Projecting Residential Construction, 2013 to 2035:

Technical Appendix to Rappaport, Jordan (2013), "The Demographic Transition from Single-Family to Multifamily Housing." Federal Reserve Bank of Kansas City *Economic Review*, Q4.*

As described in the main text, there are essentially two parts to projecting future housing construction. The first part is to project the trend number of occupied single-family and multifamily units over the intermediate and long term based on demographic considerations. Doing so is a statistical exercise that depends on three strong assumptions. First, the distribution of household sizes and the structure types in which they live is assumed to have been at its trend level in the year 2000. Second, technology and preferences as they affect housing choices are assumed to remain approximately unchanged from 2000 through 2035. Third, long-term movements in house prices—single-family relative to multifamily and each of these relative to non-housing goods—are assumed to be relatively modest from 2000 through 2035. Since each of these assumptions is likely to prove at least moderately incorrect, the unobserved "true" trend number of occupied units of each type may differ from the projections.

Beyond these strong assumptions, however, no subjective judgments are made in projecting the trend number of occupied single-family and multifamily housing units. Each of the three alternative single-family construction projections uses the same projected *trend* number of single-family occupied units. Each of the three alternative multifamily construction projections uses the same projected *trend* number of multifamily occupied units. The second part of projecting future construction requires making three important judgments. The first judgment is the number of vacant housing units at the end of 2012 that will never be reoccupied. The second judgment is on the longer-term rate at which housing units are abandoned, either to make way for new construction or due to physical deterioration or simply because they are in a location that has experienced a significant decline in population.[1] The third judg-

*The views herein are those of the author and not necessarily those of the Federal Reserve Bank of Kansas City or the Federal Reserve System.

[1]Abandonment is meant to denote a housing unit's movement from being within the aggregate stock of available housing units to being outside this available stock. Units which are occupied or which are explicitly advertised as being for rent of sales are considered to be within the stock of habitable housing units. So too are vacant housing units that are kept for occasional use, that are being used for storage, or that are being kept off the market until housing prices rise. Abandonment occurs when a unit becomes uninhabitable, for example when it is torn down or following significant physical deterioration. Researchers also refer this transition to being uninhabitable as "salvage."

ment is the differing year-by-year rate at which the gap between trend occupied and projected occupied housing units closes.

The remainder of this technical appendix describes the basis for the subjective judgments underlying the single-family and multifamily construction projections described in the main text. Extensive reference is made to eight appendix tables, included at the end of this document. Appendix Tables 1 and 5 show respective historical outcomes for single-family and multifamily occupancy and construction that serve as the basis for the reoccupancy and trend abandonment judgments. Appendix Tables 2 through 4 respectively report the baseline, optimistic, and pessimistic single-family projections, including the judgments underlying them. Appendix Tables 6 through 8 do the same for the multifamily projections.

1 Single-Family Projections

Before making each of the three judgments, it is first necessary to assume a trend single-family vacancy rate. In other words, it is necessary to assume the long-run ratio of trend vacant single-family units to the sum of trend vacant and trend single-family units. This trend ratio is key to judging the number of single-family units vacant at the end 2012 that will never be reoccupied. In addition, the trend growth rate of the number of vacant single-family units must match the judged trend growth rate of the number of *occupied* single-family units in order to keep trend vacancy at its assumed rate. For this reason, the assumed trend vacancy rate affects the evolution of the gap between the trend and projected number of occupied units.

The Census Bureau Home Owner and Vacancy Survey estimates that there were 2.7 million vacant single-family homes at the end of 2012 that were explicitly advertised as for sale or rent (Appendix Table 1, column 10). This is significantly down from 3.3 million at the end of 2008 but still well above the 1.9 million vacant units at the end of 2000. Measured relative to the total stock of units—the sum of occupied and vacant units—the single-family vacancy rate rose from 2.6 percent in 2000 to a peak of 4.0 percent in 2008 and has since fallen off to 3.2 percent at the end of 2012 (Appendix Table 1, column 11).

For all three projection scenarios, it is assumed that the trend rate of single-family vacancy relative to the trend stock of units is 2.5 percent, approximately its level at the end of 2000. This assumed trend vacancy rate can then be combined with the projected trend number of occupied units to determine a trend number of vacant units. For example, the estimated trend number of occupied single-family units in 2012 is 81.4 million (Appendix Table 2, column 1). The assumed 2.5 percent trend vacancy rate implies that there were 2.1 million trend vacant units at the end of that year. The actual number of vacant units at the end of 2012 was 2.7 million (Appendix Table 2, column 10). These can be thought of as comprising the trend vacant units

plus 600,000 cyclical vacant units.

1.1 Baseline Single-Family Judgments

The baseline-scenario judgment is that 35 percent of the cyclical vacant units at the end of 2012 will never reoccupied. The implied abandonment of 200,000 units is accounted for as taking place entirely in 2013. The reported 340,000 abandoned units for 2013 thus combines trend abandonment with cyclical abandonment (Appendix Table 2, column 12). More realistically, the cyclical vacant units are likely to be abandoned over the course of a number of years. But for projecting the number of single-family starts, the timing of this abandonment does not matter.

The projected reoccupying of the remaining 65 percent of cyclical vacant units at the end of 2012 is judged to occur over the years 2013 through 2016 (Appendix Table 2, column 8c). For each of these years, this reoccupying lowers the required construction growth needed to achieve a given assumed closure rate.

Historical experience suggests that the long-term rate at which single-family housing units are abandoned is in the range of 0.1 percent to 0.5 percent per year. For example, single-family housing starts from 1970 to 1980 exceeded the increase in occupied single-family units by 1.5 million, an average of 150 thousand per year. This corresponds to an annual abandonment rate of 0.3 percent (Appendix Table 1, columns 12 and 13). Annual average abandonment during the 1980s and 1990s was, respectively, 0.5 percent and 0.1 percent. Mayer and Somerville report similar annual abandonment rates of 0.5 percent and 0.2 percent for the 1980s and 1990s. The baseline projection uses a judgment trend abandonment rate of 0.2 percent. The optimistic and pessimistic projections respectively use judgment trend abandonment rates of 0.1 and 0.3 percent.

The rate at which the number of occupied single family units returns to its trend level is the most difficult of the required judgments. Logistically, this judgment is applied year by year and is specified as the share of the previous-year gap that is closed in a current year. For example, 2 percent of the gap between trend and projected occupied units at the end of 2016 is judged to be closed during 2017 (Appendix Table 2, column 5a). This is equivalent to closing the 2.37 million unit gap at the end of 2016 by 60,000 units in turn implying that the gap at the end of 2017 falls to 2.31 million (Appendix Table 2, column 5).

Three general principles guide the judged single-family closure rates for each year, both under the baseline projections as well as under the alternative projections. First, the implied construction growth rates must be attainable without putting implausible strains on builders' capacity. Above some threshold increase, supply considerations are likely to significantly constrain home builders' construction capacity. When this occurs, upward shifts in demand for housing are more likely to cause price increases than increased construction.

Since 1990, the fastest annual growth rate of single-family starts was 24 percent, experienced in 1992 and 2012. In both cases the level of construction the previous year represented a trough following many years of decline, and so there was likely to be considerable surplus productive capacity. Correspondingly, the numerical increase in constructed units required to achieve a given percentage growth rate was relatively low in these years. To illustrate, achieving the 24 percent growth in single family starts in 2012 required an increase of only 110,000 starts above the trough 430,000 starts in 2011 (Appendix Table 1, columns 9 and 8). For comparison, achieving a 24 percent annual growth in 2008 would have required an annual increase of 240,000 starts.

The maximum projected single-family growth rate under the baseline judgments is 18 percent (in 2017). Achieving this will require an increase of 170,000 starts above the projected 910,000 starts in 2016 (Appendix Table 2, columns 9 and 8). The 2016 projected level of starts is itself the result of five years of actual and projected annual growth rates ranging from 10 to 24 percent. The baseline judged closure rates implicitly assume that strong single-family growth of this magnitude can be sustained over many years.

The second principle guiding the judged closure rates is that they must not decrease from one year to the next. The rationale for this is straightforward. From 2019 through 2023, at least 20 percent of single-family construction is used to close the gap between trend and projected occupied units (Appendix Table 2, column 6 as a share of column 8). This "transitional" construction is simply the multiplicative product of the judged closure rate for a given year with the gap at the end of the previous year. With a constant judged closure rate, the annual number of transitional constructed units must decline at the same rate at which the gap is closed. Requiring the judged closure rate to not decrease over time rules out directly assuming an even faster decline in transitional construction and so puts some discipline on judgment.[2]

The third principle guiding the judged closure rates is they should imply a relatively smooth trajectory for construction growth. Year-by-year closure rates are chosen to avoid sharp swings from rapid growth to rapid contraction, especially for the baseline projection. As will be illustrated below, cumulative construction over the long term does *not* depend on assumed closure rates. Achieving a smooth growth trajectory over the long terms thus requires avoiding especially fast closure rates during the first part of the projection horizon, approximately through 2018. Otherwise, construction growth will soon after swing sharply from strongly positive to strongly negative.

Counter-intuitively, the gap between trend and projected occupied units is assumed to continue to widen from 2013 through 2016. This reflects that the 540,000

[2]Consistent with this guiding principle, Rappaport (2006) shows that estimated closure rates between long-run income and current income steadily rise as countries develop.

actual single-family starts in 2012 and the projected 620,000 starts in 2013 (based on actual starts through August) represent very low *levels* of construction (Appendix Table 2, column 8). In consequence, constructing 860,000 single-family units in 2014, the projected trend increase for that year (Appendix Table 2, column 3) would require a one-year 39 percent increase in starts, which would most likely exceed home builders' productive capacity.

Actually holding the gap constant in 2014 would require constructing 30,000 units above the projected trend increase. This difference combines three elements. It sums 140,000 judged trend abandoned units plus the 20,000 increase in vacant units required to maintain vacancy at its assumed trend rate less the judged 130,000 reoccupancy of cyclically vacant units (the first and third of these are reported in Appendix Table 2, columns 12 and 8c). Under the baseline judgment, the re-occupying of cyclically-vacant units falls from 130,000 in 2014 to 90,000 in 2015, then further to 40,000 in 2016, and thereafter to zero (Appendix Table 2, column 8c). Hence the "additional" construction above the trend increase in occupied units required to maintain a constant gap rises from 30,000 in 2014 to 170,000 in 2017 (Appendix Table 2, column 8a).

The enumerations herein are based on the accounting convention that new construction is immediately occupied rather than being temporarily vacant before flowing to occupancy. In other words, new construction is not directly accounted as a gross flow. To illustrate, if the number of occupied units is projected to be unchanged in one year from the previous year, each newly constructed unit implies a one unit net flow from occupied to vacant and abandonment.

Additionally, the reported total flow to abandonment for 2014 and later is made up solely of trend abandonment (Appendix Table 2, column 12). The total flow to abandonment for 2013 sums judged trend abandonment for that year and the judged number of vacant units at the end of 2012 that will never reoccupied. The total flow to abandonment for 2012 and earlier is estimated as the difference between actual single-family starts during a given year and the actual increase in the sum of occupied and vacant single-family units during the same year.

A helpful summary measure to gauge the changing gap between trend and projected occupied single family units is the cumulative change in the gap from 2012 (Appendix Table 2, column 7). An additional convention is that the shortfall of actual or projected occupied units from trend occupied units is accounted as a negative gap and so a worsening of this gap is enumerated as an increasingly negative cumulative change. Under the baseline projection, the gap between trend and projected units widens by a cumulative 45 percent from end of 2012 through the end of 2016. The gap then begins to close in 2017. It re-attains its 2012 value in 2020, and is 98 percent closed by the end of 2030.

The baseline judged closure rates together imply that the gap between trend and projected single-family occupied units is complete by the end of 2035. The implied

cumulative construction between 2013 and 2035 is jointly pinned down by four factors: the gap between trend and actual occupied units in 2012, the cumulative increase in trend units between 2012 and 2035, cumulative assumed trend abandonment from 2013 through 2035, and the number of "surplus" vacant units at the end of 2012 that eventually become reoccupied. Cumulative construction over these years, 23.4 million units, is the sum of the first three of these minus the fourth.[3]

For any proposed year-by-year projected path of annual construction, increasing the projected level of construction in one year (by increasing the assumed rate of closure for that year) necessitates a decrease in the projected level of construction in some later year. For example, judged closure rates that imply a relatively steep ramp-up in construction over the first few years of the projection horizon necessarily imply a sharp contraction a few years later. This constraint on the path of year-by-year construction is what accounts for the much more pronounced hump-shaped projection under the alternative optimistic judgments and the highly-dampened hump-shaped projection under the alternative pessimistic judgments.

1.2 Optimistic Single-Family Judgments

Compared to the baseline projection, the alternative optimistic projection combines a lower judged reoccupancy of the "surplus" vacant units at the end of 2012 (60 percent rather than 65 percent) and a higher judged trend rate of abandonment (0.3 percent per year rather than 0.2 percent). The lower reoccupancy modestly increases required total construction from 2013 through 2035. The higher trend abandonment increases the level of construction required to keep the gap between trend and projected units constant by about 100,000 units per year.

The judged optimistic year-by-year closure rates are enumerated in column 5a of Appendix Table 3. As is the case in the baseline projection, these are required to not decrease over time. Compared to the judged baseline closure rates, the optimistic ones are chosen to imply especially strong construction growth rates during 2014 through 2017. As a result, total construction from 2013 through 2035 is pulled considerably forward in time.

The construction growth rates implied by the optimistic judged closure rates may exceed plausibility. Year-over-year growth in single-family starts slows from 24 percent in 2012 to about 17 percent in 2013 and 2014 and then accelerates above 20 percent in each of 2015 through 2017. The associated projected level of starts more than doubles from 2013 to 2017 (Appendix Table 3, column 8). Peak starts in 2019 of 1.5 million approximately equal their level in 2003 (just prior to their

[3]There is also a very modest feedback effect from the timing of construction to cumulative construction. The calculations apply the judged trend abandonment rate to all occupied units rather than disproportionately to older occupied units. Hence higher judged closure rates in early years imply some modest extra abandonment in later years, thereby boosting cumulative required construction. For practical purposes, this feedback is sufficiently small to ignore.

final run up). But this level of starts in 2003 was attained following ten years of moderate annual increases from an initial level of starts in 1993 that was nearly twice optimistic-projected annual starts in 2013.

Implicitly underlying the optimistic projections is a very strong increase in demand for single-family housing. Over the short and intermediate term, this increase in demand would likely put significant upward pressure on house prices thereby dampening realized construction to levels below the optimistic projection. Over the longer term, the shared demographic trend underlying the baseline, optimistic, and pessimistic projections suggests that respective house prices will be similar.

1.3 Pessimistic Single-Family Judgments

Compared to the baseline single-family projection, the alternative pessimistic projection combines a higher judged reoccupancy of the surplus vacant units at the end of 2012 (80 percent rather than 65 percent) and a lower judged trend rate of abandonment (0.1 percent per year rather than 0.2 percent). The higher reoccupancy modestly decreases required total construction from 2013 through 2035. The lower trend abandonment decreases the level of construction required to keep the gap between trend and projected units constant by about 100,000 units per year.

The judged pessimistic year-by-year closure rates are enumerated in column 5a of Appendix Table 4. As is the case in the baseline projection, these are required to not decrease over time. Compared to the judged baseline closure rates, the pessimistic ones are chosen to imply relatively moderate growth during 2014 through 2017. As a result, total construction from 2013 through 2035 is pushed considerably back in time.

2 Multifamily Projections

As with the single-family projections, it is necessary to assume a trend multifamily vacancy rate prior to making the judgments on multifamily reoccupancy, trend abandonment, and gap closure. For each of the baseline, optimistic, and pessimistic projections it is assumed to be 7.3 percent, equal to its actual rate in 2000 (Appendix Table 5, column 11). Actual multifamily vacancy, calculated as the ratio of vacant multifamily units available for rent or sale relative to the sum rose to a maximum of 11 percent at the end of 2009 and then fell to 8.5 percent at the end of 2012 (Appendix Table 5, column 11). The demographic-projected trend number of occupied multifamily units at the end of 2012 is 30.7 million (Appendix Table 6, column 1). The assumed trend vacancy rate implies that the 2.7 million vacant multifamily units at the end of 2012 (Appendix Table 6, column 10) can be decomposed into 2.4 million trend-vacant units and 300,000 cyclical vacant units.

2.1 Baseline Multifamily Judgments

The baseline-scenario judgment is that only 75 percent of the cyclical multifamily vacant units at the end of 2012 are eventually reoccupied. The implied cyclical abandonment of 200,000 units is accounted for as taking place entirely in 2013. The reported 140,000 abandoned units for 2013 thus combines trend abandonment plus cyclical abandonment (Appendix Table 6, column 12). More realistically, they are likely to be abandoned over the course of a number of years. But for projecting construction, this timing does not matter. The reoccupying of the cyclically vacant units is projected to occur in 2013 and 2014 (Appendix Table 6, column 8c). For each of these years, this reoccupying lowers the required construction growth needed to achieve a given assumed closure rate.

The baseline trend rate of abandonment is judged to be 0.3 percent per year. Historical data leaves wide latitude on choosing this baseline rate. From 1960 through 2000, average annual abandonment was approximately 3 percent per year (Appendix Table 5, column 13), which was about ten times the single family rate. But this was an extended period of rapid suburbanization and a corresponding large shift from multifamily to single-family housing. In consequence, such a high rate of multifamily abandonment is unlikely to hold during a period when multifamily occupancy is projected to be booming. More recently, the multifamily abandonment rate has tended to be considerably lower. For nine of the 12 years, 2001 through 2012, is was below 0.5 percent. For 6 of these it was negative, which reflects that the annual increase in the sum of occupied and vacant multifamily units exceeded annual multifamily construction. (The fact that abandonment as calculated herein can be negative emphasizes that the reported rates are estimates; in reality, there may be a considerable number of vacant multifamily units that will eventually be available for rent or sale, but that are not reported as such at the time of the quarterly Census Bureau Home Occupancy survey).

As is the case with single-family housing, the judged rate of closure of the gap between the demographic-based trend number of occupied multifamily housing units and the projected number of housing units is the most difficult of the three judgments. One reason, as above, is the need to make this judgment on a year-by-year basis. A second reason is that the estimated multifamily gap at the end of 2012 was considerably larger than corresponding single-family gap (4.8 percent relative to trend rather than 2.0 percent relative to trend). Hence there is a lot more latitude in the judged path of closure rates. A third reason is that, compared to the single-family projections, capacity constraints are more likely to constrain the closure of the multifamily gap.

In contrast to the case for single-family housing, the gap between the trend and actual number of occupied number has already begun to close. At the end of 2012, this gap was 12 percent smaller than its maximum at the end of 2009 (Appendix Table

6, column 7). The rate of closure for 2012 is estimated to be 10 percent (Appendix Table 6, column 5a).

A second contrast to the single-family projection is that the rate of closure is judged to decrease in two years: from 10 percent in 2012 to 6 percent in 2013 and further down to 0 percent in 2014. These judged decreases contradict the guiding principle, described above, that the closure rate decrease over time. For 2013, the justification for the judged decrease is the lackluster growth in multifamily starts during the first half of 2013. Matching the 10 percent rate of closure in 2012 would require annualized growth of multifamily starts to be just under 150 percent during the second half of 2013 (which is indeed the judgment for the optimistic projection).

The judged zero closure rate for 2014 largely reflects that in contrast to earlier years, there are likely to be very few vacant multifamily units left that can be reoccupied. As a result, any judged closure rate for 2014 will require a substantially higher construction growth rate than previously. Under the baseline projection, the number of reoccupied units falls rapidly from a maximum of 320,000 in 2012 to 190,000 in 2013; to 40,000 in 2014; and then to zero thereafter. In other words, under the baseline projection there will be 150,000 less reoccupied units in 2014 that can contribute to matching the 2013 rate of closure. In consequence, even with a judged zero closure in 2014, projected multifamily construction increases by 22 percent. Growth much above this might strain builders' capacity.

Beginning in 2015, the judged baseline closure rates are again required to be non-decreasing over time. For 2015 through 2018, they are chosen so as to imply a moderately decelerating rate of growth (Appendix Table 6, column 9). As in with the single family projections, the baseline multifamily projection assumes that the gap between trend and projected occupied units is completely closed by 2035. Together with the baseline reoccupancy and abandonment judgments, doing so pins down total multifamily construction from 2013 through 2035 at 10.2 million units. The judged baseline closure rates for 2019 through 2035 are chosen to smooth the level of construction over these years while matching required cumulative construction.

2.2 Optimistic Multifamily Judgments

Compared to the baseline single-family projection, the alternative optimistic single-family projection combines a higher trend rate of abandonment (0.5 percent per year rather than 0.3 percent). This increases trend multifamily construction levels by approximately 60,000 per year.

Unlike the case for the single-family optimistic projection, the optimistic multifamily judged reoccupancy rate of vacant units at the end of 2012 is higher than the judged baseline rate. This reflects that the estimated number of cyclical vacant multifamily units at the end of 2012 (300,000, calculated as described above) is relatively low compared to multifamily construction in that year (2.7 million). The closure rate

for 2013 is judged to be 10 percent, which is chosen to match the projected closure rate in 2012. Achieving this while keeping the implied growth in multifamily construction to an attainable rate relies on the reoccupancy of nearly all of multifamily that were vacant at the end of 2012 (Appendix Table 7, column 8c).

The judged optimistic closure rates for 2014 and 2015, -7 percent and 2 percent, are chosen to match the 24 percent optimistic projected growth rate for 2013. So notwithstanding the judged *increase* in the gap in 2014, projected construction growth remains vigorous. As described above with respect to the baseline multifamily projection, this unintuitive combination reflects the falloff in the reoccupancy of vacant multifamily units. Also as in the baseline projection, the judged rate of closure is allowed to decrease from 2013 to 2014 in order to keep the implied construction growth rate arguably within builders' capacity. If, instead, the 2014 closure of the gap between trend and projected multifamily closure were to match its 2013 rate of 10 percent, multifamily construction would need to nearly double.

The judged optimistic closure rates for 2016 and 2017 are similarly chosen to maintain strong construction growth. As a result, multifamily construction rises sixfold from 2010 through 2017, and then peaks one year later near its highest level in more than 30 years. Achieving such sustained strong growth will most likely strain multifamily builders' productive capacity. It might plausibly be attained5 by hiring workers away from the non-residential and single-family construction sectors.

Cumulative multifamily construction through 2018 is sufficiently high to require relatively sharply contracting multifamily construction beginning in 2019. This is true notwithstanding a relatively high and increasing judged rate of closure. The onset of the contraction could be delayed an extra year or two, but only at the cost of making the eventual decrease in construction even sharper.

2.3 Pessimistic Multifamily Judgments

Compared to the baseline multifamily projection, the alternative pessimistic projection combines a higher judged reoccupancy of the surplus vacant units at the end of 2012 (100 percent rather than 75 percent) and a lower judged trend rate of abandonment (0.1 percent per year rather than 0.3 percent). The higher reoccupancy modestly decreases required total construction from 2013 through 2035. The lower trend abandonment decreases the level of construction required to keep the gap between trend and projected units constant by about 60,000 units per year.

The judged pessimistic year-by-year closure rates are enumerated in column 5a of Appendix Table 8. These are chosen to imply moderately high multifamily construction growth from 2013 through 2016 and then gradually decelerating positive construction growth through 2020 (Appendix Table 8, column 9). As a result, total construction from 2013 through 2035 is pushed considerably back in time.

As in the baseline and optimistic projections, the rate of closure is allowed to

decrease to achieve this target path. Under the pessimistic projection, these decreases occur in 2014 and 2015.[4]

References:

Mayer, Christopher J. and C Tsuriel Somerville (2000). "Residential Construction: Using the Urban Growth Model to Estimate Housing Supply." *Journal of Urban Economics* 48, pp. 85-109.

Rappaport, Jordan (2006). "A Bottleneck Capital Model of Development." *Journal of Monetary Economics* 53, 8 (November), pp. 2113-2129.

[4]The decrease in the judged closure rate in 2015 is not reflected in Appendix Table 8 because of rounding. Measured to one decimal place, judged closure falls from 9.9 percent in 2013 to 4.1 percent in 2014 and then further 3.5 percent in 2015. The closure rate for 2016 is judged to tick up to 4.8 percent.

Appendix Table 1: Historical Single-Family House Starts, 1960 to 2012

	(1)	(2)	(3)	(4)	(5)	(6)	(8)	(8a)	(8b)	(8c)	(9)	(10)	(11)	(12)	(13)
	Single-Family Occupied Units				**Occupied Unit Gap**		**Single-Family Starts**					**Vacant Units**		**Abandoned Units**	
	demo-graphic trend level	actual level	trend in-crease	actual in-crease	level gap =(2)-(1)	change in gap =(4)-(3)	actual =(4)+(8a)	total net flow from occpd	toal net flow pct of occpd units	cyclical net flow from occpd	starts growth rate	actual	pct of ttl units	net flow to aban-doned	net flow pct of ttl units
1960	42,400	*31,600*			-10,780										
1970	48,100	*44,000*	570**	*1240***	-4,060	670**	*910***		-0.9%**	-140					-0.9%
1980	54,900	*53,700*	680**	*960***	-1,240	280**	*1140***		0.4%**	-140	0%**			150**	0.3%
1990	61,200	*60,300*	630**	*660***	-950	30**	*990***		0.6%**	-150	1%**			310**	0.5%
2000	70,700	*70,700*	940**	*1040***	0	90**	*1140***		0.1%**	-150	3%**	*1,890*	*2.6%*	40**	0.1%
2001	71,500	*71,300*	860	*580*	-280	-280	*1,270*	690	1.0%	550	12%	*2,290*	*3.1%*	290	0.4%
2002	72,400	*72,700*	870	*1,460*	310	590	*1,360*	-100	-0.1%	-240	7%	*2,230*	*3.0%*	-40	-0.1%
2003	73,300	*73,800*	840	*1,030*	500	190	*1,510*	470	0.6%	330	10%	*2,300*	*3.0%*	410	0.5%
2004	74,100	*75,300*	880	*1,530*	1,150	650	*1,600*	70	0.1%	-70	7%	*2,460*	*3.2%*	-90	-0.1%
2005	75,100	*76,100*	920	*770*	990	-150	*1,720*	950	1.3%	800	7%	*2,730*	*3.5%*	690	0.9%
2006	76,000	*76,800*	940	*750*	800	-190	*1,470*	730	0.9%	580	-1%	*3,130*	*3.9%*	320	0.4%
2007	76,900	*77,700*	950	*890*	750	-60	*1,040*	140	0.2%	-10	-30%	*3,160*	*3.9%*	120	0.1%
2008	77,900	*78,200*	960	*550*	330	-410	*620*	70	0.1%	-90	-40%	*3,300*	*4.0%*	-70	-0.1%
2009	78,800	*78,500*	930	*300*	-300	-630	*440*	140	0.2%	-10	-28%	*3,120*	*3.8%*	320	0.4%
2010	79,800	*79,100*	920	*610*	-610	-310	*470*	-140	-0.2%	-300	7%	*3,080*	*3.7%*	-100	-0.1%
2011	80,600	*79,300*	830	*150*	-1,290	-680	*430*	290	0.4%	130	-8%	*2,900*	*3.5%*	460	0.6%
2012	81,400	*79,800*	850	*510*	-1,630	-350	*540*	30	0.0%	-130	24%	*2,670*	*3.2%*	270	0.3%

** ten year annual average through listed year

Notes: Italics indicate observed outcomes rather than inferred outcomes and projected trends. Except when indicated by a percent sign, all units are in thousands.
Constructed housing units are assumed to be completed in the same calendar year in which they are started. Growth rates are year-over-year

Appendix Table 2: Single-Family House Starts, Baseline Projection

	(1)	(2)	(3)	(4)	(5)	(5a)	(6)	(7)	(8)	(8a)	(8b)	(8c)	(9)	(10)	(11)	(12)	(13)
	Single-Family Occupied Units				**Single-Family Occupied Unit Gap**				**Single-Family Starts**					**Vacant Units**		**Abandoned Units**	
	demo-graphic trend level	pro-jected level	trend in-crease	pro-jected in-crease	level gap =(2)-(1)	judged pct closure of prev yr gap	change in gap =(4)-(3) =-(5a)•(5_{y-1})	cumulative change in gap from 2012	pro-jected =(4)+(8a)	total net flow from occpd	toal net flow pct of occpd units	cyclical net flow from occpd	starts growth rate	pro-jected	pct of ttl units	net flow to aban-doned	net flow pct of ttl units
2012	81,400	*79,800*	850	*510*	-1,630		-350	0%	*540*	30	0.0%	-130	*24%*	*2,670*	*3.2%*	270	0.3%
2013	82,300	80,400	850	570	-1,920	-18%	-290	-18%	620	50	0.1%	-110	15%	2,370	2.9%	340	0.4%
2014	83,100	81,000	860	650	-2,130	-11%	-210	-30%	680	30	0.0%	-130	10%	2,260	2.7%	140	0.2%
2015	84,000	81,700	890	710	-2,300	-8%	-170	-41%	790	70	0.1%	-90	15%	2,200	2.6%	140	0.2%
2016	84,900	82,500	870	800	-2,370	-3%	-70	-45%	910	120	0.1%	-40	16%	2,170	2.6%	140	0.2%
2017	85,800	83,400	860	920	-2,310	2%	60	-42%	1,080	170	0.2%	0	18%	2,200	2.6%	140	0.2%
2018	86,600	84,500	850	1,050	-2,110	9%	200	-29%	1,210	170	0.2%	0	12%	2,220	2.6%	150	0.2%
2019	87,500	85,600	840	1,110	-1,850	13%	270	-13%	1,280	170	0.2%	0	6%	2,240	2.5%	150	0.2%
2020	88,300	86,800	860	1,170	-1,540	17%	310	6%	1,340	170	0.2%	0	4%	2,260	2.5%	150	0.2%
2021	89,100	88,000	830	1,180	-1,190	22%	340	27%	1,350	170	0.2%	0	1%	2,280	2.5%	150	0.2%
2022	90,000	89,100	820	1,150	-860	28%	330	47%	1,330	180	0.2%	0	-2%	2,300	2.5%	150	0.2%
2023	90,800	90,200	800	1,070	-590	32%	270	64%	1,250	180	0.2%	0	-6%	2,320	2.5%	160	0.2%
2024	91,600	91,200	790	980	-400	32%	190	75%	1,160	180	0.2%	0	-7%	2,340	2.5%	160	0.2%
2025	92,400	92,100	810	940	-270	32%	130	83%	1,120	180	0.2%	0	-3%	2,360	2.5%	160	0.2%
2026	93,200	93,000	780	870	-190	32%	90	89%	1,050	180	0.2%	0	-6%	2,380	2.5%	160	0.2%
2027	93,900	93,800	750	810	-130	32%	60	92%	990	190	0.2%	0	-6%	2,400	2.5%	170	0.2%
2028	94,600	94,500	730	770	-90	32%	40	95%	960	190	0.2%	0	-4%	2,420	2.5%	170	0.2%
2029	95,400	95,300	730	760	-60	32%	30	96%	950	190	0.2%	0	-1%	2,440	2.5%	170	0.2%
2030	96,100	96,100	740	760	-40	32%	20	98%	950	190	0.2%	0	1%	2,460	2.5%	170	0.2%
2031	96,800	96,800	710	720	-30	32%	10	99%	920	190	0.2%	0	-4%	2,480	2.5%	170	0.2%
2032	97,500	97,500	670	680	-20	32%	10	99%	870	190	0.2%	0	-5%	2,500	2.5%	180	0.2%
2033	98,100	98,100	650	660	0	100%	20	100%	850	190	0.2%	0	-2%	2,510	2.5%	180	0.2%
2034	98,800	98,800	640	650	0				840	200	0.2%	0	-1%	2,530	2.5%	180	0.2%
2035	99,400	99,400	640	640	0				840	200	0.2%	0	-1%	2,540	2.5%	180	0.2%

Notes: Italics indicate actual 2012 outcomes rather than future projected ones. Except when indicated by a percent sign, all units are in thousands. Constructed housing units are assumed to be completed in the same calendar year in which they are started. Growth rates are year-over-year

Appendix Table 3: Single-Family House Starts, Optimistic Projection

	(1)	(2)	(3)	(4)	(5)	(5a)	(6)	(7)	(8)	(8a)	(8b)	(8c)	(9)	(10)	(11)	(12)	(13)
	Single-Family Occupied Units				**Single-Family Occupied Unit Gap**				**Single-Family Starts**					**Vacant Units**		**Abandoned Units**	
	demo-graphic trend level	pro-jected level	trend in-crease	pro-jected in-crease	level gap =(2)-(1)	judged pct closure of prev yr gap	change in gap =(4)-(3) $=-(5a)\cdot(5_{y-1})$	cumulative change in gap from 2012	pro-jected =(4)+(8a)	total net flow from occpd	toal net flow pct of occpd units	cyclical net flow from occpd	starts growth rate	pro-jected	pct of ttl units	net flow to aban-doned	net flow pct of ttl units
2012	81,400	*79,800*	850	*510*	-1,630		-350	0%	*540*	30	0.0%	-210	*24%*	*2,670*	*3.2%*	270	0.3%
2013	82,300	80,300	850	530	-1,960	-20%	-330	-20%	620	100	0.1%	-140	16%	2,310	2.8%	450	0.5%
2014	83,100	80,900	860	600	-2,220	-13%	-260	-36%	730	140	0.2%	-100	18%	2,230	2.7%	220	0.3%
2015	84,000	81,600	890	720	-2,390	-8%	-170	-46%	890	180	0.2%	-70	22%	2,190	2.6%	220	0.3%
2016	84,900	82,500	870	880	-2,380	1%	20	-45%	1,090	210	0.3%	-40	23%	2,170	2.6%	220	0.3%
2017	85,800	83,700	860	1,130	-2,110	11%	270	-29%	1,370	250	0.3%	0	25%	2,200	2.6%	230	0.3%
2018	86,600	84,900	850	1,250	-1,710	19%	400	-4%	1,500	250	0.3%	0	9%	2,220	2.5%	230	0.3%
2019	87,500	86,200	840	1,270	-1,280	25%	430	22%	1,530	250	0.3%	0	2%	2,240	2.5%	230	0.3%
2020	88,300	87,400	860	1,190	-940	26%	330	42%	1,450	260	0.3%	0	-5%	2,260	2.5%	240	0.3%
2021	89,100	88,400	830	1,080	-700	26%	250	57%	1,340	260	0.3%	0	-8%	2,280	2.5%	240	0.3%
2022	90,000	89,500	820	1,000	-520	26%	180	68%	1,270	270	0.3%	0	-5%	2,300	2.5%	240	0.3%
2023	90,800	90,400	800	930	-380	26%	130	77%	1,200	270	0.3%	0	-6%	2,320	2.5%	250	0.3%
2024	91,600	91,300	790	890	-280	26%	100	83%	1,160	270	0.3%	0	-3%	2,340	2.5%	250	0.3%
2025	92,400	92,200	810	890	-210	26%	70	87%	1,160	270	0.3%	0	0%	2,360	2.5%	250	0.3%
2026	93,200	93,000	780	840	-160	26%	50	91%	1,110	280	0.3%	0	-4%	2,380	2.5%	260	0.3%
2027	93,900	93,800	750	790	-110	26%	40	93%	1,070	280	0.3%	0	-4%	2,400	2.5%	260	0.3%
2028	94,600	94,500	730	760	-80	26%	30	95%	1,040	280	0.3%	0	-3%	2,420	2.5%	260	0.3%
2029	95,400	95,300	730	750	-60	26%	20	96%	1,040	280	0.3%	0	0%	2,440	2.5%	260	0.3%
2030	96,100	96,100	740	760	-50	26%	20	97%	1,050	290	0.3%	0	1%	2,460	2.5%	270	0.3%
2031	96,800	96,800	710	720	-30	26%	10	98%	1,010	290	0.3%	0	-3%	2,480	2.5%	270	0.3%
2032	97,500	97,500	670	680	-20	26%	10	99%	970	290	0.3%	0	-4%	2,500	2.5%	270	0.3%
2033	98,100	98,100	650	660	0	100%	20	100%	950	290	0.3%	0	-2%	2,510	2.5%	280	0.3%
2034	98,800	98,800	640	650	0				950	290	0.3%	0	0%	2,530	2.5%	280	0.3%
2035	99,400	99,400	640	640	0				940	300	0.3%	0	-1%	2,540	2.5%	280	0.3%

Notes: Italics indicate actual 2012 outcomes rather than future projected ones. Except when indicated by a percent sign, all units are in thousands. Constructed housing units are assumed to be completed in the same calendar year in which they are started. Growth rates are year-over-year

Appendix Table 4: Single-Family House Starts, Pessimistic Projection

	(1)	(2)	(3)	(4)	(5)	(5a)	(6)	(7)	(8)	(8a)	(8b)	(8c)	(9)	(10)	(11)	(12)	(13)
	Single-Family Occupied Units				**Single-Family Occupied Unit Gap**				**Single-Family Starts**					**Vacant Units**		**Abandoned Units**	
	demo-graphic trend level	pro-jected level	trend in-crease	pro-jected in-crease	level gap =(2)-(1)	judged pct closure of prev yr gap	change in gap =(4)-(3) $=-(5a)\cdot(5_{y-1})$	cumulative change in gap from 2012	pro-jected =(4)+(8a)	total net flow from occpd	toal net flow pct of occpd units	cyclical net flow from occpd	starts growth rate	pro-jected	pct of ttl units	net flow to aban-doned	net flow pct of ttl units
2012	81,400	*79,800*	850	*510*	-1,630		-350	0%	*540*	30	0.0%	-50	*24%*	*2,670*	*3.2%*	270	0.3%
2013	82,300	80,400	850	610	-1,880	-15%	-250	-15%	610	0	0.0%	-80	14%	2,490	3.0%	170	0.2%
2014	83,100	81,100	860	700	-2,040	-9%	-160	-25%	630	-70	-0.1%	-150	3%	2,360	2.8%	60	0.1%
2015	84,000	81,800	890	710	-2,210	-9%	-170	-35%	680	-30	0.0%	-120	8%	2,270	2.7%	60	0.1%
2016	84,900	82,500	870	720	-2,360	-7%	-140	-44%	740	10	0.0%	-70	8%	2,220	2.6%	60	0.1%
2017	85,800	83,300	860	760	-2,460	-4%	-100	-50%	800	40	0.0%	-50	8%	2,200	2.6%	60	0.1%
2018	86,600	84,100	850	780	-2,520	-3%	-70	-54%	860	80	0.1%	0	8%	2,220	2.6%	60	0.1%
2019	87,500	84,900	840	850	-2,520	0%	10	-54%	930	80	0.1%	0	8%	2,240	2.6%	60	0.1%
2020	88,300	85,900	860	930	-2,450	3%	70	-50%	1,010	80	0.1%	0	8%	2,260	2.6%	60	0.1%
2021	89,100	86,900	830	1,000	-2,290	7%	160	-40%	1,080	90	0.1%	0	7%	2,280	2.6%	60	0.1%
2022	90,000	87,900	820	1,040	-2,070	10%	220	-27%	1,130	90	0.1%	0	5%	2,300	2.6%	70	0.1%
2023	90,800	89,000	800	1,070	-1,790	13%	270	-10%	1,160	90	0.1%	0	3%	2,320	2.5%	70	0.1%
2024	91,600	90,100	790	1,090	-1,500	17%	300	8%	1,180	90	0.1%	0	2%	2,340	2.5%	70	0.1%
2025	92,400	91,100	810	1,080	-1,230	18%	270	25%	1,170	90	0.1%	0	0%	2,360	2.5%	70	0.1%
2026	93,200	92,200	780	1,050	-960	22%	270	41%	1,140	90	0.1%	0	-3%	2,380	2.5%	70	0.1%
2027	93,900	93,200	750	1,010	-700	27%	260	57%	1,100	90	0.1%	0	-4%	2,400	2.5%	70	0.1%
2028	94,600	94,200	730	950	-470	32%	220	71%	1,050	90	0.1%	0	-5%	2,420	2.5%	70	0.1%
2029	95,400	95,100	730	910	-300	37%	180	82%	1,000	90	0.1%	0	-4%	2,440	2.5%	80	0.1%
2030	96,100	95,900	740	870	-180	41%	120	89%	960	100	0.1%	0	-4%	2,460	2.5%	80	0.1%
2031	96,800	96,700	710	790	-100	45%	80	97%	880	100	0.1%	0	-8%	2,480	2.5%	80	0.1%
2032	97,500	97,400	670	710	-60	47%	50	98%	810	100	0.1%	0	-8%	2,500	2.5%	80	0.1%
2033	98,100	98,100	650	680	-30	49%	30	99%	780	100	0.1%	0	-4%	2,510	2.5%	80	0.1%
2034	98,800	98,800	640	650	-10	49%	20	99%	750	100	0.1%	0	-3%	2,530	2.5%	80	0.1%
2035	99,400	99,400	640	650	0	100%	10	100%	750	100	0.1%	0	0%	2,540	2.5%	80	0.1%

Notes: Italics indicate actual 2012 outcomes rather than future projected ones. Except when indicated by a percent sign, all units are in thousands. Constructed housing units are assumed to be completed in the same calendar year in which they are started. Growth rates are year-over-year

Appendix Table 5: Historical Multifamily Housing Unit Starts, 1960 to 2012

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(8a)	(8b)	(8c)	(9)	(10)	(11)	(12)	(13)
	Multifamilyy Occupied Units				**Occupied Unit Gap**			**Multifamilyy Starts**					**Vacant Units**		**Abandoned Units**	
	demo-graphic trend level	actual level	trend in-crease	actual in-crease	level gap =(2)-(1)	change in gap =(4)-(3)	cumulative change in gap from 2009	actual =(4)+(8a)	total net flow from occpd	toal net flow pct of occpd units	cyclical net flow from occpd	starts growth rate	actual	pct of ttl units	net flow to aban-doned	net flow pct of ttl units
1960	15,900	*10,000*			-5,870											
1970	18,300	*17,400*	250**	*740***	-990	490**		*520***		-1.7%**	-80				130**	1.1%
1980	22,300	*22,800*	400**	*540***	490	150**		*600***		0.4%**	-80	0%**			550**	2.5%
1990	24,700	*24,600*	240**	*180***	-190	-70**		*490***		1.4%**	-80	1%**			800**	3.1%
2000	27,300	*27,300*	250**	*270***	0	20**		*270***		0.0%**	-80	3%**	*2,150*	*7.3%*	810**	2.9%
2001	27,500	*27,900*	250	*580*	320	320		*330*	-250	-0.9%	-330	21%	*2,270*	*7.5%*	-370	-1.2%
2002	27,800	*27,300*	260	*-520*	-450	-780		*350*	860	3.2%	780	5%	*2,480*	*8.3%*	650	2.2%
2003	28,000	*27,400*	250	*100*	-600	-150		*350*	250	0.9%	160	0%	*2,870*	*9.5%*	-140	-0.5%
2004	28,300	*27,400*	270	*-40*	-910	-310		*350*	380	1.4%	300	-1%	*2,700*	*9.0%*	560	1.9%
2005	28,600	*27,800*	280	*400*	-800	120		*350*	-40	-0.2%	-130	3%	*2,530*	*8.3%*	120	0.4%
2006	28,900	*27,600*	300	*-250*	-1,350	-550		*340*	590	2.1%	510	-2%	*2,810*	*9.2%*	310	1.0%
2007	29,200	*27,700*	300	*100*	-1,550	-210		*310*	210	0.8%	130	-10%	*2,900*	*9.5%*	110	0.4%
2008	29,500	*27,900*	310	*230*	-1,640	-90		*280*	60	0.2%	-30	-7%	*3,110*	*10.0%*	-150	-0.5%
2009	29,800	*28,100*	300	*260*	-1,680	-40		*110*	-150	-0.5%	-230	-61%	*3,490*	*11.0%*	-520	-1.7%
2010	30,100	*28,500*	300	*330*	-1,660	20	1%	*110*	-210	-0.7%	-300	2%	*2,990*	*9.5%*	280	0.9%
2011	30,400	*28,800*	310	*330*	-1,640	20	2%	*180*	-150	-0.5%	-240	56%	*2,940*	*9.3%*	-100	-0.3%
2012	30,700	*29,300*	320	*480*	-1,480	160	12%	*250*	-230	-0.8%	-320	39%	*2,730*	*8.5%*	-20	-0.1%

** ten year annual average through listed year

Notes: Italics indicate observed outcomes rather than inferred outcomes and projected trends. Except when indicated by a percent sign, all units are in thousands.
Constructed housing units are assumed to be completed in the same calendar year in which they are started. Growth rates are year-over-year

Appendix Table 6: Multifamily Housing Unit Starts, Baseline Projection

	(1)	(2)	(3)	(4)	(5)	(5a)	(6)	(7)	(8)	(8a)	(8b)	(8c)	(9)	(10)	(11)	(12)	(13)
	Multifamily Occupied Units				Multifamily Occupied Unit Gap				Multifamily Starts					Vacant Units		Abandoned Units	
	demo-graphic trend level	pro-jected level	trend in-crease	pro-jected in-crease	level gap =(2)-(1)	judged pct closure of prev yr gap	change in gap =(4)-(3) $=-(5a)\cdot(5_{y-1})$	cumulative change in gap from 2009	pro-jected =(4)+(8a)	total net flow from occpd	toal net flow pct of occpd units	cyclical net flow from occpd	starts growth rate	pro-jected	pct of ttl units	net flow to aban-doned	net flow pct of ttl units
2009	29,800	*28,100*	300	*260*	-1,680		-40	0%	*110*	-150	-0.5%	-230	*-61%*	*3,490*	*11.0%*	-520	-1.7%
2010	30,100	*28,500*	300	*330*	-1,660	1%	20	1%	*110*	-210	-0.7%	-300	*2%*	*2,990*	*9.5%*	280	0.9%
2011	30,400	*28,800*	310	*330*	-1,640	1%	20	2%	*180*	-150	-0.5%	-240	*56%*	*2,940*	*9.3%*	-100	-0.3%
2012	30,700	*29,300*	320	*480*	-1,480	10%	160	12%	*250*	-230	-0.8%	-320	*39%*	*2,730*	*8.5%*	-20	-0.1%
2013	31,100	29,700	310	400	-1,390	6%	90	17%	290	-100	-0.4%	-190	19%	2,480	7.7%	140	0.4%
2014	31,400	30,000	310	310	-1,390	0%	0	17%	360	50	0.2%	-40	22%	2,470	7.6%	60	0.3%
2015	31,700	30,300	290	330	-1,350	3%	30	19%	420	90	0.3%	0	16%	2,490	7.6%	70	0.3%
2016	31,900	30,700	290	380	-1,260	7%	90	25%	470	90	0.3%	0	13%	2,510	7.6%	70	0.3%
2017	32,200	31,100	290	430	-1,120	11%	140	33%	520	90	0.3%	0	10%	2,540	7.5%	70	0.3%
2018	32,500	31,600	290	470	-940	16%	180	44%	560	90	0.3%	0	7%	2,560	7.5%	70	0.3%
2019	32,800	32,100	280	480	-740	21%	200	56%	570	90	0.3%	0	2%	2,580	7.5%	70	0.3%
2020	33,100	32,500	280	460	-560	25%	190	67%	560	100	0.3%	0	-2%	2,600	7.4%	70	0.3%
2021	33,300	33,000	270	430	-390	29%	160	77%	530	100	0.3%	0	-6%	2,620	7.4%	80	0.3%
2022	33,600	33,300	280	390	-280	29%	110	83%	490	100	0.3%	0	-7%	2,650	7.4%	80	0.3%
2023	33,900	33,700	280	360	-200	29%	80	88%	460	100	0.3%	0	-6%	2,670	7.3%	80	0.3%
2024	34,200	34,000	280	340	-140	29%	60	92%	440	100	0.3%	0	-6%	2,690	7.3%	80	0.3%
2025	34,500	34,400	280	320	-100	29%	40	94%	420	100	0.3%	0	-4%	2,710	7.3%	80	0.3%
2026	34,700	34,700	280	310	-70	29%	30	96%	410	100	0.3%	0	-2%	2,730	7.3%	80	0.3%
2027	35,000	35,000	300	320	-50	29%	20	97%	420	100	0.3%	0	4%	2,760	7.3%	80	0.3%
2028	35,300	35,300	300	310	-40	29%	10	98%	420	100	0.3%	0	-2%	2,780	7.3%	80	0.3%
2029	35,600	35,600	280	290	-20	29%	10	99%	400	110	0.3%	0	-5%	2,800	7.3%	80	0.3%
2030	35,900	35,900	280	290	-20	29%	10	99%	390	110	0.3%	0	-1%	2,830	7.3%	80	0.3%
2031	36,200	36,200	280	280	-10	29%	10	99%	390	110	0.3%	0	-1%	2,850	7.3%	90	0.3%
2032	36,500	36,500	310	310	-10	29%	0	100%	420	110	0.3%	0	8%	2,870	7.3%	80	0.3%
2033	36,800	36,800	300	310	-10		0		420	110	0.3%	0	-1%	2,900	7.3%	90	0.3%
2034	37,100	37,100	300	300	0		0		410	110	0.3%	0	-2%	2,920	7.3%	90	0.3%
2035	37,400	37,400	290	290	0		0		410	110	0.3%	0	-1%	2,940	7.3%	90	0.3%

Notes: Italics indicate observed outcomes in 2009 through 2012. Except when indicated by a percent sign, all units are in thousands. Constructed housing units are assumed to be completed in the same calendar year in which they are started. Growth rates are year-over-year

Appendix Table 7: Multifamily Housing Unit Starts, Optimistic Projection

	(1)	(2)	(3)	(4)	(5)	(5a)	(6)	(7)	(8)	(8a)	(8b)	(8c)	(9)	(10)	(11)	(12)	(13)
	Multifamily Occupied Units				Multifamily Occupied Unit Gap				Multifamily Starts					Vacant Units		Abandoned Units	
	demo-graphic trend level	pro-jected level	trend in-crease	pro-jected in-crease	level gap =(2)-(1)	judged pct closure of prev yr gap	change in gap =(4)-(3) $=-(5a)\cdot(5_{y-1})$	cumulative change in gap from 2009	pro-jected =(4)+(8a)	total net flow from occpd	toal net flow pct of occpd units	cyclical net flow from occpd	starts growth rate	pro-jected	pct of ttl units	net flow to aban-doned	net flow pct of ttl units
2009	29,800	*28,100*	300	*260*	-1,680		-40	0%	*110*	-150	-0.5%	-290	*-61%*	*3,490*	*11.0%*	-520	-1.7%
2010	30,100	*28,500*	300	*330*	-1,660	1%	20	1%	*110*	-210	-0.7%	-350	*2%*	*2,990*	*9.5%*	280	0.9%
2011	30,400	*28,800*	310	*330*	-1,640	1%	20	2%	*180*	-150	-0.5%	-290	*56%*	*2,940*	*9.3%*	-100	-0.3%
2012	30,700	*29,300*	320	*480*	-1,480	10%	160	12%	*250*	-230	-0.8%	-380	*39%*	*2,730*	*8.5%*	-20	-0.1%
2013	31,100	29,700	310	450	-1,340	10%	140	20%	310	-150	-0.5%	-290	24%	2,420	7.5%	160	0.5%
2014	31,400	29,900	310	210	-1,430	-7%	-90	15%	380	170	0.6%	0	24%	2,470	7.6%	120	0.5%
2015	31,700	30,300	290	320	-1,400	2%	30	17%	470	150	0.5%	0	24%	2,490	7.6%	130	0.5%
2016	31,900	30,700	290	410	-1,270	9%	130	24%	570	150	0.5%	0	20%	2,510	7.6%	130	0.5%
2017	32,200	31,200	290	510	-1,050	17%	220	37%	660	150	0.5%	0	17%	2,540	7.5%	130	0.5%
2018	32,500	31,700	290	520	-820	22%	230	51%	680	160	0.5%	0		2,560	7.5%	130	0.5%
2019	32,800	32,200	280	500	-600	26%	210	64%	660	160	0.5%	0	-3%	2,580	7.4%	140	0.5%
2020	33,100	32,700	280	460	-420	30%	180	75%	620	160	0.5%	0	-5%	2,600	7.4%	140	0.5%
2021	33,300	33,100	270	420	-270	35%	150	84%	580	160	0.5%	0	-6%	2,620	7.4%	140	0.5%
2022	33,600	33,400	280	370	-180	35%	100	89%	540	170	0.5%	0	-7%	2,650	7.3%	140	0.5%
2023	33,900	33,800	280	340	-120	35%	60	93%	510	170	0.5%	0	-5%	2,670	7.3%	140	0.5%
2024	34,200	34,100	280	320	-70	40%	50	96%	490	170	0.5%	0	-3%	2,690	7.3%	150	0.5%
2025	34,500	34,400	280	300	-40	40%	30	98%	470	170	0.5%	0	-4%	2,710	7.3%	150	0.5%
2026	34,700	34,700	280	290	-20	40%	20	99%	470	170	0.5%	0	-2%	2,730	7.3%	150	0.5%
2027	35,000	35,000	300	310	-10	40%	10	99%	480	170	0.5%	0	4%	2,760	7.3%	150	0.5%
2028	35,300	35,300	300	300	-10	40%	10	99%	480	180	0.5%	0	-1%	2,780	7.3%	150	0.5%
2029	35,600	35,600	280	290	-10	40%	0	100%	460	180	0.5%	0	-3%	2,800	7.3%	150	0.5%
2030	35,900	35,900	280	280	0	40%	0	100%	460	180	0.5%	0	-1%	2,830	7.3%	160	0.5%
2031	36,200	36,200	280	280	0	40%	0	100%	460	180	0.5%	0	0%	2,850	7.3%	160	0.5%
2032	36,500	36,500	310	310	0	40%	0	100%	490	180	0.5%	0	7%	2,870	7.3%	160	0.5%
2033	36,800	36,800	300	300	0	40%	0	100%	490	180	0.5%	0	-1%	2,900	7.3%	160	0.5%
2034	37,100	37,100	300	300	0		0	100%	480	180	0.5%	0	-1%	2,920	7.3%	160	0.5%
2035	37,400	37,400	290	290	0		0	100%	480	190	0.5%	0	0%	2,940	7.3%	160	0.5%

Notes: Italics indicate observed outcomes in 2009 through 2012. Except when indicated by a percent sign, all units are in thousands. Constructed housing units are assumed to be completed in the same calendar year in which they are started. Growth rates are year-over-year

Appendix Table 8: Multifamily Housing Unit Starts, Pessimistic Projection

	(1)	(2)	(3)	(4)	(5)	(5a)	(6)	(7)	(8)	(8a)	(8b)	(8c)	(9)	(10)	(11)	(12)	(13)
	Multifamily Occupied Units				Multifamily Occupied Unit Gap				Multifamily Starts					Vacant Units		Abandoned Units	
	demo-graphic trend level	pro-jected level	trend in-crease	pro-jected in-crease	level gap =(2)-(1)	judged pct closure of prev yr gap	change in gap =(4)-(3) =-(5a)•(5_{y-1})	cumulative change in gap from 2009	pro-jected =(4)+(8a)	total net flow from occpd	toal net flow pct of occpd units	cyclical net flow from occpd	starts growth rate	pro-jected	pct of ttl units	net flow to aban-doned	net flow pct of ttl units
2009	29,800	*28,100*	300	*260*	-1,680		-40	0%	*110*	-150	-0.5%	-170	*-61%*	*3,490*	*11.0%*	-520	-1.7%
2010	30,100	*28,500*	300	*330*	-1,660	1%	20	1%	*110*	-210	-0.7%	-240	*2%*	*2,990*	*9.5%*	280	0.9%
2011	30,400	*28,800*	310	*330*	-1,640	1%	20	2%	*180*	-150	-0.5%	-180	*56%*	*2,940*	*9.3%*	-100	-0.3%
2012	30,700	*29,300*	320	*480*	-1,480	10%	160	12%	*250*	-230	-0.8%	-260	*39%*	*2,730*	*8.5%*	-20	-0.1%
2013	31,100	29,700	310	460	-1,330	10%	150	21%	280	-180	-0.6%	-210	12%	2,550	7.9%	0	0.1%
2014	31,400	30,100	310	360	-1,280	4%	50	24%	310	-50	-0.2%	-80	12%	2,490	7.6%	10	0.1%
2015	31,700	30,400	290	340	-1,230	4%	40	27%	350	10	0.0%	-20	12%	2,490	7.6%	10	0.1%
2016	31,900	30,800	290	350	-1,170	5%	60	30%	380	30	0.1%	0	9%	2,510	7.6%	10	0.1%
2017	32,200	31,100	290	370	-1,100	7%	80	35%	400	30	0.1%	0	5%	2,540	7.5%	10	0.1%
2018	32,500	31,500	290	380	-1,000	9%	90	40%	410	30	0.1%	0	4%	2,560	7.5%	10	0.1%
2019	32,800	31,900	280	390	-900	11%	110	47%	420	30	0.1%	0	2%	2,580	7.5%	10	0.1%
2020	33,100	32,300	280	390	-780	13%	110	53%	420	30	0.1%	0	0%	2,600	7.5%	10	0.1%
2021	33,300	32,700	270	390	-660	15%	120	61%	420	30	0.1%	0	-1%	2,620	7.4%	10	0.1%
2022	33,600	33,100	280	380	-560	16%	110	67%	420	30	0.1%	0	-1%	2,650	7.4%	10	0.1%
2023	33,900	33,400	280	380	-460	17%	90	72%	410	30	0.1%	0	-2%	2,670	7.4%	10	0.1%
2024	34,200	33,800	280	360	-380	18%	80	77%	390	30	0.1%	0	-3%	2,690	7.4%	10	0.1%
2025	34,500	34,100	280	340	-310	18%	70	81%	380	30	0.1%	0	-4%	2,710	7.4%	10	0.1%
2026	34,700	34,500	280	330	-260	18%	60	85%	370	30	0.1%	0	-3%	2,730	7.3%	10	0.1%
2027	35,000	34,800	300	350	-210	18%	50	88%	380	30	0.1%	0	4%	2,760	7.3%	10	0.1%
2028	35,300	35,200	300	340	-170	18%	40	90%	370	30	0.1%	0	-3%	2,780	7.3%	10	0.1%
2029	35,600	35,500	280	310	-140	18%	30	92%	350	40	0.1%	0	-6%	2,800	7.3%	10	0.1%
2030	35,900	35,800	280	300	-120	18%	30	93%	340	40	0.1%	0	-2%	2,830	7.3%	10	0.1%
2031	36,200	36,100	280	300	-90	18%	20	95%	330	40	0.1%	0	-2%	2,850	7.3%	10	0.1%
2032	36,500	36,400	310	320	-80	18%	20	96%	360	40	0.1%	0	8%	2,870	7.3%	10	0.1%
2033	36,800	36,700	300	320	-60	18%	10	97%	350	40	0.1%	0	-2%	2,900	7.3%	10	0.1%
2034	37,100	37,000	300	310	-50	18%	10	97%	340	40	0.1%	0	-3%	2,920	7.3%	10	0.1%
2035	37,400	37,300	290	300	-40	18%	10	98%	340	40	0.1%	0	-1%	2,940	7.3%	10	0.1%

Notes: Italics indicate observed outcomes in 2009 through 2012. Except when indicated by a percent sign, all units are in thousands. Constructed housing units are assumed to be completed in the same calendar year in which they are started. Growth rates are year-over-year