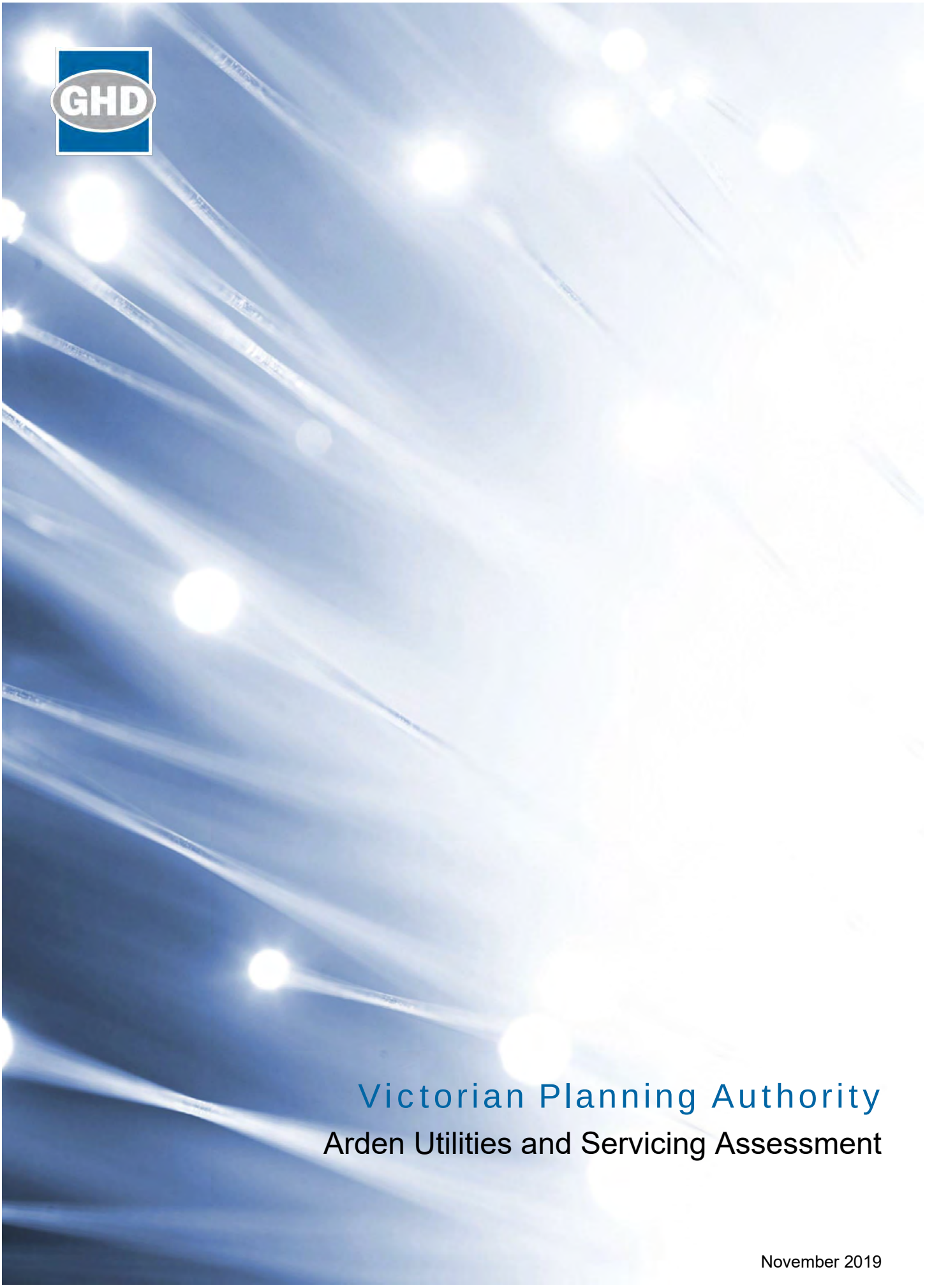

Victorian Planning Authority

Arden Utilities and Servicing Assessment

November 2019

Executive Summary

This report is subject to, and must be read in conjunction with, the limitations set out in Section 1.3 and the assumptions and qualifications contained throughout the Report.

GHD was engaged by the Victorian Planning Authority (VPA) in 2019 to provide an assessment of existing infrastructure capacity and future servicing requirements of the Arden Urban Renewal Precinct (Arden Precinct) in North Melbourne.

Findings considered to be the most significant are summarised in Table 1 below.

Table 1 Key Findings

Sector	Findings
Stormwater Drainage and Flooding	• There is significant piped stormwater drainage infrastructure within the Arden Precinct • Flooding and drainage is a significant challenge for development planning within the Arden Precinct • A significant portion of the Arden Precinct is affected by a Land Subject to Inundation Overlay and a portion of the Arden North sub-precinct is affected by a Special Building Overlay. Associated planning requirements will apply to developments within these zones • The City of Melbourne and Melbourne Water Corporation advised that a Development Contributions Plan (DCP) and a Development Services Scheme (DSS) respectively would be created to fund their required works • The total cost of proposed MWC drainage works in the Arden Precinct is approximately $200 million • Stormwater drainage infrastructure within the Arden Precinct will require significant works to service future development including the following key proposed upgrades: – Raised and extended levees for the Moonee Ponds Creek – New flood storage in Stubbs Street – New flood storage in Arden Central – New flood storage in Langford Street – New underground flood storage within North Melbourne Recreation Reserve – Upgrade works to 6 existing pump stations – Upgrades to gravity pipes within the Arden Precinct – Pressure pipe upgrades within the Arden Precinct including pressurising the Arden Street Main Drain

Water	• The existing Arden Precinct is well serviced by potable water supply infrastructure • Although there is no existing water reticulation infrastructure within the Arden Central sub-precinct, the existing mains on Arden Street have capacity to supply the sub-precinct • There is no existing non-potable water infrastructure in the Arden Precinct and City West Water (CWW) is investigating supply options for alternative water, including stormwater harvesting and sewer mining • CWW has planned works to the 375 mm diameter main on the north of Arden Street • New reticulation mains will be needed throughout the Arden Precinct to service high density developments, and the cost of water reticulation infrastructure is generally attributable to developers • New distribution mains will be needed throughout the Arden Central sub-precinct to provide water supply service, and the cost of water distribution infrastructure is generally attributable to CWW • CWW advised that the upgrades required to service the redevelopment of the Arden Precinct include: 400 metres of new 225 mm diameter main on Laurens Street, 220 metres of new 300 mm diameter main on Fogarty Street and existing 100 mm mains in the Laurens Street and Arden North sub-precincts may require upsizing depending on local development requirements
Sewer	• The existing Arden Precinct is well serviced by sewer infrastructure • Both CWW and MWC have significant sewer infrastructure within the Arden Precinct, and advised that the majority of sewer infrastructure in the Arden Precinct is over 100 years old • CWW would like to proactively work with developers to incrementally replace aging reticulation assets as part of upgrade works to the road network and streetscapes • New reticulation mains will be needed throughout the Arden Precinct to service high density developments and the cost of sewer reticulation infrastructure is generally attributable to developers • CWW advised that the upgrades required to service the redevelopment of the Arden Precinct include: a new maintenance hole and connecting infrastructure between this maintenance hole and an existing MWC transfer sewer maintenance hole will be required to service Arden Central, and an upgrade of CWW's North Melbourne Branch sewer may be required to service the Laurens Street sub-precinct

Electrical	• The Arden Precinct is serviced from existing sub-transmission lines from the West Melbourne Terminal Station (WMTS), the Victoria Market Zone Substation (VMZS) and the Laurens Street Zone Substation (LSZS) • Current planned works include: the decommissioning of the Laurens Street Zone Substation and the upgrade of the West Melbourne area from 6.6 kV to 11 kV • A 66 kV electrical service corridor has been constructed in the Queensberry Street extension and includes the conduits required for future electrical infrastructure, and infrastructure servicing the Melbourne Metro Tunnel rail project • CitiPower advised that the upgrades required to service the redevelopment of the Arden Precinct include: 1 x 22kV cable bundle (4 cables) to extend from the LSZS to the North Melbourne Train Station Substation to service other parts of the network ,and 1 x 66kV cable bundle (3 cables) to run between the WMTS and the LSZS to service the Arden Central sub-precinct • A new zone substation will be required to support development and it may be located on the existing LSZS site • If the LSZS is heritage listed (currently under review), CitiPower will likely sell the site and require new land in the Arden Precinct for the new zone substation
Gas	• A transmission gas pipeline is present in the Arden North and Laurens Street sub-precincts with 250 mm and 450 mm diameters • The 250 mm diameter main has a measurement length of 170 metres, and the 450 mm diameter main has a measurement length of 220 metres, on either side of the pipelines • Development within the measurement length must respond to Australian Standard regulatory constraints relating to sensitive land uses and development density • Gas infrastructure within the Arden Precinct is likely to be inadequate to support the proposed redevelopment • A Safety Management Study will be required for development surrounding the transmission pipeline • APA advised that the upgrades required to service the redevelopment of the Arden Precinct include: reinforcement of existing gas assets to support gas reticulation throughout the Arden Precinct and additional gas injection to the distribution network, including either a pressure reducing station or below ground kiosk

Telecommunications	• There are 8 telecommunications authorities with assets in the Arden Precinct • Telstra has critical fibre assets located in Arden Street, Queensberry Street and Munster Terrace • NBN is the Infrastructure Provider of Last Resort within the Arden Precinct and also has the Right of First Refusal for new developments • Telstra will not enter into commercial agreements for telecommunications infrastructure for redevelopment in the Arden Precinct • Backhaul infrastructure in the form of a new distribution fibre network will be required from a service area module location less that 1 km from the Arden Precinct • Backhaul costs are attributable to the developer if the length of backhaul required is greater than 1 km

Key opportunities in regards to utility infrastructure for the next stage of planning for the Arden Precinct are summarised below:

- Undertake an assessment of the ultimate Arden Precinct Structure Plan to determine opportunities for sustainable utility infrastructure planning in consultation with utility Authorities
- Consult with relevant stakeholders to enable greater understanding of the impact of all development on networks, and explore what identified upgrades and extensions are able to be included in any developer funding plan
- Consult with utility Authorities to understand the infrastructure requirements of the new North Melbourne Station and whether this has flow on impacts for the infrastructure required in the Arden Precinct
- Evaluate the findings of this assessment against the findings of other detailed stormwater assessments to understand the next steps for development planning
- Undertake a water sensitive city drainage assessment to understand the role of green and blue drainage infrastructure within the streetscape and its role in stormwater management
- Undertake an urban ecology assessment to understand the integration of the public and private realms in delivering coordinated infrastructure outcomes
- Undertake detailed modelling of the Arden Precinct to understand the interaction between existing services, the proposed location of stormwater storages and cloudburst / green streets, and the subsequent benefit of the infrastructure
- Undertake further analysis to understand where stormwater storages would be, the connection of stormwater drains to the storages, the location of a stormwater treatment plant, and the timing of an future alternative water network
- Investigate the feasibility of onsite electricity generation in order to reduce the future electrical infrastructure required to service the Arden Precinct
- Collaborate with CitiPower for the planning for the new LSZS to provide a substation building with possible multiple uses and a visually appealing and integrated design

- Undertake a Safety Management Study to understand the impacts of the transmission pipeline on future development within the Arden Precinct, and to understand what mitigation strategies could be implemented to decrease the impact of the pipeline's location on the Arden Precinct
- Investigate the opportunity of the Arden Precinct to provide a 'gas-free' Precinct
- Consult with stakeholders and NBN to determine whether opportunities exist to integrate environmentally sustainable initiatives into the telecommunications servicing strategy for the Arden Precinct

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1. Introduction

1.1 Project Context

1.1.1 Precinct Location

The Arden Urban Renewal Precinct (Arden Precinct) is located within the municipality of the City of Melbourne (CoM) in North Melbourne. The Arden Precinct is comprised of 50 hectares of land bounded by Macaulay Road in the north, Dryburgh Street in the east, the existing rail reserve in the south and west as well as a portion of the existing CityLink toll road in the west. A Locality Plan has been provided in Appendix A illustrating the location and boundaries of the Arden Precinct.

The Arden Precinct forms part of the 600 hectares of land available for urban renewal within close proximity to Melbourne's Central Business District (CBD) as part of Plan Melbourne 2017 – 2050 planning strategy.[1]

The Arden Precinct is divided into three sub-precincts; Arden North, Arden Central and Laurens Street as depicted in Figure 1 below.

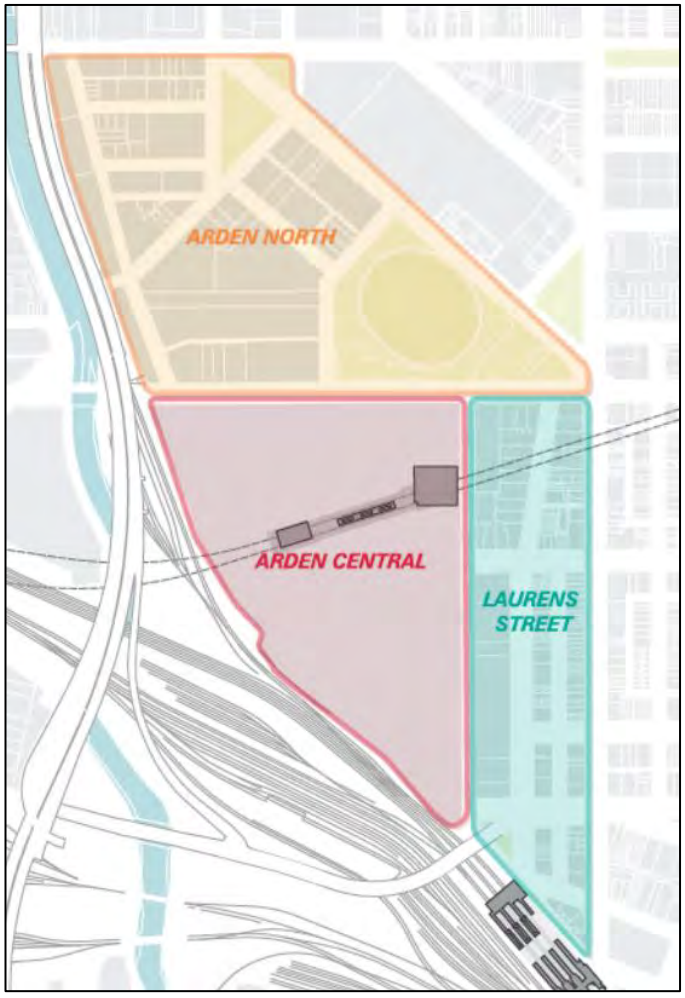


Figure 1 Project Area Sub-Precincts

Source: Victorian Planning Authority, 2019

1 https://www.planmelbourne.vic.gov.au/the-plan

1.1.2 Existing Land Use

The Victorian Planning Authority (VPA) provided the following information regarding existing land uses in the Arden Precinct:

- Historically, the Arden Precinct has primarily been used for industrial, transport and open space purposes since the 19th century.The current existing land uses in the Arden Precinct include predominantly light industrial, commercial and low to medium density residential.
- The current land use differs between the three sub-precincts. The 22 hectare Arden North sub-precinct is currently utilised for small-scale industry, warehousing, community services, open space and recreation.
- The 16 hectare Arden Central sub-precinct is predominantly owned by the Victorian Government and utilised for transport purposes, with a few privately owned lots fronting Arden Street.
- The 12 hectare Laurens Street sub-precinct has diverse land uses including low density residential, commercial and industrial land uses.

The Arden Precinct is bounded by the CityLink tollway, providing a direct transport link from the redevelopment area to Melbourne's Tullamarine Airport. The Moonee Ponds Creek forms the western border of the Arden Precinct. This creek functions as a key drainage corridor as well as a popular active transport route.

The planning zones and overlays within the Arden Precinct are provided in Appendix B. The zones governing the use of land within the Arden Precinct vary from sub-precinct to sub-precinct. The relevant zones for each sub-precinct are summarised in Table 2.

Table 2 Land Use Zones by Sub-Precinct

Sub-Precinct	Zone
Arden North	Industrial 3 Zone (IN3Z)
	Public Park and Recreation Zone (PPRZ)
	Industrial 1 Zone (IN1Z)
Arden Central	Industrial 1 Zone (IN1Z)
	Public Use Zone – Transport (PUZ4)
Laurens Street	Industrial 1 Zone (IN1Z)
	Mixed Use Zone 1 (MUZ)
	Public Park and Recreation Zone (PPRZ)

The PPRZ zone in Arden North consists of the existing North Melbourne Recreation Reserve and North Melbourne Recreation Centre and Pool. The IN3Z and IN1Z is made up of small-scale industry and warehousing. Arden Central is largely comprised of a PUZ4 zone, and this land is owned by the Victorian Government and consists primarily of the rail reserve. The MUZ in Laurens Street includes residential, commercial and industrial uses.

1.1.3 Project Overview

The Arden Precinct is a strategic urban renewal project led by the VPA and CoM in partnership and collaboration with various government departments and agencies. The VPA outlined the key objectives and opportunities for the redevelopment of the Arden Precinct as a 'new destination for Melbourne' and a significant opportunity to deliver best practice urban renewal outcomes. The underdeveloped nature of the Arden Precinct, as well as its proximity to the

Melbourne CBD, major hospitals and universities, key transport routes, provides substantial incentive for development. The Metro Tunnel works and the construction of the new North Melbourne Station within the Arden Central Precinct creates a significant catalyst for future large scale redevelopment.

The Arden Precinct is part of a broader strategy of urban intensification in the Arden and Macaulay urban renewal area in North Melbourne, and development consisting of more intensive mixed use and residential development will aid in transforming the previously underutilised area into an exemplary urban renewal precinct and innovation district.

As part of its planning works for the Arden Precinct, the VPA has commissioned various studies to inform the preparation of the Arden Precinct Structure Plan (PSP). This Utilities and Servicing Assessment will provide key information regarding the current infrastructure capacity and future servicing requirements of the Arden Precinct, and may inform the future land development due diligence for the precinct.

1.2 Purpose of this Report

1.2.1 Authority Consultation

The focus of this assessment is to determine the condition and capacity of existing infrastructure servicing the Arden Precinct redevelopment area, as well as to advise whether upgrades, relocations, network augmentation or alteration works, extensions of new infrastructure will be required to support redevelopment. This report includes an assessment of stormwater, sewerage, water, gas, telecommunications and electricity infrastructure.

Utility infrastructure has the potential to contribute significant costs and delays if constraints are not identified and addressed early in the redevelopment process and therefore this report is crucial to maintaining lines of communication with, and giving pre-planning development information to Utility Services Authorities (Authorities), who own or manage utility assets in the development area.

The Authorities consulted in this assessment are outlined in Table 3 below. This report integrates their advice regarding existing and required infrastructure to service the Arden Precinct.

Table 3 Utility Service Authorities in the Arden Precinct

Utility	Utility Service Authority
Electricity	CitiPower
	Jemena
Gas	APA Group
	AusNet Gas Services
Sewer	City West Water
	Melbourne Water Corporation
Stormwater Drainage	City of Melbourne
	Melbourne Water Corporation
Telecommunications	AAPT/ PowerTe l/ TPG / PIPE Networks
	AARNet
	FiberSense
	NBN Co
	Nextgen / Vocus
	Optus / Uecomm
	Superloop
	Telstra
	Transgrid
Water	City West Water

1.2.2 Sustainability

As sustainability is a key consideration for the planning of the Arden Precinct, this assessment included analyses of government policy that supports sustainable development and best practice sustainability outcomes in other developed precincts both nationally and internationally. These analyses focused on the opportunities for utility servicing to support the following:

- Resilience by utilising low carbon emitting energy
- Climate change adaptation
- Urban cooling
- Zero net emissions pathway to year 2050
- Other state government sustainability and energy requirements

A key outcome of these analyses was identifying the barriers and opportunities for integrating sustainable infrastructure and development within the Arden Precinct. Authorities were also consulted to understand how each utility could support the above objectives, and where available, their advice has been integrated into this report.

1.3 Limitations and Assumptions

The location of existing services has been approximately determined based on Dial Before You Dig information and information provided by Authorities. The location and depth of existing infrastructure is approximate and service proving is recommended to confirm the location and depth.

Assessment of the condition and capacity of existing infrastructure has been based on advice and data received from Authorities. Information provided by stakeholders is preliminary information only, subject to change and should not be relied upon without verification.

This report has been prepared by GHD for the Victorian Planning Authority and may only be used and relied on by the Victorian Planning Authority for the purpose agreed between GHD and the Victorian Planning Authority as set out in this section.

GHD otherwise disclaims responsibility to any person other than the Victorian Planning Authority arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared. The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this section of the report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by the Victorian Planning Authority and others who provided information to GHD (including Government and Utility Service Authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report, which were caused by errors or omissions in that information.

1.4 Methodology

GHD undertook an initial investigation into the utility infrastructure within the Arden Precinct area through a desktop study. This research involved using information obtained through a Dial Before You Dig (DBYD) enquiry.

Following the desktop investigation, GHD commenced obtaining spatial data from each Authority to create Existing Infrastructure Plans. Where spatial data was not able to be obtained from Authorities, it has been digitised from the Authorities' DBYD responses. A summary of the infrastructure data type utilised in the Existing Infrastructure Plans is provided below in Table 4.

Table 4 Infrastructure Data Types by Utility Service Authority

Utility Service Authority	Infrastructure Data Type
AAPT/ PowerTel/ TPG/ PIPE Networks	Digitised DBYD Data
AARNet	Digitised DBYD Data
APA Group	Digitised DBYD Data
AusNet Gas Services	Digitised DBYD Data
City of Melbourne	Spatial Data
CitiPower	Spatial Data
City West Water	Spatial Data
FiberSense	Digitised DBYD Data
Jemena	Spatial Data
Melbourne Water Corporation	Spatial Data
NBN Co	Digitised DBYD Data
Nextgen/Vocus	Digitised DBYD Data
Optus/Uecomm	Digitised DBYD Data
Superloop	Digitised DBYD Data
Telstra	Spatial Data
Transgrid	Digitised DBYD Data

Using the estimated proposed development dwelling yields and commercial and retail land use predictions provided by the VPA, GHD commenced discussions with the relevant Authorities to determine the potential impacts of proposed development on existing infrastructure. These discussions focussed on the expected constraints due to existing infrastructure on the proposed development, the expected impact of the proposed development on local infrastructure and the identification of services that were likely to require relocation, replacement or upgrade.

GHD provided Authorities with a questionnaire highlighting relevant supply side information necessary for an analysis of their infrastructure networks. In response, Authorities outlined predicted infrastructure capacity constraints and upgrade requirements necessary to facilitate development, whilst maintaining the level of service provided to existing customers. Where applicable, Authorities also provided high level indicative costs associated with infrastructure upgrade requirements.

GHD utilised the information provided by Authorities to prepare Existing Typical Sections. Where plans indicating the location of future infrastructure were provided by Authorities, these plans were included and reference in the body of the report.

GHD reviewed previous studies provided by the VPA to identify information relevant to this assessment and identify any knowledge gaps.

GHD undertook a desktop research investigation to identify local and state policy that supports low carbon emissions and to identify global leading practice in Ecologically Sustainable Development (ESD) for employment precincts. These investigations enabled the provision of key opportunities and recommendations for the integration of sustainable development with the Arden Precinct.

2. Stormwater Drainage and Flooding Infrastructure

2.1 Overview of Melbourne's Stormwater Drainage Network

The primary purpose of Melbourne's stormwater drainage network is to minimise the impact of flooding, by directing stormwater caused by rain events away from developed areas into the bay.

Drainage Authorities are responsible for the installation and maintenance of drainage infrastructure including drainage system capacity and mitigation of floodwater.

Stormwater drainage infrastructure varies significantly in size and type. Local councils are responsible for catchment areas within their municipalities less than 60 hectares, and their infrastructure includes local drains such as underground pipelines and open drains, as well as street gutters and the pits that connect the gutters to the underground pipes. Melbourne Water Corporation (MWC) is responsible for the larger regional drainage network servicing areas over 60 hectares, as well as waterways and floodplains.

2.2 Responsible Authorities

The regional drainage network in the Arden Precinct is managed by MWC. The City of Melbourne Council (CoM) is responsible for local drainage infrastructure.

2.3 Existing Conditions

Existing stormwater drainage assets and associated overlays are shown in Appendix C.

2.3.1 City of Melbourne Infrastructure

CoM has drainage assets throughout the Arden Precinct with diameter sizes varying from 225 mm to 1350 mm.

Within the Arden North sub-precinct, CoM drainage assets can be found on Langford, Gracie, Henderson, Green and Fogarty streets. The drainage pipes on these streets have diameters ranging from 300 mm to 700 mm and are predominantly located within road reserves. A 1275 mm diameter drainage pipe also runs along a portion of Arden Street, adjacent to the North Melbourne Recreation Reserve.

In the Arden Central sub-precinct, a 225 mm diameter drainage pipe is located within the road reserve in Barwise Street. 450 mm and 1350 mm diameter drainage pipes run east-west within the Arden Central sub-precinct parallel to one another. CoM has a drainage pipe located in the proposed Queensberry Street extension, beginning with a 750 mm diameter and becoming a 1200 mm diameter. A 750 mm diameter pipe connects to this infrastructure at the intersection of Queensberry and Laurens Streets and then runs parallel to the previously mentioned 750 mm diameter pipe. CoM also has a 900 mm diameter pipe crossing through the Arden Central sub-precinct running approximately parallel to the existing rail reserve to the west of the sub-precinct.

CoM has drainage pipes throughout the Laurens Street sub-precinct, located primarily within road reserves. These drainage pipes vary in diameter, from 225 mm to 600 mm.

CoM advised that its stormwater infrastructure is almost 100 years old. It advised that the capacity of infrastructure varies between a 1 in 10 year rainfall event and a 1 in 20 year rainfall

event. CoM does not know the invert levels of its infrastructure within the Arden Precinct and advised that these levels would need to be verified on site.

2.3.2 Melbourne Water Corporation Infrastructure

MWC manages the Melbourne Water Arden Street Main Drain, comprising two stormwater drains extending along both sides of the road on Arden Street. This asset is over 100 years old, and comprises a 2450 x 1830 mm drain on the northern side of Arden Street and a 1800 x 1775 mm drain on the southern side of Arden Street. An 1800 mm diameter drain connects to the northern main drain and then crosses through the North Melbourne Recreation Reserve to Macaulay Road.

2.3.3 Existing Flood Conditions

MWC provided the following advice in 2018 regarding the wider Arden-Macaulay Precinct:

> *Flooding is a threshold issue that must be resolved. Around 330 properties across 45 hectares are currently exposed to very serious flooding where the flood depth is greater than 500 mm for longer than 2 hours. This will worsen with climate change and upstream infill development.*

Drainage of low lying areas of the Arden Precinct relies on pump stations and flood gates.

MWC provided the following advice on existing flood conditions within the Arden Precinct:

> *Overall, flooding within the Arden Macaulay Precinct can be attributed to the following factors.*
>
> – *High flood levels in Moonee Ponds Creek overtopping the levees and flowing into low lying areas. The high flood levels in the creek are caused by a combination of flows from the upstream catchment, downstream tidal levels and the hydraulic restriction of bridges.*
> – *Local flows from within the [Arden Precinct] and upstream local catchments draining to low lying areas, and once runoff is in the low lying areas, the drainage system is unable to convey flow into Moonee Ponds Creek when the water level in the creek is higher than the water level in the local catchment. While the existing flood mitigation measure of the creek's levees reduces the severity of flooding in the local catchment, it also raises the flood level in the creek, increasing the constraint of the tail water level on the local drainage system.*

2.4 Flood Overlays

There is a risk of overland flow inundation in parts of the Arden Precinct, characterised by the presence of a Special Building Overlay (SBO) as depicted in Appendix C. This SBO affects a small area to the north-east of the Arden North sub-precinct. Overflow inundation, also known as stormwater flooding, refers to the flooding that occurs when runoff from a catchment exceeds the capacity of the underground of piped drainage network and passes overland. Areas affected by the overland flows are referred to as overland flow paths. The purpose of the SBO is to set appropriate conditions and building floor levels to address the flood risk and to ensure that flood waters are not obstructed or diverted by development.[13]

The underground drainage system in Melbourne is generally designed to manage rain events that have a 20% chance of occurring in any year. The flood level categorised by this rain event is known as the 5-year ARI level, as it is predicted to occur once every 5 years. For land developed since the mid 1970s, the 100-year ARI stormwater flows up to the level caused by rain events with a 1% chance of occurring in any year, are managed by conveying stormwater

13 https://www.melbournewater.com.au/sites/default/files/Flood-prone-area-development-guidelines.pdf

through overland paths, such as floodways, roads and channels. As outlined above, CoM believes that its underground network is likely designed for a 10-year ARI level.

A significant area of the Arden Precinct is affected by a Land Subject to Inundation Overlay (LSIO), predominantly on the western portion of the Arden Precinct as depicted in Appendix C. Almost the entirety of Arden North is subject to the LSIO, as is just over half of the Arden Central sub-precinct. The LSIO identifies land in a flood storage or flood fringe area affected by the 100-year ARI stormwater flows, and relates to flooding along major waterways. The LSIO only required a permit for buildings and works and does not prohibit either use or development.

Planning conditions that attach *generally* to developments within flood prone areas are summarised below:

- Development must not affect floodwater flow capacity: developers must ensure existing flood risks are not made worse by alterations to the flow characteristics of the overland flow path
- Development must not reduce floodwater storage capacity
- Developments in overland flow paths should ensure that building and garage floor level heights should be set a minimum of 300 mm and 150 mm respectively, above the maximum level that would be reached by floodwaters during a 100-year ARI flood event, the current flood protection standard
- Developments in floodplains should ensure that building and garage floor level heights should be set a minimum of 600 mm and 300 mm respectively, above the maximum level that would be reached by floodwaters during a 100-year ARI flood event, the current flood protection standard
- Development must not be allowed on properties where the depth and flow of floodwaters would create a hazard. This requirement is to ensure that people moving about on a property during a flood event are not endangered by deep or fast-flowing water.

MWC is the approval Authority for development of land within the SBO, therefore development within these areas is referred to MWC to ensure it is appropriately designed for flood restrictions and to ensure overland flow paths are maintained.

2.5 Planned Upgrades & Redevelopment Scenarios

Both CoM and MWC are coordinating their planned infrastructure works within the Arden Precinct with proposed redevelopment. CoM and MWC are collaborating with the VPA to provide stormwater drainage strategies to service the Arden Precinct.

2.5.1 City of Melbourne Infrastructure

CoM advised that it has planned works within the wider Arden Macaulay Precinct, and this information is summarised below in Table 5.

Table 5 City of Melbourne Planned Infrastructure Works

Upgrade Works	Estimated Project Cost	Estimated Year of Construction
Upgrades to 6 pump stations	$16.8 million	2021 – 2022
Construction of high capacity inlet drainage pits	$20,000	2022 – 2023
Construction of pressure drainage pipes	$7.7 million	2021 – 2022
Upgrade to existing gravity drainage pipes	$4.4 million	2021 – 2022

CoM advised that these upgrades are intended to decrease the impact of flooding issues in the wider Arden Macaulay Precinct. It also advised these upgrades are currently in concept stage and could not provide further information regarding the details and locations of proposed upgrades.

2.5.2 Melbourne Water Corporation Infrastructure

MWC advised that its planned upgrades are consistent with the findings of various flood management reports undertaken for the wider Arden Macaulay Precinct. The drainage upgrade works scenarios outlined in these reports are summarised below:

- Raised and extended levees for the Moonee Ponds Creek
- Flood storage in Stubbs Street
- Flood storage in Arden Central
- Flood storage in Langford Street
- An underground flood storage tank within the North Melbourne Recreation Reserve
- Upgrades to 6 pump stations
- Upgrades to gravity pipes within the Arden Precinct
- Pressure pipe upgrades, including pressuring the Arden Street Main Drain
- Works to the bridge crossings of the Moonee Ponds Creek at Arden Street, Macaulay Road and the first rail bridge downstream of Arden Street

MWC noted that modifications are expected to the Moonee Ponds Creek levee bank, and the levees will be raised as part of the Development Services Scheme and delivered as needed for the development. The total raised height of the levees is still to be confirmed.

MWC confirmed that its anticipated growth in the Arden Precinct is consistent with the VPA's growth estimates.

The timing of MWC upgrade works will be coordinated to support redevelopment in the Precinct.

MWC advised that CoM is also delivering drainage infrastructure in the Arden Precinct and as CoM is integrating open space considerations, CoM is likely to co-manage any above ground storage works.

2.6 General Requirements

2.6.1 City of Melbourne Infrastructure

Any realigned or new drainage to be vested in CoM would need to be located within the proposed road reserves and laneways or if located within private property drainage easements would need to be created in CoM's favour.

2.6.2 Melbourne Water Corporation Infrastructure

MWC advised that it generally requires an easement width of minimum 6 metres from its main drain infrastructure, and this includes a 1.5 metre minimum lateral clearance from the outside edge of the drain on both sides.

Developers will need permits for construction where works are within 5 metres of the outside edge of a stormwater drain or other main asset, or where vibration will impact assets. This could result in a setback being imposed by MWC if the property boundary is within 5 metres of the asset. MWC do not require permits for works within 5 metres of abandoned assets.

MWC advises that developers should consult MWC as early as possible in the redevelopment process regardless of whether an SBO or a MWC asset impacts their site. Clause 56 of the Victorian Planning Provisions sets stormwater management objectives that residential subdivisions must meet, and therefore a portion of planning permit applications are referred to MWC whether or not developers choose to consult with them.

2.7 Cost Allocation

2.7.1 City of Melbourne Infrastructure

CoM advised that as the VPA is producing the delivery strategy for the Arden Precinct, the funding model for the infrastructure works has not been determined. It advised that there will be an interim Development Contributions Plan (DC) utilised and a permanent DCP will be realised upon the completion of the Arden Precinct Structure Plan.

2.7.2 Melbourne Water Corporation Infrastructure

MWC estimated that the capital expenditure associated with planned stormwater drainage upgrade works is approximately $200 million. MWC is currently exploring the use of a Development Services Scheme (DSS) and will proceed with consultation over the next few months. It will be funded solely via contributions from public and private landowners in the wider Arden Macaulay Precinct. The application of a DSS is subject to consultation with the development industry. MWC confirmed it will not be funding infrastructure within the Arden Precinct through its Waterways and Drainage Charge.

3. Water Infrastructure

3.1 Overview of Melbourne's Water Network

In the metropolitan area of Melbourne there are three water retail corporations and one supplier. Melbourne Water Corporation (MWC) manages the source and supply of water and manages delivery to water retailers via trunk water mains. Water retailers supply water from these mains to individual developments or users within a specified geographic region of Melbourne.

The Victorian water industry is regulated by the Essential Services Commission (ESC).

3.2 Responsible Authorities

There are no MWC trunk water supply assets in the Arden Precinct. City West Water (CWW) is the water retailer responsible for the distribution and reticulation infrastructure within the Arden Precinct.

3.3 Existing Conditions

Existing potable water assets are shown in Appendix C. There are no non-potable water assets within the Arden Precinct.

CWW has a 355 mm diameter polyethylene (PE) transfer main extending along Macaulay Road in the Arden North sub-precinct. Additionally, a 375 mm diameter cast iron (CI) transfer main runs along the northern side of Arden Street and a 300 mm diameter mild steel cement lined (MSCL) transfer main extends along the southern side of Arden Street. Within the road reserve of Arden Street is an abandoned water main. There are also potable reticulation mains present throughout the Arden North sub-precinct of both 100 mm and 150 mm diameter sizes.

Although there are no CWW assets within the Arden Central sub-precinct., the sub-precinct is bounded by a 300 mm diameter CWW pipe to the north, and a 100 – 150 mm diameter CWW pipe to the east.

In the Laurens Street sub-precinct on Arden Street, there is the continuation of the 375 mm diameter CI and 300 mm diameter MSCL potable transfer mains from the Arden North sub-precinct. There are also potable reticulation mains throughout the Laurens Street sub-precinct varying in diameter sizes between 100 mm and 225 mm.

CWW considers the existing Arden Precinct area well serviced by water infrastructure.

3.4 Planned Upgrades

CWW advised the 375 mm diameter water main on the north side of Arden Street was constructed in 1889 and is due for renewal. CWW highlighted in yellow the area of water main due for renewal in Figure 2 below. The timing of this renewal is yet to be confirmed. CWW advises that apart from this transfer main, generally, water mains in the Arden Precinct do not need renewal in the short term.

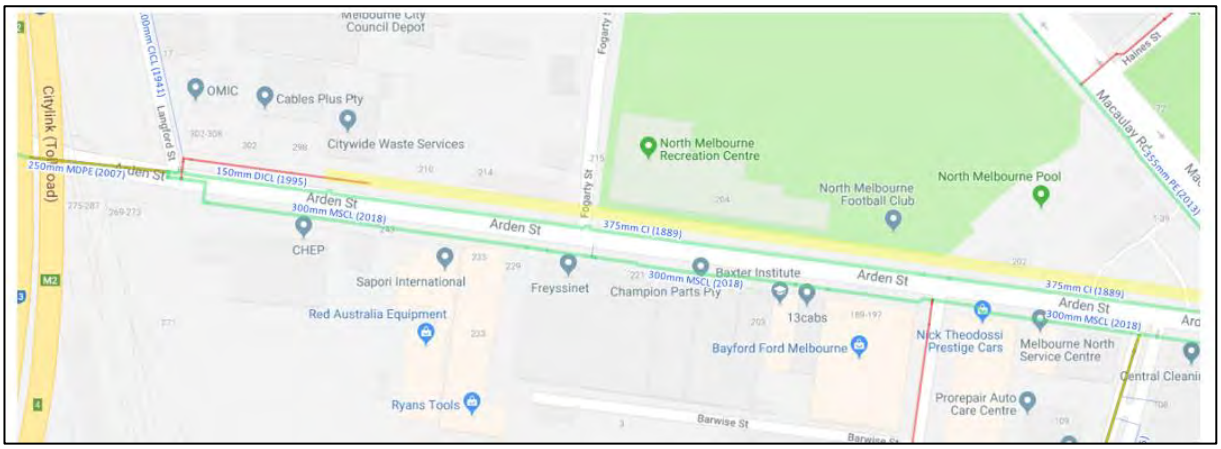


Figure 2 Required renewal of 375 mm diameter water main on the north of Arden Street

Source: City West Water, 2019

3.5 General Requirements

3.5.1 Residential Requirements

CWW's *Land Development Manual*[16] notes that lots of a size less than 4000 metres^2 should be provided with a reticulated water supply service.

3.5.2 Multi Unit Developments

For both residential and industrial / commercial multiple unit developers, developers can choose to install common water supply infrastructure either to:

- AS/NZS 3500 Acceptable Solutions, or AS/NZS 3500 Performance Requirements, with the Owners Corporation owning, operating and maintaining the works, or
- WSAA MRWA standards with CWW owning, operating and maintaining the assets.

All dwellings on the site should be within 130 meters of the nearest fire hydrant based on fire authority requirements.

3.5.3 High Rise Developments

All high rise developments must have CWW water services to the property boundary. The maintenance, operation and replacement of the internal plumbing is the responsibility of the property owners.

CWW guarantees water quality, pressure and flow to the meter of each development but an alternative solution may be required to deliver the same level of service to the upper floors. CWW outlines three typical options to deliver an acceptable level of service to high rise developments:

- Install tank storage on the ground floor level supplied by a pump located on ground floor level
- Install tank storage on the roof level of the building supplied by a pump located on a lower floor level
- Install an inline booster pump connected directly to the water supply network.

16 https://www.citywestwater.com.au/building_renovating/land_development.aspx

3.5.4 Existing Services

The *Land Development Manual* outlines key guidance for the treatment of existing services and is as follows:

- Where an existing service is to be realigned due to redevelopment or changes to the subdivision of land, the property owner is liable for all associated costs
- Where an existing service needs to be abandoned due to redevelopment or changes to the subdivision or land, the property owner is liable for all associated costs and may have to pay the undepreciated value of the service.

3.5.5 Easements and Reserves

The Plan of Subdivision must establish easements to cover any new water service that is proposed to cross private land and all easements need to comply with Section 12 of the Subdivision Act 1988. Reserves need to be established where the proposed water service crosses land owned by another Government Authority.

3.6 Redevelopment Scenarios

CWW advised that the key required upgrades of the water servicing strategy are as follows:

- The existing 300 mm diameter and 375 mm diameter mains have capacity to supply water the Arden Central sub-precinct
- New 150 mm diameter reticulation mains will be required in the Arden Precinct to service the high-density development
- New distribution and reticulation infrastructure will be required in the Arden Central sub-precinct to supply individual allotments
- New connections will be required to the existing water mains on Arden Street
- One of the new connections will be a 225 mm diameter main along Laurens Street with an approximate length of 400 meters
- The other is a new 300 mm diameter main along Fogarty Street with an approximate length of 220 meters

CWW also advised that the existing 100 mm diameter water mains within the Laurens Street and Arden North sub-precincts may also require upsizing depending on the local development requirements.

3.6.1 Provision of Alternative Water

CWW led an investigation into the provision of alternative water within the wider Arden Macaulay Precinct in October 2018. The investigation was completed by GHD and included engagement with MWC, CoM, VPA and the Department of Jobs, Precincts and Regions (DJPR). CWW outlined that the key findings were:

- All above organisations are supportive of an alternative water supply to the Arden Precinct
- The business case requires further development prior to confirmation of the final scheme
- Possible sources of alternative water include stormwater harvesting and sewer mining
- Land for a stormwater treatment plant will be required and must be allowed for in the PSP
- Land for water storage is also required and CWW advises its preference is to co-locate this storage facility with MWC's proposed flood storages

- CWW suggests that a natural stormwater treatment and storage asset along Langford Street is an opportunity to deliver stormwater quality, greening and amenity benefits to the Arden Precinct

The following points summarise further key information the above investigation:

- Rainwater tanks are expected in 90% of buildings and were therefore considered in the base case for the alternative water investigation
- The options presented focused on the non-potable demands of the Arden Central sub-precinct
- There are non-potable demands in the other sub-precincts and these would be partially supplied with alternative water from CoM stormwater quality policies (i.e. rainwater tanks)
- It is more economical to construct alternative water within sub-precincts that are to be completely redeveloped and therefore it is expected that a wider variety of integrated water management (IMW) options will be available within the Arden Central sub-precinct
- The provision of recycled water from the Fishermans Band sewer mining plant is technically feasible, but it may be cost prohibitive and its commercial viability has not been explored to date
- As there is uncertainty in relation to non-potable water demand estimates, a flexible adaptive alternative water solution may be preferable to a fixed solution
- The following IWM planning gaps for the Arden Precinct were outlined in the 2018 report:
- CWW has yet to determine its key strategic intentions within the Arden Precinct, which should be taken into consideration with the parallel planning efforts
- Decisions around alternative water use within buildings will need to be made soon, so that they can be included within the VPA and CoM Arden Structure Plan which is currently under development

CWW clarified in its advice that its strategic intention is to provide fit for purpose water servicing, and that the issue is finding an adequate business case. It advised that CWW is committed to further investigating the business case for an alternative water supply into the Arden Precinct, and that CWW is working closely with the VPA, DJPR, CoM and MWC to further understand details of preferred options and to investigate funding opportunities to improve the business case.

3.7 Cost Allocation

CWW advised that the cost allocation principles to provide water supply for the Arden Precinct are the general principles applying to all developments as outlined below.

3.7.1 Shared Distribution Assets

CWW is responsible for providing shared infrastructure assets (such as headworks, treatment plants, pumping stations and trunk mains) with sufficient capacity in accordance with CWW's predetermined development plan.[19] Where proposed development will require the provision of shared distribution assets earlier than was has been planned by CWW, developers will be responsible for the costs associated with bringing forward the provision of these assets ahead of CWW's asset development sequence.

19 City West Water *https://www.citywestwater.com.au/documents/land_development_manual.doc*

3.7.2 Reticulation Assets

Developers are responsible for providing reticulation assets and for the cost of connecting those assets to CWW's existing infrastructure. Reticulation assets are generally defined as water mains or recycled water mains that are 150mm or less in diameter.

Generally, if a development requires extensions or upgrade works to the water network, the developer has to arrange and pay for construction. A reimbursement is payable by CWW when shared distribution assets are required to be constructed for a development and the reimbursement provided varies with the type and value of the asset.

Temporary works must be approved by CWW and costs would be attributable to the developer.

If existing CWW assets require alteration as a result of a proposed development, the developer must pay the actual cost of this work.

3.7.3 New Customer Contributions

CWW may levy new customer contributions (NCC) by scheduled charges on any connection of a new customer that is separately titled or can be individually metred. The contribution is standard for all lot sizes and is $713.80 per lot. An NCC applies to each separate service provided by CWW including water, recycled water and sewer.

If the cost of providing infrastructure for a development varies materially from that assumed in the scheduled NCC, CWW may calculate and apply a negotiated NCC.

3.7.4 Application Fees

Application fees must be paid by developers in accordance with CWW's *Land Development Manual.* Application fees may be charged due to:

- Connection or disconnection application to CWW's network
- Early release of a Statement of Compliance
- Audit
- Supply pressure and flow information request
- Build over easement application
- Operations and maintenance for temporary works
- Issue or revision of a development deed

4. Sewer Infrastructure

4.1 Overview of Melbourne's Sewerage Network

MWC provides bulk sewerage services in the Melbourne Metropolitan area and controls the headworks and major sewerage treatment plants in Melbourne. Three retail companies operate distribution and reticulation sewerage system services within specified geographical regions of metropolitan Melbourne.

The Victorian sewer industry is regulated by the Essential Services Commission (ESC).

4.2 Responsible Authorities

MWC is responsible for the trunk sewerage network in the Arden Precinct. CWW is the authority responsible for the distribution and reticulation sewerage network in the Arden Precinct.

4.3 Existing Conditions

Existing sewerage assets are shown in Appendix C.

4.3.1 City West Water Infrastructure

The CWW sewer network in the Arden Precinct is predominantly comprised of vitrified clay (VC) sewer pipes. Within the Arden North sub-precinct there are sewer pipes with diameters varying between 142 mm and 225 mm. There is a 150 mm VC sewer pipe within the road reserve of Barwise Street in the Arden Central sub-precinct. The Laurens Street sub-precinct is reticulated with sewer pipes varying between 90 mm and 225 mm.

CWW has advised that most of the local reticulation sewer network is over 100 years old, and the existing Arden Precinct is well serviced by existing major sewerage infrastructure.

4.3.2 Melbourne Water Infrastructure

MWC has a 2100 mm diameter trunk sewer, the North Yarra Main, running along Arden Street that crosses through the North Melbourne Recreation Reserve to Haines Street. Previous studies have indicated that the sewer is located approximately 11 metres below the existing surface level and its condition is not known.

4.4 Planned Upgrades

CWW advised that the Cross Yarra Partnership (CYP) are doing works in the area around surrounding the MWC maintenance hole NYM36.

4.5 General Requirements

4.5.1 Residential Requirements

CWW's *Land Development Manual*[21] notes that lots of a size less than 4000 metres^2 should be provided with a reticulated sewerage service.

4.5.2 Multi Unit Developments

For both residential and industrial / commercial multiple unit developers, CWW advised that developers should install common sewerage infrastructure either to AS/NZS 3500 Acceptable Solutions, or AS/NZS 3500 Performance Requirements, with the Owners Corporation owning,

21 https://www.citywestwater.com.au/building_renovating/land_development.aspx

operating and maintaining the works as CWW would prefer not to own assets in private property where possible.

4.5.3 High Rise Developments

All high rise developments must have a CWW sewer connection to the property boundary. The maintenance, operation and replacement of the internal plumbing is the responsibility of the property owners.

4.5.4 Existing Services

The *Land Development Manual* outlines key guidance for the treatment of existing services and is as follows:

- Where an existing service is to be realigned due to redevelopment or changes to the subdivision of land, the property owner is liable for all associated costs
- Where an existing service needs to be abandoned due to redevelopment or changes to the subdivision or land, the property owner is liable for all associated costs and may have to pay the undepreciated value of the service.

4.5.5 Easements and Reserves

The Plan of Subdivision must establish easements to cover any new sewer service that is proposed to cross private land and all easements need to comply with Section 12 of the Subdivision Act 1988. Reserves need to be established where the proposed sewer service crosses land owned by another Government authority.

All sewer constructed within private property will require the creation of an easement in CWW's favour. Easements shall be design in accordance with WSA 02-2014-3.1 Clause 5.2.8 (Easements). All buildings and dwellings constructed within private property must comply with CWW's Build Over Easement (BOE) conditions.

4.5.6 Sewer Location

- The following summarises general advice provided by Melbourne's sewer Authorities regarding the location of sewer infrastructure:
- Sewers shall be located in accordance with WSA 02-2014-3.1 Clause 5.2.4
- Sewers shall only be located along the rear boundary of private lots where reasonable access to the sewer is maintained, as outlined in WSA 02-2014-3.1 Clause 5.2.4.3
- For sewers proposed to be located along the rear boundary of private lots, a Plan of Subdivision showing building envelopes must be submitted with the sewer design drawings to verify that access requirements can be met
- Where compliance with access requirements cannot be verified at the design stage, the sewer must be located in public or road reserve.
- Generally, maintenance holes shall not be located in the rear of private property without reasonable access
- Notwithstanding any other requirements, sewers servicing industrial/commercial allotments shall be located in the road reserve
- Unless noted otherwise, internal sewers must be extended to the development's upstream boundary and be designed and constructed to control upstream catchments
- Sewers and maintenance assets adjacent to structures such as buildings and retaining walls shall be located clear of the zone of influence of the structure's foundations to ensure

that the stability of the structure is maintained, excessive loads are not imposed on the sewer and maintenance access is not restricted as per WSA 02-201403.1 Clause 5.4.4

4.6 Redevelopment Scenarios

CWW provided advice regarding the MWC North Yarra Main and stated that this asset has capacity to service the Arden Precinct redevelopment.

4.6.1 Arden Central

CWW advised that its servicing strategy assumes the Arden Central sub-precinct will drain into the NYM36 structure on the MWC's North Yarra Main sewer and its advice is based on this assumption. CWW advised the following connection works would be required at NYM36:

- A new maintenance hole NYM36-1 will be required to service Arden Central, located approximately 1.5 metres into the sub-precinct
- A new sewer of external diameter 376 mm and internal diameter 338 mm will be required to connect this new maintenance hole NYM36-1 to existing NYM36, and will connect at an invert level (IL) of -2.0 metres AHD. Noting this IL may need to deeper to provide clearance under the existing 1800 mm diameter stormwater drain on the south side of Arden Street
- The grade of this new length of sewer will be minimum grade of 1 in 150
- The new maintenance hole is to include provision at table level for a future 300 mm diameter sewer heading south, and a 225 mm diameter sewer heading east

CWW provided the following Figure 3 illustrating its future servicing strategy for the Arden Central sub-precinct. CWW advised that this strategy is future proofed to meet the needs of the Melbourne Metro Tunnel rail project and the future development.

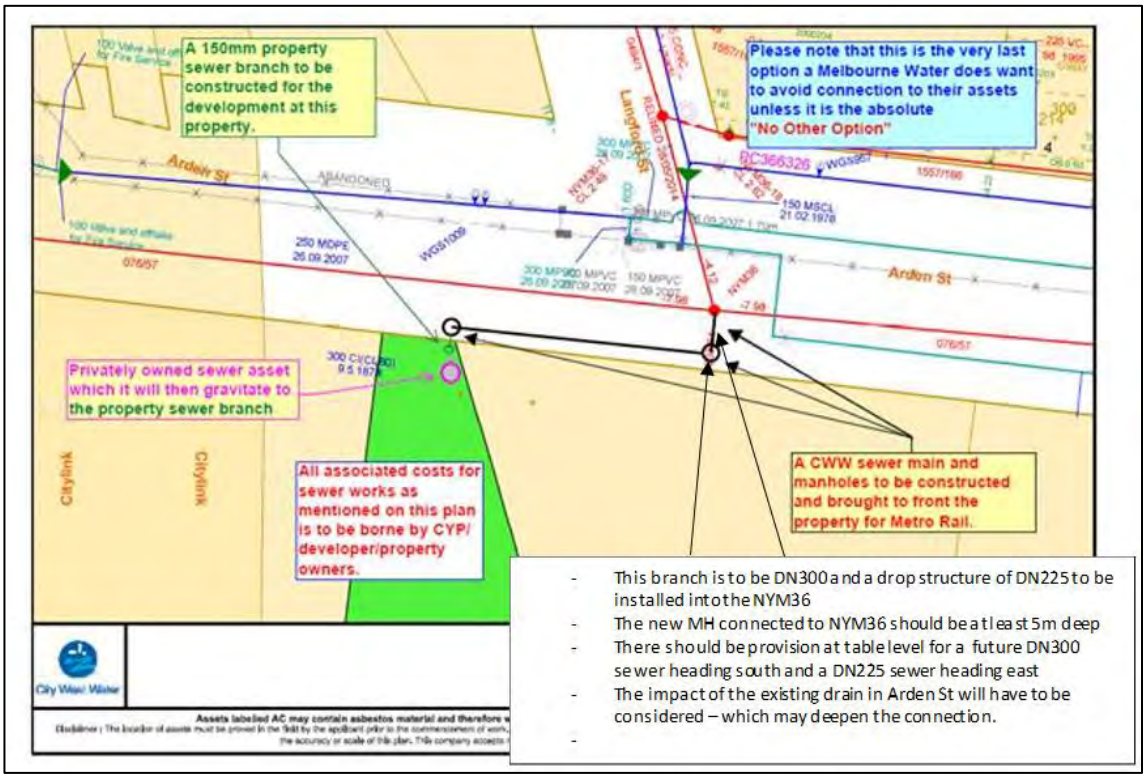


Figure 3 **CWW's** Sewer Servicing Strategy for Arden Central Sub-Precinct

Source: City West Water, 2019

4.6.2 Laurens Street

CWW advised that the following upgrades may be required depending on the location of development density in the Laurens Street sub-precinct:

- An upgrade of the 450 mm diameter NMB branch sewer upstream from the maintenance hole NYM38
- An upgrade of the existing 225 mm diameter sewer on Laurens Street from maintenance hole NMB1 to NBM1-7 with 450 mm and 375 mm diameters. CWW would prefer to divert the Laurens Street catchment through the Arden Central sub-precinct and avoid this upgrade.

4.6.3 Arden North

CWW advised that the Arden North sub-precinct consists of 3 sub-catchments, two of which discharge into MWC's North Yarra Main sewer and 1 which discharges into the 1200 mm diameter MPM. Each sub-catchment is serviced by 225 mm diameter reticulation assets. Depending on the development density, some local upgrades may be required.

4.6.4 Servicing Strategy Summary

CWW provided the following Figure 4 to illustrate its sewer servicing strategy for the Arden Precinct.

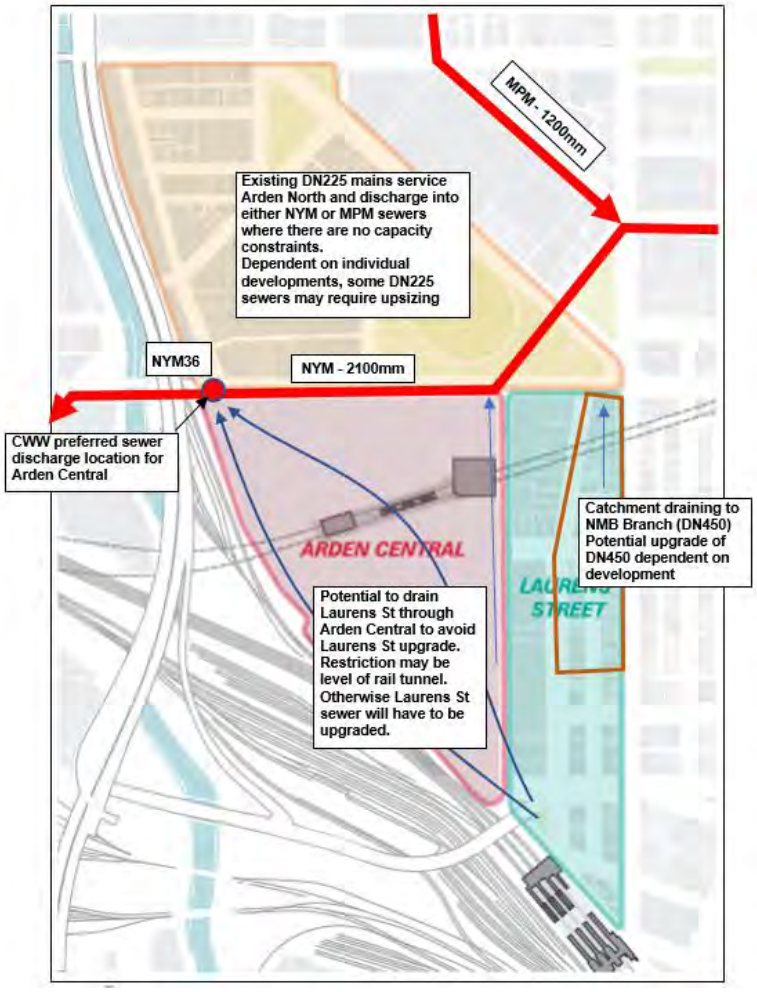


Figure 4 **Summary of CWW's** Sewer Servicing Strategy for the Arden Precinct

Source: City West Water, 2019

As the majority of the local reticulation sewer network is over 100 years old, CWW would like to proactively work with developers to incrementally replace these older assets prior to, or as part of, upgrade works to the roads and streetscape. CWW advises that this will 'mitigate future expensive and disruptive repairs to sewerage infrastructure, the deepest of all services', and that programmed renewal works will enable the required upsizing to be undertaken at a marginal cost. CWW suggests that pre-emptive works are considered likely to deliver lowest community cost on a triple bottom line basis.

4.7 Cost Allocation

CWW advised that the cost allocation principles to provide water supply for the Arden Precinct are the general principles applying to all developments as outlined below.

4.7.1 Shared Distribution Assets

CWW is responsible for providing shared infrastructure assets (such as headworks, treatment plants, pumping stations and trunk mains) with sufficient capacity in accordance with CWW's predetermined development plan.[22] Where proposed development requires the provision of shared distribution assets earlier than had been planned by CWW, developers will be responsible for the costs associated with bringing forward the provision of these assets ahead of CWW's asset development sequence.

4.7.2 Reticulation Assets

Developers are responsible for providing reticulation assets and for the cost of connecting those assets to CWW's existing infrastructure. Reticulation assets are generally defined as sewer mains that are 225 mm or less in diameter.

Generally, if a development requires extensions or upgrade works to the sewer network, the developer has to arrange and pay for construction.

CWW will reimburse the developer for works they have undertaken if CWW requires the developer to build a main that is larger than needed for the developer's development or the works required are larger than reticulation size. A reimbursement is payable by CWW when shared distribution assets are required to be constructed for a development and the reimbursement provided varies with the type and value of the asset.

Temporary works must be approved by CWW and costs would be attributable to the developer.

If existing CWW assets require alteration as a result of a proposed development, the developer must pay the actual cost of this work.

4.7.3 New Customer Contributions

CWW may levy new customer contributions (NCC) by scheduled charges on any connection of a new customer that is separately titled or can be individually metred. The contribution is standard for all lot sizes and is $713.80 per lot. The NCC applies to each separate service provided by CWW including water, recycled water and sewer.

If the cost of providing infrastructure for a development varies materially from that assumed in the scheduled NCC, CWW may calculate and apply a negotiated NCC.

22 City West Water *https://www.citywestwater.com.au/documents/land_development_manual.doc*

4.7.4 Application Fees

Application fees must be paid by developers in accordance with CWW's *Land Development Manual.* Application fees may be charged due to:

- Connection or disconnection application to CWW's network
- Extension of CWW''s network
- Early release of a Statement of Compliance
- Audit
- Flow information request
- Build over easement application
- Operations and maintenance for temporary works
- Mandatory sewer inspection fee
- Issue or revision of a development deed

5. Electrical Infrastructure

5.1 Overview of Victoria's Electrical Network

The electricity 'grid' is the term used to describe the interconnected network that transports electricity generated at power stations to individual properties.

Electricity is generated at power stations across the country, generally located proximate to energy sources. The *transmission* network includes terminal stations and transmission lines, which connect the power stations to the terminal stations. The terminal stations lower the voltage level of the electricity that passes to the *distribution* network, connecting the terminal stations to individual properties. The transmission network is generally categorised as 220 kilovolts and above and the distribution network is 66 kilovolts and below.

The distribution network comprises the following components:

- Sub-transmission lines connect terminal stations to zone substations
- Zone substations
- Distribution feeders: either overhead or underground lines that connect zone substations to local substations
- Local substations: indoor, kiosk or pole mounted
- Low voltage power lines: either overhead lines or underground cables connecting power from the local substations to the customers.

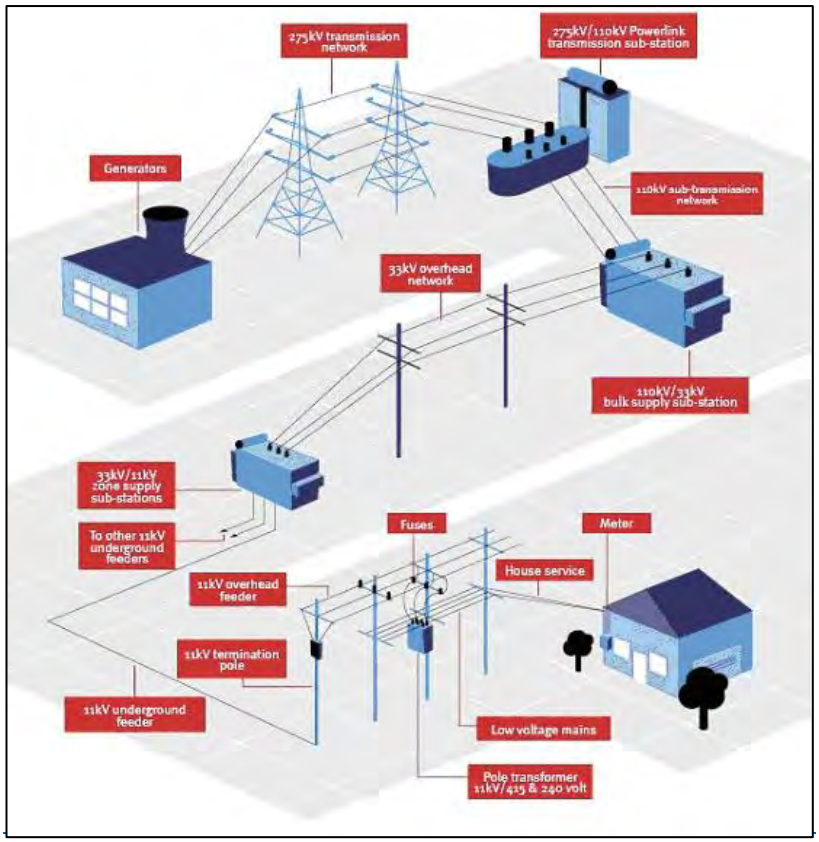


Figure 5 Typical Electricity Transmission and Distribution Network

Source: Australian Energy Regulator 2015 'Consumer guide to Victorian electricity distribution pricing review' p5

5.2 Responsible Authorities

Victoria's electricity industry is privately owned. The transmission electricity network is regulated by the Australian Energy Market Operator and distribution electricity network is regulated by the Australian Energy Regulator.

The entirety of the Victorian electricity transmission network is owned and operated by AusNet Services (AusNet).The distribution network in the Arden Precinct is operated by CitiPower, one of five electricity distributors in Victoria.

Jemena owns a high voltage underground cable crossing into the Arden Precinct in Arden Street but confirmed it does not service the Arden Precinct, and should only be contacted regarding future relocation works if required.

5.3 Existing Conditions

Existing electrical assets are shown in Appendix C.

High voltage (HV) and low voltage (LV) power lines extend throughout the Arden Precinct with a combination of both overhead and underground assets. From previous studies it is understood that the Arden Precinct is serviced from existing 66 kV and 22 kV overhead sub-transmission lines that connect to the West Melbourne Terminal Station (WMTS), and service the Victoria Market Zone Substation (VMZS) and the Laurens Street Zone Substation (LSZS) respectively.

CitiPower advised that the LSZS is at the end of its life and will not be servicing the Arden Precinct.

5.4 Planned Upgrades

CitiPower highlighted the following key upgrades planned for the Arden Precinct:

- The existing LSZS is being decommissioned over the next couple of years as part of the decommissioning of the 22 kV network in West Melbourne
- CitiPower is currently upgrading the network in this area from 6.6 kV to 11 kV to offload the LSZS and the existing 22 kV sub-transmission line will be decommissioned
- CitiPower is currently assisting AusNet in the upgrade of the WMTS. Having reached the end of its operational life, the WMTS is being rebuilt and redesigned to cater for the Melbourne Metro Tunnel rail project and the Westgate Tunnel road project.[24] CitPower advised that this upgrade will provide flexibility for CitiPower's network in the future.

5.5 General Requirements

CitiPower advised that any asset relocation costs will be at the developer's expense, and CitiPower has no plans to retire or relocate any electrical assets within the Arden Precinct.

CitiPower requires 5 years for load planning to existing terminal stations, and 3 years for planning for load planning to other CitiPower shared network electrical assets.

5.6 Redevelopment Scenarios

CitiPower advised that the electrical servicing strategy key requirements are:

- 2 x 66 kV cable bundles (6 cables) will be required to run between the WMTS and the LSZS for the operation of the Melbourne Metro Tunnel rail project

24 https://www.ausnetservices.com.au/Projects/Terminal-Stations/West-Melbourne-Terminal-Station

- 1 x 22 kV cable bundle (4 cables) will be required to extend from the LSZS to the North Melbourne Train Station Substation (NMTSS) to service other parts of the network.
- 1 x 66 kV cable bundle (3 cables) will be required to run between the WMTS and the LSZS zone substation to service the Arden Central Precinct.
- The conduits required for the above works should all be trenched at the same time to avoid future works adjacent to live cables.
- Distribution substations will be required through the Arden Precinct and the exact location of these is dependent on the density and demand requirements of future development

CitiPower also provided the following advice regarding the future electrical servicing of the Arden Precinct:

- The initial stages of development in the Arden Precinct will be supplied by the existing electrical network infrastructure, and may be supplied from an 11 kV feeder from either the VMZS or the Bouverie Queen Zone Substation (BO), depending on the capacity available at the time.
- The 66 kV electrical service corridor has already been constructed in the Queensberry Street Extension. This current infrastructure includes the 66 kV cables and ancillary infrastructure required for the Melbourne Metro Tunnel rail project. This service corridor also includes 7 x 63 mm diameter conduits and 14 x 150 mm diameter conduits for the future servicing of the Arden Precinct.
- CitiPower requires details regarding the quantity of electrical customers, a future load profile and future demand to begin planning network augmentation
- A new zone substation will be required to service the full redevelopment of the Arden Precinct
- There is potential for the new zone substation required to service development to be located on the site of the existing LSZS
- CitiPower confirmed the following key challenges in planning electrical infrastructure in the Arden Precinct:
- CitiPower would like confirmation of the future road network and future road cross sections to plan for its infrastructure and to understand if there will be opportunities for synergy in infrastructure location
- CitiPower would like confirmation as to the likelihood that the LSZS will be heritage listed

CitiPower has high level plans to rebuild the LSZS as an indoor substation, and hopes to combine the substation building with another land use and integrate it aesthetically into the Arden Precinct. If the LSZS receives heritage status, CitiPower advised that it may sell the LSZS land and will require new land within the Arden Precinct.

5.7 Cost Allocation

CitiPower has previously provided advice to the VPA regarding cost allocation summarised in the following bullet points:

- CitiPower will be responsible for the costs associated with the augmentation and new works of the zone substation, distribution substations, and the 66 kV and 22 kV sub-transmission cables
- The cost of the 22 kV and 66 kV network was estimated at approximately $917,000
- Developers will be responsible for a customer network contribution for the provision of this infrastructure, and the rate typically varies from $500 / MVA to $500,000 / MVA, with larger projects paying less per MVA
- In situations where there is no current developer, CitiPower may elect to forward fund the required works, which may be then be subjected to a reimbursement approach as development occurs at a future time, or the Victorian Government may fund these works.

CitiPower's *Connection Policy*[26] sets out the circumstances in which connection applicants may be required to pay connection changes to CitiPower and explains how those charges will be calculated, by applying the principles set out in the National Electricity Rules and Australian Energy Regulator's *Connection Charge Guidelines for Electricity Retail Customers.*[27]

- Planned upgrade works initiated by CitiPower will generally be funded by CitiPower. Should any upgrade works be initiated by customers as a result of new supply or an increase in supply, the customer will be required to pay a contribution towards the works.
- CitiPower does not have a mandatory policy in place that requires developers to relocate existing high and low voltage assets underground. Undergrounding assets is based on developer requirements, or if construction does not comply with CitiPower's No Go Zone requirements.
- Undergrounding of existing overhead assets would need to be fully funded by the developer. Costs vary according to the type and location of the existing assets.

26 Available at <https://media.powercor.com.au/wp-content/uploads/2018/11/26113220/citipower-connection-policy-v11.pdf

27 Available at < https://www.ausnetservices.com.au/-/media/Files/AusNet/New-Connections/National-Electricity-Rules-chapter5A.ashx?la=en>

6. Gas Infrastructure

6.1 Overview of Victoria's Gas Network

The gas network in Victoria includes transmission and distribution pipelines. The transmission of natural gas involves transporting gas through pipelines from extraction to reticulation processing facilities and direct supply to major customers.

Gas is depressurised at either city gates or field regulators to appropriate pressures for the distribution of gas to final users through the distribution network, which can include commercial and industrial users as well as residential users. Gas is transported in smaller volumes and at lower pressures through the distribution network.

6.2 Responsible Authorities

APA Group owns the gas transmission network and APT O&M services (APA) operates and manages the natural gas reticulation network within the Arden Precinct on behalf of Australian Gas Networks (AGN).

The Australian Energy Regulator administers the National Gas Law and Rules that governs the gas networks in eastern Australia.

Ausnet Services (AusNet) responded to the DBYD request however upon consultation indicated that it does not service the Arden Precinct.

6.3 Existing Conditions

Existing gas supply assets are shown in Appendix C.

6.3.1 Transmission Network

A 450 mm diameter transmission pressure gas pipeline is present throughout Arden North and Laurens Street sub-precincts. This pipeline runs along Green and Fogarty Street where it then extends along Macaulay Road and Dryburgh Street. This transmission pipeline is accompanied by a priority main coverage that governs the clearance to buildings and similar structures.

APA advised that regulatory restrictions from the Australian Standard 2885 Part 6 *Pipeline Safety and Due Diligence* apply to this area. The regulations apply a buffer to the fuel pipeline for a measurement length either side of the existing transmission pipeline.

The 250 mm diameter transmission pipeline has a measurement length of 170 metre and the 450mm diameter transmission pipeline has an associated measurement length of 220 metre. These measurement lengths apply to either side of the pipeline.

6.3.2 Distribution Network

Existing gas distribution assets are located throughout the Arden Precinct in the form of low, medium and high pressure gas mains.

Within the Arden North sub-precinct, high pressure gas mains run along sections of Langford and Boundary Roads, Steel, Straker, Gracie, Green, Henderson and Fogarty Streets and Macaulay Road. High pressure gas mains are also located within title boundaries of properties along Arden Street. A low pressure gas main is located in Macaulay Road, crossing Arden Street to extend along Dryburgh Street within the Laurens Street sub-precinct.

The Arden Central sub-precinct has limited gas distribution assets.

The Laurens Street sub-precinct is predominantly serviced by low pressure gas mains extending through Munster Terrance, Laurens, Stawell, Victoria and Miller Streets. Medium pressure gas mains present along a section of Laurens and Queensberry Streets.

6.4 Planned Upgrades

APA has indicated that there are no planned upgrade works for the Arden Precinct. Recently, gas main renewal works have been completed in the area adjacent to the Arden Precinct.

6.5 General Requirements

Currently, the Crown Land Agreement between the gas authorities and the State Government gives the same rights to Authorities as they would have had if they had a registered easement for assets located within Crown Land, including road reserves. If the land use changes, then easement, licence or lease arrangements may need to be formalised.

Adequate clearances to gas assets needs to be maintained for both asset integrity reasons and in the interest of public safety.

APA requires that the following clearances be maintained from its assets:

- Property boundary to distribution sized gas main less than 100mm diameter: 1 metre
- Property boundary to distribution supply gas mains greater than 100mm diameter: 2 metres
- In high density areas, distribution supply gas mains greater than 100mm diameter are required to be offset a minimum of 3 metres from the predominant building boundary, regardless of their alignment

The measurement length and buffer governs the area where development should be carefully designed from a safety perspective. These regulations state that the following land uses must *generally* be excluded from the measurement length:

- Child care centres
- Cinemas
- Corrective institutions
- Schools
- Hospitals
- Places of assembly
- Places of worship
- Residential aged care facilities
- Retirement villages.

Other requirements imposed by the regulations are:

- No permanent structures to be located within 3 metres of a distribution pipeline
- Additionally for transmission pressure gas pipelines, the minimum clearance to any structures or buildings (including canopies) can vary from 3 metres to 8 metres. This clearance is dependent on the nature of the structure and location of the transmission pipeline asset. Approval by Energy Safe Victoria (ESV) following review and acceptance by APA is also required for any buildings within 3 metres of a transmission pipeline asset.
- All new development or works must be sited to provide unobstructed vehicle access to transmission gas pipelines including a minimum access width of 9 metres for emergency services vehicles and 12 metres for maintenance vehicle access

APA provides the following summary information regarding developments in the vicinity of transmission pipelines:[28]

- APA's pipelines are designed, constructed, operated and maintained in accordance with Australian Standard 2885 Part 6 Pipeline Safety and Due Diligence to ensure the integrity of the pipeline and community safety
- APA must manage any emerging risks in accordance with the above Australian Standard, including land use change
- The associated requirements, risks and issues around pipeline safety are incorporated in the design phase of any planning scheme or developments. This is particularly the case when planning for sensitive-type land uses such as retirement homes, hospitals and schools

A Safety Management Study (SMS) is required for developments within the measurement length of a transmission pipeline. An SMS is required to evaluate the risks associated with both future land use and construction activities and assign mitigation controls. Additionally an SMS will identify appropriate protection measures and manage risks associated with the transmission pipeline.

If an upgrade to underground power is required, APA requires a minimum of 1 metre separation between the gas main and low voltage distribution electricity. High voltage cable separation will require a referral to a qualified Engineer for design.

APA requires that buildings, or parts of buildings including canopies, awnings and verandas, are not built over existing gas assets.

6.6 Redevelopment Scenarios

APA has advised that the current capacity of existing gas infrastructure is inadequate to support indicative redevelopment loads.

APA advised that its servicing strategy for the Arden Precinct is to match gas asset sizing to reasonable estimates of the gas requirements throughout the Precinct.

To support redevelopment in the Arden Precinct, in particular Arden Central, existing gas assets will need to be reinforced to support gas reticulation throughout the precinct. These works will also include additional gas injection to the distribution network in the form of either a pressure reducing station or below ground kiosk.

A Safety Management Study (SMS) will be required for the Arden Precinct due to the scale of the proposed development and its proximity to the transmission pressure pipeline.

APA advised that the presence of the rail corridor and station box, as well as the availability of future alignments in the area, may result in issues with the staging of development and associated utility infrastructure.

APA was consulted to understand how it could support the Arden Precinct to achieve its goal of reducing greenhouse gas emissions to zero by the year 2050. It stated that APA has an active research program aimed at material selection for a net carbon zero future and that, although the study is in its infancy, modern gas reticulation materials are believed to be generally compatible with a move towards the introduction of carbon neutral gas.

In order to estimate indicative redevelopment loads, APA made assumptions based on past development trends regarding the potential uptake of gas servicing within the Arden Precinct. Any trend towards limiting non-essential gas servicing or policies to restrict gas servicing within

28 https://www.apa.com.au/pipeline-corridors/information-for-planners-and-developers/

the Arden Precinct would decrease the indicative redevelopment loads and would therefore potentially reduce the required future gas infrastructure. This would need to be further investigated and confirmed once gas loads for the precinct are known.

6.7 Cost Allocation

There are two types of tariff arrangements for gas customers depending on the volume of gas required: tariff volume (Tv) customers include residential, small industrial and commercial end customers, and tariff demand customers (Td) include larger commercial and industrial end customers. APA provides general advice for distinguishing between the two customer types based on gas consumption: Tv customers have gas consumption below 10 terajoules per year and Td customers have gas consumption above 10 terajoules per year. Customers such as residential developers usually fall into the category of a Tv customer. Td customers have an extremely high peak hourly load or annual volume required. Cost for gas is less expensive for Td customers but they are liable for greater capital costs in financing extensions and network augmentation.

Typically, provision of gas is at a lower cost to the asset owner for areas where high pressure gas mains are present or in close proximity. Financing of extensions and network augmentation would be economically assessed in accordance with Table 6 below.

Table 6 Gas Tariff Arrangements

	Tariff (volume) Tv	Tariff (demand) Td
Financing of Extensions	Economic Feasibility Tested	Almost always fully chargeable to developer Proposal will be analysed to see if any non-chargeable network benefit would be realised
Financing of Network Augmentation	Funded by APA (specific case dependent)	Economic Feasibility Tested (any revenue shortfall required to establish an economic proposal is generally chargeable to developers unless some augmentation component is incorporated to allow for other non-Td future development)

In line with regulatory requirements gas project funding is determined in several ways. The potential requirement for new infrastructure will be assessed on an individual request evaluation made via a gas Retailer. This evaluation includes a review of the economic viability of the connection based upon the requested demand against the gas supply infrastructure required, inclusive of any mains extensions.

Where a request is made for installation of a gas main to a building or site for the purposes of enabling future connection, with no connection requests being current at the time of installation, the full construction cost is passed onto the developer.

Any development charges, levies or applicant contribution will be deemed applicable on a case by case basis, in line with the requirements of the National Gas Rules.

The costs of relocating APA gas infrastructure are fully attributable to the developer. The cost of any new assets is determined through a comparison of the incremental cost and the future incremental revenue of the asset to be installed, and this is usually determined by the gas retailer.

7. Telecommunications Infrastructure

7.1 Overview of Victoria's Telecommunications Network

Australia has had an open market in telecommunications since 1997, where providers can enter the market and compete to provide infrastructure to new developments. In March 2015, the Australian Minister for Communications released the *Telecommunications infrastructure in new developments policy* (TIND) to increase the efficiency in the provision of telecommunication services.

The key policy change was the introduction of infrastructure contributions to promote fairer and more effective competition, thereby creating greater efficiency, innovation and choice.

The key elements of this policy, with regard to telecommunications providers, are:

- Developers will be able to choose among competing infrastructure providers to service a new development
- Developers will be required to provide 'fibre-ready facilities' in all new buildings, units or lots in a new real estate development
- NBN is the Infrastructure Provider of Last Resort (IPOLR) in developments of 100 lots or more
- Telstra is the IPOLR in developments of less than 100 lots until the NBN network rolls out in the area
- Where an area is already serviced by NBN fixed line infrastructure, NBN has the Right of First Refusal for the telecommunications servicing of new developments regardless of which authority is the IPOLR
- NBN will be able to purchase networks built to its specifications at pre-agreed prices from infrastructure providers, contractors or developers
- Consistent with the NBN multi-technology mix model, NBN will be able to select the technology it will deliver to a development.

The creation of the IPOLR ensures that one provider in an area of its responsibility will be obliged to service a new development, a crucial protection where developments are less commercially attractive to providers.

A key component of the NBN is that it is an open access network. This allows any Retail Service Provider to enter into an access agreement with NBN and ultimately sell services to consumers. The network is a combination of fibre to the premises, fixed wireless and satellite services. The fixed wireless and satellite services are intended for areas where the rollout of fibre optic cable is uneconomical, representing approximately 7% of premises.

7.2 Responsible Authorities

The Arden Precinct is serviced by multiple telecommunication authorities.

NBN is the IPOLR in the Arden Precinct. As the Arden Precinct is located within NBN's fixed line footprint, it will also have the Right of First Refusal to service the development.

7.3 Existing Conditions

Existing telecommunication assets are shown in Appendix C.

7.3.1 AAPT / PowerTel / TPG / PIPE Networks

TPG are responsible for AAPT, PowerTel, TPG and PIPE Network telecommunication assets.

TPG has stated that there are 34 fibre underground cables throughout the Arden Precinct. Within Arden North, PIPE Network cables are located on sections of Green Street and Macaulay Road.

In the Arden Central sub-precinct, there are cables along Laurens Street and Barwise Street.

There are PIPE Network cables throughout the Laurens Street sub-precinct, primarily on Munster Terrace, Dryburgh and Queensberry Streets. There is also a TPG data centre located within the Laurens Street sub-precinct on Dryburgh Street.

7.3.2 AARNet

AARNet has fibre optic assets extending along Macaulay Road in the Arden North sub-precinct. This asset crosses Arden Street to Dryburgh Street in the Laurens Street sub-precinct and enters the TPG data centre.

AARNet has stated that the assets throughout the Arden Precinct are trunk fibre assets and are considered high value assets.

7.3.3 FiberSense

FiberSense responded to the DBYD however upon consultation stated that it does not have assets within the Arden Precinct. FiberSense monitors underground fibre optic assets on behalf of a utility-asset owner.

7.3.4 NBN

In the Arden North sub-precinct there are cables running along Langford and Arden Streets and Macaulay Road. NBN assets are located along Laurens Street and extend partially into the southern portion of the Arden Central sub-precinct. There are NBN assets present throughout the Laurens Street sub-precinct, predominantly along Munster Terrace, Anderson Street and Stawell Street. There is also a section of Queensberry Street where NBN cables are located within the road reserve.

NBN’s network is currently under construction and will be rolled out between March and June 2020 predominantly with fibre to the curb (FTTC) technology.

7.3.5 Nextgen and Vocus

There are Nextgen cables managed by Vocus within the Arden North and Laurens Street sub-precinct. Nextgen cables situated along Arden Street, extending to Munster Terrace and Queensberry Street.

7.3.6 Optus and Uecomm

Uecomm assets are now owned and managed by Optus. Uecomm has underground fibre optic / telecommunications cables extending along Macaulay Road and crossing Arden Street in Munster Terrace to the TPG data centre.

Optus has fibre optic telecommunication assets along Macaulay Road in the Arden North sub-precinct. This asset crosses Arden Street into Munster Terrace within the Laurens Street sub-precinct and extends west along Queensberry Street. In the Arden Precinct the asset runs north along Laurens Street and extends into Barwise Street. Optus has also stated that there are assets present associated with the fibre optic cable such as splice cases and pits.

Optus has advised that there is a transmission fibre optic telecommunication asset extending along Arden Street to Munster Terrance and continuing along Queensberry Street. This asset is of national significance and operates as a transmission link for Optus from the Melbourne CBD out to the Optus exchange located in Sunshine. Optus has stated that interference with this asset could potentially disrupt telecommunications throughout Australia.

7.3.7 Superloop

Superloop has assets in the form of underground cable conduit and pits along Dryburgh Street within the Laurens Street sub-precinct. The cable conduits are located at a depth of 0.65 metres.

There are no Superloop assets in the Arden North or Arden Central sub-precincts.

7.3.8 Telstra

Telstra has extensive assets in the form of conduits and pits throughout the Arden Precinct. Telstra has stated that it has critical fibre assets situated within the Arden North and Laurens Street sub-precincts, along Arden Street, Queensberry Street, Langford Street and Munster Terrace. These comprise of 28 to 30 nested conduits which carry critical fibre connecting the western and northern suburbs of Melbourne. Telstra provided the below Figure 6 to illustrate its critical fibre route.

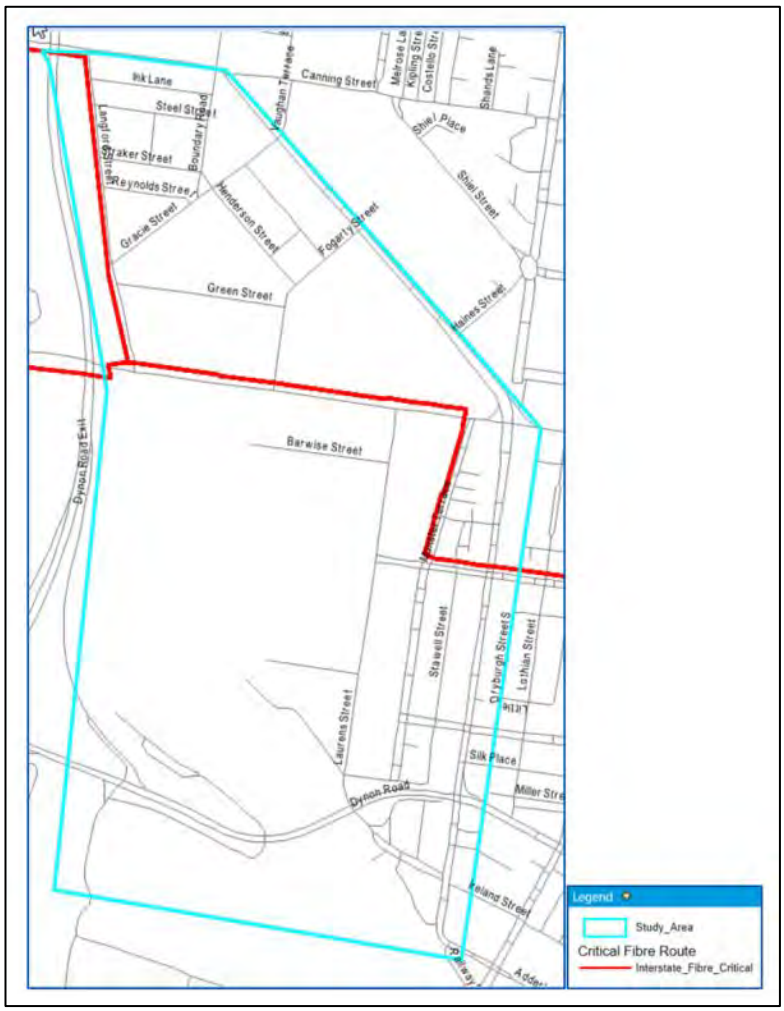


Figure 6 **Telstra's Critical Fibre Route within the Arden Precinct**

Source: Telstra, 2019

7.3.9 Transgrid

Transgrid has communication cables that extend along Munster Terrace and Arden, Queensberry and Dryburgh Streets. These communication cables also connect to the TPG data centre.

7.4 Planned Upgrades

AARNET, TPG, Superloop and Telstra have stated that there are currently no planned upgrades or works to their respective networks and assets in the Arden Precinct

7.5 General Requirements

TPG advised that it generally requires 2 -4 weeks lead time to plan relocation works.

Superloop advised that the asset relocation process has a timeline of a few months, which includes notification to customers of an outage, followed by planning and execution.

Optus and Uecomm generally require a 3 month lead time for asset relocations and this time frame is inclusive of a permit notification period (6 weeks). Due to the significant nature of the Optus transmission link, an impact assessment would also be required prior to the commencement of any proposed design work to determine the impact to its the fibre network.

NBN requires at least 6 months' notice of any request for services and is generally unable to provide telecommunications infrastructure any earlier.

Telstra needs approximately 20 weeks to plan for asset relocation works. For new telecommunications infrastructure, Telstra requires a 3 month lead time to prepare infrastructure designs.

7.6 Redevelopment Scenarios

7.6.1 Telstra

As the area is within an NBN fixed line rollout region, Telstra will not enter into commercial agreements for telecommunications infrastructure for redevelopment in the area.

7.6.2 NBN

NBN advised that if developers commit to NBN, it will proactively plan and build a network to service the development through to completion.

NBN confirmed that the Arden Precinct is located within NBN's fixed line footprint. There are two service area modules (SAMs) which will be ready for service (RFS) by May 2020. These SAMs are not sufficient to service the entire proposed redevelopment and a new distribution fibre network (DFN) will be required from a SAM Exchange located less than a kilometre from the site. NBN has provided an indicative route (marked red) for this connection in Figure 7 below.

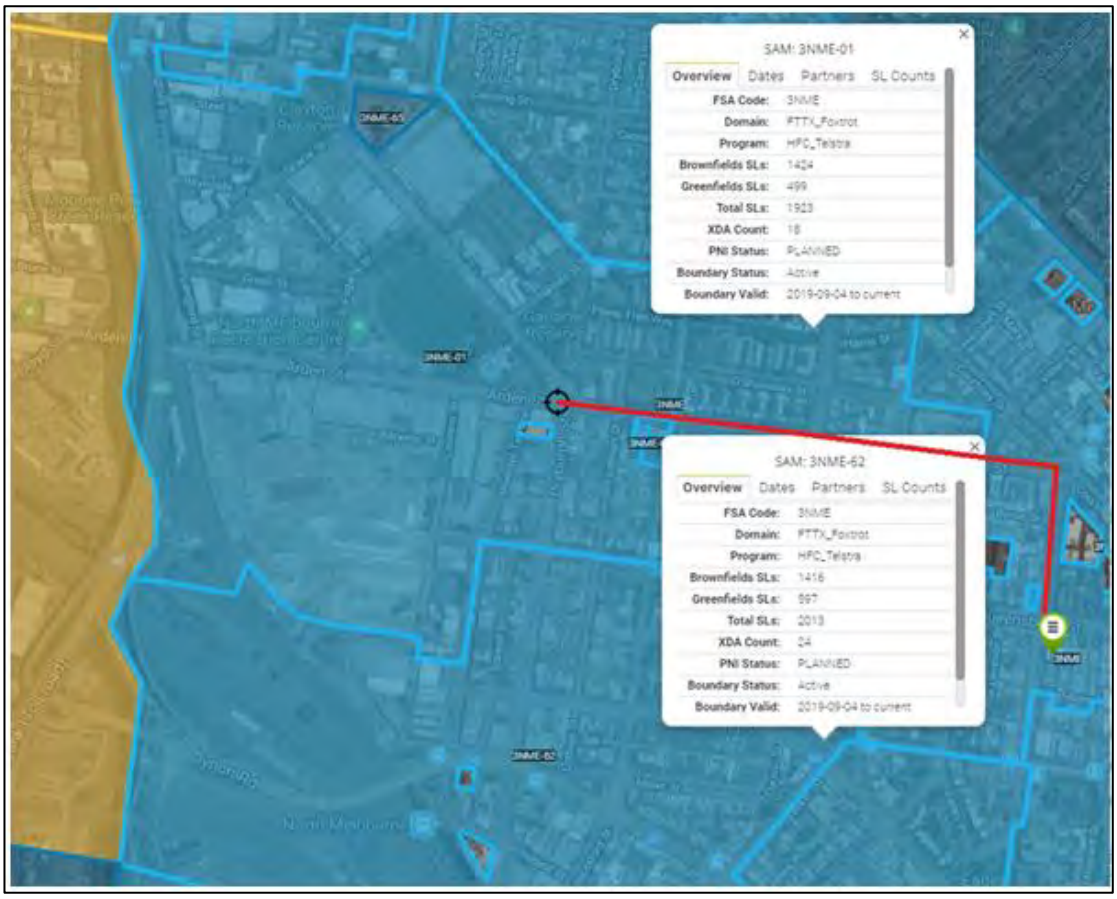


Figure 7 Indicative Distribution Fibre Network Connection Route

Source: NBN, 2019

7.7 Cost Allocation

The information provided in this section reflects the likely cost allocation for NBN infrastructure to be provided to the Arden Precinct.

7.7.1 In-Estate Infrastructure

Developers will be liable for the cost of connection infrastructure as shown in Table 7 below. Premises is defined by NBN as a single place capable of having its own physical address for which the end user may require broadband services.

Table 7 NBN Deployment Contributions on Developers for In-Estate Infrastructure

Lot Type	Developer Contribution
Single-Dwelling Unit Lot/Premises (SDU)	$600
Multi-Dwelling Unit Premises (MDU)	$400

7.7.2 Backhaul Infrastructure

Backhaul costs are attributable to the developer if the length of backhaul required is greater than 1 kilometre. The indicative cost allocation for backhaul for NBN infrastructure is outlined in Table 8 below. NBN has stated that the DFN connection to the NME exchange is located less than a kilometre for the Arden Precinct, therefore it is unlikely that there will be any costs associated with backhaul infrastructure.

Table 8 Developer Contributions for NBN Backhaul Infrastructure

Component	NBN Average Cost	Developer Contribution 50% of the first $1,000 per premises	Developer Contribution 100% above first $1,000 per premise
Haul	$13 / metre	$6.5 / metre	$13 / metre
Construction	$60 / metre	$30 / metre	$60 / metre

NBN requires an end-user (consumer) contribution of $300 per premises that is allocated to the Retail Service Provider, which may be passed through to the end-user. This end-user contribution is only applicable in new developments and developments of existing built-up areas for further construction such as this precinct.

8. Typical Cross Sections and Flood Storage Locations

This assessment included the preparation of typical cross sections in order to illustrate the location of utility services within the major road reserves. The typical sections are located in Appendix D.

8.1 Typical Road Cross Sections

Typical sections have been prepared for the following existing roads:

- Macaulay Road
- Queensberry Street
- Arden Street
- Fogarty Street

The typical sections highlight the approximately location of existing utility infrastructure within the road reserves. They have been informed by a desktop assessment of online information, an assessment of spatial information received from Authorities, and liaison with Authorities. The location of existing services is approximate only and has not been confirmed on site.

8.2 CoM Road and Utility Delivery Requirements

CoM provided the following general advice for the delivery of road networks and utility services within its municipality:

- CoM Civil Standards are to be applied to the development of the road network
- Third party utility services should be located away from intersections on the footpath to allow the provision of Disability Discrimination Act (DDA) compliant pedestrian crossings
- Developers should refer to the Road Management Act (RMA) Code of Practice for the Management of Infrastructure within Road Reserves for the location of services within the road reserve
- Services should be located away from tree zones and banks of conduits for third party assets must be located away from tree planting areas
- Shared trenching opportunities should be considered for the provision of utility services and the introduction of a shared services trench should be investigated
- The impact of utility development works on environmentally sustainable infrastructure must be minimised, and additional environmentally sustainable infrastructure must not be limited by the installation of new utility infrastructure (i.e. utility services should be located away from tree planting zones)

8.3 Location of Flood Storages

There has been significant planning work undertaken to understand the key locations for stormwater drainage flood reserves and other related flood management infrastructure.

8.3.1 Cloudburst Flood Management

One of the local flood management solutions proposed by Ramboll within the Arden Precinct is the inclusion of a ‘cloudburst’ flood management approach. The aim of this solution is to use a

network of detention and conveyance areas to manage water across the site before discharging to Moonee Ponds Creek. Ramboll's concept largely revolves around the installation of multi-use green / blue streets and parks (dropped streets and parks that retain and convey water) as well as rainwater tanks and green roofs.

A key consideration for the planning and integration of cloudburst or other flood management infrastructure with the Arden Precinct is the interaction of this infrastructure with other utility services.

The following key factors regarding utility infrastructure may impact the viability of cloudburst or other flood storage infrastructure within the Arden Precinct:

- Horizontal clearance: the horizontal clearance between proposed flood storage infrastructure may constrain the possible location and size of flood management infrastructure
- Vertical clearance: the vertical clearance between proposed flood storage infrastructure may constrain the possible location and size of flood management infrastructure
- Existing cover: the depth to which flood storage infrastructure can be constructed over the top of existing services may be limited by the existing cover of underground services
- Type of infrastructure: authorities do not generally accept the construction of drainage infrastructure vertically above electrical, gas or telecommunications assets. Authorities generally do not support the construction of drainage infrastructure vertically below potable water assets

The following Table 9 summarise key opportunities and limitations to the implementation of the Cloudburst Masterplan.

Table 9 Key Opportunities and Limitations to the implementation of the Cloudburst Masterplan

Key Issues	Key Opportunities
A 66 kV sub-transmission electrical corridor has already been constructed in the Queensberry Street extension. This may limit the available of space within the Queensberry Street extension road reserve to include a cloudburst street and cloudburst detention	The Arden Central sub-precinct has the least existing sewer, water, telecommunications and gas infrastructure and therefore appears to have the least impediments within the Arden Precinct to accommodate future stormwater drainage storages and the easiest region to construct new cloudburst / green streets
The presence of a transmission gas pipeline will limit the extents of any proposed flood storages or green/blue streets at Langford Street, Green Street, Macaulay Road and Dryburgh Street	The existing North Melbourne Oval is not hindered by any existing utility infrastructure and therefore would have less conflicts accommodating stormwater detention infrastructure
The location of existing transfer sewer and water infrastructure may limit the availability of space within Arden Street to accommodate flood management infrastructure.	As the transmission gas pipeline is predominantly within the road reserves, flood storages proposed within existing allotments are unlikely to be directly affected by this asset as long as appropriate clearance requirements are met

9. Sustainability and Precinct Development

9.1 Introduction

Sustainability is a key consideration for the supporting infrastructure and services in the Arden Precinct. In order to provide useful and practical recommendations regarding a sustainable approach to servicing the Arden Precinct, GHD undertook an assessment regarding sustainability in precinct development and the policy context of sustainability development. This assessment provides an overview of policy drivers and global leading practices that can be considered by the Arden Precinct.

In providing this assessment, GHD undertook desktop research to identify local and state policy that supports low carbon development, as well as desktop research to identify relevant current world leading practices in Ecologically Sensitive Development (ESD) for employment precincts.

9.2 Review of State and National Policies

There are a range of statutory and non-statutory planning tools, policies and controls in place that affect the provision of sustainable residential development, and the key policies and tools are summarised below:

- Planning and Environment Act 1987 ('the Act') contains objectives which support the sustainable use and development of land within Victoria. The objectives of the Act seek to 'provide for the fair, orderly, economic and sustainable use and development of land'.
- Plan Melbourne 2017-2050 supports ESD design that fuses geography, planning and design in ways that facilitates connections between people, places and resources. It also supports the inclusion of energy efficiency and renewable energy that assist in the delivery of cost-effective environmental outcomes.
- The Victorian Government's Climate Change Framework recognises climate change as a complex and evolving challenge for the Victorian Government and the community, and one of Victoria's most critical issues. The Government has revised the Climate Change Act (2017), established the Climate Change Framework (2017) and released Victoria's Climate Change Adaptation Plan 2017-2020 (Adaptation Plan). As part of the Adaptation Plan the Government has committed to reviewing land-use planning policies and provisions to improve the way the land-use planning system manages natural hazards in the context of climate change. The land use planning plays an important role for sustainable precinct design.

There are a number of other relevant policies that can support the Arden Precinct incorporating sustainable design and low carbon ideals. Table 10 provides details of the policies and tools, and opportunities for the Arden Precinct.

Table 10 Policies and Tools to Support Sustainable Development in Arden Precinct

Policy/Tool	Description	Opportunity for Arden Precinct
Renewable Energy Target	The Victorian government set a Renewable Energy Target of 25% renewal energy by 2020 and 40% by 2025. These targets will increase renewable energy investment in Victoria, creating thousands of new jobs and moving the state towards a future of sustainable energy. The Victorian government is considering both policy level and financial support to meet its renewable energy target. Some of these are discussed below: • $10 million to provide energy efficiency upgrades to 1,500 public housing properties and 1,000 households who are most in need due to chronic health conditions • $5.4 million to expand the Victorian Energy Efficiency Target (VEET) scheme to provide incentives for more Victorians to take up energy efficiency measures • $3 million for grants to assist small and medium businesses to identify and implement energy efficiency opportunities • Funding new energy technologies through the 20 million New Energy Jobs fund. Renewable energy targets will deliver up to 5,400 MW of renewable energy projects. This is likely to create $9 billion in new capital expenditure, contribute $2.5 billion in direct economic activity, and an additional 11,000 Victorian jobs. Energy use, including electricity and gas for heating, cooking and for industry is Victoria's biggest source of greenhouse gas emissions and electricity sector alone emits about half of Victoria's overall emissions. Actions to reduce emissions from energy use have economic benefits: reducing energy use saves money, while increasing renewable energy and shifting to clean energy technologies drives investment and creates new jobs.	• Investment in renewable energy – on site or purchase of renewable electricity through power purchase agreements. The renewable energy target can be set in line with Victoria's targets. • Energy efficient building design • Investing in and enhancing public transport and embedding active transport concept in design

Low carbon funding – Clean Energy Finance Corporation (CEFC)	The CEFC is responsible for investing $10 billion in clean energy projects on behalf of the Australian Government.[30] It promotes projects that will help to lower Australia's carbon emissions, by investing in renewable energy, energy efficiency and low emission technologies. CEFC also invests to increase the flow of finance into the clean energy sector, using investment strategies focused on cleaner power production. This sector includes large and small solar, wind, bioenergy, vehicles, infrastructure, manufacturing, transport, storage and industry.	Review the bio-energy and innovation fund and invest in projects that involve: • Biomass to energy • Renewable energy • Energy efficiency • Low carbon technologies
National Energy Productivity Plan (NEPP)	The National Energy Productivity Plan (NEPP) is a Council of Australian Governments (COAG) Energy Council agreed plan, aimed at improving Australia's energy productivity by 40% by 2030. Energy productivity is a measure of the value received from an investment in energy and energy infrastructure. To achieve the goal of 40% growth, Australia will need to double its current rate of energy productivity improvement compared to 'business as usual'. This can be achieved through a range of initiatives generally falling under two categories; productive consumer choices and productive energy services. The National Energy and Productivity Plan has identified that opportunities to increase energy productivity in many sectors. In the commercial and residential sectors alone, there are the opportunities for improvement by 104 petajoules (PJ) and 84 PJ respectively	• Tracking energy performance of buildings • Encourage consumers to reduce energy system peaks

30 https://www.cefc.com.au

National Carbon Offset Standards (NCOS) for precincts	National Carbon Offsets Standards (NCOS) provides a rigorous framework and greenhouse auditing process that requires the purchase of accredited offsets for all residual emissions. Participating in the voluntary carbon market provides councils with the opportunity to play their global citizen roles by supporting the development of a global carbon market. The Australian Government, in partnership with the property sector and business, has developed the National Carbon Offset Standard for Precincts (Precinct Standard). The Precinct Standard is a voluntary standard to manage greenhouse gas emissions and to achieve carbon neutrality for precincts. It provides best-practice guidance on how to measure, reduce, offset, report and audit emissions that occur as a result of the operations of a precinct. The Precinct Standard can be used to better understand and manage carbon emissions, credibly claim carbon neutrality and to seek carbon neutral certification. Certification of carbon neutral claims can be sought through the Australian Government's Carbon Neutral Program. The certification is granted through the approval of an application for carbon neutral certification against the requirements of the Precinct Standard.	The choice to reduce emissions and move towards carbon neutrality is driven by the improving business case of investing in renewable energy, and the demand from occupants and tenants for sustainable and energy efficient accommodation. The Arden Precinct may benefit from NCOS certification through: • Increased recognition • Competitive edge • Positive social and environmental outcomes • Energy conservation and cost savings
National Australia Build Environment Rating System (NABERS)	Formerly the Australian Building Greenhouse Rating (ABGR) in 1998, NABERS was extended nationally in 2000 with support from the property industry, state and federal governments. NABERS has recently partnered with the Australian government and Green Building Council of Australian (GBCA) to develop carbon neutral certification pathway for buildings. The buildings covered under NABERS include: • Residential apartments • Office buildings • Shopping centres • Data centres • Hotels	• Mandate NABERS ratings within the precinct and include ratings for waste and water

Nationwide House Energy Rating Scheme (NatHERS)[31]	The Nationwide House Energy Rating Scheme (NatHERS) is a star rating system (out of ten) that measures the energy efficiency of a home based on its design. The software model estimates the amount of energy a house will require for heating and cooling purposes. Builders often use a NatHERS rating to show a new home or renovation meets the minimum energy efficiency requirements required.	• Mandate NatHERS ratings within the precinct and mandate minimum energy efficiency requirements
Green Building Council of Australia (GBCA)	The Green Building Council of Australia (GBCA) was established in 2002 and developed the Green Star green building standard. The Green Star environmental rating tool for buildings benchmarks the building against nine environmental impact categories: management; indoor environment quality; energy; transport; water; materials; land use & ecology; emissions and innovation. As well as this, Green Star can be used for neighbourhood development to provide a comprehensive assessment across governance, liveability, environment, prosperity and innovation. The GBCA aims to drive the sustainable transformation of the built environment. As Australia's leading authority on sustainable buildings and communities, the GBCA has three main areas of activity: • Setting standards and certifying achievements in the built environment through Green Star • Educating and communicating the value of sustainability to all stakeholders • Advocating for changes in the regulatory environment at a local, state, and federal level.	• Consider utilising the Green Star rating to assess the planning, design and construction of large-scale development projects at a precinct, neighbourhood and/or community scale.
State Planning Policy Framework (SPPF)	The State Planning Policy Framework (SPPF) currently includes high-level strategic objectives and statements, which encourage developments to incorporate ESD and consider the environment in land use and development. Clause 11.07 seeks to develop environmentally sustainable regions and settlements in regional Victoria. This clause identifies key principles to guide settlement planning in Victoria's regions (including peri-urban areas), and provides strategies to respond to the impacts of climate change include: • Siting and designing subdivisions to minimise the impact on the natural environment • Encouraging reduced energy and water consumption through environmentally sustainable subdivision and building design.	• Consider measuring the Arden Precinct's impact on the natural environment and develop approaches to reduce energy and water consumption

31 http://www.nathers.gov.au/

Climate Solutions Fund (formerly Emission Reduction Fund)	The Australian Government established the Climate Solutions Fund (CSF) (formerly the Emission Reduction Fund) to support and encourage projects to reduce greenhouse gas emissions. Businesses with approved project types may apply to the Clean Energy Regulator to receive an Australian Carbon Credit Unit (ACCU) for each tonne of greenhouse gases avoided or stored. The Clean Energy Regulator (CER) is responsible for the administration of the ERF, including key elements of the crediting and purchasing aspects of the scheme. These include the registration of projects, the conduct of auctions and purchasing, the management of contracts and the issuance of ACCUs to scheme participants. The CER is also responsible for monitoring and compliance with the rules of the scheme, as well as pursuing breaches of these rules if they occur. Businesses from across the economy can participate in the fund through a range of eligible project types. Some of the eligible projects include: • Energy efficiency • Vegetation • Agriculture • Savanna burning • Industry fugitives • Transport and • Waste	• Explore possibility of participating in the emission reduction fund.

9.3 Leading Practices in Ecologically Sustainable Development

A number of cities internationally have successfully developed sustainable precincts by integrating sustainable design principles. GHD undertook a review of the precinct's leading practices in energy, water, waste, transportation, and information communication and technology. This study focused on four key regions: Australia, Canada, Doha and Sweden.

The Arden Precinct is in a strategic position to implement a number of sustainability initiatives and position itself as one of Australia's leading climate smart precincts. This section provides a high-level overview of global leading practices in ESD for employment precincts.

9.3.1 Energy

9.3.1.1 Distributed and Renewable Energy Generation

Distributed energy generation refers to a variety of different grid-connected energy technologies that generate electricity at, or close to, the location of use. Whilst a number of different technologies can be utilised, the most accessible technologies for the residential or commercial sectors are solar photovoltaic panels and small wind-turbines.

Distributed and renewable energy grids provide numerous benefits to residents and businesses within an employment precinct, including energy security and the potential for energy export and income generation. When combined with energy storage technologies, a distributed network can reduce the load on centralised utilities and provide reduced and predictable energy pricing.

9.3.1.2 Energy Efficient Buildings

The benefits to increased energy efficiency in buildings include moderated temperatures, lower energy bills and increased air quality. It also provides benefits residents and business owners in the form of increased resale value.

All new homes and buildings in Victoria must comply with the Building Code of Australia. The National Australian Built Environment Rating System (NABERS) and National House Energy Rating Scheme (NatHERS) can be used to measure a building's energy efficiency and carbon emissions.

Many new urban developments implement a target building rating, and some precincts have gone as far as mandating a minimum rating.

9.3.1.3 Reduced Energy Use

Improving the efficiency of lighting can be one of the most simple and effective methods of reducing energy consumption. Lighting requirements for public areas can have a lot of variability, however the use of energy efficient lighting provides several universal benefits, including: reduced electricity consumption, reduced operating costs**,** decreased maintenance costs.

Case Study 1 Distributed renewable energy generation and energy efficient buildings White Gum Valley, Fremantle, WA[32]

One of the aims of White Gum Valley is to achieve 'net zero energy' status, meaning the precinct generates as much energy as it uses, balanced over the year. This will be achieved through a combination of energy-efficient buildings and rooftop solar energy generation. Several apartment buildings are installing solar energy storage, which will see grid energy reliance reduced by up to 80%.

Design guidelines were prepared for the single residential dwellings to facilitate the building of energy efficient homes. Requirements include minimum 7-star NatHERS performance, solar passive design including provisions to limit overshadowing of neighbours, a minimum 1.5kW roof top solar PV system, and the installation of efficient hot water systems and heating, ventilation and air conditioning (HVAC). Development tenders for the apartment sites required proposals to demonstrate innovation in energy efficiency and provision of renewable energy.

Case Study 2 LED Street Lights, Calgary, Canada[33]

The City of Calgary implemented a project where they replaced approximately 84,000 streetlights throughout the city, with newer energy efficient LED (light-emitting diode) lights.

The city-wide LED implementation will reduce operating and maintenance costs for roads as LEDs have a longer life and consume up to 50% less energy than the replaced fixtures.

The conversion to LED street lights will save approximately 40,000,000 kWh annually and is expected to save $5 million annually in operating costs.

CoM advised that it already utilised LED street lights on all new street lighting projects within the City of Melbourne municipality.

9.3.1.4 Switch from Gas to Electricity

It is an ambition of CoM to more broadly transition away from utilising natural gas in buildings. It advises that there is an opportunity in the Arden Precinct to avoid the delivery of expensive and non-essential gas infrastructure. CoM's *Climate Change Mitigation Strategy to 2050* includes actions to manage the transition from gas, petrol, diesel and coal fuel sources towards electricity in buildings and precincts.

The transition from natural gas servicing to electrical servicing has environmental benefits as electrical generation moves towards renewable energy and away from fossil fuels.

Gas is not an essential service and therefore individual developments have the option whether or not to service their development with gas. Although Councils cannot enforce a prohibition on gas servicing, Councils can discourage applications from using gas and encourage the switch to

32 Wiktorowicz, J. et al. (2018). WGV: An Australian Urban Precinct Case Study to Demonstrate the 1.5 °C Agenda Including Multiple SDGs. Urban Planning, 3(2)

33 Gray, M., & Bain, C., (2018). e2 (Energy Efficient) Street Lighting Program Update

electrical servicing. CoM advised that this can be facilitated by using the Green Star system if there is an explicit standard within the precinct's planning requirements.

Case Study 3 A Gas Free City, Amsterdam, The Netherlands[34]

The City of Amsterdam plans to phase out the use of natural gas by 2050. Natural gas currently heats approximately 90% of all homes and business, and the city council expects that switching to more sustainable energy sources will greatly reduce Amsterdam's carbon emissions. The majority of the city's population are in favour of switching the more sustainable energy sources.

The city council is taking the following steps in the push to transition towards fully electrical servicing:

- Newly developed regions of the city are no longer being connected to the gas grid
- Various new neighbourhoods are being designed without gas pipeline infrastructure
- Centralised heat networks will be utilised to deliver hot water to an estimated 102,000 homes by 2020
- The city council is working closely with stakeholders to determine methods for the quickest transition from existing gas infrastructure to electrical infrastructure

9.3.2 Water

9.3.2.1 Localised water capture and wastewater treatment

The water balance of urban environments is characterised by large inflows of potable water and significant outflows of waste water. In addition to this, urban areas experience natural water flows from rainfall and site run-off.

In order to reduce the demand for potable drinking water, there are a number of water efficiency measures which can be employed. These include water harvesting from rainwater and stormwater collection for use in laundries and toilets, and using recycled wastewater for gardens.

Rain water harvesting should be considered when planning a community-oriented water supply system and typically requires rainwater tanks. The collection and storage of rainwater within precincts is possible from roof and land surfaces, and land surfaces can be designed to maximise runoff collection.

Although opportunities for rainwater collection and use vary with location, there are some universal benefits, including:

- Reduction of infrastructure operating costs
- Reduce the need for new potable water storages
- Reduce rainfall runoff flows into rivers

34 https://www.amsterdam.nl/en/policy/sustainability/policy-phasing-out/

Case Study 4 One Central Park Tower, Central Park, Sydney, NSW[35]

Central Park is a major mixed-use urban renewal precinct located in inner city Sydney. Located on approximately 6,500 square meters of rehabilitated industrial land, it features exciting architecture and biophilic design. A key feature of the urban renewal project is the One Central Park Tower.

The tower is characterised by its green façade and innovative technologies. The tower includes a 'circular' wastewater system that captures and reuses wastewater at source. The on-site wastewater treatment plant processes sewage and stormwater through several steps, including screening for solids, disinfection through bioreactor treatment (anaerobic and aerobic tanks), membrane tanks, UV filtration and chlorination. The treated water is used for a number of non-potable uses such as irrigation, toilet flushing and washing machines.

The benefits of the system include a reduction of water consumption by residents of 40-50%.

9.3.2.2 Drainage and flooding resistance

Due to the increased areas of impermeable surfaces, urban environments may be susceptible to flooding after a significant rainfall event. Water Sensitive Urban Design (WSUD) is an approach to planning and design which integrates the management of the total water cycle into urban development. It aims to provide drainage systems that provide water-quality treatment as well as flood management. Some of the key elements of WSUD include:

- Integrated management of groundwater, surface runoff (including stormwater), drinking water and wastewater to protect water related environmental, recreational and cultural values
- Storage, treatment and beneficial use of runoff
- Treatment and reuse of wastewater
- Use of vegetation for treatment purposes, water efficient landscaping and enhanced biodiversity
- Water saving measures within and outside domestic, commercial, industrial and institutional premises

Flood and river monitoring programs are also an effective method to enable efficient responses to flood conditions.

35 Central Park – A Sustainable Habitat, Available: https://www.centralparksydney.com/explore/a-sustainable-habitat

Case Study 5 Flood and River Monitoring, Calgary, Canada[36]

City of Calgary maintains a flood and river monitoring program, enabling effective response to both flood and drought conditions. The monitoring includes:

- Rain and snow
- Snowpack depth
- River and creek flows
- Reservoir levels
- Soil moisture
- Weather models
- Water use and demand

The City of Calgary works with partner organisations, irrigation groups, internal groups and other municipalities to understand the conditions, which may impact the city. When required, operations are adjusted based on the information.

9.3.3 Waste

The National Waste Report 2018, prepared for the Department of Environment and Energy, describes three main waste generation streams in Australia:

- Households and local government activity
- Offices, factories and institutions
- Construction and demolition waste

An effective waste management system encompasses the collection, transport; processing, recycling and disposal of waste and aims introduce strategies, which reduce the likelihood of producing waste.

9.3.3.1 Smart separation and disposal

Generally speaking, waste collection in Australia is highly dependent on regional and local requirements, often involving the collection of waste using garbage trucks.

An emerging technology in this area is the use of an underground pneumatic waste conveyance system. The system transports waste from residential and commercial buildings through a system of underground pipes that appear above ground at collection points. The system is suitable to high-density urban environments and represents a significant reduction in resources in terms of labour, hours and fuel when compared to the traditional waste collection practices.

The system is being used or trialed around the world, including locations such as the Pearl-Qatar (Doha), Wembley (UK), Singapore and in the Maroochydore City Centre (Queensland).

36 The City of Calgary,Flood and River Monitoring Program Available: https://www.calgary.ca/UEP/Water/Pages/Flood-Info/Types-of-flooding-in-Calgary/Flood-monitoring.aspx

Case Study 6 The Pearl-Qatar Pneumatic Waste Conveyance System, Doha, Qatar[37]

The Pearl-Qatar is a man-made island in the Middle East. The island is home to 41,000 residents, two million square meters of retail space, restaurants and entertainment facilities.

Using one of the largest pneumatic waste conveyance systems in the world, a pipe network 55 km in length carries waste to two waste collection stations. There are 415 waste inlets throughout the island, installed both indoors and outdoors. The system is capable of servicing 135 tonnes of waste per day.

9.3.3.2 Waste to energy

One of the most common waste to energy technologies is the conversion of wastewater and sewage into a useable fuel product. When organic waste decomposes in an oxygen free environment, it releases methane. This methane can be captured and reused to produce energy. The captured biogas can either be used to generate both heat and electricity.

One of the major advantages to using waste for energy purposes is that unlike solar and wind, waste flow occurs in relatively constant volumes. Coupled with the added benefits of reduced waste removal costs and reduced dependency on fossil fuels, waste to energy systems present a unique opportunity for new urban renewal projects, such as the Arden Urban Renewal Precinct.

Whilst there are few examples of waste to energy systems used in Australian cities, there are numerous European examples, including two Swedish examples, Hammarby Sjöstad and Helsingborg.

Case Study 7 Hammarby Sjöstad, Stockholm, Sweden[38]

The neighbourhood of Hammarby Sjöstad is a mixed-use, medium-high density region, comprised of 10,000 residential buildings, offices, retail, restaurants and community spaces. It was developed as a highly integrated neighbourhood and contains a number of sustainability initiatives, including renewable energy generation, numerous green spaces and a waste to energy network.

The model reuses waste streams as resources in a ‘metabolic loop’. As an example of this, sewage is converted into biogas and treated wastewater. The biogas is used in a number of ways including:

- Fuel to generate both electricity and district heating.
- Vehicle fuel use in inner city buses and garbage trucks
- Used in 1,000 gas stoves

37 Underground Vacuum Systems for Sustainable Waste Handling ,Available: https://nctce.com.au/wp-content/uploads/2019/03/Envac_brochure-11-16-Lee-Gyuhwang.pdf

38 Fraanne, L. (2017) Hammarby Sjöstad – a unique environmental project in Stockholm, Available: http://large.stanford.edu/courses/2014/ph240/montgomery2/docs/HS_miljo_bok_eng_ny.pdf

9.3.4 Transportation

9.3.4.1 Prioritising active transport

Sustainable precincts that prioritise active transport prioritise pedestrians, cyclists and mass transit over private vehicles. Reducing the use of private vehicles requires a change in thinking towards high levels of accessibility. To achieve this, services, facilities and activities must be located in close proximity to housing, with good pedestrian and cycle access.

There are a number of different initiatives that can be employed to encourage more sustainable forms of transport including;

- Improving accessibility to services
- Planning for pedestrians, cyclists, transits and private vehicles (in that order)
- Designing of a precinct 'centre', i.e. public transport access located alongside shops and services
- Reduced vehicle speeds to encourage walking and cycling

Case Study 8 "Step Forward" action framework, Calgary, Canada[39]

In 2016, Calgary's first pedestrian strategy was approved. Its strategy was built integrating consultation from thousands of local residents and is aimed at making the city safer, more comfortable and interesting for walking.

The framework outlines:

- Short term actions, aimed at instigating immediate and noticeable impact. These actions focus on pedestrian safety, locating funding sources and creating partnerships.
- Medium term actions, which use the assembled resources and relationships to make improvements to the network, and foster a culture which encourages walking
- Long term actions, which are the most costly but do the most to promote walkability. These include major infrastructure projects to transform neighbourhoods.

9.3.4.2 Encouraging electric vehicle use

By 2040, it is predicted that 70% of all new vehicle sales will be represented by Electric Vehicles (EVs)[40]. One of the major barriers for EV uptake is the availability of public charging station infrastructure. In sustainable precinct developments, EV charging stations should be provided in anticipation of increased demand. Many cities around the world already have extensive public charging infrastructure. The world leaders in this field are Norway and the Netherlands, each with over 1,500 public charging points per million population. Whilst there are currently fewer than 800 charging stations located throughout Australia, the development of a more extensive infrastructure network has been identified as a high priority initiative by Infrastructure Australia.

CoM advised that recharging EVs off-street is its preferred option within its municipality and in the Arden Precinct. CoM provided the following summary goals of its *Transport Strategy 2030* and *Climate Change Mitigation Strategy to 2050*:

- Support electric vehicles powered by renewable energy
- Support electrical car charging in buildings and minimize on-street charging
- Support off-street electric vehicle charging. On street charging is not supported in the central city
- Advocate for lower carbon intensity motor vehicles and support transition to electric vehicles.

39 Transportation Department, (2016), Step Forward: A strategic plan for improving walking in Calgary

40 Infrastructure Australia, (2019), Infrastructure Priority List: Project and Initiative Summaries

9.3.5 Technology

9.3.5.1 Monitoring of operational performance

Remote sensing and monitoring systems allow precincts and individual members of the community to monitor and improve their environmental sustainable performance. By monitoring performance, and then using a system of evaluation and improvement, long-term value can be added to the community as a whole. Monitoring of operational performance provides the following benefits:

- Promoting success boosts confidence among residents and business owners
- Reduces in water, fuel and energy use
- Reduces operational costs

The costs of this type of monitoring can be expensive when retrofitting into the built form. The Arden Precinct is well positioned to integrate these monitoring technologies during the planning stage. Doing so will lead to a cost-effective method of tracking and evaluating operational and environmental improvement.

Case Study 9 **Lochiel Park 'Eco-vision' monitoring displays, Adelaide, South Australia**[41]

Lochiel Park is a small community, home to more than 150 residents. Residents in Lochiel Park enjoy sustainable living due to a number of sustainability initiatives, including a minimum 7.5 star energy efficiency rating and water efficiency measures.

Amongst other initiatives, all houses in Lochiel Park are fitted with an 'eco-vision' system which allows individual households to monitor their water, energy use, greenhouse gas emissions and gas use behaviours. The use of these systems highlighted the following results:

- Between 2010 and 2011, houses exhibited a 64% reduction of electricity usage compared to the 2004 baseline. Average consumption was 53% less than the average South Australian levels.
- Greenhouse gas reduction of 55% compared to the baseline target
- Daily water consumption around half that of the average household in Adelaide.

9.3.5.2 Telecommunication

In recent decades, telecommunications and connectivity have become an essential part of life, connecting individuals, businesses and processing business information around the world. Technology is advancing rapidly and consumer requirements change continuously. It is imperative that new urban precincts maintain appropriate telecommunication infrastructure that can keep pace with these requirements.

41 Renewal South Australia – Lochiel Park, Available: https://renewalsa.sa.gov.au/projects/lochiel-park/

Case Study 10 Telecommunications initiatives, Calgary, Canada[42]

Dark Fibre Installation

In order to deliver telecommunication services to its residents and businesses, The City of Calgary has been developing and increasing its fibre optic footprint. Installing dark fibre, i.e. unused but accessible fibre optic cable infrastructure, ensures that all residents, industries and organisations have access to a high-speed network.

Free public Wi-Fi initiative

Available to any member of the public, 'Public Wi-Fi' provides access to the internet at no cost to the user. Guest access is available up to 500MB per 30 day period. Currently, access to the free network is available at all train stations and 34 other locations.

42 The City of Calgary – Access the City of Calgary's dark fibre, Available: https://www.calgary.ca/cfod/it/Pages/Dark-fibre.aspx?redirect=/darkfibre

9.4 Barriers to the Uptake of Ecologically Sustainable Development

There are a number of barriers preventing further uptake of ESD in development precincts. These barriers exist in many forms including institutional, policy, regulatory, community and financial barriers. Table 11 below summarises some of the most common barriers to the implementation of sustainability practices and ESD principles, including possible means of overcoming these barriers.

Table 11 Barriers to the Uptake of Ecologically Sustainable Development

	Barrier	Description	Enabling Practices
Institutional	Lack of organisational support	A lack of leadership or the failure of the leadership group can fail to inspire others within the organisation, leading to poor sustainability performance. The outcome of this barrier is that the sustainability agenda often falls to individuals or pockets of the organisation, who do not receive the priority or resources to achieve their intended outcomes.	Endorse sustainability policy and initiatives at all levels of the organisation, including top management support Share sustainability responsibilities across all involved organisational units External facilitators can help to raise awareness of sustainability internally.
Policy	Theory versus practice	In some cases, sustainability plans or policies may not be carried through to the implementation stage, or the implementation of a plan may be a 'watered down' version of what was intended	Embed sustainable practices into organisational management plants, trainings, procedural documents etc. Foster a positive sustainability culture within the organisation by involving staff from across the organisation in sustainability planning and actions
	Competing priorities	If sustainability issues or social equity issues are given a lower priority, it is more difficult to achieve effective sustainability outcomes. This can arise from prevailing community attitudes or the lobbying of particular stakeholder groups.	Use community and external stakeholder expectations to drive change and highlight the importance of sustainability projects

Financial	Lack of funding	A lack of financial resources can severely hamper the efforts and implementation of a sustainability plan.	Seek external funding opportunities. By forming partnerships with relevant stakeholders, the financial burden of implementing a sustainability initiative can be shared. Identify environmental and sustainability levies. Identify and implement low cost initiatives.
Regulatory	Inadequate or prohibitive legislation	Whilst there are a number of local and state policies which support low-carbon development, many of them may be seen as lacking or behind current practice. Without strict guidelines or principles to follow, sustainability practices may not be considered and implemented in the planning, design and post-construction stages	Educate staff on current legislation and where possible, link sustainability initiatives to current supportive legislation During the planning and design stages, set targets higher than the minimum requirements outlined in local and state policy
Community	Dealing with stakeholders / government agencies / community groups	A lack of coordination with stakeholders, other agencies or groups may hinder progress significantly.	Perform stakeholder engagement activities throughout the planning, design and implementation phases of sustainability initiatives. Partner with government and other agencies to increase resources and facilitate information

10. Summary

This assessment provided a high level review of infrastructure requirements and impacts of the proposed Arden Precinct development on existing utility infrastructure, as established through consultation with key Utility Authorities.

10.1 Key Findings

Key findings of the assessment are outlined in Table 12 below.

Table 12 Key Findings

Infrastructure Type	Key Findings	Capital Works Required for Development
Stormwater Drainage	• Both CoM and MWC have significant piped stormwater drainage infrastructure within the Arden Precinct • Flooding and drainage is a significant challenge for development planning within the Arden Precinct • A significant portion of the Arden Precinct is affected by a Land Subject to Inundation Overlay and a portion of the Arden North sub-precinct is affected by a Special Building Overlay. Associated planning requirements will apply to developments within these zones • CoM and MWC are coordinating their planned infrastructure works with the VPA • Stormwater drainage infrastructure within the Arden Precinct will require significant works to service future development • The total cost of proposed MWC drainage works in the Arden Precinct is approximately $200 million • CoM advised that a Development Contributions Plan (DCP) would be created to fund its required works • MWC advised that a Development Services Scheme (DSS) would be created to fund its required works	• Raised and extended levees for the Moonee Ponds Creek • New flood storage in Stubbs Street • New flood storage in Arden Central • New flood storage in Langford Street • New underground flood storage within the North Melbourne Recreation Reserve • Upgrade works to 6 existing pump stations • Upgrades to gravity pipes within the Arden Precinct • Pressure pipe upgrades within the Arden Precinct including pressurising the Arden Street Main Drain
Water	• The existing Arden Precinct is well serviced by potable water supply infrastructure • There is no existing water reticulation infrastructure within the Arden Central sub-precinct	• New reticulation mains will be needed throughout the Arden Precinct to service high density developments • The cost of water reticulation infrastructure is generally attributable to developers

Infrastructure Type	Key Findings	Capital Works Required for Development
	• The existing mains on Arden Street have capacity to supply the Arden Central sub-precinct • CWW has planned works to the 375 mm diameter main on the north of Arden Street • There is no existing non-potable water infrastructure in the Arden Precinct • CWW investigated the provision of non-potable water within the Arden Precinct and supply options included stormwater harvesting and sewer mining	• New distribution mains will be needed throughout the Arden Central sub-precinct to provide water supply service • The cost of water distribution infrastructure is generally attributable to CWW • A new 225 mm diameter main is required on Laurens Street for approximately 400 metres • A new 300 mm diameter main is required on Fogarty Street with an approximate length of 220 metres • Existing 100 mm mains in the Laurens Street and Arden North sub-precincts may require upsizing depending on local development requirements
Sewer	• The existing Arden Precinct is well serviced by sewer infrastructure • Both CWW and MWC have significant sewer infrastructure within the Arden Precinct and advised that the majority of sewer infrastructure in the Arden Precinct is over 100 years old • CWW would like to proactively work with developers to incrementally replace aging reticulation assets as part of upgrade works to the road network and streetscapes • CWW advised its preference is for the Laurens Street sub-precinct to drain into the Arden Central sub-precinct to avoid upgrade works to its North Melbourne Branch sewer	• New reticulation mains will be needed throughout the Arden Precinct to service high density developments • The cost of water reticulation infrastructure is generally attributable to developers • A new maintenance hole and connecting infrastructure between this maintenance hole and an existing MWC transfer sewer maintenance hole will be required to service Arden Central • An upgrade of CWW's North Melbourne Branch sewer may be required to service the Laurens Street sub-precinct • Upgrades to aging reticulation sewer assets will be required in the long term

Infrastructure Type	Key Findings	Capital Works Required for Development
Electricity	• AusNet owns and manages the electrical infrastructure within the Arden Precinct • The Arden Precinct is serviced from existing sub-transmission lines from the West Melbourne Terminal Station (WMTS), the Victoria Market Zone Substation (VMZS) and the Laurens Street Zone Substation (LSZS) • The Laurens Street Zone Substation is at the end of its life and is currently being decommissioned • The West Melbourne area is currently being upgraded from 6.6 kV to 11 kV • A 66 kV electrical service corridor has been constructed in the Queensberry Street extension and includes the conduits required for future electrical infrastructure, and infrastructure servicing the Melbourne Metro Tunnel rail project • A new zone substation will be required to support development and it may be located on the existing Laurens Street Zone Substation site • If the Laurens Street Zone Substation is heritage listed (currently under review), CitiPower will likely sell the site and require new land in the Arden Precinct for the new zone substation	• 1 x 22 kV cable bundle (4 cables) will be required to extend from the LSZS to the North Melbourne Train Station Substation to service other parts of the network • 1 x 66 kV cable bundle (3 cables) will be required to run between the WMTS and the LSZS zone substation to service the Arden Central Precinct • The conduits required for the above works should all be trenched at the same time to avoid future works adjacent to live cables • Local substations will be required through the Arden Precinct and the exact location of these is dependent on the density and demand requirements of future development • Developers will be responsible for a customer network contribution for the provision of electrical infrastructure
Gas	• The Arden Precinct is serviced by low, medium and high pressure pipes • A transmission gas pipeline is present in the Arden North and Laurens Street sub-precincts with 250 mm and 450 mm diameters	• A Safety Management Study will be required for development surrounding the transmission pipeline • Reinforcement of existing gas assets to support gas reticulation throughout the Arden Precinct • Additional gas injection to the distribution network including either a pressure reducing station or below ground kiosk

Infrastructure Type	Key Findings	Capital Works Required for Development
	• The 250 mm diameter main has a measurement length of 170 metres, and the 450 mm diameter main has a measurement length of 220 metres, on either side of the pipeline • Development within the measurement length must respond to Australian Standard regulatory constraints relating to sensitive land uses and development density • Gas infrastructure within the Arden Precinct is likely to be inadequate to support the proposed redevelopment	may be required to provide supply required to support proposed redevelopment
Telecommunications	• There are 8 telecommunications authorities with assets in the Arden Precinct • Telstra has critical fibre assets located in Arden Street, Queensberry Street and Munster Terrace • NBN is the Infrastructure Provider of Last Resort within the Arden Precinct and also has the right of first refusal for new developments • Telstra will not enter into commercial agreements for telecommunications infrastructure for redevelopment in the area • NBN has planned works for two service area modules in the Arden Precinct due for completion in 2020	• Backhaul infrastructure in the form of a new distribution fibre network will be required from a service area module location less that 1km from the Arden Precinct • Backhaul costs are attributable to the developer if the length of backhaul required is greater than 1km • NBN deployment contributions are $600 per single-dwelling lots and $400 per multi-dwelling lot

10.2 Key Issues and Opportunities

The following Table 13 highlights key issues and opportunities in regards to utility infrastructure for the next stage of planning for the Arden Precinct.

Table 13 Key Issues and Opportunities

Infrastructure Type	Key Issue	Key Opportunity
General	• Utility authorities require detailed development information, including location of dwellings, lot sizes and alignment of new roads, in order to provide detailed future infrastructure information	• Undertake an assessment of the ultimate Arden Precinct Structure Plan to determine opportunities for sustainable utility infrastructure planning in consultation with utility authorities • Consult with relevant stakeholders to enable greater understanding of the impact of all development on networks and explore what identified upgrades and extensions are able to be included in any developer funding plan • Consult with utility Authorities to understand the infrastructure requirements of the new North Melbourne Station and whether this has flow on impacts for the infrastructure required in the Arden Precinct • Consult with utility Authorities to understand requirements for future road and utility cross-sections
Stormwater Drainage	• Stormwater drainage is a significant issue affecting development within the Arden Precinct • GHD is aware that other reports are being undertaken for the VPA to assess stormwater drainage in more significant detail • Existing services pose a challenge for the proposed location of stormwater storages and cloudburst / green streets	• Evaluate the findings of this assessment against the findings of other detailed stormwater assessments to understand the next steps for development planning • Undertake a water sensitive city drainage assessment to understand the role of green drainage infrastructure within the streetscape and its role in stormwater management • Undertake an urban ecology assessment to understand the integration of the public and private realms in delivering coordinated infrastructure outcomes • Detailed modelling could be undertaken of the Arden Precinct to understand the interaction between existing services, the proposed location of stormwater storages and cloudburst / green streets and the subsequent benefit of the infrastructure

Infrastructure Type	Key Issue	Key Opportunity
Water	• CWW did not provide any information regarding the timing of any alternative water initiatives • CWW has yet to determine its strategic intention regarding the provision of alternative water • Approvals by CoM, CWW and MWC will need to be thoroughly considered for any integrated water management options	• CoM, CWW and MWC are supportive of an alternative water supply to the Arden Precinct • Undertake further analysis to understand where stormwater storages would be, the connection of stormwater drains to the storages, the location of a stormwater treatment plant and the timing of an alternative water network
Sewer	• The majority of the sewer network is over 100 years old and assets will require replacement during the development of the Arden Precinct	• CWW would like to proactively work with developers to incrementally replace these older assets prior to, or as part of, upgrade works to the roads and streetscape
Electricity	• CitiPower did not provide any information regarding the feasibility of innovative electrical servicing opportunities in the Arden Precinct • Clarification is required regarding the potential heritage listing of the Laurens Street Zone Substation	• Consider investigating the feasibility of onsite electricity generation in order to reduce the future infrastructure required to service the Arden Precinct • Collaborate with CitiPower for the planning for the new Laurens Street Zone Substation to provide a substation building with possible multiple uses and an visually appealing and integrated design
Gas	• The presence of a transmission gas infrastructure within the Arden Precinct will have impacts on future development • These impacts will not be well understood until a Safety Management Study has been undertaken	• Undertake a Safety Management Study to understand the impacts of the pipeline on future development within the Arden Precinct and understand what mitigation strategies could be implemented to decrease the impact of the pipeline's location on the Arden Precinct • The limitations of the existing gas network to supply the development of the Arden Precinct provides an opportunity to explore a 'gas-free' Precinct

Infrastructure Type	Key Issue	Key Opportunity
Telecommunications	• Neither NBN nor Telstra provided any information regarding environmentally sustainable telecommunications servicing • Neither NBN nor Telstra provided any information regarding what telecommunications infrastructure would be required to support a high-tech innovation precinct	• Consult with stakeholders and NBN to determine whether opportunities exist to integrate environmentally sustainable initiative into the telecommunications servicing strategy for the Arden Precinct • Undertake research to understand what telecommunications infrastructure would be required to support a high-tech innovation precinct

10.3 Key Sustainability Recommendations

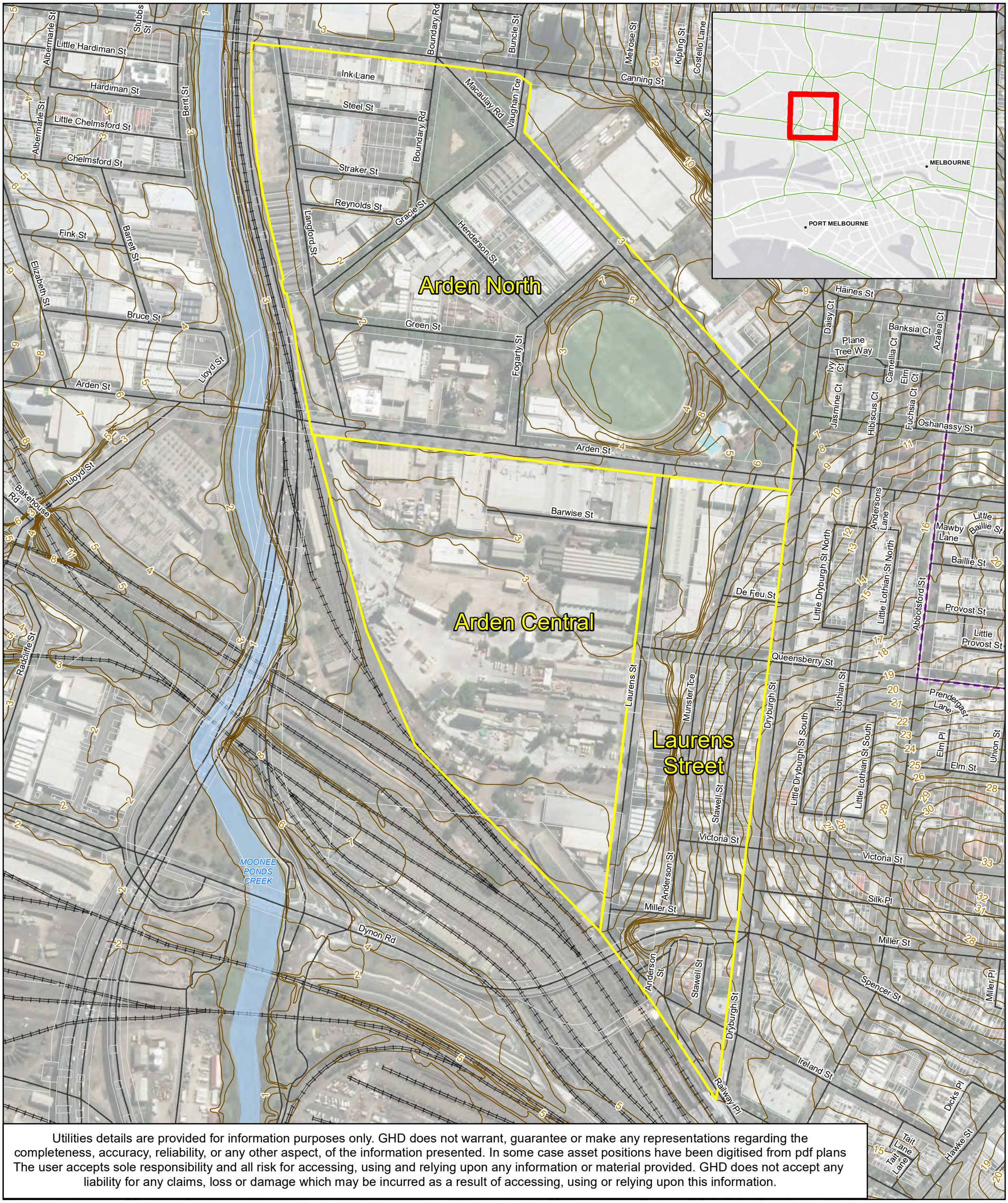
Based on the desktop review of sustainability policies and leading practices, the following Table 14 summarises key recommendations that may be incorporated into the Arden Precinct.

Table 14 Key Sustainability Recommendations for the Arden Precinct

Item	Key Recommendations
Energy	• Mandate a minimum energy efficiency requirement and target for all residential and commercial buildings in Arden Precinct. i.e. NABERS / NatHERS targets • Encourage solar passive design, including optimised urban structure for solar access • Investigate areas where energy reduction measures can be implemented, i.e. the use of LED lighting in streetlights • Consistent with CoM's existing approach, LED street lights should be used for all new street lighting throughout the precinct
Water	• Integrate elements of Water Sensitive Urban Design for effective surface run-off management • Explore integrated localised wastewater treatment opportunities • Foster relationships with water and weather groups / authorities in Melbourne for enhanced flood monitoring capabilities • Undertake a flood and river monitoring program to enable effective responses to flood conditions
Waste	• Explore smart waste management solutions, such as a pneumatic waste conveyance system • Explore waste to energy opportunities
Transportation	• Prioritise active transport throughout Arden precinct by planning for improved walkability, bicycle and public transport accessibility • Promote the uptake of electric vehicles by installing a number of charging stations throughout the precinct
Technology	• Investigate in home monitoring technologies, which enable residents to monitor and improve on operational performance • Explore technologies to ensure that the telecommunications network to be installed is future proof and resilient to the changes in both user operation and volume • CoM advised that the smart capabilities of CitiPower's existing Silverspring mesh network should be investigated

Appendices

Appendix A Locality Plan



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LEGEND

- Contour (1m)
- Road
- Tramway
- Railway
- Approximate Project Study Area sub-precincts
- Parcel
- Watercourse

Paper Size A3

0 20 40 80 120 160

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Victorian Planning Authority
Arden Utilities and Servicing Assessment

Locality Plan and Contour Map

Job Number 31-12513664
Revision E
Date 18/11/2019

Figure 1

G:\31\12513664\GIS\Maps\Deliverables\12513664_KBM_A3P.mxd

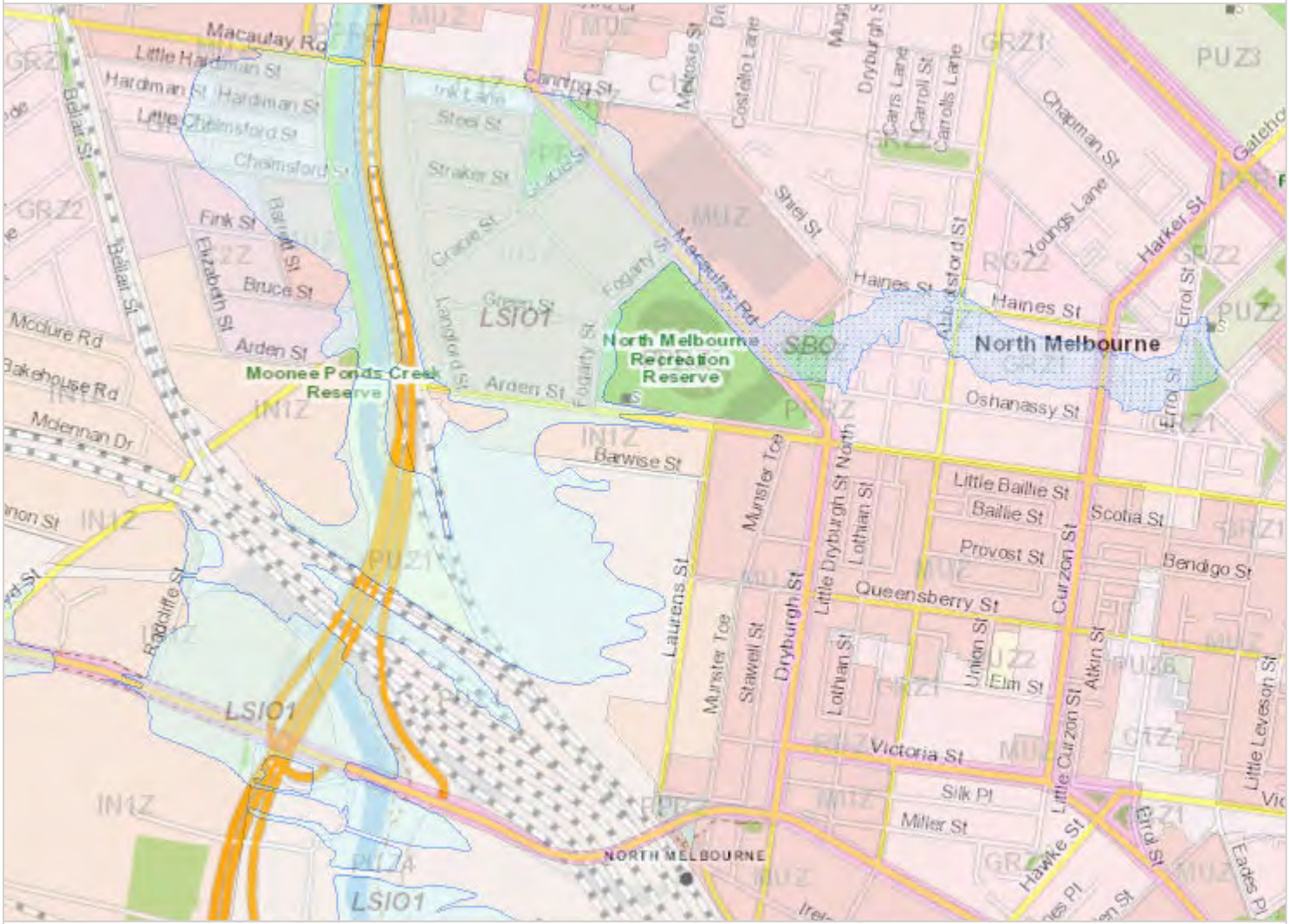
Hazelwood Drive (cnr Lignite Court) Morwell VIC 3840 Australia **T** 61 3 5136 5800 **F** 61 3 5136 5888 **E** mwlmail@ghd.com **W** www.ghd.com

Data source: DEWLP, VicMap, 2019; GHD, 2019; Service Layer Credits: source: ESRI, DigitalGlobe, GeoEye, Earthstar Geographics Created by: cjauniau

Appendix B Planning Zones and Overlays

Planning Map

VICTORIA State Government | Environment, Land, Water and Planning



Planning Scheme Overlays

Land Management

- LSIO - Land Subject to Inundation Overlay
- SBO - Special Building Overlay

Planning Scheme Zones

Residential Zones

- LDRZ - Low Density Residential Zone
- MUZ - Mixed Use Zone
- TZ - Township Zone
- RGZ - Residential Growth Zone
- NRZ - Neighbourhood Residential Zone
- GRZ - General Residential Zone
- R1Z - Residential 1 Zone (superseded by GRZ)

Industrial Zones

- IN1Z - Industrial 1 Zone
- IN2Z - Industrial 2 Zone
- IN3Z - Industrial 3 Zone

Commercial Zones

- C1Z - Commercial 1 Zone
- C2Z - Commercial 2 Zone
- B1Z - Business 1 Zone (Superceded by C1Z)
- B2Z - Business 2 Zone (Superceded by C1Z)
- B3Z - Business 3 Zone (Superceded by C2Z)
- B4Z - Business 4 Zone (Superceded by C2Z)
- B5Z - Business 5 Zone (Superceded by C1Z)

Rural Zones

- RLZ - Rural Living Zone
- GWZ - Green Wedge Zone
- GWAZ - Green Wedge A
- RCZ - Rural Conservation Zone
- FZ - Farming Zone
- RAZ - Rural Activity

Public Land Zones

- PUZ1 - Public Use Zone-Service and Utility
- PUZ2 - Public Use Zone-Education
- PUZ3 - Public Use Zone-Health & Community
- PUZ4 - Public Use Zone-Transport
- PUZ5 - Public Use Zone-Cemetery/Crematorium
- PUZ6 - Public Use Zone-Local Government
- PUZ7 - Public Use Zone-Other Public Use
- PPRZ - Public Park and Recreation Zone
- PCRZ - Public Conservation and Resource Zone
- RDZ1 - Road Zone-Category 1
- RDZ2 -Road Zone-Category 2

Special Purpose Zones

- SUZ - Special Use Zone
- CDZ - Comprehensive Development Zone
- UFZ - Urban Floodway Zone
- CCZ - Capital City Zone
- DZ - Dockland Zone
- PDZ - Priority Development Zone
- UGZ - Urban Growth Zone
- PZ - Port Zone
- CA- Commonwealth land (Not in scheme)

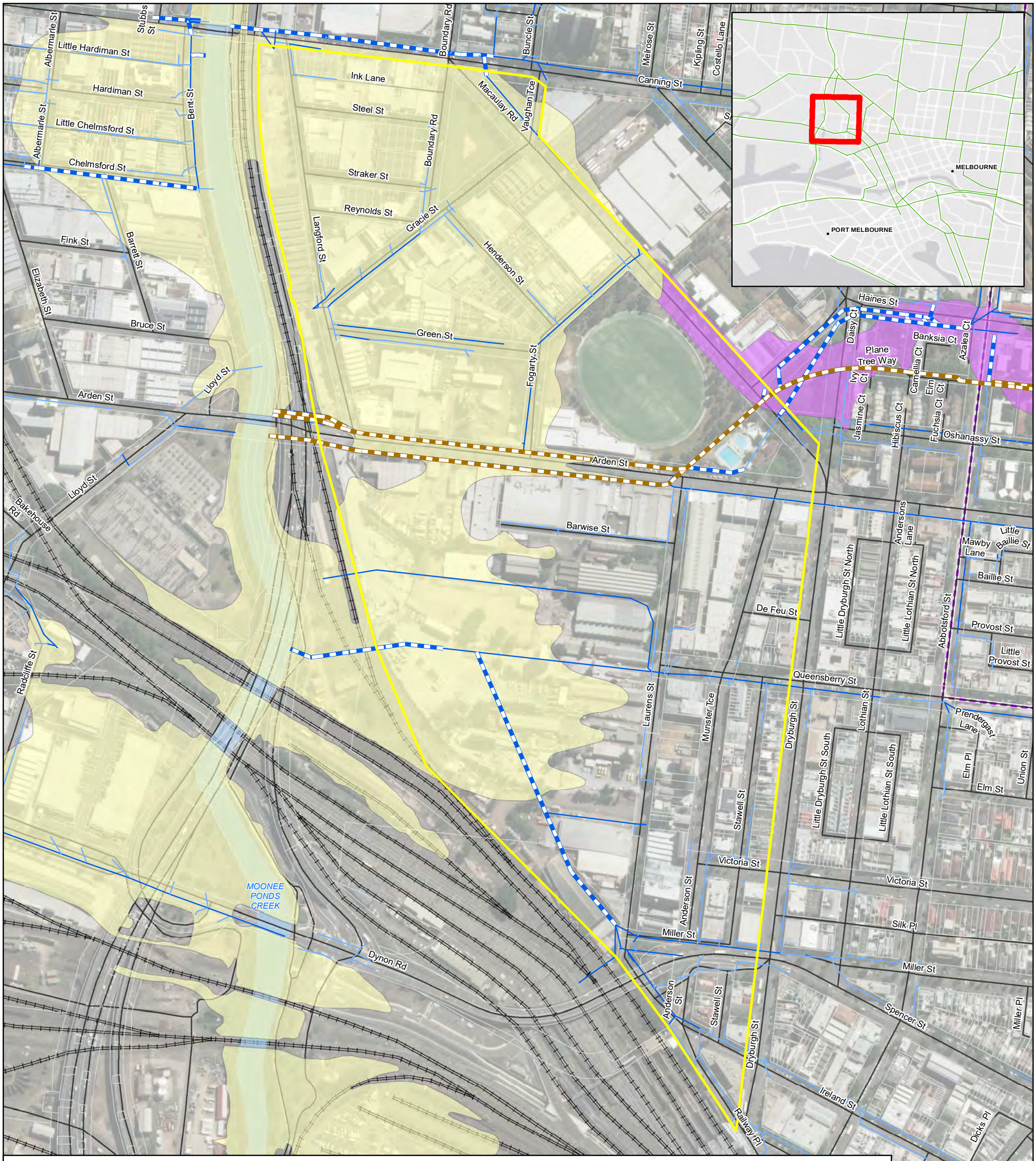
NORTH

0 0.2 0.4

Kilometres

Map Projection: GDA 1994 VICGRID94
Print Date: 18/11/2019

Appendix C Existing Infrastructure Plans



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LEGEND

- Road
- Tramway
- Railway
- Parcel
- Land Subject to Inundation Overlay
- Special Building Overlay
- Approximate Project Study Area
- Watercourse

City of Melbourne Assets

- Drainage Pipe, 900mm - 3000mm dia
- Drainage Pipe, 450mm - 850mm dia
- Drainage Pipe, < 450mm dia

Melbourne Water Assets

- Drainage Pipe, 900 mm - 3000mm dia

Paper Size A3

0 20 40 80 120 160

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Victorian Planning Authority
Arden Utilities and Servicing Assessment

Job Number 31-12513664
Revision E
Date 18/11/2019

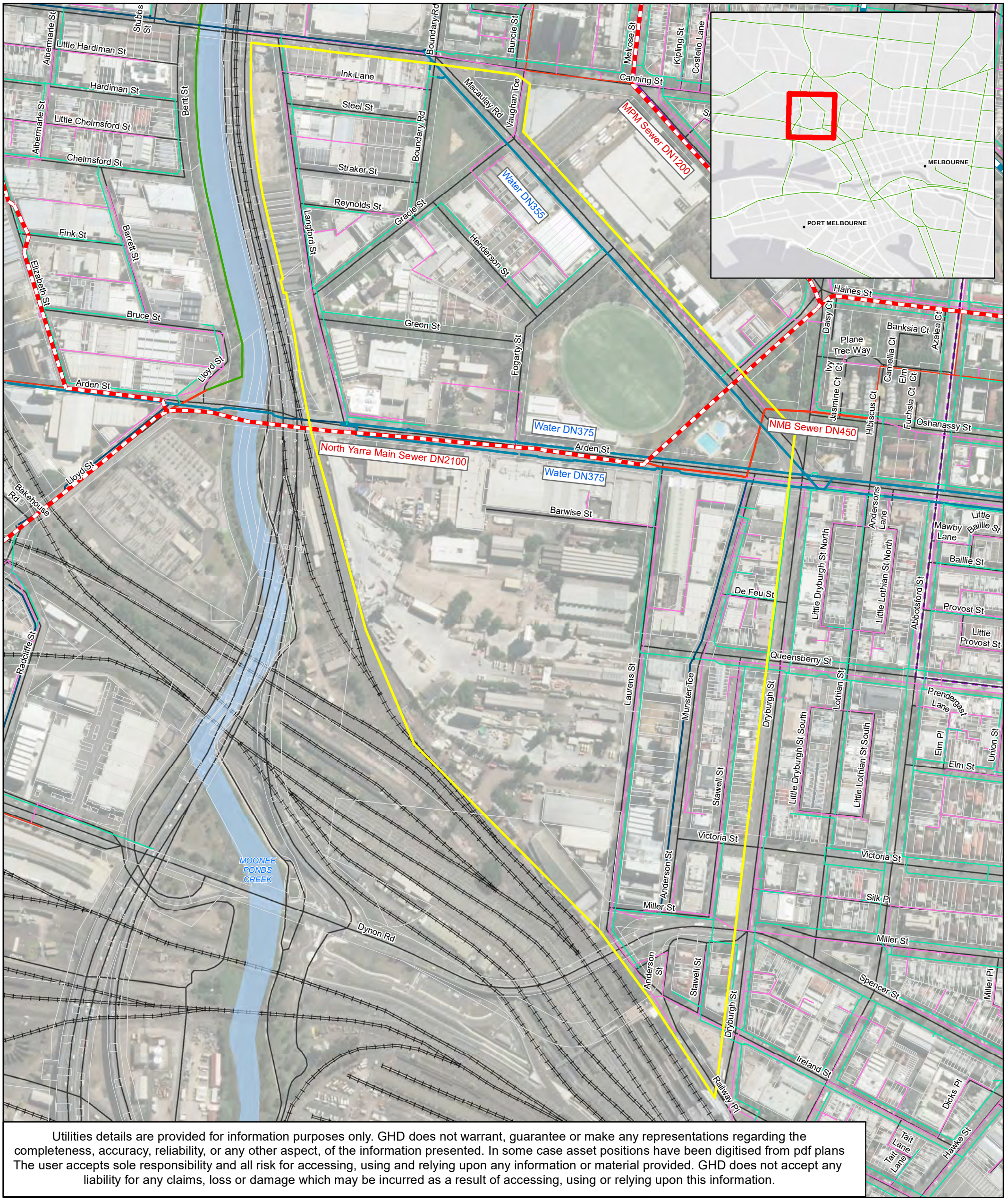
Stormwater Drainage Assets

Figure 2

G:\31\12513664\GIS\Maps\Deliverables\12513664_KBM_A3P.mxd

Hazelwood Drive (cnr Lignite Court) Morwell VIC 3840 Australia **T** 61 3 5136 5800 **F** 61 3 5136 5888 **E** mwlmail@ghd.com **W** www.ghd.com

Data source: DEWLP, VicMap, 2019; Drainage, Melbourne Water data,2019; Drainage, City of Melbourne, 2019; GHD, 2019; Service Layer Credits: source: ESRI, DigitalGlobe, GeoEye, Earthstar Geographics Created by: cjauniau



LEGEND

- Road
- Tramway
- Railway
- Parcel
- Approximate Project Study Area
- Watercourse

Melbourne Water Assets

- Sewer Pipes, < 975mm - 2500mm

City West Water Assets

- Water Main Pipe Transfer, 900mm dia
- Water Main Pipe Transfer, 255-450mm dia
- Water Main Pipe Reticulation, 225-355mm dia
- Water Main Pipe Reticulation, < 150mm dia
- Sewer Rising Main
- Sewer Pipe Transfer Main 1200mm dia
- Sewer Pipe Transfer Main 900-1050mm dia
- Sewer Pipe Main 450mm dia
- Sewer Pipe Main 250-400mm dia
- Sewer Pipe Grav up to 225mm dia

Paper Size A3

0 20 40 80 120 160

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Victorian Planning Authority
Arden Utilities and Servicing Assessment

Job Number 31-12513664
Revision H
Date 18/11/2019

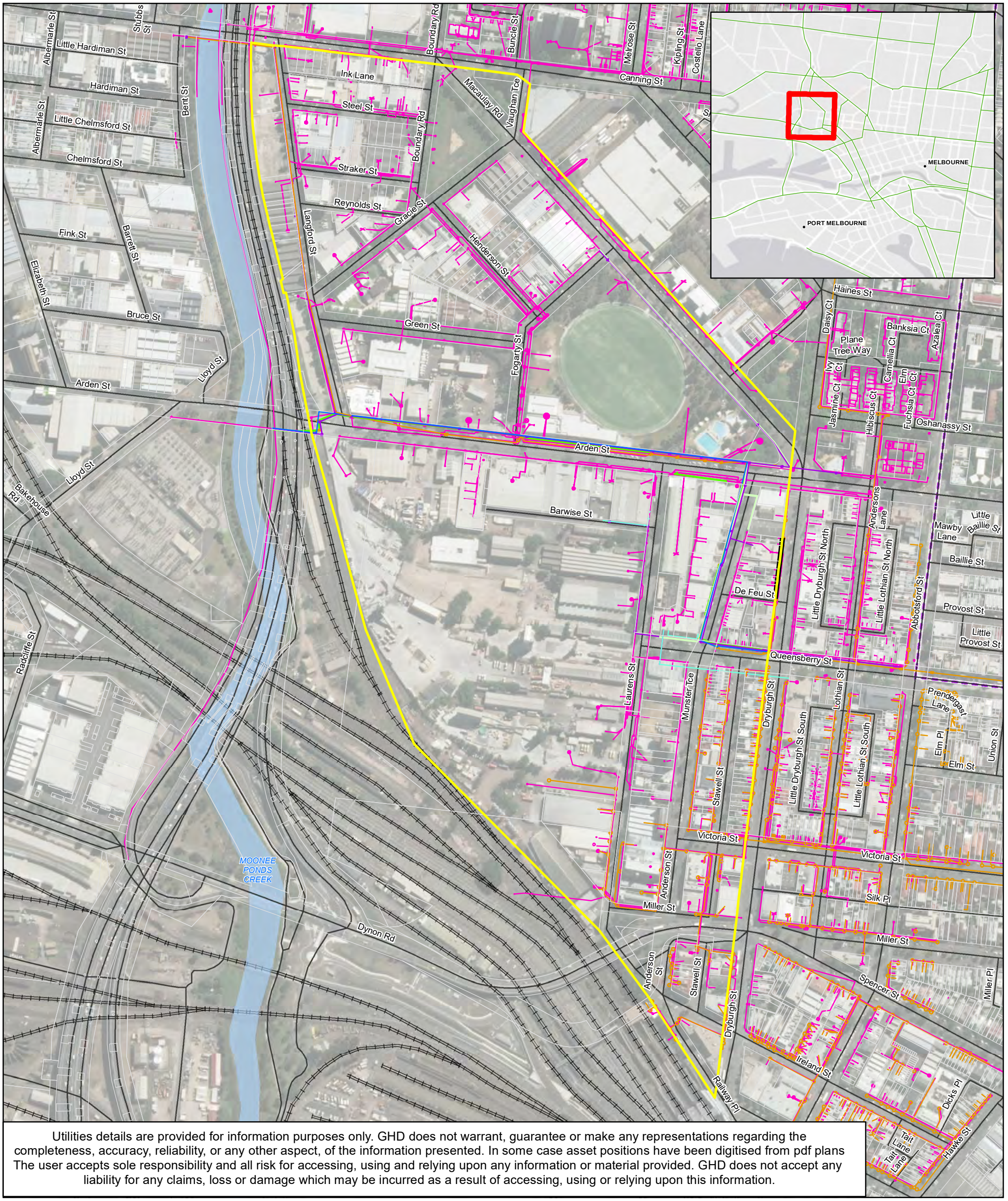
Water and Sewer Assets

Figure 3

G:\31\12513664\GIS\Maps\Deliverables\12513664_KBM_A3P.mxd

Hazelwood Drive (cnr Lignite Court) Morwell VIC 3840 Australia **T** 61 3 5136 5800 **F** 61 3 5136 5888 **E** mwlmail@ghd.com **W** www.ghd.com

Data source: DEWLP, VicMap, 2019; GHD, 2019, CWW assets provided by CWW, 2019; Melbourne water data provided by MW, 2019; Service Layer Credits: source: ESRI, DigitalGlobe, GeoEye, Earthstar Geographics Created by: cjauniau



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LEGEND

- Road
- Tramway
- Railway
- Parcel
- Approximate Project Study Area
- Watercourse
- Telstra Assets
- PIPENETWORKS Assets
- Nextgen Vocus Assets
- Uecomm Assets
- Transgrid Cable Assets
- NBN Assets
- Optus Assets
- Superloop Assets

Paper Size A3

0 20 40 80 120 160

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Victorian Planning Authority
Arden Utilities and Servicing Assessment

Job Number 31-12513664
Revision E
Date 18/11/2019

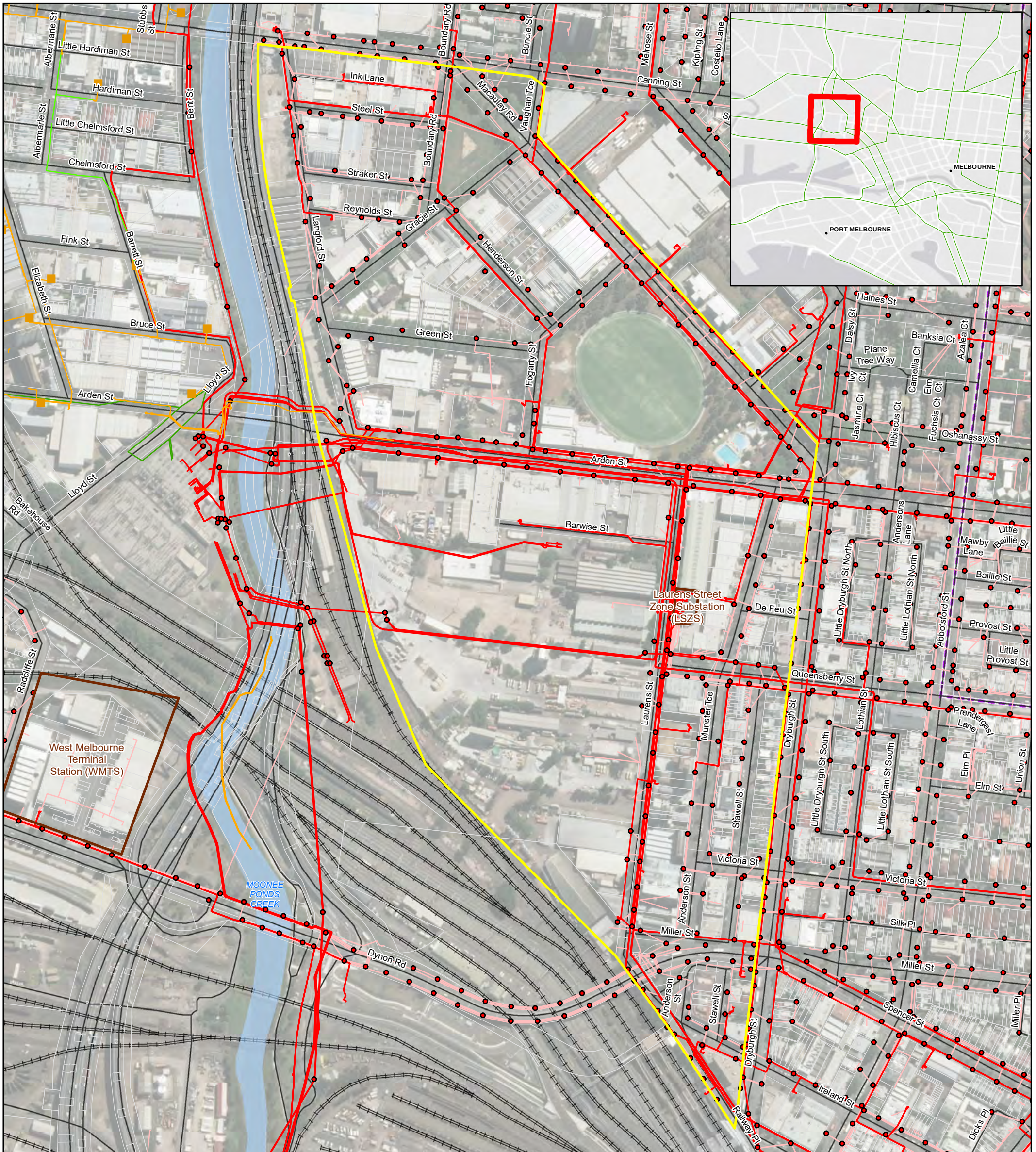
Telecommunication Assets

Figure 4

G:\31\12513664\GIS\Maps\Deliverables\12513664_KBM_A3P.mxd

Hazelwood Drive (cnr Lignite Court) Morwell VIC 3840 Australia **T** 61 3 5136 5800 **F** 61 3 5136 5888 **E** mwlmail@ghd.com **W** www.ghd.com

Data source: DEWLP, VicMap, 2019; GHD, 2019, NBN Assets digitised from DBYD, 2019; Optus Assets digitised from DBYD, 2019; Service Layer Credits: source: ESRI, DigitalGlobe, GeoEye, Earthstar Geographics Created by: cjauniau



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LEGEND

- Road
- Tramway
- Railway
- Parcel
- Approximate Project Study Area
- Watercourse

CityPower Assets

- Pole
- High Voltage Conductor
- Low Voltage Conductor

Jemena Assets

- Substation Location
- High Voltage Underground Cable
- High Voltage Overhead Cable
- FO Cable

Paper Size A3

0 20 40 80 120 160

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Victorian Planning Authority
Arden Utilities and Servicing Assessment

Job Number 31-12513664
Revision E
Date 18/11/2019

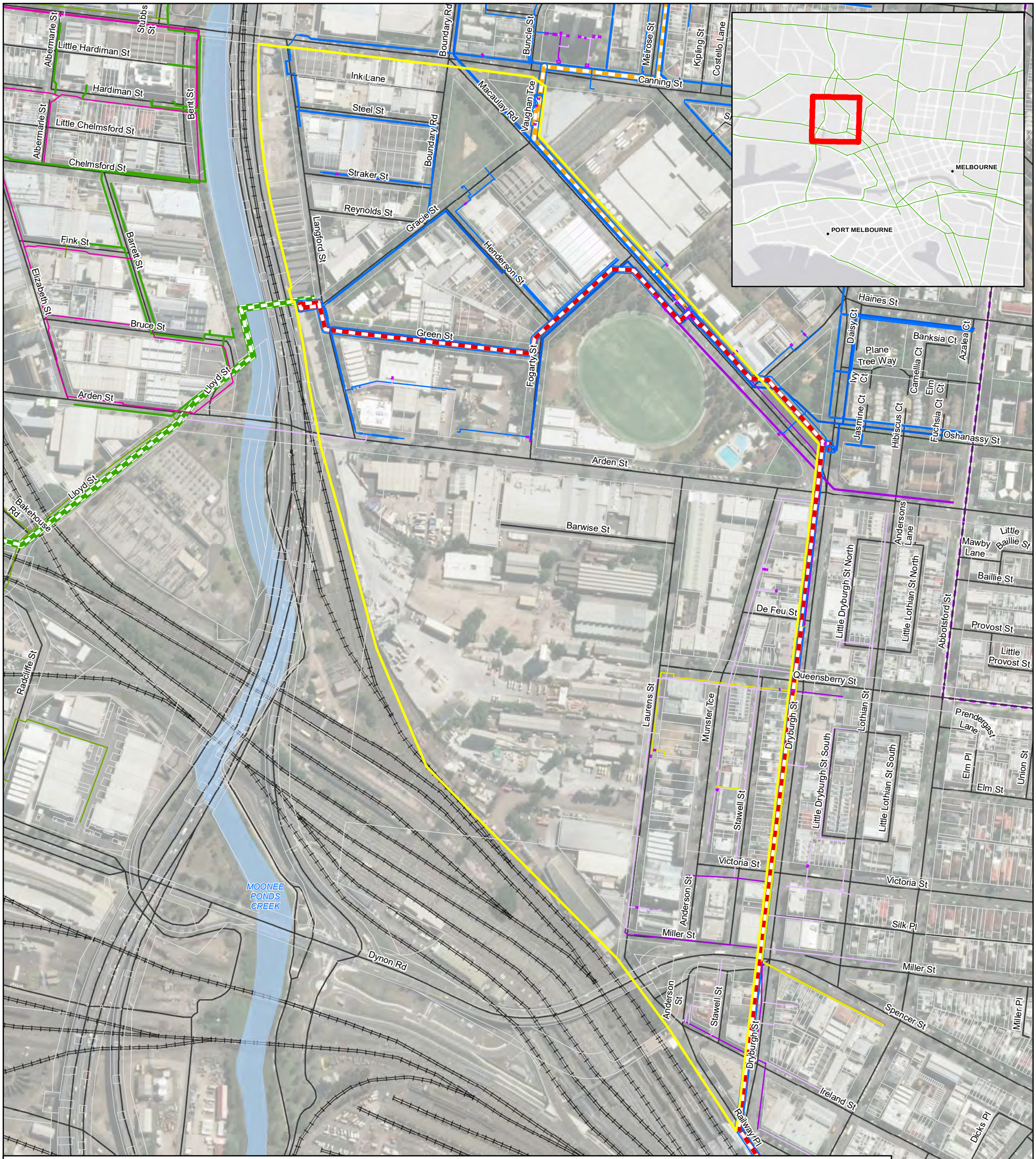
Electricity Assets

Figure 5

Hazelwood Drive (cnr Lignite Court) Morwell VIC 3840 Australia **T** 61 3 5136 5800 **F** 61 3 5136 5888 **E** mwlmail@ghd.com **W** www.ghd.com

G:\31\12513664\GIS\Maps\Deliverables\12513664_KBM_A3P.mxd

Data source: DEWLP, VicMap, 2019; GHD, 2019, Jemena Assets, 2019; City Power & Powercor Assets, 2019; Service Layer Credits: source: ESRI, DigitalGlobe, GeoEye, Earthstar Geographics Created by: cjauniau



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LEGEND

- Road
- Tramway
- Railway
- Parcel
- Approximate Project Study Area
- Watercourse

AUSNET Assets

- Transmission Gas Pipeline 450m dia
- High Main Distribution Gas Pipeline 100 -150mm dia
- High Main Distribution Gas Pipeline < 63mm dia
- Low Main Distribution Gas Pipeline 450mm dia
- Low Main Distribution Gas Pipeline 100mm dia

APA Assets

- Transmission Pressure Gas Pipeline 450mm
- Transmission Pressure Gas Pipeline up to 250mm
- High Pressure Gas Pipeline 110-300mm dia
- High Pressure Gas Pipeline 40-100mm dia
- Low Pressure Gas Pipeline 600mm dia
- Low Pressure Gas Pipeline 150-375 mm dia
- Low Pressure Gas Pipeline 25-100mm dia
- Medium Pressure Gas Pipeline 600mm dia
- Medium Pressure Gas Pipeline 100mm dia
- Valve Gas

Paper Size A3

0 20 40 80 120 160

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Victorian Planning Authority
Arden Utilities and Servicing Assessment

Job Number 31-12513664
Revision F
Date 18/11/2019

Gas and Fuel Assets

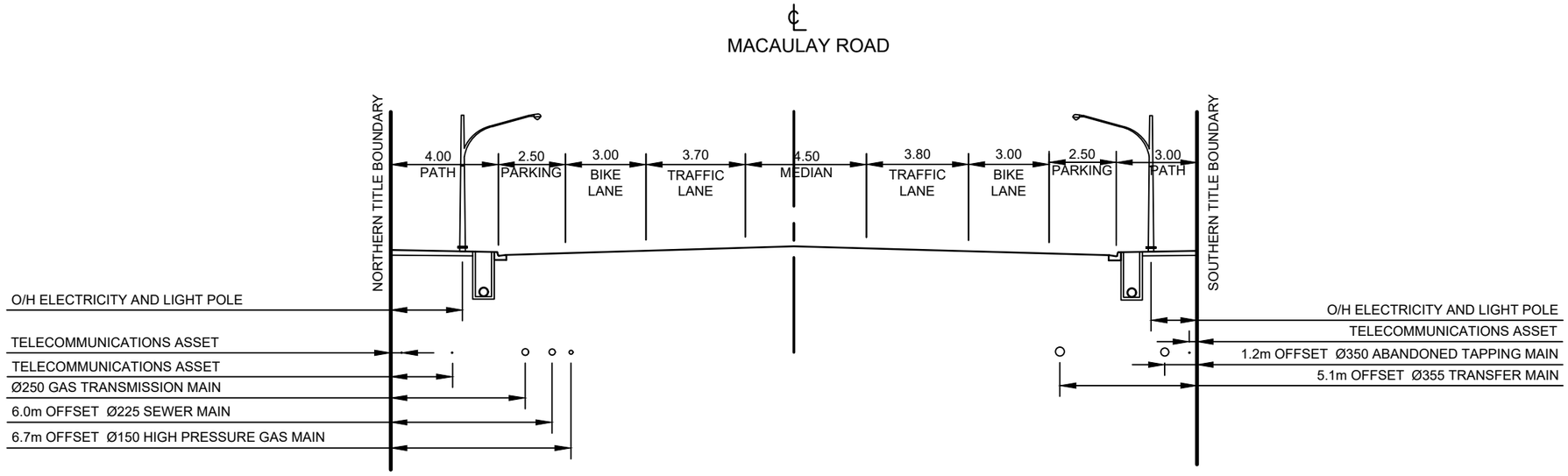
Figure 6

G:\31\12513664\GIS\Maps\Deliverables\12513664_KBM_A3P.mxd

Hazelwood Drive (cnr Lignite Court) Morwell VIC 3840 Australia T 61 3 5136 5800 F 61 3 5136 5888 E mwlmail@ghd.com W www.ghd.com

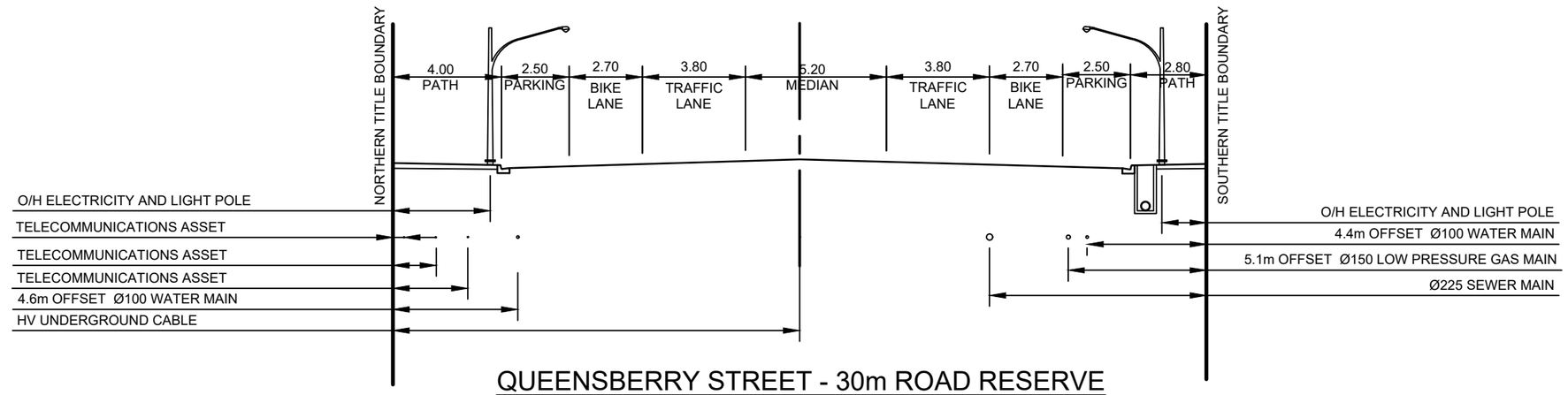
Data source: DEWLP, VicMap, 2019; GHD, 2019, APA and AUSNET Gas Assets digitised from DBYD, 2019; Service Layer Credits: source: ESRI, DigitalGlobe, GeoEye, Earthstar Geographics Created by: cjauniau

Appendix D Typical Cross Sections



MACAULAY ROAD - 30m ROAD RESERVE

SCALE 1:200



QUEENSBERRY STREET - 30m ROAD RESERVE

SCALE 1:200

NOTE:

1. ALL SERVICES SHOWN ARE EXISTING SERVICES.

Paper Size A3

0 2 4 6m

SCALE 1:200 AT ORIGINAL SIZE

Victoria Planning Authority
Arden Utilities Servicing and Infrastrcture Assesment

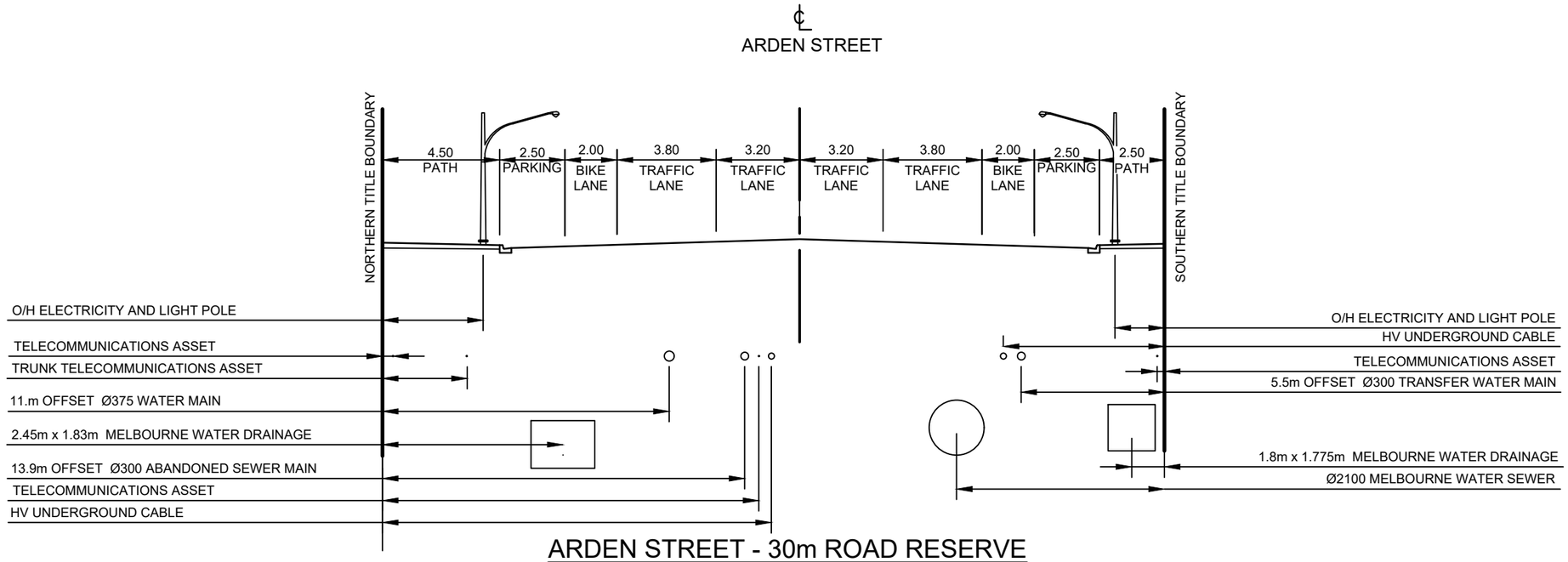
Existing Typical Sections

Job Number 12513664
Revision B
Date October 2019

Figure 7

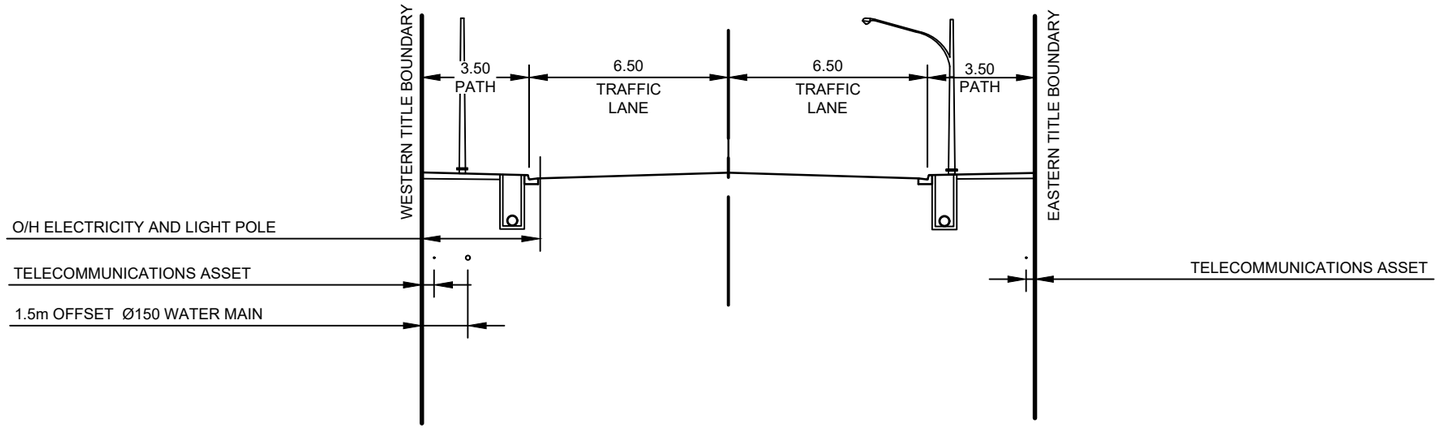
Level 8, 180 Lonsdale Street Melbourne VIC 3000 Australia **T** 61 3 8687 8000 **F** 61 3 8687 8111 **E** melmail@ghd.com.au **W** www.ghd.com

Plot Date: 17 October 2019 - 2:00 PM Plotted by: Tina Cooley Cad File No: G:\31\12513664\CADD\Drawings\31-12513664 -TYPICAL SECTIONS.dwg



ARDEN STREET - 30m ROAD RESERVE

SCALE 1:200



FOGARTY STREET - 20m ROAD RESERVE

SCALE 1:200

NOTE:

1. ALL SERVICES SHOWN ARE EXISTING SERVICES.

Paper Size A3

0 2 4 6m

SCALE 1:200 AT ORIGINAL SIZE

Victoria Planning Authority
Arden Utilities Servicing and Infrastrcture Assesment

Existing Typical Sections

Job Number 12513664
Revision B
Date October 2019

Figure 8

Level 8, 180 Lonsdale Street Melbourne VIC 3000 Australia **T** 61 3 8687 8000 **F** 61 3 8687 8111 **E** melmail@ghd.com.au **W** www.ghd.com

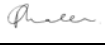
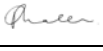
Plot Date: 17 October 2019 - 2:01 PM Plotted by: Tina Cooley Cad File No: G:\31\12513664\CADD\Drawings\31-12513664 -TYPICAL SECTIONS.dwg

GHD

Level 8, 180 Lonsdale Street Melbourne, Victoria 3000
T:03 8687 8000 E: melmail@ghd.com

12513664-85171/https://projectsportal.ghd.com/sites/pp17_03/ardenutilitiesandser/ProjectDocs/12513664 - REP - Utilities and Servicing Assessment.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
Draft A	T. Cooley	M. George				14.10.19
Final 0	T. Cooley	M. George		M. George		18.11.19
Final 1 For Issue	T. Cooley	M. Whalen		M. Whalen		03.09.21

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