CYCLE LINK – DRUMMOND COVE TO SUNSET BEACH

Chapman Road
FEASIBILITY STUDY

Prepared by: GTA Consultants (WA) Pty Ltd for City of Greater Geraldton

on 14/03/19

Reference: W1219424

Issue #: A-F

GTAconsultants

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Quality Record

Issue	Date	Description	Prepared By	Checked By	Approved By	Signed
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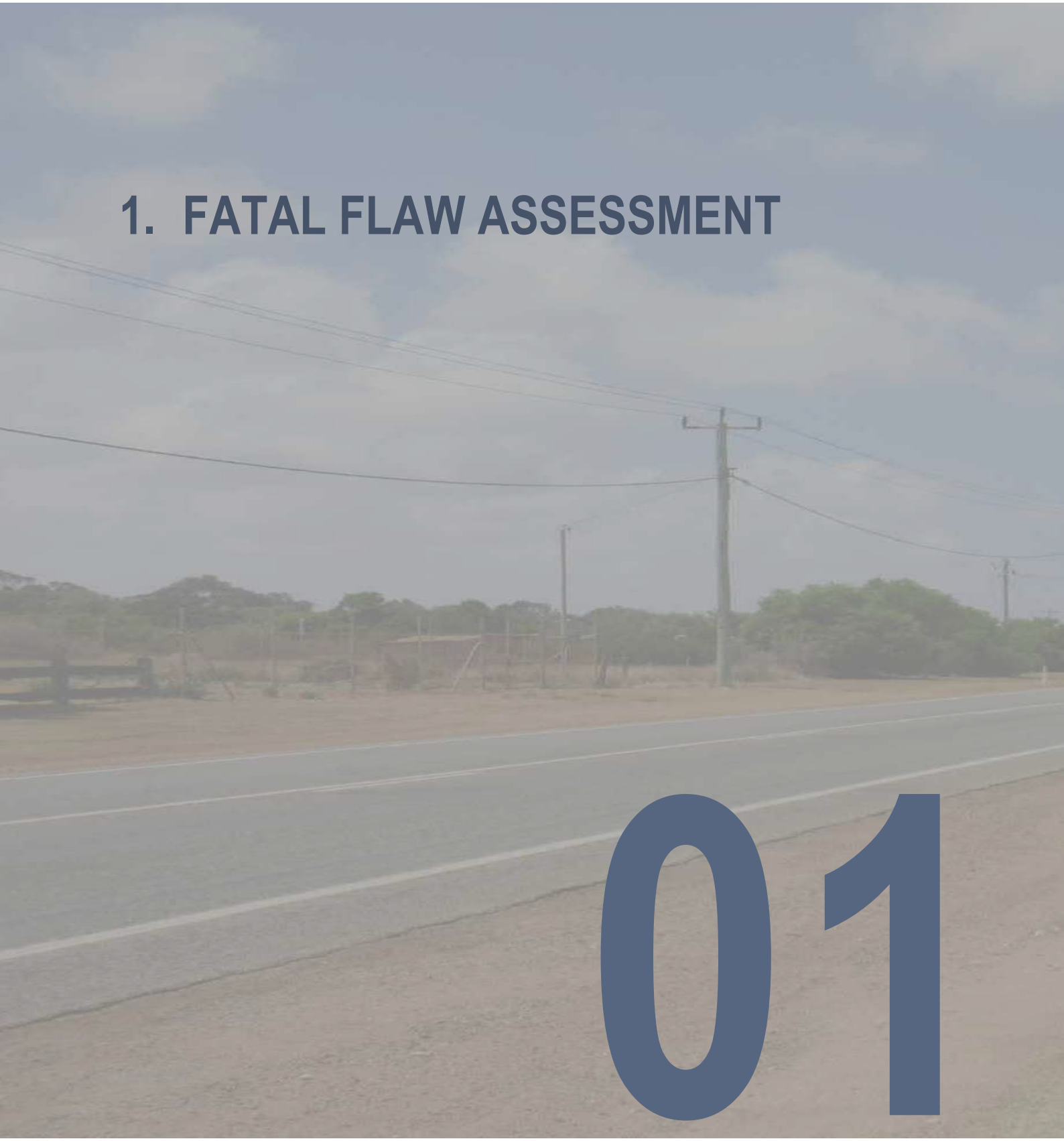


1. FATAL FLAW ASSESSMENT

01

1.1. Introduction

GTA Consultants (GTA) has been engaged by CGG to undertake a feasibility study and concept design for a cycle link between Drummond Cove in the north to Sunset Beach to the south.

This project is an initiative of the Geraldton 2050 Cycling Strategy, which provides a long-term aspirational vision of Geraldton's proposed 2050 cycling network and makes recommendations for short-term actions and initiatives to plan the development of the cycle network. This project has identified the ideal cycling link along Chapman Road between Drummond Cove and Sunset Beach accompanied with a concept design.

To determine the feasibility of the cycle link GTA investigated all the relevant data, Strategies and Future Structure Plans to ensure the study aligns with pre-adopted strategic directions.

1.2. City of Greater Geraldton Integrated Transport Strategy

The City of Greater Geraldton Integrated Transport Strategy (ITS) was prepared based on information provided as part of community and stakeholder consultation, review of current policy context, best-practice review, strategic transport modelling, on-site observations and a TransPriority assessment. Based on this information, key issues and opportunities were determined and recommendations and priority projects identified.

A key priority project for the pedestrian and cyclist network include a review of speed limits and traffic management on Chapman Road. The ITS also identifies the need to increase walking and cycling within the CGG area, incorporation of active transport into redevelopments and new developments and increase of walking and cycling to schools.

1.3. Geraldton 2050 Cycling Strategy

The Geraldton 2050 Cycling Strategy (Cycling Strategy) is the strategic document prepared jointly by the CGG and Department of Transport (DoT). It identifies six guiding principles for the development of the cycling infrastructure in Geraldton.

The six principles are listed below:

1. **Safe**

Geraldton's 2050 cycling network should be built to a standard which reflects the "8 to 80" design philosophy. People of all ages should be able to cycle safely and confidently to the places they need and want to go to. Unprotected cycling facilities located on busy roads are not considered suitable for vulnerable road users, and will not encourage more people to cycle, more often.

2. **Connected**

Like a road network, all cycling routes should connect to something at each end (whether that be a destination, or another cycling route).

3. **Widespread**

The network should be comprehensive enough for people to safely assume they can get to their destination without encountering hostile traffic conditions. When cycling networks reach a certain level of density it enables families to live comfortably without a second car.

4. **Legible**

The cycling network needs to be both intuitive and direct. To achieve this, it makes sense to locate major cycling routes parallel to natural land forms such as rivers and coastlines or within major road and rail corridors. Coherent way-finding initiatives are also important in ensuring legibility.

5. **Aspirational**

Given the long-term nature of this strategy, several ambitious ideas have been put forward to help position Greater Geraldton as a safe, pleasant and enjoyable region for cycling.

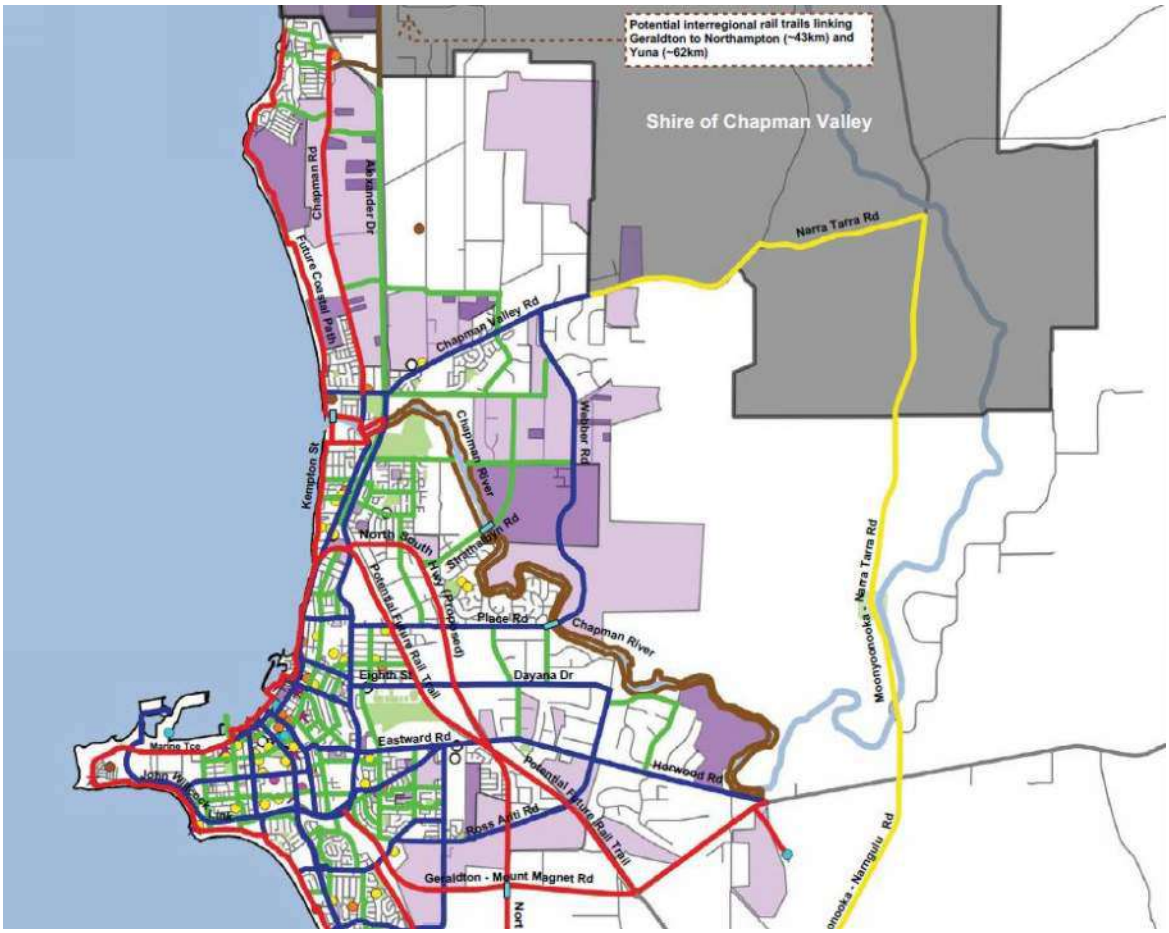
6. **Achievable**

For the most part, the proposals put forward in this strategy adopt tried-and-tested planning principals. The case studies chosen to provide local and interstate examples of similar projects undertaken in recent years.

A review of the existing network identified that the "legibility of Geraldton's existing cycling network is compromised by its disconnectedness and frequent changes between on-road and off-road infrastructure". This will be important to take into consideration as part of the design, to ensure that the cycling infrastructure is consistent to minimise disruption to the cyclist.

Chapman Road, north of Bosley Street, to Drummond Cove was also identified as a primary route of the 2050 network.

Figure 1.1: Extract of the proposed 2050 cycling network for Geraldton's urban area



(Reproduced from the Geraldton 2050 Cycling Strategy)

A high-quality cycling route that caters to the needs of cyclists of all ages and abilities between Sunset Beach and Drummond Cove was identified as an opportunity due to the lack of existing continuous infrastructure as well as Chapman Road's high-speed limit.

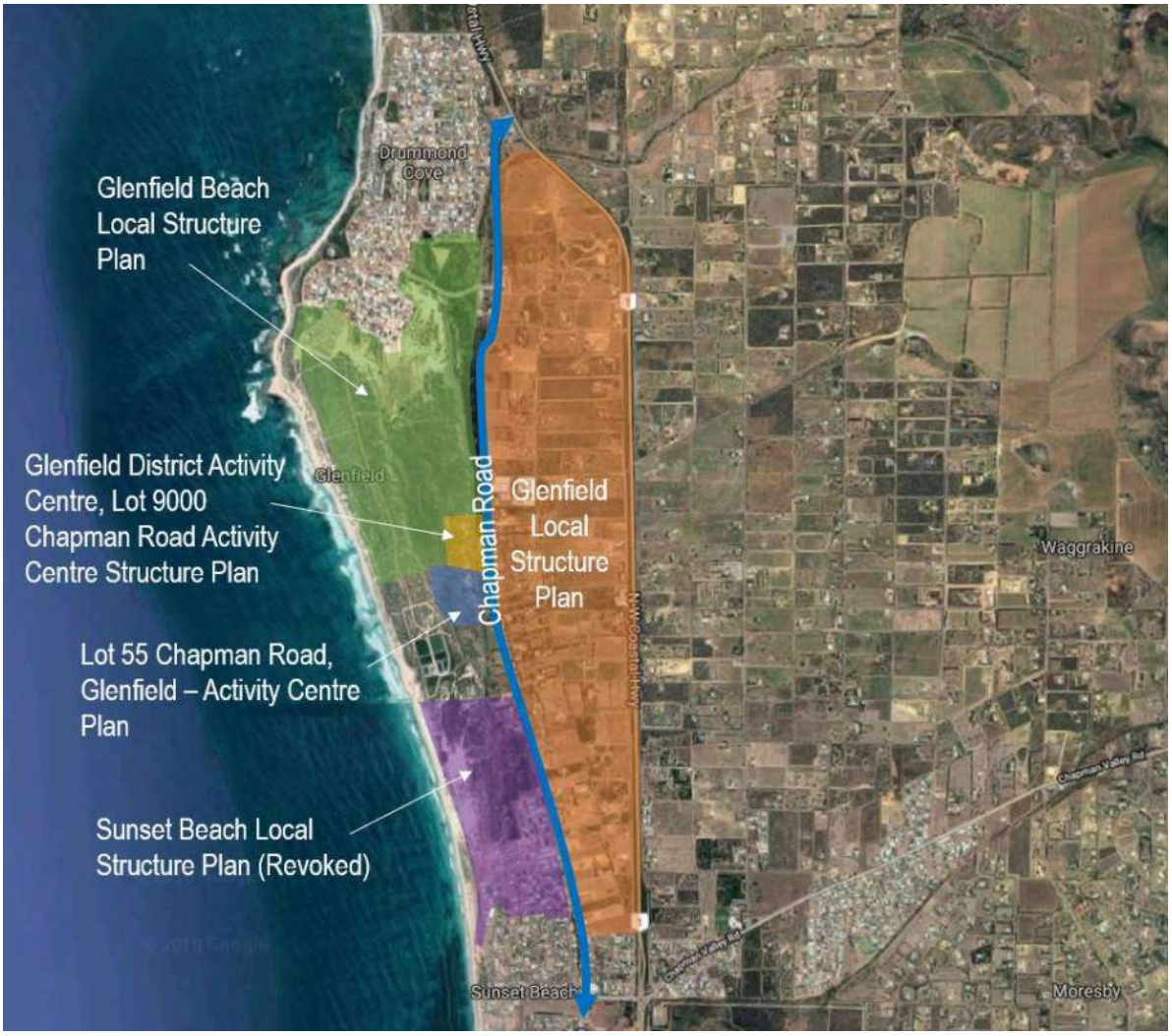
The Cycling Strategy suggests a shared path on the western verge or a coastal shared path through the coastal vistas. As part of this project, GTA have analysed the feasibility of these suggested routes and provided recommendations accompanied with a concept design of the selected route.

1.4. Local Structure Plans

Chapman Road, between Drummond Cove to Sunset Beach abuts a number of structure plans, as illustrated in Figure 1.2.

- Lot 55 Chapman Road, Glenfield – Activity Centre Plan
- Glenfield District Activity Centre, Lot 9000 Chapman Road Activity Centre Structure Plan
- Glenfield Beach Local Structure Plan
- Glenfield Local Structure Plan
- Sunset Beach Local Structure Plan (Revoked).

Figure 1.2: Surrounding Structure Plans



(Picture Map Reproduced from Nearmaps)

A summary of the characteristics of the proposed structure plans is presented in Table 1.1.

Table 1.1: Proposed Local Area Structure Plans

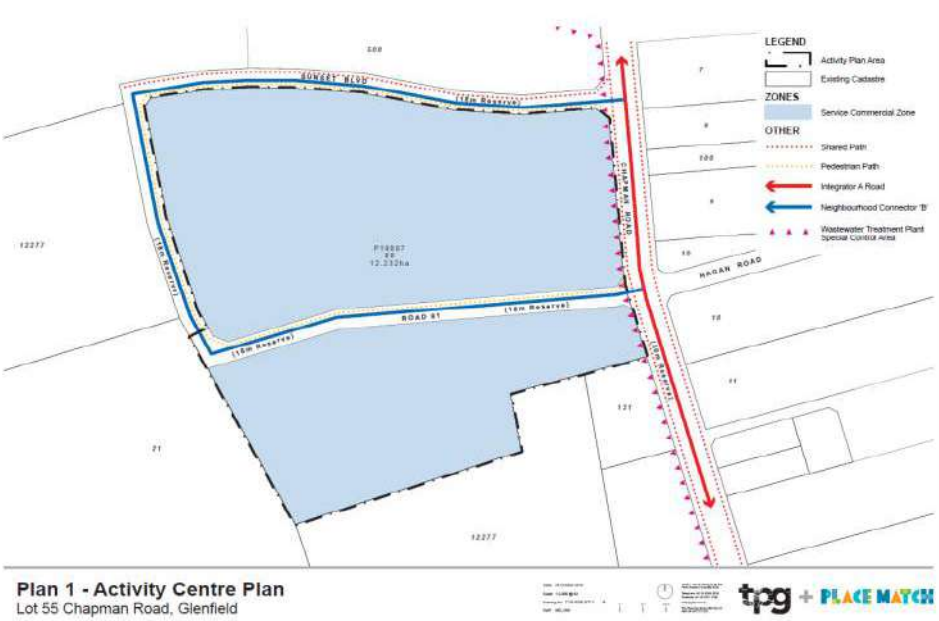
Structure Plan	Estimated Number of Dwellings (approx.)	Estimated Population (approx.)	Estimated Commercial, Community, Bulky Goods, Light Service Industry, Mixed Business NLA (approx.)
Lot 55 Chapman Road, Glenfield – Activity Centre Plan	100	230	33,660m^2
Glenfield District Activity Centre, Lot 9000 Chapman Road Activity Centre Structure Plan	830	N/A	111,250m^2
Glenfield Beach Local Structure Plan	2,000	5,500	N/A
Glenfield Local Structure Plan	5,324	12,245	7,933sqm
Estimated dwellings within the undeveloped portion of the Revoked Sunset Beach Local Structure Plan	323	743	N/A
Total	**8,577**	**18,718**	**152,843m^2**

1.4.1. Lot 55 Chapman Road, Glenfield – Activity Centre Plan

Lot 55 Chapman Road, Glenfield Activity Centre Plan (Figure 1.3) identifies the key movement networks proposed, including a pedestrian footpath around the perimeter of the northern lot along the Neighbourhood Connector 'B' road, and a shared path along the northern side of Sunset Boulevard and along both sides of Chapman Road. The structure plan is for an Activity Centre and as such does not comprise of any Residential Land Uses. The Structure Plan identifies all the land to be zoned as the Service Commercial Zone, including approximately 32,040m^2 Gross Floor Area (GFA) of bulky goods showrooms, a 120m^2 service station and a 1,500m^2 liquor store, as well as associated car parking.

The structure plan area is on the western side of Chapman Road and includes two road connections to Chapman Road. A single lane roundabout at the intersection of Chapman Road, Hagan Road and Road 1 is proposed, as well as at the intersection of Sunset Boulevard and Chapman Road.

Figure 1.3: Lot 55 Chapman Road, Glenfield – Activity Centre Plan Transport Network (TPG 2016)



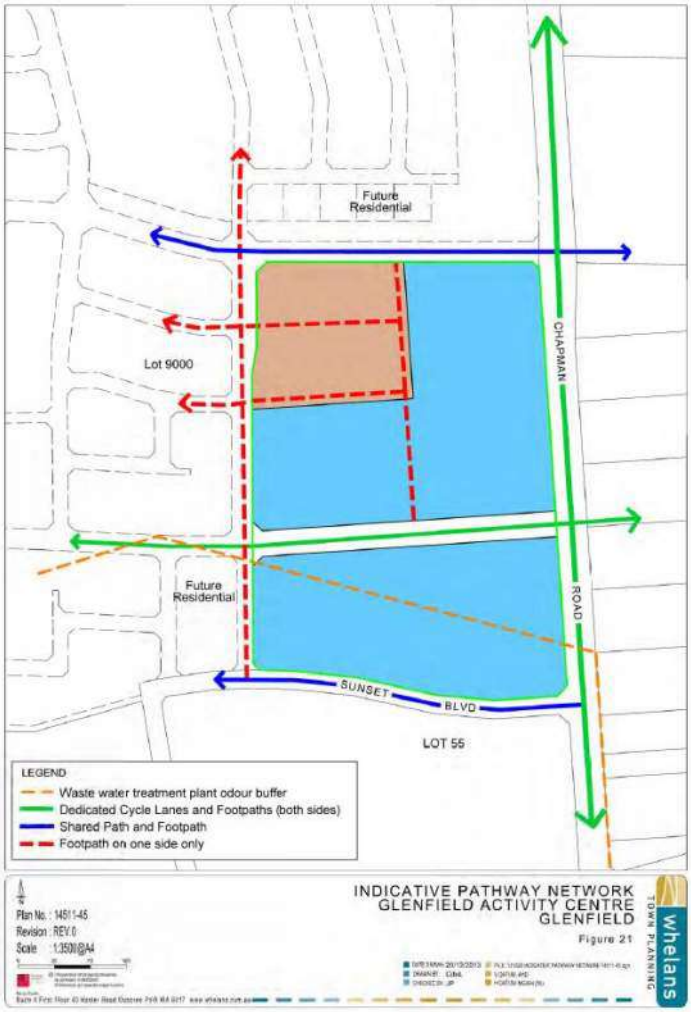
1.4.2. Glenfield District Activity Centre, Lot 9000 Chapman Road Activity Centre Structure Plan

The Glenfield District Activity Centre Structure Plan (Figure 1.4) is located on the western side of Chapman Road, to the north of the Lot 55 Chapman Road, Glenfield Activity Centre Plan. The structure plan will result in three four-way intersections which connect with the Glenfield Structure Plan, to the east of Chapman Road. The northernmost and southernmost proposed intersections are indicated to be roundabouts whilst the central access is proposed to be signalised in the future.

The majority of this structure plan is zoned for Commercial (22,500m^2 GFA), Community (750m^2 GFA), Bulky Goods (10,000m^2 GFA), Mixed Business (14,000m^2 GFA), or Light Service Industry (64,000m^2 GFA), (indicated in blue in Figure 1.4), with a portion (145,000m^2) zoned for medium density Residential, with a Residential Density Code (R-Code) of R60, and estimating approximately 830 dwellings.

This structure plan states that dedicated cycle lanes within the road reserve should be considered at subdivision stage. This is also reiterated as part of this assessment, and it is recommended that the City encourage cycling facilities to be provided as part of the subdivision of this area. Figure 1.4 indicates that a shared path should be constructed along the northern and southern perimeters of the structure plan area, whilst dedicated cycle lanes and footpaths to both sides should be constructed along Chapman Road and the Integrator B Road through the centre of the structure plan. Footpaths to one side only are recommended on the other key internal connections and to the western portion of the structure plan.

Figure 1.4: Glenfield District Activity Centre Structure Plan Indicative Pathway Network (Whelans 2013)



1.4.3. Glenfield Beach Local Structure Plan

The Glenfield Beach Structure Plan abuts the Glenfield District Activity Centre Structure Plan and identifies that the structure plan area including the residential and non-residential land uses including the Foreshore Reserve, Public Open Space, Primary School and Activity Centre, would generate approximately 3,000 vehicle trips in the peak hour, with the majority of traffic being distributed onto Glenfield Beach Drive.

The structure plan proposes two connections to Chapman Road due to the large area of public open space within this structure plan (Rum Jungle) which runs adjacent to Chapman Road.

The northernmost intersection, at Glenfield Beach Drive, is currently a roundabout and will remain as a roundabout in the future. The structure plan also recommends a roundabout to the southern intersection as a minimum, which is consistent with the Glenfield District Activity Centre Structure Plan.

This structure plan is primarily zoned Residential. However, it also includes a Primary School, local commercial centre and a special use area. Key cycling and pedestrian access throughout the structure plan is recommended through the main access points to Chapman Road, and a 2.5m shared path and footpath on the opposite side are recommended.

Figure 1.5: Glenfield Beach LSP Active Transport Network (Aecom 2010)

1.4.4. Glenfield Local Structure Plan

The Glenfield Local Structure Plan is located on the eastern side of Chapman Road and identifies the broad linkages which would provide a strong east-west and north-south connection using the road network. The anticipated future pedestrian and cycling network is illustrated in Figure 1.6, which is consistent with the proposed route along Chapman Road. The structure plan proposes to maintain the existing access points to Chapman Road at Macedonia Drive, Hagan Road and Okahoma Road whilst also proposing at least one additional connection to the adjoining structure plans which would traverse Chapman Road and four additional roads intersecting Chapman Road

The form of these intersections has not been identified in the Glenfield Local Structure Plan.

The structure plan proposes a mix of Zones, including Residential, Mixed Use, Special Use (for a future mixed business area), Public Open Space and a Primary School, with the predominant land use being Residential.

The structure plan area is capable of generating up to 578 jobs with the range of commercial land uses as well as the school, and therefore active transport links are important to support local trips.

Figure 1.6: Glenfield Structure Plan Pedestrian and Cycle Network (City of Greater Geraldton 2015)

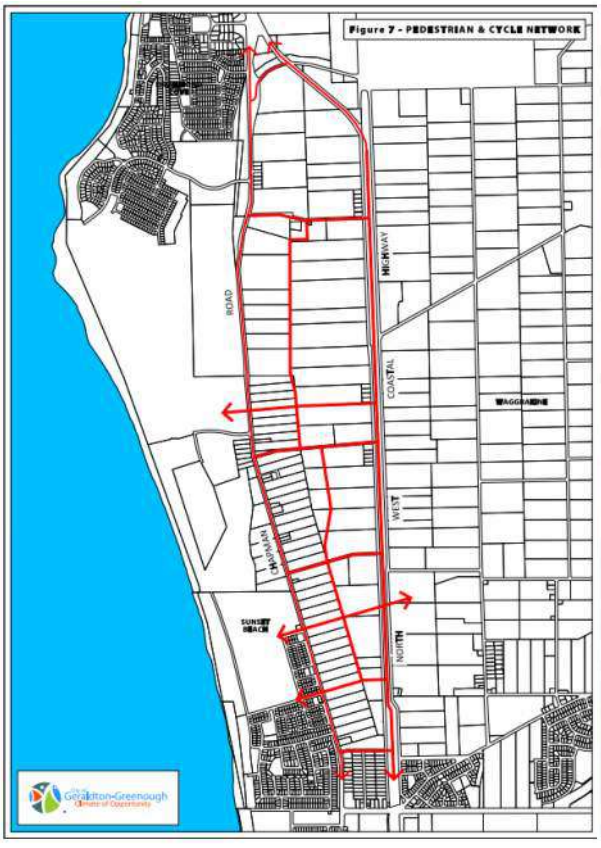
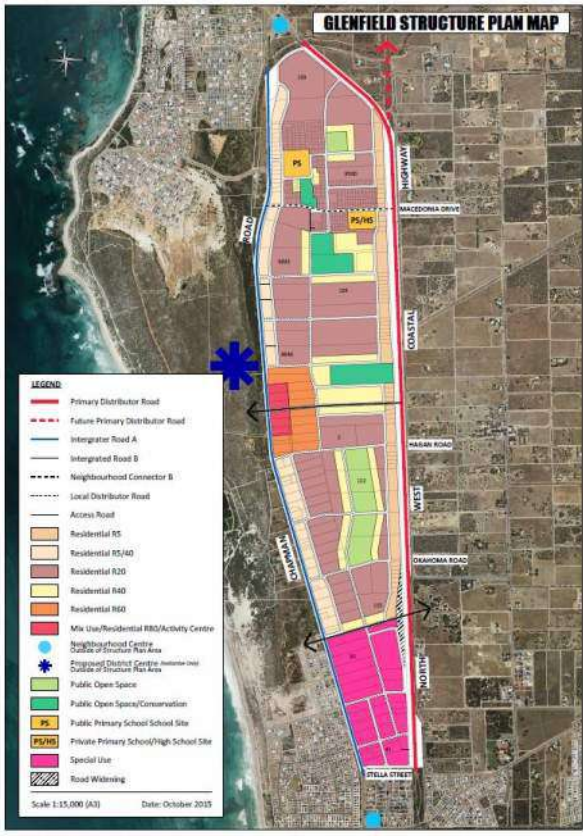


Figure 1.7: Glenfield Structure Plan Map



1.4.5. Sunset Beach Local Structure Plan

The Sunset Beach Local Structure Plan was prepared on October 2007, however, has since been revoked. Whilst the Sunset Beach Structure Plan has been revoked, it has been observed that the majority of developed land which was subject to the Sunset Beach Local Structure Plan was developed accordingly. Notwithstanding, there is still a large portion of this land which has not been developed.

The revoked Sunset Beach Local Structure Plan identified an estimated 1,081 dwellings, which was comprised of 765 single residential dwellings and approximately 316 dwellings in two lifestyle villages and applied a base residential density of R17.5. It was noted that approximately 330 lots have already been created within the revoked Sunset Beach Structure Plan area.

Notwithstanding the above, in correspondence between GTA and the City of Greater Geraldton's Planning Engineer, it was understood that an average R-Code of R12.5 is to be applied to the remaining section for the purposes of estimating the future number of dwellings. Given this, GTA has identified approximately 305,000m^2 of undeveloped land, and subtracted an assumed10% of open space (as per Liveable Neighbourhoods) to identify the total area of developable land. This was then divided by the 800m^2 average lot area applicable to the R12.5 density code, and based on this very high-level calculation, it was assumed that approximately 343 dwellings could be constructed. It is noted that no area for the construction of roads or other infrastructure was included, as this information was not available to GTA at the time of reporting. When estimating the future population, GTA also assumed the Greater Geraldton household average from the 2016 ABS Census data of 2.9 people per dwellings.

1.5. User Survey

The City undertook a cycling survey in June 2017 (Cycling in the City of Greater Geraldton Survey). 472 responses were received in this survey, with 95% of the responses being those who rode a bike. Of those who responded, 73% rode at least once a week. It was also noted that the most (40%) people rode alone, with the second largest user group being those who rode with their children (18%) followed by their partner (16%). The busiest period to ride was noted to be the afternoons between 3pm to 6pm (24%) and mornings 7.30am to 9am (20%). 41% of respondents identified that a lack of dedicated cycling and/or shared path infrastructure was the main reason why they did not ride a bike or did not ride often. This data offers an understanding of the users that should be catered for, as well as major detractors.

It was also noted that only 14% of respondents cycle for commuting purposes from home to work. The responses to some key survey questions are shown in Figure 1.8 to Figure 1.12.

Figure 1.8: Survey Response to "Who do you mostly ride with?" from Cycling in the City of Greater Geraldton Survey

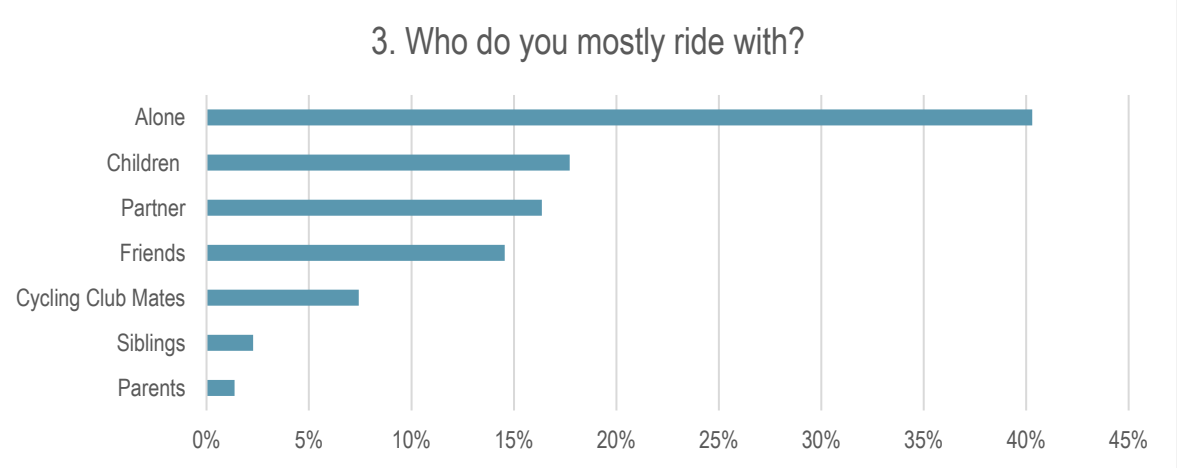


Figure 1.9: Survey Response to "What time of day do you usually ride?" from Cycling in the City of Greater Geraldton Survey

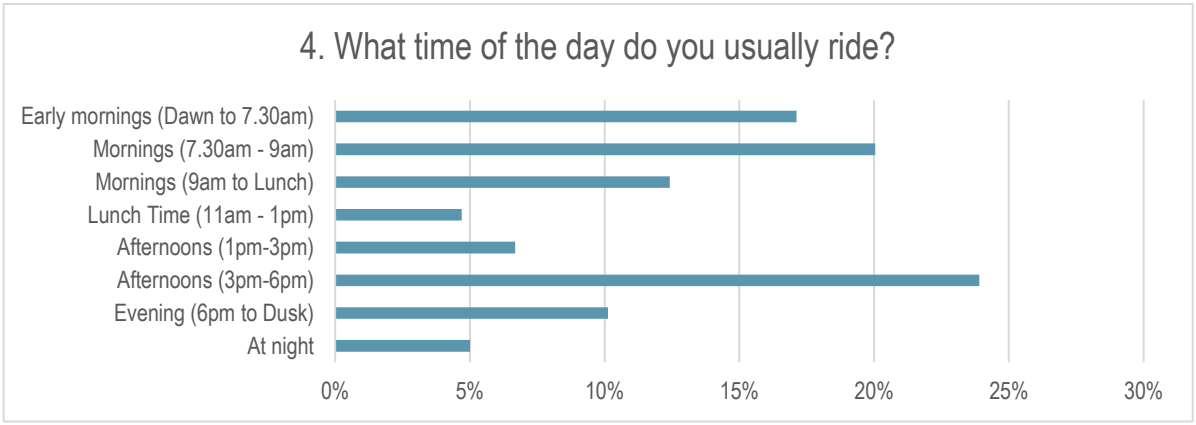


Figure 1.10: Survey Response to "Why Do You Ride a Bike?" from Cycling in the City of Greater Geraldton Survey

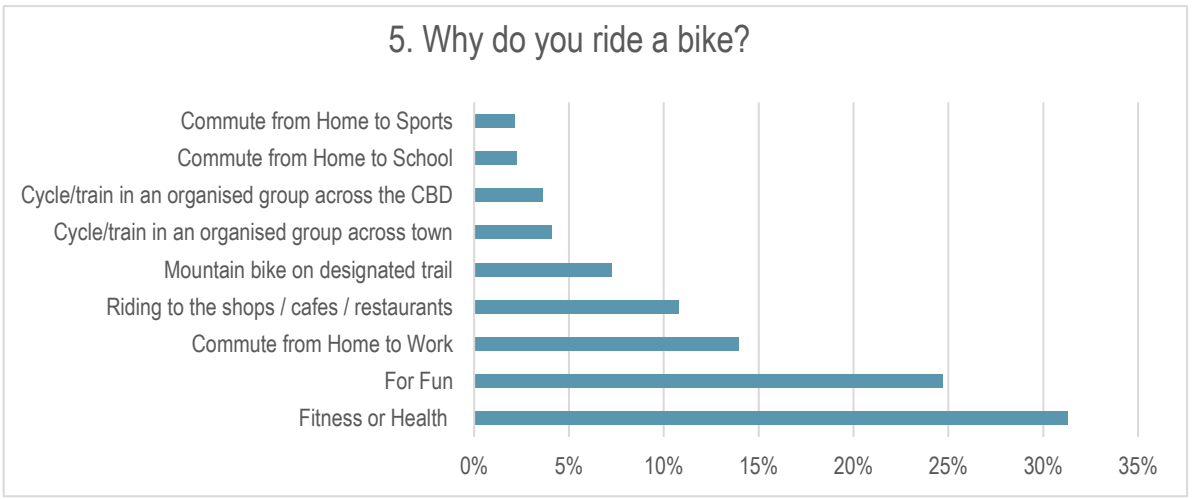


Figure 1.11: Survey Response to "What describes you best as a cyclist?" from Cycling in the City of Greater Geraldton Survey

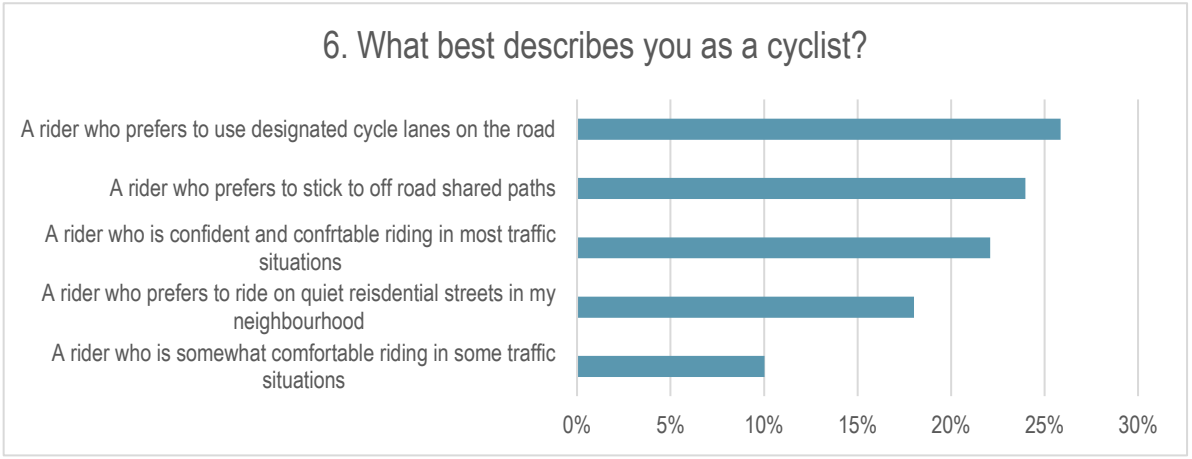
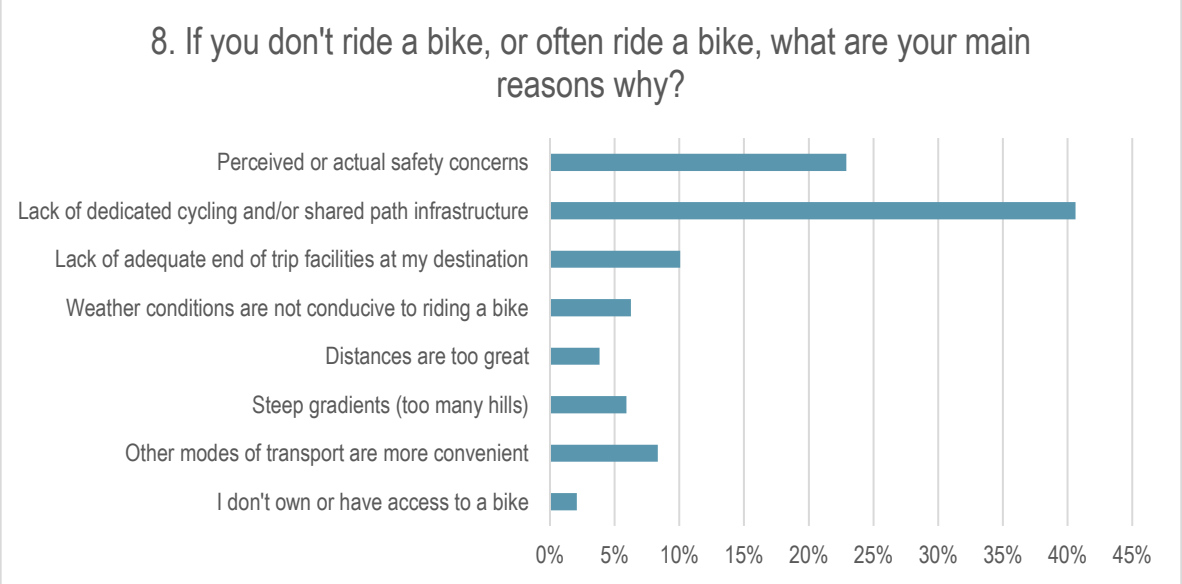


Figure 1.12: Survey Response to why the community didn't cycle from Cycling in the City of Greater Geraldton Survey



49 people identified the Drummond Cove to Sunset Beach route as their most frequently used route, with 40% of respondents identifying the Drummond Cove to Sunset Bach Bike Path or cycle lane as their top priority project to encourage more cycling.

Based on the survey responses, it is noted that many cyclists in the area ride with children. Children are vulnerable cyclists and it is not appropriate to cycle on-road with children, which supports the need for safe off-road cycling infrastructure. Another key finding is that over 40% of respondents identified that the key barrier to cycling was the lack of infrastructure.

These survey results provide an understanding of the local residents' need, desire and support for the subject route. The full survey is included as Appendix A.

1.6. Traffic Data

Vehicle Traffic volumes were collected along Chapman Road (South of Hagan Rd, approximately in the middle of the 4km cycle route). The counts for the period are as follows:

- 4,113 ADT (Mon-Fri)
- 3,994 ADT (Mon-Sun)

The posted speed limit on Chapman Road between Drummond Cove and Sunset Beach is 90 km/h.

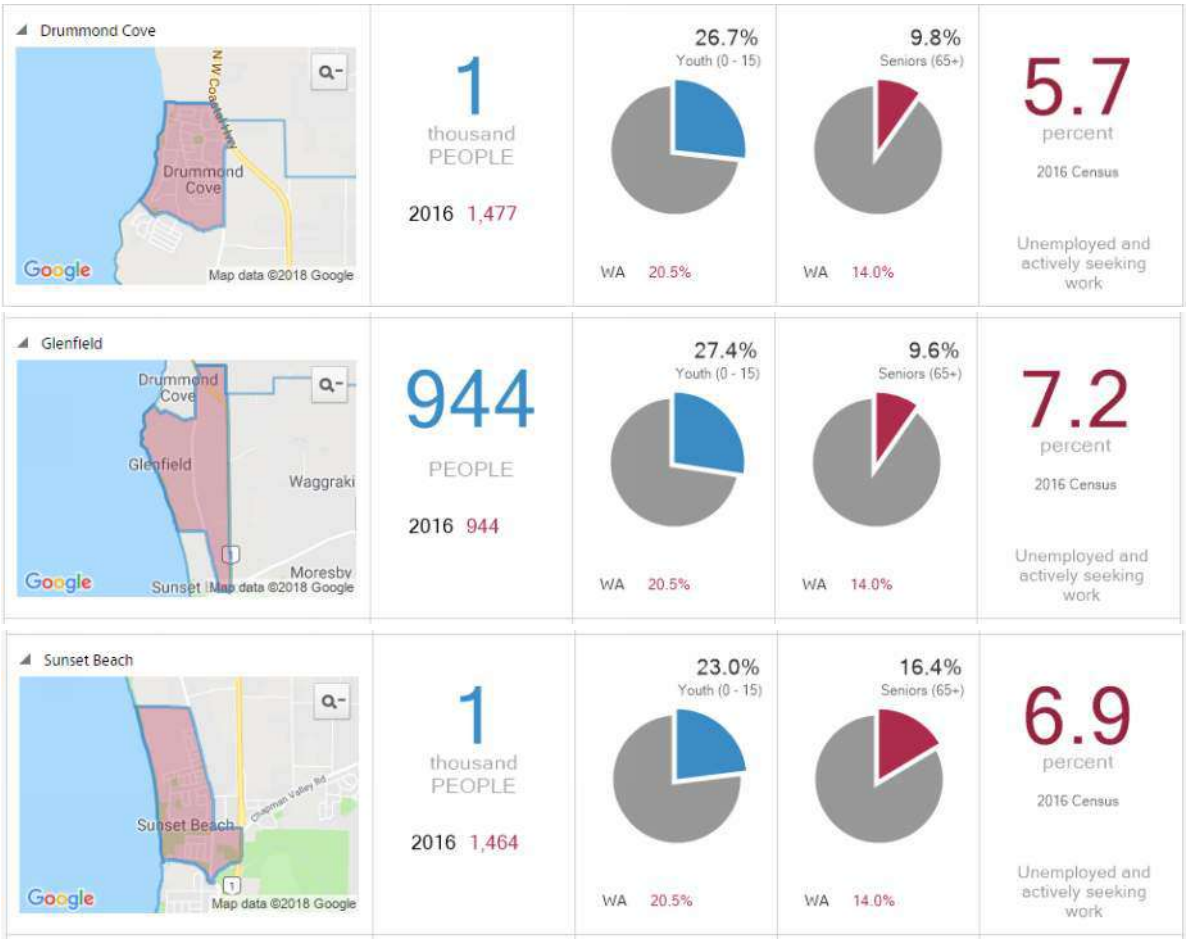
Cyclist counts were collected from a counter installed along the Chapman Road cycle path located south of Stella Road. Cycle counts in both directions for the period July-September 2017 are presented below:

- Annual Average Daily Traffic (M-S) = 21
- Annual Average Daily Traffic (M-F) = 18
- Annual Average Daily Weekend Traffic = 27

1.7. Socio-Economic Data

To gain an understanding of the current travel mode behaviour of the CGG population GTA have reviewed the CGG's online Community Profile based on the 2016 ABS Census data.

The following summarises the demographic population of the Sunset Beach and Drummond Cove areas, including mode of transport to work.



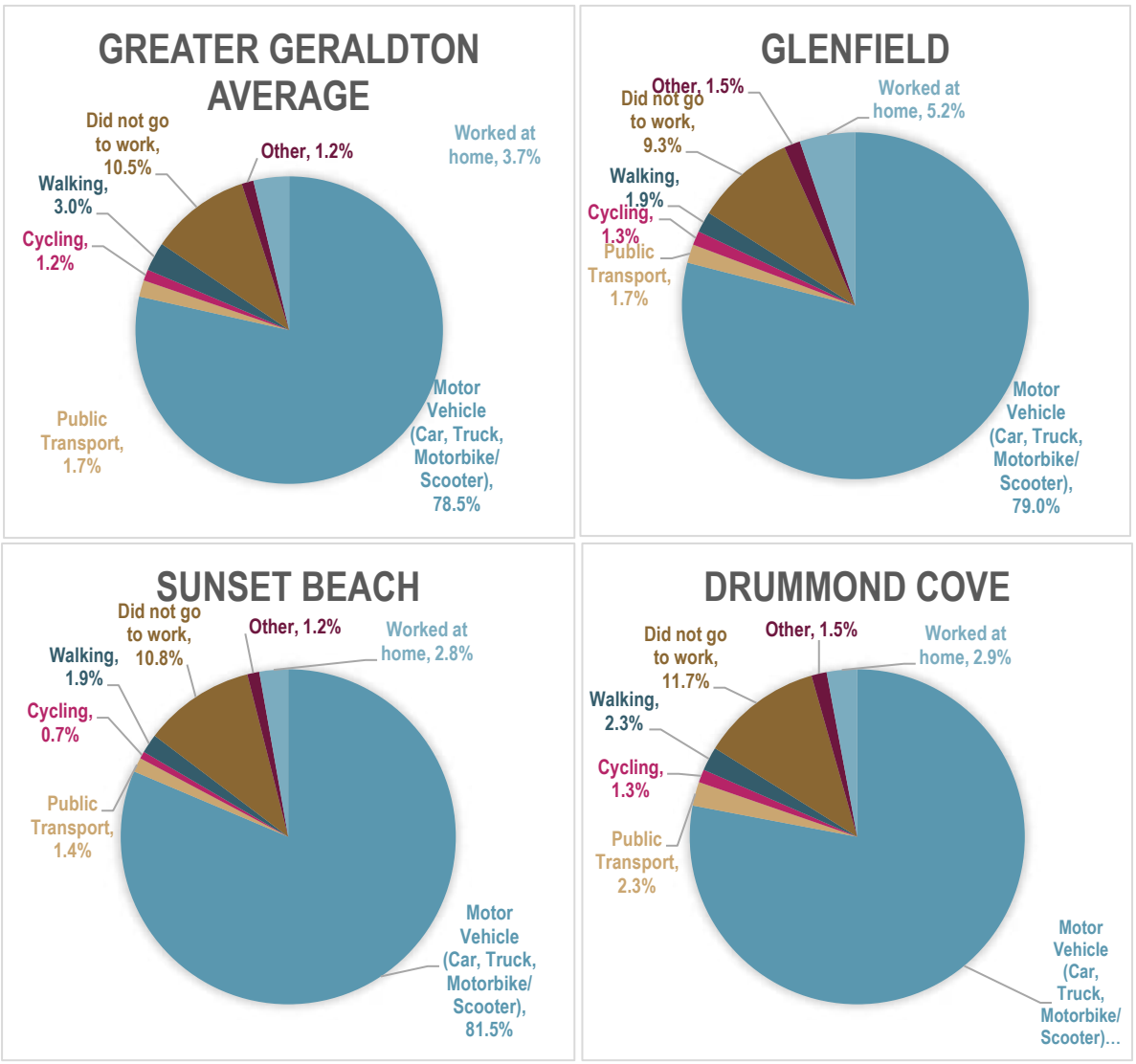
(Reproduced from City of Greater Geraldton Website)

An analysis of the mode of travel to work has been undertaken noting that while it only represents one of the reasons people travel, it provides a valuable picture of the movement behaviour and preferences of the population. It should also be noted that, as per Figure 1.10, commuters to work, school or sports only represented 18% of total survey respondents, and therefore the Mode of Travel to Work census data only provides a snapshot into the community's travel behaviour.

The following graphs in Figure 1.13 illustrate the Travel to Work Mode Share from the ABS Census Data and has been categorised into six categories including those who travel to work by a private motor vehicle such as a car (either as passenger or driver), truck, motorbike or scooter, as well as by cycling, walking and an alternative mode of transport or did not go to work.

The results show that both Sunset Beach and Drummond Cove area have a higher percentage of people who drive to work than the Greater Geraldton average. The Sunset Beach area has a lower percentage of those who cycle and catch public transport to work than the Greater Geraldton average, with the Drummond Cove area having a higher percentage that cycle and catch public transport.

Figure 1.13: Current Travel to Work Mode Share Comparison (ABS 2016)



1.8. Forecasted Mode Share

Based on the existing Greater Geraldton average travel to work mode share splits, the following estimated future mode shares have been extrapolated. The detailed estimates are included in Appendix 0.

These figures are based on the number of existing dwellings in the built-up areas as well as the forecasted future maximum number of dwellings set out in the respective structure plans. West of Chapman Road includes the suburbs of Drummond Cove (entirely), Glenfield (partially) and sunset Beach (partially). The suburbs east of Chapman Road include parts of Glenfield and Sunset Beach. The existing rural lots were subtracted from the current number of dwellings as they are expected to be developed into urban lots in the future and would be captured within the structure plans.

It has been assumed that each dwelling will generate an average of eight (8) vehicle trips per day, based on the Western Australian Planning Commission (WAPC) Transport Impact Assessment (TIA) Guidelines. Typically, 10% of the total daily volume of traffic is generated during the peak hour, and this has been included in the following tables.

Table 1.2 also provides the estimated existing mode share.

Table 1.2: Estimated Existing Mode Share on either side of Chapman Road

	West of Chapman Road		East of Chapman Road		Total	
	Average Trips per Day	Peak Hour	Average Trips per Day	Peak Hour	Average Trips per Day	Peak Hour
Estimated Number of Dwellings	1,500		228		1,728	
Vehicle trips	12,000	1,200	1,824	182	13,824	1,382
Public transport	275	28	38	4	313	31
Cycling	154	15	27	3	181	18
Walking	310	31	44	4	354	35
Did not go to work	1,652	165	221	22	1,873	187
Other	202	20	33	3	235	23
Worked at home	482	48	106	11	588	59

Table 1.3: Estimated Future Mode Share on either side of Chapman Road

	West of Chapman Road		East of Chapman Road		Total	
	Average Trips per Day	Peak Hour	Average Trips per Day	Peak Hour	Average Trips per Day	Peak Hour
Estimated Number of Dwellings	4,753		5,552		10,305	
Vehicle trips	38,024	3,802	44,416	4,442	82,440	8,244
Public transport	840	84	981	98	1,821	182
Cycling	568	57	663	66	1,230	123
Walking	1,476	148	1724	172	3,199	320
Did not go to work	5,108	511	5966	597	11,074	1,107
Other	602	60	703	70	1,304	130
Worked at home	1,816	182	2121	212	3,937	394

It is noted that a significant portion of the total number of dwellings are subject to future development. Whilst it is acknowledged that cycling facilities could be provided as part of the subdivision, the timeframe for the development of land is unknown and not controlled by the City, but rather developers and the market. It would be important to provide a facility now, so that when development occurs, the facilities are already in place and can support behaviour change to establish an active transport mindset. The estimated future modes share analysis suggests the proposed developments may generate 123 peak hour cycling trips and 320 pedestrian trips (assuming the mode share is the same as the existing mode share).

As an aspirational target, GTA suggest that the cycling and walking mode share is doubled. There is the opportunity for this to occur through a mode share shift in local trips to shops, schools and work. This would reduce the impact of congestion on the road network (from an estimated 7,978 peak hour vehicle to 7,092 peak hour vehicles), and support a healthier, stronger community.

Table 1.4: Future Aspirational Mode Share

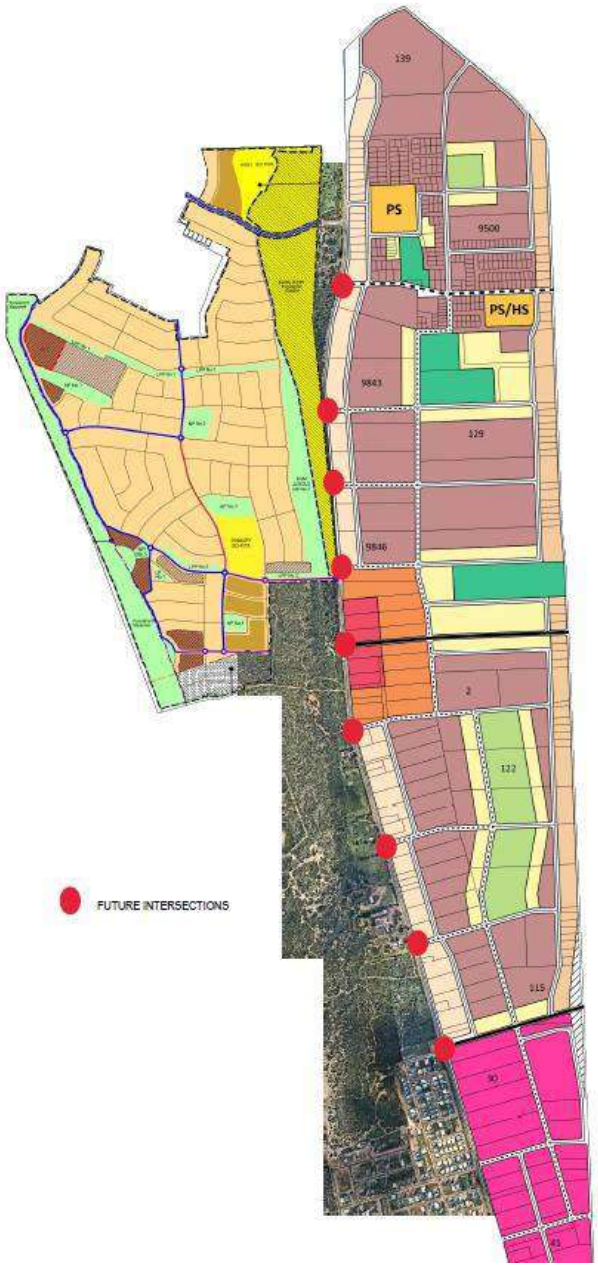
	West of Chapman Road		East of Chapman Road		Total	
	Average Trips per Day	Peak Hour	Average Trips per Day	Peak Hour	Average Trips per Day	Peak Hour
Vehicle trips	33,938	3,394	36,979	3,698	70,917	7,092
Public transport	840	84	981	98	1,821	182
Cycling	1,135	114	1,326	133	2,461	246
Walking	2,951	295	3,447	345	6,398	640
Did not go to work	5,108	511	5,966	597	11,074	1,107
Other	602	60	703	70	1,304	130
Worked at home	1,816	182	2,121	212	3,937	394

1.9. Opportunities and Constraints

There are opportunities for a cycle network on the eastern side of Chapman Road to be constructed as part of the development of the Glenfield Structure Plan, which would allow for cycling facilities on both sides of Chapman Road if dedicated infrastructure is constructed on the west. The western side also allows for more continuity due to the lack of intersecting roads. It would also directly connect to the future Activity Centre.

It would be important, when designing the cycle route, that appropriate links and crossings are included between the eastern and western sides of Chapman Road. These links should be consistent with those identified in the existing structure plans. These are shown in Figure 1.14.

Figure 1.14: Future Road Network (Base map source:Nearmap, structure plans City of Geraldton)



It is also important to note that mode share splits applied in paragraph 1.8 is based on travel to work census data only and does not consider recreational users. If recreational users are included in addition to the above, a higher cycling rate could be assumed. Based on the Cycling in the City of Greater Geraldton Survey, only 14% of respondents cycled to commute to work, whilst a further 4% cycled to commute from home to school or sports. As such, approximately 82% of respondents cycled for leisure. This project provides the opportunity to provide the infrastructure to further support the existing cycling community as well as encourage the future community to cycle through the availability of infrastructure.

There is an opportunity to integrate the Rum Jungle as part of the cycle link along Chapman Road. Currently, the Rum Jungle is subject to antisocial behaviour and littering. Integrating the reserve with the cycle link will help to activate the reserve through increased passive surveillance and provide a more pleasant cycling environment, away from the busy Chapman Road. This solution has been applied in similar scenarios such as the Karak Trail in Collie, which is a successful example of where a reserve adjacent to a highway was utilised to accommodate a cycling link. It was identified as a better cycling environment, given the high-speed adjacent highway and is used by a wide variety or users. Figure 1.15 below show the Karak Trail link.

Figure 1.15: Karak Trail, Collie

(Photo source: DoT 2018)

1.10. Recommendation

Based on the Fatal Flaw Assessment, GTA's recommendation is to proceed with delivering a concept design for cycling infrastructure along Chapman Road between Drummond Cove and Sunset Beach This is supported by the following:

- The ITS identifies the need to increase walking and cycling within the CGG area. The cycling link along Chapman Road was identified has a priority link in the CGG Cycling Strategy and through the user survey. 49 people identified the Drummond Cove to Sunset Beach route as their most frequently used route, with 40% of respondents identifying the Drummond Cove to Sunset Bach Bike Path or cycle lane as their top priority project to encourage more cycling.
- Along the Chapman Road corridor, a number of structure plans are proposed (Lot 55 Chapman Road, Glenfield – Activity Centre Plan, Glenfield District Activity Centre, Lot 9000 Chapman Road Activity Centre Structure Plan, Glenfield Beach Local Structure Plan, Glenfield Local Structure Plan). The proposed structure plan will accommodate a population of approximately 19,000 people and will include an activity centre as well. Therefore, proposed cycle link will be also beneficial to cater for future transport demand generated by the population growth and the future activity centre. The cycle link along Chapman Road will provide the opportunity to deliver the infrastructure to further support the existing cycling community as well as encourage the future community to cycle through the availability of infrastructure.

2. CONCEPT DESIGN

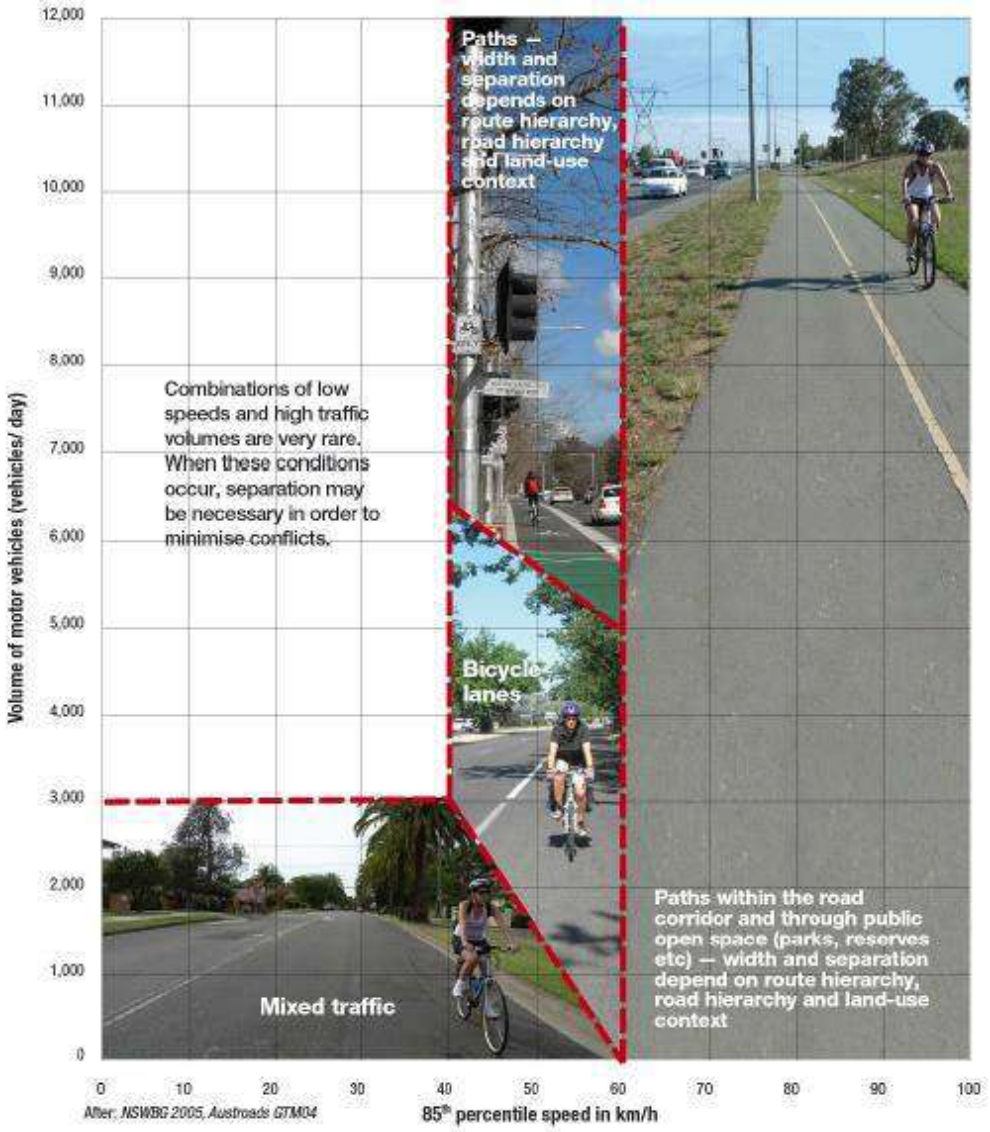
02

2.1. Optioneering

2.1.1. What kind of facility?

The first stage of the concept design is to decide the kind of infrastructure to be designed. For this we referred to the Cycling facilities for Community Routes conceptual diagram from the Draft ACT guidelines, as shown in Figure 2.1.

Figure 2.1: Separation of cycles and motor vehicles by speed and volume



(Reproduced from Draft ACT Guidelines Figure 5.2)

The average weekday traffic on chapman road is just above 4000 vehicle and the 85th percentile speed is assumed to be around 90km/h, therefore the suggested infrastructure in accordance with Figure 2.1 is a separated shared path. Even if the speed limit along Chapman Road was reduced to 60km/h there would still be scope to provide an off-road path.

This is also what the community is expecting. The president of Drummond Cove progress association and the Bicycle Shop owner have both expressed the preference for a separated off-road facility.

Furthermore, as shared path will cater for cyclists of all ages and abilities in line with the principles expressed in the CGG 2050 Cycling Strategy.

2.1.2. Which side of the Road?

To determine which side of Chapman Road the infrastructure would suit, we considered the following factors. This has also been summarised in Table 2.1 below.

Existing Cycling Infrastructure

There is an existing shared path 3m wide running along the west side of Chapman Road from Bosley Street to Sail Boulevard. Between Bosley Street and Whitworth Drive the path is made of concrete, whereas between Whitworth Drive and Sail Boulevard the path is made of red asphalt.

The CGG has also applied to the DoT for Grant Funding for the construction of a new shared path on the west side of Chapman Road between Sail Boulevard and Corallina Quays.

Continuity of the Shared Path

Given that the proposed link is identified as a primary cycling route it would have to satisfy the network principles stated in the CGG 2050 Cycling Strategy.

Primary routes are high demand corridors that connect to major destinations. They provide high quality, safe, convenient (and where possible uninterrupted) routes that form the spine of the cycle network.

In the current scenario a shared path on the west side would be uninterrupted for about 3.4km between Glenfield Beach Drive and Corallina Quays whereas on the east side the path would be interrupted at Macedonia Drive Hagan Road and Okahoma Road.

Looking at the future scenario the LSPs on the western side will create four interruptions of the path at the four new roads proposed to intersect with Chapman Road between whereas Corallina Quays and Glenfield Beach Drive on the eastern side the path would be interrupted at eight locations between Corallina Quays and Glenfield Beach Drive.

Future Developments

Based on the proposed developments the eastern side of Chapman Road is expected to have more population than the western side of the road. As shown in

Table 1.2 and Table 1.3 dwellings are estimated on the western side and 5,552 dwellings are estimated on the eastern side.

In terms of future population there would be scope to provide a path on the east side of Chapman Road, however, the path on the eastern side would be interrupted by a number of intersecting roads reducing the level of service.

It is important to note that the eastern side would still require shared path links between the blocks with safe crossing facility to the primary shared path on the opposite side of the road.

An activity centre is proposed on the west side of Chapman Road therefore a primary cycle link would be more beneficial on the west side to provide direct connectivity to the activity centre.

Location of sensitive public utility services

The majority of the services are located on the eastern side. Furthermore, the main Fibre Optic line runs along the entire length of the west side of the road. On the west side of the road there are located GAS, TELECOM and SEWER services and only short sections of fibre optics.

As such on the basis of impact on the public utility services it would be preferable to construct a shared path on the western side of the road.

Table 2.1: Table Summary

Factors	Preferred side of the road
Existing Cycling Infrastructure currently on the west side of the road	Western Side
Continuity of the future infrastructure with less intersecting roads	Western Side
Future Developments	Eastern Side
Location of sensitive public utility services	Western Side

Recommendation:

Given the above, the preferred side for the installation of a shared path would be the western side as it allows for the delivery of continuous cycling infrastructure linked to existing infrastructure, creating a primary route in line with the objective of the Cycling Strategy. As structure plans are developed, sections of shared paths would also be required on the eastern side to connect to dedicated future crossing points provided to access the primary route on the west side.

2.1.3. Width of the shared path.

To determine the width of the proposed shared path, we referred to the path capacity diagram from VicRoads Guidelines shown in Figure 2.2.

Considering future developments, the estimated future peak hour cycling traffic is 123 and the estimate peak hour pedestrian trips is 320 as shown in Table 1.3.

If we assume double the participation in cycling and walking, the estimated peak hour cycling trips are 246 and the pedestrian peak hours trips are 640, as shown in Table 1.4

Given that only a portion of the estimated peak hour traffic will be travelling along the path on the western side, 3.0m wide shared path would still be capable of accommodating the future demand.

Furthermore, given that the existing shared path on the western side is 3.0m wide, GTA is proposing to continue the path with the same 3.0m width.

Figure 2.2: Separation of cycles and motor vehicles by speed and volume

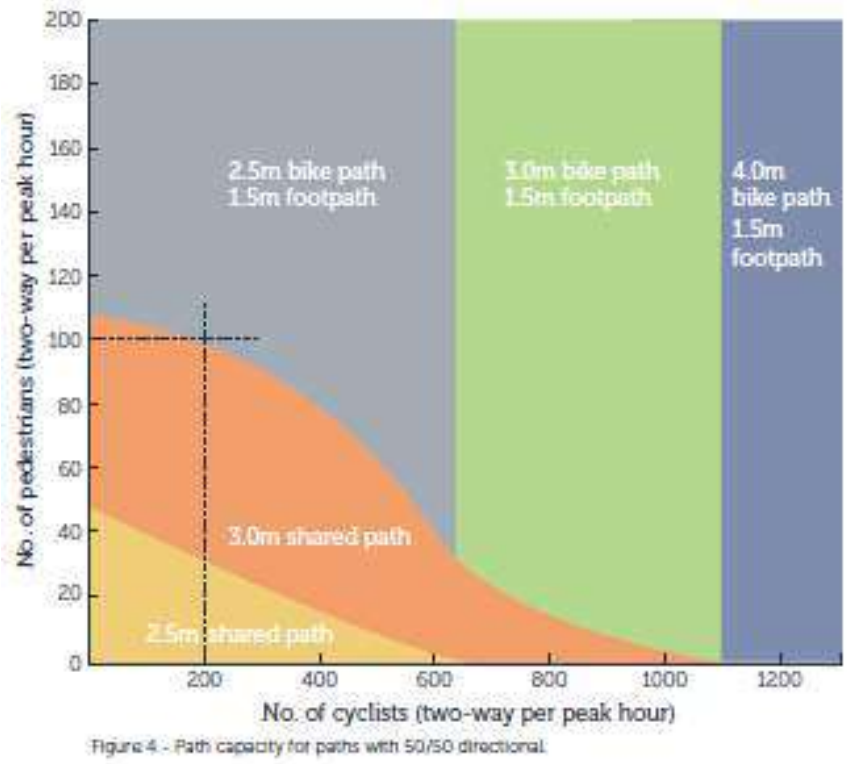


Figure 4 - Path capacity for paths with 50/50 directional

(Reproduced from VicRoads Cycle Note 21)

2.2. Environmental Engineer Report

Strategen completed an Acid Sulfate Soils (ASS) and soil permeability testing program along the route of the proposed cycle way from Drummond Cove to Sunset Beach along the alignment of Chapman Road in the City of Greater Geraldton.

The full Environmental Engineer's report is attached in Appendix C.

ASS and permeability testing were undertaken at the same time as per the scope below:

1. A desktop review of available soil mapping to determine the potential ASS risk and likely locations of poor permeability soils.
2. Collection of ASS samples from 20 locations (every 200m) to a depth of 2m below surface levels or until refusal due to rock or impenetrable soil.
3. Laboratory analysis of 84 soil samples for (pHF, pHFOX), and 10 samples for Chromium reducible sulfur [CRS] and heavy metals.
4. Infiltration testing at the same 20 locations along the alignment using a falling head permeameter.
5. Review, analysis and reporting of the field and laboratory analytical data

The results from the field testing indicate acid sulphate soils are not present and the soils are likely to have good buffering capacity. Suspension Peroxide Oxidation Combined Acidity and Sulfur (SPOCAS) results in four soils exceed 0.03% S and indicate a liming rate excluding ANC of 9kg/tonne. If soils are stockpiled, liming at 9kg/tonne is recommended, otherwise liming is probably not required, given the soils are all above the water table and continually exposed to air.

Stormwater is likely to have a reasonable chance of infiltrating into the soils along the alignment of the cycle way, however, the hard-pan sandy clay may reduce infiltration rates. The average saturated hydraulic conductivity, Ksat values, are on the low end for sand ranging from 0.8 to 42m/day with an average of approximately 5m/day and the resultant anticipated quantity of runoff from the cycle way and road along with the size of the swale/drainage basin would need to be calculated at detailed design stage.

2.3. Design Elements

The key principles followed for the first draft concept design were:

1. The path alignment to minimize conflict with existing utility services
2. To increase safety and comfort for the cyclist the path alignment was design to allow a minimum of 2.5m buffer between the road edge and the path where possible
3. Speed humps were included at the intersection with Sail Boulevard and Corallina Quays to increase the level of priority of the path. This type of treatment is already present in the CGG as shown in the picture below. (Figure 2.3)
4. The path alignment to have minimal impact on the existing swales.
5. Driveways intersecting the shared path are proposed to be made in concrete to reduce debris on the path.

Figure 2.3: Speed Hump across the intersection to improve path crossing

2.3.1. Lighting Requirements

Lighting categories for pathways (including cycleways) are indicated in Table 2.2 of AS/NZS 1158.3.1:2005 Lighting for roads and public spaces. Part 3.1: Pedestrian area (Category P) lighting – Performance and design requirements.

For pathways with a medium pedestrian/cycle activity and low risk of crime the applicable lighting subcategory is P3.

In accordance with clause 3.3 of AS/NZS 1158.3.1:2005, where pathway forms part of a local road that is to be lit to subcategory P3 no special lighting requirements apply other than those specified in clause 3.2.1 for the whole road reserve.

Given the above, it would be most cost effective to provide lighting for the road using the existing overhead infrastructure on the east side of Chapman Roads.

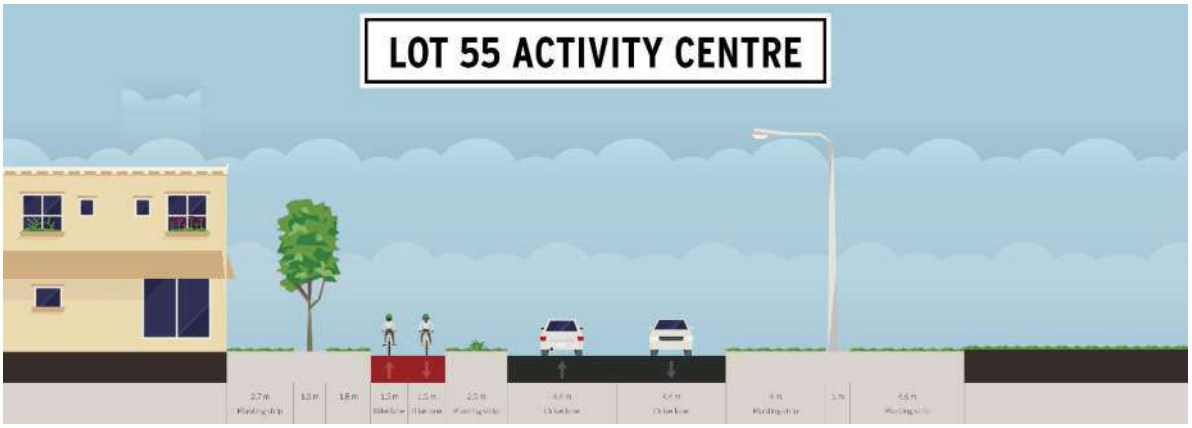
Details on spacing of the lamps, type of lamps would have to be determined via illuminance-based computer calculation design method. Existing power poles can be used for installation for the lamps and additional poles may be required to achieve P3 category lightning however this would have to be determined through a specific Detailed Lighting Design.

2.4. Design Recommendations

The following recommendations are made to the Council with regard to the proposed design and future detail design phase.

1. Where the shared path intersects existing roads, it is recommended to include a raised speed hump with priority given to cyclist. The ideal configuration is shown in plan W1219424-SK13. At detail design stage it is important to refer to the Share Paths Design Guidelines currently being developed by the DoT to ensure the adopted final solution is in line with the DoT strategy.
2. The structure plan for Lot 55 indicates an activity centre will be develop with two roundabouts at the intersecting road north and south of the lot. Currently a specific design of the roundabout is not available. As such, GTA has provided and indicative solution for the shared path at the roundabout as shown on plan W1219424-SK13. An indicative visualisation of the cross section of the path adjacent to the activity centre is shown in the picture below Figure 2.4.

Figure 2.4: Lot 55 indicative cross section

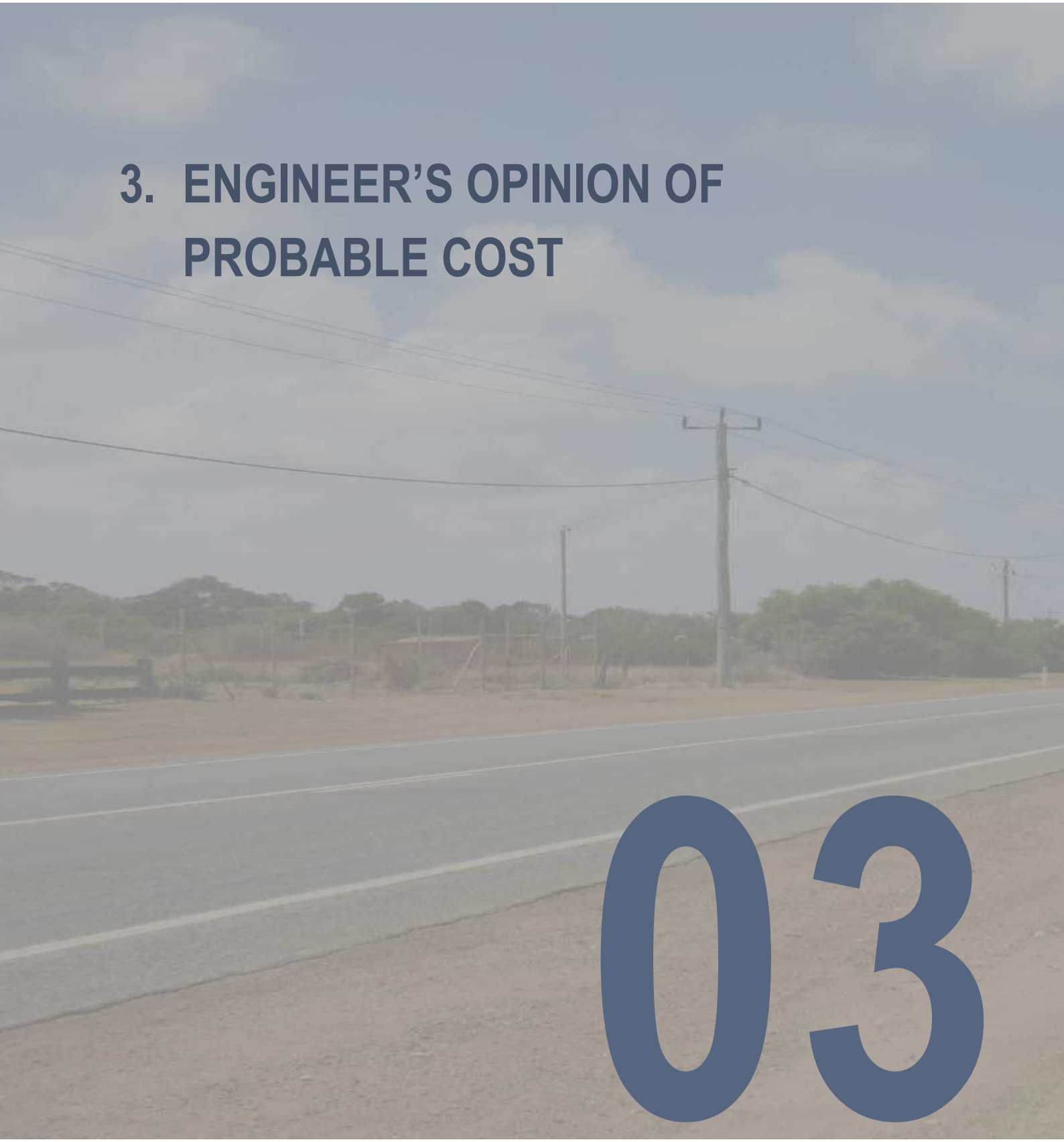


3. A concrete flush kerb should be installed on each side of the path to increase path durability. An example of constructed shared path is shown on the pictures below (Figure 2.5). The cost estimate includes the flush kerbs items.

Figure 2.5: Example of shared path

4. GTA recommends a more detailed survey of the trees and vegetation north of LoT 55 is undertaken as part of the Detailed Design phase to confirm the proposed alignment of the path. The alignment of the path shown from plan W1219424-SK07 to W1219424-SK10 is indicative only as the survey did not indicate the location of the trees.
5. To improve path connectivity, crossing point should be provided at the intersections with Okahoma Road, Hagan Road and Macedonia Drive. Median islands refuge should also be provided however these would have to be considered at detail design phase.

6. The proposed design does not impact on the capacity of existing stormwater drainage system. There is an opportunity to enhance the capacity and conductivity of the existing swale however this would have to be considered at detail design phase.
7. At each private or public crossover intersection, the shared path should be upgraded in concrete to ensure no debris are carried on the path by crossing vehicle. This would also reduce the need for maintenance and sweeping activities. A detail of the typical crossover is shown on plan W1219424-SK14.
8. The Public Transport Authority have confirmed they have no plans to relocate the bus stops along the west side of Chapman Road and have indicated that they have no plans to upgrade the bus stops due to the very low patronage. The concept design shows it is possible to upgrade the bus stop with a hardstand and bus shelter. The bus stops could also be used by the cycling as a resting area. The final treatment would have to be confirmed at detailed design. It is likely the cost to upgrade the bus stop would have to be borne by the City.



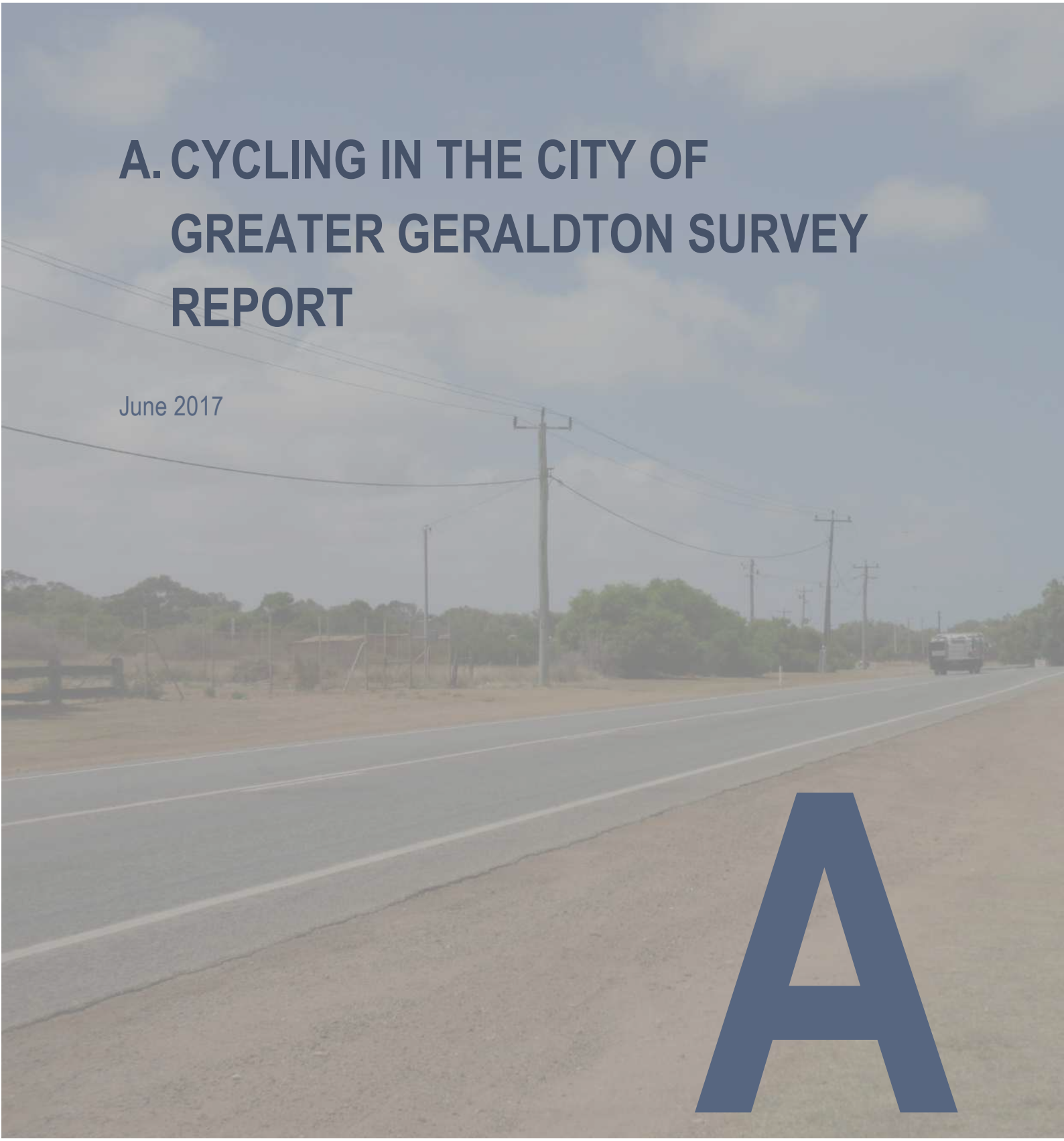
3. ENGINEER'S OPINION OF PROBABLE COST

03

3.1. Engineers Opinion of Probable Cost

Preliminary cost estimates indicate the project including contingencies will cost in the order of $3 million.

The itemised Engineer's Opinion of Probable Cost can be found in Appendix E.



A. CYCLING IN THE CITY OF GREATER GERALDTON SURVEY REPORT

June 2017

A

City of Greater Geraldton
a vibrant future

Cycling in the City of Greater Geraldton Survey Report

June 2017

Cycling In the City of Greater Geraldton Survey Report

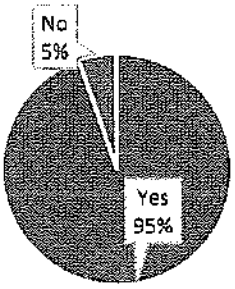
To support and inform the development of a Regional Cycle Plan for the City of Greater Geraldton a community survey was conducted from 10 to 29 May 2017 to gather information on the cycling community and to get a better understanding of their wants and needs.

The survey was available both online and in hard copy at the Civic Centre on Cathedral Avenue. The survey was launched with a media release followed by a number of social media posts on the City's Facebook page and an advertising campaign on Everything Geraldton website and Facebook page. Posters promoting the survey were on display at key locations including at the two cycle shops in the City. Emails were also sent to a wide range of stakeholders including community and sporting groups, all schools, government agencies and known interested individuals inviting them to take the survey. The survey received 475 responses.

Survey Results

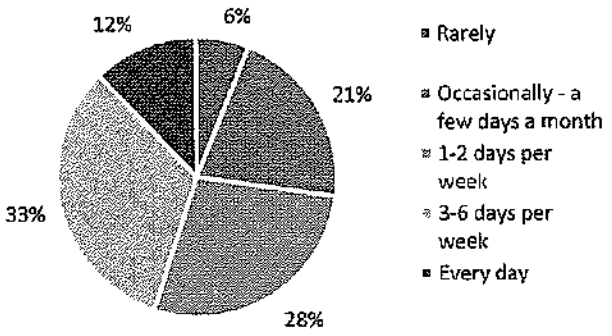
1. Do you ride a bike?

Yes	447
No	25

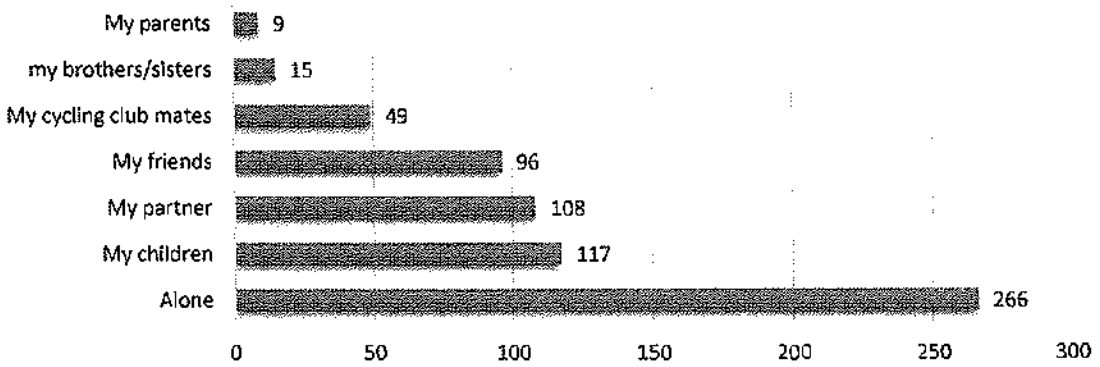


2. How often do you ride a bike?

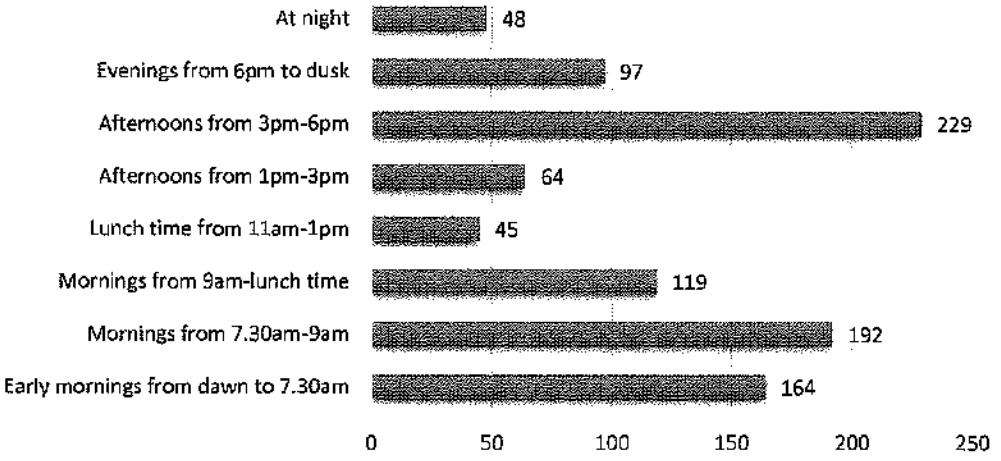
Rarely	28
Occasionally - a few days a month	95
1-2 days per week	126
3-6 days per week	148
Every day	55



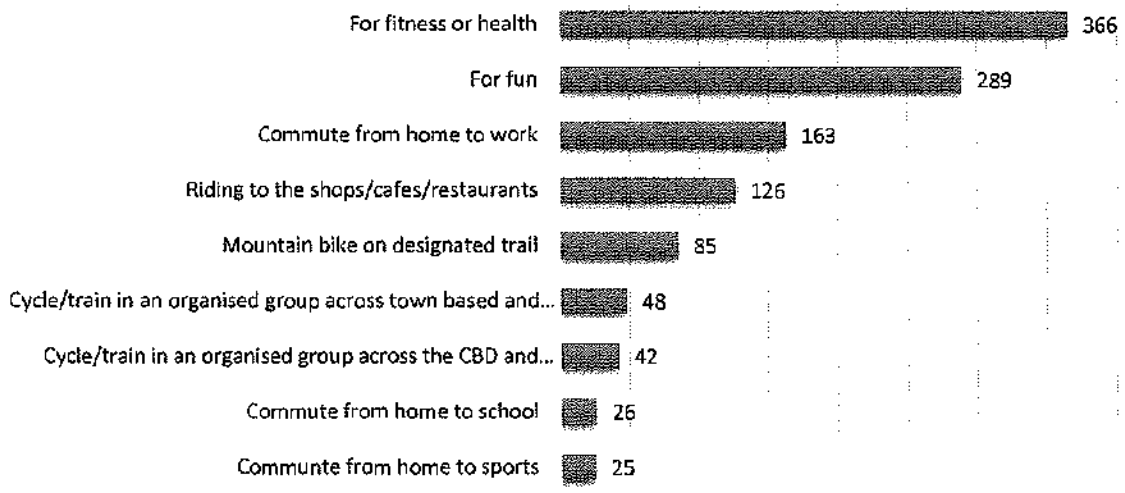
3. Who do you mostly ride with?



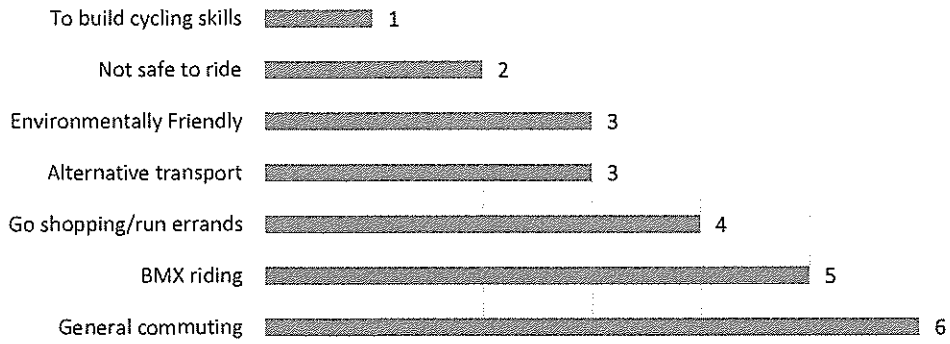
4. What time times of the day do you usually ride?



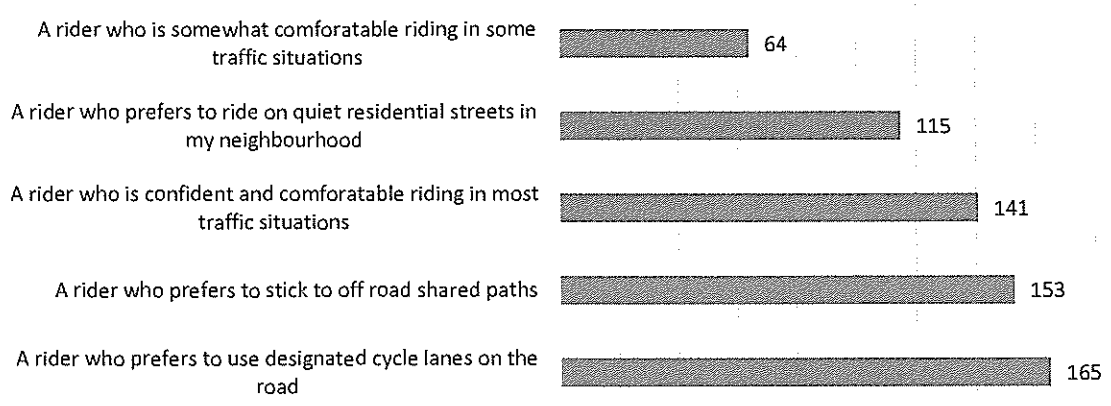
5. Why do you ride a bike?



General comments submitted regarding why they ride bikes:



6. What best describes you as a cyclist?

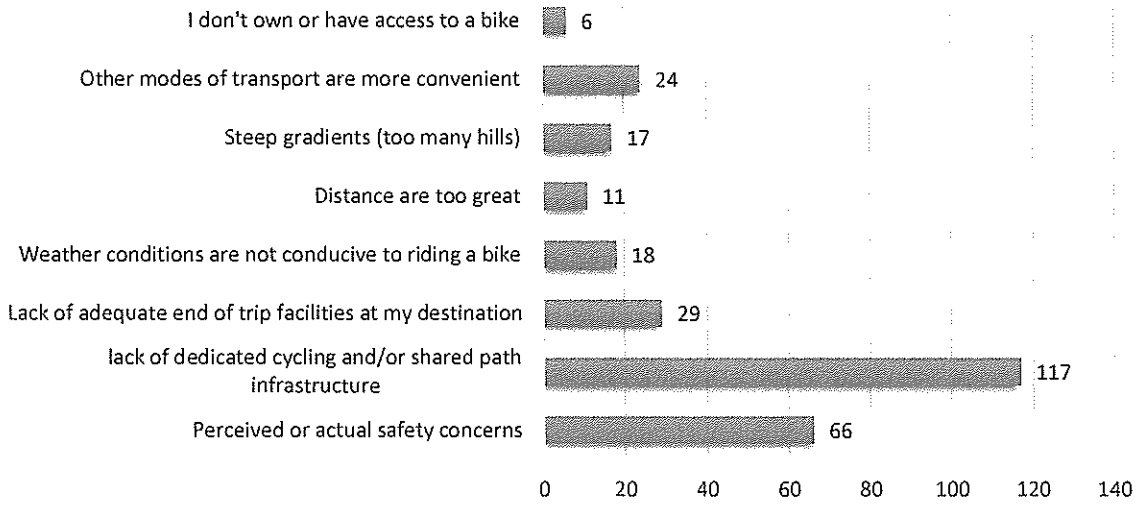


7. Which routes do you usually ride on, in and around Geraldton?

Along the Foreshore	102	Along Place Road	11
On Chapman Road	85	To the airport	10
Sunset Beach to the CBD	79	Along Fitzgerald Street	10
To the light house	67	In Geraldton suburb	10
Along Marine Terrace	54	Along Horwood Road	10
To Back Beach/Mahomets flats	53	To Moonyoonooka	10
Throughout the CBD	53	Tarcoola Beach to the CBD	10
Along Beresford Foreshore path	52	Along Hall and David Roads	8
Drummond Cove to Sunset Beach	49	Along Greenough River	8
Coastal paths only	44	To 8th Street Sports precinct	8
Along Willcock Drive path	39	From Wandina to the CBD	8
Along Kempton Street path	38	Along Foreshore Drive	7
In the Chapman River Park	33	To Separation Point	7
Along Chapman Valley Road	33	In Deepdale suburb	5
Along Glendinning Road	30	In Rangeway suburb	5
Along Rudds Gully Road	24	In Sunset Beach suburb	5

5hared paths only	23	From Cape Burney to CBD on Highway	5
In Drummond Cove/Glenfield 5uburb	20	Along Cathedral Avenue	5
From Bluff Point to the CBD	20	Along Durlacher 5treet	5
Along the North West Coastal Highway	19	Along Flores Road	5
In Tarcoola Beach suburb	18	From Glendinning to Drummond Cove	5
In Beachlands 5uburb	16	In Moresby 5uburb	5
In Woorree suburb	16	In Mount Tarcoola to the CBD	5
In Waggrakine 5uburb	15	In Wonthella to the CBD	5
Along Brand Highway	14	In Beresford suburb	4
Along Willcock Drive Road	14	In Mount Tarcoola suburb	4
In 5trathalbyn suburb	13	Greenough to CBD on highway	4
In Wonthella suburb	12	Along Fifth 5treet	3
Everywhere	12	In Point Moore/West End suburb	3
In 5palding suburb	3	From Woorree to the CBD	2
In Webberton Suburb	3	In Utakarra suburb	1
In Wandina Suburb	3	Along Eastern Road	1
To the BMX track in Woorree	3	Along Edward Road	1
Along 5anford 5treet	3	Along Francis 5treet	1
Along Anderson Street	2	Along George Road	1
In Bluff Point suburb	2	Along Mark 5treet	1
In Cape Burney suburb	2	Along Mount Magnet Road	1
Along Bayley Street	2	Along Verita Road	1
From Ellendale Pool to the CBD	2	In Walkaway suburb	1
Along Mabel 5treet	2	Along Winetta Ridge	1
Along Phelps Street	2		

8. If you don't ride a bike, or often ride a bike, what are your main reasons why?



Comments regarding why they do not ride bikes.

lack of paths to town	9	broken or uneven paths	1
no paths in my suburb	9	disabled	1
don't feel safe	8	eco friendly	1
can't keep kids safe	6	hate helmet law	1
lack of bike lanes on roads	5	injured	1
motorist attitudes and actions	4	just lazy	1
motorists speeding past	4	not practical - carrying bags	1
road is too dangerous, no shoulders	4	paths are full of broken glass	1
My kids are too young	3	too windy	1
Broken bike	2	need to upgrade skate parks	1
lack of continuous paths	2		

9. What would be your top priority project(s) to encourage more cycling?

a) Specific off of road shared paths or on road cycle lanes

Drummond Cove to Sunset Beach bike path or cycle lane	74
Cape Burney to Glendinning bike path	19
Brand Highway cycle lanes	9
Bike lane/path along Chapman Valley Road	8
Flores Road bike path	7
NWCH bike lanes	6
8th Street path/lane	5
Horwood Road bike lane	5
Durlacher Street cycle lanes	4
Former railway corridor bike path	4
Place Road - cycle lane to the east end	4
Bike lanes on Chapman Road between Morris Street and Mitchell Street	3
NWCH cycle lanes between Place Road and Chapman River	3
Rowan Road path/lane	3
Anderson Street	2
Bayley Street path/lane	2
Bike paths/lanes to the BMX park in Woorree	2
Wider bike lanes on Chapman Road	2
Bike lanes all along Chapman Road	2
Fitzgerald Street cycle lane	2
Phelps Street and Chapman Road Roundabout bike lane	2
Rudds Gully Road cycle lane	2
Bike path/cycle lane Willcock Drive to Glendinning Road	2
5th street path/lane	1
Streets leading to Sydney memorial	1
Beachlands to Mahomets path	1
Boyd Street cycle lane	1
David Road cycle lane	1

Bike lanes in Drummond Cove suburb	1
Bike lanes in Deepdale suburb	1
Extend Drosera Street path	1
Fallowfield Street path	1
Moonyoonooka Road cycle lane	1
Narngulu to Walkaway cycle lane	1
Bike path around outer edge of Rangeway suburb	1
Bike paths to Moresby range and into Chapman Valley	1
Waldeck Street cycle lane	1
Utakarra Road cycle path	1

b) Non-specific off of road shared paths, on road cycle lanes or other projects.

Build more off of road shared bike paths	11S
Build more on road cycle lanes	74
Build more off road mountain bike or free style trails	29
Provide bike racks	24
Provide bike lockers	23
Signage to inform where paths go, paths continue and rules of cycling	16
Extend all existing paths	13
End of trip facilities at major destinations (CBD, 8th Street, sporting centres, Hospital, Foreshore, Glenfield Shopping Centre)	13
Woorree Suburb bike paths	8
Bike lanes throughout the CBD	8
Improve Chapman River path, make it more fun	6
Build a pump and jump track	6
Build paths that go somewhere interesting	S
Cycle lanes in Geraldton suburb	4
Foot/cycle bridge across the Chapman River mouth	4
Build more skate parks	4
Provide bike paths/lanes/footpaths on all major roads	3
bike lane from Drummond Cove to Glendinning	2
A continuous bike path along the coast	2
Bike paths/lanes in all suburbs	2
Build bike boulevards	2
Paths in Cape Burney locality	2
Bike paths/cycle lanes to eastern suburbs	2
Bike paths to all schools	2
Build a street plaza close to the Foreshore	2
Food and drink facilities along major cycling routes	2
Bike lockers at Glenfield IGA Roundabout	1
Bike lanes from CBD into commercial/industrial areas	1
Build a beginners mountain bike trail	1

Bike lanes around Point Moore suburb	1
Build footpaths/cycle lanes from Wonthella to the beach	1
Walkaway township cycle paths	1
Install a foam pit at skate park	1
Build and indoor skate park	1
Build an inland bike path and connect to coastal path to make a loop	1
Build more facilities	1
Build more footpaths	1
Bike paths to all beaches	1
Build a cycle/footpath tunnel under the NWCH	1

c) Ideas to improve rider safety, awareness and convenience.

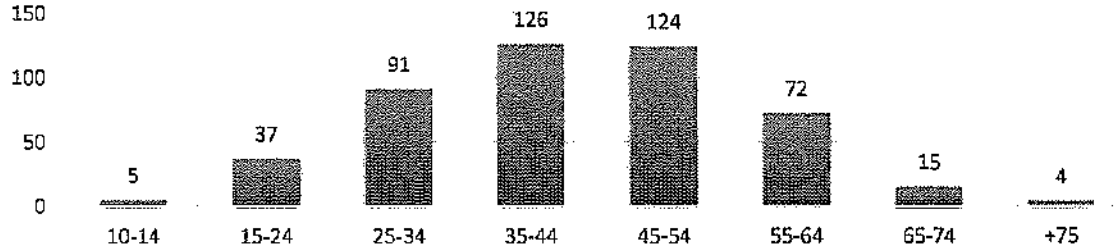
Improve awareness of cyclists and motorist of laws to build respect and increase cyclist safety	37
Reduce speed limits on major roads	6
Promote bike riding	4
Provide bike hire on the Foreshore	3
Make wearing helmets optional	3
Support more bike events	2
Riders must wear high vis clothing and use lights during day	1
Fine cyclists doing the wrong thing	1
Make bells on bike mandatory	1
Public buses should transport bicycles	1
Free drop off and pick up points	1
Reduce speeds from 6am-10pm on weekends on certain roads (i.e. Rudds Gully)	1
Use coloured stripes on road to remind drivers of cycle lanes	1
Use curbing instead of white lines to mark cycle lanes	1

d) Ideas to improve cycling infrastructure.

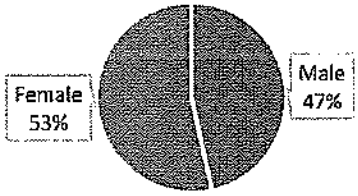
Better maintain paths/lanes, keep them clean and free of debris	12
Ensure path/lane surfaces are smooth	10
Improve footpaths so you can ride on them	7
Ensure verges are clean and clear of debris	5
Build wider bike paths	5
Build wider cycle lanes	4
Pave wider shoulders on the road	4
Cycle lanes across bridges	1
Improve pinch points	1
Ensure there are no drains in cycle lanes	1
Make paths safer for kids	1
Improve street/bike path lights	3
Improve highway lighting on path by Ackland Street crossing	1

Install lighting on shared paths	2
Self-activation of street lights (bikes aren't heavy enough)	2
Remove speed humps on Foreshore Drive	1

10. How old are you?



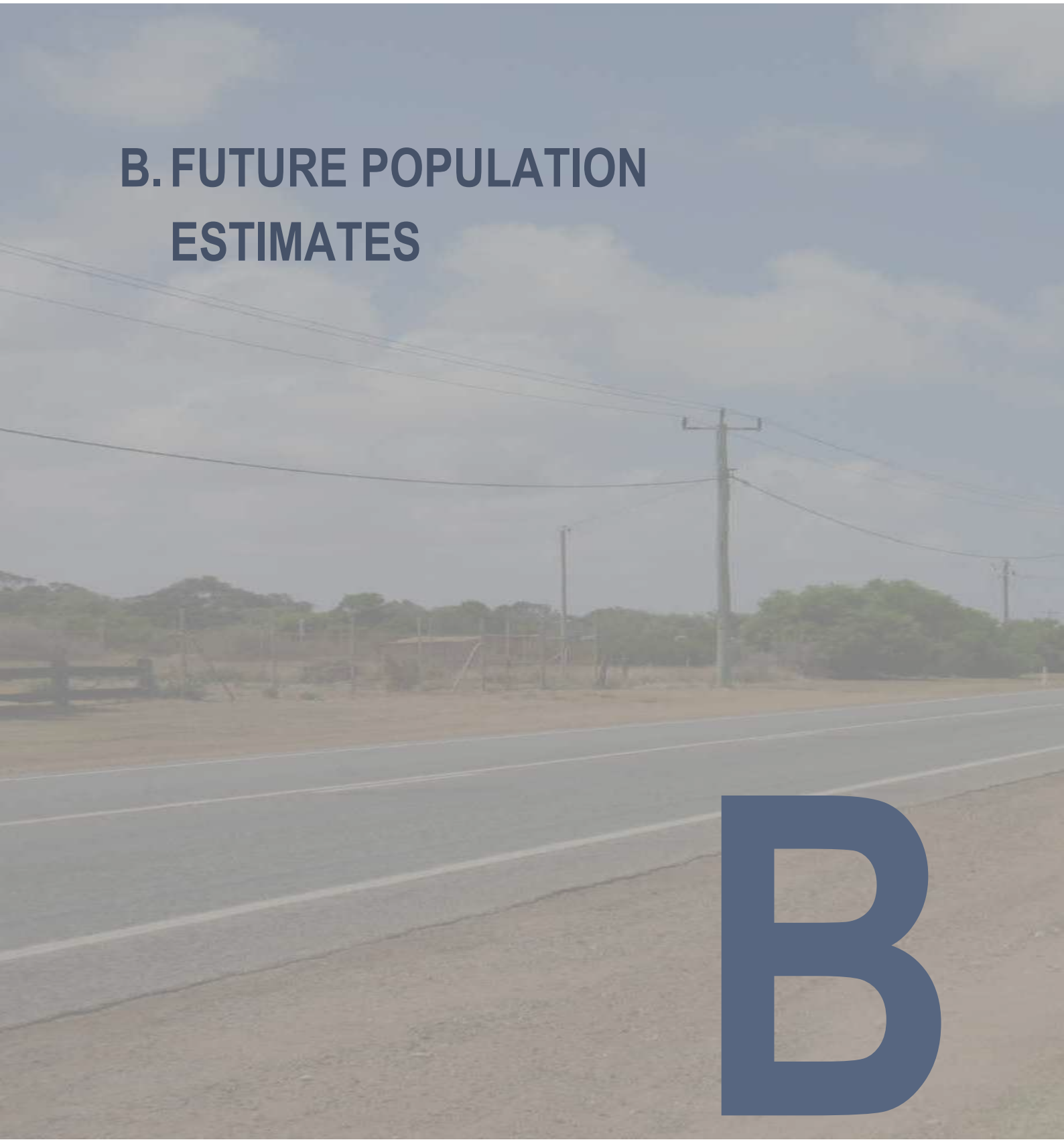
11. What is your Gender?



12. What locality do you live in?

Drummond Cove	71
Wandina	54
Geraldton	34
Mount Tarcoola	28
Sunset Beach	28
Woorree	28
Beachlands	24
Bluff Point	23
Beresford	22
Tarcoola Beach	21
Wonthella	20
Strathalbyn	16
Spalding	13
Glenfield	12
Cape Burney	11
Deepdale	10
Moresby	10
Rangeway	10
Waggrakine	10
Mahomets Flats	6
Utakarra	6

West End	6
Walkaway	4
Park Falls	3
Moonyoonooka	2
Rudds Gully	2
Chapman Valley	1
Dongara	1
Greenough	0
Karloo	0
Meru	0
Mullewa	0
Narngulu	0
Webberton	0



B. FUTURE POPULATION ESTIMATES

B

APPENDIX: FUTURE POPULATION ESTIMATES

Figure B.1 Estimated Future Mode Share per Structure Plan

	West of Chapman Road					East of Chapman Road		
Future Development (Structure Plan)	Lot 55 Chapman Road, Glenfield – Activity Centre Plan	Glenfield District Activity Centre, Lot 9000	Glenfield Beach	Sunset Beach	Subtotal	Glenfield LSP	Subtotal	Total
Estimated Number of Dwellings	100	830	2,000	323	3,253	5,324	5,324	7,747
Vehicle trips per day	800	6640	16000	2584	26,024	42,592	42,592	61,976
Public Transport	18	113	0	57	188	118	118	193
Cycling	12	57	239	39	346	1,653	1,653	1,943
Walking	31	151	621	100	903	1,653	1,653	2,405
Did not go to work	107	878	2,149	347	3,481	64	64	2,668
Other	13	94	253	41	401	674	674	981
Worked at home	38	226	545	123	933	1,452	1,452	2,159

Figure B.2: Existing Mode Share per Suburb

Suburb	Glenfield	Drummond Cove	Sunset Beach	Greater Geraldton
Existing Number of Dwellings	386	617	718	174,481
Vehicle trips per day	3088	4936	5744	1,395,848
Public Transport	68	146	98	30,834
Cycling	51	80	49	20,834
Walking	76	146	131	54,167
Did not go to work	364	743	759	187,502
Other	59	93	82	22,084
Worked at home	203	186	196	66,667

APPENDIX: FUTURE POPULATION ESTIMATES

Figure B.3: Existing Mode Share per Suburb East and West of Chapman Road

Suburb	Glenfield East	Sunset Beach East	Total East	Sunset Beach West	Drummond (West only)	Glenfield West	Total West
Existing Number of Dwellings	174	54	228	664	617	219	1,500
Vehicle trips per day	1,392	432	1824	5,312	4,936	1,752	12,000
Public Transport	31		38	91	146	39	275
Cycling	23	4	27	45	80	29	154
Walking	34	10	44	121	146	43	310
Did not go to work	164	57	221	702	743	207	1,652
Other	27	6	33	75	93	34	202
Worked at home	91	15	106	181	186	115	482

C. ENVIRONMENTAL ENGINEER REPORT

C

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To: Simon Pedretti

Date: 9 January 2019

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Drummond Cove to Sunset Beach Cycleway
Acid Sulfate Soils and Permeability Investigation Results

Background

Strategen completed an Acid Sulfate Soils (ASS) and soil permeability testing program along the route of the proposed cycle way from Drummond Cove to Sunset Beach along the alignment of Chapman Road in the City of Greater Geraldton.

The northern portion of the proposed route transverses the red loamy earths (alluvium) and the southern section yellow sands and Tamala limestone. The alluvium is mapped as having a high to moderate risk of containing acid sulfate soils, although soil mapping notes describe the soil as 'often alkaline'. Figures 1 - 4 present the sampling locations.

Scope of Works

ASS and permeability testing were undertaken at the same time as per the scope below:

1. A desktop review of available soil mapping to determine the potential ASS risk and likely locations of poor permeability soils.
2. Collection of ASS samples from 20 locations (every 200m) to a depth of 2m below surface levels or until refusal due to rock or impenetrable soil.
3. Laboratory analysis of 84 soil samples for (pH_F, pH_{FOX}), and 10 samples for Chromium reducible sulfur [CRS] and heavy metals.
4. Infiltration testing at the same 20 locations along the alignment using a falling head permeameter.
5. Review, analysis and reporting of the field and laboratory analytical data.

Results

Acid Sulfate Soil field testing

Table 1 presents the results of the pH_f and pH_{fox} testing. The testing showed pH_f ranged from 7.6 to 8.8 and pH_{fox} ranged from 6.2 to 8.4. This indicates the soils are slightly alkaline, which is to be expected given the presence of limestone at depth. The soils comprise shallow fine-grained siliceous red-brown sand with calcareous Tamala limestone cap rock and cobbles outcropping over the limestone of the Tamala Limestone Formation.

Some samples show a strong reaction to the addition of hydrogen peroxide as an oxidant. Up to 14 samples with a high reaction rate and/or with the highest pH drops between the pH_f and pH_{fox} are currently being tested for Suspension Peroxide Oxidation Combined Acidity and Sulfur [SPOCAS] suite and heavy metals.

The soils types on both sides of Chapman road are likely to be similar based on field observations. Anecdotal evidence was provided to Strategen field staff that land to the north of the proposed route, on both sides of road are likely to be inundated following winter rains and can be quite boggy.

Table 1: pH_f and pH_{fox} results

Sample Id	pH_f	pH_{fox}	Rate of Reaction
G1-1	8	7.5	X
G1-2	8	7.6	XX
G1-3	8.1	6.7	X
G1-4	7.9	6.9	X
G2-1	8.3	6.7	XX
G2-2	8.1	7	XX
G2-3	8.3	7.1	X
G2-4	8.4	6.9	XX
G3-1	8.2	6.3	X
G3-2	8.3	6.5	XX
DUP1	8.5	8.2	X
DUP2	8.5	6.9	XX
G4-1	8	6.2	XXX
G4-2	8.4	6.8	XX
DUP3	8.7	6.8	XXX
DUP4	8.1	6.4	XXX
G5-1	8.1	6.5	XXX
G5-2	8.2	6.6	XX
G6-1	7.8	6.2	XX
G6-2	7.8	6.6	X
G7-1	8.4	6.3	X
G7-2	8.5	6.7	XX
G8-1	8.1	6.4	XXX
G8-2	8	6.7	XX
G9-1	8.4	7	XX
G9-2	8.3	7	XX
G9-3	8.4	6.8	XX
G10-11	8.7	6.9	XX
G11-1	8.1	6.6	XX
G11-2	8.1	6.6	XXX
G12-1	8.6	8.3	XXXX
G13-1	8.1	7.7	XXXX
G13-2	8.5	8.4	XXXX
G14-1	8.5	6.8	XXXX
G14-2	8	8	XXXX
G15-1	8	8	XXXX
G15-2	7.7	7.6	XXXX
G15-3	7.6	7.6	XXXX
G16-1	8.3	6.6	XX
G16-2	8.3	6.6	XX
G16-3	8.6	7	XX
G16-4	8.5	7	X
G17-1	8.5	6.8	XXX
G17-2	8	7.3	XXXX
G17-3	8	7.5	XX
G17-4	8.1	7.4	XX
G18-1	8.6	7.6	XXXX
G18-2	7.9	7.9	XXXX
G18-3	8.3	8.2	XXXX
G18-4	8.3	8	XXXX
G19-1	8.8	7.2	X
G19-2	8.5	6.9	XXXX
G19-3	8.6	7.3	XXXX
G19-4	8.7	8.1	XXXX
G20-1	8.5	7.9	XXXX
G20-2	8.3	7.6	XXXX
G20-3	8.4	6.7	X
G20-4	8.6	7.7	XXXX

Table 2: SPOCAS results

Description			Sample Id													
Sample	Units	LOR	G2-4	G3-2	G4-1	G5-1	G7-1	G9-3	G11-2	G13-1	G14-2	G15-3	G17-2	G18-4	G19-2	G20-4
Arsenic	mg/kg	5	<5	6	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Cadmium	mg/kg	0.1	<0.1	<0.1	0.5	0.1	0.2	<0.1	<0.1	0.2	0.2	0.3	0.1	0.1	0.2	0.2
Chromium	mg/kg	1	5	4	14	12	16	<1	<1	2	12	19	5	6	6	7
Copper	mg/kg	1	9	8	9	9	10	<1	3	1	5	7	<1	3	2	3
Mercury	mg/kg	0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	<0.02	<0.02	<0.02	<0.02
Nickel	mg/kg	1	2	1	2	1	2	<1	<1	2	3	4	1	1	1	2
Lead	mg/kg	1	2	4	12	2	15	<1	<1	5	6	8	3	10	9	7
Zinc	mg/kg	1	3	3	110	3	9	<1	<1	4	6	8	1	7	8	6
Moisture	%w/w	0.1	32.4	22.6	14.3	20.5	12	27.4	14.6	16.4	11.4	23.5	1.3	9.4	3	5.2
pH_{KCl} (23A)	pH Units	0.1	9.1	8.8	8.8	8.9	8.8	9.5	9.2	9.2	8.5	8.7	8.1	9.1	9.2	9.2
pH_{ox} (23B)	pH Units	0.1	8.1	7.8	7.4	7.6	7.4	8.1	8.5	8.7	8.4	8.8	7.6	8.8	9.6	9.6
Titratable Actual Acidity (23F)	mol H^+/t	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Titratable Peroxide Acidity (23G)	mol H^+/t	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Titratable Sulphidic Acidity (23H)	mol H^+/t	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Sulphidic - TAA (s-23F)	% Pyrite Sulfur	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Sulphidic - TPA (s-23G)	% Pyrite Sulfur	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Sulphidic - TSA (s-23H)	% Pyrite Sulfur	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
KCl Extractable Sulfur (23Ce)	% S	0.005	0.039	0.05	0.055	0.096	0.15	0.045	0.033	0.034	0.008	0.011	0.009	0.007	0.063	0.011
Peroxide Extractable Sulfur (23De)	% S	0.005	0.093	0.1	0.089	0.12	0.071	0.15	0.033	0.034	0.008	0.015	0.009	0.007	0.063	0.011
Peroxide Oxidisable Sulfur (23Ee)	% S	0.005	0.054	0.05	0.034	0.024	<0.005	0.11	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Acidic S_{pos} (a-23Ee)	mol H^+/t	4	34	31	21	15	<4	66	<4	<4	<4	<4	<4	<4	<4	<4
KCl Extractable Calcium (23Vh)	% Ca	0.005	0.31	0.39	0.48	0.4	0.42	0.3	0.28	0.29	0.23	0.3	0.053	0.13	0.23	0.2
Peroxide Extractable Calcium (23Wh)	% Ca	0.005	12	12	5.4	6.8	7.8	17	1.5	2.2	0.31	0.53	0.12	0.19	0.45	0.35
Acid Reacted Calcium (23Xh)	% Ca	0.005	12	12	4.9	6.4	7.4	17	1.2	1.9	0.08	0.23	0.067	0.06	0.22	0.15
Acidity - Ca (a-23Xh)	mol H^+/t	4	5,800	5,800	2,500	3,200	3,700	8,300	610	950	40	110	33	30	110	75
Sulphidic - Ca (s-23Xh)	% Pyrite S	0.005	9.4	9.3	3.9	5.1	5.9	13	0.98	1.5	0.064	0.18	0.054	0.048	0.18	0.12
KCl Extractable Magnesium (23Sm)	% Mg	0.005	0.081	0.15	0.063	0.079	0.079	0.07	0.006	0.028	0.015	0.031	<0.005	<0.005	<0.005	<0.005
Peroxide Extractable Magnesium (23Tm)	% Mg	0.005	0.79	1	0.33	0.34	0.4	0.43	0.028	0.2	0.048	0.053	0.017	0.021	0.014	0.017
Acid Reacted Magnesium (23Um)	% Mg	0.005	0.71	0.85	0.27	0.26	0.32	0.36	0.022	0.17	0.033	0.022	0.017	0.021	0.014	0.017
Acidity - Mg (a-23Um)	mol H^+/t	4	580	700	220	210	260	300	18	140	27	18	14	17	12	14
Sulphidic - Mg (s-23Um)	% Pyrite S	0.005	0.94	1.1	0.35	0.34	0.42	0.48	0.029	0.23	0.044	0.029	0.022	0.028	0.018	0.022
Excess Acid Neutral. Capacity (23Q)	% $CaCO_3$	0.02	37	37	15	18	21	47	3.9	5.9	0.54	0.67	0.27	0.27	0.74	0.61
Excess ANC - Acidity (a-23Q)	mole H^+/t	4	7,400	7,400	3,000	3,600	4,200	9,400	780	1,200	110	130	54	54	150	120
Excess ANC - Sulphidic (s-23Q)	% Pyrite S	0.005	12	12	4.8	5.8	6.7	15	1.3	1.9	0.17	0.22	0.087	0.087	0.24	0.2
ANC Fineness Factor	-	0.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Net Acidity excluding ANC	% S	0.005	0.054	0.05	0.034	0.024	<0.005	0.11	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Net Acidity excluding ANC	mole H^+/t	5	34	31	21	15	<5	65	<5	<5	<5	<5	<5	<5	<5	<5
Liming Rate excluding ANC	kg $CaCO_3$/t	1	5	4	3	2	<1	9	<1	<1	<1	<1	<1	<1	<1	<1
Net Acidity	% S	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Net Acidity	mole H^+/t	5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Liming Rate	kg $CaCO_3$/t	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

The Net Acidity Excluding ANC is due entirely to Spos (TPA, TAA, TSA all zero) and is usually well correlated with Scr. Four out of 15 samples shown (Table 3) exceed 0.03 %S with the highest measurement being 0.11 %S.

The high reaction rates are likely to be a result of calcium carbonate in the soils. Normally to be conservative the DWER require the liming rate to be determined by excluding the existing buffering capacity (i.e. Excluding ANC). In the case of the four soils exceeding the %S of 0.03, a calculated liming rate (excl. ANC) of 9kg/tonne was calculated. However, if ANC is included no lime is required. Given the position in the landscape and the fact that the soils will be above the water table, and the calcium carbonate is clearly available (as evidenced by the reaction vigour), Strategen believe no liming is required, if the soils are to be reworked. If the soils are to be stockpiled for any length of time consideration should be given to liming the soils as a precaution.

Table 3: Samples of Interest

Sample	Peroxide Oxidisable Sulfur (Spos)	Net Acidity excluding ANC	Net Acidity excluding ANC	Liming Rate excluding ANC
	% S	% S	mole H+/t	kg CaCO3/t
G2-4	0.054	0.054	34	5
G3-2	0.05	0.05	31	4
G4-1	0.034	0.034	21	3
G9-3	0.11	0.11	65	9

Infiltration testing

Table 4 presents the results of the infiltration (permeability) testing. The saturated hydraulic conductivity (Ksat) results range from 0.8 to 42 m/day, with an average of approximately 5 m/day, which are indicative of sandy clay loams through to fine sands. The infiltration rates are as anticipated based on the hardness of the soil to penetrate with an auger. A layer of hard-pan soils consisting of sandy clays was intercepted at various locations that have a potential to retard water infiltration. Using a point source permeameter can over estimate infiltration (Ksat) in dry soils due to the sorptivity of the soil around the permeameter and potentially underestimate Ksat in wet conditions. In a situation such as a basin or swale, infiltration of stormwater into the soils may be lower as the water is less likely to move laterally when saturated over a larger area.

The drying and wetting of soils will alter infiltration rates due to hysteresis and clogging of soil pores due to fines being washed off surfaces as well as biological clogging from algal slime that can build up in swales if water remains in them for long periods. No groundwater was intercepted.

Table 2: Infiltration Test Results

Location	Soil Texture	Ksat m/day
G1	SCL	1
G2	S	42
G3	S	7
G4	S	4.5
G5	CS	2.9
G6	CS	3.1
G7	SCL	1
G8	S	8
G9	SCL	0.9
G10	CS	2.8
G11	S	3.9
G13	CS	1.7
G14	SCL	0.8
G15	CS	1.6
G16	S	5.1
G17	S	6.2
G18	CS	1.2
G19	CS	4.5
G20	CS	2.2
S denotes sand CS denotes clayey sand SCL denotes sandy clay loam		

Discussion

The results from the field testing indicate acid sulfate soils are not present and the soils are likely to have good buffering capacity. SPOCAS results in four soils exceed 0.03% S and indicate a liming rate excluding ANC of 9kg/tonne. If soils are stockpiled, liming at 9kg/tonne is recommended, otherwise liming is probably not required, given the soils are all above the watertable and continually exposed to air.

Stormwater is likely to have a reasonable chance of infiltrating into the soils along the alignment of the cycle way, however the hard-pan sandy clay may reduce infiltration rates. The average Ksat values are on the low end for sand and the resultant anticipated quantity of runoff from the cycle way (and road?) along with the size of the swale/drainage basin would need to be calculated.

Closure

This report has provided the results of the ASS and infiltration test results. The observations indicate a low-medium risk of ASS which are moderately permeable.

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Drummond Cove to Sunset Beach Cycle Way,
Acid Sulfate Soils and Infiltration Testing Program

Approximate Sample and Infiltration Test Locations

Figure 1

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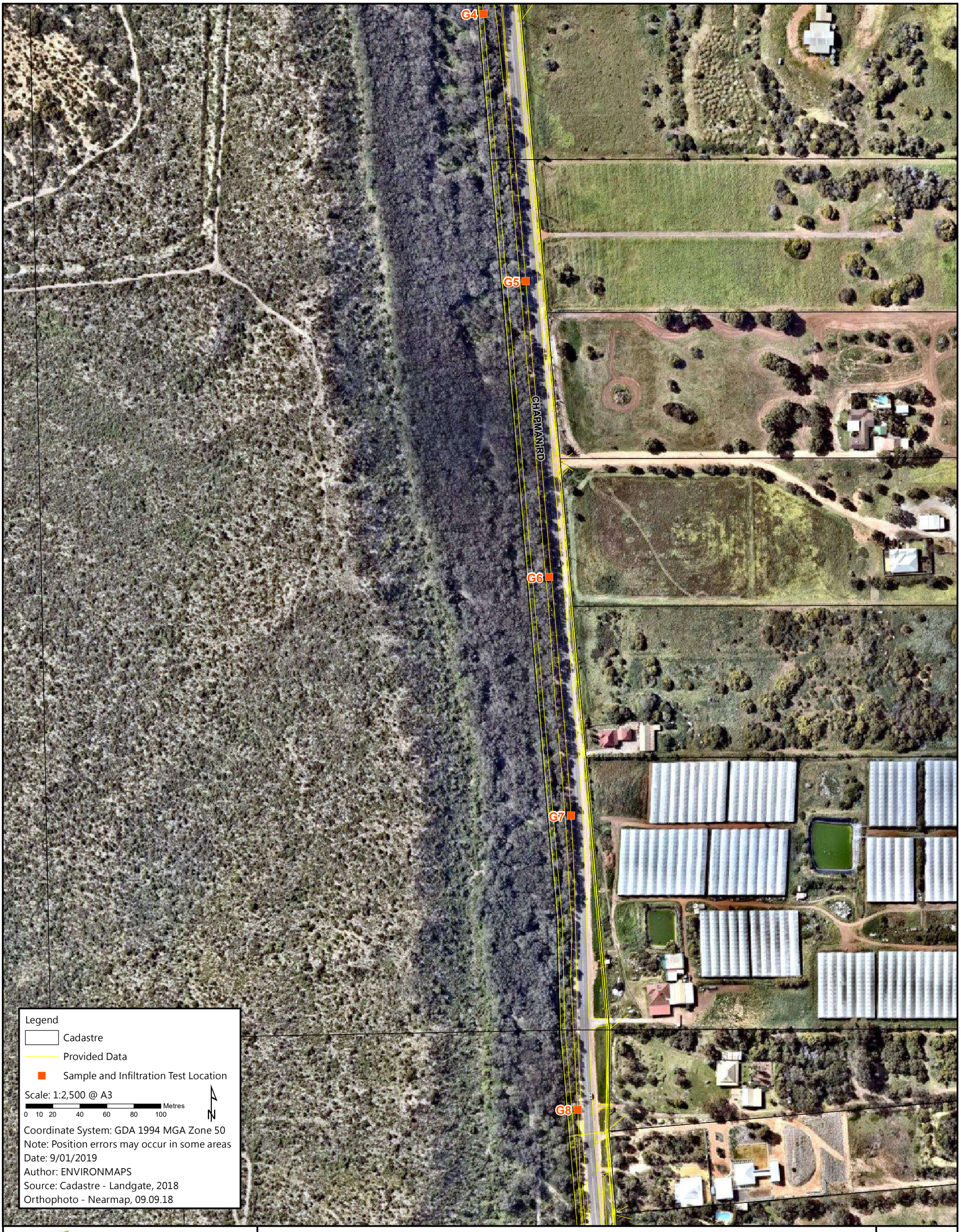

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Drummond Cove to Sunset Beach Cycle Way,
Acid Sulfate Soils and Infiltration Testing Program

Approximate Sample and Infiltration Test Locations

Figure 2

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G9
G10
G11
G12
HAGAN RD
WHYATT RD
CHAPMAN RD

Legend
- Cadastre
- Provided Data
- Sample and Infiltration Test Location

Scale: 1:2,500 @ A3
0 10 20 40 60 80 100 Metres

Coordinate System: GDA 1994 MGA Zone 50
Note: Position errors may occur in some areas
Date: 9/01/2019
Author: ENVIRONMAPS
Source: Cadastre - Landgate, 2018
Orthophoto - Nearmap, 09.09.18

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Drummond Cove to Sunset Beach Cycle Way,
Acid Sulfate Soils and Infiltration Testing Program

Approximate Sample and Infiltration Test Locations

Figure 3

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Drummond Cove to Sunset Beach Cycle Way,
Acid Sulfate Soils and Infiltration Testing Program

Approximate Sample and Infiltration Test Locations

Figure 4

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Drummond Cove to Sunset Beach Cycle Way,
Acid Sulfate Soils and Infiltration Testing Program

Approximate Sample and Infiltration Test Locations

Figure 5

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Appendix 1
Field notes

Quick Soil Log

Page No:	Driller: STRATEGON
Job Number: GTA 18611.01	Drill method: HAND AUGER
Project: GERALDTON ASS	Hole diameter: 50 mm
Date started: 3/12/18	Groundwater at: –
Date completed: 3/12/18	Screen diameter: –
Borehoe ID: G20	End of hole: 2.00 m bgl
Logged by: PM	GPS: 0268055 6821244
	Checked by:

Depth	Sample Id	PID	Graphic Log	USCS Class	Description of Soil Type	Well Construction
0						
	G20-1 + DUP1 + TRIP1					Becoming moist @ 0.3 mbgl
	G20-2					
1.2						
	G20-3					
1.6						
2.0	G20-4					

Decription Major	Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anuguler	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: LIMESTONE + FGM GRAVEL RED-BROWN LESS COMM CONTENT DOWN PROFILE

Decription Major	Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anuguler	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: Yellow brown

Decription Major	Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anuguler	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: Red-brown

Decription Major	Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anuguler	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription Major	Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anuguler	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderlate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription Major	Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anuguler	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

* DUP1 + TRIP1 TAKEN @ G20-1

Quick Soil Log

Page No:		Driller:	Strategen [?]
Job Number:	GTA 1811.0 [?]	Drill method:	Hand Auger
Project:	[illegible] AG [?]	Hole diameter:	50mm
Date started:	3/12/18	Groundwater at:	-
Date completed:	3/12/18	Screen diameter:	-
Borehoe ID:	GA	End of hole:	2.00m
Logged by:	PM [?]	GPS:	0267997 6824?52 [?]
		Checked by:	

Depth	Sample Id	PID	Graphic Log	USCS Class	Description of Soil Type	Well Construction
0						
0.4	GA-1					
0.6	GA-2					
	GA-3					
2.0	GA-4					

Description of Soil Type

Decription		Plasticity	Graduation / Angularity		Colour	Sorting / Grading		Mositure
Major	Minor	(Typically clays only)	(Typically sands only)			Sorting	Grading	
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: Red Brown [?]

Silty Clay [?]

Decription		Plasticity	Graduation / Angularity		Colour	Sorting / Grading		Mositure
Major	Minor	(Typically clays only)	(Typically sands only)			Sorting	Grading	
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: Pale Yellow [?]

Limestone [?]

Decription		Plasticity	Graduation / Angularity		Colour	Sorting / Grading		Mositure
Major	Minor	(Typically clays only)	(Typically sands only)			Sorting	Grading	
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: Red Brown [?]

Brown limestone gravel [illegible]

Decription		Plasticity	Graduation / Angularity		Colour	Sorting / Grading		Mositure
Major	Minor	(Typically clays only)	(Typically sands only)			Sorting	Grading	
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription		Plasticity	Graduation / Angularity		Colour	Sorting / Grading		Mositure
Major	Minor	(Typically clays only)	(Typically sands only)			Sorting	Grading	
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription		Plasticity	Graduation / Angularity		Colour	Sorting / Grading		Mositure
Major	Minor	(Typically clays only)	(Typically sands only)			Sorting	Grading	
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Quick Soil Log

Page No:		Driller:	SPARTACUS
Job Number:	GTA 1361.01	Drill method:	HAND AUGER
Project:	GEOMATRIX	Hole diameter:	50mm
Date started:	31/2/15	Groundwater at:	-
Date completed:	31/2/15	Screen diameter:	-
Borehoe ID:	GH3	End of hole:	2.0m
Logged by:	PM	GPS:	0267950 6821620
		Checked by:	

Depth	Sample Id	PID	Graphic Log	USCS Class	Description of Soil Type	Well Construction

Description of Soil Type

Description Major	Description Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading: Sorting	Sorting / Grading: Grading	Moisture
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: RED-BROWN

Description Major	Description Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading: Sorting	Sorting / Grading: Grading	Moisture
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

GH3-1
GH3-2
GH3-3
Additional Comments: RED-BROWN
WET CLAY

Description Major	Description Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading: Sorting	Sorting / Grading: Grading	Moisture
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

GH3-4
Additional Comments: RED-BROWN
MINOR UNDERLYING LITHOLOGY TRANSITION

Description Major	Description Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading: Sorting	Sorting / Grading: Grading	Moisture
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Description Major	Description Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading: Sorting	Sorting / Grading: Grading	Moisture
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Quick Soil Log

Page No:		Driller:	STANTEC
Job Number:	GTA1811-01	Drill method:	HAND AUGER
Project:	GENERATION 45	Hole diameter:	50mm
Date started:	4/12/18	Groundwater at:	-
Date completed:	5/12/18	Screen diameter:	-
Borehole ID:	GT7	End of hole:	1.00m
Logged by:	PM	GPS:	0267846 6521787
		Checked by:	

Depth	Sample Id	PID	Graphic Log	USCS Class	Description of Soil Type	Well Construction

Description of Soil Type

Description Major	Description Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading: Sorting	Sorting / Grading: Grading	Moisture
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

0.4

Description Major	Description Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading: Sorting	Sorting / Grading: Grading	Moisture
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

0.8

Description Major	Description Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading: Sorting	Sorting / Grading: Grading	Moisture
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

1.2

Description Major	Description Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading: Sorting	Sorting / Grading: Grading	Moisture
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

1.6

Description Major	Description Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading: Sorting	Sorting / Grading: Grading	Moisture
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Description Major	Description Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading: Sorting	Sorting / Grading: Grading	Moisture
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Quick Soil Log

Page No:		Driller:	STRATEGEN
Job Number:	GTA1861I-01	Drill method:	HAND AUGER
Project:	GOULBURN ASS	Hole diameter:	50mm
Date started:	4/12/18	Groundwater at:	—
Date completed:	4/12/18	Screen diameter:	—
Borehoe ID:	G16	End of hole:	2.0m
Logged by:	PM	GPS:	0267830 6322012
		Checked by:	

Depth	Sample id	PID	Graphic Log	USCS Class	Description of Soil Type	Well Construction
0	G16-1					
	-2					
	-3					
	-4					
2.0						

Description of Soil Type (block 1)

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	Non (circled)	Fine	V. anugular	Red	Well	Poor	Dry (circled)
CLAY	Silty	Low	Medium (circled)	Angular	Orange	Moderate (circled)	Moderate (circled)	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND (circled)	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: RED-BROWN
MINOR TRACES OF CLAY (ROUNDED) PIECE OF PLASTIC (<2%)

Description of Soil Type (block 2)

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Description of Soil Type (block 3)

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Description of Soil Type (block 4)

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Description of Soil Type (block 5)

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Description of Soil Type (block 6)

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments

Quick Soil Log

Page No:		Driller:	STRATEGEN
Job Number:	GTA18611-01	Drill method:	HAND AUGER
Project:	GERALDTON AS1	Hole diameter:	50 mm
Date started:	4/12/18	Groundwater at:	—
Date completed:	4/12/18	Screen diameter:	—
Borehoe ID:	G15	End of hole:	1.20 m
Logged by:	PM	GPS:	0267775 6822207
		Checked by:	

Depth	Sample Id	PID	Graphic Log	USCS Class	Description of Soil Type	Well Construction
0						

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Mositure
FILL	(Clayey)	(Non)	(Fine)	V. anugular	Red	Well	Poor	(Dry)
CLAY	Silty	(Low)	(Medium)	Angular	Orange	Moderate	(Moderate)	Moist
SILT	Sandy	Moderate	(Coarse)	Sunangular	Yellow	(Poor)	Well	Wet
(SAND)	(Gravelley)	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: SOF-FIRM

0.2			

W/ LIMESTONE GRAVEL.

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Mositure
FILL	Clayey	(Non)	(Fine)	V. anugular	Red	Well	(Poor)	(Dry)
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	(Poor)	Well	Wet
(SAND)	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: BROWN / PINK YELLOW

0.4			

PINK YELLOW MOTTLED WITH LIMESTONE FRAGMENTS.

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Mositure
FILL	(Clayey)	Non	(Fine)	V. anugular	Red	(Well)	Poor	(Dry)
CLAY	(Silty)	(Low)	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	(Well)	Wet
(SAND)	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

G15-1

Additional Comments: DARK BROWN

G15-2

1.1			

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Mositure
FILL	Clayey	Non	(Fine)	V. anugular	Red	(Well)	Poor	Dry
(CLAY)	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	(Sandy)	Moderate	Coarse	Sunangular	Yellow	(Poor)	(Well)	Wet
SAND	Gravelley	(High)		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: RED BROWN

1.5	G15-3		

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Mositure
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Mositure
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

TRIED ALL AUGER HEADS - COULD NOT PENETRATE FIRM CLAY @ 1.50m bgl

Quick Soil Log

Page No:		Driller:	[illegible]
Job Number:	GTA 18611-01	Drill method:	HAND AUGER
Project:	GERALDTON AST	Hole diameter:	50mm
Date started:	4/12/18	Groundwater at:	–
Date completed:	4/12/18	Screen diameter:	–
Borehoe ID:	G/4	End of hole:	1.00m
Logged by:	[illegible]	GPS:	0267729 6322375
		Checked by:	

Depth	Sample Id	PID	Graphic Log	USCS Class	Description of Soil Type	Well Construction
0					Block 1 (below) – Additional Comments: RED-BROWN. PEA GRAVEL + LIMESTONE	
0.2					Block 2 (below) – Additional Comments: DARK BROWN / PALE YELLOW. LIMESTONE HARDPAN + BLUE METAL	
0.4	G/4-1				Block 3 (below) – Additional Comments: RED BROWN. @ 30% clay	
1.0	G/4-2				Block 4 (below) – Additional Comments:	
					Block 5 (below) – Additional Comments:	
					Block 6 (below) – Additional Comments:	

Block 1 (0) (circled items in bold)

Decription Major	Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	**Clayey**	**Non**	Fine	V. anugular	Red	Well	**Poor**	**Dry**
CLAY	Silty	Low	**Medium**	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderlale	Coarse	Sunangular	Yellow	**Poor**	Well	Wel
SAND	**Gravelley**	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: RED-BROWN

PEA GRAVEL + LIMESTONE

Block 2 (0.2)

Decription Major	Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	**Non**	Fine	V. anugular	Red	Well	**Poor**	**Dry**
CLAY	Silty	Low	**Medium**	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderlale	**Coarse**	Sunangular	Yellow	**Poor**	Well	Wel
SAND	**Gravelley**	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: DARK BROWN / PALE YELLOW

LIMESTONE HARDPAN + BLUE METAL

Block 3 (0.4)

Decription Major	Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	**Clayey**	Non	**Fine**	V. anugular	Red	**Well**	Poor	**Dry**
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	**Moderlale**	Coarse	Sunangular	Yellow	Poor	**Well**	Wel
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: RED BROWN

@ 30% clay

Block 4 (1.0)

Decription Major	Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderlale	Coarse	Sunangular	Yellow	Poor	Well	Wel
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Block 5

Decription Major	Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderlale	Coarse	Sunangular	Yellow	Poor	Well	Wel
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Block 6

Decription Major	Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderlale	Coarse	Sunangular	Yellow	Poor	Well	Wel
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

ATTEMPT #1 – REFUSAL @ 0.5 mbgl @ limestone layer due to large chunks of limestone

ATTEMPT #2 – REFUSAL @ 1.0 mbgl –

Quick Soil Log

Page No:		Driller:	SMATCHEN
Job Number:	GTA1866/1-01	Drill method:	HAND AUGER
Project:	GREAYDON ASI	Hole diameter:	50mm
Date started:	4/12/18	Groundwater at:	—
Date completed:	4/12/18	Screen diameter:	—
Borehoe ID:	G13	End of hole:	1.00mbgl
Logged by:	PM	GPS:	0267665 6922578
		Checked by:	

Depth	Sample Id	PID	Graphic Log	USCS Class	Description of Soil Type	Well Construction
0						

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Mositure
FILL	Clayey	(Non)	(Fine)	V. angular	Red	(Well)	Poor	(Dry)
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	(Well)	Wet
(SAND)	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: dark brown

G13-1

0.6

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Mositure
FILL	(Clayey)	Non	(Fine)	V. angular	Red	Well	(Poor)	(Dry)
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	(Poor)	Well	Wet
(SAND)	(Gravelley)	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: orange-brown w/ fine + coarse sand

0.8

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Mositure
FILL	(Clayey)	Non	(Fine)	V. angular	Red	(Well)	Poor	(Dry)
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	(Moderate)	Coarse	Sunangular	Yellow	Poor	(Well)	Wet
(SAND)	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: red brown

G13-2

1.0

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Mositure
FILL	(Clayey)	Non	(Fine)	V. angular	Red	(Well)	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	(Moderate)	(Moderate)	(Moist)
SILT	Sandy	(Moderate)	Coarse	Sunangular	Yellow	Poor	Well	Wet
(SAND)	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: red brown

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Mositure
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Mositure
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Refusal @ 1.00mbgl - auger (all types & heads) just spinning on surface. Tried water down hole as well

Quick Soil Log

Page No:		Driller:	Spartan
Job Number:	GTA 18611.01	Drill method:	Hand Auger
Project:	Goulburn AS1	Hole diameter:	50 mm
Date started:	4/12/18	Groundwater at:	-
Date completed:	4/12/18	Screen diameter:	-
Borehoe ID:	G12	End of hole:	0.70 mbgl
Logged by:	PM	GPS:	0267608 6822777
		Checked by:	

Depth	Sample Id	PID	Graphic Log	USCS Class	Description of Soil Type	Well Construction
0						
0.2						
	G12-1					
0.6						
0.8						

Description of Soil Type – 0 m

Decription Major	Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	**Non**	**Fine**	V. anugular	Red	**Well**	Poor	**Dry**
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	**Moderate**	Moist
SILT	Sandy	Moderlate	Coarse	Sunangular	Yellow	**Poor**	**Well**	Wet
SAND	**Gravelley**	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: brown
Limestone Gravel

Description of Soil Type – 0.2 m

Decription Major	Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	**Clayey**	Non	**Fine**	V. anugular	Red	Well	Poor	**Dry**
CLAY	Silty	Low	Medium	Angular	Orange	**Moderate**	**Moderate**	Moist
SILT	Sandy	**Moderlate**	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	**High**		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: ~50% LVM dark-brown
small amount of limestone pieces present

Description of Soil Type – 0.6 m

Decription Major	Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	**Clayey**	Non	**Fine**	V. anugular	Red	**Well**	Poor	**Dry**
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	**Moderlate**	Coarse	Sunangular	Yellow	**Poor**	**Well**	Wet
SAND	Gravelley	**High**		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: red-brown

Description of Soil Type – 0.8 m

Decription Major	Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderlate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription Major	Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anuguiar	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderlate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription Major	Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderlate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Refusal @ 0.80 mbgl - appears to be a big limestone rock. Looking down the hole it looks like a white rock. Auger is just spinning on top.

Quick Soil Log

Page No:	1	Driller:	STATTEN
Job Number:	GTA 15611-01	Drill method:	HAND AUGER
Project:	BRIGHTON ASS	Hole diameter:	50mm
Date started:	4/12/18	Groundwater at:	—
Date completed:	4/12/18	Screen diameter:	—
Borehole ID:	GH	End of hole:	1.10m bgl
Logged by:	PM	GPS:	0267554 6822981
		Checked by:	

Depth	Sample Id	PID	Graphic Log	USCS Class	Description of Soil Type	Well Construction

0

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading: Sorting	Sorting / Grading: Grading	Mositure
FILL	Clayey	(Non)	(Fine)	V. angular	Red	Well	(Poor)	(Dry)
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	(Poor)	Well	Wet
(SAND)	(Gravelley)	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: dk brown

GH-1

0.6

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading: Sorting	Sorting / Grading: Grading	Mositure
FILL	Clayey	(Non)	Fine	V. angular	Red	Well	(Poor)	(Dry)
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	(Sandy)	Moderate	(Coarse)	Sunangular	Yellow	(Poor)	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
(GRAVEL)				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: Orange / brown

Lots Gravel minor

0.7

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading: Sorting	Sorting / Grading: Grading	Mositure
FILL	Clayey	(Non)	Fine	V. angular	Red	Well	(Poor)	(Dry)
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	(Coarse)	Sunangular	Yellow	(Poor)	Well	Wet
(SAND)	(Gravelley)	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: dark grey-brown

Lots Gravel

GH-2

1.00

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading: Sorting	Sorting / Grading: Grading	Mositure
FILL	Clayey	(Non)	Fine	V. angular	Red	Well	(Poor)	(Dry)
CLAY	Silty	Low	(Medium)	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	(Poor)	Well	Wet
(SAND)	(Gravelley)	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: LIGHT GREY

REFUSAL LIMESTONE GRAVEL - GRAVEL

1.10

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading: Sorting	Sorting / Grading: Grading	Mositure
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading: Sorting	Sorting / Grading: Grading	Mositure
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Refusal @ 1.10m bgl - hard grey gravelly material has been encountered immediately prior to this. Augur is just spinning on top. Advise a bit of some description responsible. Hard limestone at this depth.

Quick Soil Log

Page No:		Driller:	STRATEGEN
Job Number:	GTA 18611.01	Drill method:	HAND AUGER
Project:	GORPADON RD	Hole diameter:	50mm
Date started:	4/12/18	Groundwater at:	–
Date completed:	4/12/18	Screen diameter:	–
Borehoe ID:	G10	End of hole:	0.70mbgl
Logged by:	PM	GPS:	0267522 6823192
		Checked by:	

Depth	Sample Id	PID	Graphic Log	USCS Class	Description of Soil Type	Well Construction
0					Layer 1 (see below)	
0.2	G10-1 + QC3				Layer 2 (see below)	
	FTB3					
0.6					Layer 3 (see below)	
0.7					Layer 4 (see below)	

Layer 1 (0 – 0.2)

Decription Major	Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	**Clayey**	Non	**Fine**	V. anugular	Red	Well	**Poor**	**Dry**
CLAY	Silty	**Low**	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	**Poor**	Well	Wet
SAND	**Gravelley**	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: RED-BROWN
FILL GRAVEL

Layer 2 (0.2 – 0.6)

Decription Major	Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	**Non**	Fine	V. anugular	Red	Well	Poor	**Dry**
CLAY	Silty	Low	**Medium**	Angular	Orange	**Moderate**	**Moderate**	Moist
SILT	Sandy	Moderate	**Coarse**	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: DARK GREY

Layer 3 (0.6 – 0.7)

Decription Major	Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	**Non**	**Fine**	V. anugular	Red	Well	**Poor**	**Dry**
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	**Poor**	Well	Wet
SAND	**Gravelley**	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: WHITE

Layer 4 (0.7)

Decription Major	Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription Major	Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription Major	Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

REFUSAL @ 0.70mbgl – very hard – auger (will recede) just spinning on top. Seems to be a rock. Limestone sand immediately above it.

Quick Soil Log

Page No:		Driller:	STRATEGEN
Job Number:	GTA 18611.01	Drill method:	HAND AUGER
Project:	GERALDTON ASS	Hole diameter:	50mm
Date started:	4/12/18	Groundwater at:	–
Date completed:	4/12/18	Screen diameter:	–
Borehoe ID:	G9	End of hole:	1.70mbgl
Logged by:	PM	GPS:	0267511 6823415
		Checked by:	

Depth	Sample Id	PID	Graphic Log	USCS Class	Description of Soil Type	Well Construction
0					See description block 1	
0.2	G9-1, G9-2, G9-3				See description block 2	
1.6					See description block 3	
1.7					See description block 4	

Description block 1 (0):

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	**Non**	**Fine**	V. anugular	Red	**Well**	Poor	**Dry**
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	**Well**	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: dark-brown

Description block 2 (0.2):

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	**Fine**	V. anuguler	Red	**Well**	Poor	**Dry**
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertale	Coarse	Sunanguler	Yellow	Poor	**Well**	Wet
SAND	Gravelley	**High**		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: LIGHT GREY/WHITE w/ TRACE OF FINE SAND – MINOR CONCRETE GRAVEL IN BOTTOM [illegible]

Description block 3 (1.6):

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	**Non**	**Fine**	V. anugular	Red	Well	**Poor**	**Dry**
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertale	Coarse	Sunangular	Yellow	**Poor**	Well	Wet
SAND	**Gravelley**	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: WHITE LIMESTONE

Description block 4 (1.7):

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anuguler	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunanguler	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Description block 5:

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Description block 6:

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertale	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Attempt 1 – Refusal @ 0.30mbgl

Attempt 2 (this attempt) – refusal @ 1.70mbgl. all augers just spinning on top. White limestone sand immediately above this.

Quick Soil Log

Page No:		Driller:	STRATEGEN
Job Number:	GTA 1361(1-0)	Drill method:	HAND AUGER
Project:	CONDUDTON ASS	Hole diameter:	50mm
Date started:	4/12/18	Groundwater at:	-
Date completed:	4/12/18	Screen diameter:	-
Borehoe ID:	G8	End of hole:	0.8m bgl *
Logged by:	PM	GPS:	0267501 / 6823557
		Checked by:	

Depth	Sample Id	PID	Graphic Log	USCS Class	Description of Soil Type	Well Construction
0						
0.3	G8-1					
0.6						
0.8	G8-2					

Depth 0 – 0.3

Decription		Plasticity	Graduation / Angularity		Colour	Sorting / Grading		Mositure
Major	Minor	(Typically clays only)	(Typically sands only)			Sorting	Grading	
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderlate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: dark brown + organic material - sticks + tree roots

Depth 0.3 – 0.6

Decription		Plasticity	Graduation / Angularity		Colour	Sorting / Grading		Mositure
Major	Minor	(Typically clays only)	(Typically sands only)			Sorting	Grading	
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderlate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: light brown

Depth 0.6 – 0.8

Decription		Plasticity	Graduation / Angularity		Colour	Sorting / Grading		Mositure
Major	Minor	(Typically clays only)	(Typically sands only)			Sorting	Grading	
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderlate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: grey/dark brown
REFUSAL @ 0.8m bgl *

Decription		Plasticity	Graduation / Angularity		Colour	Sorting / Grading		Mositure
Major	Minor	(Typically clays only)	(Typically sands only)			Sorting	Grading	
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderlate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription		Plasticity	Graduation / Angularity		Colour	Sorting / Grading		Mositure
Major	Minor	(Typically clays only)	(Typically sands only)			Sorting	Grading	
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertale	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription		Plasticity	Graduation / Angularity		Colour	Sorting / Grading		Mositure
Major	Minor	(Typically clays only)	(Typically sands only)			Sorting	Grading	
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

* Location is on a drainage swale so depth of hole is approx 2.0m below road height

- could not see what refusal was on but all 3 auger heads were jamming on top of it.

Quick Soil Log

Page No:		Driller:	STRATEGEN
Job Number:	GTA 18611.01	Drill method:	HAND AUGER
Project	GUNDAGAI ASS	Hole diameter:	50mm
Date started:	4/12/18	Groundwater at:	—
Date completed:	4/12/18	Screen diameter	—
Borehole ID:	G7	End of hole:	0.80m bgl
Logged by:	PM	GPS	0267493 6823765
		Checked by:	

Depth	Sample Id	PID	Graphic Log	USCS Class	Description of Soil Type	Well Construction
0					Decription: SAND (circled); Plasticity: Non (circled); Graduation / Angularity: Fine (circled); Sorting: Moderate (circled); Grading: Moderate (circled); Moisture: Dry (circled). Additional Comments: light brown w/ occasional fine gravel	
	G7-1					
0.55					Decription: CLAY (circled), Sandy (circled); Plasticity: Moderate (circled), High (circled); Graduation / Angularity: Fine (circled); Sorting: Well (circled); Grading: Well (circled); Moisture: Dry (circled). Additional Comments: dark brown	
0.65					Decription: CLAY (circled), SILT (circled); Plasticity: High (circled); Graduation / Angularity: Fine (circled); Sorting: Well (circled); Grading: Well (circled); Moisture: Dry (circled). Additional Comments: white	
	G7-2					
0.80						

Form options printed in each description block:

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity (Typically sands only)	Colour	Sorting	Grading	Moisture
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Refusal @ 0.80m bgl. Really tight clay — only auger heads just spin on top.

Quick Soil Log

Page No:		Driller:	STRATHEN
Job Number:	GTA 18611.01	Drill method:	HAND AUGER
Project:	GOODWIN ASI	Hole diameter:	50 mm
Date started:	4/12/18	Groundwater at:	—
Date completed:	4/12/18	Screen diameter:	—
Borehole ID:	G6	End of hole:	1.10m bgl
Logged by:	RM	GPS:	0267476 6323939
		Checked by:	

Depth	Sample Id	PID	Graphic Log	USCS Class	Description of Soil Type	Well Construction
0						

Description Major	Description Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Moisture
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: G6-1 — dark brown

0.6 — TRACE OF ROOTS (<2%)

Description Major	Description Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Moisture
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: G6-2 — TRACE OF ROOTS (<2%) light grey/dark brown

1.10 — REFUSAL

Description Major	Description Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Moisture
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Description Major	Description Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Moisture
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments.

Description Major	Description Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Moisture
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments.

Description Major	Description Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Moisture
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

REFUSAL @ 1.10m bgl — hit clay the reason - and 2 auger heads spinning on top - I don't know the weight to get that through

Quick Soil Log

Page No:		Driller:	STH WESTON
Job Number:	GTH 1361.01	Drill method:	MAND AUGER
Project:	GRANDTON ASS	Hole diameter:	50mm
Date started:	5/12/18	Groundwater at:	—
Date completed:	5/12/18	Screen diameter:	—
Borehole ID:	GS	End of hole:	1.15m bgl
Logged by:	PH	GPS:	0267453 6824169
		Checked by:	

Depth	Sample Id	PID	Graphic Log	USCS Class	Description of Soil Type	Well Construction
0						

Description Major	Description Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Moisture
FILL	Clayey	(Non)	(Fine)	V. angular	Red	(Well)	Poor	(Dry)
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	(Well)	Wet
(SAND)	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: Dark grey

0.4

Description Major	Description Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Moisture
FILL	Clayey	(Non)	(Fine)	V. angular	Red	(Well)	Poor	(Dry)
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	(Well)	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
(PEAT)				W. rounded	Grey			

GS-1 + WAP 4 + DUP 4

Additional Comments: Dark grey

0.6

Description Major	Description Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Moisture
FILL	(Clayey)	Non	(Fine)	V. angular	Red	(Well)	Poor	(Dry)
CLAY	Silty	Low	(Medium)	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	(Moderate)	Coarse	Sunangular	Yellow	Poor	(Well)	Wet
(SAND)	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: grey-brown

0.9

Description Major	Description Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Moisture
FILL	Clayey	Non	(Fine)	V. angular	Red	(Well)	Poor	(Dry)
(CLAY)	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	(Sandy)	Moderate	Coarse	Sunangular	Yellow	Poor	(Well)	Wet
SAND	Gravelley	(High)		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

GS-2

Additional Comments: REPEAT grey-brown/white

1.1

Description Major	Description Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Moisture
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Description Major	Description Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Moisture
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

REPEAT - AN AUGER HOLD STANDING ON TOP OF WHAT APPEARS TO BE TIGHT CLAY / ROCK MADE THE WEIGHT TO GET THROUGH IT ~~BEDROCK~~

Quick Soil Log

Page No:		Driller:	STRATTON
Job Number:	GTA 1861.01	Drill method:	HAND AUGER
Project:	GORDON ASS	Hole diameter:	50mm
Date started:	5/12/18	Groundwater at:	–
Date completed:	5/12/18	Screen diameter:	–
Borehoe ID:	G4	End of hole:	1.10m bgl
Logged by:	PM	GPS:	0267438 6824382
		Checked by:	

Depth	Sample Id	PID	Graphic Log	USCS Class	Description of Soil Type	Well Construction
0					Layer 1 (see below)	
	G4-1					
0.6					Layer 2 (see below)	
	G4-2					
1.10					REFUSAL	

Layer 1 (0 – 0.6) (circled options shown in bold)

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	**Non**	**Fine**	V. anugular	Red	**Well**	Poor	**Dry**
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	**Well**	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: brown-grey

Layer 2 (0.6 – 1.10) (circled options shown in bold)

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	**Fine**	V. anugular	Red	**Well**	Poor	**Dry**
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	**Sandy**	**Modertate**	Coarse	Sunangular	Yellow	Poor	**Well**	Wet
SAND	Gravelley	**High**		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: white/grey-brown

REFUSAL

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation (Typically sands only)	Angularity	Colour	Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

REFUSAL – APPEARS TO BE CLAY OR TREE ROOTS – TRIED ALL 3 AUGER HEADS BUT THEY JUST SPIN ON TOP

Quick Soil Log

TOP OF HOLE IS ~1.00m below road height

Page No:		Driller:	STRATEGEN
Job Number:	GTA18611.01	Drill method:	HAND AUGER
Project:	GORUNDIN	Hole diameter:	50mm
Date started:	5/12/18	Groundwater at:	—
Date completed:	5/12/18	Screen diameter:	—
Borehoe ID:	G3	End of hole:	0.40mbgl
Logged by:	PM	GPS:	0267462 6824531
		Checked by:	

Depth	Sample Id	PID	Graphic Log	USCS Class	Description of Soil Type	Well Construction
0						
	G3-1				Block 1 (see below)	
0.55						
	G3-2				Block 2 (see below)	
0.9						

Block 1

Decription Major	Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Grading	Mositure
FILL	Clayey	(Non)	(Fine)	V. anugular	Red	(Well)	Poor	(Dry)
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	(Well)	Wet
(SAND)	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	(Grey)			

Additional Comments:

Block 2

Decription Major	Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Grading	Mositure
FILL	Clayey	Non	(Fine)	V. anugular	Red	(Well)	Poor	(Dry)
(CLAY)	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	(Sandy)	(Moderate)	Coarse	Sunangular	Yellow	Poor	(Well)	Wet
SAND	Gravelley	(High)		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: grey/white
REFUSAL @ 0.90mbgl

Blocks 3–6 (blank)

Decription Major	Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Grading	Mositure
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Refusal @ 0.90mbgl - tight clay - all 3 auger heads just spinning on top of it.

Quick Soil Log

Page No:		Driller:	SPOTTORE
Job Number:	GTA 18611-01	Drill method:	HAND AUGER
Project:	GEOMOTION ASS	Hole diameter:	50 mm
Date started:	5/12/18	Groundwater at:	-
Date completed:	5/12/18	Screen diameter:	-
Borehoe ID:	G2	End of hole:	1.90 mbgl
Logged by:	PM	GPS:	0267487 6824745
		Checked by:	

Depth	Sample Id	PID	Graphic Log	USCS Class	Description of Soil Type	Well Construction
0						

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Mositure
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: ORANGE to 2cm

0.3 — LIMESTONE + RED GRAVEL

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Mositure
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

G2-1

G2-2

Additional Comments: dark grey

1.2

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Mositure
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

G2-3

Additional Comments: LIGHT BROWN/WHITE

~ 5% CLAY

1.7

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Mositure
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: + BIG LIMESTONE AT BACK ~ 3cm x 3cm — white fragments ~10% 5mm

REFUSAL - HEAD CLAY + LIMESTONE PIECE

G2-4

1.9

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Mositure
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Mositure
FILL	Clayey	Non	Fine	V. angular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Quick Soil Log

Page No:		Driller:	STRATEGEN
Job Number:	GTA18611-C1	Drill method:	HAND AUGER
Project:	GEOMATION ASS	Hole diameter:	50 mm
Date started:	5/12/18	Groundwater at:	—
Date completed:	5/12/18	Screen diameter:	—
Borehole ID:	G-1	End of hole:	2.00 mbgl
Logged by:	PM	GPS:	0267521 6824927
		Checked by:	

Depth	Sample Id	PID	Graphic Log	USCS Class	Description of Soil Type	Well Construction
0						

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Moisture
FILL	Clayey	(Non)	Fine	V. anugular	Red	Well	(Poor)	(Dry)
CLAY	Silty	Low	(Medium)	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	(Coarse)	Sunangular	Yellow	(Poor)	Well	Wet
(SAND)	(Gravelley)	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: DARK-BROWN

0.2

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Moisture
FILL	Clayey	Non	(Fine)	V. anugular	Red	Well	(Poor)	(Dry)
(CLAY)	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	(Sandy)	(Moderate)	Coarse	Sunangular	Yellow	(Poor)	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

G1-1 — Additional Comments: DK BROWN — GRAVEL LIMESTONE

G1-2 — ~45% SAND ~50% CLAY ~5% GRAVEL

1.1

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Moisture
FILL	(Clayey)	Non	(Fine)	V. anugular	Red	Well	(Poor)	(Dry)
CLAY	Silty	(Low)	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	(Poor)	Well	Wet
SAND	(Gravelley)	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments: DK BROWN

A LOT MORE LIMESTONE GRAVEL IN THIS LAYER ONLY

1.4

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Moisture
FILL	Clayey	Non	(Fine)	V. anugular	Red	(Well)	Poor	(Dry)
CLAY	Silty	(Low)	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	(Well)	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
(PEAT)				W. rounded	Grey			

G1-3 — Additional Comments: V. DARK GREY/BLACK

1.9

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Moisture
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	(Dry)
(CLAY)	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	(High)		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

G1-4 — Additional Comments: LIGHT GREY

2.0

Decription Major	Decription Minor	Plasticity (Typically clays only)	Graduation / Angularity (Typically sands only)		Colour	Sorting / Grading Sorting	Sorting / Grading Grading	Moisture
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Moderate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Quick Soil Log

Page No:	Driller:
Job Number:	Drill method:
Project:	Hole diameter:
Date started:	Groundwater at:
Date completed:	Screen diameter:
Borehoe ID:	End of hole:
Logged by:	GPS:
	Checked by:

Depth	Sample Id	PID	Graphic Log	USCS Class	Description of Soil Type	Well Construction

Decription		Plasticity	Graduation / Angularity		Colour	Sorting / Grading		Mositure
Major	Minor	(Typically clays only)	(Typically sands only)			Sorting	Grading	
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertale	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription		Plasticity	Graduation / Angularity		Colour	Sorting / Grading		Mositure
Major	Minor	(Typically clays only)	(Typically sands only)			Sorting	Grading	
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertale	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription		Plasticity	Graduation / Angularity		Colour	Sorting / Grading		Mositure
Major	Minor	(Typically clays only)	(Typically sands only)			Sorting	Grading	
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertale	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription		Plasticity	Graduation / Angularity		Colour	Sorting / Grading		Mositure
Major	Minor	(Typically clays only)	(Typically sands only)			Sorting	Grading	
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertale	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription		Plasticity	Graduation / Angularity		Colour	Sorting / Grading		Mositure
Major	Minor	(Typically clays only)	(Typically sands only)			Sorting	Grading	
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertale	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription		Plasticity	Graduation / Angularity		Colour	Sorting / Grading		Mositure
Major	Minor	(Typically clays only)	(Typically sands only)			Sorting	Grading	
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertale	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Quick Soil Log

Page No:	**Driller:**
Job Number:	**Drill method:**
Project:	**Hole diameter:**
Date started:	**Groundwater at:**
Date completed:	**Screen diameter:**
Borehoe ID:	**End of hole:**
Logged by:	**GPS:**
	Checked by:

Depth	Sample Id	PID	Graphic Log	USCS Class	Description of Soil Type	Well Construction

Decription		Plasticity	Graduation / Angularity		Colour	Sorting / Grading		Mositure
Major	Minor	(Typically clays only)	(Typically sands only)			Sorting	Grading	
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription		Plasticity	Graduation / Angularity		Colour	Sorting / Grading		Mositure
Major	Minor	(Typically clays only)	(Typically sands only)			Sorting	Grading	
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription		Plasticity	Graduation / Angularity		Colour	Sorting / Grading		Mositure
Major	Minor	(Typically clays only)	(Typically sands only)			Sorting	Grading	
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription		Plasticity	Graduation / Angularity		Colour	Sorting / Grading		Mositure
Major	Minor	(Typically clays only)	(Typically sands only)			Sorting	Grading	
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription		Plasticity	Graduation / Angularity		Colour	Sorting / Grading		Mositure
Major	Minor	(Typically clays only)	(Typically sands only)			Sorting	Grading	
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Decription		Plasticity	Graduation / Angularity		Colour	Sorting / Grading		Mositure
Major	Minor	(Typically clays only)	(Typically sands only)			Sorting	Grading	
FILL	Clayey	Non	Fine	V. anugular	Red	Well	Poor	Dry
CLAY	Silty	Low	Medium	Angular	Orange	Moderate	Moderate	Moist
SILT	Sandy	Modertate	Coarse	Sunangular	Yellow	Poor	Well	Wet
SAND	Gravelley	High		Subrounded	Green			
GRAVEL				Rounded	Black			
PEAT				W. rounded	Grey			

Additional Comments:

Appendix 2
Laboratory reports

CHAIN OF CUSTODY DOCUMENTATION

strategen ENVIRONMENTAL

Level 1,
50 Subiaco Square Road
Subiaco WA 6008
PO Box 243
Subiaco WA 6904
Ph: (08) 9380 3100

Client: STRATEGEN
Site: GERO.
Project Manager: BOURGAULT

Project No.: GTA8611.01
Report To: BOURGAULT.
Sampled By: PM

Page: 1 of 4
Phone: 0414 261 160
Quote No.: GTA18611.01

Send invoice to accounts@strategen.com.au

LAB No. (18-18401)	SAMPLE ID.	DATE	SOIL/WATER (S/W)	NO. SAMPLE CONTAINERS	pH & pH Fox	HOLD										COMMENTS
-1	G1-1				X											
-2	G1-2				X											
-3	G1-3				X											
-4	G1-4				X											
-5	G2-1				X											
-6	G2-2				X											
-7	G2-3				X											
-8	G2-4				X											
-9	G3-1				X											
-10	G3-2				X											
-11	Dup1	~~G3-3~~			X											
-12	Dup2	~~G3-4~~			X											
-13	G4-1				X											
-14	G4-2				X											
-15	Dup3	~~G4-3~~			X											
-16	Dup4	~~G4-4~~			X											
-17	TRIP2,3,4	TRIP1-4				X										Not for analysis.

Strategen Environmental

-17-18-19 RELINQUISHED BY
Name:
Signature:

Date: 10/12/18

Time:

Laboratory

RECEIVED BY
Name P. Nolte
Signature:

Date: 10/12/18

Time: 1.30pm

CHAIN OF CUSTODY DOCUMENTATION

strategen ENVIRONMENTAL

Level 1,
50 Subiaco Square Road
Subiaco WA 6008
PO Box 243
Subiaco WA 6904
Ph: (08) 9380 3100

Client: STRATEGEN

Site: GERO.

Project Manager: BOURGAULT

Project No.: GTA18611.01

Report To: BOURGAULT.

Sampled By: PM

Page: 2 of 4

Phone:

Quote No.: GTA18611.01

Send invoice to accounts@strategen.com.au

LAB No.	SAMPLE ID.	DATE	SOIL/WATER (S/W)	NO. SAMPLE CONTAINERS	TPH C6 - C10 + BTEX											COMMENTS
-20	G5-1				X											
-21	G5-2				X											
-22	G6-1				X											
-23	G6-2				X											
-24	G7-1				X											
-25	G7-2				X											
-26	G8-1				X											
-27	G8-2				X											
-28	G9-1				X											
-29	G9-2				X											
-30	G9-3				X											
-31	G10-1				X											
-32	G11-1				X											
-33	G11-2				X											
-34	G12-1				X											
-35	G13-1				X											
-36	G13-2				X											

Strategen Environmental

RELINQUISHED BY	Date:	Time:
Name:	10/12/18	
Signature:		

Laboratory

RECEIVED BY	Date:	Time:
Name:	10/12/18	1:30 pm
Signature: P. Neide		

4.6

CHAIN OF CUSTODY DOCUMENTATION

strategen
ENVIRONMENTAL

Level 1,
50 Subiaco Square Road
Subiaco WA 6008
PO Box 243
Subiaco WA 6904
Ph: (08) 9380 3100

Client: STRATEGEN
Site: GERD
Project Manager: BOURGAULT

Project No.: GTA18611-01
Report To: BOURGAULT
Sampled By: PM

Page: 3 of 4
Phone:
Quote No.: GTA18611 · 01

Send invoice to accounts@strategen.com.au

LAB No.	SAMPLE ID.	DATE	SOIL/WATER (S/W)	NO. SAMPLE CONTAINERS	pH (EA)											COMMENTS
-37	G14-1				X											
-38	G14-2				X											
-39	G15-1				X											
-41	G15-2-40				X											
-42	G16-1				X											
-43	G16-2				X											
-44	G16-3				X											
-45	G16-4				X											
-46	G17-1				X											
-47	G17-2				X											
-48	G17-3				X											
-49	G17-4				X											
-50	G18-1				X											
-51	G18-2				X											
-52	G18-3				X											
-53	G18-4				X											

Strategen Environmental			Laboratory		
RELINQUISHED BY	Date:	Time:	RECEIVED BY	Date:	Time:
Name:	10/12/18		Name P. Nicube	10/12/18	1.30pm
Signature:			Signature:		

CHAIN OF CUSTODY DOCUMENTATION

strategen ENVIRONMENTAL

Level 1,
50 Subiaco Square Road
Subiaco WA 6008
PO Box 243
Subiaco WA 6904
Ph: (08) 9380 3100

Client: STRATEGEN
Site: GERO
Project Manager: BOURGAULT
Project No.: GTA18611.01
Report To: BOURGAULT
Sampled By: PM
Page: 4 of 4
Phone:
Quote No.: GTA18611.01

Send invoice to accounts@strategen.com.au

LAB No.	SAMPLE ID.	DATE	SOIL/WATER (S/W)	NO. SAMPLE CONTAINERS	pH + pH FOX											COMMENTS
-54	G19-1				X											
-55	G19-2				X											
-56	G19-3				X											
-57	G19-4				X											
-58	G20-1				X											
-59	G20-2				X											
-60	G20-3				X											
-61	G20-4				X											

Strategen Environmental

RELINQUISHED BY
Name:
Signature:
Date: 10/12/18
Time:

Laboratory

RECEIVED BY
Name: L. Noble
Signature:
Date: 10/12/18
Time: 1.30pm

Quality Control Report

Job Number: 18-18401
Date: 14/12/2018

This Quality Control Report is issued in accordance with Section 18 of the ARL Quality Management Manual. All QC parameters are contained within the relevant ARL Method as indicated by the method reference, either on this report or the Laboratory Report.

Acceptance of Holding Times, Duplicate RPD, Spike, LCS and CRM Recoveries are determined at the time of analysis by the Signatory indicated on the Laboratory Report.

DEFINITIONS

Duplicate Analysis
A sample, chosen randomly by the analyst at the time of sample preparation, analysed in duplicate.

RPD
Relative Percent Difference is the absolute difference between the sample and a duplicate analysis compared to the average of the two analytical results. Acceptance Limits can be exceeded by matrix interference or when the result is less than 5 times the LOR.

Matrix Spike
An additional portion of sample to which known amounts of the target analytes are added before sample preparation. Acceptance Limits can be exceeded by matrix interference or when the target analytes are present in the sample.

Certified Reference Material (CRM)
A commercially available certified solution/mixture of the target analyte of known concentration.

Laboratory Control Sample (LCS)
An in-house certified solution/mixture of the target analyte of known concentration.

Analytical Reference Laboratory (WA) PTY. Ltd
46-48 Banksia Road, Welshpool, Western Australia 6106 Telephone: 08 6253 4444 Facsmile 08 6253 4440
www.arlwa.com.au ABN: 91 050 159 898

Quality Control Report

Job Number: 18-18401

Date: 14/12/2018

Environmental and Analytical Laboratory

'Field' pH in Acid Sulphate Soils

Holding Time Criteria	Date	
Analysed	13/12/2018	
Duplicate Analysis (18-18401-1)	**RPD (%)**	**Limits (%)**
pH_f (23Af)	0	25
pH_{fox} (23Bf)	0	25
Duplicate Analysis (18-18401-10)	**RPD (%)**	**Limits (%)**
pH_f (23Af)	1	25
pH_{fox} (23Bf)	2	25
Duplicate Analysis (18-18401-24)	**RPD (%)**	**Limits (%)**
pH_f (23Af)	0	25
pH_{fox} (23Bf)	2	25
Duplicate Analysis (18-18401-33)	**RPD (%)**	**Limits (%)**
pH_f (23Af)	1	25
pH_{fox} (23Bf)	0	25
Duplicate Analysis (18-18401-44)	**RPD (%)**	**Limits (%)**
pH_f (23Af)	1	25
pH_{fox} (23Bf)	1	25
Duplicate Analysis (18-18401-53)	**RPD (%)**	**Limits (%)**
pH_f (23Af)	1	25
pH_{fox} (23Bf)	0	25
Blank Analysis	**Result (pH units)**	**Limit (pH units)**
pH_f (23Af)	5.2	0.1
pH_{fox} (23Bf)	5.5	0.1
Blank Analysis	**Result (pH units)**	**Limit (pH units)**
pH_f (23Af)	5.3	0.1
pH_{fox} (23Bf)	5.5	0.1
Blank Analysis	**Result (pH units)**	**Limit (pH units)**
pH_f (23Af)	5.3	0.1
pH_{fox} (23Bf)	5.5	0.1
Certified Reference Material	**Recovery (%)**	**Limits (%)**
pH_f (23Af)	100	95 - 105
pH_{fox} (23Bf)	100	95 - 105
pH_f (23Af)	100	95 - 105
pH_{fox} (23Bf)	100	95 - 105
pH_f (23Af)	100	95 - 105
pH_{fox} (23Bf)	100	95 - 105

Analytical Reference Laboratory (WA) PTY. Ltd
46-48 Banksia Road, Welshpool, Western Australia 6106 Telephone: 08 6253 4444 Facsmile 08 6253 4440
www.arlwa.com.au ABN: 91 050 159 898

Quality Control Report

Job Number: 18-18401-A
Date: 24/12/2018

Environmental and Analytical Laboratory

This Quality Control Report is issued in accordance with Section 18 of the ARL Quality Management Manual. All QC parameters are contained within the relevant ARL Method as indicated by the method reference, either on this report or the Laboratory Report.

Acceptance of Holding Times, Duplicate RPD, Spike, LCS and CRM Recoveries are determined at the time of analysis by the Signatory indicated on the Laboratory Report.

DEFINITIONS

Duplicate Analysis
A sample, chosen randomly by the analyst at the time of sample preparation, analysed in duplicate.

RPD
Relative Percent Difference is the absolute difference between the sample and a duplicate analysis compared to the average of the two analytical results. Acceptance Limits can be exceeded by matrix interference or when the result is less than 5 times the LOR.

Matrix Spike
An additional portion of sample to which known amounts of the target analytes are added before sample preparation. Acceptance Limits can be exceeded by matrix interference or when the target analytes are present in the sample.

Certified Reference Material (CRM)
A commercially available certified solution/mixture of the target analyte of known concentration.

Laboratory Control Sample (LCS)
An in-house certified solution/mixture of the target analyte of known concentration.

Analytical Reference Laboratory (WA) PTY. Ltd
46-48 Banksia Road, Welshpool, Western Australia 6106 Telephone: 08 6253 4444 Facsmile 08 6253 4440
www.arlwa.com.au ABN: 91 050 159 898

Quality Control Report

Job Number: 18-18401-A

Date: 24/12/2018

Environmental and Analytical Laboratory

Metals in Soil and Sediment

Holding Time Criteria	Date	
Extracted	18/12/2018	
Analysed	19/12/2018	
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Arsenic	<5	5
Cadmium	<0.1	0.1
Chromium	<1	1
Copper	<1	1
Nickel	<1	1
Lead	<1	1
Zinc	<1	1
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Arsenic	115	80 - 120
Cadmium	114	80 - 120
Chromium	110	80 - 120
Copper	102	80 - 120
Nickel	99	80 - 120
Lead	98	80 - 120
Zinc	101	80 - 120

Mercury in Soils

Holding Time Criteria	Date	
Extracted	20/12/2018	
Analysed	21/12/2018	
Duplicate Analysis (18-18357-C-8)	**RPD (%)**	**Limits (%)**
Mercury	0	200
Duplicate Analysis (18-18847-1)	**RPD (%)**	**Limits (%)**
Mercury	40	200
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Mercury	<0.02	0.02
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Mercury	80	80 - 120

Analytical Reference Laboratory (WA) PTY. Ltd
46-48 Banksia Road, Welshpool, Western Australia 6106 Telephone: 08 6253 4444 Facsimile 08 6253 4440
www.arlwa.com.au ABN: 91 050 159 898

Quality Control Report

Job Number: 18-18401-A

Date: 24/12/2018

Environmental and Analytical Laboratory

Ca and Mg in TAA and TPA ASS

Holding Time Criteria	Date	
Extracted	20/12/2018	
Analysed	21/12/2018	
Duplicate Analysis (18-18401-A-13)	**RPD (%)**	**Limits (%)**
KCl Extractable Calcium (23Vh)	0	25
Peroxide Extractable Calcium (23Wh)	9	25
KCl Extractable Magnesium (23Sm)	3	50
Peroxide Extractable Magnesium (23Tm)	10	25
Duplicate Analysis (18-18401-A-33)	**RPD (%)**	**Limits (%)**
KCl Extractable Calcium (23Vh)	0	25
Peroxide Extractable Calcium (23Wh)	7	25
KCl Extractable Magnesium (23Sm)	200	200
Peroxide Extractable Magnesium (23Tm)	0	50
Duplicate Analysis (18-18401-A-47)	**RPD (%)**	**Limits (%)**
KCl Extractable Calcium (23Vh)	2	50
Peroxide Extractable Calcium (23Wh)	9	25
KCl Extractable Magnesium (23Sm)	0	200
Peroxide Extractable Magnesium (23Tm)	6	200
Blank Analysis	**Result (% Ca)**	**Limit (% Ca)**
KCl Extractable Calcium (23Vh)	<0.005	0.005
Peroxide Extractable Calcium (23Wh)	<0.005	0.005
KCl Extractable Magnesium (23Sm)	<0.005	0.005
Peroxide Extractable Magnesium (23Tm)	<0.005	0.005
Laboratory Control Sample	**Recovery (%)**	**Limits (%)**
KCl Extractable Calcium (23Vh)	89	80 - 120
Peroxide Extractable Calcium (23Wh)	90	80 - 120
KCl Extractable Magnesium (23Sm)	92	80 - 120
Peroxide Extractable Magnesium (23Tm)	91	80 - 120

Analytical Reference Laboratory (WA) PTY. Ltd
46-48 Banksia Road, Welshpool, Western Australia 6106 Telephone: 08 6253 4444 Facsmile 08 6253 4440
www.arlwa.com.au ABN: 91 050 159 898

Quality Control Report

Job Number: 18-18401-A

Date: 24/12/2018

Environmental and Analytical Laboratory

Sulphur in TAA and TPA ASS

Holding Time Criteria	Date	
Extracted	20/12/2018	
Analysed	21/12/2018	
Duplicate Analysis (18-18401-A-13)	**RPD (%)**	**Limits (%)**
KCl Extractable Sulfur (23Ce)	32	50
Peroxide Extractable Sulfur (23De)	2	25
Duplicate Analysis (18-18401-A-33)	**RPD (%)**	**Limits (%)**
KCl Extractable Sulfur (23Ce)	3	50
Peroxide Extractable Sulfur (23De)	3	25
Duplicate Analysis (18-18401-A-47)	**RPD (%)**	**Limits (%)**
KCl Extractable Sulfur (23Ce)	25	200
Peroxide Extractable Sulfur (23De)	25	25
Blank Analysis	**Result (% S)**	**Limit (% S)**
KCl Extractable Sulfur (23Ce)	<0.005	0.005
Peroxide Extractable Sulfur (23De)	<0.005	0.005
Laboratory Control Sample	**Recovery (%)**	**Limits (%)**
KCl Extractable Sulfur (23Ce)	88	80 - 120
Peroxide Extractable Sulfur (23De)	94	80 - 120

pH KCL and TAA in Soil

Holding Time Criteria	Date	
Extracted	19/12/2018	
Analysed	19/12/2018	
Duplicate Analysis (18-18401-A-33)	**RPD (%)**	**Limits (%)**
pH_{KCl} (23A)	1	25
Titratable Actual Acidity (23F)	0	25
Blank Analysis	**Result (pH Units)**	**Limit (pH Units)**
pH_{KCl} (23A)	6.6	0.1
Titratable Actual Acidity (23F)	<2	2
Laboratory Control Sample	**Recovery (%)**	**Limits (%)**
pH_{KCl} (23A)	99	80 - 120
Titratable Actual Acidity (23F)	98	80 - 120

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Quality Control Report

Job Number: 18-18401-A

Date: 24/12/2018

Environmental and Analytical Laboratory

pHox and TPA in Soil

Holding Time Criteria	Date	
Extracted	19/12/2018	
Analysed	19/12/2018	
Duplicate Analysis (18-18401-A-33)	**RPD (%)**	**Limits (%)**
pH_{ox} (23B)	1	25
Titratable Peroxide Acidity (23G)	0	25
Blank Analysis	**Result (pH Units)**	**Limit (pH Units)**
pH_{ox} (23B)	6.3	0.1
Titratable Peroxide Acidity (23G)	<2	2
Laboratory Control Sample	**Recovery (%)**	**Limits (%)**
pH_{ox} (23B)	99	80 - 120
Titratable Peroxide Acidity (23G)	99	80 - 120

Moisture in ASS

Holding Time Criteria	Date	
Extracted	18/12/2018	
Analysed	19/12/2018	
Duplicate Analysis (18-18401-A-33)	**RPD (%)**	**Limits (%)**

pHox and TPA in Soil

Holding Time Criteria	Date	
Extracted	18/12/2018	
Analysed	18/12/2018	
Duplicate Analysis (18-18401-A-13)	**RPD (%)**	**Limits (%)**
pH_{ox} (23B)	0	25
Titratable Peroxide Acidity (23G)	0	25
Duplicate Analysis (18-18401-A-47)	**RPD (%)**	**Limits (%)**
pH_{ox} (23B)	1	25
Titratable Peroxide Acidity (23G)	0	25
Blank Analysis	**Result (pH Units)**	**Limit (pH Units)**
pH_{ox} (23B)	5.7	0.1
Titratable Peroxide Acidity (23G)	<2	2
Laboratory Control Sample	**Recovery (%)**	**Limits (%)**
pH_{ox} (23B)	95	80 - 120
Titratable Peroxide Acidity (23G)	93	80 - 120

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Quality Control Report

Job Number: 18-18401-A

Date: 24/12/2018

Environmental and Analytical Laboratory

pH KCL and TAA in Soil

Holding Time Criteria	Date	
Extracted	18/12/2018	
Analysed	19/12/2018	
Duplicate Analysis (18-18401-A-13)	**RPD (%)**	**Limits (%)**
pH_{KCl} (23A)	0	25
Titratable Actual Acidity (23F)	0	25
Duplicate Analysis (18-18401-A-47)	**RPD (%)**	**Limits (%)**
pH_{KCl} (23A)	0	25
Titratable Actual Acidity (23F)	0	25
Blank Analysis	**Result (pH Units)**	**Limit (pH Units)**
pH_{KCl} (23A)	6.6	0.1
Titratable Actual Acidity (23F)	<2	2
Laboratory Control Sample	**Recovery (%)**	**Limits (%)**
pH_{KCl} (23A)	101	80 - 120
Titratable Actual Acidity (23F)	97	80 - 120

Moisture in ASS

Holding Time Criteria	Date	
Extracted	17/12/2018	
Analysed	18/12/2018	
Duplicate Analysis (18-18401-A-13)	**RPD (%)**	**Limits (%)**
Duplicate Analysis (18-18401-A-47)	**RPD (%)**	**Limits (%)**
Blank Analysis	**Result (%w/w)**	**Limit (%w/w)**
Moisture	<0.1	0.1

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ARL Analytical Reference Laboratory

ARL Group
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ProMicro
Science with Ethics

LABORATORY REPORT

Job Number: 18-18401
Revision: 00
Date: 14 December 2018

ADDRESS: **Strategen Environmental Consultants Pty Ltd**
Level 1, 50 Subiaco Square Road
Subiaco WA 6008

ATTENTION: Phil Bourgault

DATE RECEIVED: 10/12/2018

YOUR REFERENCE: GTA18611-01

PURCHASE ORDER:

APPROVALS:

Sean Sangster
Inorganics Supervisor

REPORT COMMENTS:

This report is issued by Analytical Reference Laboratory (WA) Pty Ltd
Samples are analysed on an as received basis unless otherwise noted.
Rates of Reaction are determined by visual observation and are based on Acid Sulphate Soils Laboratory Methods Guidelines: Section H - Table H1.1

RATES OF REACTION
Slight Reaction = X
Moderate Reaction = XX
Vigorous Reaction = XXX
Very Vigorous Reaction = XXXX

METHOD REFERENCES:
Methods prefixed with "ARL" are covered under NATA Accreditation Number: 2377
Methods prefixed with "PM" are covered under NATA Accreditation Number: 2561

Method ID	Method Description
ARL No. 208	"Field" pH measurements
23A and 23B	QASSIT et al Method Code

NATA
WORLD RECOGNISED ACCREDITATION
Accredited for compliance with ISO/IEC 17025 - Testing

Strategen Environmental Consultants Pty Ltd *LABORATORY REPORT*
Job No: 18-18401 *Revision: 00* *Date: 14/12/18*

Acid Sulfate Soils		Sample No:	18-18401-1	18-18401-2	18-18401-3	18-18401-4	18-18401-5
		Sample Details:	G1-1	G1-2	G1-3	G1-4	G2-1
ANALYTE	LOR	Units	10/12/2018	10/12/2018	10/12/2018	10/12/2018	10/12/2018
pH_f (23Af)	0.1	pH units	8.0	8.0	8.1	7.9	8.3
pH_{fox} (23Bf)	0.1	pH units	7.5	7.6	6.7	6.9	6.7
Rate of Reaction			X	XX	X	X	XX

Acid Sulfate Soils		Sample No:	18-18401-6	18-18401-7	18-18401-8	18-18401-9	18-18401-10
		Sample Details:	G2-2	G2-3	G2-4	G3-1	G3-2
ANALYTE	LOR	Units	10/12/2018	10/12/2018	10/12/2018	10/12/2018	10/12/2018
pH_f (23Af)	0.1	pH units	8.1	8.3	8.4	8.2	8.3
pH_{fox} (23Bf)	0.1	pH units	7.0	7.1	6.9	6.3	6.5
Rate of Reaction			XX	X	XX	X	XX

Acid Sulfate Soils		Sample No:	18-18401-11	18-18401-12	18-18401-13	18-18401-14	18-18401-15
		Sample Details:	DUP1	DUP2	G4-1	G4-2	DUP3
ANALYTE	LOR	Units	10/12/2018	10/12/2018	10/12/2018	10/12/2018	10/12/2018
pH_f (23Af)	0.1	pH units	8.5	8.5	8.0	8.4	8.7
pH_{fox} (23Bf)	0.1	pH units	8.2	6.9	6.2	6.8	6.8
Rate of Reaction			X	XX	XXX	XX	XXX

Acid Sulfate Soils		Sample No:	18-18401-16	18-18401-20	18-18401-21	18-18401-22	18-18401-23
		Sample Details:	DUP4	G5-1	G5-2	G6-1	G6-2
ANALYTE	LOR	Units	10/12/2018	10/12/2018	10/12/2018	10/12/2018	10/12/2018
pH_f (23Af)	0.1	pH units	8.1	8.1	8.2	7.8	7.8
pH_{fox} (23Bf)	0.1	pH units	6.4	6.5	6.6	6.2	6.6
Rate of Reaction			XXX	XXX	XX	XX	X

Acid Sulfate Soils		Sample No:	18-18401-24	18-18401-25	18-18401-26	18-18401-27	18-18401-28
		Sample Details:	G7-1	G7-2	G8-1	G8-2	G9-1
ANALYTE	LOR	Units	10/12/2018	10/12/2018	10/12/2018	10/12/2018	10/12/2018
pH_f (23Af)	0.1	pH units	8.4	8.5	8.1	8.0	8.4
pH_{fox} (23Bf)	0.1	pH units	6.3	6.7	6.4	6.7	7.0
Rate of Reaction			X	XX	XXX	XX	XX

Acid Sulfate Soils		Sample No:	18-18401-29	18-18401-30	18-18401-31	18-18401-32	18-18401-33
		Sample Details:	G9-2	G9-3	G10-11	G11-1	G11-2
ANALYTE	LOR	Units	10/12/2018	10/12/2018	10/12/2018	10/12/2018	10/12/2018
pH_f (23Af)	0.1	pH units	8.3	8.4	8.7	8.1	8.1
pH_{fox} (23Bf)	0.1	pH units	7.0	6.8	6.9	6.6	6.6
Rate of Reaction			XX	XX	XX	XX	XXX

Acid Sulfate Soils		Sample No:	18-18401-34	18-18401-35	18-18401-36	18-18401-37	18-18401-38
		Sample Details:	G12-1	G13-1	G13-2	G14-1	G14-2
ANALYTE	LOR	Units	10/12/2018	10/12/2018	10/12/2018	10/12/2018	10/12/2018
pH_f (23Af)	0.1	pH units	8.6	8.1	8.5	8.5	8.0
pH_{fox} (23Bf)	0.1	pH units	8.3	7.7	8.4	6.8	8.0
Rate of Reaction			XXXX	XXXX	XXXX	XXXX	XXXX

Strategen Environmental Consultants Pty Ltd *LABORATORY REPORT*
Job No: 18-18401 *Revision: 00* *Date: 14/12/18*

Acid Sulfate Soils		Sample No:	18-18401-39	18-18401-40	18-18401-41	18-18401-42	18-18401-43
		Sample Details:	G15-1	G15-2	G15-3	G16-1	G16-2
ANALYTE	LOR	Units	10/12/2018	10/12/2018	10/12/2018	10/12/2018	10/12/2018
pH_f (23Af)	0.1	pH units	8.0	7.7	7.6	8.3	8.3
pH_{fox} (23Bf)	0.1	pH units	8.0	7.6	7.6	6.6	6.6
Rate of Reaction			XXXX	XXXX	XXXX	XX	XX

Acid Sulfate Soils		Sample No:	18-18401-44	18-18401-45	18-18401-46	18-18401-47	18-18401-48
		Sample Details:	G16-3	G16-4	G17-1	G17-2	G17-3
ANALYTE	LOR	Units	10/12/2018	10/12/2018	10/12/2018	10/12/2018	10/12/2018
pH_f (23Af)	0.1	pH units	8.6	8.5	8.5	8.0	8.0
pH_{fox} (23Bf)	0.1	pH units	7.0	7.0	6.8	7.3	7.5
Rate of Reaction			XX	X	XXX	XXXX	XX

Acid Sulfate Soils		Sample No:	18-18401-49	18-18401-50	18-18401-51	18-18401-52	18-18401-53
		Sample Details:	G17-4	G18-1	G18-2	G18-3	G18-4
ANALYTE	LOR	Units	10/12/2018	10/12/2018	10/12/2018	10/12/2018	10/12/2018
pH_f (23Af)	0.1	pH units	8.1	8.6	7.9	8.3	8.3
pH_{fox} (23Bf)	0.1	pH units	7.4	7.6	7.9	8.2	8.0
Rate of Reaction			XX	XXXX	XXXX	XXXX	XXXX

Acid Sulfate Soils		Sample No:	18-18401-54	18-18401-55	18-18401-56	18-18401-57	18-18401-58
		Sample Details:	G19-1	G19-2	G19-3	G19-4	G20-1
ANALYTE	LOR	Units	10/12/2018	10/12/2018	10/12/2018	10/12/2018	10/12/2018
pH_f (23Af)	0.1	pH units	8.8	8.5	8.6	8.7	8.5
pH_{fox} (23Bf)	0.1	pH units	7.2	6.9	7.3	8.1	7.9
Rate of Reaction			X	XXXX	XXXX	XXXX	XXXX

Acid Sulfate Soils		Sample No:	18-18401-59	18-18401-60	18-18401-61
		Sample Details:	G20-2	G20-3	G20-4
ANALYTE	LOR	Units	10/12/2018	10/12/2018	10/12/2018
pH_f (23Af)	0.1	pH units	8.3	8.4	8.6
pH_{fox} (23Bf)	0.1	pH units	7.6	6.7	7.7
Rate of Reaction			XXXX	X	XXXX

Result Definitions
LOR Limit of Reporting [NT] Not Tested [ND] Not Detected at indicated Limit of Reporting
* Denotes test not covered by NATA Accreditation

FOR MICROBIOLOGICAL TESTING - The data in this report may not be representative of a lot, batch or other samples and may not necessarily justify the acceptance or rejection of a lot or batch, a product recall or support legal proceedings. Tests are not routinely performed as duplicates unless specifically requested. Changes occur in the bacterial content of biological samples. Samples should be examined as soon as possible after collection, preferably within 6 hrs and must be stored at 4 degrees Celsius or below. Samples tested after 24 hrs cannot be regarded as satisfactory because of temperature abuse and variations.

LABORATORY REPORT

Job Number: 18-18401-A
Revision: 00
Date: 24 December 2018

ADDRESS: **Strategen Environmental Consultants Pty Ltd**
Level 1, 50 Subiaco Square Road
Subiaco WA 6008

ATTENTION: Phil Bourgault

DATE RECEIVED: 10/12/2018

YOUR REFERENCE: GTA18611-01

PURCHASE ORDER:

APPROVALS:

Sean Sangster
Inorganics Supervisor

REPORT COMMENTS:

This report is issued by Analytical Reference Laboratory (WA) Pty Ltd
Samples are analysed on an as received basis unless otherwise noted.
Samples were dried and ground prior to analysis.

METHOD REFERENCES:
Methods prefixed with "ARL" are covered under NATA Accreditation Number: 2377
Methods prefixed with "PM" are covered under NATA Accreditation Number: 2561

Method ID	Method Description
ARL No. 401/403	Metals in Soil and Sediment by ICPOES/MS
ARL No. 406	Mercury by Cold Vapour Atomic Absorption Spectrophotometry
ARL No. 135	Moisture
ARL No. 201	KCL Extractable pH and TAA
ARL No. 202	Peroxide Extractable pH, TPA and ANCe
ARL No. 204	Sulfur, Calcium and Magnesium by KCl Extraction
ARL No. 203	Sulfur, Calcium and Magnesium by Peroxide Extraction
ARL No. 205	Sulfur, Calcium and Magnesium by 4M HCl Extraction
ARL No. 210	Acid Sulfate Soils Method Codes and Further Calculations

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Strategen Environmental Consultants Pty Ltd *LABORATORY REPORT*
Job No: 18-18401-A *Revision: 00* *Date: 24/12/18*

8 Heavy Metals in Soil		Sample No:	18-18401-A-8	18-18401-A-10	18-18401-A-13	18-18401-A-20	18-18401-A-24
		Sample Details:	G2-4	G3-2	G4-1	G5-1	G7-1
ANALYTE	LOR	Units					
Arsenic	5	mg/kg	<5	6	<5	<5	<5
Cadmium	0.1	mg/kg	<0.1	<0.1	0.5	0.1	0.2
Chromium	1	mg/kg	5	4	14	12	16
Copper	1	mg/kg	9	8	9	9	10
Mercury	0.02	mg/kg	<0.02	<0.02	0.02	<0.02	<0.02
Nickel	1	mg/kg	2	1	2	1	2
Lead	1	mg/kg	2	4	12	2	15
Zinc	1	mg/kg	3	3	110	3	9

8 Heavy Metals in Soil		Sample No:	18-18401-A-30	18-18401-A-33	18-18401-A-35	18-18401-A-38	18-18401-A-41
		Sample Details:	G9-3	G11-2	G13-1	G14-2	G15-3
ANALYTE	LOR	Units					
Arsenic	5	mg/kg	<5	<5	<5	<5	<5
Cadmium	0.1	mg/kg	<0.1	<0.1	0.2	0.2	0.3
Chromium	1	mg/kg	<1	<1	2	12	19
Copper	1	mg/kg	<1	3	1	5	7
Mercury	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	0.03
Nickel	1	mg/kg	<1	<1	2	3	4
Lead	1	mg/kg	<1	<1	5	6	8
Zinc	1	mg/kg	<1	<1	4	6	8

8 Heavy Metals in Soil		Sample No:	18-18401-A-47	18-18401-A-53	18-18401-A-55	18-18401-A-61
		Sample Details:	G17-2	G18-4	G19-2	G20-4
ANALYTE	LOR	Units				
Arsenic	5	mg/kg	<5	<5	<5	<5
Cadmium	0.1	mg/kg	0.1	0.1	0.2	0.2
Chromium	1	mg/kg	5	6	6	7
Copper	1	mg/kg	<1	3	2	3
Mercury	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02
Nickel	1	mg/kg	1	1	1	2
Lead	1	mg/kg	3	10	9	7
Zinc	1	mg/kg	1	7	8	6

SPOCAS Suite		Sample No:	18-18401-A-8	18-18401-A-10	18-18401-A-13	18-18401-A-20	18-18401-A-24
		Sample Details:	G2-4	G3-2	G4-1	G5-1	G7-1
ANALYTE	LOR	Units					
Moisture	0.1	%w/w	32.4	22.6	14.3	20.5	12.0
pH_{KCl} (23A)	0.1	pH Units	9.1	8.8	8.8	8.9	8.8
pH_{ox} (23B)	0.1	pH Units	8.1	7.8	7.4	7.6	7.4
Titratable Actual Acidity (23F)	2	mol H^+/t	<2	<2	<2	<2	<2
Titratable Peroxide Acidity (23G)	2	mol H^+/t	<2	<2	<2	<2	<2
Titratable Sulphidic Acidity (23H)	2	mol H^+/t	<2	<2	<2	<2	<2
Sulphidic - TAA (s-23F)	0.005	% Pyrite Sulfur	<0.005	<0.005	<0.005	<0.005	<0.005
Sulphidic - TPA (s-23G)	0.005	% Pyrite Sulfur	<0.005	<0.005	<0.005	<0.005	<0.005
Sulphidic - TSA (s-23H)	0.005	% Pyrite Sulfur	<0.005	<0.005	<0.005	<0.005	<0.005

Strategen Environmental Consultants Pty Ltd *LABORATORY REPORT*
Job No: 18-18401-A *Revision: 00* *Date: 24/12/18*

SPOCAS Suite		Sample No:	18-18401-A-8	18-18401-A-10	18-18401-A-13	18-18401-A-20	18-18401-A-24
		Sample Details:	G2-4	G3-2	G4-1	G5-1	G7-1
ANALYTE	LOR	Units					
KCl Extractable Sulfur (23Ce)	0.005	% S	0.039	0.050	0.055	0.096	0.15
Peroxide Extractable Sulfur (23De)	0.005	% S	0.093	0.10	0.089	0.12	0.071
Peroxide Oxidisable Sulfur (23Ee)	0.005	% S	0.054	0.050	0.034	0.024	<0.005
Acidic S_{pos} (a-23Ee)	4	mol H^+/t	34	31	21	15	<4
Residual Acid Soluble Sulfur (23Re)	0.005	% S	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
S_{ras} - Pyrite S (s-23Re)	0.005	% Pyrite S	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
S_{ras} - Acidic (a-23Re)	4	mol H^+/t	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
KCl Extractable Calcium (23Vh)	0.005	% Ca	0.31	0.39	0.48	0.40	0.42
Peroxide Extractable Calcium (23Wh)	0.005	% Ca	12	12	5.4	6.8	7.8
Acid Reacted Calcium (23Xh)	0.005	% Ca	12	12	4.9	6.4	7.4
Acidity - Ca (a-23Xh)	4	mol H^+/t	5,800	5,800	2,500	3,200	3,700
Sulphidic - Ca (s-23Xh)	0.005	% Pyrite S	9.4	9.3	3.9	5.1	5.9
KCl Extractable Magnesium (23Sm)	0.005	% Mg	0.081	0.15	0.063	0.079	0.079
Peroxide Extractable Magnesium (23Tm)	0.005	% Mg	0.79	1.0	0.33	0.34	0.40
Acid Reacted Magnesium (23Um)	0.005	% Mg	0.71	0.85	0.27	0.26	0.32
Acidity - Mg (a-23Um)	4	mol H^+/t	580	700	220	210	260
Sulphidic - Mg (s-23Um)	0.005	% Pyrite S	0.94	1.1	0.35	0.34	0.42
Excess Acid Neutral. Capacity (23Q)	0.02	% $CaCO_3$	37	37	15	18	21
Excess ANC - Acidity (a-23Q)	4	mole H^+/t	7,400	7,400	3,000	3,600	4,200
Excess ANC - Sulphidic (s-23Q)	0.005	% Pyrite S	12	12	4.8	5.8	6.7
ANC Fineness Factor	0.5	-	1.5	1.5	1.5	1.5	1.5
Net Acidity excluding ANC	0.005	% S	0.054	0.050	0.034	0.024	<0.005
Net Acidity excluding ANC	5	mole H^+/t	34	31	21	15	<5
Liming Rate excluding ANC	1	kg $CaCO_3$/t	5	4	3	2	<1
Net Acidity	0.005	% S	<0.005	<0.005	<0.005	<0.005	<0.005
Net Acidity	5	mole H^+/t	<5	<5	<5	<5	<5
Liming Rate	1	kg $CaCO_3$/t	<1	<1	<1	<1	<1

SPOCAS Suite		Sample No:	18-18401-A-30	18-18401-A-33	18-18401-A-35	18-18401-A-38	18-18401-A-41
		Sample Details:	G9-3	G11-2	G13-1	G14-2	G15-3
ANALYTE	LOR	Units					
Moisture	0.1	%w/w	27.4	14.6	16.4	11.4	23.5
pH_{KCl} (23A)	0.1	pH Units	9.5	9.2	9.2	8.5	8.7
pH_{ox} (23B)	0.1	pH Units	8.1	8.5	8.7	8.4	8.8
Titratable Actual Acidity (23F)	2	mol H^+/t	<2	<2	<2	<2	<2
Titratable Peroxide Acidity (23G)	2	mol H^+/t	<2	<2	<2	<2	<2

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SPOCAS Suite		Sample No:	18-18401-A-30	18-18401-A-33	18-18401-A-35	18-18401-A-38	18-18401-A-41
		Sample Details:	G9-3	G11-2	G13-1	G14-2	G15-3
ANALYTE	LOR	Units					
Titratable Sulphidic Acidity (23H)	2	mol H^+/t	<2	<2	<2	<2	<2
Sulphidic - TAA (s-23F)	0.005	% Pyrite Sulfur	<0.005	<0.005	<0.005	<0.005	<0.005
Sulphidic - TPA (s-23G)	0.005	% Pyrite Sulfur	<0.005	<0.005	<0.005	<0.005	<0.005
Sulphidic - TSA (s-23H)	0.005	% Pyrite Sulfur	<0.005	<0.005	<0.005	<0.005	<0.005
KCl Extractable Sulfur (23Ce)	0.005	% S	0.045	0.033	0.034	0.008	0.011
Peroxide Extractable Sulfur (23De)	0.005	% S	0.15	0.033	0.034	0.008	0.015
Peroxide Oxidisable Sulfur (23Ee)	0.005	% S	0.11	<0.005	<0.005	<0.005	<0.005
Acidic S_{pos} (a-23Ee)	4	mol H^+/t	66	<4	<4	<4	<4
Residual Acid Soluble Sulfur (23Re)	0.005	% S	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
S_{ras} - Pyrite S (s-23Re)	0.005	% Pyrite S	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
S_{ras} - Acidic (a-23Re)	4	mol H^+/t	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
KCl Extractable Calcium (23Vh)	0.005	% Ca	0.30	0.28	0.29	0.23	0.30
Peroxide Extractable Calcium (23Wh)	0.005	% Ca	17	1.5	2.2	0.31	0.53
Acid Reacted Calcium (23Xh)	0.005	% Ca	17	1.2	1.9	0.080	0.23
Acidity - Ca (a-23Xh)	4	mol H^+/t	8,300	610	950	40	110
Sulphidic - Ca (s-23Xh)	0.005	% Pyrite S	13	0.98	1.5	0.064	0.18
KCl Extractable Magnesium (23Sm)	0.005	% Mg	0.070	0.006	0.028	0.015	0.031
Peroxide Extractable Magnesium (23Tm)	0.005	% Mg	0.43	0.028	0.20	0.048	0.053
Acid Reacted Magnesium (23Um)	0.005	% Mg	0.36	0.022	0.17	0.033	0.022
Acidity - Mg (a-23Um)	4	mol H^+/t	300	18	140	27	18
Sulphidic - Mg (s-23Um)	0.005	% Pyrite S	0.48	0.029	0.23	0.044	0.029
Excess Acid Neutral. Capacity (23Q)	0.02	% $CaCO_3$	47	3.9	5.9	0.54	0.67
Excess ANC - Acidity (a-23Q)	4	mole H^+/t	9,400	780	1,200	110	130
Excess ANC - Sulphidic (s-23Q)	0.005	% Pyrite S	15	1.3	1.9	0.17	0.22
ANC Fineness Factor	0.5	-	1.5	1.5	1.5	1.5	1.5
Net Acidity excluding ANC	0.005	% S	0.11	<0.005	<0.005	<0.005	<0.005
Net Acidity excluding ANC	5	mole H^+/t	65	<5	<5	<5	<5
Liming Rate excluding ANC	1	kg $CaCO_3$/t	9	<1	<1	<1	<1
Net Acidity	0.005	% S	<0.005	<0.005	<0.005	<0.005	<0.005
Net Acidity	5	mole H^+/t	<5	<5	<5	<5	<5
Liming Rate	1	kg $CaCO_3$/t	<1	<1	<1	<1	<1

SPOCAS Suite		Sample No:	18-18401-A-47	18-18401-A-53	18-18401-A-55	18-18401-A-61
		Sample Details:	G17-2	G18-4	G19-2	G20-4
ANALYTE	LOR	Units				
Moisture	0.1	%w/w	1.3	9.4	3.0	5.2
pH_{KCl} (23A)	0.1	pH Units	8.1	9.1	9.2	9.2

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SPOCAS Suite		Sample No:	18-18401-A-47	18-18401-A-53	18-18401-A-55	18-18401-A-61
		Sample Details:	G17-2	G18-4	G19-2	G20-4
ANALYTE	LOR	Units				
pH_{ox} (23B)	0.1	pH Units	7.6	8.8	9.6	9.6
Titratable Actual Acidity (23F)	2	mol H^+/t	<2	<2	<2	<2
Titratable Peroxide Acidity (23G)	2	mol H^+/t	<2	<2	<2	<2
Titratable Sulphidic Acidity (23H)	2	mol H^+/t	<2	<2	<2	<2
Sulphidic - TAA (s-23F)	0.005	% Pyrite Sulfur	<0.005	<0.005	<0.005	<0.005
Sulphidic - TPA (s-23G)	0.005	% Pyrite Sulfur	<0.005	<0.005	<0.005	<0.005
Sulphidic - TSA (s-23H)	0.005	% Pyrite Sulfur	<0.005	<0.005	<0.005	<0.005
KCl Extractable Sulfur (23Ce)	0.005	% S	0.009	0.007	0.063	0.011
Peroxide Extractable Sulfur (23De)	0.005	% S	0.009	0.007	0.063	0.011
Peroxide Oxidisable Sulfur (23Ee)	0.005	% S	<0.005	<0.005	<0.005	<0.005
Acidic S_{pos} (a-23Ee)	4	mol H^+/t	<4	<4	<4	<4
Residual Acid Soluble Sulfur (23Re)	0.005	% S	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
S_{ras} - Pyrite S (s-23Re)	0.005	% Pyrite S	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
S_{ras} - Acidic (a-23Re)	4	mol H^+/t	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
KCl Extractable Calcium (23Vh)	0.005	% Ca	0.053	0.13	0.23	0.20
Peroxide Extractable Calcium (23Wh)	0.005	% Ca	0.12	0.19	0.45	0.35
Acid Reacted Calcium (23Xh)	0.005	% Ca	0.067	0.060	0.22	0.15
Acidity - Ca (a-23Xh)	4	mol H^+/t	33	30	110	75
Sulphidic - Ca (s-23Xh)	0.005	% Pyrite S	0.054	0.048	0.18	0.12
KCl Extractable Magnesium (23Sm)	0.005	% Mg	<0.005	<0.005	<0.005	<0.005
Peroxide Extractable Magnesium (23Tm)	0.005	% Mg	0.017	0.021	0.014	0.017
Acid Reacted Magnesium (23Um)	0.005	% Mg	0.017	0.021	0.014	0.017
Acidity - Mg (a-23Um)	4	mol H^+/t	14	17	12	14
Sulphidic - Mg (s-23Um)	0.005	% Pyrite S	0.022	0.028	0.018	0.022
Excess Acid Neutral. Capacity (23Q)	0.02	% $CaCO_3$	0.27	0.27	0.74	0.61
Excess ANC - Acidity (a-23Q)	4	mole H^+/t	54	54	150	120
Excess ANC - Sulphidic (s-23Q)	0.005	% Pyrite S	0.087	0.087	0.24	0.20
ANC Fineness Factor	0.5	-	1.5	1.5	1.5	1.5
Net Acidity excluding ANC	0.005	% S	<0.005	<0.005	<0.005	<0.005
Net Acidity excluding ANC	5	mole H^+/t	<5	<5	<5	<5
Liming Rate excluding ANC	1	kg $CaCO_3$/t	<1	<1	<1	<1
Net Acidity	0.005	% S	<0.005	<0.005	<0.005	<0.005
Net Acidity	5	mole H^+/t	<5	<5	<5	<5
Liming Rate	1	kg $CaCO_3$/t	<1	<1	<1	<1

Result Definitions

Strategen Environmental Consultants Pty Ltd *LABORATORY REPORT*

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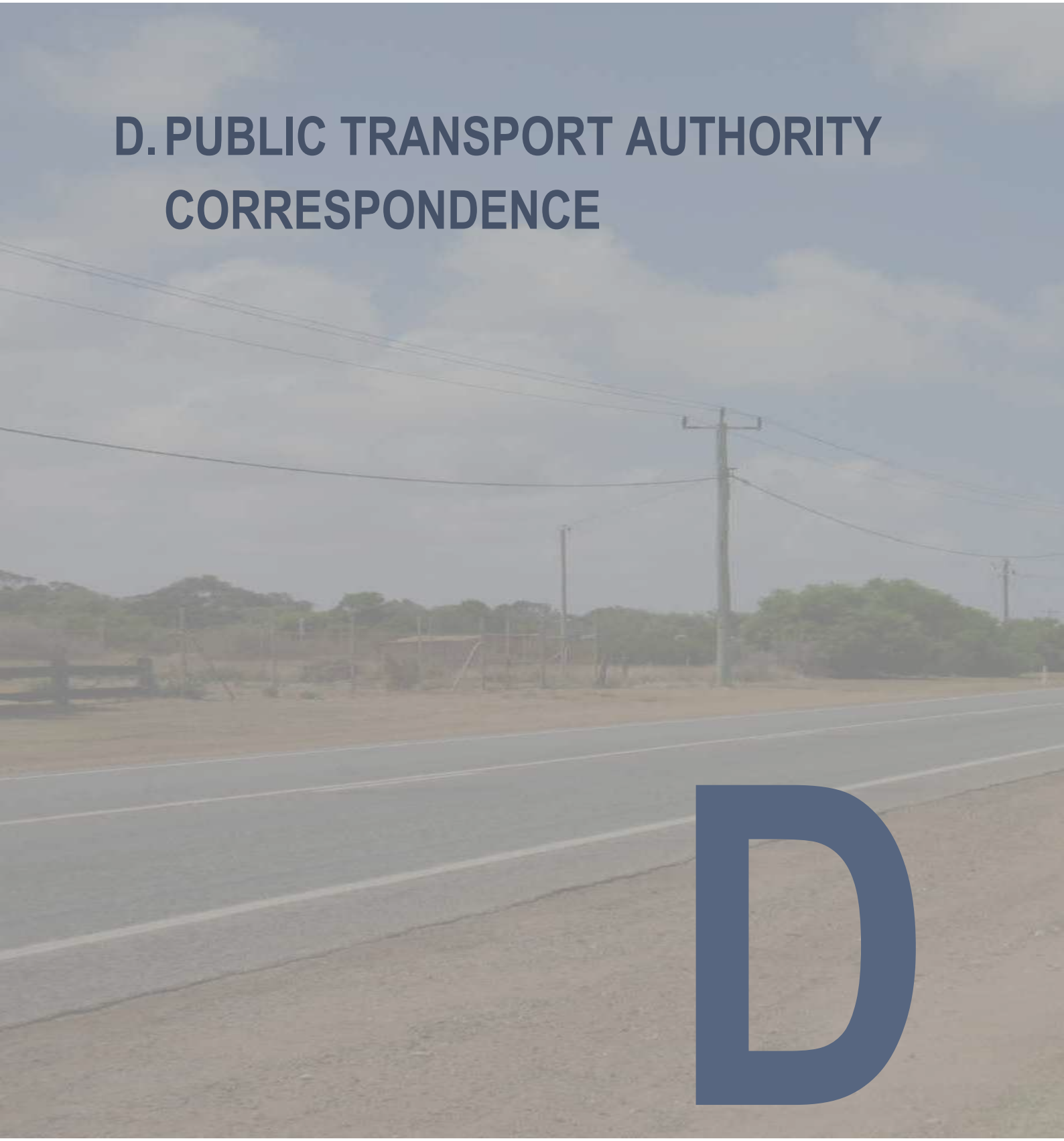
LOR Limit of Reporting [NT] Not Tested [ND] Not Detected at indicated Limit of Reporting
* Denotes test not covered by NATA Accreditation

FOR MICROBIOLOGICAL TESTING - The data in this report may not be representative of a lot, batch or other samples and may not necessarily justify the acceptance or rejection of a lot or batch, a product recall or support legal proceedings. Tests are not routinely performed as duplicates unless specifically requested. Changes occur in the bacterial content of biological samples. Samples should be examined as soon as possible after collection, preferably within 6 hrs and must be stored at 4 degrees Celsius or below. Samples tested after 24 hrs cannot be regarded as satisfactory because of temperature abuse and variations.

D. PUBLIC TRANSPORT AUTHORITY CORRESPONDENCE



D

Simon Pedretti

From: Saliacus, Matthew <Matthew.Saliacus@pta.wa.gov.au>
Sent: Friday, 1 February 2019 12:34 PM
To: Simon Pedretti
Subject: REQUEST FOR INFORMATION - Geraldton Bus Stop Numbers 73866 & 70269

Hi Simon

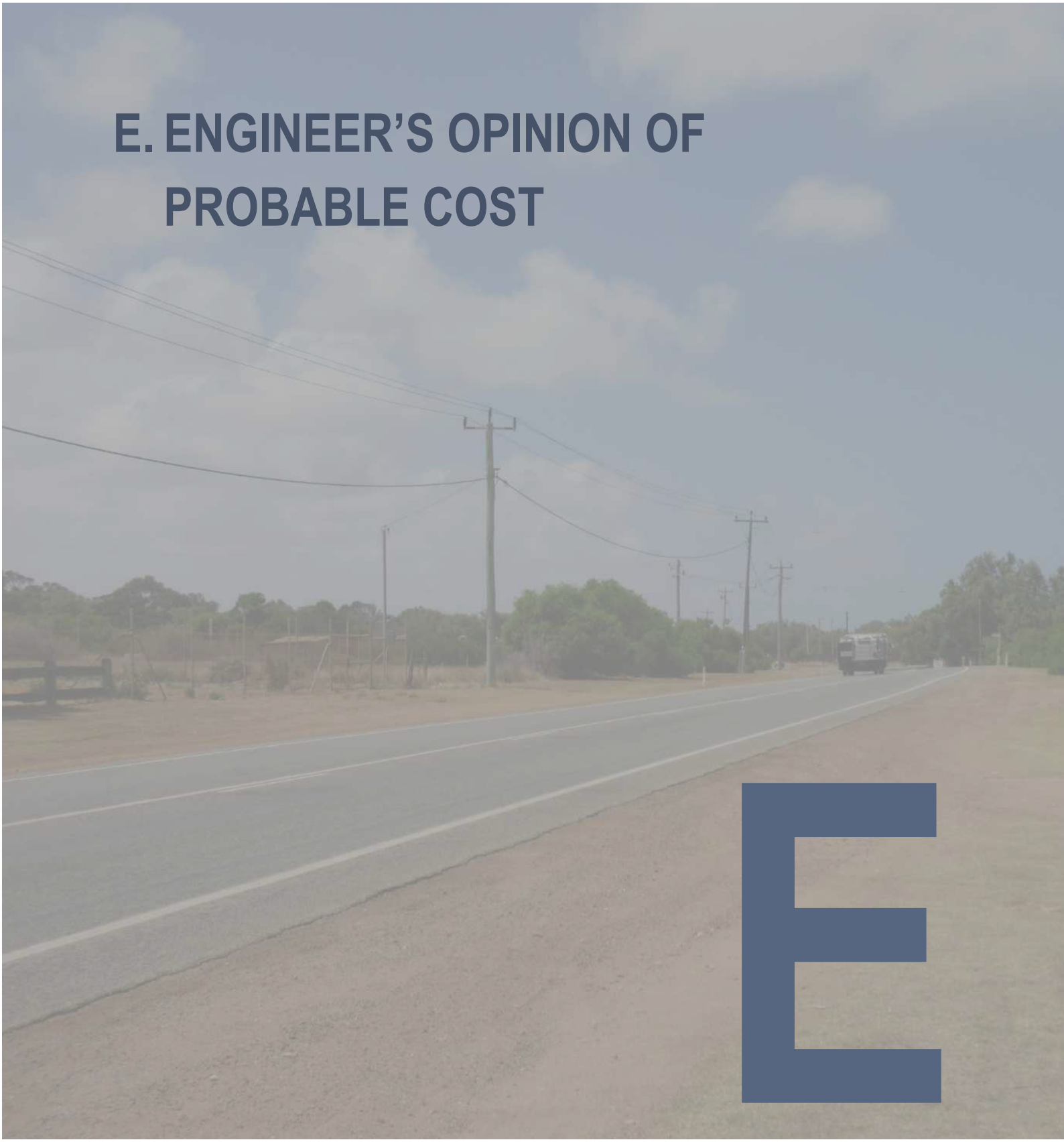
The PTA has no plans to upgrade or move these stops in the short term. Both of these stops have extremely low patronage and would not be considered for upgrading at this time.

If you need any further information please let me know.

Kind regards,

Matt Saliacus | Manager - Regional Town Bus Services
Public Transport Authority of Western Australia | PO Box 8125, Perth Business Centre, WA, 6000
☏ Ph 9326 3964 | ☏ Ph 0417950659 | ☏ Fax 9326 2487 | ✉ matthew.saliacus@pta.wa.gov.au

E. ENGINEER'S OPINION OF PROBABLE COST



E

GTAconsultants

W1219424 - Cycle Link Chapman Road Geraldton - Engineer's Opinion of Probable Cost

Date: 07/02/2019

Civil Works				
Item	**Description**	**Quantity**	**Rate**	**Total (ex. GST)**
1.0	**Demolition Works (including removal from site)**			
1.01	Topsoil removal, 150mm deep, and disposal of surplus topsoil to contractors spoil area off site	11800m²	$20.00/m	$236,000.00
1.02	Removal of existing asphalt wearing course over proposed red asphalt area speed humps	142m²	$7.50/m2	$1,065.00
1.03	Removal of trees	5 Item(s)	$550 ea	$2,750.00
2.0	**Concrete and Kerb Works and Drainage**			
	Construction of the following items including provision of all necessary plant and materials, trimming, bedding, forming, mixing, paving, jointing, making and finishing.			
2.01	**Kerb and Channel, Concrete Strength**			
	25MPa Standard			
2.01.1	Flush Kerb (edge of shared path)	8000 l.m	$30.00/m	$240,000.00
2.02	**Concrete footpath and driveways**			
2.02.1	100mm thick plain concrete complete with expansion and contraction joints (includes new driveways and bus stops hardstands)	490 m²	$80.00/m2	$39,200.00
2.02.2	100mm thick plain concrete complete with expansion and contraction joints (includes path along Glenfield Beach Drive)	800 m²	$80.00/m2	$64,000.00
2.03	**Concrete Kerb Ramp**			
2.03.1	Supply and install DDA compliant kerb ramp with TGSI tactiles. Kerb ramp construction to consist of 75mm thick concrete paving with nom. 50mm thick compacted crushed rock bedding	3 No(s)	$1000 ea	$3,000.00
	Other items not listed above as deemed to be required by the works, please specify			
2.04	**Drainage Works**			
2.04.1	300mm pipe culvert	50 l.m	$300.00/m	$15,000.00
2.04.2	Driveable headwalls at the end of each culvert	15 No(s)	$550 ea	$8,250.00
2.04.3	Rock beaching at each headwalls	8 m²	$200.00/m2	$1,600.00
2.04.4	Regrading of swale	2060 m²	$6.00/m	$12,360.00
2.04.5	Install 375mm dia RCP	20 l.m	$310.00/m	$6,200.00
2.04.6	Install side entry pits	2 No(s)	$2750 ea	$5,500.00

2.04.7	Breaking into existing drainage structure and building-in 375mm diameter pipe	2 No(s)	$450 ea	$900.00
3.0	**Pavements, Flexible**			
	The supply and installation of the following compacted depth asphalt wearing courses including labour, materials, compaction and bituminous prime coat, to relevant specifications and as specified.			
3.01	Red asphalt wearing course, nominal depth varies to suit design, including raised pavement thresholds.	11600 m²	$50.00/m2	$580,000.00
3.02	Red asphalt shared path inc. 150mm nominal depth crushed limestone basecourse	11400 m²	$60.00/m2	$684,000.00
5.0	**Delineation**			
5.01	**Signage**			
5.01.1	Installation of wayfinding signs	4 No(s)	$300 ea	$1,200.00
5.02	**Linemarking**			
6.02.1	Installation of proposed linemarking to WA main Roads standards, including , separation line, piano key ,shared path line marking	1 Item(s)	$4,000.00/Item	$4,000.00
7.0	**Landscaping**			
7.01	Areas of landscaping including trees	3090 m²	$40.00/m2	$123,600.00
8.0	**Miscellaneous**			
8.01	Final clean-up, including demobilisation and removal of temporary structures, etc.	1 Item(s)	$5000 ea	$5,000.00
8.02	Minor adjustment of existing services covers to suit design surface level (does not allow for relocation or adjustment of underground services)	1 Item(s)	$10000 ea	$10,000.00
8.03	Bus Shelters (supply installation)	2 Item(s)	$15000 ea	$30,000.00
	Sub Total - Civil			**$2,073,625.00**
8.0	**General**			
8.01	Traffic Management	70 days	$1200/day	$84,000.00
8.02	Site Establishment	1 Item(s)	2.5% of sub total	$51,840.63
8.03	Supervision and Project Management	10 weeks	$5000/week	$50,000.00
8.04	Detailed design services and documentation	1 Item(s)	$30,000/Item	$30,000.00

8.05	Sedimentation Control	1 Item(s)	$5,000/Item	$5,000.00
8.06	As-built drawings	1 Item(s)	$5,000/Item	$5,000.00
8.07	Surveying	1 Item(s)	$18,000/Item	$18,000.00
	Other items not listed above as deemed to be required by the works, please specify			
	Total			**$2,317,465.63**
	30% Contingency			**$695,239.69**
	Total with 30% Contingency			**$3,012,705.31**

Assumptions and exclusions:

1. The engineer's opinion of probable costs have been based on drawing nos. W1219424-SK00_SK14-P3 and further revisions
2. Insurances and bank guarantees have been excluded.
3. Allowances for existing services relocations, lowering or realignment thereof have been excluded other than those included in the above opinion of probable cost.
4. Protection of existing underground services during construction has been excluded.
5. A 30% contingency has been applied to the opinion of probable costs.
6. Specific construction works including rock boring, rock blasting or rock excavation and removal have been excluded as geotechnical conditions are yet to be confirmed.
8. Authority design review fees, prepayment and charges have been excluded.
9. This estimate also excludes an allowance for abnormal weather conditions or nightworks.
10. GST is excluded.
11. Price escalation is excluded.
12. Geotechnical investigation and reporting.
13. Subgrade treatment along shared path alignment as geotechnical conditions are yet to be confirmed.
14 .Public lighting along shared path and at intersections (Sail Boulevard and Corallina Quays) where raised threshold treatments are proposed.
15. Underground services proving.
16. The opinion of probable costs should be considered current to the date of the document only and is based upon the project scope as shown on W1219424-SK00_SK14-P3. GTA cannot provide any form of assurance that the costs provided will not rise or fall due to changes to the project scope, as a result of further design development, and/or any future variation of the cost of construction or materials. The future outcome may vary, and this variation may be material. Any party requiring opinion of probable costs for budgeting, quoting or construction purposes should seek a detailed cost estimate from a suitably qualified quantity surveyor.

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