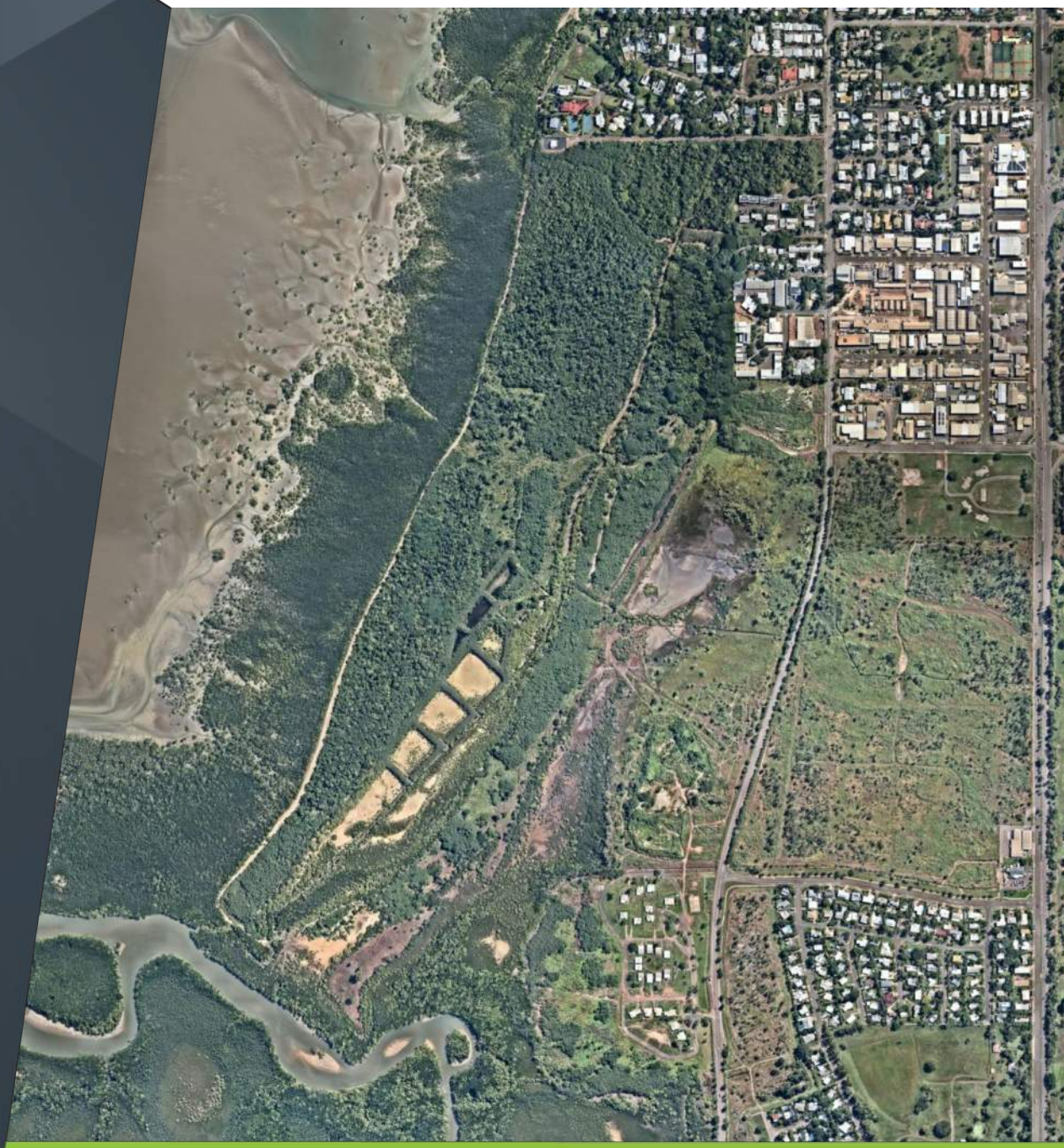
Kulaluk and Minmarama Park Land Assessment

REPORT

Department of Territory Families, Housing and Communities

10 August 2023



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1 Executive Summary

The Gwalwa Daraniki Association Inc (GDA) hold title to the Kulaluk and Minmarama Park Town Camps under a Crown Lease in perpetuity. The Crown Lease allows the land to be utilised for uses 'consistent with the zoning of the land'. The land is currently subject to a number of zones including conservation, restricted development, community living, specific use (SD37 and SD44) and public open space.

The objective of the of the Kulaluk and Minmarama Park Land Assessment project was to undertake preliminary planning and assessment of the enabling infrastructure required to support the future development for Kulaluk and Minmarama Park Town Camps.

Based on the Darwin Mid Suburbs Area Plan, current development applications and discussions with Northern Territory Government Agencies and GDA, 11 potential development areas were identified and assessed:

- Area 1 – community living - housing
- Area 2 – existing aged care
- Area 3 – commercial
- Area 4 – commercial / light industry
- Area 5 – existing aquaculture
- Area 6 – commercial / light industry
- Area 7 – community living – camping
- Area 8 – commercial / light industry
- Area 9 – commercial / light industry
- Area 10 – open space
- Area 11 – residential

Likely constraints to development were considered and 12 key constraints were identified:

- Land use zoning
- Protected aboriginal sites (AAPA)
- Heritage
- Geotechnical issues
- Land contamination
- Environmental issues
- Biting insects
- Flooding and storm surge
- Roads and traffic
- Water capacity
- Sewer capacity
- Electrical capacity

Risks posed by the 12 key constraints to future development were categorised on a red, amber green basis:

- Red – high risk
- Amber – moderate risk
- Green – low or no risk

High risks (red) to potential development across the identified the potential development areas included:

- Geotechnical
- Land contamination
- Flooding
- Water capacity
- Sewer capacity
- Electrical capacity

Moderate risks (amber) to potential development across the identified the potential development areas included:

- Land use zoning
- Protected aboriginal sites (AAPA)

In order to understand and mitigate risks it is recommended that each potential development area have a range of further studies and assessment undertaken including but not limited to:

- AAPA – seek current clearance certificates
- Geotechnical - undertake additional geotechnical testing including ASS and remove uncontrolled fill
- Land contamination – site assessment, removal and disposal of asbestos containing material
- Environmental – verify land units, assess habitat and conduct targeted threatened species surveys
- Flooding and storm surge - fill required to achieve flooding immunity
- Water – undertake significant headworks
- Sewer – undertake significant headworks
- Electrical – undertake significant headworks

The indicative costs of key infrastructure items include:

- Water headworks - $2.2M
- Sewer headworks - $8.9M
- Electrical headworks - $5.9M
- Road intersections - $8.0M
- Area 4 fill - $1.3M
- Area 6 disposal of asbestos waste - $55.0 M
- Area 6 disposal of asbestos waste - $22.7 M

The high cost of development may render some potential development areas as commercially unviable.

2 Project Summary

2.1 Project Overview

The Department of the Chief Minister and Cabinet has established the Interagency Transition Working Group. Under the Terms of Reference, this group has responsibility to identify and review opportunities to resolve governance and compliance matters affecting the sustainability of town camps including the Kulaluk and Minmarama Park Town Camps having regard to the Northern Territory Government's Local Decision Making Agenda.

The Gwalwa Daraniki Association Inc (GDA) hold title to the Kulaluk and Minmarama Park Town Camps under a Crown Lease in perpetuity. The Crown Lease allows the land to be utilised for uses 'consistent with the zoning of the land'. The land is currently subject to a number of zones including conservation, restricted development, community living, specific use (SD37 and SD44) and public open space.

The objective of the of the Kulaluk and Minmarama Park Land Assessment project was to undertake preliminary planning and assessment of the enabling infrastructure required to support the future development for Kulaluk and Minmarama Park Town Camps. The project included:

- Assessment of the requirements and costs to support development of land consistent with the Darwin Mid Suburbs Area Plan including servicing, stormwater management, environmental audit, traffic impact assessment, landfill and any other necessary works to make the land development ready.
- Based on this assessment, review the commercial viability of undertaking development on the land in accordance with the Darwin Mid Suburbs Area Plan (noting that the land can be subleased to a developer/third party but not sold) including an assessment of potential returns to the landowner.
- Utilise existing stakeholder data and reports to enhance potential development opportunities if available.

For the project, DTFHC engaged a consulting team led by Byrne Consultants. The project team comprised:

- Byrne Consultants – project management, roads, drainage, water and sewer
- CRTPC – town planning
- EcOz – contaminated land and environmental assessments
- WRM – flood analysis
- Arccos – traffic impact
- AGA – electrical

Based on the Darwin Mid Suburbs Area Plan, current development applications and discussions with Northern Territory Government Agencies and GDA, 11 potential development areas were identified and assessed.

This project report is submitted as an overview and summary of findings. Detailed reports prepared by subconsultants are presented as standalone appendices to the report.

2.2 Potential Development Areas

Based on the Darwin Mid Suburbs Area Plan, current development applications and discussions with Northern Territory Government Agencies and GDA, 11 potential development areas were identified and assessed:

- Area 1 – community living - housing
- Area 2 – existing aged care
- Area 3 – commercial
- Area 4 – commercial / light industry
- Area 5 – existing aquaculture
- Area 6 – commercial / light industry
- Area 7 – community living – camping
- Area 8 – commercial / light industry
- Area 9 – commercial / light industry
- Area 10 – open space
- Area 11 – residential

These areas are shown in Figure 2.1 and Attachment 1.

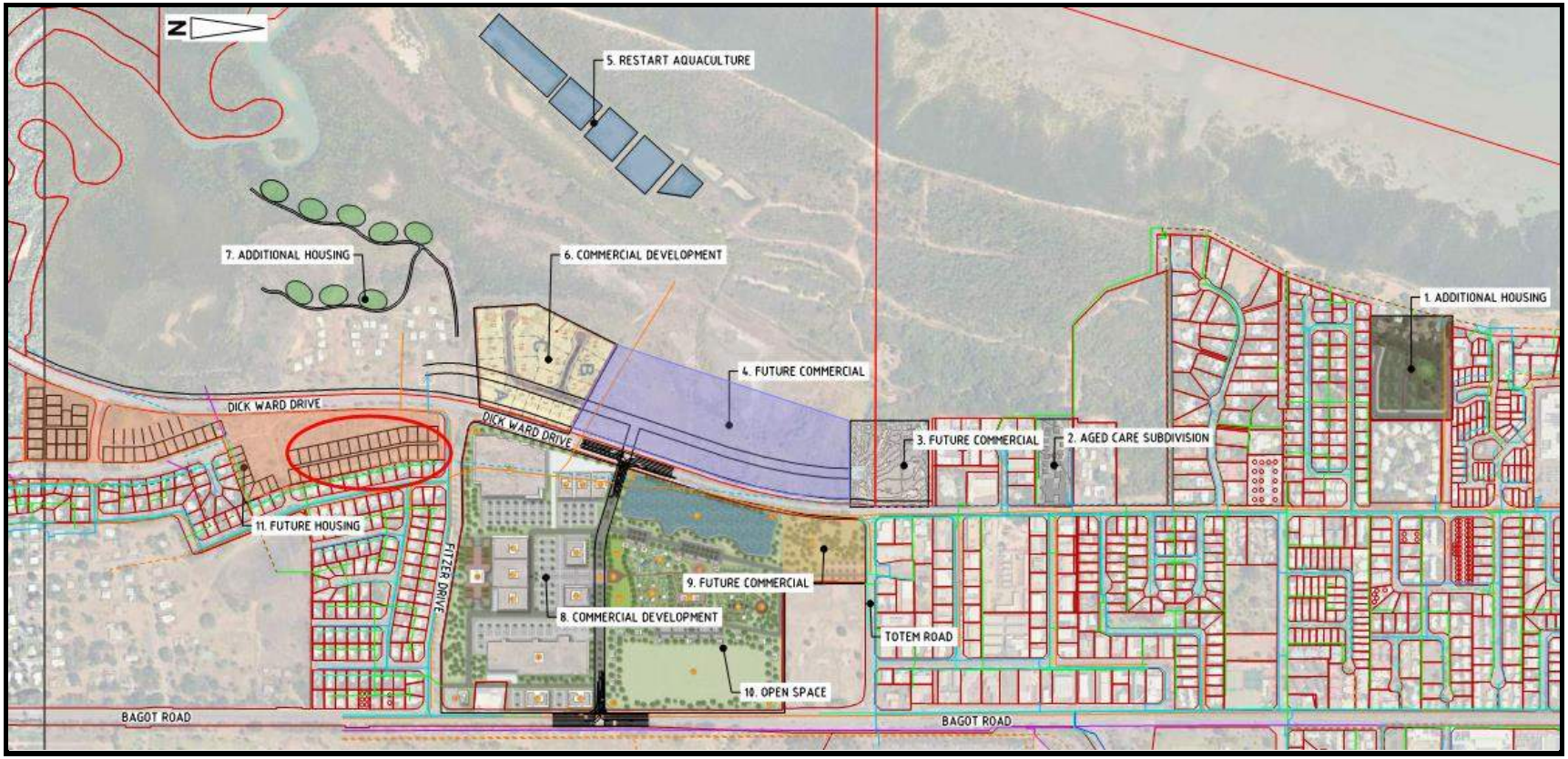

Figure 2.1 – Identified Potential Development Areas

2.3 Key Constraints to Development

2.3.1 Key Constraints

Likely constraints to development were considered and 12 key constraints identified:

- Planning and land use zoning
- Protected aboriginal sites (AAPA)
- Heritage
- Geotechnical issues
- Land contamination
- Environmental issues
- Biting insects
- Flooding and storm surge
- Roads and traffic
- Water capacity
- Sewer capacity
- Electrical capacity

Risks posed by the 12 key constraints to future development were considered on a red, amber green basis:

- Red – high risk
- Amber – moderate risk
- Green – low or no risk

The development requirements and the level of risk posed are considered and summarised for each potential development area in Table 2.1 to Table 2.11.

2.4 Planning

Cunnington Rosse Town Planning Consultants (CRTPC) undertook an assessment of the lease areas and identified the following key findings relating to land planning associated with the site:

- The site has a long and complicated planning history. Further investigations of the planning history documentation are required to determine any potential impacts on the site's development opportunities.
- The site is constrained by a number of easements identified on the survey plans.
- The site is constrained by storm surge and areas of cultural significance.
- The site is subject to numerous zones.
- The development potential of land within Zone CN -Conservation is constrained by the provisions of the zone which are to protect the natural features of the area. The Darwin Mid Suburbs Area Plan (DMSAP) provides further protection of these areas and suggests the subject area is not appropriate for rezoning, except for:
    - Land within the Kulaluk, Juninga Centre and Minmarama Park Concept to Zone CL (Community Living); and
    - Land within the flight path to Zone RD (Restricted Development).

- The land within Specific Use Zone SD37 and SD44 is capable of supporting limited service commercial and light industry type development, in accordance with the provisions of this zone.
- Land to the northwest of Fitzer Drive may be rezoned to allow for limited service commercial type development.
- Where existing development does not reflect the existing zoning, the DMSAP generally supports rezoning to a more appropriate zone.

2.4.1 AAPA

No current AAPA certificates were in place for the potential development areas. Some proposed developments have previously been issued with AAPA certificates which identified registered sites or restricted work areas, however these certificates have expired.

AAPA registered sites and restricted work areas may impact some proposed developments and all proposed development areas should seek new AAPA certificates. For example the restricted work area previously recorded over Area 1 would appear to prevent the proposed development of the residential area.

2.4.2 Heritage

The Heritage Branch of DTFHC was consulted and advised that the lease area was nominated for heritage listing in 2014 however the area was not declared a heritage place. The conservation zone of large parts of the area and registered sites and restricted work areas provide a level of protection. Heritage Branch further advised:

> *Although the Minister did not declare the Kulaluk lease area as a heritage site, this does not mean that there is no cultural heritage on the site. Heritage Branch strongly advises consulting with the Gwalwa Daraniki Association to understand the cultural heritage of the site and which areas are sensitive.*

2.4.3 Geotechnical

A number of previous, preliminary geotechnical assessments have been under been undertaken for Area 1, Area 4, Area 6 and Area 7.

- Geotechnical assessment confirmed that:
    - Area 1 has sections of uncontrolled fill which should be removed prior to development of infrastructure (*Refer Douglas Partners Report 91961.00R.001.Rev1 July 2019*).
    - Area 4 and Area 6 were used around 1975 for the disposal of demolition waste from Cyclone Tracy and as such have large areas of uncontrolled fill across the sites.
    - Area 7 characterised by a layer of variable fill placed as a capping layer over uncontrolled fill consisting of general rubbish and building rubble.
- Area 6 has also been utilised more recently to stockpile building demolition and spoil from construction sites around Darwin. The volume of this uncontrolled fill is in the order of 113,000 $m^{3.}$
- Geotechnical assessment indicates removal of uncontrolled fill in Area 1, Area 4, Area 6 and Area 7.
- Due to the nature of the proposed development for Area 7 no allowance has been made to remove uncontrolled fill at this time.

2.4.4 Land Contamination

EcOz undertook a desk top review of available information relating to contaminated land on the lease areas and identified the potential contaminants of concern through a review of the existing documentation including assessment of site history, previous site use and surrounding land use. No site visit was undertaken.

Based on the previous activities at the site and its surrounds, the following list of potential contaminants of concern was identified:

- Asbestos waste from Cyclone Tracy and other dumped asbestos containing material (ACM).
- Material of fill within the site.
- Stockpiling of materials from various sources and unknown composition.
- Illegal dumping of household and construction wastes.
- Acid sulfate soils (ASS).

EcOz has recommended that for lower risk sites:

- Undertake a Preliminary Site Investigation.
- Assessment of ASS and development of ASS Management Plan if required.

And for higher risk sites:

- Undertake a full contaminated land assessment as risks include asbestos waste, dumped rubbish and stockpiling / fill material.
- Assessment of ASS and development of ASS Management Plan if required.

DIPL previously engaged SLR to undertake preliminary site inspections and characterisation of waste in the Cyclone Tracy dump area and the stockpiled material across Area 4 and Area 6. SLR determined that the Cyclone Tracy sites were contaminated with asbestos containing material (ACM) as were some areas of the stockpiled material and that the ACM posed a risk to humans if disturbed. Historical imagery indicated that the Cyclone Tracy dump site extends across Minmarama Park, Area 4, Area 6 and Area 8.

The Shoal Bay Waste Disposal Site (SBWDS) will accept ACM for registered disposal at a cost of $480 / tonne or approximately $720 /$m^3$. Based on limited geotechnical testing it has been assumed that a depth of approximately 1.5 m of ACM would be required to be removed across Area 6 with a total estimate volume of 76,500 m^3. If this waste was to be disposed at SBWDS, the cost would be in the order of $55 million which is considered cost prohibitive. It is expected that the most pragmatic approach to addressing the ACM would be to utilise the clean stockpile material and encapsulate Area 6 in situ.

2.4.5 Environmental

EcOz undertook a desk top review of available information relating to an environmental assessment to evaluate the ecological, environmental, and other constraints to development for the lease areas. EcOz noted that:

> *The study area sits within the Darwin Harbour Site of Conservation Significance (SOCS) that is of international significance. Darwin Harbour was listed as a SOCS due to supporting a range of estuarine, freshwater and terrestrial environments including, extensive areas of tidal mudflats and one of the largest and most diverse areas of mangroves in the Northern Territory (Pavey et al. 2009) – some of these values are present within the study area.*

Key ecological and land suitability constraints within the survey area included:

- A high likelihood of occurrence of ten threatened or migratory species and a medium likelihood of occurrence of nine threatened or migratory species.
- Presence of three sensitive and/or significant vegetation types.
- Drainage was the most significant constraint to land suitability.
- Acid sulfate soils were found to be a potential risk for all areas as they are located close to coastal floodplains with potential development Areas 4, 5, 7, and 11 considered to be high risk.
- Potential development areas are subject to the Clearing of Native Vegetation (CNV) overlay that identifies areas with limits to native vegetation clearance and that clearing in these areas does not impact on conservation values in land zoned as Conservation (CN) or unreasonably contribute to environmental degradation. Consent will be required to clear more than one hectare. The CNV overlay covering the study area requires the avoidance of significant sensitive vegetation types.

EcOz has made the following recommendations based on the findings of the desktop assessment and are summarised according to proposed development area in Table 10.1 –.

- Undertake a field assessment to:
  - Ground truth land unit mapping.
  - Assess habitat quality including impacts from threatening processes such as fire, weeds, and historic disturbance.
  - Determine the extent and habitat quality of significant sensitive vegetation types (i.e. monsoon rainforest and mangroves) within the study area.
  - Determine the requirements for targeted surveys for the following threatened species: Atlas Moth (including food plants and other monsoon rainforest flora species), Black-footed Tree-rat, Northern Brushtail Possum, Pale Field-rat, Yellow-spotted Monitor and Mitchell's Water Monitor.
  - Undertake a comprehensive assessment of potential significance of survey area for shorebirds.
- Liaise with the Department of Environment, Parks and Water Security (DEPWS) regarding the presence of significant and sensitive vegetation types, the proposed clearance of native vegetation associated with the development and the expectations for provision of protective buffers.
- Address other environmental considerations outlined in the Land Clearing Guidelines e.g. acid sulfate soil testing and engineering studies for drainage and flooding mitigation.

2.4.6 Biting Insects

The potential development areas are situated in close proximity to tidal areas, mangroves and low lying areas. Entomolgy records indicate that the area is an historical breeding site for pest and disease carrying mosquitoes. The development of any residential or camping areas are likely to expose humans to a high risk of exposure to disease carrying mosquitoes. It is suggested that a biting insect mitigation plan is developed which may include controls such as any buildings constructed are suitably screened to minimise this risk. An ongoing chemical control program of the surrounding areas should be considered in association with entomologists.

2.4.7 Flooding and Storm Surge

WRM Water and Environment Pty Ltd (WRM) was engaged to undertake a high level stormwater assessment of the potential development areas. Key findings from the WRM assessment were:

- Potential development areas are affected by predicted year 2100, 1% AEP storm surge. This results in substantial fill requirements, with some sites requiring filling of the entire proposed development area in order to achieve the required immunity.
  - The predicted year 2100, 1% AEP storm surge level is 5.4 m AHD.
  - Based on an assumed freeboard of 0.5 m, the required indicative minimum fill level to protect against storm surge inundation at the site is 5.9m AHD.
- The proposed drains in development area 1 are based on previous WRM (2022) and PF (2019) assessments. These reports were preliminary concept design studies, and it is recommended that these be updated before commencement of design work.
- Development area 2 is already constructed, it is not known whether the required immunity has been achieved.
- Very flat existing site topography makes it difficult to achieve minimum slope requirements for proposed drains. The proposed design and alignment of these drains should be reviewed during the design phase, in order to achieve acceptable drain design solutions.
- Other design guidelines which have not been fully assessed here (e.g., maximum flow depth limits, maximum velocity and maximum depth x velocity product limits) may apply to the design of the proposed drains, and should be considered in detail during the design phase.

For roads to be above primary storm surge, roads will be required to have an approximate surface level of 5.9 m. Allowing for a kerb height of 150 mm and verge grading, the minimum required lot fill height is approximately 6.2 m. This level was used to calculate required fill volumes. For example, to fill Area 4 to 6.2 m AHD will require approx 217,000 m3 of fill at an approximated cost of $1.3 million.

Many of the existing storm water drains do not have registered easements and / or discharge storm water mid lot.

Storm water detention basins are expected to be required as part of any detailed design for proposed developments but have not been considered in detail as part of this report.

2.4.8 Roads and Traffic

Arccos Consulting was engaged to review potential future traffic movements and impacts on the road network from the potential 11 development sites.

The study area includes the arterial road network (primarily Dick Ward Drive and Bagot Road), as well as sub-arterial roads (Fitzer Drive, Totem Road, Nemarluk Drive, Old McMillans Road) and the proposed new road networks and connections:

- Upgrade of Dick Ward Drive between Hazell Court and Progress Drive
- New connection between Bagot Road and Dick Ward Drive (Area 8)

DIPL has advised that the upgrade of Dick Ward Drive (DWD) is a proposal to duplicate DWD to create a dual carriageway. The current road reserve is 30 m and this project has assumed the road reserve will be widened to 40 m to accommodate a typical NT road cross section for a primary arterial road

Key recommendations include:

- Access for Area 1 is widened to provide two way access, or that formal passing opportunities are provided.
- Existing Minmarama Park access is upgraded in the short term to provide a channelised right turn lane and raised median islands (to allow for staged pedestrian crossing movements at the junction.
- Future access to Area 4, Area 6 and Minmarama Park on the western side of Dick Ward Drive is consolidated with an internal road network.
- Any new direct access to Dick Ward Drive should be limited to left in/left out configurations, or to a signalised intersection to the new link road connecting through to Bagot Road.

It is assumed that Area 3 access will be a commercial crossover access from Dick Ward Drive subject to City of Darwin approval.

2.4.9 Water

Water demand for the potential development areas was calculated based on Power and Water Corporation (PWC) Guidelines. Peak flows were then determined for 2/3 peak hour flows in conjunction with commercial fire flows of 45 L/s. It is expected that the minimum accepted commercial area pipe diameter of DN225 will be adequate, however network modelling would be required during detailed design.

PWC advised that the potential development areas span two water supply zones – Stuart Park in the south and Marara in the north, with the approximate zone boundary along the proposed Area 8 internal road. Flows and pressures in these areas are insufficient to supply the potential development areas and are expected to be increased by undertaking a number of likely upgrades to the water distribution system including:

- New water main along Totem Road.
- New water main along the proposed Area 8 internal Road linking to the existing water main in Bagot Road in the vicinity of MacDonalds and to Fitzer Drive via DWD.
- New reticulation mains internal to Area 4 and Area 6.
- New reticulation main to a part section of Area 11.

Detailed water network modelling and analysis is beyond the scope of this report and will be required as part of any proposed detailed design.

2.4.10 Sewer

Sewer loads for the potential development areas were calculated based on Power and Water Corporation (PWC) Guidelines. Based on the likely sewer loads PWC advised:

- *There is no capacity available in the DN225/150 sewer reticulation line in Dick Ward Drive (north).*
- *The existing Ludmilla SPS at full capacity and cannot accept any more load.*
- *The prefer sewer servicing strategy is to maximise gravity system for the new catchment and minimise number of pump station at no more than 6m deep. Desktop study suggest to have a pump station within Area 8. The new pump station is to discharge to Ludmilla Treatment Plant.*
- *Alignment of new sewer rising mains and location of pumps stations are to be in unconstrained land (e.g. road reserves, non-flooding areas).*
- *PWC would consider diverting existing catchments to the new catchment / SPS to decommission old constrained assets (e.g. remove Ludmilla SPS and divert old catchment to new SPS).*

- *There is an existing gravity trunk main through Lot 5646 that is within flooding area and is constraining drainage. NTG is exploring options to remove the sewer trunk to improve overall stormwater drainage in the area. It is preferred to not add any more load to this catchment.*
- *Land tenure for new pump stations to be secured. Consider development constraints with buffer zones around SPS based on its pumping rate.*

An indicative sewer network has been suggested which includes:

- New sewer pump station (SPS) in Area 4.
- Relocate the existing DN450 asbestos cement sewer rising main to the duplicated DWD road verge and upgrade the new main to DN500 DICL.
- New gravity sewer network to sewer Area 3, Area 4, Area 6, Area 8, Area 9 and part of Area 11 draining to the new SPS.

Detailed sewer network modelling and analysis is beyond the scope of this report and will be required as part of any proposed detailed design.

2.4.11 Electrical

Electrical demand for each proposed development area was calculated based on PWC Planning Guides. A planning load of 10 kVA was allowed for each additional house while commercial area electrical planning loads were determined based on 70% of gross area @ 90 VA/m^2. It has been assumed that Area 7 camping electrical demand would most likely be minimal and has not been considered further.

The potential electrical demand for each proposed development Area was provided to PWC for consideration and advice. PWC advised that electrical constraints include:

- Limited capacity in the existing distribution networks.
- Available capacity is on a first come basis and capacity is not guaranteed to be available.

PWC also advised:

The following minimum headworks are required on a distribution level to supply the loads at Kulaluk-Minmarama Park:

- *Areas 1, 2, 5 and 7 and require no headworks, as these are able to utilize the existing overhead connection on the 11WN22 (Ludmilla) feeder which has enough spare capacity to supply these areas.*
- *Prior to new load in areas 3, 4, 6, 8, 9, 10 or 11 with combined load < 9 MVA (assumed Stage 1, within 5 years):*
    - *Install one (1) new feeder from Woolner Zone Substation to area of works*
        - *New 400 sqmm Al XLPE underground cable (approx. 2.2km to edge of area Lot 5182)*
    - *Install RMU on existing 11WN14 (Airport 1) feeder (approximately opposite MacDonald's, exact location tbc)*
        - *Extend new 400 sqmm Al XLPE cable into area Lot 5182*

Required before combined new load in all areas reaches 9 MVA (assumed Stage 2, 5+ years):

- *Install second new feeder from Woolner Zone Substation to area of works*
- *Install new RMU on 11WN07 feeder (on Casuarina side of McMillans Rd Airport Intake Station)*
    - *Extend new 400 sqmm Al XLPE cable back to Lot 5182 as backup feeder supply option from 11CA06 (Lyons FAC)*

Note that these studies have been performed at a high level and load is provided on a first come first serve basis. Capacity is not guaranteed until the HV masterplan is approved.

PWC has estimated the associated costs for headworks to reach the end of Bagot Road as:

- *Stage 1: $1.7 m*
- *Stage 2: $2.2 m*

2.4.12 Indicative Costs

Infrastructure costs were approximated for some of the proposed development areas.

Area 11 - The proposed residential Area 11 is currently zoned RD restricted development and the DMSAP does not support rezoning. Area 11 is constrained by the LWWTP odour buffer, flooding and storm surge (residential area has higher immunity requirements) and sewer capacity. As such only approx 30 lots located between Harney Street and Dick Ward Drive have been considered further for estimation of infrastructure costs.

Infrastructure costs for each proposed development area included preliminary costs such as design, headworks costs to provide enabling or linking infrastructure and subdivision costs where required for internal roads, drainage and services.

Subdivision costs were determined based on a planning cost allowance for either indicative per lot or unit cost or per linear metre.

Approximated costs for major headworks such as road intersections, electrical, water and sewer rising main (SRM) and sewer pump station (SPS) have been based on the total approximated cost apportioned on a pro-rata basis by size for each potential development area. For example, the total cost of the sewer rising main and pump station is approximated as $6,388,750 with cost allocated based on the ratio of the size (ha) of potential development areas to the total development size (ha) serviced by the SPS.

Approximated costs apportioned to potential development areas are dependent on all areas proceeding. Should an area not proceed to development this will increase the development costs of the other areas proportionately.

Total indicative approximated costs for each potential development area are included in the following summary tables.

Costs were not approximated for:

- Area 2 – existing facility and will retain existing services.
- Area 5 – existing facility however current servicing requirements unknow.
- Area 7 – new camping area with minimal load – expect to utilise existing Minmarama services.
- Area 10 – to be retained as open space and not considered further at this time.

2.5 Development Area Potential Constraints, Risks and Indicative Cost

Table 2.1 – Potential Constraints Summary - Development Area 1

Potential Constraint	Current Situation	Development Requirement	Risk
Planning	• Zoned community living	• None - compliant	
AAPA	• C2016/049 expired • Existing RWA	• New AAPA certificate	
Heritage	• None	• None - compliant	
Geotechnical	• No ASS encountered • Uncontrolled fill	• Undertake additional geotechnical testing across site for housing including ASS • Remove uncontrolled fill	
Land Contamination	• Old building material encountered in fill • No ACM observed	• Undertake contaminated land assessment • Seek asbestos clearance certificate	
Environmental	• None known	• Undertake preliminary site investigation	
Biting Insects	• Known mosquito area	• Screen new buildings • Manage local ponding and vegetation • High risk to residents	
Flooding and Storm Surge	• Subject to primary storm surge	• Construct new open drains • Fill to minimum 6.2 m	
Roads and Traffic	• Direct access from Dick Ward Drive	• Retain existing access subject to Council requirements • Upgrade existing internal road • Construct new internal road	
Water	• Current connection	• PWC has not advised of any required upgrade	
Sewer	• Current connection	• PWC has not advised of any required upgrade	
Electrical	• Current connection	• PWC has not advised of any required upgrade	

Indicative Cost	$2,420,940	

Key risks:

- AAPA restrictions impacting proposed development of residential area.

Table 2.2 – Potential Constraints Summary - Development Area 2

Potential Constraint	Current Situation	Development Requirement	Risk
Planning	• Zoned CL community living	• None – permitted use	
AAPA	• Unknown	• New AAPA certificate	
Heritage	• None	• None - compliant	
Geotechnical	• Existing development	• None	
Land Contamination	• Existing development • Desktop ecological assessment undertaken 2011	• Seek asbestos clearance certificate	
Environmental	• Existing development	• Preliminary site investigation	
Biting Insects	• Known mosquito area	• Screen new buildings • Manage local ponding and vegetation • High risk to residents	
Flooding and Storm Surge	• Subject to primary storm surge	• Future buildings FFL above flood height • Investigate engineering solutions to mitigate flooding	
Roads and Traffic	• Direct access from Dick Ward Drive	• Retain existing access subject to Council requirements • Upgrade existing internal road • Construct new internal road	
Water	• Current connection	• PWC has not advised of any required upgrade	
Sewer	• Current connection	• PWC has not advised of any required upgrade	
Electrical	• Current connection	• PWC has not advised of any required upgrade	

Indicative Cost	Existing development - not calculated $0	

Key risks:

- Existing development - Nil identified.

Table 2.3 – Potential Constraints Summary - Development Area 3

Potential Constraint	Current Situation	Development Requirement	Risk
Planning	• Zoned SD44 Specific Use	• None - compliant	
AAPA	• C2014/011 expired • Existing RWA	• New AAPA certificate	
Heritage	• None	• None - compliant	
Geotechnical	• No known assessment	• Undertake geotechnical testing across site including ASS	
Land Contamination	• Ecological assessment undertaken 2011	• Full contaminated land assessment • Risks include asbestos waste, dumped rubbish and any stockpiling/fill material • Development of ASSMP	
Environmental	• Ecological assessment undertaken 2011	• Undertake field investigation to verify land units, assess habitat and conduct targeted threatened species surveys	
Biting Insects	• Known mosquito area	• Screen new buildings • Manage local ponding and vegetation	
Flooding and Storm Surge	• Subject to primary storm surge	• Construct new open drains • Fill to minimum 6.2 m	
Roads and Traffic	• Frontage to Dick Ward Drive • No current access	• Subject to Council requirements • Possible access via Area 4 road	
Water	• Limited capacity and pressure	• Headworks required	
Sewer	• No capacity	• Headworks required	
Electrical	• Limited capacity	• Headworks required	

Indicative Cost	$2,029,865	

Key risks:

- Sewer capacity – headworks dependent on several potential development areas progressing concurrently.

Table 2.4 – Potential Constraints Summary - Development Area 4

Potential Constraint	Current Situation	Development Requirement	Risk
Planning	• Zoned CN Conservation	• Rezone	
AAPA	• Unknown	• New AAPA certificate	
Heritage	• None	• None - compliant	
Geotechnical	• Investigation trenching SLR 2022	• Remove uncontrolled fill in southern area (waste)	
Land Contamination	• Cyclone Tracy waste dump with building waste and ACM to the south • Area north of proposed road appears clear of waste • Preliminary site investigation SLR 2019 and SLR 2022	• Remove and characterize uncontrolled fill • Remove / contain and cap Cyclone Tracy waste dump • Development of ASSMP	
Environmental	• Preliminary site investigation SLR 2019 and SLR 2022	• Undertake field investigation to verify land units, assess habitat and conduct targeted threatened species surveys	
Biting Insects	• Known mosquito area	• Screen new buildings • Manage local ponding and vegetation	
Flooding and Storm Surge	• Subject to primary storm surge	• Construct new open drains • Fill to minimum 6.2 m	
Roads and Traffic	• No current access	• Construct access road and signalized intersection to Dick Ward Drive	
Water	• Limited capacity and pressure	• Headworks required	
Sewer	• No capacity	• Headworks required	
Electrical	• Limited capacity	• Headworks required	

Indicative Cost	$14,178,095	

Key risks:

- Land contamination – removal and disposal of Cyclone Tracy ACM.
- Earthworks – significant fill required.
- Water supply - headworks dependent on several potential development areas progressing concurrently.
- Sewer capacity – headworks dependent on several potential development areas progressing concurrently.
- Electrical – headworks dependent on several potential development areas progressing concurrently.

Table 2.5 – Potential Constraints Summary - Development Area 5

Potential Constraint	Current Situation	Development Requirement	Risk
Planning	• Zoned CN Conservation	• May require rezoning	
AAPA	• Unknown	• New AAPA certificate	
Heritage	• None	• None - compliant	
Geotechnical	• Existing use • No known assessment	• None proposed – existing development	
Land Contamination	• Existing use • No known assessment	• Undertake preliminary site investigation • Development of ASSMP	
Environmental	• Unknown – assume previous studies undertaken to establish aquaculture	• Existing use • Undertake field investigation to verify land units, assess habitat and conduct targeted threatened species surveys	
Biting Insects	• Known mosquito area	• Manage local ponding and vegetation	
Flooding and Storm Surge	• Subject to primary storm surge	• Construct new open drains • Fill immediate surrounding area and access to minimum 6.2 m	
Roads and Traffic	• Existing gravel access track	• Formalise gravel access	
Water	• Existing development – no current load	• Development dependent	
Sewer	• Existing development – no current load	• None proposed	
Electrical	• Existing development – no current load	• Headworks required dependent on timing	

Indicative Cost	Existing development - not calculated	

Key risks:

- Existing development - Nil identified.

Table 2.6 – Potential Constraints Summary - Development Area 6

Potential Constraint	Current Situation	Development Requirement	Risk
Planning	• Zoned CN Conservation • Rezoning flagged DMSAP	• Requires rezoning	
AAPA	• Unknown	• New AAPA certificate	
Heritage	• None	• None - compliant	
Geotechnical	• Trench assessment by SLR 2022	• Remove up to 1.9 m of uncontrolled fill (waste)	
Land Contamination	• Cyclone Tracy waste dump with building waste and ACM • Stockpiled material contains contaminants including ACM • Preliminary site investigation by SLR 2019 • Trench assessment by SLR 2022	• Remediation action plan • Remove and characterize approx 113,000 m3 of uncontrolled fill • Remove / contain and cap Cyclone Tracy waste dump • Development of ASSMP	
Environmental	• Preliminary site investigation by SLR 2019	• Undertake field investigation to verify land units, assess habitat and conduct targeted threatened species surveys	
Biting Insects	• Known mosquito area	• Screen new buildings • Manage local ponding and vegetation	
Flooding and Storm Surge	• Subject to primary storm surge	• Construct new open drains • Fill to minimum 6.2 m	
Roads and Traffic	• No current access	• Construct access road and signalized intersection to Dick Ward Drive	
Water	• Limited capacity and pressure	• Headworks required	
Sewer	• No capacity	• Headworks required	
Electrical	• Limited capacity	• Headworks required	

Indicative Cost	$91,943,690	

Key risks:

- Land contamination – removal and disposal of Cyclone Tracy ACM.
- Earthworks – significant fill required.
- Water supply - headworks dependent on several potential development areas progressing concurrently.
- Sewer capacity – headworks dependent on several potential development areas progressing concurrently.
- Electrical – headworks dependent on several potential development areas progressing concurrently.

Table 2.7 – Potential Constraints Summary - Development Area 7

Potential Constraint	Current Situation	Development Requirement	Risk
Planning	• Zoned RD restricted development	• Requires rezoning to CL to recognize existing community housing	
AAPA	• Unknown	• New AAPA certificate	
Heritage	• None	• None - compliant	
Geotechnical	• WANT Geotech investigation 2022	• Remove up to 1.9 m of uncontrolled fill	
Land Contamination	• Uncontrolled fill with rubbish and building waste - potential ACM • Stockpiled material contains contaminants including ACM • Preliminary site investigation by SLR 2019	• Remediation action plan • Remove and characterize uncontrolled fill (waste) • Remove / contain and cap waste dump • Development of ASSMP	
Environmental	• Preliminary site investigation by SLR 2019	• Undertake field investigation to verify land units, assess habitat and conduct targeted threatened species surveys	
Biting Insects	• Known mosquito area	• Manage local ponding and vegetation • High risk to users	
Flooding and Storm Surge	• Subject to primary storm surge	• Construct new open drains • Fill development area and access to minimum 6.2 m	
Roads and Traffic	• Utilise existing Minmarama access	• None proposed	
Water	• Minor development – no current load	• None proposed	
Sewer	• Minor development – no current load	• None proposed	
Electrical	• Minor development – no current load	• None proposed	

Indicative Cost	Not calculated	

Key risks:

- Land contamination – remediation of waste area, removal and disposal of any ACM.
- Earthworks – significant fill required.
- Biting insects.

Table 2.8 – Potential Constraints Summary - Development Area 8

Potential Constraint	Current Situation	Development Requirement	Risk
Planning	• Zoned SD37 Specific Use	• None - compliant	
AAPA	• C2015/130 expired – RWA	• New AAPA certificate	
Heritage	• None	• None - compliant	
Geotechnical	• Unknown	• Undertake geotechnical testing across site including ASS	
Land Contamination	• Ecological assessment undertaken 2011 • Cyclone Tracy waste dump with building waste and ACM	• Full contaminated land assessment • Risks include asbestos waste, dumped rubbish and any stockpiling/fill material • Development of ASSMP • Remediation action plan • Remove / contain and cap Cyclone Tracy waste dump	
Environmental	• Ecological assessment undertaken 2011	• Undertake field investigation to verify land units, assess habitat and conduct targeted threatened species surveys	
Biting Insects	• Known mosquito area	• Screen new buildings • Manage local ponding and vegetation	
Flooding and Storm Surge	• Subject to primary storm surge • Existing easements discharge to area	• Construct new open drains • Detention basin required • Fill development area and access to minimum 6.2 m	
Roads and Traffic	• No current access	• Construct access road and signalized intersection to Dick Ward Drive and Bagot Road • Fitzer Drive convert to left in left out	
Water	• Existing DN100 connection • Limited capacity and pressure	• Headworks required	
Sewer	• No capacity	• Headworks required	
Electrical	• Limited capacity	• Headworks required	

Indicative Cost	$58,025,157	

Key risks:

- Land contamination – removal and disposal of Cyclone Tracy ACM.
- Earthworks – significant fill required.
- Stormwater – existing easements discharge to lot.
- Water supply - headworks dependent on several potential development areas progressing concurrently.
- Sewer capacity – headworks dependent on several potential development areas progressing concurrently.
- Electrical – headworks dependent on several potential development areas progressing concurrently.

Table 2.9 – Potential Constraints Summary - Development Area 9

Potential Constraint	Current Situation	Development Requirement	Risk
Planning	• Zoned SD37 Specific Use	• None - compliant	
AAPA	• C2012/127 expired – RWA	• New AAPA certificate	
Heritage	• None	• None - compliant	
Geotechnical	• Unknown	• Undertake geotechnical testing across site including ASS	
Land Contamination	• Ecological assessment undertaken 2011	• Full contaminated land assessment	
Environmental	• Ecological assessment undertaken 2011	• Undertake field investigation to verify land units, assess habitat and conduct targeted threatened species surveys	
Biting Insects	• Known mosquito area	• Screen new buildings • Manage local ponding and vegetation	
Flooding and Storm Surge	• Subject to primary storm surge	• Construct new open drains • Fill development area and access to minimum 6.2 m	
Roads and Traffic	• Frontage to Totem Road • No current access	• Subject to Council requirements	
Water	• Limited capacity and pressure	• Headworks required	
Sewer	• No capacity	• Headworks required	
Electrical	• Limited capacity	• Headworks required	

Indicative Cost	$1,684,169	

Key risks:

- Water supply - headworks dependent on several potential development areas progressing concurrently.
- Sewer capacity – headworks dependent on several potential development areas progressing concurrently.
- Electrical – headworks dependent on several potential development areas progressing concurrently.

Table 2.10 – Potential Constraints Summary - Development Area 10

Potential Constraint	Current Situation	Development Requirement	Risk
Planning	• Zoned SD37 Specific Use	• None - compliant	
AAPA	• C2012/127 expired – RWA	• New AAPA certificate	
Heritage	• None	• None - compliant	
Geotechnical	• Unknown	• Undertake geotechnical testing across site including ASS	
Land Contamination	• Ecological assessment undertaken 2011 • Cyclone Tracy waste dump with building waste and ACM	• Full contaminated land assessment • Risks include asbestos waste, dumped rubbish and any stockpiling/fill material • Development of ASSMP • Remediation action plan • Remove / contain and cap Cyclone Tracy waste dump	
Environmental	• Ecological assessment undertaken 2011	• Undertake field investigation to verify land units, assess habitat and conduct targeted threatened species surveys	
Biting Insects	• Known mosquito area	• Screen new buildings • Manage local ponding and vegetation • Potential issues for open space users	
Flooding and Storm Surge	• Subject to primary storm surge • Existing easements discharge to area	• Construct new open drains • Fill development area and access to minimum 6.2 m	
Roads and Traffic	• No current access	• Utilise Area 8 access road	
Water	• Limited capacity and pressure	• Headworks required	
Sewer	• No capacity	• Headworks required	
Electrical	• Limited capacity	• Headworks required	

Indicative Cost	Proposed open space - not calculated	

Key risks:

- Land contamination – removal and disposal of Cyclone Tracy ACM.
- Earthworks – significant fill required.
- Stormwater – detention basis expected to be required to support Area 8.

Table 2.11 – Potential Constraints Summary - Development Area 11 - 30 lots only

Potential Constraint	Current Situation	Development Requirement	Risk
Planning	• Zoned RD Restricted development • Part of area in LWWTP odour and SPS buffer zone	• Rezoning required • Rezoning not supported by DMSAP	
AAPA	• C2015/130 expired – RWA	• New AAPA certificate	
Heritage	• None	• None - compliant	
Geotechnical	• Unknown	• Undertake geotechnical testing across site including ASS	
Land Contamination	• Land suitability assessment undertaken (EcOz 2014)	• Full contaminated land assessment • Risks include asbestos waste, dumped rubbish and any stockpiling/fill material • Development of ASSMP	
Environmental	• Land suitability assessment undertaken (EcOz 2014)	• Undertake field investigation to verify land units, assess habitat and conduct targeted threatened species surveys	
Biting Insects	• Known mosquito area	• Screen new buildings • Manage local ponding and vegetation • High risk to residents	
Flooding and Storm Surge	• Subject to primary storm surge •	• Construct new open drains • Fill development area and access to minimum 6.2 m	
Roads and Traffic	• Potential road stubs available off Harney Street and Nemarluk Drive	• Detailed traffic impact assessment required • Roads subject to Council approval	
Water	• Limited capacity and pressure	• Headworks required	
Sewer	• No capacity	• Headworks required	
Electrical	• Limited capacity	• Headworks required	

Indicative Cost	$4,801,371	

Key risks:

- Earthworks – significant fill required.
- Water supply - headworks dependent on several potential development areas progressing concurrently.
- Sewer capacity – headworks dependent on several potential development areas progressing concurrently.
- Electrical – headworks dependent on several potential development areas progressing concurrently.

3 Introduction

3.1 Background

The Department of the Chief Minister and Cabinet (DCM&C) has established the Interagency Transition Working Group. Under the Terms of Reference, this group has responsibility to identify and review opportunities to resolve governance and compliance matters affecting the sustainability of town camps, including the Kulaluk and Minmarama Park Town Camps Camps having regard to the Northern Territory Government's Local Decision Making Agenda.

The Gwalwa Daraniki Association Inc hold title to the Kulaluk and Minmarama Park Town Camps (Figure 3.1) under a Crown Lease in perpetuity.

The Crown Lease allows the land to be utilised for uses 'consistent with the zoning of the land'. The land is currently subject to a number of zones including conservation, restricted development, community living, specific use (SD37 and SD44) and public open space.

Long-term subleases and under leases to private businesses are in place over part of the land. This includes the land area in Ludmilla, occupied by McDonalds Ludmilla and a proposed development over part of the land on Dick Ward Drive.

Figure 3.1 – GDA Lease Areas Lot 8630 and Lot 5182

3.2 Project Objective

The objective of the of the Kulaluk and Minmarama Park Land Assessment project was to undertake preliminary planning and assessment of the enabling infrastructure for Kulaluk and Minmarama Park Town Camps. The project included:

- Assessment of the requirements and costs to support development of land consistent with the Darwin Mid Suburbs Area Plan including servicing, stormwater management, environmental audit, traffic impact assessment, landfill and any other necessary works to make the land development ready.
- Based on this assessment, review the commercial viability of undertaking development on the land in accordance with the Darwin Mid Suburbs Area Plan (noting that the land can be subleased to a developer/third party but not sold) including an assessment of potential returns to the landowner.
- Utilise, where available, existing stakeholder data and reports to enhance potential development opportunities if available.

3.3 Project Team

For the project, DTFHC engaged a consulting team led by Byrne Consultants. The project team comprised:

- Byrne Consultants – project management, roads, drainage, water and sewer
- CRTPC – town planning
- EcOz – contaminated land and environmental assessments
- WRM – flood analysis
- Arccos – traffic impact
- AGA – electrical

3.4 Project Report

The project report is submitted as an overview and summary of findings. Detailed reports prepared by subconsultants are presented as standalone appendices.

4 Proposed Development Areas

4.1 Darwin Mid Suburbs Area Plan

The Darwin Mid Suburbs Area Plan (DMSAP) was released in 2016 envisaged that land use on specific sites may change in the future. The DMSAP noted:

> *A number of sites will require rezoning before the land use and development potential envisaged by this Area Plan can be realised.*

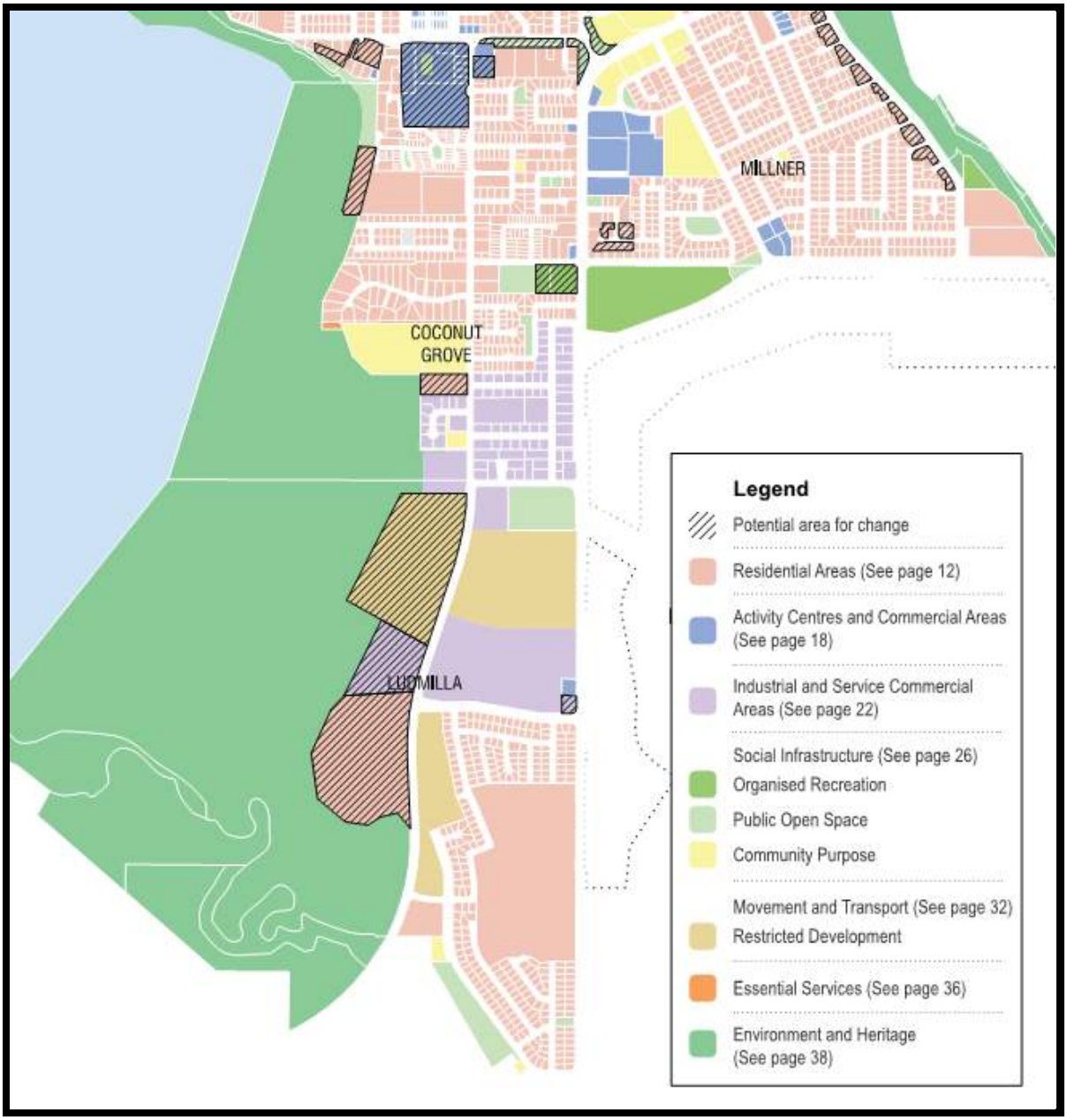

Figure 4.1 – DMSAP District Level Land Use Map - Extract

4.2 GDA Discussion

A meeting was held between Byrne Consultants, DTFHC and DIPL representatives and the Executive of GDA on 20 October 2022 (Meeting notes Appendix A). During the meeting GDA expressed that:

- GDA aspirations are to provide Housing, firstly for their members, with a secondary priority around accommodation for 'countrymen' who may be there for a short time.
- GDA are interested in possibly expanding the aged care.
- GDA see their land as a way of providing economic opportunity to create a viable organisation and to enable them to grow their housing base.
- There are a raft of zoning and heritage issues associated with the site that will need to be resolved before development can occur.
- There seems to be some progress on development of the Jape site with an 'approval' in place for the road between Bagot Road and Dick Ward Drive with a master plan being prepared.
- GDA did not have any specific ideas about preferred commercial development.
- There are some areas which will be restricted for cultural reasons.
- GDA the lease area includes the site directly across the road from Minmarama. It would be the area most suitable for housing development, however this could be a commercial opportunity rather than housing.

Documents provided by GDA are included as Appendix A.

4.3 Existing Development

4.3.1 Kulaluk Housing – Lot 6830

A number of existing dwellings are located at the Kulaluk town camp.

Figure 4.2 – Kulaluk Housing – Lot 6830

4.3.2 Aged Care – Lot 8630

An existing aged care facility (Juninga) is located on Lot 8630. GDA are pursuing a sublease or similar to be placed over the facility. The Juninga facility is currently operated by Australian Regional and Remote Community Services (ARRCS). The ARRCS website notes:

> *At Juninga, we have 26 permanent residential beds. We also have 10 independent living cabins, which provide support via ARRCS Community Care Darwin services.*

Figure 4.3 – Juninga Aged Care – Lot 8630

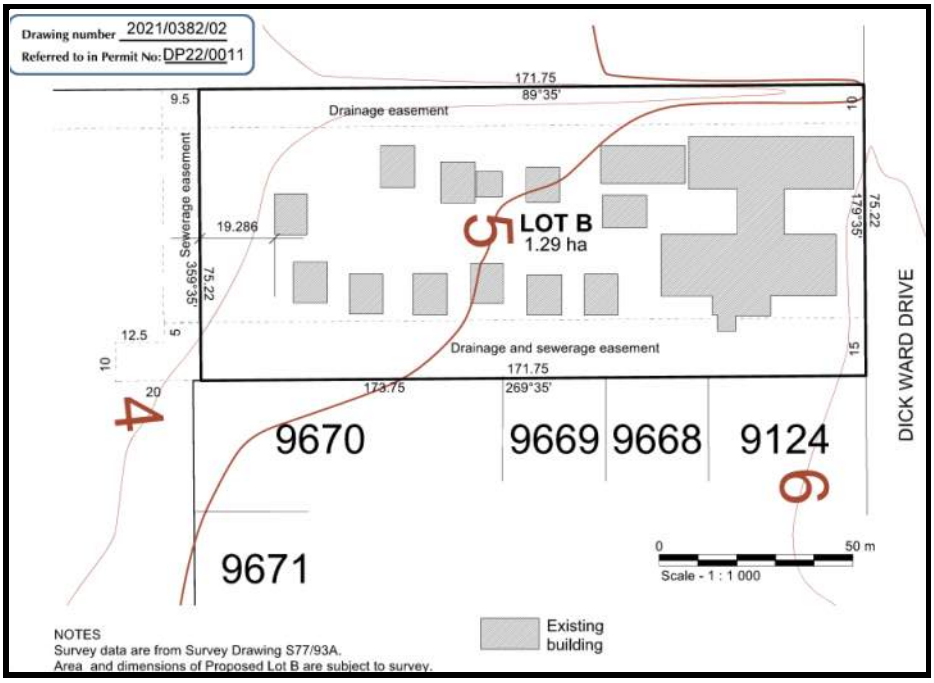

Figure 4.4 – Proposed Juninga Subdivision / Sublease

4.3.3 Minmarama Camp Housing – Lot 5182

A number of existing dwellings are located at the Minmarama Park Town Camp.

Figure 4.5 – Minmarama Camp Housing – Lot 5182

4.3.4 Abandoned Aquaculture – Lot 5182

Aquaculture ponds were initially developed around 1996 and several attempts have been made to establish an aquaculture enterprise including a prawn farm and crab farm. On 1 January 2005, GDA and residents of Minmarama entered into a Shared Responsibility Agreement with the Australian Government to establish an aquaculture venture (crab farm) on Lot 5182. The SRA noted:

> *The Kulaluk and Minmarama Park 'Developing a Mud-Crab Business Shared Responsibility Agreement (SRA) provides the foundations for a mud-crab business that can employ young people and develop business skills amongst Indigenous communities in Darwin Harbour. The business venture has commenced, with the purchase of crablets, the development of hatchery facilities and the preparation of a business plan.*
>
> *Source: https://database.atns.net.au/agreement.asp?EntityID=2767*

Figure 4.6 – Abandoned Aquaculture – Lot 5182

4.3.5 McDonalds – Lot 5182

Over time, GDA has engaged with various private developers to explore development opportunities on the town camp leases. An existing commercial development (McDonalds) is located on the corner of Bagot Road and Fitzer Drive.

**Source: Googlemaps*

Figure 4.7 – McDonalds – Lot 5182

4.4 Historical Proposals

A range of historical development proposals have been considered for the Kulaluk and Minmarama camp areas including the Arafura Harbour Marina Development however these developments did not proceed. The history of previous development proposals related to Lot 5182 and Lot 6830 are included in various papers by Dr Bill Day available at *https://www.drbilldayanthropologist.com/ .*

Figure 4.8 – Arafura Harbour Proposal

4.5 Proposed Development Areas

Based on discussion with GDA, the DMSAP, private proposals and NTG concepts, 11 potential development areas have been identified for further consideration and preliminary assessment as part of this project as set out in Table 4.1 and as shown in Figure 4.9 (Attachment 1).

Table 4.1 – Proposed Development Areas

Area	Lot	Proposed Use	Development	Proponent
1	8630	Additional housing	11 houses	GDA / NTG
2	8630	Aged Care	Subdivision	GDA
3	8630/5182	Commercial	Retail / industrial	Dragon Lady
4	5182	Commercial	Retail / industrial	DMSAP
5	5182	Aquaculture	Aquaculture	GDA
6	5182	Commercial	20 lots	NTG
7	5182	Transient camp	Camping	GDA
8	5182	Commercial	Retail	Citiland
9	5182	Commercial	Offices	Citiland
10	5182	Open Space	Parkland	Citiland
11	5182	Residential / commercial	Up to 80 houses	GDA

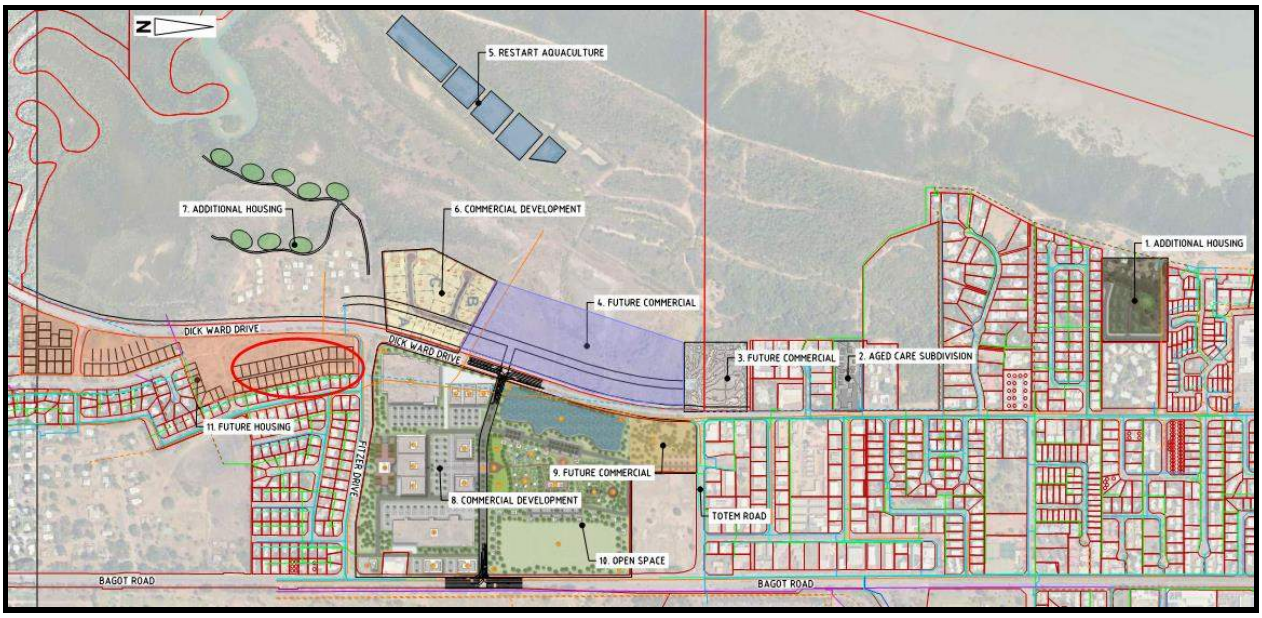

Figure 4.9 – Potential Development Areas

4.6 NT Government Development Concepts

4.6.1 Area 1 - Kulaluk Additional Housing

Based on the aspirations of GDA, NTG has undertaken some preliminary planning and engineering design to develop a working concept for additional housing to be located at the Kulaluk camp. The concept design allows for filling of low lying land, drainage roads and up to 11 additional houses as shown below in Figure 4.10 and Attachment 2.

Figure 4.10 – Kulaluk Additional Housing Areas

4.6.2 Area 6 - Minmarama Commercial

An historical stockpile of uncontrolled fill was previously placed by a third party on an area adjacent to Minmarama Park camp and Dick Ward Drive. NTG has developed a planning concept for a small commercial / light industrial subdivision as shown below in Figure 4.11 and Attachment 3.

Figure 4.11 – Minmarama commercial

4.7 Private Development Concepts

4.7.1 Area 8, 9 and 10 - Citiland – Jape

Over time, GDA has engaged with various private developers to explore development opportunities on the town camp leases. Citiland (Jape) has an active development permit (DP14/0831), for a proposed development (Figure 4.12) bounded by Bagot Road, Fitzer Drive ad Dick Ward Drive (Appendix B).

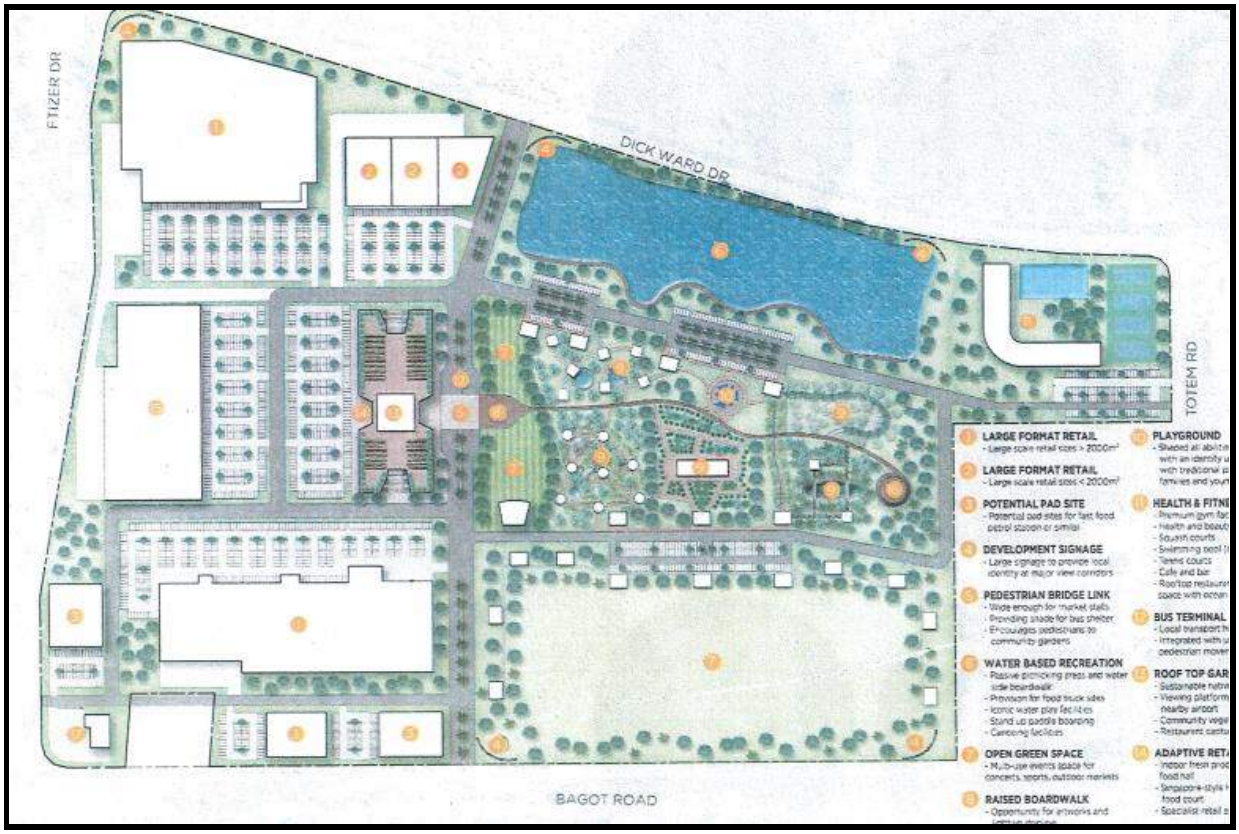

Figure 4.12 – Citiland Proposed Development

4.7.2 Area 3 - Chin

A commercial development has been proposed adjacent to the Dick Ward Drive Totem Road intersection (DP15/0078 – Appendix C) as shown in Figure 4.13.

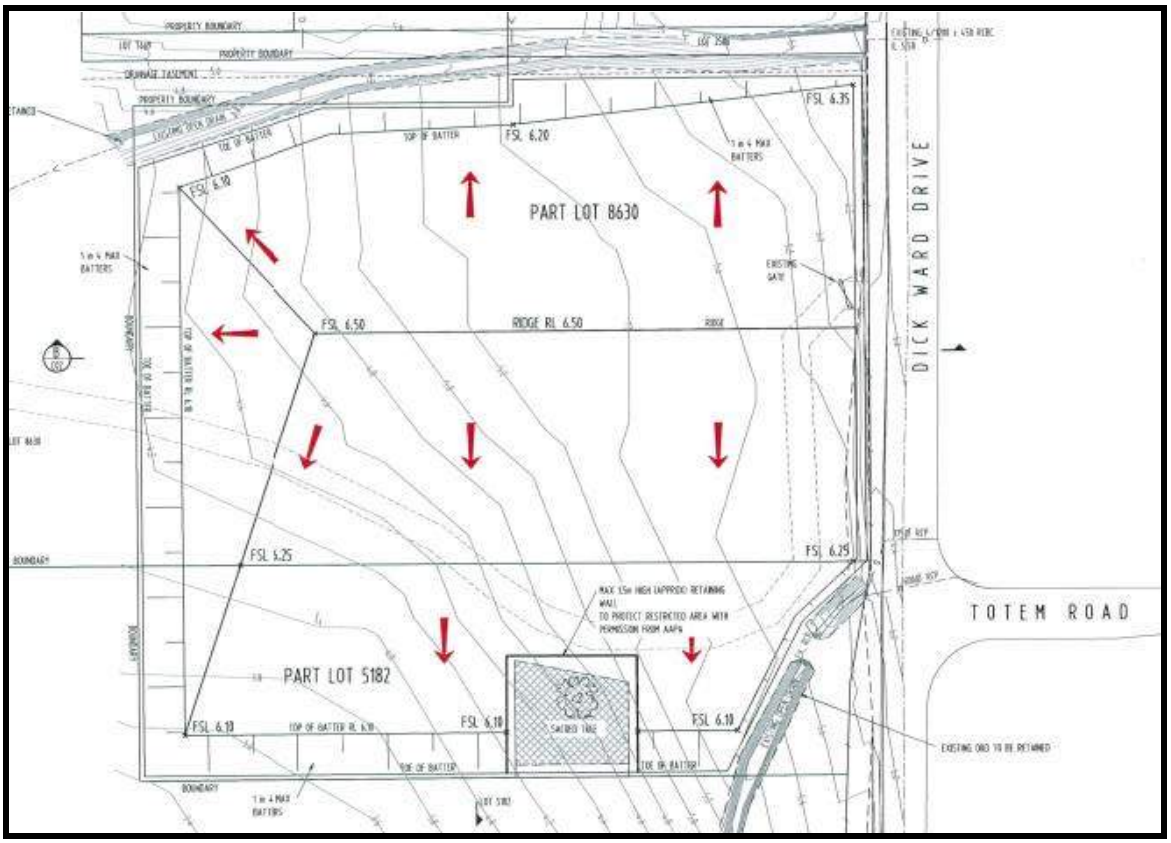

Figure 4.13 – Proposed development area Dick Ward Drive – Totem Road Intersection

4.8 Assumed Development Concepts

4.8.1 Area 4 – Potential Commercial

The DMSAP identifies Area 4 as potential commercial development. Area 4 is extremely low lying to the west and for the purpose of this project the nominal western boundary has been matched to the south west corner of Area 3 and the north west corner of Area 6. An indicative lot layout is shown in Figure 4.14 with nominal approximate lot sizes of 2000 m2 to 4000 m2.

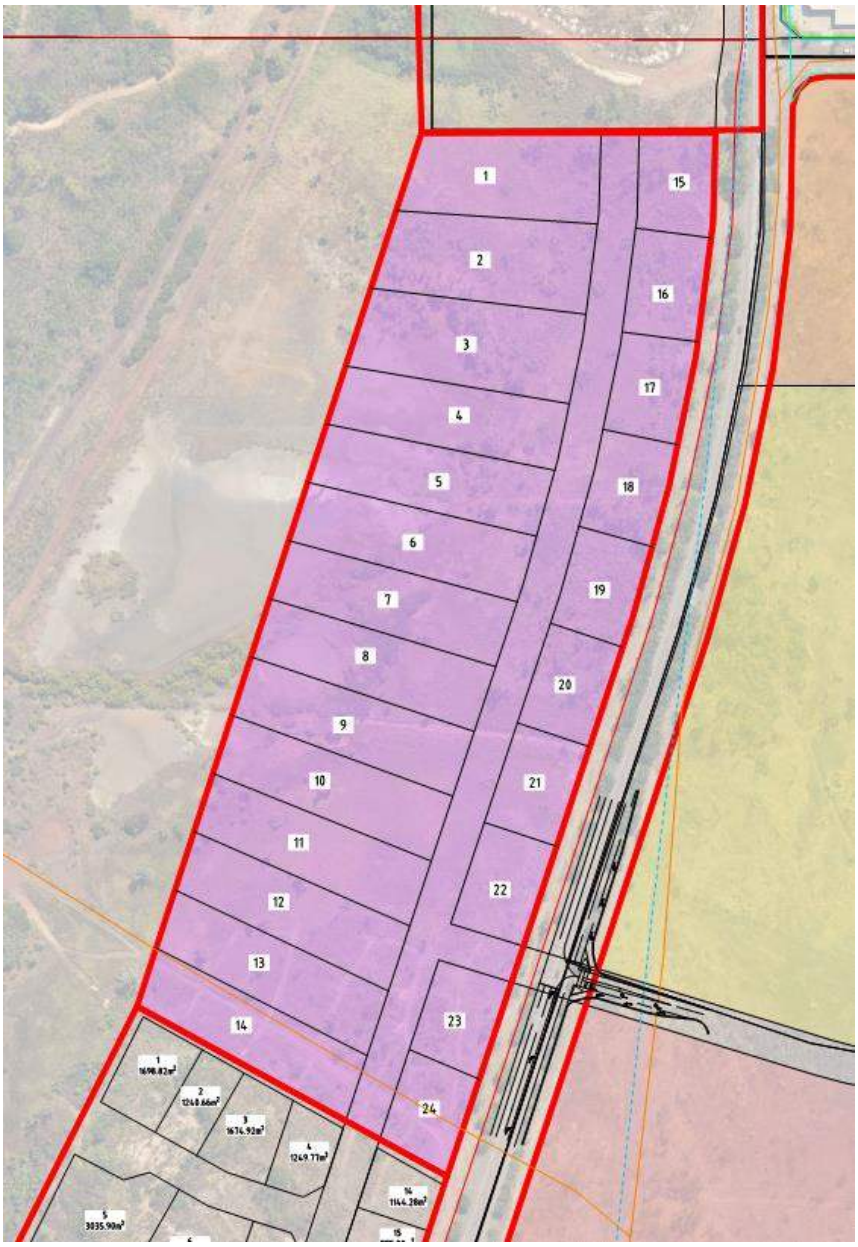

Figure 4.14 – Proposed development area Dick Ward Drive

4.8.2 Area 11 – Potential Residential

As noted previously, GDA has identified potential to develop the area opposite Minmarama Park as residential housing. An indicative lot layout of approximately 81 lots, each around 580 m^2 was developed for the area based on current road network and other constraints such as the existing sewer pump station and rising main.

Figure 4.15 – Area 11 Residential Lots

As shown in the DMSAP, parts of Area 11 are within the 700 m Ludmilla Wastewater treatment plant odour buffer (Figure 4.16). This area may be more suitable for commercial development if commercially viable.

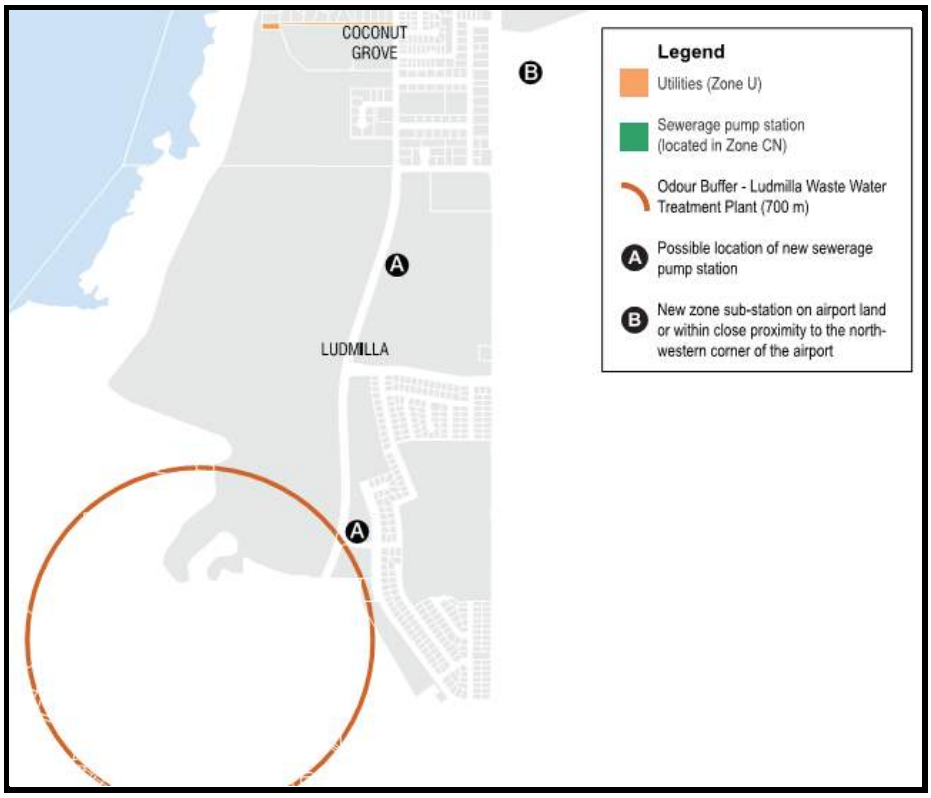

Figure 4.16 – LWWTP odour buffer

5 Planning

5.1 Overview

Cunnington Rosse Town Planning and Consulting (CRTPC) were engaged to prepare a preliminary report outlining the planning considerations for the future development of the site.

Table 5.1 – Site Planning Overview

Site Details	
Location	Lot 5182 and Lot 8630 Town of Darwin
Tenure	Crown Lease in Perpetuity 671
Landowner	Gwalwa Daraniki Association Inc
Area	301.69 hectares (3,016,900m^2)
Easements	Electricity Supply Easements to Power and Water Authority Power Line Easement to Power and Water Authority Water Supply Easement to Power and Water Authority Sewage Easement to the Power and Water Authority Access Easement to the Northern Territory of Australia Pedestrian Access Easement to Northern Territory of Australia Drainage Easement to the Northern Territory of Australia Right of Way Easement to Citiland Corporation Pty Ltd
Planning Considerations	
Planning Scheme	Northern Territory Planning Scheme 2020
Zones	CN (Conservation) RD (Restricted Development) CL (Community Living) PS (Public Open Space) Specific Use Zone SD37 Specific Use Zone SD44
Strategic Framework	Darwin Regional Land Use Plan Darwin Mid Suburbs Area Plan
Overlays	None applicable

5.2 Planning Considerations

The CRTPC report is at Appendix D. CRTPC noted:

- The site is subject to several town planning zones.
- The location of easements identified in the summary table are notated on the Survey Plans.
- The site has an extensive planning history.
- The site includes Zone CN, RD, CL and PS under the *NT Planning Scheme 2020*. The site also includes Specific Use Zones SD37 and SD44 which are subject to the provisions of the *NT Planning Scheme 2007*.
- The following Overlays are applicable to the land:
  - CR (Coastal Reclamation)
    - relates to the placement of fill material below the level of the highest astronomical
  - LPA (Land in Proximity to Airports)
    - land that is within Zones RL, R, A, CP, CN, RD, WM and FD and subject to the Australian Noise Exposure Forecast (ANEF) 20-unit value contour line or greater as defined on the ANEF maps produced by the Department of Defence
    - maybe subject to height restrictions
  - CNV (Clearing of Native Vegetation)
    - clearing of native vegetation of more than one hectare in aggregate of land (including any area already cleared of native vegetation) within the area subject to this Overlay requires consent
  - LSSS (Land Subject to Storm Surge)
    - applies to land within the Primary Storm Surge Area (PSSA) and Secondary Storm Surge Area (SSSA)
    - Development in the PSSA should be limited to uses such as open space, recreation, non-essential public facilities (wastewater treatment works excepted) and short-stay tourist camping/ caravan areas.
    - Development within the SSSA should be confined to those uses permitted in the PSSA as well as industrial and commercial land uses.
    - Residential uses, strategic and community services (such as power generation, defence installations, schools, hospitals, public shelters and major transport links) should be avoided in the PSSA and the SSSA.
  - DHD (Darwin Harbour Dredging)
    - relates to dredging of the Darwin Harbour seabed
- Overlays are not applicable to the specific use zones which are subject to the relevant provisions of the Northern Territory Planning Scheme 2007, however similar provisions are contained within this Scheme.
- The site is subject to a Planning Strategic Framework that includes the Darwin Regional Land Use Plan (DRLUP) and the Darwin Mid Suburbs Area Plan (DMSAP):
  - The DRLUP includes a Land Use Structure that identifies development opportunities throughout the region and, within the Regional Context and Polices section, objectives which will guide more specific planning within the context of these opportunities.

- The DMSAP seeks to provide a framework to guide change and improvements in the area and to ensure the area is a sustainable and liveable place into the future.

5.3 Planning Summary

CRTPC identified the following key findings relating to land planning associated with the site:

- The site has a long and complicated planning history. Further investigations of the planning history documentation are required to determine any potential impacts on the site's development opportunities.
- The site is constrained by a number of easements identified on the Survey Plan.
- The site is constrained by storm surge and areas of cultural significance.
- The site is subject to numerous zones.
- The development potential of land within Zone CN (Conservation) is constrained by the provisions of the zone which are to protect the natural features of the area. The DMSAP provides further protection of these areas and suggests the subject area is not appropriate for rezoning, except for:
  - Land within the Kulaluk, Juninga Centre and Minmarama Park Concept to Zone CL (Community Living); and
  - Land within the flight path to Zone RD (Restricted Development).
- The land within Specific Use Zone SD37 is capable of supporting limited service commercial and light industry type development, in accordance with the provisions of this zone.
- Land to the northwest of Fitzer Drive may be rezoned to allow for limited service commercial type development.
- Where existing development does not reflect the existing zoning, the DMSAP generally supports rezoning to a more appropriate zone.

Planning constraints and zoning requirements are summarised in Table 4.2 and Attachment 4.

Table 5.2 – Zoning Requirements and Planning Constraints

Area	Current Use	Current Zoning	Compliant Use (Y/N)	Proposed Use	Required Zoning	Permitted Use in Proposed Zone (Y/N)	Planning Constraints	Comments (What is required to rezone and / or sublease)
1	Community Housing	CL (Community Living)	Dwelling-group (more than 1 ground floor dwelling on a site) is Permitted in this zone subject to compliance with the relavant NTPS requirements.	Community Housing	No rezoning required	Yes	Relevant development requirement of the NTPS. Storm surge Overlay.	Subdivision (inc. lease in excess of 12 years) requires subdivision approval including assessment against NTPS subdivison requirements and Strategic Framework. Rezoning requires Planning Scheme Amendment including assessment against the Strategic Framework among other things.
2	Aged care	CN (Conservation)	Existing development appears to be covered under planning instruments.	Aged care	No rezoning required for subdivison but may be requested by planing Department to reflect existing use. The Area Plan identifies Zone CL as the most appropriate zone for this area.	Residential care facility is Pemitted use in Zone CL	Relevant development requirement of the NTPS. Clearing of native vegetation, land in proximity to airports, and storm surge Overlays.	Refer above.
3	Undeveloped	Specific Use Zone SD44	NA	Commercial	No rezoning required	The zone provides for limited commercial uses. Refer report.	Relevant provisions of the 2007 NTPS.	Refer above.
4	Undeveloped	CN (Conservation)	NA	Commercial	Rezoning required to support commercial uses, however the Area Plan seeks for a large portion of this area to be rezoned to Zone RD (Restricted Development) to reflect it's location		Relevant development requirement of the NTPS. Clearing of native vegetation, land in proximity to airports, and storm surge Overlays.	Refer above.

Area	Current Use	Current Zoning	Compliant Use (Y/N)	Proposed Use	Required Zoning	Permitted Use in Proposed Zone (Y/N)	Planning Constraints	Comments (What is required to rezone and / or sublease)
					under the flight path. Further investigations and discussions with Planning Department required.			
5	Aquaculture	CN (Conservation)	Further investigations required to determine whether aquiculture use is covered under any existing planning instruments or existing use rights. Appears unlikely.	Aquaculture	Further discussions with plannign Department required to determine suitability of existing or other zones.		Relevant development requirement of the NTPS. Clearing of native vegetation, land in proximity to airports, and storm surge Overlays.	Refer above.
6	Undeveloped	CN (Conservation)	NA	Commercial	The area plan seeks for land in this area to be rezoned to a service commercial type specific use zone, similar to Specific Uze Zone SD37.		Relevant development requirement of the NTPS. Clearing of native vegetation, land in proximity to airports, and storm surge Overlays.	Refer above.
7	Undeveloped	RD (Restricted Development)	Dwelling-group (more than 1 ground floor dwelling on a site) is Prohibited in this zone.	Residential	The area plan seeks for land in this area to be rezoned to Zone CL	Yes	Relevant development requirement of the NTPS. Storm surge Overlay.	Refer above.
8	Undeveloped	Specific Use Zone SD37	NA	Commercial	No rezoning required	The zone provides for limited commercial uses. Refer report.	Relevant provisions of the 2007 NTPS.	Refer above.
9	Undeveloped	Specific Use Zone SD37	NA	Commercial	No rezoning required	The zone provides for limited commercial uses. Refer report.	Relevant provisions of the 2007 NTPS.	Refer above.

Area	Current Use	Current Zoning	Compliant Use (Y/N)	Proposed Use	Required Zoning	Permitted Use in Proposed Zone (Y/N)	Planning Constraints	Comments (What is required to rezone and / or sublease)
10	Undeveloped	Specific Use Zone SD37	NA	Open Space	No rezoning required	Open space does not require planning approval if not commercial in nature	None	Refer above.
11	Undeveloped	RD (Restricted Development)	NA	Private Residential	Residential zone. Area Plan does not appear to support this. Further investigations required.	If a rezoning was approved, residential development in a residential zone would likely be permitted.	Relevant development requirement of the NTPS. Storm surge Overlay.	Refer above.

6 AAPA

Historical AAPA certificates were reviewed and restrictions summarised below in Table 6.1. While the reviewed AAPA certificates had expired, at the time of issue, the AAPA Certificates recorded registered sites that would impact some of the proposed development areas (Figure 6.1) including:

- Area 1 - Kulaluk additional housing
- Area 3 – Commercial development
- Area 8 – Commercial development
- Area 9 – Open Space

Table 6.1 – AAPA Certificates

Proposed Area	Certificate	Restriction	Recommendation
1	C2106/049	RWA	Seek new certificate
2	-	None known	Seek new certificate
3	C2014/011	Recorded site / RWA	Seek new certificate
4	-	None known	Seek new certificate
5	-	None known	Seek new certificate
6	-	None known	Seek new certificate
7	-	None known	Seek new certificate
8	C2015/130	Recorded site	Seek new certificate
9	C2012/127	Recorded site	Seek new certificate
10	C2012/127	RWA	Seek new certificate
11	C2015/130	Recorded site / RWA	Seek new certificate

**Also refer to EcOz Environmental Constraints Assessment Report (Appendix C).*

Existing, known recorded sites and restricted work areas present a number of risks to potential development. For example, the restricted work area previously recorded over Area 1 would appear to prevent the proposed development of the residential area.

It is recommended that new AAPA certificates be sought over an area before proceeding with any development plans.

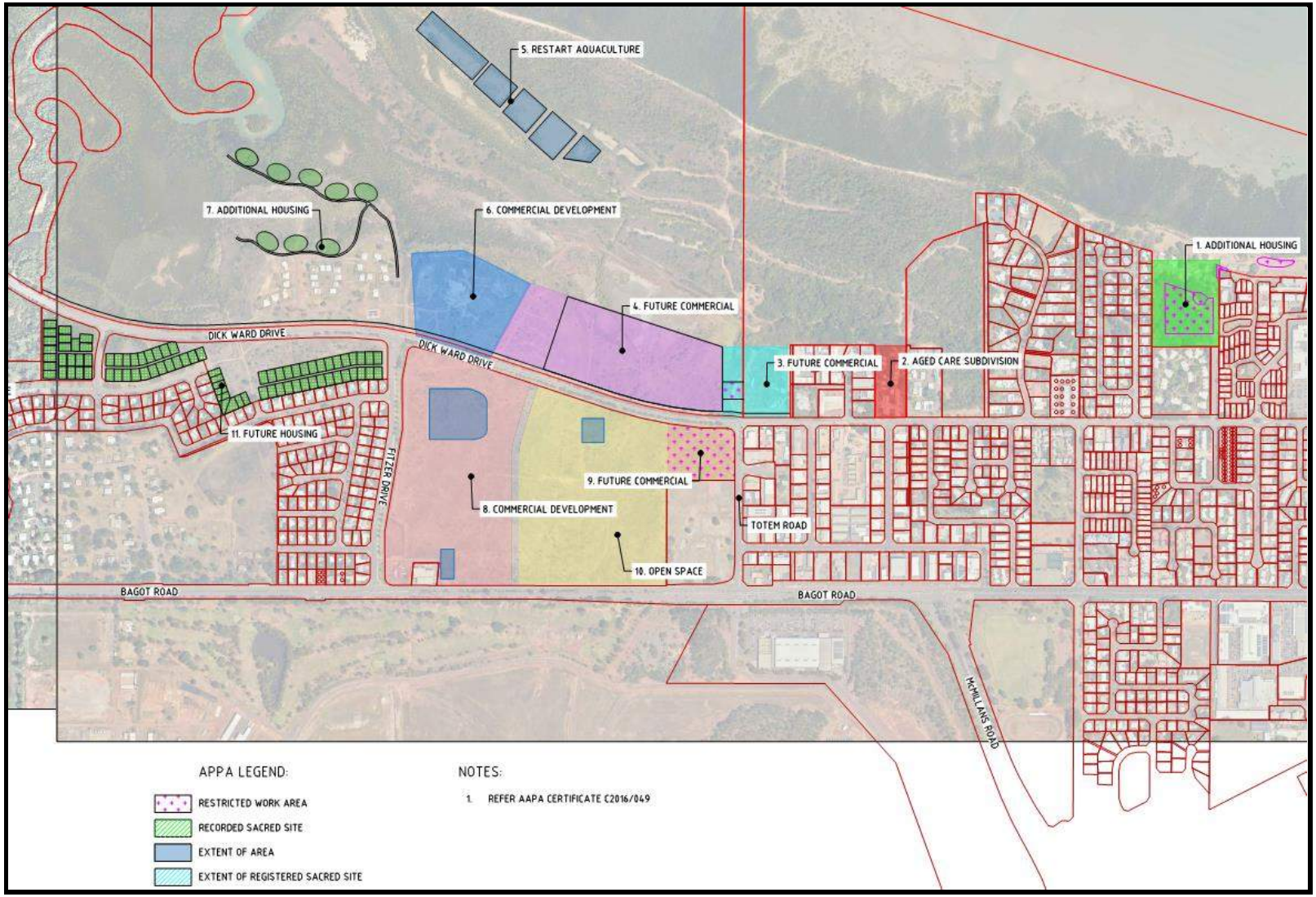

Figure 6.1 – AAPA Areas

7 Heritage

The Heritage Branch of DTFHC was consulted for input to the project. Heritage Branch advised that:

> *The Kulaluk Crown Lease was nominated for Heritage Listing in June 2014. However, the then Minister for Tourism and Culture decided not to formally declare the Kulaluk Lease area as a heritage place because, while important historically, it was believed that it could be appropriately preserved and protected under existing provisions. At that time 80% of the area was zoned Conservation under the Planning Act and this zoning protected the natural and ecological significance of the area. All Aboriginal archaeological places and objects (including burial sites and ancestral remains) are automatically protected by the Heritage Act 2011. In addition, sacred sites are protected under the Sacred Sites Act.*
>
> *Although the Minister did not declare the Kulaluk lease area as a heritage site, this does not mean that there is no cultural heritage on the site. Heritage Branch strongly advises consulting with the Gwalwa Daraniki Association to understand the cultural heritage of the site and which areas are sensitive.*

Heritage Branch also advised that historical documents indicate a burial ground located over an area in the vicinity of Dick Ward Drive and Totem Road. The indicative area corresponds to proposed development area 3.

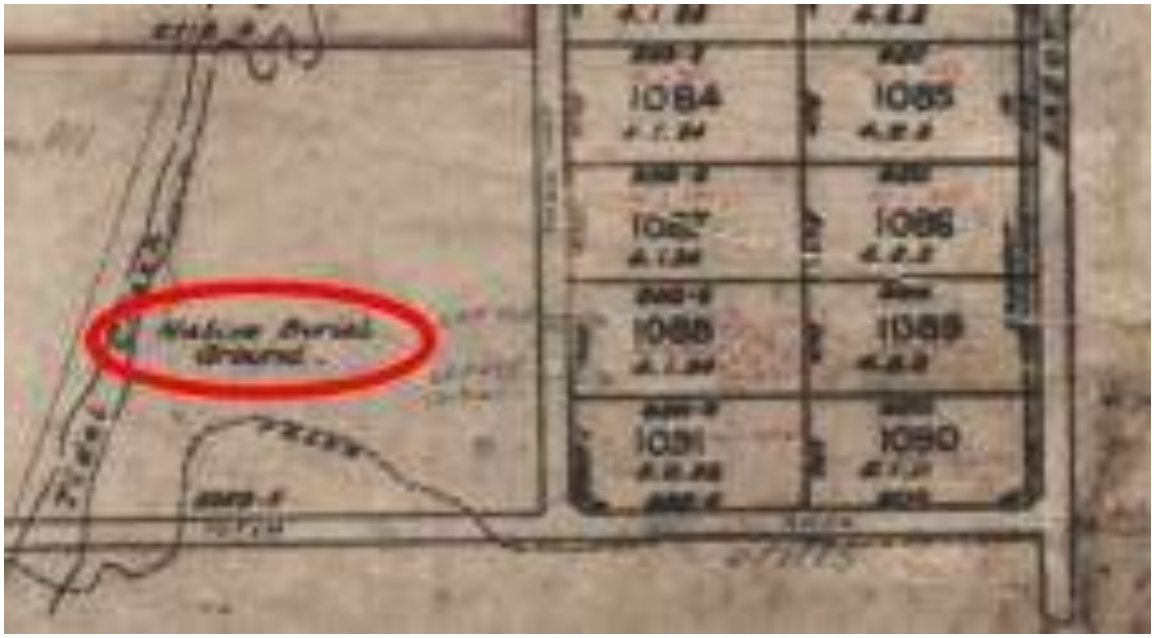

Figure 7.1 – Native Burial Ground Indicated on Historical Map

A report by David Ritchie (2015) for the NT Heritage Council titled: *Review of the Assessment Process Carried Out in Relation to the Kulaluk Lease Area* is included for the purpose of records in Appendix E.

The David Ritchie report supports the site being heritage listed.

8 Geotechnical

8.1 Background Information

DTFHC in association with DIPL provided previous geotechnical assessments that had been undertaken for proposed development areas 1, 6 and 7:

- Area 1 – Douglas Partners (Appendix F-1)
- Area 6 – SLR (Appendix F- 2)
- Area 7 – WANT (Appendix F-3)

8.2 Area 1

Based on limited testing, Douglas Partners offered a preliminary assessment for the Kulaluk additional housing area (Area 1) which is summarised as:

- Fill was located in some areas across the site. Earthworks will require removal of uncontrolled fill. General engineering practice was recommended for site preparation and earthworks including ripping and compaction of fill with Level 1 geotechnical inspection and testing required for areas where structural loads are supported by filling.
- Groundwater was encountered in all boreholes drilled at depths of 0.3 to 2 m below ground level and any subgrade works should be carried out in the dry season. Temporary dewatering with localised pumps likely to be adequate.
- Limited potential for reuse of excavated material as suitable fill material.
- Acid sulfate soil screening testing was undertaken on natural soils from the lower end of the site. Tests indicated that soils were not actual acid sulfate soil.

8.3 Area 4

SLR was previously engaged by DIPL to assess the area north of the existing stockpiles (Area 4).

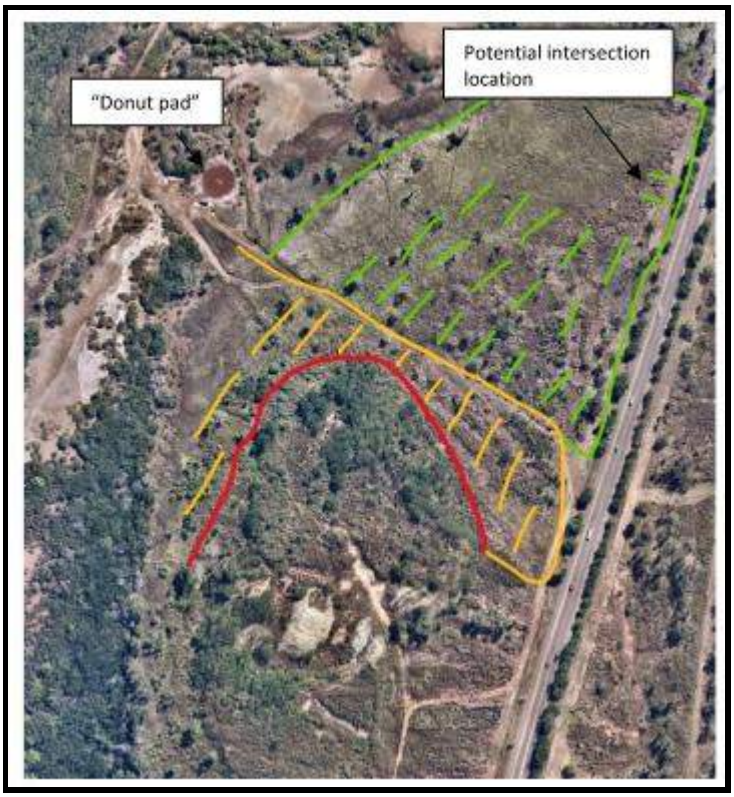

Figure 8.1 – SLR Geotechnical Investigation Area. ***(Source SLR)***

Based on the investigation conducted. SLR conclude that:

- *The accessible extent of the Cyclone Tracy buried waste is present to the east of the existing stockpile areas.*
- *The depth to waste encountered varies to a depth of approximately 0.3m – 0.5mbgs.*
- *Observed waste consisted of general demolition waste consisting of steel, roof sheeting, Asbestos Containing Material (ACM) debris, bricks, concrete, bitumen, plastic, children's toys, carpet etc.*
- *The area to the north of the "access road" is considered unimpacted by buried CT waste.*
- *There is a potentially suitable area to the north/northeast of the existing stockpile area where a containment cell could be positioned.*
- *Further detailed geotechnical investigation is recommended to inform future design of the intersection, internal roads, subdivision and potential containment cell location.*

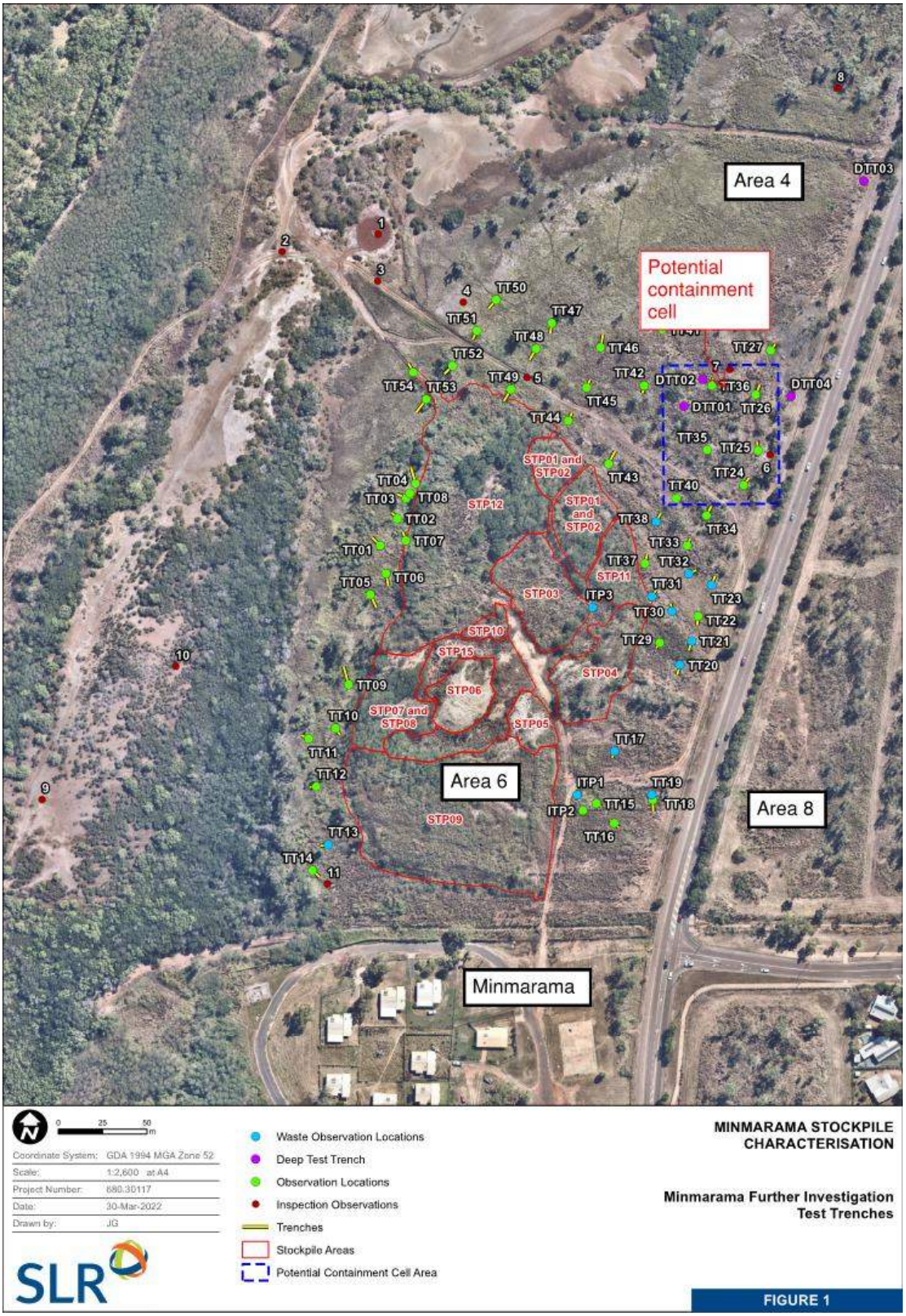

Figure 8.2 – Test Pit Locations and Potential Containment Cell Area *(Source SLR)*

8.4 Area 6

SLR was previously engaged by DIPL to undertake a preliminary site investigation of the stockpiled material at Area 6. SLR advice is reproduced below for information however SLR note the report must be read in full.

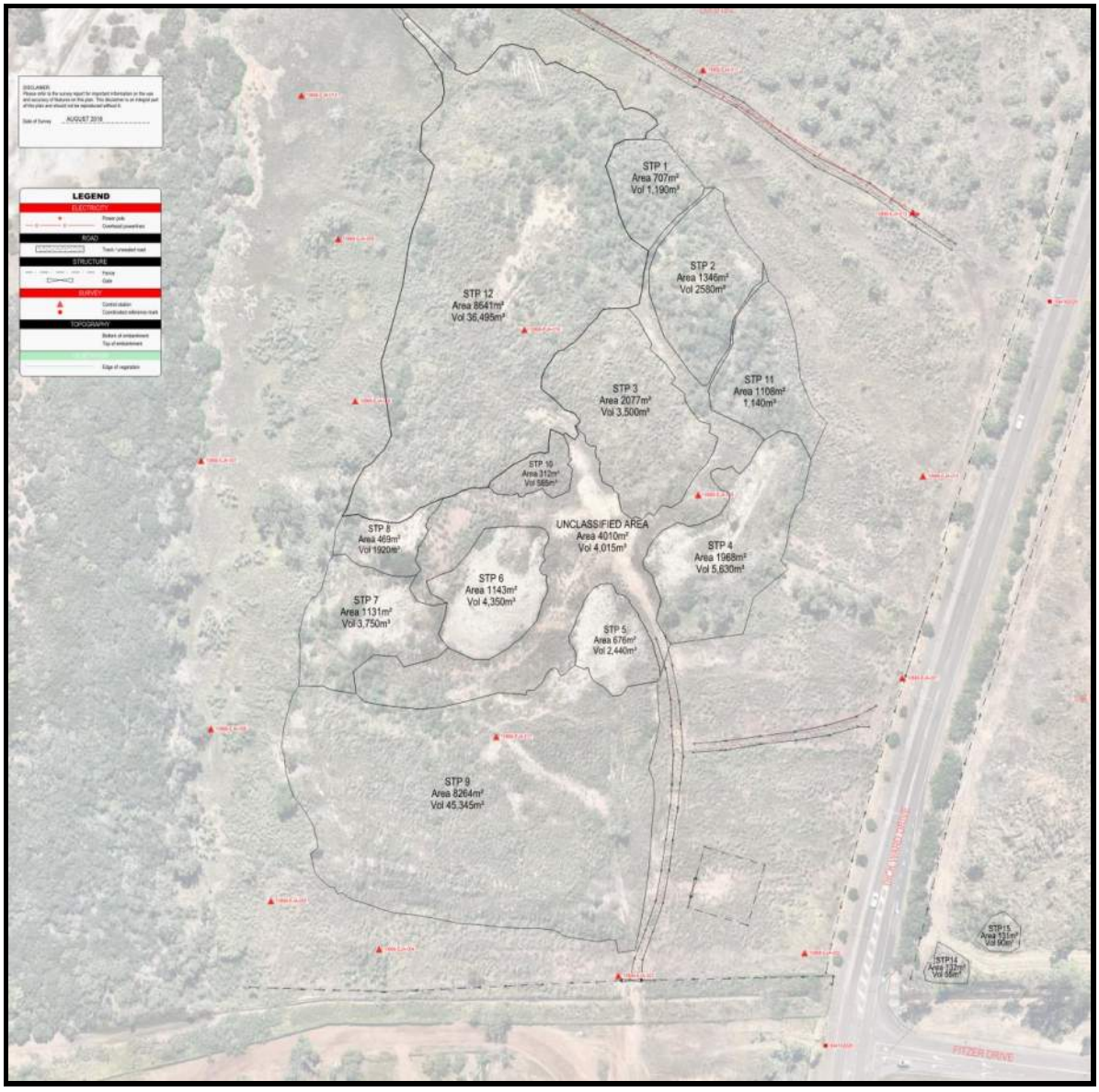

Figure 8.3 – SLR Preliminary Site Investigation Area *(Source SLR)*

Table 8.1 – Preliminary Characterisation of Identified Stockpiles on Site *(Source SLR)*

Stockpile ID	Area (m^2)	Volume (m^3)	Apparent Constituents
STP01	707	1,190	Predominantly soil with some construction and demolition waste throughout.
STP02	1,346	2,580	Soil with construction and demolition waste throughout.
STP03	2,077	3,500	Soil with construction and demolition waste and ACM fragments throughout.
STP04	1,968	5,630	Apparent screened rock and soil with sporadic construction and demolition waste (tiles, bricks, concrete).
STP05	676	2,440	Apparent screened rock with sporadic construction and demolition waste (tiles, bricks, concrete).
STP06	1,143	4,350	Apparent screened rock with sporadic construction and demolition waste (tiles, bricks, concrete).
STP07	1,131	3,750	Apparent screened rock with sporadic construction and demolition waste (tiles, bricks, concrete).
STP08	469	1,920	Predominant red to brown soil stockpile.
STP09	8,264	45,345	Mixture of soil, construction and demolition waste (tiles, bricks, concrete), and rock (not screened).
STP10	312	585	Soil with construction and demolition waste and ACM fragments throughout.
STP11	1,108	1,140	Soil with construction and demolition waste throughout.
STP12	8,641	36,495	Soil and rock mixture with some waste material.
STP13	132	55	Mixture of soil and rock with some construction and demolition waste (tiles, bricks, concrete) and ACM fragments.
STP14	131	90	Mixture of soil and rock with some construction and demolition waste (tiles, bricks, concrete) and ACM fragments.
Unclassified	4,010	4,015	Remaining apparent soil located between identified stockpiles.
TOTAL	**32,115**	**113,085**	-

The result of the SLR preliminary site investigation found:

- *The site was located adjacent to the Minmarama Park community and was used by the local community members to access tidal mangrove areas for fishing and crabbing activities. An application was made in 2014 to have the Site and surrounding area heritage listed, as part of the Kulaluk Lease Area, however this application was refused by the Minister in 2016.*
- *The Site was used by the Commonwealth Government in 1975 to dispose of Cyclone Tracy debris as an emergency response to the cyclone clean-up. Large trenches were excavated through the Site and filled with cyclone debris. It is understood the area was sealed and capped with soil materials and left in an undeveloped state. It is likely that this cyclone clean-up debris contains asbestos material.*
- *Material has been stockpiled across the Site by unconfirmed sources (it has been anecdotally reported to SLR that some material was brought onsite from 130 Esplanade), on top of the capped cyclone clean-up debris. Aerial imagery from the period between 2006 and 2008 show a large portion of the Site was cleared and access tracks re-established during this time. Between 2006 and 2009 large amounts of material were observed to be stockpiled across the site. From 2010 to 2012 aerial imagery shows the movement of the stockpiled materials on site. Equipment observed in the 2011 image is suspected to the screening plant.*
- *Fragments of assumed asbestos containing material have been reported by members of the community, prompting environmental investigation into the site. A limited visual site inspection was conducted by SLR in October 2017 during which apparent ACM was observed at surface across the Site.*
- *Sources of potential contamination identified on site included the disposal of cyclone debris undertaken following Cyclone Tracy, uncharacterised stockpiled material (apparently deposited between 2006-2012), and apparent ACM fragments located on the ground surface at multiple locations on Site.*
- *Any disturbance of the underlying cyclone clean-up debris, assumed to contain asbestos, has the potential to aerially disperse any asbestos from the material and increase the risk of asbestos inhalation by commercial/industrial workers involved in the project and off-site residential and recreational land users. Appropriate controls must be implemented to mitigate the risk of asbestos inhalation associated with future rehabilitation of the site. Note that it was assumed that on-site recreational land users would not have access to the Site during any future rehabilitation works and that any future works would be undertaken following the development of an appropriate work methodology to minimise the generation of dusts and potential contaminants.*
- *Given the uncharacterised nature of the underlying cyclone clean-up debris, dermal contact and ingestion of contaminated media was also considered a risk to future on-site commercial/industrial workers.*
- *Concerning the stockpiled material on Site and its uncharacterised nature, there exists a potential for an unacceptable risk to exist to the aforementioned environmental receptors. Inhalation of contaminants (including asbestos), was considered a potentially complete exposure pathway for on-site commercial/industrial and off-site residential land uses during future rehabilitation works. Dermal contact and ingestion of contaminated media was also considered a risk to future on-site commercial/industrial workers.*

- *Note that in its current undisturbed state, the surficial ACM was considered to be low risk to the current on-and-off-site sensitive environmental receptors.*
- *Should disturbance of the ACM occur, inhalation of asbestos fibres from the identified ACM fragments located at ground surface on Site by nearby environmental receptors will be considered a potentially complete exposure pathway. Disturbance of the ACM (i.e. by mechanical means) has the potential to aerially disperse asbestos fibres allowing for inhalation by environmental receptors including future commercial/industrial and off-site residential land users. The methodology of any future works must include control measures to mitigate the risk of exposure.*

Based on the results of this PSI, SLR recommends the following:

- *Characterisation of the material stockpiles and consideration of characterisation of underlying cyclone clean-up debris be undertaken by a suitably qualified and suitably experienced environmental professional Pending the results of the characterisation assessment, a remediation action plan (RAP) may require development to facilitate the rehabilitation of the Site.*
- *The surficial ACM fragments be removed by a licenced asbestos removal contractor to alleviate the concerns of the Traditional Owners.*

Stockpile material that has been checked and characterised as clean fill could be utilised as fill for other sites such as Area 3, Area 4, Area 8 and / or Area 11.

8.4.1.1 Area 7

WANT was engaged by SLR on behalf of DIPL to undertake some geotechnical assessment of the area west of the Minmarama Park housing.

Figure 8.4 –WANT Geotechnical Investigation Area *(Source WANT)*

WANT noted Area 7 was characterised by a layer of variable fill placed as a capping layer over uncontrolled fill consisting of general rubbish and building rubble.

Based on the materials encountered and the aims of the project, it is expected that there will be significant geotechnical related construction issues around the development, they are likely to include:

Geotechnical Issue	Potential Solution
P Class site and low bearing capacity subsoils	Removal of up to 1.90m of uncontrolled fill Replace with Standard / Select Fill under Level 1 supervision Raft foundations for larger structures Driven pile foundations
Potential inundation	Raise site to a uniform level
Groundwater in excavations	Extensive pumping required Undertake construction during the dry season
Site access / trafficability	Build working platforms for heavy equipment ,i.e., piling rigs Undertake construction during the dry season
Unstable ground in trench excavations	Utilise shoring boxes Undertake construction during the dry season

Table 6: Potential Geotechnical Issues

9 Contaminated Land

EcOz undertook a desk top review of available information relating to contaminated land on the lease areas (Apendix G).

EcOz identified the potential contaminants of concern through a review of the existing documentation for this desktop constraints assessments, including assessment of site history, previous site use and surrounding land use. No site visit was undertaken.

Based on the previous activities at the site and its surrounds, the following list of potential contaminants of concern has been identified:

- Asbestos waste from Cyclone Tracy and other dumped asbestos containing material (ACM)
- Material of fill within the site
- Stockpiling of materials from various sources and unknown composition
- Illegal dumping of household and construction wastes
- Acid sulfate soils (ASS)

To further identify potential contaminants of concern a Sampling and Analysis Quality Plan (SAQP) would be required, which would detail the proposed sampling plan to define the contaminants of concern across the site.

Pathways for the potential contaminants include both direct and indirect methods either through soil, dust, surface water runoff (including sediments), and groundwater migration. Key potential pathways for the site include vertical and lateral migration through the soil into the groundwater, direct surface water runoff via creeks and drains migrating towards Darwin Harbour and the Timor Sea.

Receptors include individuals working and visiting the site, as well as nearby residents. Ecological receptors include biota (flora and fauna) downstream of the site and the Timor Sea. The surrounding soils, surface and groundwater's may be a potential receptor where they are utilised by adjacent the general public.

Initial findings and required future assessments are summarised in Table 9.1.

As noted in Section 7, Areas 4, 6 and 8 have known historical Cyclone Tracy waste dump areas with waste materials including ACM.

Table 9.1 – Contaminated Land Assessment

Proposed Development Area	Proposed New Land Use	Address	Existing Assessments Completed	Required Future Assessments
1	Additional housing	Lot 8630, Coconut Grove and Part of Lot 5182, Ludmilla	Kulaluk ASS Management Plan (EcOz 2016)	• Preliminary Site Investigation • Development of ASSMP
2	Aged care subdivision (partial)	107 Dick Ward Drive, Coconut Grove	Desktop Ecological Assessment – Bakhita Centre (EcOz 2021)	• Preliminary Site Investigation • Development of ASSMP
3	Future commercial	Lot 8630, Coconut Grove and Part of Lot 5182, Ludmilla	Ecological Assessment for Rezoning from Conservation to Light Industrial (VDM Consulting (EcOz), 2011)	• Full contaminated land assessment (as risks include asbestos waste, dumped rubbish and any stockpiling / fill material dumped, however extent is not known • Development of ASSMP
4	Future commercial	213 Dick Ward Drive, Ludmilla	Preliminary Site Investigation – Stockpiled Materials Minmarama Park (SLR, 2019) Memorandum – Minmarama Investigation Trenches (SLR, 2022)	• Further delineation of asbestos piles • Development of Remediation Action Plan (RAP) • Development of ASSMP
5	Restart aquaculture	Block of land – 400m northwest Minmarama Park, Part of Lot 5182, Town of Darwin	-	• Preliminary Site Investigation • Development of ASSMP
6	Commercial development	213 Dick Ward Drive, Ludmilla	Preliminary Site Investigation – Stockpiled Materials Minmarama Park (SLR, 2019) Memorandum – Minmarama Investigation Trenches (SLR, 2022)	• Further delineation of asbestos piles • Development of Remediation Action Plan (RAP) • Development of ASSMP
7	Additional housing	Block of land located to the west of the Minmarama Community (adjacent to Dick Ward Drive in Ludmilla)	WANT Geotechnical Investigation Report on the Minmarama Park Development (WANT Geotechnics, 2022)	• Full contaminated land assessment (as risks include asbestos waste, dumped rubbish and any stockpiling / fill material dumped, however extent is not known • Development of ASSMP

Proposed Development Area	Proposed New Land Use	Address	Existing Assessments Completed	Required Future Assessments
8	Commercial development	Area A, Part of Lot 5182, Town of Darwin	Ecological Assessment for Master Planning of Area A, Part of Lot 5182, Town of Darwin (VDM Consulting (EcOz), 2011)	• Full contaminated land assessment (as risks include asbestos waste, dumped rubbish and any stockpiling / fill material dumped, however extent is not known • Development of ASSMP
9	Future commercial	Area B, Part of Lot 5182, Town of Darwin	Ecological Assessment for Master Planning of Area B, Part of Lot 5182, Town of Darwin (VDM Consulting (EcOz), 2011)	• Full contaminated land assessment (as risks include asbestos waste, dumped rubbish and any stockpiling / fill material dumped, however extent is not known • Development of ASSMP
10	Open space	Central precinct, between Bagot Road and Dick Ward Drive, Part of Lot 5182, Town of Darwin	Ecological Assessment Bagot Road Central Precinct, Part of Lot 5182, Town of Darwin (VDM Consulting (EcOz), 2011)	• Full contaminated land assessment (as risks include asbestos waste, dumped rubbish and any stockpiling / fill material dumped, however extent is not known • Development of ASSMP
11	Future housing	Part of Lot 5182, Town of Darwin	Nermarluk and Dickward Drive Land Suitability Assessment (EcOz, 2014)	• Full contaminated land assessment (as risks include asbestos waste, dumped rubbish and any stockpiling / fill material dumped, however extent is not known • Development of ASSMP

10 Environmental

10.1 Overview

EcOz undertook a desk top review of available information relating to an environmental assessment to evaluate the ecological, environmental, and other constraints to development for the lease areas (Appendix H).

The assessment was undertaken in accordance with requirements of the following Northern Territory Government documents:

- *NT Planning Scheme 2020*
- *NT Land Suitability Guidelines 2020*
- *NT Land Clearing Guidelines 2021.*

EcOz noted that:

> *The study area sits within the Darwin Harbour Site of Conservation Significance (SOCS) that is of international significance. Darwin Harbour was listed as a SOCS due to supporting a range of estuarine, freshwater and terrestrial environments including, extensive areas of tidal mudflats and one of the largest and most diverse areas of mangroves in the Northern Territory (Pavey et al. 2009) – some of these values are present within the study area.*

A summary and recommendations of the EcOz assessment are provided in the EcOz Report (Appendix H) and are reproduced below:

10.2 Summary

A summary of the key constraints (ecological, land suitability and other) within the survey area based on the desktop assessment is provided below. These are:

10.2.1 Ecological

- A high likelihood of occurrence of ten threatened or migratory species; a medium likelihood of occurrence of nine threatened or migratory species, based on previous records and the presence of certain habitat types within the study area.
- Presence of three sensitive and/or significant vegetation types (monsoon rainforest, mangroves, and the potential for large hollow-bearing trees) and groundwater-dependant ecosystems (low and moderate potential). The Land Clearing Guidelines recommend that significant sensitive vegetation types be excluded from clearing footprints and that appropriate buffers (varying width depending on assessment of vegetation quality) be implemented to protect them.

10.2.2 Land Suitability

- Drainage was the most significant constraint to land suitability, due to the dominance of waterlogged soils (Hydrosols) throughout the study area. The more easterly proposed development areas of 8-10, situated on higher ground, were the least constrained areas due to drainage.
- The two most constrained proposed developments were Restart Aquaculture (5) and the southern portion of Future Housing (11), due to a combination of drainage, storm surge, acid sulphate soils

and salinity constraints. These constraints may not present major obstacles to the Restart Aquaculture (5) project due to the needs of this development.

- Storm surge (primary and secondary) is a major constraint to five of the proposed developments (1, 4, 5, 7, 11); however, NT Government mapping suggests it has the potential to affect all land within the study area. The two areas least constrained by storm surge are Commercial Development (8) and Future Commercial (9).
- Acid sulfate soils were found to be a potential risk for all areas as they are located close to coastal floodplains. Desktop surveys found that four proposed developments (4, 5, 7, and 11) are considered to be the highest risk.

10.2.3 Other Constraints

- Sacred or significant sites were found to be a constraint to three proposed developments (1, 9, and 11).
- Planning Zones – Several proposed developments (2, 4, 5, and 6) are located on land zoned as Conservation (CN). Another proposed development (1) is located party on land zoned Public Space (PS). Both CN and PS zones explicitly protect ecological values and may be a constraint to development. The Darwin Mid Suburbs Area Plan supports re-zoning of the land containing the proposed developments 1, 2, 3 and 6 in future.
- Planning overlays – The study area is subject to the Clearing of Native Vegetation (CNV) overlay that identifies areas with limits to native vegetation clearance and that clearing in these areas does not impact on conservation values in land zoned as Conservation (CN) or unreasonably contribute to environmental degradation. Consent will be required to clear more than one hectare. The CNV overlay covering the study area requires the avoidance of significant sensitive vegetation types.

10.3 Recommendations

EcOz has made the following recommendations based on the findings of the desktop assessment and are summarised according to proposed development area in Table 10.1.

- Undertake a field assessment to:
  - Ground truth land unit mapping
  - Assess habitat quality including impacts from threatening processes such as fire, weeds, and historic disturbance.
  - Determine the extent and habitat quality of significant sensitive vegetation types (i.e. monsoon rainforest and mangroves) within the study area
  - Determine the requirements for targeted surveys for the following threatened species: Atlas Moth (including food plants and other monsoon rainforest flora species), Black-footed Tree-rat, Northern Brushtail Possum, Pale Field-rat, Yellow-spotted Monitor and Mitchell's Water Monitor.
  - Undertake a comprehensive assessment of potential significance of survey area for shorebirds.
  - Re-apply for AAPA Authority Certificates for any proposed development areas as all previous Certificates have expired.
- Liaise with the Department of Environment, Parks and Water Security (DEPWS) regarding the presence of significant and sensitive vegetation types, the proposed clearance of native vegetation associated with the development and the expectations for provision of protective buffers.

- Liaise with a planner within the Development Assessment Services regarding the need and application process for a planning scheme amendment (land subject to CN zone).
- Address other environmental considerations outlined in the Land Clearing Guidelines (e.g. acid sulfate soil testing and engineering studies for drainage and flooding mitigation).

Table 10.1 – Summary of Actions

Proposed Development Area	Proposed New Land Use	Address	Existing Assessments Completed	Required Future Assessments
1	Additional housing	Lot 8630, Coconut Grove and Part of Lot 5182, Ludmilla	Kulaluk ASS Management Plan (EcOz 2016)	• Engineering studies to address drainage and flood mitigation. • Undertake field investigation to verify land unites, assess habitat and conduct targeted threatened and migratory species surveys. • Development of ASSMP. • AAPA Authority Certificate.
2	Aged care subdivision (partial)	107 Dick Ward Drive, Coconut Grove	Desktop Ecological Assessment – Bakhita Centre (EcOz 2021)	• Engineering studies to address drainage and flood mitigation. • Undertake field investigation to verify land unites, assess habitat and conduct targeted threatened and migratory species surveys. • Development of ASSMP. • AAPA Authority Certificate.
3	Future commercial	Lot 8630, Coconut Grove and Part of Lot 5182, Ludmilla	Ecological Assessment for Rezoning from Conservation to Light Industrial (VDM Consulting (EcOz), 2011)	• Engineering studies to address drainage and flood mitigation. • Undertake field investigation to verify land unites, assess habitat and conduct targeted threatened and migratory species surveys. • Development of ASSMP. • AAPA Authority Certificate.
4	Future commercial	Block of land on western side of Dick Ward Drive at northern portion lot 5182, 213 Dick Ward Drive, Ludmilla	Preliminary Site Investigation – Stockpiled Materials Minmarama Park (SLR, 2019) Memorandum – Minmarama Investigation Trenches (SLR, 2022)	• Engineering studies to address drainage and flood mitigation. • Undertake field investigation to verify land unites, assess habitat and conduct targeted threatened and migratory species surveys.

Proposed Development Area	Proposed New Land Use	Address	Existing Assessments Completed	Required Future Assessments
				• Development of ASSMP. • AAPA Authority Certificate.
5	Restart aquaculture	Block of land – 400m northwest Minmarama Park, Part of Lot 5182, Town of Darwin	-	• Engineering studies to address drainage and flood mitigation. • Undertake field investigation to verify land unites, assess habitat and conduct targeted threatened and migratory species surveys. • Development of ASSMP. • AAPA Authority Certificate.
6	Commercial development	Block of land to the north of Minamarama Park, 213 Dick Ward Drive, Ludmilla	Preliminary Site Investigation – Stockpiled Materials Minmarama Park (SLR, 2019)	• Engineering studies to address drainage and flood mitigation. • Undertake field investigation to verify land unites, assess habitat and conduct targeted threatened and migratory species surveys. • Development of ASSMP. • AAPA Authority Certificate.
7	Additional housing	Block of land located to the west of the Minmarama Community (adjacent to Dick Ward Drive in Ludmilla)	WANT Geotechnical Investigation Report on the Minmarama Park Development (WANT Geotechnics, 2022)	• Engineering studies to address drainage and flood mitigation. • Undertake targeted threatened species surveys. • Development of ASSMP. • AAPA Authority Certificate.
8	Commercial development	Area A, adjacent to Fitzer Drive, Bagot Road and Dick Ward Drive, part of Lot 5182, Town of Darwin	Ecological Assessment for Master Planning of Area A, Part of Lot 5182, Town of Darwin (VDM Consulting (EcOz), 2011)	• Engineering studies to address drainage and flood mitigation. • Undertake field investigation to verify land unites, assess habitat and conduct targeted threatened and migratory species surveys. • Development of ASSMP.

Proposed Development Area	Proposed New Land Use	Address	Existing Assessments Completed	Required Future Assessments
				• AAPA Authority Certificate.
9	Future commercial	Area B, adjacent to Totem Road, Bagot Road and Dick Ward Drive, part of Lot 5182, Town of Darwin	Ecological Assessment for Master Planning of Area A, Part of Lot 5182, Town of Darwin (VDM Consulting (EcOz), 2011)	• Engineering studies to address drainage and flood mitigation. • Undertake field investigation to verify land unites, assess habitat and conduct targeted threatened and migratory species surveys. • Development of ASSMP. • AAPA Authority Certificate.
10	Open space	Central precinct, between Bagot Road and Dick Ward Drive, Part of Lot 5182, Town of Darwin	Ecological Assessment for Master Planning of Area A, Part of Lot 5182, Town of Darwin (VDM Consulting (EcOz), 2011)	• Engineering studies to address drainage and flood mitigation. • Undertake field investigation to verify land unites, assess habitat and conduct targeted threatened and migratory species surveys. • Development of ASSMP. • AAPA Authority Certificate.
11	Future housing	Part of Lot 5182, Town of Darwin	Nermarluk and Dickward Drive Land Suitability Assessment	• Engineering studies to address drainage and flood mitigation. • Undertake field investigation to verify land unites, assess habitat and conduct targeted threatened and migratory species surveys. • Development of site assessment to determine presence of ASS. • AAPA Authority Certificate.

11 Biting Insects

A medical entomology technical report published in 2009 by the Department of Health (Warcot and Whelan) noted:

> *The upper tidal reaches of the various arms of Ludmilla Creek in Darwin have been historical breeding sites for pest and disease carrying mosquitoes. Most of the historical mosquito breeding in the Ludmilla Creek catchment was a direct result of urban development and associated stormwater discharge. The major mosquito breeding sites associated with Ludmilla Creek were targeted in 1984 under the combined Northern Territory Government and Darwin City Council mosquito engineering program. Mosquito breeding areas were identified by Medical Entomology (ME), with construction supervised by Darwin City Council (DCC). This included constructing drains in the Coconut Grove, Fannie Bay and East Point areas of Ludmilla Creek from suburban areas to the central section of the creek. The construction of the drains removed the dry season ponding and associated mosquito breeding, although the northern salt marsh mosquito Aedes vigilax does still breed in some tidally affected drains and the Kulaluk rice field during the late dry season/early wet season.*
>
> *Based on the literature review, Entomology Branch of the Department of Health and the City of Darwin continue to undertake surveys of the lease areas with a Kulaluk Lease routine larval mosquito control survey undertaken in the 2020/21 season.*

Summary information from the program noted:

> *The most important mosquitoes in the Kulaluk Lease are the common banded mosquito Culex annulirostris, and the northern salt march mosquito Aedes vigilax. Previously before the drainage and filling of sandmining pits in the 1980's, potential vectors of malaris (Anopheles mosquitoes) were also prevalent in the Kulaluk Lease, along with pest mosquitoes Coquillettidia xanthagaster. The three western crab ponds remain the only potentially significant breeding site for Anopheles mosquitoes in the Kulaluk Lease.*
>
> *Culex annulirostris is the main potential vector of mosquito borne disease in the NT. It is capable of transmitting the potentially fatel Murray Valley encephalitis virus, along with other mosquito borne diseases such as Kunjin virus, Ross River virus and Barmah Forest virus. It only bites at night. The peak breeding season in the Kulaluk Lease is usually the wet season, although dry season breeding can occur in drains with dry season flows, and if the Minmarama effluent plant overflows into the nearby drain. Seasonal populations in the lease are generally low to moderate due to drainage and insecticide control.*
>
> *Aedes vigilax is the main pest mosquito in the Kulaluk Lease, due to numerous tidal and rain filled breeding sites, its long flight range and thus dispersal into the lease from distant swamps, and its aggressive day biting habits. It is also capable of transmitting Ross River virus and Barmah Forest virus. Breeding can occur all year in the Kulaluk Lease, with October to February / March the peak months. Populations are usually lower to moderate, although occasional high pest problems may occur ager very large breeding events.*
>
> *It is likely to be seen in the results that there are more areas treated with insecticide than was found breeding mosquitoes. This is due to known breeding sites being pre-treated with residual insecticide*

(prolink pellets) before the tide or rain event causes mosquito breeding. Pre-treatment of known mosquito breeding areas allows more time to look for new / emerging breeding sites.

Biting insects pose a risk to residents, workers and users of the potential development areas. It is suggested that a biting insects mitigation plan be developed in conjunction with Entomology Branch as part of any development proposal. Mitigation may include items such as screening buildings, ensuring good drainage and chemical control.

12 Flooding and Storm Surge

12.1 Overview

WRM Water and Environment Pty Ltd (WRM) was engaged to undertake a high level stormwater assessment of the proposed development in the Kulaluk and Minmarama Park areas. The WRM report presents the methodology and findings of the high-level stormwater assessment across the eleven development areas, as well as a high-level post-development conditions stormwater management plan.

It is noted that a number of drains exist within the lease areas. Drains from Bagot Road are located in easements contiguous with the Bagot Road, road reserve. These drains do not have a continuous route to the Darwin Harbour and discharge stormwater to Lot 5182. Similarly, a number of drains have been constructed across the lease areas and discharge stormwater water from Dick Ward Drive and upstream catchments towards Darwin Harbour.

12.2 Storm Surge

The Kulaluk and Minmamara Park areas (and surrounding areas) are subject to the expected 100 year primary storm surge and in some areas the secondary storm surge as shown in Figure 12.1 extract of the NTG Darwin area storm surge map.

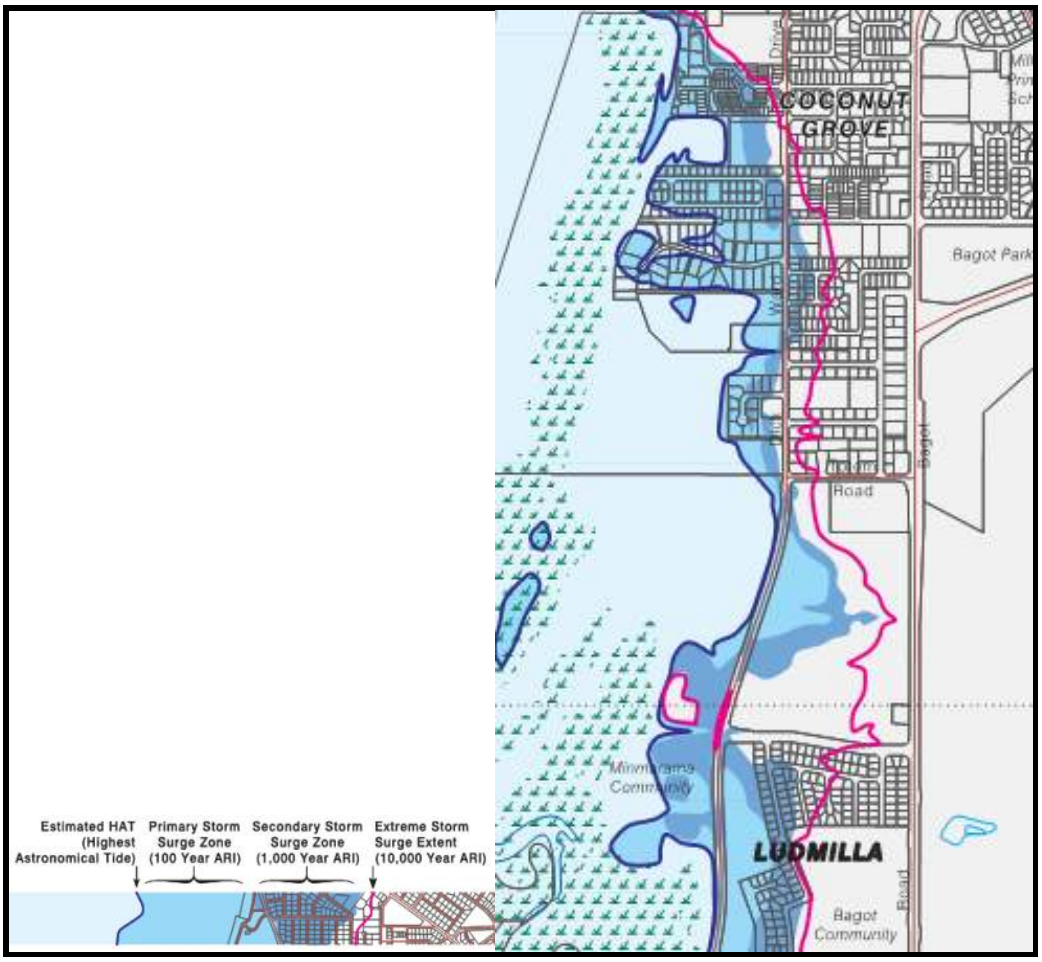

Figure 12.1 – Darwin Area Storm Surge

12.3 Stormwater Drainage

WRM determined that:

> *The study area covers the area between Parap and Fannie Bay to the south, and Coconut Grove and Nightcliff to the north. The study area is generally located in low-lying undeveloped areas between Bagot Road and the coastline. Runoff from the Darwin International airport drains towards the study area via a number of cross-road culverts along Bagot Road and Dick Ward Drive.*
>
> *There are a number of culverts and open drains in the study area including:*
>
> - *Sixteen (16) cross drainage culverts under Dick Ward Drive and eleven (11) cross drainage culverts under Bagot Road, between Old McMillans Road and the Stuart highway*
> - *The Kulaluk and Orchard Road drains, which are located at the northern end of the study area and receive inflows from south of Progress Drive and west of Sabine Road. The Kulaluk and Orchard Road drains discharge directly to the Beagle Gulf.*
> - *Several other drains including Nemarluk Drive drains, Watts Street drain, Richardson Drive drains, Kurringal Court drain, Waratah Crescent and George Crescent drain, which drain to the Beagle Gulf via Ludmilla Creek.*
>
> *The total catchment area draining to the study area is approximately 1,290 ha. The study area topography is generally flat and low-lying, with a significant proportion of the study area below the 2100 1% AEP storm surge level of 5.4 mAHD (including the Kulaluk and Minmarama Parkland camps) SEA (2010).*
>
> *Four (4) regional detention basins/water quality devices have been identified in the catchment to the east of Bagot Road. … The drainage plans show:*
>
> - *Catchment areas draining to the site*
> - *Overland flow paths*
> - *Existing trunk drainage infrastructure, including:*
>   - *open drains*
>   - *cross-road culverts*
>   - *stormwater detention basins*
>   - *stormwater quality devices*

Figure 12.2 – Existing Drainage Catchments – North

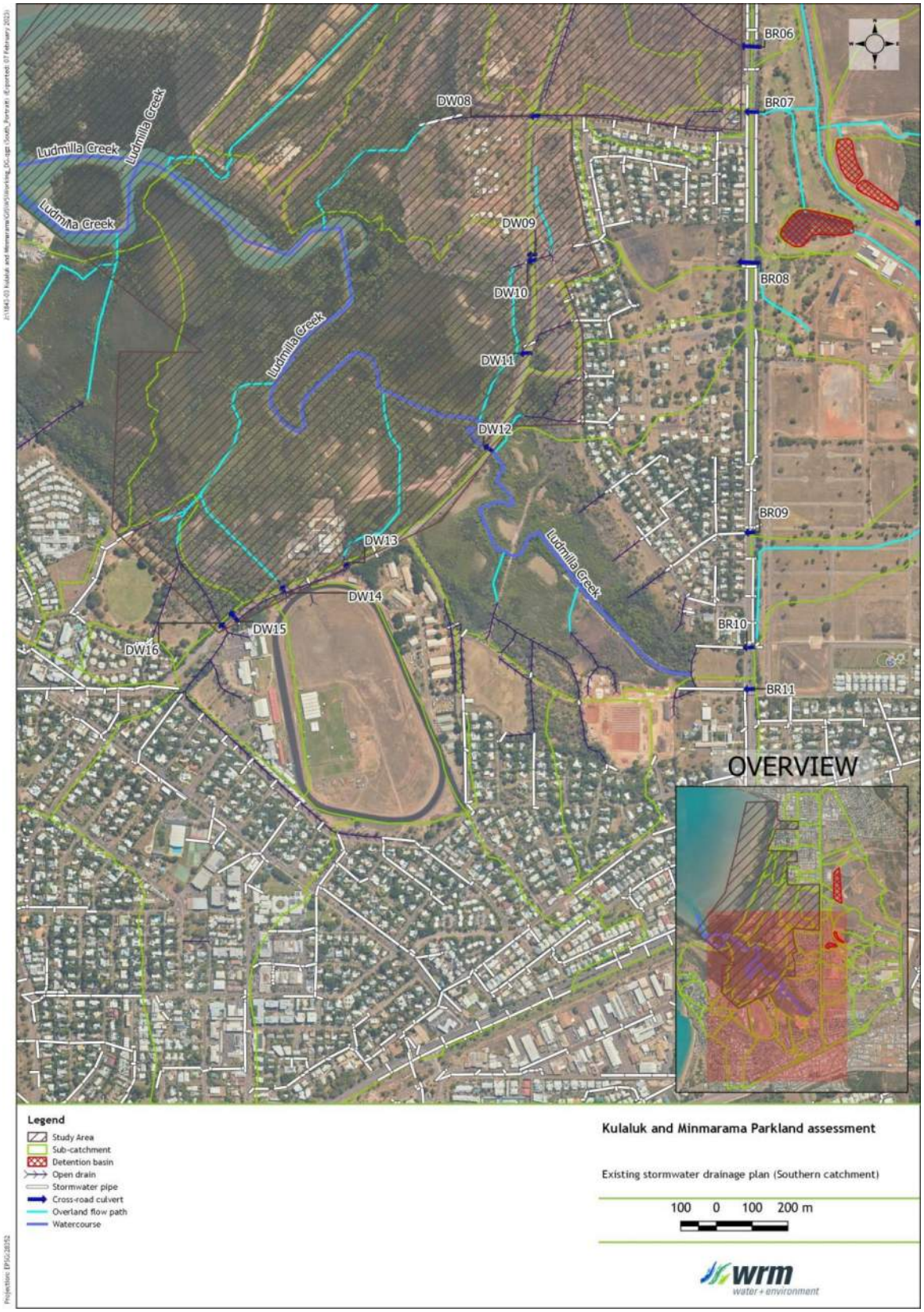

Figure 12.3 – Existing Drainage Catchments – South

12.4 Stormwater Modelling

WRM utilised the XP-RAFTS rainfall-runoff routing software package to estimate the design discharge hydrographs for events from 50% AEP to 1% AEP, in accordance with ARR 2019 guidelines (Ball et al, 2019).

WRM validated the XP-RAFTS model by comparing the estimate of peak design discharge, to an estimate derived using an alternative methodology. For this study, the Rational Method was adopted as the alternative methodology for estimation of peak discharges and the XP-RAFTS model was validated at drainage model Node KM_28. The validation results showed a good agreement between the two estimates (within 2%) and the XP-RAFTS parameters are considered appropriate and were adopted for the study.

12.5 Future Drainage Infrastructure Requirements

Based on the available topographic data, existing stormwater management structures and previous design work provided, indicative stormwater management structures (drains and detention basin) for future development have been proposed by WRM.

These proposed drainage structures:

- Maintain existing flow paths as far as possible.
- Connect existing crossroad drainage infrastructure where possible.
- Maintain existing downstream discharge points.

Indicative infrastructure sizing was based on estimated 1% AEP peak design discharge estimates from XP-RAFTS, and the results of capacity analysis of key existing structures. The proposed stormwater drainage network is shown in Figure 12.4 and Figure 12.5. Refer to WRM Report (Appendix I) for further detail.

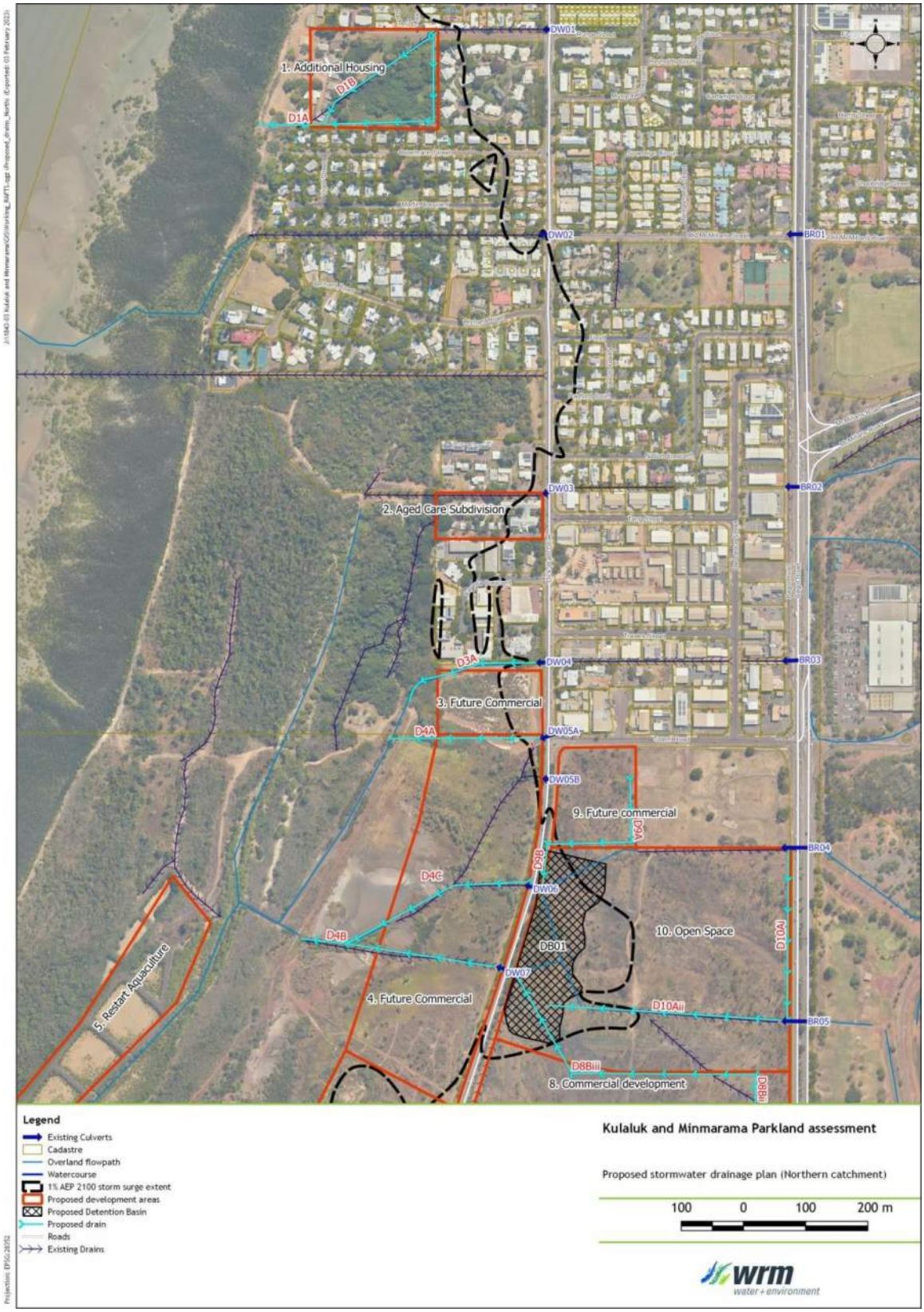

Figure 12.4 – Proposed Stormwater Drainage

Figure 12.5 – Proposed Stormwater Drainage

12.6 Flood and Drainage Study Summary

Key findings from the WRM assessment are:

- All the proposed development areas are affected by predicted year 2100, 1% AEP storm surge. This results in substantial fill requirements, with some sites requiring filling of the entire proposed development area in order to achieve the required immunity.
    - The predicted year 2100, 1% AEP storm surge level is 5.4 m AHD
    - Based on an assumed freeboard of 0.5 m, the required indicative minimum fill level to protect against storm surge inundation at the site is 5.9m AHD
- The proposed drains in development area 1 are based on previous WRM (2022) and PF (2019) assessments. These reports were preliminary concept design studies, and it is recommended that these be updated before commencement of design work.
- Development area 2 is already constructed, it is not known whether the required immunity has been achieved.
- Very flat existing site topography makes it difficult to achieve minimum slope requirements for proposed drains D4C, D8Ai, D8Aii, D8Biii, D11C and D11Di. The proposed design and alignment of these drains should be reviewed during the design phase, in order to achieve acceptable drain design solutions.
- Other design guidelines which have not been fully assessed here (e.g., maximum flow depth limits, maximum velocity and maximum depth x velocity product limits) may apply to the design of the proposed drains, and should be considered in detail during the design phase.

13 Roads and Traffic

13.1 Overview

Arccos Consulting was engaged to review potential future traffic movements and impacts on the road network from the potential 11 development sites. The assessment was undertaken at a high level, considering the potential individual and combined impacts of the projects on the road network. The Arccos Report is at Appendix J.

Previous reporting for some sites within the study have been considered as part of this assessment.

It is intended that more detailed assessments would be undertaken for the individual sites as the developments are progressed.

13.2 Site Location and Study Area

The study area includes the arterial road network (primarily Dick Ward Drive and Bagot Road), as well as sub-arterial roads (Fitzer Drive, Totem Road, Nemarluk Drive, Old McMillans Road) and the proposed new road networks and connections.

The area currently includes a mixture of residential, environmental, industrial and commercial uses. A similar mix of uses is proposed to be maintained.

The area falls within the Darwin Mid Suburbs Area Plan.

13.3 Previous Traffic Analysis

The Citiland development (Areas 8, 9 and 10) were previously the subject of a Traffic Impact Assessment (TIA). The TIA recommended:

- *The internal road network of the northern precinct will consist of a new east-west road link extending between Bagot Road and Dick Ward Drive and connections to Fitzer Drive. The proposed new intersections with Dick Ward Drive and Bagot Road will be signalised with dedicated turning lanes provided in each approach.*
- *The existing median break at the Bagot Road / Fitzer Drive intersection will be closed, restricting the intersection to left-in / left-out only from Fitzer Drive. This will require all right turning traffic related to the service station, McDonald's restaurant and neighbouring residential development to divert to the proposed new signal controlled intersection on Bagot Road. An internal connection will be provided to the service station and McDonald's restaurant from the subject site to allow traffic to access the new Bagot Road intersection via the proposed internal road network. This is considered to be acceptable given the relatively short distance to the proposed new intersection.*

13.4 DMSAP Road Network Upgrades

The DMSAP identifies potential upgrades to the existing road network to facilitate the identified growth within the area including:

- Upgrade of Dick Ward Drive between Hazell Court and Progress Drive
- New connection between Bagot Road and Dick Ward Drive (Area 8)

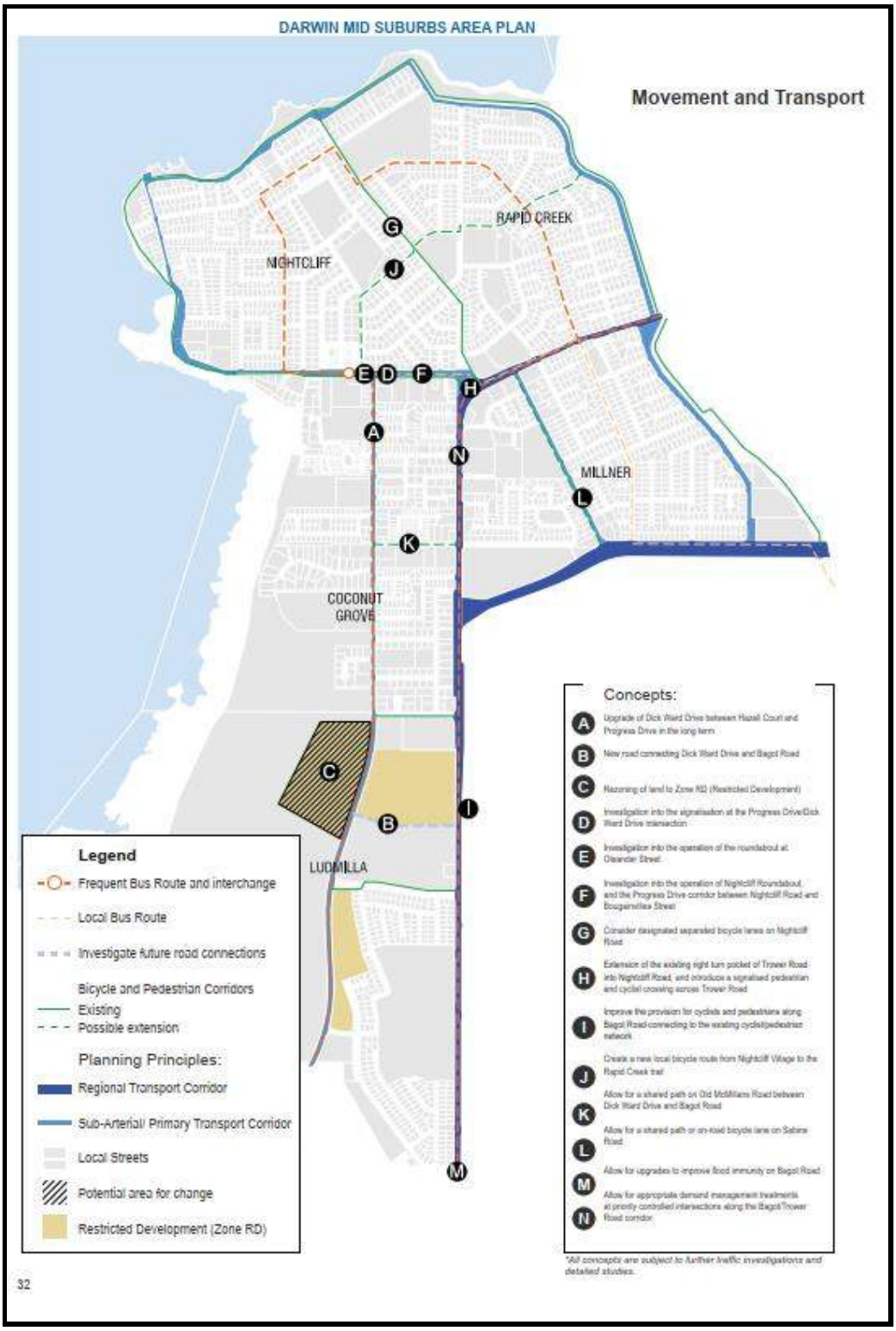

Figure 13.1 – DMSAP Proposed Road Development

DIPL has advised that the upgrade of Dick Ward Drive is a proposal to duplicate DWD to create a dual carriageway. The current road reserve is 30 m and this project has assumed the road reserve will be widened to 40 m to accommodate a typical NT road cross section for a primary arterial road as shown in Figure 13.2.

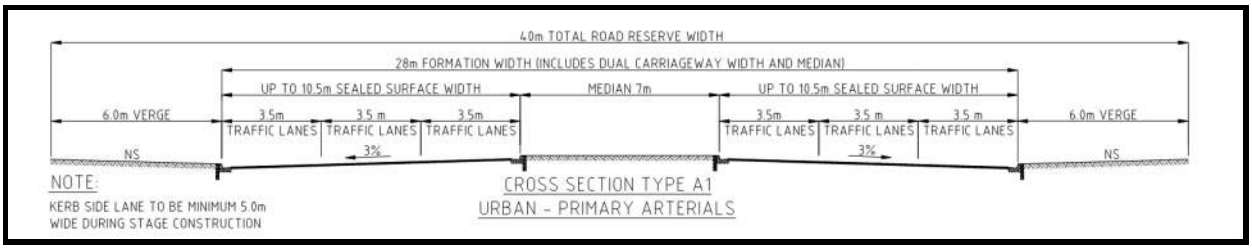

Figure 13.2 – Standard NT Road cross section – Urban Primary Arterial Road

13.5 Arccos Recommendations

13.5.1.1 Site Access

It is recommended that site access for Area 1 is widened to provide two way access, or that formal passing opportunities are provided.

It is recommended that access to the Area 4 and Area 6 and Minmarama Park on the western side of Dick Ward Drive is consolidated with an internal road network. Any new direct access to Dick Ward Drive should be limited to left in/left out configurations, or to a signalised intersection to the new link road connecting through to Bagot Road.

13.5.1.2 Roadway Improvements

The identified improvements are primarily associated with access.

The new link road will cater for significant traffic volumes and the design of this road should minimise direct property connections in favour of an internal road network.

The existing Minmarama Park access is wide and the width caters for adjacent bus stops (which generate pedestrian crossing demand). It is recommended that this existing junction is upgraded in the short term to provide a channelised right turn lane and raised median islands (to allow for staged pedestrian crossing movements at the junction. When Dick Ward Drive is duplicated, safety will be improved if access to Minmarama is via the signalised intersection rather than allowing an all movements T intersection.

13.5.1.3 Phasing

The internal road network on Area 8 (or at a minimum the main link road and traffic signals) would be best provided prior to the development of Areas 3, 4, 6 and 7. This will facilitate the safe access at Bagot Road and Dick Ward drive and will allow for the development of a road network to the west of Dick Ward Drive.

13.5.1.4 Transit, Pedestrians and Bicycles

New bus routes could be considered to provide access to the proposed commercial and residential areas.

13.5.1.5 Further Studies

It is recommended that further assessment and analysis is undertaken including:

- Review existing traffic volumes including through traffic on minor link roads and turn counts
- Assessment of junction capacities (ie intersection modelling), at a minimum this should consider
    - Dick Ward Drive / Totem Road

- Dick Ward Drive / New Road
- Dick Ward Drive / Fitzer Drive
- Dick Ward Drive / Nadpur Street
- Bagot Road / Totem Road
- Bagot Road / New Road
- Bagot Road / Fitzer Drive
- Bagot Road / Nemarluk Drive

- Review of crash data throughout the area.
- Review of other likely development, including timings, to identify future traffic within the area.

14 Utility Constraints

14.1 Water

14.1.1 Water Demand

Water demand for each proposed development area was calculated based on Power and Water Corporation (PWC) Planning Guides. The increase in peak hour demand for water is shown in Table 14.1. PWC requirements for fire flow is 2/3 peak hour demand plus the fire flow requirements which for commercial areas is 45 L/s. Where fire flows may not be available it is possible to develop engineered alternate fire fighting systems such as on-site tanks for water storage. Alternate systems are beyond the scope of this project and have not been considered.

Table 14.1 – Water - Increase in Peak Hour Demand

Area	Lot	Proposed Development	Peak Hour Demand Increase (L/s)
1	8630	Additional housing	3.8
2	8630	Retain existing	0.0
3	8630	Commercial	1.9
4	5182	Commercial	7.5
5	5182	Aquaculture (restart)	6.1
6	5182	Commercial	4.1
7	5182	Additional housing (camping)	0.6
8	5182	Commercial	14.3
9	5182	Commercial	1.6
10	5182	Open space	21.1
11	5182	Additional housing	10.8

Table 14.2 – Water - Increase in Maximum Demand including Fire Flow

Area	Lot	Proposed Development	Increased Max Demand (L/s)
1	8630	Additional housing	3
2	8630	Retain existing	0
3	8630	Commercial	46
4	5182	Commercial	50
5	5182	Aquaculture (restart)	49
6	5182	Commercial	48
7	5182	Additional housing	0
8	5182	Commercial	55
9	5182	Commercial	46
10	5182	Open space	39
11	5182	Additional housing	32

14.1.2 Water Constraints

PWC advised (16 March 2023):

- *The main development area is between the two pressure zones (Casuarina / Marrara zone is from Totem Rd towards the north; Stuart Park zone is from Fitzer Drive towards the south).*
- *The expected pressures for north area (connecting into Totem Rd) is between 320 and 360 kPa and for the south network (Fitzer Drv) between 400 and 430 kPa. Please note these pressures are subject to change due to network operational changes and growth of area.*
- *Upgrades may be required for existing DN150 water mains in Totem Road and Fitzer drive based on (current size constrains fire flow requirements)*
- *It is expected minimum size DN225 water mains to be extended into the area.*
- *Zone boundaries may change and normally closed valves are to be advised as detailed design progresses.*
- *Reticulation design to cater for greater of peak day demand or fire flow demand at 2/3 peak day. Specific water reticulation upgrades for existing water mains to be determined in detailed design.*

Significant water distribution upgrades and reticulation will be required to deliver adequate flows and pressures to the proposed developments.

14.2 Sewer

14.2.1 Sewer Load

Sewer loads for each proposed development area were calculated based on PWC Planning Guides.

Sewer loads are typically calculated based on equivalent persons (EP). The existing, additional and total EP for each Area is shown in Table 14.3.

Table 14.3 – Sewer – EP Loads

Area	Lot	Proposed Development	Existing (EP)	Additional (EP)	Total (EP)
1	8630	Additional housing	135	99	234
2	8630	Retain existing	52	0	52
3	8630	Commercial	0	81	81
4	5182	Commercial	0	326	326
5	5182	Aquaculture (restart)	0	0	0
6	5182	Commercial	0	179	179
7	5182	Additional housing	216	32	248
8	5182	Commercial	0	546	546
9	5182	Commercial	0	74	74
10	5182	Open space	0	10	10
11	5182	Additional housing	0	291	291

14.2.2 Sewer Constraints

PWC advised (16 March 2023):

- *There is no capacity available in the DN225/150 sewer reticulation line in Dick Ward Drive (north).*
- *The existing Ludmilla SPS at full capacity and cannot accept any more load.*
- *The prefer sewer servicing strategy is to maximise gravity system for the new catchment and minimise number of pump station at no more than 6m deep. Desktop study suggest to have a pump station within Area 8. The new pump station is to discharge to Ludmilla Treatment Plant.*
- *Alignment of new sewer rising mains and location of pumps stations are to be in unconstrained land (e.g. road reserves, non-flooding areas).*
- *PWC would consider diverting existing catchments to the new catchment / SPS to decommission old constrained assets (e.g. remove Ludmilla SPS and divert old catchment to new SPS).*
- *There is an existing gravity trunk main through Lot 5646 that is within flooding area and is constraining drainage. NTG is exploring options to remove the sewer trunk to improve overall stormwater drainage in the area. It is preferred to not add any more load to this catchment.*
- *Land tenure for new pump stations to be secured. Consider development constraints with buffer zones around SPS based on its pumping rate.*

Significant sewer upgrades and a new gravity sewer will be required to deliver adequate capacity to the proposed developments.

14.3 Electrical

14.3.1 Electrical Demand

Electrical demand for each proposed development area was calculated based on PWC Planning Guides.

A planning load of 10 kVA was allowed for each additional house while commercial area electrical planning loads were determined based on 70% of gross area @ 90 VA/m^2. It has been assumed that Area 7 camping electrical demand would most likely be minimal and has not been considered further. The existing, additional and total load for each Area is shown in Table 14.4.

Table 14.4 – Electrical Loads

Area	Lot	Proposed Development	Existing Load kVA	Additional Load kVA	Total Load kVA
1	8630	Additional housing	173	110	283
2	8630	Retain existing	0	813	813
3	8630	Commercial	0	1449	1449
4	5182	Commercial	0	5859	5859
5	5182	Aquaculture (restart)	0	1953	1953
6	5182	Commercial	0	3213	3213
7	5182	Additional housing / camp	240	0	240
8	5182	Commercial	0	11151	11151
9	5182	Commercial	0	1260	1260
10	5182	Open space	0	40	40
11	5182	Additional housing	0	810	810

Electrical demand and indicative timings are shown in Figure 14.1 and Attachment 5.

14.3.2 Electrical Constraints

PWC advised that electrical constraints include:

- Limited capacity in the existing distribution networks.
- Available capacity is on a first come basis and capacity is not guaranteed to be available.

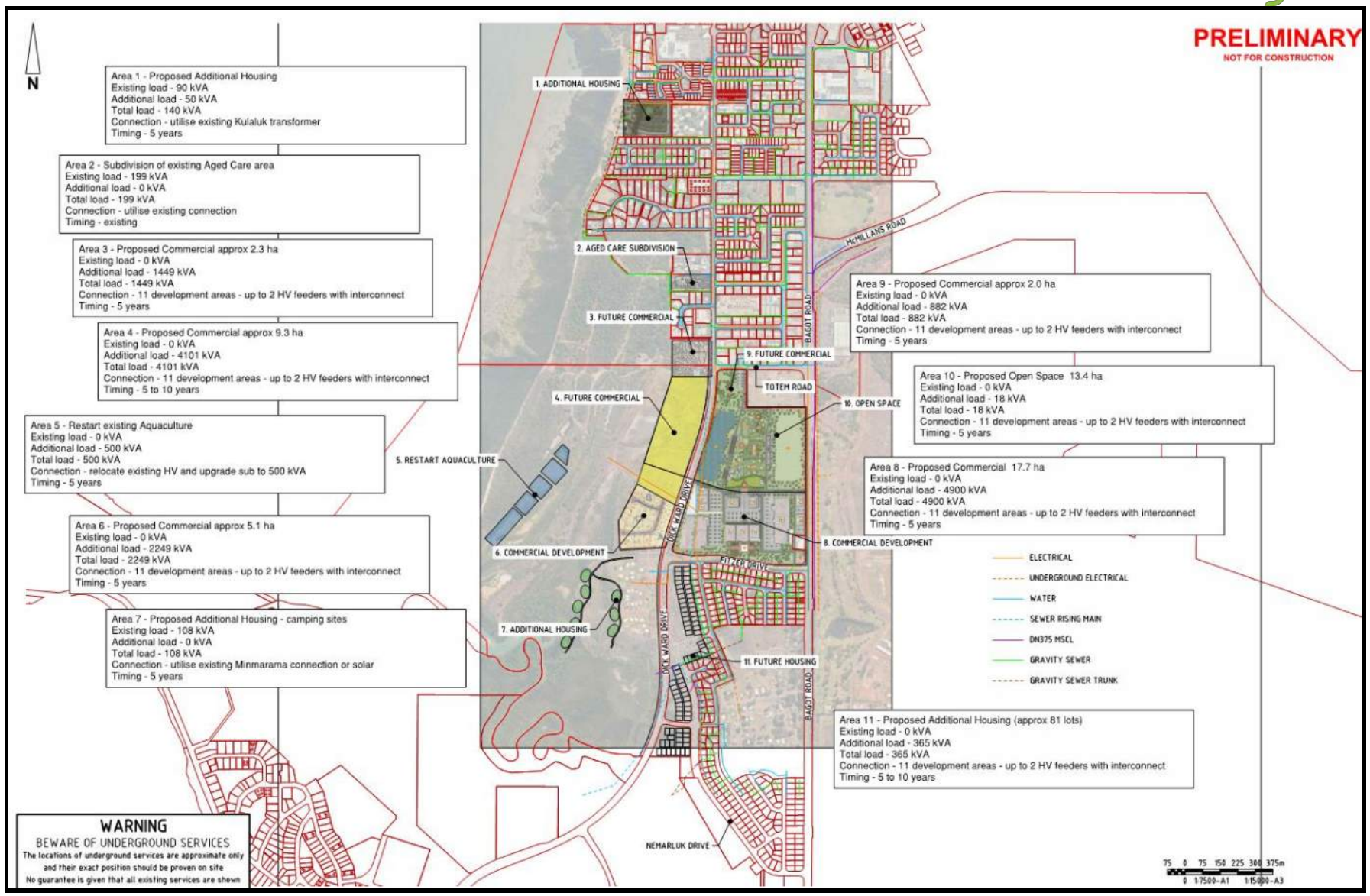

Figure 14.1 – Electrical Demand and Indicative Development Timing

15 Engineered Solutions

15.1 Earthworks

As noted previously, the proposed development areas are generally subject to primary storm surge and secondary storm surge and development of these areas would require the filling of the lots.

DIPL provided the existing digital elevation model for the GDA lease areas. WRM have recommended that lots are filled to a minimum finished surface level of AHD 5.9 m to ensure that lots are not impacted by primary storm surge.

For roads to be above primary storm surge, roads will be required to have a surface level of 5.9 m. Allowing for a kerb height of 150 mm and verge grading, the minimum required lot fill height is approx 6.2 m.

Significant amounts of fill will be required across most lots to achieve the required minimum surface level. Where a proposed development area is above the minimum required surface level the surface has been retained and no cut is proposed, other than Area 6 which was previously used as an uncontrolled fill material stockpile. This material will need to be removed before Area 6 could be utilised. Adjacent Area 4 requires significant fill and suitable material could be cut from Area 6 to part fill Area 4, minimising transport and associated traffic impacts.

The earthworks cut / fill plan based on a finished surface level of 6.2 m is shown in Figure 15.1 and Attachment 6.

Cut / fill volumes for each Area are shown in Table 15.1. The volumes shown do not consider clearing and grubbing or removal of acid sulfate soils, contaminated materials or uncontrolled fill.

Table 15.1 – Cut and Fill Volumes for each Area

Area	Cut Volume (m3)	Fill Volume (m3)	Balance (m^3)
1	0	68,850	68,850
2	Existing	Existing	
3	200	36,040	35,840
4*	0	245,460	245,460
5	Existing	Existing	
6*	113,000	62,450	50,550
7*	Existing	Existing	
8*	Existing	2,470	2,470
9	Existing	1,760	1,760
10	Existing	68,060	68,060
11	Existing	130,850	130,850

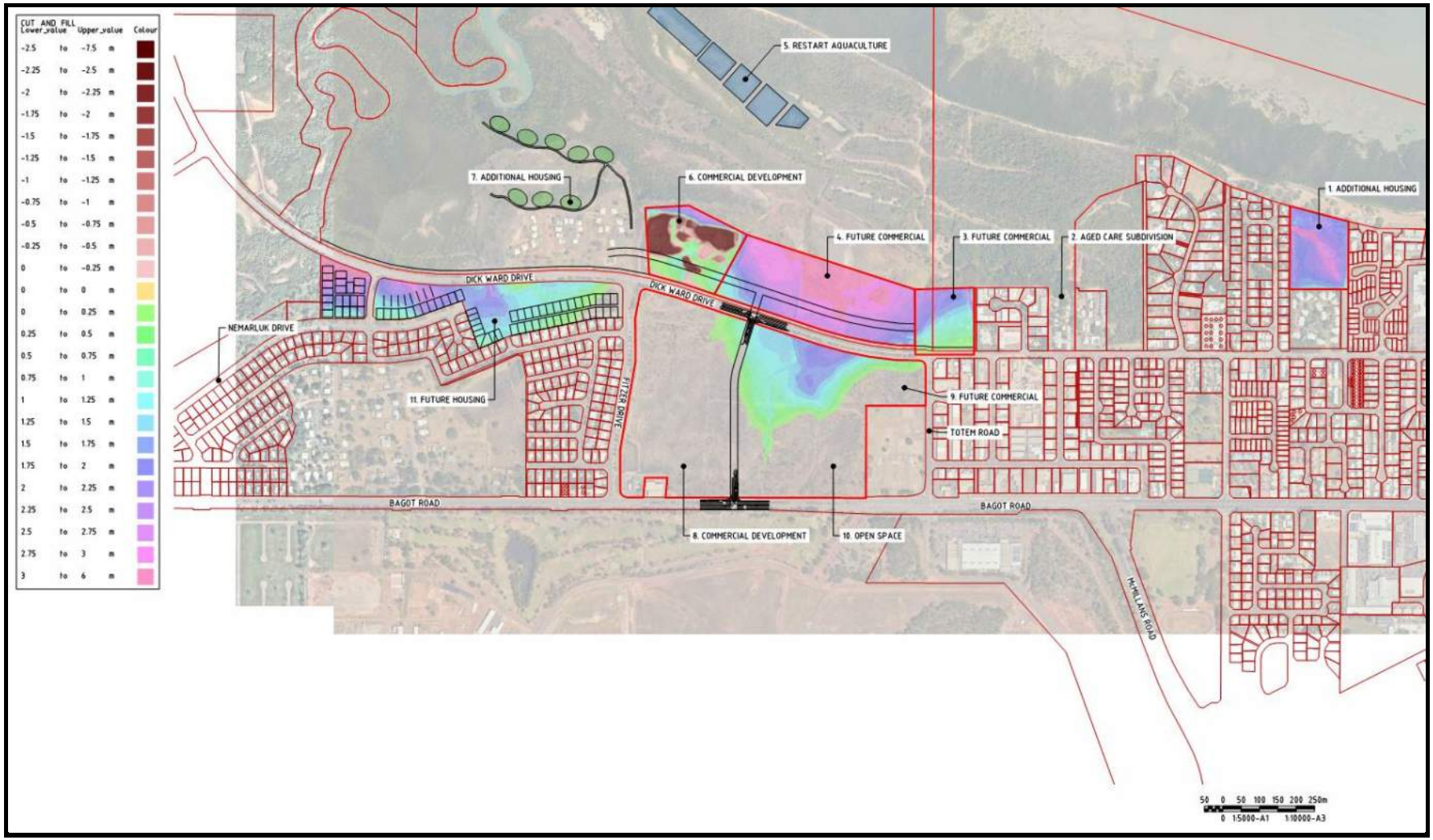

Figure 15.1 – Cut / Fill Earthworks Plan AHD 6.2m

15.2 Drainage

WRM has proposed a network of upgraded drains throughout the lease areas, predominantly to better convey upstream stormwater flows to the Darwin Harbour.

Based on the available topographic data, existing stormwater management structures, previous design work provided, indicative stormwater management structures (drains and detention basin) for future development are proposed. These proposed drainage structures:

- *maintain existing flow paths as far as possible;*
- *connect existing cross road drainage infrastructure where possible; and*
- *maintain existing downstream discharge points.*

Indicative infrastructure sizing is based on estimated 1% AEP peak design discharge estimates from XP-RAFTS, and the results of capacity analysis of key existing structures.

Figure 14.3 and Figure 14.4 *show locations and alignments of the proposed future stormwater drainage infrastructure.*

NT government subdivision guidelines were followed for indicative drain sizing and key assumptions include:

- *Drains are assumed to be grass lined;*
- *Drain side slopes are assumed to be 1V:6H.*
- *The minimum assumed drain base width is 2 m.*
- *The maximum channel flow depth is 0.8 m.*
- *A minimum freeboard allowance of 0.5 m is assumed for both general site filling and drain design.*

Note, other design guidelines (e.g., including maximum flow depths, maximum velocities and maximum depth x velocity product) may apply, and these should be assessed as part of any detailed design works.

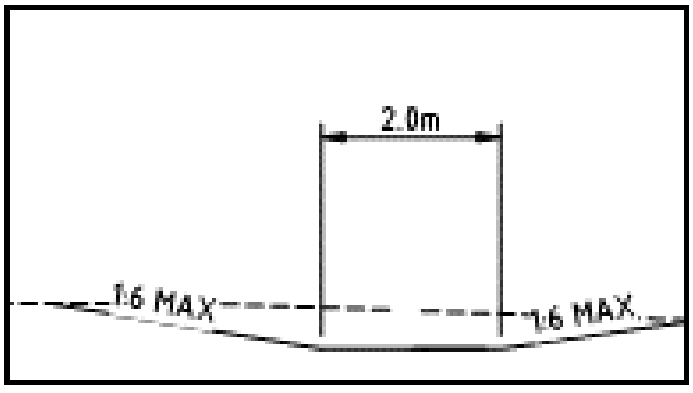

Figure 15.2 – Typical Open Drain Cross Section

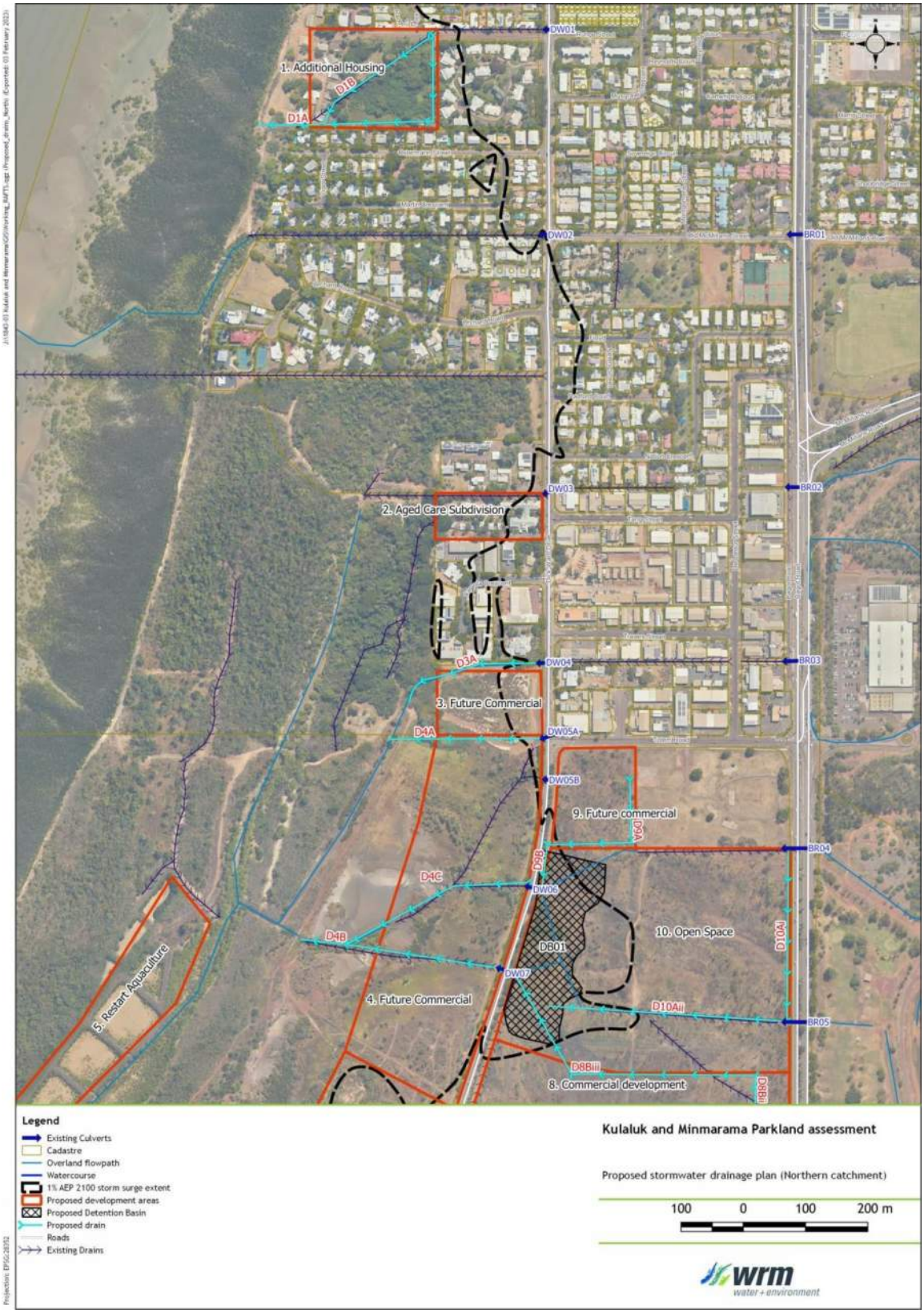

Figure 15.3 – Stormwater drainage plan - north

Figure 15.4 – Stormwater Drainage Plan – South

It is noted that much of the existing drainage network does not have formalised easements over the engineered drains. For example, Bagot Road stormwater is discharged to drainage easements that generally terminate within the lease area as shown in Figure 15.5.

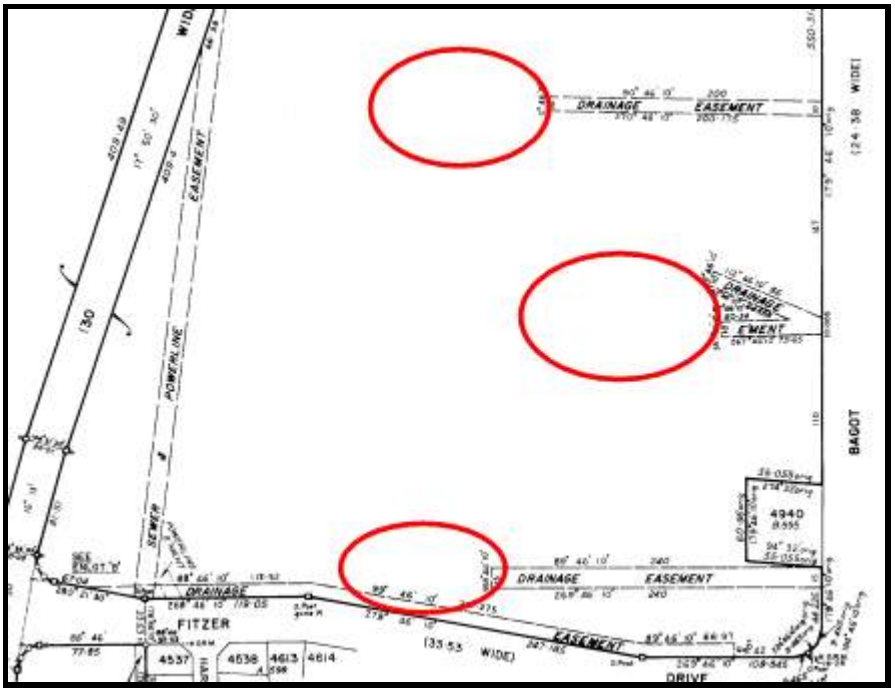

Figure 15.5 – Bagot Road Drainage Easements Terminate in Lease Area

15.3 Water

Based on PWC advice, indicative water headworks that are required are shown in Figure 15.6.

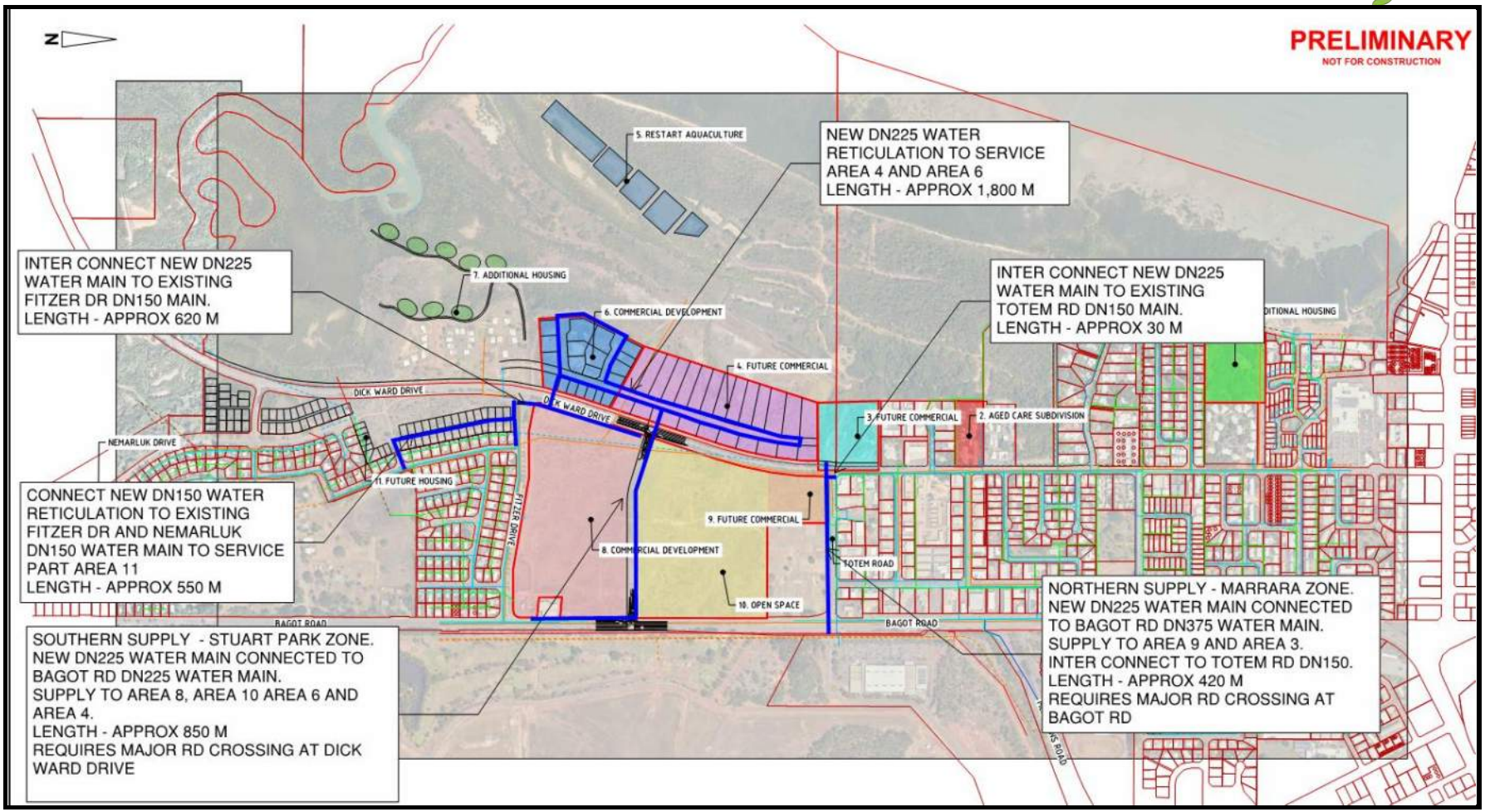

Figure 15.6 – Indicative Water Headworks Required

Water upgrades will be dependent on detailed network modelling and analysis during detailed design of any potential development.

Area 3 and Area 9 will require the upgrade of the Totem Road water main while Areas 4, 6, 8 and 11 require significant upgrades / new water mains to increase supply to the potential development areas with associated internal reticulation.

Minimum size water reticulation to commercial areas is DN225.

15.4 Sewer

Based on PWC advice, indicative water headworks that are required are shown in Figure 15.7.

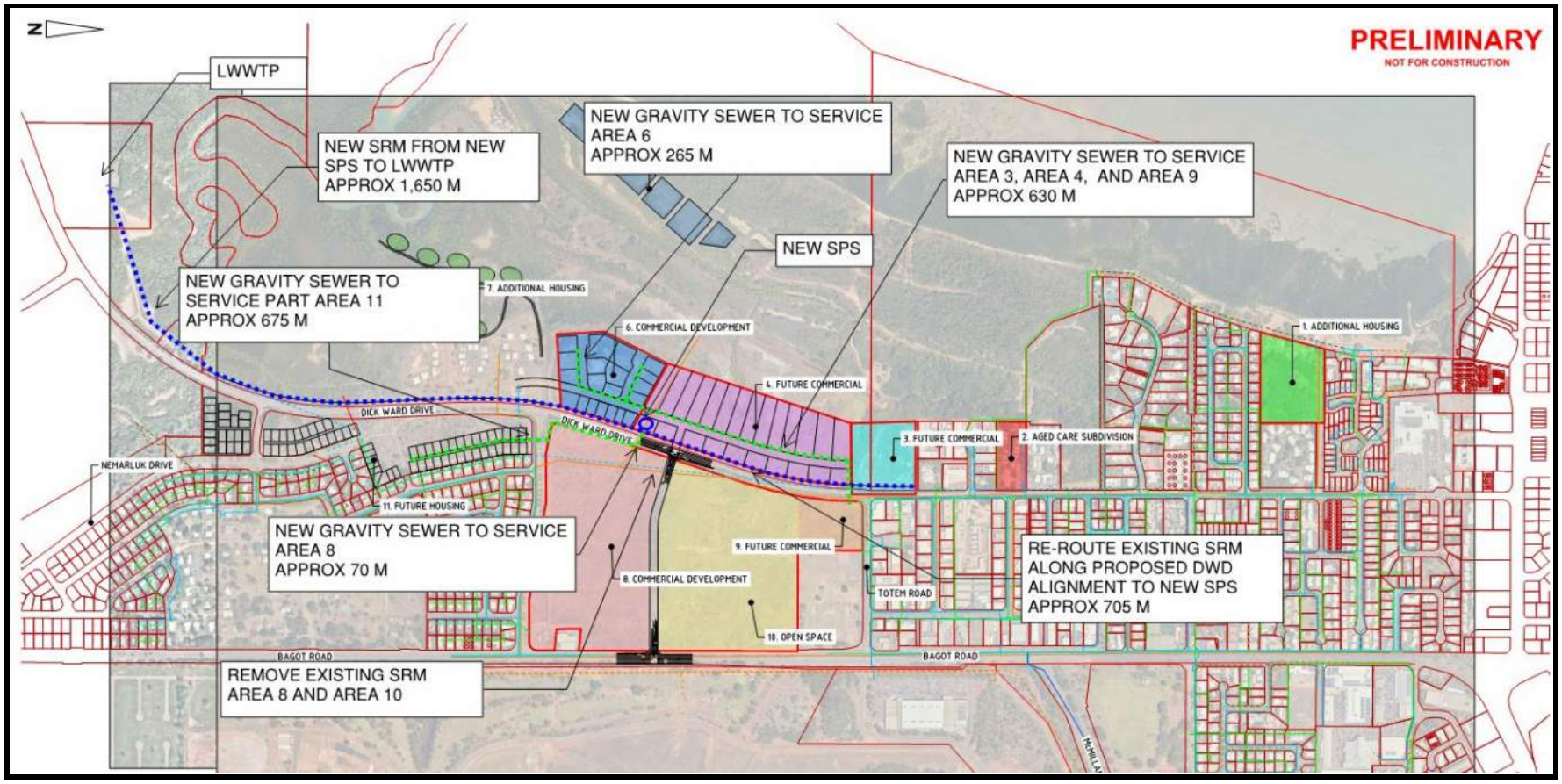

Figure 15.7 – Indicative Sewer Headworks Required

Sewer upgrades will be dependent on detailed network modelling and analysis during detailed design of any potential development.

As there is no available sewer capacity, significant upgrades are required to the sewer rising mains (SRM) including a new sewer pump station (SPS). The proposed sewer rising main would redirect flows from the existing Coconut Grove SPS and SRM the proposed SPS. The proposed SRM would be located in the duplicated Dick Ward Drive road verge.

The SPS and SRM from the SPS to LWWTP are required before any of the potential development areas can proceed.

Area 3, 4, 6, 8, 9 and 11 require a new gravity sewer system which is proposed would drain to the new major SPS. There is limited opportunity to grade a gravity sewer from Area 11 to the new SPS which would limit the development of this area to approximately 30 lots.

Sewer is considered the major constraint to development of the area and a strategic approach to sewering the area will be required for any potential development area to proceed.

15.5 Electrical

The potential electrical demand for each proposed development area was provided to PWC for consideration and advice.

PWC advised (Attachment 7):

The following minimum headworks are required on a distribution level to supply the loads at Kulaluk-Minmarama Park:

- *Areas 1, 2, 5 and 7 and require no headworks, as these are able to utilize the existing overhead connection on the 11WN22 (Ludmilla) feeder which has enough spare capacity to supply these areas.*
- *Required prior to new load in areas 3, 4, 6, 8, 9, 10 or 11 with combined load < 9 MVA (assumed Stage 1, within 5 years):*
    - *Install one (1) new feeder from Woolner Zone Substation to area of works*
        - *New 400 sqmm Al XLPE underground cable (approx. 2.2km to edge of area Lot 5182)*
    - *Install RMU on existing 11WN14 (Airport 1) feeder (approximately opposite MacDonald's, exact location tbc)*
        - *Extend new 400 sqmm Al XLPE cable into area Lot 5182*

Required before combined new load in all areas reaches 9 MVA (assumed Stage 2, 5+ years):

- *Install second new feeder from Woolner Zone Substation to area of works*
- *Install new RMU on 11WN07 feeder (on Casuarina side of McMillans Rd Airport Intake Station)*
    - *Extend new 400 sqmm Al XLPE cable back to Lot 5182 as backup feeder supply option from 11CA06 (Lyons FAC)*

Note that these studies have been performed at a high level and load is provided on a first come first serve basis. Capacity is not guaranteed until the HV masterplan is approved.

PWC has approximated the associated costs for headworks to reach the end of Bagot Road as:

For each stage (individually) the estimate is roughly:

- ***Stage 1**: $1.7 m*
- ***Stage 2**: $2.2 m*

Please note the costings are based on best estimates on current pricing, and no detailed quotes/surveys have been done.

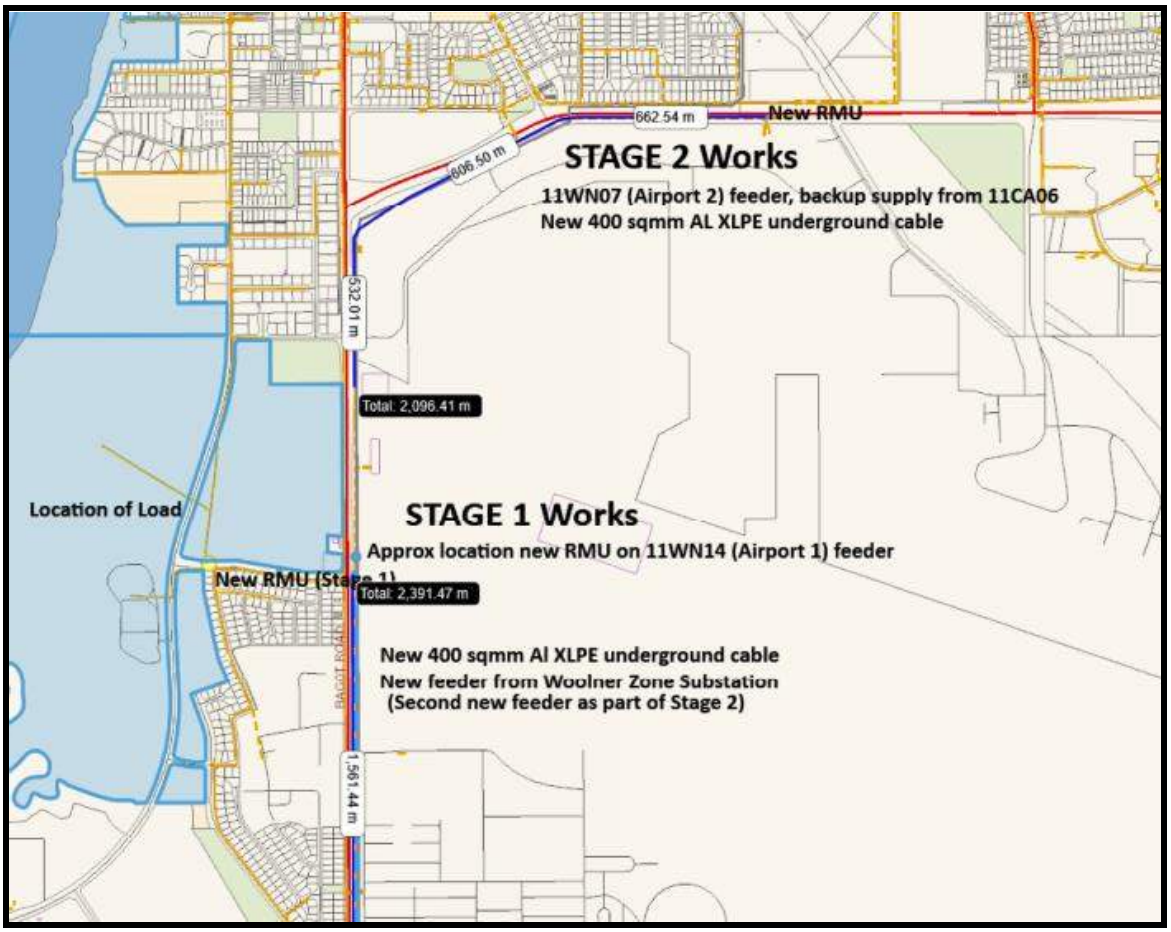

Figure 15.8 – Indicative Electrical Headworks Required

15.6 Roads

15.6.1 Area 1

The DIPL proposal to add additional houses to Kulaluk includes a partial upgrade of the internal access road and a gravel unsealed road with the drainage network is proposed as open drains. It is expected that the upgraded internal road would be based on the NT Subdivision Guidelines rural access road (Figure 15.9).

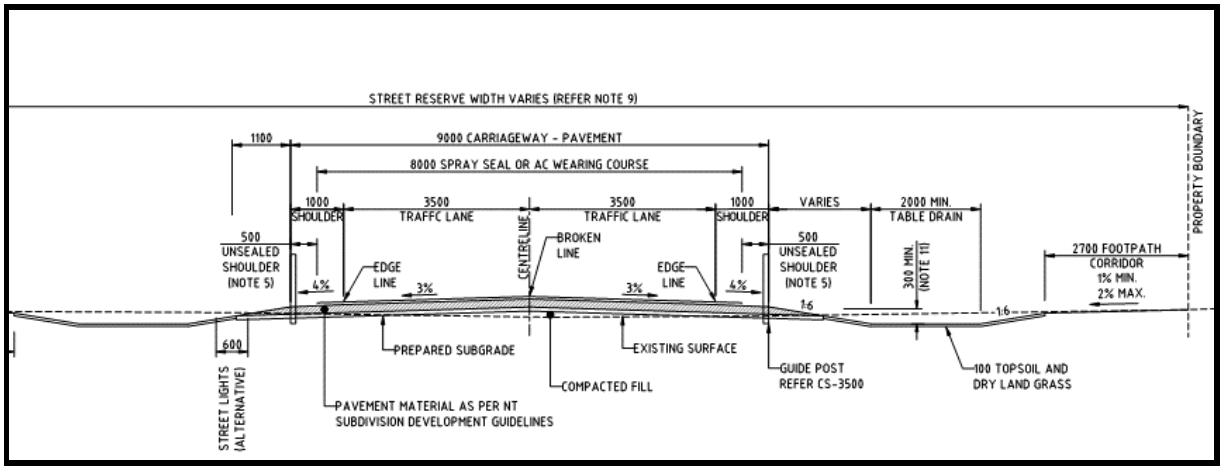

Figure 15.9 – NT Subdivision Guidelines Standard Drawing SS1005 Road Cross Section – Rural

15.6.2 Area 2

No changes are proposed to the existing access / egress point for the Juninga Aged Care facility.

15.6.3 Area 3

It is assumed that Area 3 will be a commercial crossover access from Dick Ward Drive subject to City of Darwin approval.

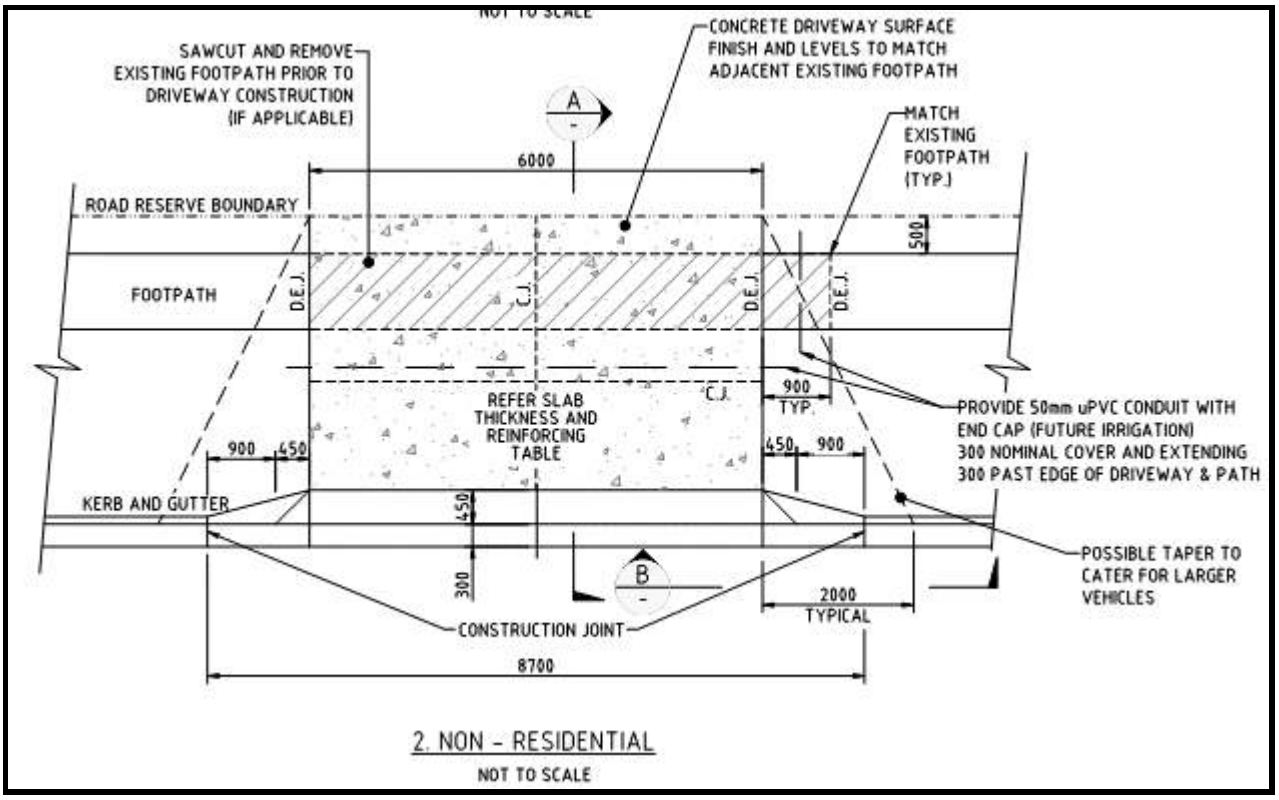

Figure 15.10 – NT Subdivision Guidelines Standard Drawing SS1006 – Vehicle Access

15.6.4 Area 8 and Area 10

The changes to the local road network are expected to be predominantly driven by the development of Area 8. Citiland previously commissioned CRG Traffic and Transport Engineering Consultants to prepare a traffic impact assessment for the development. Based on the Citiland TIA:

- Fitzer Drive - Bagot Road intersection is to be converted to a left in left out intersection.
- Bagot Road – internal link road intersection will be a fully signalised all movement intersection.
- Dick Ward Drive – internal link road intersection will be a fully signalised all movement intersection.
- An internal link road. The DMSAP also notes this future link road. This road could reasonably be expected to be based on the NT Subdivision Guidelines road cross section for an industrial area as show in Figure 15.11.

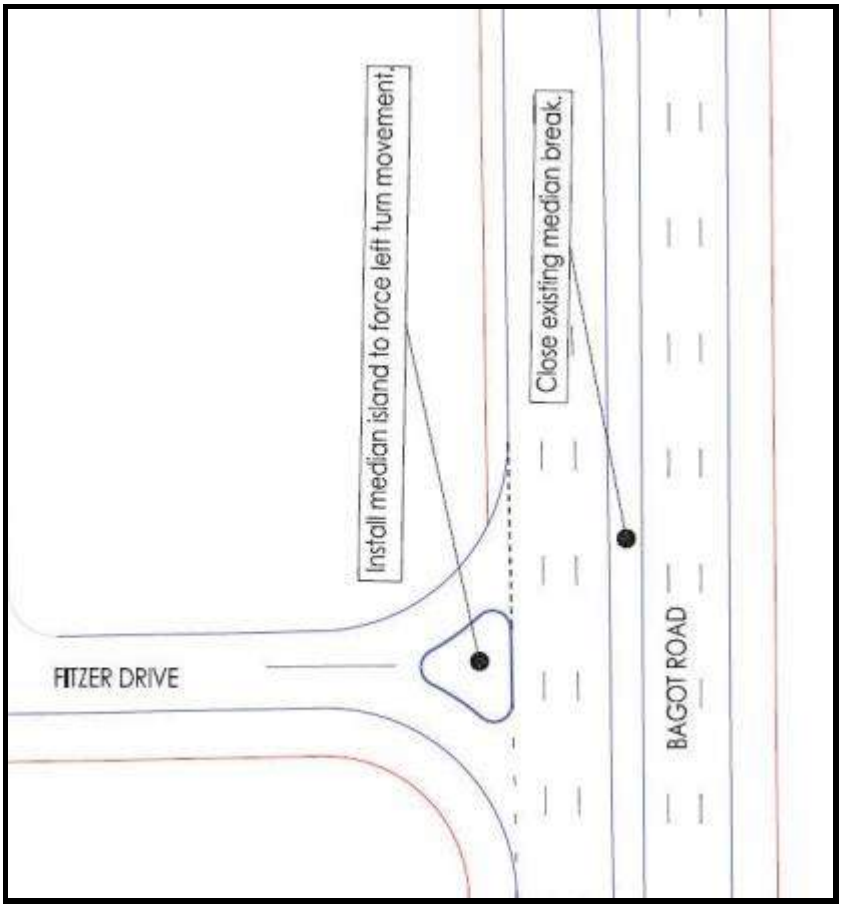

Figure 15.11 – Fitzer Drive -Bagot Road left in left out Intersection *(Source Citiland DA)*

CRG has proposed:

> *At the proposed Bagot Road intersection, dedicated turning lanes will be provided in each approach. The three existing through lanes in each direction will be maintained. Some land dedication from the subject site will be required in order to allow dedicated left and right turning lanes to be provided in Bagot Road and to maintain the existing lane profile such that lane capacity is not compromised. The median would also need to be widened slightly (approx 0.5 metre) in order to facilitate the dedicated right turn lane.*

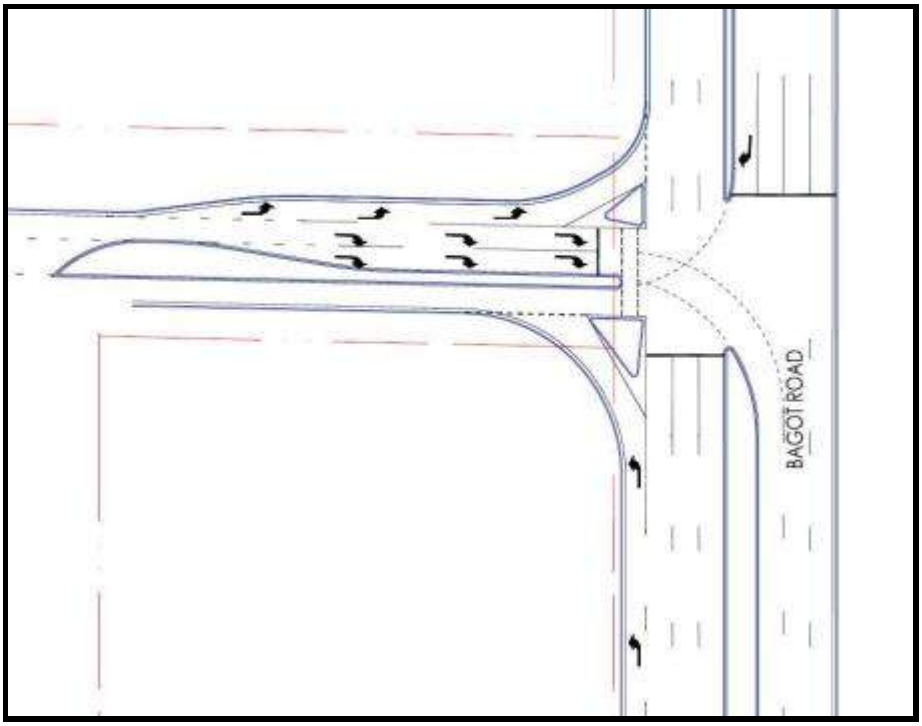

Figure 15.12 – Bagot Road – Internal Road Signalised Intersection *(Source Citiland DA)*

CRG has proposed:

> *At the proposed Dick Ward intersection, dedicated left and right turning lanes will be provided in Dick Ward Drive. Left turn slip lanes are proposed in and out of the proposed east-west collector road.*

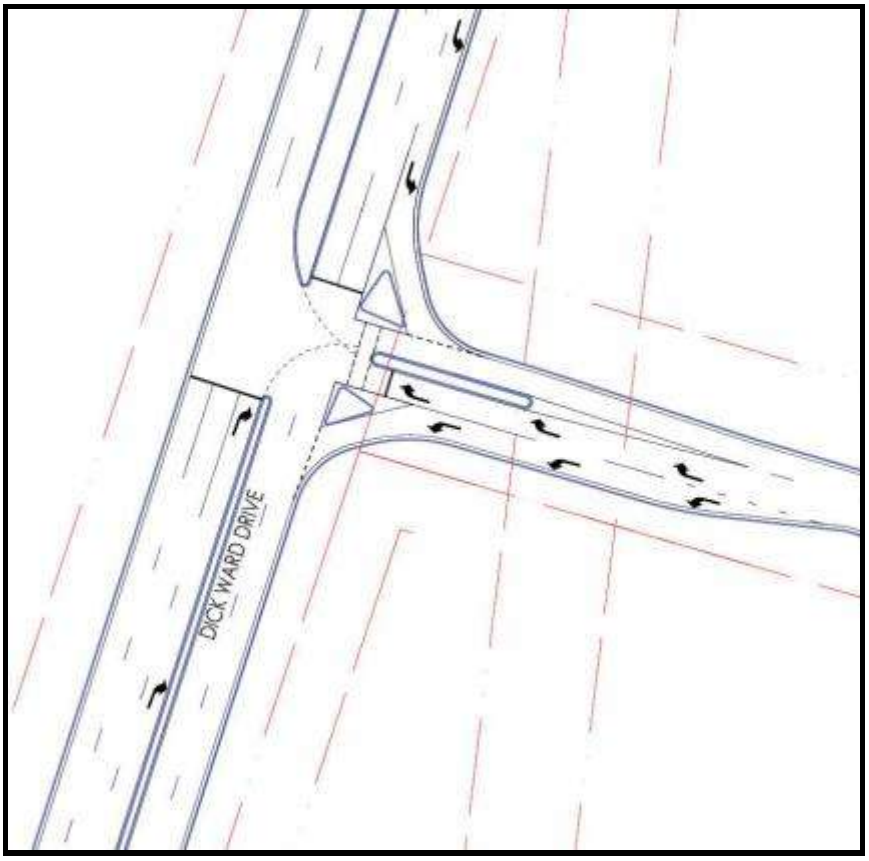

Figure 15.13 – Citiland Indicative T Signalised Intersection *(Source Citiland DA)*

15.6.5 Area 4, Area 6 and Area 7 West of Dick Ward Drive

The DMSAP proposes that Dick Ward Drive will be upgraded in the future. DIPL has advised that DWD is expected to be duplicated. The DIPL concept for Area 6 has assumed the Citiland signalised intersection with DWD will become a four way signalised intersection. Should Area 8 not progress to development, this leg of the intersection would not be required and a three-way signalised intersection would service Area 4, 6 and 7.

The duplication of DWD would increase the likelihood of traffic accidents at the existing Minmarama Camp access and it is suggested to re-route the camp access through Area 6 to provide safe egress to DWD at the signalised intersection. It is also suggested that any potential development of Area 4 would also utilise this four-way signalised intersection.

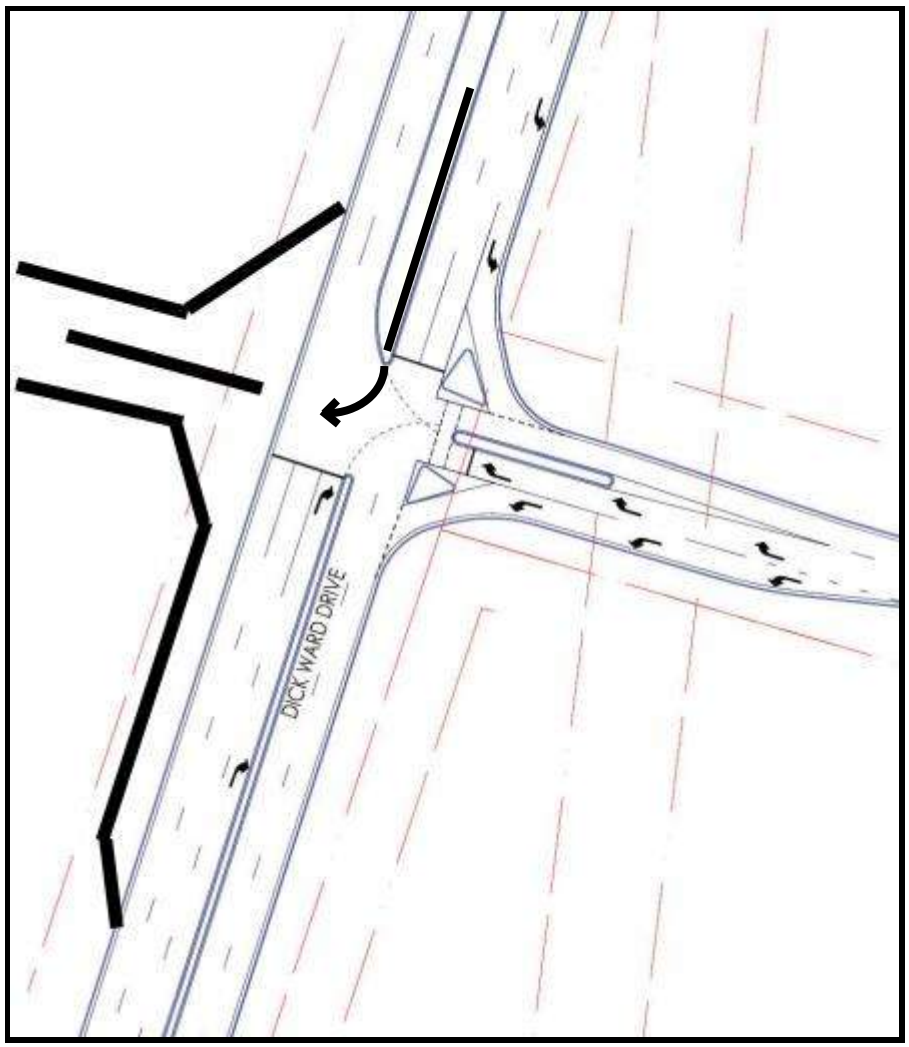

Figure 15.14 – Indicative 4 way Signalised Intersection based on Citiland DWD Intersection

Internal roads for Area 4 and Area 6 could reasonably be expected to be based on the NT Subdivision Guidelines road cross section for an industrial area as show in Figure 15.15.

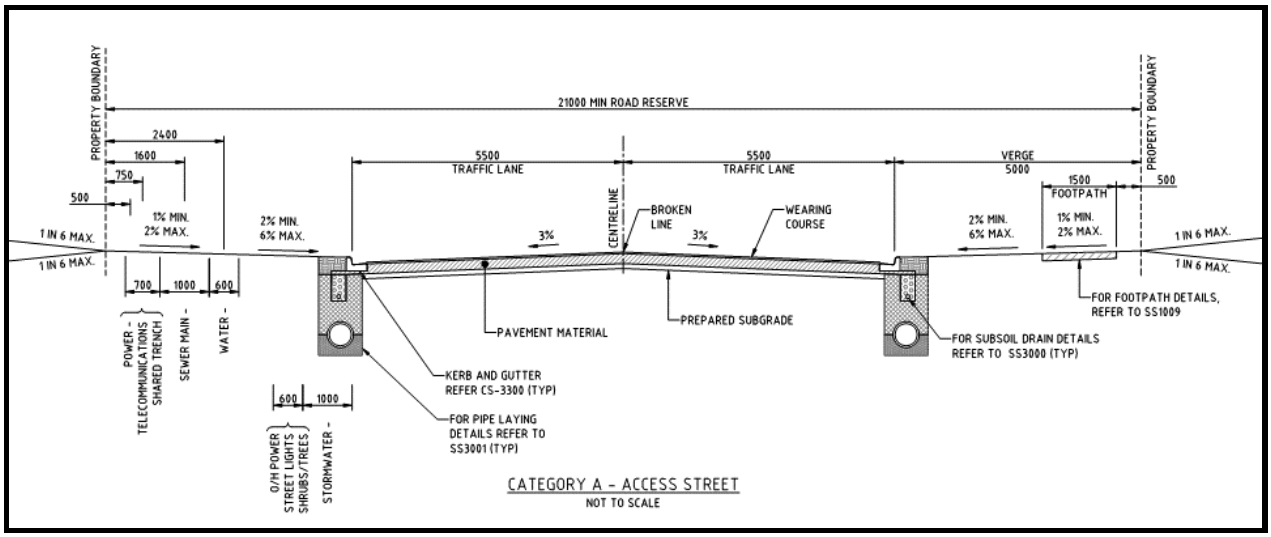

Figure 15.15 – NT Subdivision Guidelines Standard Drawing SS1003 Road Cross Section – Industrial

15.6.6 Area 9

It is assumed that Area 9 will only require a commercial crossover access from Totem Road subject to City of Darwin approval.

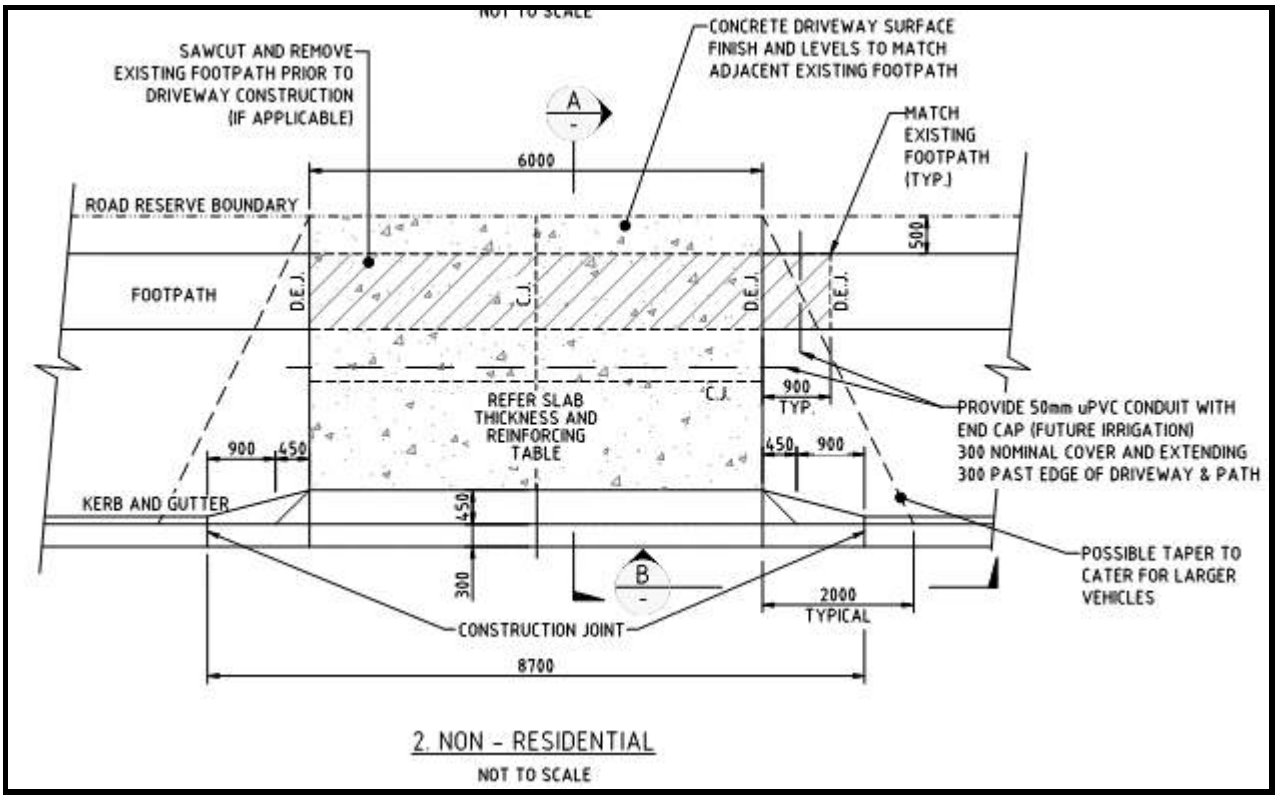

Figure 15.16 – NT Subdivision Guidelines Standard Drawing SS1006 – Vehicle Access

15.6.7 Area 11

It is likely that any additional residential development in this area would utilise road extensions of the existing road network comprised of Harvey, Nemarluk and Nadpur Streets. Significant traffic modelling would be required to assess any network impacts. If Dick Ward Drive is duplicated additional works will be required

Any new roads for Area 11 could reasonably be expected to be matched into the existing network and be based on the NT Subdivision Guidelines road cross section for a minor residential area as show in Figure 15.17.

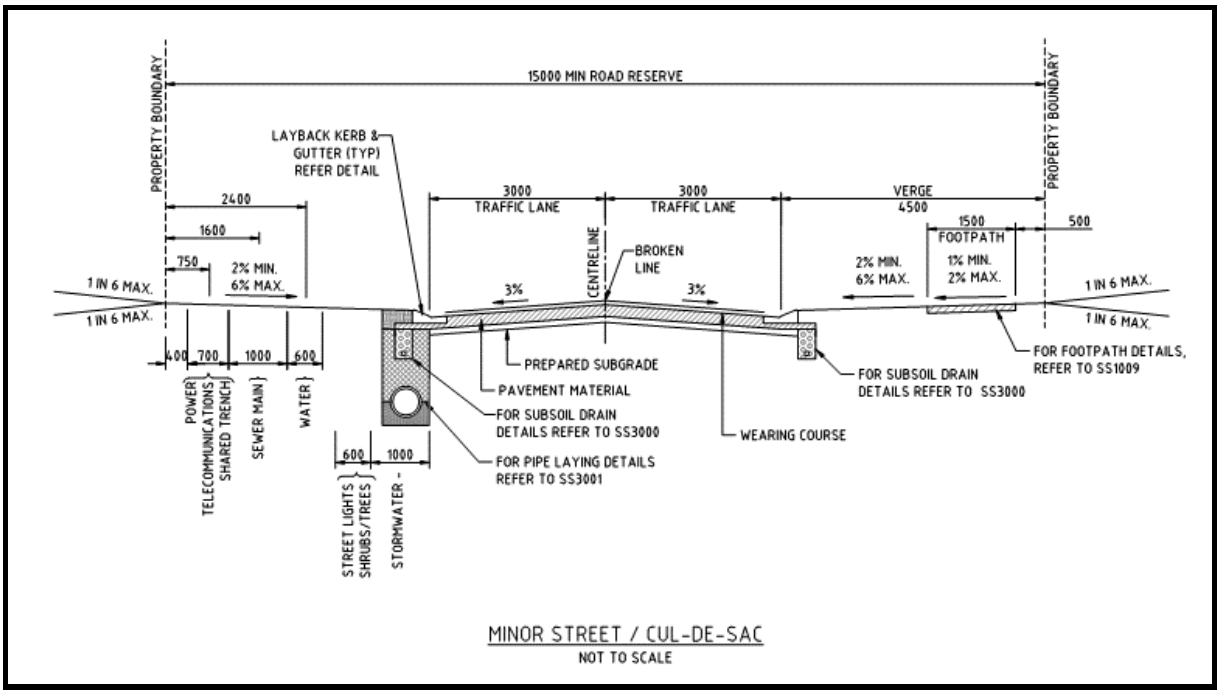

Figure 15.17 – NT Subdivision Guidelines Standard Drawing SS1000 Road Cross Section – Residential

16 Indicative Infrastructure Cost

16.1 Overview

Infrastructure costs for each proposed development area include preliminary costs such as design, headworks costs to provide enabling or linking infrastructure and subdivision costs where required for internal road, drainage and services.

Subdivision costs have been determined based on a planning cost allowance for either indicative per lot or unit cost or per linear metre. Indicative planning costs are shown in Table 16.1. Costs are high-order of cost approximations only and should not be used for construction budgeting purposes.

Table 16.1 – Indicative Planning Costs

Infrastructure Component	Unit	Rate ($/unit)
Asbestos disposal (SBWDS)	m3	720
Earthworks – cut or fill	m3	6
Drainage - open	m2	250
Drainage - piped	lm	720
Drainage - subsoil	lm	75
Road – urban	m2	90
Road – rural spray seal	m2	45
Commercial crossover	Unit	15,000
Footpath - 1.5 m	m2	100
Water - DN150	lm	250
Water – DN225	lm	350
Water – connections DN25	Unit	2,500
Sewer - DN150	lm	450
Sewer – DN225	lm	500
Sewer - connections	Unit	2,500
Sewer rising main – DN500 DICL	lm	900
Sewer pump station – 200 L/s	Unit	3,750,000
Electrical, lighting and comms	Per 20 m frontage	14,000
Major road intersection	Unit	4,000,000

16.2 Indicative Infrastructure Costs

Infrastructure costs have been approximated for the proposed development areas other than:

- Area 2 – existing facility and will retain existing services.
- Area 5 – existing facility however current servicing requirements unknow.
- Area 7 – new camping area with minimal load – expect to utilise existing Minmarama services.
- Area 10 – to be retained as open space and not considered further at this time.

Area 11 - The proposed residential Area 11 is currently zoned RD restricted development and the DMSAP does not support rezoning. Area 11 is constrained by the LWWTP odour buffer, Ludmilla SPS, flooding and storm surge (residential area has higher immunity requirements) and sewer capacity. As such only approx 30 lots located approximately between Harney Street and Dick Ward Drive have been considered further for estimation of infrastructure costs.

Approximated costs for major headworks such as road intersections, electrical, water and sewer rising main (SRM) and sewer pump station (SPS) have been based on the total approximated cost pro-rata by area for each potential development area. For example, the total cost of the sewer rising main and pump station is approximated as $7,666,500 with cost allocated based on the size (ha) of the development as shown in Table 16.2.

Table 16.2 – Cost Allocation based on Area Serviced

Proposed Development	Land Size (ha)	Size as a % of Total Size	Allocated Indicative Cost
SRM and SPS	38.8	100	$7,666,500
Area 3	2.3	6	$454,457
Area 4	9.3	24	$1,837,589
Area 6	5.1	13	$1,007,710
Area 8	17.7	46	$3,497,347
Area 9	2	5	$395,180
Area 11	2.4	6	$474,216

16.3 Contingency Allowance

The maturity level of design significantly influences the infrastructure cost estimate. The extract below sourced from the Department of Infrastructure, Regional Development and Cities (2018), shows a Class 5 (0-2% design) cost estimate at an 80 % confidence interval may range from – 50% to 100%.

	Primary Characteristic	*Secondary Characteristic*		
ESTIMATE CLASS	**MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES** Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE** Typical variation in low and high ranges at an 80% confidence interval
Class 5	0% to 2%	Concept screening	Cost/length factors, parametric models, judgment, or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Study or feasibility	Cost/length, factored or parametric models	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	Budget authorization or control	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%
Class 2	30% to 75%	Control or bid/tender	Detailed unit cost with forced detailed take-off	L: -5% to -15% H: +5% to +20%
Class 1	65% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%

Figure 10: Table 1 AACE RP 98R-18

A construction contingency of 50% has been adopted due to the high level of uncertainty as no infrastructure design has been undertaken.

Table 16.3 – Area 1 Residential – Indicative Infrastructure Costs

Infrastructure	Indicative Amount	Subtotal
Preliminaries		
Planning	$50,000	
AAPA	$20,000	
Environmental	$20,000	
Contamination	$20,000	
Geotechnical	$20,000	
Survey	$0	
Design	$100,000	**$230,000**
Headworks		
Remove uncontrolled fill	$6,000	
Replace uncontrolled fill	$6,000	
Contaminated Land Remediation	$0	
Earthworks	$0	
Drainage - open	$0	
Drainage - piped	$0	
Road intersection	$0	
Road - 8 m	$112,000	
Water	$0	
Sewer	$0	
Electrical,lighting,comms	$0	**$124,000**
Subdivision		
Earthworks	$589,160	
Drainage - open	$105,000	
Drainage - piped	$0	
Drainage - subsoil	$0	
Road - 6 m	$98,550	
Footpath - 1.5 m	$0	
Water - DN150	$113,750	
Water - connections	$27,500	
Sewer - DN150	$144,500	
Sewer - connections	$27,500	
Electrical, lighting and comms	$154,000	**$1,259,960**
Infrastructure		**$1,613,960**
Contingency 50%		**$806,980**
Total		**$2,420,940**

Table 16.4 – Area 3 Commercial – Indicative Infrastructure Costs

Infrastructure	Indicative Amount	Subtotal
Preliminaries		
Planning	$50,000	
AAPA	$20,000	
Environmental	$20,000	
Contamination	$20,000	
Geotechnical	$20,000	
Survey	$30,000	
Design	$100,000	**$260,000**
Headworks		
Remove uncontrolled fill	$0	
Replace uncontrolled fill	$0	
Contaminated Land Remediation	$0	
Drainage - open	$0	
Drainage - piped	$0	
Road intersection	$0	
Road	$0	
Water	$104,688	
Sewer	$378,715	
Electrical, lighting and comms	$221,705	**$705,107**
Subdivision		
Earthworks	$168,636	
Drainage - open	$25,000	
Drainage - piped	$36,000	
Drainage - subsoil	$0	
Road - 6 m	$10,000	
Footpath - 1.5 m	$24,000	
Water - DN225	$0	
Water - connections	$10,000	
Sewer - DN225	$0	
Sewer - connections	$2,500	
Electrical, lighting and comms	$112,000	**$388,136**
Infrastructure		**$1,353,243**
Contingency 50%		**$676,622**
Total		**$2,029,865**

Table 16.5 – Area 4 Commercial – Indicative Infrastructure Costs

Infrastructure	Indicative Amount	Subtotal
Preliminaries		
Planning	$50,000	
AAPA	$20,000	
Environmental	$20,000	
Contamination	$50,000	
Geotechnical	$40,000	
Survey	$40,000	
Design	$240,000	**$460,000**
Headworks		
Remove uncontrolled fill	$6,000	
Replace uncontrolled fill	$6,000	
Contaminated Land Remediation	$720,000	
Drainage - open	$0	
Drainage - piped	$0	
Road intersection	$1,158,879	
Road - 11 m	$0	
Water	$421,723	
Sewer	$1,531,324	
Electrical, lighting and comms	$937,209	**$4,781,136**
Subdivision		
Earthworks	$1,304,628	
Drainage - open	$157,500	
Drainage - piped	$453,600	
Drainage - subsoil	$94,500	
Road - 6 m	$623,700	
Footpath - 1.5 m	$86,000	
Water - DN225	$189,000	
Water - connections	$60,000	
Sewer - DN225	$300,000	
Sewer - connections	$60,000	
Electrical, lighting and comms	$882,000	**$4,210,928**
Infrastructure		**$9,452,064**
Contingency 50%		**$4,726,032**
Total		**$14,178,095**

Table 16.6 – Area 6 Commercial – Indicative Infrastructure Costs

Infrastructure	Indicative Amount	Subtotal
Preliminaries		
Planning	$50,000	
AAPA	$20,000	
Environmental	$20,000	
Contamination	$75,000	
Geotechnical	$50,000	
Survey	$50,000	
Design	$200,000	**$465,000**
Headworks		
Remove uncontrolled fill	$678,000	
Replace uncontrolled fill	$459,000	
Contaminated Land Remediation	$55,080,000	
Earthworks - cut	$0	
Earthworks - fill	$374,700	
Drainage - open	$0	
Drainage - piped	$0	
Road intersection	$635,514	
Road - 11 m	$0	
Water	$231,268	
Sewer	$839,758	
Electrical, lighting and comms	$513,953	**$58,812,193**
Subdivision		
Earthworks	$0	
Drainage - open	$99,000	
Drainage - piped	$417,600	
Drainage - subsoil	$87,000	
Road - 6 m	$445,500	
Footpath - 1.5 m	$135,000	
Water - DN225	$0	
Water - connections	$50,000	
Sewer - DN225	$132,500	
Sewer - connections	$50,000	
Electrical, lighting and comms	$602,000	**$2,018,600**
Infrastructure		**$61,295,793**
Contingency 50%		**$30,647,897**
Total		**$91,943,690**

Table 16.7 – Area 8 Commercial – Indicative Infrastructure Costs

Infrastructure	Indicative Amount	Subtotal
Preliminaries		
Planning	$50,000	
AAPA	$20,000	
Environmental	$20,000	
Contamination	$40,000	
Geotechnical	$40,000	
Survey	$50,000	
Design	$200,000	**$420,000**
Headworks		
Remove uncontrolled fill	$0	
Replace uncontrolled fill	$189,000	
Contaminated Land Remediation	$22,680,000	
Drainage - open	$487,500	
Drainage - piped	$0	
Road intersections	$6,205,607	
Road - 11 m	$0	
Water	$802,634	
Sewer	$2,914,456	
Electrical, lighting and comms	$1,783,721	**$35,062,918**
Subdivision		
Earthworks	$14,820	
Drainage - open	$0	
Drainage - piped	$1,094,400	
Drainage - subsoil	$114,000	
Road - 11 m	$1,504,800	
Footpath - 1.5 m	$0	
Water - DN225	$0	
Water - connections	$15,000	
Sewer - DN225	$35,000	
Sewer - connections	$2,500	
Electrical, lighting and comms	$420,000	**$3,200,520**
Infrastructure		**$38,683,438**
Contingency 50%		**$19,341,719**
Total		**$58,025,157**

Table 16.8 – Area 9 Commercial – Indicative Infrastructure Costs

Infrastructure	Indicative Amount	Subtotal
Preliminaries		
Planning	$0	
AAPA	$20,000	
Environmental	$20,000	
Contamination	$10,000	
Geotechnical	$20,000	
Survey	$10,000	
Design	$100,000	**$180,000**
Headworks		
Remove uncontrolled fill	$0	
Replace uncontrolled fill	$0	
Contaminated Land Remediation	$0	
Drainage - open	$0	
Drainage - piped	$0	
Road intersections	$0	
Road - 11 m	$0	
Water	$104,688	
Sewer	$329,317	
Electrical, lighting and comms	$201,550	**$635,555**
Subdivision		
Earthworks	$14,820	
Drainage - open	$55,000	
Drainage - piped	$0	
Drainage - subsoil	$0	
Road - 11 m	$10,000	
Footpath - 1.5 m	$18,000	
Water - DN225	$0	
Water - connections	$15,000	
Sewer - DN225	$107,904	
Sewer - connections	$2,500	
Electrical, lighting and comms	$84,000	**$307,224**
Infrastructure		**$1,122,779**
Contingency 50%		**$561,390**
Total		**$1,684,169**

Table 16.9 – Area 11 Residential Housing (30 lots only) – Indicative Infrastructure Costs

Infrastructure	Indicative Amount	Subtotal
Preliminaries		
Planning	$50,000	
AAPA	$20,000	
Environmental	$20,000	
Contamination	$20,000	
Geotechnical	$40,000	
Survey	$40,000	
Design	$240,000	**$430,000**
Headworks		
Remove uncontrolled fill	$0	
Replace uncontrolled fill	$0	
Contaminated Land Remediation	$0	
Drainage - open	$0	
Drainage - piped	$0	
Road intersections	$0	
Road - 11 m	$0	
Water	$0	
Sewer	$395,180	
Electrical, lighting and comms	$241,860	**$637,041**
Subdivision		
Earthworks	$253,073	
Drainage - open	$105,000	
Drainage - piped	$302,400	
Drainage - subsoil	$63,000	
Road - 11 m	$302,400	
Footpath - 1.5 m	$63,000	
Water - DN225	$137,500	
Water - connections	$75,000	
Sewer - DN225	$337,500	
Sewer - connections	$75,000	
Electrical, lighting and comms	$420,000	**$2,133,873**
Infrastructure		**$3,200,914**
Contingency 50%		**$1,600,457**
Total		**$4,801,371**

ATTACHMENT 1 – Potential Development Areas

ATTACHMENT 2 – Kulaluk Housing

ATTACHMENT 3 – Minmarama Commercial Area

ATTACHMENT 4 – CRTCP Planning Summary

ATTACHMENT 5 – Kulaluk Minmarama Electrical Demand

ATTACHMENT 6 – Earthworks Plan

ATTACHMENT 7 – PWC Electrical Headworks Advice

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