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Infrastructure Provision in Different Development Settings Metropolitan Melbourne Costing and Analysis Report

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Front Image: Melbourne Western Suburbs from the air (S. Carne 2017)

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Definitions

ABBREVIATION	TERM	DESCRIPTION
LOCN	Low Order Circulation Networks	Networks of connectivity and movement around development that is not formal road corridor
EDCM	Engineering Design & Construct Manual	Design manual for engineering standards in Melbourne growth areas
VPA	Victorian Planning Authority	
MRWA	Melbourne Retail Water Agency	
CKC	Charter Keck Cramer	
RPM	RPM Real Estate Group	
RLB	Rider Levett Bucknall	Cost Consultant
DELWP	Department of Environment, Land Water and Planning	State department of Victoria
MW	Melbourne Water	
GFA	Gross Floor Area	The sum of the “Fully Enclosed Covered Area” and “Unenclosed Covered Area” as defined by the Australian Institute of Quantity Surveyors and the Royal Australian Institute of Architects.
NSA	Net Saleable Area	The net saleable area of an apartment is the sum of the internal floor areas within the enclosing walls of the apartment. This does not include service areas, balconies, circulation spaces. Lift cores or entry foyer of apartments.

1 Organisation Information

1.1 Infrastructure Victoria

Infrastructure Victoria (IV) is tasked with ensuring that the future of our state is planned with transparent, independent and expert infrastructure advice. It guides decision-making and enhances public debate about Victoria's future.

1.1.1 Purpose

Infrastructure Victoria is transforming the way infrastructure planning is undertaken in Victoria. IV aim to ensure long-term infrastructure planning is thoughtful, evidence-based, consultative and transparent.

IV promote rigorous and transparent decision-making and work with the community and stakeholders to build consensus about well-planned and high-quality infrastructure projects.

1.1.2 Independent Advice

One of Infrastructure Victoria's core roles is to provide written advice to government on specific infrastructure matters. The advice that may be sought from Infrastructure Victoria is not limited to but can include:

- Assessment of any major infrastructure projects proposed by government or the private sector (market-led proposals)
- Intergovernmental submissions
- Government's infrastructure plans.

Infrastructure Victoria will report each year in its annual report what matters the government has requested advice on.

1.2 SMEC Australia

SMEC Australia is a large multi-disciplined progressive global company, delivering engineering excellence and design innovation to clients worldwide. We provide consulting expertise across a range of industry sectors and have developed and refined a core service offering to cover the life of a project, from concept to completion.

Our integrated services contribute to national development in some of the world's fastest growing economies, and since our formation, we have delivered thousands of projects in over 100 countries. We align technical expertise with local knowledge to deliver cost effective, practical and sustainable project outcomes.

The Urban Development division of SMEC includes dedicated professionals in the fields of engineering, surveying, town planning, urban design, landscape architecture and project managers. These specialist key urban development disciplines are supported by a range of additional 'value add' resources ranging from traffic, geotechnical and structural engineers, environmental specialists and infrastructure experts. We provide integrated consulting services needed to plan, design, construct and manage projects from concept to completion.

We understand today's property markets and work to deliver sustainable solutions that maximise the social, economic and environmental potential of each project and have over 50 years' experience in the urban development consulting industry via several predecessor companies including Fisher Stewart and Earth Tech.

Our Urban Communities team is active in all areas of land development ranging from greenfield, brownfield, aged living, industrial, urban renewal, mixed use, education and master planned communities. We have a solid understanding of urban development market trends and are well equipped to provide professional advice in accordance with the project brief.

SMEC's Global Footprint

2 Project Background

2.1 Project Brief

One of the top recommendations in Victoria's 30-year infrastructure strategy was to increase the proportion of housing in areas that are well serviced with infrastructure – to intensify housing density in established areas and around employment centres to make better use of existing infrastructure.

To provide evidence for this recommendation, IV engaged SGS Consulting in 2015 to undertake a literature review to investigate the comparative costs of infrastructure to accommodate population growth across various development settings and locations in Victoria. (Ref: SGS, 2015, Comparative cost of urban development: a literature review prepared for IV). A key finding of the SGS report was:

"infrastructure provision to greenfield lots costs approximately 2-4 times more than infill, depending on the capacity of existing infrastructure to support additional people".

The SGS report also highlighted that most of the existing studies on infrastructure costs in different development settings in Australia draw their data from the same source, the Future Perth (FP) 2001 Infrastructure Study. Key considerations with the Future Perth (FP) 2001 Infrastructure Study are as follows:

- The data does not strongly relate to Victoria
- The data does not relate to directly sourced evidence but comes from other studies undertaken between 1970 and 2000.
- Capital costs are available only, with firm conclusions not able to be drawn on the operational and maintenance costs.

Infrastructure Victoria has subsequently undertaken further work (Phase 1 of this project), consulting with infrastructure providers, to understand what the key issues are that determine the capacity of existing infrastructure to support additional residential growth and the cost of that provision in Victoria.

Arising from this IV have split the project into two streams:

- Phase 2B Melbourne Project: Investigating infrastructure costs in Melbourne and;
- Phase 2C Regional Project: Investigating infrastructure costs in the 3 regional centres of Bendigo, Ballarat and Geelong.

This report has been prepared in conjunction with Infrastructure Victoria who have liaised with authorities to document head works charges.

2.1.1 Melbourne Project

The objective of the Melbourne project is to compare the relative costs of accommodating residential development in different development settings, comparing areas where existing infrastructure can be leveraged against greenfield development settings.

Infrastructure Victoria have already consulted with infrastructure providers in phase 1 of the project and obtained an understanding of the constraints of the existing infrastructure and is now seeking to develop a cost matrix, that identifies the cost of each infrastructure element in the following development settings:

- Greenfield developments
- Small scale dispersed infill developments in middle established areas
- Precinct scale brownfield medium density development in middle/outer established areas
- Precinct scale brownfield high density development in inner Melbourne

As the costs of development are influenced by many variable factors, IV are aiming to identify an average cost for the provision of each infrastructure element and provide scenarios that display the extent to which costs can vary, providing detail on the reason for that variance. Our approach is to not choose sites as case studies but identify different scenarios for each infrastructure element that best display the cost variances that can be experienced for that infrastructure element.

The emphasis of the work is to understand the relative costs for each infrastructure element to identify which infrastructure elements have significant cost, rather than developing a detailed cost build up for each infrastructure

item. Costs, where possible, will be based on existing developments completed in the last 3 to 5 years, or where this is not possible, developed from existing cost data bases or existing feasibility studies.

Through undertaking the work, the IV objective is to progress the initial findings by SGS on the relative costs of infrastructure provision to the different development scenarios to provide cost data for broader economic modelling purposes and to better understand what factors impact on those costs.

The scope of Phase 2b is to further develop the costs in phase 1 and provide auditable evidence base for each cost element included. As the costs of development are influenced by many variable factors, we are aiming to identify an average cost for the provision of each infrastructure element and provide scenarios that display the spectrum of how costs can vary, providing detail on the reason for that variance.

Capital and recurrent costs are provided to enable a 30-year lifecycle cost to be calculated, as well as the initial capital cost. The variance scenarios predominantly relate to capital costs, however when recurrent costs for an infrastructure element vary these are provided also.

The costs provided are the direct costs of construction and operation of the infrastructure and therefore items such as financing costs and government taxes have not been included, however consultant's fees have been included. The costs also represent the actual cost of the infrastructure provision, rather than the costs that are paid by developers or owners of the dwelling.

2.2 Project Methodology

2.3 Literature Review

A literature review was completed by SGS in developing the 2016 Infrastructure Victoria 30 year Infrastructure Strategy. To limit overlap, SMEC has provided a summary of this literature review below.

Following is a list of the literature selected to be reviewed by SGS as part of Phase 1 Project:

- Biddle, T. et al (2006), The Costs of Infill versus Greenfield Development – A Review of Recent Literature, Institute of Transport & Logistics Studies, The University of Sydney, NSW, Australia
- Centre for International Economics (2015) Cost of Residential Servicing, Prepared for Auckland Council.
- City of Sydney (2006) Green Square Town Centre Infrastructure Strategy.
- Evans Paull (June 2012), "Infrastructure Costs, Brownfields vs Greenfield", Redevelopment Economics, Massachusetts, USA.
- Hamilton, C. and Kellett, J. (2015) Exploring infrastructure provision issues in greenfield and urban infill residential developments, State of Australian Cities Conference 2015, Adelaide.
- Infraplan (December 2013) Urban Infill vs Greenfield Development: A review of economic benefits and costs for Adelaide, [Discussion Paper].
- Kinhill Engineers (April 1995), Smart planning not sprawl: the costs and benefits of alternative fringe planning, The Australian Urban and Regional Development Review, Canberra.
- Newton, P.W., Newman, P., Glackin, S., Stephen & Trubka, R. (2012) Greening the Greyfields: Unlocking the Redevelopment Potential of the Middle Suburbs in Australian Cities, World Academy of Science, Engineering and Technology: Proceedings of the 33rd International Conference on Urban Planning and Regional Development (ICUPRD 2012), Venice, Italy, Vol. 71 (2012), pp. 658-677.
- Newton, P. (2013) Regenerating cities: technological and design innovation for Australian suburbs, Building Research & Information, Vol. 41, No. 5, 575-588.
- Newton, P. & Glackin, S. (2014) Understanding Infill: Towards New Policy and Practice for Urban Regeneration in the Established Suburbs of Australia's Cities, Urban Policy and Research, 32:2, 121143,
- Property Council of Australia et al (June 2016) Design Perth: a joint vision for a connected, liveable and sustainable Perth, Australia.
- SGS Economics and Planning (June 2013) Financial costs of settlement patterns in rural Victoria: Final Report, Australia.
- SGS Economics and Planning (January 2012), Where and how should we grow? Final Report, Prepared for Rural Councils Victoria
- Trubka, R., Newman, P., & Bilsborough, D. (2009) Assessing the Costs of Alternative Development Paths in Australian Cities, Curtin University Sustainability Policy Institute Fremantle, Parsons Brinckerhoff Australia/Curtin University.

- Trubka, R., Newman, P. & Bilsborough, D. (2010) The Cost of Urban Sprawl – Infrastructure and Transportation, Environment Design Guide.
- Environmental Resources Management Australia Pty Ltd (ERM) (2001), Future Perth: Costs of Urban Form, Working Paper No. 2, Western Australian Planning Commission, Perth.

SMEC has completed a review of the following literature in addition to the above:

- SGS, Comparative costs of urban development: A literature review Final Report (SGS July 2016)
- DELWP, 2018 – Housing outcomes in established Melbourne 2005 to 2016
- DELWP, 2018 – Urban Development Program
- ABS, 2018 – Building Approvals Australia 2018
- GHD, 2017 - Strategic Utility Assessment Metro Melb Geological/geotechnical aspects associated with cost of construction of shallow infrastructure
- ARUP, 2016 – Victoria Planning Authority – Arden Investment Case, Engineering and Cost Input Final Report
- GHD, 2016 – DELWP – Fishermans Ben Baseline Utility Assessment Report
- Melbourne Water, 2008 – Guidelines for development in flood-prone areas
- Melbourne Water, 2017 – Planning for Sea Level Rise
- Australian Social & Recreation Research, 2008, Planning for Community Infrastructure in Growth Areas
- CKC, 2018 – Valuation Data provided by Charter Keck Cramer based on benchmarked projects
- RPM, 2018 – Sales and Valuation Data provided by RPM Real Estate based on benchmarked projects
- Planisphere 2017 – Fishermans Bend Public Space Strategy

2.3.1 Review of Phase 1 Project

SMEC has completed a review of the SGS report prepared for IV titled '*Comparative costs of urban development: A literature review Final Report'* (SGS July 2016). The key findings of this report of note were as follows:

- SGS completed a review of literature on comparative infrastructure costs and found most authors rely on their own reviews of existing literature, very few produced their own costs
- Infrastructure costs are heavily dependent on different development settings
- There are significant data gaps in literature regarding infrastructure costs for National Employment Clusters, Activity Centres and greyfield development settings. This could be due to the recent nature of this development and the fact that authority development contribution schemes are generally not evident for this type of development. Greenfield development has well defined statutory policy around cost allocation and sharing.
- Generally, the data sources generally show infrastructure supply to infill locations can be provided at comparatively lower costs
- From the data that was compared it was found that infrastructure for greenfield scenarios was found to cost 2-4 times more than infill development.
- In literature reviewed, there was a considerable variation in which comparative developments are costed and variations in the discount rates. Most infrastructure is costed over 15-30 years and has discount rates of 4-7% applied.
- Significant ongoing transport costs apply to development scenarios, in particular, greenfield development
- The literature found greenfield development costs to be reasonably consistent between Australian cities but that the cost of infrastructure at infill locations is much more difficult to ascertain due to the varying capacity of the existing systems.

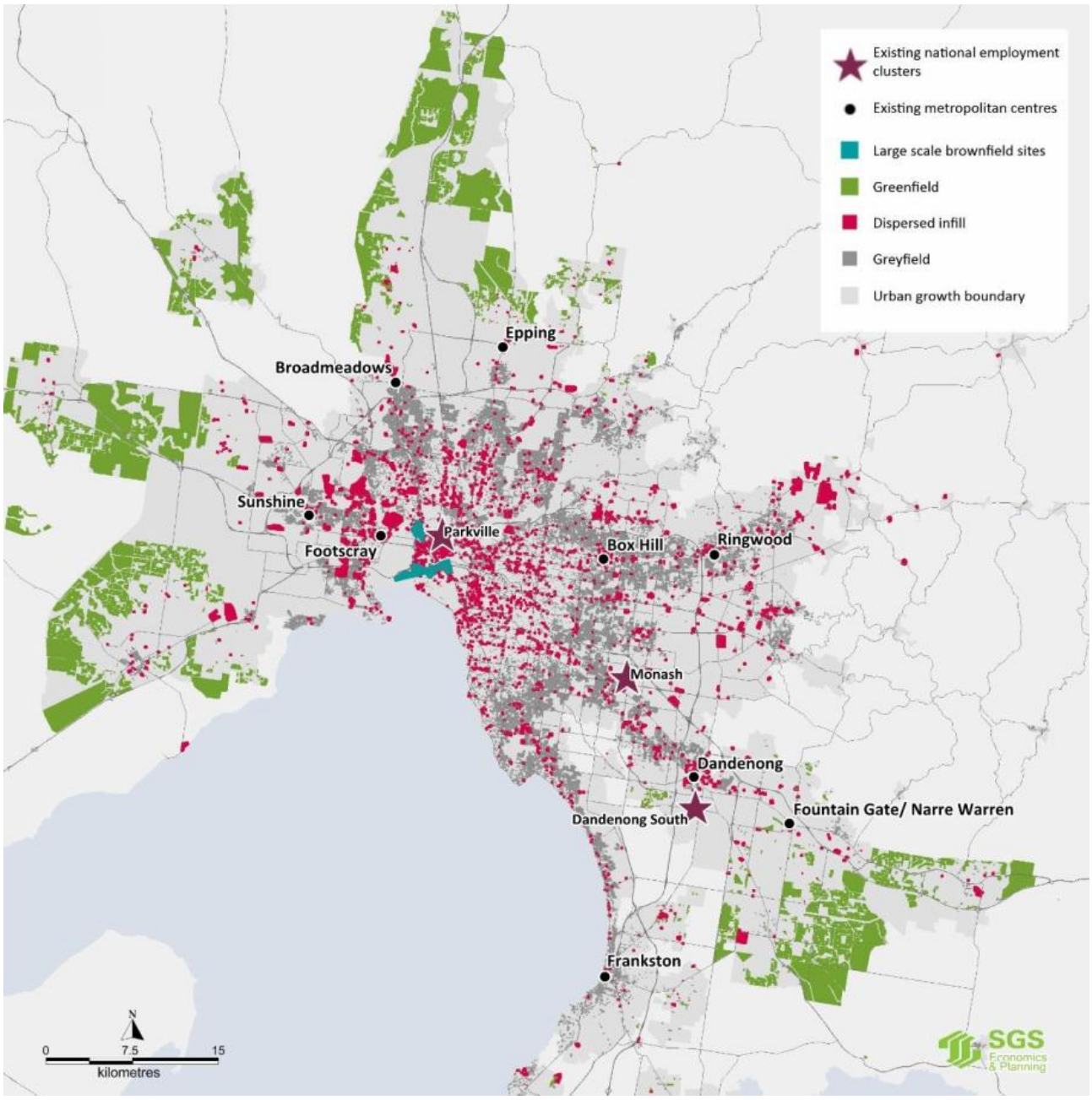

Figure 1 - Indicative development settings in the Melbourne Context (SGS, 2016)

2.4 Report Contributors

SMEC collaborated with industry specialists to deliver this project. The following parties contributed key information to this report and SMEC acknowledges them for their input.

2.4.1 Cost Consultant

Rider Levett Bucknall (RLB) provided key construction and infrastructure cost information for the project backed up by actual construction project database.

Key Contact

Brendan Young - Associate
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2.4.2 Land Valuations

Charter Keck Cramer (CKC) provided property advisory, land valuation data and analysis of localities for the project. This data included actual sales data for projects.

Key Contact

Rob Burgess -National Director of Research and Strategy
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3 Scenario Definition

3.1 Greenfield Development

Greenfield development consists of subdivision of historically agricultural land into residential lots with a density between 10 and 20 dwellings per hectare of net developable area. In Melbourne, Greenfield development is contained to areas within the Urban Growth Boundary which took effect in June 2014.

This Urban Growth Boundary and the location forms one of the key policies of Plan Melbourne 2017-2050 (DEWLP, State Government Victoria 2017). Direction 2.1 of the plan seeks to '*Manage the supply of new housing in the right locations to meet population growth and create a sustainable city*'. Policy 2.1.1 regarding the Urban Growth Boundary lists priorities as follows:

- Seeks to reduce urban sprawl
- Increase metropolitan housing densities in the right places
- Ensure Melbourne's established suburbs accommodate a greater share of Melbourne's Growth
- Create a more consolidated city of 20-minute neighbourhoods with good access to public transport and services
- Protecting the values of non-urban land, opportunities for productive agricultural land and significant landscapes

The Plan states a permanent urban growth boundary will be maintained to constrain Melbourne's outward growth.

The key management body for greenfields development roll out is the Victorian Planning Authority (VPA), previously Growth Areas Authority. This state government organisation oversees the creation of Precinct Structure Plans (PSP) for all growth areas and works closely with local government and referral authorities across Melbourne.

The trend for average lot size within Melbourne metropolitan greenfields growth areas continues a downward trend from an average of 630m^2 in 2001 to 430m^2 in 2018.

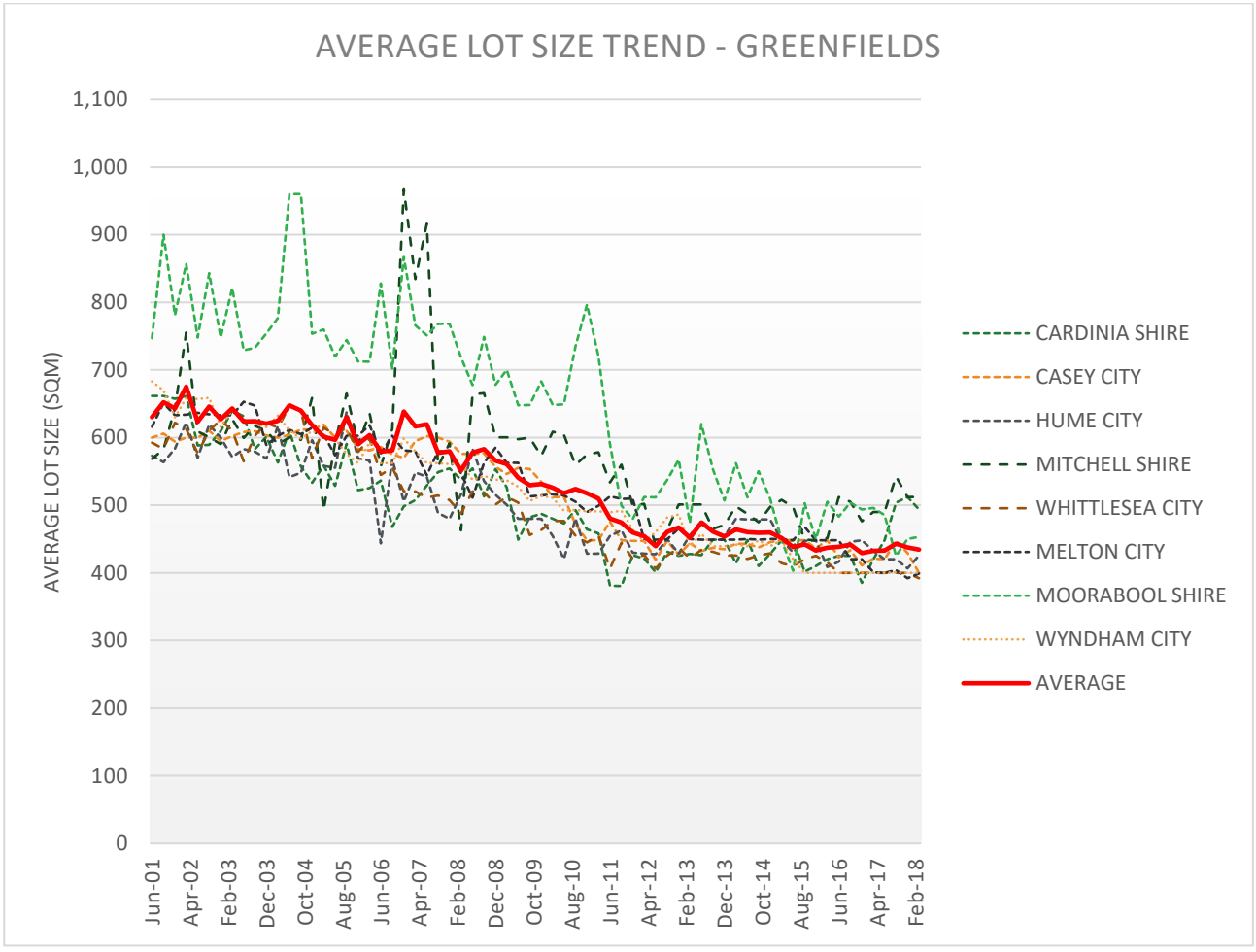


Figure 2 - Average lot size trend (RPM Real Estate Group 2018)

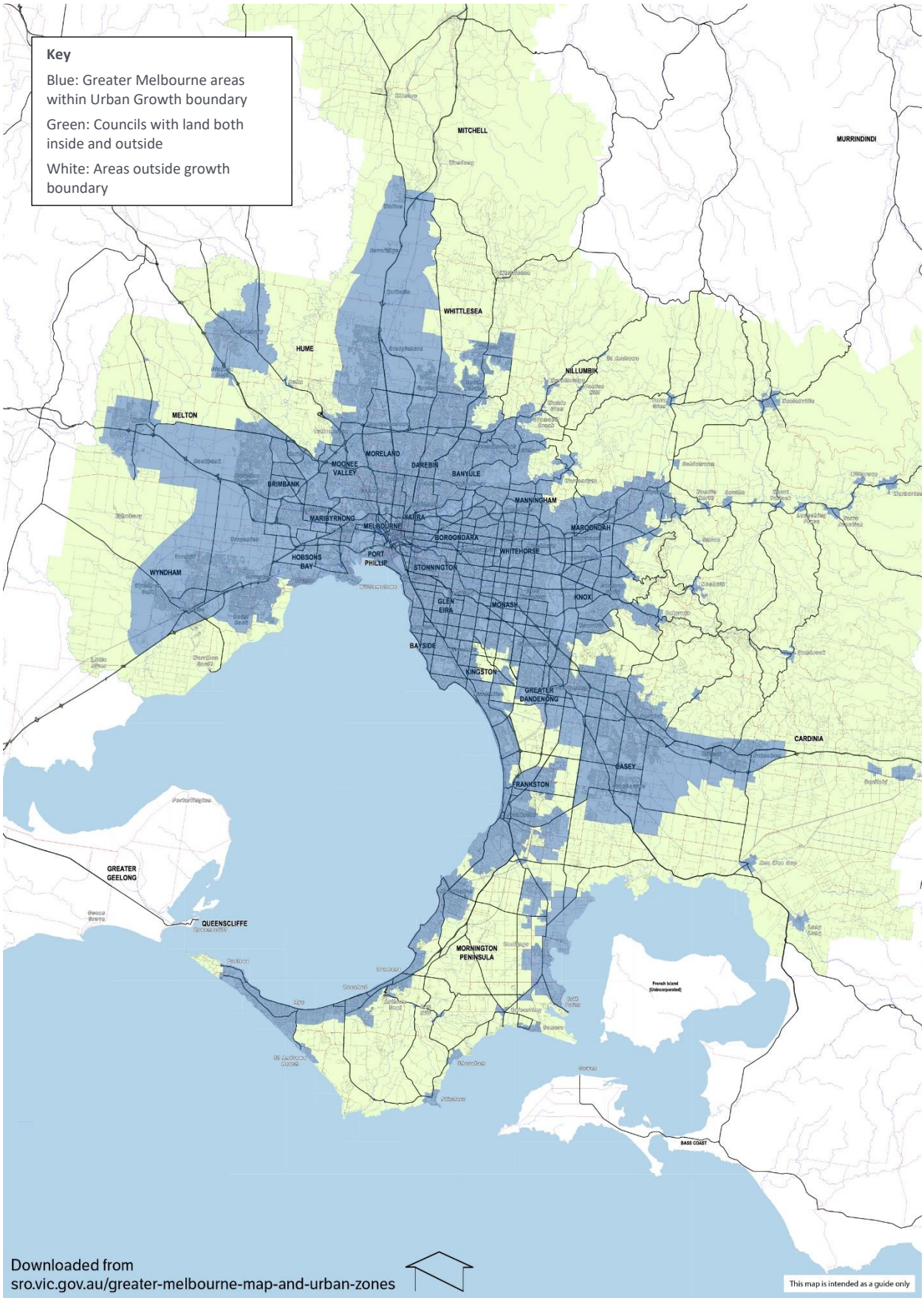


Figure 3 - Melbourne Urban Growth Boundary (SRO 2018)

3.2 Small Scale Dispersed Infill Development

Small Scale Dispersed Infill Development (SSDID) is characterised as re-development of an existing single dwelling residential lots, commercial or industrial lots of 2 up to 10 dwellings. This is most prevalent in inner ring suburbs. Tracking and analysis of SSDID is undertaken by DELWP under the Housing Development Data (HDD) information package. This data records all residential development activity (i.e. dwellings constructed or demolished) in Metropolitan Melbourne for a period from 2005-2016. Metropolitan Melbourne saw an average annual increase in dwelling stock of 32,090 dwellings over this period, with the Western region seeing the greatest increase. As at 2016, there were an estimated 1,833,950 dwellings in the Metropolitan Melbourne subregion (DELWP). For the purposes of this assessment, SSDID is defined as 2-4 dwellings as this is representative of the majority of SSDID.

Analysis of net lots constructed has been completed for metropolitan Melbourne Local Government Areas (LGA) excluding growth areas of City of Casey, Melton City Council, Hume City Council, Mitchell Shire Council, Whittlesea Council and Wyndham City. Data contained within **Error! Reference source not found.** and Figure 4 below relates to NET dwelling increases. For example, if a single dwelling was demolished to construct two dwellings, it would be represented as one NET dwelling. If a single dwelling was demolished to construct a single dwelling, this would be counted as zero NET and have no impact on these figures.

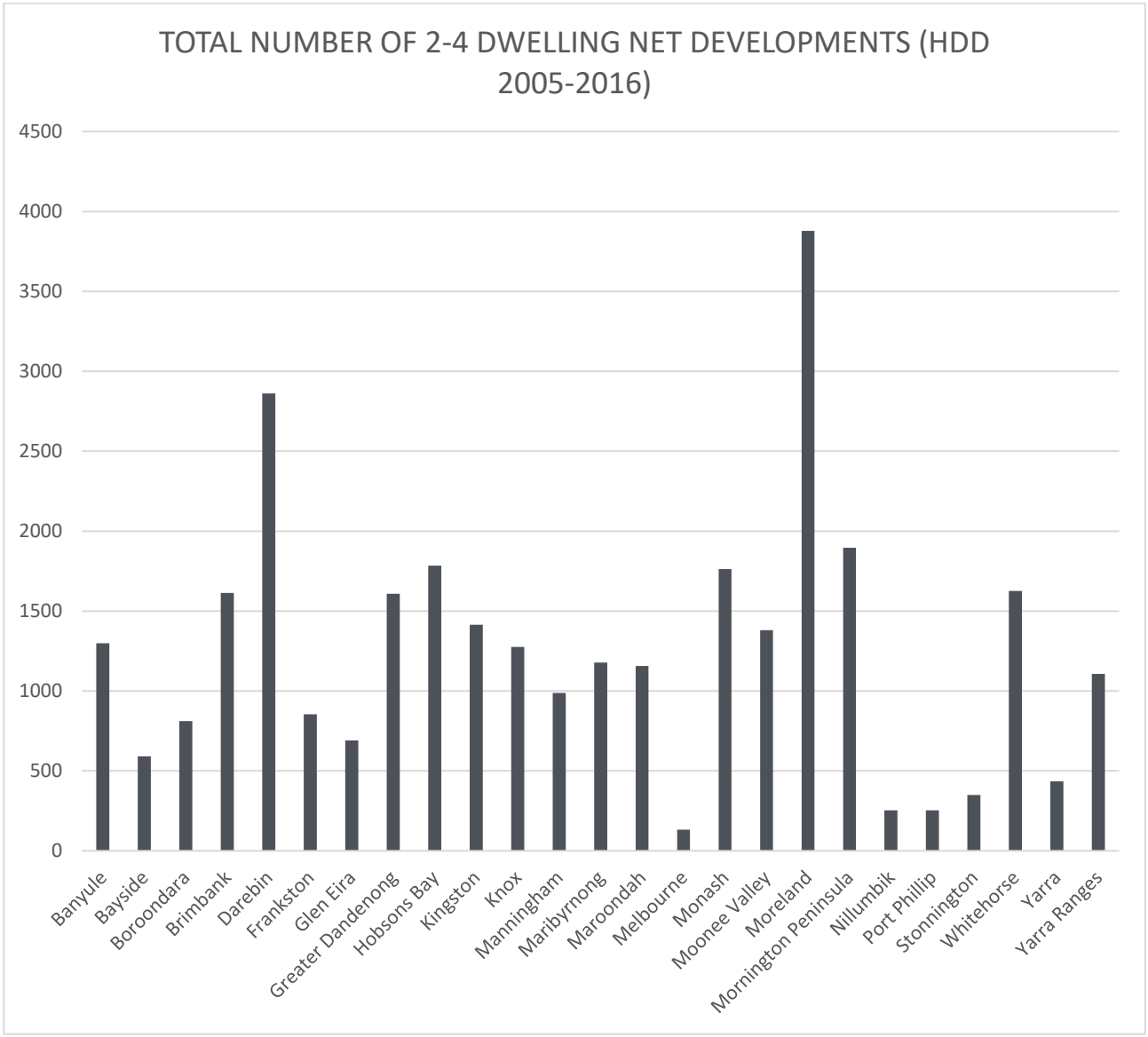


Figure 4 - HDD data, dwellings constructed by type (DELWP)

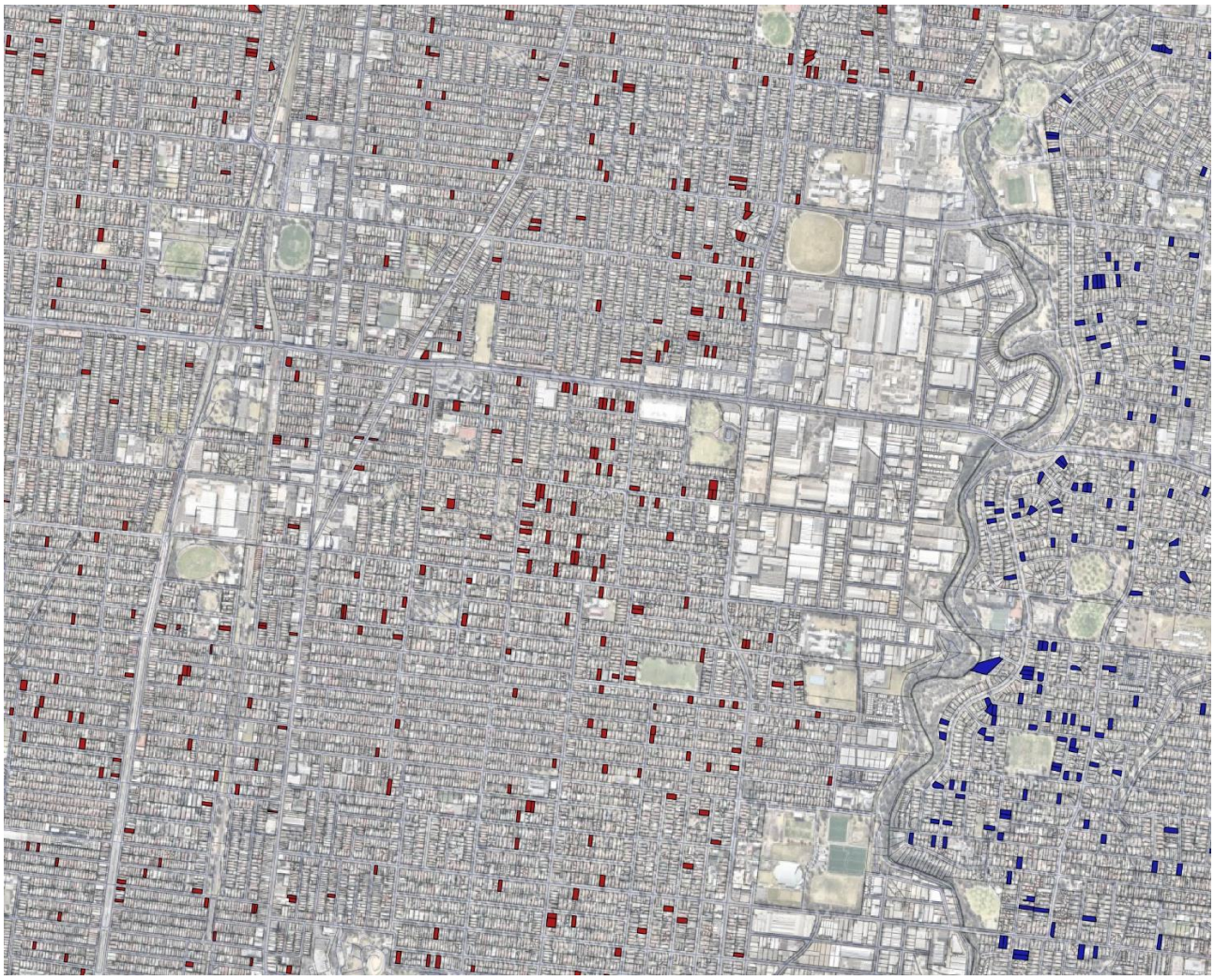


Figure 5 - HDD date, 2-4 dwelling SSDID projects within Preston (DELWP HDD, 2018)

The figure above shows the 2-4 dwelling SSDID development projects in the last 10 years (to 2016) within Preston (Darebin City Council, red) and Heidelberg West (Banyule City Council, blue)

3.3 Precinct Scale Brownfield (Medium Density)

Precinct Scale Brownfield Development (PSBD) is Medium Density Residential defined as development of a lot with more than 10 dwellings. Buildings can be detached, semi-detached or attached residential dwelling developments with a density range between 20 and 80 dwellings per net developable hectare. Typical densities are between 30 and 40 dwellings per hectare. Development is generally in 1-4 storey form. Dwelling can be without garages or be front loaded, rear loaded, or basement loaded. Examples of medium density residential include:

- terrace style housing on torrens or strata titled lots;
- dual occupancies and semi-detached dwellings;
- villa and townhouse development;
- community titled, master-planned and medium density developments;
- low rise apartment buildings;
- 8-10 storey transit-orientated developments.

The development pipeline includes strategic sites identified for development, sites currently in the planning process, sites with planning approval or under appeal and sites currently under construction. Some sites with were planning approval has not been granted are included as long term possible pipeline supply. (DELWP Urban Development Program (UDP)) pipeline.

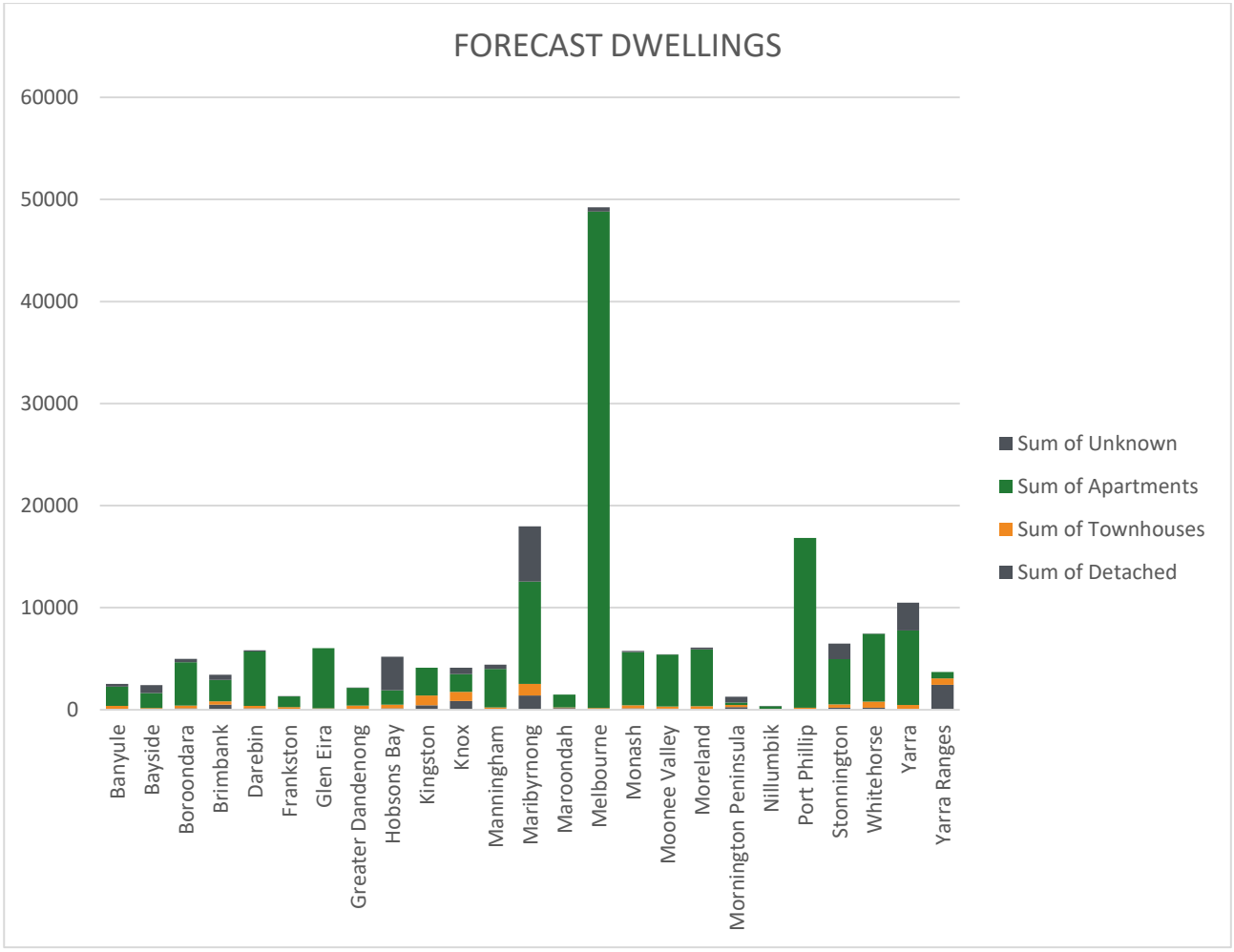


Figure 6 - Residential redevelopment pipeline by region and built form (Urban Development Program DELWP, 2017)

3.4 Precinct Scale High Density

High density development includes residential flat and apartment buildings 10 storeys in height or greater but may include alternative housing forms which deliver higher dwelling yields. High density housing development includes high-rise development. High density development should occur in locations of intense activity with excellent public transport and be largely limited to locations within the Central City Activity Centre, regional activity centres and some district activity centres where appropriate. High density development also has a place as part of transport orientated developments along major public transport routes.

High density development applies to developments with yields upwards of 80 dwellings per hectare with no upper limit.

The High Density Residential Sector is generally guided by residential apartment sales demand but also through government policy for increased density. Plan Melbourne (2017-2050) documents 121 Major Activity Centres where significant increases in high density development will be supported by structure plans and local government policy. These Major Activity Centres together with around 50 strategic development sites and a significant number of infill sites will contribute to a significant number of dwellings in the order of 240,000 dwellings. (DELWP Urban Development Program update 2017)

Development of this nature is generally typical in inner and middle ring suburbs. High density development is the largest growth sector in Melbourne metropolitan residential development. Key comparison between greenfields and infill and high-density development is as follows:

- As at July 2017, there were 234,500 dwellings identified for future development in major residential redevelopment projects across metropolitan Melbourne (sites yielding 10 dwellings or more excluding growth area precincts). In the past decade the pipeline of dwellings planned for major redevelopment sites has more than doubled. (DELWP HDD, 2017)
- As at November 2017, the total supply of broad-hectare residential lots within Melbourne's growth areas was approximately 348,000 lots. Of this supply, 206,500 lots are 'development ready' (i.e. either zoned for residential use, or subject to an approved precinct structure plan). (DELWP HDD, 2017)

Development approvals of apartments in Melbourne is expected to overtake houses by 2030, based on current trend in growth in this sector (Source ABS Building approvals 2018). It should be noted that building approval data can be inaccurate representation of actual dwelling construction given some developments submit for multiple building approvals. Information provided for reference only.

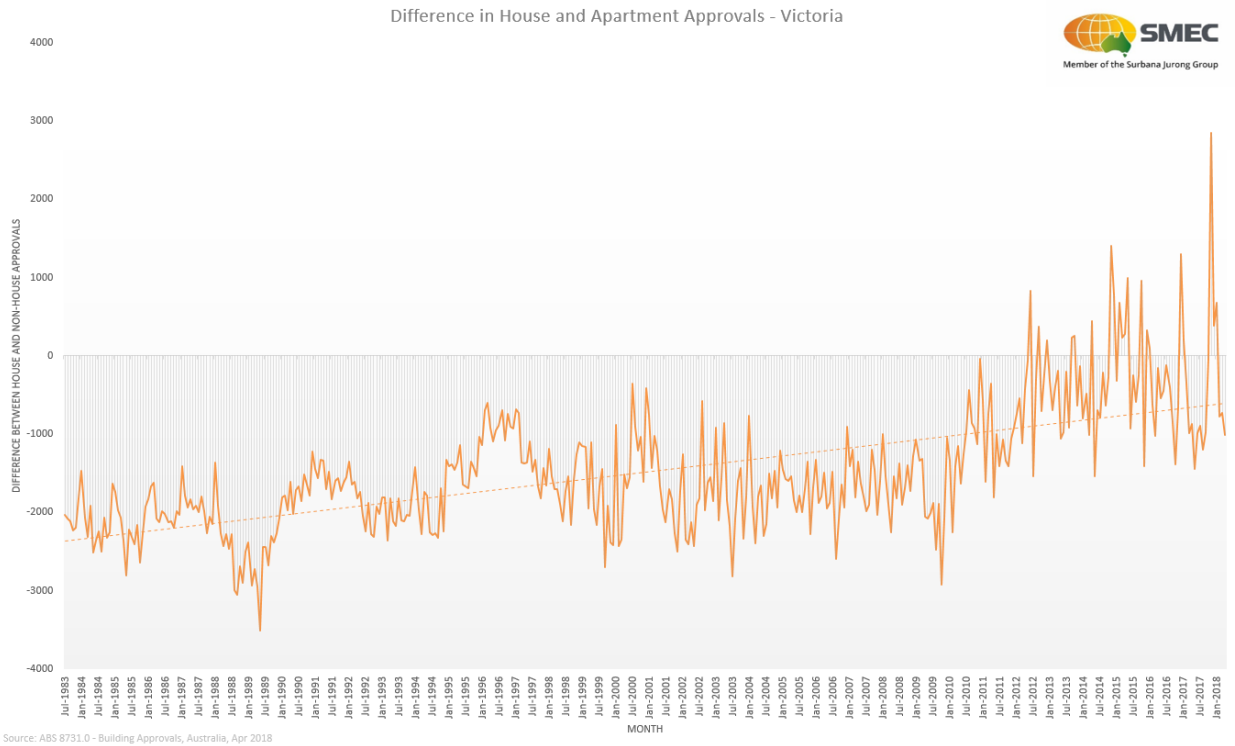


Figure 7 - Historical trend difference between apartment and house development approvals (ABS, 2018)

4 Infrastructure Considerations

4.1 Transportation & Circulation

Transportation and circulation varies across the four development scenarios with greenfields, SSDID and medium density being road transport orientated whereas high density being more pedestrian orientated. Transport and circulation therefore consists of two elements being Roads and Low Order Circulation Networks (LOCN). These are defined further below.

4.1.1 Low Order Circulation Networks

In assessing transportation and circulation through the four development scenarios, the term 'low order circulation networks' (LOCN) has been defined. The LOCN costs are borne by the overall development and through owners once development is complete. Ongoing maintenance is the responsibility of the Owner's Corporation.

These LOCN refer to different project components for the different scenarios, with items falling within this definition as follows:

- **Greenfield development:** Minimal occurrence. Relates only to movement of people throughout a lot, i.e driveways, laneways footpaths etc. Responsibility of the private land owner or public reserves and road reserves responsibility of local government.
- **Small Scale Dispersed Infill:** Medium occurrence. Relates to movement around Owner's Corporation common property and can include shared driveways, paths and garden areas.
- **Precinct Scale Brownfield (Medium Density):** Medium occurrence. Relates to movement around Owner's Corporation common property and can include private laneways, roads, footpaths, cycling paths and parklands or linear strips.
- **Precinct Scale High Density:** High occurrence. Relates to movement around Owner's Corporation. This includes items such as basement car parking, lifts and elevators, bridges, circulation areas for common movement, hallways and corridors. These have an associated cost element in the project delivery.

4.1.2 Roads

Generally, roads across all development scenarios fall into five main categories as follows:

- Arterial
- Local Roads
  - Connector Street
  - Local Access Street – Level 2
  - Local Access Street – Level 1
  - Laneways

These road categories are applicable to all development scenarios from high density to greenfield. The variation is where, relative to the development, the roads exist. Other road categories such as highways, freeways and tollways are not included in this assessment given impact on the development scenarios is difficult to define.

4.1.3 Arterial Roads

Arterial Roads, generally external to the development and managed by the State Government, are higher order roads providing a higher speed inter suburban links and access to freeways. Road reserve widths are generally between 35m and 60m in width dependent on lane configuration.

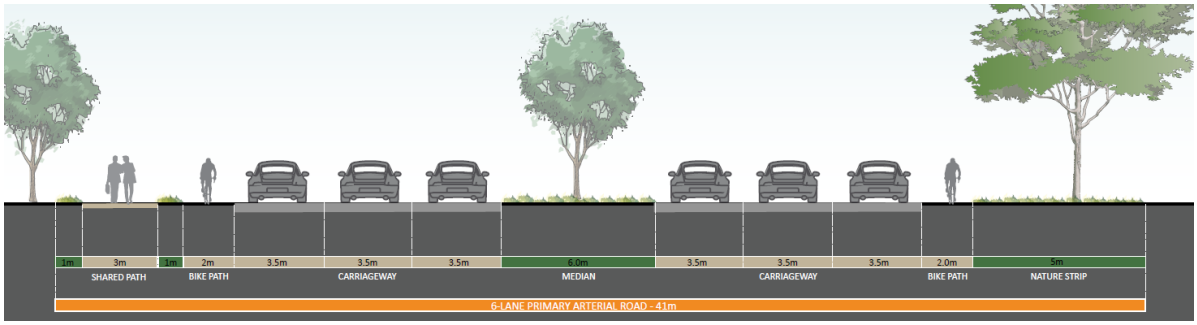


Figure 8 - Arterial Road typical cross section

4.1.4 Local Roads

Local roads, categorised as non-Arterial Roads, are the maintenance responsible of the relevant local government (Council) once constructed and accepted. Local roads will be designed and constructed, by developers, in accordance with the Victorian Planning Authority (VPA) Engineering Design and Construction Manual (EDCM, 2011) and any local Council guidelines.

Local Roads are categorised by the surrounding land use and traffic demand and can be classified generally into the following classes:

4.1.4.1 Connector Street

Connector Streets are strategically placed throughout the development, typically at around 800 metres, and provide links between local streets and the arterial network. Road reserve widths are generally between 20m and 35m in total. Connector Streets should consider the surrounding land use and proposed public transport routes. Connector roads can often include off road shared paths, footpaths or bicycle paths and can have carriageways delineated by medians.

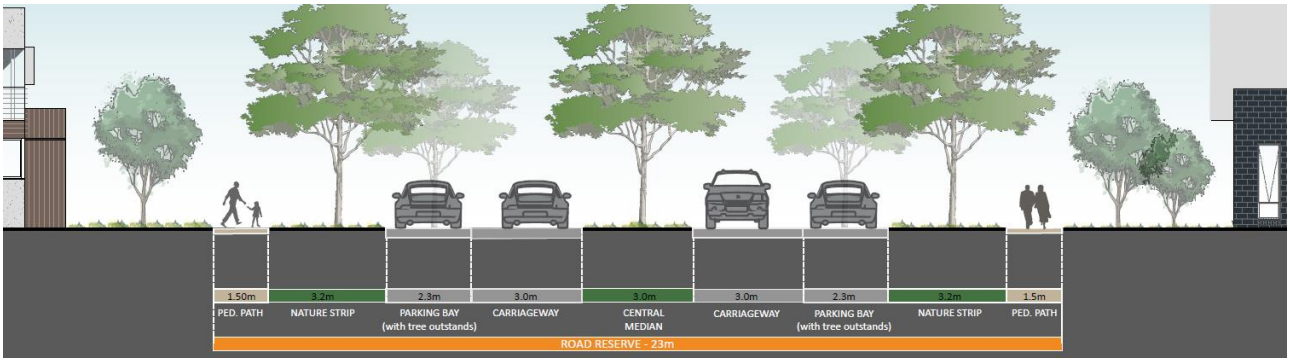


Figure 9 - Connector Street typical cross section

4.1.4.2 Local Access Street

Local access streets run throughout the development and provide access to development lots. Road reserve widths are generally between 16m and 20m in total. Generally, roads do not include median but do include footpaths on either one or both sides of the road. Variations of local access streets exist for single frontage roads (one side reserve) which see total road reserve width reduced.

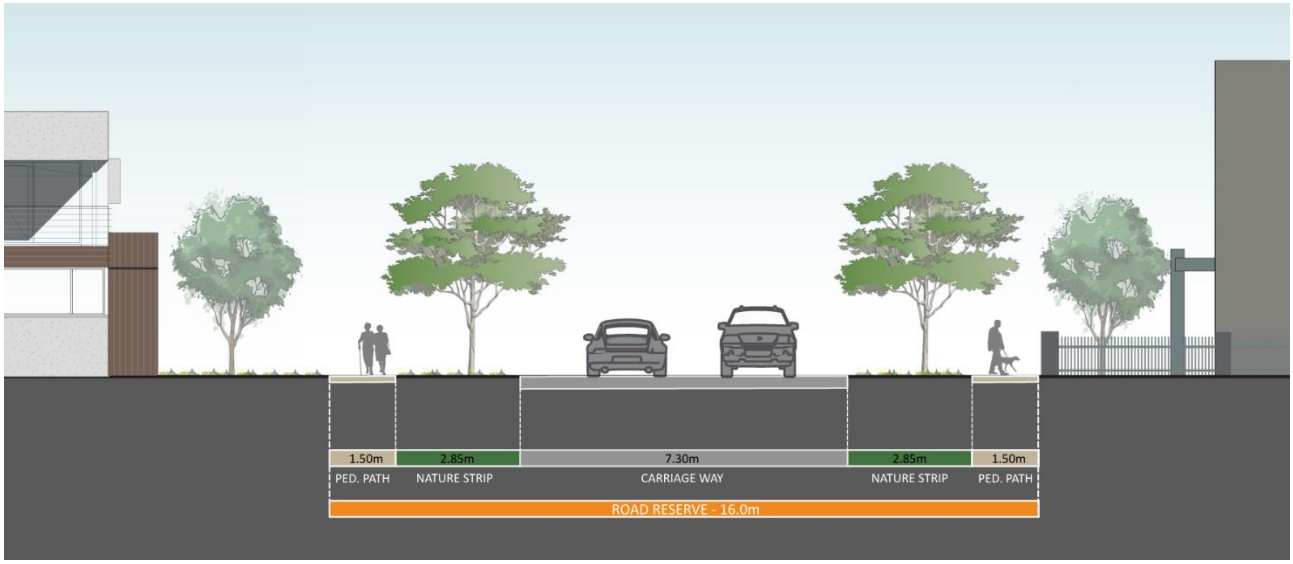


Figure 10 - Local Access Street typical cross section

4.1.4.3 Laneways

Laneways are used for access to medium density dwellings and can facilitate access to rear loaded dwellings. Road reserve widths are generally between 8m and 12m total width. Laneways will have limited inground infrastructure due to space constraints within the narrowed road reserves.

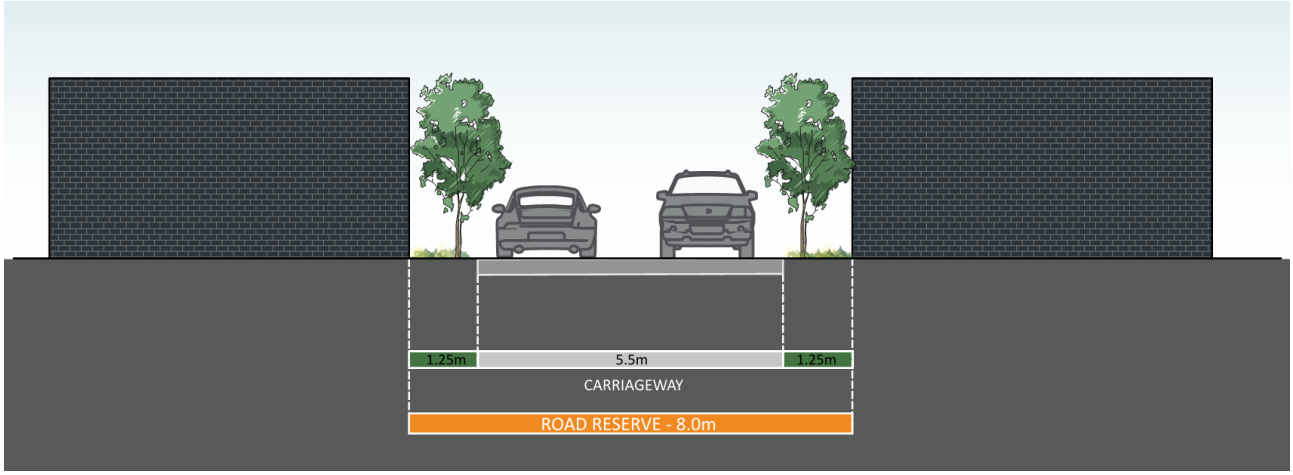


Figure 11 - Laneway typical cross section

4.1.5 Private Roads

For SSDID, Medium and High density the above categories of Connector Street, Local Access Street and Laneways can occur also as Private assets. That is, assets that are owned and maintained at completion of construction by the Owners Corporation. These categories of roads can form the same transport purpose but can be smaller in nature than their Council authority counterparts. The reduced size is generally driven by authority inground asset clearance requirements. In Owner's Corporation private roads, in ground assets are also private and fall under different clearance requirements (less stringent) to authority assets. An example of this would be the ability to 'double-stack' telecommunications and electrical assets in private arrangement. Arterial Roads will always be authority assets.

4.1.6 Discussion

The key variation between the four scenarios is as follows:

- Greenfield Development:
  - These road types all exist throughout greenfield development scenarios in different categories (i.e arterial, connector, local). Larger road reserves are seen more often on perimeters of development sites. Car parking is within the lot or on Council roads adjacent to the dwelling (within the development site). Roads in greenfield environment are generally Council assets following construction completion and acceptance of works.
- Small scale dispersed infill Development:
  - For SSDID external road works (road works external to development site) are generally not required. Development road works are limited to shared private driveways in common property (owner's corporation) and crossover works tying into existing street network. Car parking is generally within common areas or on existing Council roads adjacent external to the development site.
- Medium Density:
  - Within medium density development roads are generally required but are of smaller order. These roads vary from private roads (owner's corporation strata title) to Council roads. Private road arrangements allow for smaller road reserves given private infrastructure can be placed within the road pavement. Medium density can also include rear loaded dwellings onto laneways. These laneways are generally private Owner's Corporation laneways but can occur as Council roads in some developments. Car parking is generally dispersed through the development and within lots. Limited car parking would be provided on existing external Council roads.

- High Density Development:
  - While private or Council roads are generally not required as part of the high-density development setting, inclusion of other elements for LOCN are required. High density development has an impact on surrounding existing Council local and Vicroads arterial road and transport networks. Development contributions payable to asset owners, local government and roads authorities can be used to offset impact. Access roads to basements are private roads.
  - High density development generally incorporates on-site car parking in the form of basement or podium car park areas. This cost is not evident in other development scenarios.

4.2 Internal Estate Infrastructure

4.2.1 Drainage

Stormwater management is split into two categories for assessment and provision through all the development scenarios:

- **Stormwater Quantity** relates to peak discharge flow rates and allowable discharge:
  - The common objective for stormwater quantity is for developments to maintain existing minor event peak storm flows to existing conditions peak storm flow rates.
  - In some locations and Council areas a more stringent stormwater detention rate adopting set drainage criteria for pre-developed conditions is required. This applies when Council desire to improve local drainage conditions or where problems are already present with conveyance.
  - Stormwater discharge is controlled by Council through application for Legal Point of Discharge or through drainage schemes with main drainage authorities.
- **Stormwater Quality** relates to controls on discharge stormwater quality including nutrient and pollutant loading, to ensure protection of receiving waters. This is controlled in line with Council Planning Policy and Best Practice Environmental Management Guidelines (BPEMG) for Stormwater.

Stormwater Quantity and Quality management varies across the development scenarios as defined below.

4.2.1.1 Greenfield Development

Internal drainage works within Greenfield development is constructed generally in accordance with the Victorian Planning Authority (VPA) Engineering Design and Construction Manual (EDCM, 2011). Internal drainage infrastructure, in general, flows to the defined main drainage authority (Melbourne Water) main drains discharging from, or near the site.

Council/VPA requires that underground drainage be constructed within the development to cater for 1 in 5-year stormwater events. Storm events up to 1 in 100-year frequency within the site are accommodated within the road reserves or floodways where necessary. Greenfield development drainage is generally managed under Main Drainage Authority drainage schemes which stipulate major drainage corridors, conveyance and treatment. This is discussed further in the 4.3 Catchment Stormwater section of this report. Greenfield development stormwater management must comply with relevant Main Drainage Authority, Council, VPA and Planning Scheme Clause 56.07 requirements - Integrated Water Management.

All lots must achieve an appropriate freeboard in relation to local overland flow paths. Typically, these are designated as:

- 150mm freeboard above the 100-year flood levels in the road reserves;
- 300mm freeboard adjacent to a Melbourne Water pipeline, and
- 600mm freeboard adjacent to a Melbourne Water waterway, wetland or retarding basin.

4.2.1.2 Small Scale Dispersed Infill Development

Stormwater quality and quantity management for small scale dispersed infill developments (SSDID) is generally provided within the development lot on a small-scale owner's corporation basis this is due to the following:

- Disconnected development, each site assessed individually rather than as a precinct:
  - No drainage schemes
  - Applications at varying times

- Planning scheme requirements for compliance of individual developments

Stormwater quantity is managed through above or below ground detention tanks that limit peak discharge to predevelopment levels. Stormwater quality is managed through constructed Water Sensitive Urban Design (WSUD) treatment trains utilising natural (swales, raingardens, etc) or proprietary (rainwater harvesting, gross pollutant traps, tertiary treatment) systems. SSDID stormwater management must comply to Victorian Planning scheme requirements under Clause 56.07 – Integrated Water Management. SSDID generally does not fall under Main Drainage Authority drainage schemes as it occurs in established suburbs.

4.2.1.3 Precinct Scale Brownfield (Medium Density)

Stormwater quality and quantity management for precinct scale medium density development is generally on a site wide basis. This can be through centralised or de-centralised WSUD measures within the Owner's Corporation land. Considerations are as follows:

- Developments delivered with a master plan for infrastructure that considers the overall development
- Generally legal point of discharge limited to single point (topography driven) which requires consideration of the overall development
- Space can be allocated for centralised stormwater infrastructure from early development stages
- Integrated development, site assessed as a precinct rather than individually
- Planning scheme requirements for compliance of overall development

Stormwater quantity is managed through above ground basins or below ground detention tanks that limit peak discharge to predevelopment rates. Stormwater quality is managed through constructed Water Sensitive Urban Design (WSUD) treatment trains utilising natural (swales, raingardens, etc) or proprietary (rainwater harvesting, gross pollutant traps, tertiary treatment) systems. These can be centralised or de-centralised. Precinct stormwater management must comply to Victorian Planning scheme requirements under Clause 56.07 – Integrated Water Management. Main Drainage Authority drainage schemes generally not applicable, although on some larger precincts these apply. This generally is only the case on state significant projects.

4.2.1.4 Precinct Scale High Density

Stormwater quality and quantity management for high density development is generally provided upstream of the buildings legal point of discharge to the Council network. Due to limited landscape and land space on these types of developments stormwater management is generally contained within the building structure. Stormwater detention is provided in underground tanks or tanks within the building structure (basement). Stormwater treatment is provided through WSUD treatment train with proprietary systems (gross pollutant traps, stormwater harvesting, tertiary treatment).

Stormwater management is based on individual projects due to density and must comply to Victorian Planning scheme requirements under Clause 56.07 – Integrated Water Management. Main Drainage Authority drainage schemes are generally not applicable, although on some larger precincts these apply. This generally is only the case on State significant projects such as Fisherman's Bend of Arden Precincts.

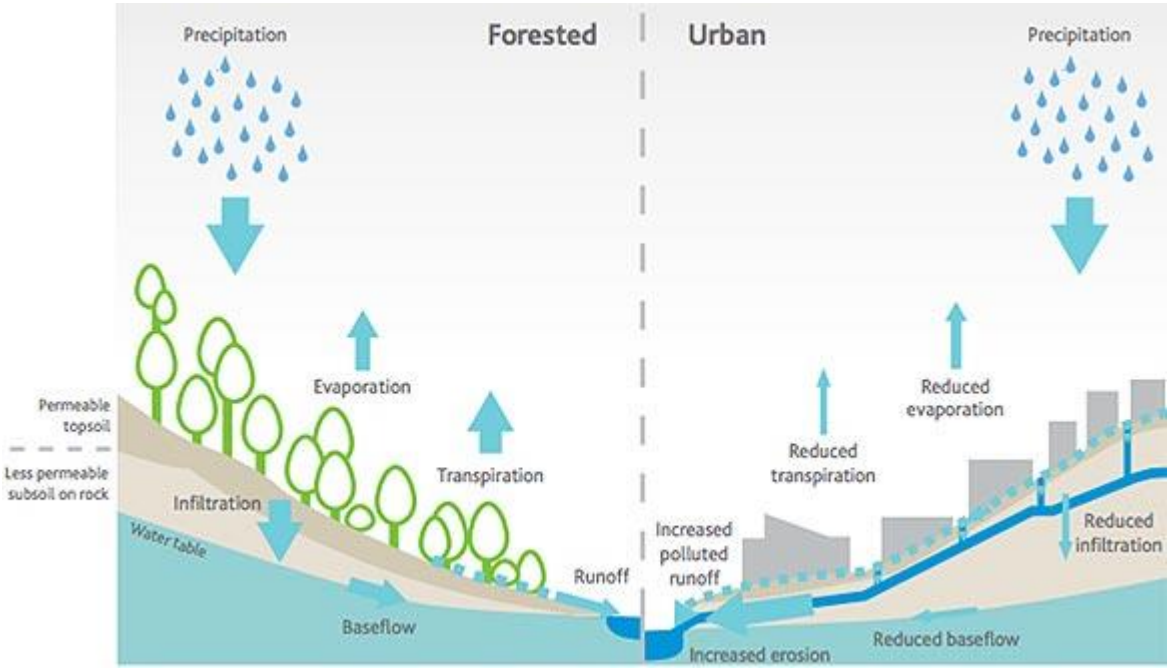


Figure 12 - Stormwater management impact of development (Melbourne Water, 2018)

4.2.2 Water

Reticulation of potable and recycled water supply in the four development scenarios is delivered in three categories:

- **Water authority headworks:** External supply to development delivered by developer (as reimbursable works) or direct by water authority to provide water supply to development. Generally larger trunk infrastructure. Ownership lies with water authority. Not included in this assessment
- **Water Authority Reticulation**: Development reticulation water infrastructure to provide water supply to dwellings. Asset built by the developer, handed to the authority by the developer at construction completion and generally run within road reserve or easement when in private land.
- **Private Reticulation:** Reticulation throughout common property on strata title land provided by the developer. Design of infrastructure to AS3500.1 and maintained as owner's corporation asset.

The local Water Authorities; City West Water, South East Water, Yarra Valley Water or Western Water are the responsible authority for the provision of water supply facilities to service residential development within the Urban Growth Boundary and Metropolitan Melbourne. Collectively they are referred to as Melbourne Retail Water Agencies (MRWA). Recycled water supply is mandated in some greenfield development regions by the water authorities. In infill and established areas water authorities adopt principles of Integrated Water Cycle Management in lieu of mandated supply requirements to ensure sustainable water use.

Development scenario water supply is categorised as follows:

4.2.2.1 Greenfield Development

The arrangement in the greenfield development scenario is that water supply infrastructure is provided by developer to water authority (MRWA) standard with authority assets constructed through development and handed over to authority at completion of construction, testing, defect liability period and Authority acceptance. This applies for both potable and recycled water networks. For large diameter trunk infrastructure, mains larger than 225mm diameter, water supply assets are partially or fully reimbursable from the MRWA to the developer. The reimbursement amount is dependent on MRWA authority planned timing of the assets and should developers require these earlier than the Authority had planned a 'Bring Forward Charge' may be applicable

Recycled water third pipe networks are mandated in some greenfield areas. Wastewater is treated centrally to EPA Victoria Class A requirements and reticulated from waste treatment facility back to development areas in purple (lilac) pipe. This varies across MRWA authorities and is dependent on recycled water supply availability. On estates with recycled water third pipe network, dwellings are required to be plumbed into recycled network for irrigation and non-potable water uses. Recycled water is generally not impacted by water restrictions on usage.

4.2.2.2 Small Scale Dispersed Infill Development

For SSDID a single water supply tapping is taken off the authority main in the street to a bank of house lot meters or to each dwelling (check meters). This work is developer funded and non-reimbursable. Downstream of the meters the water supply is a private main under ownership of Owner's Corporation delivered under AS3500.1 standard. If supply is required for owner's corporation common property, a main meter would be required upstream of check meters for dwellings.

4.2.2.3 Precinct Scale Brownfield (Medium Density)

In medium-density development, ownership of water reticulation infrastructure is generally private if the development is strata title. If the development includes Council road reserves with all lots fronting these reserves, the development can be delivered with authority infrastructure which would be authority reticulation assets and individual property connections to dwelling meters on each property. A hybrid supply is also achievable between private and authority infrastructure. A main site meter would be required at tapping point off authority main external to the development site, with individual check meters required for dwellings. For private mains, ownership of the asset generally remains with owner's corporation with design of infrastructure to AS3500.1 (provided by the developer and maintained as owner's corporation asset). Separate fire hydrant supply infrastructure can be required in some cases.

Generally, fire hydrants can run off authority or private mains and are delivered in a similar basis to greenfield development.

4.2.2.4 Precinct Scale High Density

For high density development water supply is provided from a single tapping point off authority main. A main meter assembly is installed upstream of check meters for each dwelling. All water supply infrastructure is delivered to AS3500.1 standard. For firefighting supply there is a requirement to provide fire hydrant, hose and sprinkler reticulation booster assemblies and in some cases storage tanks can be required. Reticulation through the building is provided on zoned supply with storage tanks and pumps at intermittent floors throughout the building (every 10-15 levels). High density development water supply is not impacted by ground conditions as mains run through buildings. District hot water supply through the building is a consideration in high density development with centralised hot water supply plants being constructed in some buildings.

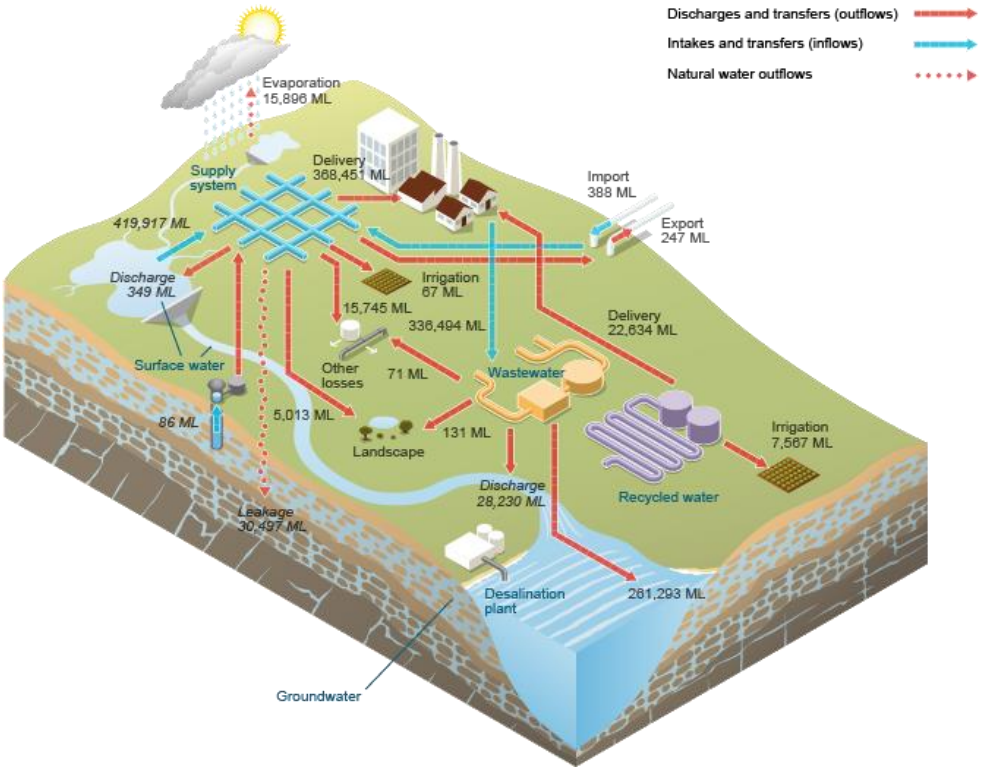


Figure 13 - Water inflow and outflow for Melbourne Urban water system (2014-2015), BOM 2018

4.2.3 Sewer

Melbourne's metropolitan retail water corporations; City West Water, South East Water, Yarra Valley Water or Western Water are the responsible authority for the provision of sewer supply facilities to service residential development within the Urban Growth Boundary.

The developer will be required to extend services into the site as per the standard conditions outlined within each Authorities Land Development Manual in accordance with the Authorities Servicing Infrastructure Plans. These plans detail the 'branch' sewers that are required to be constructed in the growth areas to service residential development. Typically, these assets are designed and constructed by the developers with costs for those assets larger than 300mm diameter being reimbursed by the retail water corporation as these are considered 'shared assets'. These shared assets are partially or fully reimbursable, with the reimbursement value being dependent on MRWA authority planned timing of the assets. Should developers require these earlier than the Authority had planned a 'Bring Forward Charge' may be applicable

Reticulation of sewerage in the four development scenarios is delivered in three categories:

- **Authority headworks:** External sewer infrastructure to supply development delivered as reimbursable works or by water authority direct. Not included in this assessment.
- **Authority Sewer**: Asset paid for and constructed by the developer then handed to authority by developer at construction completion and generally run within road reserve or easement when in private land (). For any mains above 300mm in diameter the costs are reimbursed (fully or partially) by the retail water corporation.
- **Private Sewer:** Reticulation throughout common property on strata title land. Design of infrastructure to AS3500.2 (provided by the developer and maintained as owner's corporation asset).

4.2.3.1 Greenfield Development

Sewer infrastructure is provided by developers to water authority (MRWA) standards with authority sewer assets constructed through development and handed over to authority at completion of construction, testing, defect liability period and Authority acceptance.

4.2.3.2 Small Scale Dispersed Infill Development

For SSDID private sewer infrastructure is reticulated through common property to a single sewer discharge point where it is connected to the authority main in the street for all dwellings within the development. All construction works are at the cost of the developer.

4.2.3.3 Precinct Scale Brownfield (Medium Density)

In medium-density development, ownership of sewer infrastructure is generally private (developer funded) if the development is strata title. If the development includes Council road reserves with all lots fronting these reserves, the development can be delivered with authority reticulation infrastructure with authority assets and individual property connections to each dwelling. In this scenario, developer pays, and assets are handed over to the water authority. A hybrid supply is also achievable between private and authority infrastructure. In a hybrid scenario the assets are still delivered by developer. A single discharge point to authority main is preferred. For private mains, ownership of the asset generally remains with owner's corporation with design of infrastructure to AS3500.2 (provided by the developer and maintained as owner's corporation asset).

4.2.3.4 Precinct Scale High Density

For high density development sewer infrastructure is provided to a single discharge point to authority main. Reticulation through the building is provided as private infrastructure by the developer. High density development sewer supply is not impacted by ground conditions as the mains run through building. Outfall capacity can be a limiting factor with external upgrades required to facilitate the

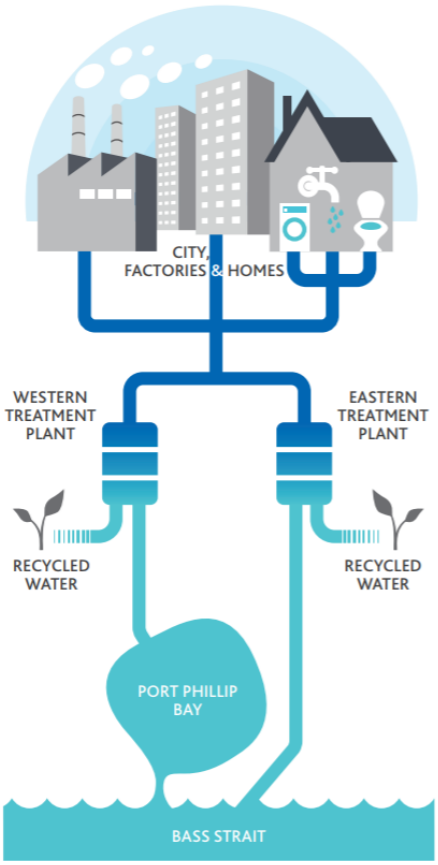


Figure 14 - Melbourne's sewage network (MW, 2018)

sewer outfall. This can require developer funded upgrades to authority sewer reticulation external to the site to a point that is deemed by the authority to have sufficient capacity to service the development.

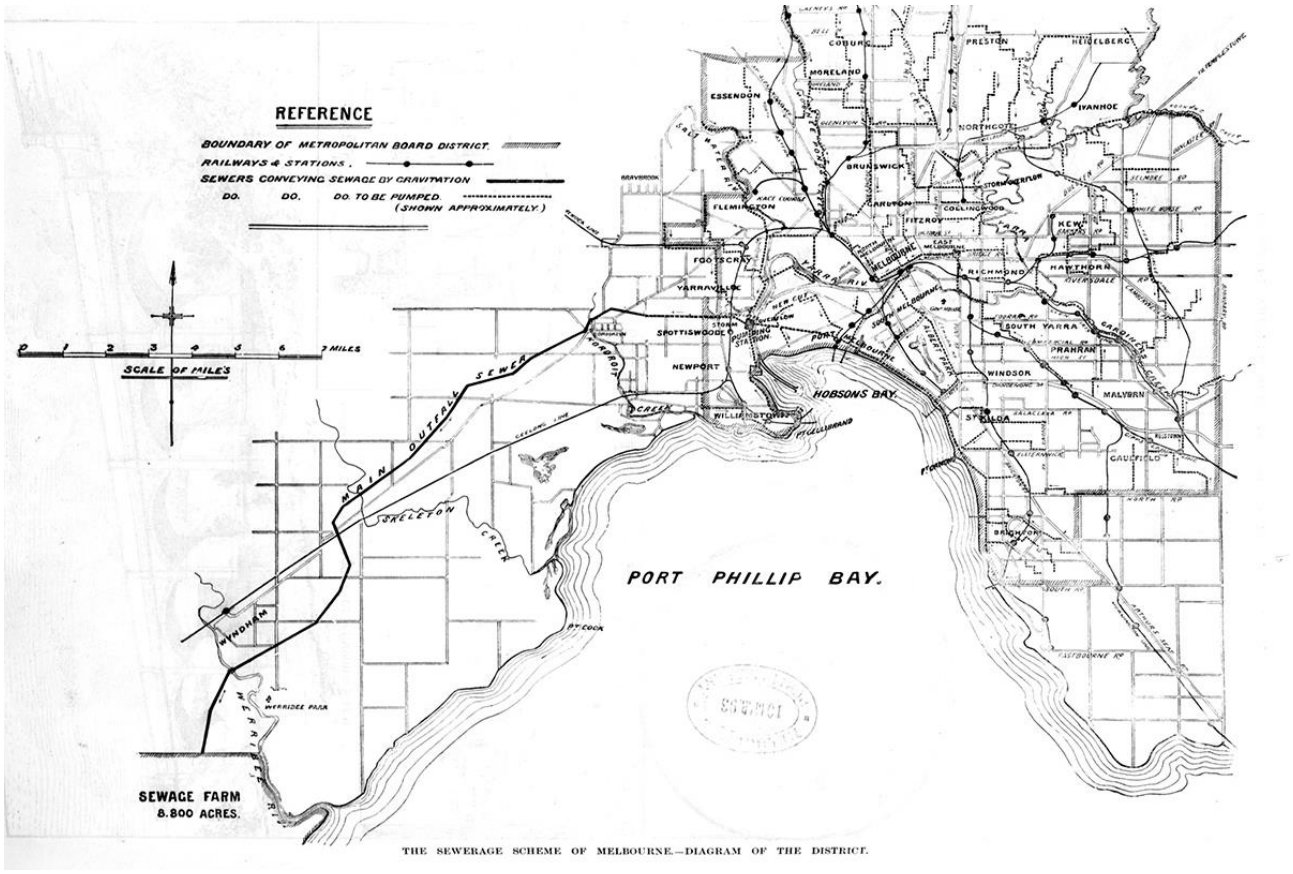


Figure 15 - Melbourne historical sewer network (Melbourne Water, 2018)

4.2.4 Gas

The local gas authority is responsible for the provision of gas reticulation to service developments within the growth areas and in urban renewal areas. Supply is provided by the authority to the development in accordance with the retailer's terms and conditions for residential land development.

Under current supply policy, gas mains are normally installed within residential developments at no cost to the developer or through a supply funding arrangement. The developer is required to undertake trenching and backfill for the gas mains and installation of conduits under roads. For any extension to the development site, usual industry practice is for the initial developer who requires the service to fund the extension through a contribution to the gas authority. We understand that there are current discussions in the industry with respect to a precinct approach whereby costs may be apportioned across several developments.

4.2.5 Electricity

Electricity infrastructure is provided to new subdivisions by the developer in accordance with the electrical distributors terms and conditions for residential land development.

The developer is required to provide each lot with an underground electrical supply along with kiosk type substations located within the development. In some instances, upgrades or alteration (undergrounding) to precinct infrastructure may be required to service the proposed development.

The delivery of electrical infrastructure is generally consistent across the development scenarios. In SSDID, medium and high density, private electrical reticulation inclusive of network of substations, switchboards, grouped meter boxes and reticulation can be provided under AS3000 requirements for private electrical networks. This infrastructure is delivered by the developer at their cost. External supply to the development is provided by the electrical authority with a contribution charged to the developer for the works. In high density development, electrical reticulation supply cost is not affected by ground conditions as conduits run through building.

4.2.6 Telecommunications

It is the responsibility of the developer to provide pit and pipe ("fibre ready") infrastructure in new developments. The developer will be responsible for cost and provision of trenching, supply and installation of pits and conduits followed by engagement of either NBN Co or a private operator, to supply and install optical fibre cables to each lot at a per dwelling fee paid by the developer as a contribution.

4.3 Catchment Stormwater

Catchment stormwater relates to the macro greater catchment management surrounding development within all scenarios. Catchment management relates to how the development fits within the wider stormwater network and catchment area. Melbourne has a complicated network of stormwater catchments due to varying topography across the metropolitan area. In some locations major drainage networks exist across catchment boundaries. Melbourne Water manage over 200 retarding basins across Greater Melbourne that all work to manage and mitigate catchment stormwater flows. Major stormwater management can be provided in centralised catchment arrangements or through de-centralised development focus throughout the catchment.

4.3.1 Main Drainage

Melbourne Water is the major drainage authority in Melbourne. Their role is water and sewer supply wholesaler and Catchment Management Authority. Melbourne Water is responsible for:

- Managing water supply catchments
- Treatment and supply of drinking and recycled water
- Removal and treatment of majority of Melbourne's sewage
- Management of waterways and major drainage systems in the Port Phillip and Westernport region.

4.3.1.1 Greenfield Development

Melbourne Water is the Responsible Authority for 'precinct' or regional drainage infrastructure within Urban Growth Areas. Development within greenfield areas is governed by catchment specific Drainage Schemes. These schemes are site specific catchment-based strategies that ensure that development is coordinated and provides flood protection, environmental protection and enhancement of Melbourne Water waterways and infrastructure.

The works designated within the drainage schemes are funded by developers within the scheme making a financial contribution towards hydraulic and water quality elements. The hydraulic component funds flood protection works, such as retarding basins, while the water quality component funds treatment assets such as wetlands, rain gardens and bioretention basins.

Contributions are calculated based on the elements within the scheme to ensure that Melbourne Water receives adequate funds to cover the cost of works. Works are usually completed by developers and reimbursed by Melbourne Water.

There is a requirement of subdivision for the developer to enter into an agreement with Melbourne Water for the provision of drainage facilities to service the subdivision. This agreement may require the construction of appropriate sections of drainage scheme works, including water quality items, necessary to service the development and / or payment of drainage scheme contributions. Drainage scheme works will generally be delivered by the developer but reimbursed under the drainage scheme collected funds. Some drainage scheme works such as major centralised wetlands are delivered direct by Melbourne Water

Drainage scheme assets with contributing catchments under 60 hectares in size are generally handed over as assets to the local government authority.

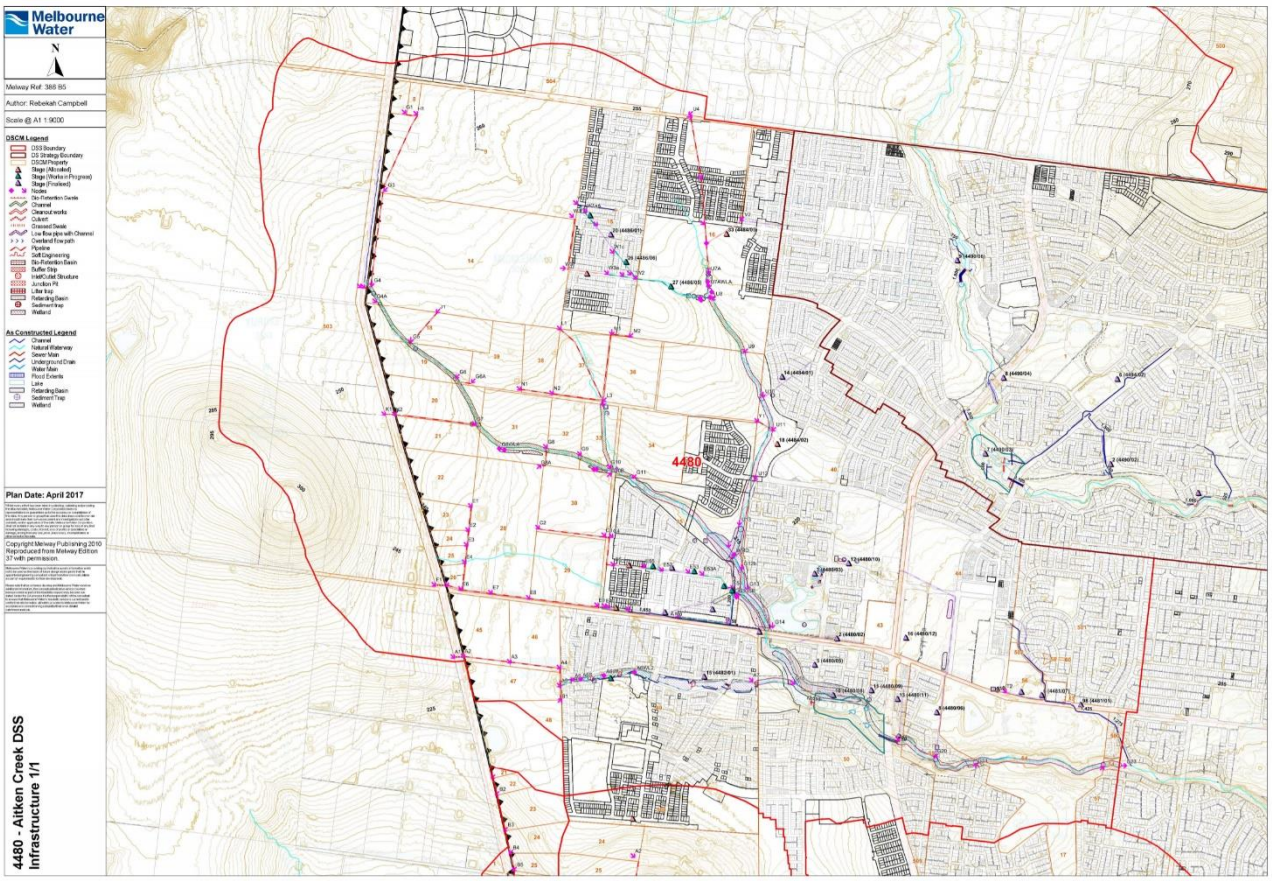


Figure 16 - Melbourne Water drainage scheme example (MW, 2018)

4.3.1.2 Small Scale Dispersed Infill Development

In SSDID main drainage management generally does not come into the project given the small-scale nature of the development. Main drainage is generally only a consideration in this development scenario if major Melbourne Water infrastructure assets or flood overlays are present within the site or adjacent to it. Melbourne Water stormwater treatment and water quality infrastructure applies to catchments over 60 hectares in area however in SSDID they still will be a referral authority to the planning permit. Stormwater detention and treatment is considered on a de-centralised per development assessment.

4.3.1.3 Precinct Scale Brownfield (Medium) Density

For precinct scale medium density projects, Melbourne Water input is more prevalent. This is particularly applicable in larger scale precincts. Melbourne Water would be involved in the overall drainage scheme and management for the precinct like a typical greenfields development drainage scheme. If a drainage scheme is adopted, the developer would pay a contribution for scheme works. Scheme works constructed by the developer would be reimbursed under the collected scheme rates. In some cases, Melbourne Water collect drainage scheme contributions from the developer and build assets accordingly. Stormwater detention and treatment is more likely to be considered on a development wide centralised approach with medium density development supporting larger areas of open space that can be utilised for dual purpose recreation and stormwater management. Flood impacts on precincts would also be assessed as part of major drainage catchments. Conveyance of major overland flow through precincts would be assessed with management frameworks adopted.

4.3.1.4 Precinct Scale High Density

In high density development, catchment stormwater management only applies to the management of major storm event overland flooding overlays and routes and the impact on the development. Development requires assessment for compliance of standard flood criteria. Stormwater treatment is generally managed on the per development scale rather than precinct scale. Individual developers are responsible for the provision of stormwater management to Council and Melbourne Water requirements on their site including funding of this infrastructure. This includes consideration of applicable flood levels that may impact the development.

Precinct scale catchment stormwater management is difficult on high density precincts built in infill areas due to the following:

- A large amount of existing inground infrastructure limiting possible locations for large scale in-ground drainage infrastructure such as pipes, detention and treatment
- Cost prohibitive to construct centralised treatment given land value and existing infrastructure modifications that can be required
- Fragmented land ownership means many more parties within the drainage scheme which creates much more management requirements.

On high density precincts built as new developments, site wide catchment stormwater management can be applicable.

4.3.2 Flood mitigation infrastructure

Management of flooding and the impact on new development is a major consideration through all development scenarios. This is controlled through overlays within the Victorian Planning Scheme and referenced within individual local government Planning Schemes. According to Melbourne Water, the key purpose of overlays is to:

- minimise the effects of overland flows and flooding on new buildings
- ensure new developments don't adversely affect existing properties

In Victoria the 1 in 100-year Average Recurrence Interval (ARI) or 1% Annual Exceedance Probability (AEP) flood is the current flood protection standard, which is used in providing flood level advice, in delineating land affected by flooding and setting requirements for most developments. The 1% AEP event (for the locality being considered) has a probability of 1% chance of being equalled or exceeded in any year and will occur, on average, once in 100 years. It should be noted that for some land uses, such as hospitals or emergency services, a higher standard may be appropriate.

In addition to floodplain management issues, Melbourne Water may consider other matters as a part response to planning permit applications. Information could include conditions or advice relating to drainage, building over Melbourne Water assets, or waterway protection or enhancement.

The most common source of flooding experienced in Melbourne is from heavy rainfall. Flooding occurs when runoff from heavy or widespread rainfall fills drains, channels, depressions and watercourses and then continues to rise, inundating adjacent areas. The types of flooding that occurs is defined by Melbourne Water as follows:

- **Mainstream Flooding:** Mainstream flooding refers to the inundation, which occurs when runoff from a catchment into streams and rivers continues to rise and overtops the waterway channel. The area affected by flooding is generally referred to as the floodplain.
- **Stormwater Flooding:** Stormwater flooding refers to the inundation that occurs when runoff from the catchment exceeds the capacity of the underground or piped drainage system and passes overland. In general, areas affected by overland flows are referred to as overland flow paths.

Overlays are based on the extent of flooding resulting from a 1 in 100-year storm. This relates to a storm event of such intensity, based on historical rainfall data, which has a one per cent chance of occurring in any given year. There are four types of applicable flood management overlays as follows:

- **Special Building Overlay:** These are planning scheme controls that identify areas prone to overland flooding. The purpose of these overlays is to set appropriate conditions and floor levels to address any flood risk to developments. These overlays require a planning permit for buildings and works.
- **Land Subject to Inundation Overlays (LSIO):** These are planning scheme controls that apply to land affected by flooding associated with waterways and open drainage systems. Such areas are commonly known as floodplains. These overlays require a planning permit for buildings and works.
- **Floodway Overlays (FO):** These apply to land that's identified as carrying active flood flows associated with waterways and open drainage systems. This overlay is categorised by depths in excess of one metre.
- **Urban Floodway Zone (UFZ):** Unlike the overlays, the UFZ controls land use as well as development, with land use being restricted to low intensity uses such as recreation and agriculture. Development is generally not encouraged in the UFZ.

Having this information means drainage issues can be addressed at the start of the development process and proposals are properly designed.

Figure 17 - Example of flood overlays in Melbourne (DELWP, 2018)

Guidelines for development in flood prone areas have been produced by Melbourne Water. These guidelines stipulate required freeboard levels relative to finished floor levels for dwellings to mitigate any potential building flooding issues for new development across all scenarios. Melbourne Water's guidelines are intended to be consistent with best practice principles, policies and guidelines developed by State and Federal governments. The following principles have been applied in the development of the guidelines:

- Risk to people and property minimised;
- Potential for adverse impacts on adjacent, upstream or downstream areas must be identified and prevented;
- Any appropriate development within a flood-prone area must be designed accordingly; and
- Reduced reliance on emergency service personnel when flooding events occur.

Freeboard is the difference between the floor level of a building and the 100-year flood level. Under the Victorian Building Regulations 2005, floor level heights for buildings should be set a minimum **300 mm above** the applicable flood level, or as otherwise determined by the floodplain management authority. Requirements differ depending on whether the development is in a floodplain or an overland flow path. The key requirements of these guidelines in terms of freeboard are summarised as follows:

- **Freeboard in Overland Flow Paths:** Building floor level should be at least 0.30m above the 100-year flood level. Outbuilding floor level should be at least 0.15m above the 100-year flood level
- **Freeboard in Floodplains**: Building floor level should be at least 0.6m above the 100-year flood level. Outbuilding floor level should be at least 0.3m above the 100-year flood level

Requirement	Overland Flow Path	Floodplain	Comments
Flood Flow	Works or buildings must not affect floodwater flow capacity		Very important for all works in flow paths
Flood Storage	Works or buildings must not reduce floodwater storage capacity		May not be a restriction on the minor fringes of large floodplains
Freeboard	• 0.3m minimum for main buildings; • 0.15m minimum for garages/ outbuilding	• 0.6m minimum for main buildings; • 0.3m minimum for garages/ outbuildings	Higher freeboards are required where additional margins of safety are warranted.
Site Safety	Developments should not occur where the depth and flow of floodwater on a property will be hazardous: • Depth ≤ 0.35m • Velocity ≤ 1.5m/s • Depth x Velocity ≤ 0.35m^2/s		Important for building entrances and their surrounds, and other key outdoor access areas, ingress and egress routes
Access Safety	The depth and flow of floodwater affecting access to a property must not be hazardous: • Depth ≤ 0.35m • Velocity ≤ 1.5m/s • Depth x Velocity ≤ 0.35m^2/s		Important for connecting roads, driveways, footpaths, ingress and egress routes.

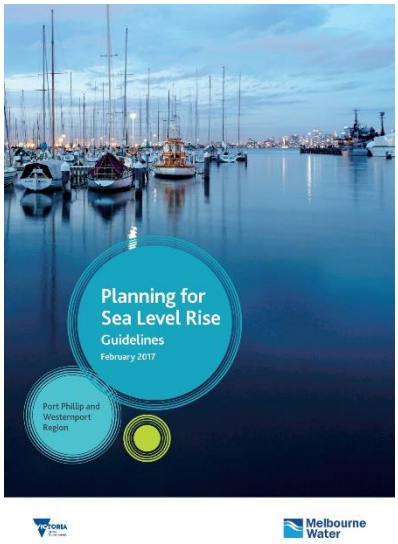


Figure 18 - Requirements in flood prone areas (MW Flood prone area development guideline)

A further consideration for flood mitigation within Melbourne's Port Phillip and Western Port Bay catchments is the impact of sea level rise on existing and proposed development areas. The combination of predicted sea level rise and higher intensity storms will combine to result in expected increased flood impact across metropolitan Melbourne.

Melbourne Water have released 'Planning for Sea Level Rise Guidelines, 2017' to outline the mitigation direction for such impacts. The guidelines set out specific requirements that apply to development proposals in areas that will be affected by tidal inundation (including storm surge and wave action) with the aim to ensure proposed development is compatible with flood risk. Victorian Government planning policy requires authorities, agencies and developers to 'plan for possible sea level rise of 0.8 metres by 2100, and allow for the combined effects of tides, storm surges, coastal processes …', the guideline applies to areas that will be affected by tidal inundation within the Port Phillip and Westernport region.

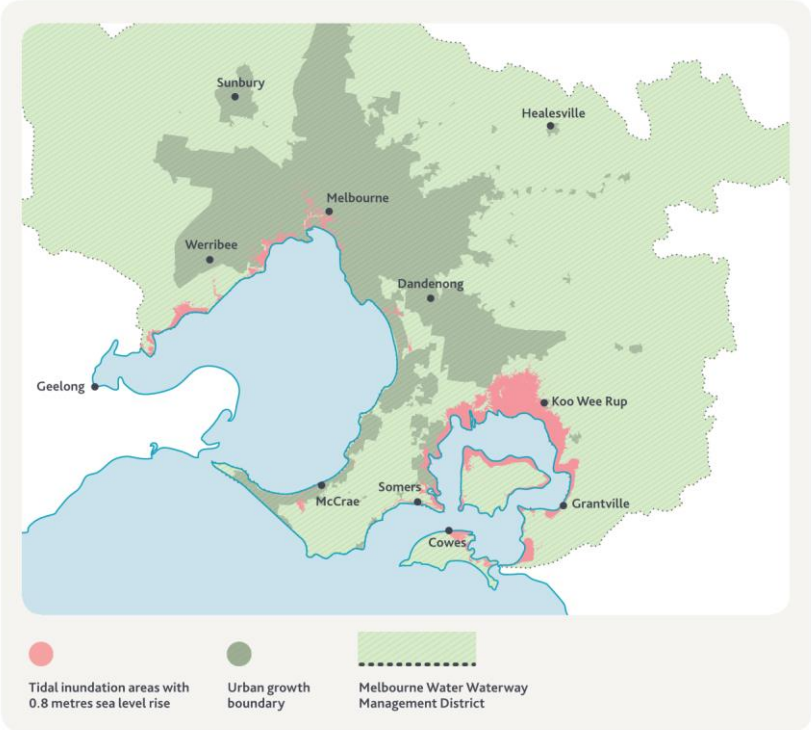


Figure 19 - 2100 tidal inundation areas in the Port Phillip and Westernport region area (MW, 2017)

Predicted future flood levels for development assessment	
Development type	**Predicted future flood level**
Urban infill development (single dwelling/retail/office in established urban areas)	2040 1% AEP flood level
Greenfield development Urban renewal area development Emergency, community or hazardous facilities Isolated or rural development All other development	2100 1% AEP flood level

Figure 20 - Summary of future flood levels for development (MW, Planning for Sea-levels guidelines, 2017)

Applicable flood levels to Australian height datum (AHD)			
Region	**Current adopted 1% AEP flood level**	**Predicted 2040 1% AEP flood level**	**Predicted 2100 1% AEP flood level**
Port Phillip Bay	1.6 metres	1.8 metres	2.4 metres
Western Port			
North east	3.3 metres*	3.5 metres*	4.0 metres*#
South	2.1 metres*	2.3 metres*	2.9 metres*#

* Flood levels for Western Port vary around the bay. Please contact Melbourne Water for site-specific flood levels.
# Predicted 2100 1% AEP flood levels for Western Port have been determined from flood modelling and are not a simple addition of 0.8 metres to current 1% AEP flood levels.

Figure 21 - Melbourne Water Planning for sea levels guideline (2017) applicable flood levels (MW, 2017)

4.3.2.1 Greenfield Development

Flood mitigation within greenfield development macro environments is managed through Melbourne Water Drainage Scheme process which stipulates requirements for precinct scale stormwater detention. Overland gap flow generated from major event stormwater (1 in 100 year ARI event) is conveyed via road reserves, public open space and floodway with design criteria ensuring safety of public and environment.

According to Melbourne Water guidelines, planning policy identifies the need to apply a long-term planning approach to 2100 for new greenfield development. Therefore, greenfield development will be assessed against the predicted 2100 1% AEP (Average Exceedance Probability) flood level. Flood mitigation infrastructure could include large storage basins, increased drainage pipe capacity, higher finished floor levels and larger overland flow paths to mitigate increased flood.

4.3.2.2 Small Scale Dispersed Infill

For SSDID, Melbourne Water and Council will require evidence to ensure development proposed complies to flood management guidelines for minimum freeboard to finished floor levels and flood safety criteria.

Single dwellings, dwelling extensions and small multi-unit developments. According to Melbourne Water guidelines, the majority of applications currently assessed in areas affected by future for sea level rise are dispersed urban infill development comprising new or replacement dwellings, minor dwelling extensions and smaller urban subdivisions in established urban areas.

These types of developments may be assessed against the predicted 2040 1% AEP food level given the proximity of surrounding urban development already built to a lower flood protection standard, and the shorter asset life typical of single dwellings. This approach is consistent with state policy directions.

Flood mitigation infrastructure could include underground storage tanks, increased drainage pipe capacity, higher finished floor levels and larger overland flow paths to mitigate increased flood.

4.3.2.3 Precinct Scale Brownfield (Medium Density)

For medium density, Melbourne Water and Council will require evidence to ensure the development proposed complies to flood management guidelines for minimum freeboard to finished floor levels and flood safety criteria.

According to Melbourne Water (similar to greenfield development) urban renewal areas provide an opportunity to apply a long-term planning approach to an entire development or redevelopment area. Also, these areas will see an increased number of occupants at risk of flooding in future. Therefore, urban renewal developments will be assessed against the predicted 2100 1% AEP food level.

Flood mitigation infrastructure could include underground storage tanks, increased drainage pipe capacity, higher finished floor levels and larger overland flow paths to mitigate increased flood.

4.3.2.4 Precinct Scale High Density

For high density, Melbourne Water and Council will require evidence to ensure the development proposed complies to flood management guidelines for minimum freeboard to finished floor levels and flood safety criteria. This includes any entrance ramps to basements.

According to Melbourne Water guidelines, multistorey buildings (such as apartment buildings) will be complex to rebuild at the end of the design life of the building. This difficulty in upgrading to future flood protection standards will pose an increased flood risk over time; therefore, a long-term planning approach to 2100 is preferred for these types of buildings. Floor level concessions for sea level rise may be considered.

Flood mitigation infrastructure could include underground storage tanks, increased drainage pipe capacity, higher finished floor levels and larger overland flow paths to mitigate increased flood.

Multistorey development with floor level concessions

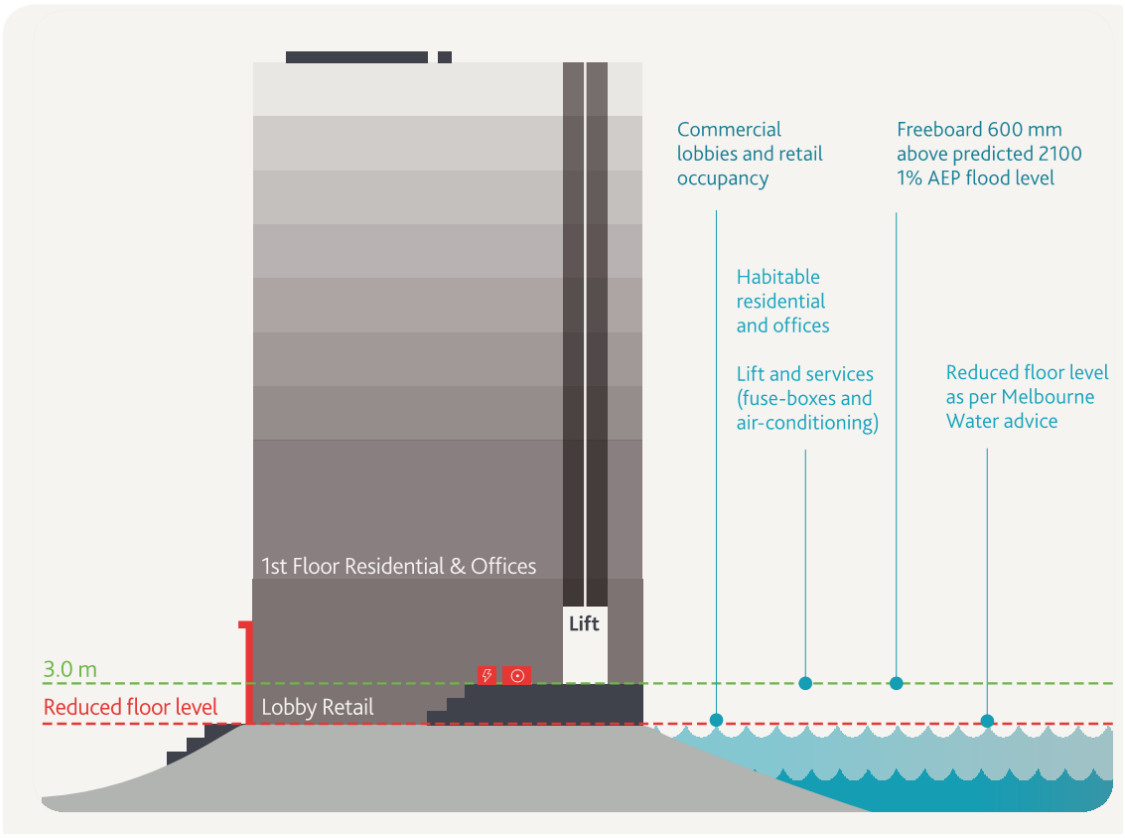


Figure 22 - Floor level concession concept (MW, 2017)

4.4 Telecommunications

Supply of telecommunications infrastructure external to development sites across the four scenarios is generally consistent. Most of telecommunications supply in Metropolitan Melbourne is managed by NBN. Private provider networks exist also. These networks are more prevalent through all scenarios other than greenfields particularly when assets run through private common property within developments. Trunk telecommunications infrastructure supply is required to supply development areas.

Developing technologies will see telecommunications supply continue to evolve. It is likely a hybrid supply between traditional copper and coaxial, modern fibre optics and developing wireless technology will be continuing to be supply arrangement. The changing pattern of telecommunications users to data heavy requirements will continue to drive technological developments.

4.5 Community & Emergency Services Infrastructure

Community and Emergency Services Infrastructure generally falls into the same building type category across each scenario. The variation between the scenarios is the type of built form. In higher density scenarios, land availability and cost are a consideration. Therefore, building facilities reflect this and can incorporate space saving measures or vertical delivery approaches.

4.5.1 Greenfield Development

For greenfield development, Community & Emergency Services facilities are generally set aside as part of the Precinct Structure Plan (PSP) process where gross floor area allocations are provided relative to the overall expected population and allocated to sites strategically around PSP areas. Land area allocation supports traditional ground floor development with limited facilities in major activity centres, neighbourhood activity centres or town centres being constructed with multiple floors.

Community facilities such as libraries, sport & recreation pavilions, club rooms etc. that are currently being delivered are providing more multi-purpose and multi-user offerings to the community and stakeholders than traditional facilities delivered through the latter part of the 20th century which were general use specific facilities. This trend sees efficiencies in construction and ongoing management of facilities. Shared facilities such as amenity (toilets, kitchens) can be provided and accessed by all user groups. The PSP allocation and process has provided the basis for considered planning of these facilities. Community facilities are also being combined with municipal facilities in some scenarios to create community hubs.

Emergency facilities are being provided on individual sites but also shared use sites where Police, Fire and Ambulance can co-locate. In some locations State Emergency Service (SES) facilities are also being provided. This arrangement provides advantages for a coordinated response. Shared buildings are rarer between different organisations due to building specifications required.

4.5.2 Small Scale Dispersed Infill Development

For SSDID development, residents of new development utilise existing Community & Emergency Services infrastructure near each development. SSDID is occurring most commonly in areas that were developed between the 1930's and 1990's. This is due to larger lot sizes supporting redevelopment of single dwellings to multiple dwellings. Development occurring in these areas generally consists of redevelopment of previous commercial or industrial sites which fall into the medium and high-density categories discussed further below. For periods post 1990's, SSDID is again limited due the following:

- Age of original dwelling not supporting demolition yet
- Dwelling lot sizes have reduced in average size
- Precinct Structure Planning required lot mix from standard density down to medium density townhouse product

For community facilities, these suburbs have been through multiple generations of growth which results in cyclic demand for community facilities required by younger families. This is particularly evident for pre-school, childcare, school and library facilities for example.

SSDID sees use of existing community facilities but as the number of dwellings grows there could potentially be demand for new facilities or increased floor area of facilities. This is difficult to quantify and depends on current usage.

Regarding Emergency facilities, SSDID driven outcomes would combine with other higher density development scenarios to drive the requirement for re-development and re-construction of facilities as population grows in suburbs. Expansion of existing sites is more likely than acquiring new sites in SSDID as the spread of emergency facilities is already existing. Re-development of these emergency facilities could require development of multi-storey buildings to fit required floor areas for larger operations. Another trend is re-purposing of government land that has been utilised for other purposes in the past to supply land for emergency services sites.

4.5.3 Precinct Scale Brownfield (Medium Density)

The requirement for provision of community and emergency services infrastructure in medium density precincts reflects a similar position to that of SSDID with the difference being that population within larger development precincts may drive the need to incorporate these facilities within the development. These facilities could be present in new town centres or neighbourhood activity centres within the precinct. It is more likely that existing facilities in areas nearby the precinct would be modified or expanded to account for the increase in population. For precincts that were previously government owned, there is a trend to include a requirement for developers of these sites to include fixed community and emergency services infrastructure within the development. This can also be imposed through development contributions.

For new build community and emergency services infrastructure in this scenario, the trend is for higher density facilities delivered on smaller land parcels given higher land value.

4.5.4 Precinct Scale High Density

The requirement for provision of community and emergency services infrastructure in high density development scenario reflects a similar position to that of SSDID and medium density scenario with the difference being available land area and value of land. This is driving co-located facilities that can be multiple storey or ‘vertical’ type facitilies. In some developments, provision of community infrastructure has been provided in ground floor levels of multi-storey mixed-use developments. This can be required through Council permit conditions or through developer commercial offerings for infrastructure such as childcare facilities.

Provision of new community and emergency services infrastructure is most costly in the high density scenario given land value and the requirement to construct multi-storey facilities and limit land footprint.

4.6 Other Infrastructure Considered

Infrastructure Victoria have completed an assessment of the infrastructure supply authority requirements and costs. This refers to provision of infrastructure across the macro extent rather than on an individual development scale. Consideration of authority new customer contributions has also been made within the Infrastructure Victoria report.

5 Scenario Costing

It is important to initially define the over total costs to develop. This assessment of cost completed covers only a portion of the overall development costs applicable in all scenarios. The overall development costs are defined as follows:

- Development land purchase cost
- Due diligence cost
- Consultant fees
- Finance, bank and holding costs
- Authority contributions
- Public Open Space contributions
- Development civil, infrastructure and landscape construction cost
- External civil, infrastructure and landscape construction cost
- Building and dwelling construction cost
- Marketing cost
- Legal cost

Transport costs outside of the development site (i.e major road and public transport) are not included in this assessment. Authority supply costs are also not included other than standard authority connection charges. These costs would incorporate back haul supply and upgrade costs.

5.1 Development Cost Definition

In developing the applicable infrastructure costings for the project across the development scenarios, SMEC have adopted the following methodology:

- Assessment of the cost to supply the following infrastructure:
  - Road & Earthworks
  - Local Internal Drainage Infrastructure
  - Main Drainage including Water Sensitive Urban Design and stormwater detention
  - Sewer reticulation
  - Water reticulation
  - Gas trenching (reticulation cost by authority)
  - Telecommunications pit and pipe (reticulation of fibre optical cable by authority)
  - Electricity reticulation
  - Landscape
  - Community & emergency services facilities
- Inclusion of cost of consultant fees for development is limited to the following:
  - Town Planning
  - Land Survey
  - Civil Engineering
  - Urban Design
  - Geotechnical Engineering
  - Electrical Consultant
  - Telecommunications
  - Stormwater Engineer
- Excluded the following consultant fees given the significantly varied scope of work for each discipline:
  - Legal / Conveyancing
  - Marketing

- Other development costs excluded:
  - Finance and holding costs
  - Purchase price of undeveloped land
  - Environmental Contamination clean-up
  - Cultural heritage construction costs
  - Environmental remediation costs
- Infrastructure construction costs only were assessed, authority charges per lot or dwelling were not included as these were reflected in the assessment completed by IV and attached as Appendix B to this report. These excluded costs fall within the following categories:
  - Supply authority new customer contributions (water authorities, electrical and telecommunications authorities and gas authority)
  - Council fees for plan checking, supervision
  - Council fees for Development Contributions Plan (DCP) and Infrastructure Contributions Plan (ICP)
  - Growth Areas Infrastructure Contribution (GAIC)
- Costs provided based on July 2018 figures
- Costs for in-lot elements such as fencing, landscaping, footpaths and driveways have not been considered as part of the overall infrastructure costs. These elements fall within the dwelling cost component.
- Cost of dwelling construction (building construction costs) are considered in a separate section of this report.

5.2 Data Sources

The following data sources have been utilised in determining typical costs:

- Infrastructure Cost Data
  - Cost Estimate Data taken as a snapshot of time produced by SMEC as part of development feasibility assessment. Referred to as Opinion of Probably Cost (OPC) data
  - Construction Costs from civil works tenders utilising data collated by SMEC from projects in which there was involvement and access to tender results or construction contracts. Information contained within SMEC database of tendered results
  - Publicly accessible data
- Land Values
  - Project sales information and actual land valuations provided Charter Keck Cramer with applicable reference sites
  - Land sales data summary provided by RPM Real Estate
  - Multiple sources of publicly available sales information from real estate websites of actual sales data
  - Real estate agent data
- Construction Costs
  - Construction cost data from recent projects indexed to June 2018 with actual evidence provided by Rider Levett Bucknall (RLB)
  - SSDID construction cost data based on estimated construction scope and values
  - High density infrastructure cost data based on averaged allowances from SMEC feasibility. Infrastructure cost data in this scenario within the site generally not costed as separate component in build cost

5.3 Greenfield Development Costs

5.3.1 Infrastructure

5.3.1.1 Data Sources

In assessing the overall development costs SMEC analysed significant data from greenfield projects between the years 2007 and 2018. The total number of individual projects assessed was 124 and this totalled around 74,000 lots. Each data source varied in size from as small as 50 lots through to 8,000+ lots. The average project size was around 600 lots.

To ensure that data was being represented equally, costs were indexed by 2% each year to convert all costs into current 2018 dollars. Data was filtered to remove significant outliers. This occurred in a small number of projects due to varying issues including projects with:

- Large areas of undevelopable land;
- Projects consisting of large Superlots which are represented as one lot and not the true potential yield;
- Projects requiring significant external upgrade works;

The plan below shows the locations of the project data source.

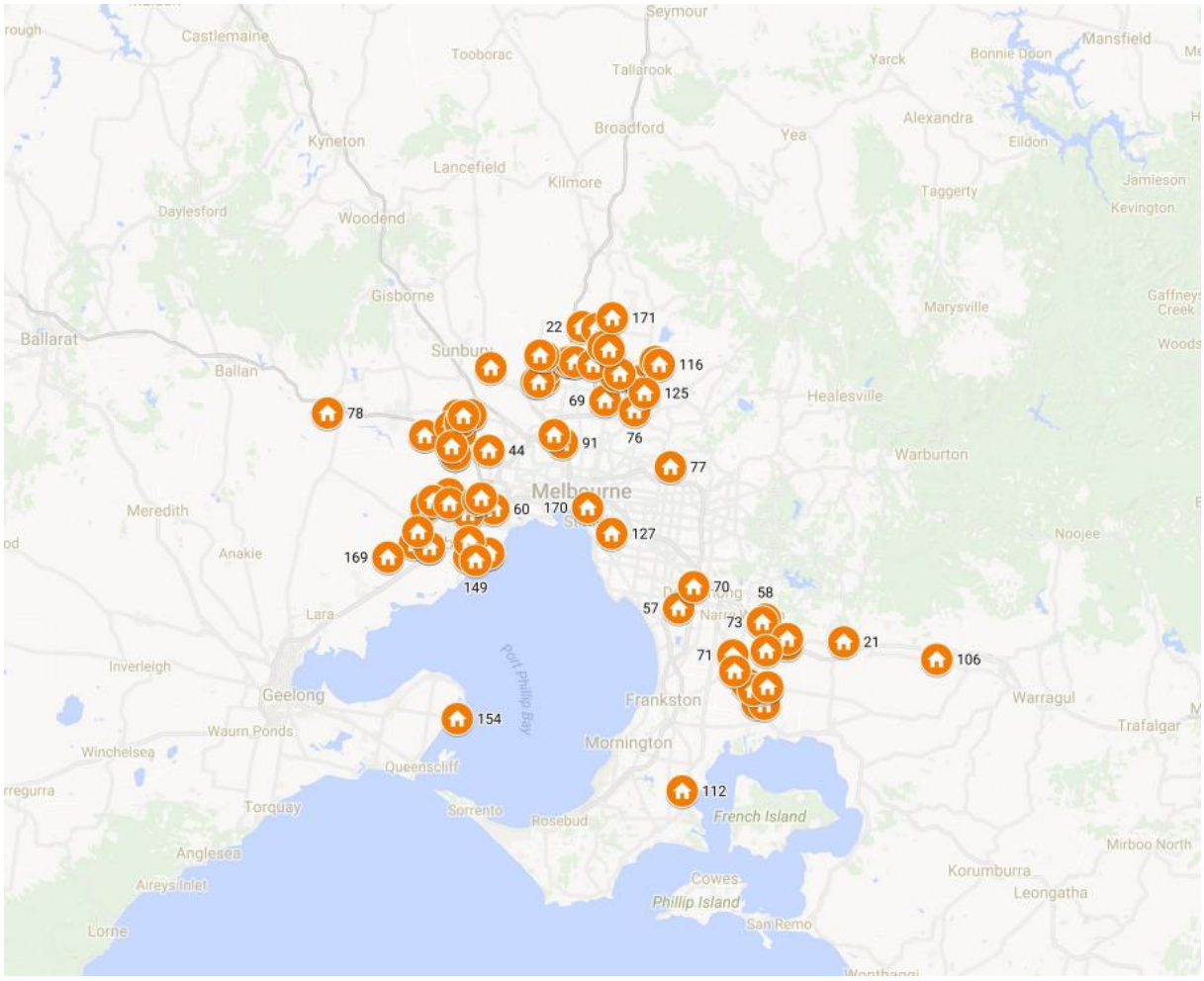


Figure 23 - Location of Greenfield Data Source

5.3.1.2 Development Cost Inclusions

The table below provides a summary of the specific elements within each cost area. Costs exclude infrastructure costs within the dwelling site (lot). Costs allow for provision of infrastructure to lot boundary only.

Table 1 - Cost Inclusions (Greenfields)

ELEMENT	INCLUSIONS
Earthworks & Roads	Local Roads Traffic Management Environmental Management Construction Fencing Site Setout / Survey Lot Grading, Earthworks & Retaining Walls (where necessary).
Drainage	Local Council Drainage within development site
Sewer Reticulation	Internal Reticulated Sewer. Typically, services 300mm diameter or smaller.
Water	Internal Potable Water Mains and Recycled Mains (if applicable). Typically, services 225mm diameter or smaller.
Gas Reticulation	Trenching and appropriate backfill material. Mains reticulation by the gas authority. Allowance for gas trenching only. (Costs for trenching included in water reticulation cost given works are completed together.
Electrical Reticulation	Internal High Voltage and Low Voltage Infrastructure including Electrical Kiosk Substations as necessary.
Telecommunications	Pit & Pipe Infrastructure including Fibre Distribution Hubs (FDH) as needed to service the development. Fibre infrastructure provided by authority under per lot contribution.
Landscape	Streetscapes (trees & nature strips) Public Open Space to Council Requirements.
Main Drainage / Stormwater Management	'Main' Drainage and Stormwater Management Assets (Rain Gardens, Wetlands, Sedimentation Ponds etc.) that are included in the overall precinct Drainage Scheme. These are generally within the development site but can be required offsite in some cases dependent on the Drainage Scheme requirements.
Miscellaneous	Temporary Works Site Specific requirements Variations and provisional sums
Consultant Fees including: (Included in overall costs above)	Key Urban Development Disciplines – Planning – Urban Design – Survey – Engineering – Landscape Architecture Other Fees: – Electrical & Telecommunications – Archaeological (desktop initial assessment only) – Flora & Fauna / Biodiversity (desktop initial assessment only) – Geotechnical – Hydraulic / Stormwater Management – Structural Engineering

There are certain elements that may impact the development costs including

- Geotechnical conditions
  - North & West Growth Corridors are typically developed in rock which impacts the development timing and construction costs.
  - The Southern Growth Corridor is typically impacted by silty soils and are low lying with potential groundwater issues.
- Authority Requirements
- Provision of recycled water
- Depth & Location of Services
- Current Market Conditions
- Contractor Availability & Construction Timing
- Existing Site Conditions
- Site slope/contours
- Project Location and Size

Some of these elements are explored further below.

Geotechnical conditions have not necessarily been a driver for development areas or selection of sites across the scenarios. Growth, demand, land availability and planning requirements have been the key drivers. In recent times, contractors have acquired heavy equipment to tackle increased challenges of working in rock in the west for example. This heavy machinery attempts to offset the slower construction time of this material. Historically, Melbourne has always had varying geotechnical conditions from stable and strong in areas north east such as Box Hill etc where tertiary siltstone is the key base, to poor in areas of Coode Island silt such as Port Melbourne. Key development areas in the west such as Point Cook were characterised by low lying swamp land geotechnics. Contractors continue to adapt to varying geotechnical conditions.

5.3.1.3 Development Cost Exclusions

Elements excluded from the cost review are external costs such as outfall drains and sewers, external road/intersection upgrades. These costs are variable between projects depending on site location and how far the projects are from existing outfall services.

5.3.1.4 Key Findings

Figure 24 - Greenfield development, range of internal reticulation infrastructure costs

5.3.2 Discussion

There are generally three types of infrastructure relevant to Greenfield development:

- **External Infrastructure:** External infrastructure is funded and planned through drainage schemes, Infrastructure Contribution Plans, Council Development Contributions and Growth Areas Infrastructure Contributions.
- **Internal Development Infrastructure:** Earthworks, roads, drainage, infrastructure and landscape run through road reserves to supply multiple dwellings. Infrastructure supply to more than one single dwelling funded by developer and handed over at completion of defects period as authority asset
- **Dwelling Services:** Internal services run throughout the dwelling lot to service dwelling or alternate land uses (commercial / mixed use / schools / community centres etc.) located within the greenfield setting. These costs form part of the dwelling construction costs.

This section of the report is only analysing internal reticulation costs, however later sections of the report consider dwelling and land costs and IV report considers external authority infrastructure supply costs.

5.3.2.1 Overall Costs

The average overall cost per lot was $61,854 and the table below details the average cost per lot for the greenfield setting for each of the infrastructure cost areas.

Table 2 - Average greenfield internal reticulation infrastructure costs

ELEMENT	AVERAGE COST PER LOT	% OF TOTAL
Earthworks & Roads	$33,844	46%
Drainage	$10,243	14%
Sewer	$5,540	8%
Water	$4,264	6%
Electrical	$4,266	6%
Telecommunications	$1,398	2%
Landscape	$2,299	3%
Total	**$61,854**	

Consultant fees have been allocated across all disciplines as shown below. Miscellaneous & Provisional costs have been allocated at 50% each to Earthworks & Roads and Drainage.

Table 3 - Consultant cost allocation across disciplines

ELEMENT	% OF CONSULTANT FEES ALLOCATED
Earthworks & Roads	51.6%
Drainage	20.0%
Sewer Reticulation	9.0%
Water	6.9%
Electrical	6.9%
Telecommunications	3.5%
Landscape	2.1%

5.3.2.2 Roads

In the greenfield setting roads are delivered by the developer to Council requirements. Most municipalities within the Urban Growth Corridor are mandating the use of the Victorian Planning Authority (VPA) Engineering Design and Construction Manual (EDCM). There are some Council's that have adopted Council specific standards / requirements on top of the EDCM that may impact costs in different regions.

The category of road required; Connector, Local etc. is determined from the traffic volumes utilising the roads as determined by a suitably qualified transport planner / traffic engineer. The location and project size may impact the road category and construction methodology required.

Of the overall average cost of $61,854 per lot, around 36% was attributed to road and auxiliary works. Auxiliary works include elements such as contractor setup, traffic management, environmental management, site fencing, preliminary survey setout and generally elements required by the contractor prior to construction. Typically, auxiliary works only account for around 5% of the road construction amount.

Site specific elements impacting this category include the actual amount of road within the subdivision. As a rule, approximately 30% of the Net Developable Area (NDA) usually forms roads, however, where there is a large proportion of 'one sided road' we see a larger amount of road and consequential costs. One sided road (dwellings occurring on one side of road reserve only) occurs next to subdivisional elements such as drainage corridors, school sites, arterial roads etc.

Geotechnical conditions impact the excavation costs and required pavement composition, varying the cost of road construction. Poor soils can impact the cost in the same order as rock can. Stabilisation of sub-grade can be a considerable cost in road construction.

5.3.2.3 Drainage / Stormwater

Internal drainage costs accounted for approximately 11% of the total costs and are estimated at around $6,600 per lot.

As with roads, internal drainage is required to be delivered by developers to Council Standards, typically in accordance with the EDCM. Developers are responsible for:

- House connections: Drainage connections from dwelling to site drainage;
- Site drainage: Network of pipes capturing site surface runoff and dwelling drainage outfalls run through common property or within road reserves.

Site drainage is usually discharged to 'main drains' adjacent to or within the property that relay flows to designated 'precinct' treatment and retarding facilities which are managed via the Melbourne Water Drainage Services Schemes

Elements that can influence the construction cost include:

- Positioning of site drainage either within the rear of lots and backfilled with standard backfill material (clay) or pipes located within the road reserve requiring crushed rock backfill.
- General slope of the land and location of the 'outfall' drainage network.
- Site location within the catchment impacting the catchment size and impacting pipe size.

5.3.2.4 Earthworks, Lot Benching and Retaining Walls

Earthworks, benching and retaining walls (if needed) account for 9% of the total cost at around $5,500 per lot. This element is highly variable as a result of the underlying site conditions. Aside from the required earthworks to provide a 'free draining' site, current typical housing product in the greenfield market usually requires flat, levelled allotments and developers are keen to implement walls and lot benching to achieve this requirement.

A key element impacting earthworks are the underlying site conditions and suitability of sub soils, for example rock in the west and north growth areas and silt in the south east.

Where filling is required, and fill is required to be imported the availability and location of fill can vary costs considerably.

5.3.2.5 Sewer

Reticulated sewer required to service greenfield developments account for around $5,000 per lot or 8% of the overall cost.

The Melbourne Regional Water Authorities (MRWA) which include South East Water, Yarra Valley Water and City West Water have introduced a MRWA 'standard' for sewer infrastructure. This policy attempts to standardise the requirements for servicing greenfield residential development. The developer is responsible for the design, construction and testing of sewer assets within the development including:

- House connections: Sewer connections from Inspection Opening (IO) to sewer main;
- Sewer Main: Sewer pipes collecting dwelling discharge and conveying to sewer outfall through common property;
- Sewer outfall: Connection from site sewer to authority external reticulation network

Upgrades to external networks may be required to facilitate development. Where external mains require augmentation, sewers larger than 300mm diameter are treated as 'shared assets' and are typically reimbursed by the water authority.

Elements that can influence the construction cost of this item include:

- Positioning of sewer either within the rear of lots and backfilled with standard backfill material (clay) or pipes located within the road reserve requiring crushed rock backfill.
- Size and type of residential house product impacting the location of the sewer. Large lots permit sewer within the rear of the lot while smaller lots (with access issues) usually mandate the sewer at the front of the lot within the road reserve triggering crushed rock backfill.
- Topography of the site impacting the size and capacity of the sewer.

Once works are accepted by the water authority, ongoing ownership and maintenance will also be transferred. Maintenance responsibilities are detailed below.

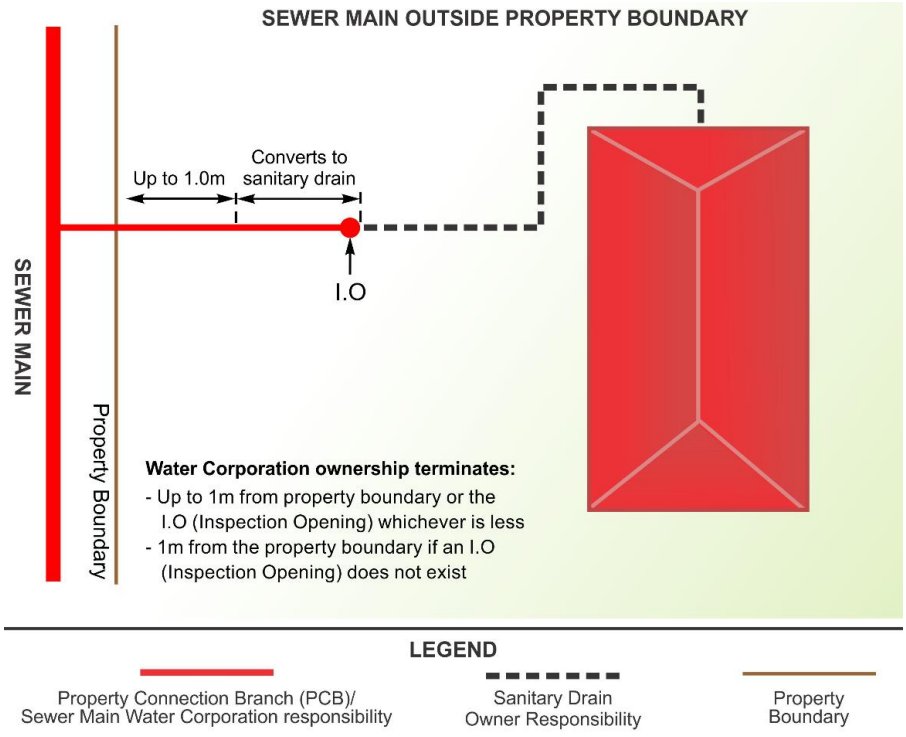


Figure 25 - Maintenance Responsibility (source www.southeastwater.com.au)

5.3.2.6 Water

Potable and recycled water, if mandated, account for around $3,300 per lot or 5% of the overall development cost. It should be noted that this cost may be considered low due to some of the data dating back to a period where recycled water was not provided in new developments.

Typically, developments in growth areas within the City West, South East and Yarra Valley Water regions are mandated to provide recycled water. Currently Western Water do not mandate recycled water and the provision of this asset is determined by the developer.

Typically, we experience a cost of $2,500 per lot per service, therefore, $5,000 for developments where potable and recycled water is required.

As with the requirements of sewer, potable and recycled water (if mandated), shall be provided by the developer in accordance with the MRWA standards including:

- House tapping: Connection from internal water main to lot
- Internal Water Mains: Water supply pipes located within the road reserve providing water to the development.

Aside from the requirement to provide recycled water the costs to supply water in new developments are relatively constant.

5.3.2.7 Gas

Gas reticulation accounts for around 1% of the total cost and under current gas supply policy, gas mains are normally installed within residential developments at no cost to the developer. The developer is required to undertake trenching and backfill for the gas mains and installation of conduits under roads. For any extension to the site, usual industry practice is for the initial developer who requires the service to deliver this. We understand that there are current discussions in the industry with respect to a precinct approach whereby costs may be apportioned across several developments.

Gas costs are not highly variable across the projects and scenarios and are therefore not considered to impact overall development cost. Major supply to developments is managed by authorities. Gas trenching costs have been included in water reticulation costs as these are delivered together.

5.3.2.8 Electricity

Electricity supply accounts for around $3,800 per lot or 6% of the total development cost. Supply within the greenfield setting requires developers to provide an internal network of high and low voltage infrastructure, usually below ground, that connects houses to the external distribution network.

Lighting design must be completed in accordance with the retailer's policies and Australian Standards and developers can choose to undertake the design and construction themselves (turnkey) or have this done directly by the electrical distributor.

Developers are required to install the following:

- Service Connection (Pit) for each allotment
- Low and High Voltage cable
- Utility Service Substations (Kiosks)
- Public Street & Reserve Lighting

Elements impacting the electrical component within the greenfield setting include:

- External upgrades or alterations to the existing assets such as undergrounding of above ground infrastructure;
- Mixed use developments where higher demand is required for other land uses including Town Centres, Schools etc.

5.3.2.9 Telecommunications

Telecommunications facilities account for $1,164 per lot or around 2% of the total development cost. Costs are not highly variable across the projects and scenarios and are therefore not considered to impact overall development cost.

It will be the responsibility of the developer to provide a local network that connects to the external distribution network. Developers are required to install the internal network including:

- Local Pit and Pipe infrastructure
- Trenching, bedding and backfill of service trenches and pits.

Individual lot owners are responsible for the connection between the house and the Local Network Pit.

Telecommunications authority will supply telecommunications reticulation (fibre or similar) to service the development under an authority per lot contribution rate.

There may be occasions where the nearest external network requires significant external 'backhaul' works. This element is dependent upon the project location and has been excluded from our review.

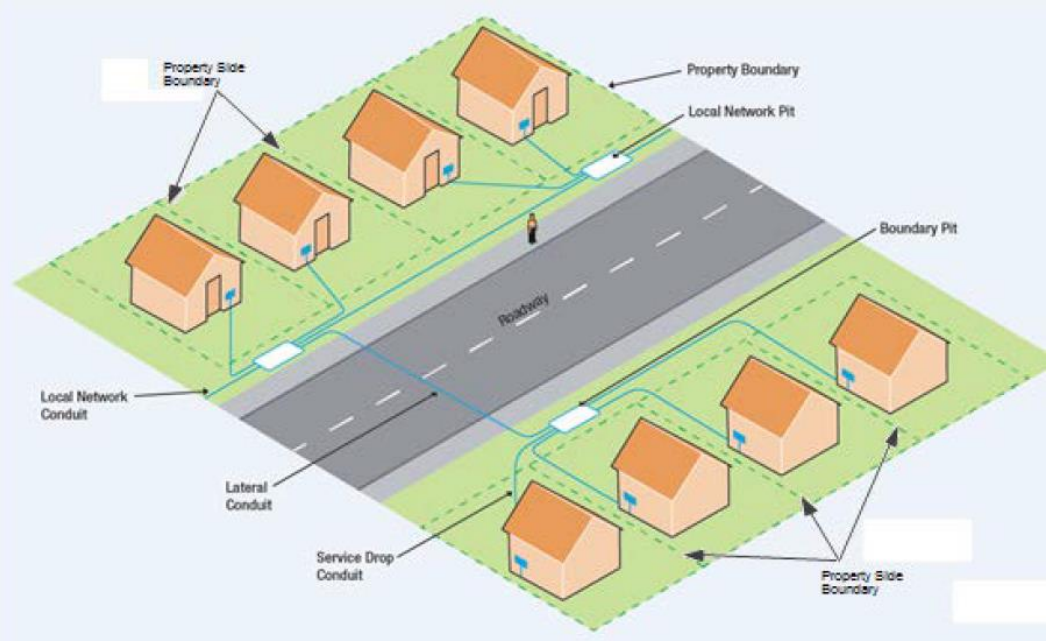


Figure 26 - Fibre deployment in greenfield subdivisions (source: www.nbnco.com.au)

5.4 Small Scale Dispersed Infill Development Costs

5.4.1 Infrastructure Costs

Infrastructure cost data for SSDID is generally harder to define given these developments are completed by much smaller developers that deliver a limited number of projects. Statutory requirements for financial reporting are also less common given smaller project value. It is however, relatively easy to estimate the overall cost of infrastructure provision for these developments given the infrastructure is all private reticulation rather than authority asset and the limited external works required. Key cost items to consider for the delivery of these projects are:

- Shared driveways and footpaths
- Retaining walls
- Building pad earthworks
- Private Water reticulation
- Private Sewer reticulation
- Telecommunications (trenching and conduits), fibre infrastructure provided by authority under per lot contribution charge.
- Private Gas reticulation from site boundary at street front of development to each dwelling (included in cost of water supply per dwelling).
- In-ground infrastructure that can impact the overall cost of the development depending on site geology and in situ conditions (i.e. rock excavation costs)

Note: Dwelling (building) costs have been excluded from this cost analysis.

An example cost estimate for SSDID has been completed on a typical development to advise on the typical development cost for SSDID. This development is a flat block that was developed as three dwellings. It has a driveway up one side that services two rear dwellings and a third minor driveway for the street frontage dwelling.

Figure 27 - Example SSDID cost estimate property

Site Area:	800m^2
Number of dwellings:	3
Parcel length:	50m
Parcel width:	16m
Common property area:	165m^2
Shared driveway area:	142m^2

Estimated Per lot infrastructure cost:	$30,000
Range of infrastructure per lot:	$25,000 – $35,000

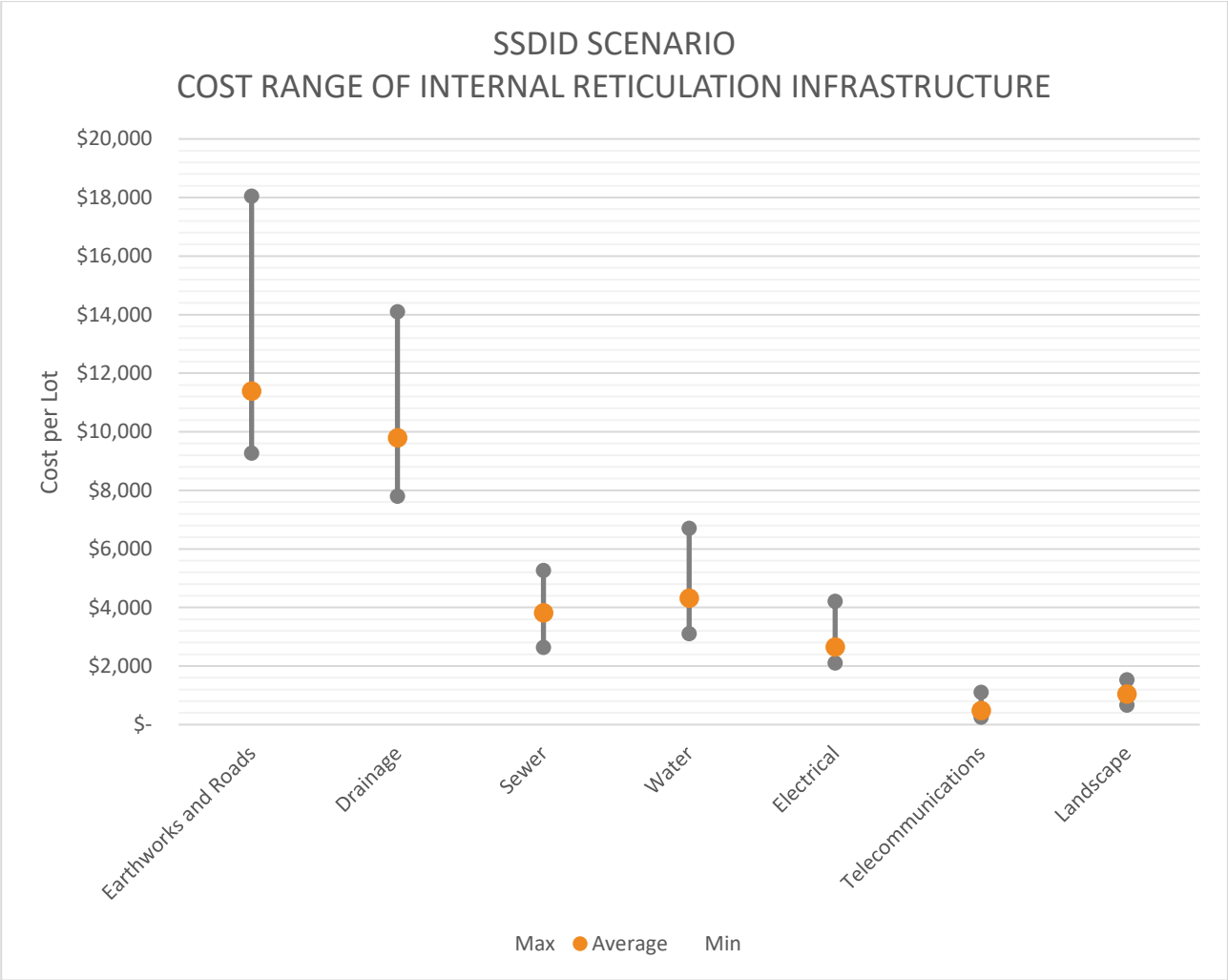


Figure 28 – SSDID development, range of internal reticulation infrastructure costs

Table 4 - Average SSDID internal reticulation infrastructure costs

ELEMENT	AVERAGE COST PER LOT	% OF TOTAL
Earthworks & Roads	$11,387	46%
Drainage	$9,788	14%
Sewer	$3,815	8%
Water	$4,316	6%
Electrical	$2,649	6%
Telecommunications	$476	2%
Landscape	$1,045	3%
Total	**$33,477**	

Consultant fees have been allocated across all disciplines as in Table 3 of this report. Miscellaneous & Provisional costs have been allocated at 50% each to Earthworks & Roads and Drainage.

5.4.2 Discussion

When considering Infrastructure costs for SSDID it is generally considered that no external infrastructure costs would be required. The nature of SSDID is that development is dispersed and occurring independent of other developments. There will be a point in time when SSDID needs to be considered on a holistic densification to assess the potential supply constraints on the greater reticulation network. For the purposes of this study it is assumed that SSDID requires no external infrastructure upgrades. Authority contributions are excluded from this report and are discussed further in the Infrastructure Victoria report.

Elements that vary in SSDID compared to other scenarios are as follows:

- Group meters for electrical supply
- Group meters for gas and water supply
- Owners Corporation common property for landscaping
- Private infrastructure supply: Water and sewerage supply to Plumbing Code standard, Electrical supply to AS3000 design and private roads
- Gas reticulation: Private reticulation from site meter to each dwelling.
- On-site detention: As development is generally in fill there can be a requirement to detain peak storm flow rates to pre-developed levels.
- Stormwater Treatment: Treatment of stormwater runoff prior to discharge
- Retaining walls to form building pads
- Visitor car parks
- In-ground infrastructure that can impact the overall cost of the development depending on site geology and in situ conditions (i.e. rock excavation costs)

As per other scenarios, SSDID infrastructure is categorised by three key areas as follows:

- **External Infrastructure:** Given development is limited to 4 dwellings per lot, developer funded external infrastructure upgrades are generally not required to facilitate this type of development. Any upgrades in areas where SSDID is common would fall to authority responsibility.
- **Internal Development Infrastructure:** Earthworks, private roads, drainage, infrastructure and landscape run through common property to supply multiple dwellings. Infrastructure supply to more than one single dwelling.
- **Dwelling Services:** Internal services run throughout the dwelling (considered as part of building construction cost)

5.4.2.1 Roads and earthworks

No roads would be constructed for SSDID, road works are limited to construction of shared driveway pavements that generally run down one side of the development to service the garages of townhouses. Construction of a new driveway crossover to a main road is also generally required.

Earthworks for the development will vary depending on topography. SSDID site yield is generally governed by slope and existing site vegetation. Steeper sites will see lower yield. The most efficient development will be on a relatively flat lot with slope in one direction (average preferred slope 1 in 50). Retaining walls and earthworks construction required is dependent on existing site slope. This can skew the overall development cost considerably.

5.4.2.2 Stormwater

Stormwater infrastructure required to service SSDID dwellings is private and delivered to AS3500 requirements and generally includes the following key drainage infrastructure cost elements:

- **House connections**: Drainage connections from dwelling to development site drain;
- **Development site drain**: Pipe capturing site surface runoff and dwelling drainage outfalls run through common property;
- **Stormwater treatment**: Ensures discharge stormwater quality meets objectives of Planning Scheme. Can be in form of rainwater tanks, proprietary treatment device such as gross pollutant trap or constructed rain gardens. Cost of providing stormwater treatment elements on site verses discharging to a standard connection range in order of $3,000 - $6,000 per dwelling;
- **Stormwater detention tank:** Generally located underground upstream of legal point of discharge to limit peak discharge flow rates for minor storms. The cost of providing on-site detention storage tanks for developments of

this nature upstream of discharge equates to around $500-750 per kilolitre (1,000 litres of storage) of storage. Generally, a standard SSDID development would require around 1,000-2,000L per dwelling of detention storage equating to a cost in the order of $1,500 per tank plus any fittings per dwelling. Centralised detention storage can be more cost effective than individual per dwelling tanks. This is dependent on local hydrologic conditions.

- **Stormwater legal point of discharge:** Connection from site drainage to Council drainage network external to site

5.4.2.3 Sewer

Sewer reticulation for SSDID is delivered as private sewer reticulation to AS3500 requirements. Key sewer infrastructure cost elements are as follows:

- **House connections**: Sewer connections from dwelling to site sewer;
- **Site sewer**: Sewer pipe collecting dwelling discharge and conveying to sewer outfall through common property;
- **Sewer outfall:** Connection from site sewer to authority external reticulation network

5.4.2.4 Water

Water supply for SSDID is delivered as private water reticulation to AS3500 requirements and in line with MRWA Water authority requirements. Recycled water is not prevalent in SSDID scenario. Stormwater harvesting can be incorporated on a per dwelling level and reticulated as private infrastructure. This cost would apply to dwelling cost. Key water infrastructure cost elements are as follows:

- **House tapping:** Connection from internal water main to dwelling
- **Site Water reticulation:** Water supply pipe run through common property to service dwellings
- **Dwelling check meters:** Individual dwelling meters to determine water usage
- **Site water meter:** Overall site meter required if common property water supply is utilised, installed upstream of dwelling check meters
- **Connection to External main:** Connection to external water authority main external to street

5.4.2.5 Gas

Gas reticulation supply for SSDID is delivered as a private reticulation downstream of meters located at street frontage boundary of development. From this point, gas is run through the site to each dwelling as private asset. Gas supply and metering is provided by gas authority through development supply agreement. Key gas infrastructure cost elements are as follows:

- **Gas reticulation:** Gas pipe from meters to each dwelling

5.4.2.6 Electricity

Electricity supply for SSDID is delivered as private AS3000 infrastructure through agreement with an electrical provider. Key electrical infrastructure cost elements required are as follows:

- **House connections:** Connection from site switch board to dwelling meter and switchboard
- **Site reticulation:** Electrical supply run through common property from site switchboard to dwelling connection
- **Site switchboard:** Required if servicing multiple dwellings from one supply point
- **Site meter:** Required if common property electrical demand (lighting, irrigation or other electrical fittings)
- **Connection to main:** Connection from switchboard to supply point external to site

5.4.2.7 Telecommunications

Telecommunications supply through SSDID development is delivered by a provider under a contribution arrangement. Site supply is provided and associated per lot contribution paid. Pit and pipe infrastructure is constructed by the civil contractor funded by the developer with reticulation of telecommunications infrastructure through development delivered by telecommunications sub-contractor.

5.5 Precinct Scale Brownfield (Medium Density) Costs

5.5.1 Infrastructure Costs

In assessing the overall applicable development infrastructure cost for infrastructure SMEC analysed 18 individual projects from within the past 4 years across greater Melbourne. These projects vary in size from 20 dwellings up to 575 dwellings and fit within the standard site yield of 20 to 80 dwellings per hectare. Figure 29 below shows the locations of the project data source. Assessment was completed on both civil construction tender pricing and Opinion of Probable Cost (OPC) data. OPC is assumed to be a snapshot in time from when costing was completed.

Costs provided are for traditional townhouse developments in medium density context from tendered rates and pre-tender estimates of cost.

Gas infrastructure costs apply only to trenching for this scenario with cost of trenching allocated to water cost for consistency across scenarios. Gas authority provides reticulation network to individual dwelling meters.

Table 5 - Project source data from civil contractor tenders

ITEM	UNIT	1	2	3	4	5	6	7	8	9
Number of Dwellings		117	98	176	58	116	135	21	20	143
Construction Period	Start	Jun-15	Nov-16	Oct-15	Jul-12	Jan-18	Aug-16	Dec-17	Jun-17	Dec-16
	End	Oct-17	Jan-18	Dec-17	Dec-13	May-18	May-18	Jun-18	Nov-17	May-18

Table 6 - Project source data from Opinion of Probable Cost

ITEM	UNIT	1	2	3	4	5	6	7	8	9
Date of Estimate		Aug-17	Oct-17	Jan-18	Apr-17	Nov-16	May-18	Jul-17	Feb-18	Mar-17
Number of Dwellings	No	455	149	200	343	575	227	56	173	64
Total Area	Ha	12.4	2.2	3.97	11.4	47.14	8.72	1.8	3.95	1.389
NDA		10.53	1.59	2.15	9.64	28.84	8.72	1.8	3.95	1.389
Lot Ratio	Lot/Ha	44	94	94	36	20	27	32	44	47
Number of Stages		8	1	4	3	7	5	2	4	1

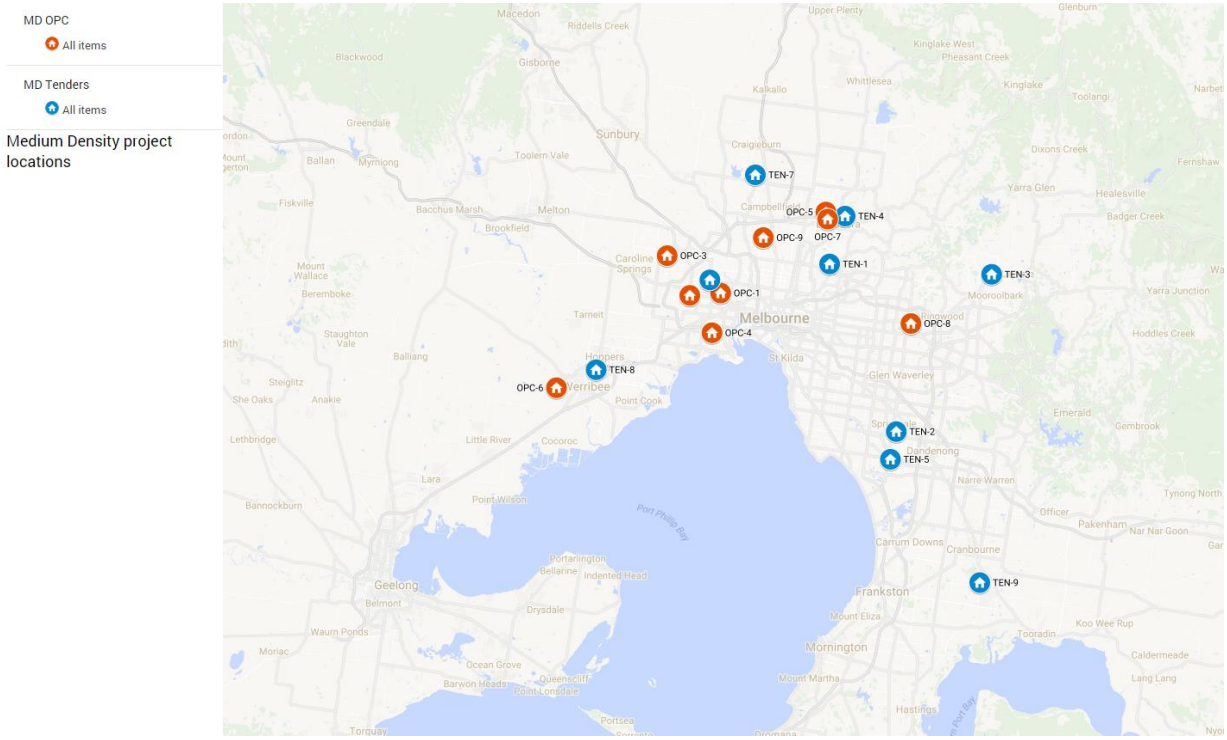


Figure 29 - Map of infrastructure cost data

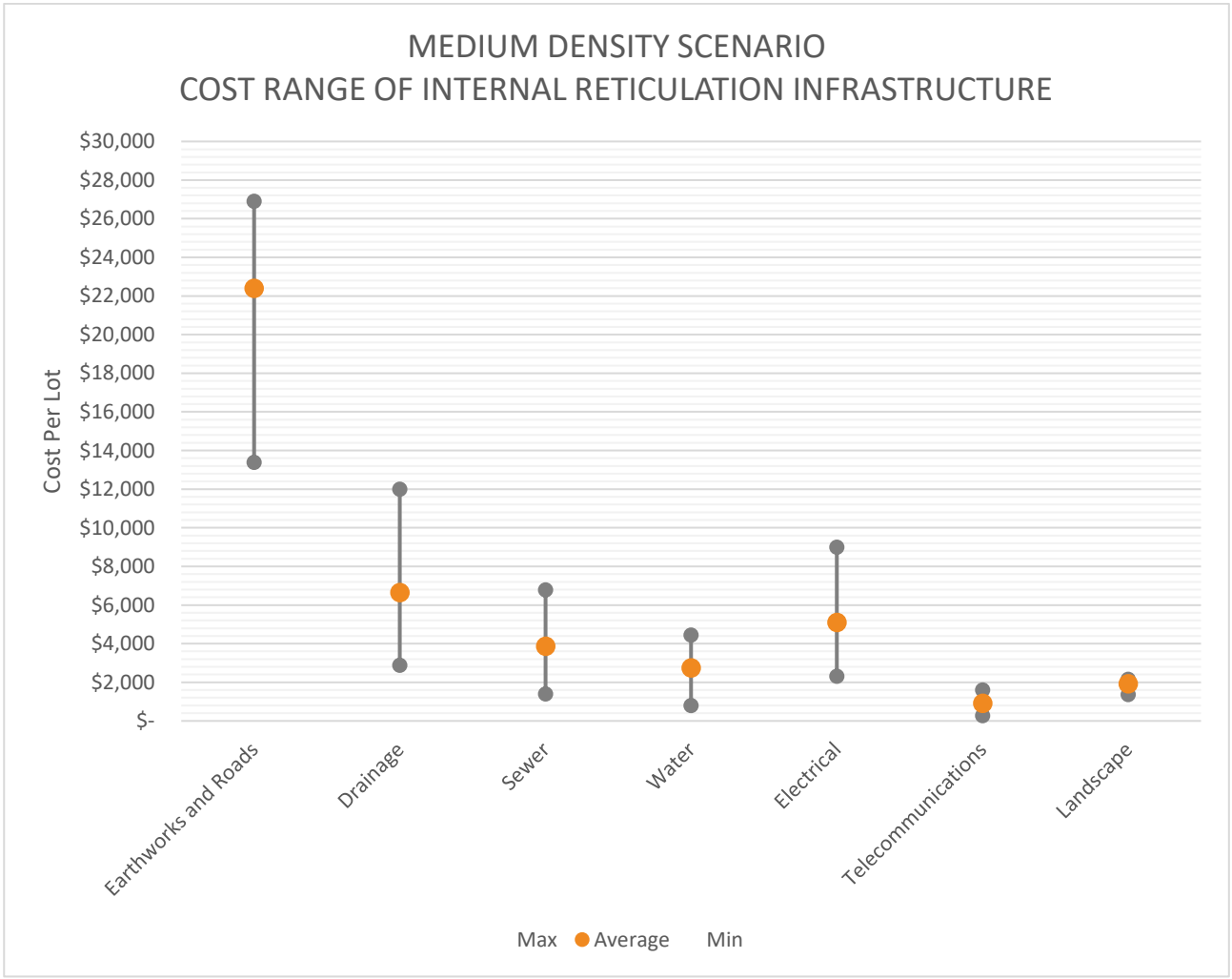


Figure 30 -Medium density development, range of internal reticulation infrastructure costs

Table 7 - Average Medium Density internal reticulation infrastructure costs

ELEMENT	AVERAGE COST PER LOT	% OF TOTAL
Earthworks and Roads	$22,391	51.4%
Drainage	$6,640	15.3%
Sewer	$3,863	8.9%
Water	$2,743	6.3%
Electrical	$5,093	11.7%
Telecommunications	$900	2.1%
Landscape	$1,919	4.4%
Total	**$43,551**	

5.5.2 Discussion

Other elements that vary in medium density development compared to other scenarios are as follows:

- Group meters for electrical supply
- Group meters for gas and water supply
- Owners Corporation common property for landscaping
- Private infrastructure supply: Water and sewerage supply to Plumbing Code standard, Electrical supply to AS3000 design and private roads
- Gas infrastructure: Reticulated gas infrastructure provided by authority. Trenching only and connections downstream of dwelling meters are provided by developer
- On-site detention: As development is generally in fill there can be a requirement to detain peak storm flow rates to pre-developed levels. For medium density this is generally done as centralised storage either above ground or below ground
- Stormwater treatment: Stormwater treatment required to ensure development complies to Planning Scheme requirements. Treatment can be centralised or decentralised.
- Visitor car parks
- In-ground infrastructure that can impact the overall cost of the development depending on site geology and in situ conditions (i.e. rock excavation costs)

As per other scenarios, medium density development infrastructure is categorised by three key areas as follows:

- **External Infrastructure:** Infrastructure upgrades to authority assets required to facilitate supply to, or discharge from the site. This can be dependent on surrounding infrastructure availability and adjacent development. The requirement for external infrastructure upgrades varies significantly in cost dependent on surrounding conditions. External upgrades can be imposed on developer in some cases or provided by infrastructure authority
- **Internal Development Infrastructure:** Earthworks, Private roads, drainage, infrastructure and landscape run through common property to supply multiple dwellings. Supply to more than one single dwelling. Can be authority infrastructure standard in some cases and handed over to authority at construction completion.
- **Dwelling Services:** Internal services run throughout the dwelling. (considered as part of building construction cost)

5.5.2.1 Roads and earthworks

Roads constructed within medium density development can fall under the following categories:

- Private estate common property (ownership to Owner's corporation)
- Council roads (public road, ownership to Council)

Generally, in medium density development, delivery of road reserves to be handed back to Council will require wider reserves to facilitate infrastructure that is to be handed back to the relevant authority. Council will generally limit infrastructure within the road pavement. In the case that private roads are delivered, assets can be constructed within the road pavement which supports narrower road reserves and in turn increases net developable area. Private roads will have an ongoing maintenance requirement that is borne by the Owner's Corporation of the estate.

External intersection upgrades are often required to facilitate precinct medium density development. The cost of these external upgrades varies on the level of surrounding infrastructure.

As per SSDID, earthworks for the development will vary depending on topography. Site yield is generally governed by slope and existing site vegetation. Steeper sites will see lower yield. The most efficient development will be on a relatively flat lot with slope in one direction (average preferred slope 1 in 50). Retaining walls and earthworks construction required is dependent on existing site slope. This can skew the overall development cost considerably.

5.5.2.2 Stormwater

Stormwater infrastructure required to service precinct medium density projects can be Council assets if in Council road reserves or private and delivered to AS3500 requirements and generally includes the following key drainage infrastructure cost elements:

- **House connections**: Drainage connections from dwelling to site drainage;
- **Site drainage**: Network of pipes capturing site surface runoff and dwelling drainage outfalls run through common property or within road reserve;
- **Stormwater treatment**: Ensures discharge stormwater quality meets objectives of Planning Scheme. Can be in form of rainwater tanks, proprietary treatment device such as gross pollutant trap or constructed rain gardens;
- **Stormwater detention:** Can be located underground or as an open basin upstream of legal point of discharge to limit peak discharge flow rates for minor storms
- **Stormwater legal point of discharge:** Connection from site drainage to Council drainage network external to site
- **External drainage works:** In medium density precincts there is sometimes a need to upgrade drainage infrastructure downstream of the development site to facilitate the development.

5.5.2.3 Sewer

Sewer reticulation for medium density precincts can be delivered as private sewer reticulation to AS3500 requirements or as MRWA authority asset or a hybrid. Key sewer infrastructure cost elements are as follows:

- **House connections**: Sewer connections from dwelling to site sewer;
- **Site sewer**: Sewer pipes collecting dwelling discharge and conveying to sewer outfall through common property;
- **Sewer outfall:** Connection from site sewer to authority external reticulation network
- **External upgrades:** In some cases, upgrades to external water networks are required to facilitate development of the site. This can include construction of authority mains back to larger diameter supplies in close proximity to the site

5.5.2.4 Water

Water supply for medium density precincts can be delivered as private water reticulation to AS3500 requirements and in line with MRWA Water authority requirements or to MRWA authority asset or a hybrid. Recycled water is not common or mandated in medium density scenarios but can occur within some larger precincts as harvested wastewater or stormwater that is treated and reticulated through the development. Stormwater harvesting can be incorporated on a per dwelling level or as a centralised capture and supply system and reticulated as private infrastructure. This cost would apply to dwelling cost. None of the development projects assessed included recycled water or similar harvesting reticulation schemes. Key water infrastructure cost elements are as follows:

- **House tapping:** Connection from internal water main to dwelling
- **Site Water reticulation:** Water supply pipe run through common property to service dwellings
- **Dwelling check meters:** Individual dwelling meters to determine water usage
- **Site water meter:** Overall site meter required if common property water supply is utilised, installed upstream of dwelling check meters
- **Firefighting booster assemblies:** In some case, booster assemblies and other water supply equipment can be required to ensure sufficient firefighting water supply

- **Connection to External main:** Connection to external water authority main external to street
- **External upgrades:** In some cases, upgrades to external water networks are required to facilitate development of the site. This can include construction of authority mains back to larger diameter supplies near the site

5.5.2.5 Gas

Gas reticulation supply for medium density is delivered as authority reticulation through road reserves or common property to meters located at street frontage of each dwelling. Gas supply and metering is provided by gas authority through development supply agreement. Trenching is provided by developer. Key gas infrastructure cost elements are as follows:

- **Gas reticulation:** Gas trenching (cost included under water cost)

5.5.2.6 Electricity

Electricity supply for medium density precincts can be delivered as private AS3000 infrastructure through agreement with an electrical provider or through traditional authority electrical reticulation. Key electrical infrastructure cost elements vary between the two options with infrastructure required for AS3000 as follows:

- **House connections:** Connection from site switch board to dwelling meter and switchboard
- **Site reticulation:** Electrical supply run through common property from site switchboard to dwelling connection
- **Site switchboard:** Required if servicing multiple dwellings from one supply point
- **Site meter:** Required if common property electrical demand (lighting, irrigation or other electrical fittings)
- **Substation:** Site substation (or multiple) required to supply precinct
- **Connection to main:** Connection from switchboard to supply point external to site
- **External upgrades:** Backhaul upgrades or high voltage supply to electrical network can be required in some cases, this cost is generally borne by the developer through authority contributions

5.5.2.7 Telecommunications

Telecommunications supply through medium density precinct development is delivered by a provider under a contribution arrangement. Site supply is provided and associated per lot contribution paid. Pit and pipe infrastructure is constructed by the civil contractor funded by the developer with reticulation of telecommunications infrastructure through development delivered by telecommunications sub-contractor.

5.6 Precinct Scale High Density Costs

5.6.1 Infrastructure

Cost of infrastructure for high density development can be difficult to estimate as procurement of key shared infrastructure is combined with packages for dwelling services. For example, the procurement of a hydraulics package for a 20-storey apartment development would include works from the boundary (meter room, assemblies, supply to building), works within the common property areas to reticulate through the building (through risers, ducts and ceiling space) and hydraulic infrastructure throughout the apartments (private infrastructure).

Generally, the cost to supply the development site is separated out as site infrastructure works. This procurement could be by the site civil contractor. This can include the following works:

- Water supply from street authority main into building
- Sewer outfall from building to authority main in street
- Gas connection from authority main in street
- On site stormwater detention and treatment
- Drainage legal point of discharge connection to Council drainage network
- Telecommunications connection to authority street network
- Electrical connection to external authority network

There is a degree of efficiency in the scalability of a building based on building height. A tall tower development with a small land footprint would still require more supply infrastructure to service an increased number of dwellings. There are cost efficiencies with scale. For example, a water supply connection cost is not directly linear cost between number of dwellings and supply cost. Infrastructure costs form a logarithmic progression relative to dwelling numbers.

The only category of infrastructure that is impacted by land area is drainage. Councils assess stormwater detention and treatment by land title area. Therefore, the drainage cost component is not tied to the height of the development. It is tied to the site coverage density. An estimate of the cost break-down of these components as a per dwelling rate for typical high-density developments (10-20 storey building), is shown below:

- **Overall development site infrastructure cost per dwelling:** $5,000 - $8,000 per dwelling inclusive of the following elements
    - Sewer outfall: $1,000 per dwelling
    - Water supply connection: $500 per dwelling
    - Fire booster assembly: $750 per dwelling
    - Electrical supply connection (including substation): $2,000
    - Telecommunications: $750 per dwelling
    - Stormwater treatment and detention: $1,000 per dwelling
    - Drainage legal point of discharge: $500 per dwelling

These costs do not include any external authority infrastructure upgrades that may be required to service the development but do include provision of infrastructure to the building boundary (on lot). External infrastructure costs vary significantly depending on location of development and accessibility to existing infrastructure.

Figure 31 - High density development, range of internal reticulation infrastructure costs

Table 8 - Average High Density internal reticulation infrastructure costs

ELEMENT	AVERAGE COST PER LOT	% OF TOTAL
Earthworks and Roads	$3,290	7.55%
Drainage	$2,250	5.17%
Sewer	$1,225	2.81%
Water	$1,173	2.69%
Electrical	$2,173	4.99%
Telecommunications	$600	1.38%
Landscape	$803	1.84%
Total	**$11,513**	

5.6.2 Discussion

In assessing the cost of infrastructure provision to high density development there are many varied factors when compared back to the other scenarios. Firstly, high density development has a much greater variation in development type, ranging from 10 storeys to 108 storeys in height and often accommodating uses other than purely residential. Secondly, it is difficult to separate the cost of an individual development from shared developments costs for areas such as circulation space, lifts, basement car parks and podiums, in the way that it can for shared roads and access ways in a greenfield development and other scenarios.

Construction costs for infrastructure such as water, sewer, gas, telecommunications and stormwater are generally costed and delivered as overall building packages that include apartment fit out as noted in section 5.6.1.

As per other scenarios, high density development infrastructure is categorised by three key areas as follows:

- **External Infrastructure:** Infrastructure upgrades to authority assets required to facilitate supply to, or discharge from the building. This can be dependent on surrounding infrastructure availability and adjacent development. The requirement for external infrastructure upgrades varies significantly in cost dependent on surrounding conditions. External infrastructure upgrades to facilitate high density projects are generally imposed on developer for funding and delivery. Larger scheme upgrades would be delivered by infrastructure authority. Assessment of the costs of this item is covered under IV report and excluded from this assessment.
- **Internal Development Infrastructure:** Private Infrastructure run through common spaces of building required to supply multiple dwellings. Generally, run through common property, service cores, podiums and basements. Infrastructure supply to more than one single dwelling.
- **Dwelling Services:** Internal services run throughout the dwelling (assessed as part of the overall building cost).

Infrastructure cost elements that vary in high density compared to other scenarios are as follows:

- Firefighting equipment
- Elevators and Escalators
- Ventilation Systems
- Basement excavation for car parks
- Car stackers
- Group meter rooms and space allocation
- Common property
- On-site detention: As development is generally infill or redevelopment of existing development, there can be a requirement to detain peak storm flow rates to pre-developed levels.
- Private Gas reticulation from authority meter on development boundary to individual dwellings
- District hot water
- Infrastructure construction not within the ground

The requirement for these additional building elements can offset the cost of providing in ground infrastructure reticulated through developments.

5.6.2.1 Roads and earthworks

Generally, no roads would be constructed for high density development, road works are limited to construction of shared driveway pavements and entrances to buildings (porte cochere etc) to connect the development to the adjacent road.

Earthworks for the development will vary depending on topography and proposed basement excavation. High density site yield is less governed by slope particularly when buildings include basements. Steeper sites will require additional earthworks but basement levels (if constructed) can be used to mitigate slope impacts. The most efficient development will be on a relatively flat lot with slope in one direction (average preferred slope 1 in 50). Depth of basement and site conditions can skew the overall development cost considerably. In-situ geology can significant impact the overall design methodology and construction cost. Basements in poor ground conditions will cost more than those in sound conditions. Groundwater infiltration can also impact cost.

5.6.2.2 Stormwater

Stormwater infrastructure required to service precinct high density projects can be Council asset if in Council road reserve or private and delivered to AS3500 requirements and generally includes the following key drainage infrastructure cost elements:

- **House connections**: Drainage connections from dwelling to site drainage network (within building);
- **Site drainage**: Network of pipes capturing site surface runoff and dwelling drainage outfalls run through common property or within road reserve;
- **Stormwater treatment**: Ensures discharge stormwater quality meets objectives of Planning Scheme. Can be in form of rainwater tanks, proprietary treatment device such as gross pollutant trap;
- **Stormwater detention:** Can be located as tank upstream of legal point of discharge to limit peak discharge flow rates for minor storms
- **Stormwater legal point of discharge:** Connection from site drainage to Council drainage network external to site
- **External drainage works:** In medium density precincts there is sometimes a need to upgrade drainage infrastructure downstream of the development site to facilitate the development.

5.6.2.3 Sewer

Sewer reticulation for high density precincts can be delivered as private sewer reticulation to AS3500 requirements or as MRWA authority asset or a hybrid. Key sewer infrastructure cost elements are as follows:

- **House connections**: Sewer connections from dwelling to site sewer (within building);
- **Site sewer**: Sewer pipes collecting dwelling discharge and conveying to sewer outfall through common property;
- **Sewer outfall:** Connection from site sewer to authority external reticulation network
- **External upgrades:** In some cases, upgrades to external water networks are required to facilitate development of the site. This can include construction of authority mains back to larger diameter supplies near the site

5.6.2.4 Water

- Water supply for high density precincts can be delivered as private water reticulation to AS3500 requirements and in line with MRWA Water authority requirements. Recycled water is not prevalent in high density scenarios but can occur within some larger precincts as harvested wastewater or stormwater that is treated and reticulated through the development. Stormwater harvesting can be incorporated on a per dwelling level or as a centralised capture and supply system and reticulated as private infrastructure. This cost would apply to dwelling cost. Key water infrastructure cost elements are as follows:
- **House tapping:** Connection from internal water main to dwelling
- **Site Water reticulation:** Water supply pipe run through building to service dwellings
- **Dwelling check meters:** Individual dwelling meters to determine water usage
- **Site water meter:** Overall site meter required if common property water supply is utilised, installed upstream of dwelling check meters
- **Firefighting booster assemblies:** In some case, booster assemblies and other water supply equipment can be required to ensure sufficient firefighting water supply
- **Connection to External main:** Connection to external water authority main external to street

- **External upgrades:** In some cases, upgrades to external water networks are required to facilitate development of the site. This can include construction of authority mains back to larger diameter supplies near the site
- **Centralised Hot water:** In some high-density developments centralised hot water is delivered to dwellings from plant. This can provide cost and space efficiencies

5.6.2.5 Gas

Gas reticulation supply for high density is delivered as authority reticulation through road reserves or common property to meters located at street frontage of each dwelling. Gas supply and metering is provided by gas authority through development supply agreement. Key gas infrastructure cost elements are as follows:

- **Gas reticulation:** Gas reticulation from site meter to each dwelling (delivered at developer cost).
- **Site meter:** Meter assembly for main supply to site (funded under developer contribution to gas authority)
- **Boilers:** In some high-density developments, hot water boilers and centralised heating may be provided.

5.6.2.6 Electricity

Electricity supply for high density precincts can be delivered as private AS3000 infrastructure through agreement with an electrical provider or through traditional authority electrical reticulation. Key electrical infrastructure cost elements vary between the two options with infrastructure required for AS3000 as follows:

- **House connections:** Connection from site switch board to dwelling meter and switchboard through building
- **Site reticulation:** Electrical supply run through building from site switchboard to dwelling connection
- **Site switchboard:** Required if servicing multiple dwellings from one supply point
- **Site meter:** Required if common property electrical demand (lighting, irrigation or other electrical fittings)
- **Substation:** Site substation (or multiple) required to supply precinct
- **Connection to main:** Connection from switchboard to supply point external to site
- **External upgrades:** Backhaul upgrades or high voltage supply to electrical network can be required in some cases, this cost is generally borne by the developer through authority contributions
- **Embedded network:** In some high-density development embedded network sees the dwelling owners purchase power through the owner's corporation bulk supply
- **Renewable Energy:** In some high-density developments, renewable energy such as solar power is included to offset power consumption in common property or individual dwellings

5.6.2.7 Telecommunications

Telecommunications supply through high density precinct development is delivered by a provider under a contribution arrangement. Site supply is provided and associated per lot contribution paid. Reticulation through development is delivered by telecommunications sub-contractor at the cost of the developer.

5.7 Catchment Drainage

5.7.1 Cost

Catchment drainage costs relate to Melbourne Water contributions. For development areas that fall within a Melbourne Water scheme, contributions are payable in two categories as follows:

There are two components:

1. Hydraulic component - funds and drainage infrastructure, including waterway protection works
2. Water quality component - funds the construction of stormwater quality treatments such as wetlands and WSUD elements. The stormwater quality component may be reduced or negated by the developer undertaking their own on-site stormwater quality treatment works (works additional to any proposed scheme works).

Drainage scheme costs are charged on a per hectare basis as development occurs. There are currently upwards of 275 drainage schemes across Melbourne Water area. Costs range across the schemes as follows

Table 9 - Melbourne Water drainage scheme contributions (MW, 2018)

	HYDRAULIC ($/HA)	WATER QUALITY ($/HA)
Max	$481,620	$160,511
Average	$66,104	$27,780
Min	$4,163	$109

Not all development scenarios fit within Melbourne Water drainage schemes. For scenarios that do not, no applicable catchment hydraulic contribution is required to be paid by the developer. An additional charge is payable for developments that do not meet the stormwater treatment objectives. This charge is known as a stormwater offset contribution. Stormwater offset contributions are payable by local government area. Stormwater offset contributions are paid by developers to reduce the impacts of stormwater pollution from urban developments. Developers pay a contribution to Melbourne Water for necessary stormwater management works if they don't meet their stormwater objectives. Contributions are paid as development occurs.

Current stormwater offset contributions payable range from $17,500 to $40,000 (MW, 2018) per hectare of development.

In some cases, for precinct wide development, a drainage scheme may be adopted to offset stormwater management costs. This is at the discretion of the main drainage authority. Given information on varying scenario catchment drainage schemes is not available, the average cost of drainage schemes has been applied to the factored land component in each development scenario to provide an estimate of applicable catchment drainage costs.

Table 10 - Catchment drainage scheme applicable costs per dwelling (estimated)

CATEGORY	DENSITY	AVERAGE LOT SIZE	TOTAL PER DWELLING COST
	Dw/Hectare	sq.m	$/Dw
Greenfield Average	17.00	411.76	$4,078
Small Scale Dispersed Infill Average	40.00	175.00	$1,689
Medium Density Average	50.00	140.00	$1,408
High Density Average	200.00	35.00	$268

Note – Drainage schemes generally not applied to scenarios other than greenfield conditions. Typical rates for greenfield have been applied to other scenarios based on average lot area factor to correlate the dwelling cost.

5.7.1.1 Flood mitigation infrastructure

Catchment scale flood mitigation costs are difficult to quantify at individual development level. The main drainage authority (Melbourne Water) generally deliver major flood mitigation infrastructure as part of overall capital works.

Key flood mitigation infrastructure that can be applied on the catchment wide scale is as follows:

- Above ground detention basins
- Below ground detention storage tanks
- Channel formalisation and diversion
- Creek and stream mitigation and re-vegetation
- Trunk and branch drainage pipe construction

These projects can vary in cost from small scale ($100k construction cost) to large scale ($5-40M). Melbourne Water own large portions of land in low lying or flood impacted areas and assess requirements for formal flood mitigation on a case by case scenario. Projects to improve known flood issues continue to be delivered.

The cost of any land acquisition for flood mitigation can impact on financial feasibility of flood mitigation projects.

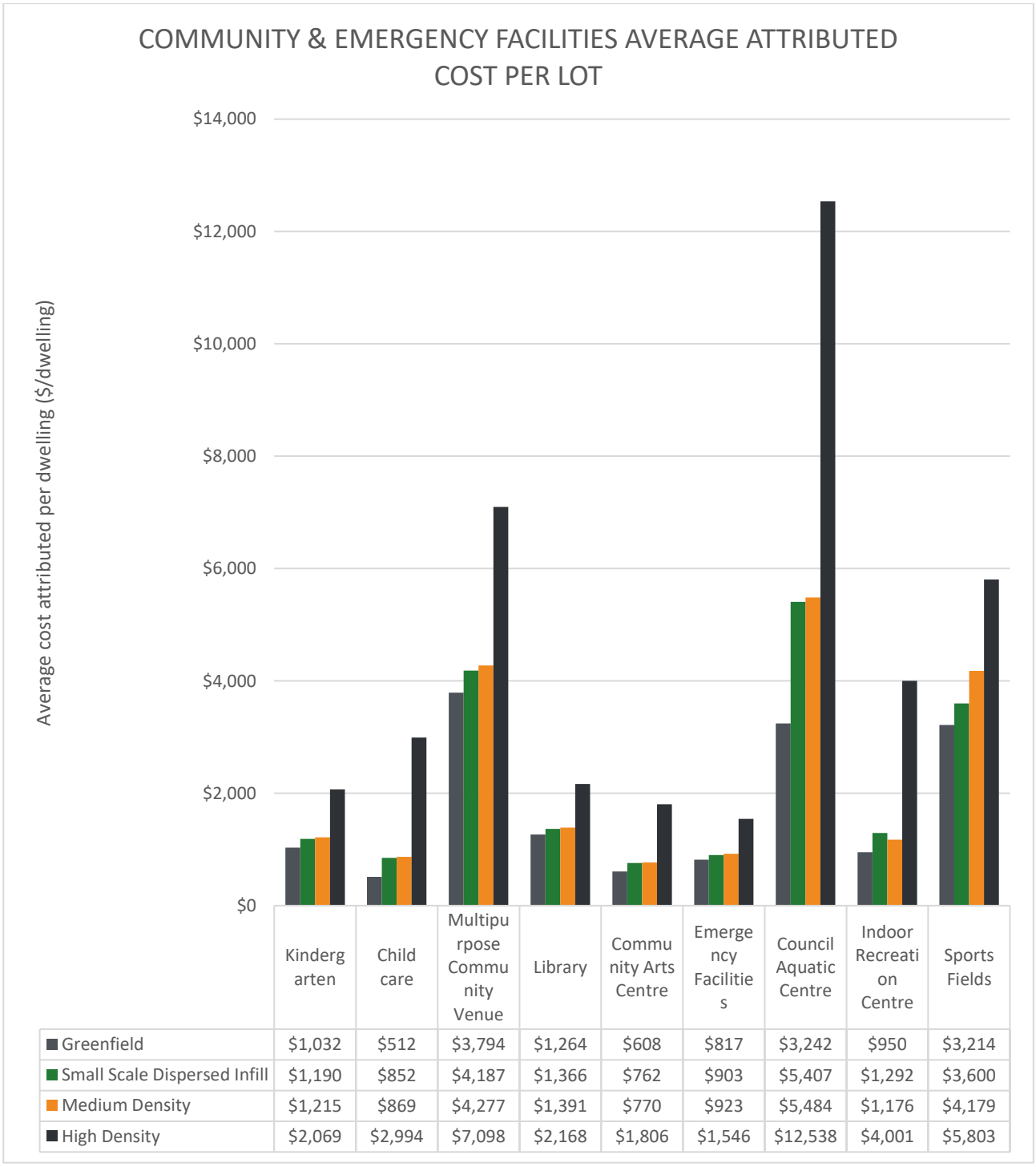
Assessment of precinct wide flood mitigation has occurred for precincts such as Fisherman's Bend, Docklands and Arden. This will continue to occur for major precinct development.

5.8 Community & Emergency Services Infrastructure

5.8.1 Cost

In determining the overall cost of Community and Emergency facilities relative to a per lot factor, an assessment of the applicable gross floor area (GFA) requirements per base population of 10,000 residents was completed. This GFA requirement data was provided by Infrastructure Victoria for assessment. A detailed summary of the assumptions is shown in Appendix E of this report.

Construction cost data was provided by RLB (refer Appendix D) and factored by applicable GFA.



	Kindergarten	Child care	Multipurpose Community Venue	Library	Community Arts Centre	Emergency Facilities	Council Aquatic Centre	Indoor Recreation Centre	Sports Fields
Greenfield	$1,032	$512	$3,794	$1,264	$608	$817	$3,242	$950	$3,214
Small Scale Dispersed Infill	$1,190	$852	$4,187	$1,366	$762	$903	$5,407	$1,292	$3,600
Medium Density	$1,215	$869	$4,277	$1,391	$770	$923	$5,484	$1,176	$4,179
High Density	$2,069	$2,994	$7,098	$2,168	$1,806	$1,546	$12,538	$4,001	$5,803

Figure 32 – Community and Emergency facilities attributed costs per lot

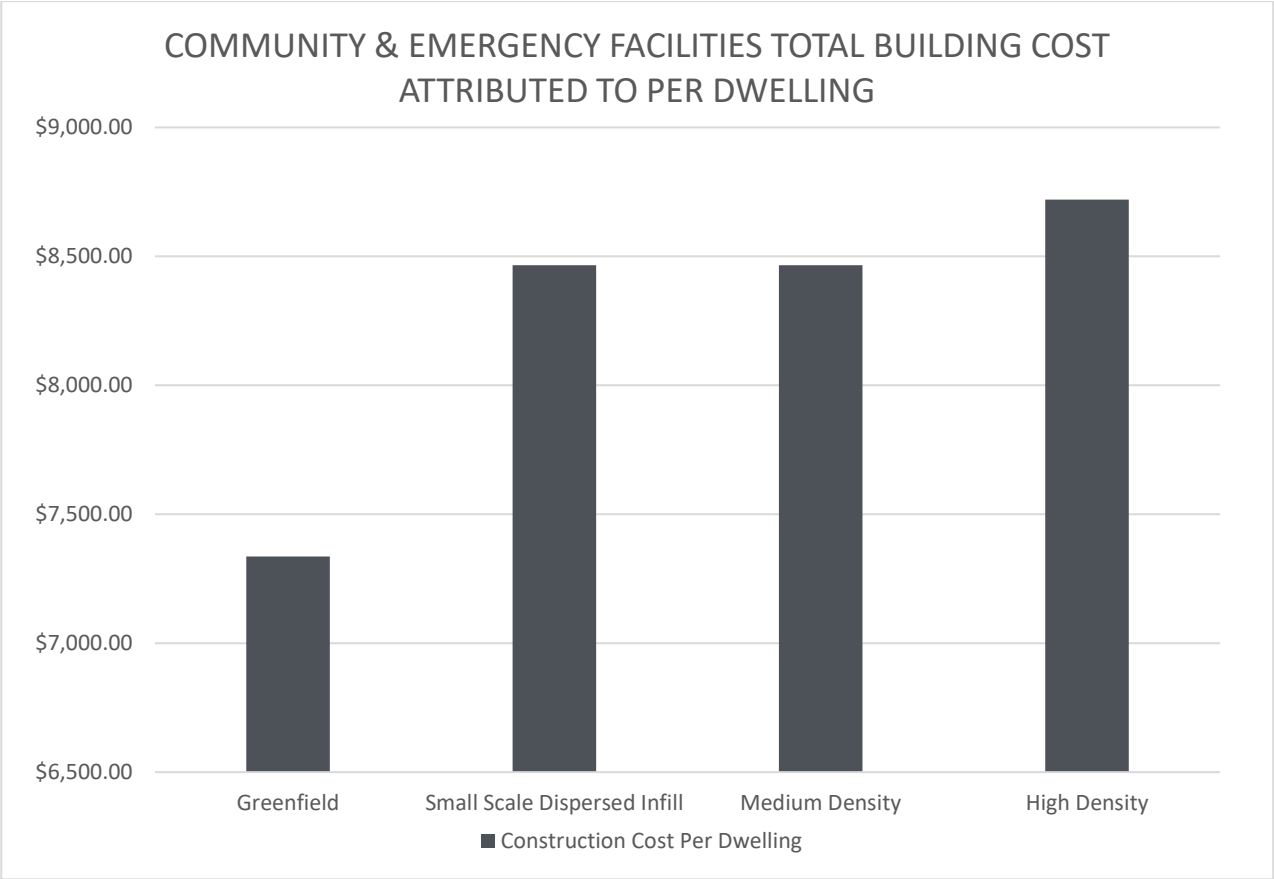


Figure 33 - Community infrastructure cost per lot attributed

5.8.2 Discussion

In assessing the cost of provision of Community Facilities across the scenarios the following should be considered:

- Community facilities in greenfield development are generally single level and across a larger site area as land has been allocated through Precinct Structure Plan process
- Construction cost ranges were assessed to give average costs
- GFA requirement for population divided by population to give a unit per dwelling
- In SSDID, Medium Density and High Density, Community facilities are generally provided through modification, renovation or re-development of existing facilities. In the case of this assessment, these scenarios were assumed to require new facilities with a smaller land area than Greenfield. However, in real-life scenario it is more likely existing facilities, space share or developer provided sites would be utilised. This is difficult to quantify so for comparison the same approach as greenfield was taken. The key difference assessed was cost of construction (multi-level verses single level) and land area (less land area for higher densities)
- Assumed SSDID and Medium Density scenarios have the same site and building area given they occur in similar areas
- Higher density development results in 'vertical' development of community facilities which require less land take. Land cost is the largest contributing factor to the variance in the scenarios. Some variance in the build cost is present between the scenarios due to the nature of the construction type (i.e multi-level construction)
- Land value of sports fields has a significant impact on the overall cost. For this assessment an average land value of $350 per square metre was adopted for the sports field land acquisition. This resulted in a total average sports field cost of $20,310,811 for high density scenario. SMEC reviewed relevant literature (Planisphere 2017, Fishermans Bend Open Space Strategy) and found the average land value for high density precincts varied from $1,500 to $6,500 per square metre. In the case that an upper land value was adopted the cost factor of a sports field at this land rate would escalate to approximately $290M which is a significant increase. It is expected that land of this value would not be utilised for sport and recreation unless uses were limited by contamination or similar. It would be expected if uses were limited, the square metre rate would be much lower. The $6,500 per square metre purchase rate is for ultimately developable land.

5.9 Land value

5.9.1 Greenfield Development

In assessing the cost of land for greenfield development scenario, the price for the developer to purchase the un-serviced agricultural land was utilised as the cost component. This approach was adopted as the retail purchase price of land would generally include the applicable infrastructure cost, other costs and developer profit. Therefore, if retail price was used, costs would be double counted as an expense.

Multiple site sales were utilised to determine an average land component cost across Melbourne. Refer Appendix C for detailed summary. The following should be noted:

- Significant variance in land value dependent on area and final retail sale price expected
- Significant variance in land value dependent on status of development process and approvals. For Precinct Structure Plan (PSP) approved land, cost almost double per developable hectare compared to that of non-PSP approved land
- Overall land parcel sales prices were factored by net developable area on assumed development density. This equates to applicable square metre cost per lot uplift of between 1.3 and 1.4 times the raw land purchase price. This accounts for non-saleable land such as road reserve, parks, community land etc.

Table 11 - Greenfield land costs (RPM & CKC)

	RAW LAND PURCHASE PRICE	ASSUMED DEVELOPED LOT DENSITY	LOTS TO OVERALL RATIO	ADJUSTED PRICE PER SQM	TOTAL LAND COST (UNSERVICED)
Max (large lots)	$240.00	15	1.3021	$312.50	$160,000.00
Average (Average size lots)	$158.89	17	1.3542	$215.17	$92,724.87
Min (Small lots)	$80.78	18	1.4172	$114.49	$44,880.55

Refer Appendix C for detailed land cost benchmarked data provided by CKC and RPM.

The average greenfield retail lot price for all land sizes for developed (serviced lots) as at March 2018 for all growth area councils is $309,694 (RPM, 2018). This varies across the growth area councils as shown in graph below. The average lot size across the growth corridors in March 2018 was 434m^2.

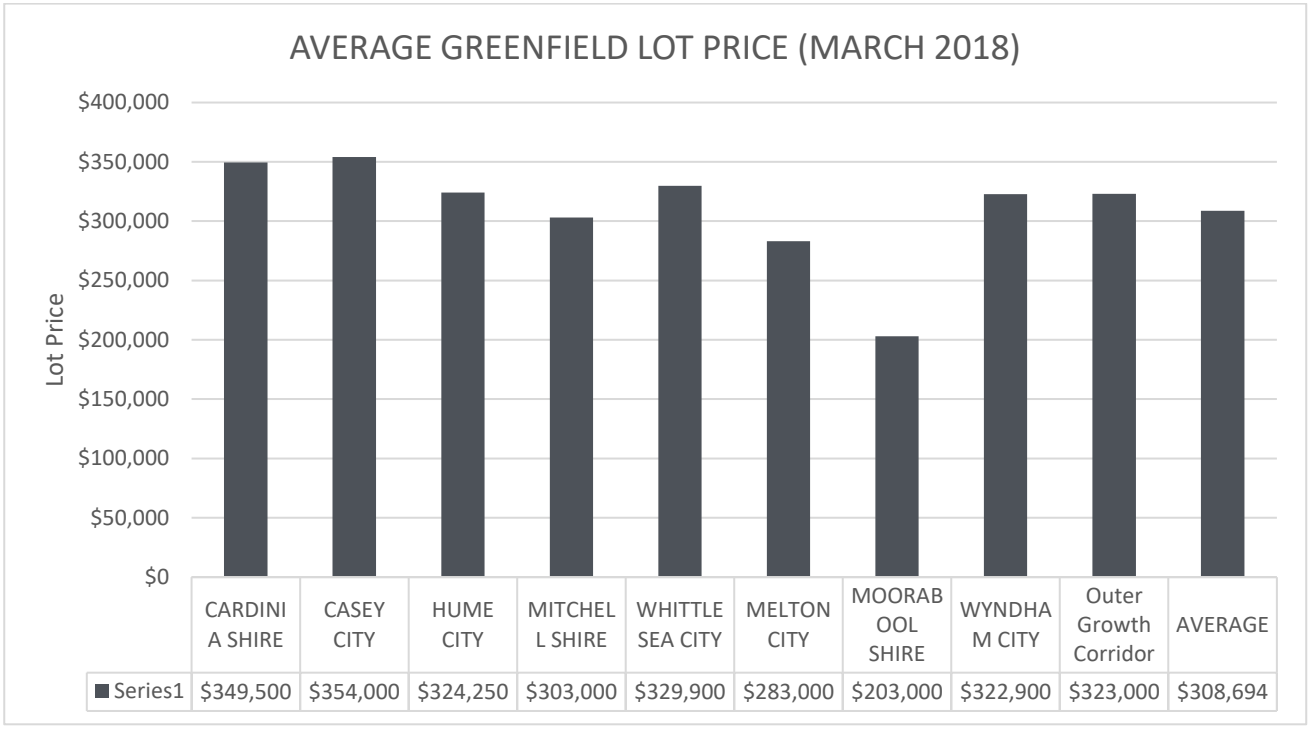


Figure 34 - Average greenfield lot price at March 2018 (RPM, 2018)

The trend in land values has been upwards consistently since June 2001 (available data) with a minor correction in pricing between July 2012 and January 2013. Median lot price in June 2001 was $66,654.

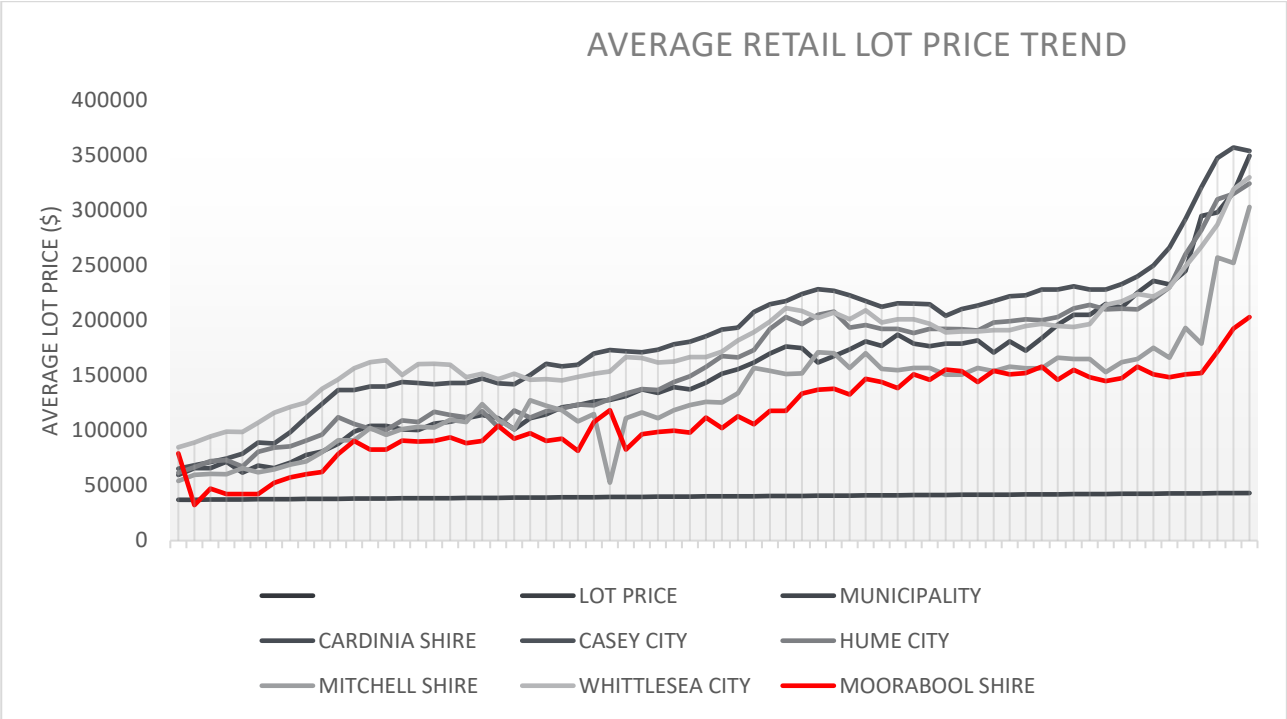


Figure 35 - Average lot price for greenfield land (RPM, 2018).

5.9.2 Small Scale Dispersed Infill

Small scale land costs have been determined from a sample of 11 land sales per region dating back to mid 2016. Parcels included were without a dwelling to represent likelihood of redevelopment to SSDID.

SSDID sites are generally valued higher than adjacent single dwelling sites as developer potential and profit drives up value.

Figure 36 - Land value SSDID

Map 13

Metropolitan Melbourne regions

Local Government Area boundary | Metropolitan Partnership boundaries | Part of Mitchell Shire (1)

Map key

	Inner Metro Region	Inner South East Region	Western Region	Northern Region	Eastern Region	Southern Region
Local Government Area	1. Melbourne 2. Port Phillip 3. Yarra	4. Stonnington 5. Bayside 6. Boroondara 7. Glen Eira	8. Melton 9. Brimbank 10. Hobsons Bay 11. Wyndham 12. Moonee Valley 13. Maribyrnong	14. Banyule 15. Whittlesea 16. Nillumbik 17. Hume 18. Moreland 19. Darebin 20. Mitchell (part)	21. Manningham 22. Whitehorse 23. Knox 24. Yarra Ranges 25. Maroondah 26. Monash	27. Kingston 28. Frankston 29. Cardinia 30. Casey 31. Greater Dandenong 32. Mornington Peninsula

Figure 37 - Plan Melbourne regions (DELWP)

5.9.3 Precinct Scale Brownfield (Medium Density)

Land value for medium density development scenario sees a significant variance across Melbourne. This is driven by proximity to city, developer desire, competition and development potential. This variance has the largest impact on total development cost out of any of the scenarios. The high land value is offset though by higher sales prices generally. Refer Appendix B for detailed site information. In order to assess against other scenarios, data has been filtered to sites that are medium density townhouses or low-rise apartment (less than 4 storey).

Table 12 - Medium density land value range (CKC, 2018)

CATEGORY	CITY CENTRAL	CITY FRINGE	NORTH	EAST	SOUTH	WEST	AVERAGE
Max	$15,000	$19,953	$4,930	$7,444	$6,081	$4,300	$3,107
Average	$10,750	$11,750	$3,431	$4,922	$3,256	$3,122	$1,676
Min	$6,500	$3,546	$1,931	$2,400	$430	$1,944	$1,676

Average excludes City Central and City Fringe and apartment sites, evidence incorporated in average shown bolded as representation of medium density

Refer Appendix C for detailed land cost benchmarked data provided by CKC and RPM.

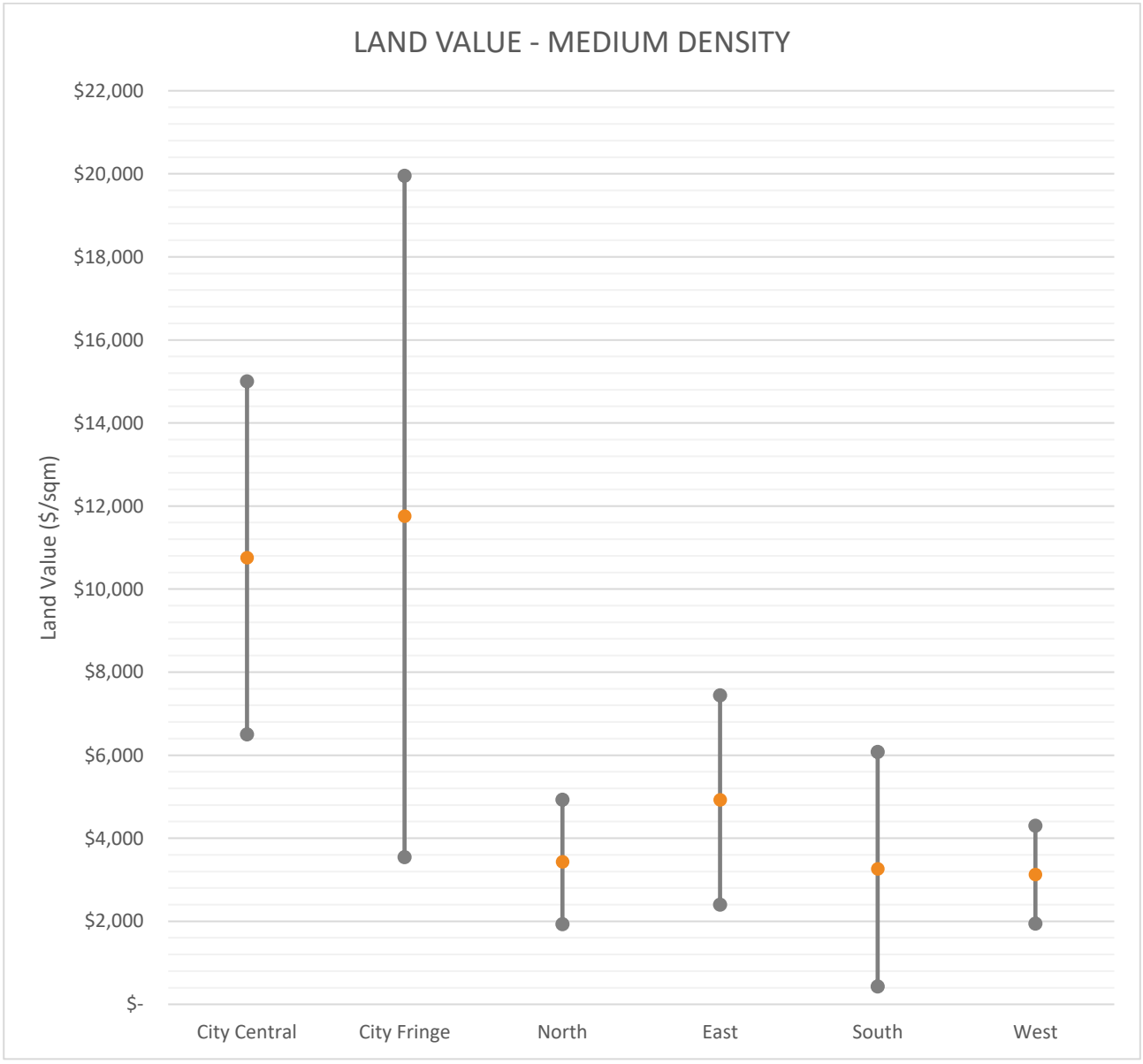


Figure 38 - Land value range - Medium density (CKC, 2018)

5.9.4 Precinct Scale High density

For high density land value, there is significant variation in the range of prices per square metre. Regions also drive the price range. For detailed costing refer to RLB report within Appendix D. Refer Appendix C for detailed land cost benchmarked data provided by CKC and RPM.

Table 13 - Land values across regions (Charter Keck Cramer, 2018)

DENSITY	REGION	LAND VALUE RATE (P.S.M.)		EVIDENCE 1	EVIDENCE 2	EVIDENCE 3
		Low Range	High Range			
High	City Central	$15,138	$34,314	300 City Road Southbank $15,138 p.s.m.	25-29 Coventry Street Southbank $17,500 p.s.m.	183-189 A'Beckett Street Melbourne $34,314 p.s.m.
	City Fringe	$4,000	$15,000	2-8 Gough Street Cremorne $4,000 p.s.m.	171 Buckingham Street Richmond $5,338 p.s.m.	42-48 Claremont Street South Yarra $15,000 p.s.m.
	North	$2,525	$4,543	37-39 Bell Street & 45 Linden Avenue Ivanhoe $2,525 p.s.m.	264-266 Raglan Street Preston $2,820 p.s.m.	30 Cramer Street Preston $4,543 p.s.m.
	East	$2,043	$11,435	500 Burwood Highway Wantirna South $2,043 p.s.m.	31-35 Prospect Street Box Hill $8,167 p.s.m.	843 Whitehorse Road Box Hill $11,435 p.s.m.
	South	$1,775	$4,025	2107-2125 Dandenong Road Clayton $1,775	14-22 Woorayl Street Carnegie $3,975 p.s.m.	956-958 Nepean Highway Moorabbin $4,025 p.s.m.
	West	$1,038	$3,380	74-76 Cottrell Street Werribee $1,038 p.s.m.	327-357 Mount Alexander Road Ascot Vale $3,136 p.s.m.	94-104 Buckley Street Footscray $3,380 p.s.m.

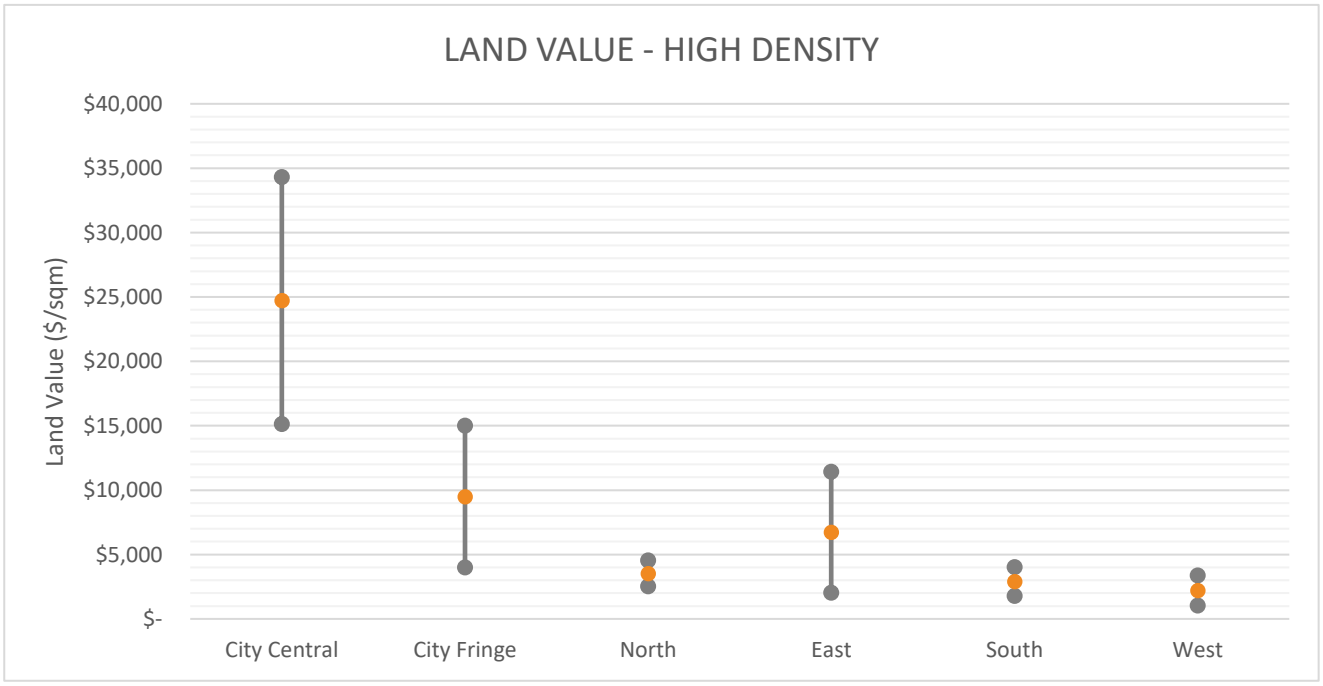


Figure 39 - Land value high density

5.9.5 Discussion

The trend for median house price (house and land) in the growth areas is also upwards. Significant increases in overall median house price cost have been present for the last 15 years.

Generally, land value is directly correlated to sale price. The variance in dwelling construction cost between scenarios is much smaller than that of un-developed land value. The variance in un-developed land value is offset by final retail sale price. Developers would be expected to achieve similar (order of magnitude) percentage profits for development across the scenarios, therefore the variance needs to be present in the final retail sale price to offset variance in other costs such as un-developed land value and infrastructure costs.

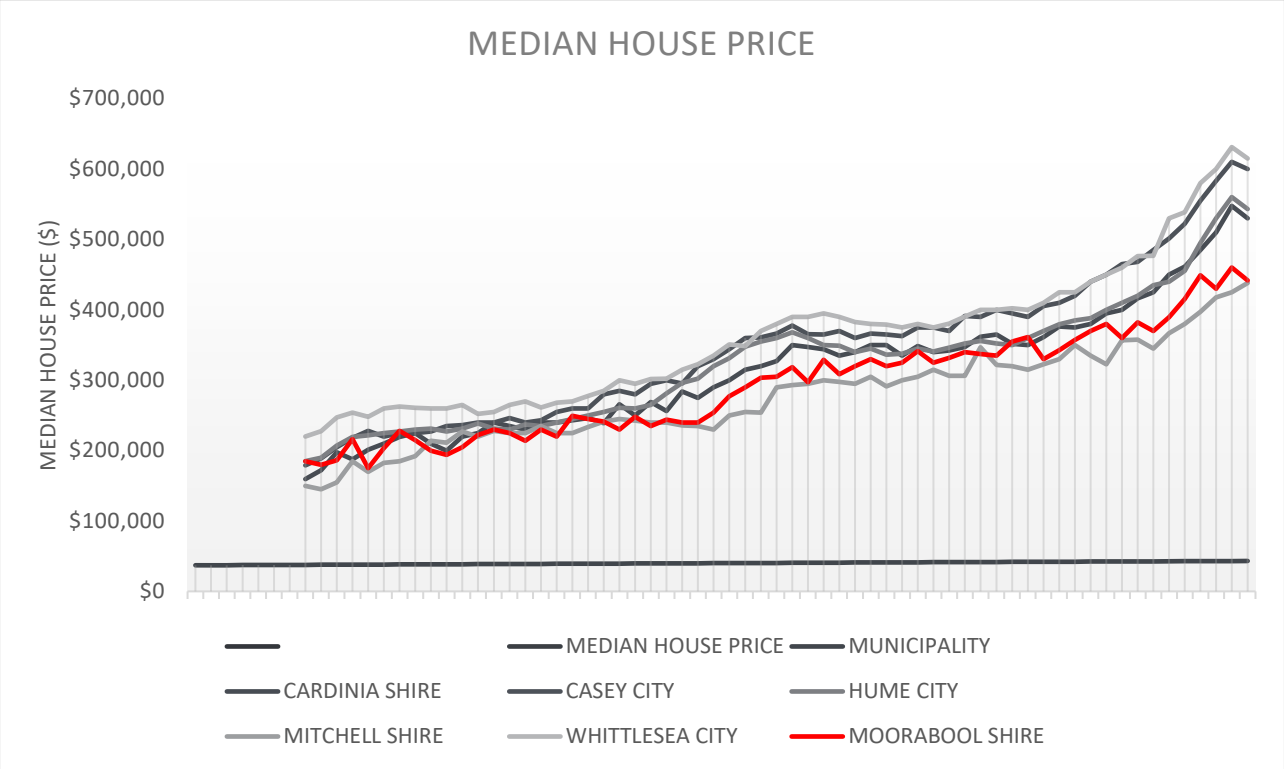


Figure 40 - Median house price values in greenfield government areas (RPM, 2018)

5.10 Dwelling Cost

Dwelling cost for construction has been analysed across all development scenarios for typical 3 bedroom dwellings. The cost of both single and double storey dwellings have been accounted for within the square metre cost range. This considers the cost to construct the individual dwelling including all internal service infrastructure but excluding landscaping and site works. The data suggests that dwelling cost while varying across the scenarios, is generally size driven. With greenfields dwellings generally being the largest in floor area, the average dwelling cost is highest out of the scenarios. The assumed square metre rates for each scenario adopted were as follows:

- Greenfield: Average $1,600 per m^2
- Small scale dispersed: Average $1,700 per m^2
- Medium density: Average $1,800 per m^2
- High density: Average $2,800* per m^2, factored to $3,920 per m^2

  * - High density cost per square metre for apartments has been factored by 140% to account for the non-saleable construction cost for circulation areas, car parks and lift cores that are required to be constructed as part of the development. This is considered a more accurate representation of the cost.

Variance in level of fit out, fixtures and finishes and also whether dwelling is single or double storey all factor into the square metre cost range. An average cost per square metre has been adopted to limit variance in final figures.

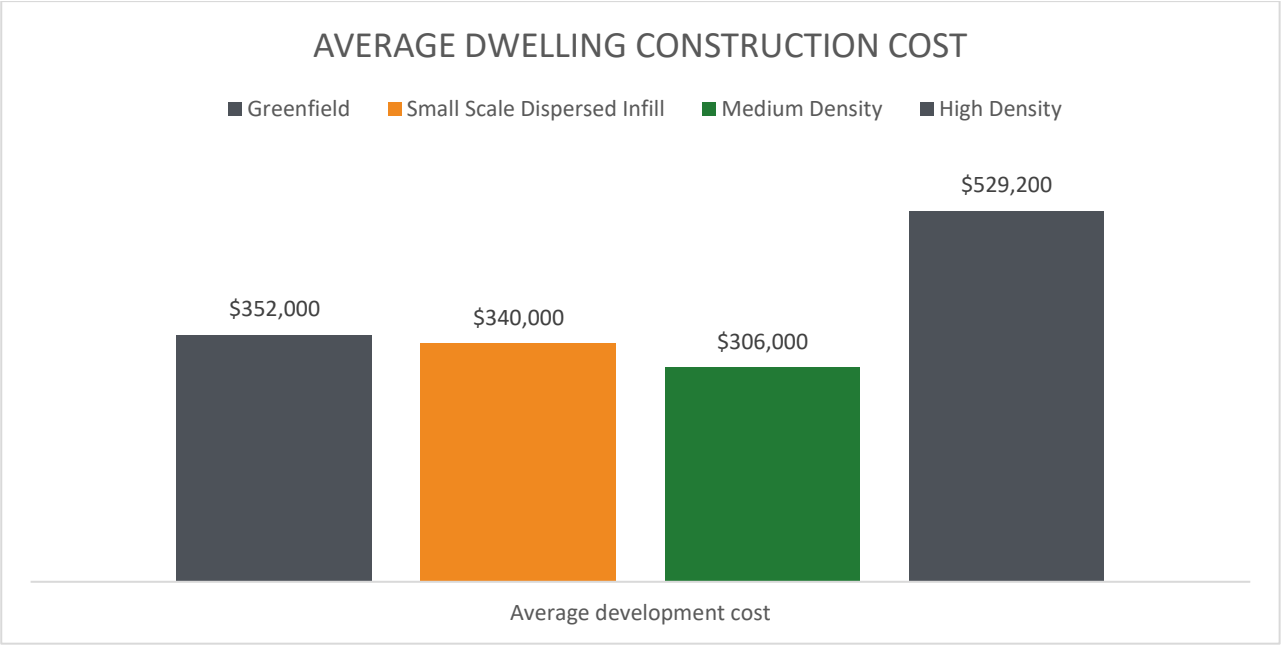


Figure 41 - Average dwelling construction cost by scenario (3 bedroom)

The following average dwelling sizes have been utilised for the costing of dwelling construction in overall costings:

- Greenfield: 220 m^2
- Small scale dispersed: 200 m^2
- Medium density: 170 m^2
- High density: 135 m^2

These figures are considered typical dwelling sizes for these categories. Assessment of publicly available dwelling purchase and sales data was made to determine typical value. Given the basis of this study is infrastructure costs, the adopted typical dwelling sizes are somewhat arbitrary for assessment of cost magnitude. It should be noted that significant variation still occurs in each category dependent on specific development objectives, target sales rates, demographics and locality.

5.10.1 Greenfield Development

Dwelling cost has been provided by RLB from benchmarked project cost as follows.

Table 14 - Greenfield development construction cost range (RLB, 2018)

TYPE	AVERAGE GFA	$/GFA LOW	$/GFA HIGH
Single family Dwellings	220	1,400	1,600
Townhouses	180	1,700	2,200
Apartments	100	2,000	2,500

Greenfield Dwelling costs are based on Greenfield sites in outer suburbs of Melbourne or larger regional centres of Victoria with appropriate available levels of labour, materials and supplies. Benchmarks have been based on numerous independent living villages developed in new suburbs, planned residential subdivisions and aged care homes. Refer Appendix D for benchmarked projects.

5.10.2 Small Scale Dispersed Infill

Dwelling cost has been provided by RLB from benchmarked project cost as follows.

Table 15 - SSDID development construction cost range (RLB, 2018)

TYPE	AVERAGE NSA / APARTMENT GFA	AVERAGE PROJECT TOTAL GFA	$/GFA LOW	$/GFA HIGH
Townhouses	n/a	1,000	1,700	2,200
Apartments	80%	2,000	2,200	2,750

Refer Appendix D for list of benchmarked projects.

5.10.3 Precinct Scale Brownfield (Medium Density)

Dwelling cost has been provided by RLB and project builders from benchmarked project cost as follows.

Table 16 - Medium Density development construction cost range (RLB, 2018)

TYPE	AVERAGE NSA / APARTMENT GFA	AVERAGE PROJECT TOTAL GFA	$/GFA LOW	$/GFA HIGH
Apartment Buildings	75%	15,000	2,400	3,200
Townhouses	-	170	1,600	1,900

Refer Appendix D for list of benchmarked projects.

5.10.4 Precinct Scale High density

Dwelling cost has been provided by RLB from benchmarked project cost as follows.

Table 17 – High density development construction cost range (RLB, 2018)

TYPE	AVERAGE NSA / APARTMENT GFA	AVERAGE PROJECT TOTAL GFA	$/GFA LOW	$/GFA HIGH
Apartments	72%	30,000	2,500	3,300
Precinct development (retail, commercial and residential)	60%	100,000	2,400	3,200

Benchmark data provided from apartment blocks of more than 10 storeys both standalone and mixed-use developments incorporating car parking. Refer Appendix D for list of benchmarked projects.

5.10.5 Discussion

Dwelling construction cost is generally consistent across each of the scenarios between $1,600 and $2,800 per square metre for construction. High density development per square metre rate is considerably higher than the other scenarios given the amount of non-saleable land (circulation space, car parking etc) that requires construction. The three lower density scenarios will see similar cost with the variance being in whether dwelling is free standing or shared wall.

The dwelling cost of high density development is impacted by the ratio between Total Gross Floor Area (GFA) and Net Selling Area (NSA) for the developments. To accurately depict cost, this ratio needs to be considered in the cost given that applicable costs to construct corridors, lift cores, car parks and common areas are attributed to the project. An assessment by RLB (refer Appendix D) found the average ratio between NSA to Total GFA for investigated projects to be 52%.

This figure displays the considerable increase in cost outside of typical dwelling construction.

5.11 Scenario Comparison

5.11.1 Overall Costs

The key purpose of this study was to compare the development costs between each development scenario. Given the large number of components in development costs, this comparison is based only on the following items:

- Infrastructure costs within development
- Dwelling costs
- Land costs
- Community Infrastructure Cost

Transport costs outside of the development site (i.e major road and public transport) are excluded from in this assessment. Authority supply costs are also excluded. These costs would incorporate back haul supply and upgrade costs.

With increased density there is an associated increase in costs with each scenario increasing in density. The key reason for this trend is land value and construction cost. Greenfields land value portion of costs is low relative to all scenarios.

Infrastructure cost follows an opposite trend with high density having the lowest infrastructure cost given the overall cost is divided by a lot more dwellings generally. When assessing the average costs across all scenarios the order of cost is as follows:

- Least Cost: Community Infrastructure
- Infrastructure Cost
- Land Cost
- Highest Cost: Dwelling Cost

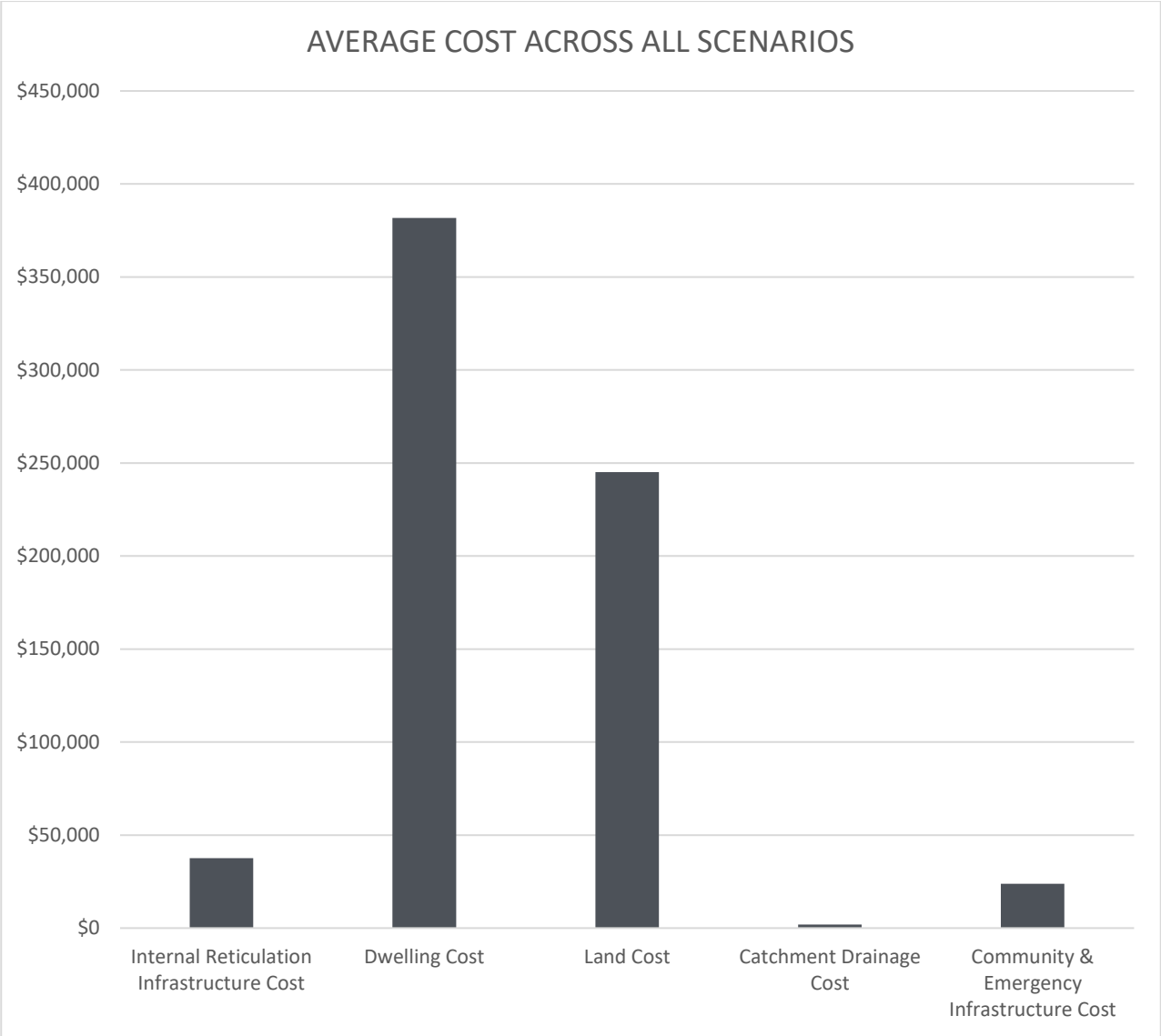


Figure 42 - Overall development costs by cost element

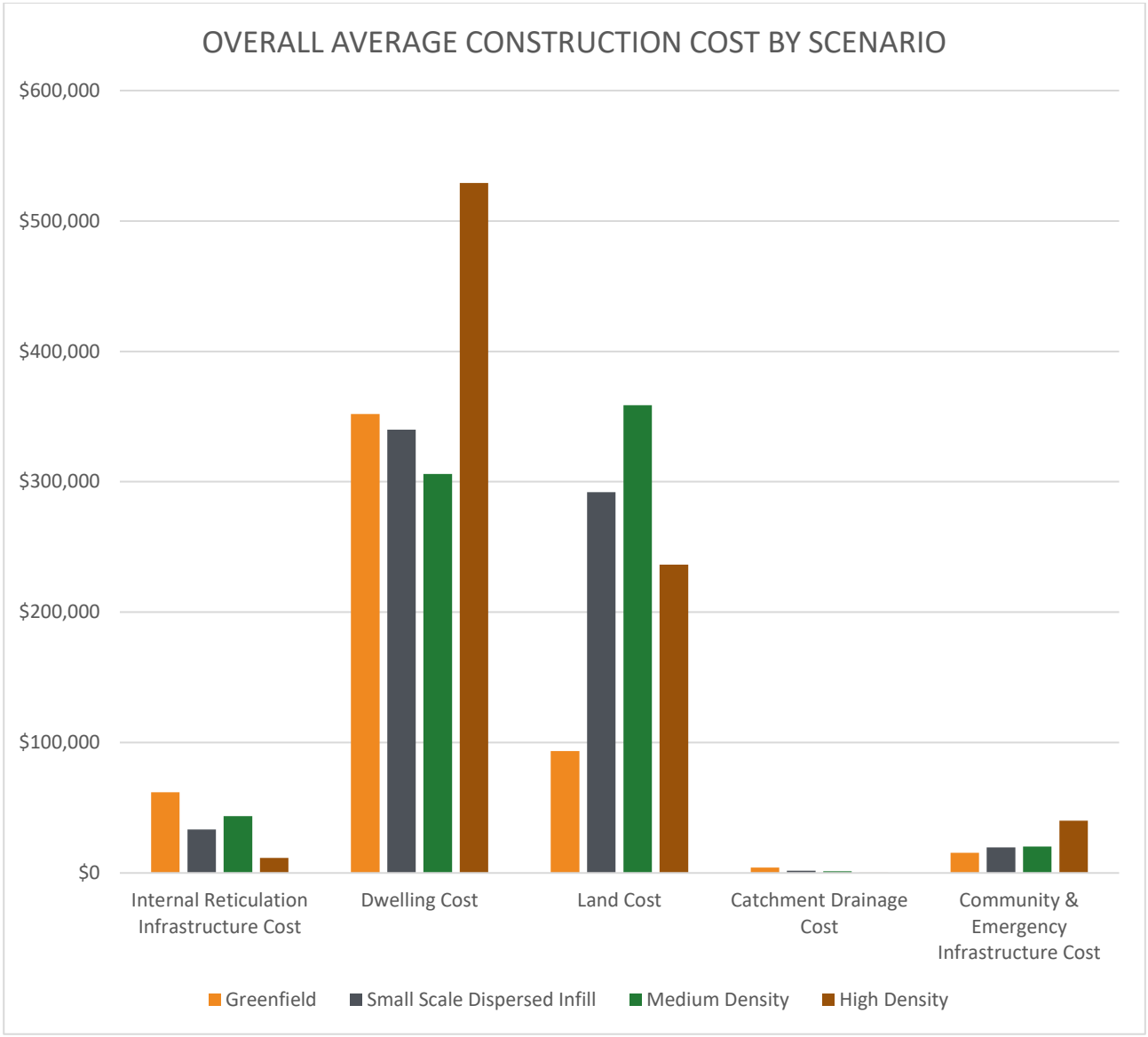


Figure 43 - Overall development costs by element and scenario

5.11.2 Infrastructure Costs

Average Infrastructure costs between each scenario vary considerably from each other. The largest range of costs is within greenfield development scenario. Data analysed for other scenarios had smaller ranges. Greenfield infrastructure large cost range is expected given range of project types. Large scale infrastructure is required in some projects. A key reason for the variance between costs comes down to two categories:

- Private or public infrastructure
- In-ground or in building infrastructure

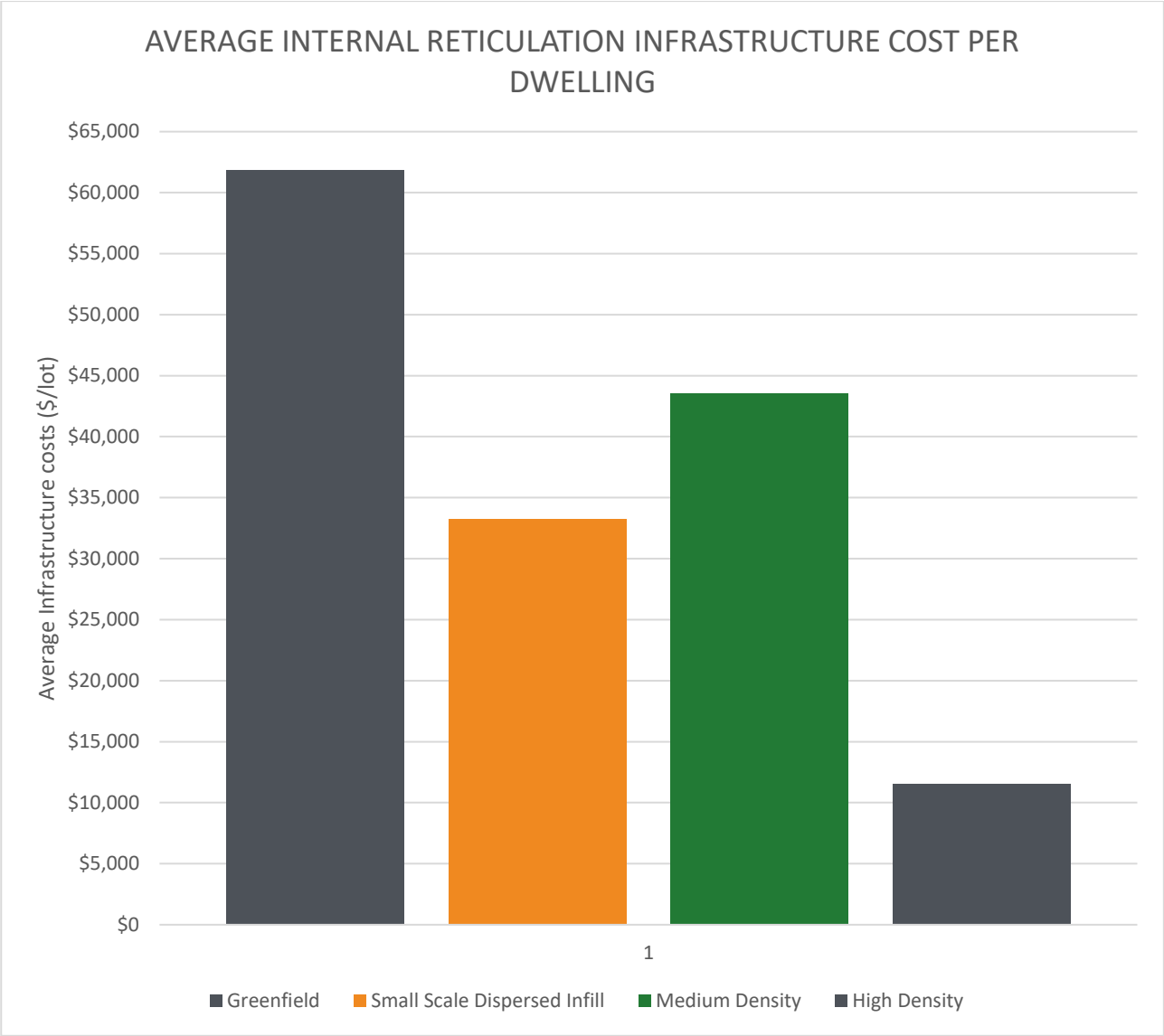


Figure 44 - Average infrastructure costs per lot across development scenarios

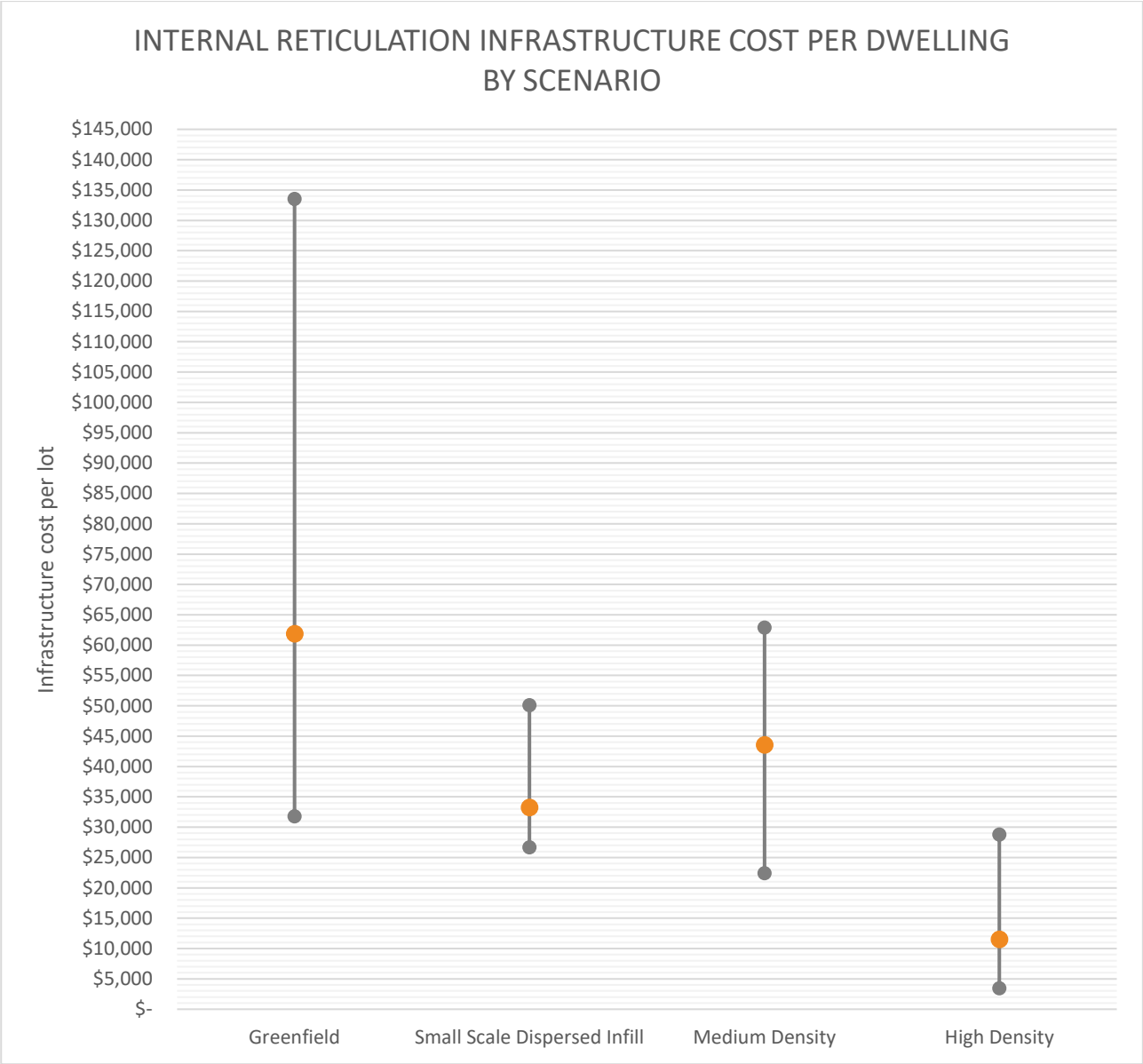


Figure 45 - Average infrastructure cost ranges across scenarios

5.11.2.1 Key Differences

The key differences in cost of infrastructure between the four scenarios can be summarised into the following categories.

Ground conditions

Ground conditions have effect on the cost of all scenarios. For greenfields, SSDID and medium density the impact of ground conditions such as rock, soft ground and groundwater impacts in ground infrastructure. The impact has the following effect on each project:

- Construction Progress: For poor ground conditions and rock, progress is much slower as larger machinery is required to excavate trenches and additional construction steps are required. Progress of excavation in rock can be limited to 15-20% of that in excavatable material.
- Methodology: In some cases, blasting is required to speed up progress. This has an associated cost also.
- Machinery Cost: Rock excavation requires much larger plant. This has an associated cost that is passed onto the developer. The cost increase is also due to labour and machinery operating costs.
- Noise: Excavation of rock can be loud and if in a developed area, noise restrictions may limit work time

For high density development, ground conditions effect cost of development through:

- Basement excavation: Poor ground conditions and groundwater can require varied construction methodology to enable construction. This has an associated cost in the form of increased construction cost and lost time.
- Building foundation: For buildings in poor ground condition areas, foundations generally cost more as the structure needs to penetrate through to solid ground (bedrock for example). This can increase the construction cost.

Water Supply arrangement

For greenfield developments, the provision of potable water supply and recycled water supply increases the cost of development. The cost factor would be close to twice for the water infrastructure element. There is some cost saving through utilisation of joint trenching, but this is insignificant. Typically, we experience a cost of $2,500 per lot per service, therefore, $5,000 for developments where potable and recycled water is required.

The cost of running recycled water through dwellings is also a component of the dwelling costs.

Statutory and Authority Requirements

The standard of infrastructure and requirements imposed by authority is a large factor on cost. Infrastructure that is handed to the authority as an asset at completion of the construction, will generally have a higher capital cost than private infrastructure that remains under the ownership of the Owner's Corporation. This is generally linked to the location. Authority assets are generally within road reserves and designed to carry applicable traffic loads. This requires surface fittings to be of a higher class and associated cost. Private infrastructure can be run through landscape or building zones. Private infrastructure can also run within common trenches with smaller offsets vertically and horizontally which can limit trench width.

5.11.3 Dwelling Costs

Greenfield scenario dwellings tend to be larger in size with each category reducing in size which can be expected due to density. The difference between SSDID and Medium density construction cost is minimal given both categories end up with a similar outcome in terms of built form. High density dwellings are quite different cost arrangements due to the extent on non-saleable area components in the buildings that elevate the overall cost of construction. This corresponds to road reserves in other scenarios that are not developable areas either.

Dwelling costs also vary within each scenario on the quality of fixture and finish. This impacts the range of averages. This is the only category that would be impacted by quality. The cost variance between quality alone could be up to 50% excess of per square metre rate for higher specification dwelling.

5.11.3.1 High Density indirect dwelling costs

In order to estimate an indicative cost to high density development of the indirect dwelling cost elements (As defined in section 5.6.2), in particular 'constructed floor area' based elements such as car parks and circulation, lift wells, corridors, stair cases, foyers, entertainment areas etc, the ratio between Net Saleable Area (NSA) and Total Gross Floor Area (GFA) was utilised (Refer RLB report within appendices). This ratio allows for quantification of total cost of indirect areas not attributable to the individual dwelling (apartment) and factors up overall dwelling construction cost accordingly. This process benchmarks high density dwelling construction cost against the other scenarios (SSDID, MD, Greenfields) that apply the square metre construction cost to just the dwelling and do not have associated common areas.

It can be assumed that the quoted $/sq.m construction rate for an overall project GFA incorporates the cost of these indirect dwelling cost elements also.

To approximate the cost attributed to non-saleable areas and infrastructure that is required for high density development the ratio of 52% Total NSA to Total GFA was used against the full average construction rate of $2,888 per GFA. This equates to the attributable cost for indirect dwelling cost elements being in the order of $1,380 per sq.m. For the average 135 sq.m apartment size adopted this equates to approximately $185,000 per apartment. While this cost seems significant, the lower direct cost of construction is offset by this indirect extra cost within the total dwelling cost. This cost is assumed to include car park construction also. The cost of car parking per dwelling in high density can be assumed to be in the order of $46,000 per dwelling for construction ($2,880 per square metre building construction cost applied to one car park plus 30% car park circulation). Inclusion of this figure in the indirect dwelling cost results in an overall cost of $139,000 per dwelling for indirect infrastructure costs in high density development.

These indirect dwelling cost elements are one of the key reasons high density development square metre construction rates are higher than the other scenarios.

5.11.4 Land Costs

The key variance in land costs across the scenarios is the locality of the land. Land that is closer to the central area of Melbourne is naturally more expensive per square metre. For high density development, the land per square metre is considerably higher but a much smaller portion is attributed to each dwelling given multi-storey development. Land value therefore has a correlation between the number of dwellings that can be achieved on the site.

The property price is constantly evolving and changes across the overall metropolitan area vary greatly year on year. It is difficult to base figures on a snapshot in time.

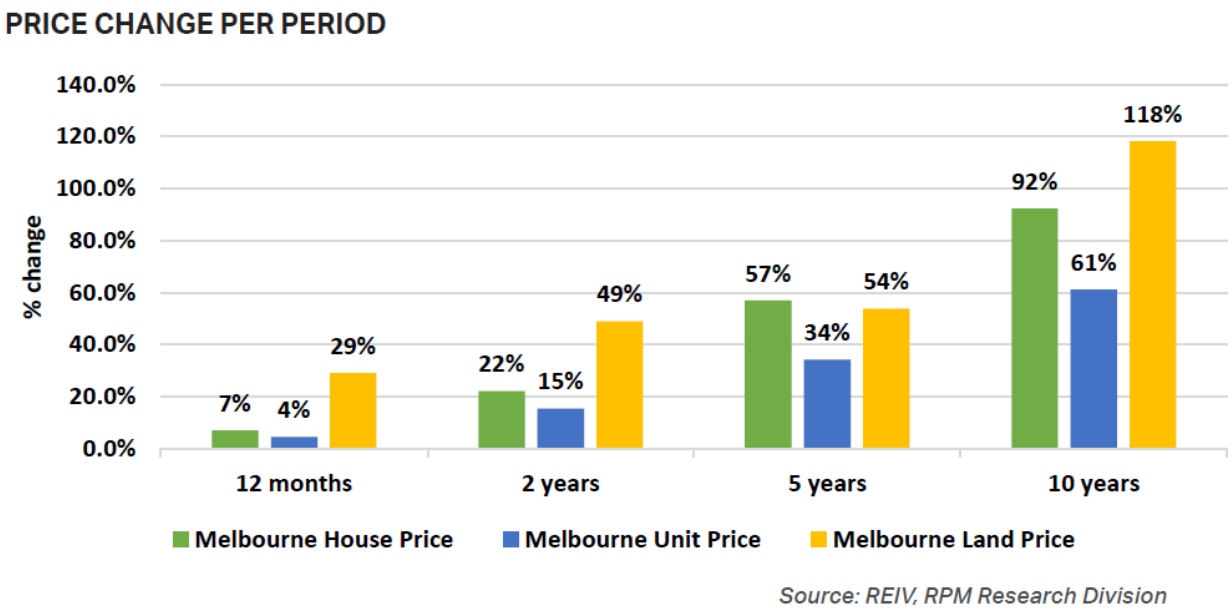


Figure 46 - Comparison of price change per unit benchmarked to 2008 (RPM)

Activity and competition in the greenfield market has been in growth mode from 2012 to 2017 with a plateau in sales rates in 2018.

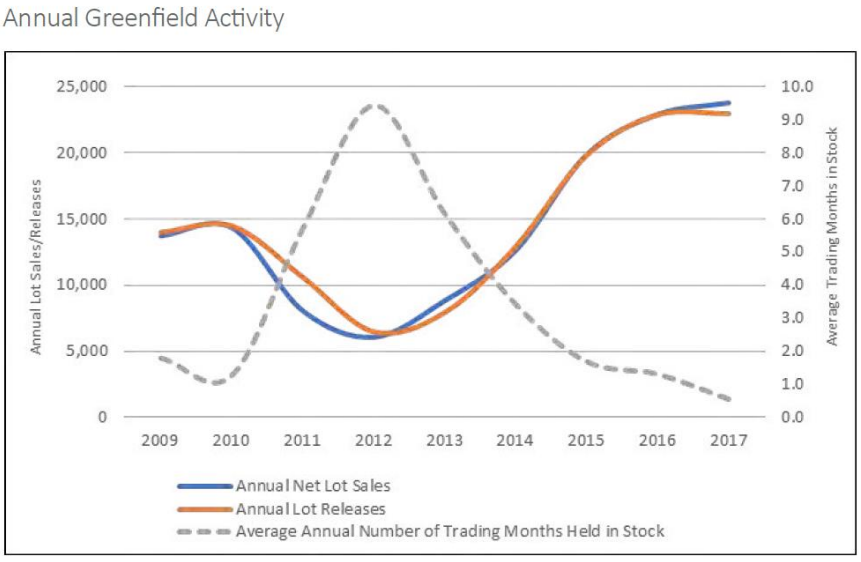


Figure 47 - Annual greenfield activity summary (National Land Survey Program)

5.12 Operating Costs

An analysis was completed on the ongoing operation costs for all the scenarios. A fixed figure of 3% per year was applied to the 30-year life cycle of the development costs in each scenario. The results of this analysis are shown below. The figure of 3% is considered appropriate representation of the operating costs for civil assets given a 50-year replacement design life for items such as pavements and in-ground infrastructure can be achieved (Resulting in 2% operating cost). On top of this replacement, on-going maintenance of each element is required periodically. For example, a road pavement may be replaced in entirety every 50 years however regular maintenance of potholes and road failures would be required throughout this life. An additional 1% was therefore allocated on top of the replacement percentage to cover ongoing maintenance.

Operating costs were applied to Earthworks & Roads, Drainage, Landscape, Community & Emergency facility construction costs and dwelling construction costs. Water, sewer, gas and electricity operating cost was excluded from this assessment as these operating costs are assessed by Infrastructure Victoria as authority costs. Land costs were excluded.

The 3% figure was adopted as a typical value. There is expected to be some variance between the scenarios with maintenance requirements and costs varying significantly between a road and a lift for example.

Table 18 - Average costs per dwelling inclusive of operating and maintenance costs

Category	Internal Reticulation Infrastructure Cost	Dwelling Cost	Land Cost	Catchment Drainage Cost	Community & Emergency Infrastructure Cost	Total cost per dwelling
Greenfield						
Average	$128,059	$854,396	$93,465	$4,078	$25,904	**$1,105,903**
Small Scale Dispersed Infill						
Average	$64,614	$825,269	$292,052	$1,690	$31,640	**$1,215,265**
Medium Density						
Average	$87,726	$742,742	$358,744	$1,408	$32,365	**$1,222,985**
High Density						
Average	$20,565	$1,284,507	$236,521	$269	$49,395	**$1,591,257**
Average	**$75,241**	**$926,729**	**$245,195**	**$1,861**	**$34,826**	**$1,283,853**

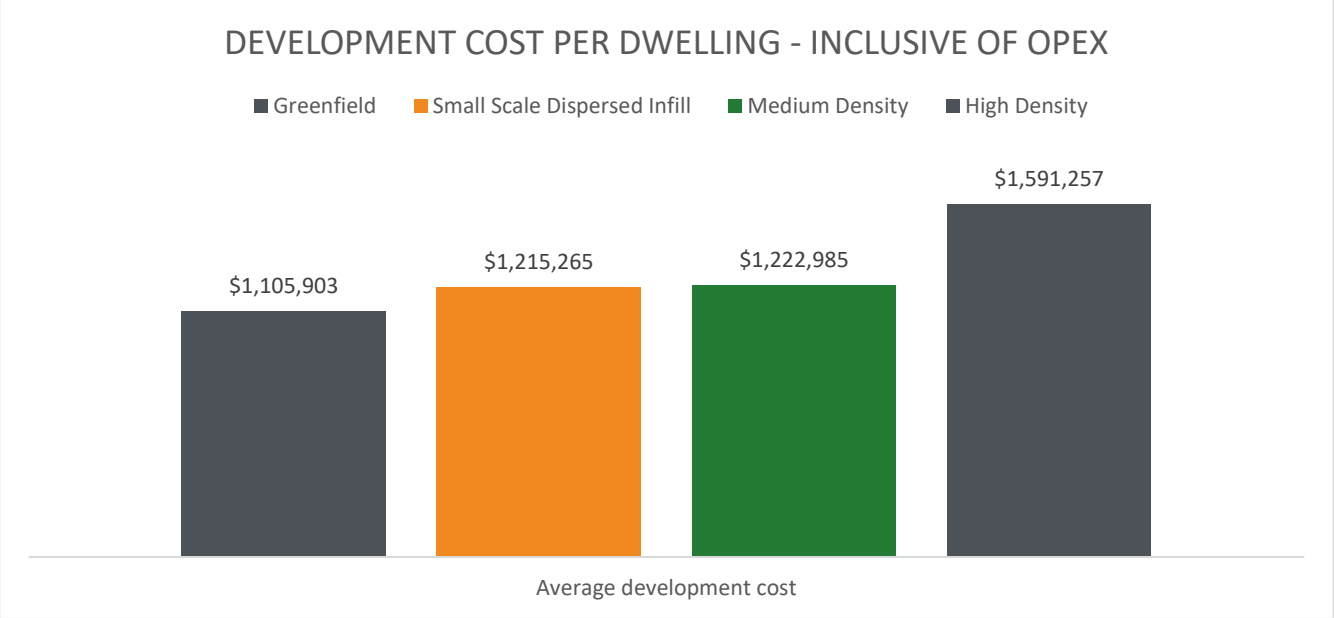


Figure 48 - Overall operating costs inclusive of maintenance and operation

6 Conclusion

The aim of this project was to quantify the overall development costs with emphasis on key infrastructure costs for four development scenarios:

- Greenfield Development
- Small Scale Dispersed Infill (SSDID)
- Precinct Scale Brownfield (Medium Density)
- Precinct Scale High Density

The analysis found the key scenarios are all influenced by different levels of cost from land, infrastructure, dwelling construction and community facility costs. The largest component of the development cost is Dwelling and Land cost.

The results of this assessment found that for the development cost assessed across the four scenarios varied from $526k per dwelling for greenfield scenario up to $816k for high density development. Land cost played a large part in the development cost variance between the scenarios with the attributable land cost per dwelling in medium density being 3.8 times that of the un-developed greenfields cost ($358k medium density compared with $93k greenfields per dwelling). For SSDID the land cost component was lower but relatively close to medium density given nature of development locality land value. The comparable greenfields land value is for undeveloped agricultural land which in some cases has value up-lift due to speculation around planning approvals for Precinct Structure Plans. This compares to other scenarios that have established infrastructure and roads surrounding the sites. The actual land component area for high density development scenario equates to 28sq.m average size (total development land area divided by apartment number) compared to 434sq.m for greenfield, 180 sq.m for SSDID and 150sq.m for medium density scenarios.

Dwelling costs for all scenarios other than high density are relatively similar and would be expected to range from $1,600 to $1,800 per sq.m dependent on quality and house arrangement (single verses multiple floors). SSDID and medium density dwellings are typically double storey with some dwellings three storeys. The raw construction cost of high density buildings equates to $2,800 per sq.m however this has been factored up by 1.4 times to offset the cost of building infrastructure and common area costs which account for up to 48% of the overall development and can be attributed back to actual dwelling cost components.

For Infrastructure costs, strong data is available for greenfield and medium density costs as these projects are generally tendered as single packages of work. SMEC has a large database of information from these categories. For high density development the cost data for infrastructure is contained within set trade packages that generally includes both apartment and common area infrastructure, therefore it is difficult to split out and determine standalone infrastructure costs applicable. The estimates for this scenario are based on feasibility advice and developer pricing. For SSDID development, costs are generally based on contractor rates with estimates of scope of work. The scope in this type of development has minor variance compared with other categories.

Community and emergency infrastructure forms a part of the development cost assessed. The large total project cost for each item is relatively small on a per dwelling basis given that such a large population is serviced by a single facility. The cost of community and emergency infrastructure is highly defined by land value. In higher density development, while land area is generally smaller for the facilities given site constraints, the significant increase in square metre cost of land offsets any savings in the overall development cost and leads to an increase. An example of this is the sports field category where land take is defined by playing surface area. The average total cost for this facility in High Density scenario when compared to Greenfields scenario is almost twice the development cost.

Ongoing maintenance costs were applied at 3% over 30 years to compare final costs. A separate assessment could be completed for each of the scenarios on maintenance costs to confirm actual figures for ongoing maintenance costs. It is expected the maintenance cost of high density elements such as lifts, plant and other common area infrastructure would be higher than maintenance of in ground infrastructure in other scenarios.

It is expected that the development cost between the scenarios would vary further when incorporating cost of authority reticulation supply and external transport networks. These cost elements were assessed by Infrastructure Victoria in their concurrent study.

To improve the data set and assessment it is recommended the following future works be completed. This will provide a more precise assessment of actual costs:

- Acquire more sales data for SSDID, medium and high-density scenarios to advise on the land cost component. This data could be further broken up within the densities by project type and locality. Sale price data for large development sites has been difficult to acquire. This could be aided through government sales information such as Stamp Duty payment records (State Revenue Office) etc.
- Further discussion with Melbourne Water to assess catchment scale cost impacts for SSDID, medium and high-density development scenarios
- Specific liaison with builders and trades to further confirm the cost of common property reticulation through high density developments
- Further discussion with cost consultants to broaden construction cost data pool

This project sought to review a large suite of data. To improve precision, it is recommended to complete specific studies on a single cost element i.e. assessment of land value only and the impact on development

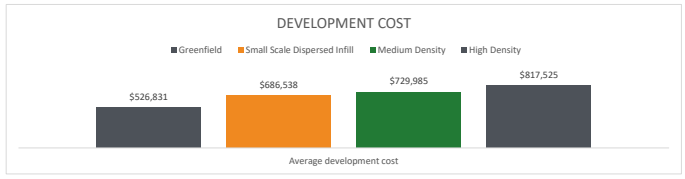
SMEC acknowledges the input of our project partners and collaborators in preparing this report.

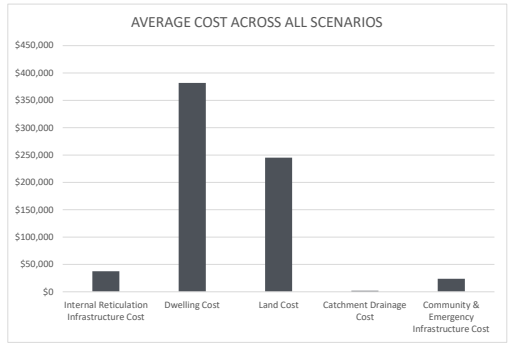
APPENDIX A

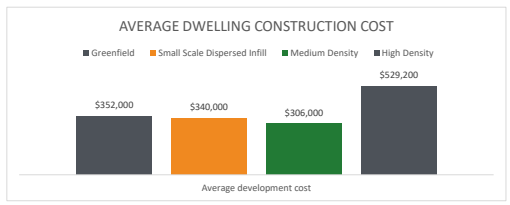
SMEC Overall Development Cost Summary

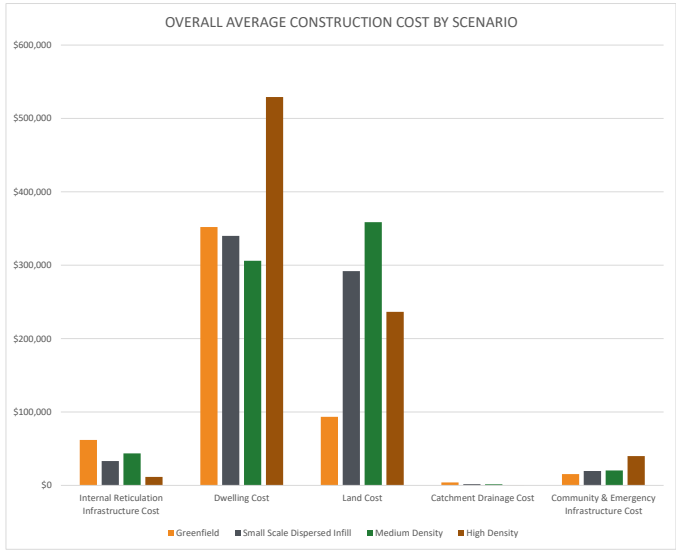
Development Infrastructure Cost Summary
Across all scenarios

Category	Internal Reticulation Infrastructure Cost	Dwelling Cost	Land Cost	Catchment Drainage Cost	Community & Emergency Infrastructure Cost	Total cost per dwelling
Greenfield						
Max	$133,535	$352,000	$93,465	$27,893	$19,010	**$625,902**
Average	$61,854	$352,000	$93,465	$4,078	$15,434	**$526,831**
Min	$31,780	$352,000	$93,465	$186	$10,869	**$488,299**
Small Scale Dispersed Infill						
Max	$51,000	$340,000	$292,052	$11,558	$32,554	**$727,164**
Average	$33,239	$340,000	$292,052	$1,690	$19,557	**$686,538**
Min	$25,800	$340,000	$292,052	$77	$12,500	**$670,429**
Medium Density						
Max	$62,884	$306,000	$358,744	$9,632	$29,902	**$767,162**
Average	$43,551	$306,000	$358,744	$1,408	$20,283	**$729,985**
Min	$22,405	$306,000	$358,744	$64	$17,620	**$704,833**
High Density						
Max	$28,781	$529,200	$236,521	$1,837	$55,790	**$852,129**
Average	$11,513	$529,200	$236,521	$269	$40,023	**$817,525**
Min	$3,454	$529,200	$236,521	$12	$23,596	**$792,783**
Average	**$37,539**	**$381,800**	**$245,195**	**$1,861**	**$23,824**	**$690,220**









Detailed Costs

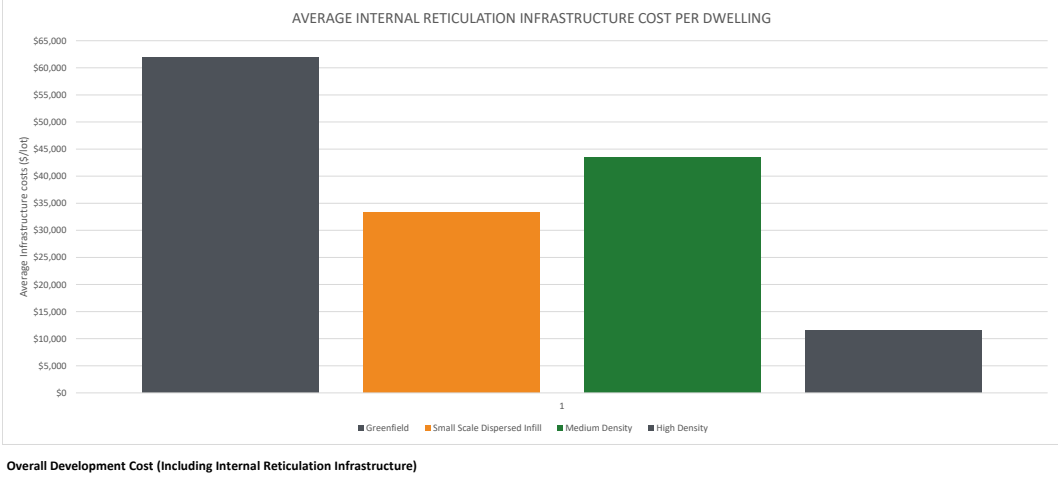
	Internal Reticulation Infrastructure Cost								Dwelling Construction Cost			Land Purchase Cost			Catchment Drainage	Dwelling CostPrice
Category	Earthworks and Roads	Drainage	Sewer	Water	Electrical	Telecommunications	Landscape	Total	3 bedroom	Average size	Average Cost	Average size	Average rate per sqm	Average land cost		
Greenfield																
Max	$70,341	$18,622	$15,324	$8,580	$11,405	$3,573	$5,688	**$133,535**	$1,600	220	**$352,000**	434	215.17	$93,465	$27,893	$445,465
Average	$33,843.74	$10,243	$5,540	$4,264	$4,266	$1,398	$2,299	**$61,854**	$1,600	220	**$352,000**	434	215.17	$93,465	$4,078	$445,465
Min	$19,386.74	$4,378	$3,126	$1,541	$2,071	$586	$692	**$31,780**	$1,600	220	**$352,000**	434	215.17	$93,465	$186	$445,465
Small Scale Dispersed Infill																
Max	$18,048	$14,100	$5,270	$6,707	$4,207	$1,105	$1,563	**$51,000**	$1,700	200	**$340,000**	180	1622.51	$292,052	$11,558	$632,052
Average	$11,387	$9,550	$3,815	$4,316	$2,649	$476	$1,045	**$33,239**	$1,700	200	**$340,000**	180	1622.51	$292,052	$1,690	$632,052
Min	$9,274	$7,800	$2,635	$3,104	$2,104	$253	$632	**$25,800**	$1,700	200	**$340,000**	180	1622.51	$292,052	$77	$632,052
Medium Density																
Max	$26,902.84	$11,997.06	$6,786	$4,447	$9,000	$1,600	$2,152	**$62,884**	$1,800	170	**$306,000**	150	2391.63	$358,744	$9,632	$664,744
Average	$22,391.20	$6,640	$3,863	$2,743	$5,093	$900	$1,920	**$43,551**	$1,800	170	**$306,000**	150	2391.63	$358,744	$1,408	$664,744
Min	$13,381.77	$2,881.99	$1,402	$789	$2,308	$272	$1,370	**$22,405**	$1,800	170	**$306,000**	150	2391.63	$358,744	$64	$664,744
High Density																
Max	$8,225	$5,625	$3,063	$2,931	$5,431	$1,500	$2,006	**$28,781**	$3,920	135	**$529,200**	29	8268.00	$236,521	$1,837	$765,721
Average	$3,290	$2,250	$1,225	$1,173	$2,173	$600	$803	**$11,513**	$3,920	135	**$529,200**	29	8268.00	$236,521	$269	$765,721
Min	$987	$675	$368	$352	$652	$180	$241	**$3,454**	$3,920	135	**$529,200**	29	8268.00	$236,521	$12	$765,721
Consultant Fee Allocation	51.6%	20.0%	9.0%	6.9%	6.9%	3.5%	2.1%									

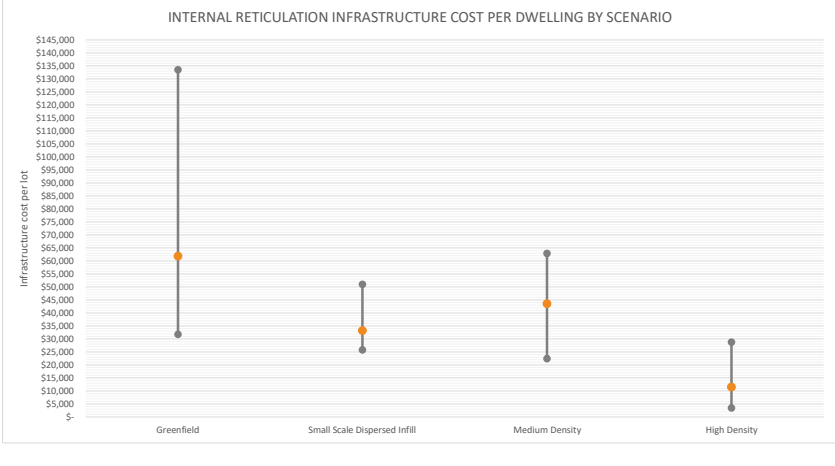
Notes

1. Miscellaneous costs allows for contingency, variations and general items allocated to Earthworks and Roads and Drainage at 50% evenly
2. Design fee for high density assumed to be 15% of total construction cost
3. Greenfield land area factored for % of lot area developed on unserviced greenfield site
4. Land component for high density factored from total site area divided by number of dwellings
5. Dwelling areas based on average size of 3 bedroom dwelling in all scenarios
6. Marketing, legal, environmental excluded
7. Catchment drainage cost component corresponds to MW scheme rates applied to land area only. No consideration of cost within road reserves etc
8. Overall costs based on data from combination of tendered projects and project cost estimates utilising contractor rates within SMEC database
9. Gas trenching cost included in water construction total
10. High density dwelling cost rate factored by 1.4 times to account for cost to dwelling of non-saleable areas outside of the dwelling. This allows benchmarking of dwelling cost across all scenarios.
11. Costs current as at June 2018

Internal Reticulation Infrastructure Cost

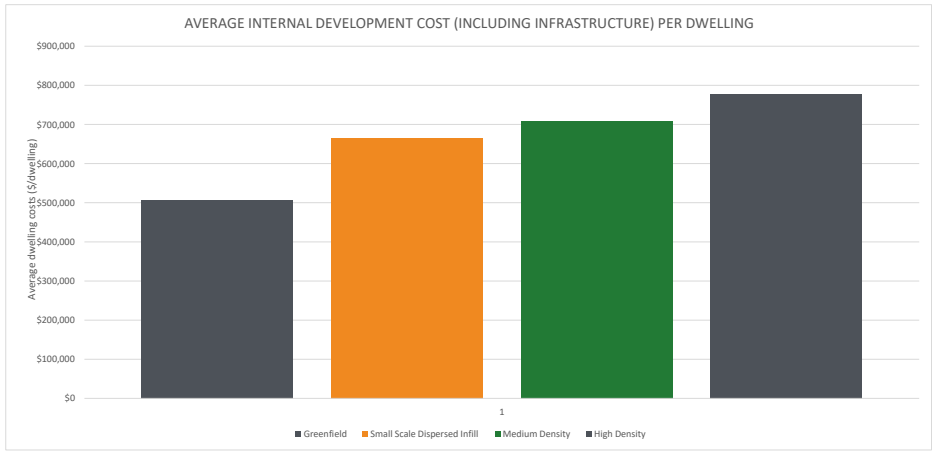
Category	Greenfield	Small Scale Dispersed Infill	Medium Density	High Density	Average
Max	$31,780	$51,000	$62,884	$28,781	$43,611
Average	$61,854	$33,239	$43,551	$11,513	$37,539
Min	$133,535	$25,800	$22,405	$3,454	$46,299

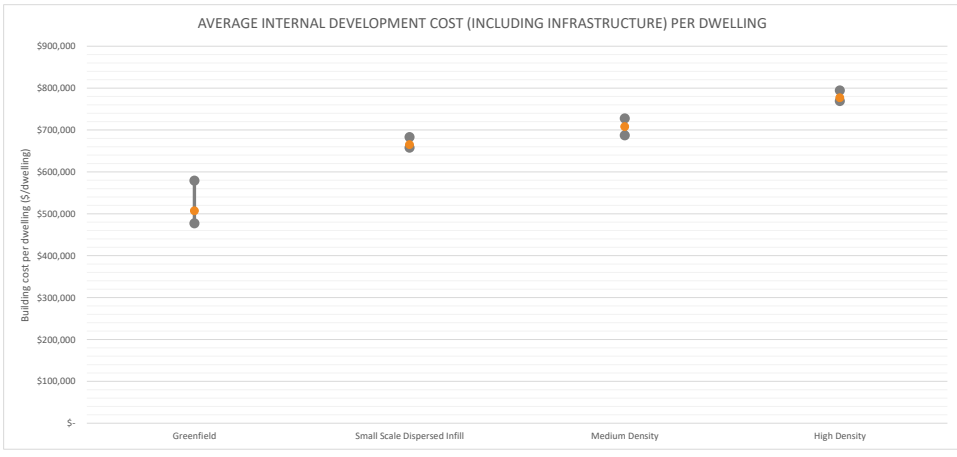




Overall Development Cost (Including Internal Reticulation Infrastructure)

	Greenfield	Small Scale Dispersed Infill	Medium Density	High Density	Average
Max	$578,999	$683,052	$727,628	$794,502	$696,045
Average	$507,319	$665,291	$708,294	$777,233	$664,534
Min	$477,244	$657,852	$687,149	$769,175	$647,855





High density yield assessment

Project	Site area	Apartment Yield	Land area per apartment
	sq.m	o per developme	sq.m
Abbotsford	5967.00	202	29.54
Southbank	2885.00	185	15.59
Project 3	3500.00	250	14.00
Ivanhoe Apartments	3362.00	256	13.13
The Emerald	2238.00	293	7.64
Toorak Park	24942.00	479	52.07
Clifton St Apartments Prahr	4551.00	335	13.59
The Clarindale Oakleigh Sou	6694.00	137	48.86
M. Carnegie	3278.00	52	63.04
Average land component per dwelling			28.607 sq.m

APPENDIX B

Infrastructure Cost Summary

Greenfield Internal Reticulation Infrastructure Costs

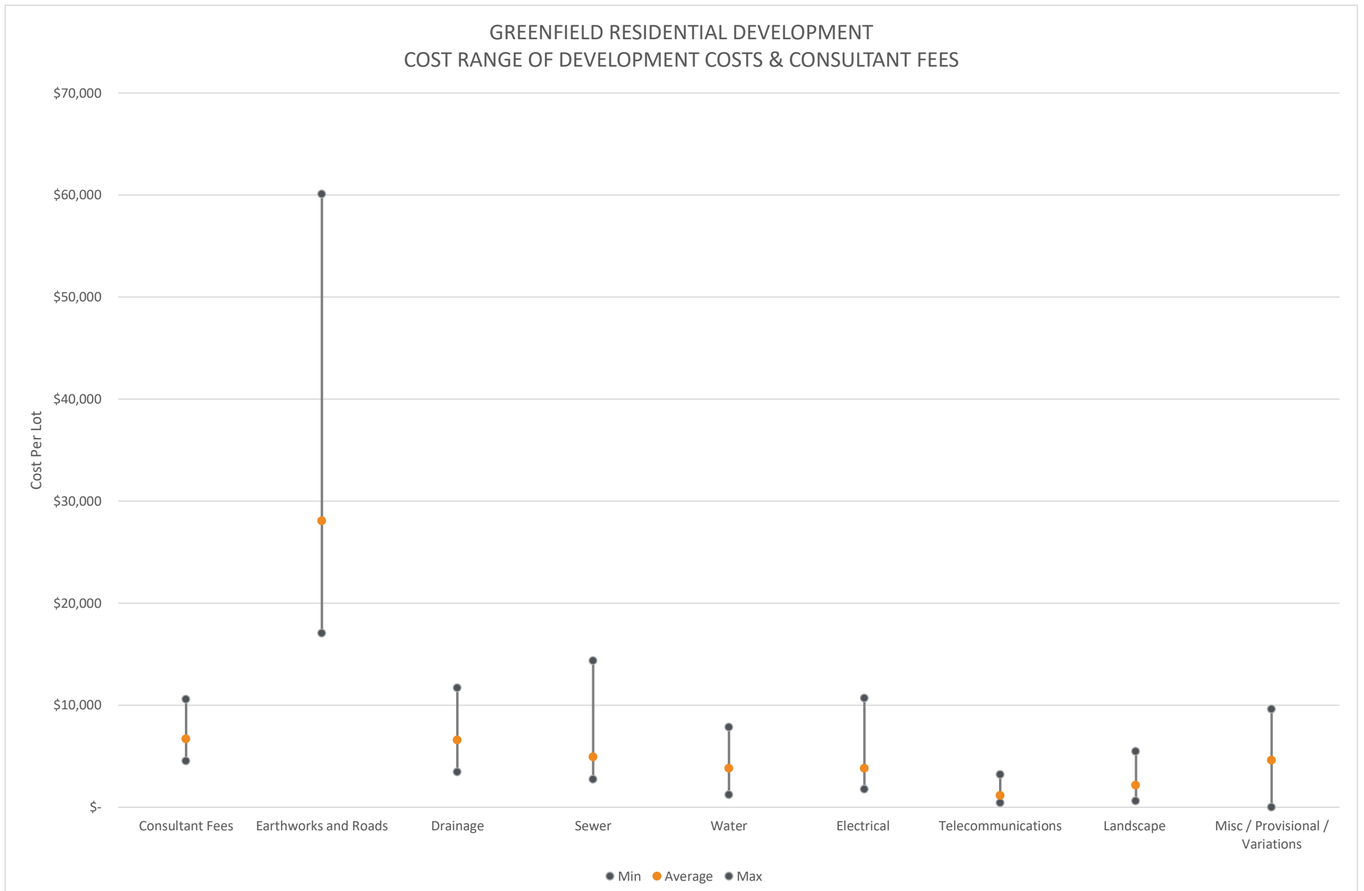
Date: 29/11/2018

ALL DATA - AVERAGE

Construction & Consultant Fees		Average (all data)		%
	Roadworks & Auxiliary	$	22,554	36%
	Earthworks, Lot Benching & Walls	$	5,526	9%
	Drainage	$	6,599	11%
	Sewer	$	4,936	8%
	Water	$	3,290	5%
	Gas	$	512	1%
	Electrical	$	3,803	6%
	Telecommunications	$	1,164	2%
	Landscape	$	2,158	3%
	Misc / Provisional / Variations	$	4,606	7%
	Consultant Fees	$	6,707	11%
	Total	**$**	**61,854**	

Construction Costs		Average (all data)	%
	Roadworks & Auxiliary	$22,554.19	41%
	Earthworks, Lot Benching & Walls	$5,525.63	10%
	Drainage	$6,598.65	12%
	Sewer	$4,936.21	9%
	Water	$3,289.51	6%
	Gas	$511.89	1%
	Electrical	$3,803.45	7%
	Telecommunications	$1,163.62	2%
	Landscape	$2,158.05	4%
	Misc / Provisional / Variations	$4,606.41	8%
	Total	**$55,147.61**	

Consultant Fees		Average (all data)		%
	Planning & Urban Design	$	530	8%
	Survey	$	1,201	18%
	Engineering	$	3,658	55%
	Landscape Architecture	$	521	8%
	Other	$	796	12%
	Total	**$**	**6,707**	



MIN & MAX - 2017 & 2018

	Min		Average		Max
$	15,104	$	22,554	$	44,210
$	3,471	$	6,599	$	11,708
$	1,948	$	5,526	$	15,869
$	2,720	$	4,936	$	14,371
$	1,172	$	3,290	$	6,613
$	1,760	$	3,803	$	10,674
$	57	$	512	$	1,236
$	427	$	1,164	$	3,202
$	597	$	2,158	$	5,466
$	7	$	4,606	$	9,590
$	4,518	$	6,707	$	10,596
$	**31,780**	**$**	**61,854**	**$**	**133,535**

	Consultant Fees	Earthworks and Roads	Drainage	Sewer	Water	Electrical	Telecommunications	Landscape	Misc / Provisional / Variations
Min	$4,517.76	$17,051.95	$3,470.55	$2,719.65	$1,228.85	$1,759.50	$427.46	$596.70	$7.25
Average	$6,706.80	$28,079.82	$6,598.65	$4,936.21	$3,801.39	$3,803.45	$1,163.62	$2,158.05	$4,606.41
Max	$10,595.77	$60,078.68	$11,708.04	$14,370.78	$7,849.29	$10,674.19	$3,202.26	$5,465.69	$9,590.14

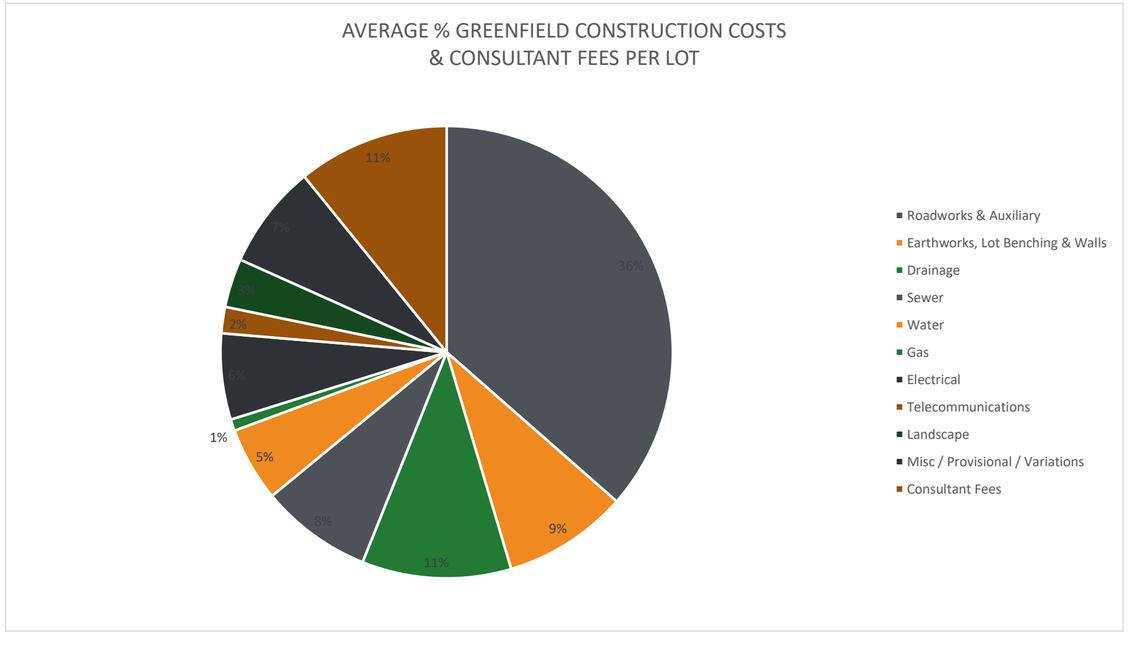
Notes

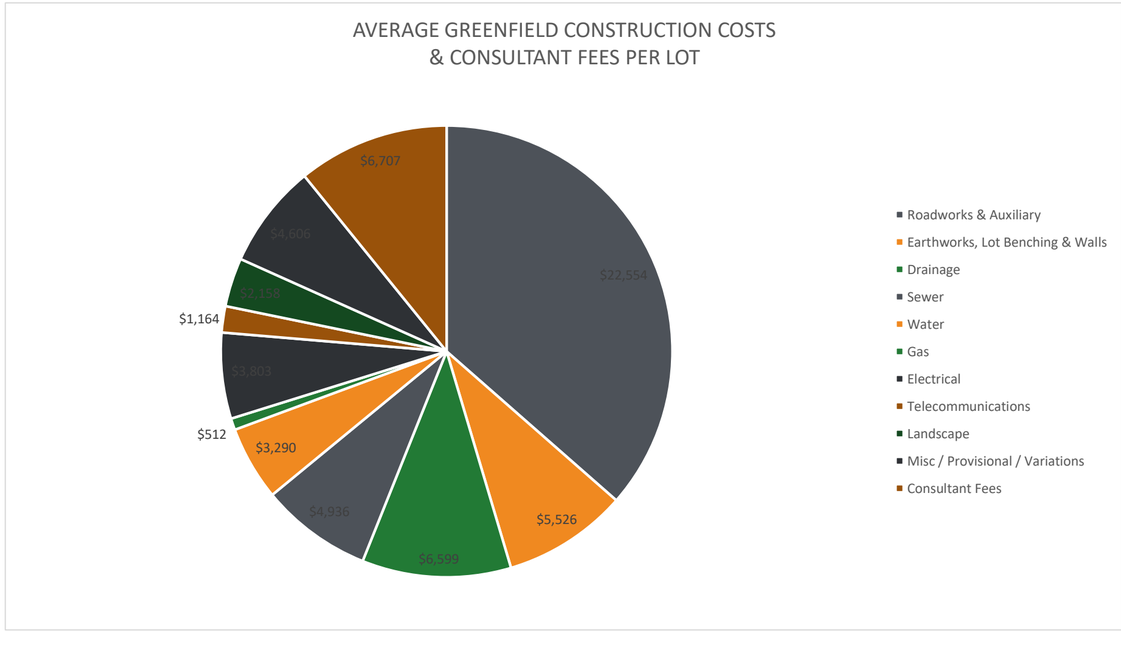
1. Gas trenching costs included in Water costs in overall total
2. Costs based on mix of actual tender data and estimated project costs utilising applicable rates

MIN & MAX - ALL DATA

		Min		Average		Max
	Roadworks & Auxiliary	$ 10,709	$	22,554	$	44,210
	Earthworks, Lot Benching & Walls	$ 771	$	5,526	$	15,869
	Drainage	$ 1,420	$	6,599	$	17,528
	Sewer	$ 1,211	$	4,936	$	14,371
	Water	$ 1,171	$	3,290	$	6,613
	Gas	$ 57	$	512	$	1,345
	Electrical	$ 1,468	$	3,803	$	10,674
	Telecommunications	$ 411	$	1,164	$	3,360
	Landscape	$ 84	$	2,158	$	6,274
	Misc / Provisional / Variations	$ 7	$	4,606	$	9,590
	Consultant Fees	$ 1,607	$	6,707	$	14,588
	Total	**$ 18,917**	**$**	**61,854**	**$**	**144,422**

	Consultant Fees	Earthworks and Roads	Drainage	Sewer	Water	Electrical	Telecommunications	Landscape	Misc / Provisional / Variations
Min	$1,606.81	$11,479.93	$1,419.60	$1,211.25	$1,228.53	$1,468.38	$411.25	$84.15	$7.25
Average	$6,706.80	$28,079.82	$6,598.65	$4,936.21	$3,801.39	$3,803.45	$1,163.62	$2,158.05	$4,606.41
Max	$14,588.00	$60,078.68	$17,527.50	$14,370.78	$7,958.78	$10,674.19	$3,360.00	$6,273.89	$9,590.14





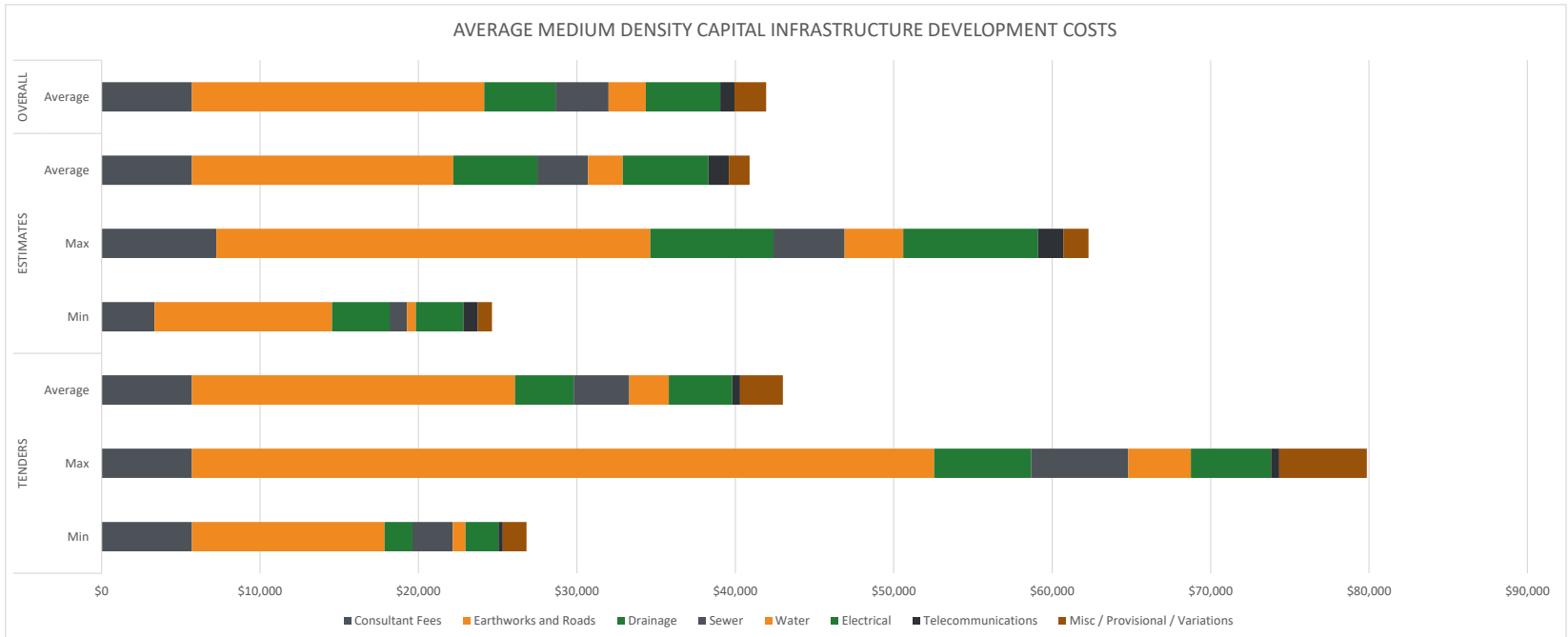
Medium Density Internal Reticulation Infrastructure Costs

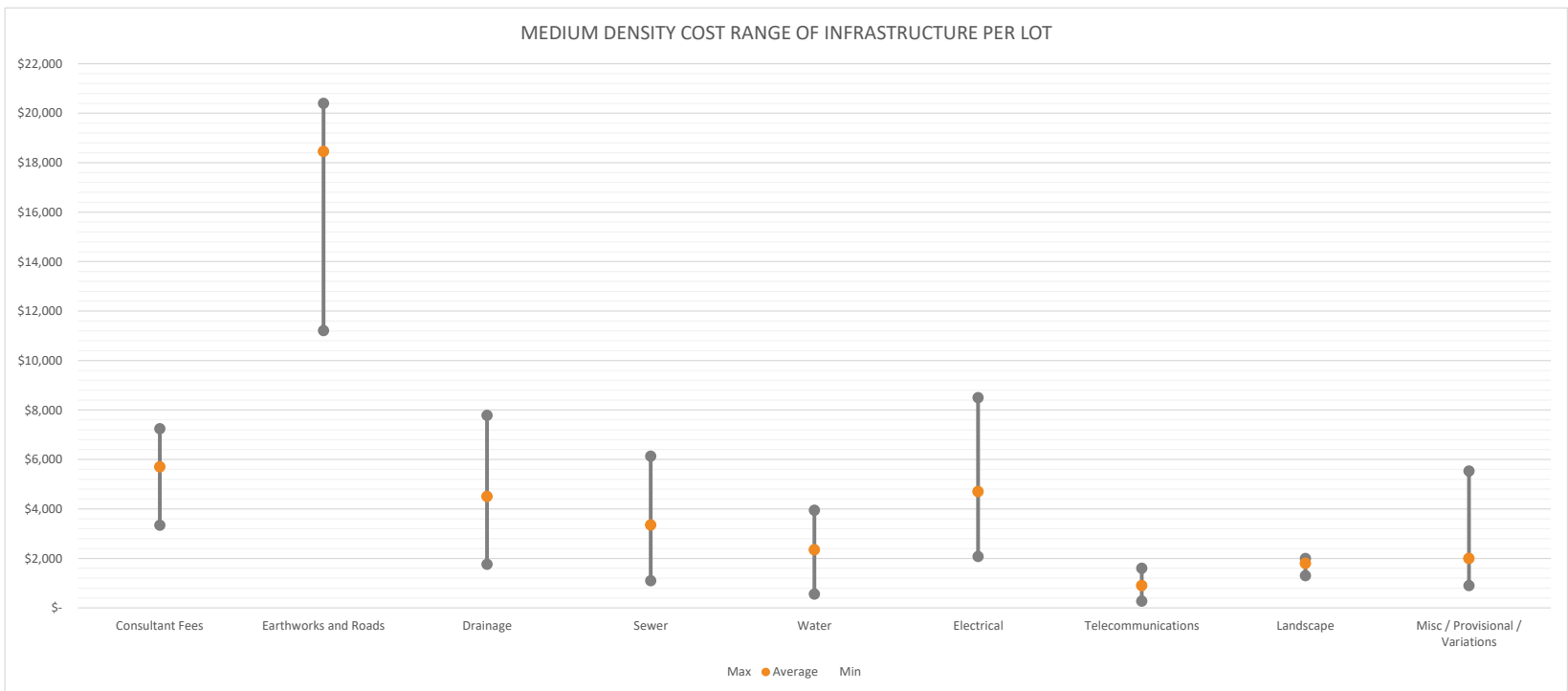
Member of the Surbana Jurong Group

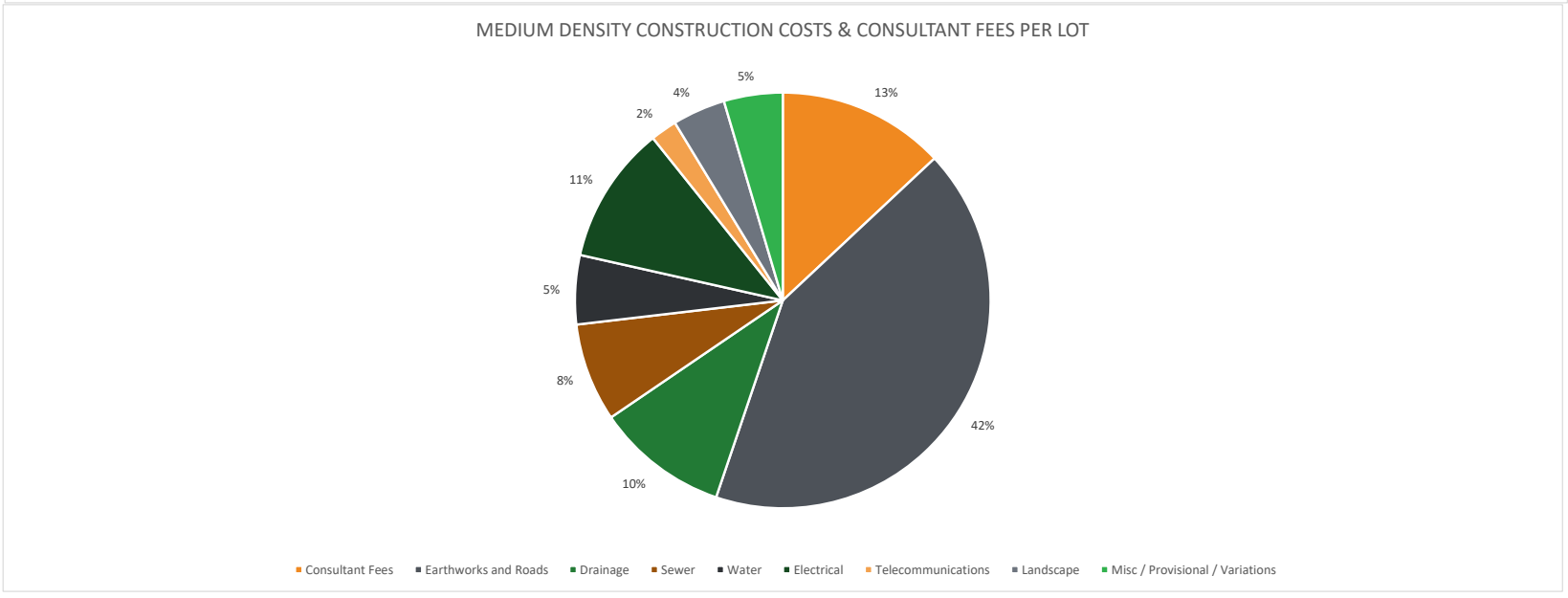
Construction Cost

ITEM	TENDERS			ESTIMATES			OVERALL	%
	Min	Max	Average	Min	Max	Average	Average	
Consultant Fees	$ 5,700.00	$ 5,700.00	$ 5,700.00	$ 3,338.33	$ 7,241.74	$ 5,700.00	$ 5,700.00	13%
Earthworks and Roads	$ 12,156.90	$ 46,854.78	$ 20,400.00	$ 11,209.20	$ 27,387.81	$ 16,500.00	$ 18,450.00	42%
Drainage	$ 1,764.33	$ 6,119.76	$ 3,700.00	$ 3,630.87	$ 7,782.61	$ 5,300.00	$ 4,500.00	10%
Sewer	$ 2,547.06	$ 6,133.84	$ 3,500.00	$ 1,101.34	$ 4,482.14	$ 3,200.00	$ 3,350.00	8%
Water	$ 805.20	$ 3,947.09	$ 2,500.00	$ 559.06	$ 3,705.73	$ 2,200.00	$ 2,350.00	5%
Electrical	$ 2,077.83	$ 5,066.33	$ 4,000.00	$ 3,000.00	$ 8,500.00	$ 5,400.00	$ 4,700.00	11%
Telecommunications	$ 272.24	$ 510.46	$ 500.00	$ 900.00	$ 1,600.00	$ 1,300.00	$ 900.00	2%
Landscape	$ 1,700.00	$ 2,000.00	$ 1,900.00	$ 1,300.00	$ 1,900.00	$ 1,700.00	$ 1,800.00	4%
Misc / Provisional / Variations	$ 1,502.94	$ 5,532.20	$ 2,700.00	$ 900.00	$ 1,600.00	$ 1,300.00	$ 2,000.00	5%
	$ 28,600.00	**$ 81,900.00**	**$ 44,900.00**	**$ 25,938.80**	**$ 64,200.02**	**$ 42,600.00**	**$ 43,750.00**	100%

Category	Consultant Fees	Earthworks and Roads	Drainage	Sewer	Water	Electrical	Telecommunications	Landscape	Misc / Provisional / Variations	
Max	$ 7,241.74	$ 20,400.00	$ 7,782.61	$ 6,133.84	$ 3,947.09	$ 8,500.00	$ 1,600.00	$ 2,000.00	$ 5,532.20	$ 63,137.48
Average	$ 5,700.00	$ 18,450.00	$ 4,500.00	$ 3,350.00	$ 2,350.00	$ 4,700.00	$ 900.00	$ 1,800.00	$ 2,000.00	$ 43,750.00
Min	$ 3,338.33	$ 11,209.20	$ 1,764.33	$ 1,101.34	$ 559.06	$ 2,077.83	$ 272.24	$ 1,300.00	$ 900.00	$ 22,522.32







Notes

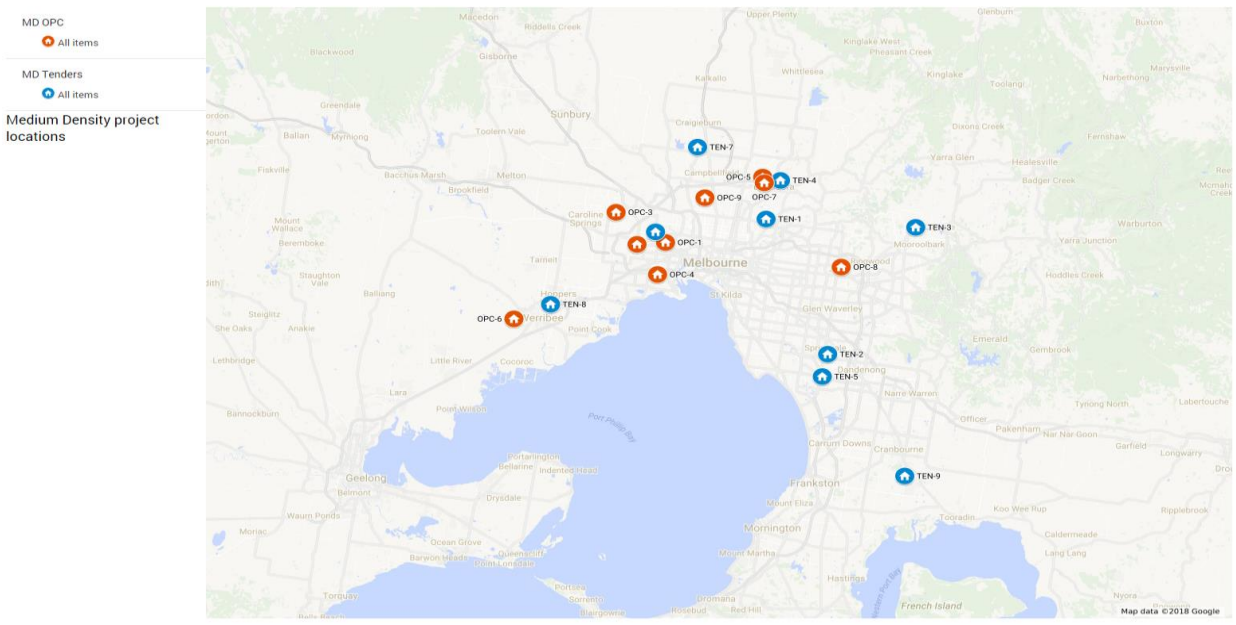
1. Overall costs based on data from combination of tendered projects and project cost estimates utilising contractor rates within SMEC database
2. Gas trenching cost included in water construction total
3. Miscellaneous, Provisional and Variations item relates to general category items that were not allocated to set schedule of works. This includes provisional construction allowances, project variations and other minor costs
4. Costs current as at June 2018
5. For presentation of summary of findings, Consultant fees have been allocated across each category utilising percentage documented in Appendix A. Miscellaneous Costs have been allocated to Earthworks and Roads and Drainage categories at 50% allocation each.

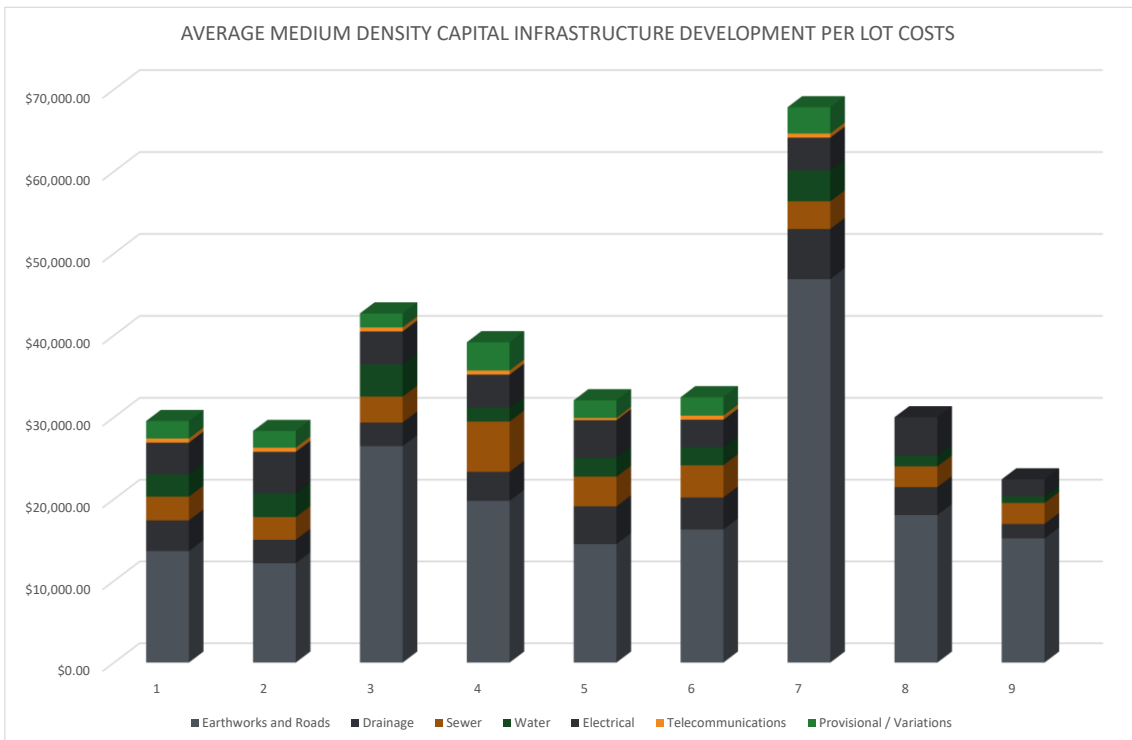
Medium Density Project Data
Tendered Rates

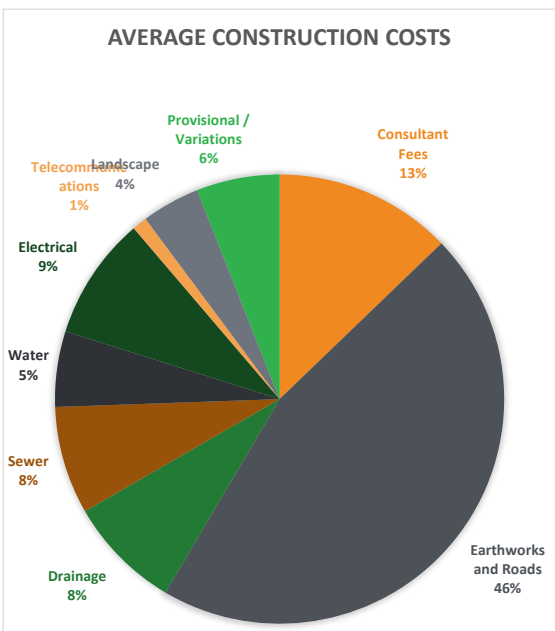
SMEC
Member of the Surbana Jurong Group

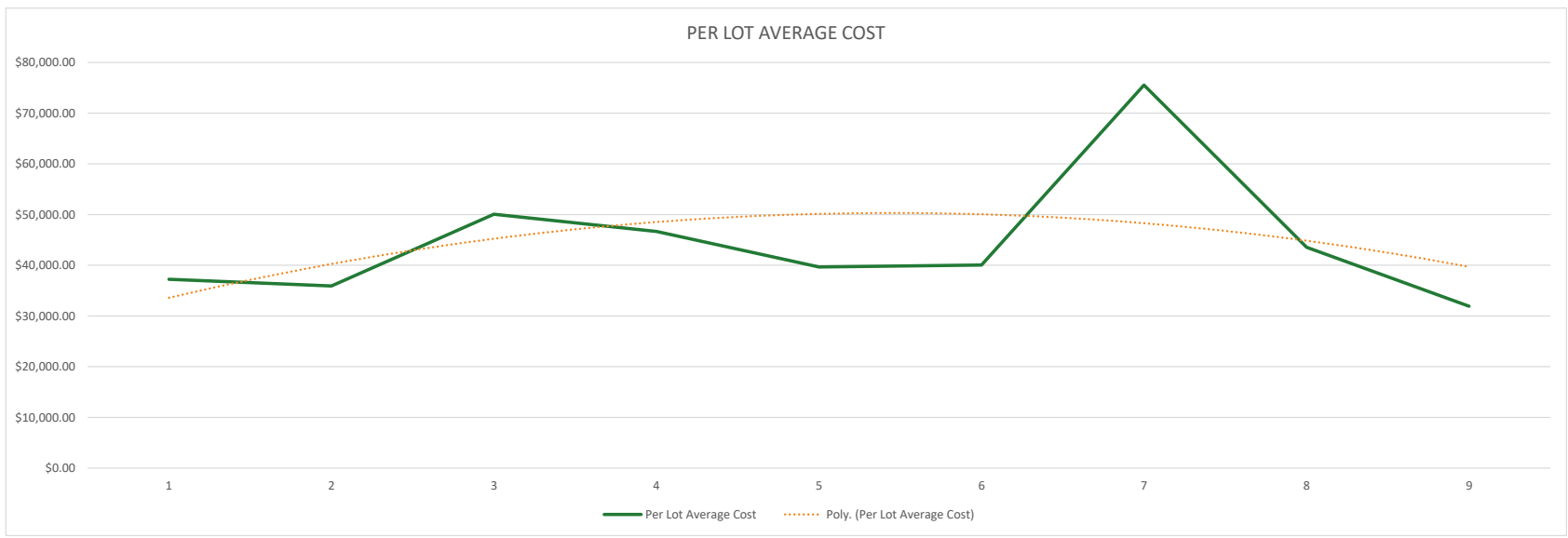
Item	Unit	Average	1	2	3	4	5	6	7	8	9
Project Data											
Number of Dwellings		98	117	98	176	58	116	135	21	20	143
Construction Period	Start		Jun-15	Nov-16	Oct-15	Jul-12	Jan-18	Aug-16	Dec-17	Jun-17	Dec-16
	End		Oct-17	Jan-18	Dec-17	Dec-13	May-18	May-18	Jun-18	Nov-17	May-18
Consultant Fees			$666,900	$558,600	$1,003,200	$330,600	$661,200	$769,500	$119,700	$114,000	$815,100
Construction Costs											
Earthworks and Roads	Total (Ex GST)	$1,777,354	$1,597,176	$1,191,376	$4,659,676	$1,148,291	$1,682,092	$2,199,584	$983,950	$361,060	$2,172,981
Drainage		$326,927	$438,733	$280,485	$506,241	$205,387	$534,785	$527,601	$128,515	$68,295	$252,299
Sewer		$330,280	$340,311	$273,019	$557,647	$355,763	$422,362	$532,644	$70,977	$50,941	$368,860
Water		$243,597	$319,608	$285,238	$694,688	$100,583	$273,875	$297,896	$79,128	$26,213	$115,143
Recycled Water		$115,385									$115,385
Electrical		$370,782	$452,111	$496,500	$704,000	$232,000	$526,180	$451,629	$84,000	$93,491	$297,129
Telecommunications		$46,289	$58,500	$50,025	$88,000	$29,000	$31,580	$67,500	$10,500	$10,000	$71,500
Landscape		$181,789	$234,000	$186,200	$299,200	$104,400	$220,400	$256,500	$42,000	$36,000	$257,400
Provisional / Variations		$210,719	$250,000	$200,000	$300,000	$200,000	$250,000	$303,571	$67,334	$110,644	$214,920
Total Construction Value		**$3,175,954**	**$3,017,705**	**$2,496,158**	**$6,769,884**	**$2,010,024**	**$3,720,873**	**$4,636,924**	**$1,466,404**	**$600,000**	**$3,865,618**
Per Dwelling Cost											
Consultant Fees	Per Dwelling (Ex GST)	$5,700	$5,700.00	$5,700.00	$5,700.00	$5,700.00	$5,700.00	$5,700.00	$5,700.00	$5,700.00	$5,700.00
Earthworks and Roads		$20,331	$13,651.07	$12,156.90	$26,475.43	$19,798.11	$14,500.79	$16,293.21	$46,854.78	$18,052.98	$15,195.67
Drainage		$3,650	$3,749.85	$2,862.09	$2,876.37	$3,541.16	$4,610.22	$3,908.16	$6,119.76	$3,414.75	$1,764.33
Sewer		$3,454	$2,908.64	$2,785.91	$3,168.45	$6,133.84	$3,641.05	$3,945.51	$3,379.86	$2,547.06	$2,579.44
Water		$2,419	$2,731.69	$2,910.59	$3,947.09	$1,734.19	$2,360.99	$2,206.64	$3,768.00	$1,310.66	$805.20
Electrical		$3,952	$3,864.20	$5,066.33	$4,000.00	$4,000.00	$4,536.03	$3,345.40	$4,000.00	$4,674.55	$2,077.83
Telecommunications		$476	$500.00	$510.46	$500.00	$500.00	$272.24	$500.00	$500.00	$500.00	$500.00
Landscape		$1,867	$2,000.00	$1,900.00	$1,700.00	$1,800.00	$1,900.00	$1,900.00	$2,000.00	$1,800.00	$1,800.00
Provisional / Variations		$2,664	$2,136.75	$2,040.82	$1,704.55	$3,448.28	$2,155.17	$2,248.67	$3,206.36	$5,532.20	$1,502.94
Total per dwelling		**$44,513**	**$37,242.20**	**$35,933.09**	**$50,071.88**	**$46,655.58**	**$39,676.50**	**$40,047.59**	**$75,528.76**	**$43,532.20**	**$31,925.40**

IV PROJECT









Notes
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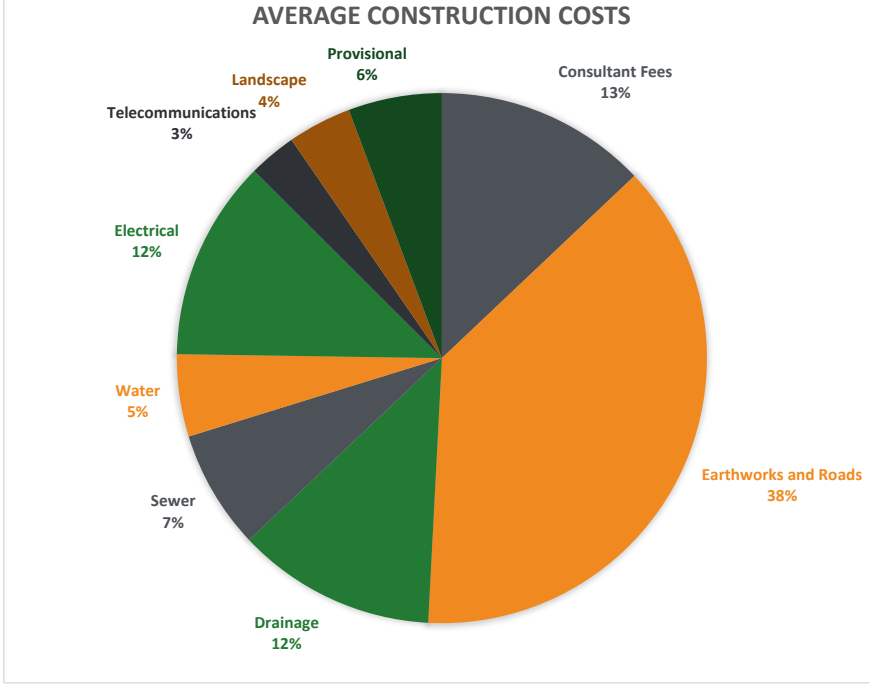
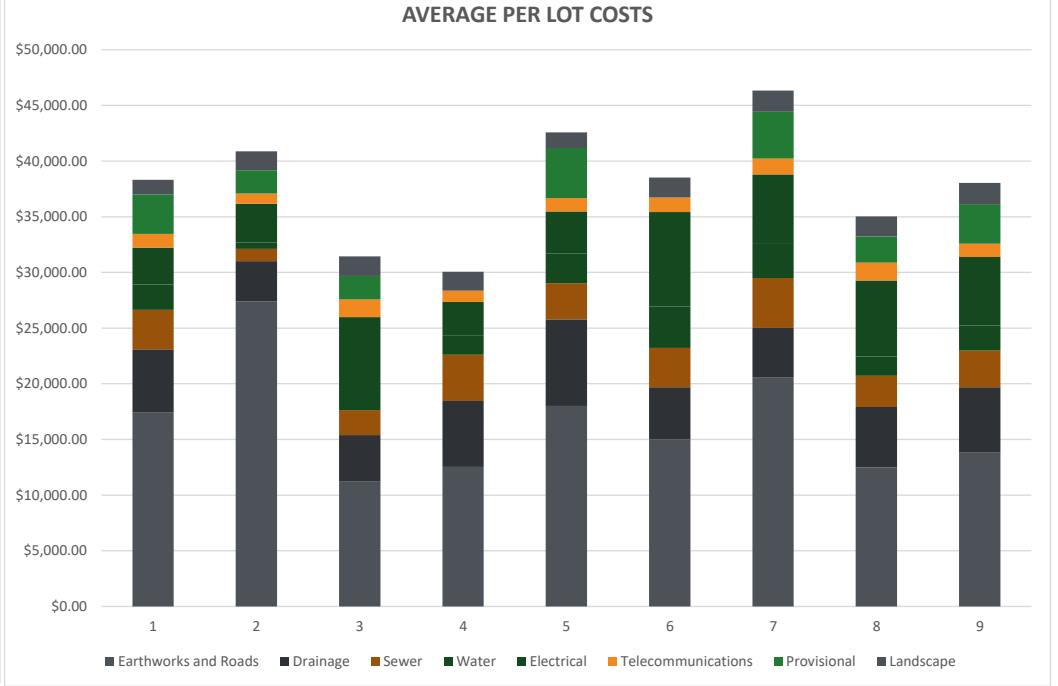
2. Gas trenching cost included in water construction total
3. Miscellaneous, Provisional and Variations item relates to general category items that were not allocated to set schedule of works. This includes provisional construction allowances, project variations
4. Costs current as at June 2018

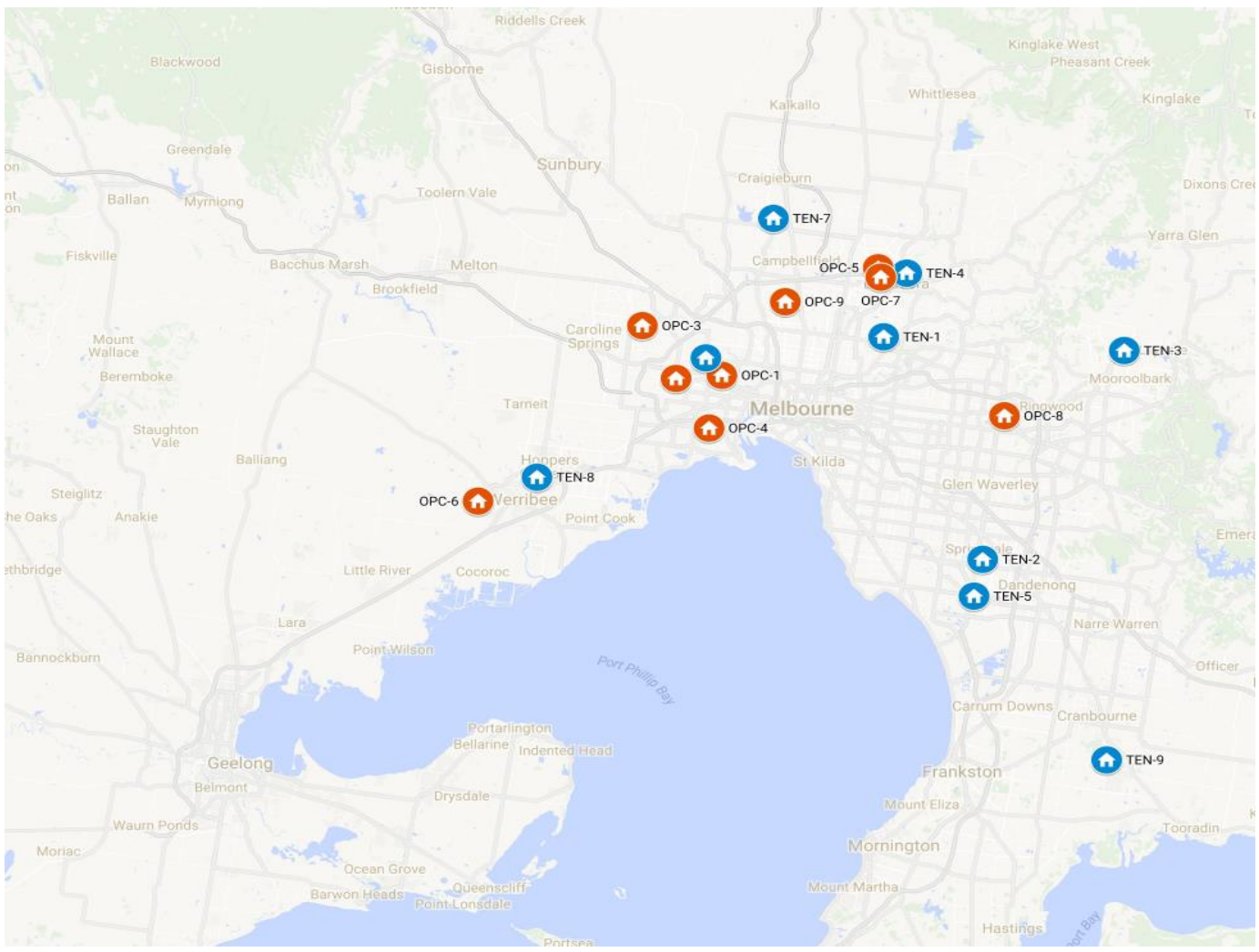
Medium Density Project Data
Cost Estimates

Member of the Surbana Jurong Group

Item	Unit	Average	1	2	3	4	5	6	7	8	9
Project Data											
Number of Dwellings		249	455	149	200	343	575	227	56	173	64
Total Area			12.4	2.2	3.97	11.4	47.14	8.72	1.8	3.95	1.389
NDA			10.53	1.59	2.15	9.64	28.84	8.72	1.8	3.95	1.389
Lot Ratio	Lot/Ha		44	94	94	36	20	27	32	44	47
Number of Stages			8	1	4	3	7	5	2	4	1
Development Charges											
Consultancy Fees		$1,471,768	$2,730,000	$1,030,800	$1,295,600	$1,546,600	$4,164,000	$757,800	$247,000	$1,140,110	$334,000
Consultancy Fees ($/lot)			$6,000.00	$6,918.12	$6,478.00	$4,509.04	$7,241.74	$3,338.33	$4,410.71	$6,590.23	$5,218.75
Construction Costs											
Earthworks and Roads	Total (Ex GST)	$4,055,948	$7,919,200	$4,080,783	$2,241,840	$4,299,031	$10,351,000	$3,410,172	$1,151,000	$2,163,510	$887,000
Drainage		$1,454,051	$2,586,800	$541,000	$836,373	$2,028,900	$4,475,000	$1,059,000	$250,000	$936,389	$373,000
Sewer		$808,984	$1,620,000	$164,100	$450,724	$1,427,700	$1,868,000	$803,200	$251,000	$485,135	$211,000
Water		$558,057	$1,035,000	$83,300	$323,297	$598,200	$1,523,000	$841,200	$175,400	$298,512	$144,600
Electrical		$1,159,222	$1,507,000	$521,500	$1,343,500	$1,029,000	$2,182,000	$1,929,500	$346,000	$1,181,500	$393,000
Telecommunications		$308,111	$556,000	$134,100	$320,000	$343,000	$692,000	$295,100	$79,000	$276,800	$77,000
Landscape		$392,322	$591,500	$253,300	$350,000	$583,100	$805,000	$408,600	$106,400	$311,400	$121,600
Provisional		$829,995	$1,619,000	$311,904	$423,060		$2,586,000		$236,000	$407,000	$227,000
Total Cost Estimate			$20,170,500	$7,127,705	$7,590,871	$11,860,040	$28,653,242	$9,507,910	$2,846,211	$7,206,946	$2,773,419
Per Dwelling Costs											
Consultant Fees		$5,634	$6,000.00	$6,918.12	$6,478.00	$4,509.04	$7,241.74	$3,338.33	$4,410.71	$6,590.23	$5,218.75
Earthworks and Roads		$16,498	$17,404.84	$27,387.81	$11,209.20	$12,533.62	$18,001.74	$15,022.78	$20,553.57	$12,505.84	$13,859.38
Drainage		$5,285	$5,685.27	$3,630.87	$4,181.87	$5,915.16	$7,782.61	$4,665.20	$4,464.29	$5,412.65	$5,828.13
Sewer		$3,161	$3,560.44	$1,101.34	$2,253.62	$4,162.39	$3,248.70	$3,538.33	$4,482.14	$2,804.25	$3,296.88
Water		$2,185	$2,274.73	$559.06	$1,616.49	$1,744.02	$2,648.70	$3,705.73	$3,132.14	$1,725.50	$2,259.38
Electrical		$5,330	$3,312.09	$3,500.00	$6,717.50	$3,000.00	$3,794.78	$8,500.00	$6,178.57	$6,829.48	$6,140.63
Telecommunications		$1,271	$1,221.98	$900.00	$1,600.00	$1,000.00	$1,203.48	$1,300.00	$1,410.71	$1,600.00	$1,203.13
Landscape		$1,694	$1,300.00	$1,700.00	$1,750.00	$1,700.00	$1,400.00	$1,800.00	$1,900.00	$1,800.00	$1,900.00
Provisional		$2,486	$3,558.24	$2,093.32	$2,115.30	$0.00	$4,497.39	$0.00	$4,214.29	$2,352.60	$3,546.88
Total per dwelling		**$43,545**	**$44,317.58**	**$47,790.52**	**$37,921.97**	**$34,564.23**	**$49,819.13**	**$41,870.36**	**$50,746.43**	**$41,620.55**	**$43,253.13**







Notes
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4. Costs current as at June 2018

APPENDIX C

Land Cost Summary

Land Cost Summary

Across all scenarios

Greenfields - Retail

MUNICIPALITY	Average Lot Size	Average Lot Price	Cost per sq.m
	Mar-18	Mar-18	Mar-18
CARDINIA SHIRE	494	$349,500	$708
CASEY CITY	400	$354,000	$885
HUME CITY	426	$324,250	$762
MITCHELL SHIRE	512	$303,000	$592
WHITTLESEA CITY	392	$329,900	$842
MELTON CITY	399	$283,000	$709
MOORABOOL SHIRE	453	$203,000	$448
WYNDHAM CITY	400	$322,900	$807
Outer Growth Corridor	400	$323,000	$808
AVERAGE	**434**	**$308,694**	**$719**

Source : RPM Real Estate, 2018

Greenfields - Unserviced

Category	Site	Area	Sale Price	Sale Rate	Rate	NDHa	Rate	Source
		sq.m	$	$/Ha	$/sqm	$/Ha	$/sqm	
PSP Approved High Lot Price	Clyde North	920000	$ 180,000,000.00	$ 1,956,521.74	$ 195.65	$ 2,400,000.00	$ 240.00	RPM
	Tarneit	600000	$ 80,000,000.00	$ 1,333,333.33	$ 133.33	$ 1,990,000.00	$ 199.00	RPM
	Fraser Rise	120100	$ 22,000,000.00	$ 1,831,806.83	$ 183.18	$ 2,226,720.65	$ 222.67	CKC
	Bonnie Brook	144300	$ 24,250,000.00	$ 1,680,526.68	$ 168.05	$ 1,692,000.00	$ 169.20	CKC
	Fraser Rise	120000	$ 21,000,000.00	$ 1,750,000.00	$ 175.00	$ 1,718,500.00	$ 171.85	CKC
PSP approved mid-level lot price	Woolert	560000	$ 74,000,000.00	$ 1,321,428.57	$ 132.14	$ 1,500,000.00	$ 150.00	RPM
	Gisborne	756700	$ 61,130,000.00	$ 807,849.87	$ 80.78	$ 807,849.87	$ 80.78	RealCommercial
No PSP, high demand	Thornhill Park	240000	$ 26,000,000.00	$ 1,083,333.33	$ 108.33	$ 1,070,000.00	$ 107.00	RPM
	Fieldstone	120000	$ 11,000,000.00	$ 916,666.67	$ 91.67	$ 895,000.00	$ 89.50	RPM

Category	Raw land purchase price	Assumed developed Lot density	Lots to overall ratio	Adjusted price per sqm	Total land cost (unserviced)	Category
Max (large lots)	$240.00	15	1.3021	$312.50	$160,000.00	Large lots
Average (Average size lots)	$158.89	17	1.3542	$215.17	$92,724.87	Average lots
Min (Small lots)	$80.78	18	1.4172	$114.49	$44,880.55	small lots

Small Scale Dispersed Infill

Density	Region	Land Value Rate (p.s.m.)			Evidence 1	Evidence 2	Evidence 3	Evidence 4	Evidence 5	Evidence 6	Evidence 7	Evidence 8	Evidence 9	Evidence 10	Evidence 11
		Low Range	High Range	Average											
SSDID	North	$791	$3,222	$1,821	35 Elliot Street (Apr 2018)	78 Ferguson Street (Jan 2016)	54 Fitzjohns Dr (Jul 2018)	59 McNamara Street (Jul 2018(	20 French Ave (Jun 2018)	16-18 Clarendon Street (Nov 2017)	12 Trevannion Street (Mar 2018)	7 Corio Street (Mar 2018)	11-15 Smiley Road (May 2018)	99 Charles Street (Jun 2018)	7 Afton Street (Jul 2017)
					Heidelberg Heights	Macleod	Bundoora	Preston	Northcote	Thornbury	Glenroy	Glenroy	Broadmeadows	Ascot Vale	Aberfeldie
					$1,896.55	$1,179.55	$1,556.96	$1,717.99	$2,884.62	$3,222.22	$1,044.57	$1,299.44	$790.71	$2,329.61	$2,113.21
	East	$1,111	$7,103	$2,213	24 Kangerong Road (Sep 2017)	5 James St (Jan 2018)	47 Doncaster East Road (May 2017)	21 Stanton Street (Jun 2017)	214 Belmore Road (May 2017)	1 Rhubane Crt (Jul 2016)	21 Grove Street (Jul 2016)	419 Middleborough Road (Jun 2016)	6 Elland Ave (Oct 2017)	3 Colchester Dr (May 2016)	7 Savage Crt (Sep 2017)
					Box Hill	Ringwood	Mitcham	Doncaster	Balwyn	Blackburn	Vermont	Box Hill	Box Hill	Doncaster East	Nunawading
					$2,519.58	$1,570.95	$1,457.14	$1,616.42	$2,367.18	$1,666.67	$1,110.77	$1,813.73	$7,103.45	$1,808.34	$1,308.62
	South	$449	$2,407	$1,260	1-2 Moola Court (Dec 2016)	23 Stanley (Apr 2018)	494 Main Street (Nov 2017)	29 Marriott Dr (Jun 2018)	9 Patricia Loop (Nov 2017)	4-6 Bank Road (Sep 2016)	7-11 Sheppard Street (Oct 2016)	28 Blackwood Dr (Jul 2017)	117 Narre Warren Road (Oct 2017)	2 Barnett Ave (May 2018)	nkston - Dandenong Road (May 2018)
					Cheltenham	Frankston	Mordialloc	Keysborough	Keysborough	Edithvale	Moorabbin	Hampton Park	Cranbourne	Carrum Downs	Carrum Downs
					$1,353.61	$1,139.46	$1,996.44	$1,564.89	$1,287.88	$2,406.83	$1,991.15	$449.20	$585.02	$611.96	$473.03
	West	$805	$1,973	$1,196	255 Queen Street (Jun 2018)	17 Commecrial Road (Mar 2016)	12 Abbott St (Feb 2018)	22 Henry Street (May 2017)	2 Matthews St (May 2017)	21 Station Pl (Apr 2017)	2 Gilligan Rd (Mar 2018)	8 Lindsay Pl (Jun 2018)	23 Burrowye Cr (Apr 2017)	33 Rice Flower Rd (Jun 2018)	86 Warwick Rd (Apr 2018)
					Altona	Footscray	Spotswood	St Albans	Sunshine	Sunshine	Altona North	Keilor	Keilor	Sunshine North	Sunshine North
					$1,972.74	$1,475.41	$1,773.20	$883.08	$804.51	$1,463.62	$840.58	$904.30	$834.60	$881.83	$1,318.98

Source: REA Group, 2018

Medium Density

Density	Region	Land Value Rate (p.s.m.)			Evidence 1	Evidence 2	Evidence 3
		Low Range	High Range				
Medium	City Central	$6,500	$15,000		286-294 Kings Way & 77 Parks Street	62-63 Palmerston Crescent	31-33 Park Street
					South Melbourne	South Melbourne	South Melbourne
					$6,500.00	$10,935.00	$15,000.00
	City Fringe	$3,546	$19,953		286-316 Mt Alexander Road	1 Brighton Road	55 Claremont Street
					Kensington	St Kilda	South Yarra
					$3,546.00	$9,442.00	$19,953.00
	North	$1,931	$4,930		62 Oakover Road	260-266 Bell Street	5-13 Clarke Street
					Preston	Heidelberg Heights	Brunswick East
					$1,931.00	**$3,114.00**	$4,930.00
	East	$2,400	$7,444		173 Whitehorse Road	254-258 Burwood Highway	2-4 Roche Street
					Blackburn	Burwood	Hawthorn
					$2,400.00	**$3,063.00**	$7,444.00
	South	$430	$6,081		25 Lats Avenue	16-18 Dalgety Street	1396-1402 Malvern Road
					Carrum Downs	Oakleigh	Glen Iris
					$430.00	**$3,839.00**	$6,081.00
	West	$1,944	$4,300		8-10 Sloane Street	14-16 Williamson Road	40-44 Buckley Street
					Maribyrnong	Maribyrnong	Footscray
					$1,944.00	**$2,412.00**	$4,300.00

Source: Charter Keck Cramer, 2018

Category	City Central	City Fringe	North	East	South	West	Average
Max	$15,000	$19,953	$4,930	$7,444	$6,081	$4,300	$3,107
Average	$10,750	$11,750	$3,431	$4,922	$3,256	$3,122	$1,676
Min	$6,500	$3,546	$1,931	$2,400	$430	$1,944	$1,676

Average excludes City Central and City Fringe and apartment sites, evidence incorporated in average shown bolded as representation of medium density

High Density

Density	Region	Land Value Rate (p.s.m.)			Evidence 1	Evidence 2	Evidence 3
		Low Range	High Range				
High	City Central	$15,138	$34,314		300 City Road Southbank $15,138 p.s.m.	25-29 Coventry Street Southbank $17,500 p.s.m.	183-189 A'Beckett Street Melbourne $34,314 p.s.m.
	City Fringe	$4,000	$15,000		2-8 Gough Street Cremorne $4,000 p.s.m.	171 Buckingham Street Richmond $5,338 p.s.m.	42-48 Claremont Street South Yarra $15,000 p.s.m.
	North	$2,525	$4,543		37-39 Bell Street & 45 Linden Avenue Ivanhoe $2,525 p.s.m.	264-266 Raglan Street Preston $2,820 p.s.m.	30 Cramer Street Preston $4,543 p.s.m.
	East	$2,043	$11,435		500 Burwood Highway Wantirna South $2,043 p.s.m.	31-35 Prospect Street Box Hill $8,167 p.s.m.	843 Whitehorse Road Box Hill $11,435 p.s.m.
	South	$1,775	$4,025		2107-2125 Dandenong Road Clayton $1,775	14-22 Woorayl Street Carnegie $3,975 p.s.m.	956-958 Nepean Highway Moorabbin $4,025 p.s.m.
	West	$1,038	$3,380		74-76 Cottrell Street Werribee $1,038 p.s.m.	327-357 Mount Alexander Road Ascot Vale $3,136 p.s.m.	94-104 Buckley Street Footscray $3,380 p.s.m.

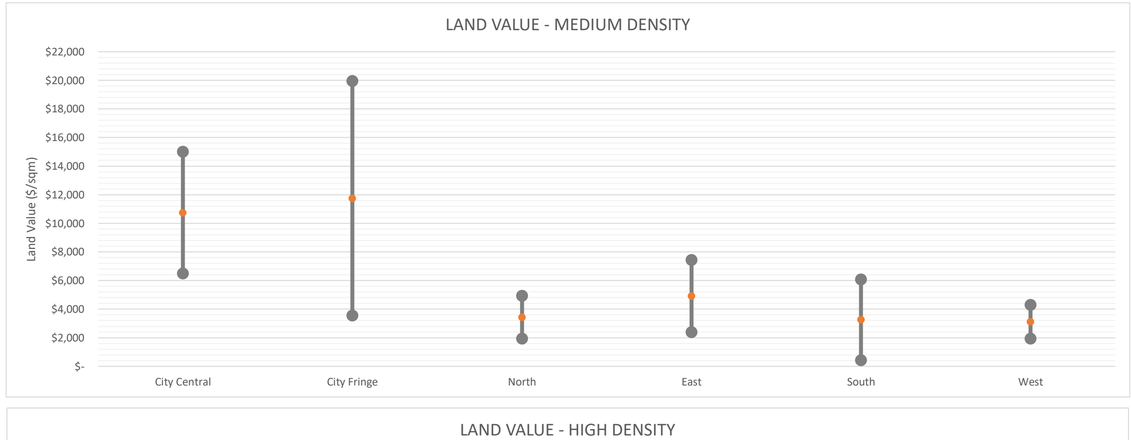
Source: Charter Keck Cramer, 2018

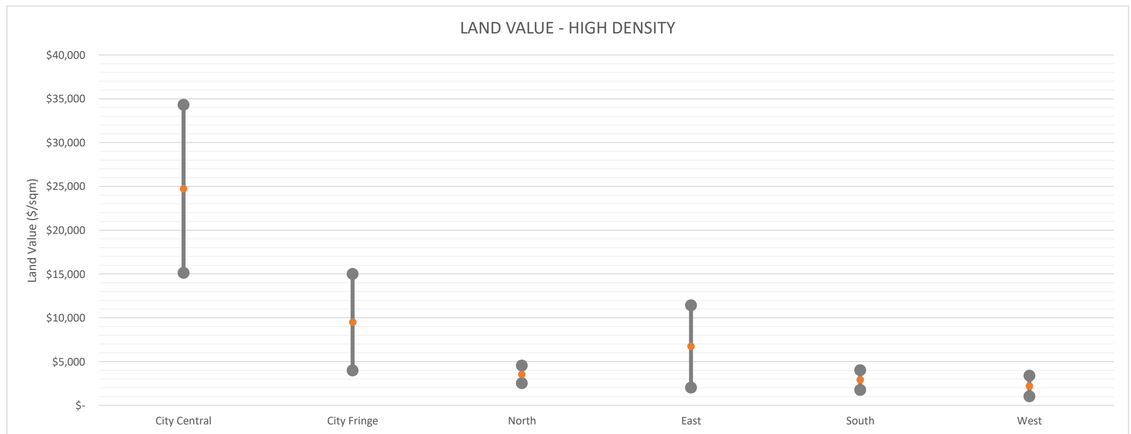
Category	City Central	City Fringe	North	East	South	West	Average
Max	$34,314	$15,000	$4,543	$11,435	$4,025	$3,380	$12,116
Average	$24,726	$9,500	$3,534	$6,739	$2,900	$2,209	$8,268
Min	$15,138	$4,000	$2,525	$2,043	$1,775	$1,038	$4,420

Apartment Sizes

3 bedroom

Apartment	Apartment Area (sq.m)
Ivanhoe	$118
Cremorne	$124
Moonee Ponds 1	$182
Moonee Ponds 2	$140
Moonee Ponds 3	$110
Northcote	$215
Southbank	$107
South Yarra	$115
South Yarra	$95
Southbank	$136
Average	**$134**





APPENDIX D

Dwelling Cost Summary (RLB)

COST BENCHMARKING

04 OCTOBER 2018

DWELLING & SOCIAL INFRASTRUCTURE ANALYSIS

INFRASTRUCTURE VICTORIA

RLB Rider Levett Bucknall

PREPARED FOR

SMEC

SUBMITTED ON

4 October 2018

SUBMITTED BY

Rider Levett Bucknall Victoria Pty Ltd
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PREPARED BY

Brendan Young brendan.young@au.rlb.com

PROJECT NO.

OUR REF

Ver 2

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4 October 2018

Document1
JC/BY/

SMEC
Level 10
71 Queens Road,
Melbourne VIC 3004

Attention: Mr S Carne

Dear Sir

INFRASTRUCTURE PROVISION IN DIFFERENT DEVELOPMENT SETTINGS (IPIDDS)

COST BENCHAMRKING REPORT V2

We trust this report is suitable to your present requirements. Should you require any additional information or clarification, please do not hesitate to contact this office.

Yours faithfully

Brendan Young

Associate
Rider Levett Bucknall Victoria Pty Ltd

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

The objective of the Melbourne project is to compare the relative costs of accommodating residential development in different development settings, comparing areas where existing infrastructure can be leveraged against greenfield development settings.

Infrastructure Victoria have already consulted with infrastructure providers in phase 1 of the project and obtained an understanding of the constraints of the existing infrastructure and is now seeking to develop a cost matrix that identifies the cost of each infrastructure element in the following development settings:

- Greenfield developments
- Small scale dispersed infill developments in middle established areas
- Precinct scale brownfield medium density development in middle/outer established areas
- Precinct scale brownfield high density development in inner Melbourne

As the costs of development are influenced by many variable factors, IV are aiming to identify an average cost for the provision of each infrastructure element and provide scenarios that display the extent to which costs can vary, providing detail on the reason for that variance.

RLB' s emphasis of the work is to provide a range of costs for each building element relating to the provision of social infrastructure and dwellings within the various scenarios. Cost ranges have been compiled from actual development costs, tender estimates of current projects and detailed estimates of proposed developments within each scenario. All costs have been escalated to a baseline of June 2018.

Benchmarked data contains projects of all sizes and quality. The summary table of each scenario is intended to complement the numbers contained in the high/low tables in each scenario. Even though the Benchmark Summary Data may be both higher and lower than that data within the Construction Range table, the data contained in the Construction Range Table is deemed to be the construction range matching the scenarios as presented.

2. SCENARIO CATEGORIES

The following scenarios have been used as the basis for benchmarked cost ranges for projects:

1. Greenfield Developments

Greenfield development consists of subdivision of historically agricultural land into residential lots with a density between 10 and 20 dwellings per hectare of net developable area. In Melbourne, Greenfield development is contained to areas within the Urban Growth Boundary which took effect in June 2014.

2. Small Scale Dispersed Infill Development

Small Scale Dispersed Infill Development (SSDID) is characterised as re-development of existing single dwelling residential lots, commercial or industrial lots of 2 up to 10 dwellings. This most prevalent in inner ring suburbs.

3. Precinct Scale Brownfield Development – low Density

Precinct Scale Brownfield Development (PSBD) is Medium Density Residential defined as development of a lot in excess of 10 dwellings. Buildings can be detached, semi-detached or attached residential dwelling developments with a density range between 20 and 80 dwellings per net developable hectare.

Typical densities are between 30 and 40 dwellings per hectare. Development is generally in 1-4 storey form. Dwelling can be without garages or be front loaded, rear loaded or basement loaded. Examples of medium density residential include:

- terrace style housing on torrens or strata titled lots
- dual occupancies and semi-detached dwellings
- villa and townhouse development
- community titled, master-planned and medium density developments
- manor houses and 'one on top of other' dual occupancies - buildings of between 2-4 dwellings
- low rise apartment buildings

4. Precinct Scale Brownfield Development – High Density

High density development includes residential flat buildings and apartment buildings 5 storeys in height or greater, but may include alternative housing forms which deliver higher dwelling yields. High density housing development includes high-rise development. High density development should occur in locations of intense activity with excellent public transport and be largely limited to locations within the Central City Activity Centre, regional activity centres and some district activity centres where appropriate. High density development also has a place as part of transport orientated developments along major public transport routes.

High density development applies to developments with yields upwards of 80 dwellings per hectare with no upper limit.

Development of this nature is generally typical in inner and middle ring suburbs. High density development is the largest growth sector in Melbourne Residential development.

3. GREENFIELD DEVELOPMENTS

Construction Ranges
Community & Emergency Services Infrastructure

Type	Average Project GFA	$/GFA Low	$/GFA High
Mixed Use Community centre	2,500	3,100	3,500
Cultural Precinct	25,000	4,800	5,500
Child Care / Early Learning Centre	1,500	1,750	2,250

Notes:
Cultural Precinct includes council offices, community use, library, multipurpose spaces for art, performances and meeting use.
Costs include on grade car parking and landscaping to authorities requirements, base levels of FF&E.
Costs exclude Development contributions, Headworks outside site boundary and Design consultant's fees.

Benchmarked Data:

- Local Authority cultural precinct
- Regional Authority new council activity centre
- Childcare centres in new subdivisions in outer ring of Melbourne
- Places of Assembly, church, community centres in new subdivisions

Construction Ranges
Dwelling Costs

Type	Average GFA	$/GFA Low	$/GFA High
Single family Dwellings	220	1,400	1,600
Townhouses	180	1,700	2,200
Apartments	100	2,000	2,500

Notes:
Dwelling costs are based on Greenfield sites in outer suburbs of Melbourne or larger regional centres of Victoria with appropriate available levels of labour, materials and supplies.

Benchmarks have been based on numerous independent living villages developed in new suburbs, planned residential subdivisions and aged care homes.

4. SMALL SCALE DISPERSED INFILL DEVELOPMENTS

Construction Ranges
Community & Emergency Services Infrastructure

Type	Average Project total GFA	$/GFA Low	$/GFA High
Mixed Use Community centre	2,500	3,300	3,700
Cultural Precinct	25,000	4,800	5,500
Child Care / Early Learning Centre	1,500	1,750	2,250

Notes:
Cultural Precinct includes council offices, community use, library, multipurpose spaces for art, performances and meeting use.
Costs include on grade car parking and landscaping to authorities requirements, base levels of FF&E.

Construction Ranges
Dwelling Cost range per m2 on a Total Project basis

Type	Average NSA / Apartment GFA	Average Project Total GFA	$/GFA Low	$/GFA High
Townhouses	n/a	1,000	1,700	2,200
Apartments	80%	2,000	2,200	2,750

Smaller scale developments on existing land blocks. Average size of apartment - 85 m2 NSA

Benchmarked Data Summary:

	Total NSA /Total GFA	Total NSA / Total Apart. GFA	Total $ per GFA	Apartment $ per Apartment GFA	Apartment $ per NSA
Total Project Population Average	63%	79%	2,616	3,048	3,714
Low project	44%	65%	1,767	2,081	2,509
High project	84%	88%	4,103	3,861	5,031
Standard Deviation to mean	10%	4%	556	511	754
Low range	*53%*	*75%*	*$2,060*	*$2,540*	*$2,960*
High range	*73%*	*83%*	*$3,170*	*$3,560*	*$4,470*

Project Population

Suburb	Project Type	No of Dwellings	No of Car Spots	Total GFA M2	Apartment GFA M2	Net Selling Area M2	NSA /Total GFA %	NSA/ Apartment GFA %	Total Cost per GFA $/M2
Footscray	Childcare Centre	-	-	978					$1,778
	Civic redevelopment	-	-	7,589	-				$2,593
	Fire Station	-	-	2,574	-				$2,798
South Melbourne	Mixed Use	70	51	9,765	6,389				$2,555
Carnegie	Apartments	48	58	6,596	4,583	3,519	53%	77%	$2,416
Carnegie	Apartments	40	48	4,137	2,913	2,623	63%	90%	$2,401
Oakleigh South	Apartments	137	150	16,578	12,062	8,707	53%	72%	$1,767
Doncaster East	Apartments	36	50	5,277	3,706	2,870	54%	77%	$1,944
Fitzroy	Apartments	19	19	2,190	1,743	1,225	56%	70%	$3,020
Geelong	Apartments	48	52	5,246	3,595				$2,753
Camberwell	Apartments	8	16	2,270	1,535	1,224	54%	80%	$3,084
Shepparton	Apartments	120	59	3,852	3,852	3,159	82%	82%	$4,103
Mosman	Apartments	10	18	4,397	3,385	2,794	64%	83%	$2,994
East Melbourne	Apartments	16	15	2,690	2,145	1,889	70%	88%	$2,742
Fitzroy	Apartments	12	14	2,295	1,887	1,602	70%	85%	$2,785
Alexandria	Apartments	16	16	2,450	1,760	1,460	60%	83%	$1,845
Ivanhoe East	Apartments	7	11	1,325	1,325	1,113	84%	84%	$2,725
Box Hill	Apartments	34	15	1,650	1,235	1,038	63%	84%	$2,847
South Yarra	Apartments	28	39	6,097	4,392	3,192	52%	73%	$3,120
Wantirna South	Townhouses	94	-	12,445	9,517	7,117	57%	75%	$2,274
Ringwood	Townhouses	7	-	975					$2,001
Bulla	Townhouses	6	-	880					$2,087
Carlton	Townhouses	45	-	3,676	3,261	2,479	67%	76%	$2,800
Elwood	Townhouses	31	-	6,959	4,663	3,044	44%	65%	$3,126
Geelong	Townhouses	28	-	2,530	2,530				$2,734
Ferntree Gully	Townhouses	6	-	1,307					$1,790
Preston	Secondary College	-	-	2,455					$3,553

5. PRECINCT SCALE – BROWNFIELD (LOW DENSITY)

A summary of the budget transfers and variations are as follows:

Construction Ranges
Dwelling Costs

Type	Average NSA / Apartment GFA	Average project Total GFA	$/GFA Low	$/GFA High
Apartment Buildings	75%	15,000	2,400	3,200

Apartment blocks of Three to Eight levels incorporating car parking. Average size of apartment - 85 m2 NSA

Benchmarked Data Summary:

	Total NSA /Total GFA	Total NSA / Total Apart. GFA	Total $ per GFA	Apartment $ per Apartment GFA	Apartment $ per NSA
Total Project Population Average	54%	74%	3,145	2,565	4,482
Low project	32%	65%	2,309	2,116	3,831
High project	78%	90%	5,961	3,682	5,173
Standard Deviation to mean	13%	8%	940	515	462
Low range	*42%*	*66%*	*$2,205*	*$2,050*	*$4,019*
High range	*67%*	*82%*	*$4,085*	*$3,080*	*$4,944*

Project Population

Suburb	Project Type	No of Dwellings	No of Car Spots	Total GFA M2	Apartment GFA M2	Net Selling Area M2	NSA /Total GFA %	NSA/ Apartment GFA %	Total Cost per GFA $/M2
Macleod	Aged Care	124		7,641					$3,351
South Yarra	Residential Aged Care	79		17,248					$5,961
Ashburton	Apartments	200	221	28,896	20,104	13,857	48%	69%	$2,466
Fitzroy	Mixed Use	106	176	26,969	12,916	8,568	32%	66%	$2,309
East Melbourne	Apartments	81	118	13,635	9,055	6,487	48%	72%	$2,895
St. Leonards	Apartments	43	43	9,806	6,661	5,991	61%	90%	$2,547
Braddon	Apartments	50	100	8,880	6,140	4,940	56%	80%	$2,785
St Kilda	Apartments	70	80	7,693	5,628	4,598	60%	82%	$2,823
Prahran	Apartments	84	59	9,010	6,640	4,290	48%	65%	$2,809
Melbourne	Apartments	80		3,705	3,705	2,637	71%	71%	$3,726
Flemington	Residential Aged Care	127	72	10,581	10,581	8,255	78%	78%	$3,452
Brunswick	Mixed Use	122	100	16,220	10,898	7,192	44%	66%	$2,615

6. PRECINCT SCALE (HIGH DENSITY)

Construction Ranges
Dwelling Costs

Type	Average NSA / Apartment GFA	Average Project Total GFA	$/GFA Low	$/GFA High
Apartments	72%	30,000	2,500	3,300
Precinct development (retail, commercial and residential)	60%	100,000	2,400	3,200

Apartment blocks of more than 10 storeys both standalone and mixed use developments incorporating car parking. Average size of apartment - 85 m2 NSA

Benchmarked Data Summary:

	Total NSA /Total GFA	Total NSA / Total Apart. GFA	Total $ per GFA	Apartment $ per Apartment GFA	Apartment $ per NSA
Total Project Population Average	52%	72%	$2,888	$2,608	$4,967
Low project	25%	58%	$2,008	$1,702	$3,239
High project	68%	92%	$6,636	$3,403	$6,719
Standard Deviation to mean	8%	7%	767	415	905
Low range	*44%*	*65%*	*$2,122*	*$2,192*	*$4,062*
High range	*59%*	*79%*	*$3,655*	*$3,023*	*$5,872*

Project Population

Suburb	Project Type	No of Dwellings	No of Car Spots	Total GFA M2	Apartment GFA M2	Net Selling Area M2	NSA /Total GFA %	NSA/ Apartment GFA %	Total Cost per GFA $/M2
Glen Waverly	Aged Care Facility	156	131	19,372					$2,659
Ashburton	Apartments	200	221	28,896	20,104	13,857	48%	69%	$2,466
Ivanhoe	Apartments	201	202	32,708	23,358	14,840	45%	64%	$2,469
Richmond	Apartments	109	131	14,494					$2,677
Richmond	Apartments	233	351	32,225					$2,293
Richmond	Apartments	87	-	7,324					$3,108
Coburg	Apartments			65,833	44,173				$2,318
Sandringham	Apartments	187	374	28,582	16,041	12,985	45%	81%	$2,170
Melbourne	Apartments	300	357	54,592	41,037	28,500	52%	69%	$2,776
Melbourne	Apartments	210	427	46,852	34,561	26,282	56%	76%	$3,291
Zetland	Apartments	228	262	46,712	37,186	25,054	54%	67%	$2,367
Melbourne	Apartments	195	373	42,945	31,764	21,577	50%	68%	$2,825
Doncaster	Apartments	273	364	42,086	28,381	20,486	49%	72%	$2,082
Zetland	Apartments	221	257	36,403	28,781	20,146	55%	70%	$2,805
South Yarra	Apartments	308	409	43,061	30,905	19,742	46%	64%	$2,757
Melbourne	Apartments	119	203	29,796	20,988	15,091	51%	72%	$4,052
Dockland	Apartments	193	276	29,590	19,795	15,366	52%	78%	$2,545
North Sydney	Apartments	241	256	34,897	25,677	18,268	52%	71%	$3,305
Port Melbourne	Apartments	200	378	32,692	22,217	17,283	53%	78%	$3,008
Melbourne	Apartments	104	230	27,596	19,365	15,082	55%	78%	$3,228
Melbourne	Apartments	121	244	27,870	20,970	13,723	49%	65%	$2,753
South Melbourne	Apartments	218	248	27,460	19,086	11,068	40%	58%	$2,763
Melbourne	Apartments	108	181	17,782	12,412	7,731	43%	62%	$3,059
Potts Point	Apartments	71	56	10,114	7,449	6,827	68%	92%	$2,774
Melbourne	Apartments	165	92	11,470	8,418	6,537	57%	78%	$4,034
St Kilda	Apartments	101		8,230	8,230	5,615	68%	68%	$2,622
Melbourne	Apartments	292	262	34,765	25,928	21,114	61%	81%	$2,422
Melbourne	Apartments	180	245	56,244	38,008	27,366	49%	72%	$2,882
	Cultural Precinct	-		24,909					$6,636
Caulfield	Luxury Apartments	165	141	19,188	14,850	11,513	60%	78%	$2,008
Caulfield	Luxury Apartments	278	172	37,965	24,100	18,070	48%	75%	$2,851
Melbourne	Luxury Apartments	575	680	130,778	102,465	72,094	55%	70%	$3,565
Melbourne	Luxury Apartments	529	751	111,685	82,879	52,498	47%	63%	$2,678
Melbourne	Luxury Apartments	137	423	64,575	43,391	31,559	49%	73%	$3,424
Melbourne	Luxury Apartments	303	247	48,305	45,300	28,925	60%	64%	$3,331

Suburb	Project Type	No of Dwellings	No of Car Spots	Total GFA M2	Apartment GFA M2	Net Selling Area M2	NSA /Total GFA %	NSA/ Apartment GFA %	Total Cost per GFA $/M2
Melbourne	Luxury Apartments	104	230	26,275	19,465	15,082	57%	77%	$3,366
	Mixed Use	279	1011	102,875	36,061	25,717	25%	71%	$2,059
	Mixed Use	553	880	146,284	125,498				$2,851
Glen Iris	Residential Apartments	107	164	16,090	10,527	8,565	53%	81%	$2,849
Hampton	Residential Apartments	198	286	28,638	20,009	15,390	54%	77%	$2,120

7. BASIS OF COSTS

The costs presented are based on either tendered contract prices, estimate prices based on DA documentation or estimate prices based on pre-tender documentation. All prices have been indexed up to July 2018 prices.

The costs are reflective of the individual design and site characteristics and each project has varying floor plate sizes, number of floors, number of apartments per floor, design articulation, site location and each project aims at a different market sector.

Due to the individual project variables, this report is intended to present cost ranges only, rather actual market costs based on a diverse range of benchmark projects.

Rider Levett Bucknall publish nationally the "Riders Digest" together with our smartphone App which provides ready access to "standardised" cost data in each respective market.

8. DATA SOURCE

The benchmark data has been sourced from recent projects (within the last five years) at varying stages of the project cycle, i.e. from DA standard of documentation to "for construction" documentation.

The base data costs were all reflective of the market as at the time of the estimate or time of the tender and indexed to June 2018 prices in this Report.

9. QUALITY

The quality of finishes and fit-out of the buildings selected reflects a diverse market standard not only in the buildings selected but also within each building. Generally the lower floors of residential towers have a lower quality of finish than the more desirable higher level. The basis of costing data however is that the standard of appointments are "investment" grade with good quality finishes built to current Australian and Victorian building regulations and standards .

10. CONTRACTORS

The standard of contractor (builder) who has been, or is likely to be, awarded the construction contract is generally Tier One for high density developments and Tier Two & Three for those in the brownfield infill smaller developments. However complexity of the project and site location will also be a factor in the selection of the contractor. Greenfield townhouses and dwellings have been assumed to be built by a project builder or domestic local builders.

11. EXCLUSIONS

The items specifically excluded from the Construction Cost Benchmark data are as follows:

- Design Consultants Fees
- Demolition
- Services Infrastructure Augmentation Costs
- Construction Phase Contingency (up to 5%)
- Statutory Fees, Charges and Contributions (Allowances)
- Legal Fees
- Planning Fees
- Land costs
- Legal and Valuation costs on land purchase
- Stamp duty and registration on land purchase
- Land Holding costs
- Site Decontamination
- Public Artworks
- Prototypes
- Relocation or diversion of existing site services
- Headworks Charges
- Subdivision/consolidation of title costs
- Strata Survey costs
- Marketing, leasing or promotional costs
- Real Estate Agent' s fees, charges or leasing costs
- Escalation beyond June 2018
- Finance costs and Interest charges
- Goods and Services Tax (GST)

12. DEFINITIONS

12.1. GROSS FLOOR AREA (GFA)

The sum of the "Fully Enclosed Covered Area" and "Unenclosed Covered Area" as defined by the Australian Institute of Quantity Surveyors and the Royal Australian Institute of Architects.

12.2. NET SALEABLE AREA (NSA)

The net saleable area of an apartment is the sum of the internal floor areas within the enclosing walls of the apartment. This does not include service areas, balconies, circulation spaces. Lift cores or entry foyer of apartments.

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AFRICA | AMERICAS | ASIA | EUROPE | MIDDLE EAST | OCEANIA

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APPENDIX E

Community Infrastructure Cost Summary

Community & Emergency Infrastructure Cost Summary

Across all scenarios

Population Size	10000
Dwellings	3500
Ratio	2.857142857

Site Area Scaling Ratios

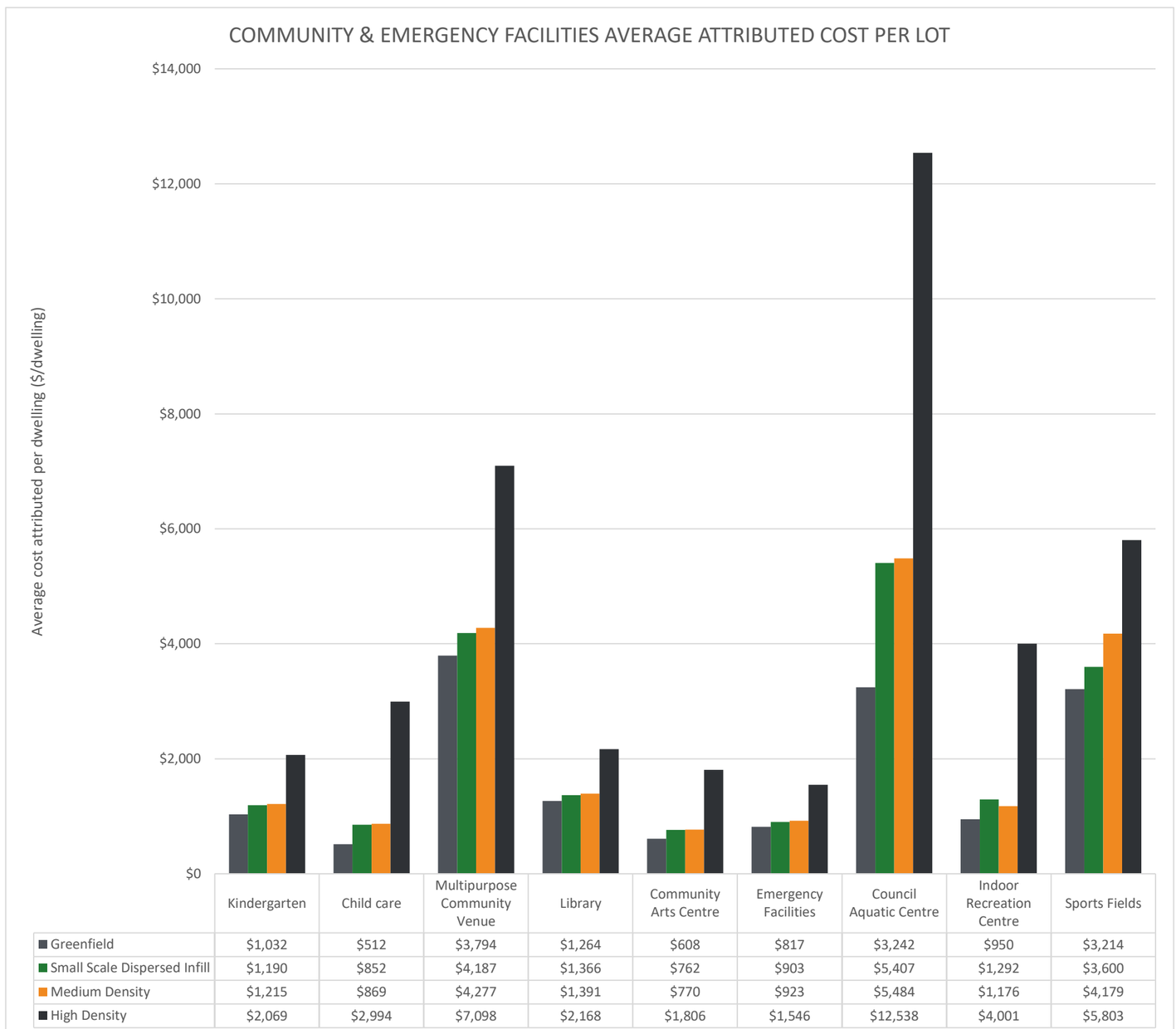
Greenfield	100%
Small Scale Dispersed Infill	50%
Medium Density	50%
High Density	20%

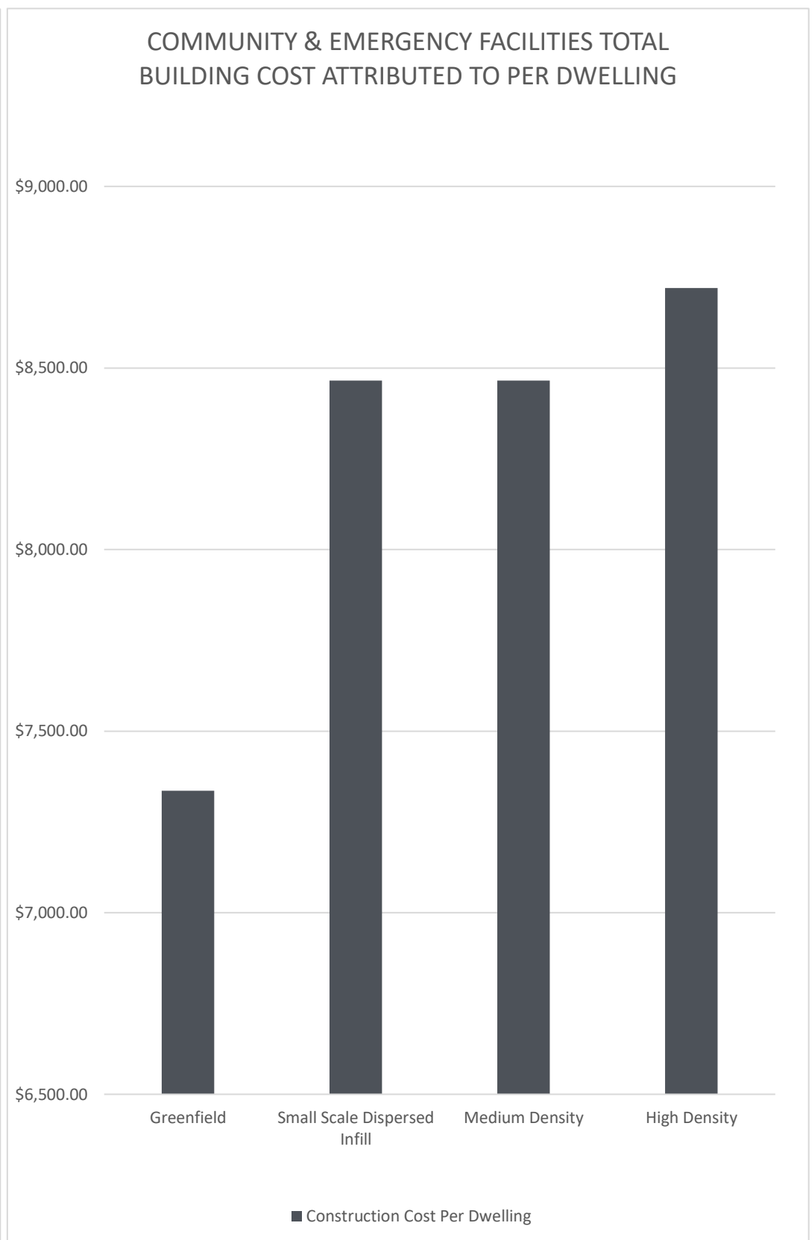
Total Costs

Scenario	Total Construction Cost all facilities	Construction Cost Per Dwelling	Land Cost all facilities	Land Cost per dwelling	Total Cost	Total Cost per dwelling
Greenfield	$25,676,150.00	$7,336.04	$28,342,766.43	$8,097.93	$54,018,916.43	$15,433.98
Small Scale Dispersed Infill	$29,629,850.00	$8,465.67	$38,819,857.83	$11,091.39	$68,449,707.83	$19,557.06
Medium Density	$29,629,850.00	$8,465.67	$41,359,404.38	$11,816.97	$70,989,254.38	$20,282.64
High Density	$30,521,970.00	$8,720.56	$109,558,355.61	$31,302.39	$140,080,325.61	$40,022.95

Land Purchase Cost
Average rate per sq.m
$885
$719
$448
$3,676
$1,623
$789
$3,107
$1,676
$1,676
$12,116
$8,268
$4,420

Scenario	Total Construction Cost	Construction Cost Per Dwelling	Land Cost per facility	Land Cost per dwelling	Total Cost	Total Cost per dwelling
Greenfield						
Max	$31,864,500	$9,104	$35,557,125	$9,906	$67,421,625	$19,010
Average	$25,676,150	$7,336	$28,342,766	$8,098	$54,018,916	$15,434
Min	$19,187,800	$5,482	$17,958,664	$5,387	$37,146,464	$10,869
Small Scale Dispersed Infill						
Max	$34,611,900	$9,889	$83,001,741	$22,664	$117,613,641	$32,554
Average	$29,629,850	$8,466	$38,819,858	$11,091	$68,449,708	$19,557
Min	$22,335,300	$6,382	$19,837,095	$6,118	$42,172,395	$12,500
Medium Density						
Category	$34,611,900	$9,889	$73,151,285	$20,013	$107,763,185	$29,902
Max	$29,629,850	$8,466	$41,359,404	$11,817	$70,989,254	$20,283
Average	$22,335,300	$6,382	$35,981,904	$11,238	$58,317,204	$17,620
High Density						
Category	$35,747,760	$10,214	$171,631,669	$45,576	$207,379,429	$55,790
Max	$30,521,970	$8,721	$109,558,356	$31,302	$140,080,326	$40,023
Average	$22,983,680	$6,567	$52,971,459	$17,029	$75,955,139	$23,596





Detailed Costs

Category	Kindergarten										
	GFA per Population	GFA per dwelling	Site Area	Site Area per dwelling	Construction Cost per sq.m	Total Construction Cost	Construction Cost Per Dwelling	Land Cost per facility	Land Cost per dwelling	Total Cost	Total Cost per dwelling
Greenfield											
Max	620.00	0.18	3300.00	0.94	$2,250	$1,395,000	$399	$2,920,500	$834	$4,315,500	$1,233
Average	620.00	0.18	3300.00	0.94	$2,000	$1,240,000	$354	$2,373,227	$678	$3,613,227	$1,032
Min	620.00	0.18	3300.00	0.94	$1,750	$1,085,000	$310	$1,478,808	$423	$2,563,808	$733
Small Scale Dispersed Infill											
Max	620.00	0.18	1650.00	0.47	$2,700	$1,674,000	$478	$6,065,913	$1,733	$7,739,913	$2,211
Average	620.00	0.18	1650.00	0.47	$2,400	$1,488,000	$425	$2,677,147	$765	$4,165,147	$1,190
Min	620.00	0.18	1650.00	0.47	$2,100	$1,302,000	$372	$1,301,515	$372	$2,603,515	$744
Medium Density											
Category	620.00	0.18	1650.00	0.47	$2,700	$1,674,000	$478	$5,126,550	$1,465	$6,800,550	$1,943
Max	620.00	0.18	1650.00	0.47	$2,400	$1,488,000	$425	$2,765,813	$790	$4,253,813	$1,215
Average	620.00	0.18	1650.00	0.47	$2,100	$1,302,000	$372	$2,765,813	$790	$4,067,813	$1,162
High Density											
Category	620.00	0.18	660.00	0.19	$3,240	$2,008,800	$574	$7,996,670	$2,285	$10,005,470	$2,859
Max	620.00	0.18	660.00	0.19	$2,880	$1,785,600	$510	$5,456,880	$1,559	$7,242,480	$2,069
Average	620.00	0.18	660.00	0.19	$2,520	$1,562,400	$446	$2,917,090	$833	$4,479,490	$1,280

Category	Child care										
	GFA per Population	GFA per dwelling	Site Area	Site Area per dwelling	Construction Cost per sq.m	Total Construction Cost	Construction Cost Per Dwelling	Land Cost per facility	Land Cost per dwelling	Total Cost	Total Cost per dwelling
Greenfield											
Max	504.00	0.14	1092.00	0.31	$2,250	$1,134,000	$324	$966,420	$276	$2,100,420	$600
Average	504.00	0.14	1092.00	0.31	$2,000	$1,008,000	$288	$785,322	$224	$1,793,322	$512
Min	504.00	0.14	1092.00	0.31	$1,750	$882,000	$252	$489,351	$140	$1,371,351	$392
Small Scale Dispersed Infill											
Max	504.00	0.14	1092.00	0.31	$2,700	$1,360,800	$389	$4,014,531	$1,147	$5,375,331	$1,536
Average	504.00	0.14	1092.00	0.31	$2,400	$1,209,600	$346	$1,771,785	$506	$2,981,385	$852
Min	504.00	0.14	1092.00	0.31	$2,100	$1,058,400	$302	$861,366	$246	$1,919,766	$549
Medium Density											
Max	504.00	0.14	1092.00	0.31	$2,700	$1,360,800	$389	$3,392,844	$969	$4,753,644	$1,358
Average	504.00	0.14	1092.00	0.31	$2,400	$1,209,600	$346	$1,830,465	$523	$3,040,065	$869
Min	504.00	0.14	1092.00	0.31	$2,100	$1,058,400	$302	$1,830,465	$523	$2,888,865	$825
High Density											
Max	504.00	0.14	1092.00	0.31	$3,240	$1,632,960	$467	$13,230,854	$3,780	$14,863,814	$4,247
Average	504.00	0.14	1092.00	0.31	$2,880	$1,451,520	$415	$9,028,656	$2,580	$10,480,176	$2,994
Min	504.00	0.14	1092.00	0.31	$2,520	$1,270,080	$363	$4,826,458	$1,379	$6,096,538	$1,742

Category	Multipurpose Community Venue										
	GFA per Population	GFA per dwelling	Site Area	Site Area per dwelling	Construction Cost per sq.m	Total Construction Cost	Construction Cost Per Dwelling	Land Cost per facility	Land Cost per dwelling	Total Cost	Total Cost per dwelling
Greenfield											
Max	1463.00	0.42	11750.00	3.36	$3,500	$5,120,500	$1,463	$10,398,750	$2,971	$15,519,250	$4,434
Average	1463.00	0.42	11750.00	3.36	$3,300	$4,827,900	$1,379	$8,450,125	$2,414	$13,278,025	$3,794
Min	1463.00	0.42	11750.00	3.36	$3,100	$4,535,300	$1,296	$5,265,453	$1,504	$9,800,753	$2,800
Small Scale Dispersed Infill											
Max	1463.00	0.42	5875.00	1.68	$3,700	$5,413,100	$1,547	$21,598,326	$6,171	$27,011,426	$7,718
Average	1463.00	0.42	5875.00	1.68	$3,500	$5,120,500	$1,463	$9,532,266	$2,724	$14,652,766	$4,187
Min	1463.00	0.42	5875.00	1.68	$3,300	$4,827,900	$1,379	$4,634,183	$1,324	$9,462,083	$2,703
Medium Density											
Max	1463.00	0.42	5875.00	1.68	$3,700	$5,413,100	$1,547	$18,253,625	$5,215	$23,666,725	$6,762
Average	1463.00	0.42	5875.00	1.68	$3,500	$5,120,500	$1,463	$9,847,969	$2,814	$14,968,469	$4,277
Min	1463.00	0.42	5875.00	1.68	$3,300	$4,827,900	$1,379	$9,847,969	$2,814	$14,675,869	$4,193
High Density											
Max	1463.00	0.42	2350.00	0.67	$4,000	$5,852,000	$1,672	$28,472,992	$8,135	$34,324,992	$9,807
Average	1463.00	0.42	2350.00	0.67	$3,700	$5,413,100	$1,547	$19,429,800	$5,551	$24,842,900	$7,098
Min	1463.00	0.42	2350.00	0.67	$3,400	$4,974,200	$1,421	$10,386,608	$2,968	$15,360,808	$4,389

Category	Library										
	GFA per Population	GFA per dwelling	Site Area	Site Area per dwelling	Construction Cost per sq.m	Total Construction Cost	Construction Cost Per Dwelling	Land Cost per facility	Land Cost per dwelling	Total Cost	Total Cost per dwelling
Greenfield											
Max	480.00	0.14	3333.00	0.95	$4,500	$2,160,000	$617	$2,949,705	$843	$5,109,705	$1,460
Average	480.00	0.14	3333.00	0.95	$4,225	$2,028,000	$579	$2,396,959	$685	$4,424,959	$1,264
Min	480.00	0.14	3333.00	0.95	$3,950	$1,896,000	$542	$1,493,596	$427	$3,389,596	$968
Small Scale Dispersed Infill											
Max	480.00	0.14	1666.50	0.48	$4,600	$2,208,000	$631	$6,126,572	$1,750	$8,334,572	$2,381
Average	480.00	0.14	1666.50	0.48	$4,325	$2,076,000	$593	$2,703,919	$773	$4,779,919	$1,366
Min	480.00	0.14	1666.50	0.48	$4,050	$1,944,000	$555	$1,314,530	$376	$3,258,530	$931
Medium Density											
Max	480.00	0.14	1666.50	0.48	$4,600	$2,208,000	$631	$5,177,816	$1,479	$7,385,816	$2,110
Average	480.00	0.14	1666.50	0.48	$4,325	$2,076,000	$593	$2,793,471	$798	$4,869,471	$1,391
Min	480.00	0.14	1666.50	0.48	$4,050	$1,944,000	$555	$2,793,471	$798	$4,737,471	$1,354
High Density											
Max	480.00	0.14	666.60	0.19	$4,600	$2,208,000	$631	$8,076,637	$2,308	$10,284,637	$2,938
Average	480.00	0.14	666.60	0.19	$4,325	$2,076,000	$593	$5,511,449	$1,575	$7,587,449	$2,168
Min	480.00	0.14	666.60	0.19	$4,050	$1,944,000	$555	$2,946,261	$842	$4,890,261	$1,397

Category	Community Arts Centre										
	GFA per Population	GFA per dwelling	Site Area	Site Area per dwelling	Construction Cost per sq.m	Total Construction Cost	Construction Cost Per Dwelling	Land Cost per facility	Land Cost per dwelling	Total Cost	Total Cost per dwelling
Greenfield											
Max	410.00	0.12	550.00	0.16	$4,500	$1,845,000	$527	$486,750	$139	$2,331,750	$666
Average	410.00	0.12	550.00	0.16	$4,225	$1,732,250	$495	$395,538	$113	$2,127,788	$608
Min	410.00	0.12	550.00	0.16	$3,950	$1,619,500	$463	$246,468	$70	$1,865,968	$533
Small Scale Dispersed Infill											
Max	410.00	0.12	550.00	0.16	$4,600	$1,886,000	$539	$2,021,971	$578	$3,907,971	$1,117
Average	410.00	0.12	550.00	0.16	$4,325	$1,773,250	$507	$892,382	$255	$2,665,632	$762
Min	410.00	0.12	550.00	0.16	$4,050	$1,660,500	$474	$433,838	$124	$2,094,338	$598
Medium Density											
Max	410.00	0.12	550.00	0.16	$4,600	$1,886,000	$539	$1,708,850	$488	$3,594,850	$1,027
Average	410.00	0.12	550.00	0.16	$4,325	$1,773,250	$507	$921,938	$263	$2,695,188	$770
Min	410.00	0.12	550.00	0.16	$4,050	$1,660,500	$474	$921,938	$263	$2,582,438	$738
High Density											
Max	410.00	0.12	550.00	0.16	$4,600	$1,886,000	$539	$6,663,892	$1,904	$8,549,892	$2,443
Average	410.00	0.12	550.00	0.16	$4,325	$1,773,250	$507	$4,547,400	$1,299	$6,320,650	$1,806
Min	410.00	0.12	550.00	0.16	$4,050	$1,660,500	$474	$2,430,908	$695	$4,091,408	$1,169

Category	Emergency Facilities										
	GFA per Population	GFA per dwelling	Site Area	Site Area per dwelling	Construction Cost per sq.m	Total Construction Cost	Construction Cost Per Dwelling	Land Cost per facility	Land Cost per dwelling	Total Cost	Total Cost per dwelling
Greenfield											
Max	300.00	0.09	2600.00	0.74	$3,500	$1,050,000	$300	$2,301,000	$657	$3,351,000	$957
Average	300.00	0.09	2600.00	0.74	$3,300	$990,000	$283	$1,869,815	$534	$2,859,815	$817
Min	300.00	0.09	2600.00	0.74	$3,100	$930,000	$266	$1,165,121	$333	$2,095,121	$599
Small Scale Dispersed Infill											
Max	300.00	0.09	1300.00	0.37	$3,700	$1,110,000	$317	$4,779,204	$1,365	$5,889,204	$1,683
Average	300.00	0.09	1300.00	0.37	$3,500	$1,050,000	$300	$2,109,267	$603	$3,159,267	$903
Min	300.00	0.09	1300.00	0.37	$3,300	$990,000	$283	$1,025,436	$293	$2,015,436	$576
Medium Density											
Max	300.00	0.09	1300.00	0.37	$3,700	$1,110,000	$317	$4,039,100	$1,154	$5,149,100	$1,471
Average	300.00	0.09	1300.00	0.37	$3,500	$1,050,000	$300	$2,179,125	$623	$3,229,125	$923
Min	300.00	0.09	1300.00	0.37	$3,300	$990,000	$283	$2,179,125	$623	$3,169,125	$905
High Density											
Max	300.00	0.09	520.00	0.15	$4,000	$1,200,000	$343	$6,300,407	$1,800	$7,500,407	$2,143
Average	300.00	0.09	520.00	0.15	$3,700	$1,110,000	$317	$4,299,360	$1,228	$5,409,360	$1,546
Min	300.00	0.09	520.00	0.15	$3,400	$1,020,000	$291	$2,298,313	$657	$3,318,313	$948

GFA estimated from floor layouts

Category	Council Aquatic Centre										
	GFA per Population	GFA per dwelling	Site Area per population	Site Area per dwelling	Construction Cost per sq.m	Total Construction Cost	Construction Cost Per Dwelling	Land Cost per facility	Land Cost per dwelling	Total Cost	Total Cost per dwelling
Greenfield											
Max	3000.00	0.86	6000.00	1.43	$4,000	$12,000,000	$3,429	$5,310,000	$1,264	$17,310,000	$4,693
Average	2500.00	0.71	5000.00	1.43	$3,100	$7,750,000	$2,214	$3,595,798	$1,027	$11,345,798	$3,242
Min	1250.00	0.36	3000.00	1.43	$2,200	$2,750,000	$786	$1,344,371	$640	$4,094,371	$1,426
Small Scale Dispersed Infill											
Max	3000.00	0.86	6000.00	1.43	$4,600	$13,800,000	$3,943	$22,057,865	$5,252	$35,857,865	$9,195
Average	2500.00	0.71	5000.00	1.43	$4,325	$10,812,500	$3,089	$8,112,567	$2,318	$18,925,067	$5,407
Min	1250.00	0.36	3000.00	1.43	$4,050	$5,062,500	$1,446	$2,366,391	$1,127	$7,428,891	$2,573
Medium Density											
Max	3000.00	0.86	6000.00	1.43	$4,600	$13,800,000	$3,943	$18,642,000	$4,439	$32,442,000	$8,381
Average	2500.00	0.71	5000.00	1.43	$4,325	$10,812,500	$3,089	$8,381,250	$2,395	$19,193,750	$5,484
Min	1250.00	0.36	3000.00	1.43	$4,050	$5,062,500	$1,446	$5,028,750	$2,395	$10,091,250	$3,841
High Density											
Max	3000.00	0.86	5000.00	1.14	$4,600	$13,800,000	$3,943	$60,580,833	$13,847	$74,380,833	$17,790
Average	2500.00	0.71	4000.00	1.14	$4,325	$10,812,500	$3,089	$33,072,000	$9,449	$43,884,500	$12,538
Min	1250.00	0.36	2500.00	1.14	$4,050	$5,062,500	$1,446	$11,049,583	$5,051	$16,112,083	$6,498

Assumed 1 No. facility per 20,000 population (0.5 per population)

Category	Indoor Recreation Centre										
	GFA per Population	GFA per dwelling	Site Area	Site Area per dwelling	Construction Cost per sq.m	Total Construction Cost	Construction Cost Per Dwelling	Land Cost per facility	Land Cost per dwelling	Total Cost	Total Cost per dwelling
Greenfield											
Max	800.00	0.23	2400.00	0.69	$2,200	$1,760,000	$503	$2,124,000	$607	$3,884,000	$1,110
Average	800.00	0.23	2400.00	0.69	$2,000	$1,600,000	$457	$1,725,983	$493	$3,325,983	$950
Min	800.00	0.23	2400.00	0.69	$1,800	$1,440,000	$411	$1,075,497	$307	$2,515,497	$719
Small Scale Dispersed Infill											
Max	800.00	0.23	1800.00	0.51	$2,200	$1,760,000	$503	$6,617,359	$1,891	$8,377,359	$2,394
Average	800.00	0.23	1800.00	0.51	$2,000	$1,600,000	$457	$2,920,524	$834	$4,520,524	$1,292
Min	800.00	0.23	1800.00	0.51	$1,800	$1,440,000	$411	$1,419,835	$406	$2,859,835	$817
Medium Density											
Max	800.00	0.23	1500.00	0.43	$2,200	$1,760,000	$503	$4,660,500	$1,332	$6,420,500	$1,834
Average	800.00	0.23	1500.00	0.43	$2,000	$1,600,000	$457	$2,514,375	$718	$4,114,375	$1,176
Min	800.00	0.23	1500.00	0.43	$1,800	$1,440,000	$411	$2,514,375	$718	$3,954,375	$1,130
High Density											
Max	800.00	0.23	1500.00	0.43	$2,200	$1,760,000	$503	$18,174,250	$5,193	$19,934,250	$5,696
Average	800.00	0.23	1500.00	0.43	$2,000	$1,600,000	$457	$12,402,000	$3,543	$14,002,000	$4,001
Min	800.00	0.23	1500.00	0.43	$1,800	$1,440,000	$411	$6,629,750	$1,894	$8,069,750	$2,306

Indoor recreation centre construction cost rates provided from Rawlinsons 2018 in lieu of actual construction cost data

Category	Sports Fields											
	GFA per Population	GFA per dwelling	Site Area	Site Area per dwelling	Construction Cost per sq.m	Total Construction Cost	Construction Cost Per Dwelling	Land Cost per facility	Land Cost per dwelling	Total Cost	Total Cost per dwelling	Assumed land cost $/sq.m
Greenfield												
Max	45000.00	12.86	45000.00	12.86	$120	$5,400,000	$1,543	$8,100,000	$2,314	$13,500,000	$3,857	$180
Average	45000.00	12.86	45000.00	12.86	$100	$4,500,000	$1,286	$6,750,000	$1,929	$11,250,000	$3,214	$150
Min	45000.00	12.86	45000.00	12.86	$90	$4,050,000	$1,157	$5,400,000	$1,543	$9,450,000	$2,700	$120
Small Scale Dispersed Infill												
Max	45000.00	12.86	45000.00	12.86	$120	$5,400,000	$1,543	$9,720,000	$2,777	$15,120,000	$4,320	$216
Average	45000.00	12.86	45000.00	12.86	$100	$4,500,000	$1,286	$8,100,000	$2,314	$12,600,000	$3,600	$180
Min	45000.00	12.86	45000.00	12.86	$90	$4,050,000	$1,157	$6,480,000	$1,851	$10,530,000	$3,009	$144
Medium Density												
Max	45000.00	12.86	45000.00	12.86	$120	$5,400,000	$1,543	$12,150,000	$3,471	$17,550,000	$5,014	$270
Average	45000.00	12.86	45000.00	12.86	$100	$4,500,000	$1,286	$10,125,000	$2,893	$14,625,000	$4,179	$225
Min	45000.00	12.86	45000.00	12.86	$90	$4,050,000	$1,157	$8,100,000	$2,314	$12,150,000	$3,471	$180
High Density												
Max	45000.00	12.86	45000.00	12.86	$120	$5,400,000	$1,543	$22,135,135	$6,324	$27,535,135	$7,867	$492
Average	45000.00	12.86	45000.00	12.86	$100	$4,500,000	$1,286	$15,810,811	$4,517	$20,310,811	$5,803	$351
Min	45000.00	12.86	45000.00	12.86	$90	$4,050,000	$1,157	$9,486,486	$2,710	$13,536,486	$3,868	$211

Notes and Assumptions

1. Sports fields land cost based on cost to acquire only land component. This is base loaded against $2M per hectare given purchase price is not generally full residential development price
2. Assumed 1 No. single oval facility per 10,000 population
3. Construction cost data provided by RLB as a per square metre cost for construction by category. Refer detailed report of provided costs. Costs averaged and applied across scenarios where data gaps present
4. Land cost component determined from evidence as provided by Charter Keck Cramer for different scenarios

Community & Emergency Facilities Requirements
Across all scenarios

Category	Description	Factored Data - 10,000 Population				Base Data			
		Base population	Built Form (UFA - SQM)	Site Area (SQM)	Notes	Reference	Base population	Built Form (UFA - SQM)	Site Area (SQM)
Kindergarten*	4 yo Kindergarten - double room facility	10,000	420sqm landscaped outdoor play area 400sqm floor area	3,300	1- 4yo double room/10,000	AS&RR 2008	10,000	420sqm landscaped outdoor play area 400sqm floor area	3300sqm
	3yo kindergarten	10,000	100sqm floor area	incl with 4yo kinder	1- 3yo single room/10,000	AS&RR 2008		100sqm floor area	incl with 4yo kinder
Child Care	Floor space	10,000	Facility for for 120 children	2,500		AS&RR 2008	8000 to 10000	Facility for for 120 children	2,500
	Outdoor paved area	10,000	Facility for for 120 children			AS&RR 2008	8000 to 10000	Facility for for 120 children	
Multipurpose Community Facilities*	level 1 Multipurpose community facility	10,000		8,000		AS&RR 2008	8000 to 10000		8,000
	level 3 Multipurpose community facility	10,000		3,750			40,0000 to 50,000		15,000
	Maternal & child health - Floor area sqm	10,000	63			AS&RR 2008	16,000	100	
	Play group - floor space	10,000	300			AS&RR 2008	5,000	150	
	neighbourhood house	10,000	300		200-600 sqm range provided. Adopt 600 as assume covering all other general facilities below	AS&RR 2008	20,000	600	
	Home & community Care- planned Activity group room		80				40,000 to 60,000	400	
	Home & commnity Care - Meals dispatch		0		assume existing services can support or private provider				
	Meeting rooms								
	200+	10,000	125			AS&RR 2008	20,000	250	
	101-200	10,000	231			AS&RR 2008	8,000	185	
	51-100	10,000	113			AS&RR 2008	8,000	90	
	21-50	10,000	63			AS&RR 2008	8,000	50	
	1-20	10,000	188			AS&RR 2008	4,000	75	
	Occasional care, early childhood intervention				included in shared meeting space				
	Youth services & facilities, seniors facilities				included in shared meeting space				
Library (Level 3 &4)		10,000	480	3,333	Level 3 library for 30,000 people assumed	AS&RR 2008	30,000	1,440	10,000
Arts Centres	Community Arts Centres								
	Level 2 / Colocated Level 3 community ar	10,000	160		colocated on school or MPCC	AS&RR 2008	40,000 to 60,000	800	
	Level 3 community arts centre	10,000	250	550			40,000 to 60,000	1,250	2,750
	Regional Arts Centre		0	-	assume already in existence for all municpalirties	AS&RR 2008	municipality		
Aquatic Centres	Council Indoor Aquatice/Fitness Centre l	10,000	Refer AS&RR 2008 for description	Refer AS&RR 2008 for description		AS&RR 2008	40,000	Refer AS&RR 2008 for description	Refer AS&RR 2008 for description
Recreation Centre	Council Indoor recreation centres level1,	10,000	800	2,400	Refer AS&RR 2008 for description		20,000 to 30,000	2000	6,000
Sports Fields	Open space and sports fields	10,000		45,000	PSP Review		10000		
Emergency services infrastructure	Colocated facility Vic Police, Fire, VICSES & Ambulance (Greenfield only, not required in established areas)	10,000		2,600	1 police station, I colocated fire/ses facility & 1 ambulance station		50000		13,000

Basis of facility areas - AS&RR 2008, Planning for Community Infrastructure in Growth Areas
https://vpa.vic.gov.au/wp-content/Assets/Files/Planning_for_Community_Infrastructure_in_Growth_Areas_Apr08.pdf

Facility area scaled to a population of 10,000 people (3,500 dwellings based on GA ratios)

local people
global experience

SMEC is recognised for providing technical excellence and consultancy expertise in urban, infrastructure and management advisory. From concept to completion, our core service offering covers the life-cycle of a project and maximises value to our clients and communities. We align global expertise with local knowledge and state-of-the-art processes and systems to deliver innovative solutions to a range of industry sectors.

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