

THERE'S NO PRIME DELIVERY FOR HOUSING

**How to Prepare Arlington's Housing
Stock for Amazon's HQ2**



**Naomi Gaba
APP Report
2019**



ACKNOWLEDGEMENTS

I could not have completed this project without the guidance and support from so many. First, I would like to thank Mike Kingsella for allowing me the pleasure of working on such a topical, fascinating project. His guidance and thoughts on the project were invaluable, and I truly hope that this report helps Up for Growth continue its mission to alleviate the housing crisis.

I would also like to thank my advisor, Professor Leora Friedberg, for the countless hours she spent providing feedback and offering ideas to elevate this project. Her time and dedication to her students is so appreciated. Thank you to my APP Buddy, Layla Bryant. From first year roommates to finishing our APPs together, we have really come full circle and I am grateful for her thoughts on my work. Thank you to each of the incredible professors, faculty, and students at the Batten School for inspiring me and pushing me to produce the best possible work.

Finally, I cannot thank my friends and family enough for their enduring support. Mom and Dad, you give me everything and continue to encourage me every day.

Cheers!

On my honor as a student, I have neither given, nor received aid on this assignment.

Naomi Gaba

A handwritten signature in black ink that reads "Naomi Gaba". The signature is fluid and cursive, with "Naomi" on the top line and "Gaba" on the bottom line.

DISCLAIMER

The author conducted this study as a part of the program of professional education at the Frank Batten School of Leadership and Public Policy, University of Virginia. This paper is submitted in partial fulfillment of the course requirements for the Master of Public Policy degree. The judgements and conclusions are solely those of the author, and are not necessarily endorsed by the Batten School, by the University of Virginia, or by any other entity.

CLIENT PROFILE

This project was completed for the Up for Growth National Coalition. Up for Growth is a non-profit coalition that is dedicated to tackling the affordable housing crisis in the United States. Up for Growth conducts research by focusing on three areas: process (streamlining land-use regulation), production (innovating public-private financing), and product (more modern, compact, and efficient housing). As a national coalition, the group aims to provide research, tools, and innovative ideas to local and federal decision makers. More information about the organization can be found on their website: www.upforgrowth.org.



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EXECUTIVE SUMMARY

Arlington County will not produce enough housing to accommodate the anticipated demand shock arising from Amazon's new Headquarter Office, HQ2. Amazon plans to hire 25,000 employees and provide an average annual salary of \$150,000. A minimum of 8,250 units need to be added to accommodate the Amazon employees. Arlington is running out of available land to develop and is nearing its maximum capacity of residential units. Without action, rent increases, congestion, and displacement of low- and moderate-earners is expected. Adopting a policy to allow for an increase in housing supply will mitigate a significant increase in rent and will allow more residents to live near their place of work. *The current supply stream is lagging, which will result in increasing housing costs and housing scarcity as the new employees move into the Arlington area.*

In addition to allowing present trends to continue, this paper posits three methods to enhance supply of housing in Arlington County:

- 1) Advocate for moderate up-zoning to allow for middle housing
- 2) Support the expansion of intense densification near transit hubs
- 3) Alter regulations to allow for up-zoning in conjunction with a land value capture mechanism

Each option is evaluated based on its projected effectiveness, political feasibility, cost, and distribution of costs and benefits.

The final recommendation is to ensure the adoption of moderate up-zoning across single-family residential zones in Arlington County. Moderate up-zoning will incentivize densification at a gradual pace, reducing displacement and protecting neighborhood integrity. The recommendation will increase property values for current residents while increasing the stock of unsubsidized, moderately affordable housing.

BASIC DEFINITIONS AND ACRONYMS

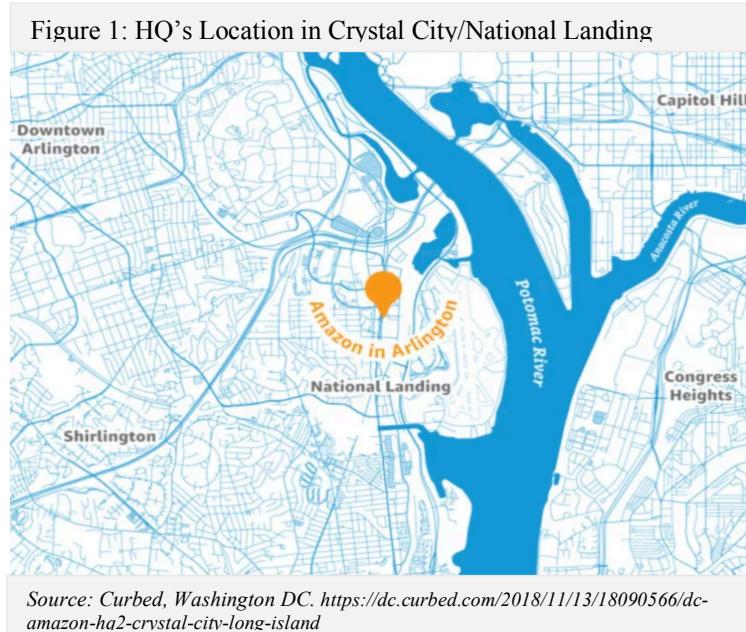
- ◊ **ADU:** accessory dwelling unit. An ADU is a small, independent unit located on the same lot as a detached single-family home. An ADU may take a few different forms. It either converts a part of a home into a new unit (i.e. an internal ADU), creates a new living unit as an addition to the home (i.e. attached ADU), or creates a unit as a stand-alone structure on the property (i.e. detached ADU) (American Planning Association).
- ◊ **AMI:** area median income.
- ◊ **APS:** Arlington Public Schools.
- ◊ **Betterment tax:** a tax levied on private land owners who experience property value increase as a result of a policy intervention. The revenue may be used to benefit residents who do not experience the property value increase.
- ◊ **Cost burdened:** an individual is considered cost burdened if they dedicated more than one-third of their income to housing (rent or mortgage plus utilities).
- ◊ **FAR:** floor area ratio. It is the ratio of a building's total floor area to the size of the piece of land on which the building is constructed.
- ◊ **Gentrification:** the process in which low-income, working class, or vacant areas are transformed to cater to middle-class residence and preferences (Lees, *et al.* 2013).
- ◊ **HQ2:** The name of Amazon's new headquarter office.
- ◊ **HUD:** Department of Housing and Urban Development.
- ◊ **LVC:** Land value capture.
- ◊ **Middle-housing:** multi-family dwelling structures that span from duplexes to small apartment complexes.
- ◊ **Smart growth planning:** the practice of efficient land use to make neighborhoods more attractive and economically productive (EPA, 2019).
- ◊ **Zoning:** designation for allowed development in a specified area.

PROBLEM DEFINITION

Housing scarcity and high cost of housing are persistent challenges facing residents of American cities. In the ten most expensive cities in the US, 41 percent of households were cost burdened in 2013 (JCHS, 2015). Rising rents are an indication of increasing land prices. Land value in cities is a complex measure, but increasing values are largely explained due to population growth in metro areas and new regulatory barriers that limit supply of housing on available land (JCHS, 2018).

Amazon's decision to locate its new Headquarter Office (HQ2) in Arlington, Virginia will exacerbate housing scarcity in the area. Promising to create at least 25,000 jobs with an average annual pay of \$150,000, experts and residents are concerned that high demand for housing will increase the price of homes and rents.

If employees gradually move to the area over the next ten years, the rate of population growth will increase by 30 percent¹. Assuming that one-third of the new employees decide to live in Arlington, approximately 8,250 market-rate units need to be constructed to accommodate the Amazon employees, in addition to the 19,700 projected housing demand apart from Amazon employees (Sturtevant & Chapman, 2013). Over the last ten years, approximately 6,000 units were added, but only 400 were added between 2016 and 2017. Arlington's current plans do not account for the significant increase in housing demand that is attributed to the opening of HQ2. *The current supply stream is lagging, which will result in increasing housing costs and housing scarcity as the new employees move into the Arlington area.*



¹ Over the last ten years, Arlington County added an average of 2,780 new residents each year. Assuming the trend continues and that one-third of Amazon employees choose to live in Arlington, it will add 3,610 residents each year for the next decade. Growth is increasing by 29.88 percent.

BACKGROUND

High housing costs and housing scarcity are persistent challenge facing residents of American cities. Affordable, quality housing is crucial to a healthy and productive society. Increased demand for housing in cities, combined with regulations that tend to decrease the number of units developed, result in a supply imbalance. Between 2000 and 2015 in the United States, housing was underproduced by 7.3 million units, which is approximately 5.4 percent of the total housing stock in the US (Up for Growth, Baron *et al.*, 2018). Housing prices are rising faster than incomes, largely because housing is under-supplied (Schuetz & Murray, 2018). Amazon's decision to move HQ2 into Arlington impacts its housing market. Attracting 25,000 employees with an average salary of \$150,000 increases demand for housing in the area. Arlington County is expected to increase population density to 9,632 people per square mile (a 6 percent increase from 2017) (ACS 2017). Allowing for more housing development is critical to minimizing displacement and maintain rent stability. The deal between Amazon and Arlington included a pledge to commit \$150 million to affordable housing over the next ten years (Oliver, 2019).

Amazon

Amazon was founded in 1994 by Jeff Bezos in Seattle, Washington. The company was the first to capitalize on the growth of online commerce. In February of 2018, Amazon became the third most valuable company in the world, hiring more than 600,000 employees. According to glassdoor reviews, entry level engineers earn a base pay of nearly \$100,000.² Amazon is now one of the most profitable companies in the world.

When Amazon announced its plans to open HQ2, cities from across the country submitted bids to house the new campus. Amazon ultimately selected two locations for HQ2: Long Island City in Queens, New York, and Crystal City in Arlington, Virginia. Facing opposition from residents, Amazon decided to terminate its plan to move into Long Island City in February of 2019. At this time, it appears that Amazon will not select a new location to replace their Long Island City plan, but rather expand the future office in Crystal City and other existing offices. There is no sign that Amazon has the intention of exiting its plans in Crystal City.

Virginia's education pipeline and qualified workforce is cited as a strong selling point for Amazon (VEDP, 2018). It is important to note that while the workforce in Northern Virginia is highly qualified and Amazon will be able to hire a substantial number of local employees, it is still assumed that 25,000 high-paying jobs will be added to the area. Any local employee Amazon hires will have to be replaced by someone else. If, for example, Amazon were to hire a software engineer from a local tech company, that company would

² This estimate does not account for bonuses and stock options that are frequently offered to employees.

have to replace the worker they lost. Moving forward, the analysis assumes that 25,000 high-paying jobs will be added, regardless of the employees' previous residences. In addition to the minimum 25,000 employees who will be working for Amazon, the Washington, DC metro area will see an influx of residents who work for contractors or partners with Amazon. It is likely that Amazon's move to the area will inspire other tech companies to move into the areas as well. Journalists report that Apple is considering Northern Virginia for its next headquarter (O'Connell, 2018). Virginia Tech and George Mason University are planning to build a joining STEM campus in nearby Alexandria (Martz & Mattingly, 2018). These advances in the tech stream indicate that there will be a greater need for housing as more tech jobs are created in the area.

Arlington Trends and Demographics

Arlington, Virginia is a suburb of Washington, DC. Arlington is a relatively wealthy area. In 2017, Arlington's median income was \$112,138 and its average income was \$145,577 (ACS 2017). Within its nearly 26-square miles, Arlington houses 230,000 residents and maintains a population density of 8,837 people per square mile (ACS 2017). Arlington is an expensive place to live. The average price of a home is \$850,000³, but a median earner can afford a \$450,000 home without cost-burdening themselves (Alliance for Housing Solutions, 2016).

Arlington planners enabled and welcomed the large population by utilizing smart growth planning. Arlington was one of the first counties to recognize the value of transit-oriented development (Arlington Smart Growth). The result of its smart growth planning are the urban villages (e.g. Rosslyn, Clarendon, Ballston) within the Rosslyn-Ballston corridor. Arlington County won a planning award in 2017 for its smart growth implementation of the Rosslyn-Ballston corridor.

Figure 2: Aerial view of the Rosslyn-Ballston corridor; demonstrates the narrow development

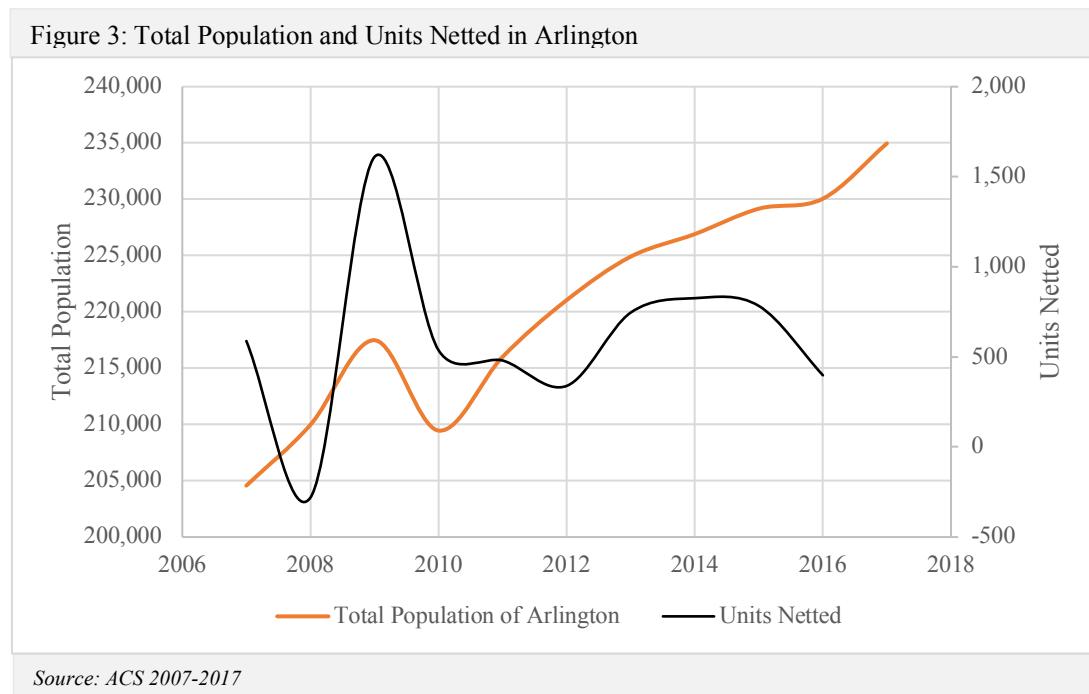


Photo captured by Arlington County. Retrieved: <https://www.planning.org/awards/2017/achievement/>

³ According to Zillow home price data

The Rosslyn-Ballston corridor allowed for intense densification around the Orange Metro line, which connects Washington, DC to the Virginia suburbs by running through Northern Arlington.⁴ The dense areas do not expand beyond approximately one-quarter mile from the tracks. The small urban villages created by the smart growth planning are now areas with high demand for housing.⁵

Arlington County is nearing capacity on land to develop for housing. Since the housing market crash in 2008, the net number of units⁶ steadily declined as the population has increased (see Figure 3). This trend is likely to increase rapidly as HQ2 opens and adds 25,000 jobs.



Increased demand for housing, housing scarcity, and public resources in Arlington impact residents differently. Wealthier land owners reap the benefit of steadily increasing property values. The concentration of wealthier residents in Northern Arlington raises concerns about disparity across the county (see Figures 4, 5, and 6). The Washington DC-Arlington-Alexandria area is considered one of the most income-segregated metropolitan areas in the

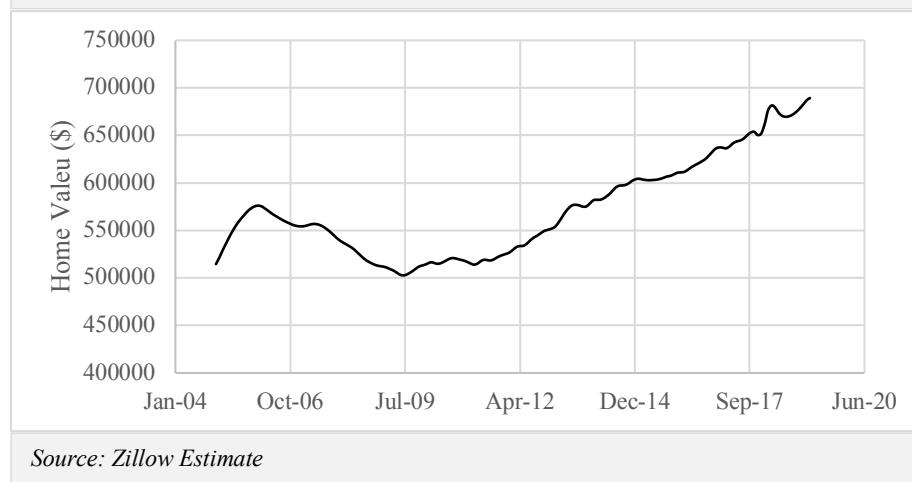
⁴ Reference a Metro Map on Appendix A

⁵ These neighborhoods are categorized as high demand because median monthly rent is more than \$300 higher in the urban areas than the rest of Arlington and they are the designated urban villages of the county.

⁶Calculated by taking the difference between total units from one year to its prior. This method accounts for units created and destroyed.

country (Florida, 2014). Black residents comprise nearly 9 percent of Arlington's population (about 20,000 residents), but they earn less than 5 percent of aggregate earnings (ACS 2017). According to Census data, Arlington County possess a Gini Index of 0.44⁷ (ACS, 2017).

Figure 4: Median Home Value, Arlington VA



Home values are not evenly distributed across Arlington. The maps below demonstrate the wealth is concentrated in Northern Arlington as is a high concentration of White residents. The Southern parts of Arlington experience lower median property values and greater proportions of minority residents. Noting the divide between the North Arlington and South Arlington is important when considering how housing policy may impact the respective residents. Without intervention, new residents are likely to move into the urban villages of Northern Arlington, could concentrate wealth even more intensely.

Figure 5: Map of Median Home Value, Arlington, VA

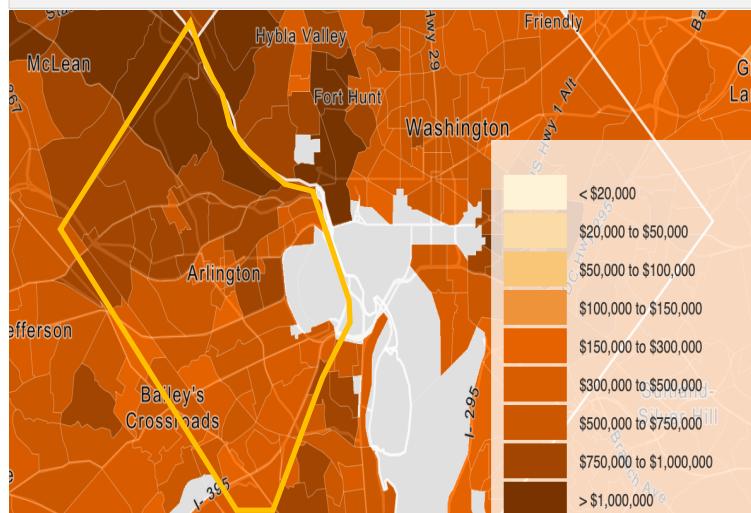


Figure 6: Map of Percent White Population, Arlington VA



⁷ The Gini Index is a scale measuring inequality. A score of 0 indicates there is total equality, and 1 represents total inequality. The 0.44 rating is similar to its neighboring localities.

Economic argument for supply-side interventions

Supply side interventions are effective because they specifically target the issue of underproduction and constrained land capacity, therefore this paper specifically focuses on supply side interventions to address increasing housing costs and scarcity. Enabling greater supply of housing generally requires increasing density and relaxing zoning regulations. Important stakeholders, such as affordable housing advocates and very low-income residents, may find this approach inadequate in the short-term. These stakeholders may advocate for traditional housing interventions, such as vouchers, rent control, or mixed-income housing. Effectiveness of these traditional interventions to improve a locality's housing market remain inconclusive (Bloom *et al.*, 2015 (139-154); NYU Furman Center, 2016; Rajasekaran *et al.*, 2019). The effectiveness of traditional housing interventions deserves more research, and there is a need for innovation, but such efforts falls outside the scope of this project. A focus on supply in the face of increased demand is a decision founded in economic theory.

If reduced to a simple model, every jurisdiction has a maximum number of housing units that it can supply. The maximum number of units is a function of space allocation and zoning regulations that dictate how that space may be developed. Once that maximum is reached, supply is inelastic because more units cannot be developed (see Figure 5). If there is no change in supply, a surge in demand will result in drastic increase in housing price and few additional units (see Figure 6).

Figure 5: Limited Capacity Supply Model

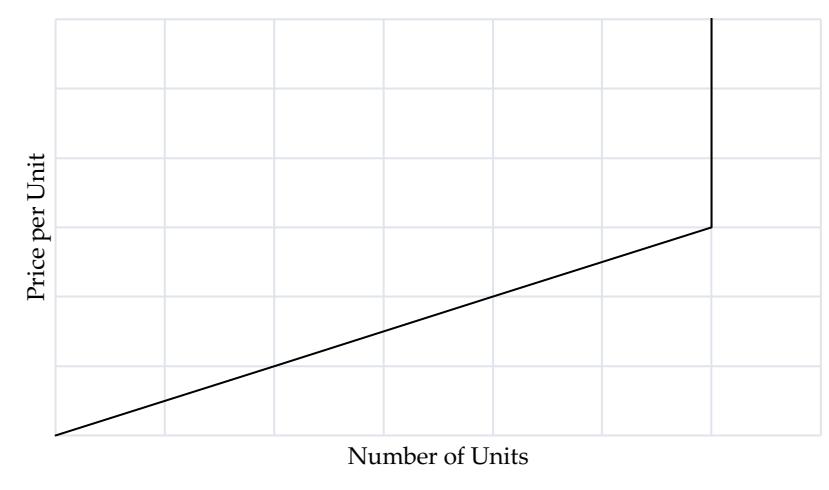
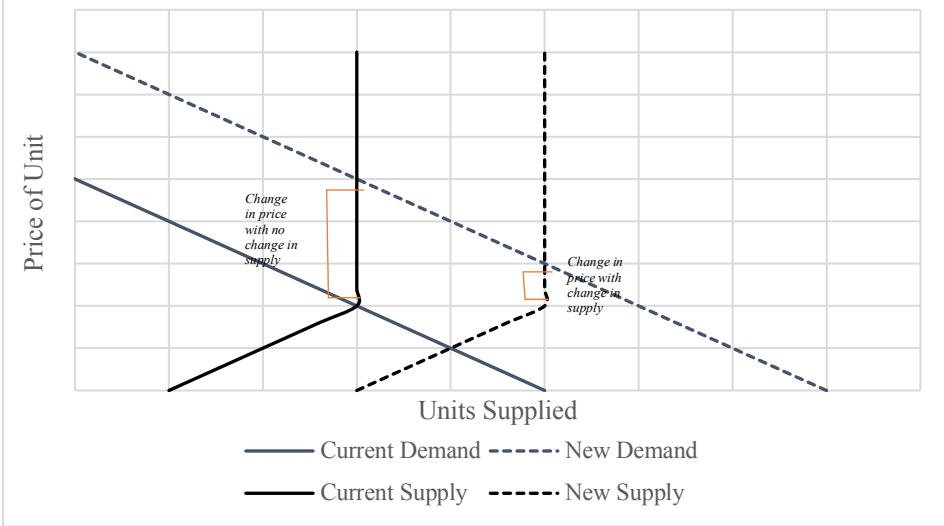


Figure 6: Model of relaxed zoning and a demand increase



In urban areas where there is persistent demand for housing, lagging supply is partly explained by zoning regulations. Density restrictions may limit the number of units a developer can build, resulting in construction of larger units for a higher price. Use restrictions, frontage, and setbacks may restrict the types of units allowed by requiring deep lots and preventing maximization of space and construction of alternative homes, like triplexes or row houses (Haluska, 2018). Minimum lot size regulations limit the minimum size of lots and reduces the number of overall units on a parcel (Haluska, 2018). Policy makers and planners use housing regulations and zoning to assure quality building, to protect of neighborhood integrity, and to exercise control over developers. A trade-off of regulation is that it imposes a barrier in the market and reduces efficiency for developers. Despite good reasons for regulation in many cases, there are costs associated with regulations. Specifically, increased regulation may result in higher home prices and rent. Regulation may also reduce overall housing stock, because developers are less incentivized to build in areas where there are regulations (Calder, 2017). These cost concerns are largely reflected in the literature, although local context is the most important factor in determining impacts on the housing market.

Evidence suggests that building restrictions are associated with greater housing cost and less overall affordability. Glaeser and Gyourko (2003) find that where zoning restrictions are strict, the gap between home prices and construction costs is significantly larger than where restrictions are lax. Their finding demonstrates the nature of regulations may inflate the cost of housing. Quigley and Raphael (2005) utilize Census Public Use Microdata Samples to conclude that California regulations have powerful impacts on housing prices. They examined 407 California cities and found that adding a regulatory measure was associated with a 3 percent increase in housing price for owners in 1990, and a 4.5 percent increase in 2000. The trend was less drastic among renters, with a 1 percent in 1990 and a 2.3 percent increase in 2000. Hsieh and Moretti (2015) found that stringent restrictions to new housing supply in San Francisco and New York resulted in a limited number of

workers with access to high productivity. They performed a spatial analysis across 220 metropolitan areas that indicated the limited access to productivity lowered aggregate economic growth in the US by 36 percent between 1964 and 2009. Ihlanfeldt (2007) determined that a unit increase in the restrictiveness⁸ increased the price of housing by nearly eight percent in his examination of the Florida housing market. *If regulations are relaxed to allow for denser development, it is expected that supply will increase. This is a crucial step in avoiding rapid price increase in the instance of increasing demand.*

Unlike other goods, housing cannot be redistributed with changes in migration. Significant influxes of residents, as is expected in Arlington, further exacerbates the supply-demand imbalance (Schuetz (a), 2018). Local government approval is required enable housing supply increases. Local governments utilize regulations to control growth and achieve (what they deem to be) the most socially beneficial outcome. Such regulations are put in place to ensure neighborhoods do not change rapidly, but make it harder for producers to respond to housing shortages (Taylor, 2015). *High demand metro areas with restrictive regulations are particularly vulnerable to underproduction of housing* (Schuetz (a), 2018).

Supply-Side interventions

Interventions that allow and incentivize increasing supply of housing include up-zoning and land value capture (LVC). These interventions can be implemented separately, or in conjunction with one another.

Up-Zoning

Up-zoning is the process of changing the zoning to allow for more dense or higher value use. For example, increasing allowable FAR, altering use restrictions, and density allowances are all mechanism to up-zone. When market demand is high, up-zoning could be used as a tool to spur development and growth in an area. For example, Washington, DC up-zoned the land adjacent to Union Station. The up-zoning enabled the creation of a new, 358-acre mixed-use neighborhood. Relative to their 2006 contributions, the neighborhood contributed \$49 million more annually in property taxes. This revitalization increased productivity and density without investing in neighborhood upgrades, but rather, it incentivized developers to build and residents to buy these units (World Bank (a), 2015). Property value increase is associated with up-zoning, because the value of a parcel of land is worth more once it is up-zoned. For example, if zoning is altered such that a parcel of land that previously only allowed for a single dwelling unit now allows for a structure with multiple units, that parcel of land is significantly more valuable.

⁸ Restrictiveness was measured using an endogenous variable that uses the instrumental variables technique to describe community characteristics at the time of its comprehensive land use plan approval.

Up-zoning most often occurs when there are opportunities for economic development and limited political resistance. Home owners who fear changes to their neighborhoods generally resist up-zoning, so it occurs more frequently in commercial zones (Gabbe, 2018). To avoid displacement of current residents, local governments are beginning to link up-zoning and affordability in their regulations (Hickey, 2014). Such a policy is called “inclusionary up-zoning” (Hickey, 2014). This practice is well suited to communities with high demand for housing with support for greater development. Impactful up-zoning policies apply to broad geographies to various development types (i.e. office, commercial, and residential) (Hickey, 2014). A major drawback of up-zoning is that it does enable gentrification and displacement in the relevant areas. The increase productivity of the area tends to make it more attractive to a wealthier crowd that out-prices the original residents. When Washington, DC up-zoned the area adjacent to Union Station, widespread gentrification followed (Goldchain, 2016).

Land Value Capture

There are two different intentions of land value capture (LVC). LVC may be used as a method to recover the cost of capital associated with a project by capturing some, or all, of the increase in land value to third parties as a result of the project (Medda, 2012). This method is commonly employed to fund transportation projects. A second intention of LVC is to spread gains from densification and property value increases across the community, rather than the private owners. Increased population density is associated with increased demand for housing and for land, which is encapsulated in higher property values (Walters, 2013). Certain parts of Arlington County will experience increased property values, depending on the demand for land in that area. LVC could be used to spread some portion of those increased property values across Arlington County. A common method to exercise LVC to spread gains from property values are betterment taxes. Betterment taxes impose a tax on private land owners to pay some portion of the incremental increase in their property values. The tax often ranges from 30 to 60 percent of the value increase (Walters, 2013).

Betterment taxes have been tried internationally in places such as India, Poland, and Denmark, but the taxes are widely unpopular and difficult to collect (Walters, 2013). To successfully implement a betterment tax, Day (2005) and Bahl, and Wallace (2008) found that clear beneficiaries, quantifiable impact on land values, a mechanism to implement the tax, and political will are essential.

Critics of LVC argue that the practice is very challenging to implement. It is often politically unfavorable and difficult to justify. Betterment taxes may also be considered regressive, as they require potentially lower-income property owners to pay for new infrastructure that could benefit higher-income residents (World Bank

(b), 2015). The potentially redistributive nature of LVC is an important consideration, although it must be examined on a case-by-case basis.

The theory and background discussed in this section are the basis on which alternatives to the problem are based.

EVALUATIVE CRITERIA

The four criteria used to evaluate the alternatives are effectiveness, political feasibility, cost, and distribution of cost and benefits.

Effectiveness

Effectiveness is defined as how many addition units could be delivered given the intervention. Effectiveness is also evaluated on change in rent of impacted areas. Each option is evaluated to produce an upper and a lower estimate because it is impossible to precisely predict how residents and developers will respond to zoning changes.

Political feasibility

Political feasibility measures how likely the alternative is to be adopted by politicians and supported by residents. Measuring this criterion involves comprehensive research on where similar interventions have been tried across the country, as well as an evaluation of the demonstrated interests of stakeholders.

Cost

This criterion measures the total cost of each intervention (reported in 2019 dollars). The costs of each alternative will be valued and monetized, the details of which can be found in the Benefit Cost analysis.⁹ In addition to total cost, the net present value (NPV) and cost effectiveness of each option is presented. Net present value is calculated by subtracting total present value of costs from total present value of benefits. The cost effectiveness score is calculated by dividing the total present value of cost by the total number of units built. The score signifies the cost of each unit added.

Distribution of Cost and Benefits

This criterion evaluates the winners and losers of the policy. The criterion accounts for the relative income of the impacted groups. Rather than applying a score of low, medium, and high, this criterion categorizes the costs and benefits as widely or narrowly distributed, and identifies the groups impacted.

⁹ See Appendix E

ALTERNATIVES

HQ2 is the impetus behind the demand shock that is likely to impact Arlington. Without action, there is risk of a steep increase in average rent and displacement of low-and moderate-income residents to sprawling neighborhoods. To address this problem, there must be intervention to allow for increased housing supply. In addition to allowing present trends to continue, three potential options to address the problem are to (1) allow for moderate up-zoning across large swaths of Arlington County, (2) allow for intense densification near transit hubs, and (3) up-zoning in conjunction with value capture mechanism to fund housing vouchers.

Let present trends continue with no change in zoning.

The status quo requires no immediate action and leaves it to the housing market to adjust to the increase of demand. Over the next ten years, Arlington County will struggle to build more housing. As a result, more people will move into the surrounding suburbs, increasing congestion, commute time, and strain on surrounding neighborhoods.

Effectiveness

Letting present trends continue results in a low effectiveness rating. An additional 400 units were netted in 2016-2017, and the trend seems to be declining (ACS). Production in 2016 was 50 percent lower than in 2015. If this trend continues, **397 units¹⁰ will be added over the next twenty years.** Average rent could increase from anywhere between \$150 per month¹¹ and \$1,748 per month¹².

Political Feasibility:

This option is politically feasible, because taking no action is simple for political leaders. There may be demand for action from residents, but most will be thinking about traditional affordable housing initiatives rather than zoning. Because this option, requires no formal action, its **political feasibility is high.** It is likely that in the long run, residents will demand that more action is taken to create more housing units.

Cost

The major costs associated with present trends are the increase in rent and congestion due to increased commuter traffic. The benefits are encapsulated in expected property value

¹⁰ This estimate assumes that current production trends continue (see Figure 3).

¹¹ This estimate was projected by the Virginia Economic Development Partnership (2018) and Shanholtz (2018). Their prediction risks underestimating the increase if rent by assuming supply of housing is more elastic than in reality.

¹² This estimate assumes that the maximum rent in the area could be one-third of the average Amazon employee, which is \$4,166.67 per month. It can be assumed that rent will not exceed one-third of the Amazon employees rent because anything higher would make them cost-burdened. It is highly unlikely that an worker earning \$150,000 per year would be cost-burdened.

increase. To predict property value increase, Nashville was used as a model for how property values may change with a tech bloom, because the city experienced a tech bloom beginning in 2012.¹³

The total cost of the increased demand without any change in zoning policy is **\$826,035,446.97**.

The net present value is:

$$\$460,903,111.48 - \$826,035,446.97 = \textcolor{red}{-\$365,132,335.50}$$

The negative net present value indicates that allowing present trends to continue is not socially efficient.

The cost effectiveness for present trends is:

$$\frac{\$826,035,446.97}{397 \text{ units added}} = \textbf{\$2,080,693.82 per unit added}$$

Distribution of Cost and Benefits

Low- and moderate-income residents will bear the burden if no action is taken. The wealthier home owners will see their property values increase, while renters (especially in the Southern part of Arlington) will likely face displacement. The distribution of costs is broad, and the benefits are narrowly attained by the already stable homeowners and landlords. The benefits are encapsulated by the moderate increase in property values that is expected as demand for homes in the high demand areas increase. This option results in a **broad distribution of costs and a narrow distribution of benefits**.

Figure 7: Summary Matrix of Present Trends

		Present Trends
Evaluative Criteria		
Effectiveness	<i>Units added</i>	397
	<i>Average rent change</i>	increase of \$150 to \$1,748/mo
Political Feasibility		Moderate
Cost	<i>Total Cost</i>	\$826,035,447
	<i>NPV</i>	-\$365,132,336
	<i>Cost Effectiveness (cost per unit added)</i>	\$2,080,694
Distribution		Broad costs; narrow benefits to Northern property owners

¹³ See Appendix D and E for more details on valuation and the Benefit Cost Analysis.

Option 1: Advocate for moderate up-zoning across large swaths of Arlington County.

There are approximately 27,000 single dwelling units in Arlington County (ACS 5-year estimates, 2017). If zones that currently authorize only single-family homes¹⁴ were upgraded to allow middle housing units, slow and substantial change would occur. Middle housing structures are efficient uses of space that allow for more units to be built on a parcel. Examples of middle housing include duplexes, triplexes, fourplexes, courtyard apartments, bungalows, townhomes, and 3-5 story. Middle housing is currently missing due to zoning codes that restrict residential neighborhoods to single-family homes, zoning that limits units per acre (incentivizing developers to build larger units per acre to maximize price), and off-street parking requirements. Residents fear that multi-unit structures will disrupt the integrity and feel of their neighborhood, but this is often not the case with moderate up-zoning (Alliance for Housing Solutions 2016).

Benefits of this option include that it largely preserves the integrity of the Arlington neighborhoods. Additionally, it would increase property values across a large group of residents, so the costs and burdens are widely distributed. An important drawback is that this option would increase the number of residents who are car dependent, as growth would take place in areas far from transit hubs. It is expected that transit (bus) routes will be adjusted to accommodate the dispersed densification.

Figure 9: Middle Housing



Source: <http://missingmiddlehousing.com>

Effectiveness

This option impacts approximately 20,165 single family units. If half of the single-family homes were converted to duplexes, there would be a total of 32,289. This is a 12,124 unit increase and represents a low estimate. The high estimate assumes one-half of the impacted single-family homes will be converted into fourplexes. This marks a 20,165 unit increase and a total number of a high estimate of 40,330 units. The resulting average estimate is

¹⁴ See Appendix C for zoning map.

37,809 additional total units, or 17,644 units added.¹⁵ Average rent in the impacted area is projected to decrease by \$45.12 per month.

Political Feasibility

This option is **moderate-to-highly politically feasible**. Commitment to moderate up-zoning by eliminating zones strictly for single dwelling units is exemplified in the cases of Minneapolis, Olympia, Oregon, and California. This type of policy is applicable both of the state and local level. Its recent surge in popularity is an indicator of its political favorability. Residents who value the integrity of their neighborhood and oppose change are somewhat appeased. Evidence suggests that residents do not report a noticeable change in the integrity of their neighborhoods where middle housing is allowed (HUD, 2008; Alliance for Housing Solutions, 2016). Finally, if a resident on a block is unwilling to sell their home to have it renovated or replaced to accommodate more units, they will not necessarily hold-up other construction projects. Arlington residents have supported the intense growth over the last 20 years, so they may be less willing to accept changes in their own neighborhoods.

Cost

Significant costs associated with moderate up-zoning include the years of transition costs (crowding in schools and congestions), as well as long-term additional funding for public goods, which is accounted for from year 4 to year 20. The significant benefits of moderate densification are encapsulated in the expected increase in property values.¹⁶

The total cost associated with this option in present value is **\$116,945,279.17**.

The net present value of this option is:

$$\$331,665,956.95 - \$116,945,279.17 = \$214,720,677.78$$

The cost effectiveness of moderate up-zoning is:

Minneapolis 2040 Plan

Minneapolis's 2040 Comprehensive plan up-zones most of the city, enabling taller building and denser development in zones that currently only allow single-family homes (Sisson (a), 2018). It aims to build more housing, to build less expensive housing, and to build affordable housing in desirable neighborhoods (Schuetz (b), 2018).

Olympia, Washington

In November of 2018, the City of Olympia, Washington passed an ordinance to bolster development of Middle Housing. Their decision to increase the variety of housing types was recommended and supported by residents. The city formed a citizen work group that reviewed existing regulations that prevented middle housing development, and measured their effects on affordable housing, sustainability, and livability.

Oregon State House Bill 2001

A bill in Oregon (HB 2001) was introduced to prevent the exclusion of middle housing. If passed, the bill would require that cities with populations over 10,000 and counties with population greater than 15,000 allow for middle housing in lands currently zoned for single-family development.

California SB 50

Bipartisan support for a plan to eliminate all single-family residential zones in the state of CA was passed by a key committee in California's Senate. The bill will soon face committee hearings and governor approval (SB 50; Cavanaugh, 2019).

¹⁵ In reality, the new development will not be solely comprised of duplexes or fourplexes, but rather a mix of ADUs, walk-ups and other forms of middle housing. These estimates are a logical way to calculate a reasonable upper and lower estimate for development over the course of 20 years.

¹⁶ See Appendix D and E for more details on costing.

$$\frac{\$116,945,279.17}{17,644 \text{ additional units}} = \$6,628.05 \text{ per unit added}$$

Distribution of Cost and Benefits

Moderate up-zoning across Arlington is characterized by **widely distributed costs and benefits**. The most significant costs of the moderate up-zoning are increased congestion, as car dependency will increase, as well as the short-term strain on public goods (e.g. schools, roads, and hospitals). Home owners in wealthy, high demand areas generally see their property values drop in the long run if they do opt to stay in their homes after the area is up-zoned (Glaeser, E., Gyourko, J., 2002). Residents in Northern Arlington represent the group that may suffer more of a consequence than the generally lower income Southern Arlington. The certainty of this concentrated cost is unclear, but it is progressive in nature and remains largely equitable. The benefits of this intervention are encapsulated in short-term increased property values of homes within the up-zoned boundaries and reduced housing price in the long run. Evidence suggests that relaxed zoning enables greater affordability by closing the gap between housing price and cost of construction (Glaeser, E., Gyourko, J., 2002). Finally, allowing for middle housing may increase capital to smaller developers and low-income residents. If the option exists to convert a home from a single-family into a triplex, for example, a smaller developer could complete the project, rather than a large developer that has the capacity to build high-rise apartments.

Figure 10: Summary Matrix of Moderate Up-Zoning

		Moderate Up-Zoning
Evaluative Criteria		
Effectiveness	<i>Units added</i>	17,644
	<i>Average rent change</i>	decrease of \$45.12/mo
Political Feasibility		High/Medium
Cost	<i>Total Cost</i>	\$116,945,279
	<i>NPV</i>	\$214,720,668
	<i>Cost Effectiveness (cost per unit added)</i>	\$6,628.05
Distribution		Broad costs; broad benefits

Option 2: Expand intense up-zoning near transit hubs

Arlington planners have already invested in developing transit hubs, like Clarendon, Courthouse, Rosslyn, and Ballston. Arlington successfully developed along the transit corridor, in which intense development remains within approximately a quarter to a half mile from the metro rail. This option proposes to widen regulations to allow for dense development within one-mile of transit stops. Significant changes to the current land use code is required for this option. Immediately outside the existing narrow density allowance, zoning allows for single family homes and a few smaller apartment buildings.¹⁷ By changing the zoning and allowing for the densification of housing and urban growth experienced in areas directly surrounding the metro, the single-family homes would slowly be replaced by larger multifamily structures.

Overarching benefits of this option are that allowing development of denser areas accommodate the preferences of younger, millennial workers who prefer urban lifestyles (JCHS, 2018). They would not be car dependent, because their homes would be within walking distance the Metro. There would also be a significant increase in property value in the impacted zones. Overtime, it is expected that property values would closely match those in the dense neighborhood- an average increase of \$77.30 per square foot.¹⁸ The most significant drawbacks of this option is that it would eliminate the quaint, highly desired Arlington neighborhoods and opposition from residents.

Effectiveness

This option is likely to result in the creation of 30,800 new units and the destruction of 10,156 units netting **20,644 units added**. The upper bound of the estimate is 44,000 and the lower bound is 17,600 additional units. Average rent in the impacted area is projected to **decrease by \$374 per month**.¹⁹

Political Feasibility

Intense up-zoning is **moderately politically feasible**. The commitment and success to smart growth in Arlington is consistent with the intervention of intense up-zoning and densification. The significant barrier to this alternative is resident objection. The majority of housing outside the current density boundary is single-family housing, with a few areas zoned for small apartment complexes.²⁰ Relaxing regulations and allowing for intense densification would drastically change these neighborhoods over the next twenty years. It is expected that after regulations are relaxed, impacted residents will see their property values increase, because their land parcels are now more profitable to developers. As a

¹⁷ See Appendix C for zoning map

¹⁸ \$77.30 is the average difference in property value between the current denser areas (e.g. Clarendon and Rosslyn) and their neighboring residential (low-density) areas. See Appendix D for more detail.

¹⁹ See Appendix B for details

²⁰ See Appendix for zoning map and satellite images

result, some property owners will be happy to sell their homes. Others, however, will refuse to leave their homes. These hold-outs could halt or delay larger projects that promise to a significant number of new units to the area.

Cost

Significant costs of intense up-zoning are loss of neighborhood integrity, transition costs (congestions and school crowding) in the first three years, and long-run additional costs for the provision of public goods.²¹

The total present value of costs for intense up-zoning this option is: **\$1,075,306,052.99**

The net present value is: $\$1,296,682,567.74 - \$1,075,306,052.99 = \$221,376,514.76$

This cost effectiveness for this option is:

$$\frac{\$1,075,306,052.99}{20,644 \text{ units}} = \$52,088.07 \text{ per unit added}$$

Distribution of Cost and Benefits

The majority of the benefits and costs of this option are absorbed by the residents in the impacted zones. Property owners absorb the major benefit of increase property values. Property values are expected to increase because the land becomes immediately more valuable. Over time, property values will remain high as increased services and business are introduced to accommodate the population increase. Benefits distributed to the rest of Arlington are that new employees will be living close to transit, so they will not be car dependent. All residents and commuters benefit from the prevention of too many cars on the road. A major cost to the rest of Arlington is that capital and economic opportunity will remain fairly confined to the wealthier, Northern neighborhoods of Arlington. All of the costs and benefits discussed are important, however the most significant costs and benefits will be absorbed by the residents in the impacted neighborhoods, classifying both the **benefits and costs as narrowly distributed**.

²¹ See Appendix D and E for more details on valuation and the cost/benefit analysis

Figure 11: Summary Matrix of Intense Up-Zoning

		Intense Up-Zoning
Evaluative Criteria		
Effectiveness	<i>Units added</i>	20,644
	<i>Average rent change</i>	decrease of \$374/mo
Political Feasibility		Medium/Low
Cost	<i>Total Cost</i>	\$1,75,306,053
	<i>NPV</i>	\$221,376,515
	<i>Cost Effectiveness (cost per unit added)</i>	\$52.088.07
Distribution		Narrow costs to Northern property owners; narrow benefits Northern property owners

Option 3: Encourage up-zoning in conjunction with value capture

Both the moderate and intense up-zoning result in significant increases in property values for private owners of land. Creating and imposing a land capture mechanism enables Arlington County to maintain some portion of the increased property value and use to redistribute to the rest of the county. If the county were to maintain 25 percent²² of the increased property values and allocate those funds toward housing vouchers, they could fund an additional 3.4 million vouchers under the intense densification model, and 2.9 million vouchers funded under moderate densification over the next twenty years.²³ The incremental land value would be captured through a betterment tax that would be levied on property owners in the impacted areas.

A significant benefit of this option is that it would allow for developers to create as many new units as they otherwise would, while redistributing benefit to low-earners who struggle to access the housing vouchers. Significant drawbacks of this option are that property owners will have to pay a betterment tax in addition to their property tax. This could potentially be a regressive tax because middle- and low-income residents would be taxed at the same rate as higher earners. The betterment tax is also unpopular and difficult to implement.

Effectiveness

The LVC model is not expected to change the number of units produced that would be produced with up-zoning, however, it may increase rents of market rate rental units. The current or future landowner of a property that has seen increased property values as a result of the up-zoning will be taxed 25 percent of the property value increase. Rather than building fewer units, landlords and developers may pass that cost along to their tenants by increasing rents, as has been seen with other inclusionary zoning policies (Ellickson, 1980). Therefore, the moderate zoning would continue to yield **17,644 new units** and the intense zoning would yield **20,644 new units**. Under moderate up-zoning, **rent may increase by \$6.05 per month**. Under intense up-zoning, rent may **decrease by \$233.67 per month**.²⁴

Political Feasibility

Implementing a land value capture system, enforcing the tax, and measuring the appropriate tax poses a challenging obstacle (World Bank (b), 2015). The time and cost of

²² Common betterment taxes range from 30-60 percent (Walters, 2013), but these cases are cited internationally. As such, a tax in the US is likely to be lower.

²³ On average, it costs \$1,090 (2018 dollars) to fund one housing voucher in Virginia (Fischer, *et al.*, 2017). Assuming the property value increases and benefits were captured in year 0 (2019), 250,000 vouchers would be funded in the first year. I assume the same revenue would be raised each year for the next 20, so the 250,000 vouchers is discounted at a rate of 7 percent, to produce a total estimate of 2.9 million for the moderate densification option. The same analysis is applied to the intense densification process. See Appendix E for further details of the benefit-cost analysis.

²⁴ See Appendix B for details

implementing the land value capture system categorizes its **political feasibility as low**. In addition to the time and cost on the government, current landowners and residents would oppose the betterment tax. They will argue that the betterment tax is essentially a double tax, because they already pay a property tax that is proportional to the value of their property. Land value has worked fairly well in the United States to fund transportation projects, but have little to no reported success when implemented with betterment taxes to fund housing vouchers.

Cost

The major costs are the same as those associated with each form of zoning, as well as the cost of appraisal.²⁵

Moderate Up-Zoning:

The total cost associated with LVC and moderate up-zoning is **\$226,896,410.09**

The net present value is: $\$331,665,956.95 - \$226,896,410.09 = \$104,769,546.86$

The cost effectiveness of this option is

$$\frac{\$226,896,410.09}{17,644 \text{ units added}} = \$12,859.69 \text{ per unit added}$$

Intense Up-Zoning:

The total cost associated with LVC and intense up-zoning is: **\$1,116,517,121.55**

The net present value is:

The cost effectiveness of this option is

$$\frac{\$1,116,517,121.55}{20,644 \text{ units added}} = \$54,084.34 \text{ per unit added}$$

Distribution of Cost and Benefits

Cost of this option are narrowly absorbed by property owners, and the benefits are narrowly absorbed by low-income residents who qualify for housing vouchers. This distribution has elements of both equitable and inequitable distribution. Redistributing funds that allow vulnerable populations to receive aid is considered equitable. The betterment tax, however, may ultimately be regressive. If the tax were levied in conjunction with the intense up-zoning plan, then the tax would tend to be more progressive, as the wealthier property owners in Arlington would pay the majority of the tax. If the betterment tax were levied in conjunction to the moderate up-zoning, then property value owners from across the county (including lower-income earners) might pay a disproportionate amount

²⁵ See Appendix E for more detail

of the tax. The ultimate payment of the tax is dependent on each property's increased value, so the tax could vary between neighborhoods. Under the moderate up-zoning, the costs are broad and regressive, and the benefits are narrow. With the intense up-zoning, the costs are narrow and progressive, and the benefits are narrow.

Figure 12: Summary Matrix of Value Capture Methods

		Value Capture	
Evaluative Criteria		Moderate Up-Zoning	Intense Up-Zoning
Effectiveness	<i>Units added</i>	17,644	20,644
	<i>Average rent change</i>	increase of \$6.05/mo	increase of \$233.67/mo
Political Feasibility		Low	Low
Cost	<i>Total Cost</i>	\$226,896,410	\$1,116,517,121
	<i>NPV</i>	\$104,769,547	\$180,165,446
	<i>Cost Effectiveness (cost per unit added)</i>	\$12,860	\$54,084
Distribution		Broad regressive costs; narrow benefits to low-income families	Narrow progressive costs; narrow benefits to low-income families

OUTCOMES MATRIX

Figure 13: Summary Matrix for all options

		Present Trends	Moderate Up-Zoning	Intense Up-Zoning	Value Capture	
Evaluative Criteria					Moderate Up-Zoning	Intense Up-Zoning
Effectiveness	<i>Units added</i>	397	17,644	20,644	17,644	20,644
	<i>Average rent change</i>	increase of \$150 to \$1,748/mo	decrease of \$45.12/mo	decrease of \$374/mo	increase of \$6.05/mo	increase of \$233.67/mo
Political Feasibility		Moderate	High/Medium	Medium/Low	Low	Low
Cost	<i>Total Cost</i>	\$826,035,447	\$116,945,279	\$1,75,306,053	\$226,896,410	\$1,116,517,121
	<i>NPV</i>	-\$365,132,336	\$214,720,668	\$221,376,515	\$104,769,547	\$180,165,446
	<i>Cost Effectiveness (cost per unit added)</i>	\$2,080,694	\$6,628.05	\$52.088.07	\$12,860	\$54,084
Distribution		Broad costs; narrow benefits to Northern property owners	Broad costs; broad benefits	Narrow costs to Northern property owners; narrow benefits to Northern property owners	Broad regressive costs; narrow benefits to low-income families	Narrow progressive costs; narrow benefits to low-income families

RECOMMENDATION: Support Moderate Up-Zoning

Based on the extensive analysis, I recommend **option two: moderate up-zoning across Arlington County**. This option is likely to produce the greatest number of units at the lowest cost to current Arlington residents. This option ranks the highest on political feasibility, given the growing popularity of middle housing across in land-restricted, neighborhood-oriented communities. There may be some initial resident push-back from moderate up-zoning, but the expected resistance is significantly less than anticipated in the case of intense up-zoning. The distribution of costs and benefits is favorable. The lower-income, relatively more isolated residents of Southern Arlington will reap the benefits of this option through higher property values and, overtime, increased economic activity. Smaller contractors and developers will have the opportunity to work on projects renovation and smaller-scale projects to convert single-family homes into duplexes and triplexes, as well as new construction of small apartment complexes. Another positive outcome of this option is that it lends itself to producing a range of housing that can be rented or bought from a range of prices.

A significant concern of this option is the possibility of displacement of low- and moderate-income renters Southern Arlington. Rates of displacement and gentrification are very hard to predict, however, if growth is controlled and limited to middle-housing, risk of displacement should remain low. In the long-term, the additional units should maintain lower rents than luxury apartments that tend to be built in the urban-villages of Northern Arlington. Neighborhoods will be relatively more affordable than they are now because rent will be maintained as housing quantity is increased. Although the net present value of this option is higher than the intense up-zoning, the sensitivity analysis reveals that changing the assumptions may alter the result of the benefit cost analysis.²⁶

²⁶ See Appendix F for details on the Sensitivity Analysis.

IMPLEMENTATION OF MODERATE UP-ZONING

Thoughtful implementation is required to ensure optimal outcomes are achieved. Below are recommended steps to achieve smooth implementation.

1. *Complete an Effectiveness Study and a Community Character Analysis to compliment the preliminary estimates in this report:*

Analyzing property-level rent data and conducting interviews with local developers and real estate agents will produce a more specific estimate of how many units will be created when zoning is changed. The results should be compiled into a report that lays out the possible outcomes of moderate up-zoning across Arlington. The Community Character Analysis will assign the range of middle housing types allowed in a given area, ensuring the protection of the community and neighborhood integrity.

2. *Publish finding of the Effectiveness Report and the Community Character Analysis:*

It is crucial that residents are aware of potential positive and negative outcomes of the zoning change. Residents will feel differently about the potential change, but it is crucial that their reactions are based on fact and predicted outcomes, rather than the possible assumptions that accompany significant changes to the zoning law. For example, many residents may wrongfully assume that changing the zoning will change the fabric of their neighborhood. The report would reveal, however, that the neighborhoods will not face drastic change.

3. *Target stakeholders to help support the zoning amendment:*

Likely supporters of moderate up-zoning are small business owners who may benefit from the possibility of increased economic opportunity in Southern Arlington.

Affordability advocates may also support the growth of middle-housing, because it tends to be more affordable (especially to moderate-income earners) in the area. The moderate up-zoning should mitigate the risk of rapid rent increases, so all renters across Arlington should be supportive.

4. *Propose Amendment to the Arlington County Zoning Ordinance:*

Zoning changes are proposed as Amendments to the 2013 Zoning Ordinance. The Amendment proposes to convert all single-dwelling districts (R-6, R-8, R-10, and R-10T) into areas that allow and incentivize the construction of middle housing. Traditional zoning reforms, such as density, FAR, or use-zones. Middle housing is not allowed in single-dwelling zones, but multi-family zones are typically high-rise apartments.

Middle housing is intended for low-rise areas, so neither category is suitable (MMH, 2019). Effective zoning for middle housing is a **form-based** approach (MMH, 2019). The first step is to establish a range of housing that is allowed and appropriate for the community. Examine the new form-based zones, and decide what range of housing types is appropriate for each neighborhood. The range is determined by the desired

density and current neighborhood feel. Each unit type may have its own regulations (such as height, set-back, and unit size).²⁷

5. Approval from the Arlington County Board:

The Arlington County Board approves the Amendment to the Zoning Ordinance. Once approved, Up for Growth can provide tools to local developers, residents, and planners to ensure development is carried out appropriately. They can assist smaller developers understand the new zoning law and educate the public on the benefits of the unique housing style.

²⁷ Cincinnati has had success with form-based planning to incentivize middle housing. The steps highlighted toward form-based planning are interpolated from the City of Cincinnati's Form-Based Code (2013)

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APPENDICES

Appendix A: Metro Map

The Orange and Silver lines running through the area West of Washington DC travel through the Northern urban hubs of Arlington. The relevant stops are Rosslyn, Court House, Clarendon, Virginia Square, Ballston, and East Falls Church (indicated on the map).

Figure 14: Washington, DC Metro Map



Appendix B: Effectiveness Projection Details

Projecting effectiveness accounts for both number of units added and average rent change. Both estimates are accompanied with a range of uncertainty, because it is impossible to know exactly how developers and residents will respond to zoning amendments. To accommodate the uncertainty of the estimate, a low and high estimate are provided.

UNITS ADDED PROJECTIONS

Intense Densification

To estimate the number of units added if the neighborhoods within 1 mile of the Northern metro stops were re-zoned for apartments, the Arlington zoning map is overlaid with a satellite pictures of the neighborhoods to estimate how much space is currently dedicated to single family dwelling units. The low estimate assumes that each zoning district will add a small apartment complex of 50 units. The high estimate assumes that each will add a large apartment complex of 200 units. The median estimate is the average of the low and high estimate.

Figure 15: Units Generated w/ Intense Development			Units Produced		
Metro area	neighborhood impacted	Current single dwelling districts (#)	Low estimate	High estimate	Middle estimate
Rosslyn	North Highland	8	800	2000	1400
	Fort Myer	7	700	1750	1225
Court House/Clarendon	Colonial Village	2	200	500	350
	Lyon Village	12	1200	3000	2100
	Lyon Park	40	4000	10000	7000
	Ashton Heights	30	3000	7500	5250
	Virginia Square/Ballston	4	400	1000	700
East Falls Church	Buckingham	5	500	1250	875
	Arlington Forest	20	2000	5000	3500
	s/e	13	1300	3250	2275
	north of metro	35	3500	8750	6125
Total units			17600	44000	30800

Moderate Densification

Large portions of Arlington (outside of the transit corridor) are zoned for single family residents. I estimate how many single-family homes there are in these zones, and calculate an upper and lower estimate for how many additional units could be added. The low estimate assumes that, on average, one in two properties will be converted to a duplex. The high estimate assumes one in two homes are converted into fourplexes.

Figure 16: Units Generated w/ Moderate Up-Zoning

homes on large block (assumed)	25	
homes on small block (assumed)	15	
	total large block	total small block
Aurora heights	35	3
Arlington ridge	40	4
Nauk	12	3
Douglas Park	18	10
Barcroft	20	3
Arlington Forest	19	0
Buckingham	2	1
Bluemont / Brockwood	34	11
Ashton Heights	17	4
Lyon Park	25	8
Dominion Hills	24	4
Madison Manor	25	3
East falls church	80	8
Tara/Lee Hwy, highland park, Westover	95	10
North Arlington	160	25
Lyon Village	6	6
Lyon Park	20	20
Alcova heights	16	5
Penrose	18	2
Columbia heights	12	4
Arlington heights	19	3
Aston heights	25	4
Total blocks	722	141

RENT PROJECTIONS

Intense densification

The analysis assumes that 10,156 single-family units will be replaced by apartment complexes comprising a total of 30,800 new units. It is assumed that the units created will be evenly split between studio, 1-bedroom, 2-bedroom, and 3-bedroom units. There will be 7,700 of each unit type. Using current average rental data for each of these rent types, the proportional weights of the average rent will shift because there will be more apartment and fewer single-family homes. The new average rent of the impacted areas will be 2418.75 per unit. This is a \$374 decrease from current average rent of the changing neighborhoods, on average.

Figure 17: Rent Change w/ Intense Densification		Total new units added
		30,800
Type	Number added	Current market rent (2019 dollars) of type
studio	7700	1625
1 br	7700	2020
2 br	7700	2650
3 br	7700	3380
Expected average rent (based on current market rent of each type)		
2418.75		
Current average rent in impacted areas		
2792.75		
Average per-unit rent decrease (current average-expected average)		
374		

Moderate Up-Zoning

To determine an approximate rent for new middle housing unit, I observe how rent differs between duplexes and triplexes and the market median rent in cities that allow for such housing units. Comparative cities were chosen based on available rental data and similar trends to those of Arlington County. Boston shows similar cyclical trends and maintains relatively similar increases and decreases. Between February 2013 and March 2019, the

duplex and triplex rentals are, on average, \$244.30 less expensive than the market rental average. Other cities showing similar trends to the Arlington market are Chicago and Minneapolis, where duplex/triplex rent averages \$102.3 and \$342.8 less expensive, respectively. The nature of these comparisons is challenging, because no city is a perfect comparison for another due to the localized nature of the rental market. Therefore, I use a weighted average of these three cities to determine an estimate for the difference between overall market rent and middle housing rent in Arlington. The weights are determined by the relative population of each city. The weighted difference between overall market rent and rent of duplexes and triplexes is \$154.30. The current overall market rent in Arlington is \$2447.50. Therefore, the average rent of the new middle- housing units would be \$2,293.20. To find the new average rent, I assume every unit in Arlington is currently rented for \$2447.50. Then, assuming 37,809 new units are added with an average rent of \$2,293.20, the new average rent is \$2,402.38, which is a \$45.12 less expensive than current rent of the impacted areas.

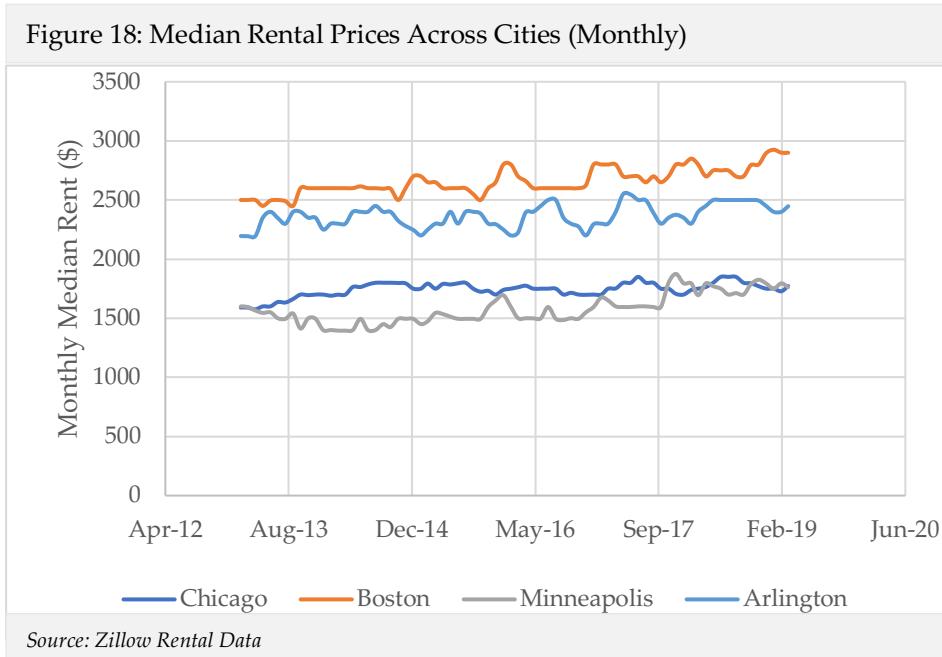


Figure 19: Rent Change w/ Moderate Densification

Expected average rent of middle housing units	Middle units added	
2293.203528	37809	
Current number of units in Arlington		
111646		
Average rent of units lost 20165		
middle housing units added	proportion middle rate	proportion market rate
37809.375	0.292	0.708
Average rental 2402.377901		
Decrease rent 45.12		

Value capture

If the tax is 25% of the increased property value the cost will not be born entirely by landlords. Rather, it will get passed on the rents of their tenants. The burden on each group depends on their relative elasticities. The best estimate for long-run price elasticity of demand is 0.7 (Polinsky & Ellwood, 1979). Long-run elasticity of housing supply is estimated to be between 1.6 and 3.7 (Blackley, 1999). If the elasticity of supply is 1.6, then landlords would bear 70% of the tax. If the elasticity of supply were 3.7, then the landlord would bear 84% of the tax.

Moderate up-zoning:

The total amount captured by the government is estimated to be \$82,916,489.24. I assume that amount is divided by the number of total units in the relevant area. If the elasticity of supply is more elastic, then the renter would bear a monthly cost \$47.51. If the elasticity of supply is lower, then the monthly cost to the renter is an additional \$54.83.

Therefore, the average expected burden on the renter is \$51.17.

Figure 20: Rent Change w/ LVC Moderate Up-Zoning

total value captured	\$ 82,916,489.24	
number of units to pay the tax	37809	
Annual tax per unit	\$2,193.04	
low estimate cost to renter	\$570.19	\$47.52 per month
high estimate cost to renter	\$657.91	\$54.83 per month
median cost to renter	\$614.05	\$51.17 per month

Intense up-zoning:

The predicted amount of money captured by the government is \$324,170,642. If this were divided among all the expected number of future residents in the area (53,900 (assuming even split of new units)). The low estimate of supply elasticity indicates each renter would pay \$130.31 per month, and the higher estimate would result in each renter paying \$150.36 per month. The median cost to the renter is \$140.33.

Figure 21: Rent Change w/ LVC Intense Up-Zoning		
total value captured		
324,170,642		
Number of total units	Number of renters	
30,800	53900	
to pay per person		
\$6,014.30		
low estimate cost to renter		
\$1,563.72	\$130.31	per month
high estimate cost to renter		
\$1,804.29	\$150.36	per month
median cost to renter		
\$1,684.00	\$140.33	per month

Average rents for these alternatives are the average rent from the intervention, minus the tax burden.

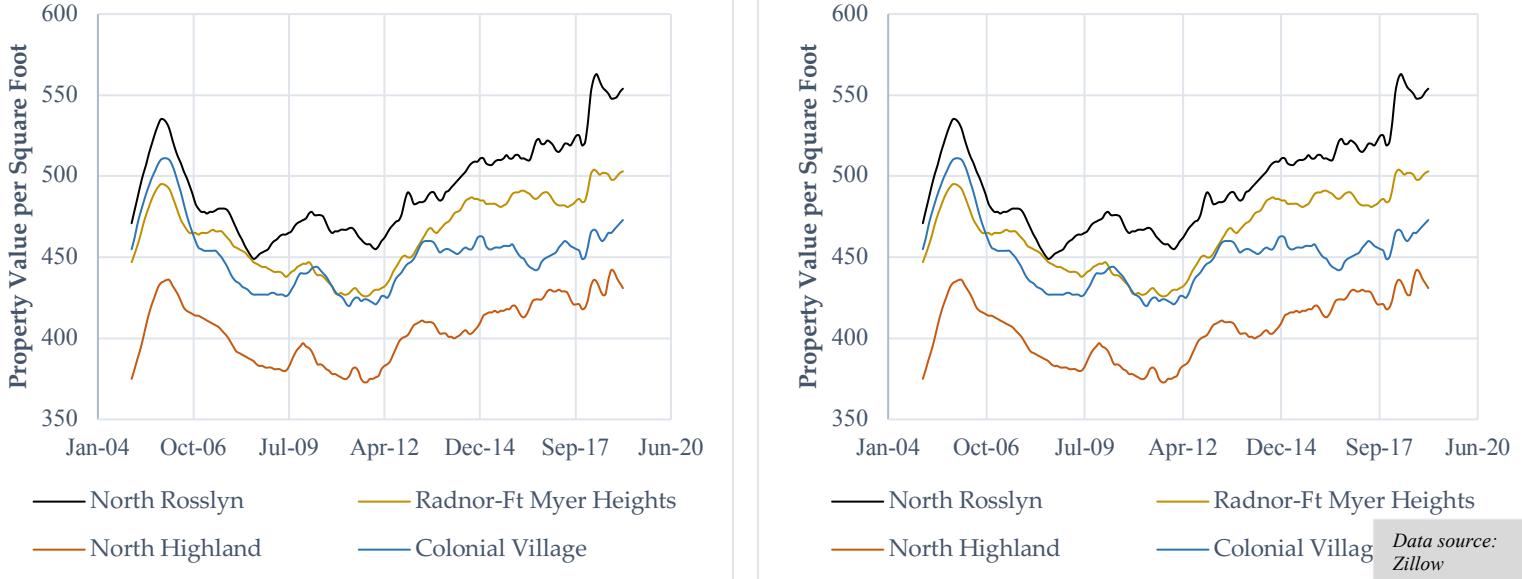
Appendix C: Arlington Zoning Map

Figure 22: Arlington Zoning Map



Appendix D: Property Value Change Projections

Figure 23: Willingness to Pay for Low-Density Neighborhoods



If zoning were adjusted so large multifamily buildings could be constructed (intense up-zoning) to match the current densification of the transit hubs (Rosslyn, Clarendon, Courthouse, and Ballston), I assume the gap in property values between the dense and single-family areas would close. Therefore, I expect property values in neighborhoods like Lyon Park to match those of their dense neighbor (Clarendon-Courthouse, in this example). I assume that single family homes outside of these districts would not experience a change in property values different from that projected by the baseline. The average difference between property values across the dense hubs and their neighbors is \$77.30, which is assumed to be the willingness to pay to live in a less dense neighborhood. Had those residents allowed for densification, it is expected that their property values would be \$77.30 higher per square foot. This value is used to estimate the increased property value revenue that would be used to fund additional public goods to make up for the strain they will face in the short run. The increase in property tax revenue is used as a measure of increased funding for public goods in the long run according to the Tiebout equilibrium. The Tiebout (1956) posits that jurisdictions are competitive and that people will migrate across jurisdictions until they reach their optimal bundle of taxes to public goods. In this case, I assume that the current tax rate will not change over the long, so as to predict the tax revenue. This assumption produces a minimum estimate cost of public goods, because it is likely that the tax rate will increase to further increase funding to support increased demand for public goods.

In the case of moderate up-zoning, I estimate the property value increase to be approximately \$7.93 increase per square foot in the relevant areas. This estimate was lifted

from Ihlanfeldt's (2007) study on the impact of regulation on housing cost in Florida. A value localized to Arlington would have been ideal, but the data to support such an estimate was not available. The literature regarding the relationship of property values and regulation is fairly limited, and should be further pursued. Please refer to the sensitivity analysis in Appendix F to account for the uncertainty of the property value projections.

Appendix E: Benefit Cost Analysis

Figure 24: Assumptions		
Discount rate		7%
All costs occur at end of the year (standard practice)		year end
Property Tax rate		0.996
Current median prop value per square foot less dense neighborhoods		\$463
Current median prop value per square foot more dense neighborhoods (Ballston, Roslyn, Courthouse)	\$	565.67
Average hourly wage for Washington-Arlington-Alexandria	\$	35.75
per-student spending in Arlington	\$	20,012.00
baseline annual property value increase	\$	5.32
average square foot of single-family home in Arlington, VA		1167.794118
average square foot of apartment in Arlington, VA		797.5384615
cost of a voucher per family in VA	\$	1,090.94
Low rent increase		150
Number Renter units		56,785
<i>Intense Densification (10 yr)</i>		
SF units in Arlington		40623
how many are within 1 mile of metro		0.25
Total number of units within intense densification option		10155.75
Average increase in PVs in impacted areas		\$55.83
Number of apartment units created over ten years		10,000
Value of integrity of neighborhood (per square foot)		\$77.30
additional children in Arlington schools		1400
additional car commuters		19000
additional accidents		1384.799368
Minutes in traffic		45698.37913
number of units added		20644
number of apartments in Arlington		49147
avg apartment square footage		812.5
<i>Moderate Densification (10 yr)</i>		

SF units in Arlington		40623
portion to be impacted		0.667
Total number of units within moderate densification option		27095.541
additional children in Arlington schools for 3 years		1197
property value increase for impacted units	\$	7.93
additional car commuters		23000
additional accidents		1384.967656
Minutes in traffic		45703.93264
number of units added		17644
<i>Value Capture</i>		
cost of appraisal (market rate)	\$	350.00
<i>Present Trends</i>		
annual PV increase (per sq ft)	\$	5.32
number of square feet in Arlington		86635923.21

Figure 25: Summary BCA of Present Trends

	Amount	Discounted	Method of Calculation
<i>Costs</i>			
Aggregate Rent increase	\$ 102,213,000.00	7% over 20 years	Minimum expected rent increase * number of renters
Congestion	\$ 1,633,717.05	7% year 0-3	Expected time in traffic * average hourly wage
<i>Benefits</i>			
Property value increase	\$ 460,903,111.48	None- property values reported in present value	Nashville comparison

Figure 26: Summary BCA Intense Densification

	<i>Amount</i>	<i>Discounted</i>	<i>Method of Calculation</i>
<i>Costs</i>			
School crowding	\$ 28,016,800.00	7% year 0-3	expected student increase (<i>calculated following area family trends (ACS 2017)</i>) * average spending per student
Congestion	\$ 1,225,287.79	7% year 0-3	Expected time in traffic * average hourly wage
Long-run cost of public goods	\$ 6,594,855.00	7% year 4-20	expected property tax revenue (Tiebout Equilibrium)
Loss of Neighborhood	\$916,764,481.03	None- property values reported in present value	Average difference between high and low dense neighborhoods * sq ft impacted
<i>Benefits</i>			
Property value increase	\$ 1,296,682,567.74	None- property values reported in present value	Nashville comparison

Figure 27: Summary BCA Moderate Up-Zoning

	<i>Amount</i>	<i>Discounted</i>	<i>Method of Calculation</i>
<i>Costs</i>			
School crowding	\$ 23,954,364.00	7% year 0-3	expected student increase (<i>calculated following area family trends (ACS 2017)</i>) * average spending per student
Congestion	\$ 1,470,524.03	7% year 0-3	Expected time in traffic * average hourly wage
Longrun cost of public goods	\$ 2,499,174.82	7% year 4-20	expected property tax revenue (Tiebout Equilibrium)
<i>Benefits</i>			
Property value increase	\$ 330,083,856.28	None- property values reported in present value	1.5*current PV

Figure 28: Summary BCA Intense Densification w/ Land Value Capture

	<i>Amount</i>	<i>Discounted</i>	<i>Method of Calculation</i>
<i>Costs</i>			
Loss of neighborhood	\$916,764,481.03	None- estimate based on property values	Average difference between high and low dense neighborhoods * sq ft impacted
School crowding	\$ 28,016,800.00	7% year 0-3	expected student increase * average spending per student
Congestion	\$ 1,225,287.79	7% year 0-3	Expected time in traffic * average hourly wage
Longrun cost of public goods	\$ 6,594,855.00	7% year 4-20	expected property tax revenue (Tiebout Equilibrium)
<i>Benefits</i>			
Money raised for housing vouchers	\$ 324,170,641.94	None- estimate based on property values	PV (expected)*0.25
Property value increase	\$ 972,511,925.81	None- property values reported in present value	Nashville comparison*0.75

Figure 29: Summary BCA Moderate Up-Zoning with Land Value Capture

	<i>Amount</i>	<i>Discounted</i>	<i>Method of Calculation</i>
<i>Costs</i>			
School crowding	\$ 23,954,364.00	7% year 0-3	expected student increase (calculated following area family trends (ACS 2017)) * average spending per student
Congestion	\$ 1,470,524.03	7% year 0-3	Expected time in traffic * average hourly wage
Long-run cost of public goods	\$ 2,499,174.82	7% year 4-20	expected property tax revenue (Tiebout Equilibrium)
<i>Benefits</i>			
Money raised for housing vouchers	\$ 82,520,964.07	None- estimate based on property values	PV (expected)*0.25
Property value increase	\$ 247,562,892.21	None- property values reported in present value	Moderate expected PV *0.75

Figure 30: Final BCA Summary Table

Option	Net Present Value	Cost Effectiveness
Intense up-zoning	\$ 221,376,514.76	\$ 52,088.07
Moderate up-zoning	\$ 213,264,161.41	\$ 6,620.93
Intense up-zoning w/LVC	\$ 180,165,446.20	\$ 54,084.34
Moderate up-zoning w/LVC	\$ 103,313,030.48	\$ 12,852.57

Appendix F: Sensitivity Analysis

The sensitivity analysis reveals that if the property value change for the intense up-zoning option had been overestimated by 10 percent or more, then the moderate up-zoning would have resulted in a higher NPV. This is important, given the uncertainty surrounding property value projection. Moreover, the analysis was conducted assuming a 7 percent discount rate (as the industry standard suggests). If the discount rate were actually 5 percent or less, then the moderate up-zoning would have been a more efficient choice. There is not a discount rate that would have resulted in a negative NPV for either the moderate, intense, or intense with LVC options. A discount rate of 0 would have resulted in a negative NPV for moderate up-zoning with LVC. Given reasonable uncertainty, the sensitivity analysis supports the decision to recommend moderate up-zoning, despite a higher predicted NPV with intense up-zoning.

Figure 31: Projected Property Value Sensitivity Analysis

<i>Intense PV change</i>	<i>Moderate PV change</i>	<i>Intense</i>	<i>Moderate</i>	<i>Intense w/ LVC</i>	<i>Moderate w/LVC</i>
\$ 16.75	\$ 2.38	\$ (516,993,119.93)	\$ 51,590,843.70	\$ (558,204,188.49)	\$ (58,360,287.22)
\$ 22.33	\$ 3.17	\$ (411,565,725.82)	\$ 74,603,802.44	\$ (452,776,794.38)	\$ (35,347,328.48)
\$ 27.92	\$ 3.97	\$ (305,949,393.74)	\$ 97,908,064.45	\$ (347,160,462.30)	\$ (12,043,066.47)
\$ 33.50	\$ 4.76	\$ (200,521,999.64)	\$ 120,921,023.19	\$ (241,733,068.20)	\$ 10,969,892.27
\$ 39.08	\$ 5.55	\$ (95,094,605.53)	\$ 143,933,981.92	\$ (136,305,674.09)	\$ 33,982,851.00
\$ 44.66	\$ 6.34	\$ 10,332,788.57	\$ 166,946,940.66	\$ (30,878,279.99)	\$ 56,995,809.74
\$ 50.25	\$ 7.14	\$ 115,949,120.65	\$ 190,251,202.67	\$ 74,738,052.09	\$ 80,300,071.75
\$ 55.83	\$ 7.93	\$ 221,376,514.76	\$ 214,720,677.78	\$ 180,165,446.20	\$ 104,769,546.86
\$ 61.41	\$ 8.72	\$ 326,803,908.86	\$ 236,277,120.14	\$ 285,592,840.30	\$ 126,325,989.22
\$ 67.00	\$ 9.52	\$ 432,420,240.94	\$ 259,581,382.15	\$ 391,209,172.38	\$ 149,630,251.23
\$ 72.58	\$ 10.31	\$ 537,847,635.05	\$ 282,594,340.89	\$ 496,636,566.49	\$ 172,643,209.97
\$ 78.16	\$ 11.10	\$ 643,275,029.15	\$ 305,607,299.62	\$ 602,063,960.59	\$ 195,656,168.70
\$ 83.75	\$ 11.90	\$ 748,891,361.23	\$ 328,911,561.64	\$ 707,680,292.67	\$ 218,960,430.72

Figure 32: Discount Rate Sensitivity Analysis

Discount rate	Intense	Moderate	Intense w/ LVC	Moderate w/LVC
0	\$ 150,837,200.60	\$ 187,212,551.67	\$ 76,192,438.10	\$ (11,939,674.68)
1	\$ 165,063,017.14	\$ 192,705,511.30	\$ 97,365,361.05	\$ 12,088,164.85
2	\$ 177,528,691.19	\$ 197,534,338.98	\$ 115,852,804.48	\$ 32,983,073.22
3	\$ 188,500,989.66	\$ 201,800,256.51	\$ 132,064,306.80	\$ 51,227,186.64
4	\$ 198,201,634.66	\$ 205,587,341.32	\$ 146,340,137.29	\$ 67,220,866.33
5	\$ 206,815,496.70	\$ 208,965,648.57	\$ 158,963,901.76	\$ 81,297,593.27
6	\$ 214,497,207.78	\$ 211,993,730.87	\$ 170,172,716.93	\$ 93,735,989.29
7	\$ 221,376,514.76	\$ 214,720,677.78	\$ 180,165,446.20	\$ 104,769,546.86
8	\$ 227,562,625.03	\$ 217,187,771.22	\$ 189,109,384.84	\$ 114,594,526.40
9	\$ 233,147,744.33	\$ 219,429,832.83	\$ 197,145,702.15	\$ 123,376,384.27
10	\$ 238,209,964.72	\$ 221,476,323.77	\$ 204,393,883.56	\$ 131,255,019.23
11	\$ 242,815,628.66	\$ 223,352,244.76	\$ 210,955,366.82	\$ 138,349,066.19