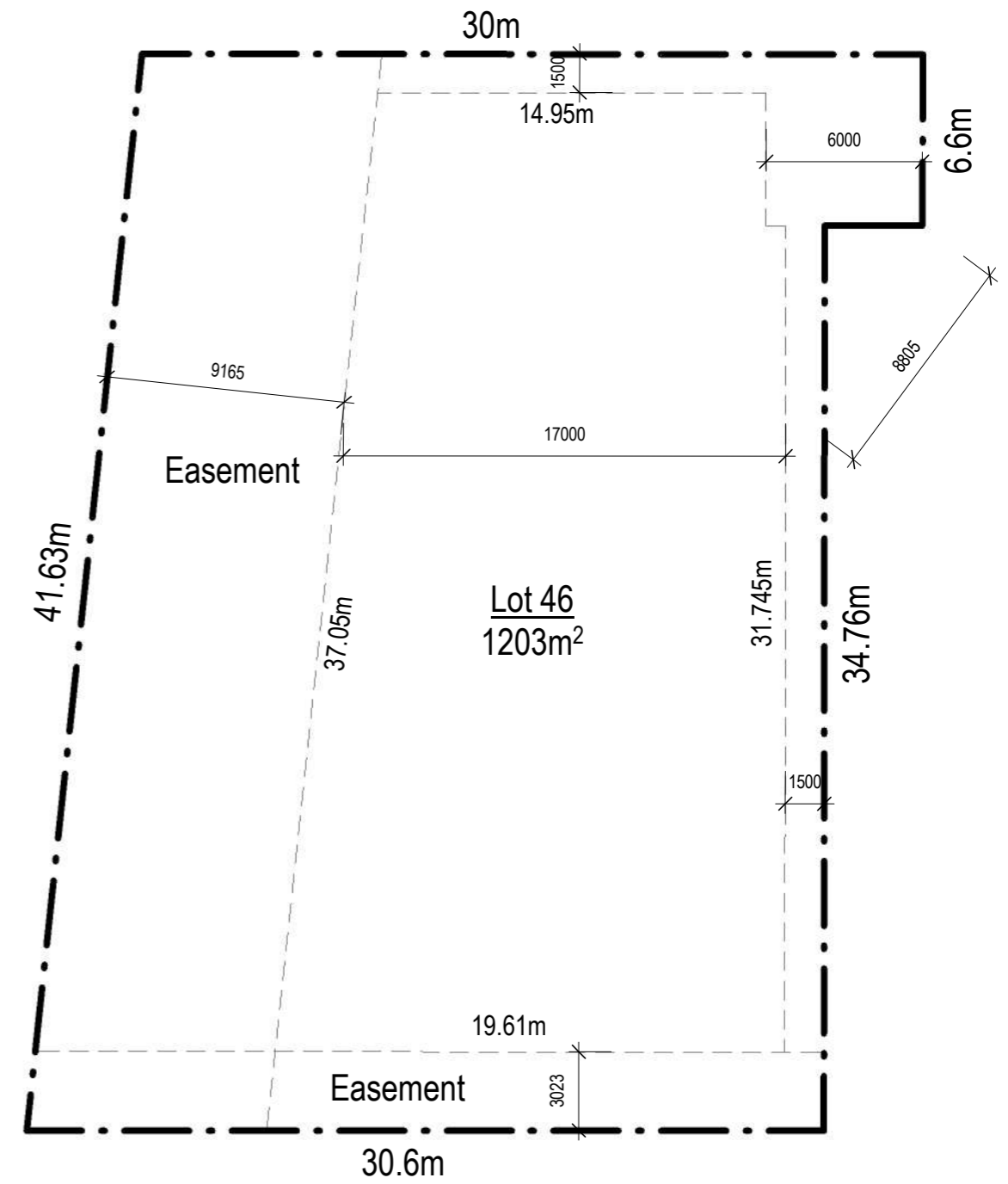




**Lot 44 - Envelope Plan**



**Lot 45 - Envelope Plan**



**Lot 46 - Envelope Plan**

Envelope Plans  
Proposed Subdivision



# Appendix B

## Bulk Earthworks Layout Plan

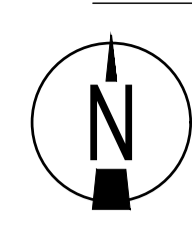




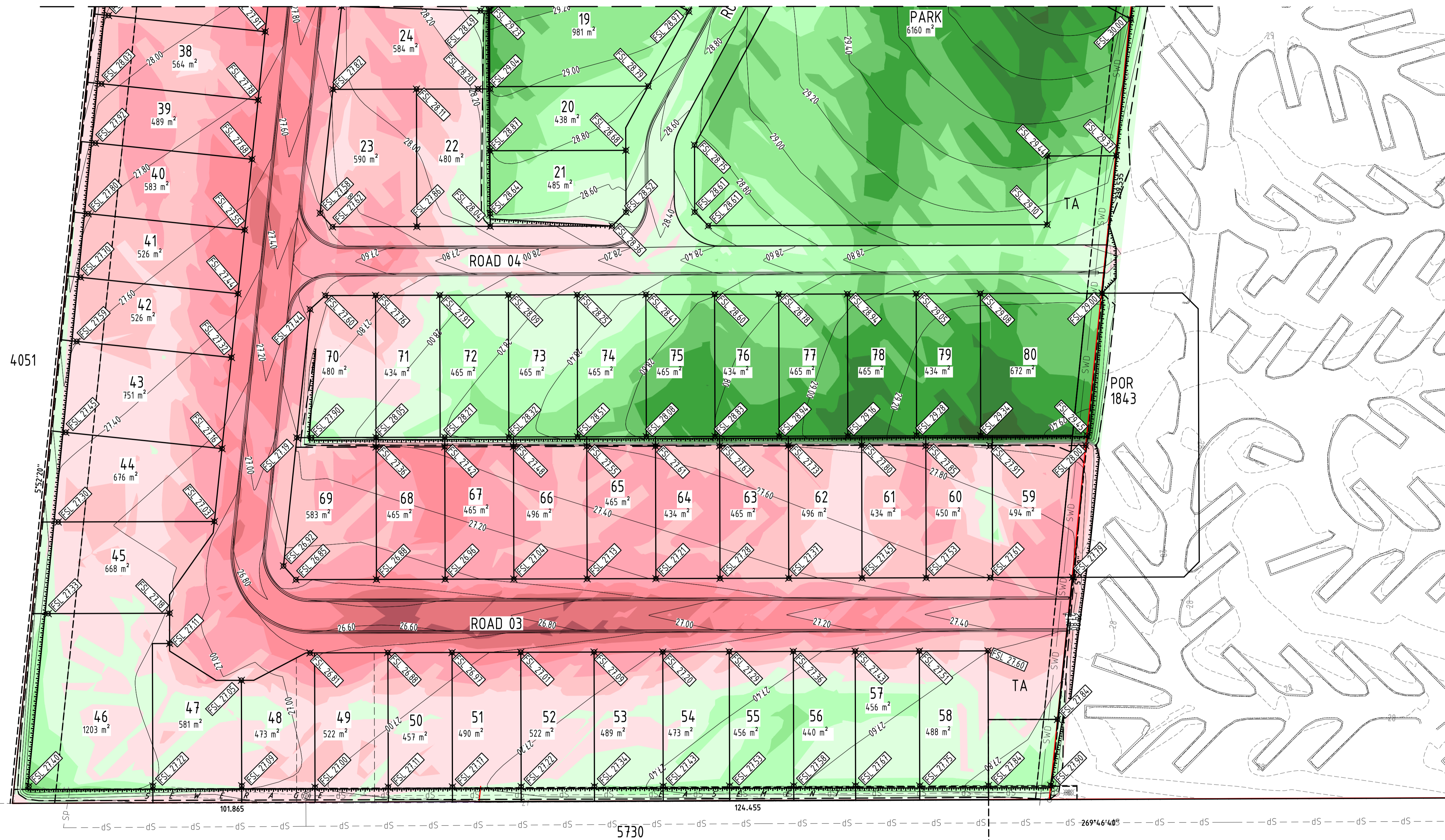


**NOTE**

1. FOR LEGEND, REFER TO DRG SK04.

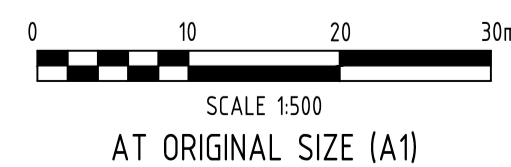


MATCHLINE - REFER DRG. SK03 FOR CONTINUATION



**PRELIMINARY**  
NOT FOR CONSTRUCTION

Rev	Date	Description	By	Chk
B	08.03.22	ISSUED FOR INFORMATION - LOT BOUNDARIES ADJUSTED	JMB	HD
A	25.02.22	ISSUED FOR INFORMATION	AB	HD



**Darwin Office**  
Suite G01, Marunda Place, 38 Cavenagh Street,  
Darwin, Northern Territory 0800, Australia  
GPO Box 2422, Darwin, Northern Territory 0801  
T 1300 657 402 F +617 3871 2266  
E info@adgce.com W www.adgce.com  
BRISBANE / DARWIN / GOLD COAST / MELBOURNE / PERTH /  
SUNSHINE COAST / SYDNEY / TOOWOOMBA

Client  
GEMA (NT) PTY LTD

Project Name  
MARRARA GARDENS  
SUBDIVISION

Discipline  
CIVIL

Designed By  
JMB

Checked By  
HD

Status  
INFO

Approved By  
DG

Project No.  
23884.002

Drawn By  
AB

Scale at A1  
1:500

The concepts and information contained in this document are the copyright of ADG Engineers (Aust) Pty Ltd. Use or copying of the document in whole or in part without the written permission of ADG Engineers (Aust) Pty Ltd constitutes an infringement of copyright. Do not scale drawings. If in doubt, ask!

Title  
BULK EARTHWORKS  
LAYOUT PLAN  
SHEET 2 OF 2

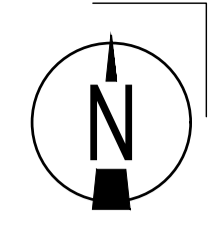
Drawing No. SK04	Revision B
---------------------	---------------



# Appendix C

## Stage 1 Functional Layout Plan





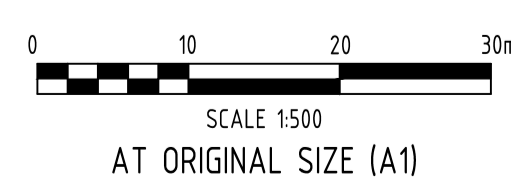
LEGEND	
	DESIGNED SURFACE CONTOURS
	EXISTING SURFACE CONTOURS
	STAGE BOUNDARY
	PROPOSED STORMWATER DRAINAGE PIPE AND SIZE
	PROPOSED SIDE ENTRY PIT
	PROPOSED ASPHALT PAVEMENT
	PROPOSED TEMPORARY TURNAROUND
	PROPOSED FOOTPATH
	PROPOSED SEWER MAIN
	PROPOSED WATER MAIN
	PROPOSED SEWER PROPERTY CONNECTION
	PROPOSED WATER PROPERTY CONNECTION
	PROPOSED LAYBACK KERB & GUTTER
	PROPOSED UPRIGHT KERB & GUTTER
	EXISTING STORMWATER DRAINAGE
	EXISTING SEWER
	EXISTING WATER (RECORDS)
	EXISTING OVERHEAD ELECTRICAL
	EXISTING TELECOMMUNICATIONS (RECORDS)
	EXISTING EASEMENT
	EXISTING STORMWATER OUTLET HEADWALL AND SCOUR PROTECTION



MATCHLINE - REFER DRG. SK02 FOR CONTINUATION

**PRELIMINARY**  
NOT FOR CONSTRUCTION

Rev	Date	Description	By	Chk
B	08.03.22	ISSUED FOR INFORMATION - LOT BOUNDARIES ADJUSTED	JMB	HD
A	25.02.22	ISSUED FOR INFORMATION	AB	HD



**ADG**  
 Darwin Office  
 Suite G01, Manunda Place, 38 Cavenagh Street,  
 Darwin, Northern Territory 0800, Australia  
 GPO Box 2422, Darwin, Northern Territory 0801  
 T 1300 657 402 F +617 3871 2266  
 E info@adg.com W www.adg.com  
 BRISBANE / DARWIN / GOLD COAST / MELBOURNE / PERTH /  
 SUNSHINE COAST / SYDNEY / TOOWOOMBA

Client GEMA (NT) PTY LTD	Discipline CIVIL	Status INFO
Project Name MARRARA GARDENS SUBDIVISION	Designed By JMB	Checked By HD
	Project No. 23884.002	Drawn By AB
		Scale at A1 1:500

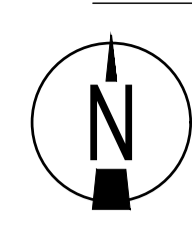
The concepts and information contained in this document are the copyright of ADG Engineers (Aust) Pty Ltd. Use or copying of the document in whole or in part without the written permission of ADG Engineers (Aust) Pty Ltd constitutes an infringement of copyright. Do not scale drawings. If in doubt, ask!	
Drawing No. SK01	Revision B

Title FUNCTIONAL LAYOUT PLAN SHEET 1 OF 2
Full Size on Original 0 10 20 30 40 50 60 70 80 90 100mm



**NOTE**

1. FOR LEGEND, REFER TO DRG SK01.

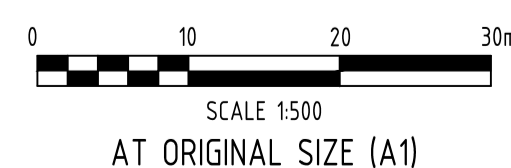


MATCHLINE - REFER DRG. SK01 FOR CONTINUATION



**PRELIMINARY**  
NOT FOR CONSTRUCTION

Rev	Date	Description	By	Chk
B	08.03.22	ISSUED FOR INFORMATION - LOT BOUNDARIES ADJUSTED	JMB	HD
A	25.02.22	ISSUED FOR INFORMATION	AB	HD



**Darwin Office**  
Suite G01, Marunda Place, 38 Cavenagh Street,  
Darwin, Northern Territory 0800, Australia  
GPO Box 2422, Darwin, Northern Territory 0801  
T 1300 657 402 F +617 3871 2266  
E info@adgce.com W www.adgce.com  
BRISBANE / DARWIN / GOLD COAST / MELBOURNE / PERTH /  
SUNSHINE COAST / SYDNEY / TOOWOOMBA

Client  
GEMA (NT) PTY LTD

Project Name  
MARRARA GARDENS  
SUBDIVISION

Discipline  
CIVIL

Designed By  
JMB

Project No.  
23884.002

Checked By  
HD

Drawn By  
AB

Status  
INFO

Approved By  
DG

Scale at A1  
1:500

Title  
FUNCTIONAL LAYOUT PLAN  
SHEET 2 OF 2

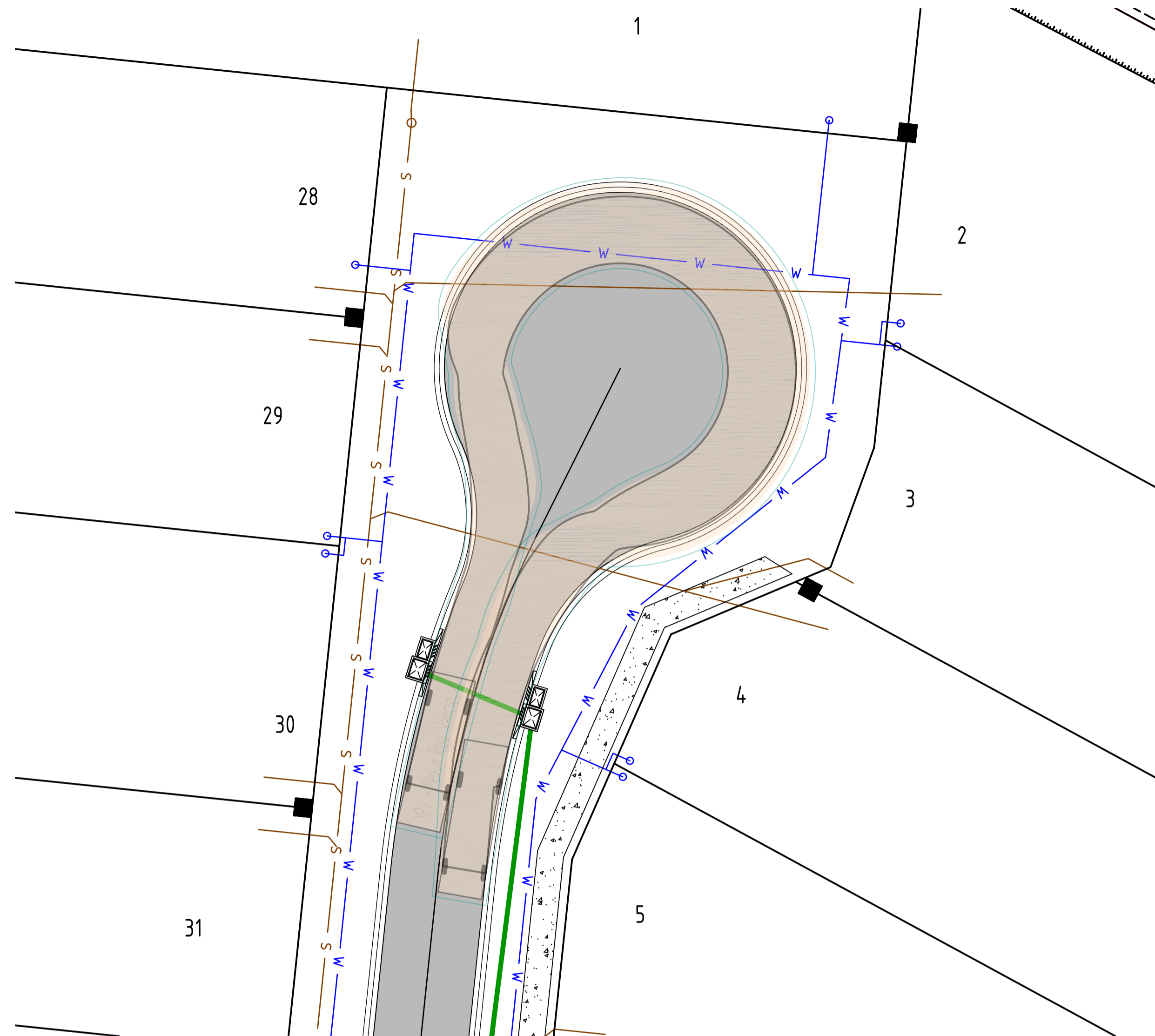
Drawing No.  
SK02

Revision  
B

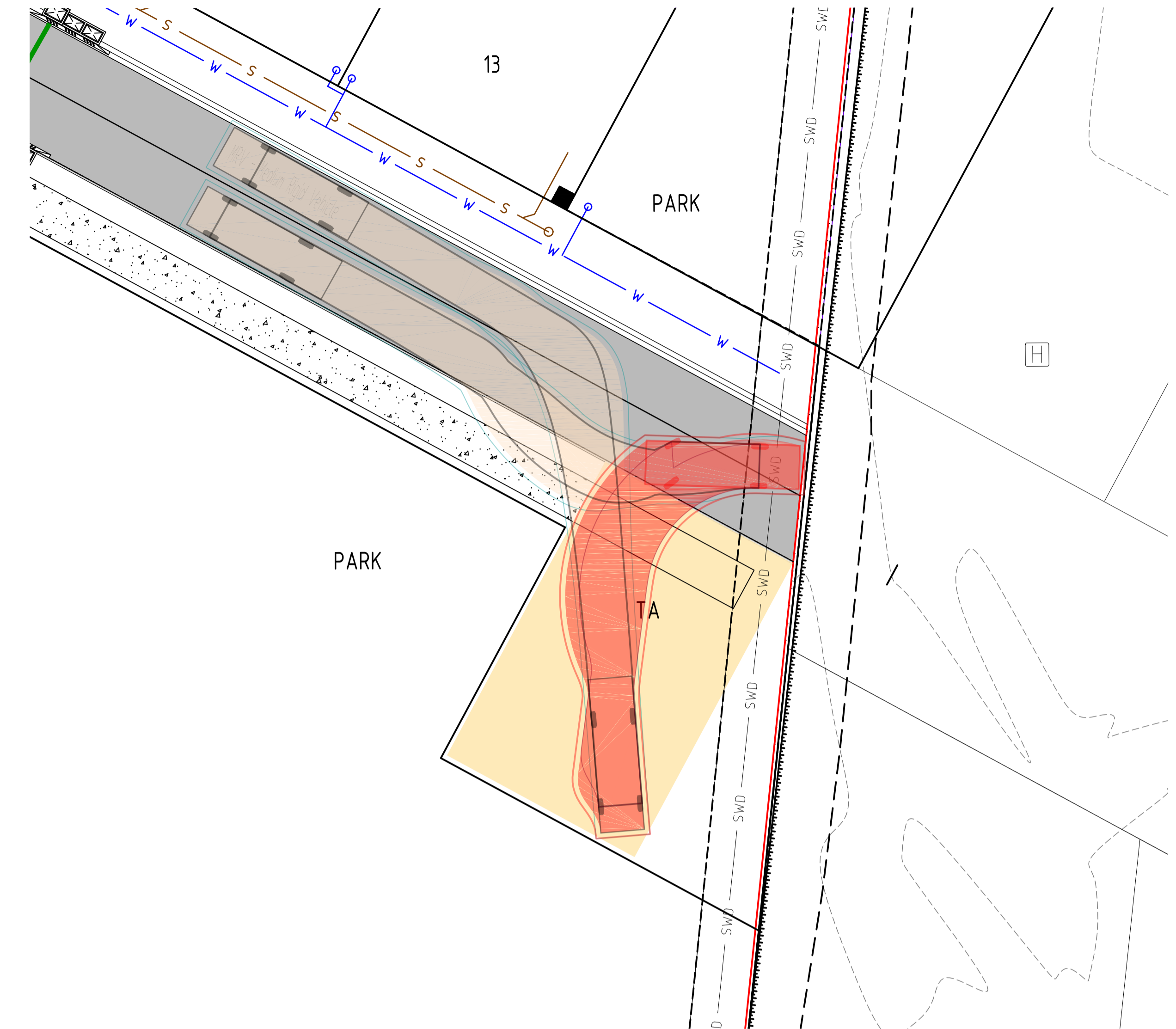
# Appendix D

## Turn Path Analysis





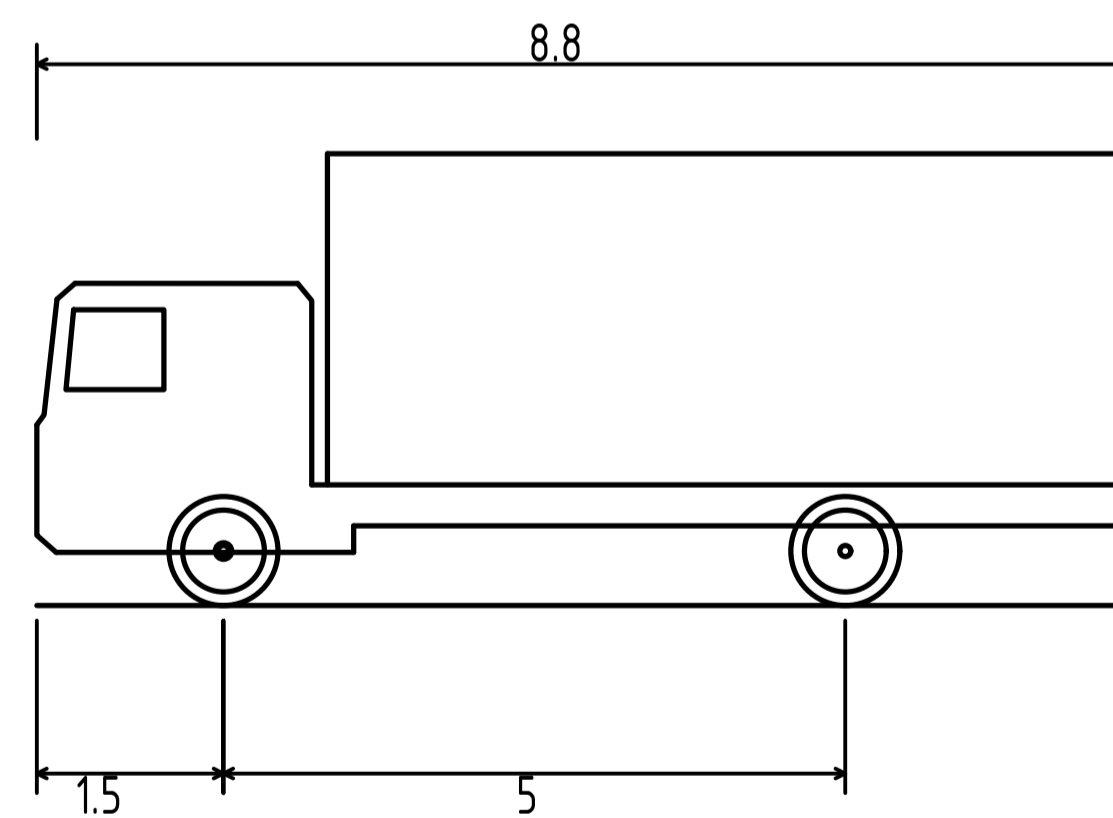
**SERVICE VEHICLE CUL-DE-SAC TURNAROUND**  
SCALE: 1:200



**SERVICE VEHICLE - TEMPORARY TURNAROUND 1**  
SCALE: 1:200

**HATCH LEGEND**

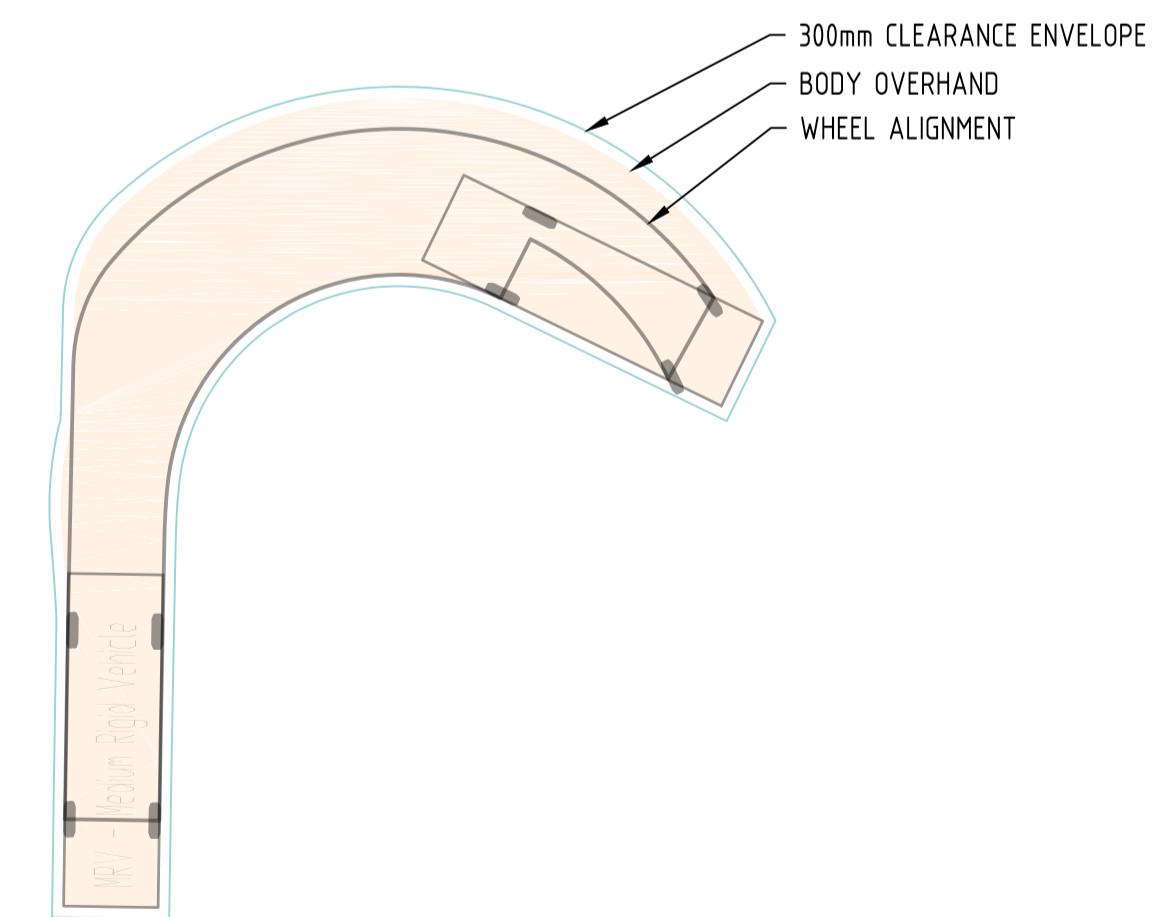
- FORWARD DIRECTION
- REVERSE DIRECTION
- PROPOSED TEMPORARY TURNAROUND
- PROPOSED ASPHALT PAVEMENT



**SERVICE VEHICLE**

N.T.S

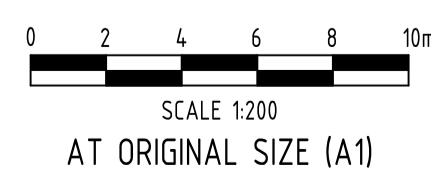
Overall Length	8.800m
Overall Width	2.500m
Overall Body Height	3.633m
Min Body Ground Clearance	0.428m
Track Width	2.500m
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	10.000m



**SERVICE VEHICLE TRACK PATH**  
SCALE: 1:200

**PRELIMINARY**  
NOT FOR CONSTRUCTION

Rev	Date	Description	By	Chk
B	08.03.22	ISSUED FOR INFORMATION - LOT BOUNDARIES ADJUSTED	JMB	HD
A	25.02.22	ISSUED FOR INFORMATION	AB	HD



**Darwin Office**  
Suite G01, Manunda Place, 38 Cavenagh Street,  
Darwin, Northern Territory 0800, Australia  
GPO Box 2422, Darwin, Northern Territory 0801  
T 1300 657 402 F +617 3871 2266  
E info@adgce.com W www.adgce.com  
BRISBANE / DARWIN / GOLD COAST / MELBOURNE / PERTH /  
SUNSHINE COAST / SYDNEY / TOOWOOMBA

Client  
GEMA (NT) PTY LTD

Project Name  
MARRARA GARDENS  
SUBDIVISION

Discipline  
CIVIL

Designed By  
JMB

Project No.  
23884.002

Checked By  
HD

Drawn By  
AB

Status  
INFO

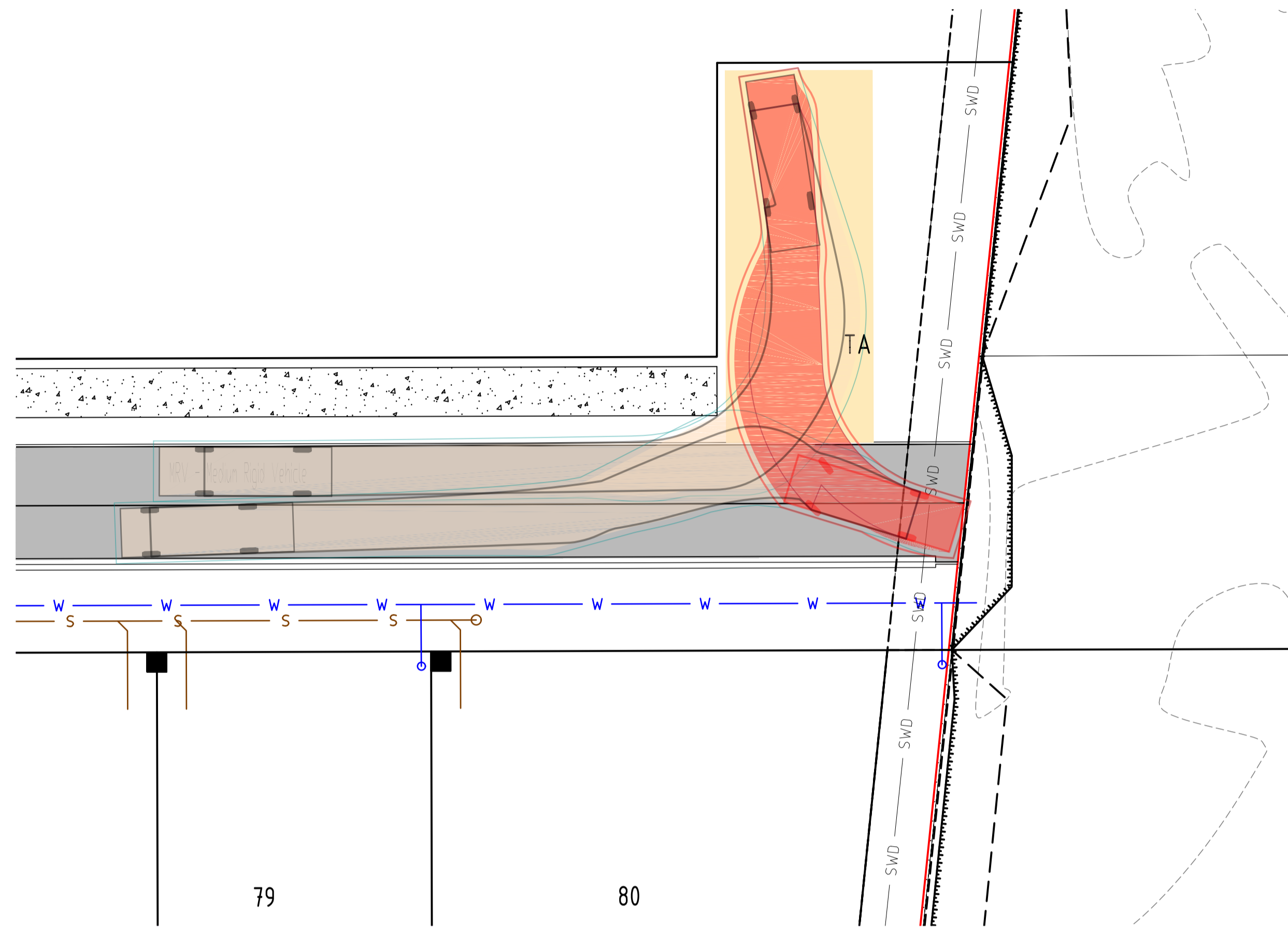
Approved By  
DG

Scale at A1  
1:200

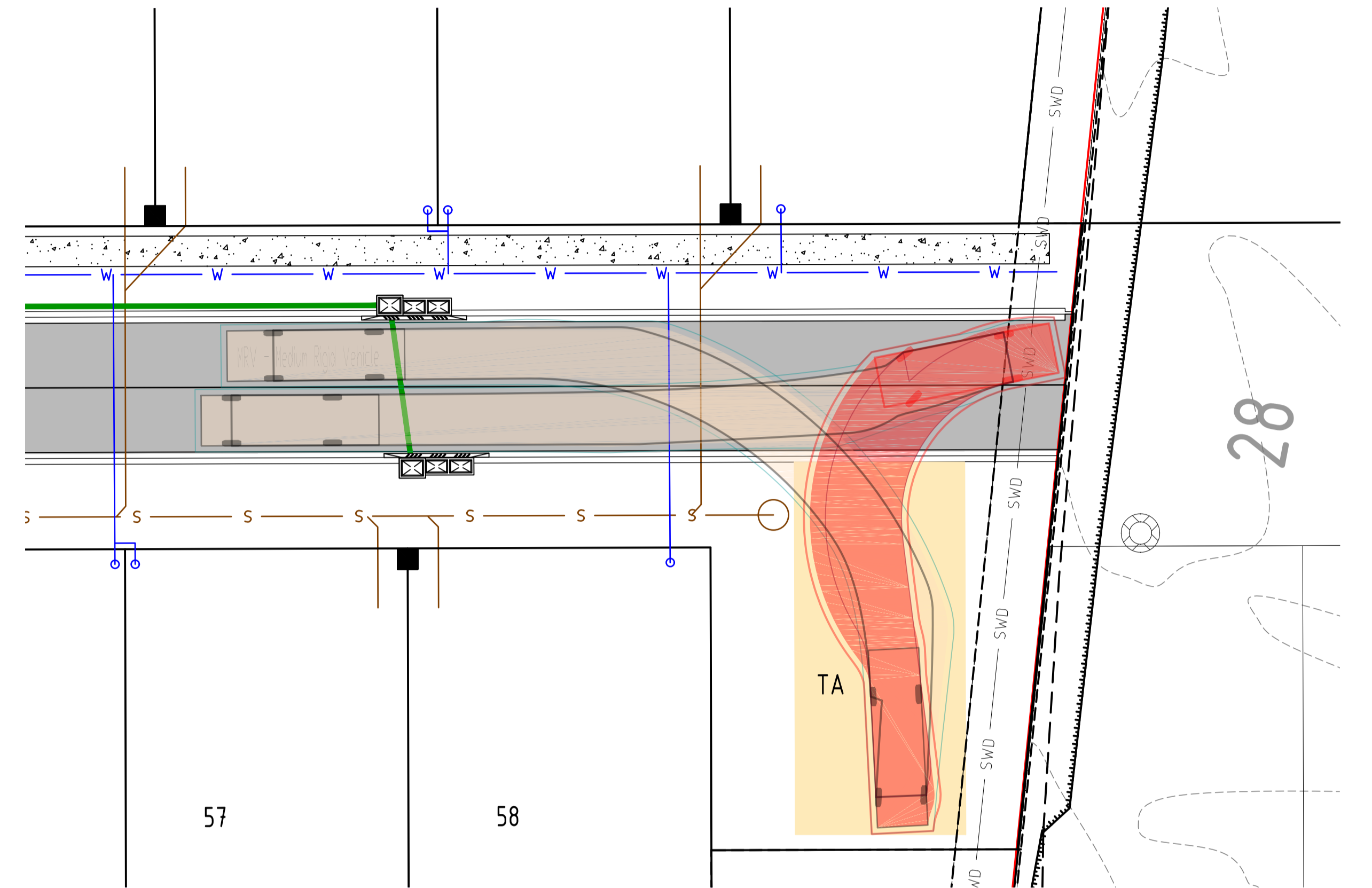
Title  
VEHICLE TRACKING  
MEDIUM RIGID VEHICLE  
SHEET 1 OF 2

Drawing No.  
SK05

Revision  
B



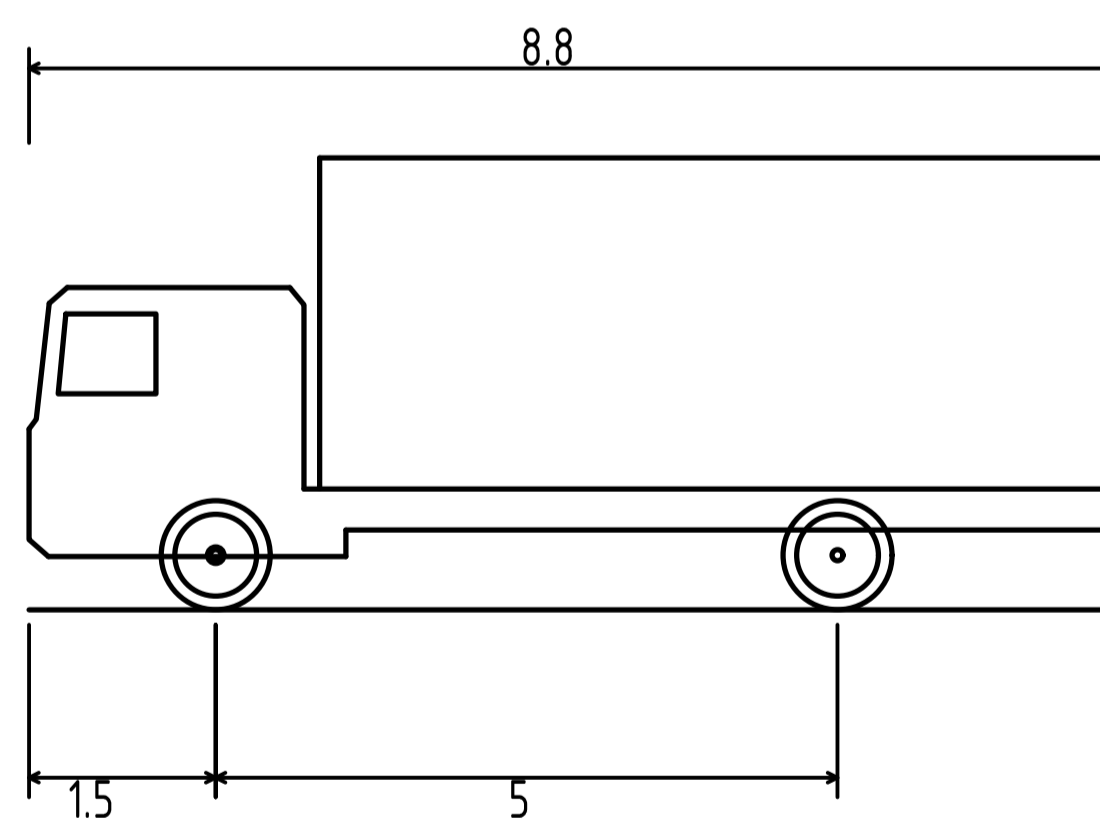
**SERVICE VEHICLE - TEMPORARY TURNAROUND 2**  
SCALE: 1:200



**SERVICE VEHICLE - TEMPORARY TURNAROUND 3**  
SCALE: 1:200

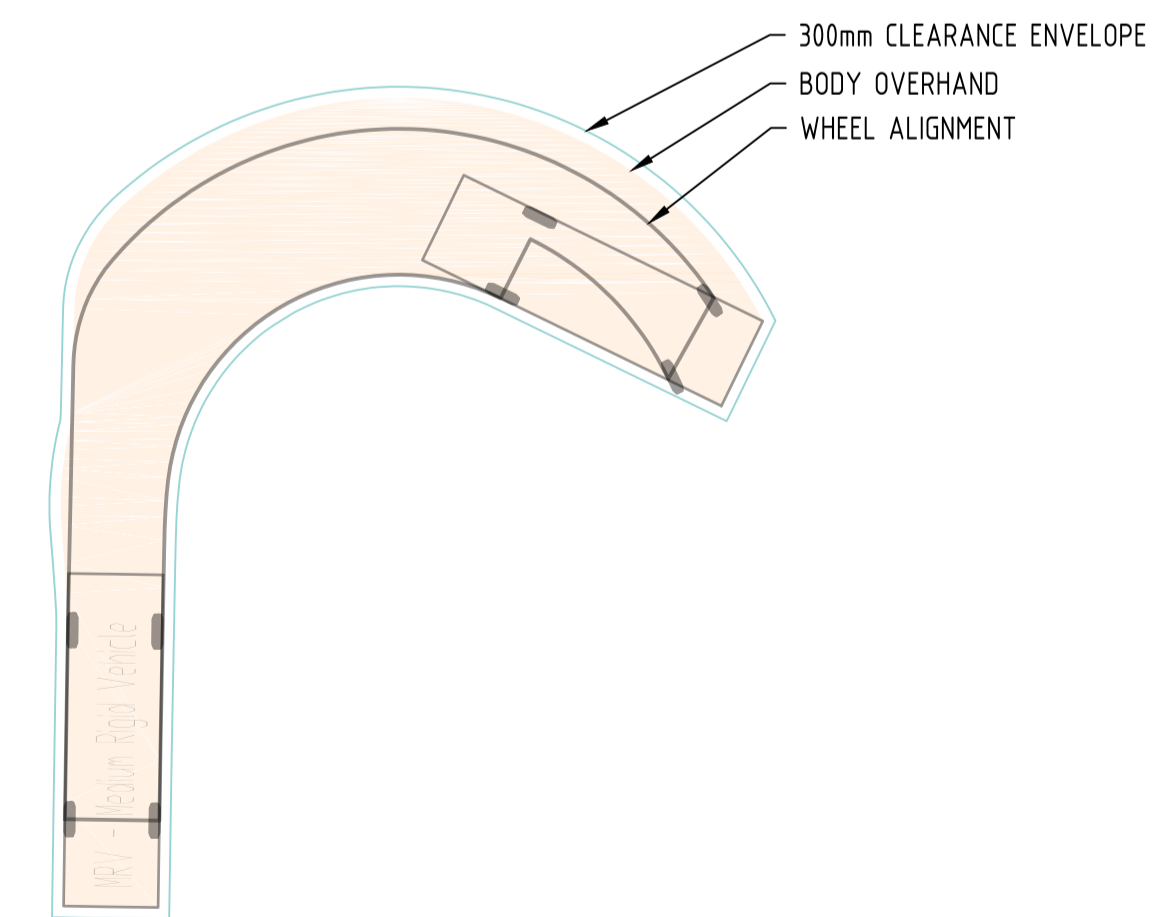
**HATCH LEGEND**

- FORWARD DIRECTION
- REVERSE DIRECTION
- PROPOSED TEMPORARY TURNAROUND
- PROPOSED ASPHALT PAVEMENT



**SERVICE VEHICLE**  
N.T.S

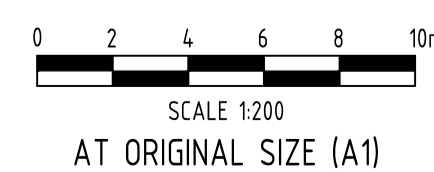
Overall Length	8.800m
Overall Width	2.500m
Overall Body Height	3.633m
Min Body Ground Clearance	0.428m
Track Width	2.500m
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	10.000m



**SERVICE VEHICLE TRACK PATH**  
SCALE: 1:200

**PRELIMINARY**  
NOT FOR CONSTRUCTION

Rev	Date	Description	By	Chk
B	08.03.22	ISSUED FOR INFORMATION - LOT BOUNDARIES ADJUSTED	JMB	HD
A	25.02.22	ISSUED FOR INFORMATION	AB	HD



**Darwin Office**  
Suite G01, Manunda Place, 38 Cavenagh Street,  
Darwin, Northern Territory 0800, Australia  
GPO Box 2422, Darwin, Northern Territory 0801  
T 1300 657 402 F +617 3871 2266  
E info@adgce.com W www.adgce.com  
BRISBANE / DARWIN / GOLD COAST / MELBOURNE / PERTH /  
SUNSHINE COAST / SYDNEY / TOOWOOMBA

Client  
GEMA (NT) PTY LTD

Project Name  
MARRARA GARDENS  
SUBDIVISION

Discipline  
CIVIL

Designed By  
JMB

Project No.  
23884.002

Checked By  
HD

Drawn By  
AB

Scale at A1  
1:200

Status  
INFO

Approved By  
DG

Scale at A1  
1:200

Title  
VEHICLE TRACKING  
MEDIUM RIGID VEHICLE  
SHEET 2 OF 2

Drawing No.  
SK06

Revision  
B



# Appendix E Traffic Assessment



A better approach  
to traffic solutions

13 Dec 2021

Mr George Tsirbas  
39 Winnelie Road,  
Winnelie, 0820

Dear George,

### **INTERNAL ROAD NETWORK ASSESSMENT- PORTIONS 1841, 1842, AND 1843 HUNDRED OF BAGOT**

A traffic analysis was undertaken to determine the daily access volumes for the internal road network for proposed 158 lot residential subdivision at 440, 450 and 460 McMillans Road, in Marrara.

#### **Daily traffic generation**

The RTA *Guide to Traffic Generating Developments 2002* used to estimate traffic generation from developments recommends for residential houses (conventional lots) a daily trip rate of 9 trips per dwelling. For the purpose of this assessment, a conservative daily trip rate of 10 trips per dwelling per day was assumed for each of the lots for the proposed residential subdivision.

#### **Traffic distribution**

It is assumed that all vehicles within the subject site will utilise the two accesses on McMillans Road to travel to / from the site. No access was provided to the east of the subject site. Vehicles from each lot were distributed within the internal road network to travel to and from the closest access via McMillans Road.

Figure 1 provides and traffic distribution within the proposed residential subdivision.

#### **Daily traffic volumes**

From the above assumption, anticipated daily traffic volumes were estimated for each of the road segments within the proposed residential subdivision. Refer to Figure 2 for the anticipated daily volumes within the internal road network.

Figure 1: Internal Road network traffic distribution

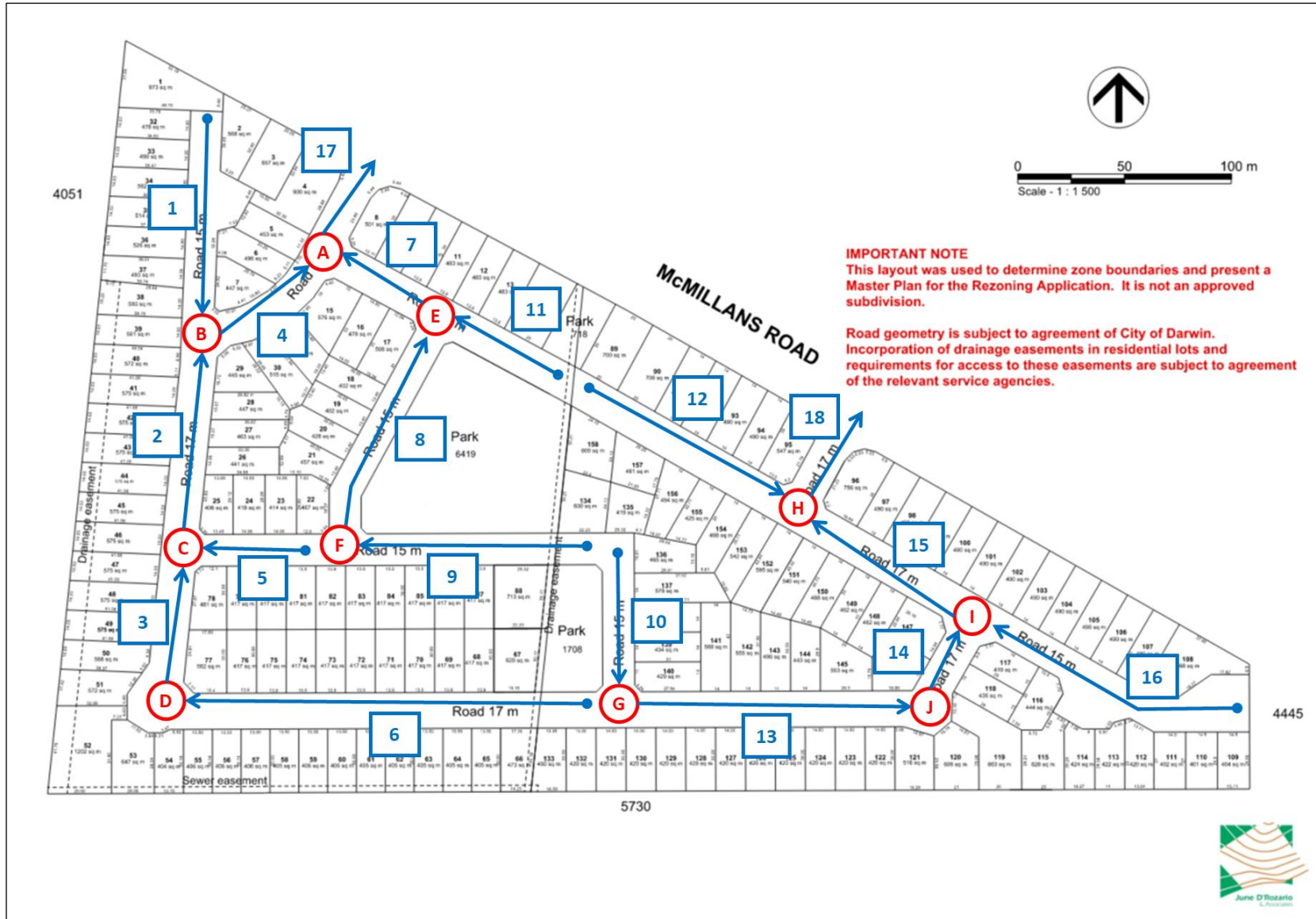
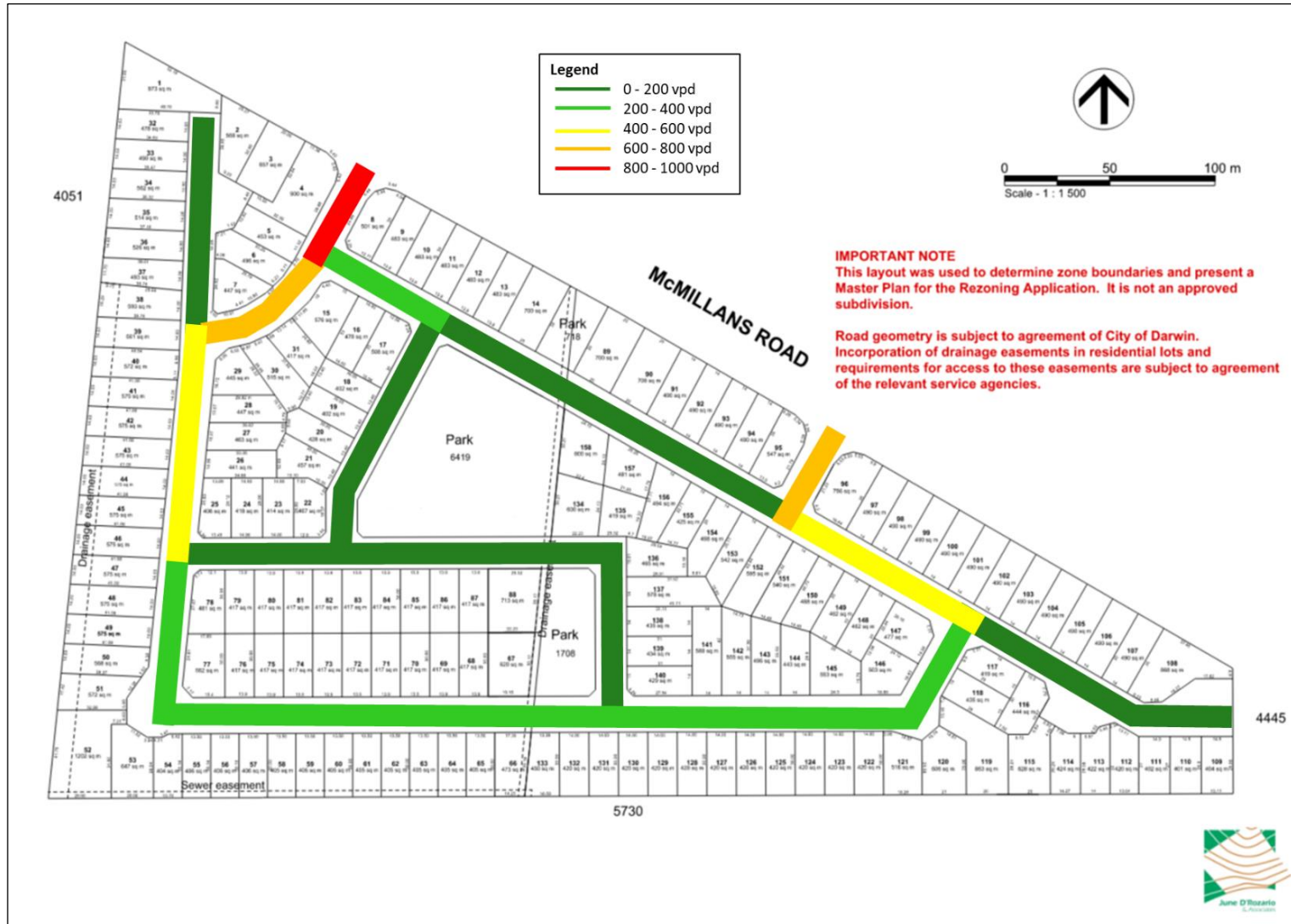




Figure 2: Internal road network traffic distribution



## Street Hierarchy

Northern Territory *Subdivision Development Guidelines August 2020* provides street classifications and design criteria for roads within the residential subdivisions. Typical max annual daily traffic volumes and minimum reserve widths are provided for each street type, including for Minor Street / Cul-de-sac and Access Street. Tables 5 and 6 of the Northern Territory *Subdivision Development Guidelines August 2020* provide the street hierarchy selection and design criteria, respectively.

An assessment was undertaken to compare the anticipated volumes and road reserves within the subject site with the Northern Territory *Subdivision Development Guidelines August 2020* and determine the suitable for each road segments within the proposed residential subdivision.

Refer to Table 1 for the road reserve suitability.

Zoning	Street Type	Typical Max Annual Daily Traffic Volumes (vpd)	Typical Max No. of Dwellings	Typical Max Street Length (m)
Residential/ Mixed Use	Laneway (Set A Only)	n/a	10	140
	Minor Street/ Cul-de-sac	1,500	30	300
	Access Street	3,000	60	600
	Secondary Collector	5,000	300	As approved
	Primary Collector	10,000	400	As approved
Industrial	Access Street	n/a	50	1,000
	Collector	n/a	>50	As approved

Table 6 – Street Hierarchy Design Criteria - Category A - Set 1

Zoning Type	Street Hierarchy	Reserve Width (Minimum)	Carriageway Width (Minimum)	Central Median	Verge Width (Minimum)	Formalised Parking Lanes <sup>2</sup>	Footpath <sup>4</sup>	Lot Access
Residential/ Mixed Use <sup>1</sup>	Laneway	6.25m <sup>2</sup>	2 x 3m	None	None	None	None	Direct access
	Minor Street/ Cul-de-sac	15m	2 x 3m	None	2 x 4.5m	None	1 x 1.5m	Direct access
	Access Street	16m	2 x 3.5m	None	2 x 4.5m	None	1 x 1.5m	Direct access
	Secondary Collector	21.6m	2 x 3.5m	As Required	2 x 5m	2 x 2.3m	1 x 1.5m 1 x 2.5m	Direct access
	Primary Collector	24.6m	2 x 3.5m	3m	2 x 5m	2 x 2.3m	2 x 2.5m	Access via rear laneway where ADT > 5000
Industrial	Access Street	21m	2 x 5.5m	As Required	2 x 5m	None	1 x 1.5m	Direct access
	Collector	23m	2 x 6.5m	As Required	2 x 5m	None	1 x 1.5m	Direct access

Table 1: Internal road reserve width suitability

Road Segment	Residential Subdivision		Northern Territory Subdivision Development Guidelines August 2020		
	Anticipated Daily Volumes (vpd)	Proposed Road Reserve (metres)	Street Classification	Required Reserve With (metres)	Suitability
1	150	15	Minor Street	15	Yes
2	520	17	Minor Street	15	Yes
3	480	17	Minor Street	15	Yes
4	690	17	Minor Street	15	Yes
5	80	15	Minor Street	15	Yes
6	260	17	Minor Street	15	Yes
7	220	17	Minor Street	15	Yes
8	120	15	Minor Street	15	Yes
9	80	15	Minor Street	15	Yes
10	60	15	Minor Street	15	Yes
11	30	17	Minor Street	15	Yes
12	130	17	Minor Street	15	Yes
13	220	17	Minor Street	15	Yes
14	280	17	Minor Street	15	Yes
15	540	17	Minor Street	15	Yes
16	150	15	Minor Street	15	Yes
17	910	17	Minor Street	15	Yes
18	670	17	Minor Street	15	Yes

From Table 1 above, the proposed road reserve on each segment within the internal subdivision road network meets the design criteria for the anticipated daily traffic volumes as per the Northern Territory *Subdivision Development Guidelines August 2020*.

The internal road in the south east corner (road segment 16) could be increased to 17 m in width to match the remaining sections of that road and to future-proof for future additional traffic, however, this is not necessary as it is noted that the daily volumes required to trigger an Access Street is 3,000 vpd. The expected volumes on the internal streets are significantly below this, and therefore, it is anticipated that the internal roads will be able to accommodate additional traffic that may be generated from the adjacent future development to the east.

As such, the proposed road reserve widths is determined to be suitable for the residential subdivision.

Yours faithfully,  
SJ Traffic Consulting



Afshin Beigi,  
Director

## Sam Warner

---

**From:** Afshin Beigi <afshin@sjtrafficconsulting.com.au>  
**Sent:** Tuesday, 21 December 2021 12:37 PM  
**To:** Sam Warner  
**Cc:** George Tsirbas; Dalton Glasby; Jonathan Lanyon  
**Subject:** RE: 23884 - Marrara Gardens Traffic

Hi Sam,

I've undertaken a SIDRA analysis for the AM and PM peaks at the site access intersection. For this analysis I have based it on the following assumptions:

### Traffic volume – residential development traffic volumes

- Road segment 17 (Stage 1 access) has been calculated to have 910 vpd
- Assumed that the peak hour volume will be 10% of the daily volume – 91 vph
- Assumed that in the AM peak: 80% are exiting and 20% are entering the residential area
- Assumed that in the PM peak: 40% are exiting and 60% are entering the residential area
- Assumed 50% / 50% split with residential traffic travelling east and west

Total	91			
	IN	OUT	EAST	WEST
AM	20%	80%	50%	50%
PM	60%	40%	50%	50%
	IN		OUT	
	East	West	East	West
AM	9	9	37	37
PM	28	28	18	18

### Model notes

- Assumed 3% per annum growth rate for McMillans Road through traffic

### Model results

- The intersection will operate well in existing and proposed conditions (10 year design life)
- In the proposed conditions (10 year design life), the 95<sup>th</sup> percentile queue in the short right turn lane will continue to be contained within the storage length

In summary, the existing access arrangements will be able to adequately accommodate for the traffic generated by Stage 1 from an operation perspective.

Regards

### **Afshin Beigi**

Senior Traffic Engineer  
BEng(Civil) MEng( Traffic)

Accredited Senior Road Safety Auditor | Accredited Paramics Modeller (APU)  
PO Box 29/29 Woods St, Darwin, 0800  
mobile 0451501408

---

**From:** Sam Warner <swarner@adgce.com>  
**Sent:** Wednesday, December 15, 2021 5:19 PM  
**To:** Afshin Beigi <afshin@sjtrafficconsulting.com.au>

# Appendix F

## Power Water Existing Services Plan



All network data is the property of Power and Water and no warranty as to the accuracy or completeness of information is provided. No liability for any loss or damage arising from the use of this information will be accepted. Copyright (c) Power and Water Corporation.

Land information has been provided by the NT Department of Infrastructure, Planning and Logistics. Land data should not be used externally to Power and Water. Copyright (c) Northern Territory Government.





---

**Brisbane**

584 Milton Road, Cnr Sylvan Road  
Toowong, QLD 4066  
PO Box 1492  
Toowong BC, QLD 4066  
**Phone:** +61 07 3300 8800  
**Email:** info@adgce.com

---

---

**Sydney**

13 / 20 Berry Street,  
North Sydney NSW 4006  
**Phone:** +61 02 8908 5400  
**Email:** info@adgce.com

---

---

**Melbourne**

Suite 323, 838 Collins Street,  
Docklands VIC 3008  
**Phone:** +61 03 9269 6300  
**Email:** info@adgce.com

---

---

**Gold Coast**

Suite 201, Level 1, 1 Short Street  
Southport, QLD 4215  
PO Box 208  
Southport, QLD 4215  
**Phone:** +61 07 5552 4700  
**Email:** info@adgce.com

---

---

**Sunshine Coast**

Level 3, 2 Emporio Place  
Maroochydore, QLD 4558  
PO Box 5014  
Maroochydore BC, QLD 4558  
**Phone:** +61 07 5444 0400  
**Email:** info@adgce.com

---

---

**Darwin**

Suite G01, Manunda Place, 38  
Cavenagh St,  
Darwin NT 0800  
GPO Box 2422  
Darwin, NT 0801  
**Phone:** +61 08 8944 6300  
**Email:** info@adgce.com

---

---

**Perth**

Level 3, Suite 15, 23 Railway Road,  
Subiaco, WA 6008  
PO Box 443  
Subiaco, WA 6904  
**Phone:** +61 08 9217 0900  
**Email:** info@adgce.com

---

