

GLA 2020-based Population Projections

Model configuration

September 2021

Introduction

This document provides details about the specific model inputs, assumptions, and configurations used for the GLA's 2020-based demographic projections.

The assumptions and model configurations were developed in consultation with an expert panel. Details of the consultation and the expert panel's recommendations are published in an accompanying document.

For an overview of the GLA's demographic projection system, the individual models of which it is currently comprised, how the model is implemented and maintained, and the range of outputs available, see the accompanying methodological document 'GLA Demographic Projection Models: System overview'.

These documents, together with the results of the projections are published on the London Datastore¹.

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Glossary of acronyms

¹ <https://data.london.gov.uk/demography/population-and-household-projections/>

Trend-based population model

The trend model produces populations at local authority in England and Wales and at national level for Northern Ireland and Scotland. Model inputs are required at this spatial disaggregation.

Model inputs

- Mid-year population estimates (ONS, NISRA, NRS)
- Detailed internal migration estimates by origin and destination (ONS)
- Future fertility and mortality assumptions from the National Population Projections (ONS)
- Age-specific fertility rates for local authorities in England and Wales from the Subnational Population Projections (ONS)
- COVID-19 deaths (GLA modelled from ONS data)

Mid-year population estimates

The ONS mid-year population estimates series provides a number of inputs to the model for local authority districts in England and Wales:

- Annual population estimates by age and sex
- Annual live births by sex
- Annual deaths by age and sex
- International inflows by age and sex
- International outflows by age and sex

National estimates of population are produced by NRS in Scotland and NISRA in Northern Ireland. Component data is not as detailed as for the ONS release and some aspects of the components for these areas are modelled to produce components consistent with the ONS outputs.

- Births by sex are modelled by applying a male-to-female birth ratio of 105:100 to total births.
- Deaths by single-year-of-age are modelled by applying the age structure for England & Wales to total deaths.
- International migration flows by single-year-of age are modelled by applying the age structure for Northern Ireland/Scotland from the NPP to total gross flows.

Adjustments to population estimates for London local authorities

The GLA adjusts the official estimates for London local authorities to account for identified errors in the assumed age structures of international migration flows since 2011. These errors result in compounding inflation of the number of resident children in London over time.

The GLA's adjustments are made through a separate modelling process that incorporates data on past births, the number of children in schools, and the number of children present on GP patient registers.

The first stage of this process is concerned with adjustments to the data relating to children and generates:

- Annual estimates of the number of resident children in each London authority from 2010 to 2020 that are consistent with births, pupils in school, and the patient register.
- Annual estimates of international migration flows of children consistent with these estimated populations.

The second stage of the process adjusts the data for other ages such that the total populations are consistent with those from the official estimate. This is achieved by:

- Making adjustments to the size of international migration flows of young adults such that the net migration totals for each local authority are consistent with those from the mid-year estimates
- Recalculating the estimated adult populations to be consistent with the adjusted migration components.

A detailed description of this modelling process is set to be published in a separate methodology note.

Detailed internal migration estimates by origin and destination

Accompanying the main mid-year population estimates data, ONS publish a detailed series internal migration flow estimates. This is a single-year-of-age and sex matrix of annual domestic migration moves between all local authorities in England & Wales and the nations of Northern Ireland and Scotland.

Future fertility and mortality assumptions from the National Population Projections

The National Population Projections (NPP) are published by ONS on two-year cycle, the most recent being the 2018-based NPP. Included in the projection outputs are the detailed assumptions of future fertility and mortality rates by single-year-of-age for each UK nation.

These annual rates are used as the basis of assumed future changes to fertility and mortality rates within the GLA model. The NPP include multiple sets of outputs that reflect alternative scenarios of future trends in fertility and mortality (labelled as: *low*, *principal*, and *high*).

COVID-19 deaths

The GLA models deaths from COVID-19 by age and sex for model areas for the year to mid-2021. This is achieved by bringing together data from a number of sources:

- ONS Registered Weekly Deaths in England & Wales provides weekly counts of deaths from COVID-19 at the national level by sex and 5-year age bands. These are modelled to a single-year-of-age structure using mid-year estimate deaths for England & Wales for 2019.
- ONS Death Registrations by local authority provides counts of deaths from COVID-19 in local authorities in England and Wales.
- Data on total deaths from COVID-19 in Northern Ireland and Scotland are taken from NISRA and NRS outputs.

The derived national COVID-19 mortality age structure is applied to total COVID-19 deaths in each area to give area-specific single-year-of-age/sex estimates for use in the model.

Model configuration

Variant projections

The GLA 2020-based outputs include multiple variants of trend projection. Four of these variants comprise the 'main' set of projections; a further five are considered 'supplemental' projections.

These variants incorporate common assumptions about fertility and mortality and are differentiated only by the assumptions made about long-term international and domestic migration trends.

In collaboration with the expert panel, three different sets of long-term assumptions were defined for both international and domestic migration. The full set of variants produced reflect the nine different permutations of international and domestic migration assumptions.

Table: List of 2020-based trend model variants

Code	International assumption	Domestic assumption	Name (main projections only)
CC	Central	Central	Central Upper bound
CH	Central	High	Central Lower bound
CL	Central	Low	
HC	High	Central	High population
HH	High	High	
HL	High	Low	
LC	Low	Central	Low population
LH	Low	High	
LL	Low	Low	

Fertility rates

All variants use the same fertility assumptions.

In the first year of the projection rates are calculated by trending forward the last five years' rates (2016-2020).

In subsequent years this base rate is adjusted by the rate of change taken from the NPP principal fertility assumptions.

Mortality rates

All variants use the same mortality assumptions.

In the first year of the projection rates are calculated by trending forward five years of observed rates (2015-19).

In subsequent years this base rate is adjusted by the rate of change taken from the NPP principal mortality assumptions.

Mortality from COVID-19

Additional deaths from COVID-19 in the year to mid-2021 are calculated from ONS reporting. These are added to the deaths calculated for 2021 through the application of mortality rates. In subsequent years the application of mortality rates is assumed to account for deaths from all causes, including COVID-19.

Table: COVID-19 mortality assumptions

	UK	London
Year to Mid-2020	55,094	8,421
Year to Mid-2021	92,669	10,158
Total	147,763	18,579

Note: COVID-19 deaths for the year to mid-2020 are not explicitly included in the model input as these are included in the mid-year estimate total deaths component for that year. They are provided here for context.

Migration methodologies

International migration is based on assumed annual flows and domestic migration is based on deriving rates from periods of past flows and applying them to the population at risk.

Short-term migration assumptions

Migration assumptions in the initial two years (2021 and 2022) are the same for all projection variants. International flows and domestic rates for these years are determined through consultation with the Expert Panel. Levels are set which are consistent with current understanding of the immediate impact of COVID-19 and Brexit on the migration flows. This includes the use of contextual data such as UK visa issuances and GP registrations data to inform decisions about flow levels.

The projections diverge from 2023 onwards as migration patterns incrementally transition toward each variant's individual long-term assumption (which are reached in 2025).

Table: International migration assumptions for London (short-term period)

Projection year	International In	International Out	International Net
2021	40,260	49,230	-8,970
2022	100,660	29,540	71,120

Table: Domestic migration assumptions for London (short-term period)

	proportion of average migration rates over the period 2016-2020	
Projection year	Domestic In	Domestic Out
2021	20%	60%
2022	50%	50%

Long-term international migration assumptions

The central migration assumption is an average of the international flows over the period 2010-2019. The data for 2020 were not included when calculating this average. This is because the 2020 mid-year estimate international migration data rely on much of the same underlying data for distributing flows within England & Wales as was used in the 2019 estimates. This has been necessary due to pandemic-related disruption to normal data collection operations. It was felt that including 2020 data in the average may place undue importance on recent patterns and introduce bias into the model inputs.

The high and low migration scenarios represent a step change in net flows outside those observed over the last 20 years. These levels of net migration were agreed in consultation with the Expert Panel.

Gross flows were derived by first calculating an average in-migration to out-migration ratio for international flows over the period 2011-2019. For both the low and the high scenarios the ratio was applied to the net London figure to calculate gross flows for London. A scaling factor was then calculated between the 10-year average gross flow and the adjusted scenario gross flow. This scaling factor was applied to all model areas. The result is a set of local authority-level single-year-of-age by sex international in and out flows consistent with the London-level net migration figure for both the high and low scenarios as set by the Panel.

Table: Long-term international migration assumptions, London

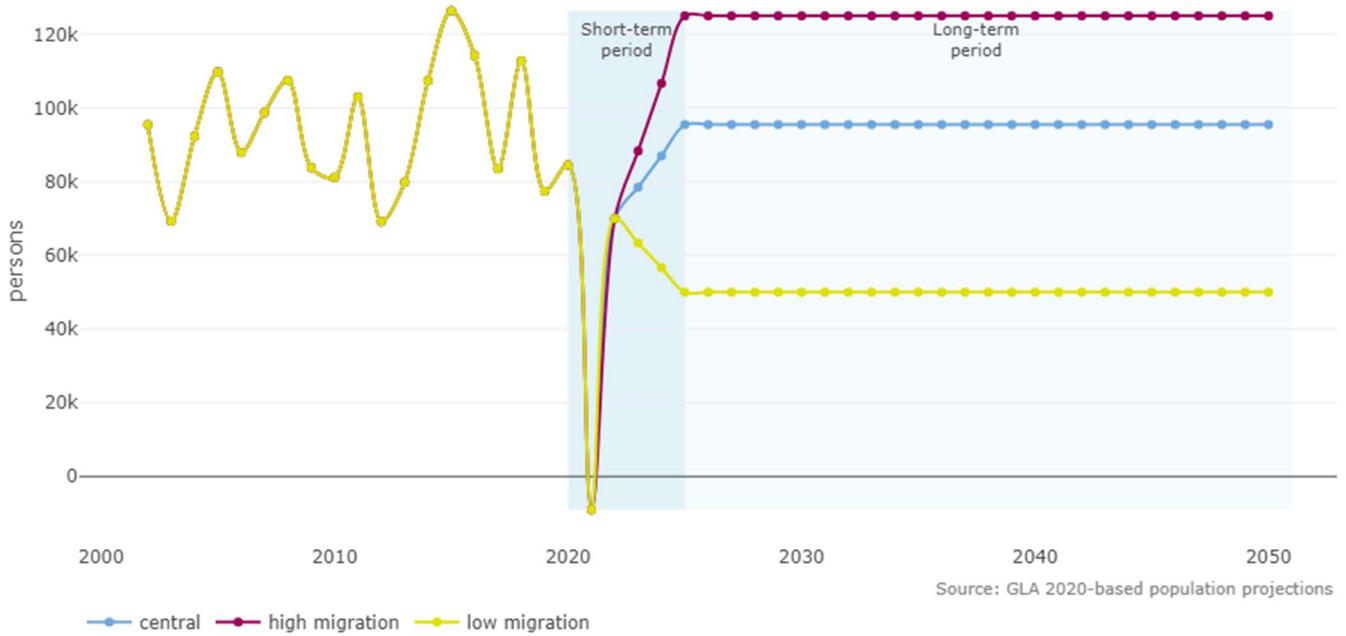
	Low	Central	High
International In	102,892	204,000	257,232
International Out	52,892	109,000	132,232
International Net	50,000	95,000	125,000

Table: Long-term international migration assumptions, UK

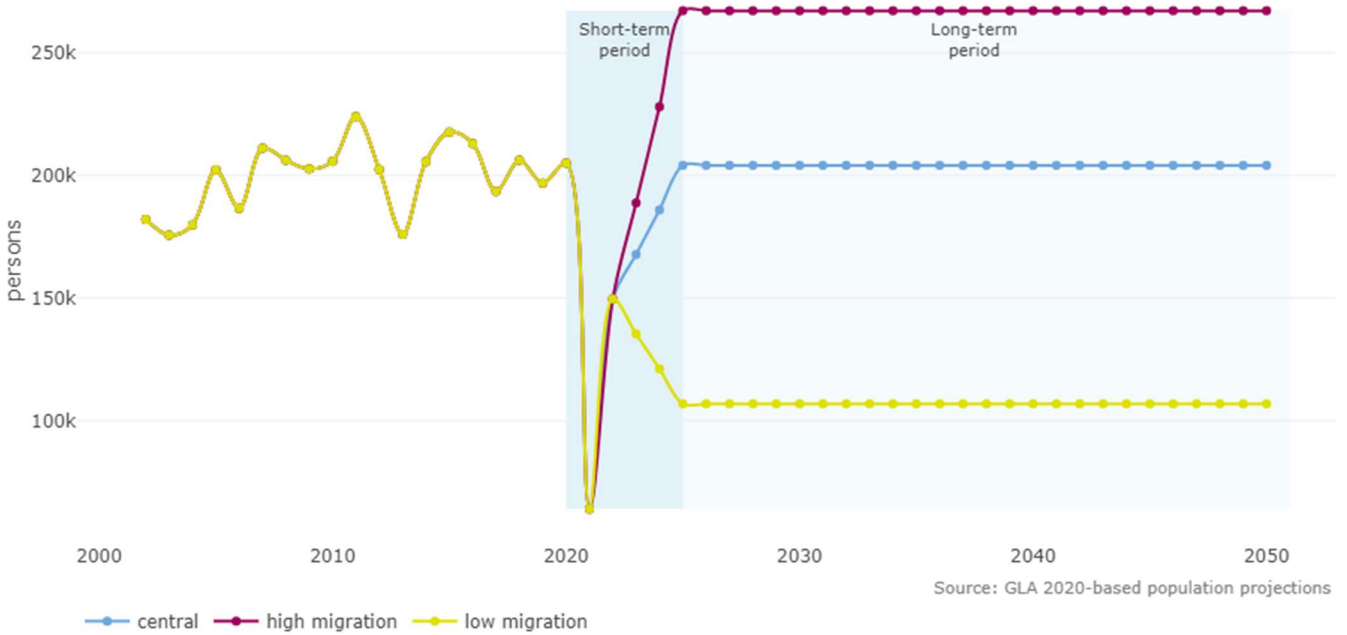
	Low	Central	High
International In	312,300	596,500	780,800
International Out	180,200	344,100	450,500
International Net	132,100	252,400	330,400

Note: UK total includes London

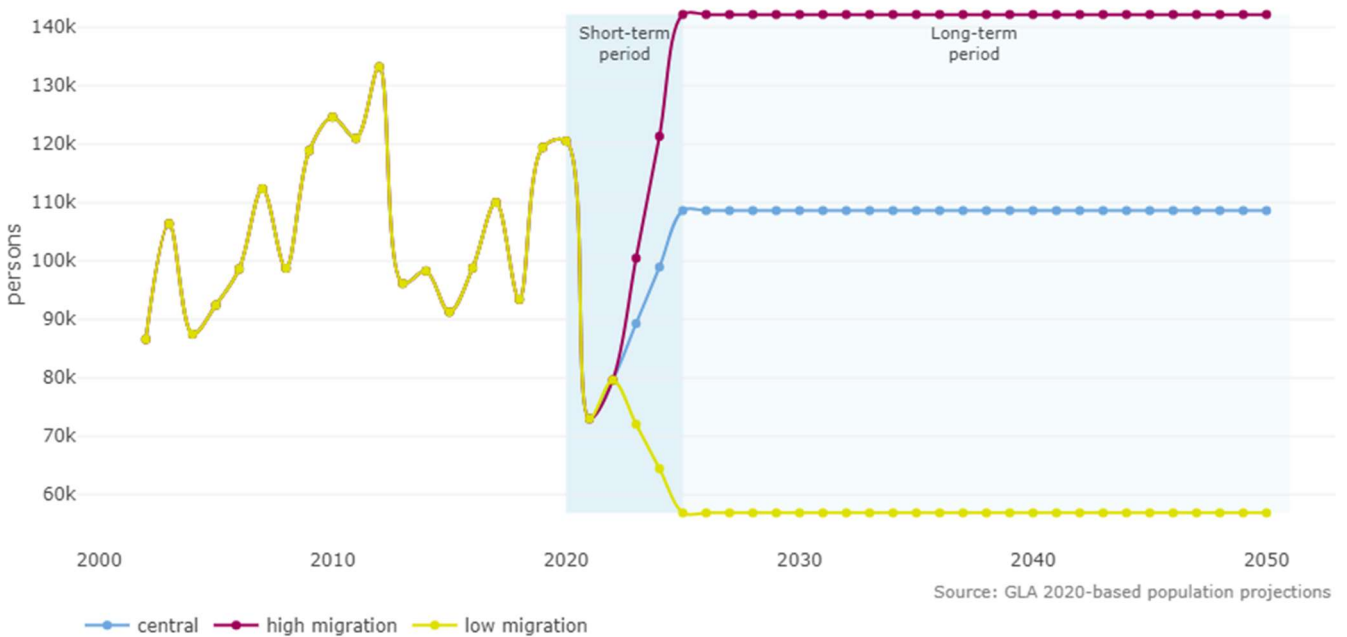
Net International migration assumptions, London



International In migration assumptions, London



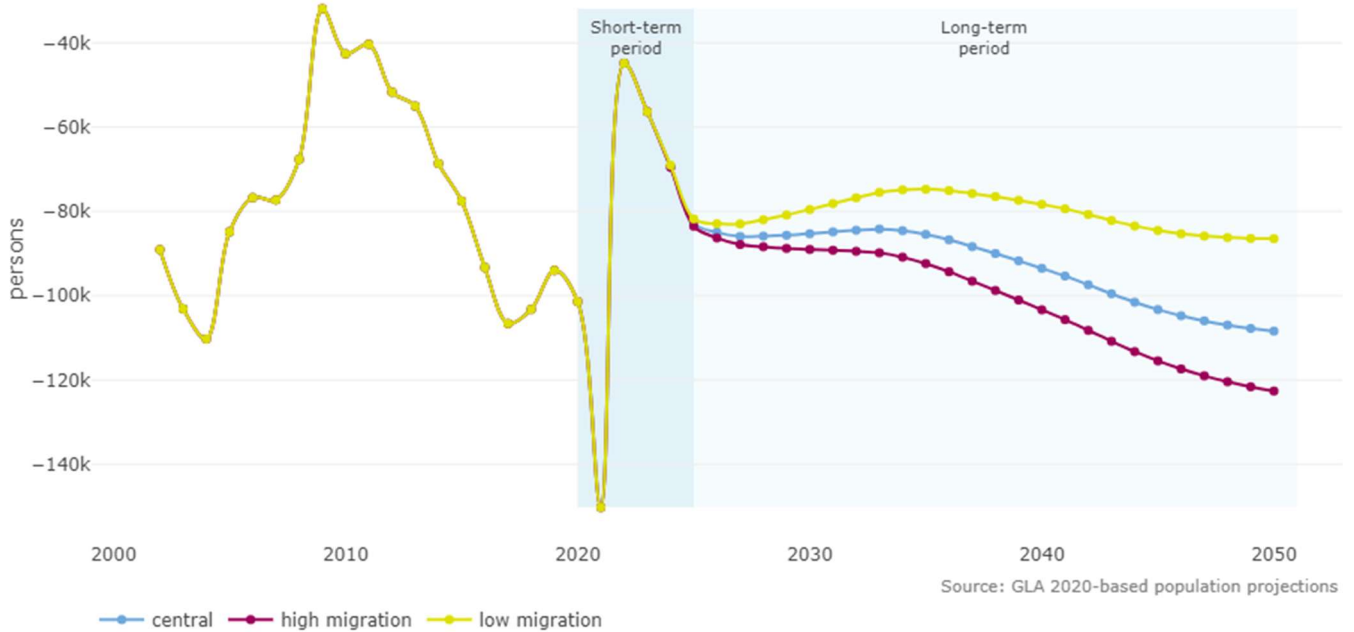
International Out migration assumptions, London



Long term domestic migration assumptions

Net domestic migration has consistently been negative over the past two decades meaning more people leave London for elsewhere in the UK than migrate to the capital. During periods of economic downturn mobility is reduced meaning fewer people are moving with the UK. This can be seen in the figure below where the period around the 2008 ‘Great Recession’ show a fall net out migration (2009 minimum of 31,900). Conversely, the recent pre-pandemic past was a period of relatively strong economic growth which saw high levels of mobility with London reaching a peak of net outmigration in 2017 (106,600).

Domestic net migration, London



The low and high domestic migration assumptions are based on averages which reflect past periods of low and high migration. Both take a five-year average with the low scenario using a period of low mobility (2008-2012) and the high scenario using a period of increased mobility (2016-2020). The central scenario takes a ten-year average (2011-2020) which incorporates behaviours across the economic cycle.

Table: Long-term domestic migration

	Low	Central	High
2020-based projections	5-year average 2008-2012	10-year average 2011-2020	5-year average 2016-2020

Household model

Household projections consistent with the trend-based population projections were produced using the GLA’s implementations of both the 2014-based DCLG household model and the 2018-based ONS household model.

The implementations of these models are based on the methodology documentation and *detailed data for modelling and analysis* that both ONS and DCLG published to accompany their projections.

For both models, the assumed communal establishment population is taken from the ONS model, on the basis that this data directly supersedes that used in the earlier DCLG model.

Housing-led population model

Model inputs

The housing-led model extends the trend-based population and household models and incorporates the same input data as already described.

In addition to these, the model uses the following housing data inputs:

- Assumed future housing development trajectories (GLA)
- Estimated annual change in dwellings since 2011 (GLA)
- Census estimates of the number of households and dwellings in 2011 (ONS)

Estimated numbers of existing dwellings

Estimates of the number of dwellings in each local authority are created by applying estimated annual change, based on data captured in the London Development Database, to a base estimate of dwelling numbers in 2011 from the Census.

Future dwelling stock capacity

The housing-led model requires an input development trajectory in the form of annual net changes in housing units for each model area.

This annual change is applied to the estimated number of dwellings in the base year to create the assumed number of dwellings for each projection year.

The ratios of households to dwellings captured in the 2011 census are applied to these dwelling stocks to create a nominal household capacity by local authority for each projection year.

Model configuration

The 2020-based housing-led projections includes outputs based on three alternative housing delivery scenarios. These scenario projections differ only in the input housing trajectory used. All other model inputs and configuration settings are identical across the projections.

The base demographic trend assumptions are these same as those used for the *Central Lower* variant trend projection. The long-term migration assumptions are based on 10-years of past international flow data and the most recent 5-years of domestic migration patterns.

The DCLG household model is used as the basis for estimating nominal demand for household spaces for a given population.

The three housing delivery scenarios are as follows:

Identified Capacity scenario

This scenario adapts the 2018-based Strategic Housing Land Availability Assessment (SHLAA)² housing capacity study for use as a future delivery scenario. A SHLAA is a technical exercise to determine the quantity and suitability of land potentially available for housing development. It is a required part of the evidence base needed for the preparation of a Local Plan.

In the initial years of the projection the delivery assumptions have been amended to reflect housing market analysis undertaken by Savills Estate Agents. In 2020 assumed delivery is 41,700 while for 2021–2025 it is 43,000 per annum. The total delivery over this period is 256,700 while the SHLAA capacity identifies

² <https://www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan/strategic-housing-land-availability-assessment>

333,100 units over the same period. The difference (76,400) is assumed to come forward over the period 2026-2041 and is distributed to the trajectory for those years.

In later years the trajectory assumes lower levels of delivery. This is largely because the SHLAA, on which this delivery scenario is based, is a capacity study with a focus on identifying sites in the short-to-medium term. In the longer-term SHLAA capacity is based on more generalised assumptions about the level of development likely to come forward rather than that from specific sites. As a result, annual delivery in later years is much lower than the initial years of the trajectory.

In the Identified Capacity scenario, the number of dwellings in London is forecast increase by 788 thousand over the 21-year period to 2041. This is an increase of 21.6 percent over current stocks.

Past Delivery scenario

This scenario assumes that the average of past levels of development, as reported in the London Development Database (LDD) will come forward each year for the period 2022-2041.

In the initial years of the projection, the level of delivery is assumed to be the same as in the Identified Capacity scenario: 41,700 in 2020 and 43,000 in 2021. Beyond 2021, the LDD average of 31,100 units is used.

In this scenario, the number of dwellings is forecast increase by 664 thousand over the 21-year period to 2041. This is an increase of 18.2 percent over current stocks.

Housing Targets scenario

This scenario assumes that the London Plan target of 52,300 dwellings will be delivered in each year of the projection period up to 2041. In the initial years of the projection, the level of delivery is assumed to be the same as in the Identified Capacity scenario: 41,700 in 2020 and 43,000 in 2021.

In the Housing Targets scenario, the number of dwellings is forecast increase by 1.089 million over the 21-year period to 2041. This is an increase of 29.8 percent over current stocks.

Assumed annual housing delivery, London



Small area population model

The small area model is designed to operate at both the ward and MSOA level. The model operates for area within the Greater London boundary only.

Model inputs

Annual population data inputs

ONS publish small area population estimates at lower super output area (LSOA) level. These are aggregated to ward and MSOA for use in the model. The populations are constrained to fit the GLA's adjusted population estimates by local authority (see trend model above) to ensure consistency across models and outputs.

Small area births and deaths data, on a mid-year basis, are not yet published by ONS as standard outputs. Live births and deaths by sex for small areas are based on data commissioned from and published by ONS at LSOA level and aggregated to wards and MSOAs.

Data for mid-2020 were not available at the time of running the 2020-based projections. The latest mid-year data inputs for the small area model are for the year to mid-2019 (population, births and deaths). For mid-2020, projected small area data are constrained to be consistent with actual mid-2020 borough-level data.

Borough-level inputs and constraints

The model is constrained to match the equivalent housing-led population projection at borough-level. The small area model takes the following borough-level outputs from the housing-led model as inputs:

- Population by age and sex
- Births by sex
- Deaths by age and sex

In addition, for fertility and mortality, where small area data is not readily available, the model generates proxy rates for each area by using borough-level rates from the housing-led model as a starting point and rescaling these to be consistent with local estimates of births, deaths, and the population at risk for each ward or MSOA.

Housing data inputs

The small-area model uses the same housing data inputs as detailed for the housing-led model, but with all data disaggregated to ward/MSOA level.

Future assumed development at the borough level is distributed to small areas using a distribution adapted from the 2017 SHLAA. The same distribution is used for each of the three development scenarios.

Census data inputs

Detailed small-area-specific data on the characteristics of areas is taken from the 2011 Census. These inputs are:

- Communal establishment population (DC1104)
- Internal migrants by sex and age (Ward CT0356, MSOA - CT0543, CT0544)
- Internal migrants by sex and age, destination: (Ward - CT0354, MSOA - CT0498, CT0499)

- Migrants to London by sex by age - international and domestic (Ward - CT0409)
- Migrants to London, origin: overseas, Scotland and Northern Ireland (MSOA – CT0496, CT0497)
- Non-UK-born population by sex (LC2103EW)
- Census dwelling and household estimates (KS401EW)

Model configuration

As the small area projections are constrained to borough-level outputs much of the model's configuration is effectively inherited from the housing-led model.

Fertility rates in the small area model are calculated as an average of the last five years of observed fertility rates. Births resulting from the application of these rates in projected years are scaled so that the aggregated total of all small area births within a local authority sum to the local authority births from the housing-led model.

Mortality rates in the small area model are calculated as an average of the last five years of observed mortality rates. Deaths resulting from the application of these rates in projected years are scaled so that the aggregated total of all small area deaths within a local authority sum to the local authority deaths from the housing-led model.

Links to data sources

Population Estimates

ONS mid-year population estimates -

<https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/populationestimatesforukenglandandwalesscotlandandnorthernireland>

NRS mid-year population estimates - [https://www.nrscotland.gov.uk/statistics-and-](https://www.nrscotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/population/population-estimates/mid-year-population-estimates)

[data/statistics/statistics-by-theme/population/population-estimates/mid-year-population-estimates](https://www.nrscotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/population/population-estimates/mid-year-population-estimates)

NISRA population estimates - <https://www.nisra.gov.uk/statistics/population/mid-year-population-estimates>

ONS Internal migration: detailed estimates by origin and destination local authorities, age and sex -

<https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/migrationwithintheuk/datasets/internalmigrationbyoriginanddestinationlocalauthoritiessexandsingleyearofagedetailedestimatesdataset>

Small Area inputs

ONS Lower layer Super Output Area population estimates -

<https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/lowersuperoutputareamidyearpopulationestimatesnationalstatistics>

Births by Lower Layer Super Output Area (LSOA), England and Wales, mid-year 2001 to 2019 -

<https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/livebirths/adhocs/12627birthsbylowerlayersuperoutputarealsoenglandandwalesmidyear2001to2019>

Deaths by Lower Layer Super Output Area (LSOA), England and Wales, mid-year 2001 to 2019 -

<https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/adhocs/12626deathsbylowerlayersuperoutputarealsoenglandandwalesmidyear2001to2019>

External model

ONS National Population Projections: 2018-based -

<https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/nationalpopulationprojections/2018based>

ONS 2018-based household projections for England -

<https://www.ons.gov.uk/releases/householdprojectionsforengland2018based>

DCLG 2014-based household projections for England - <https://www.gov.uk/government/statistics/2014-based-household-projections-in-england-2014-to-2039>

ONS Subnational Population Projections for England: 2018-based -

<https://www.ons.gov.uk/releases/subnationalpopulationprojectionsforengland2018based>

Housing development data

The Planning London Datahub (supersedes the London Development Database) -

<https://www.london.gov.uk/what-we-do/planning/digital-planning/planning-london-datahub>

London Strategic Housing Land Availability Assessment - <https://www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan/strategic-housing-land-availability-assessment>

The London Plan Housing Targets -

https://www.london.gov.uk/sites/default/files/the_london_plan_2021.pdf

Census data

ONS 2011 Census data - <https://www.ons.gov.uk/census/2011census/2011censusdata>

COVID-19 mortality

ONS Death registrations and occurrences by local authority and health board -

<https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/causesofdeath/datasets/deathregistrationsandoccurrencesbylocalauthorityandhealthboard>

ONS Deaths registered weekly in England and Wales, provisional -

<https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/datasets/weeklyprovisionalfiguresondeathsregisteredinenglandandwales>

NISRA Deaths Registered Dashboard – <https://datavis.nisra.gov.uk/vitalstatistics/weekly-deaths-dashboard.html>

NRS Deaths involving coronavirus (COVID-19) in Scotland - <https://www.nrscotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/vital-events/general-publications/weekly-and-monthly-data-on-births-and-deaths/deaths-involving-coronavirus-covid-19-in-scotland>

Glossary of Acronyms

DCLG	Department for Communities and Local Government (now MHCLG, Ministry of Housing, Communities and Local Government)
LDD	London Development Database
LSOA	Lower-level Super Output Area
MSOA	Middle-level Super Output Area
MYE	Mid-year Estimate
NISRA	Northern Ireland Statistics & Research Agency
NPP	National Population Projections
NRS	National Records Scotland
ONS	Office for National Statistics
SAPE	Small Area Population Estimates
SNPP	Subnational Population Projections

GLAINTELLIGENCE

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