UMDI V2024 H1–H3 Population Projections Methodology

Background and Overview

In May of 2024, UMDI contracted with the Massachusetts Executive Office of Housing and Livable Communities (EOHLC) to develop population forecasts by age, sex, and planning region as inputs to household forecasts produced by the Metropolitan Area Planning Council (MAPC). These household forecasts, in turn, are used in scenario planning as part of the statewide housing plan developed by EOHLC. For this purpose, UMDI produced three population forecasts, each varying according to different assumptions about future migration and immigration.

The three population forecast scenarios developed by UMDI include *UMDI V2024.H1, V2024.H2,* and *V2024.H3*, each named first for UMDI's vintage 2024 statewide population projections series (UMDI V2024*) and then by the order of production for the statewide housing plan (H1, H2, and H3). Each series also corresponds to the various household scenarios produced by MAPC and described in the Future Housing Needs section of the *A Home for Everyone* website. The crosswalk in Table 1 below provides a brief overview of which population forecasts correspond to which household scenarios:

Table 1: Household Scenario and Population Projection Matrix

Household Scenario	Population Forecast Series
Scenario 1: Crisis as Usual	UMDI_V2024_H2
Scenario 2: A Sense of Normalcy	UMDI_V2024_H2
Scenario 3: Competing and Growing	UMDI_V2024_H1
Scenario 4: Ready for What Comes	UMDI_V2024_H3

The following report sections detail the methodology, sources, and assumptions used to develop the UMDI population forecasts. and assumptions.

Baseline Population Projections: UMDI Vintage 2024 Series

Each of the population projection scenarios produced for this report are modifications of the UMass Donahue Institute's *Vintage 2024 Long-Term Population Projections for Massachusetts Cities and Towns* (UMDI V2024) released in May 2024. Briefly, the UMDI V2024 projections use a cohort-component method that applies recently observed survival, fertility, and migration rates by age and sex to Census 2020 base populations to project population by 5-year age groups in 5-year increments to 2050 for all Massachusetts cities and towns. The projections are produced at three distinct geographic levels — city/town, county, and MIGPUMA region — with age/sex projections in smaller geographies controlled to age/sex projections in larger geographies.[1]

[1] A MIGPUMA is a geographic statistical reporting area defined by the U.S. Census Bureau to publish migration variables included in the Public-Use Microdata Sample Area (PUMA) dataset of the American Community

For each geographic level, input components sometimes differ depending on the availability of data for each and other considerations. These input components include the 2020 launch population, deaths data, births data, and migration data.

Launch Population

The initial 2020 launch population for all geographic levels is the 2020 Decennial Census data from the U.S. Census Bureau with some modifications.[2] We adjust the 2020 launch populations for ten cities and towns (also referred to as municipal civil divisons, or MCDs) that we identified as having the highest liklihood of child undercounts in the 2020 Census and also for muncipalities that submitted challenges to the 2020 Census count. To identify child undercounts, we reviewed various indicators, such as the size of maternal cohort, school enrollment patterns, and the Census "hard to count" index, and determined that the 0–4 cohort in Boston, Brockton, Chelsea, Everett, Fall River, Holyoke, Lawrence, Lynn, New Bedford, and Springfield was likely under-counted. To rectify this, we back-calculated a new 0–4 population by applying a child-survival ratio from 2010 (based on 2005–2009 births and Census 2010 0–4 population) to births from 2016 - 2020 by MCD. Sex was estimated by applying the standard ratio for male and female births.

We also adjust the launch populations to account for post-Census corrections. based on research by UMDI. After the 2020 Census count, UMDI assisted cities and towns with population challenges and supporting research to address missing housing units or "group quarters" populations. These towns included Middlefield, Erving, Chester, Boston, Bourne, Chicopee, Dartmouth, Dedham, Franklin, Middleton, Randolph, Springfield, Wareham, and Wenham. Challenges prepared for or submitted to the Census Bureau (regardless of acceptance status) are incorporated into the 2020 launch population in the V2024 projection series.[3]

Survival Rates (Mortality)

Death data used to calculate survival rates for all levels of geography are from the Massachusetts Department of Public Health (MA DPH) vital statistics records by age and city/town. For the years 2020 through 2024, at all geographic levels, we estimate the number of deaths by age and sex in each area as the sum of 2020 deaths plus four times the deaths in 2021 to create a 5-year total. In this way, this estimate includes the increased mortality seen in 2020, plus four years of more typical, post-pandemic death levels. For intervals 2025 through 2050, at the regional and county levels, we estimate survival rates for each cohort using the average number of deaths in years 2010 to 2019 divided by the cohort's base population in 2015, assuming that survival rates by age and

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Survey (ACS). Starting with PUMS data released in 2012, the Census Bureau changed the geographic levels for which they release migration data from PUMAs to much larger "Migration PUMAS", or "MIGPUMAs". A key feature of the MIGPUMA development was that any time a PUMA crossed over a county boundary, the total extent of both counties represented in the PUMA had to be aggregated into the same MIGPUMA. The result of this was that instead having access to 52 Massachusetts PUMAs with gross migration data last decade, the most current PUMA series includes gross migration data for only five large Massachusetts MIGPUMAs.

[2] 2020 Census Demographic and Housing Characteristics File (DHC), U.S. Census Bureau, May 25, 2023.

[3] For more details on child undercount adjustments, Census challenge adjustments, and all other methods and components used in the UMDI V2024 projections series, refer to the full methodological report: *Long-Term Population Projections for Massachusetts Cities and Towns: Vintage 2024 Methodology Statement*, UMass Donahue Institute, May 9, 2024. Available at: https://donahue.umass.edu/business-groups/economic-public-policy-research/massachusetts-population-estimates-program/population-projections

sex in future years will be similar to those in the recent past. At the city and town level, we use deaths by age, sex and town from 2012 to 2022 from MA DPH, excluding deaths from 2020, and the base population in 2017 to develop survival rates.

Births and Fertility Rates

For births in the first interval from 2020–2025, the UMDI V2024 model develops estimates using reported MA DPH births from 2020 through 2022. We take the sum of (1 x 2020 births) plus (2 x 2021 births) plus (2 x 2022 births) to synthesize five years of data. Births are further allocated into male and female shares using a multiplier of 0.512 for male births and 0.488 for female births. We use the most recent years of births in this case to account for the dramatic reduction in births in 2020 in the first-year period of projections. For the remaining projection periods (2025–2050) at the county and regional level we estimate fertility rates using data on the number of live births by age and residence of the mother for years 2017 through 2022 and age cohorts 15–19 through 45–45 provided by MA DPH. We exclude births in the year 2020 due to anomalies associated with the pandemic, and aggregate the births in other years for each maternal cohort by county or region. Next, an average annual number of births for each maternal cohort is calculated and multiplied by five to determine the average number of births per five-year period for each age/region cohort. The five-year average births over the 2017–2022 period are then divided by the corresponding 2020 female population by age and region to transform average births into five-year fertility rates. Each fertility rate is further allocated into male and female shares of births using the multipliers described above. At the city/town level, the same method to develop age-specific fertility rates is used except that the model takes a longer period of births. For each cohort, the sum of births over the period 2012–2022, excluding 2020, divided by two gives average births over a five-year period. Age-specific fertility rates are computed by dividing the five-year average number of births by age by the corresponding number of females in that age group in 2017, the midpoint of the 2012–2022 period.

Births calculated using the methods and sources decsribed above are counted as the 0–4 population in the subsequent interval after accounting for mortality and migration of 0–4 year olds. For this adjustment, we develop *Child-Survival Ratios* (CSRs) that include population changes due to the combined effects of mortality and migration for births during the course of the projection period. A CSR for a given period is the ratio of the decennial 0–4 single-sex cohort and the sum of the five years of single sex births prior to that decennial year.[4] In the regional and county models, CSRs were developed for each sex for periods 2005–2010 and 2015–2020, and averaged. To estimate the number of children that will "survive" in the projected 0–4 cohort after mortality and migration, the sex-specific CSR is multiplied by the total number of projected births for each sex.[5]

Migration

Migration rate modelling also differs by geographic level. At the highest level, the MIGPUMA region, data are available from the Census *American Community Survey* on *gross* migration by age and sex. This means that in-migrant and out-migrants rates can be modelled separately and can be tied to

[4] For the regional model, due to the way in which international migration is operationalized and how CSRs are applied, the "births" also include half the 0–4 cohorts of international migrants.

[5] Sex-specific CSRs are used at the county and regional levels since these geographies have populations large enough to support more specific rates that may account for small differences in male and female mortality.

changes in the projected population in the U.S. at large.[6] In the V2024 series, MIGPUMA data from years 2012–2019 are averaged and developed into in- and out-migration rates by age and sex for the Berkshire MIGPUMA, corresponding to Berkshire County; for the Suffolk MIGPUMA, corresponding to Suffolk County; and for the very large Eastern MA MIGPUMA, which includes Bristol. Essex, Middlesex, Norfolk, Plymouth, and Worcester Counties. In Suffolk County, the model also uses a "college fix" adjustment to stabilize both the numbers of college-students in the region and the proportion of students who stay in the region and join the non-college population in future years.

At both the county and municipal level, migration rates are developed using a *net residual survival* method. This method takes the population by age and sex in each geography, adds or subtracts births and deaths by age, sex, and geography as reported by MA DPH, and ages each cohort forward ten years to calculate a "natural increase" population for each cohort in 2020. The predicted 2020 populations are then compared to the actual Census 2020 counts by age, sex, and geography, and the difference between the two is attributed to the effect of net migration between 2010 and 2020 for the age/sex/geography cohort. This migration can be expressed as a migration rate, or share of the starting population, and each cohort-specific rate is then applied to its cohort, starting with the 2020 launch population and to each successive launch population (2025, 2030, 2035, etc.)

Immigration

Net international migration in our regional model is based on the average annual net international migrants estimated for each region in the U.S. Census Bureau's annual county-level population estimates series for years 2010–2019.[7] Because the annual county-level components-of-change estimates released by the Bureau do not break the components into age/sex cohorts, we take the age/sex shares of immigrants by region reported in the averaged 2012–2019 ACS PUMS data, and apply these to the net international migrant totals for each corresponding region. This method assumes that emigrants in each region — persons leaving the U.S. for other countries — have the same age distribution as immigrants coming into each region. At the county and city/town levels, immigration is accounted for together with domestic migration as the single net-migration component that is derived using the net-residual-survival method.

[6] Using the Weldon Cooper V2018 Projections by age, sex, and state for Northeast Region and Balance of U.S. in-migration populations.

[7] Annual Resident Population Estimates, Estimated Components of Resident Population Change, and Rates of the Components of Resident Population Change for States and Counties: April 1, 2010 to July 1, 2020 (CO-EST2020-ALLDATA). U.S. Census Bureau Population Division. Release date: May 2021.

Summary of Model Components

Table 2 below summarizes the components by type, geographic level, data source, years of data source used, and interval applied to for the baseline UMDI V2024 population projections series.

Table 2: Data Input Source and Years by Geographic Level and Model Interval

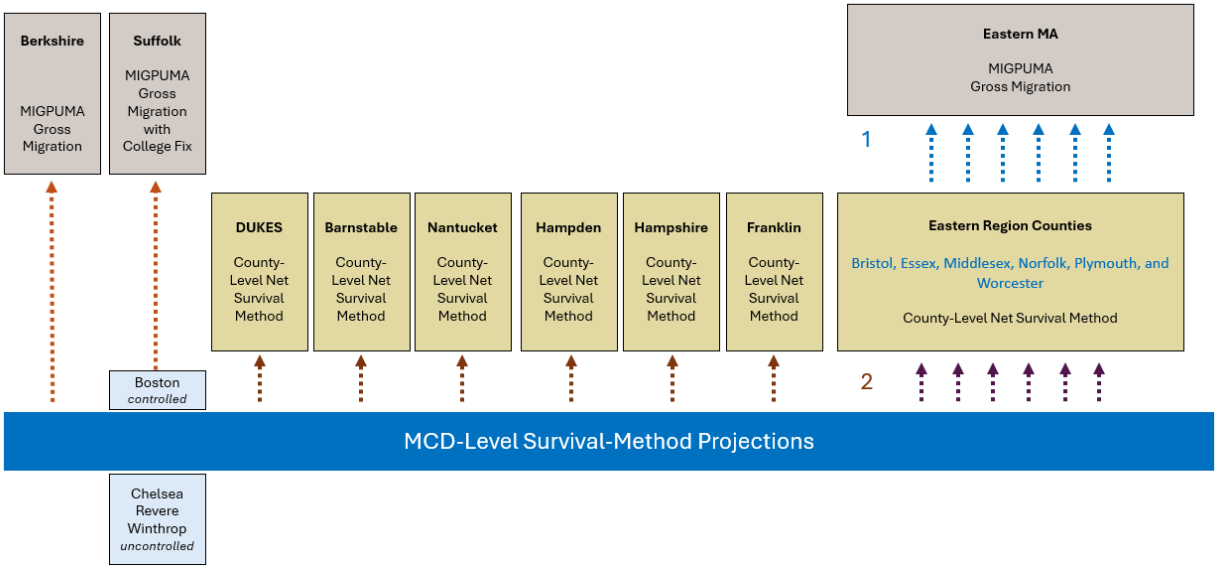
Component	Geography	Source	Years	For Interval
Survival Rates (Mortality)	County and MIGPUMA Region	MA DPH	2020–2021	2020–2025
			2010–2019	2025–2050
	City/Town		2020–2021	2020–2025
			2012–2022, excluding 2020	2025–2050
Fertility Rates (Births)	County and MIGPUMA Region	MA DPH	2020–2022	2020–2025
			2017–2022, excluding 2020	2025–2050
	City/Town		2020–2022	2020–2025
			2012–2022, excluding 2020	2025–2050
Migration	MIGPUMA Region	ACS PUMS	2012–2019	2020–2050
	County	Net Residual Survival Method, Decennial Census Counts and Vital Statistics	2010–2020	
	City/Town			
Immigration	MIGPUMA Region	U.S. Census Bureau's annual county-level population estimates	2010–2019	2020–2050
	County	Included in Migration	2010–2020	2020–2050
	City/Town			

Geographic Controls

At each 5-year interval, fertility rates, survival rates, and migration rates are applied to each base cohort by age, sex, and geography to project a new cohort five years older and five years later. Then, "controls" are applied to each interval population. The city/town level cohorts by age and sex are controlled to the county-level results by age and sex — or straight to the MIGPUMA results in Suffolk and Berkshire Counties — and the county-level results are controlled to the MIGPUMA region results for the Eastern MA counties.[8] Figure 1 below displays the geographic control schema used in the UMDI V2024 projection series.

[8] An exception to this is in Suffolk County cities and towns, where Boston is controlled to the Suffolk MIGPUMA while the remaining municipalities, Chelsea, Revere, and Winthrop, remain "uncontrolled".

Figure 1: Regional Cohort Controls by Region



Aging the population and generating projections for later years

The last step in generating our five-year forecast is to age the surviving stayers in all cohorts by five years. For example, the population aged 10–14 in 2020 is "survived" according to mortality rates or deaths and migrants are added or subtracted as the cohort becomes 15–19 years old in 2025. The first (0–4) and final (85+) cohorts are treated differently. In the net county model, the number of survived births estimated in the previous step becomes the number of 0–4-year-olds in 2025. In the MIGPUMA regional model, the process is the same, plus half the 0–4 immigrants.[9] For example, the number of persons in the 85+ cohort in 2025 is the sum of surviving stayers from the 80–84 age cohort (in 2020) plus the number of surviving stayers in the 85 and older cohort in 2020. This process is repeated for all future year projections; the 2025 projection becomes the launch population for estimating the 2030 population, which in turn is used to launch the 2035 population and so-forth.

Modified Population Projections by Scenario

The baseline UMDI V2024 population projection series is modified for the purpose of four distinct housing demand scenarios. While the V2024 baseline series assumed that migration trends observed in the 2010–2020 period will continue in future years, the modified projections each adopt alternative assumptions about what future migration or immigration could look like under various alternative scenarios. Table 3 below provides an overview of which model incorporates which assumptions, and the report sections that follow describe each in more detail.

[9] The other half of the 0–4 immigrants are added to the 5–9 population so that both aging and time of arrival over a five-year period are reflected in an "operationalized" input.

Table 3: Scenario Assumptions Matrix

Population Scenario	Population Assumptions
Middle Scenario (V2024_H1)	UMDI V2024 with net domestic migration levels consistent with 201 –2019 period and aged 0–4 cohorts adjusted for Census estimated child undercounts.
Low Scenario (V2024_H2)	H1 series adjusted with net domestic migration levels consistent with lower, 2016–2021 historic averages (-27,700 per year). Adjustment increases outmigrants by 10,000 per year over the baseline series.
High Scenario (V2024_H3)	H1 series with increased immigration based on increased EA shelter applicants 2020–2025 and CBO projected increased immigration 2025–2050. Domestic outmigration is reduced by 2,500 persons per year and an additional 2,500 persons per year are redistributed within MA from more expensive housing regions to less expensive.

UMDI V2024.H1 Projections

Population projections to support this scenario are very similar to the UMDI V2024 baseline projections described earlier in this report. They assume migration and immigration levels consistent with the 2010–2020 period, a time when the Massachusetts population experienced its fastest percentage growth since the 1960s and grew by about 7.4% — on par with growth in the U.S. overall — with both high and low levels of domestic and international migration represented during the interval.

The one modification makes to the UMDI V2024 series in the H1 version is to adjust the child launch populations in each county to reflect a newly available report by the U.S. Census Bureau on census child undercounts.[10] Their analysis estimates the percentage of children aged 0–4 that were undercounted in the 2020 Census for all U.S. counties with child cohorts greater than 1,000. Table 4 below details the adjustments made to the 0–4 population in the H1 series for Massachusetts counties. Nantucket and Dukes Counties are excluded from the adjustment because they did not meet the Census Bureau's population minimum for analysis, and no adjustments are made for Franklin and Hampshire Counties, which are estimated as *overcounted* in the 2020 Census by 26 and 142 children, respectively. For each county, the additional age 0–4 population is distributed between male and female cohorts according to the proportion counted in the 2020 Census, and the additional population is added to the 2020 launch population for each county and region in the model.

[10] *Demographic Analysis Estimates of Net Coverage Error in the 2020 Census for the Population Ages 0 to 4 by County* (Table-2_0–4_CO). U.S. Census Bureau, Population Division. April 11, 2024

Table 4: Adjusted 2020 Launch Population Aged 0–4 by County in the H1 Series

County	Census 2020	Net Coverage Error Estimate	Adjust Population	Adjusted 2020 Launch Pop.
Barnstable	7,470	-1.75%	131	7,601
Berkshire	5,079	-1.54%	78	5,157
Bristol	28,177	-5.17%	1,457	29,634
Essex	41,423	-5.52%	2,287	43,710
Hampden	23,333	-6.40%	1,493	24,826
Middlesex	80,756	-3.95%	3,190	83,946
Norfolk	36,578	-4.02%	1,470	38,048
Plymouth	26,297	-4.37%	1,149	27,446
Suffolk	37,834	-5.71%	2,160	39,994
Worcester	43,417	-1.23%	534	43,951

UMDI V2024.H2 Projections

Migration Adjustments

To create the low scenario, the UMDI V2024.H2 series starts with the H1 series projections that have been adjusted for child undercounts and modifies the migration levels for each interval. For these low-growth scenarios, the model assumes net domestic migration at levels closer to the 2016–2021 period — a period of higher domestic outmigration for Massachusetts — in contrast to the 2010–2019 period represented in the baseline model, which includes both high and low periods of domestic migration. Figure 2, below, shows the long-term trend in Massachusetts migration and immigration from 2000 through 2023 according to U.S. Census estimates, together with the more stable birth and death trends.

Figure 2: Massachusetts Annual Components of Population Change 2000–2023 (Excluding 2010 and 2020)[11]

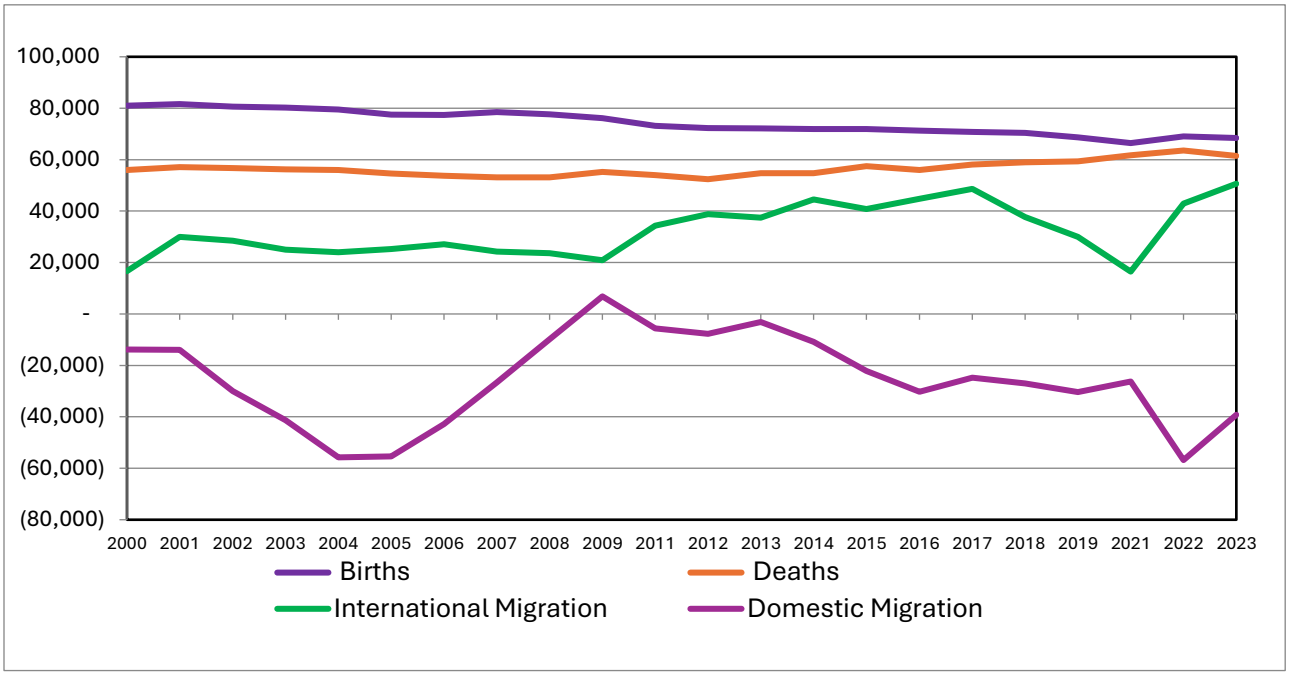


Table 5, below, shows the average net domestic migration averages in Massachusetts for the 2016–2021 period (excluding 2020) from the Census annual estimates compared to years approximating the baseline period, 2011–2019.[12] In the more recent period, outmigration was increased by approximately 10,000 per year (9,754) compared to the baseline values.

Table 5: Massachusetts Average Annual Net Domestic Migration by Period

2011 to 2019	2016 to 2021 (excluding 2020)	Difference
(17,969)	(27,724)	(9,754)

To operationalize this assumption in the H2 model, we take the baseline population projections developed in the H1 series and out-migrate (or subtract) an additional 10,000 persons per year statewide, effectively increasing outmigration by 10,000 persons per year. To estimate each region's share of the increased outmigration, we take each county's share of the total out-of-state domestic migrants in the IRS dataset for Massachusetts for years 2011–2023 and apply it to the 10,000

[11] Source Data: ST-2000–7; CO-EST2010-ALLDATA; and NST-EST2023–ALLDATA, U.S. Census Bureau Population Division. Census component estimates for years 2010 and 2020 denote only the three-month period from April 1 to July 1 and are excluded from the chart.
[12] ibid

additional outmigrants.[13] For the age/sex distribution of the additional outmigrants in all counties we use the age/sex distribution of out of state migrants from the ACS PUMS in the averaged years 2016–2021. The resulting populations by age and sex are subtracted from each county's population at each projection interval starting with the 2025 launch population and through 2050.

Because the Census Bureau estimates of net international migration in the most recent 2021–2023 period, averaging 36,685 per year, is comparable to the 2011–2019 period average of 39,681 already captured in the baseline model, the H2 model makes no special adjustment to immigration levels.[14]

UMDI.V2024.H3 Projections

The V2024.H3 projections model developed to support this scenario starts with the "H1" series, which adjusted the UMDI V2024 baseline series for estimated child undercounts, and makes additional adjustments to increase immigration, retain would-be out-of-state migrants, and redistribute population within the state based on home sales data.

Adjusted Immigration

Numerous data sources point to recent increased immigration in Massachusetts, including the annual net immigration estimates for 2020 through 2023 from the U.S. Census Bureau's annual state-level population estimates series[15], recent U.S. projections produced by the Congressional Budget Office[16], and recent increases in family Emergency Assistance (EA) shelter populations and EA shelter applications reported by the Massachusetts EOHLC. The H3 series model starts with the immigrant populations estimated in the baseline V2024 series, based on 2010–2019 levels, and then adds additional immigrant population to each new launch population, starting in 2025 and every five years through 2045.

2020–2025 Interval

For the first interval, the 2025 immigrant population is increased according to the increase in EA Shelter applicants in 2020–2024 over and above the EA shelter applicants in the 2010–2019 period — the period captured by the baseline model. As background, the last three years have seen a substantial uptick in international migrants seeking emergency assistance in the Massachusetts family shelter system. In order to estimate the number of permanent housing units that will be needed to accommodate these families, HLC and its consultant team used the following methods

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[13] U.S. Population Migration Data 2010–2022**,** Statistics of Income Division, Internal Revenue. Last updated July 29, 2024. Accessed at https://www.irs.gov/statistics/soi-tax-stats-migration-data-massachusetts on July 31, 2024.

[14] Immigration estimates from: ST-2000–7; CO-EST2010-ALLDATA; and NST-EST2023–ALLDATA, U.S. Census Bureau Population Division.

[15] Annual Population Estimates, Estimated Components of Resident Population Change, and Rates of the Components of Resident Population Change for the United States, States, District of Columbia, and Puerto Rico: April 1, 2020 to July 1, 2023 (ST-EST2023–ALLDATA), U.S. Census Bureau, Population Division, Release date: December 2023.

[16] "The Demographic Outlook: 2024 to 2054 | Congressional Budget Office," January 18, 2024. Accessed at https://www.cbo.gov/publication/59697 on August 2, 2024.

to estimate the net increase in international migrants, relative to the number of migrants seeking shelter during 2010–2019, the period used for estimating international immigration more broadly.

Data for this estimation were drawn from the state's Emergency Assistance program, which collects data on each family and individual applying for emergency family shelter. Since 2015, the enrollment process has asked about the primary language of the applicant, though it was not always mandatory or collected. In 2015, no primary language was recorded for 32% of families; this fell to 20% in 2017 and continued falling steadily to only 2% of families in 2023. In 2024, primary language was collected for all but0.5% of families.

Table 6: Recorded primary language of Emergency Assistance applicants, by year, 2015 - 2024

Primary Language	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024 (Jan-Aug)
English	51%	50%	58%	67%	66%	70%	69%	56%	49%	47%
Spanish	13%	15%	18%	16%	15%	14%	16%	19%	17%	19%
Haitian Creole	1%	1%	2%	1%	2%	2%	5%	17%	29%	31%
Other	2%	3%	3%	2%	2%	2%	3%	2%	3%	2%
Unknown	32%	30%	20%	14%	15%	12%	8%	7%	2%	0%

In November 2021, the enrollment process began asking if any member of the family was a citizen, and if any member of the family had a Green Card. From November 2023 to the end of August 2024, approximately 9,600 families applied for emergency shelter. Enrollment data indicate that 68% of applicant families included a member who was a citizen or had a Green Card, and 32% had no citizen or Green Card holder. Families in the latter category are classified as "international migrants" (or just "migrants") for our purposes, though this group could include some residents who have been living in the US legally for some period without having secured a Green Card or citizenship.

Primary language for each family was cross referenced with citizenship/Green Card status to determine the share of families in each primary language group that are international migrants. This analysis indicates that international migrants constitute approximately 2% of families with English as their primary language; 33% of Spanish-speaking families; and 79% of families speaking Haitian Creole as their primary language. These three languages constitute 97% of applicant families.

Table 7: Primary Language and citizen/migrant status of enrolled families, November 2023–August 2024

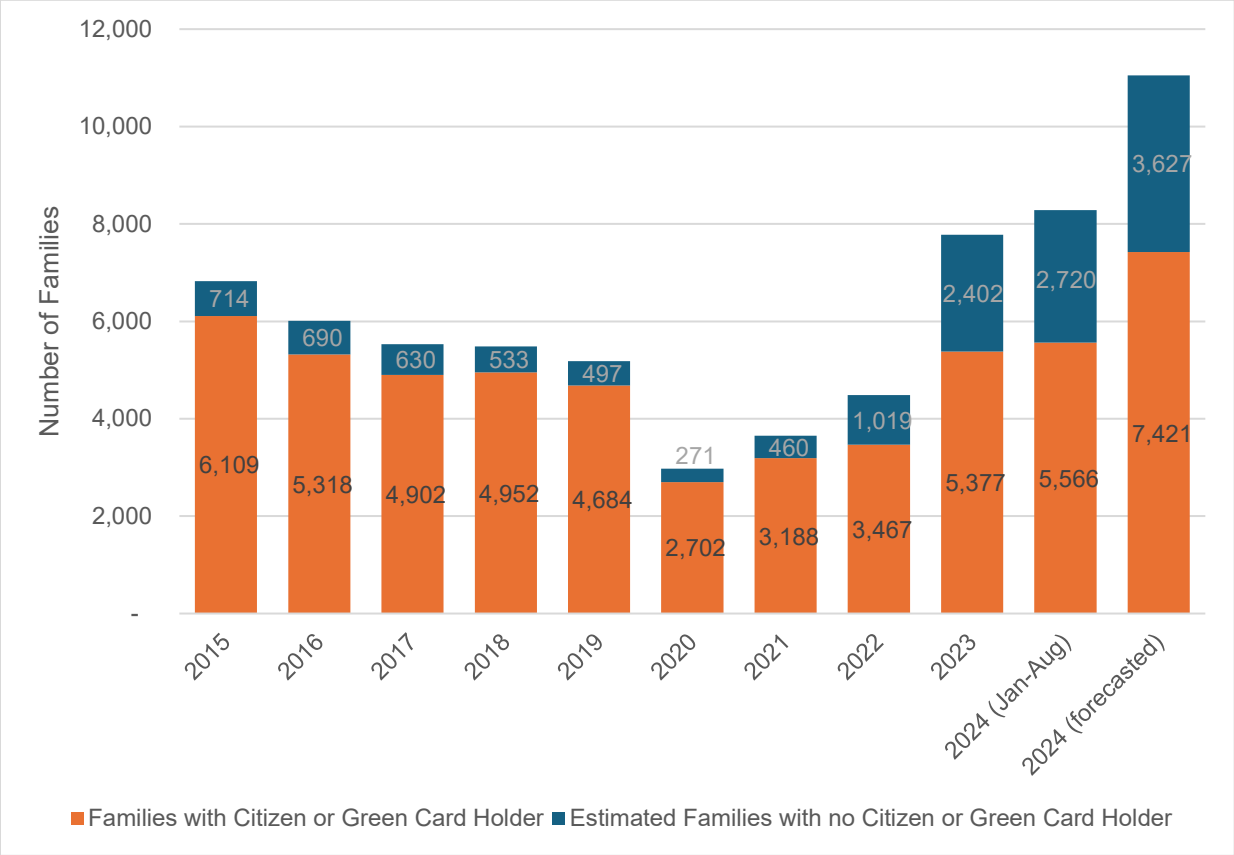
Primary Language	Enrolled Families	Families with citizen or Green Card holder	Percent with citizen or Green Card holder	International migrant share
English	4,538	4,438	98%	2%
Spanish	1,798	1,210	67%	33%
Haitian Creole	2,956	627	21%	79%
Other	243	175	72%	28%
Unknown	60	56	93%	7%
Total	9,595	6,506	68%	32%

In order to estimate the number of international migrant families since 2015, we applied these shares to the reported primary language of applicants in each year. Due to the large amount of missing data on primary language in the early part of the period, we imputed language distribution for families with unknown primary language. Families with no language recorded were removed, and we calculated the share of each language for the remaining families. This share was then applied to the total number of families in order to estimate a total number of families for each language group.

We conducted the following check to assess the validity of this imputation: from 2015–2021, the distribution of recorded languages (excluding 'unknown') was relatively stable and did not show any notable trends, even as the share of unknown languages declined from 32% to 8%. English share ranges from 72% to 80%, averaging 76%; and Spanish share ranged from 16% to 22%, averaging 19%. The share of Haitian Creole and all other languages varied little during this period as well. This suggests the "unknown" category was not disproportionately composed of English- or Spanish-speaking families, or any other single language.

Following this imputation, we had an estimated count of all enrolled families by primary language from 2015 through August of 2024. The share of international migrants for each language (based on the 2023–2024 data) was applied to the count of families for each year, and the results were summed to estimate the number of migrant families and a corresponding estimate of families with a citizen or a Green Card holder. In order to develop a full-year estimate for 2024, we assumed that the rate of family enrollment by language would continue through the final quarter of 2024 at the same monthly average observed from January to June 2024. (While the total number of enrolled families per month has generally remained between 1,000 and 1,100 since March, the share of Haitian Creole speakers has declined while the share of English-speaking applicants has increased. As a result, our full-year forecast may slightly overestimate the likely number of Haitian Creole speaking migrant families to be enrolled.) The results are shown in the chart below:

Figure 3: Families Enrolled in Emergency Assistance by Estimated Citizenship/Green Card Status, 2015–2024



We estimate that the number of migrant families averaged 613 per year from 2015–2019. Over that same period, the number of families with a citizen or Green Card holder averaged 5,193 per year. Enrollment of both citizen and migrant families declined substantially during the pandemic (2020–2021.) The number of migrant families then increased sharply in 2022 and in the subsequent years. The number of families with a citizen or Green Card holder rebounded to above the 2015–2019 average in 2023 and, as of the time of this writing, is on track to exceed 7,400 families in 2024.

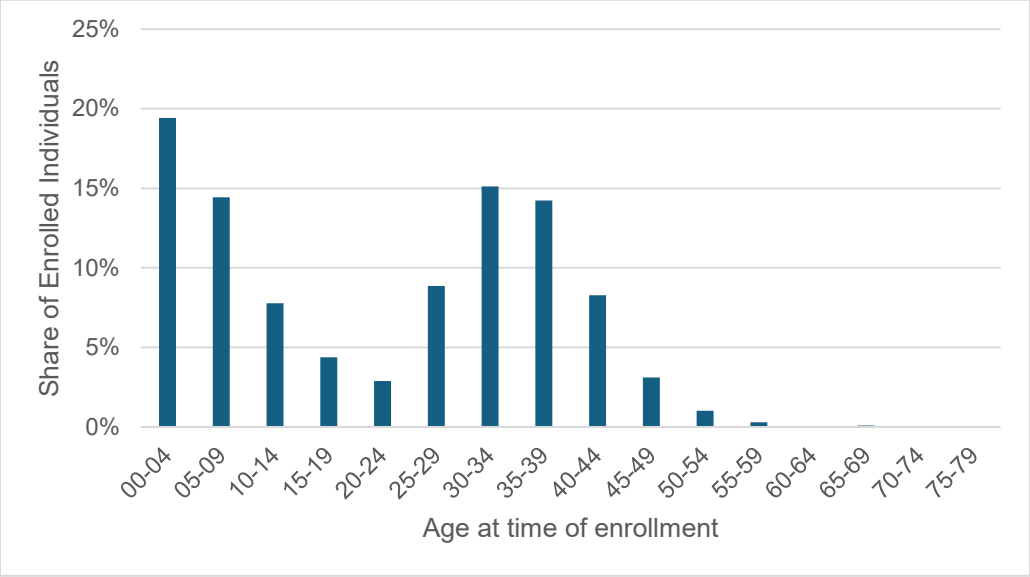
All told, the number of migrant families enrolled or forecasted from 2020 through the end of 2024 is 7,780, or an average of 1,556 annually. This is an estimated 4,716 families over and above what would have been expected based on the average of 613 families per year observed during the period 2015–2019. These 4,716 families will be referred to as the "additional migrants" for 2020 - 2024 elsewhere in this documentation.

The next step is to estimate the total number of family members and age distribution for the migrant families that have arrived since 2020. From November 2023 through August 2024, there were 3,013 families without a citizen or Green Card holder, totaling 9,359 individuals, for an average family size of 3.10 persons per family. For comparison, the size of enrolled families with a citizen or Green Card holder is 2.70, due partly to the much larger share of single-person families (solo pregnant mothers.) The distribution of family sizes for families with and without a citizen or Green Card holder is shown in the chart below.

Figure 4: Persons per Family by Citizenship/Green Card Status, EA Enrollments November 2023 - August 2024

The age distribution of enrolled families without a citizen or Green Card holder is bimodal, with a large share of family members below the age of 14 (42% of enrolled individuals), and a large share between the ages of 25 and 45 (46% of enrolled individuals). The age distribution of these individuals is shown in the chart below:

Figure 5: Enrolled individuals by Age, Families Without a Citizen or Green Card Holder, November 2023 - August 2024



Combining the average family size of 3.10 with the age distribution presented above results in the following estimate of individuals by age associated with the 4,716 "additional migrant families" that enrolled during the period 2020–2024:

Table 8: Estimated Additional Migrants, by Age, 2020–2024 (full year estimate)

Age	Estimated Additional Migrants
00-04	2,838
05–09	2,110
10–14	1,136
15–19	640
20–24	423
25–29	1,295
30–34	2,209
35–39	2,081
40–44	1,211
45–49	455
50–54	148
55–59	44
60–64	9
65–69	12
70–74	3
75–79	5
Total	14,620

For use in the cohort-component model, cohorts aged 15–19 through 75–79 are then distributed to male or female shares according to the male/female distribution by age group reported in the ACS PUMS data for Massachusetts immigrants from 2020 through 2022 (the latest PUMS file available at the time of this analysis) while the distribution of males and females ages 0–14 is assumed to be 50:50. To distribute the additional immigrant population among Massachusetts regions, we use the by-town geographic distribution of the total EA shelter population for the period April 1, 2020 through July 1, 2024 as provided by EOHLC.

For purposes of population forecasting, these individuals are added to the 2025 projected population and then subjected to standard rates of mortality, fertility, domestic migration, and headship in order to estimate future population changes and housing needs associated with the additional migrants that have arrived since 2020 over and above what would have been expected based on the baseline period of 2010–2019.

2025–2050 Intervals

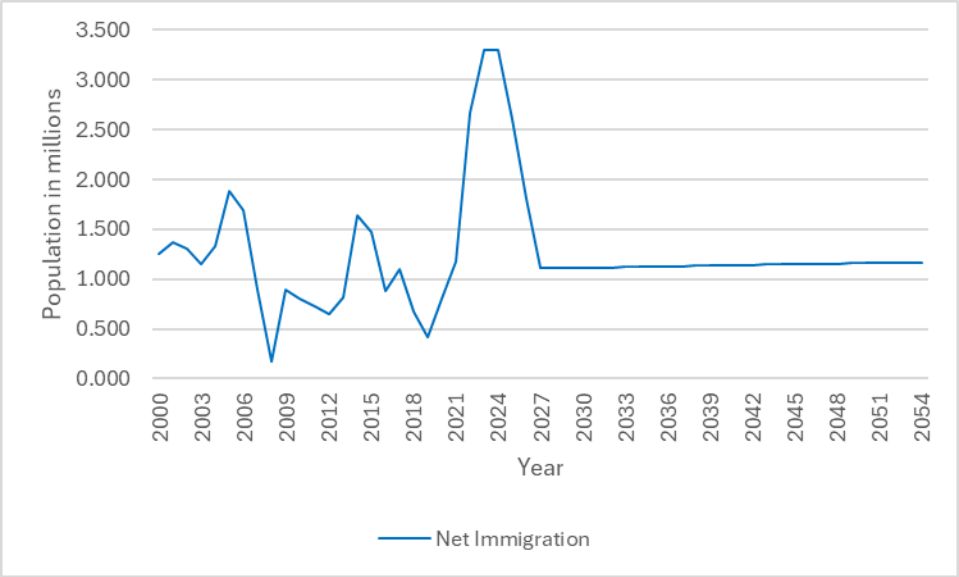
As with increased immigration in the 2020–2025 interval, later period intervals start with the "baseline" immigration levels observed in years 2010–2019 and then add population based on estimated future immigration "over and above" the baseline period. For the periods after 2025, a percentage increase over and above the baseline is calculated using the change in national immigration projected by the Congressional Budget Office (CBO) which is then applied to the baseline immigration for each Massachusetts county. [17] It must be noted that this analysis and forecasting was conducted in mid-2024, prior to the election and the subsequent changes in federal immigration policy that have resulted in fewer border crossings and increased deportation of both legal and undocumented foreign-born residents.

The CBO periodically produces U.S. population projections to support their baseline budget projections and economic forecasts. To develop immigration projections for the U.S., the CBO considers three distinct groups of immigrants: 1) lawful permanent residents (LPRs) plus people who are eligible to apply to become LPRs, such as asylees and refugees; 2) INA nonimmigrants, or persons admitted as nonimmigrants under the Immigration and Nationality Act (INA), including students and temporary workers; and 3) "other-foreign-nationals" including people "not in the first two categories and who have not subsequently become U.S. citizens or received LPR, asylee, or nonimmigrant status — such as people who entered the United States illegally and people who were permitted to enter through the use of parole authority and who may be awaiting proceedings in immigration court." [18]

Figure 6 below displays the CBO estimated and projected immigration for the U.S. as a whole for years 2000 through 2054. The estimates depict a rapid rise in immigration after 2021 followed by a sharp decrease before they settle in 2027 to levels somewhat greater than the pre-2021 averages.

[17] "The Demographic Outlook: 2024 to 2054 | Congressional Budget Office," January 18, 2024. Accessed at https://www.cbo.gov/publication/59697 on August 2, 2024.
[18] Ibid

Figure 6: Estimated U.S. Net Immigration by Year, 2000–2054[19]



The CBO report explains the rapid rise in immigration after 2021 as follows:

> "CBO increased the number of people in the other-foreign-national category in this year's projections in response to recent data and information from the Department of Homeland Security (DHS) and the Census Bureau. Publicly available data from DHS show that Customs and Border Protection (CBP) officials — officers in the Border Patrol working between ports of entry and officers in the Office of Field Operations (OFO) working at ports of entry — are encountering more people attempting to enter the country than in previous years, including years before the coronavirus pandemic.4 More of those people are also being released into the United States than previously, generally through the use of parole authority or with a notice to appear before an immigration judge. In addition, consistent with the information from DHS, data from the Census Bureau show increases in the share of foreign-born people in the United States. "[20]

To explain the forecasted levelling off in immigration following the recent spike, the CBO reports explains that:

> "In CBO's projections, total net immigration from 2024 to 2026 is larger than it was in the past, primarily reflecting the agency's assessment that net immigration of people in the other-foreign-national category in 2024 will be similar to what CBO estimates it was in 2023 … and then will decline in 2025 and 2026 as the immigration system adjusts (without new legislation) to the increase in immigration. After 2026, net immigration of other foreign nationals returns to a number that is closer to historical levels."[21]

[19] Source data: ibid
[20] ibid
[21] ibid

To develop percentage increases to apply in our model, we take CBO's immigration averages for each five-year period between 2025–2050 as compared to the five-year average in their 2010–2019 estimates. The resulting percentage increases by period are shown in table 9 below.

Table 9: Percent Increase in Immigration over 2010–2019 Baseline by Period in CBO Immigration Estimates

Period	Percent Increase over 2010–2019 5 year average
2026–2030	36%
2031–2035	22%
2036–2040	23%
2041–2045	25%
2046–2050	26%

Next, for each Massachusetts County we take the average five-year net international migration total from years 2010–2019 as estimated by the U.S. Census Bureau's annual county-level components of change to represent the "baseline" immigration levels.[22] For each five-year interval, we apply the period-specific percentage increase derived from the CBO projections. This method assumes that each Massachusetts county will see its immigration increased by the same percentage over the baseline as the U.S. and according to CBO assumptions. The difference between the increased immigration and the baseline immigration is counted as additional immigrant population for each period. As a last step, the additional immigrant population is distributed to age and sex cohorts according to the statewide age/sex distribution of immigrants over the average period 2010–2019 in the ACS PUMS data from the U.S. Census Bureau.

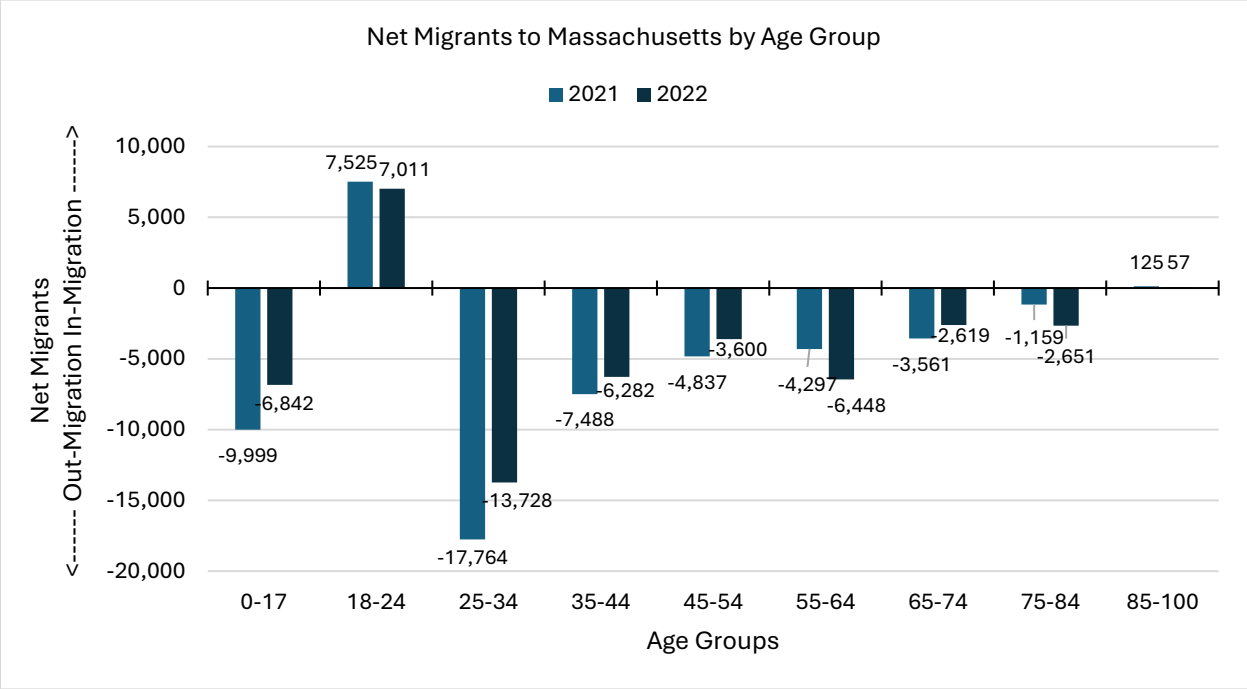
Retained State Outmigrants

The second adjustment that the H3 series makes to the H1 baseline series is to retain 2.500 would-be domestic outmigrants in Massachusetts per year, or 12,500 per five-year interval. Functionally, this retention works as population added at each time-interval, distributed to age and sex cohorts and among Massachusetts regions. To distribute the additional population to age cohorts, we use the average age distribution of Massachusetts net outmigrants from the PUMS ACS data for the years 2021 and 2022. We exclude the age 15–24 age cohorts because these age groups represent net-in-migrants for the state in the PUMS data, and we exclude population cohorts over 55. To distribute the resulting age groups to male and female cohorts, we use the 2016–2022 ACS PUMS sex ratios of net out-migrants by age, choosing a longer period in this case for a more robust sample and a more stable male-female ratio.

[22] Annual Resident Population Estimates, Estimated Components of Resident Population Change, and Rates of the Components of Resident Population Change for States and Counties: April 1, 2010 to July 1, 2020 (CO-EST2020-alldata), U.S. Census Bureau, Population Division, Release date: May 2021

Figure 7 below displays the distribution of Massachusetts net migrants by age group as estimated in the ACS PUMS dataset.

Figure 7: Net Migrants to Massachusetts by Age Group, ACS PUMS 2021 and 2022



The last step in processing the retained outmigrants is to distribute the 12,500 retained migrants by age and sex estimated in the previous step among the Massachusetts counties. In consultation with EOHLC, this distribution is based on the availability of moderately-priced homes. For distribution shares, we take each county's share of Massachusetts single-family home sales under $500,000. This distribution builds into the model an assumption that Massachusetts population, especially families and working-age adults, will remain in Massachusetts if they are able to find affordable homes, and that they are more likely to stay in areas where more affordable single-family homes are located. Data used to calculate the county shares is taken from Warren Group reported sales in 2023[23]. The resulting shares are displayed in Table 10 below.

[23] Data Source: Count of single-family home sale transactions by $100,000 price bin, year 2023. The Warren Group. Compiled by MAPC on October 2, 2024.

Table 10: Share of Single Family Home Sales under $500k By Massachusetts County, 2023 and Resulting Retained Migrants by County

County	Share of R1F sales <$500k, 2023	Retained Migrants per 5-year Interval
Barnstable	4.6%	569
Berkshire	5.5%	682
Bristol	12.8%	1,600
Dukes	0.2%	19
Essex	5.7%	716
Franklin	2.9%	362
Hampden	18.0%	2,247
Hampshire	4.1%	508
Middlesex	9.6%	1,195
Nantucket	0.1%	11
Norfolk	4.8%	606
Plymouth	9.5%	1,184
Suffolk	0.9%	116
Worcester	21.5%	2,683
MA Total	100.0%	12,500

The resulting age/sex/county populations are added to county-level launch population at each five-year interval, starting in 2025 and through 2050.

Redistributed Intra-State Migration

The final adjustment that the H3 series makes to the H1 baseline series is to increase outmigrants from the combined Eastern and Suffolk MIGPUMA regions in Massachusetts by 2,500 per year and re-distribute them within the state according to county shares of home sales <500k. This adjustment further supports a scenario in which less expensive housing areas in the state will attract more Massachusetts residents. The resulting re-allocation of population effectively moves more people from Eastern MA counties into Western Massachusetts and, to a lesser extent, into the Cape and Islands.

In this adjustment, 2,500 persons total under the age of 55 per year — or 12,500 per five-year interval — are subtracted from the population in Suffolk County and the counties located in the Eastern MA MIGPUMA, including Bristol. Essex, Middlesex, Norfolk, Plymouth, and Worcester. The age/sex distribution of the subtracted population is taken from the age/sex distribution of regional out-migrants reported in the 2012–2019 ACS PUMS data used to develop the baseline model migration estimates. Suffolk County age/sex cohorts sum to 14.8% of the 12,500 total outmigrants, and the remaining 85.2% Eastern MA PUMA outmigrants are then distributed among the Eastern MA MIGPUMA counties. Each Eastern MA county's share of the outmigrants is determined by their average share of total statewide out-migrants — including both out-of-county and out-of-state — in

the 2010–2022 period reported in IRS county-level migration data.[24] Table 21 below displays the percentage shares and resulting population subtracted from each Eastern Massachusetts county for redistribution within the state per five-year period starting in 2025.

Table 11: Share and Number of Additional Outmigrants by County for In-State Redistribution

County	Share of Outmigrants	Outmigrants per 5-year Period
Suffolk	14.8%	1,854
Bristol	7.1%	884
Essex	11.7%	1,458
Middlesex	32.0%	4,003
Norfolk	15.8%	1,980
Plymouth	7.8%	979
Worcester	10.7%	1,341
Eastern MA and Suffolk Total	100.0%	12,500

After each county's additional outmigrant population by age and sex is determined and subtracted, the 12,500 persons removed from the specified Eastern Massachusetts counties at each interval are then redistributed around the state. For this re-distribution, we once again use the county distribution of single-family home sales under $500k from the Warren Group, as described in Table 10 in the previous section. Outmigrant populations are subtracted from the launch population at each five-year interval, starting in 2025 and through 2050, and redistributed populations are added to the launch population at each five-year interval, starting in 2025 and through 2050.

[24] U.S. Population Migration Data 2010–2022**,** Statistics of Income Division, Internal Revenue. Last updated July 29, 2024. Accessed at https://www.irs.gov/statistics/soi-tax-stats-migration-data-massachusetts on July 31, 2024.