



# Daily Population Estimates

Summary Report 2019

## Contents

Introduction.....	3
Summary .....	3
Overall estimates .....	3
Small area estimates (adult daily population only) .....	4
Method .....	5
Overview.....	5
Defining daily population groups.....	6
Other considerations .....	7
Re-weighting the adult estimates.....	7
Non-adult estimates .....	7
Appendix .....	9
References .....	11

## Introduction

Since 2005 the City of Melbourne has published annual estimates of people travelling to (being present in) our municipality. Referred to as our “daily population”, these provide an important input into planning and decision making regarding our city.

Mobility data insights are a relatively recent innovation. With mobile ownership among adults in Australia reaching almost saturation point and vast improvements in mobile signal triangulation, billions of signals a day are captured by mobile networks. The resulting rich datasets can provide incredibly reliable insights about how and where people move.

Latest estimates for the City of Melbourne were principally derived via a specialist supplier of mobility data analytics. The supplier conducted their analysis using a representative sample of 2019 data from one of Australia’s largest telcos extrapolated to the population of Australian residents and international visitors. For privacy reasons, the data sample related only to adults aged 20 years and over.

Additionally, non-adult estimates were derived in-house and combined with the mobile data estimates to provide an overall picture of our daily population on an average weekday (Monday to Friday) and an average weekend day (Saturday to Sunday) in 2019.

## Summary

### Overall estimates

In 2019 an estimated 910,800 people were present in our municipality on a typical weekday and 753,100 on a typical weekend.

Around half of the people seen on a weekday were classified as domestic visitors, that is, people who live outside of the municipality and were visiting for non-work reasons. On a weekend day, the number of domestic visitors was slightly lower. In contrast, international visitors comprised around 4% of the daily population on both weekdays and weekends.

During the week, around one quarter of the daily population or 234,300 people were defined as workers. This number drops to around 90,500 people on weekends which is not surprising given around two thirds (65%) of the municipality’s employment relates to fulltime work (City of Melbourne, 2020).

### Melbourne municipality: Overall daily population by key groups 2019

Population group	Avg. weekday	Avg. weekend
Residents	185,800	182,700
Workers	234,300	90,500
Domestic visitors	454,000	446,000
International visitors	36,700	33,900
<b>Total</b>	<b>910,800</b>	<b>753,100</b>

Around 9% (86,300 out of 910,800) of the weekday daily population is estimated to comprise young people aged under 20. On weekends, this proportion increases to around 14% (108,500 out of 753,100).

## Small area estimates (adult daily population only)

Over half of the municipality's adult weekday daily population is present in the CBD. This is to be expected given the high concentration of businesses in the area. Southbank, Docklands, Carlton and East Melbourne round out most of the remainder of the adult weekday daily population, with 100,000+ people estimated in each of these areas.

On weekends, within each small area, typically fewer adults are observed. In the CBD the adult weekend population drops to around two thirds of that observed on weekdays. The exception is Southbank where the adult weekday and weekend daily populations are similar.

### Melbourne municipality: Adult daily population by small areas 2019\*

Small area	Avg. weekday	Avg. weekend
Melbourne CBD	413,200	276,800
Southbank	134,100	134,700
Docklands	126,500	85,300
Carlton	110,800	100,700
East Melbourne	106,400	99,900
South Yarra / Melbourne (Remainder)	86,000	64,500
Parkville	73,100	48,300
North Melbourne	48,100	39,900
Kensington	44,600	47,900
Port Melbourne	34,100	19,700
West Melbourne (Industrial)	28,700	24,900
West Melbourne (Residential)	26,200	25,600
<b>Total</b>	<b>824,400</b>	<b>644,500</b>

\* Note combining the estimates for each of the small areas will not add up to the total displayed as individuals may be counted in more than one area. For more information, refer to the method section of this report.

## Method

### Overview

A sample of anonymised mobile data supplied by one of Australia's largest telcos formed the basis of our adult daily population estimates. Specifically, the inputs were eight weeks (4 x fortnights) of data considered to be representative of 2019 period. The analysis was undertaken by DSpark, a specialist provider of mobile data analytics, with the inputs chosen in consultation with the supplier.

The data was first processed to determine an individual's location at each observation. When an individual stays in a location for 15 minutes or more, this is identified as a "stay point." Only individuals who had an observed stay point within the Melbourne Local Government Area (LGA) were counted towards the estimates. Those who did not, including those only travelling through (i.e. not staying for at least 15 minutes), were not counted.

An extrapolation (weighting) factor for each individual in the sample was calculated. This enables the underlying counts from the mobile data to be extrapolated to the wider population. In the case of Australian residents, this was achieved using the Estimated Resident Population (ERP) at 30 June 2018 (ABS, March 2020). This was the latest ERP available at the time with a status of "revised", meaning it is unlikely to change. Using the latest revised ERP is standard practice for DSpark in weighting their data. Immigration data from 2017-2019 was used to calculate weightings for non-Australian residents in the sample (ABS, 2020).

Weighted counts of unique people observed in the area (e.g. with at least one stay point) were aggregated for each day or 24 hour period. These were averaged across all weekdays and across all weekend days in the sample to derive the **adult daily population estimates** for the municipality.

Adult estimates for small areas within the municipality were also derived from the mobile data. City of Melbourne comprises 13 small areas which have been pre-defined by our Census of Land Use and Employment (CLUE). For the purpose of estimating our daily population, two of these areas were combined resulting in a total of 12 small areas. As Melbourne (remainder) comprises mostly parkland, it is sometimes combined with South Yarra for reporting purposes.

Small areas were mapped by combining data at the Statistical Area 1 (SA1) level. The alignment of SA1s to our small areas and indeed the overall Melbourne LGA municipal boundary is not exact, with some SA1s falling across multiple small areas or other LGAs. During the mapping process, an SA1 was included within our LGA and in turn a specific small area if the majority of that SA1 fell within the relevant boundaries.

Following provision of the mobile data estimates, the City of Melbourne applied additional weightings to the adult estimates based on the ERP at 30 June 2019 (ABS, March 2020). This estimate was first published with a status of "preliminary". Whilst changes may occur in subsequent publication updates, revisions to the preliminary ERP for Melbourne LGA have historically been quite small. Applying additional weighting was completed to ensure the estimates were reflective of the population from the period in which they were drawn. The resulting figures are referred to in this report as the **re-weighted adult daily population estimates**.

Lastly, City of Melbourne derived estimates for non-adults (aged under 20 years) and added these to the re-weighted estimates to provide a complete picture of our daily population. This was completed in-house using a range of reliable sources. The resulting figures are referred to in this report as the **overall daily population estimates**.

## Defining daily population groups

As requested by the City of Melbourne, individuals in the mobile data sample were categorised into four mutually exclusive groups: residents, workers, domestic visitors and international visitors.

This was done based on their home location and work location which are inferred using a rolling 90 days of data and looking at travel patterns including the amount of time spent at a location, when and how often. This is the only way to determine an individual's home and work location as the data is anonymised and not linked with any personal information.

Using this method DSpark maintains they can accurately differentiate home and work locations even for those who do not work the traditional Monday to Friday, nine to five hours. However this method is unable to determine a work location for every individual, including those working across many locations or changing work locations quite frequently such as couriers and tradespeople.

The result is that some individuals who have visited Melbourne LGA for work purposes (e.g. to attend meetings) may not have been counted as workers if their primary work location is outside of the LGA or was unable to be determined from the data. Instead these individuals have been counted as domestic visitors. Refer to the table below for further details.

### Daily population group definitions

Population group	Definition	Notes
Residents	<ul style="list-style-type: none"> <li>Home location in Melbourne LGA</li> </ul>	<ul style="list-style-type: none"> <li>Work location may also be in Melbourne LGA or unable to be determined</li> </ul>
Workers	<ul style="list-style-type: none"> <li>Work location in Melbourne LGA</li> </ul>	<ul style="list-style-type: none"> <li>Home location is outside of Melbourne LGA</li> <li>Excludes people like couriers for whom a work location is unable to be determined</li> <li>Excludes people travelling into the area for work purposes but whose primary work location is outside of the LGA</li> </ul>
Domestic visitors	<ul style="list-style-type: none"> <li>Home location is outside Melbourne LGA (but in Australia)</li> <li>Work location is outside Melbourne LGA (but in Australia) or unable to be determined</li> </ul>	<ul style="list-style-type: none"> <li>Includes people like students</li> <li>Includes people like couriers for whom a work location is unable to be determined</li> <li>Includes people travelling into the area for work purposes but whose primary work location is outside of the LGA</li> </ul>
International visitors	<ul style="list-style-type: none"> <li>Non Australian residents with an international SIM card</li> </ul>	N/A

It is important to note that an individual is not categorised in the same way that they would be in a traditional travel survey (e.g. I am visiting today to attend a meeting, therefore I am classified as a worker).

Another key point is that how an individual is categorised may change depending on their home and work location for the observed period (e.g. home location in January may be different in July due to moving house).

In deriving estimates at the small area level, individuals were categorised in the same way as at the LGA level, that is by looking at which small areas their home and work locations were in. However as an individual may travel to more than one small area on any given day, they may have been counted in multiple small areas. For example, a person living in South Yarra may travel to Southbank for lunch and then to the CBD to do some shopping. In this instance they would be counted as resident of South Yarra and as a domestic visitor to both Southbank and the CBD.

## Other considerations

On any given day there will be people away from the LGA for one reason or another. These could be people away from home on holiday, not attending work due to illness/injury etc. or working from home or at another location. This impacts the number of daily observations and in turn the final estimates.

Similarly the number of people observed is influenced by things such as events, public holidays and school holidays which can result in changes to an individual's usual travel patterns and behaviours. To minimise the impact of events and so on, the sample of data chosen does not contain any public holidays or school holiday periods.

- For the **adult daily population estimates** derived from mobile data as provided by DSpark, refer to the attached tables in the Appendix.

## Re-weighting the adult estimates

Melbourne is one of the fastest growing cities in Australia and the yearly increase in the residential population can be considerable according to ABS data. Consequently any mismatch in periods between the mobile data and the population data naturally raises concerns that the daily population might be underestimated.

Following provision of the mobile data estimates, the City of Melbourne requested an analysis (completed by DSpark) investigating the impact of weighting the data using the 2018 ERP versus the 2019 ERP in calculating the mobile data estimates. The analysis revealed weighting the data using the 2018 ERP had most likely had resulted in an underestimation of approximately 10%.

To ensure the estimates were more reflective of the period they represent, re-weighting of the data at the individual level was requested. This however was not practical for a number of reasons, namely it would involve re-weighting the entire DSpark dataset, not just the sample in question. As an alternative, DSpark was able to provide weighting factors from the aforementioned analysis which could be applied to the mobile data estimates to better represent the daily population in 2019. These were applied by the City of Melbourne and resulted in the **re-weighted adult daily population estimates**.

## Non-adult estimates

To protect minors, Australian privacy law prevents mobility data from being accessed for anyone under the age of 18. As an additional measure, DSpark excludes data from anyone under the age of 20. The result is that only mobile data from the adult population (20+ years) is available for analysis.

City of Melbourne sought to address this gap by estimating the non-adult daily population aged under 20 years for each of the four main groups (residents, workers, domestic visitors and international visitors). This was achieved using inputs from a range of reliable data sources such as the Australian Bureau of Statistics, the Victorian Department of Transport and Tourism Research Australia. Further details are provided in the table below.

During the estimation process, some extrapolations were required to address areas where the data was insufficient for our purposes or wasn't yet available for the period of interest. For example Tourism Research Australia data does not include individuals aged under 15 and the Department of Transport is yet to release 2019 data at the time of writing. Due to a lack of reliable data at the local level, the non-adult daily population was not able to be estimated for City of Melbourne small areas.

Once the estimation process was complete, the non-adult estimates were added to the mobile data estimates to create the overall daily population estimates for the municipality.

### Non-adult daily population estimates sources and inputs

Population group	Sources	Inputs
Residents	1. Australian Bureau of Statistics, Regional Population by Age and Sex	Estimated Resident Population at 30 June 2019 aged 0-19 years for Melbourne LGA
	2. DSpark, City of Melbourne Daily Population Estimates	Weekday to weekend ratio of residents observed in Melbourne LGA
Workers	1. Department of Transport Victoria, Victorian Integrated Survey of Travel Activity (VISTA)	Weighted count of people (on a. weekdays and b. weekends) in 2018 aged 0-19 years travelling to their primary place of work within Melbourne LGA (defined in the VISTA survey as "my workplace").*
	2. City of Melbourne, Census of Land Use and Employment	Average annual percentage increase in Melbourne LGA employment (jobs) from 2009 to 2019.
Domestic visitors	1. Department of Transport Victoria, Victorian Integrated Survey of Travel Activity (VISTA) 2012-2018	Weighted count of people (on a. weekdays and b. weekends) in 2018 aged 0-19 years travelling to a destination within Melbourne LGA other than their primary place of work.
	2. Tourism Research Australia, National Visitor Survey (NVS)	Average annual percentage increase in travellers visiting Melbourne LGA for non-work purposes from 2014-2018.**  Percentage of interstate travellers visiting Melbourne LGA for non-work in 2019.
International visitors	1. Department of Home Affairs, Overseas Arrivals and Departures, Short Term Visitor Arrivals by Age and State	Percentage of Victorian short term visitor arrivals in 2019 aged 0-14 years (monthly average)
	2. Tourism Research Australia, International Visitor Survey (IVS)	Total number of visitors to Melbourne LGA in 2019 (aged 15-19 & 20+)  Average number of nights stayed in Melbourne LGA in 2019 (aged 15-19 & 20+)
	3. DSpark, City of Melbourne Daily Population Estimates	Weekday to weekend ratio of international visitors observed in Melbourne LGA

\* Excludes people travelling to another workplace or for other work purposes within the LGA which is consistent with the way workers are defined under the DSpark approach.

\*\* 2014-2018 used due to stable methodology across this period. TRA advises not comparing 2019 with previous results due to changes in survey methodology which has likely affected results. Refer [TRA website](#).



## Appendix

The following table displays the overall daily population estimates derived from a combination of re-weighted mobile data estimates and in-house estimates for non-adults.

### Overall (all ages) daily population estimates 2019\*

All ages	Residents	Workers	Domestic Visitors	International Visitors	Total
City of Melbourne – Avg. weekday	185,800	234,300	454,000	36,700	910,800
City of Melbourne – Avg. weekend	182,700	90,500	446,000	33,900	753,100

\* Estimates have been rounded to the nearest 100.

The following tables display the mobile data estimates approximately re-weighted according to the Estimated Resident Population (ERP) at 30 June 2019 as published by the Australian Bureau of Statistics.

### Adult (20+ years) daily population estimates 2019 (re-weighted mobile data)\*

Adults – Avg. weekday	Residents	Workers	Domestic Visitors	International Visitors	Total
Carlton	24,400	10,500	71,000	4,800	110,800
Docklands	11,600	31,000	78,300	5,700	126,500
East Melbourne	9,900	15,700	76,600	4,200	106,400
Kensington	15,200	3,400	25,400	600	44,600
Melbourne CBD	40,500	98,000	257,400	17,300	413,200
North Melbourne	12,900	3,900	29,600	1,700	48,100
Parkville	7,900	13,600	49,900	1,800	73,100
Port Melbourne	800	8,300	24,100	900	34,100
South Yarra / Melbourne (Remainder)	15,400	15,700	51,800	3,100	86,000
Southbank	23,600	21,000	83,400	6,100	134,100
West Melbourne (Industrial)	1,200	3,000	23,100	1,400	28,700
West Melbourne (Residential)	5,500	1,900	17,300	1,600	26,200
<b>City of Melbourne - total</b>	<b>163,400</b>	<b>232,000</b>	<b>398,900</b>	<b>30,100</b>	<b>824,400</b>

Adults – Avg. weekend	Residents	Workers	Domestic Visitors	International Visitors	Total
Carlton	24,300	4,400	67,300	4,700	100,700
Docklands	10,900	3,800	65,400	5,100	85,300
East Melbourne	9,600	3,900	82,200	4,100	99,900
Kensington	15,300	2,000	30,000	600	47,900
Melbourne CBD	38,600	27,000	195,300	15,900	276,800
North Melbourne	12,900	1,500	23,800	1,700	39,900
Parkville	7,700	4,100	34,900	1,500	48,300
Port Melbourne	800	1,300	17,000	700	19,700
South Yarra / Melbourne (Remainder)	15,000	3,100	43,500	2,900	64,500
Southbank	23,300	7,900	97,500	5,900	134,700
West Melbourne (Industrial)	1,200	1,100	21,400	1,300	24,900
West Melbourne (Residential)	5,500	700	17,700	1,800	25,600
<b>City of Melbourne - total</b>	<b>160,700</b>	<b>89,300</b>	<b>366,800</b>	<b>27,800</b>	<b>644,500</b>

\* Estimates have been rounded to the nearest 100.

The following table displays the non-adult estimates derived by City of Melbourne.

### Non-adult (under 20 years) daily population estimates 2019\*

Non-adults	Residents	Workers	Domestic Visitors	International Visitors	Total
City of Melbourne – Avg. weekday	22,400	2,200	55,100	6,600	86,300
City of Melbourne – Avg. weekend	22,000	1,200	79,200	6,100	108,500

\* Estimates have been rounded to the nearest 100.

The following tables display the original mobile data estimates provided by DSpark. These estimates were weighted according to the Estimated Resident Population (ERP) at 30 June 2018 as published by the Australian Bureau of Statistics.

### Adult (20+ years) daily population estimates 2019 (original mobile data)

Adults – Avg. weekday	Residents	Workers	Domestic Visitors	International Visitors	Total
Carlton	20,885	9,121	63,417	4,826	98,249
Docklands	8,376	27,225	68,652	5,688	109,941
East Melbourne	9,034	13,909	71,597	4,155	98,695
Kensington	14,655	3,113	23,260	599	41,627
Melbourne CBD	29,132	85,947	229,852	17,266	362,197
North Melbourne	10,867	3,509	26,402	1,663	42,441
Parkville	7,228	11,790	44,944	1,754	65,716
Port Melbourne	718	7,305	22,122	872	31,017
South Yarra / Melbourne (Remainder)	14,820	14,143	47,925	3,109	79,997
Southbank	17,898	18,457	76,505	6,052	118,912
West Melbourne (Industrial)	1,027	2,651	20,427	1,406	25,511
West Melbourne (Residential)	4,340	1,687	14,753	1,596	22,376
<b>City of Melbourne - total</b>	<b>149,896</b>	<b>203,548</b>	<b>369,386</b>	<b>30,070</b>	<b>752,901</b>

Adults – Avg. weekend	Residents	Workers	Domestic Visitors	International Visitors	Total
Carlton	20,740	3,844	60,045	4,720	89,349
Docklands	7,902	3,347	57,392	5,132	73,773
East Melbourne	8,706	3,436	76,868	4,145	93,155
Kensington	14,676	1,832	27,523	646	44,677
Melbourne CBD	27,786	23,703	174,392	15,873	241,754
North Melbourne	10,853	1,313	21,276	1,688	35,130
Parkville	7,092	3,584	31,478	1,467	43,621
Port Melbourne	699	1,111	15,563	652	18,025
South Yarra / Melbourne (Remainder)	14,443	2,778	40,256	2,914	60,391
Southbank	17,625	6,950	89,472	5,947	119,994
West Melbourne (Industrial)	1,018	987	18,907	1,308	22,220
West Melbourne (Residential)	4,348	578	15,111	1,796	21,833
<b>City of Melbourne - total</b>	<b>147,411</b>	<b>78,336</b>	<b>339,631</b>	<b>27,762</b>	<b>593,140</b>

## References

Australian Bureau of Statistics, 2020, 'Regional Population', ABS website, reference period: 2018-2019 financial year, released: 25 March 2020: <https://www.abs.gov.au/statistics/people/population/regional-population/2018-19>

Australian Bureau of Statistics, 2020, 'Regional Population by Age and Sex', ABS website, reference period: 2019, released: 28 August 2020: <https://www.abs.gov.au/statistics/people/population/regional-population-age-and-sex/2019>

Australian Bureau of Statistics, 2020, 'Overseas Arrivals and Departures, Australia', ABS website, reference period: December 2019, released: 18 February 2020: <https://www.abs.gov.au/statistics/industry/tourism-and-transport/overseas-arrivals-and-departures-australia/jan-2020>

City of Melbourne, 2020, 'CLUE 2019 Summary Report Infographic', City of Melbourne website, accessed on 20 October 2020: <https://www.melbourne.vic.gov.au/about-melbourne/research-and-statistics/city-economy/census-land-use-employment/Pages/clue-data-and-reports.aspx>

Department of Home Affairs, 'Overseas Arrivals and Departures (OAD) 2018-19', Australian Government data.gov.au website, accessed on 30 June 2020: <https://data.gov.au/dataset/ds-dga-5a0ab398-c897-4ae3-986d-f94452a165d7/details?q=overseas%20arrivals>

Department of Home Affairs, 'Overseas Arrivals and Departures (OAD) 2019-20', Australian Government data.gov.au website, accessed on 30 June 2020: <https://data.gov.au/dataset/ds-dga-5a0ab398-c897-4ae3-986d-f94452a165d7/details?q=overseas%20arrivals>

Department of Transport Victoria, 2020, 'VISTA online data CSV 2012-2018', Department of Transport Victoria website, accessed on 24 June 2020: <https://transport.vic.gov.au/about/data-and-research/vista/vista-data-and-publications>

Tourism Research Australia, 2020, 'National Visitor Survey - NVS Domestic Trips and NVS Domestic Overnight Trips', reference period: 2014-2019, TRA Online portal, accessed on 17 August 2020: <https://traonline.tra.gov.au/>

Tourism Research Australia, 'International Visitor Survey - IVS Trips 2019', TRA Online portal, accessed on 17 August 2020: <https://traonline.tra.gov.au/>