THE POTENTIAL FOR GREEN GENTRIFICATION RESULTING FROM BUS RAPID TRANSIT AND THE LINKUS INITIATIVE IN COLUMBUS, OHIO

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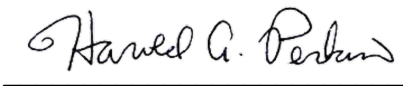

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Table of Acronyms

Acronym	Spelled Out
BRT	Bus Rapid Transit
COTA	Central Ohio Transit Authority
GIS	Geographic Information Systems
IGS	Informal Green Spaces
eTOD Action Plan	Equitable Transit-Oriented Development Action Plan
TIG	Transit-Induced Gentrification

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Abstract

Bus Rapid Transit (BRT) has emerged as a viable option to expand the city of Columbus's public transportation network to support its ever-growing population. Through the Central Ohio Transit Authority (COTA), the city has built one BRT route called CMAX, which runs north to south on Cleveland Avenue. Columbus plans to build three more BRT routes through the LinkUs initiative, which has increased the city sales tax from 7.5% to 8% to generate millions of dollars to fund these projects. Transportation projects as such could induce gentrification and further redevelopment and revitalization further in the future. This paper asks, 1) has the Cleveland Avenue BRT influenced variables associated with green gentrification, and how can planned routes in other parts of the city avoid this potential problem? And 2) is BRT a 'just green enough' urban tactic? To try and answer these questions, I have employed a set of mixed methodologies by conducting 5 semi-structured interviews with urban and transportation planners that work directly with BRT and neighborhood development in Columbus. I also performed a Geographic Information Systems (GIS) analysis by producing a series of maps, which use data from the US Census Bureau, looking at changes in parameters related to gentrification such as income, property value, educational attainment, and racial demographics. Maps for each parameter were made for years before and after the implementation of CMAX to see if there has been any real change since its completion. Overall, the interviews and maps led me to the conclusion that CMAX has not induced green gentrification and therefore, is a 'just green enough' urban tactic. Important findings from the interviews lead me to believe that the city of Columbus has employed plans to prevent gentrification from happening while supporting and aiding to community and neighborhood development around the city's busiest transit corridors where BRT will be implemented. Plans such as the equitable transit-oriented development (eTOD) action plan and the Zone in Columbus rezoning policy have allowed the city to grow around public transportation projects while providing enough affordable housing as to not push out and displace the existing, majority low-income population.

I. Introduction

Columbus, Ohio is a city defined by the automobile. Cars roam the streets, transporting people from place to place. Columbus is encompassed by a vast highway network that is filled with cars, guiding people in, out, and around the city. People spend much of their day frustrated by traffic when they are going to work, leaving work to go home, going to the grocery store, parks, restaurants, and so much more. When streets are built to get people around in the US, cars will ultimately fill those streets. Columbus needs more public transportation options so the city can alleviate some of that stress that we see on the roads, especially since it is a rapidly growing city. By 2050, there will be over 700,000 new residents that Columbus will need to support and move from place to place. Current roadway infrastructure is simply not enough to withstand the growth that the city is expecting.

The city, its officials, and the Central Ohio Transit Authority (COTA) understand that Columbus's transportation network is in shambles, and it needs to be cleaned up then put back together. COTA has since introduced a potential solution to the problem that has been created by so many years of roadway expansion by asking the question: how can we utilize what we already have to alleviate traffic and make our roadways flow smoothly? The answer lies in the realm of public transportation. Bus rapid transit (BRT) is an emerging method of public transit all over the country, and it is what COTA has and plans to implement to support the growing population's transportation needs.

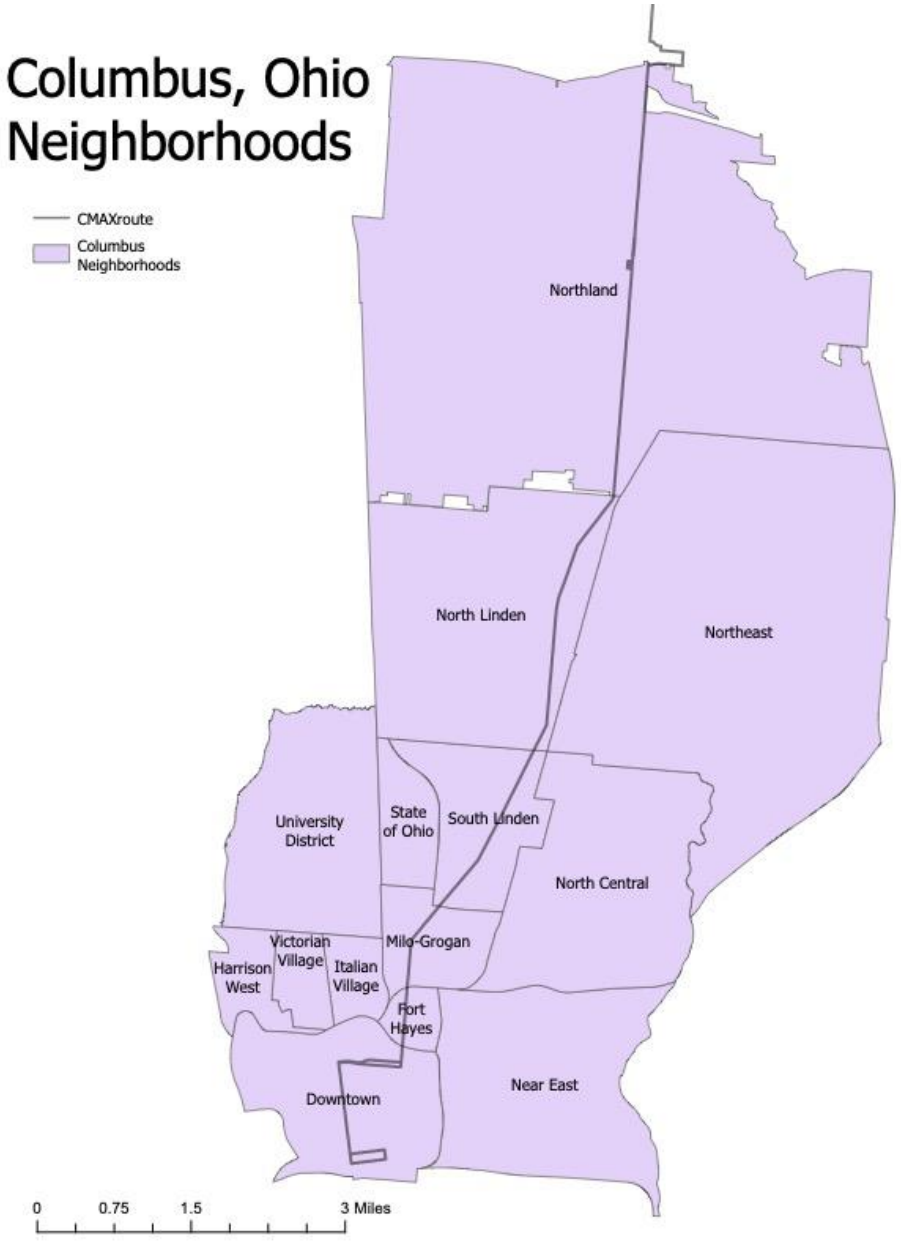
The existing bus service in Columbus is not particularly exciting to people as an alternative to driving. It is slow, soiled, and largely unreliable. People have to make one to a few transfers just to get to where they need to go (Lee & Miller, 2018). BRT, on the other hand, is an

exciting and dependable method of transportation that the city of Columbus plans to set in motion to get people from place to place without having to rely solely on cars. So, what is BRT?

Bus rapid transit is a method of bus transportation that gets people to where they need to go more quickly than a regular bus system. It does this by creating transportation hubs that ultimately move people around faster than COTA's current bussing network. BRT has its own dedicated bus only lanes that are median aligned, so buses don't get stuck in traffic and they don't have to worry about surrounding vehicles. BRT also has traffic signal prioritization, meaning that the bus connects to traffic lights, turning them green when they arrive at intersections, so they don't wait as long as regular buses or cars would. Fares are collected before the bus arrives, making boarding time go much faster. Bus stops are featured at the center of the road to make loading easier for both directions. Overall, BRT is a fast, reliable, high quality, safe, and cost-effective way to get around the city.

The picture painted above is what Columbus residents were hoping for when the city announced the construction of a BRT route stretching north to south on Cleveland Avenue from downtown Columbus to Ohio Health Westerville Medical Campus (see map 1), (Lee & Miller, 2018). Announced in 2010 and completed in 2018, the BRT route that the city promised, called CMAX, did not turn out exactly the way people wanted it to due to federal funding constraints. The CMAX BRT route is not regarded as true BRT because it lacks those dedicated bus lanes throughout the entire route. Residents that live along the transit corridor were largely disappointed by the outcome of the project. Despite that, CMAX is still considered to be BRT 'light', which comes with some benefits compared to regular COTA buses.

Map 1: Map of CMAX BRT route and neighborhoods it runs through.



Sourced from the City of Columbus' ArcGIS Online data hub.

CMAX has limited stops that facilitate faster service, while allowing riders to request a stop whenever they want so people can get to where they need to go. The route ultimately expands job access for people that live around the transit corridor, and it also expands health care

access as the route stretches to a northern medical campus just outside of the city of Columbus. Stops along the routes are different than most COTA bus stops because they feature screens that tell you bus arrival times, while being decorated with art from local artists. Although the whole route doesn't have dedicated bus only lanes, some of the route does have them. It is the same for traffic signal priority, where some of the route has priority, and other parts don't. Overall, the CMAX BRT route, while not fully BRT, contains some aspects of it which ultimately facilitates faster transit than people are used to on regular bus lines (Lee & Miller, 2018).

Importantly, CMAX has spurred the planned construction of three new BRT routes, expanding future access to reliable public transportation in the city of Columbus and its rapidly growing population. An initiative, called LinkUS, was recently launched as an effort to expand walkways, bikeways, and add three new BRT routes. The initiative calls for a 0.5% increase on the city sales tax from 7.5% to 8.0%, which will fund the construction of all this infrastructure. The tax levy passed in November 2024 by about 57% of people voting to pass the levy (LinkUS Community Plan, 2022). Differing from CMAX, the planned BRT routes will be true BRT, with dedicated bus only lanes, traffic signal prioritization, and centered bus stops at the road's median for easier loading and offloading. Since these bus routes will be true BRT, there is potential for ecological gentrification to occur along these transit corridors. The planned routes may be more appealing than CMAX for future residents to move near, which may raise surrounding property values and rent prices, pushing current residents out and replacing them with a higher income demographic.

The city of Columbus is doing a lot to ensure that does not happen. A rezoning initiative called Zone in Columbus was passed to rezone the city's primary transit corridors, raising building heights and bringing more density to these areas. Columbus has also adopted an

equitable transit-oriented development (eTOD) action plan, which will ensure the construction of affordable housing along these main transit corridors. Zone in and the eTOD action plan will work hand in hand to increase housing supply and ensure there is enough affordable housing for working class residents in main transit corridors (Zone In Columbus, 2024). Despite this, we still don't know if the planned BRT routes will induce gentrification further down the line. Further analysis is required to determine if this is the case. I plan to investigate whether this BRT route has induced ecological gentrification, a form of gentrification that is sparked from environmentally related developments.

II. Literature Review

2.1 BRT and Walkability

Bus rapid transit (BRT) is a cheaper method of transportation than light rail transit, yet it effectively works the same way in alleviating street congestion caused by cars. BRT is an emerging method of supplying transportation needs for a city to make them more connected and walkable places. Jeff Speck, the author of the book titled *Walkable City: How Downtown can Save America, One Step at a Time,* states "it could be said that people who live in a city want to have access to everything the city has to offer. If the vast majority of those things cannot be reached conveniently via transit, then people of means buy cars, and you end up with a driving city" (Speck 2012 139). Speck argues that car-centric cities have become the way they are through continuous reliance upon the automobile.

"As the city grows, it grows around the car. Its neighborhood structure dissolves and its streets widen. Walking becomes less useful or pleasant and, soon, less likely or even imaginable" (Speck 2012 139). Public transportation, no matter the form, should enhance a city's walkability. People should be able to walk to a mode of public transit, take that transit to the area in which they need to go, and then they should be able to walk to their final stop. We often see that this is not how cities work in America. People rely on cars to get them to where they need to go, which creates a whole realm of other problems that need to be faced head-on in the city. In terms of congested traffic and parking, Speck states "Parking covers more acres of urban America than any other one thing" (Speck 2012 115).

It is essential that we improve our modes of public transportation in the city. We rely so heavily on cars when the answer to this problem might be to "simply" expand public

transportation. In Columbus, Ohio, three new Bus Rapid Transit (BRT) routes have been planned and proposed through the Central Ohio Regional Transit Authority (COTA) and their initiative called LinkUS, which aims to provide better walkability, biking, and transit infrastructure with the ultimate goal of connecting disadvantaged communities to urban amenities that provide a better quality of life. Enhanced quality of life includes access to education, quality jobs, healthcare, groceries, parks, and so on.

There is an existing BRT route in Columbus, Ohio, on Cleveland Avenue, which aimed to do the same thing as the three proposed routes. According to Dooling (2009), in cities, we are seeing increased "green" developments to ensure a path toward sustainability. Oftentimes, these green revitalization projects induce gentrification by raising housing values and rent prices, ultimately pushing an existing working-class population out.

In terms of looking at how BRT enhances walkability, going back into what author, Jeff Speck, has to say on the matter. Speck proposes findings that have data backing them up: "people who live in a city want to have access to everything the city has to offer. If many of those things cannot be reached conveniently via transit, then people of means buy cars, and you end up with a driving city" (Speck 2012 139). Columbus, Ohio is a driving city. Transportation in that city is heavily reliant upon cars, and that is something that the city government and local transit authorities are trying to change. Speck goes on to say "This relationship between transit and walking is borne by the data, which clearly show that American cities with larger numbers of rail and bus commuters also have more pedestrian commuters," showing that cities with more transit leads to higher rates of walking. Speck continues to pull data backing this up by saying when a quarter of workers take transit, then more than 10 percent go on foot. There is endless data backing up the connection between transit and walkability in cities.

2.2 Gentrification, its Drivers, and Green Infrastructure

Gentrification is an urban practice that revitalizes previously disinvested neighborhoods with the goal of bringing in more affluent social classes. It is a process that pushes an existing, working-class population out, while bringing in a more affluent population through redevelopment of entire neighborhoods. It is an exercise the city takes to revitalize areas for economic development. Interestingly, an article by Lees (2000) takes a look at a theory that may explain why and how gentrification occurs in cities in the first place. Lees investigates an idea of rent-gap theory, which was developed in the late 70's by urban geographer Neil Smith as an economic explanation for the process of gentrification. It is essentially the proposition of what a property is worth now compared to what it could be worth if redeveloped. It is a form of analyzing a neighborhood's ceiling for potential investment once it is developed. This theory considers amenities that come with groups of property such as its proximity to downtown or aesthetic views, the physical and unique architecture of buildings, what kind of people live there, and so much more.

An article by Deutsche and Ryan (1984) called "The Fine Art of Gentrification" goes into interesting ways the city instills gentrification on an urban population. Deutsche and Ryan call attention to New York's gentrification strategy on the Lower East Side of Manhattan. The first step for the city is to do nothing. Urban neglect drives down property value and buys time for the city to obtain assemblages of contiguous blocks of housing property. The next step is to sell these assemblages at municipal auctions to "developers who amass entire blocks for the construction of large-scale upper-income housing." The rent gap theory is seen here because a neighborhoods' neglect can eventually lead to its revitalization and gentrification. It is essentially profitable for the city to neglect a neighborhood, so it can see eventual redevelopment

and economic prosperity down the line. Going back to Lees (2000), they say neglected neighborhoods act as a "blueprint for a civilized city life" and even suggests the idea that they are "islands of decay in seas of renewal." Now that we know more about what gentrification is, it is necessary to investigate some of its drivers.

Quastel (2009) addresses gentrification practices in Vancouver, Canada, which mask the methods the city takes to spur gentrification. The city allowed an "Onni Group" of private real estate developers to come in and build a community garden on land it owned. The goal for the Onni Group was to make the garden a marketable amenity like "swimming pools or health clubs," which shows us a couple individual contenders for drivers of gentrification. According to Quastel (2009), "The garden came to serve the further purpose of siting a large billboard for Onni's new development in the city core—a new condominium complex in Vancouver's poorest neighborhood and an area long recognized as vulnerable to gentrification pressures," which is trying to convince people to move to the new developments in the previously poor and run-down area of the city. The billboard placement is riveting because it is trying to get people to move to the formerly poorer and newly developed area where the Onni Group built new condominiums. The point here is that something as small as a community garden can induce gentrification strategies which are employed by the city. Contrasting that, larger developments like new condominiums spur economic growth in previously underfunded urban neighborhoods which ultimately leads to gentrification.

The Highline in New York City is a prime example of an underfunded neighborhood being completely transformed due to the revitalization of an old, elevated railway into a greenway park that people from around the world visit to take in its beauty, according to Loughran (2014). Once a poor area of the city, the neighborhood where the highline

transformation took place also saw a transformation of its own, when a completely new and affluent population moved in because of the added amenity. Apart from the highline, an article by Anguelovski (2016) investigates how replacing one grocery store, in a poor neighborhood, with a Whole Foods store transformed a neighborhood, and caused gentrification to take place. In this case, there are also new parks and remodeled waterfronts that aid in the gentrification process. This shows that cities employ various strategies to economically revitalize the area in a city. It is a shame that these processes push people out rather than trying to elevate them within society.

Investigating how green infrastructure might induce gentrification, Kim et al. (2024), explores how green infrastructure might have an effect on housing prices through pollution mitigation strategies. The study looked at housing prices in Los Angelos, California and whether green and climate resilience infrastructure comes with increased housing prices and cost of living. The authors find that when new green infrastructure is built or set in place, housing prices increase. It is but one study that proves green infrastructure can induce gentrification. Kim et al. (2024) tells us that past studies have linked green infrastructure to gentrification because of its ability to mitigate air pollution and heat waves. Green infrastructure comes in many ways and forms; it is necessary to investigate what types of green infrastructure there are, and how they might induce gentrification.

A study by Ling et al. (2024) suggests that transit infrastructure in the form of high-speed rail is a method of installing green infrastructure. Authors say that expanding transportation systems is a common method of dealing with environmental problems such as pollution emissions and climate change. Good public transportation is a way to get cars off the roads. Having people ride public transportation instead of driving cars releases far less green house gas

emissions. Transit infrastructure is considered green in this study and in many studies alike, according to Ling's literature review. A different study by Wang et al. (2024) gives examples of what green infrastructure really is by breaking it down to two types. One type is greenery such as trees, green roofs, and green walls. The other type is tied heavily to transportation needs, which is transportation fuel, transportation networks, and transportation organization systems. Public transportation is a key method to get cars off the street, which is but one way we air pollution is mitigated in urban environments. The tough aspect about all of this is that green infrastructure often comes along with or induces gentrification, according to Kim et al. (2024). Transportation infrastructure comes in many ways: light rail transit, high speed rail, bus transit, cars, and so on.

2.3 Green Gentrification and the "Just Green Enough" Theory

Gentrification pushes existing populations out of neighborhoods. It is a process that undermines public and affordable housing construction and replaces it with more expensive housing. A study by Anguelovski & Connolly (2024), tries to define and clarify the relationship between greening and gentrification. Their study shows us that green gentrification is a process that "generates urban green sacrifice zones, by which historically marginalized residents are forced away from greener neighborhoods." This tells us that through greening practices, gentrification can absolutely occur. Green gentrification is something that comes along as amenities are added in the city that fall under a particularly "green" category. Whether they are parks, transit, or a sustainably source-based grocery store, the addition of one single thing along those lines can spur a ripple effect of redevelopment, thus inducing gentrification.

Urban greening is a process that refers to municipal or private investment in parks, gardens, playgrounds, greenways, or climate-resilient infrastructure. These greening practices often induce gentrification in the form of higher property values and rent prices for homes near where greening occurs. It is simple; people want to live in greener areas of the city, and they are willing to pay more to live there, according to Anguelovski & Connolly (2024). A study by Rigolon et al. (2024) shows us how gentrification might follow greening practices by dubbing the "green gentrification cycle." The authors bring up the idea that gentrification may cause greening, and vice versa. Rigolon et al. (2024) states "Green gentrification describes the influx of wealthier residents to previously disinvested neighborhoods due in part to the creation of new green spaces," which tells us exactly how greening is related to gentrification. Ultimately the study suggests that green gentrification poses challenges for urban planners because they must plan around how parks might drive up property values.

Rice et al. (2019) poses a compelling study that looks at a few primary aspects of ecological gentrification. Rice aims to describe how urban efforts to be more climate friendly contribute to ecological gentrification. The authors also investigate the role of creative technologies and professionals involved in the process of eco-gentrification and aim to explore actual environmental outcomes associated with the process. Rice interestingly argues that their data presents strong proof of a connection between higher-paying tech companies and investment in low carbon-infrastructure, with signs of gentrification. The author brings up the idea of climate justice in relation to environmental justice. Climate justice essentially envelops the idea of eco-gentrification because they are both processes that focus on the pushing people out aspect of gentrification. This is so because eco-gentrification inherently displaces people while climate justice seeks to help those people who were displaced. The authors state "there is no climate

justice without a clear and central focus on housing justice," posing that the two ideas are absolutely connected.

Rice et al. (2019) concludes with asking some general questions. "How and why do some industries capitalize on the low-carbon infrastructure investments of cities, and what effect does this have on nearby populations?" The authors of this paper present a compelling and concluding question that raises awareness for the topic of eco-gentrification. We begin to consider that the greening outcomes of urban planning might prompt the process of eco-gentrification. This study looks at "climate-friendly" corporations that provide high paying jobs to a lot of people who end up supplanting people who lived there before. Displacement is a result of increased cost of living associated with green gentrification and private development.

A viable option proposed by many researchers is the "just green enough" theory. This theory stems from a paper written by Curran and Hamilton (2012) exploring environmental gentrification in Brooklyn, New York through massive greening projects. The term, "just green enough" is now an urban strategy that planners can instill to ensure gentrification does not follow urban greening. Just green enough focuses on greening areas of the city in a way that doesn't overdo it. It calls for the need to stray away from producing massive parks that only select populations can enjoy, and move towards greening smaller, more sporadic areas that work cohesively to make the city a more sustainable and greener place to live for all folks.

Curran and Hamilton (2012) coin "just green enough" as an urban environmental remediation strategy with environmental gentrification effects. The issue here, however, is that in today's day and age ecological gentrification is almost inevitable, and extreme measures must be taken by the city government, planners, developers, and most importantly, its residents, if gentrification efforts are to be halted.

An interesting aspect to “just green enough” is that there are so many ways to green a city that we may not think of. Looking at Curran and Hamilton (2012): “Many visions of the green city seem to have room only for park space, waterfront cafes, and luxury LEED-certified buildings, prompting concern that there is no place in the “sustainable” city for industrial uses and the working class,” as commonly thought of ways to green a city. Reed-Thryselius (2023) calls for a need to think of how smaller greening opportunities such as greening alleyways, rail corridors, streets, remediating brownfields might be better alternatives to what is listed by Curran above. The author proposes those ideas as they are not only are they cheaper, but these types of urban developments are proven to not spark green gentrification. Reed-Thryselius dubs these greening opportunities as informal green spaces (IGS); these are greening initiatives we might not think about as often.

Curran and Hamilton (2012), they also bring up the idea of neoliberalism in the city. Neoliberalism is what allows gentrification to happen. It is a method of governance that allows a private market to spur revitalization and eventual gentrification. Greening methods listed by Curran above usually come with other developments by private investors that end up raising prices in the housing market and pushing people out. Curran explores how different green initiatives are enacted through activism and policymaking. The paper finds that urban sustainability can be a way to open space for “diversity and democracy,” but in a neoliberal city, gentrification is almost inevitable. It is difficult because the neoliberal way of life is what we typically see in city revitalization projects. We allow private developers to come in and completely gentrify areas without consequence.

Transitioning away from the neoliberal city is something worth considering when thinking about the “just green enough” theory. A paper written by Wolch et al. (2014), sparked

from Curran and Hamilton's paper in 2013, explores the complexity and overall challenge for a city to adopt a "just green enough" outlook. Wolch offers a historical perspective on the matter saying that park design, history of land development, and history of class and racial inequities coupled with state oppression of those people show us where exactly green gentrification could occur. Wolch finds that this unequal distribution of classes uncovers a current environmental justice issue which is access to quality parks. Surely, transportation will increase people's access to different types of parks around the city, but will transportation induce gentrification along its corridor?

In Wolch's paper, they find that distribution of green spaces in most urban areas disproportionately benefits more affluent, predominately white populations. This environmental justice issue indeed raises the complexity of this situation and likely describes the demographic of many cities in the US because of our rocky history of segregation. This is an important finding because so many cities are going to be faced with the complexity of how to green a city for environmental benefit without pushing out entire working-class populations.

Diving deeper into Wolch's findings, they also propose the theory of "just green enough," so that gentrification effects and displacement do not occur following urban greening initiatives. They call for the greening of unused urban land and the reuse of underused public transport outlets, as more methods of "just green enough." We have a need for further analysis of urban areas in the wake of ecological gentrification so that we can prevent its detrimental outcomes taking part on already marginalized populations. Like Reed-Thryselius (2023), Wolch et al. (2014) offers an approach to "just green enough" by encouraging brownfield remediation projects. Brownfields are previously developed land that are abandoned and underutilized, and they often carry pollutants or contaminants that need to be cleaned up before people can live in

or around them again. Brownfield remediation involves removing or sealing off contaminated properties within a city so that it can be used again without posing health risks.

Wolch et al. (2014) also calls for the need to stop "naturalizing" the disappearance of working-class communities in the wake of green gentrification. Wolch tells us that neighborhood improvement projects become targets for further private developments inducing green gentrification. Going back to Loughran (2014) and the highline, they say that the New York City highline comes up as one of the most prominent examples of green gentrification in the United States, which contradicts one of the measures proposed by Reed-Thryselius (2023), which is the proposed greening of old rail corridors. That is exactly what happened with the NYC Highline. Its greening completely transformed the neighborhood where it took place. It raised the question of whether green gentrification is worth it because of the economic development it brings to cities. All of this makes one wonder, then, if bus rapid transit (BRT) can avoid creating green gentrification because it is 'just green enough'.

2.4 BRT and Green Gentrification

In terms of Bus Rapid Transit explicitly causing gentrification to occur, there isn't much literature. One good example is a paper written by Blake Acton, titled *Impacts of bus rapid transit (BRT) on residential property values: A comparative analysis of 11 US BRT systems,* which aims to uncover if BRT specifically, has induced green gentrification or revitalization. The study finds that only 3 of the 11 studies BRT routes have come along with increased property values in the surrounding transit corridors; this is somewhat surprising given other modes of transit usually induce gentrification to at least some extent (Acton; Huyen; Miller,

2022). It may be the case that BRT doesn't induce gentrification to the degree light rail does, for example. It is possible that some the BRT routes investigated in Acton's study haven't seen enough time and ridership to completely transform and revitalize their respective surrounding areas.

Acton's research presents a missing piece surrounding BRT literature, on whether its concept and further construction has the ability to induce green gentrification. Kim and Ewing (2024) take an interesting approach to assessing a bus rapid transit route near BYU in Utah. The study aims to see if the BRT route has led to a decrease in PM 2.5, which is a dangerous particle emitted by gas powered vehicles. Kim's goal was to find whether a new BRT route lowered people's exposure to PM 2.5. They found that the BRT did cause congestion to decrease which could be a huge factor in proving that BRT can induce green gentrification with this added and proven environmental benefit. Hernandez-Paniagua et al. (2023) also find that a BRT route in Mexico decreases residents' exposure to PM 2.5 and polyaromatic hydrocarbons (PAH's). Both studies contain similar findings which prove there are environmental advantages to constructing and using BRT infrastructure. BRT becomes a prime example of something that may induce ecological gentrification simply because of the added, and more importantly proven, environmental benefit.

Despite all those findings, Kim and Ewing (2024) did say something thought-provoking in their literature review which switches us right back to housing. To quote the authors, "with new housing and economic development opportunities, highway capacity was reaching its limit," posing a similar problem to what Columbus, Ohio is facing and presents a key reason why the city is trying to build more and better bus infrastructure. Drawing a conclusion here, by bringing in new transit-oriented developments, we can expect more housing to follow since BRT causes

road congestion to decrease, and congestion usually finds a way to come back, despite continuous roadway improvements. With expected housing development, we can expect other "amenity developments" to follow, which I describe as city expansions that aim to bring in entities such as grocery stores, green space, public transportation, and so on.

Taking a different approach, Rigolon and Németh (2019) investigate whether park location and size can influence possible gentrification. Important to my study, the authors find that parks with active transport modes connecting different parts of the city to that park usually induces further revitalization and eventual gentrification. This is a very important finding for my study because it shows that a specific Bus Rapid Transit route caused green gentrification since the route provides better connectivity to different parts of the city, increasing residential access to greenspace.

Paderiro et al. (2019) investigates transit-oriented developments and their potential impact on whether gentrification occurs or not. The paper offers a broad perspective on the matter by examining over 35 sources for its literature review. These sources draw the author to conclude that there are many connections and gaps in the existing literature on whether new transit developments can cause gentrification. Of course, there are many examples of TODs inducing green gentrification, but there are also many that have not. It proves that more research needs to be done to see whether BRT and improving walkability can cause the rippling effect of gentrification. We might need to consider producing more long-term investigations on the matter, because gentrification tends to be a mid to long term kind of process.

Choi et al. (2021) investigates the impacts of transportation options on residential property value. They ultimately find that when a property is in a walkable neighborhood with good access to transportation, then people are likely to pay more for that property. The study also

finds that different modes of transport only induce gentrification when they are coupled with high neighborhood walkability. In this case, “homebuyers also foresee a potential increase in their property value when they resell their home,” adding to the findings that transit can cause gentrification and further private development that can lead to a lack of affordable housing. One more key finding in the Choi et al (2021) study is that property values heavily depend on the type of property. Values are only going to go up if private developers are allowed in. Sometimes this can be spurred by TOD’s, and sometimes not.

An interesting and informative study by McDougall et al. (2022) shows us that transit-induced gentrification (TIG) is indeed an instrument used by the city to spur economic development. The study performs an extensive literature review that provides insight into TIG which uncovers that transit-oriented developments may be a driver for “neighborhood change and gentrification.” Key findings include that furthering our understanding of “public transportation as a driving force of gentrification” is very important for future studies in this realm to consider. In this author's path to understanding the economic part of public transit and gentrification they uncover the role transportation plays in increasing property values. Not to say that new TODs always induce higher property values, but most of the time, they do.

Another important finding in McDougall's research shows us that the “economic paradigm” around the lack of affordable housing supply plays a role in inducing ecological or green gentrification. The author advocates for a greater focus on “protective and proactive policy” that would ensure affordable housing supply in the wake of eco-gentrification. This study sheds light on the need for people to understand how transit infrastructure is associated with gentrification. McDougall et al (2022) raises concern that we need to understand transportation and gentrification as a new and complex system that needs to be independently explored if we

are going to find more significant proof connecting the two. We need to investigate the relationship of these two urban entities if we are going to truly understand how they influence each other.

2.5 Affordable Housing in Connection to BRT

Affordable housing supply is something that is lacking in gentrified areas. Why don't American cities take affordable housing into account when they are economically and socially revitalizing an area? The practice of gentrification essentially pushes out an entire workforce. Affordable housing is a key aspect when investigating gentrification on any level, and in Columbus's case, green, ecological, or transit-induced gentrification.

As mentioned before, green gentrification can stem from any new "green" development that eventually spurs other developments that usually drive up the housing market and push people out who can no longer afford increased prices of living. In this case, BRT is a green development. Let's examine a few sources that tie public transportation to a lack of affordable housing.

Mwesigwa (2024) investigates equity in access to a BRT system in Tanzania. An enormous part of this study is when the author takes a look at affordable housing in relation to bus rapid transit. In this case, the local government is trying to improve access to the BRT route and therefore access to the rest of what the city has to offer. The study finds that there is a need for preserving and establishing affordable housing in areas that might be subject to gentrification. An important piece of this finding is that "proximity to transit hubs and expanding job centers" are factors that induce gentrification (Mwesigwa 2024).

The study tells us that people living close to new transit hubs are subject to gentrification and a decreased supply of affordable housing, ultimately pushing existing residents out. Mwesigwa (2024), “Successful TODs not only prevent displacement, but also fosters new economic opportunities for all residents,” meaning that if Columbus “does it right,” then we won’t have to worry about a lack of affordable housing in these newly revitalized BRT corridors. The study produced many suggestions on how to combat gentrification with the introduction of bus rapid transit. Another finding is that we need tenant protection policies integrated into the TOD framework to ensure affordable housing supply remains consistent. If we can ensure that vulnerable populations won’t be pushed out, and instead they will enjoy access to new TODs and other parts of the city, then we can expect to see this vulnerable population benefit with increased access to where they live.

Aside from that, Higgins et al. (2024) takes an approach of looking at how a light-rail transit (LRT) route in Toronto has allowed private developers to come in and completely transform the area where LRT is built. The area had been completely uplifted since the construction of TODs. The study investigates whether transit accessibility and streetcar upgrades were capitalized by private developers in their mission to bring expensive condominiums to the area.

Higgins et al. (2024) finds that the process of “land value uplift” has the potential to contribute to or act as an indicator of decreasing housing affordability. Land value uplift happens when we bring new amenities to the city such as LRT. The study also finds that places near added transit stops experience gentrification and eventual displacement of people that lived there before. These findings call for a need to ensure affordable housing supply in the wake of transit-

oriented developments. At the very least we need to plan for more affordable housing in areas where transit stops are proposed and carried out.

2.6 Lack of Stakeholder Inclusion in the Decision-Making Process

Kruger et al. (2021), proposes a study investigating the stakeholders' inclusion or lack thereof in the delivery of a bus rapid transit route in Dar es Salaam, Tanzania. The authors say: "involvement of the public and of different stakeholders is essential and even inevitable," which is a key finding in Kruger's research study. They found stakeholders need additional services that reach out to them after projects such as introduction of new transit. Kruger states that we need a more inclusive "priority setting mechanism," that drives a better connection between stakeholders, planners and the government. We essentially need the government to do a better job of reaching out to people when they have plans to improve their everyday lives.

Despite the lack of stakeholder inclusion in this study enveloped by bus rapid transit, there are still examples of the government reaching out to people to see what they want, which is a prime model of how to include stakeholders in the decision-making process. The authors found a stakeholder inclusion workshop hosted by the government, which had over 50 participants. Participants included people from the city council, BRT representatives, bus driver representatives, citizens, scholars, other activists, and so on. It goes to show that there are many different types of stakeholders involved in a process like this and that it is essential to include them in the decision-making process. We need to hear various stakeholders' opinions because they might not want what the government proposes for them.

Al-Sharari (2022), investigates the public participation of stakeholders in the planning and delivery process of a BRT route in Amman. It specifically explores stakeholder inclusion, so

it is an essential piece to my study. The author finds that public participation in the planning and delivery of a new BRT route is minimal, and that there is a need for greater stakeholder inclusion in future projects as such. Al Sharari (2022) finds that consulting with various stakeholders is very important because they can provide "their needs and grievances." Cities need to do a better job at involving people in this process because they might be planning for something that residents don't even want. Ultimate findings include that the government didn't do a great job of including stakeholders in the planning and delivery of new BRT, but they still did some stakeholder inclusion activities that should have raised concerns about public wants and needs. The government would have found out that people may not have wanted BRT in the first place. Despite that, the authors recommend further stakeholder inclusion in projects like this.

Finally, a study by Navarrette-Hernandez and Zegras (2023) which shows us how skeptical stakeholders can actually slow down or halt a commanding process. The study explores stakeholder inclusion post-development of a BRT route. The authors reach out to various people to hear their opinions on the matter of the new BRT. The authors say "projects have faced community opposition for a range of reasons, such as concerns around loss of private transport space and parking, demand for improved pedestrian and cycle infrastructure, and impacts on streetscapes," showing that BRT infrastructure can be a difficult thing to sell to people because of all the other things it might take away from. These are genuine concerns of people worldwide when the city brings in new transit infrastructure. The question is, does it mean people don't want better transit over cars, or do they not realize how good an alternative BRT can be?

The next topic is how to sell BRT as a good alternative to other modes of transport, most namely, cars. Before we do that, however, let's explore Navarette –Hernandez and Zegras (2023) some more. The authors say that "considerable community opposition" can slow or halt the

process of installing new BRT infrastructure. Opposition is based off peoples “negative perceptions” of bus transit. People don’t believe that BRT is any better than regular old bussing, which people are generally unhappy about. People don’t like bussing because of “factors such as buses being perceived as a low-quality transport mode or a project occupying street space that could instead be used for other purposes perceived as more valuable (e.g. vegetation, pedestrian space, private traffic, parking).” All of these are valid concerns because Americas bussing systems are typically not as great as they could be. People don’t want to ride the bus simply because of the demographics we see in ridership as well as the fact that they probably own a car. A notion around bussing has developed where people think it is an impoverished method of transportation. If people own a car, they typically drive that car rather than taking a bus.

Navarette-Hernandez and Zegras (2023) ultimate finding is that certain aspects of BRT infrastructure, including added green space, crosswalk improvements, and provisions for more space to walk and ride bikes, are optimal ways of selling BRT to the general public. The problem here is that infrastructure as such often comes along with green gentrification and increased prices in the housing market. In other words, how do planners ensure that BRT is what stakeholders want? To conclude this section by posing a question: how are we to combat transit-induced gentrification while still making the city a better place to live? It is the million-dollar question surrounding transit and green gentrification.

2.7 Selling BRT as a good Alternative to Cars and Light Rail Transit

To plan for better infrastructure, we must first make sure that it is what people want through stakeholder inclusion in the decision-making process. Aside from all that, we need to

deeply investigate how we can start to sell bus rapid transit as a good alternative for other modes of transportation. There is a proven negative perception behind bussing in America, and not everyone loves the idea of it. A few authors explored how we can "sell" BRT to the public as a good and effective mode of transportation. To do that we need to show the public that these modes of transit are reliable and cost effective.

An interesting study by Zigmond (2022), investigates the branding and securing of BRT in Cleveland, Ohio. The study poses several key aspects that relate to how we can brand BRT following the negative public perception around bussing in the US. To start, Zigmond raises the concern that bus service improvement is often undermined by the need to transform the image of transit, which catalyzes urban revitalization.

Backtracking to how we can sell BRT to the public, Zigmond raises several ideas that are worth noting. One important way to demonstrate success of the infrastructure after its construction is, in the case of BRT, we would need to show the public concrete proof that BRT has improved people's lives and we need to communicate that proof simply, but effectively. Another method is to act as if new BRT infrastructure is the path toward a city's success. In the case of Columbus, Ohio, they are selling new BRT infrastructure as the path toward a walkable city. It seems as if people are beginning to think that cars are not the answer after all this time, especially people that live in urban areas. A final method could be to plan community outreach meetings, meetings stakeholders can attend for free, so that they can get a better idea of the city's plan which will likely come their way.

In many cases, a vote is required to happen if the city is to get tax money to use on TODs. When a vote is required, the city needs to gain the support of its people and convince them BRT is the way to go before construction is possible. This falls into the planning phase. It requires the

city to go out and market for the branding of its BRT. When this is the case, BRT must be sold to the public before it can be implemented. This is the case of Columbus, Ohio and its three proposed BRT routes. What are other methods of selling or "branding" BRT so the public's negative perception around buses can be reversed?

Looking into Soomro et al. (2022), their research study involves examining people's willingness to adopt BRT. Soomro proposes that "people cannot be persuaded to use public transportation until their travel patterns are understood," giving off the idea that we need to analyze where people are coming and going to if we are to adopt a transit mode that effectively is faster and cheaper than driving a car. Soomro continues to explain that the disparity between public and private transportation needs to be addressed. This is compelling because it is absolutely true. People need to understand that not everyone can afford to drive a car before we can successfully implement new TODs.

The answer might be simple. We need to first build these systems, involving stakeholders in that process as much as possible. Before construction, we must ensure the system will be more affordable than buying or consistently driving a car. After construction, we need to ensure that the system is faster than driving a car, or at least around the same speed as. To achieve this, we need to effectively plan around people's driving patterns, and to do that we must understand them (Zigmond 2022). Then, in the planning process, we can plan certain stops along the BRT corridor that catch the most people, and we can plan to take them to and from the most frequent stop.

2.8 Concluding the Literature: Hypothesis and Research Questions

Overall, different aspects of bus rapid transit literature were explored, primarily in relation to green gentrification. We looked at transit influencing walkability, gentrification as a whole, green gentrification, the 'just green enough' theory, BRT in relation to green gentrification and affordable housing, a lack of stakeholder inclusion in transit related projects, and how we can sell BRT as a viable transit option. I strongly believe that the bus rapid transit route called CMAX has not induced green gentrification of any kind. I don't think that a single bus route has the ability to cause gentrification to occur. I also believe that BRT may be a "just green enough" urban tactic, so that when it is implemented it will not induce rising housing and rent costs in the form of gentrification. I ask the research question: Has the Cleveland Avenue Bus Rapid Transit (BRT) route in Columbus, Ohio, influenced variables associated with green gentrification and, how can planned BRT routes in other parts of the city avoid this potential problem? I will also ask: is BRT is a "just green enough" urban tactic? These are gaps in the literature that I plan on trying to answer in my thesis.

III. Methods

3.1 Qualitative Methods

Qualitative research, according to Winchester and Rofe, "is concerned with elucidating human environments and human experiences with a variety of conceptual frameworks" (2016, 5). Thus, investigating how people interpret and construct the world around them as well as looking into human subjectivity of their environments are in line with qualitative research. Two fundamental questions are applied when looking into qualitative research: questions interrogating social structures and those investigating individual experiences. As Winchester and Rofe state, "qualitative geographers balance the fine line between examination of structures and processes on the one hand and of individuals and their experiences on the other" (2016, 6). Therefore, qualitative research aims at finding 'the why' about a phenomenon by exploring people's beliefs, perceptions, and experiences using methods such as in-depth interviews.

Studying preexisting structures allows qualitative researchers to understand the social, political, and institutional factors that define human experiences and behavior, where they come from, and how they affect the environment around them (Winchester, 2016). Qualitative research combines these two phenomena to gain valuable information about how and why people perceive what is going on around them and why that is the way it is. In my case I have conducted semi-structure interviews to decipher what people think about a bus rapid transit system and how it may or may not be contributing to gentrification along the route. These interviews explore both social structures around the BRT route and individual experiences with the BRT route to find out its role in affecting the environment around it.

Since qualitative research connects human experiences within to the environment, it must be conducted rigorously (Hay, 2021; Winchester and Rofe, 2016). In a book titled *Qualitative Research Methods in Human Geography*, author Iain Hay gives us several pointers and examples

on how to conduct meaningful research in the realm of geography. Qualitative research is useful in social sciences because it allows researchers to examine perceptions, relationships, and structures at various scales. The research aspect of qualitative investigations relies on several key aspects that relate to quantitative research such as the development of a research problem, building a question, development of a hypothesis, research design, the gathering of data, and analysis to derive a meaning. Differentiating the two methods of research, more specifically, qualitative research emphasizes multiple meanings and interpretations of a phenomenon rather than seeking one dominant or correct interpretation in quantitative research (Winchester 2010).

Hay suggests that qualitative analysis can include interviews, questionnaires, document analysis, participant observation, or deconstruction of media events and textual material (2021). As this study seeks to collect information on whether a bus rapid transit route has caused transit-induced gentrification, qualitative research conducted with relevant stakeholders was deemed the most effective way to reveal the answer. The most popular and widely used methods of qualitative data collection are oral, showing that rigorous interview methodology is important (Dunn, 2010). Hay also suggests that interviews are a good way to fill a gap in knowledge while doing research (2021). Pairing semi-structured interviews with a GIS analysis, the interviews will work to explain the patterns indicated on my maps. Interviews thus act to fill a gap in knowledge that other methods, such as the "observation or use of census tract data, are unable to bridge efficaciously," and "to collect a diversity of meaning, opinion, and experiences," (Dunn, 2010, 102). Semi-structured interviews will act to diversify the data collection process and provide expert's knowledge on the topic at hand, which is analyzing whether a bus rapid transit (BRT) route in Columbus, Ohio has influenced gentrification-induced displacement.

Semi-structured interviews are different from regular interviews though. They employ a set of questions that induce a conversation rather than going question by question and answer by answer. Semi-structured interviews act to employ an interview guide and focus on content and deal with issues or areas judged by the researcher to be relevant to the research question, (Dunn, 2010). Dunn states "successful interviewing requires careful planning and detailed preparation" (2010, 101). An interview schedule must be developed and prepared with questions, but the interviewer might not be restricted to deploying those questions. Hay states "The semi-structured interview is organized around ordered, but flexible questioning," which tells me that interviews do not need to follow exactly the ordered questions, but they must be structured around them to produce meaningful data (2021, 158). The researcher must redirect the conversation if it moves too far away from the research topics (Hay, 2021; Dunn, 2010).

There are many strengths to conducting interviews for an investigation as qualitative research. One primary strength, and the aim of interviews I am conducting, is to collect a diversity of meaning, opinion, and experiences. "Interviews provide insights into the differing opinions or debates within a group, but they can also reveal consensus on some issues" (Dunn, 2010, 102). The questions I asked during interviews work toward finding a common ground between people's answers as well as finding differing responses that contrast the overall data. Interviews also acted to give me, as the researcher, a cause to reflect on the respondent's experiences and the opportunity to find out more about the research project than if they were simply observing the research site at hand (Dunn, 2010). Gaining information from interview respondents proved to be one of the most valuable methods of learning about what is going on in a place and why it is happening.

In terms of being able to conduct my interviews, there were some constraints that resulted from the Institutional Review Board (IRB) process, which provides a certification that allows one to utilize human subjects in a research study. This process ensured I couldn't contact potential respondents until the process was complete. The IRB process took about three months, after which I was able to interview five relevant respondents. Interview respondents were urban planners in the neighborhoods in Columbus in which the bus route of study ran through, and transit authority workers that have either worked with or for the Central Ohio Transit Authority (COTA). COTA oversees all bus rapid transit projects in the Columbus area, including CMAX and other planned BRT routes through the LinkUS initiative. Interviews lasted roughly 30-60 minutes in length and were structured around a list of 9-10 pre-determined questions (See table 1). Table 1 list questionnaires were shortened here; the full list of questions will be provided in the appendix at the end of this document.

Table 1:
Sample questions from questionnaires provided to transit workers and urban planners
Transit Authority Worker Perspective Questions:

1. What do you know about the CMAX bus rapid transit route on Cleveland Avenue, and has it influenced transit-induced gentrification to your knowledge?
2. What was the city of Columbus's intent or goals when constructing new BRT infrastructure? Is it more to connect disadvantaged populations to other parts of the city, to spur further neighborhood redevelopment, or both?
3. How does the transit authority assess the potential effects of new transit projects on existing neighborhoods in terms of gentrification and displacement?
4. Does the transit authority ensure that the voices of vulnerable or disadvantaged groups are heard in the planning process? If so, how?

Urban Planner Perspective Questions:

1. What do you know about the CMAX bus rapid transit route on Cleveland Avenue, and has it influenced transit-induced gentrification to your knowledge?
2. What was the city of Columbus's intent or goals when constructing new BRT infrastructure? Is it more to connect disadvantaged populations to other parts of the city, to spur further neighborhood redevelopment, or both?

3. How do you assess the potential for gentrification when planning for bus rapid transit development?
4. How do you envision the long-term impact of the bus rapid transit expansion on neighborhood stability and affordability?

Research participants have been de-identified for the sake of analysis. The IRB requires that there is no identifiable data relating the interview respondents to who they actually are. De-identification involves removing one's name as well as any other identifiable information such as job title or place of work. This is to protect the anonymity of respondents, allowing them to be fully honest with their answers without fear of repercussions. For the sake of analysis, participants were given aliases and their relevance to the study was briefly described without giving away any potentially identifiable information, (see table 2).

Table 2:
Pseudonym and descriptions of interview respondents

Pseudonym	Job Description	Transit Authority Worker or Urban Planner
Barney	Management Analyst for the City of Columbus Department of Neighborhoods	Urban Planner
Ted	Transportation Planning Manager in Columbus, Ohio	Transit Authority Worker & Urban Planner
Marshall	Transit Program Manager at the Central Ohio Transit Authority (COTA) in Columbus, Ohio	Transit Authority Worker
Lily	Neighborhood Program Specialist in the Linden Neighborhood in Columbus, Ohio	Urban Planner
Robin	Neighborhood Strategies Manager in the Linden and Hilltop Neighborhoods in Columbus, Ohio	Urban Planner

An important aspect of collecting data from any type of interview is to transcribe them and analyze them for further analysis. In his book on qualitative methods in geography, Iain Hay

claims that interviews produce vast data sets that are next to impossible to analyze if they have not been converted to text (2021). Transcribing the interviews from audio recordings to text will be essential, because analyzing and finding connections and gaps with written out interview data is much more effective than listening to the data. Dunn states, “A 60-minute interview will require at least four hours of transcription if you are a fast typist, and verification of the record could stretch over a couple of weeks. After all that, you have still to analyze the interview material,” proving that transcribing interview data takes a lot of time (2010, 101). Interviews should be transcribed as soon as possible after they take place, that way they are still fresh in one's mind, minimizing losses of insights regarding the data (Hay, 2021; Dunn, 2010). Placing the initials of each speaker proceeding all text will be important, so the researcher can identify who is saying what in the interviews (Hay, 2021; Dunn, 2010). For my interviews, I used Otter AI, an artificial intelligence app that transcribed the interviews for me, which saved time that I would have otherwise spent typing. I was able to go through each interview transcription and derive themes from the interviews themselves, which were in turn used for coding.

In terms of analyzing transcribed interview data, researchers should treat it as a “latent content analysis” (Hay, 2021, 175). This involves searching for connections or themes in the transcribed data (Hay, 2021). The determination of themes and meanings within the transcribed text is a form of coding. A coding system is used to sort and retrieve the data for further analysis. Latent content analysis involves a coding system to determine underlying meanings and themes of what was said (Hay, 2021). Hay states “The purposes of coding are partly data reduction, partly organization, and partly a substantive process of data exploration,” indicating that coding is an essential piece to analyzing semi-structured interview data (2021, 377).

Coding was an essential process to making sense of the vast array of data gathered during semi-structured interviews. With each interview lasting from 30 minutes to an hour in length, it makes sense that there is a ton of data spanning through 5 interviews. Coding is the method I used to piece together groups of like data into categories, so I could narrow how much data I was dealing with. Similar questions provided similar answers, and these answers could be grouped together into different classifications and supporting themes. When applying coding to my transcribed interviews, I used a combination of inductive and deductive coding. Inductive coding develops codes directly from the data by using terms and phrases directly from the interview respondent's responses to my questions (Linneberg, 2019). Some codes that were developed from inductive coding were overarching themes such as: the CMAX bus rapid transit route is not a catalyst toward gentrification, CMAX is BRT light, the One Linden community plan and its role in revitalizing the neighborhood that CMAX runs through, and the equitable transit-oriented development (eTOD) action plan. These are all codes that were directly mentioned by interviewees during the semi-structured interviews, and they ensure that some of the codes stay close to the data, mirroring it in a way. Deductive coding is a form of coding that requires the researcher to create a pre-defined list of codes that act as a "coding frame" before one starts coding data. (Linneberg, 2019). These codes were developed from overall themes I gathered when conducting my interviews and they were created before I started coding my data. Some of the deductive codes are the CMAX BRT route expands job access from north to south in Columbus, CMAX acts to connect disadvantaged communities, public engagement is essential for transportation planning, the LinkUS initiative and the planned BRT routes that come with that, and the potential of gentrification when planning for BRT. All the deductive codes were

derived from overarching themes discussed in the interviews, and they were determined before the coding of my data (Linneberg & Korsgaard, 2019).

Conducting semi-structured interviews and performing subsequent coding provided me with the tools I needed for a rigorous analysis. Information gained throughout the interview process proved monumental in establishing my understanding of the CMAX BRT route and its effects on the neighborhoods around it. I interviewed five people that work in different positions for the city of Columbus's department of neighborhoods and the local transit authority. They provided their vast knowledge during the semi-structured interviews. They also provided me with the information I needed to further my grasp and understanding of what BRT can do for a neighborhood, both positively and negatively. Overall, BRT's effects on surrounding neighborhoods proved substantial in changing the lives of the people who live there and who rely on public transportation to move around the city.

3.2 Geographic Information Systems (GIS) Analysis

In addition to the qualitative approach to my research study, I employ a GIS analysis, so it is essential to investigate papers that examine how GIS analysis is used to study gentrification. An article by Sue Easton in 2019 shows us how GIS analysis of gentrification reveals some gaps in qualitative research. The purpose of the article is stated to "investigate qualitative methodologies that have been deployed to measure the extent of gentrification-induced displacement." (Easton, 2019, p. 288). They looked at various methods to study gentrification by using GIS. Maps included looking at income data compared to the larger metropolitan area's median income. Other maps examined a steep increase of homeowner occupied housing price as

an indicator of gentrification. They also looked at sudden rent increases that made housing unaffordable to those tenants where rent increased. Overall, the article finds that mapping gentrification often "struggles to provide meaningful estimates of the number of individuals and households displaced by gentrification" (Easton et al., 2020). It proves that no matter how many maps are produced for this project, it will not construct a clear understanding of how many people have been displaced by gentrification. Coupling the maps with various other qualitative methods, such as semi-structured interviews, will act to fill some of the gaps that the maps leave unaddressed.

An article by Mumm and Sternberg (2023) examines three Chicago neighborhoods and analyzes how mapping racial change and population characteristics can be a good measurement of gentrification. They map out property value, racial change, and material conditions in the built environment as indicators of gentrification. They examine these factors at the census block and tract level. Attributes for conditions in the built environment included the researchers driving around and taking note of "new construction, material improvements, vacant land, businesses, unoccupied commercial space, protected affordable housing, and civic uses such as schools, churches, or parks" Mumm and Sternberg (2023). These are all important components to measuring gentrification. Unfortunately, the time it will take to examine material conditions in the built environment in my study area to the extent that Mumm and Sternberg did will not be possible with the time I have. However, observing material conditions in the built environment while I spend time in my study area is possible. In the study by Mumm and Sternberg, their maps utilized GIS to show population and race change characteristics as well as property value changes. Along the BRT corridor in my study area, there are not many signs of gentrification occurring. There are sparce new developments, surrounded by tons of businesses and small

houses. There are various apartment complexes, but not enough new developments to signify major gentrification is taking place. My study will use GIS to map out variables associated with gentrification such as income, housing values, and race in the form of population percentage. As these parameters will give me an idea of if gentrification has occurred, they will not provide the full picture, which is where semi-structured interviews and document analysis will come into play.

For the GIS analysis of my study, I collected data from the United States Census Bureau. I examined some parameters related to gentrification which are median household income, median home value, percent of the population with a bachelor's degree, and the population percentage of different races. So, I looked at income, home value, education and race. I examined data for the years 2013 and 2020 to quantify if there was a difference in different variables over the course of 7 years. Construction of the bus rapid transit (BRT) route I am investigating, called CMAX, started in 2016 and was completed in 2018, so if any significant changes related to gentrification in the four variables happened, they will be present on the maps. This is still such a short time period to investigate, so it is recommended that future studies look at these same variables over a longer period of time.

For the GIS analysis, a study area needed to be identified as well as having a comparable exterior study area, so if any changes were present because of the BRT route, they could be recognized. Isolation of the CMAX BRT route in ArcGIS Pro was done to single out the bus route that I am examining. Then I overlayed census block groups with the BRT route. Census block groups for Franklin and Delaware county were used because the BRT route runs through both counties. Franklin County encompasses the city of Columbus, while Delaware County lies to the north and is where the BRT route ends. To identify the research project’s study area, a

one-mile buffer on the BRT route was performed, as that is the typically maximum distance people are willing to walk to ride public transit. With that initial buffer, a select by location query was run to select all the census block groups intersecting that buffer. This collection of block groups was defined as the research project study area. After that, a 3-mile buffer on the BRT route was run so I could have visual data outside of my study area as a comparison. The comparison data is important because if any changes take place inside the initial study area but not outside the study area, then that could be a sign of gentrification induced by the BRT route. With the 3-mile buffer, I ran another select by location query to identify the exterior study area as a comparison group.

Buffers and select by location queries were run for both the years 2013 and 2020 because census block groups differ over those years. There are more block groups for 2020 than there are for 2013. For 2013, there were 425 block groups in the overall study area, compared to 436 block groups for the same study area size, but in 2020. Block groups offer a smaller boundary level analysis than census tracts, which is better for my project because we want to see the maximum amount of change possible for each variable. Smaller boundaries are important because they help to visualize more measurements than tracts or blocks alone.

After study area boundaries and their comparable exterior boundaries were set, it was time to join the U.S. census bureau data to the actual block group boundaries, so they could be geographically represented on maps. There was a 12-digit block group Geo ID, as it is called in the census bureau data sets, that could be joined to a GIS shape file of block groups. The shape file was accessed using the census database called Tigerline, which is a database that has GIS shape files for every geographical boundary starting at the state level, all the way down to the block level. The 12-digit block group code was present in both the excel data sets and the block

group shape file, so the data in the excel sheets could be joined to the shape file using ArcGIS Pro. After the join was complete, the shape files on the GIS database contained the data relevant to my project which are income, housing value, education and percentage of the overall population by race. Symbology of each map was created based off one of these four parameters, and two sets of maps were created for each parameter for both the years 2013 and 2020. Then layouts were created using ArcGIS Pro, so maps from 2013 and 2020 could be paired side by side for further comparison and analysis. Legends and scales were added to the map layouts as they are needed to make sense of geographic data and the physical size of the study area.

There are always gaps in research when solely relying on GIS to conduct analysis of potential gentrification. These gaps were present in my geographic data as well, which is why I coupled GIS with qualitative methods in the form of conducting semi-structured interviews. I was able to quantify the change in some of the variables associated with gentrification by using GIS, with parameters such as income, home value and race. Using GIS allowed me to get a good idea of whether gentrification is taking place, but not a complete idea. Although I could measure change in certain variables, I couldn't access potential displacement and movements of residents exclusively through maps. One thing that GIS can't do is tell you what is really going on in a place and how different things influence other things. Coupling GIS with semi-structured interviews allowed me to get a better understanding of my study area through the eyes of people, and what they know about transit-induced displacement. Interviews permitted me to gain thoughtful information about the CMAX BRT route and whether or not it has induced gentrification. I interviewed people that work directly with CMAX or in the neighborhoods in which it runs through. They provided me with meaningful data that granted me to fill the gaps in research that GIS enabled.

IV. Results & Discussion

To start the analysis of my interview data, I had to code the interviews to develop a list of overarching themes that help to categorize my data into sections. Coding interviews is the process of categorizing and labeling segments of textual data to identify themes, patterns, or concepts. Categorizing my interview data helped me recognize important pieces of information that act to make sense of my data, relating it to answering my research questions. My research questions are: Has the Cleveland Avenue bus rapid transit (BRT) route in Columbus, Ohio influenced variables associated with ecological or green gentrification, and if so, how can planned BRT routes in other parts of the city avoid this problem? And, is bus rapid transit (BRT) a 'just green enough' urban tactic? The concepts derived from coding my interviews helped me answer these research questions in the following sections of my results and discussion. Below is a list of the codes I came up with and their importance to my study (see table 3).

Table 3

List of codes and their connection to my research study

Codes	Relevance to Study
1. CMAX BRT route is not a catalyst toward gentrification	A common finding in all of the conducted interviews is that there are no other developments since the completion of CMAX that would signify gentrification is taking place.
2. CMAX is BRT light, not true BRT	BRT light refers to a less robust version of BRT with fewer features such as dedicated bus only lanes or traffic signal prioritization. CMAX does not have either of these.
3. CMAX BRT expands job access north to south and connects disadvantaged communities	The intent of Columbus when constructing CMAX was to expand access to other parts of the city for places that typically have higher transit ridership.
4. CMAX bus stops differ from other COTA bus stops	There are less bus stops along CMAX, making for faster travel times. The actual bus stops have screens that show bus arrival times.

5. BRT can be lifechanging for people who don't have cars	BRT serves as a reliable, fast, and cheap method of transportation for people that live in zero car households. CMAX expands access to parts of the city that used to be unreachable without a car, allowing for greater job access for people who can't rely on a car to get them around.
6. Public engagement is essential for transportation planning	It is important for the transit authority to ensure the voices of the public are heard when planning for new transit projects that directly affect them. Public wants and needs are valuable information that can allow the transit authority to plan better for the public.
7. One Linden plan	This is a community plan that aims to revitalize the North and South Linden neighborhoods through 10 big ideas, some of which directly relate to CMAX and transportation planning. Some of these ideas are to stabilize and expand housing options, connect residents to employment, reimagine Cleveland Avenue, and to connect the community.
8. Equitable transit-oriented development (eTOD) action plan	This plan aims to provide affordable housing along Columbus's primary transit corridors as a method of combating gentrification before it could ever occur. This also aims to focus on job growth around these transit corridors to ensure the jobs people have access to are of high quality.
9. Zone in Columbus	This is a rezoning initiative along Columbus's main transit corridors that act to bring higher density and mixed-use developments. The initiative will encourage thoughtful investment in neighborhoods that have experienced racial and economic segregation and help undo the harm caused by past urban development policies.
10. LinkUS initiative and planned BRT routes	This increased sales tax initiative was passed in November 2024 and will fund three true BRT routes in the city of Columbus, further expanding job access and connectivity of disadvantaged neighborhoods. The plan will also bring more sidewalk and bikeway connectivity to the city.
11. Potential for gentrification along planned BRT corridors	There is more potential for gentrification to occur in the planned BRT corridors because

	they are true BRT. This means that they have bus stops centered in the roadway for easier loading, dedicated bus only lanes, and traffic signal prioritization. There is a better chance that people will want to move to these areas because of better public transportation options, which could in turn, displace some existing residents.

4.1 Has the Cleveland Avenue bus rapid transit (BRT) route in Columbus, Ohio influenced variables associated with green gentrification, and, how can planned BRT routes in other parts of the city avoid gentrification?

Overall, my interviews with Barney, Ted, Marshall, Robin, and Lily assisted me in the process of answering this question. Interview respondents were asked questions related to the process of planning a BRT route and how the city has acted to avoid gentrification-induced displacement as a result of the construction of the BRT route known as CMAX. Questions were asked connecting the CMAX BRT route to possible gentrification and the answers were surprising. Generally speaking, interview respondents' answers to my questions showed that the CMAX BRT route has not been a catalyst toward gentrification. There is simply not enough evidence showing that CMAX has caused the implementation of new developments along its transit corridor which would ultimately show a rise in rent prices and housing costs. Although rent and housing costs have risen over the past several years, this cannot be attributed to CMAX, but it is likely because the housing market has shown a rise in costs due to inflation and low inventory for all of Columbus's new residents. There is a need to increase density along Columbus's primary transit corridors.

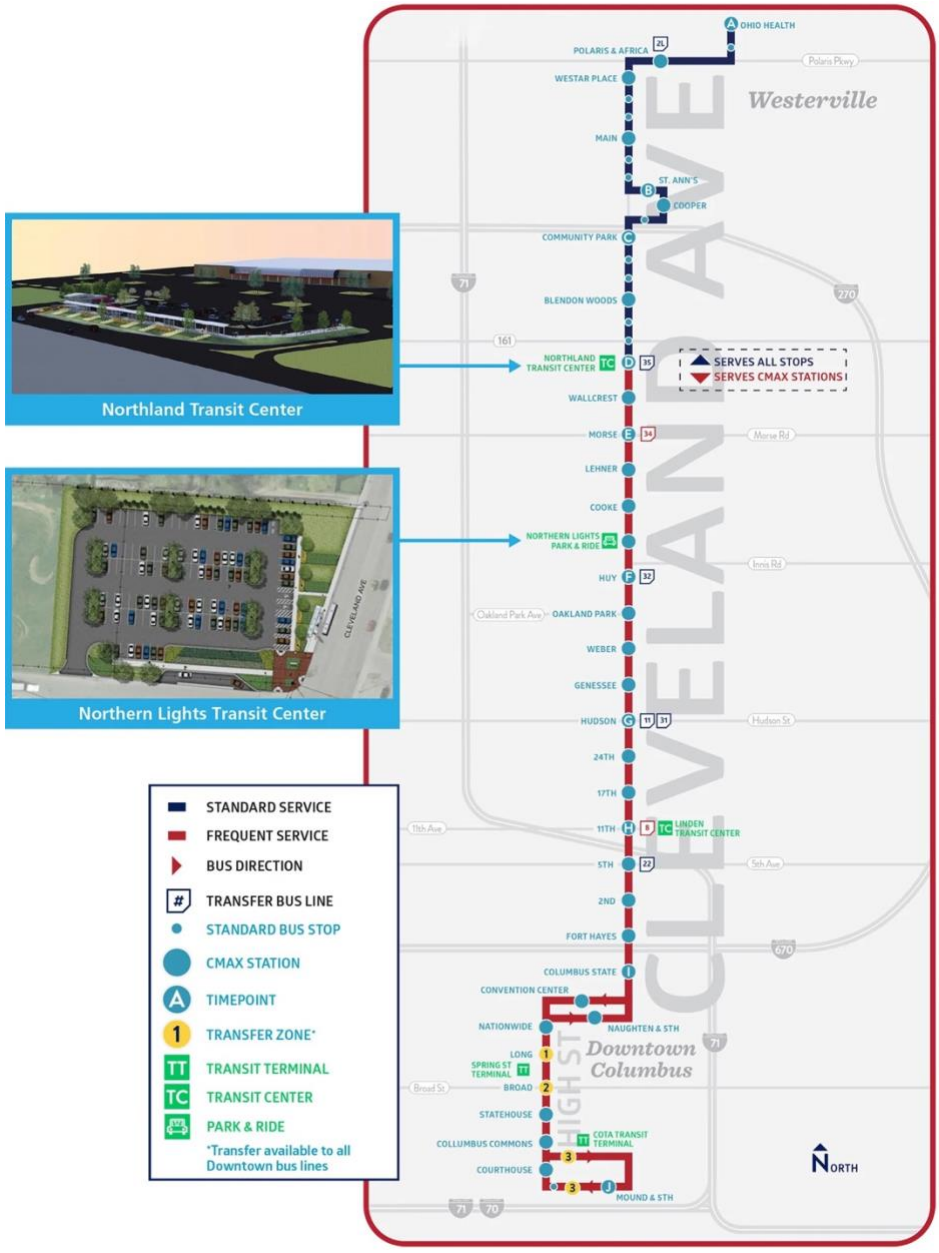
Apart from the semi-structured interviews I conducted, the maps I produced show changes in variables related to gentrification over a seven-year span. Comprehensively, the maps

do not show much change along the CMAX transit corridor in parameters such as income, housing prices, educational attainment, and movement of certain races. These relatively low changes and adjustments, shown in the maps, do not signify any evidence of gentrification because of the implementation of the CMAX BRT route. Maps will be shown in the following subsections. We must take a comprehensive exploration of the background of CMAX and the neighborhoods it runs through, so we can further understand why gentrification hasn't occurred. Following the analysis of CMAX, we will investigate three planned BRT routes in the city of Columbus and explore how these BRT routes might show more potential for gentrification to occur.

4.1.1 CMAX Background, Neighborhoods it runs through, and the One Linden Plan

CMAX is a bus rapid transit route on Cleveland Avenue in Columbus, Ohio, running 15.6 miles north to south and vice versa connecting Columbus's downtown to the northern suburb of Westerville and its OhioHealth Medical Center with 32 stations (see map 2). CMAX links people to better access to jobs, health centers, and education hubs such as Columbus State Community College, which enrolls over 24,000 students according to the Cleveland Avenue BRT Capital Investment Program's project files. The route also connects people to basic amenities such as parks, grocery stores, and housing via public transportation.

Map 2: CMAX BRT route and its stations.



Sourced from the Central Ohio Transit Authority (COTA) website

The planning process of CMAX started around 2010, construction started in early August of 2016, and the route started running January 1, 2018. Before BRT was constructed, the Cleveland Avenue bus route was the second highest in ridership among Central Ohio Transit

Authority (COTA) bus routes. Overcrowding was a common phenomenon seen on the bus route prior to CMAX, which demonstrated a need for change. Plans for CMAX would increase service times by 20%, and with traffic signal priority along certain parts of the BRT route, it would prove to run faster than the prior route, decreasing travel time for its high ridership. According to a planning document for CMAX, 53% of the BRT route's ridership is transit-dependent, where the route aims to serve these people by connecting them to economic and educational hubs in the city. Going back to the planning process, the city needed funding to construct the BRT route. Columbus was able to acquire 47.82 million dollars in a grant from the Federal Transit Administration (FTA), which covered 80% of the project's total cost. The remaining 20% was obtained through a COTA sales tax, which amounted to 9.37 million dollars.

CMAX is a form of bus rapid transit, and to differentiate the route from other bus routes in the city, we need to go into how it is different. An interview respondent for my study, Ted, who works as a transportation planning manager, stated this in regard to BRT:

> "So they have their own stations. They have their own dedicated and themed busses, or branded busses."

These dedicated and themed busses separate CMAX from other routes in the city. The buses are essentially branded as BRT to show the public that they are different from regular COTA buses. Another differentiating factor are the bus stops themselves. An interview respondent, Robin, goes over how the bus stops are different:

> "The bus stops, those are different and unique, right, than a regular bus stop. They have a little more amenities, such as a screen that helps folks show what time the bus is coming, which is what's new for Central Ohio."

Screens on the bus stops that show when the bus is actually going to arrive differentiate CMAX from other routes in the city. Other routes do not have these screens. Now, branded busses and

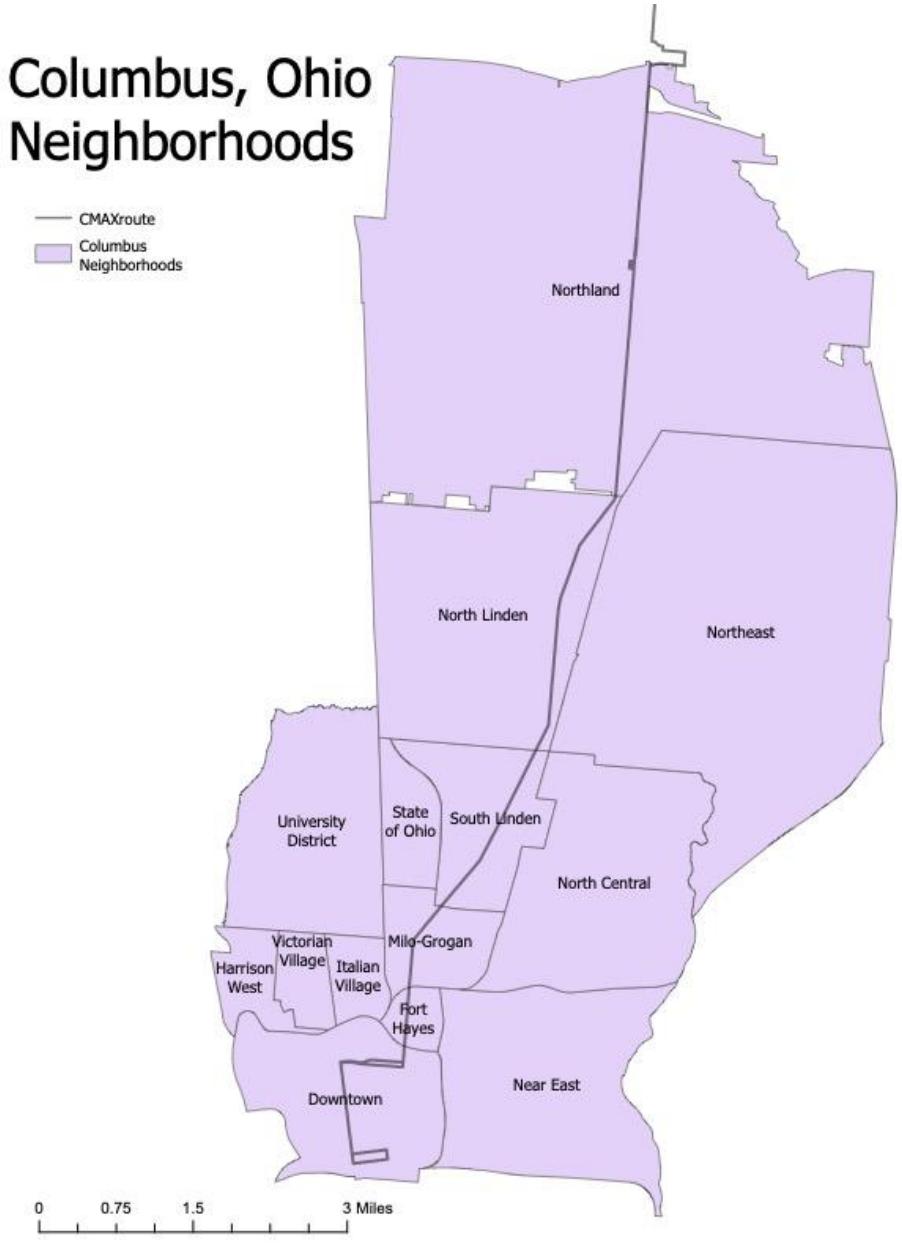
contemporary bus stops aren't what makes CMAX bus rapid transit. What makes CMAX BRT is the characteristics it possesses.

CMAX is BRT light, not true BRT. This means that the bus route lacks certain aspects of BRT that make it rapid transit, rather than a regular bus route. The most notable feature of BRT that CMAX lacks is dedicated bus lanes. This would make sure that CMAX runs smoothly through traffic because it wouldn't have to wait behind other cars and buses, but that is not the case. Since CMAX lacks dedicated bus lanes, it must wait behind other vehicles in traffic, slowing down its travel time. BRT light is essentially a less robust version of BRT. It is not as fully developed as a BRT system with dedicated bus lanes and traffic signal priority. Despite this, CMAX does still have some amenities that make it bus rapid transit. Traffic signal priority is one of them. When a CMAX bus reaches a traffic light that is red, it connects to that signal in a way that turns it green faster than it would if a CMAX bus was not there. This ensures that the buses on the route run faster than other COTA buses do. The key factors that differentiate BRT light from true BRT are less dedicated infrastructure, simplified stations, a cheaper cost, and the potential effect of the BRT light not achieving the intended benefits of BRT. CMAX was not all that Columbus residents hoped for because of limited federal funding that didn't allow the BRT to be developed to its full potential. Despite this, it is still considered some form of BRT, and it indeed provides faster and more reliable service to residents than regular COTA buses. Although CMAX wasn't exactly what residents were hoping for, the people in the neighborhoods it runs through reap the benefits of faster and publicly accessible travel. It brings us to the question, why was CMAX chosen for the neighborhoods it runs through?

There are several neighborhoods that CMAX passes through. It obviously starts in downtown Columbus, and runs north through the small community of Fort Hayes, then Milo-

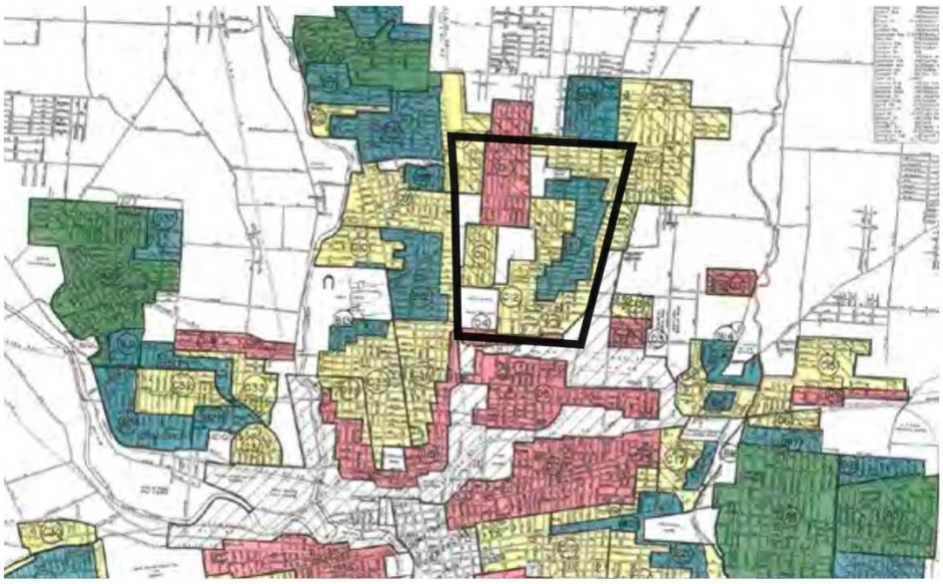
Grogan, South Linden, North Linden, and the larger Northland neighborhood (see map 1 on page 7 and again on page 56). Out of all these neighborhoods, North and South Linden prove to be the communities that have been previously marginalized and underfunded (see map 3), producing a population that relies heavily on public transportation to move around the city because they can't afford to buy cars or they don't have access to them. We need to explore the Linden neighborhoods in more depth to understand why BRT was chosen to support the people that live there.

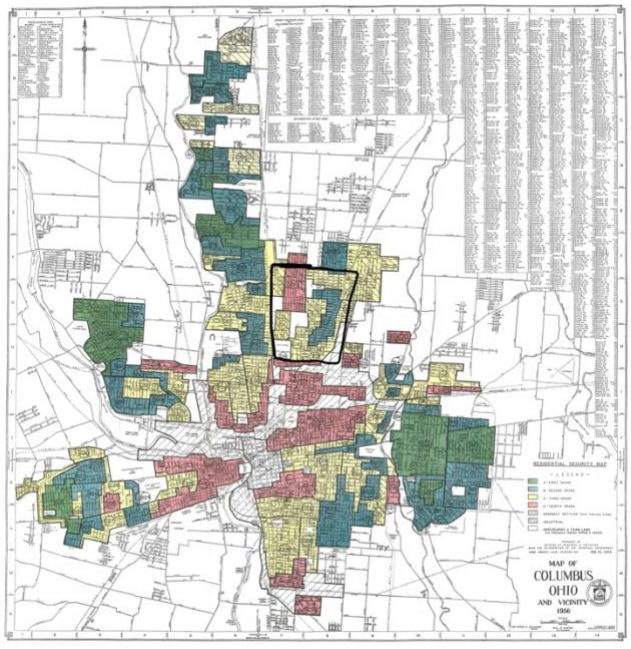
Map 1: Map of CMAX BRT route and neighborhoods it runs through.



Sourced from the city of Columbus' ArcGIS Online data hub

Map 3: Red, yellow, and blue lined sections of Linden neighborhoods and Columbus redlining map for reference

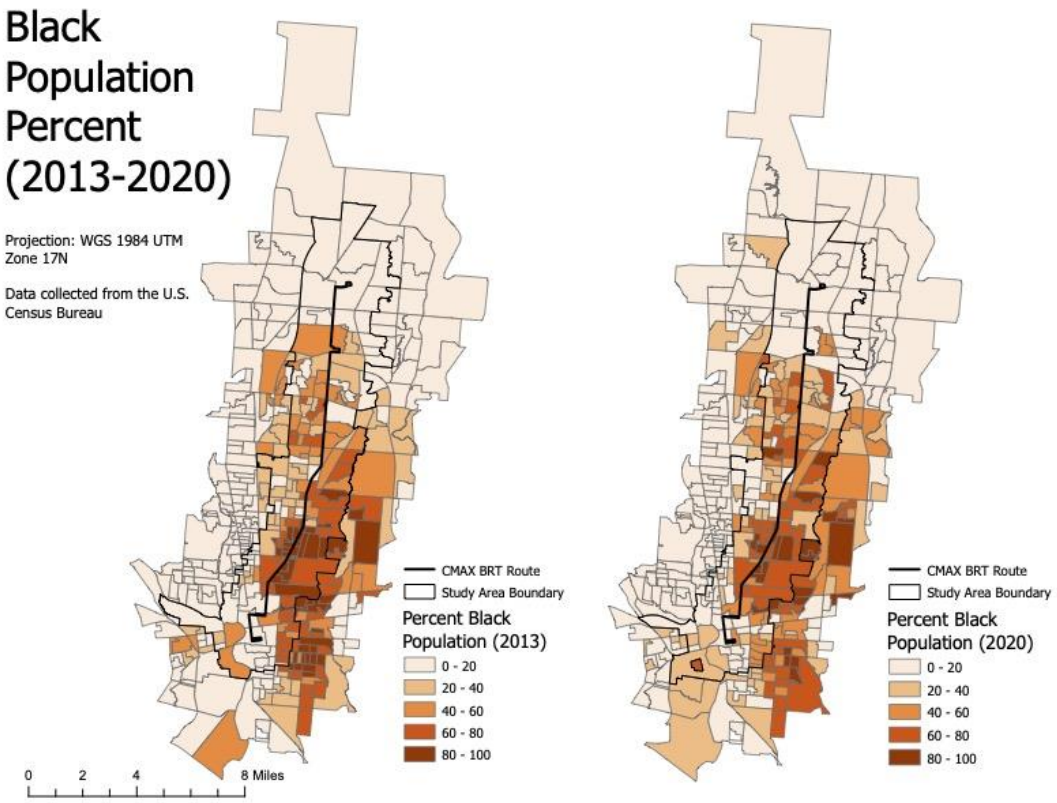




Sourced from the full One Linden planning document

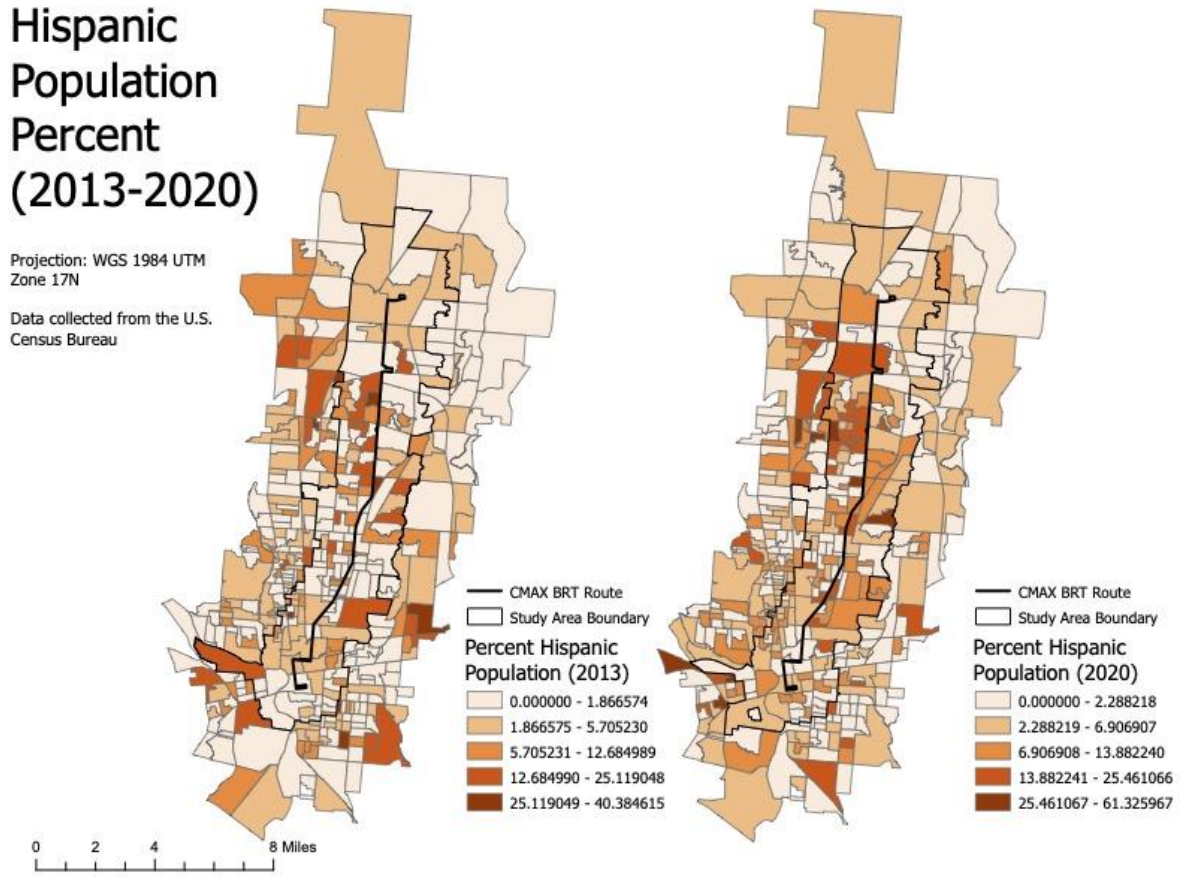
As you can see, the Linden neighborhoods are surrounded by the black box shown in the redlining map. The neighborhoods are encompassed by red, yellow, and blue sections, which are different historic designations created by the Home Owner's Loan Corporations (HOLC) that unfairly targeted minority neighborhoods and reduced access to mortgage financing based on racially restrictive covenants. Red areas were considered the riskiest for mortgage support, which blocked many minorities and low-income borrowers from accessing home mortgages and business loans. According to the One Linden planning document, this map was created in 1936, and designated Linden into three categories: red (highest risk), yellow (declining), and blue (still desirable). With the neighborhood being constricted by redlining, its population of minority groups increased significantly (see maps 4 & 5).

Map 4: Black Population Change along CMAX BRT Corridor



The Black population maps did not change very much from 2013 to 2020. Some census block groups show a slight change in the Black population, but not very many. Black residents are primarily concentrated in one large area within the transit corridor. Inside this area are the neighborhoods of North and South Linden, which have huge Black populations spanning mostly from 40 to 100 percent. These minority groups weren't always here. According to the U.S. Census Bureau, the neighborhood was primarily White and by 1970 its population had shifted to a majority Black population. The initial White population likely presided in Linden due to white flight to the suburbs, where a majority white population left downtown economic hubs to escape crime and disinvestment. Following white flight, the neighborhood saw much disinvestment and a decline in homeownership around 1970, which is when the Black population started to increase. Like most neighborhoods in the city of Columbus, Linden experienced significant population shifts with each passing decade.

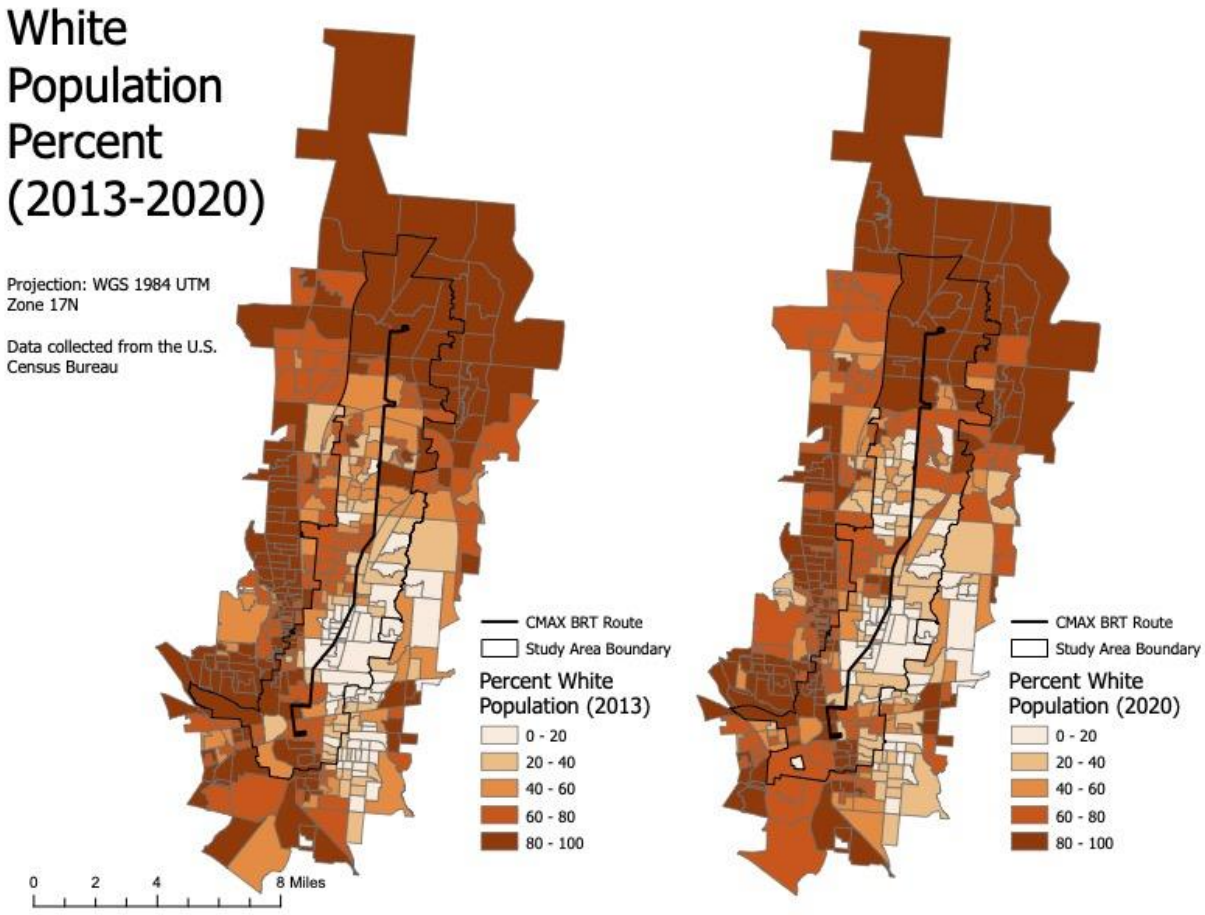
Map 5: Hispanic Population Change Along CMAX BRT Corridor



The Hispanic population along the CMAX transit corridor appears to be very dispersed, and it has changed somewhat in the years spanning from 2013 to 2020. In the Linden neighborhoods, the population appears to be dispersed as well. There is a high Hispanic population in the North Linden neighborhood compared to South Linden. This may be due to previous disinvestment in the neighborhood, where a working-class Hispanic population was concentrated to similar places. To understand the Cleveland Avenue transit corridors' population demographics, it is important to look at where the white population resides (see map 6), in comparison to where the Black and Hispanic populations are concentrated. Typically, white populations in cities are more affluent and they reside in more expensive areas within the city,

and this is true for Columbus as well. Minority populations, due to historic disinvestment, are typically low-income communities, which are shown in maps 3 and 4.

Map 6: White Population Change Along CMAX BRT Corridor



In these maps we can clearly see that most of the White population along the CMAX transit corridor lives in the downtown and Northland neighborhoods in Columbus. Northland shows mostly around 80-100% of the population being White. The downtown area shows similar numbers. The Linden neighborhoods show a very low White population which can be attributed to previous disinvestment in these neighborhoods, where a more affluent population moved out

of these neighborhoods as housing opportunities decreased with the homeownership rate decreasing from 63% in 1980 to 37% in 2015 according to the U.S. Census Bureau.

Overall, the combined Linden neighborhoods have seen a lot of disinvestments over the years, which may be attributed partly to historic redlining processes. This disinvestment has caused the neighborhood to be filled with a largely low-income working-class population that relies heavily on transit to get around the city. This may explain why about half of the transit riders in the CMAX corridor are transit dependent and can't rely on cars to move round the city because they can't afford them. Transit dependent populations are those that cannot rely on private transportation because they do not have access to cars. Transit dependency refers to individuals who rely heavily on public transportation to get around. The history and disinvestment in these neighborhoods prove why the Cleveland Avenue transit corridor sees such a high transit ridership and demonstrates why the corridor needed BRT so transit dependent people could get around the city faster and more reliably. CMAX has been a method to connect residents in disinvested neighborhoods to other parts of the city, expanding access to urban amenities. This BRT has been a way to add to the revitalization efforts of neighborhoods such as Linden, so that further economic development can take place. Although this may sound like a way to gentrify the neighborhoods, neighborhood planners have devised a plan for Linden to grow in an equitable way, as to not push existing residents out.

Linden neighborhoods have been disinvested greatly in the past, which is why the current mayor and other city officials have come up with a plan, dubbed the One Linden Plan, to revitalize the community without pushing out its residents. The One Linden Plan came up several times during my interviews, which is why I created a One Linden code to categorize all the pieces of an overarching theme of resurgence and revival for the Linden neighborhoods

where the CMAX BRT runs through. An interview respondent, Barney, who works as a management analyst for the city of Columbus's department of neighborhoods, said the One Linden Plan is essentially:

> "a road map for how they want to get to revitalize the neighborhood."

Although these revitalization efforts may sound like a road map for urban processes such as gentrification to take place, One Linden aims for economic revitalization in an equitable way. Revitalization is typically a term used by city officials to mask underlying exercises of development and eventual gentrification. Despite this, from what I've seen while reading the One Linden Plan, and what I've heard from interviewees shines light on a way to take our country's best practices and apply them to North and South Linden, so the city doesn't displace people following economic revitalization. Usually pouring money into a historically disinvested place leads to gentrification, but this plan seeks to remain at the boundary between investment and gentrification, so as not to displace low-income people. One Linden is encompassed by a variety of methods to revitalize the two communities of North and South Linden as one; there are 10 big ideas that the plan covers which aim to strengthen the neighborhoods' economy and bring opportunities to the people that live there. Notably to my study on CMAX, there are four ideas that connect directly to the BRT and variables associated with gentrification. According to the One Linden planning document, they are to stabilize and expand housing options, connect residents to employment, reimagine Cleveland Avenue, and to connect the community. These four big ideas pertain directly to CMAX and its hopes of connecting the community. Expanding housing options relates to gentrification because the city of Columbus is trying to prevent gentrification by adding to the affordable housing stock.

One of the big ideas in the One Linden Plan is to stabilize and expand housing options. By doing this, Colombus is ensuring that added amenities such as the CMAX BRT do not take away from the affordable housing stock that Linden currently possesses. Since CMAX is something that is new, exciting, and might draw people to the Cleveland Avenue corridor, the city is taking the initiative to expand housing options, so current residents can remain where they are and take advantage of BRT. Amenities such as BRT could result in people moving to an area where this transit is, so they can use it, which may increase rent and housing prices. Housing is a vital aspect to gentrification. Colombus is taking measures to ensure that people who already reside in Linden and people that want to move to Linden because of CMAX can both live there. By putting policies in place to stabilize and expand housing options, the city is trying to prevent the displacement of people due to BRT.

There are two parts to stabilizing and expanding housing options. To stabilize housing options, the city is employing a variety of techniques such as: educating landlords and tenants to ensure lower eviction rates, stabilize property taxes for long term residents and homeowners through a Longtime Owner Occupants Program (LOOP) which is a real estate tax abatement program. To retain long-term homeowners that might have encountered financial difficulty and fallen behind on property tax payments, the city aims to put a plan in place to put owners back on track. Putting in place a program like Philadelphia's Owner-Occupied Payment Program (OOPP) would prove to be helpful for the Linden neighborhoods to retain homeowners. This program would allow homeowners to make affordable monthly payments on property taxes that are past due, with most people choosing to set up their monthly payments based on their household size and monthly income. Installing landlord programs and tenant protections to ensure that tenants aren't treated unfairly by landlords and to make sure landlords act only within the laws of the

city are an important piece of the plan. Another option to stabilize housing options in the city is to support homeownership. Homeowners help to create families with generational wealth, and they support neighborhoods with residents that invest in the community. In the One Linden community plan, it is stated that it should be encouraged for owner-occupants to purchase homes rather than market investors.

The other part of this idea is to expand housing options. Preventing residential displacement is a tough task when planning to revitalize neighborhoods; there needs to be a concept of permanent affordability to ensure existing residents aren't pushed out or displaced. Current city programs such as the Low-Income Tax Credit Program and the Habitat for Humanity affordable mortgage terms only ensure that housing stays affordable for a certain period. One Linden aims to secure affordable housing options by making sure housing stays affordable in the long term. One way the city aims to subsidize market rate housing is to install a program called the Real Estate Transfer Tax (RETT), which aims to collect a tax on the sale of any real estate which will be allocated to affordable housing. Another way the city aims to ensure enough affordable housing in the wake of neighborhood revitalization is through land trusts. Land trust programs steward affordable housing by making sure housing stays affordable rather than raising with the market. To do this, these programs target specific areas where there is a need for affordable housing, where the land is owned by a trust, but leased to renters, owners, or occupants for a long period of time. In practice, this means to restrict the income of eligible buyers to about 60% of the area's median income. These properties are indistinguishable from other properties in the neighborhood, allowing residents to seamlessly integrate in the neighborhood at an affordable price.

Another big idea for the One Linden Plan is to connect the community to greater job access and employment opportunities. An important aspect to linking the community to employment is to ensure residents have educational opportunities and that they are properly trained for jobs at hand. Potential employees may face challenges with transportation to employment, which is where CMAX and other bus routes come in to connect disadvantaged populations to employment for an affordable price. Travel time to a workplace via bus transit in the Linden neighborhoods can reach from 20-45 minutes compared to a 15–20-minute commute by car. The city aims to expand high frequency transit options like CMAX to reach expanding economic and employment hubs via quick and reliable transit.

Reimagining Cleveland Avenue is a huge project that encompasses a large part of the One Linden community plan. With BRT running North to South on Cleveland Avenue, this is another method of rethinking transportation options to connect people to employment and to link communities, which is another focus of the One Linden Plan. An interview respondent, Marshall, who works as a transit program manager for COTA, said this about rethinking Cleveland Avenue as part of the One Linden Plan:

> "And it talks about, you know, looking at Cleveland Avenue to see if there's any road diets or streetscape items that can be enhanced for to create it, to be safer, and really bring back happiness to what it once was."

Road diets are prevalent on Cleveland Avenue; they are essentially a method of rethinking road space to act more efficiently for people that use it to get from place to place. Rethinking the road space in terms of road diets on Cleveland Avenue could involve taking away from street space to add amenities such as more space for public transit or biking and walking infrastructure. A road diet, or roadway reconfiguration, can improve public safety for street users, and provide better mobility and access for all road users, not just cars. Benefits of a road

diet may include lower accident rates, fewer lanes for pedestrians to cross, space for methods of multimodal transportation, calming traffic, and adding to a more community-focused, complete streets environment. CMAX is a direct method of reimagining these road diets by adding reliable and high-frequency bus transit. Apart from road diets, building high-density affordable housing along Cleveland Avenue, one of Linden's primary transit corridors, is an important piece to the puzzle of reimagining Cleveland Avenue. High-density housing will ensure that bus routes like CMAX have more riders that get from place to place, making good use of the BRT.

Cleveland Avenue connects the Linden communities with other parts of the city including downtown and the northern suburb of Westerville. An important piece of the One Linden Plan is to connect the communities, which is where CMAX comes in. CMAX acts to connect people that live in Linden to other parts of the city via fast and reliable public transportation, which is monumentally important because so many people that live in Linden rely on transit to get to their jobs.

Overall, the One Linden Plan is acting to restore the north and south Linden communities, which is needed because of historic disinvestment in those neighborhoods. People that live in Linden are largely of a low-income and working-class population. They need to be uplifted one way or another. The One Linden Plan is a way to do that. CMAX is but one finished part in the plan to revitalize Linden and help connect its residents to better employment opportunities and, generally, give them more options to explore Columbus's amenities. This brings us to our next section of investigating whether the CMAX BRT has stimulated success for residents along the Cleveland Avenue transit corridor, or if it has been a catalyst toward gentrification.

4.1.2 Has CMAX BRT caused green gentrification?

Now that we understand the background of CMAX, some of the neighborhoods it runs through, and their community revitalization plans, we can go into the primary research question around this paper. This question asks: Has the CMAX BRT caused green gentrification? Before we do that, however, it is important to explain why we are talking about green gentrification rather than gentrification. As we know from the literature we explored earlier in this paper, green gentrification is an urban phenomenon that occurs when "green" amenities are added to the city resulting in a spike in rent prices and property values, often pushing people out that belong to a lower-income demographic. Green amenities include things such as the addition of or revitalization of parks, the addition of trees and tree upkeep, infrastructure that lowers greenhouse gas emissions such as public transportation, revitalization of brownfield developments, and much more. Investing in green infrastructure can absolutely lead to luxury housing developments, displacing low-income residents.

In the case of the CMAX BRT, it falls under this green category of urban developments because one of its many goals is to lower street congestion by allowing people to take fast and reliable public transit rather than drive their cars. Getting cars off the streets lowers greenhouse gas emissions and certain chemicals released from cars that pollute the air such as PM 2.5 (Hernandez-Paniagua, 2023; Kim & Ewing, 2024). BRT contributes to alleviating street congestion, thus lowering human exposure to PM 2.5. Public transportation systems are designed to create sustainable modes of travel, making them green infrastructure, which could contribute to green gentrification. That is why we are talking about green gentrification rather than regular gentrification.

Backtracking to the primary research question of this paper, the answer lies in the several maps produced and interviews conducted for this study. The consensus from the maps and interviews is that the CMAX BRT route is not a catalyst toward green gentrification. To put it simply, there have been no significant luxury housing developments because of the construction of BRT on the Cleveland Avenue transit corridor. Private developers have not seen much opportunity for investing in the Linden neighborhoods, which CMAX runs through, resulting in a similar affordable housing stock that was seen before CMAX was implemented. It is also possible that the BRT route has not been active for enough time for gentrification to occur. It was completed in early 2018, so 7 years later we haven't seen many developments along Cleveland Avenue that would signify evidence of gentrification. It could be that gentrification might occur further down the line, especially as some aspects of the One Linden plan are implemented. According to Robin, an interview respondent who works as a neighborhood strategies manager for Linden and Hilltop:

> "I don't think it (CMAX) has been an important catalyst in regard to gentrification" and "I think that as Linden begins to grow and develop, I'm curious to see if it will be some economic gentrification, but I think that, I think we're a long way off from that."

This shows that an expert in the field of neighborhood planning and development hasn't seen any signs of gentrification because of the CMAX BRT. The respondent does add that there may be some room for economic gentrification further down the line because of strategies that will be implemented from the One Linden plan. The important takeaway here is that CMAX has not yet been a catalyst toward gentrification, (see maps 7, 8, and 9 later in this section). Other interview respondents' answers to the question relating CMAX to possible gentrification suggest that there is no connection between the two.

Barney, an interview respondent, goes into some of the aspects of why people may not be moving into the Linden neighborhoods because of the implementation of CMAX.

> "I think one thing is like, some of the crime does deter people still from moving into the neighborhood, and just the lack of like, higher quality, higher income housing might contribute to people still not wanting to really move into the neighborhoods."

This shows that certain aspects of crime and safety deter people from moving into the Linden neighborhoods. CMAX is not enough to make people want to move into the neighborhoods. If an influx of people were to move into Linden, then we may see corporations and developers trying to invest in higher income housing for the neighborhoods, but we have seen no evidence of that. Another interview respondent, Marshall, explains that he believes there is no evidence of gentrification in Linden due to CMAX and he also goes into how affordable housing developments along the Cleveland Avenue transit corridor might be aiding in preventing gentrification from happening:

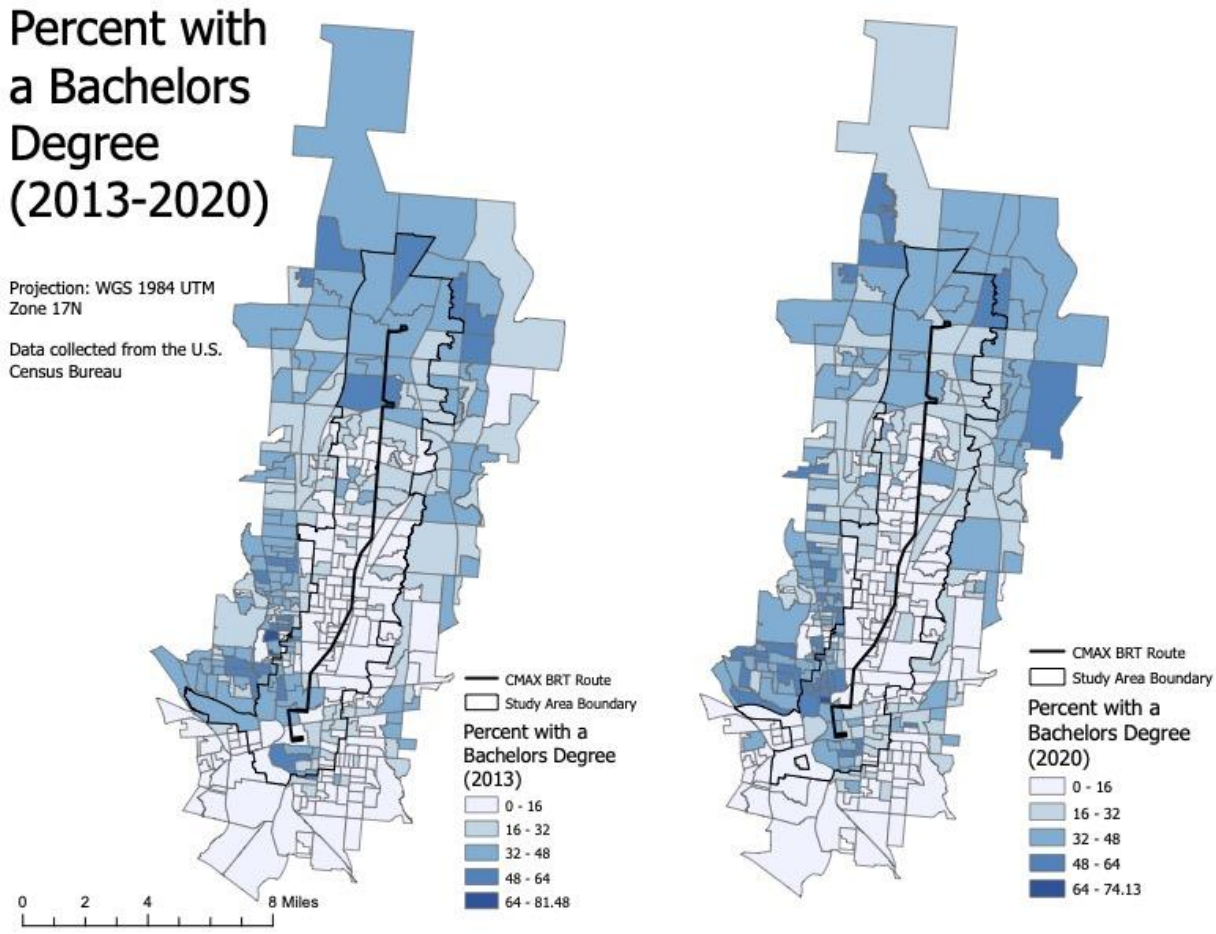
> "Gentrification, I'm not aware of any gentrification happening along the corridor, Cleveland Avenue corridor. I know there's been some developments, some affordable housing projects being built. It's been pretty few and in between, at least along the corridor. Most of those developments have been built on vacant land. To my knowledge, any displacement that happened is minimal essence."

This expert, who works as a transportation program manager at COTA, shows that they don't believe there has been anything to corroborate green gentrification occurring because of CMAX. There have even been affordable housing projects trying to combat possible gentrification along the Cleveland Avenue transit corridor.

The maps I produced for this study confirm what was said by the interview respondents, that there hasn't really been any evidence of a gentrification-induced population shift. Apart from the racial population change maps, these next maps go into parameters related to gentrification such as education, income, and housing value. If gentrification had occurred, we

would expect that all these statistics of education, income, and housing values would rise in the areas along Cleveland Avenue, where CMAX runs. The percentage of residents with a bachelor's degree in the corridor would rise, showing that residents with a higher degree of education might contribute to gentrification. Higher education levels would be attributed to higher incomes and more expensive housing, which is not corroborated in the maps (see maps 6, 7, and 8).

Map 7: Change in percentage of the population with a bachelor's degree along the CMAX BRT corridor

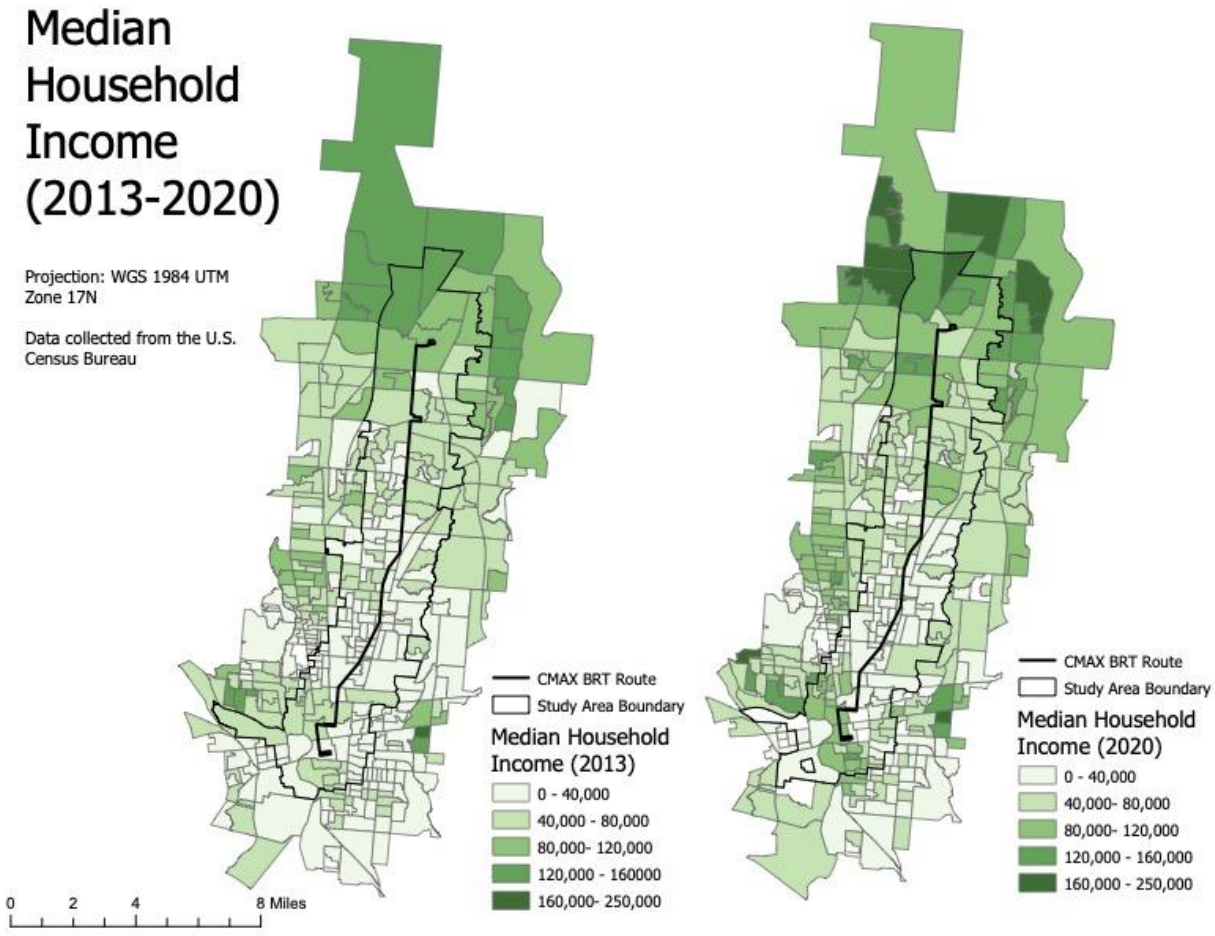


The maps showing the change in the percentage of the population with a bachelor's degree or higher show no significant changes over the course of seven years. As we know, the CMAX BRT was completed and started running early in the year of 2018. Shown above, these maps only go to the year 2020 because that was the most recent year that data was available. Only two years since the implementation of CMAX is not quite enough time to show if gentrification has occurred, which produces gaps in the data the maps represent. That is why I chose to supplement these maps with data from semi-structured interviews, so interview respondents' knowledge could fill some of the gaps in knowledge that the maps cannot answer.

Looking at educational attainment can be an important factor to see whether gentrification is present.

If we were to see significant increases in the percentage of people with a bachelor's degree or higher along the Cleveland Avenue transit corridor, that would signify higher-educated people have moved into the neighborhoods in which CMAX runs through. These people would likely make more money than the preceding population, sparking a need for higher income housing, which would displace current residents. As we can see in the maps, there is no significant change in the level of education attainment of residents along the CMAX BRT corridor over a seven-year span. Of course, there are some census block groups that show a change in educational attainment in the time represented by the maps. The maps show a higher percentage of the population with a bachelor's degree in the downtown area and the northern suburb of Westerville (census block groups at the top of the maps), with a lower educational attainment in the neighborhoods in between the two areas. Over the course of seven years, there haven't been enough changes in educational attainment status that show any evidence of green gentrification because of the implementation of the CMAX BRT.

Map 8: Change in median household income along the CMAX BRT corridor



Supplementing semi-structured interviews as well as the other maps are the maps showing median household income. There are more significant changes present in these maps compared to the educational attainment maps. Specifically, there are some census block groups in the downtown area as well as the northern Westerville area, signifying that there may have been higher income individuals moving to those areas in the span from 2013 to 2020. There are also a few census block groups that show a rise in median household income along some neighborhoods where CMAX runs through. These census block groups are in the Milo-Grogan and Linden neighborhoods. Can this be directly attributed to the implementation of CMAX? That is a question that produces a gap in the research of what the maps show, which is addressed by

interview respondents' answers. An interview respondent, Robin, said this when asked about how to measure the potential for gentrification along the CMAX transit corridor:

> "Probably will have to do with the average area, median income, where it is when, before the BRT is built, and then, whereas, after it's built"

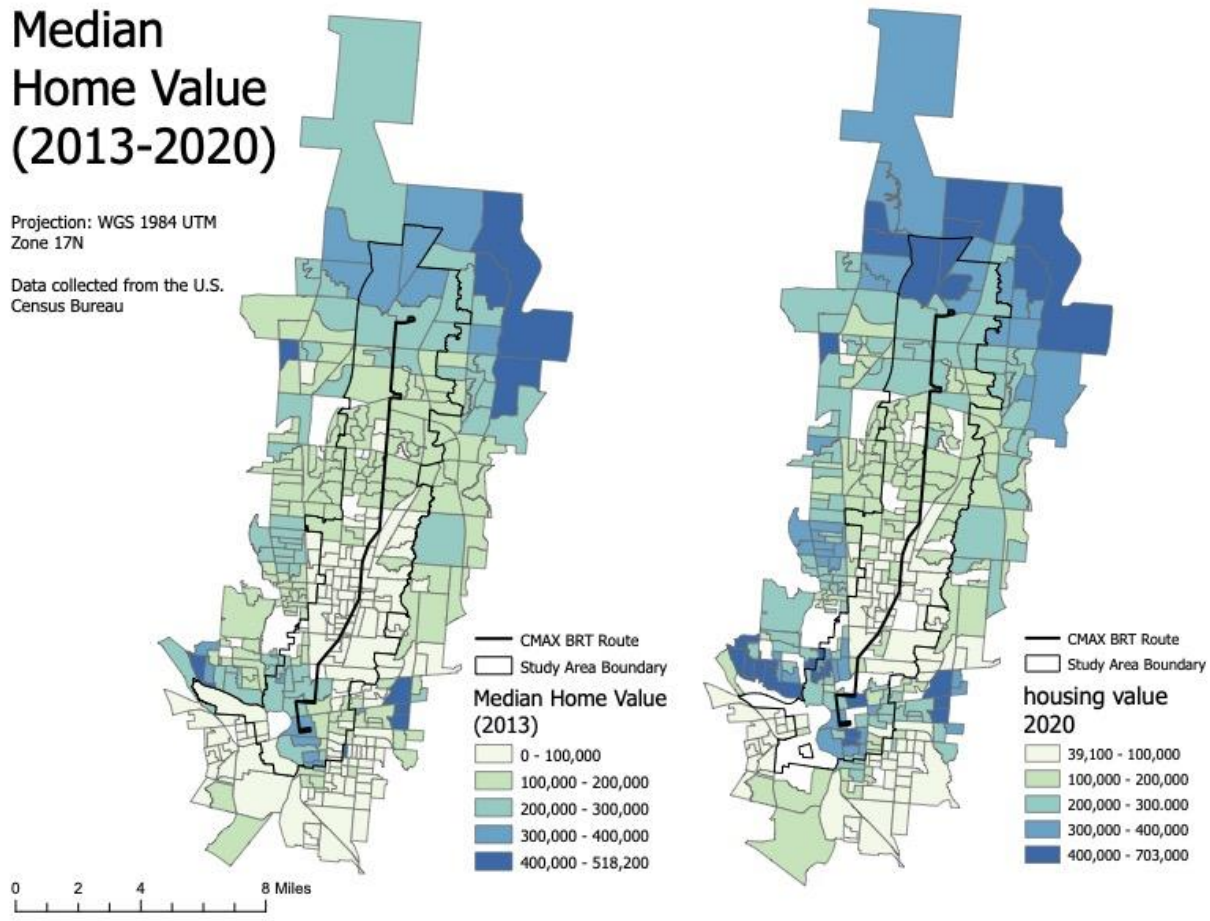
This measurement of the income statistic can be a major component to show evidence of gentrification. The problem here is with what the maps show. Although there are some increases in median household income along the CMAX corridor, these are shown in places that already had a relatively high income in 2013. The poorer neighborhoods along the transit corridor haven't seen a significant rise in income because of the implementation of CMAX.

According to another interview respondent, Marshall, who works as a transit program manager for COTA, there is a reason we see such a high ridership along the CMAX transit corridor and how it connects to low-income populations:

> "Looking at Columbus, there are a lot of the areas along Cleveland Avenue where you've had high ridership because there's zero car households and low-income populations. So, talk about the 70% ridership."

This quote tells us that the low-income populations along Cleveland Avenue persist to this day. These residents are shown to have a higher percentage of zero car households, creating a need to ride the transit provided to them. Conducting interviews proved to confirm what the median household income maps show, which is that there is no evidence of green gentrification related to changes in income along the Cleveland Avenue transit corridor because of CMAX. Maps showing median home values verify what the income maps show.

Map 9: Change in median home values along the CMAX BRT corridor



The maps above, showing median home values along the CMAX BRT corridor, don't show significant changes over the span of years ranging from 2013 to 2020. The Linden neighborhoods are encompassed by relatively low-income housing, while the downtown and Westerville areas are shown to have higher income housing. There have been some increases in median housing values downtown and in Westerville, which can't be directly attributed to CMAX. Rather, these changes are likely due to the rise in housing costs we have seen more recently. People want to live downtown to have better access to jobs and the economic hubs that downtowns produce. Just outside of downtown are the neighborhoods of Milo-Grogan and North and South Linden, which show relatively low housing costs in both 2013 and 2020. Since

CMAX isn't true BRT, it makes sense that we haven't seen an influx of higher income individuals moving to the areas in which it runs through because it is not as attractive as other potential transit options such as true BRT, light rail, or a subway system. It boils down to people staying where they already are, where low-income individuals ride the transit because they must, and high-income individuals use their cars because they can.

Generally, semi-structured interviews and the maps I produced showing variables related to gentrification told me that the CMAX BRT route has not been a catalyst toward green gentrification. Rather, the bus route has been a method to serve people that rely on it. It expands job access north to south, while allowing residents who ride it to have better means of entry to other parts of the city by connecting previously disconnected neighborhoods. There are many measures the city of Columbus has taken to ensure that residents who rely on BRT aren't pushed out due to further economic development along the Cleveland Avenue corridor. These will be explored in the next subsection. In the end, CMAX has not spurred any major housing or business developments along its corridor that would spark green gentrification and raise property values, displacing people who can no longer afford to live there. Housing values have remained relatively the same, allowing residents to stay where they are, continuing to use CMAX to get around every day.

4.1.3 Goals of CMAX and how Columbus is mitigating gentrification before it happens

CMAX is bus rapid transit route that has many goals of fostering community growth along its corridor. The most prominent goal of CMAX, brought up in interviews, was to expand job access north to south in the city of Columbus. Bus rapid transit is an exceptionally fast and reliable way to get people from their home to their job and then back home. Another huge goal of CMAX was to connect disadvantaged communities to other parts of the city via transit. An interview respondent, Robin, who works as a neighborhood strategies manager in the Linden and Hilltop communities, said:

> "I would say I think the dream would be to connect the communities right from north to south, because that's pretty much how Cleveland Avenue runs, I think, that, you know, and also to connect people to jobs."

This quote indicates that the city was trying to connect people to better job access throughout the city. Especially those that belong to zero car households and rely on public transportation to get around. Another interview respondent, Barney, who works as a management analyst for Columbus's department of neighborhoods, said:

> "I would say probably is to try and connect disadvantage communities and, like, try to connect them more to the city, and just try to get them more opportunities and everything like that, easier transit and stuff like that."

Adding to the evidence from interviews that urban planners working around neighborhoods that CMAX runs through, they believe the BRT route's aim is to connect disadvantaged populations to other parts of the city, thus expanding job access.

Before CMAX, residents might have had to take several different buses to get to where they need to go. Residents would take one bus to get part way before hopping on another bus or two to get to their destination. Moving around the city as such proved to be an inefficient way to travel. CMAX has made it easier to get to other neighborhoods and parts of the city, at least for

residents living along Cleveland Avenue. An interview respondent, Marshall, said this about the goals of CMAX:

> "really being higher quality service to one of our highest ridership corridors. That's like number one, you know, trying to make the service better" and "how can we get a direct route? Because I think before we had, like, people taking two or three different buses. You have to transfer a bunch of times, but we looked at having a direct connection"

Cleveland Avenue indeed sees a high ridership. This is why it was important for the city to build a faster direct route for people moving north to south along the transit corridor which was only possible through bus rapid transit. Now that we have investigated the intention of the city of Columbus for implementing CMAX, it is important to look into how the city is employing community plans such as Zone In Columbus and the equitable transit-oriented development (eTOD) action plan, which were brought up by interviewees as methods of combatting gentrification before it happens.

Zone in Columbus is a rezoning initiative that officially passed on July 29, 2024. Through this plan, the city council enacted a new zoning code that will act to densify Columbus's primary transit corridors to respond to the rapidly growing population. Although the zoning projects will come along with many new developments, the city aims to do this in an equitable way that ensures affordable housing for residents that need it. An interview respondent, Barney, said this:

> "It was called the Zone in Columbus initiative. So that just passed, I think, in August. So with that, they are able to build higher along these main corridors. So they focus on the main corridors in Columbus. So like West Broad, Cleveland Ave, Main Street."

According to the Zone in ArcGIS Online hub, under the new zoning code, developers can build up to ten stories high in regional activity center districts, raising the previous building height limit by up to 3 stories. This change is if developers devote 20 percent of new housing to low-income groups, creating affordable housing in otherwise expensive areas. This will ensure that

marginalized residents aren't pushed out because of new developments along transit corridors. With CMAX being one of the highest ridership transit corridors, it is important that these zoning policies are in place, so new developments to increase density don't push people out as previously underfunded neighborhoods become more attractive places to live.

Phase 1 of the new zoning project is to build more mixed-use and denser districts. Density will bring more people in, and with these new residents, there will be a greater need to ride transit to get around. Mixed-use districts will also bring people in to reside and spend money in these places that are most easily accessible by transit. An interview respondent, Robin, said this about Zone in:

> "So we had a big zoning initiative, which is, which is the first part of zoning in Columbus. And so major corridors like West Broad Street or Cleveland Avenue allow for, you know, five story type housing types, which you know, hopefully will also have some sort of affordable housing component, where it could be a mixed income community" and "affordable housing developers are definitely taking advantage of the new zoning that's going on in these major corridors."

Developers are trying to take the opportunity that Zone in has provided by building higher along Columbus's main transit corridors. Although new developments due to Zone in may sound like a potential roadmap for gentrification, the city is trying to make sure these developments include plenty of affordable housing as to not push out current residents. According to the Zone in ArcGIS Online story map, it states "housing providers could potentially build a 10-story building three stories taller than the base zoning allowance—by pledging 20% of the units to income-qualified tenants." The story map eludes that developers who contribute 20% of units to affordable housing will receive tax credits, adding to the incentive of providing affordable housing. With these new developments come more affordable housing, ensuring that people aren't displaced due to rising rent prices and gentrification. Zone in has and will continue to configure mixed income communities.

There are five goals to the Zone in Columbus initiative. According to the Zone in Columbus ArcGIS Online story map they are as follows: 1) to modernize the zoning code to reflect Columbus community's current and future values, needs and aspirations, 2) support growth that prioritizes economic and environmental sustainability through improved transit, additional housing opportunities, and the creation of job centers, 3) to encourage thoughtful investment in neighborhoods that have experienced racial and economic segregation and help undo the harm caused by past urban development policies, 4) guide the design and development of main streets, neighborhoods, and activity centers to support community goals while celebrating the unique character of our neighborhoods and creating a sense of place for residents, and 5) to ensure the Columbus zoning code is fair, understandable, and accessible. All these factors to Zone in Columbus aim to foster growth in Columbus's main communities, along their primary transit corridors. On Cleveland Avenue, CMAX falls into this category. According to the Zone in story map, any new housing developments along Cleveland Avenue will have to have 20 percent of housing designated as affordable housing, ensuring that rent stays at an accessible rate as to not displace current residents. New housing developments, due to the height limit increase, will provide space to accompany new residents and Columbus's rising population, while securing plenty of affordable housing for low-income residents.

Working hand in hand with the Zone in Columbus rezoning initiative is the equitable transit-oriented development (eTOD) action plan. According to the LinkUS community plan, this plan examines best practices from around the country, looking at how Columbus can grow in an equitable way along its primary transit corridors, including CMAX, along Cleveland Avenue. The eTOD action plan ensures that residents who have been harmed by previous disinvestment and racial segregation are helped by new developments moving forward. Strategies such as Zone

in are in place to preserve and expand affordable housing and to protect tenants from rising housing costs. CMAX acts as part of the eTOD action plan to connect residents to better job access as well as providing entrance to other parts of the city and amenities that Columbus holds.

There are three parts to the eTOD action plan that pertain directly to preventing gentrification along Columbus's main transit corridors including CMAX and Cleveland Avenue. The parts are to preserve existing housing affordability, preserve existing jobs and businesses, and to preserve valued community resources and amenities. The city is acting to preserve amenities along primary transit corridors as well as making sure new developments are brought in in a way that is equitable for everyone. An interview respondent, Marshall, believes the eTOD plan is a way to bring affordable housing to transit corridors in Columbus:

> "it really looks at best practices from around the country, of, how can we prevent displacement from people living there, and how can we add, you know, affordable housing units to these areas."

Part of this plan that works in part with Zone in is to make sure that a set number of units in new housing developments is set aside for affordable housing for low-income individuals. This will only add to the affordable housing already present along high ridership transit corridors. Another interview respondent, Ted, said this about new developments based on the eTOD action plan:

> "how can we as a city, as a region, help not only kind of fortify housing in some of the corridors, but also, what tool kit can we put in place so that a minority developer, construction company or management company can be a part of that process and also profit from its success."

By allowing minority developers to come in and build new housing, we can ensure that larger developer companies don't take advantage of the people who already live in some of these transit corridors. The goal of the eTOD action plan is to help existing residents remain where they are, while enjoying the amenities of things like public transportation and where it can bring you.

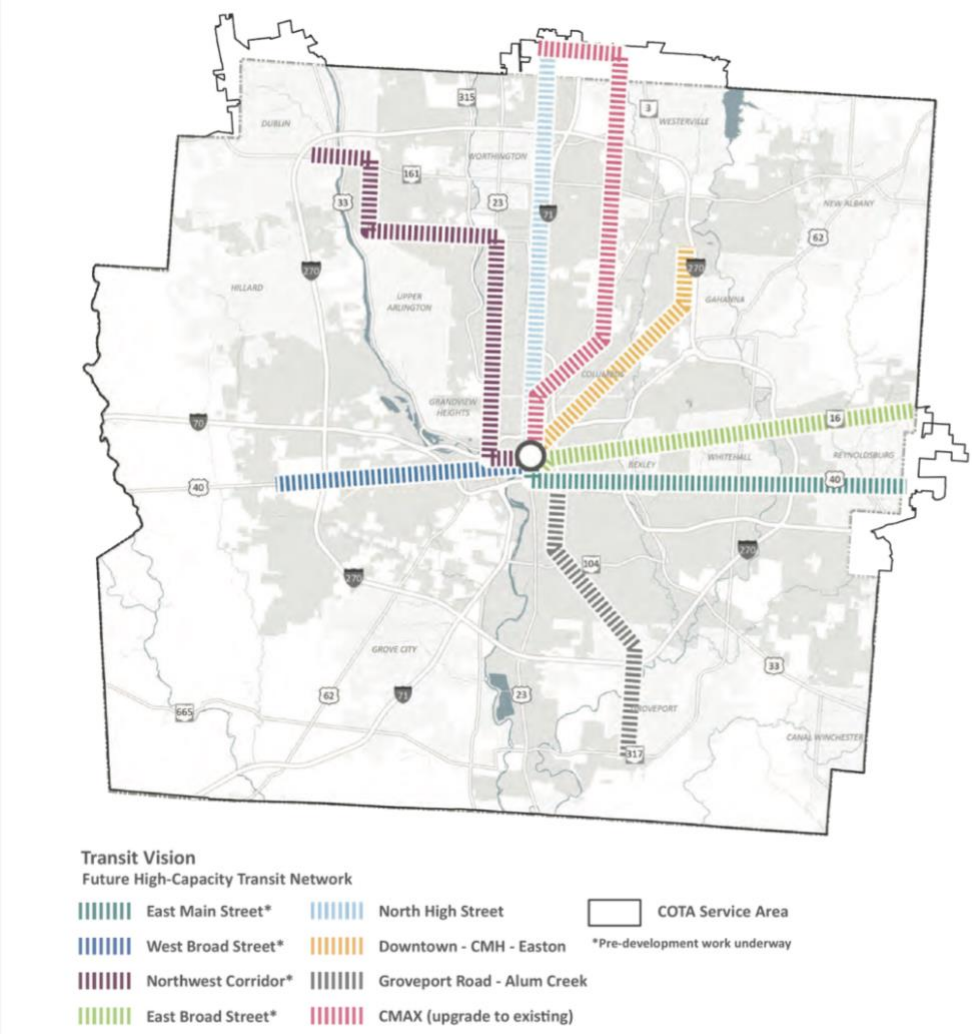
Zone in Columbus and the eTOD action plan work together to bring affordable housing to Columbus's primary transit corridors. These plans help aid the overall goal of CMAX, which is to expand job opportunities, north to south, for low-income individuals who depend on CMAX to get around the city. With equitable growth and development, the city can ensure that people aren't displaced because of transit projects that make certain neighborhoods more attractive places to live for higher income people. Zone in is acting to create denser, mixed income communities, while eTOD aims to keep existing residents where they are, preventing gentrification-induced displacement from ever happening.

4.1.4 The LinkUS initiative

As mentioned in previous sections, LinkUS is an initiative launched by the city of Columbus to improve the city's connectivity via public transportation and bike and walkability infrastructure. LinkUS aims to establish three new BRT routes along Columbus's busiest transit corridors. The routes are planned along East and West Broad St., East Main St., and through the Northwest corridor. Broad St. BRT will connect the city from east to west, Main St. will further expand rapid transit from downtown to the eastern suburb of Reynoldsburg, and the Northwest corridor will connect downtown Columbus to the suburb of Dublin (seen in map 10). The three routes mentioned above will be bus rapid transit while the others shown on the map are planned to be high frequency and capacity bus routes. An interview respondent, Lily, who works as a neighborhood planner for the Linden communities, suggested that the planned BRT routes will be true BRT, differing from CMAX, which is BRT light. True BRT contains fully dedicated bus lanes, traffic signal priority, centralized stops to make on and offloading easier, off board fare

collection for quicker loading, enhanced and modernized bus and station branding, and higher frequency and capacity.

Map 10: Planned rapid transit routes as shown in the LinkUS community plan



Planning for the construction of true BRT will be more expensive than it was to build CMAX because of all these added amenities. To fund this project, city officials placed a sales tax levy on the 2024 November ballot, raising the city sales tax from 7.5% to 8%. This simple increase will generate millions of dollars in funds for the city to take advantage of and dedicate

to COTA to build these planned BRT routes, exponentially improving neighborhood connectivity via public transit networks.

Backtracking to where the routes will run, they are planned along some of Columbus's highest ridership corridors. The goal of COTA and LinkUS is to serve populations that depend on mass transit. An interview respondent, Ted, who works as a transportation planning manager, said that the West Broad and East Main corridors are meant to serve populations that live in persistent poverty and/or rely heavily on mass transit because they live in a zero-car household. According to Ted, the third BRT route, connecting downtown to the northwest corridor, links people to around 30% of the jobs in that corridor. The route runs by Nationwide, Granby Yard, The Ohio State University, and eventually Dublin. These four areas are economic hubs and hold a ton of jobs, showing that the Northwest BRT aims to connect people to jobs. Ted says that the northwest BRT corridor aims to spur more redevelopment along a largely underutilized corridor.

Differing from BRT light, true BRT holds a lot more potential for gentrification to occur after the development of BRT. True BRT is simply more attractive for a higher-income population to move towards because it holds many added amenities that BRT light, such as CMAX, lacks. This higher-income population will want to have more transit options rather than just using a car most of the time. True BRT may prove to be faster than using a car. Drawing in a more affluent population means that rent and housing prices could increase, displacing low-income and working-class individuals who rely more heavily on the BRT. That is where plans such as Zone in and the eTOD action plan come in to prevent this displacement from happening. The goals of Columbus through these plans are to induce more equitable growth, where people of all incomes and classes can access the transit amenities that the city plans to implement. Zone in will act to increase density along transit corridors, providing enough housing for the city's

growing population. This added density and housing will prove to be essential as people begin to move toward LinkUS BRT. The eTOD action plan will ensure that enough housing added through zone in is set aside to be affordable, so low-income individuals can remain where they are without being displaced. Even though there is more potential for development along transit corridors where BRT will be added than there is around CMAX, the city is fighting to ensure that this doesn't happen.

4.2 Is CMAX Bus Rapid Transit (BRT) a 'Just Green Enough' Urban Tactic?

Green, or ecological gentrification is a process that adds green spaces or practices to a city, which usually results in contributing to increased rent and housing prices (Quastel 2013). Urban greening is a practice that involves increasing or preserving green spaces, like parks or gardens, within urban areas to improve the environment and enhance the quality of life for residents. When green spaces or initiatives are added to low-income and working-class neighborhoods, it raises the rent because they make these places more attractive for higher income individuals to move near. It undermines public and affordable housing options by replacing them with more expensive housing. Green gentrification can occur when amenities such as parks or park revitalization, community gardens, greenways, or climate resilient infrastructure such as public transportation are added to the city. These processes usually induce gentrification by spiking property values and rent prices near where greening initiatives occur. A study by Anguelovski & Connolly (2024), mentioned in this paper's literature review, suggests that it is simple, people want to live in greener areas of the city, and they are willing to pay more money to live in these places. Greening processes and initiatives can displace lower-income individuals, thus causing green gentrification.

The just green enough theory is an urban greening tactic that acts to prevent effects of gentrification-induced displacement while still greening urban areas; this idea was coined in a paper titled “Just Green Enough: Contesting Environmental Gentrification in Greenpoint, Brooklyn” by Curran & Hamilton (2012). This theory claims planners can instill greening processes that aren’t as monumental as adding things such as large, luxury parks. It is now an urban strategy to ensure that gentrification does not follow urban greening. The just green enough theory calls for the need to stray away from producing green infrastructural projects that only select populations can enjoy, and to move towards greening smaller, more sporadic areas that work cohesively to make the city a more sustainable and greener place to live for all folks. Smaller greening practices that might fall under the just green enough category that won’t instill gentrification might be greening alleyways, abandoned rail corridors, streets, remediation of brownfields, and producing and cleaning up smaller parks, as mentioned in a paper by Reed-Thryselius (2023). All these greening methods can act as sustainable rejuvenation strategies that a city can employ without causing green gentrification.

As mentioned before, the idea of an urban area being ‘just green enough’ is presented by Curran & Hamilton (2012), in their article involving a case study in Brooklyn, New York. They coin ‘’just green enough’ to be an urban environmental remediation strategy without environmental gentrification effects. The issue here, however, is that ecological gentrification is almost inevitable, and extreme measures must be taken by the city government, planners, developers, and most importantly, its residents, if green gentrifications efforts are to be halted, according to Curran & Hamilton (2012).

In a later article, Wolch et al. (2014) presents the purposeful theory of being ‘just green enough’ so that gentrification and displacement effects do not occur. This paper calls for the

greening of unused urban land, as well as the reuse of underutilized public transportation outlets. We have a desperate need for further analysis of underutilized urban land in the wake of green gentrification, so we can prevent its detrimental outcomes taking part on already marginalized populations. Urban areas need a more intense GIS analysis coupled with communication with various and diverse stakeholders. Apart from that, we need to employ vast community outreach tactics so low-income populations residing where greening occurs have a better understanding of the magnitude of the situation in which they are to play a crucial role, Wolch et al. (2014).

In addition to Wolch's findings, another article by Reed-Thryselius (2022) brings up the ideas of direct and indirect displacement as being fundamental aspects of green gentrification that are of vital importance to understanding the unequal outcome of environmental displacement. Direct displacement involves increased taxes or rent as the result of redevelopment, whole indirect displacement involves reduced feelings of social cohesion and a sense of belonging due to the influx of a more affluent population moving in, Reed-Thryselius (2022). Understanding how ecological or environmental displacement differently affects low-income communities is essential to preventing it and how to employ the 'just green enough' theory.

Reed-Thryselius (2022) calls for the need of ecological revitalization to be just green enough by adding informal green spaces (IGS) into the city, which act to aid in urban environmental remediation while not completely contributing to increased rent and property values, making them a 'just green enough' urban tactic. As mentioned before, IGS includes the greening of rail corridors, back alleyways, streets, utility corridors, waterways, and the remediation of brownfields. IGS can also include the sporadic placement of smaller parks around the city. In this paper, these tactics are proven to be less subject to green gentrification following

development. These areas of urban environmental remediation are less desirable for non-residents to move in, resulting in a greater benefit for people who already live there. IGS contributes to a better quality of life without causing displacement of the existing residents who can enjoy these green spaces, according to Reed-Thryselius (2022).

These points on the 'just green enough' theory raise the question: can certain modes of public transportation, including CMAX BRT, be considered a just green enough strategy? First, we must ask, is BRT a greening practice? In a sense, yes, it is. Bus rapid transit is a way to get cars off the street and to reduce roadway congestion. Congestion from cars causes harmful particles to enter the air, and they can be damaging to people who breathe them in. CMAX acts to "green" the Cleveland Avenue transit corridor by reducing the number of cars that are on the street, which produce greenhouse gas emissions. BRT acts to increase public transportation use because it is a viable option to move around the city as compared to people using private vehicles. BRT encourages more people to use public transport, which decreases reliance on personal cars, leading to lower traffic congestion and emissions. BRT also promotes land use efficiency by ensuing higher density developments along transit corridors which can help to reduce urban sprawl and increase the amount of people that chose to ride transit over using their cars. BRT promoting land use efficiency and higher density can be seen with CMAX, through policies such as Zone in, which aims to build denser developments along Columbus's main transit corridors. BRT also supports integration of non-motorized transport by working hand in hand with walking or biking. CMAX was designed to complement walking and cycling infrastructure through redesigning of streets to add multimodal transportation methods that further decreases car dependency. Overall, there are many ways BRT can cause a greening effect by promoting different ways of transportation that do not emit as much greenhouse gas.

Now that we know that BRT can be a method of urban greening, we need to ask the question: are CMAX and other BRT routes considered to be a 'just green enough' strategy? If CMAX were just green enough, it would mean that it causes environmental benefit without inducing green gentrification. We know that CMAX has acted to green the Cleveland Avenue transit corridor by encouraging more public transportation use and reducing the number of cars that are on the street, which cause congestion and emissions. From previous sections exploring interviews conducted and maps produced that show change in parameters related to gentrification, we know that CMAX has not caused gentrification along Cleveland Avenue. Interview respondents that are experts in the fields of neighborhood development and public transportation say that CMAX has not caused gentrification and that there is no evidence of gentrification along Cleveland Avenue. Maps produced exploring parameters such as change in income, education, home values, and racial demographics suggest that there has been no significant change in these categories that would signify gentrification is taking place. This would mean that CMAX has induced environmental benefit without causing gentrification, which would make it just green enough in this case. Although CMAX is just green enough, this doesn't mean that all bus rapid transit projects are too, especially since CMAX is BRT light, not true BRT. True BRT routes may have more potential for green gentrification to occur following their development, as explored in past sections of this paper.

The LinkUs initiative has called for and supplied funding for three new bus rapid transit routes around the city of Columbus. BRT routes, through the LinkUs initiative, will be on East and West Broad St., East Main St., and through the Northwest corridor (as seen on map 10 on page 87). These BRT routes will be true BRT, with dedicated bus lanes, traffic signal priority at intersections, and median aligned bus stops for easier offloading and onloading. Aspects which

make these bus routes true BRT also make the transit corridors where BRT will be constructed more attractive places to live. LinkUs is supplying functional and efficient modes of public transportation that could result in more people moving into the areas where BRT is installed, potentially increasing the chances for gentrification to occur as explored in past sections of this paper. Since there is potential for gentrification following the construction of LinkUs BRT, this could mean that these bus routes will not fall under the just green enough category. Although CMAX is just green enough according to this study's results, it does not mean that future BRT routes in the city of Columbus will be just green enough. There is no way to tell if LinkUs BRT routes will cause green gentrification because they haven't been built yet. Once they are built and implemented, then more studies like this one can be produced to help paint a picture on whether these true BRT routes will cause green gentrification or if they will fall under the just green enough category. That being said, Columbus is doing a lot to ensure gentrification will not follow transit projects such as the rezoning initiative called zone in and the ETOD action plan.

V. Conclusion

Bus rapid transit has emerged as a new method of public transportation that reliably moves people around a city from place to place. It is a cheaper alternative to light rail, and in most cases, it works just as efficiently. Being less costly, it has become an entrancing idea for cities to implement into their public transportation networks. In the case of Columbus, Ohio, BRT has been a way for the city to expand their bus system through the Central Ohio Transit Authority (COTA). Columbus has faced the need to evolve their transportation system in the wake of an ever-increasing population. The city's current bus network and roadway capacity is not enough to support the rising amount of people that are moving to the city, so BRT has emerged as a viable option to make public transportation easier to navigate for Columbus residents.

Columbus is using BRT as a way to get cars off the street and to reduce roadway congestion that only grows with the population. CMAX, on Cleveland Avenue, is the city's first BRT route. It runs north to south connecting downtown Columbus to the northern suburb of Westerville. CMAX has almost acted as a test run to see how well BRT will work for the city. BRT has worked overwhelmingly well for the city, providing faster and more reliable service times to residents who use one of the highest ridership corridors, which is Cleveland Avenue. The benefits of CMAX are well articulated on COTA's website which says: 1) it limited stops that facilitate faster service, 2) it has some dedicated lanes during rush hours, 3) it contains traffic signal priority on parts of the route, 4) there are CMAX-branded stations and buses that make the route stand out as BRT, 5) CMAX contains the Northland transit center about halfway through the route which connects it to other notable bus routes in the city, and 6) bus stops contain LCD powered screens that display real time next vehicle arrival information, so users know how long

they have to wait for a bus. The most notable beneficial outcomes of CMAX are that it links nearly 400,000 residents and workers living around Cleveland Avenue from downtown to the northern suburb of Westerville in a faster and more reliable fashion. CMAX connects minority and low-income residents to the many amenities that Cleveland Avenue holds, such as educational centers and resources such as Columbus State Community College, healthcare centers, and access to a vast array of jobs. According to studies employed by the city of Columbus and COTA, CMAX is projected for a 21% reduction in travel time for Cleveland Avenue transit riders, as well as a projected 15-20% increase in ridership in the first 5 years of implementation. Overall, CMAX is contributing to increased opportunities for local investment and an improved quality of life for minority and low-income residents living along Cleveland Avenue.

The success of CMAX has sparked the LinkUs initiative to construct three new BRT routes that will further expand access to other parts of the city and its amenities. Questions arise around the current success of CMAX, and the hopeful success of LinkUs, asking whether these routes were created to serve current residents or if they are acting to spur redevelopment in the form of gentrification and rising property values. We should be most concerned about the displacement of poor and working-class residents because of potential redevelopment and further gentrification.

The questions this paper seeks to answer are 1) Has the Cleveland Avenue Bus Rapid Transit (BRT) route in Columbus, Ohio, influenced variables associated with green gentrification and, how can planned BRT routes in other parts of the city avoid this problem? and 2) is BRT is a “just green enough” urban tactic? To answer these questions, I employed a set of qualitative mixed methodologies in the form of conducting five semi-structured interviews and using

geographic information systems (GIS), a mapping software, to create a series of maps investigating changes in parameters related to gentrification. In interviews, I asked a series of questions to city and neighborhood planners, and transit authority workers to try and uncover any evidence of gentrification along Cleveland Avenue since the completion of CMAX. Maps seek to find evidence of gentrification along Cleveland Avenue by investigating changes in parameters such as income, educational attainment, housing values, and racial demographics before and after the completion of CMAX.

Mixed methods produced clear answers around if there has been gentrification on Cleveland Avenue following CMAX, how the city of Columbus has employed plans to combat potential gentrification and poorly planned redevelopment following LinkUs transit projects, and if BRT can act as a 'just green enough' urban tactic to prevent green gentrification. The overall consensus from interviews conducted and maps produced was that there is no connection between CMAX and green gentrification because there have been no major developments along Cleveland Avenue since the completion of CMAX. There were no significant changes present in the maps that would signify any evidence of rising housing values and changes in economic and racial demographics as attributed to CMAX BRT. Semi-structured interviews brought up several key methods the city of Columbus has implemented to prevent major gentrification from happening following the development of new transit projects through the LinkUs initiative. Zone in Columbus is a rezoning initiative that aims to densify neighborhoods along the city's key transit corridors, including the LinkUs BRT projects. The equitable transit-oriented development (eTOD) action plan aims to provide enough affordable housing along primary transit corridors so as to not displace people that already live there. Although these policies may come with new developments, mixed-use corridors, and densification, the city is trying to ensure these

developments do not cause gentrification-induced displacement. Columbus officials want to ensure people can remain where they are and where they want to be following major public transportation projects, so people that rely on transportation to get around can continue to use it. Apart from that, I believe this study has proven that CMAX is 'just green enough' because it has acted to reduce roadway congestion and emissions without causing gentrification to occur. Despite this, it does not mean that all BRT projects are 'just green enough'. I recommend that more studies, like this one, be produced around the world to investigate whether bus rapid transit projects have induced gentrification following their development. Only then can we get a clearer answer on if BRT can be a viable option for cities to expand their transportation networks without causing gentrification.

The implications of this study are but one example of how a BRT route can affect a city. Current literature shows that BRT routes can have lasting effects on a city by not only improving a population's quality of life on how they move around a city, but also how BRT might induce further redevelopment leading to potential gentrification. However, the BRT route I investigated, CMAX, has not induced gentrification of any kind. Going into a key aspect of what this study aims to investigate, if BRT is a just green enough urban tactic, I found that CMAX is indeed just green enough. This is significant in the realm of green gentrification research because it proves that at least one example of BRT can be considered just green enough, not inducing green gentrification following its completion. Researchers and urban planners could read this study and further investigate CMAX and how Columbus went about its implementation, so they can understand a possible method of carrying out BRT projects in a way that does not induce green gentrification.

Although this study is significant in its implications for the field of green gentrification literature, it does possess some limitations. Most notably, this research project investigated potential gentrification following the completion of CMAX in 2018. With it now being 2025 at the time of this study's conclusion, there hasn't been quite enough time to see possible effects of gentrification because of this BRT route. Had this study been carried out at a longer term, then we might have seen some real signs of gentrification following the implementation of CMAX. It is recommended that city officials and researchers continue to monitor economic development around the Cleveland Avenue transit corridor to see if it is contributing to rising property values or displacing people because of gentrification. Other limitations in this study are present in the maps, especially the time of data collection from the US Census Bureau. Data present in the maps are in the years 2013 and 2020 and the maps do not show significant changes in variables between those time periods. It is possible that more relevant changes could be present in more up-to-date data. If similar maps could be produced when newer data is released, there is a greater chance that more significant changes could be present. Limitations were also present in the limited time span I had to produce this study. Had I had more time, I could have interviewed more than five experts, only adding to the knowledge they possess and to the data explored in this study. I could have also produced more maps showing different parameters related to gentrification apart from what I showed.

Limitations in this study directly pertain to suggestions I need to make on future research directions that could be taken as a result of this study. It is highly recommended that this study be produced in a longer term, collecting more up-to-date data and information that can paint a clearer picture surrounding the CMAX BRT route. It is also suggested that studies like this one be produced when the LinkUs BRT projects are completed. Since they will be true BRT, there is

the enhanced possibility that gentrification could occur, adding to the need to see if plans that Columbus is employing are succeeding in preventing gentrification following new development. Future research directions that could be taken to investigate if BRT can induce gentrification could use a similar style multi-methods approach by combining semi-structured interviews with a GIS analysis to better understand what is going on with the BRT routes at hand. To add to the relevance of this study, researchers could conduct more interviews and produce more maps than I did, taking a deeper dive into the realm of BRT and gentrification. I suggest that researchers going down this avenue look at different mappable variables than I did to investigate the connection between BRT and gentrification. Investigating population shifts between census tracts or block groups over time could be a viable way to see if people are being displaced. There are many recommendations to be made to advance this research direction and it is important to note that my study takes but one approach to investigating if gentrification is taking place.

Overall, this research study has shown that the CMAX BRT route on Cleveland Avenue in Columbus, Ohio has not been a catalyst toward gentrification-induced displacement. Being only one example of a BRT route that hasn't caused gentrification, this does not mean that all BRT routes won't cause gentrification. Cities should take a similar approach to what Columbus has done by growing and developing around transit corridors in an equitable way. Plans such as Zone in and the eTOD action plan have been viable methods to prevent displacement from occurring following the development of major transportation projects. This study proves that at least one BRT route has not caused green gentrification, which may suggest that BRT can be a way for cities to employ a just green enough tactic. On a concluding note, expanding efficient and reliable transportation networks for cities around the US is vital in improving people's quality of lives. To do this, cities must employ new modes of public transportation without

pushing people out due to rising rents and property values. BRT just might be a way to diversify transportation networks without displacing people.

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Appendix A:

List of questions asked during semi-structured interviews from the transit authority worker and urban planner's perspectives:

Transit Authority Worker Perspective Questions:

1. What is your current job position in the city of Columbus, how did you end up working in this position and how did long have you worked in that position?
2. What do you know about the CMAX bus rapid transit route on Cleveland Avenue, and has it influenced transit-induced gentrification to your knowledge?
3. What was the city of Columbus's intent or goals when constructing new BRT infrastructure? Is it more to connect disadvantaged populations to other parts of the city, to spur further neighborhood redevelopment, or both?
4. Did you work closely in the planning process of the CMAX bus rapid transit route? If so, how? If not, how else do you know about the route?
5. Is the entire CMAX bus route considered bus rapid transit, or just part of it?
6. How does the transit authority assess the potential effects of new transit projects on existing neighborhoods in terms of gentrification and displacement?
7. Does the transit authority ensure that the voices of vulnerable or disadvantaged groups are heard in the planning process? If so, how?
8. Has the transit authority received concerns from residents or community groups about potentially rising property values or rents contributing to gentrification?
9. How does the transit authority ensure that transit development benefits all residents, especially low-income or marginalized groups in the transit corridor?
10. Does the transit authority have any role in advocating for or facilitating affordable housing development near new transit stations?

Urban Planners / City Official Perspectives

1. What is your current job position in the city of Columbus, how did you end up working in this position, and how long have you worked in that position?
2. What do you know about the CMAX bus rapid transit route on Cleveland Avenue, and has it influenced transit-induced gentrification to your knowledge?
3. What was the city of Columbus's intent or goals when constructing new BRT infrastructure? Is it more to connect disadvantaged populations to other parts of the city, to spur further neighborhood redevelopment, or both?
4. Did you work closely in the planning process of the CMAX bus rapid transit route? If so, how? If not, how else do you know about the route?
5. Is the entire CMAX bus route considered bus rapid transit, or just part of it?
6. How do you assess the potential for gentrification when planning for bus rapid transit development?
7. What specific measures or policies, if any, have been put in place to mitigate displacement or affordability issues for existing residents in the CMAX bus rapid transit corridor on Cleveland Avenue?
8. How do you envision the long-term impact of the bus rapid transit expansion on neighborhood stability and affordability?

9. What role do you think community input should play in the planning process of transit projects to avoid or mitigate gentrification?

Appendix B:

IRB Clearance Certification and Number

IRB #: IRB-FY25-179
Title: How has the Cleveland Avenue Bus Rapid Transit (BRT) route in Columbus, Ohio, influenced variables associated with ecological or green gentrification and if so, how can BRT routes in other parts of the city avoid thi problem?
Creation Date: 9-25-2024
End Date:
Status: Approved
Principal Investigator: Harold Perkins
Review Board: Social Behavioral IRB
Sponsor:

Study History

Submission Type	Review Type	Decision
Initial	Limited	Exempt - Limited IRB

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