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A Flood of Consequences in Louisville, Kentucky: Using HGIS to Track Refugees Impacted by the 1937 Ohio River Flood

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A FLOOD OF CONSEQUENCES IN LOUISVILLE, KENTUCKY: USING HGIS TO TRACK REFUGEES IMPACTED BY THE 1937 OHIO RIVER FLOOD

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ABSTRACT

A FLOOD OF CONSEQUENCES IN LOUISVILLE, KENTUCKY: USING HGIS TO TRACK REFUGEES IMPACTED BY THE 1937 OHIO RIVER FLOOD

The Ohio River flood of 1937 was the most devastating flood in the recorded history of the Ohio River Valley and is commonly referred to as the "Great Flood of 1937". In January 1937, after nearly two months of continuous precipitation, over 60% of the city of Louisville, Kentucky, was flooded and at least 23,000 residents were displaced. The purpose of this research was to document, map, and compare the pre-flood residential locations, evacuation destinations, and post-flood residential locations of African American and White Louisville refugees from the 1937 Ohio River flood. Socioeconomic information from the manuscript versions of the 1930 and 1940 U.S. Censuses of Population and other archival records, including Louisville City Directories, were used to compile, analyze, and map refugee locations before and after the flood in an historical GIS (HGIS), and to determine if flood refugees stayed at their original address, moved elsewhere within Louisville or the state of Kentucky, or relocated out of state after the flood waters receded. The results indicated that Louisville's African American refugees had fewer evacuation destination options than White refugees, and household locations before and after the flood illustrated the degree of racial segregation within Louisville. White refugees, on the other hand, were more widely distributed across Louisville. The 1937 Ohio River flood exacerbated the economic hardships that these Louisvillians faced during the Great Depression, which reinforced racial segregation and led to urban disinvestment in the area.

Keywords: Louisville, Kentucky; flood refugees; historical GIS; manuscript census; 1937 Ohio River flood; racial segregation

This thesis is dedicated to dismantling the global systems of oppression that allow and encourage tragedies like this to occur.

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Chapter 1: Introduction

The most common natural disaster in the United States is inland flooding (Union of Concerned Scientists 2018). Floods are often disastrous, leading to great losses of lives and countless properties being destroyed. In urban settings, natural disasters disproportionately impact low-income, minority populations (Graif 2016). Along with destruction of property, flooding can result in the displacement of refugees, with over 14.9 million people worldwide being displaced due to natural disasters in 2011 and upwards of 24 million people in 2017 from similar circumstances (Jayawardhan 2017; Birpinar and Tugac 2022). There are many examples of catastrophic flooding that disproportionately impacted low-income and minority communities in the United States. One such example is the 1993 flood in the upper basin of the Mississippi River, which displaced over 100,000 people and destroyed more than 42,000 homes (Prince 1995).

Along with ecological and economic concerns during and after flooding events, social issues like environmental justice should also be addressed when studying flooding. Low-income people disproportionately experience the negative effects of floods (Graif 2016). Jayawardhan (2017) noted that both ecological and social vulnerability play a key role in determining who may be displaced by natural disasters. Vulnerable populations are less likely to have the resources available to mitigate floods and deal with their aftermath effectively. This conclusion remains true for minority populations in the United States, who have been historically neglected in governmental responses during crises like the 1927 Mississippi River flood and flooding in the aftermath of Hurricane Katrina in 2005 (Rivera and Miller 2007; Graif 2016).

The city of Louisville, Kentucky, is built predominantly on low-lying floodplains along the Ohio River, so large flood events have occurred frequently. Louisville experienced major

floods in 1832, 1884, 1913, 1937, 1945, 1964, and 1997. The flood of 1937, however, was the most devastating flood in the city's history (Parrish 2001a; Louisville MSD n.d.). After a relatively warm winter in 1937, the Ohio River Valley faced a deluge that broke records and has maintained its place as the rainiest winter in Louisville's recorded history (National Weather Service n.d.). The precipitation for Louisville in January 1937 was 23.59 inches, compared to an average of 3.39 inches over the last thirty years, and it rained for almost two weeks straight (Filson Historical Society 2006; National Weather Service n.d.). This culminated in the worst flooding event in the history of the Ohio River Valley (Filson Historical Society 2006). The 1937 flood inundated over 60% of Louisville's developed areas that existed at that time and forcibly displaced over 23,000 residents (Filson 2006). The most flood-prone areas of the city are situated in its western floodplains and central basin, both of which were then, and are now, populated predominantly by low-income, minority residents. The US Army Corps of Engineers (USACE) played a crucial role in the development of flood prevention infrastructure like flood walls and pumping stations to prevent another flood event from causing such widespread damage as did the 1937 flood (Parrish 2001c). This infrastructure is now outdated and degraded, which has caused concerns from West End residents and government officials. Some of the flood walls in Louisville even have the same design as the levees that failed during Hurricane Katrina and caused a deluge in the city of New Orleans, Louisiana (Van Velzer 2018). Aging infrastructure meant to protect Louisville could inevitably fail during a large rain event, which would allow for flooding on a similar scale to that of the 1937 flood.

West End neighborhoods in Louisville were consistently the most impacted by flooding and experienced White flight at higher rates after flood events occurred, which further exacerbated the already unstable economic conditions in those areas (Vision Russell n.d.). Along

with other hardships like the Great Depression, redlining, and urban renewal, this detrimental combination of socioeconomic forces stripped the few resources available to these communities and further exacerbated inequalities experienced by residents in these areas. This has had a lasting impact on the West End, which now experiences more poverty on average and whose residents have shorter life expectancies by over a decade when compared to the rest of Jefferson County (O'Neill 2013).

There is a large gap in the literature about the human impact that the 1937 flood had on Louisville, even though it is one of the worst disasters that has happened in the city. This research investigated the human impacts of the 1937 flood by analyzing the movement patterns of flood refugees from Louisville that were identified from Louisville *Courier-Journal* flood lists. African American flood refugees were found to be clustered in specific areas of the city both before and after the flood occurred, which demonstrated the degree to which the city was racially segregated. African American flood evacuees relocated to fewer destinations than Whites and had a significantly smaller representation in the *Courier-Journal* flood lists. Most households either stayed at the same address between 1937 and 1940 or changed addresses but stayed within Louisville after the flood. In fact, most African American residents returned to the same neighborhood from which they originated. White refugees, on the other hand, had a larger spatial residential distribution across the city. This research contributes to the growing body of literature that strongly reinforces claims that environmental disasters are disproportionately felt by vulnerable populations. It is with this underlying understanding that the following research questions are raised:

Research Questions

1. Where did 1937 flood refugees live before the flood occurred?

    a. How was race and pre-flood location connected to evacuation outcomes during the flood of 1937?

2. How did the flood of 1937 influence migration patterns in Louisville after the flood?
    a. Did flood refugees return to the same address after the flood? If not, where did they relocate after the flood subsided? In Louisville, in Kentucky, or out of state?
3. How did Jim Crow era legislation and racial segregation impact African American refugees' relocation patterns during and after the flood?

The purpose of this thesis is to document, map, and compare the pre-flood locations, evacuation destinations, and post-flood locations of African American and White refugees during the 1937 Ohio River flood in Louisville, Kentucky. Historical data sources like the 1940 manuscript Census, 1930 manuscript Census, and Louisville City Directories were used to compile socio-economic and geographic data for flood refugees, which were then added to an historical GIS to visualize and assess geographic patterns in the data.

The results of this research demonstrate how race, economic status, and societal norms can impact outcomes for households affected by natural disasters. Louisville has yet to experience flooding on the same scale as it did in 1937, but this does not mean that communities on the floodplain are safe. Floodwalls that were constructed as a failsafe may give residents a false sense of security, especially since 100-year return period flood events are already being recorded at a rate double the historical average and flooding is only expected to become more frequent and intense under changing climates (Louisville Metro Emergency Services 2023). As recently as 2018, Louisville experienced its rainiest February in recorded history and the Ohio River flooded to a point that required the local government to close the flood gates (Callahan 2018). The communities who live in the most environmentally vulnerable areas of the city also tend to be the

most socio-economically vulnerable, and a flood similar in scale to that of the 1937 flood would be detrimental to this area. Studying historical populations and their migration patterns after a natural disaster can be used to predict how modern populations may respond to disasters in the present and the future.

Chapter 2: Study Area

Situated on the southern bank of the Ohio River, Louisville is the largest city in Kentucky (Bennett and Gatz 2008). The city was established in 1779 and grew quickly because the Falls of the Ohio River interrupted travel downstream from Louisville (Parrish 2001b; Bennett and Gatz 2008). Some of the earliest neighborhoods in Louisville, Shippingport and Portland, developed near the riverbank because of their use in facilitating the movement of goods and travel along the river (Kramer 2001). Louisville's location on the river is convenient for commerce and river travel, but a large portion of the city's riverfront, western, and central areas are prone to flooding (Figure 2.1). The floodplain is characterized by relatively low elevations that do not exhibit significant elevation change, as well as flat-sloped stream beds (Louisville MSD 2022). The central basin has flat terrain, low elevation, and traditionally does not drain water very well due to its history as a slack water region of the Ohio River. These low-lying areas are prone to flooding and a majority of the households sampled in this study resided within the floodplain and central basin during the 1937 flood.

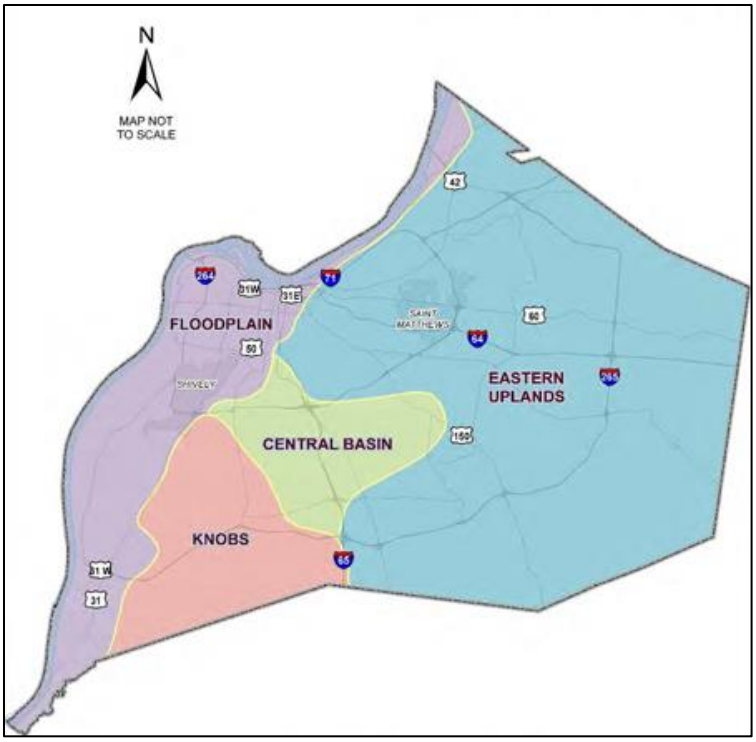


Figure 2.1. **Four Main Topographic Regions in Louisville, 2022.** A map of the four prominent topographic landscapes in Louisville, KY. The floodplain and central basin consist of low-lying terrain with little elevation change (Louisville MSD, 2022, PM-6).

Louisville's placement between the North and South made it a prime location for African American migration in the late nineteenth and early twentieth centuries, but residual racial tensions negatively impacted job security for these migrants (Adams 2001). After the Civil War, the African American population living in cities doubled by 1870, and, by 1930, African American populations tripled in "border" cities between the North and the South like Louisville (Cummings and Price 1997; Kramer 2009). The Mississippi River flood of 1927 was devastating to the farmland surrounding the Lower Mississippi River and contributed to the Great Migration, where a large number of African American sharecroppers migrated into urban areas in the South and North (Adams 2006). Although Louisville was a popular destination for migration, African American workers faced discrimination and were often paid less than their White counterparts for the same job (White et al. 2005). There was an enclave of Black-owned businesses, banks,

and white-collar professionals in the Russell neighborhood during the 1930s and 40s, located along Walnut Street between 6th Street and 18th Street (Figure 2.2). Many of these businesses were forced to close during the Great Depression (Cummings and Price 1997; Adams 2006). In fact, the unemployment rate for African Americans increased from 12.1% to 37.2% from 1930 to 1932 (Hudson 2001). This is a staggering increase in unemployment in two years, which illustrates the rate at which the Great Depression affected African Americans in Louisville.

African American residents have historically lived in the city's West End neighborhoods, and were concentrated in the Chickasaw, Russell, Smoketown, and California neighborhoods in the 1930s (Figure 2.2) (Kramer 2009; Marshall 2017). These neighborhoods often faced discriminatory housing practices that prevented residents from leaving these areas, which has had lasting effects on the demographics of the city. Although *de jure* segregation was only codified for four years, the long-term impact of unequal housing practices has resulted in modern *de facto* segregation (Adams 2001; Yater 2001; Kramer 2009). In 1940, the West End had a segregation index of 70.0, and this index rose to 73.6 in 1950, where higher segregation index scores (out of a maximum of 100) indicate higher levels of spatial segregation (Cummings and Price 1997). Even as efforts to legally desegregate schools and public spaces in Louisville were successful, West End residents were still consistently denied home loans and White flight led to a 90% decrease in the White population between 1950 and 2000 (Yater 2001; Louisville Metro Government 2010).

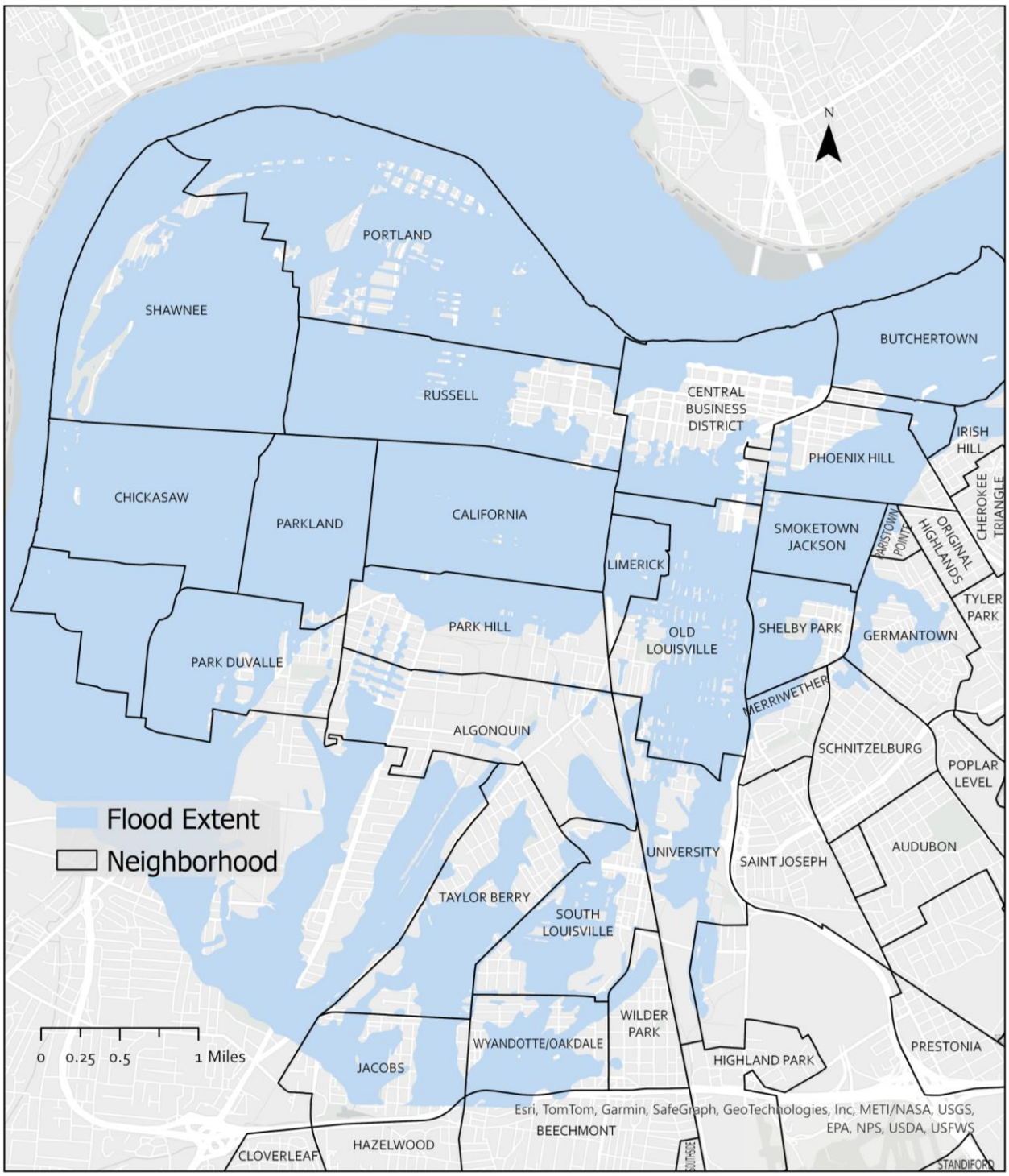


Figure 2.2. **Neighborhood Boundaries in Louisville, Kentucky.** Most of the neighborhoods on this map are represented in the study. African Americans lived mostly in Russell, California, and Chickasaw, and Whites lived mostly in Shawnee, Portland, and Parkland (LOJIC 2015).

One of the ways segregation manifested itself in the Jim Crow era was redlining, where mortgage lenders would draw red lines that formed a boundary around predominantly African American neighborhoods for the purpose of uniformly denying loans to the residents in those areas (Marshall 2017). In fact, in the same year as the flood, the Homeowner's Loan Corporation (HOLC) laid the foundation for redlining in Louisville in a residential securities map that rated predominantly African American neighborhoods poorly and White neighborhoods as more desirable. The HOLC was created by the federal government to stabilize the housing market in the 1930s and gave neighborhoods ratings from A to D based 1) officially on the quality of housing of a neighborhood and 2) unofficially by the racial makeup of the area (Poe 2013). This effectively removed any chance of African American residents obtaining a loan to buy a house, moving out of the red lined neighborhoods, or building generational wealth through real estate investment. In the 1950s and 60s, White flight and urban renewal stripped West End neighborhoods of what little wealth they had accumulated and caused some neighborhoods to have increased poverty rates, high vacancy rates, and mortgage denials (Louisville Metro Government 2010; Marshall 2017). Even in 2023, the West End is a majority minority area of the city, still has more poverty on average than the rest of Louisville, and the population has been shown to have shorter life expectancies than their East End counterparts by more than a decade (Louisville Metro Government 2010; O'Neill 2013). This observation is imperative for understanding the way that the Great Flood of 1937 not only disproportionately impacted African American residents, but also likely exacerbated poverty and the perception of "bad neighborhoods" in the West End. The 1937 HOLC map was also made after the flood occurred and the documentation that accompanied this map made note that many of the neighborhoods rated "D" had this low rating in part because of the propensity of these areas to flood (Poe 2013).

Land Use Characteristics

The flood of 1937 inundated sixty percent of the city that was developed at the time (Filson 2006). The Louisville *Courier-Journal* published a map of the flood extent on February 15, 1937, and had green area shaded in to indicate where the flood occurred (Figure 2.3) (Fisher 1937). The flood extended on banks on either side of the city, but most of the flooding occurred between Beargrass Creek and Pond Creek (Louisville MSD 2022). Pond Creek is southwest of this map because that area was not included in Louisville city limits during this time, but Beargrass Creek is in the eastern part of the city and is shown in this map as the long, curved flooded portion that extends south into the city. This map illustrates how disproportionately the flood impacted the West End and African American populations in the city.

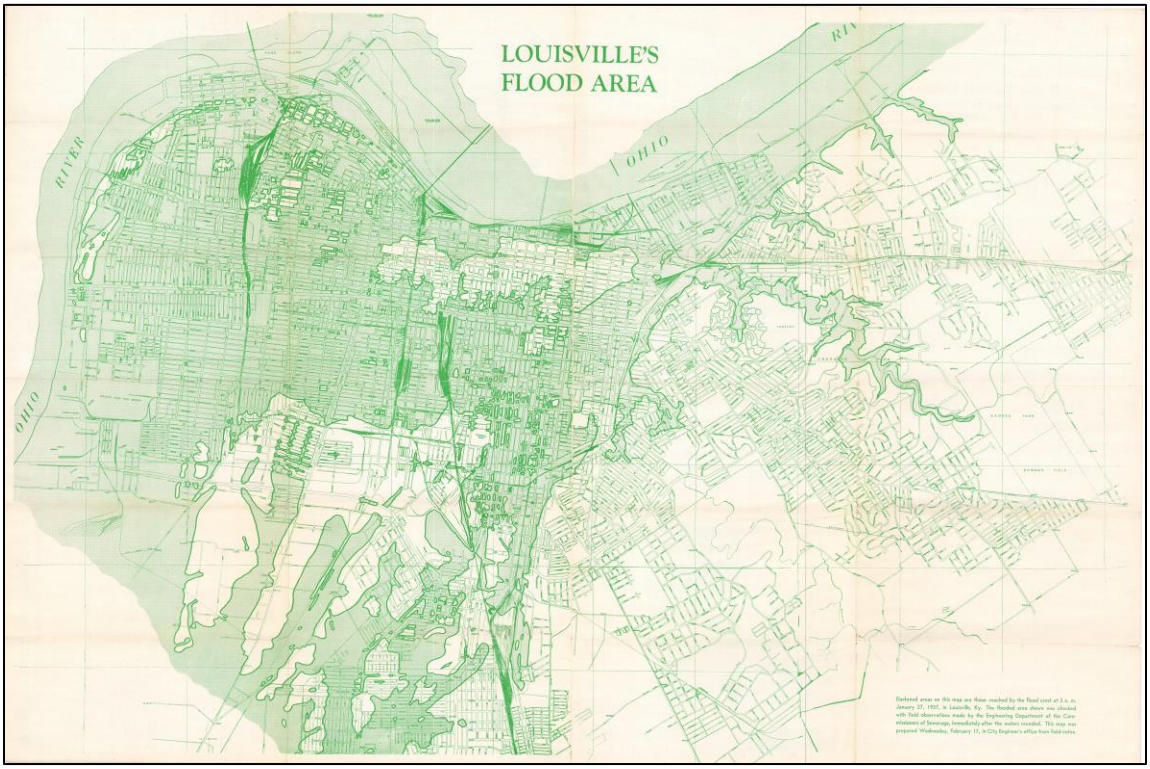


Figure 2.3. ***Courier-Journal*** **Flood Map of the 1937 Flood in Louisville.** The flood map was published on February 15, 1937. Flooded areas of the city are shaded in green (Fisher 1937).

Despite the necessary proximity to the river, Louisville has faced catastrophic damage from many large flooding events, like those in 1832, 1884, 1913, 1945, 1964, and 1997, and

most severely in 1937 (Parrish 2001a; Louisville MSD n.d.). After the flood of 1937, the local government worked with the USACE to construct flood walls along the Ohio River to protect the city from another great flood (van Velzer 2018; Louisville MSD 2022). There are 29 miles of levees and floodwalls that provide three feet of headboard above the maximum flood stage of the flood of 1937. These floodwalls would protect 17,600 acres from a flood that crested the river to 60.4 ft (Jillson 1937; Velzer 2018). As flood infrastructure ages, riverfront neighborhoods like Butchertown, Portland, and Shawnee are all at risk of failed levees during heavy precipitation events (van Velzer 2018). The floodplain has been fully developed and contains ten percent of the industrial and commercial structures in the city, as well as multiple schools, hazardous material facilities, electrical towers, and sewage infrastructure, all of which would be threatened by a flood of the same magnitude of the 1937 flood (Louisville Metro Emergency Services 2023).

Louisville's average temperature in the winter is 38.3 degrees Fahrenheit, with average lows of 30.2 degrees (National Weather Service 2020). In the last 30 years, the average precipitation in January was 3.39 inches, and the annual average was 48.34 inches. Notably, the wettest winter in Louisville was the winter of 1937, the year of the flood, where it rained a total of 23.59 inches (National Weather Service 2020). Louisville typically receives storm fronts that result in heavy rain, which was the case for this flood event (Brooks and Thiessen 1938). Severe storms form when arctic and tropical air masses meet, which causes a sudden change in air pressure and temperature and produces heavy precipitation. The largest floods in Louisville typically occur in winter and early spring (January to April) due to the severe weather fronts and colder temperatures that inhibit water absorption into soils and vegetation (Filson Historical Society 2006). Recently, Louisville experienced its rainiest February on record in 2018 (Callahan

2018), and Louisville Metro Emergency Services (2023) has recorded a two and half times increase in the frequency of 100-year floods. Louisville is still susceptible to riverine flooding despite the presence of flood infrastructure, and climate change is causing an increase in the number of severe flooding events.

Residential Characteristics

Louisville has historically had a high African American population due to its unique location between the North and the South (Cummings and Price 1997; Adams 2001). As of the 2010 Census, the West End had a population of 61,251, with 81.6% of the population belonging to a minority group (Louisville Metro Government 2010). Compared with Jefferson County totals, the West End has a 48.7% higher minority population than the county average (U.S. Census Bureau 2022b). This reinforces Marshall's (2017) HOLC map and historical accounts of segregation in these neighborhoods and indicates a long history of racial segregation that has occurred in the West End of Louisville. Furthermore, the median household income in the West End was $21,733 in 2010 dollars, and the county median household income was $58,357 in 2021 dollars (Louisville Metro Government 2010; U.S. Census Bureau 2022b). Accounting for annual inflation, the populations living in the West End made significantly less money on average than the rest of the county, and most West End residents lived in poverty. These demographic statistics demonstrate the negative consequences of segregation and disinvestment on the West End and allude to the fact that these communities have historically been underserved. The Metro Louisville government allowed for the segregation of these neighborhoods to occur and then systematically hindered development and economic growth through redlining and urban renewal efforts (Cummings 1997). Now, residents in West End neighborhoods have shorter life

expectancies than people in the East End, as well as higher rates of cancer (Gilderbloom et al. 2020).

Chapter 3: Literature Review

Natural disasters occur globally; one of the deadliest and most costly forms of which is flooding (Miao 2019). Flooding can occur in coastal areas due to tropical cyclones, inland along rivers and tributaries as a result of heavy precipitation, or anthropogenically due to changing climates and sea level rise (Alifu et al. 2022). In the United States, inland flooding is the most common natural disaster and causes the second largest number of weather-related deaths annually (Ashley and Ashley 2008; Union of Concerned Scientists 2018). Low-income and minority populations are typically disproportionately impacted by natural disasters and institutional racism can be exacerbated by natural disasters (Bullard 1993; Zack 2009). American lawmakers have relied on engineering, flood forecasting, and public relief efforts to mitigate the effects of flooding in the United States (White 1942). Lastly, historical datasets have been used in GIS projects to model migration patterns after historical droughts and floods (McLeman and Smit 2006; Schlichting et al. 2006). This chapter synthesizes the literature available on flooding, migration and forced displacement, natural disaster mitigation, and data visualization to form the intellectual basis for this project.

Flooding

Despite the risks that accompany proximity to water, humans have consistently developed societies near coasts and rivers. Excessive rain and tropical cyclones can lead to flash flooding or storm surges, resulting in loss of life, destruction of infrastructure, and socio-economic stress (Hugo and Bardsley 2014). Natural disasters caused by flooding are often traumatic and have been shown to affect temporarily where humans build settlements with respect to the floodways (Fanta et al. 2019). Immediately after a flood, there is a greater perception of risk and enhanced precautions put in place, but this perception quickly diminishes

(Fanta et al. 2019; Miao 2019). Floods occur globally but the responses to flood disasters vary by geographic location. For example, countries whose climates produce a larger amount of precipitation are less vulnerable to extreme precipitation, while places that experience tropical cyclones tend to experience more fatalities from flooding because of the extreme nature of these storms (Miao 2019). Indigenous communities, low-income populations, and historically neglected African American communities in American cities have been disproportionately impacted by floods due to their ecological and socio-economic vulnerability (Marino and Lazrus 2015; Graif 2016; and Stojanov et al. 2017).

Floods can occur on coasts, in inland rivers, or as a product of rapid, intense precipitation (Ashley and Ashley 2008). Short term heavy precipitation events are the most common causes of flooding globally, but other factors like soil moisture levels and rapid late-winter snowmelt can also contribute to floods in certain regions (Berghuijs et al. 2016; Alifu et al. 2022). In the United States, coastal and flash flooding are the two most common forms of flooding, and flash flooding causes the majority of flood fatalities (Ashley and Ashley 2008). As of 2021, over 30 million people lived in Federal Emergency Management Administration (FEMA) designated floodplains (Vanucchi 2021). This number is expected to grow as technology advances, land use changes, and precipitation increases due to changing climates.

The most common natural disaster in the United States is inland flooding (Union of Concerned Scientists 2018). There are many contributing factors to flooding, like anomalously high levels of precipitation and snowpack melt in the late winter (Union of Concerned Scientists 2018; Van der Wiel 2018). Most flooding in the eastern United States occurs in late winter and early spring because low temperatures cause the soil to freeze and rain-on-snow precipitation events compound the amount of water being added to a watershed (Van der Wiel 2018). This

phenomenon is not common in the lower Ohio and lower Mississippi River Valleys because there is not the same level of snowpack, and temperatures are not as cold compared to the northern region of these river valleys (van Velzer 2018). Flood fatalities are concentrated in the eastern part of the country, with a hotspot of deaths present in the Ohio River Valley along the southern border of Ohio (Ashley and Ashley 2008).

Development on floodplains is a common practice, but there are growing concerns about the efficacy of re-developing floodplains after disasters occur and the role that the government should play in that process (Brake 2019; Vanucchi 2021). Early scholars categorized governmental intervention into eight different strategies, ranging from flood abatement to emergency measures, insurance policies, or structural changes on the floodplain (White 1945). States have undertaken mitigation projects like constructing flood walls and buying out properties that are on floodplains or adapting to floods by raising house foundations and constructing overflow reservoirs (Buchori et al. 2018; Vanucchi 2021). These programs are typically costly for the government and place a burden on taxpayers to maintain development in unsafe areas (Brake 2019). Flood infrastructure can also cause complacency; flood prevention efforts often diminish, even when the infrastructure has aged and may not be the most effective technology (Miao 2019). Neo-liberal policies force individuals to account for and deal with flood risk independently, but many environmentally vulnerable groups are also economically vulnerable (Vanucchi 2021). When residents do not have the resources to move themselves or mitigate risk, the government should intervene during times of crisis. For example, in Vietnam, the government has a relocation program for vulnerable communities living in the Mekong Delta where they receive interest-free loans to buy property and build housing outside of the floodplain (Dun 2011). Residents of the floodplain prefer not to move away from the social networks

present in their current homes, and many of these people live in poverty and cannot afford the repayment conditions for the loan provided if they leave the floodplain. In Jakarta, Indonesia, recurrent flooding in *kampung* neighborhoods keeps the cost of living low and prevents development (Hellman 2015). Residents have adapted to the flooding because leaving this area will remove them from the social and economic networks present in the *kampung* and might produce new types of vulnerability. In the United States, the government builds flood prevention infrastructures like dams and levees, and FEMA has delineated areas of high flood risk that require flood insurance policies to alleviate the costs incurred by homeowners during flood events (Vanucchi 2021). Knighton et al. (2021) found that dam height, localized riverine conditions, and proportion of the White population in an area were all connected to how communities deal with flood risks. These communities can be flood risk-averse or risk-enduring depending on these characteristics.

Discussions of floodplain "un-development" and mitigation strategies are becoming more important as scientists learn about and prepare for the negative effects of climate change. For every degree Celsius the atmosphere warms, the potential moisture content of the air increases by 7% (Union of Concerned Scientists 2018). Climate change has been connected to flood enhancement throughout the world in the last thirty years, although the effects of enhancement have not been experienced uniformly (Union of Concerned Scientists 2019; Alifu et al. 2022). FEMA designated flood zones have consistently expanded in part due to increased precipitation levels and changes in land use (Vanucchi 2021). In the Ohio River Valley, maximum flows are projected to increase by up to 30% and Louisville already experiences 100-year return period floods 2.5 to 3.5 times more often than in the past (van Velzer 2018; Louisville Metro Emergency Services 2023). Flood infrastructure is also aging in Louisville. Some of the flood

walls that were built after the 1937 flood use the same technology as the levees that failed during Hurricane Katrina in New Orleans (van Velzer 2018). Increases in precipitation and flow levels form an important basis for this project because the areas most at risk of the detrimental effects from a flood are also the places with the most vulnerable populations in the city.

Modern and historical examples of flooding highlight how intimately connected race and class are to environmental vulnerability (Zack 2009; Union of Concerned Scientists 2018). Bullard (1993) found that minority children across the United States were more likely to suffer from lead poisoning and low-income communities had less opportunities to leave areas with hazardous waste facilities in the surrounding area. Hurricane Katrina, which inundated a staggering 80% of New Orleans, Louisiana, disproportionately impacted African American and low-income residents in the city's 9th Ward (Curtis et al. 2007; Graif 2016). The Mississippi River flooded in 1927 and levees were intentionally destroyed in African American neighborhoods in an attempt to minimize destruction of property in White neighborhoods (Rivera and Miller 2007). During the 1937 Ohio River flood, African American residents in Cairo, Illinois, were not informed when flood infrastructure failed and were unaware that they needed to evacuate (Welky 2011). As a result of such catastrophic events, environmental justice has emerged as a critical field of study, which investigates how minority and low-income populations disproportionately experience natural disasters and environmental degradation (Bullard 1993; Chakraborty et al. 2019). All the aforementioned examples demonstrate the ways that different races were treated by government officials during natural disasters.

Flooding vulnerability is only one way that different communities can be impacted by environmental injustice. In present-day Louisville, residents of the West End, who are predominantly African Americans, have shorter life expectancies than East End neighborhoods

and a higher chance of developing lung and colorectal cancer (Louisville Metro Government 2010; O'Neill 2013; and Gilderbloom et al. 2020). Neighborhoods that were redlined in the mid-twentieth century experienced increases in housing vacancies, which has led to deteriorating housing stock (Sadler and Lafreniere 2016). Minorities living in redlined neighborhoods across the United States experience segregation at a higher rate now than they did in the 1930s (Stermon and Lukinbeal 2021). Even without codified (i.e., *de jure*) segregation policies, racism still underscores the housing market in many large urban areas across the United States. Recent studies have illustrated how historically segregated neighborhoods experience more extreme flooding compared to non-segregated neighborhoods (Linscott et al. 2022). Environmental justice is an important framework through which to study natural disasters in the United States because race and class have been consistently proven to be correlated with differing disaster outcomes.

Migration

Migration is an interdisciplinary subject that analyzes the complex connections between geography, sociology, and economics to explain where people move and why. Many scholars have created theoretical models that generalize trends in migratory patterns (Ravenstein 1885; Peterson 1958; Black et al. 2011), while others have used census and quantitative methods to analyze human movement (Stouffer 1940; Tobler 1970; Tolbert et al. 2009). There are many different theories about migration patterns that have been developed through empirical studies, one of the earliest of which was Ravenstein's (1885) laws of migration. These laws explain that most migrations occur over a short distance and are completed in multiple "steps", moves that are farther typically result in migration to an urban area, and women are more migratory than men (Ravenstein 1885). Other important ideas include the theory of intervening opportunity

(Stouffer 1940), inverse distance law (Zipf 1946), and the stress threshold theory (Wolpert 1966). These approaches synthesize the sociological factors and geographic influences that push or pull migrants into leaving one place for another.

Modern migration theories are interdisciplinary and typically consider five broad categories of influencing factors when analyzing why people move: 1) social, 2) economic, 3) demographic, 4) environmental, and 5) political (Black et al. 2011). The many societal impacts of globalization, neo-classical economics, and climate change, as well as their connection to these influencing factors, have been the focus of numerous modern migration studies (Graves 1983; Black et al. 2011; Jayawardhan 2017). Scholars have built an understanding of the effects of climate change on migration patterns by analyzing how people move in response to natural disasters or forced displacement (McLeman et al. 2010; Graif 2016). Economists have proven that rent can serve as an indicator of neighborhood amenities (e.g. green space, safety) and has an impact on where migrants decide to move (Graves 1983). Birpinar and Tugac (2022) predicted how climate change may impact national security issues related to climate refugees and international migration. Residents can be pushed from their homes because they lack economic opportunity (Marino and Lazrus 2015), experience ecological or social vulnerability (Jayawardhan 2017), or live in neighborhoods that experience disamenity (Graves 1983). Race is connected to mobility and there is a negative correlation between minority racial status and mobility (Tolbert et al. 2009). On the other hand, membership and security in social and economic networks tend to inhibit movement, especially in the face of natural disasters (McLeman and Smit 2006; Black et al. 2011; Hornbeck and Naidu 2014; Hellman 2015; Marino and Lazrus 2015). Residents that live in flood prone areas of Jakarta, Indonesia, have adapted to

frequent floods and even receive a benefit from the floods because they prevent the government from evicting the residents and raising rent prices (Hellman 2015).

Scholars use different geographic scales of resolution to define what moves are considered migratory (Black et al. 2011). Migration has been defined as any move, as long as there is a permanent or semi-permanent change of address (Stouffer 1940; Lee 1966). This definition is effective when using individual level data because it allows for movement of any distance to be studied. Geographic thresholds have been used to define migration as moves between counties, cities, commuting zones, or states (Zipf 1946; Plane et al. 2005; White et al. 2005; Tolbert et al. 2009). Using state borders to determine if a move should be considered migration is not effective because most moves in the United States are intra-state (Adams 2006; Tolbert et al. 2009). Long distance migrants typically choose urban destinations due to the economic opportunities and social networks that exist there (Ravenstein 1885), but modern cities and the surrounding suburbs typically extend beyond a single county. To account for urban growth, Tolbert et al. (2009) considered movement outside of a metropolitan commuting zone to be migration and movement within a commuting zone to indicate residential mobility. Residents can move farther from their current home and maintain the social and economic networks they lived in because transportation networks have expanded and became more efficient (Tolbert et al. 2009). Scale is important in migration studies because it affects the methods used and lens through which authors interpret results.

Every migrant has a specific set of reasons for leaving an area, but some socio-economic characteristics can predispose people to be more likely to move. For example, graduating from college and birth of the eldest child were found to be the best indicators of migration, while race was shown to be a limiting factor for residential mobility in a study of migration patterns in the

United States between 1985 and 2000 (Tolbert et al. 2009). Women were more likely to be migratory, as are adults (Ravenstein 1885). Residents who were native to urban areas tended to be less migratory than those in rural places because most migration at the time of Ravenstein's study was from rural to urban areas. People who live outside of their home state tend to move more frequently than people who live in their home state (Ravenstein 1885; Tolbert et al. 2009).

People typically do not want to leave an area with which they are familiar, but once a stress threshold is exceeded, this may drive them away from their homes (Wolpert 1966). Historically, stressors have been related to job insecurity, unwelcoming social environments, and the lived experience or fear of a natural disaster (Adams 2006; Schlichting et al. 2015; Graif 2016). The devastating effects of Hurricane Katrina on the New Orleans metropolitan area highlights how socio-economic disparities between low- and high-income wards in New Orleans, Louisiana, correlated with the severity of the flood damage from the storm (Graif 2016). The poorest wards (e.g., 9th Ward) were the most vulnerable to flooding and were initially neglected in the government's response to the flood. In the aftermath of Katrina, residents who experienced flooding were likely to move out of the New Orleans metropolitan area and often opted for higher quality neighborhoods with lower levels of stress (Graif 2016). Yun and Waldorf (2016) utilized a mover-stayer framework to characterize the migration patterns of flood refugees after Hurricane Katrina and found that younger people were more likely to move, while older people, larger families, families with more than one laborer, and homeowners were more likely to stay. Other studies have applied a four-pronged framework for characterizing out migration: 1) stayers, 2) within-city movers, 3) out-of-city movers, and 4) returners (Hogg et al. 2015). Centripetal and centrifugal influences (pull and push factors, respectively) contribute to a resident's decision to migrate because they represent positive and negative aspects of their

current place and potential new residential location. People can be influenced to migrate during natural disasters, but they must also consider the costs associated with moving (Yun and Waldorf 2016).

Migration can also be necessary as a result of military conflict or changing climates (Marino and Lazrus 2015; Birpinar and Tugac 2022). Climate change is predicted to cause a rise in sea levels, increased temperatures, and changes to precipitation patterns, which are expected to have detrimental effects on infrastructure, food security, and public health (Black et al. 2011; Birpinar and Tugac 2022). Newer models of migration have considered climate change as a compounding stressor to the drivers of migration rather than a separate influencing factor in peoples' decision-making process (McLeman and Smit 2006; Black et al. 2011). Climate change will likely increase conflict, resource availability, and environmental stressors so it would be ineffective to analyze the impacts of climate change on migration outside of the context of other push/pull factors. Indigenous, low-income, and minority communities experience environmental stress at higher rate than affluent and White communities (Graif 2016). Many residents living in socio-economically vulnerable areas of Jakarta, Indonesia, have, for example, adapted to the constant threat of flooding in situ because moving to a new *kampung* (village/neighborhood) would necessitate building new social and economic networks that differ from the ones that exist in their place of origin (Hellman 2015). Indigenous communities in Alaska and Tuvalu are at-risk for extreme disaster and displacement due to sea level rise; however, residents resist abandoning their settlements because of the community connections and rural lifestyle that are integral to these group identities (Marino and Lazrus 2015). In both studies cited above, vulnerable populations work to adapt and overcome climate change-induced vulnerability rather

than leave their homes, indicating a strong relationship between social networks and migration (Hellman 2015; Marino and Lazrus 2015).

The Dust Bowl Migration in Oklahoma and a portion of the Great Migration of African Americans out of the rural South in the United States are examples of two different mass migration events that occurred for environmental, economic, and social reasons. (Adams 2006; McLeman and Smit 2006; Hornbeck and Naidu 2014; Schlichting et al. 2015). The Dust Bowl migration occurred when tenant farmers were evicted from their land after a drought from 1934-1936 caused multiple years of crop failures in eastern Oklahoma (McLeman and Smit 2006). Large portions of communities relocated from Oklahoma to California in search of fertile land as a result of environmental and economic centrifugal forces. On the other hand, in 1927, catastrophic flooding in the Mississippi River Valley induced widespread out-migration of African American farm laborers from the rural American South (Hornbeck and Naidu 2014). The 1927 flood highlighted the rigid race-based hierarchy present in the South as White refugees received aid before African American refugees were helped and African Americans were forced by their White counterparts to work in the flood evacuation camps (Rivera and Miller 2007). Great Depression era programs like the Agricultural Adjustment Agency evicted sharecroppers to drive up the cost of cash crops, which further removed African Americans from economic opportunities in the South (Adams 2006). The Great Migration had environmental, social, and economic centrifugal forces and resulted in widespread shifts in the demographic composition of urban areas and spatial concentration of African American people throughout the twentieth century (White et al. 2005). Black movement during this time was mostly intra-state or inter-southern state migrations, and a majority of in-migrants to southern cities already lived in urban areas before their move (Adams 2006). In Louisville, the African American population more

than doubled from 1920-1970, and a majority of African American professionals in Louisville during this time were migrants who came from the urban South (Adams 2001; Adams 2006). Even when migrating to predominantly Black neighborhoods, southern migrants still faced discrimination through fewer economic opportunities and fewer housing options than both their White and northern-Black counterparts (White et al. 2005; Schlichting et al. 2015).

Forced Displacement

A particularly important lens with which to analyze floods is the involuntary movement of people, also known as forced displacement or forced migration. Forced displacement is becoming more frequent with environmental disasters (Birpinar and Tugac 2022). Hurricane Katrina displaced hundreds of thousands of people in Louisiana and Mississippi and caused a mass movement of refugees after the flood (Graif 2016). It was one of the largest displacement events in the recent history of the United States and highlights how socio-economic inequalities in urban planning and governmental oversight produce disparate experiences among different classes and races of people. Many studies have been conducted to understand why floods happen and the impacts they have on humans, ranging from studies correlating vulnerability with displacement (McLeman and Smit 2006; Jayawardhan 2017) to the sociological reaction of people after a crisis (Kutak 1938).

Migration happens before and after an environmental disaster occurs, so it is important to consider a refugee's pre-disaster condition and post-disaster losses when studying environmental displacement (Marino and Lazrus 2015). Many minorities and low-income groups are disproportionately impacted by flooding and these communities often resist being forced out of their homes (Marino and Lazrus 2015; Graif 2016; Jayawardhan 2017). Impending crises or increased hardships on households can cause residents to set aside their ties to a geographic

location for a chance at better conditions in a new place. An increase in natural disasters due to climate change would likely lead to more environmental stressors that would push them from their current residence (Wolpert 1966). Indigenous groups in Alaska and Tuvalu do not have an incentive to move to urban areas, but migrations that happened before a natural disaster were caused in part because these communities had to deal with more frequent flooding (Marino and Lazrus 2015).

People usually prefer to return to their origins after being displaced but in some cases the only choice refugees have is to seek refuge in a new location. (Black et al. 2011; Jayawardhan 2017; Stojanov et al. 2017). Many small island countries do not have the resources to effectively mitigate rising sea levels, which is leading to forced international migration (Jayawardhan 2017; Birpinar and Tugac 2022). Many of these countries lack adequate resources and sufficient land to move people to less affected areas. In the United States, racial minorities typically see an increase in residential mobility after a natural disaster because the cost of staying is higher than the cost of leaving (Elliott 2015). Outmigration that occurred in the aftermath of Hurricane Katrina is a recent example of disaster induced increases in mobility. Over half of the New Orleans population lived under the federal poverty line in 2005, and many refugees did not return to the city after the flood waters receded (Zack 2009).

There is also a temporal consideration to displacement because disasters can have rapid or slow onset. Slow-onset displacement results from changes to the natural environment like soil degradation and sea level rise. Rapid-onset displacement results from natural disasters that force residents from their homes (Jayawardhan 2017). Since the nature of these two types of events are different, their resultant movement paths manifest themselves in different ways. Rapid-onset displacement events happen with a clearly defined start and end time so the study of the

movement of people after the event is more clearly defined. Slow-onset displacement has a less tangible beginning and end. The impacts of both these events cause many issues in governance, humanitarianism, and conflict with rapid-onset events offering short term glimpses of what impacts slow-onset events will have over longer periods of time (Birpinar and Tugac 2022). Rapid-onset disasters exacerbate socio-economic tensions and allow for real-time study of its impacts.

There is oftentimes a sense of community present after a natural disaster that encourages residents to rely more on the networks present in their community (Black et al. 2011; Hellman 2015). Migrants tend to move short distances and must face a specific stress threshold to feel compelled to move (Ravenstein 1885; Wolpert 1966). Communities on the floodplain in Louisville dealt with flooding relatively consistently, with major floods in 1913, 1936, and 1945 that each displaced large numbers of refugees (Parrish 2001a). The 1937 flood likely contributed to a strong sense of community that encouraged residents to return to their origins after the flood (Kutak 1938). Due to racial segregation of neighborhoods from Jim Crow era policies and societal norms, African American residents were likely more vulnerable to the flood and faced more challenges when evacuating or migrating after the flood.

Historical Data and GIS

Geographers have long relied on archival records and maps to reconstruct past landscapes and social conditions. Historical geographers build narratives that are supported by historical records, including literary documents, numerical data, and graphical images (Baker 1997). Written records like travel narratives, correspondence, and journalistic publications are valuable resources that provide insight into the daily lives of people who may not still be alive to explain their story (Baker 1997; Southall 2014). Manuscript census data (also referred to as microdata)

have gained relevance in recent years because of the individual scale at which data are collected and the fact that data are available across most of the United States (Swierenga 1990; Shertzer et al. 2016). Manuscript data includes every person in every household, with socio-economic fields that may vary by Census enumeration year. Despite the fact that these records are digitized and indexed online, they require labor intensive review and are not free from quality control issues (Schlichting et al. 2006). Studying flood induced migration at the household level allows for a more fine-grained analysis of migration patterns compared to methods that study migration at the census tract or county level. This project investigated migration patterns in Louisville at the end of the 1930s through archival journalistic publications, historical Census records, and spatially referenced GIS data.

Geographic Information Systems (GIS) are a powerful analytical and visual tool that can be used to recreate past landscapes with digitally rendered, spatially accurate datasets (Gregory and Healy 2007). When developing a GIS with a historical focus, users must account for changes in administrative units (e.g. census tracts, ZIP codes, enumeration districts) and updates to infrastructure by referencing the data with historical maps (Schlichting et al. 2006; McLeman et al. 2010; Shertzer et al. 2016). Current and historical administrative boundaries can be synthesized through a union analysis, where multiple features can be combined into one dataset, which aids users to manage data whose extent changed over time (Stermon and Mallory 2021). Scholars have also used data sources like the Kansas state population schedules (Swierenga 1990), housing condition from the city of Flint, Michigan (Sadler and Lafreniere 2017), addresses associated with IRS tax returns from different years (Plane et al. 2005), and databases containing flood records to complete historical research projects (Ashley and Ashley 2008; Alifu et al. 2022). The scale at which spatial data are analyzed can have an impact on how different

races are represented in flooding studies. Maantay and Maroko (2009) used cadastral data (at the property lot scale) to determine which populations were vulnerable to 100-year floods in New York City and found that these data were much more representative than Census tract or Census block boundaries. Scholars have used manuscript census microdata to track African American migration to the North after the 1927 Mississippi River flood (Hornbeck and Naidu 2014). This was achieved by identifying counties that were inundated by the 1927 flood and tracking the African American residents who lived in these areas in 1910 and where they went in 1920 and 1930. Schlichting et al. (2015) created a historical GIS for Hartford, Connecticut, and studied the composition of African American neighborhoods in 1910, 1920, and 1930. They created a historically accurate street shapefile and collected demographic data for Great Migration refugees at the street level. Other studies have used census data to track migration caused by droughts in Oklahoma in the 1930s (McLeman and Smit 2006) and droughts on the Canadian prairies from 1926-1936 that resulted in out migration (McLeman et al. 2010). Very few studies have been conducted on Louisville or the human effects that the 1937 flood had on the city, and none have used GIS to visualize residential movement and quantify racial or economic disparities in the migration outcomes from the flood event. The methodology used is a composite of multiple methods and it is unique in its application to Louisville and the 1937 Ohio river flood.

Despite the size and severity of the flood of 1937 and its impacts on the city and citizens of Louisville, scholarship is scant. Due to the social, political, and economic strife that occurred during this event, there were likely too few resources available to conduct research on the topic. As a result, the human impact of the flood, which had a significant impact on the region, is understudied. It is the intent of this research to add to the body of literature that relates to the

long-term consequences of the 1937 flood in Louisville and surrounding areas. African American households were likely more socially and environmentally vulnerable because of Jim Crow-era policies that enforced racial segregation and limited the resources that these people had. The flood occurred within the context of the Great Depression, which drastically changed the economic landscape of Louisville and stripped African American communities of the small amounts of wealth they had accrued. It also took place during the Great Migration, where African Americans living in the rural South moved to urban areas within the South as well as the North. The data collected for this research illustrate how historical flood victims responded to the disasters of the 1937 flood, including migration patterns after the flood occurred, and might be used to inform modern decisions regarding flood infrastructure, building resilience, and rectifying historical bias against minorities in the United States during environmental crises. Understanding historical patterns of post-disaster migration will only grow in importance due to the projected increase in the frequency and intensity of flood events in the United States. This is the first research effort that uses GIS to map the human impact of the 1937 flood, which may provide insight into management strategies that can be used in future urban flooding crises.

Chapter 4: Methodology

Refugees from the 1937 flood in Louisville were identified and their migratory patterns after the flood were studied using three methods: 1) tabulation of reported flood refugees from the Louisville *Courier-Journal* that included respective evacuation destinations; 2) collection and analysis of demographic and geographic data for a sample of the refugees; and 3) visualization of the relocation patterns of the flood refugees to create an historical GIS. In the days following the flood, the Louisville *Courier-Journal* published lists of people who were displaced. Decennial manuscript censuses helped determine the location of the refugees before and after the flood. City Directories were helpful when; 1) a resident's name or address did not match either the flood lists or census data or, 2) when entries were missing from either the 1930 or 1940 manuscript census. The historical GIS (HGIS) consisted of multiple data layers including household locations between 1937 and 1940, a digitized flood map from the Louisville *Courier-Journal*, the spatial pattern of historical streets in Louisville, desire lines mapping the origin and destination relocation patterns from the flooded area, and modern flood risk delineations produced by FEMA. The HGIS is useful for visualizing and analyzing data collected in a historically accurate digital landscape and will be published online to allow other interested parties to have easy access to this research. By using an official list of refugees from the *Courier-Journal*, the 1930 and 1940 manuscript censuses, and city directories, a story of Louisville can be woven together through the Great Depression, Great Migration, and Flood of 1937 to give insight into residential movement patterns in the late 1930s.

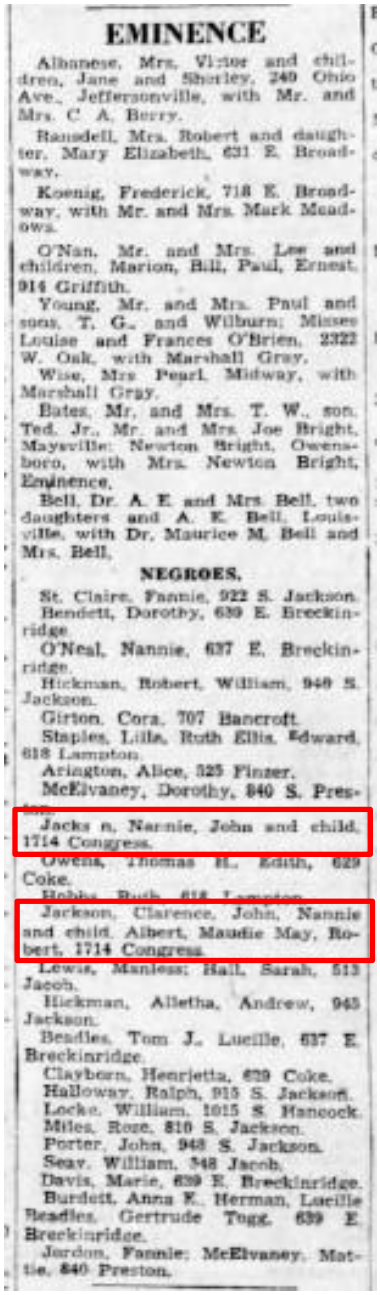
Identifying Flood Refugees and Demographic Data

Courier Journal Flood Lists

The Louisville *Courier-Journal* is a daily print newspaper that began in 1868 as a merger between two opposing publishers in Louisville during the Civil War (Wolfson 2018). The newspaper has been delivered to every county in Kentucky for over one hundred years and has repeatedly received top ten ratings by the nation's largest publishing companies (Wolfson 2018). During the 1937 flood, the *Courier-Journal* published special flood issues dealing with the impacts of the flooding and its aftermath. These issues were published in conjunction with the Lexington *Leader*. Flood migration data and maps were published in newspaper articles from January 29, 1937, to February 4, 1937. The lists were compiled from "various official and semi-official sources" including the Red Cross, Kentucky National Guard, and other authorities (*Courier-Journal,* Jan. 29, 1937, p. 1-2). The lists provide a record of residents who lived in Louisville and were relocated because of the 1937 flood. It is important to note that the lists did not include every household who left Louisville during the flood and its aftermath; rather, the lists are a compilation of people who were recorded by governmental agencies that aided in flood evacuation. There are not many other records documenting the names and addresses of every flooded household, and there are likely no records that contain every household that was evacuated during the flood. Instead, these publications provide a relatively comprehensive list of people who were undoubtedly affected by the 1937 flood.

Households were listed alphabetically by surname and included the given name of all people present in the house at the time of evacuation. Sometimes names were abbreviated with a person's first and middle initials. Most entries included the household's address in Louisville at the time of the flood, and some entries provided relocation addresses if households relocated to

another person's house rather than going to refugee centers. If a destination received both White and African American refugees, there would be a break in the list and "negroes" would be written in bold lettering to separate the flood list by race (Figure 4.1). Refugee race was assumed to be White unless it was explicitly highlighted in the list that they were African American.



EMINENCE

Albanese, Mrs. Victor and children, Jane and Shirley, 249 Ohio Ave., Jeffersonville, with Mr. and Mrs. C. A. Berry.

Ransdell, Mrs. Robert and daughter, Mary Elizabeth, 631 E. Broadway.

Koenig, Frederick, 718 E. Broadway, with Mr. and Mrs. Mark Meadows.

O'Nan, Mr. and Mrs. Lee and children, Marion, Bill, Paul, Ernest, 914 Griffith.

Young, Mr. and Mrs. Paul and sons, T. G., and Wilburn; Misses Louise and Frances O'Brien, 2322 W. Oak, with Marshall Gray.

Wise, Mrs. Pearl, Midway, with Marshall Gray.

Bates, Mr. and Mrs. T. W., son, Ted, Jr., Mr. and Mrs. Joe Bright, Maysville; Newton Bright, Owensboro, with Mrs. Newton Bright, Eminence.

Bell, Dr. A. E. and Mrs. Bell, two daughters and A. K. Bell, Louisville, with Dr. Maurice M. Bell and Mrs. Bell.

NEGROES.

St. Claire, Fannie, 922 S. Jackson.
Bendett, Dorothy, 639 E. Breckinridge.
O'Neal, Nannie, 637 E. Breckinridge.
Hickman, Robert, William, 940 S. Jackson.
Girton, Cora, 707 Bancroft.
Staples, Lilla, Ruth Ellis, Edward, 618 Lampton.
Arington, Alice, 325 Finzer.
McElvaney, Dorothy, 840 S. Preston.
Jacks n, Nannie, John and child, 1714 Congress.
Owens, Thomas H., Edith, 629 Coke.
Hobbs, Ruth, 618 Lampton.
Jackson, Clarence, John, Nannie and child, Albert, Maudie May, Robert, 1714 Congress.
Lewis, Manless; Hall, Sarah, 513 Jacob.
Hickman, Alletha, Andrew, 945 Jackson.
Beadles, Tom J., Lucille, 637 E. Breckinridge.
Clayborn, Henrietta, 629 Coke.
Halloway, Ralph, 915 S. Jackson.
Locke, William, 1015 S. Hancock.
Miles, Rose, 810 S. Jackson.
Porter, John, 940 S. Jackson.
Seay, William, 948 Jacob.
Davis, Marie, 639 E. Breckinridge.
Burdett, Anna E., Herman, Lucille Beadles, Gertrude Togg, 639 E. Breckinridge.
Jardon, Fannie; McElvaney, Mattie, 840 Preston.

Figure 4.1. **Example of *Courier-Journal* Flood Refugee List Reporting.** This flood list entry is for refugees going to Eminence, Kentucky. The refugees are separated by race and have their surname and given names written. The red boxes indicate a household reported in two separate entries (*Courier-Journal*, February 2, 1937, p. 4).

The number of households that evacuated the city were tabulated to determine the spatial scale and number of refugees by race. Each place refugees relocated to was included in a data table, and the number of White and Black refugees were tabulated for every location across the study period. This produced a daily summary of the spatial pattern of the places refugees went to and the racial composition of the refugees each place received. Refugee counts were aggregated by day and evacuation destination to provide more detail into the refugee flow patterns.

The flood lists were an effective source of information on Louisville flood refugees. There were, however, people included in the lists that were not from Louisville, name misspellings, or inconsistent address information that required cross-referencing to discern the actual locations of residents. Sometimes refugees were included who lived outside of Louisville, in places like Jeffersonville, Indiana; New Albany; Indiana; Radcliff, Kentucky; and Shively, Kentucky. For example, some of the households who evacuated to Eminence, Kentucky on February 2, 1937, lived in Jeffersonville, Indiana; Maysville, Kentucky; and Owensboro, Kentucky (Figure 4.1). These people were not included in the flood list count because they did not reside in the Louisville study area during the flood. Residents from Shively, Valley Station, and on Dixie Highway were included in the tabulation because these areas are in the modern metro Louisville area and in the floodplain, which put them at risk of future flooding on the Ohio River. A few of the households reported were evacuated from suburban areas like St. Matthews and Jeffersontown. The evacuees from these communities were not included in the count, however, because these areas were not impacted during the 1937 Ohio River flood.

The most common errors in the data were name misspellings either phonetically or from typographical errors in the transcription process. Name misspellings typically occurred to refugees of German or African American descent. To account for this issue, only names that

phonetically sounded similar and matched addresses from the flood lists or 1940 Census data were included in the study. Occasionally, members of the same household were reported as different entries in the flood list (Figure 4.1). This issue was rectified by tracking only the head of household reported in the flood list, even if members in the same household were reported separately. Using only the head of household minimized redundant entries in the flood lists from being recorded. The data in these lists were collected and published during a crisis, so it is logical to assume that some data may have been incorrectly recorded or reported. An integral part of this study was using other historical records to cross reference information that did not seem correct from the flood list. This was an attempt to minimize errors in the data collected and analyzed.

There were a total of 9,832 households counted and 175 different destinations reported in the flood lists. White households comprised 77.5% of refugees reported in the flood list and consistently made up a majority of the refugees leaving Louisville. 133 of the relocation destinations were within Kentucky. The 42 out-of-state destinations ranged from Atlanta, Georgia in the south to Poughkeepsie, New York in the north. The ten places that received the largest number of flood refugees were all located within Kentucky and southern Indiana (Figure 4.2). Jeffersontown, Kentucky received the largest number of refugees over the course of the flood and the largest number of African American households for any destination. Jeffersontown was located in the same county as Louisville during the flood and is now a suburban area in modern Louisville. It is also more diverse in terms of ethnicity and economic status, unlike other refugee destinations near Louisville (e.g., St. Matthews).

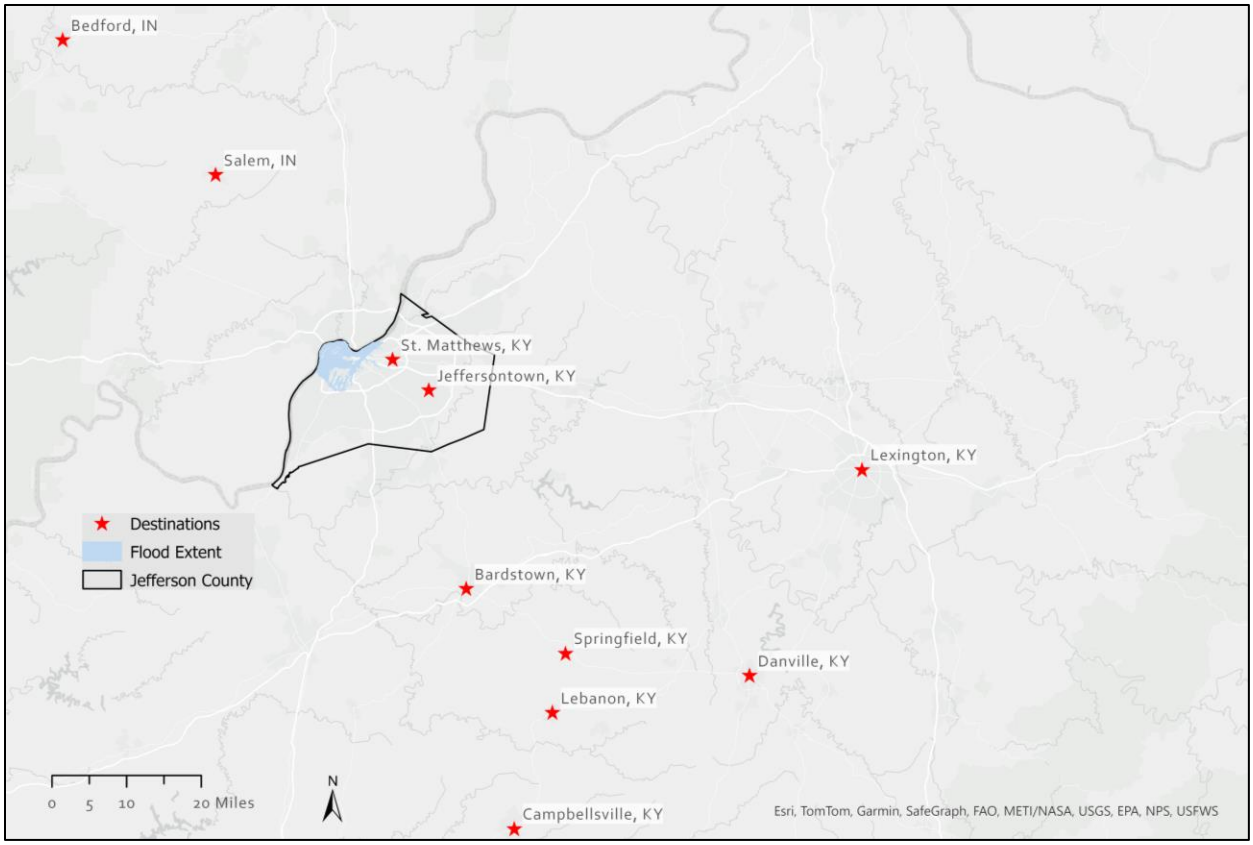


Figure 4.2. **Ten Most Common Destinations for Refugees in the Study Period.** The name and state of each location is included, as well as the flood extent in Louisville and the Jefferson County border.

1940 Manuscript Census as a Data Source

Manuscript census schedules from 1940 were used to find household addresses after the flood and to compile socio-economic data about each head of household in the sample. The census forms have information for every individual in a household for all households in the United States and these data are collected every 10 years. The federal government prohibits publication of the personal data contained in the manuscript census for 72 years after collection to protect the identities of the residents because of the confidential information contained in the forms (Penn Libraries 2023). Census data were accessed online through genealogical research sites (e.g., Ancestry.com or FamilySearch.org) where records are digitized and indexed, which

means that the words written on the census schedule have text added to it that makes the information like names and addresses searchable. The 1940 Census was used to see whether people moved after the flood and, if so, to track where they moved.

Every household sampled from the flood list was located in the 1940 census and their respective address, home ownership or rental status, home value (or monthly rent), and household size were recorded. Age, birth year, race, marital status, occupation, and annual income were also recorded for each head of household using 1940 Census data. The manuscript census contained rows for each individual in a household and columns to organize the socio-economic data collected on individuals (Figure 4.3). To see a blank example of the 1940 manuscript census pages, refer to Appendix B.

The household indicated with red rectangles from Figure 4.1, the Jackson household, was used throughout this section to demonstrate how each historical record was used to cross-reference and validate historical information. The head of household was indicated on the census schedules and could be a single person living by themselves or the parent(s) of an extended family. Tracking heads of household was deemed effective because they are typically older and easier to trace across all the data sources. City directories typically recorded only the head of household and spouse for each address but did not include children or lodgers. Children living at the same address as the head of household were unlikely to be listed in such directories. The composition of a household may change as children move out or lodgers move in, but heads of household are more likely to be consistently identified across time. The main circumstances in which the head of household was different between decades was when a spouse died, or children moved out and started their own families. Tracking heads of household also reduced redundancy in the data by representing everyone in a household with one person. Instead of tracking all

children, spouses, and lodgers that lived at the same address, the head of household was used in this research to represent the entire group. If the head of household changed between decades (i.e. spousal death, divorce, etc.), then whoever was head in 1940 was recorded for the household and the original head of household was recorded in a notes section.

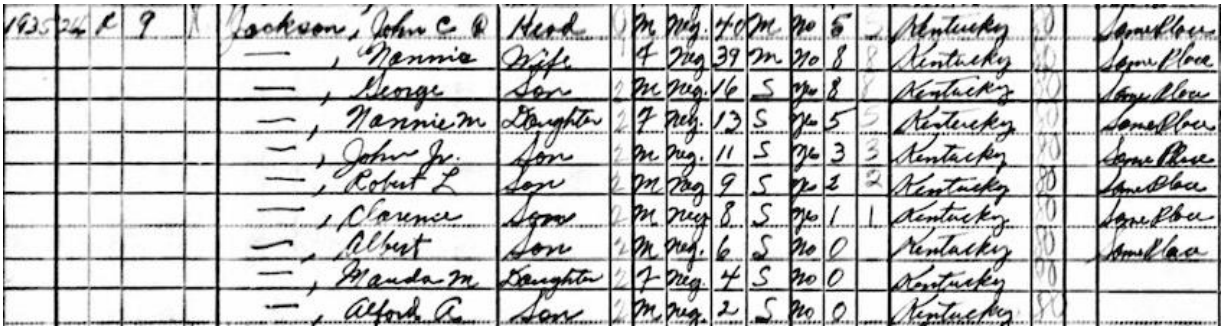


Figure 4.3. **Example of 1940 Census Entries for a Household in Louisville.** This image shows the address number, renter status, monthly rent value, name, relationship to head of household, sex, race, age, marital status, birthplace, and 1935 address (U.S. Census Bureau 1940).

Using Figure 4.3 as an example, John C. Jackson was the head of household and the 1940 address was 1935 Green Alley (the street name is not visible on the page or in the screenshot). At the time of collection, African American citizens were reported as "negro" in the census. It is also clear that the two entries circled in the flood list from Figure 4.1 were part of the same household. The R in the third column of Figure 4.3 indicated that this house was rented, and the monthly rent value was $9. John Jackson's first and last name, race, sex, age, birth year, job and income were recorded in the dataset for this household.

The manuscript census is a comprehensive dataset for the entire United States, but it is not perfect. There were clerical errors such as missing information or other issues like illegible handwritten entries that served as limiting factors to its utility as a sole source of information. The penmanship of census takers varied greatly and was difficult to read at times, and also led to inconsistencies with the digitally indexed records. Sometimes the spelling of individual's names

and other information were unclear. There were a few instances where the indexed information did not match what was written on the census schedules, which made it difficult to quickly find households. When these issues were encountered, other data sources like city directories, marriage certificates, and death certificates were useful to cross-reference the census data.

1930 Manuscript Census as a Data Source

The 1930 Census contained many similar fields to the 1940 census, but because it precedes the flood it served in a more supplemental role in this research. Household addresses in 1930, ownership status, home value/monthly rent, and household size were recorded from the 1930 Census. These 1930 Census data were useful for identifying the head of household when records were difficult to find in 1940. If a household was found in the 1930 Census, the search parameters used to search for the same household in 1940 could be refined to correctly identify the household. It also provided another method of cross-referencing the flood lists and 1940 Census data to ensure their validity. Households were included in the sample even if their record was not found in the 1930 Census because the 1930 Census is more supplemental to this research than the 1940 Census. If a household was accurately identified in both the 1930 and 1940 Census, all available information was recorded and the search was complete. By using the Jackson household (Figures 4.1 and 4.3) as an example for the 1930 Census, the wife's name, Nannie, is spelled different in the 1930 Census when compared to the flood list and 1940 Census. In 1930, the family lived at 406 Clean Alley, which indicates that they changed addresses between 1930 and 1940. There are also many fields that are difficult to read, which makes interpretation and record keeping more complicated.

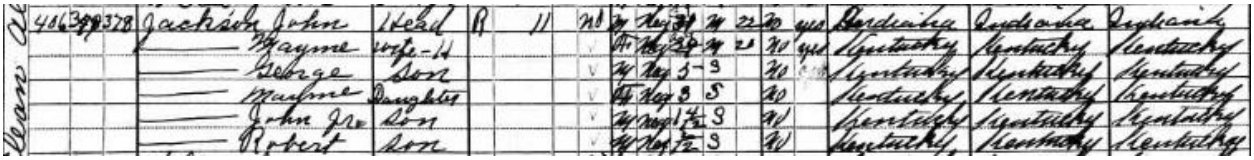
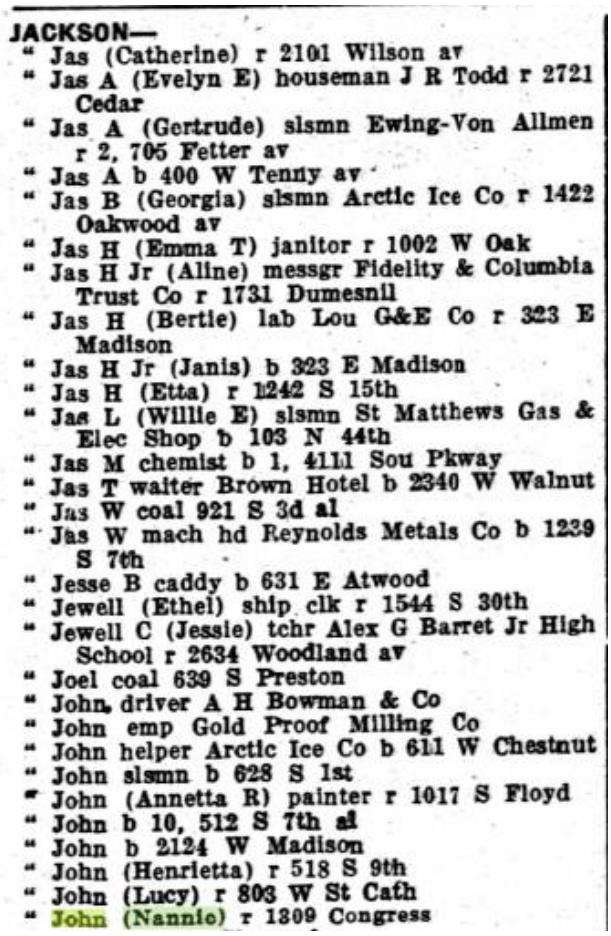


Figure 4.4. **Example of 1930 Census Entries for a Household in Louisville.** This is the same family identified in previous figures and shows how the address and household composition changed over the decade, as well as a spelling error in the wife, Nannie's, given name (U.S. Census Bureau 1930).

Louisville City Directories 1930-1940

City directories were used to fill in gaps in information between the 1930 and 1940 Censuses, specifically for changes in address and determining the way residents spelled their names. The earliest city directories in Louisville were published in 1832 and were produced almost annually until 1989 (University of Louisville n.d.). There were many companies that produced city directories, but the Caron Directory Company of Louisville published the majority of Louisville directories during the 1930s. There are volumes for every year in the decade except for 1938, most likely because the flood impacted the company's ability to collect data in 1937. Directories usually contained the name, address, and occupation information for most of the residents and businesses in the city, and after 1884 included reverse directories, where entries were organized by address rather than an alphabetical listing by residents' names. Directories provide annual data for residents and businesses; however, they do not contain as much information for each resident as does the Census data. Louisville directories from 1930 to 1940 were used to fill in gaps in information about the locations of residents between the flood in 1937 and the data found in the 1930 and 1940 Census. The city directories were organized alphabetically by last name and often used shorthand for the resident's given name and homeownership status (Figure 4.5). The Jackson household (Figure 4.1, 4.3, and 4.4) was located at 1309 Congress and they were renters in 1937 (Figure 4.5). This address was not the same as the address reported in the *Courier-Journal* flood lists, nor was it the same as either the 1930 or

1940 Censuses. The family may have moved from 1309 Congress after data collection for the 1937 city directory ended, or the flood list address (1714 Congress) may have been incorrectly recorded.



JACKSON—
" Jas (Catherine) r 2101 Wilson av
" Jas A (Evelyn E) houseman J R Todd r 2721 Cedar
" Jas A (Gertrude) slsmn Ewing-Von Allmen r 2, 705 Fetter av
" Jas A b 400 W Tenny av
" Jas B (Georgia) slsmn Arctic Ice Co r 1422 Oakwood av
" Jas H (Emma T) janitor r 1002 W Oak
" Jas H Jr (Aline) messgr Fidelity & Columbia Trust Co r 1731 Dumesnil
" Jas H (Bertie) lab Lou G&E Co r 323 E Madison
" Jas H Jr (Janis) b 323 E Madison
" Jas H (Etta) r 1242 S 15th
" Jas L (Willie E) slsmn St Matthews Gas & Elec Shop b 103 N 44th
" Jas M chemist b 1, 4111 Sou Pkway
" Jas T waiter Brown Hotel b 2340 W Walnut
" Jas W coal 921 S 3d al
" Jas W mach hd Reynolds Metals Co b 1239 S 7th
" Jesse B caddy b 631 E Atwood
" Jewell (Ethel) ship clk r 1544 S 30th
" Jewell C (Jessie) tchr Alex G Barret Jr High School r 2634 Woodland av
" Joel coal 639 S Preston
" John, driver A H Bowman & Co
" John emp Gold Proof Milling Co
" John helper Arctic Ice Co b 611 W Chestnut
" John slsmn b 628 S 1st
" John (Annetta R) painter r 1017 S Floyd
" John b 10, 512 S 7th al
" John b 2124 W Madison
" John (Henrietta) r 518 S 9th
" John (Lucy) r 803 W St Cath
" John (Nannie) r 1309 Congress

Figure 4.5. **Example from a Caron City Directory for Louisville, 1937.** The highlighted name is the same household that has been used as an example throughout this section (Caron 1937).

Many of the refugees reported in the flood list consisted of only one name and address. These refugees were difficult to connect to other data with a high level of confidence because there was such scant information upon which to ensure a confident identification. At other times, the addresses listed in the flood lists did not match any other associated address in any other data source. Some entries included first and middle initials instead of full names. City directories were especially useful in matching initials to a person's name, which would refine the search in

the manuscript censuses. The city directories were a good resource for working around name misspellings because the reverse directories are organized by street address and included the names of residents that lived there. If the address in the 1936 or 1937 city directory had a name similar to what was reported in the refugee list, it was clear that the name was misspelled in the flood list and the corrected name could be used to search the censuses. For example, one refugee was recorded as J.C. Klatt in the flood list, which returned no results from either census. By looking at the 1937 reverse directory at the address reported for J.C. Klatt, it was discovered that his name was actually Julius Clarence Kolb. Julius Kolb was subsequently located in both the 1930 and 1940 manuscript Censuses. All of the data collected in the study was cross-referenced using a combination of the 1937 flood lists, 1940 and 1930 censuses, and city directories. This minimizes errors that may be present in each data source and creates a high level of confidence in the information recorded.

It is important to note that these data do not explain why people did or did not move. Census data can provide high quality quantitative data in historical studies, but qualitative data are also integral to creating a historical story about a place in time (Carr 1964; Baker 1997; Schlichting et al. 2010). There are few remaining survivors of the flood, which limits the amount of qualitative information that can be gathered to explain why these movement patterns existed. Any patterns that are observed from data collection cannot be explicitly connected to the flood and does not prove that people moved because of the flood. Building an understanding of the socio-economic influences that may have impacted flood refugees' decision-making process and framing the migration patterns present within this context was the best substitute for the first-person accounts of the flood experience that have been lost to time.

Demographic and Movement Pattern Analysis

Louisville residents' movements were analyzed for each sampled household and were grouped into one of four categories: 1) residents who stayed at the same address; 2) residents who stayed in Louisville but moved to a different address after the flood; 3) residents who stayed in Kentucky but did not return to Louisville; or 4) residents who moved to another state. These classifications highlight key patterns of movement that can then be analyzed by other demographic variables like race or economic status. If the household address in 1940 was different from the 1930 Census or flood list, but they still lived in Louisville, they were coded as staying in Louisville. Communities near Louisville (e.g., Jeffersontown, Middletown, Anchorage, and Prospect) were considered to be outside of the city and residents who moved to these areas were coded as staying in Kentucky because these places were outside of the city limits of Louisville at the time of the flood. Refugees who moved to towns outside of Kentucky, including those who moved to New Albany or Jeffersonville, Indiana, were coded as leaving Kentucky. These codes were used to simplify changes in a refugee's address after the flood occurred and allowed for descriptive statistics to be conducted on this data.

A sample of households that were affected by the 1937 flood were identified from the Louisville *Courier-Journal* flood lists and were traced between 1930 and 1940 using manuscript census and city directory records to build a better understanding of migration patterns in the latter half of the 1930s (Figure 4.6). There were 797 households investigated with a 56% rate for successful identification, which resulted in 445 entries that were added to a dataset with all of the geographic and socio-economic data recorded from the flood lists, 1930 and 1940 Censuses, and city directories. Successfully identifying 445 households out of the 9,832 households included in the flood list resulted in a 4.5% sample of flood refugees reported by the Louisville *Courier-*

Journal. There were 249 White households, 195 Black households, and one Asian household included in sample. There were 196 sampled households who stayed at the same address in Louisville, 226 sampled households who stayed in Louisville but changed addresses between 1937 and 1940, 14 sampled households who left Louisville but stayed in Kentucky, and 9 sampled households who left Kentucky. Of the households that left Kentucky, four moved to Indiana, two went to Tennessee, and one went to Florida, Michigan, and the District of Columbia. African American and White residents were equally represented in the households that left Louisville, but the patterns in their relocation vary slightly. Whites relocated to a wider variety of places, and moved farther on average than African Americans, and almost all of the African Americans that left Louisville went to historically Black neighborhoods.

OBJECTID	Last	First	Add1930	OwnStat_1930	Val_1930	HHSize_1930	Add_1937	Migra_Dest	Migra_Date
1	Lauderdale	Agnes	430 Ormsby	O	1200	4	804 S 7th	Jeffersontown	2024-01-29
2	Bland	Albert	3316 Missouri	O	500	12	3316 Missouri	Jeffersontown	2024-01-29
3	Bryant	William	842 S Preston	R	20	4	2920 W Walnut	Jeffersontown	2024-01-29
4	Rickett	Addie	630 Burnett	R	25	6	1633 W Walnut	Jeffersontown	2024-01-29
5	Davis	Sadie	3705 Grady	R	8	6	3708 Stratton	Jeffersontown	2024-01-29

Add_1940	OwnStat_1940	Val_1940	HHSize_1940	MigraCode	HOHBirthYear	HOHage_1940	HOHSex	HOHRace	MarStat_1940	Occu_1940	Wage_1940
804 S 7th	O	1750	3	SA	1900		F	B	S	Private Cook	520
3316 Missouri	O	500	9	SA	1888	52	M	B	M	Cement Contractor	300
2920 W Walnut	O	3000	3	SA	1887	53	M	B	M	Railroad	780
1925 W Walnut	O	1700	8	SL	1891	49	F	B	S	Servant	260
3708 Stratton	O	250	7	SA	1908	32	F	B	WD	Housekeeper	280

Figure 4.6. **Dataset Containing Demographic and Geograpraphic Data**. The first image contains information like the sampled head of household name, 1930 address and household information, as well as 1937 evacuation information. The second image is a continuation of the same dataset with 1940 address and household information, as well as demographic information for the head of household found in the 1940 Census.

Descriptive statistics were generated based on the household data to investigate how different groups of people responded to the flood. The type of movement associated with each household in the sample was categorized using the four categories listed at the beginning of this subsection, then analyzed by race and ownership status. Ownership status in 1930 and 1940, average rent value or ownership value in 1930 and 1940, gender of the head of household, marital status of the head of household, median household size, average age of heads of household, and average income of heads of household in 1940 were recorded across the entire

sample and analyzed by race and ownership status. The household data were then separated into White and African American groupings to look at how race impacted refugees' experiences during and after the flood. The data were also separated into homeowner and renter groupings to better understand how the flood experience was related to economic status.

Data Visualization and Building the HGIS

The historical GIS was developed using ESRI ArcGIS Pro software for desktop. It consists of eight data layers: 1) flood map shapefile, 2) desire line shapefile, 3) 1937 road shapefile, 4) Jefferson County, Kentucky outline shapefile, 5) 1937 residential location shapefile, 6) 1940 residential location shapefile, 7) residential movement shapefile, and 8) FEMA flood insurance rate map shapefile. A shapefile is a file format used in GIS that represents real world phenomena as polygons, lines, or points. The first dataset was created by georeferencing a flood map from the Louisville *Courier-Journal* flood map and creating polygons that lined up with the flooded areas of the city. Desire lines were created using a tool that interpolates lines from a source to a destination and were symbolized to represent the flow of refugees. Louisville's historical road dataset was created by downloading a shapefile of modern roads in Louisville and rectifying the address ranges and creating/deleting roads that do not exist anymore. The Jefferson County border was also downloaded from the Louisville/Jefferson County Information Consortium (LOJIC). The fifth and sixth datasets included information about flood refugees with georeferenced points for their residence in 1937 and 1940. A tool was used to draw lines between each resident's 1937 address and 1940 address. The final dataset was downloaded from an online GIS data repository and data for Jefferson County was extracted from the national dataset. All the data were added to the same map repository in ArcGIS, which is called a project, and symbolized to effectively convey information about the historical and modern landscape of

Louisville. The historical GIS allowed for these historical and modern datasets to be overlain and created a highly detailed scale model of what Louisville looked like at the time of the flood.

The flood map published by the *Courier-Journal* in 1937 was digitized to represent the geographic extent of the flood. There were many different flood maps created immediately after the flood, but one of the most widely used maps was produced by the *Courier-Journal*. The map was made in conjunction with the Engineers Office of the City of Louisville, the Engineers Department of the Commissioners of Sewage, and a Weather Bureau meteorologist (Fisher 1937). A large print version of the flood map was scanned as a high-resolution image, georeferenced, and digitized in ArcGIS Pro in ESRI vector polygon format (Figure 4.7). When images are uploaded in GIS software, they do not have spatial reference associated with them and the images appear at the intersection of the equator and Prime Meridian. The image must be georeferenced, which is a process where users connect points on a scanned image to the real-world features in the ArcGIS project, before any data creation or spatial analysis can be performed. After the flood map was georeferenced, the outline of the flood extent was traced at a 1:1000 ft scale. When household movement was visualized in the GIS, the flood extent layer was also visible and was used to show what households lived within the flooded area, and if households moved out of the area affected by the flood. The flood extent in 1937 was also compared to current FEMA flood insurance rate maps (FIRMs), which illustrated areas that were historically and currently at risk for flooding if flood infrastructure were to fail.

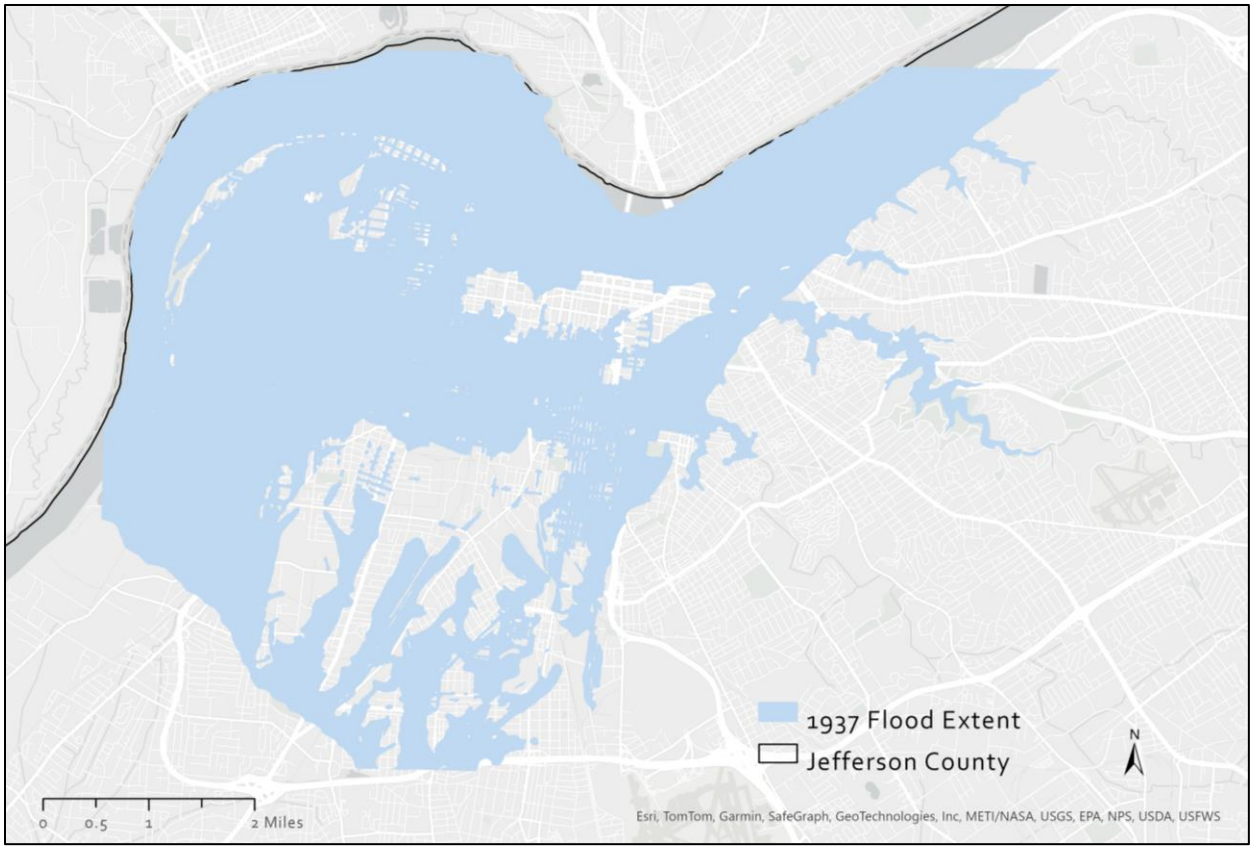


Figure 4.7. **Digitized *Courier-Journal* Flood Map Layer in the Louisville HGIS.** This map did not include the southwestern region of the floodplain because it was outside of the city limits at the time of the flood.

The desire line tool was used in ArcGIS Pro to illustrate migration flows between Louisville and the refugee destinations reported in the *Courier-Journal*. The dataset contained the name of the refugee destination and decimal degree coordinates, and daily refugee totals for each destination. The "Display XY Data" tool was used to georeference each evacuation destination with the decimal degree coordinates included in the dataset. The "Create Desire Line" tool created a line shapefile with connections between Louisville and each destination that refugees evacuated to. Each desire line represented the number of refugees that left Louisville and went to each respective destination. The data layer was symbolized with thicker lines representing a larger flow of refugees to a destination. This layer effectively visualized the flow

between Louisville and evacuation destinations during the flood and demonstrates the concept of distance decay, which is a key part of migration literature (Tobler 1970). It is important to note that desire lines are not intended to represent the actual path of movement that refugees took, but rather to symbolize the generalized number and directionality of refugee movement from Louisville after the flood.

There are many online repositories of GIS data which are publicly available to download and use for research. Many state and city municipalities have geospatial data related to demographic and economic information of the area. In Louisville, there is a collaborative online database called the Louisville/Jefferson County Information Consortium (LOJIC). This data portal allows users to access shapefiles like police reports, city planning layers, and environmental data. The counties in the Louisville Metropolitan Area and modern street centerlines were downloaded from LOJIC's open data portal and added to this GIS project. Jefferson County was the only county of interest in the Louisville Metropolitan Area County shapefile, so the Jefferson County feature was selected and extracted to create its own shapefile in the project. The road centerline shapefile was entered into the GIS, overlaid with Sanborn fire insurance maps of Louisville from 1928, and the current roads were rectified to match the historical layout of roads. Roads were deleted if they were outside of the Sanborn map depictions. Each of the seven Sanborn map sections were georeferenced into the GIS project, and each block on each street was modified to match the street layout. Address ranges for each block were also updated for each street as its location was modified to represent the road layout more accurately for Louisville in 1930. Each Sanborn map volume contained a reference map for its area of the city (Figure 4.8) and an index of the address ranges for each block of each street in the volume (Figure 4.9). Editing the street centerlines changed the modern street dataset to

represent the roads that existed in 1937 during the flood, which could then be used to more accurately visualize households that were included in the residential movement shapefile. It was necessary to create the historically referenced street dataset to account for any changes to the road network and to update address ranges for each block. For example, the modern street dataset that was downloaded included Louisville's interstate system, which did not exist in 1930. The interstate data were removed from the street shapefile and were replaced with the roads that predated the interstates. Updating the address numbers for each block made the road dataset more effective when georeferencing the household data.

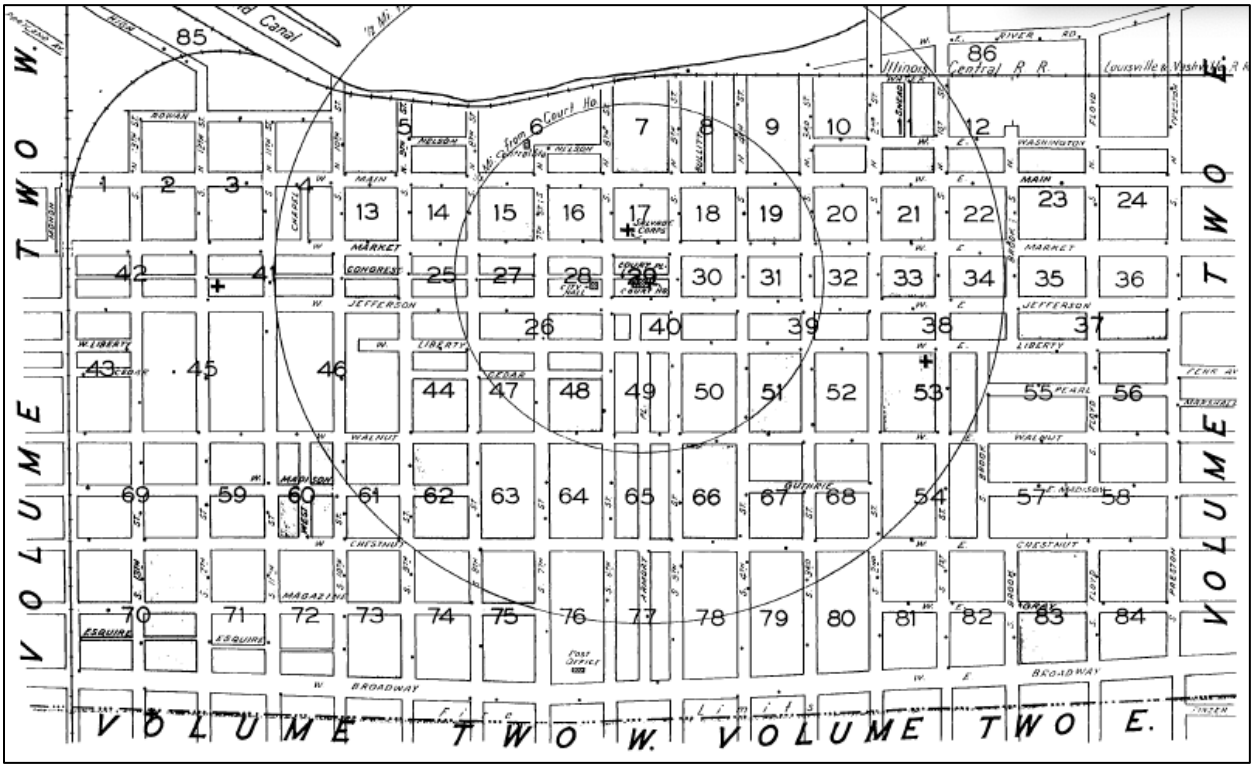
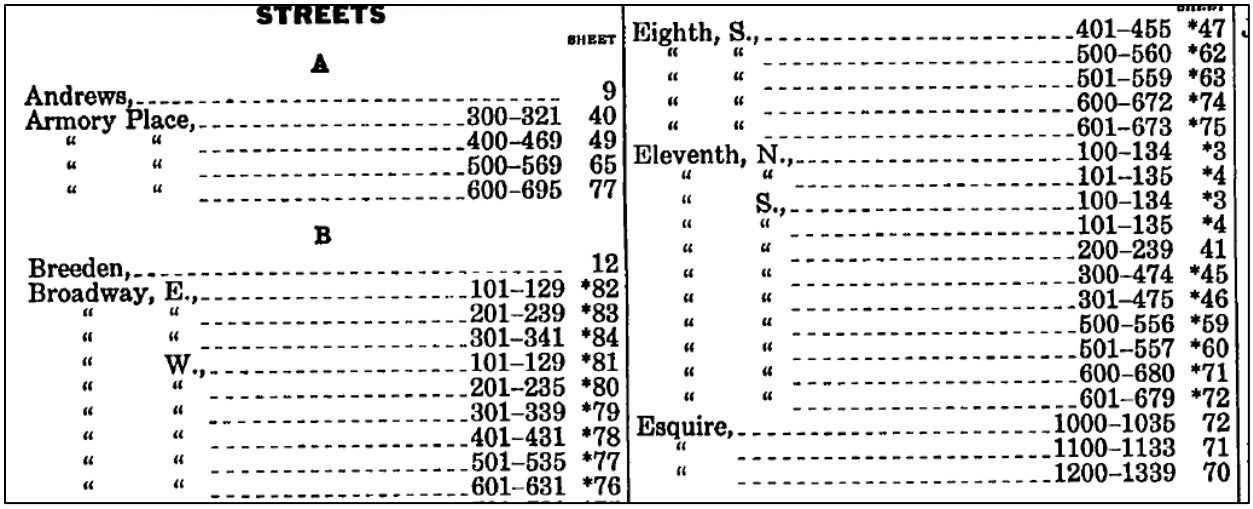


Figure 4.8. **Volume One of Sanborn Map Series for Downtown Louisville, 1928.** This reference map was used to modify modern Louisville streets into historically accurate streets (Sanborn 1940).



STREETS

		SHEET
A		
Andrews,		9
Armory Place,	300–321	40
" "	400–469	49
" "	500–569	65
" "	600–695	77
B		
Breeden,		12
Broadway, E.,	101–129	*82
" "	201–239	*83
" "	301–341	*84
" W.,	101–129	*81
" "	201–235	*80
" "	301–339	*79
" "	401–431	*78
" "	501–535	*77
" "	601–631	*76
Eighth, S.,	401–455	*47
" "	500–560	*62
" "	501–559	*63
" "	600–672	*74
" "	601–673	*75
Eleventh, N.,	100–134	*3
" "	101–135	*4
" S.,	100–134	*3
" "	101–135	*4
" "	200–239	41
" "	300–474	*45
" "	301–475	*46
" "	500–556	*59
" "	501–557	*60
" "	600–680	*71
" "	601–679	*72
Esquire,	1000–1035	72
"	1100–1133	71
"	1200–1339	70

Figure 4.9. **Index of Address Ranges and Correlated Sheets for Sanborn Maps.** This index indicates the address ranges by block. Sheets with asterisks next to them indicate that the address ranges only include one side of the street (Sanborn 1940).

The 1937 and 1940 resident location shapefiles contained all of the household information for the 445 households in the sample with the geographic coordinates of their addresses in 1937 and 1940. To create the 1937 and 1940 resident location shapefiles in the GIS software, household demographic data were added to the GIS repository. Fields for the latitude and longitude of the 1937 and 1940 addresses were added to the table. Each address was located using a combination of the historical road shapefile and Sanborn Fire Insurance maps and the geographic coordinates were added to the standalone table using decimal degree notation. For example, if a household lived at 1517 W Ormsby Ave in 1937, the Longitude_37 and Latitude_37 fields would be -85.779352 and 38.235419, respectively. Longitude was negative for these entries because, in the decimal degree notation, coordinates west of the Prime Meridian are negative. After all longitudes and latitudes were added to the household data, the "Display XY Data" tool was used to create two shapefiles for 1937 and 1940 household locations using the respective coordinates for the spatial reference. The process of georeferencing the addresses in 1937 and 1940 was time consuming but produced datasets that represent where the refugees

sampled resided at for two different points in time. These data were essential to the historical GIS because they aided in visualizing household movement after the flood in a way that non-spatial data could not illustrate.

Lastly, the Federal Emergency Management Administration (FEMA) has a publicly available repository of GIS datasets that indicate areas at risk of flooding. Flood Insurance Rate Maps (FIRMs) delineate places that are within the 100-year return period flood boundaries for all watersheds across the United States to determine who is eligible for federally-funded flood insurance. A shapefile containing FIRM lines for Jefferson County was downloaded and added to the historical GIS. There was no editing necessary for these data because it is supposed to visualize modern vulnerable places instead of historically vulnerable places. Although they are not historical data, the current FIRMs show areas of Louisville that are currently at risk for flooding.

This methodology illustrates how flood refugees who were impacted by the 1937 Ohio River flood were identified using historical newspaper publications and describes a migration study conducted on a sample of these flood refugees. Archival data sources like the 1940 manuscript Census, 1930 manuscript Census, and Louisville city directories were integral in data collection and to maintain a high level of confidence in the accuracy of the records. A historical GIS was created using flood evacuation data and residential microdata to digitally recreate the 1937 flood extent, evacuation patterns during the flood, and refugees' migration patterns after the flood occurred. Two data matrices were created as a product of this methodology and the historical GIS consisted of eight layers that represent different aspects of the effects that the flood had on Louisville residents' lives.

Chapter 5: Results and Discussion

The Ohio River flood of 1937 was the worst natural disaster in Louisville's recorded history, displacing over 20,000 residents and inundating 60% of the city (Filson 2006). The flood primarily affected the northern and western areas of the city because these areas are on the Ohio River floodplain. These neighborhoods predominantly consisted of African American residents, except for the affluent White neighborhood near Shawnee Park (Louisville Metro Government 2010). The flood occurred during the Great Depression, which increased the unemployment rate and stripped many communities of the little wealth they had heretofore accumulated. This research used archival sources like journalistic publications, manuscript censuses, and city directories to identify flood refugees in Louisville and track where they went after the 1937 flood. Refugee evacuation patterns were determined through tabulating Louisville *Courier-Journal* flood lists and spatial and temporal refugee migration was illustrated by collecting data for a sample of households identified as refugees in Louisville. These two datasets were entered into a historical GIS map of Louisville to illustrate how the race of flood refugees impacted both the flood experience and post-flood migration. The flood evacuation records show that fewer African Americans were evacuated from Louisville during the flood and had more limited evacuation options than Whites. This can likely be attributed to racist housing and labor practices present during the Southern Jim Crow era that limited the options that African Americans had in terms of residence and employment. Over the course of seven days, from January 29, 1937, to February 4, 1937, 9,832 flood refugees were recorded leaving their Louisville residences for over 170 unique post-flood destinations. White households comprised a majority of the refugees reported, went to more varied places, and spread over an area of larger spatial extent than African American households. Jeffersontown, Kentucky, was the destination that received the

largest number of refugees across the entire study period and received more African American refugees than White. Residential segregation proliferated after the flood with the publication of Homeowner's Loan Corporation (HOLC) residential security map that redlined neighborhoods that had a high concentration of African American residents (Poe 2013). These areas were primarily in Louisville's West End, specifically in the Russell and California neighborhoods, where there is now a higher poverty rate compared to the rest of the city, as well as a shorter average life expectancy and higher rates of cancer that some scholars attribute to racially motivated environmental injustice (O'Neill 2013; Gilderbloom et al. 2020). These facts are reflected in the residential location datasets, where African American residents were concentrated between the Central Business District and Shawnee neighborhoods while White households occupied a more varied area in the city.

A sample of 445 heads of households were identified by the *Courier-Journal* flood lists and traced through the 1930 and 1940 censuses to assess the movement patterns of flood refugees in the years that followed the flood. The majority of people affected by the flood, regardless of race, stayed within Louisville after the flood, but moved from their 1937 address. A majority of African American households either stayed at the same location or changed addresses within Louisville in 1940, and the Black households that stayed in Louisville after the flood typically stayed within the same neighborhoods that they lived in before the flood. There was generally a high level of mobility among all refugees from 1930 to 1940- some households changed addresses in every record year in which they were found.

When residential movement data was geocoded in ArcGIS, the results showed that households who stayed in Louisville either moved southward or eastward, or stayed in the same neighborhood that they originated. When African American residents moved out of Louisville

after the flood, they either went to historically Black neighborhoods or relocated to major urban areas to the north and south of the city. White refugees had a more varied spatial footprint than African American refugees regardless of if they stayed in Louisville or left the state. Although most of the households were located within the flood extent in 1937, there was not a mass exodus of residents from the floodplain. Historical flood map layers and modern flood risk layers indicate that residents in the West End of Louisville are still at risk for flooding despite the flood infrastructure that was built after this disaster, and continued segregation practices have resulted in the West End having an even higher concentration of African American households than it did in 1937.

Flood List Tabulation and Refugee Patterns

Tabulating the flood lists was necessary to provide more insight into the spatial patterns of Louisville flood refugees during the week-long flood evacuation and relocation period as well as the racial composition of the flood refugees. The flood list counts include daily refugee counts for every refugee destination and the racial composition of refugees for each place, which helps illustrate changes in refugee flow patterns throughout the flood for the 9,832 households that lived in Louisville in 1937. These refugees were identified going to 175 unique locations across the week of evacuation reporting (Figure 5.1). There were 133 refugee destinations in Kentucky, 25 destinations in Indiana, four destinations in Ohio and Tennessee, three destinations in Illinois, two destinations in Michigan, and one destination Georgia, New York, Pennsylvania, and Virginia. The farther away a relocation destination was from Louisville, the less people went there. Poughkeepsie, New York, is over 2,000 miles from Louisville and only one household relocated there, while nearby towns like St. Matthews and Jeffersontown received among the highest number of refugees for any location.

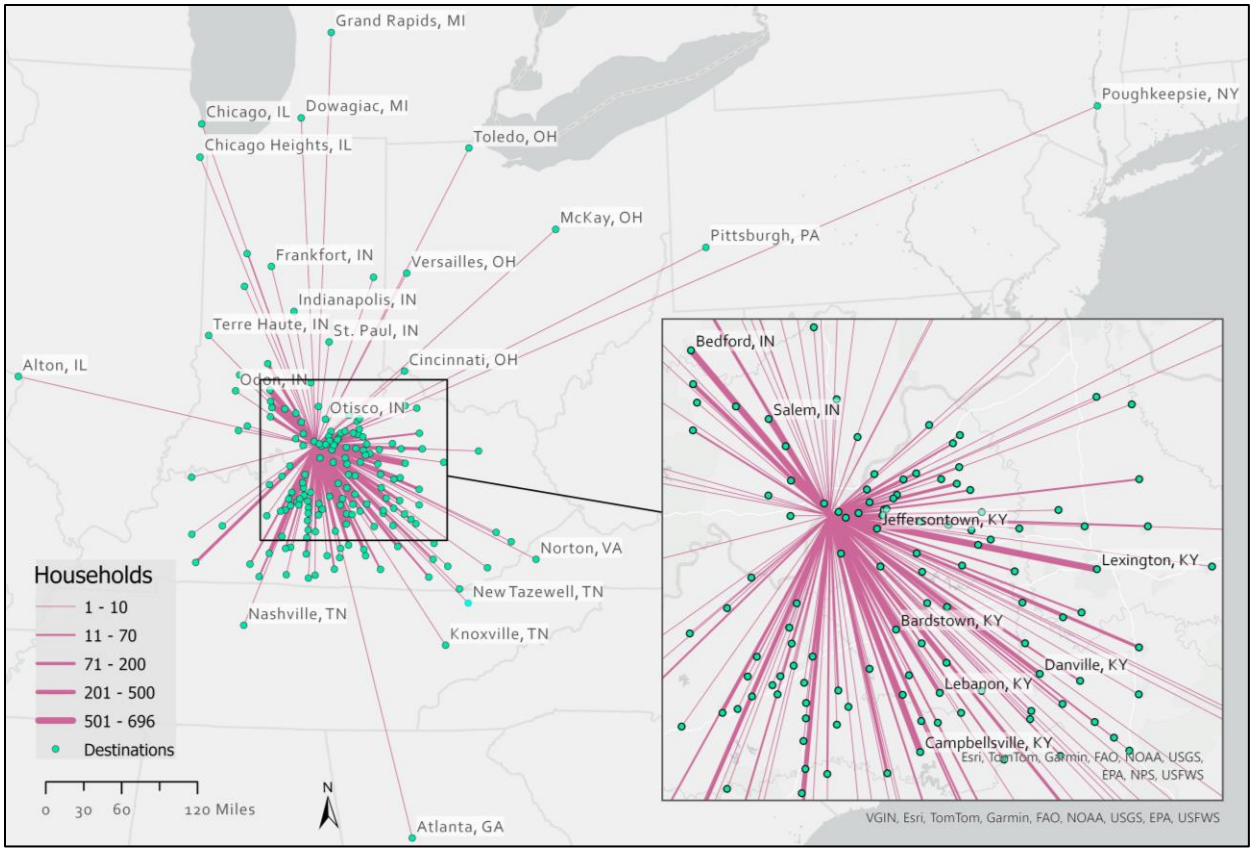


Figure 5.1. **Desire Line Map for All Refugee Evacuation Destinations.** Destinations outside of Kentucky are labeled, and line thickness represents the size of the refugee flow during flood evacuation. The ten largest evacuation destinations are labeled in the inset map.

Refugees of all races went to fewer destinations and did not go as far when they relocated at the beginning of the evacuation and relocation period. January 30, 1937 only had 14 destinations while February 2, 1937 had 73 (Figure 5.2). The latter half of the evacuation period had a larger spatial footprint and variability in the types of places refugees went to. For example, on February 2, 1937, refugees went to Chicago, Illinois; Nashville, Tennessee; Grand Rapids, Michigan; and Norton, Virginia. This day alone includes all but nine of the farthest relocation destinations from Louisville. It is likely that in the early part of the evacuation period, residents in Louisville were hesitant to leave their homes despite the threat of the flood. Since evacuation may not have been a consideration until the flood infrastructure broke, the first few days of the evacuation were less effective, included fewer people, and did not allow for refugees to move

farther distances. January 31, 1937, was the day with the highest number of refugees evacuated, with 2,639 households reported (Table 5.1).

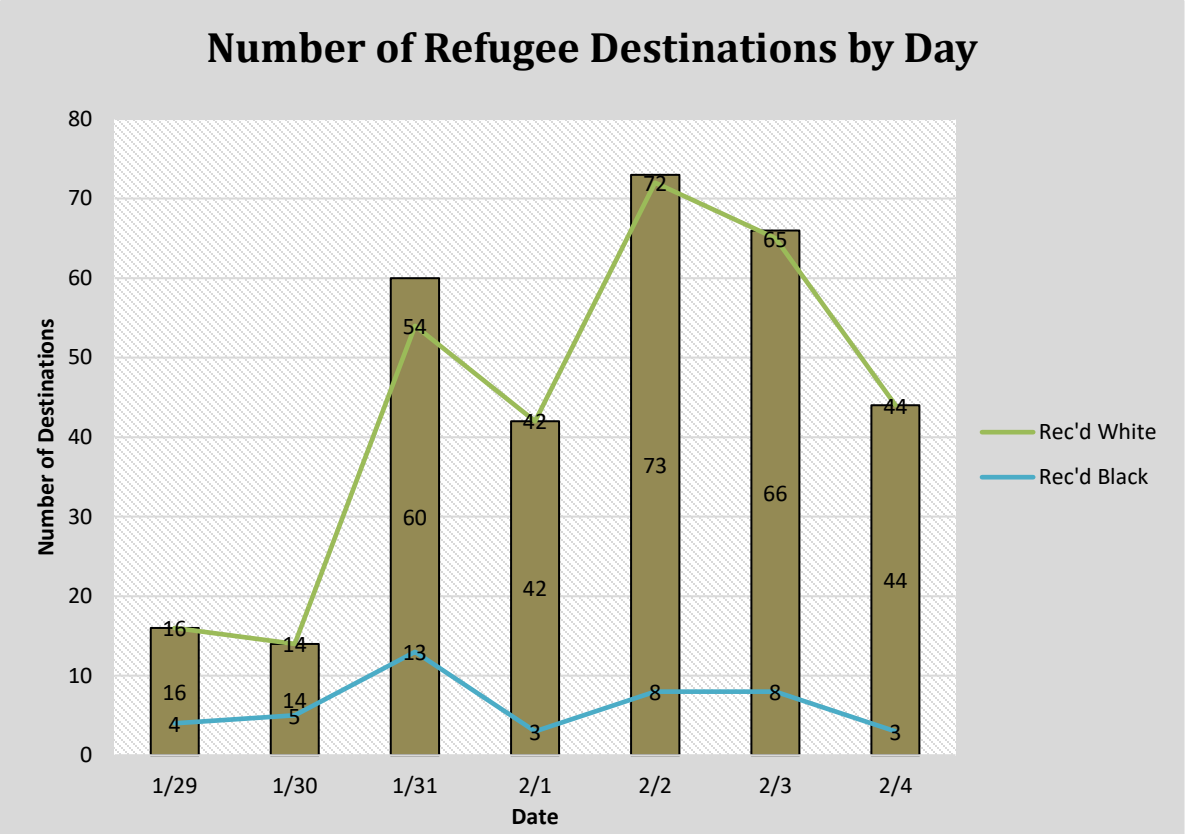


Figure 5.2. **Evacuation Destinations by Day.** The bars represent the total number of destinations refugees went to each day of reporting in the *Courier-Journal* flood lists. The green line represents the number of destinations that White households went to, and the blue line represents the number of destinations that Black households.

Date	White	Black	Total
1/29/37	427	558	985
1/30/37	311	171	482
1/31/37	1761	878	2639
2/1/37	934	25	959
2/2/37	2065	102	2167
2/3/37	1047	281	1328
2/4/37	1159	113	1272
Cumulative	7704	2128	9832

Table 5.1. **Refugee Households Reported by Race and By Day in *Courier-Journal* Flood Lists**. This includes the counts for every destination that refugees from Louisville went to for every day in the study period.

White households comprised a majority of flood refugees and outnumbered African American refugees every day except for January 29, 1937. African American refugees had less options for relocation and did not travel, on average, as far as their White counterparts. In fact, African Americans only relocated within Kentucky and southern Indiana, while Whites relocated as far as Poughkeepsie, New York, and Atlanta, Georgia. Analyzing the patterns in the flood list reported for a sample of households highlights the difference in outcomes in the evacuation process for White and Black populations in Louisville, which was most likely informed by the context of the Southern Jim Crow era.

The ten destinations that received the highest number of flood refugees from Louisville illustrate how race influenced evacuation outcomes. The ten places that received the highest numbers of refugees were located in Kentucky and Indiana (Table 5.2) and five of the top ten destinations received a disproportionate number of White households. The destination that received the most refugees was Jeffersontown, which is a town approximately twenty miles south of downtown Louisville. St. Matthews is another modern neighborhood in the Louisville Metropolitan area that was a separate city at the time of evacuation. Lexington is the second largest urban area in Kentucky, and it received an equal number of White and Black refugees during flood evacuation. Of the top ten relocation destinations, Lexington, Campbellsville, and Danville were the three farthest destinations from Louisville (Figure 5.3). It is evident that African American flood refugees overwhelmingly went south and east when evacuating from Louisville. Most destinations received more White refugees than African American refugees and all but one of the largest destinations received both White and African Americans.

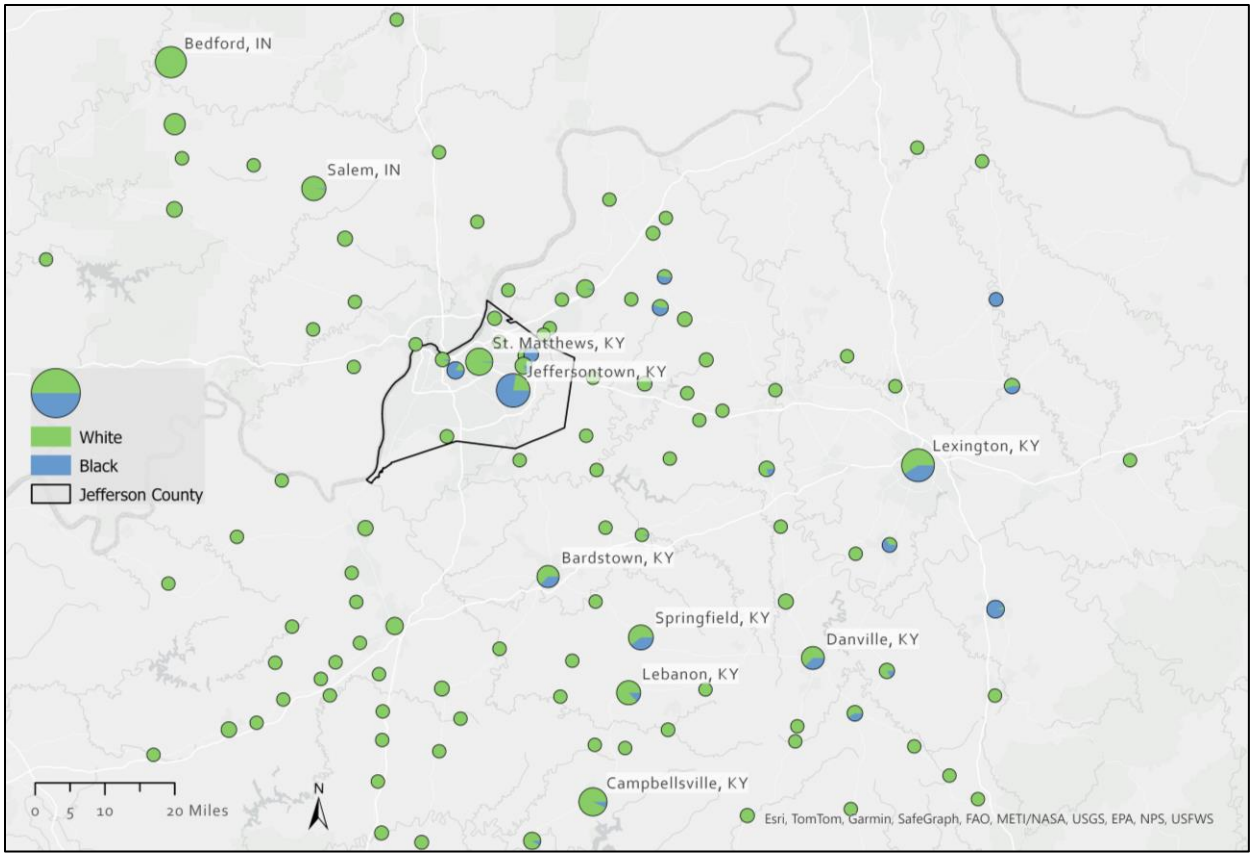


Figure 5.3. **Kentucky and Indiana Destinations by Race.** The pie charts indicate the proportion of each race received at each destination, where White refugees are colored green and Black households are colored blue. The ten destinations that received the highest numbers of refugees are labeled.

	Name	White	Black	Total
1	Jeffersontown, KY	155	541	696
2	Lexington, KY	395	275	670
3	Bedford, IN	615	0	615
4	Campbellsville, KY	478	36	514
5	St. Matthews, KY	473	8	481
6	Springfield, KY	245	161	406
7	Salem, IN	377	6	383
8	Lebanon, KY	330	48	378
9	Danville, KY	212	126	338
10	Bardstown, KY	196	117	313

Table 5.2. **Ten Destinations that Received the Most Refugees.** The counts for the White, Black, and Total columns are for the entirety of the evacuation and relocation period, not for a single day.

Five of the ten biggest destinations received disproportionately high numbers of White households. Bedford, Indiana, exclusively received White households, while Salem, Indiana; St. Matthews, Kentucky; Lebanon, Kentucky; and Campbellsville, Kentucky, received disproportionately large numbers of Whites. St. Matthews was one of the biggest areas for suburban growth in the 1950s and 60s, as well as a common place for White families to settle in as White flight became more common. In the present, St. Matthews has a higher percentage of White households, higher median cost for owner-occupied units, higher educational attainment, and double Jeffersontown's per capita income. St. Matthews did not receive many African American refugees during the evacuation process.

African American refugees consistently went to fewer destinations than White refugees and had a higher level of clustering in certain places (Figures 5.4 and 5.5). There were only two places that Black refugees exclusively relocated to, which were Berrytown and Cynthiana, Kentucky. Berrytown is a historically Black neighborhood next to Middletown and Anchorage and is now a suburban area within the Louisville Metropolitan Area. It was expected that Berrytown would receive more Black refugees than Whites. Apart from these two destinations, there were only 29 places that received both White and Black refugees and 144 places that exclusively received White refugees, which indicates that there was racial segregation present in the flood evacuation process. Black refugees relocated only in Kentucky except for the six households that went to Salem, Indiana, and the three that went to Bloomington, Indiana. Most of the places Black refugees migrated to were urbanized areas. White (2005) and Adams (2006) both found that much of the African American migration that occurred in the United States in the

1930s was step migration from the rural South to urbanized areas in the South and then to urbanized areas in the North.

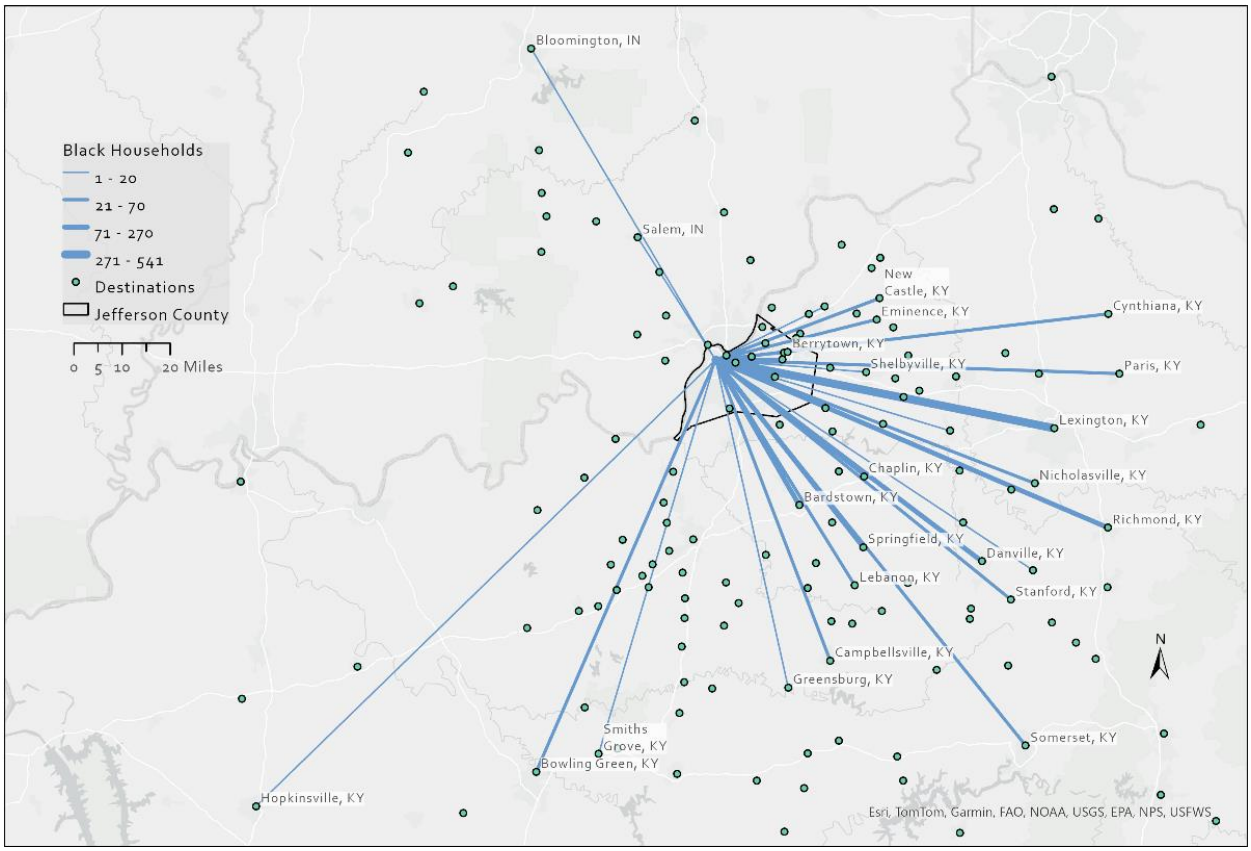


Figure 5.4. **Black Refugee Destinations with Desire Lines.** All destinations are within Kentucky and southern Indiana with desire lines that depict the flow of African American refugees during the 1937 flood. All places that received African American refugees are labeled. Unlabeled destinations were places that only White refugees relocated.

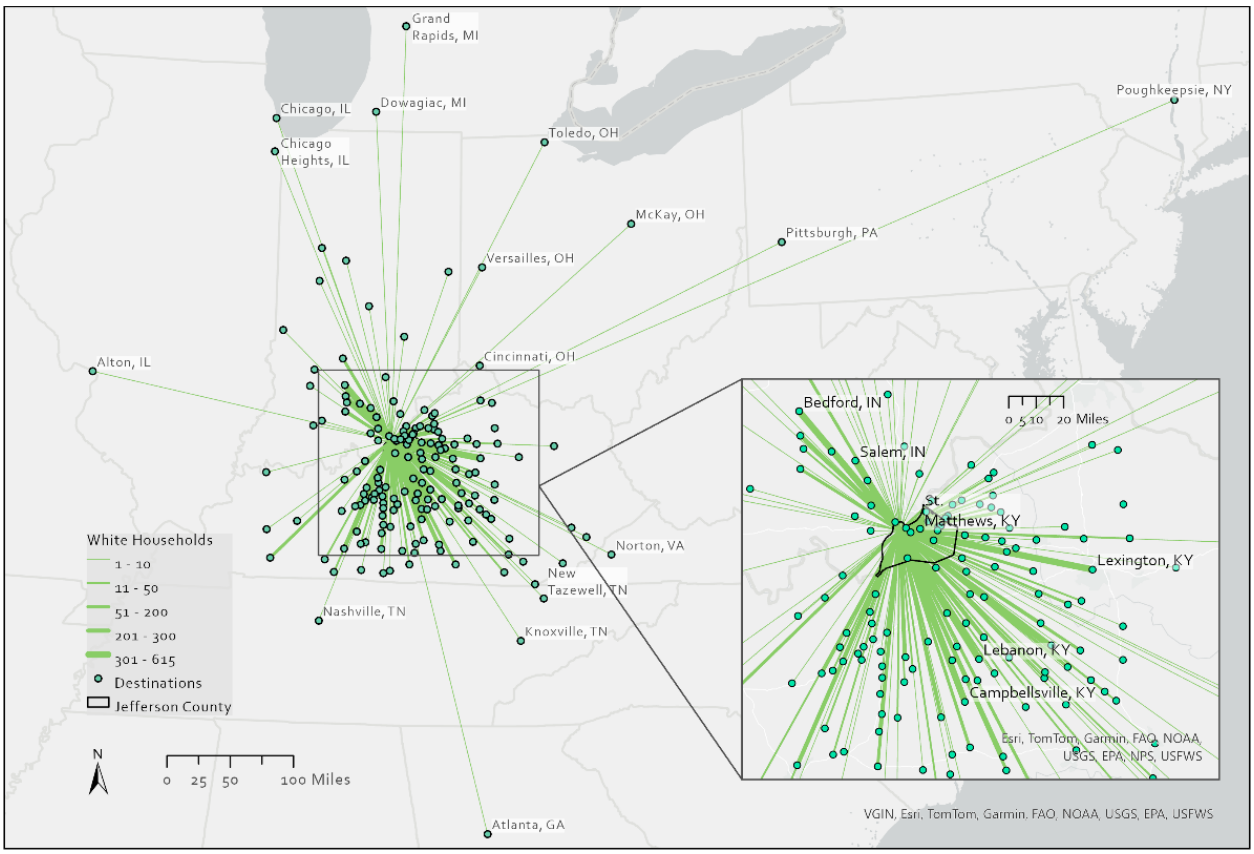


Figure 5.5. **White Refugee Destinations with Desire Lines.** The inset map shows Kentucky and southern Indiana in more detail. Refugee destinations outside of Kentucky are labelled in the main map frame, while the most common destinations for White refugees are labelled in the inset map.

As a part of the desire lines tool in ArcGIS Pro, the software created reports about the directionality and distance of the destinations from Louisville. The median straight-line distance travelled by all refugees was 203.5 miles and the farthest distance was 2,208.4 miles. Jeffersontown, Kentucky, was the closest destination for both White and Black refugees at 8.0 miles, but the farthest distance Black refugees travelled was 436.0 miles. Black refugees also had a smaller median distance than Whites (180.3 vs 203.5 miles, respectively). Refugees went to destinations located south-southwest and southeast of Louisville with the highest frequency but traveled farther when going north-northeast, north-northwest, and west-southwest. The northern and western border of Louisville is the Ohio River, so it makes sense that refugees went south

and east most frequently. Crossing the Ohio River was likely difficult during this time due to flooding on both banks of the river that would have impaired transportation infrastructure. Refugees would not have wanted to travel west along the Ohio River because the entire floodplain was inundated during this event. If refugees managed to cross the river during the flood to relocate north, they likely had more financial resources that would have allowed them to travel farther distances to reach their intended evacuation destinations. The trend for White refugees align well with the trend for all refugees. Conversely, African American refugees went east and east-southeast most frequently and traveled farther when going southwest and south-southwest. Refer to Appendices C, D, and E for copies of the ArcGIS Wind Rose reports for all refugees, White refugees, and African American refugees, respectively.

The results of the flood list tabulation reinforce the findings that African Americans living in Louisville were less likely to relocate to rural places. At this point in history, there was a mass exodus of African American sharecroppers from the rural American south, which is referred to as the Great Migration. One of the key drivers of this phenomenon was the Mississippi River flood of 1927, which exacerbated the already poor living conditions of Black farmers in the rural South (Hornbeck and Naidu 2014). The African American population doubled in Louisville from 1920 to 1970, and similar trends were present across the country (Adams 2001). Intra-state migration was the most common type of movement during the Great Migration, and movement within the same state or between states in the South was more common than movement north during this time (Adams 2006). The evacuation patterns present in Louisville after the 1937 flood align with this trend because most of the Black refugees stayed within Kentucky rather than going to other states. African Americans typically had fewer economic resources that limited their ability to move farther distances, and Jim Crow laws

reinforced racial segregation, which limited relocation opportunities for Black residents. There was likely to be African American communities present in other urbanized areas in Kentucky that would have attracted Black refugees from Louisville to these places. Rural areas were also less likely to accept Black refugees, discouraging people from seeking refuge in these places. On the other hand, White people would experience less marginalization no matter where they relocated. This is reflected in the broader spatial footprint of White refugee relocation pattern and the greater variety of urban/rural destinations those households went to.

It is evident that race had a role in determining where refugees went during the flood. African American refugees had a considerably smaller spatial footprint than their White counterparts, and mostly relocated to other urban areas. Rural areas of Kentucky were less welcoming to African Americans during this time, and it may have been more difficult to move refugees north across the Ohio River due to the widespread flooding. Despite the fact that the flood occurred during the Great Migration, where millions of African Americans migrated north out of rural southern areas, most African American refugees went south during the flood. These results shed light on the way that social and economic influences can impact refugee status and relocation efforts. The fact that African Americans stayed in urban areas and relocated mostly within Kentucky aligns with literature on the Great Migration because most migrations during this time were intra-state or urban-to-urban, not south-to-north (Adams 2006).

Migration and Demographic Analysis

The flood list count and visualization offer a broad understanding of where refugees were relocated in the immediate aftermath of the 1937 flood, but these data do not necessarily reflect a permanent change in residence after the flood, nor do they provide a detailed look into the demographic and economic situations of those reported in the lists. To build on the takeaways of

impacts from the 1937 flood, microdata were analyzed using a sample of households reported in the flood list to study their movement patterns before and after the flood. Microdata are a type of demographic data that are used to study residents at the household or individual scale and provide a fine-grained view of demographic change in the study area. For this project, heads of households were used to represent an individual or group that lived at an address in 1930 and their residential locations were tracked from 1930 to 1940. The address, household size, ownership status, and home value/monthly rent were recorded for each head of household in 1930 and 1940 from each respective census. The address reported in the flood list, date reported, and relocation destination were recorded using the *Courier-Journal* flood lists. Lastly, demographic information for each head of household in 1940 were recorded, including birth year, age, race, marital status, occupation, and annual income. Changes in the head of household or supplemental information for entries were also noted.

A total of 797 households were investigated as a sample in this migration study. Of the initial sample, 352 households were not included in the study because there was not enough information available about them to confidently identify them in the 1930 and 1940 Censuses. These 352 households were either found in 1930 but not 1940, had misspelled names, or had a common name that could not be positively identified, so they were not included in the sample. There were 445 households whose locations were verified in 1940 resulting in a 56% success rate for identifying households from the 797 households sampled. 455 households out of the 9,832 that were originally tabulated in the flood list constituted a 4.6% sample of the total population in the flood lists. This dataset provides more insight about how representative the sample is of the original dataset. Each day that refugees evacuated from the city was represented in the sample, but January 30, 1937, to February 3, 1937, are underrepresented in the data (Table

5.3). A sample of convenience was utilized in this study because one goal of the research was to explore how refugees of different races moved during and after the flood event. As such, the microdata sample over represents the African American flood refugees. All of the refugees who relocated to the farthest destinations from Louisville were sought for in the Census to see how relocation distance affected the likelihood that people left Louisville.

		1/29/37	1/30/37	1/31/37	2/1/37	2/2/37	2/3/37	2/4/37	Total
Flood List	Total	985	482	2639	959	2167	1328	1272	9832
	White	427	311	1761	934	2065	1047	1159	7704
	Black	558	171	878	25	102	281	113	2128
Sample	Total	122	47	38	31	54	46	107	445
	White	25	0	19	28	54	45	78	249
	Black	97*	47	19	3	0	1	29	196
Unlocated	Total	87	48	36	14	32	71	64	352
	White	8	0	16	12	32	71	33	172
	Black	79	48	20	2	0	0	31	180

Table 5.3. **Comparison of Flood List Counts with Located and Unlocated Samples.** * The Black sample on January 29, 1937 includes the only Asian household identified in the sample.

The sample consists of 249 white households (54.7%), 195 African American households (42.8%), and one Asian household. The singular Asian household was included in the count with African Americans because the head, Louis Yan, consistently encountered discrimination for the laundromat he owned. As a racial minority, it is fitting for him to be included with the African American sample. There were 343 male heads of household represented in the sample (75.4%) and 102 female heads of households (24.6%). Marital status was confirmed for 433 heads of household in 1940 and 429 heads of household's home occupancy status was documented for 1940. The difference in head counts was due to the fact that 1) some records were verified with the Louisville city directories instead of the census in 1940, 2) some entries in the Census did not have occupancy status filled out, or 3) the entry was illegible. Some households also had this

information missing in 1930 for the same reasons. Occupancy status was verified for 82.1% of the sample (374) in 1930 and 94.3% (429) was verified in 1940. There were more renters than owners in both decades, and the median household size was four people regardless of race or occupancy status. Almost all heads of household had their marital status confirmed in 1940 (95.2% or 433 households). Of this group, 310 were married, 29 were single, 84 were widowed, and 10 were divorced.

The average income in 1940 for the sample was $865.27, average 1940 rent was $14, and average 1940 home value was $3240.10. There were 108 households sampled that were homeowners in 1930 and 1940, and 67 of these homes saw a decrease in their home value. 53 of the 67 households who saw a decrease in their home value stayed at the same address from 1930 to 1940. Two factors likely influenced this change in home value: The Great Depression and the Great Flood of 1937. Many of the homeowners that experienced home value depreciation were White, which may indicate that the flood may have contributed to lower levels of land capital available in the flooded area. Home depreciation may have caused the urban disinvestment and blight that became prevalent in the 1950s. In fact, the HOLC frequently cited the presence of African Americans and the detrimental effects of the 1937 flood when they gave neighborhoods low ratings on their 1937 residential security maps (Poe 2013). Average homeowner value dropped from $4148 to $3240 over the decade and average monthly rent dropped from $19 to $14. A decrease in the values of property across the floodplain paired with the devastating effects of the flood could have caused homeowners to leave this area for more stable areas. All of these data were added to a table with race and gender as independent variables and movement type, marital status, occupancy status, home value in 1940, average income (in 1940 dollars), and average age as dependent variables (Table 5.4).

	Household Count	*Migration Code*				*Marital Status*					*Occupancy Status 1940*			*Avg Home Value in 1940 ($)*		*Average Income*	*Average Age*
		SA	SL	SK	LK	M	S	WD	D	Total	Rent	Own	Total	Renter	Owner	1940 $	Years
All	445	196	226	14	9	310	29	84	10	433	283	146	429	14	3240	865.27	47
Male	343	153	170	13	7	303	9	21	3	336	217	113	339	14	3277	944.20	47
Female	102	43	56	2	2	7	20	63	7	97	66	33	101	13	3107	361.89	49
White	249	126	112	6	5	183	14	39	8	244	135	110	245	17	3554	1118.16	49
Male	201	100	92	4	5	182	5	10	2	199	107	92	199	18	3753	1165.45	47
Female	48	26	20	2	0	1	9	29	6	45	28	18	46	15	2397	527.00	54
Black	196	70	113	8	4	127	15	45	2	189	148	36	184	11	2383	531.05	45
Male	142	53	78	8	2	121	4	11	1	137	110	21	131	11	1454	598.51	45
Female	54	17	35	0	2	6	11	34	1	52	38	15	53	11	3775	287.32	45

Table 5.4. **Migration and Demographic Data Summarized by Race and Gender.** The migration codes represent different types of movement exhibited by sampled households after the flood. SA represents households that stayed at the same address in 1937 and 1940, SL represents households that stayed in Louisville but changed addresses after the flood, SK represents households that left Louisville but stayed in Kentucky after the flood, and LK represents households that left Kentucky after the flood. The marital status abbreviations are as follows: M is short for married, S is short for single, WD is short for widowed, and D is short for divorced.

The largest group in the sample is White male heads of household, followed by Black men, Black women, and then White women. This result could be because many African American women moved to urban areas to seek better opportunities during the Great Migration (White 2005) while White women were more reliant on men to work and provide income for families. Most households, regardless of race, changed addresses but stayed in Louisville (SL) and an almost equal number stayed at the same address before and after the flood. White households stayed at the same address more than changing addresses within the city, while African American households moved within Louisville more frequently than staying at the same address. These moves were often over short distances and probably did not induce a change in the social networks present at the time. Social networks likely played an important role in the high number of people that stayed close to their address of origin; they were already familiar and comfortable in these areas, and moving would lead to removal from the social networks and community spaces that they were used to. Although living through the flood was likely a negative experience and one would think that refugees would want to move, these places were still the neighborhoods and communities of the flood refugees and people most likely did not want to leave these areas. Since the Great Depression negatively impacted the economic situation of households in Louisville, many of these people may not have had the resources to relocate off the floodplain if they wanted to. Most White people lived near Shawnee Park and the Ohio River, which was also the most affluent and desirable neighborhood in the West End in the 1937 HOLC map (Poe 2013). When White households relocated within the city, many moved eastward to Brownsboro Road and Grinstead Drive, which were in more predominantly White areas of town.

There were fifty-eight households that were not located in the 1930 Census and do not have addresses for the beginning of the decade. This was not an issue as long as the flood list reported an address for the household in 1937. Other fields that were often missing or filled in incorrectly were the home value/monthly rent, marital status, occupation, and annual income. Over 60 people either did not have their income filled out in 1940 or it was recorded as $0 despite actively working during that time. These data were supplemental to the racial and spatial information for households, so although it is not preferable to have missing or incomplete data, there was no effective way to work around this issue if it was not included correctly in the manuscript census. A total of 344 households had occupation and annual income data recorded from the 1940 Census. Homeownership status and home value were two more important fields that occasionally were not filled out by census enumerators. In 1930, 71 households were missing ownership status data and 86 were missing home value data. There were only 16 households missing ownership status and 24 missing home value data in the 1940 Census. It is not preferable to have missing data on households in the sample, but the number in 1940 is relatively small and these data were not essential for data analysis.

Four migration codes were used to differentiate the movement patterns of households across time (SA- same address, SL- changed address and stayed in Louisville, SK- left Louisville and stayed in Kentucky, LK- left Kentucky). Every household in the study was coded with one of these four values depending on how their address changed from 1930 to 1940. In total, 43.1% (196) of households stayed at the same address, 49.7% (226) changed addresses but stayed in Louisville, 3.1% (14) left Louisville but stayed in Kentucky, and 4.1% (9) left Kentucky after the flood. Many households moved more than once during the 10-year period of the study, which indicates a high level of residential mobility during this time. Many moves were not very far;

some people moved within a few blocks of their previous residence. Households that are displaced by a singular natural disaster event typically return back to their origins after only a short time (Black et al. 2011). In the residents' eyes, the displacing event is not enough of a reason for people to want to leave, especially when considering the social and economic networks the residents have in this place. The spatial patterns for residential movement within the city of Louisville will be discussed more comprehensively in the next subsection of the results because GIS was used to visualize these changes.

Across both races, women were more likely to be head of household if they were single, divorced, or widowed and men overwhelmingly were heads of household in married couples. Women had less economic and social freedom during this time and were shown to be less likely to be the head of the house if they had husbands. However, when compared to single men, single women were more likely to be head of house. These women were often daughters or aunts that never married (or lied about being divorced) and would care for their extended family. It is likely that the average for Black female home values were abnormally high because of bias in the sampling, especially considering that their average income in 1940 was by far the lowest of all groups in the sample. Women were also more likely to rent than own houses across both races, which further works against the high average value of owned homes.

The average income variable matches what was expected for this time and provides important context to the data related to economic status. On average, White heads of household made more money than their African American counterparts and men made more than women. African American men made almost the same amount of money as white women, which illustrates how impactful race, gender, and marital status were for economic opportunities. The wage disparity likely contributed to the reason that African American refugees relocated closer

to Louisville than their White counterparts. Along with higher income, White people's homes were valued higher than African American's homes. There were many cases in which the value of a family's home dropped by over half in the ten years between the 1930 and 1940 census.

There were many factors that contributed to White and Black people relocating differently after the flood, one of which is where people lived when the flood occurred in 1937. Black households were concentrated in between the riverfront in the West End and downtown in the Central Business District (Figure 5.6). There was a small concentration of African Americans in the southwest part of the city, which is where the current Chickasaw neighborhood is located. This neighborhood was rated as declining and hazardous in the 1937 HOLC map (Figure 5.8). Other neighborhoods like Portland, Russell, California, and Shelby Park also all had a high concentration of African American households. The central concentration of Black households aligns with where the majority of Black wealth in Louisville was located before the Great Depression on Walnut Street between 6th Street and 18th Street (Figure 5.7a). This pattern persists into 1940, which means that Black people generally did not move out of these neighborhoods after the flood (Figure 5.7b). There were a few Black households that moved east into Clifton and the Highlands, and 12 households that left Louisville after the flood.

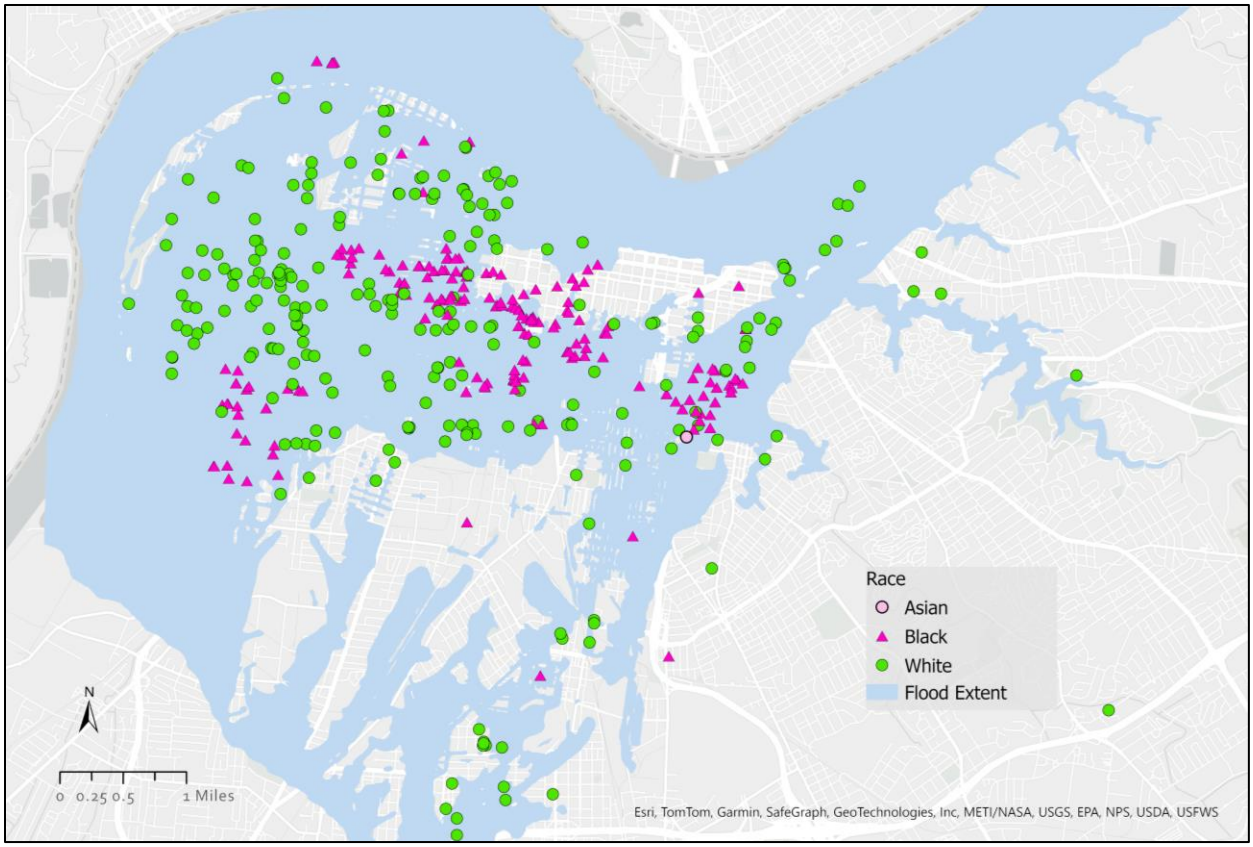


Figure 5.6. **All Household Locations, 1937**. This map shows where every household was located before the 1937 flood occurred, using the address that was reported in the *Courier-Journal* flood lists. White households are symbolized as green circles, African American households are symbolized as purple triangles, and the Asian household is symbolized as a pink circle.

Figure 5.7a

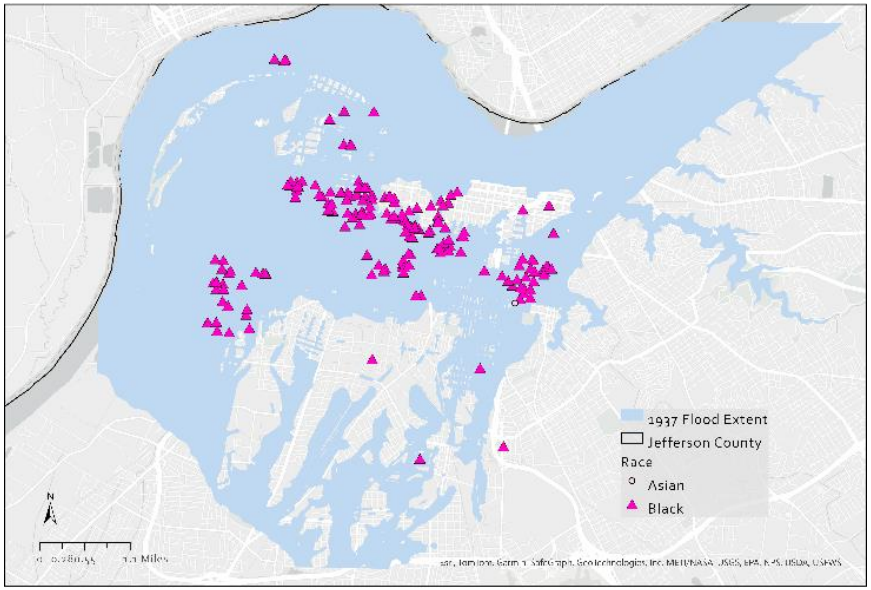


Figure 5.7b

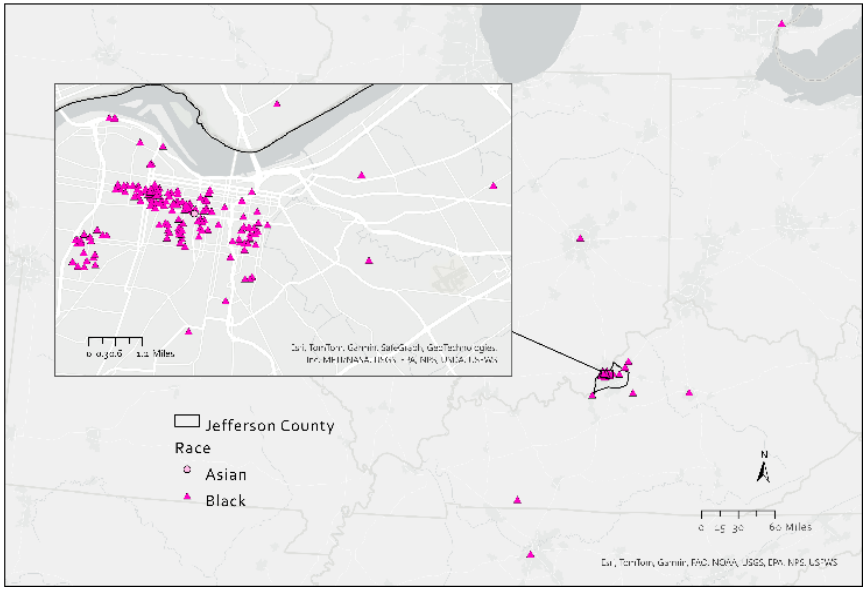


Figure 5.7a. **Black Refugee Sample Locations in 1937.** The left image shows the locations of every minority household included in the sample (Black and Asian) in 1937 before the flood occurred (n = 196). Figure 5.7b. **Black Refugee Sample Locations in 1940.** The right image depicts where each African American and Asian household lived in 1940. Four African Americans left the state in 1940 and eight left Louisville but stayed in Kentucky

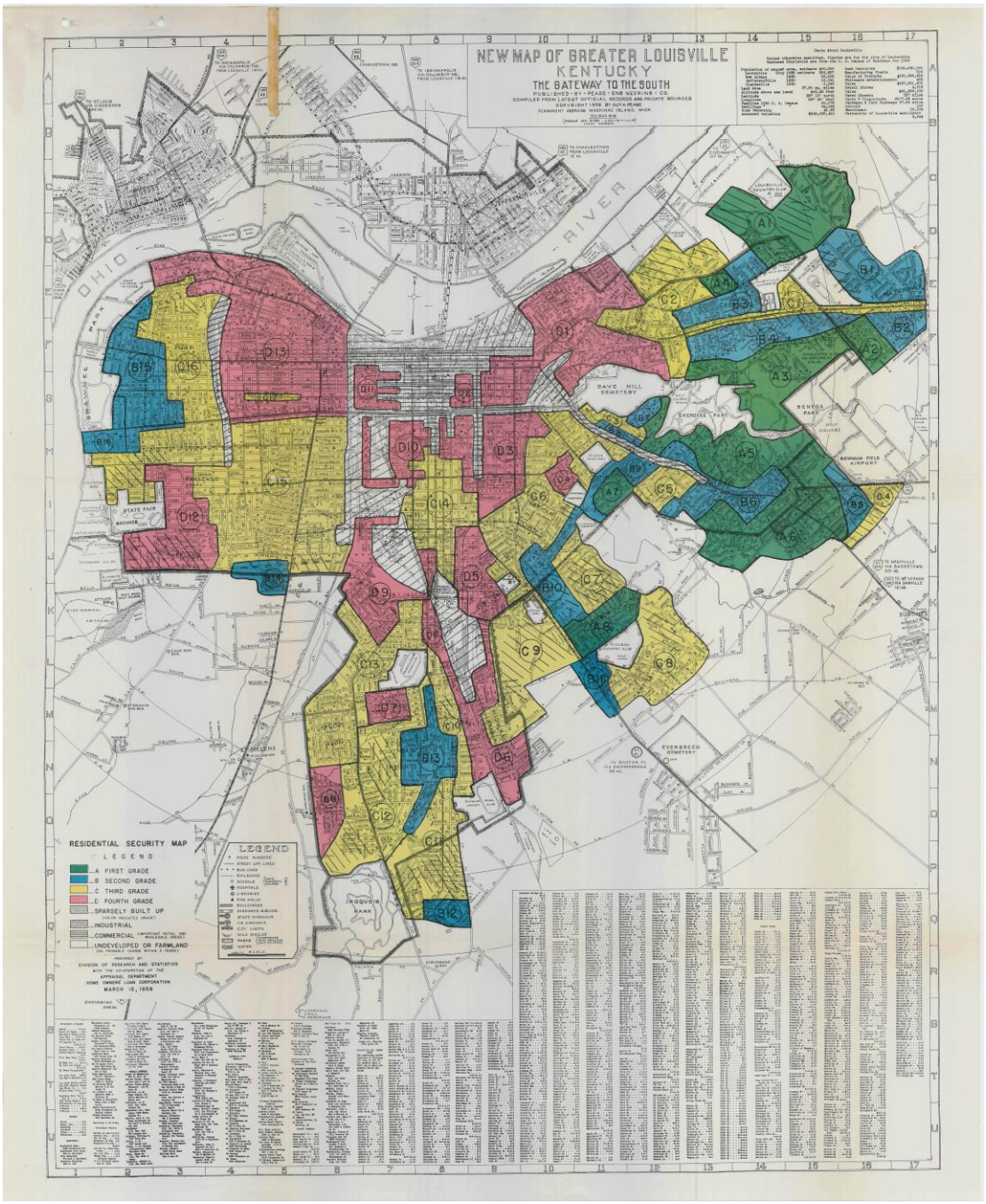


Figure 5.8. **Homeowner's Loan Corporation Residential Security Map for Louisville.** This map was created to aid in deciding where mortgage loans should be approved and was made after the flood of 1937. Green and blue neighborhoods ("A" and "B" respectively) typically consisted of White residents with more desirability. "C" (yellow) and "D" (red) neighborhoods were typically inhabited by African Americans, and in this map, indicate 1937 flood damage as a trait making these neighborhoods less desirable. Compare the lower rated neighborhoods with the location of African American residents before and after the flood in Figures 5.7a and 5.7b (Poe 2013).

On the other hand, White households occupied a much larger area of the city before the flood occurred. Many households were situated very close to the Ohio River both in the West End near Shawnee Park and Portland, which was closer to downtown (Figure 5.9a). There were White households that were flood refugees in the Butchertown, Clifton, and the Highlands neighborhoods to the east. Beargrass Creek, one of the largest tributaries to the Ohio River in Louisville, is shown in the curved flooded area that extends into the city of Louisville (Figure 5.9a). It is evident that White households had a much larger spatial footprint than African American households did in 1937 (Figures 5.7a and 5.9a). Louisville never had legalized segregation but there was consistent *de facto* segregation in terms of access to public spaces, home loan approvals, and educational opportunities (Cummings and Price 1997). This is reflected both in the original locations of White and Black households within the city of Louisville as well as the migration patterns for both groups. White people relocated south more frequently than Black people and were able to move farther away from Louisville (Figure 5.9b). They also had more options for places to relocate to in the aftermath of the flood, as well as travelling longer distances when relocating than their African American counterparts.

Figure 5.9a

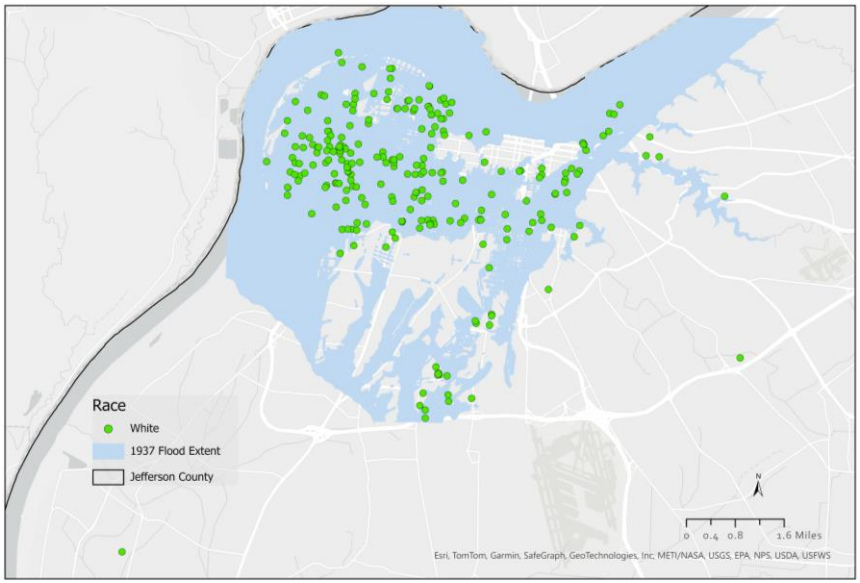


Figure 5.9b

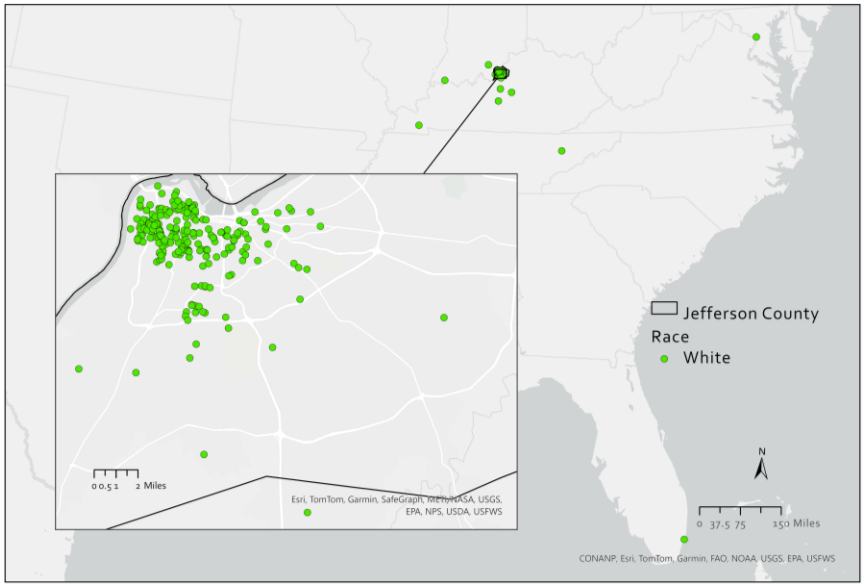


Figure 5.9a. **White Refugee Sample Locations in 1937.** The 1937 flood extent is shown as the area shaded blue. Figure 5.9b. **White Refugee Sample Locations in 1940.** On the right, White household locations in 1940 with an inset map showing Louisville in more detail.

Households that stayed in Louisville in 1940

Residents were characterized as staying in Louisville if they returned to the same address after the flood, or if they changed addresses but stayed within Louisville city limits in 1940. There were 422 households that stayed in Louisville after the flood; 196 stayed at the same address from 1937 to 1940 and 226 people moved within the city after the flood. It was expected that flood refugees would return to their 1937 addresses because they were familiar with the places they originated from, and refugees displaced from single-event natural disasters typically return to their origin after the disaster (Black et al. 2011). There were households that stayed at the same address across the entire study area (Figure 5.10). White households that stayed at the same address were most concentrated in the far West End near Shawnee Park and Parkland, and there were clusters of African American households that stayed at the same address in the Chickasaw, Russell, and Smoketown neighborhoods (Figure 5.10).

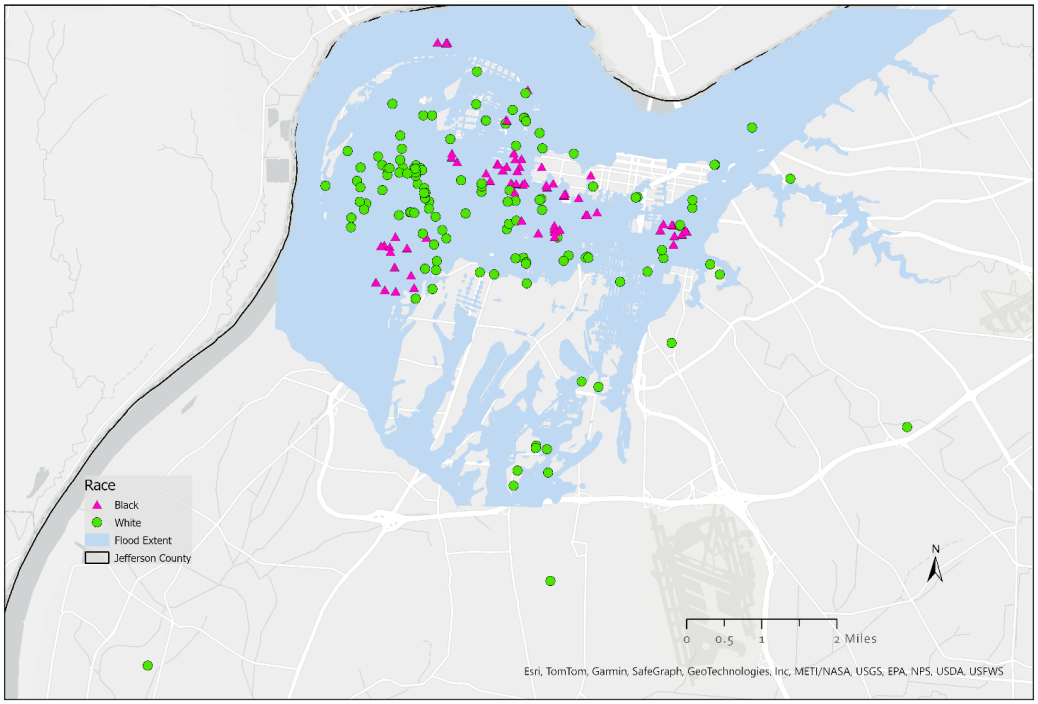


Figure 5.10. **White and Black Samples Who Stayed at the Same Address in 1937 and 1940.** White households are symbolized as green circles and Black residents are symbolized as purple triangles.

There were 126 White households that stayed at the same address and only 70 African American households. Staying in the same place was not always advantageous for residents. For example, 73 White households saw a decrease in the value of their homes from 1930 to 1940 even though they did not move. Many households lost over half of the value of their homes from 1930 to 1940, the largest loss being $4,000. Only 27 African American households had their home value decrease between 1930 and 1940, the majority of which were renters in 1940. The two main contributors to this trend were likely the Great Depression and the flood in 1937. The HOLC often cited the presence of African Americans and destruction from the 1937 flood in the neighborhoods to which it gave a "D" or hazardous rating (Poe 2013).

Most of the heads of household for this group of people were married men. There were no married women who were heads of household and there were only five divorced heads of household and 11 single heads of household. Women in this grouping were more likely to be a head of household if they were widowed in 1940; in fact, only two of the households that stayed at the same address were headed by widowed African American women. Communities rely on social networks to help recover after a natural disaster occurs (McLeman and Smit 2006), and the African American population was clearly limited in their options for relocating after the flood.

The most common migration pattern in the study was people who stayed in Louisville but changed addresses after the flood. There were 113 African American households, 112 White households, and one Asian household that changed addresses within the city of Louisville after the flood. While collecting data on the samples, it was common to see people move multiple times in the city directories in different years. There was likely a high level of residential mobility during this time, which allowed for more frequent moves. For the African American sample, most of the movement was towards the south and east, away from the river and flooded

areas (Figure 5.11). Two households moved to East End neighborhoods like Clifton and the Highlands, and both moves were made by Black women. Mattie Wise lived as a cook for a White family that owned one of the most expensive houses identified in the study. Her migration likely brought her more economic security along with safety from the floodplain. Maggie Statton was another Black woman that moved east into Clifton, into a house that she owned and headed herself. On the western side of Figure 5.11, it is evident that most of the residential movement occurred within the same neighborhood that residents lived in before the flood. This could indicate the presence of strong social networks in the African American neighborhoods that encouraged residents to stay in these areas. It is also common for environmental refugees to return to their place of origin (Black et al. 2011).

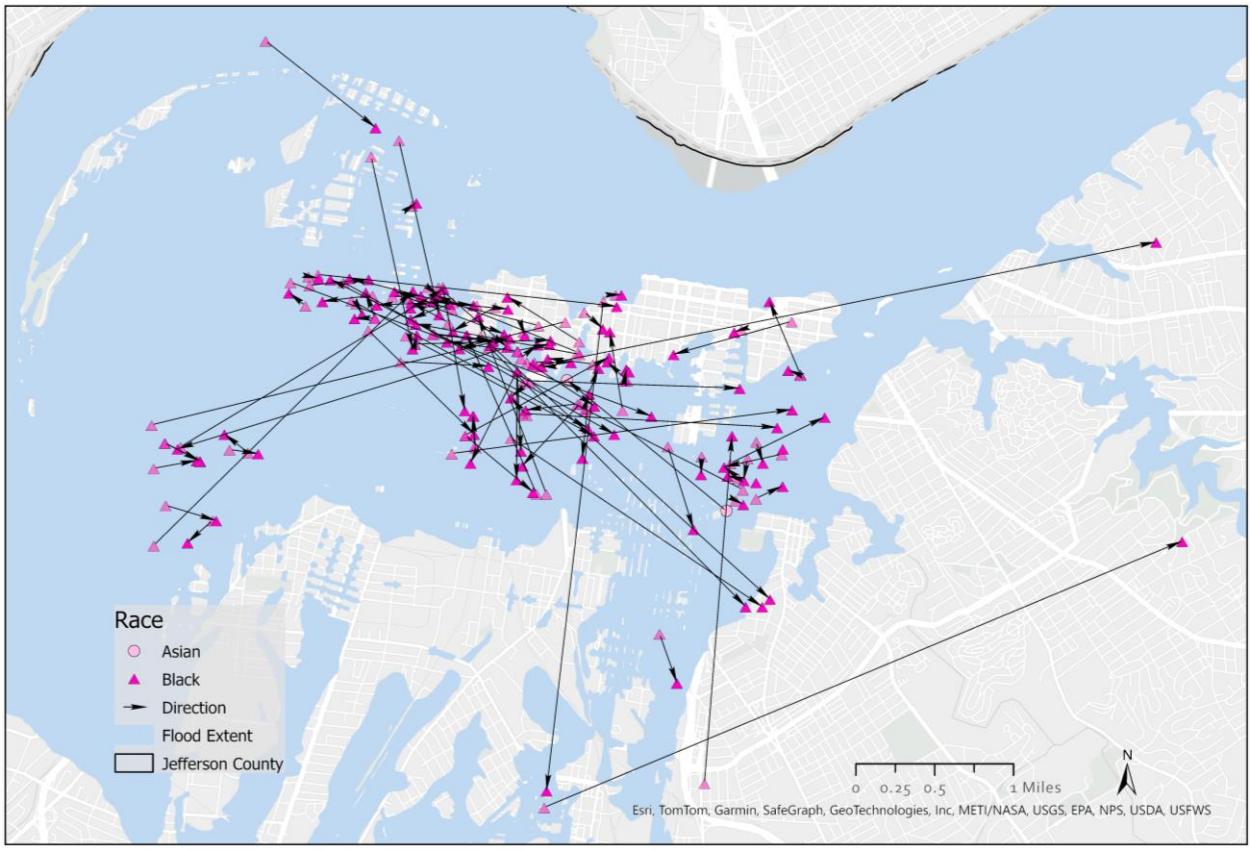


Figure 5.11. **Black Households Who Moved Within Louisville Between 1937 and 1940.** The lighter colored shapes represent the 1937 addresses, fully shaded triangles are 1940 addresses, and the arrows indicate the direction of the movement.

White households had a much larger spatial footprint within the city than African Americans and there was much less consistency in the movement patterns. A total of 11 White households moved to the East End between 1937 and 1940. There was also a general southward trend in household movement into areas south of Shawnee Park like Park Duvalle, Wyandotte, the University District, and Old Louisville (Figure 5.12). There were less restrictions- both economically and socially- for White people that allowed them more freedom when choosing a new place to live (Louisville Metro Government 2010). The 1940 addresses for people who moved within Louisville clearly shows clustering by race in the Russell and California neighborhoods for Black residents (figure 5.13). There was less clustering for White households

than African American households. This result reinforces the notion that White people had more freedom in choosing where to live than Black people during this time. It also reinforces the fact that mobility was different between races during this time. *De facto* segregation limited the number of options African Americans had during the 1930s, while White households could move to more places with better housing and economic opportunities. These figures are visual representations of the segregated housing market that was present in Louisville during the 1930's.

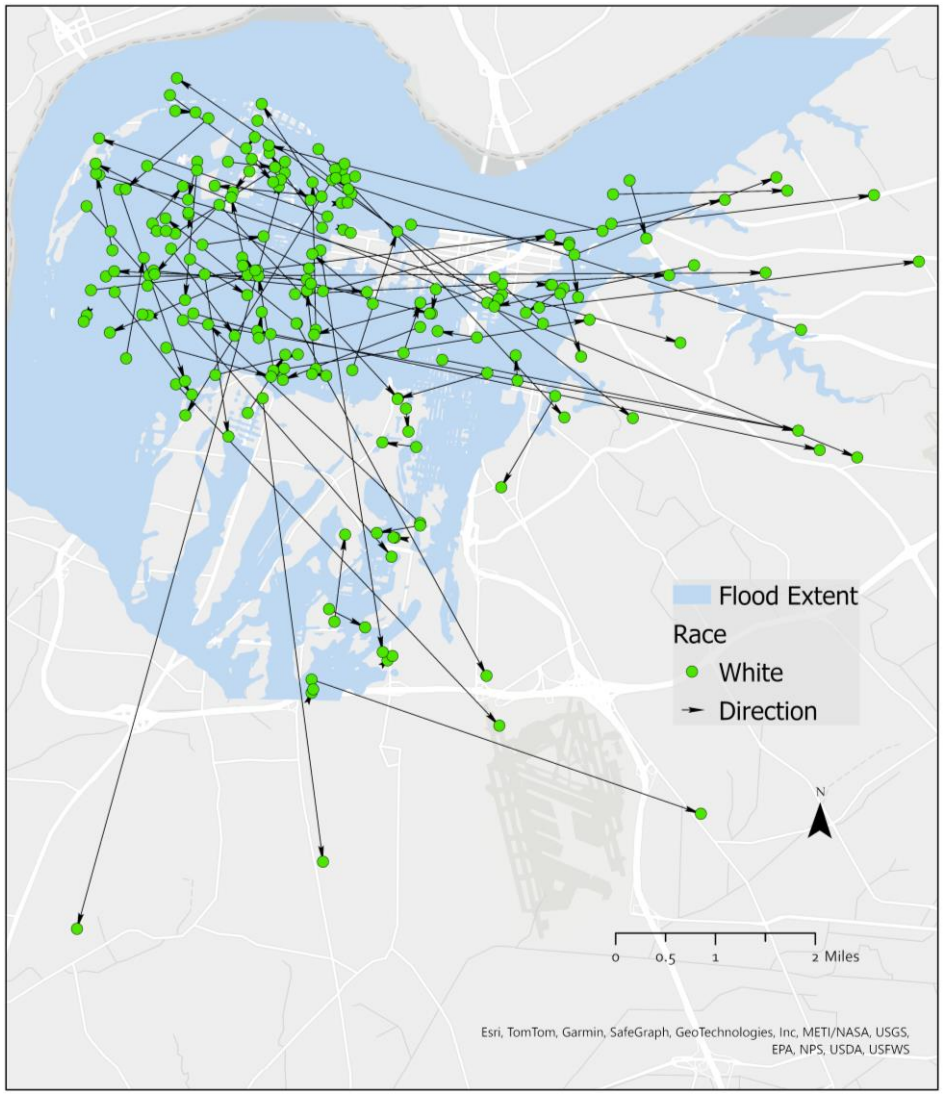


Figure 5.12. **White Samples Who Moved Within Louisville Between 1937 and 1940.** The arrows depict the movement of the households from 1937 to 1940.

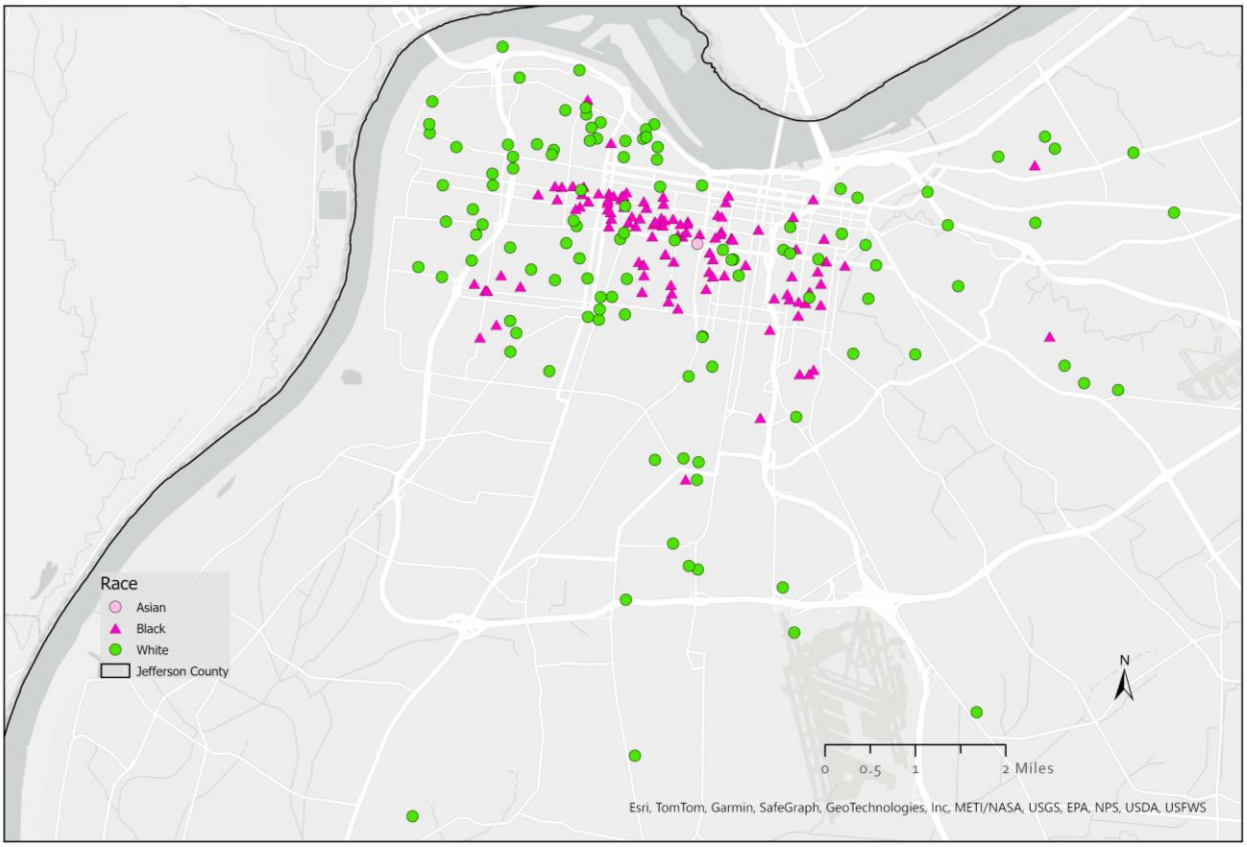


Figure 5.13. **1940 Locations for Households of All Races Who Moved Within Louisville.** White households are symbolized as green circles and Black households are symbolized as purple triangles.

Households that left Louisville in 1940:

A small number of households left Louisville in 1940 for other urban areas or rural places south of Louisville. Approximately fifty percent of the sample that left Louisville after the flood were African American. The results imply that even outside of the Louisville area, African Americans had fewer options for migration and typically did not relocate as far from their pre-flood addresses than their White counterparts. There were twenty-three households that moved out of Louisville after the flood, twelve with Black heads of household and eleven that had White heads of household. There were nine households that left Kentucky after the flood, with destinations ranging from Miami, Florida, in the south to Detroit, Michigan, in the north (Figure

5.14). There were three White households that left Kentucky after the flood who went to other urban areas. One person went to Washington D.C., one went to Evansville, Indiana, and the other went to Miami, Florida. Moves of this distance did not result in a higher homeownership rate, nor did the value of the homes increase in 1940 compared to each person's 1930 value. Lastly, all of these households were headed by men and all but one were married during their move. These moves typically involved an entire family, but the people moving all made more than $2,000 per year, which likely made that far of a move easier.

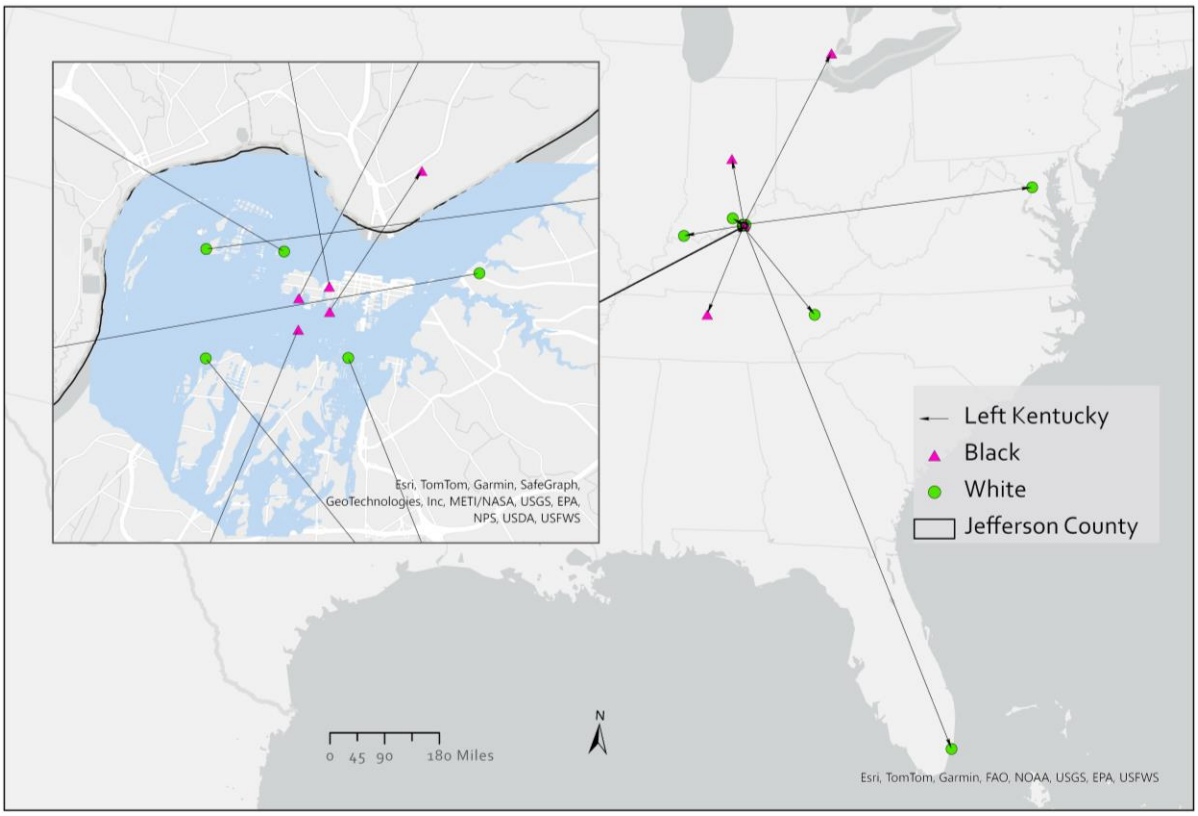


Figure 5.14. **White and Black Households Who Left Kentucky, 1940.** The inset map shows where these households originated before the flood. White households are symbolized as green circles and Black households are symbolized as purple triangles.

All but two of the households that left Kentucky relocated to urban areas. Charles Rudolph, a 34-year-old white male, moved to Palmyra, Indiana, a small rural town in Harrison County, Indiana, approximately 25 miles from Louisville. Charles Rudolph lived there in 1930

before he moved to Louisville and his family was also from this part of Indiana, which indicates that he likely had a connection with this place that drew him back after the flood. Charles Nance was a White restaurateur who moved to Grainger County, Tennessee, which is northeast of Knoxville. He was originally from Grainger County and was living in Louisville for work during the flood. In 1940, he was found in the census staying with his parents at a new place in the same county. These people may have been searching for new economic opportunities or to be close to the urban area of Louisville, but some circumstances, like the flood, may have discouraged them from staying there. They already had a connection to the places where they lived before they moved to Louisville and had social or economic connections there.

The four African American households that left Kentucky after the flood had shorter movements than the White households, but they also had a wider range of socio-economic characteristics. Two of the households were headed by widowed Black women with either zero dollars or nothing recorded for their annual income. One Black woman rented a place in Nashville, Tennessee, and the other went to Jeffersonville, Indiana. Jeffersonville is directly across the river from Louisville; it is so close that the 1940 address is visible in the inset map of Louisville (Figure 5.14). A move of this distance would be much more feasible than moving farther away, especially since the household had seven people in it and the head of household did not have a job. The two African American men that moved were both married and went north in 1940. One person moved from Scottsville, Kentucky, to Louisville before the flood, and went to Indianapolis by 1940. The last African American household to leave Kentucky after the flood went to Detroit, Michigan. The African American households were clustered together around 9th Street and Broadway, while the White households had a wider range across the city and even extended into Clifton in the East End.

There were eight African American households and six White households that left Louisville but stayed in Kentucky in 1940, with destinations ranging as far west as Mayfield, Kentucky, and as far east as Lexington, Kentucky. The closest moves were to places to the south and east of Louisville, such as Bullitt County, Jeffersontown, St. Matthews, La Grange, and Crestwood (Figure 5.15). It was unexpected for African American households to move to La Grange, St. Matthews, and Middletown because these places typically had policies of racial segregation that prevented Black people from living there. At least two of the African American households that moved to these areas, however, lived in historically Black neighborhoods that existed there at the time. Alfred Mason went to 100 W Plainover Avenue, Middletown, Kentucky, in 1940, and the historically Black neighborhood of Griffytown was centered on Old Harrods Creek Road, just one street over from Plainover Ave (Patrick 2024). Another example was Rowland Taylor, who lived in Peewee Valley, Kentucky, in 1940. The census has him marked as living on a road between state highway 146 and 22, which was near a historically Black neighborhood called Stumptown (Peewee Valley Historical Society n.d.). Rowland Taylor also lived in Peewee Valley, Kentucky, in the 1930 Census, which likely influenced his decision to move back in 1940. Another African American refugee that left Louisville went to the Kentucky State Reformatory in La Grange, Kentucky, in 1940 after being arrested for theft in 1938 (*Courier-Journal* Aug 26, 1938). This move is not voluntary, so it does not count precisely as a migration, but it is still an interesting story that highlights a refugee of the 1937 flood.

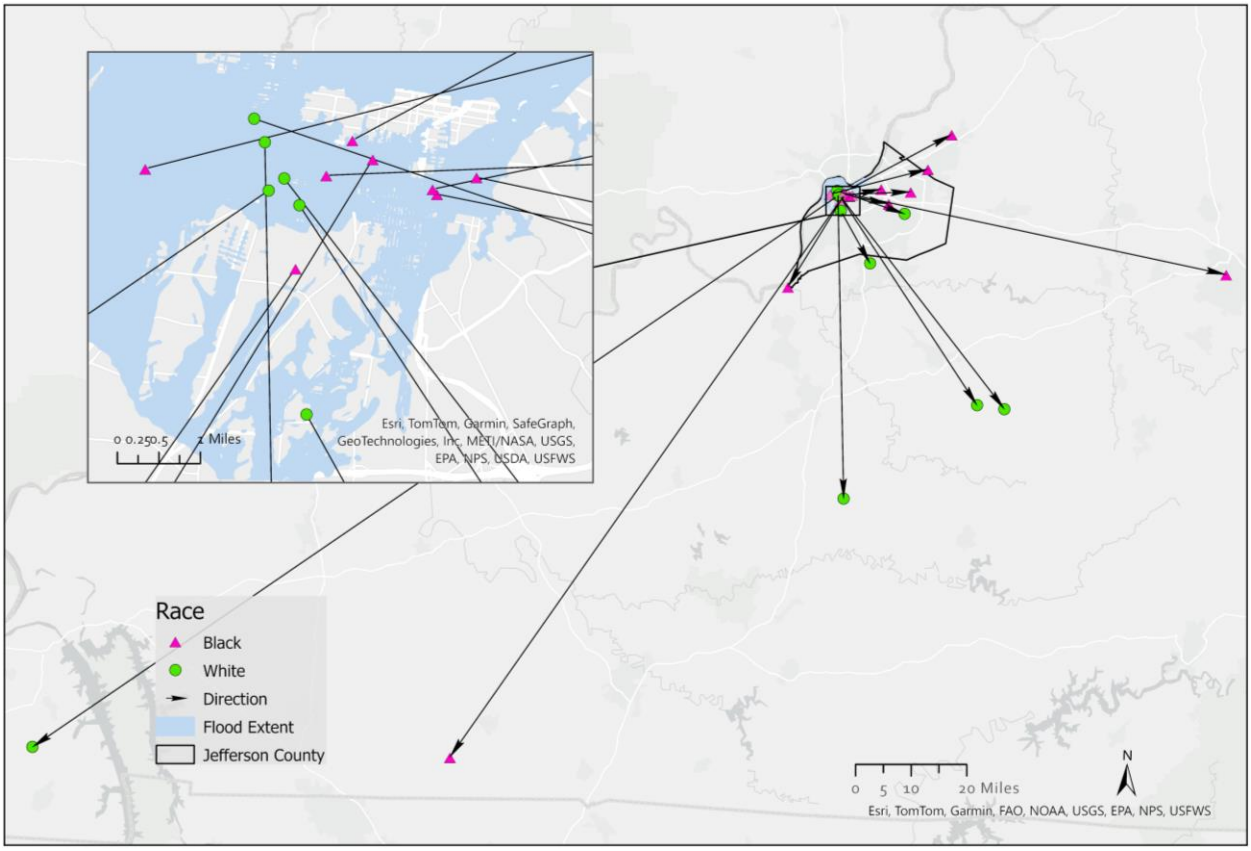


Figure 5.15. **White and Black Households Who Left Louisville and Stayed in Kentucky, 1940.** The inset map illustrates the origins for each household in 1937. White households are symbolized as green circles and African American households are symbolized as purple triangles.

Even when African American households went farther from Louisville, they still went to places with historically Black communities. Dallus Bibb lived in Allensville in southcentral Kentucky in 1930 and returned to a neighboring town after the flood in 1940. Allensville had a large African American population in the southwestern part of the city, and Dallus Bibb likely lived in proximity to that part of town (Brown 1988). One person moved to Jersey Street in Lexington, Kentucky, which is located in the South Hill Historic District. This neighborhood had a large population of freed African Americans that lived among middle class White households (NPS 2024). Lastly, one person lived on Dixie Highway in West Point, close to a Rosenwald School, which was one of the few places that provided education to African American children

in Hardin County at this point in time (City of West Point 2023). All of the African American heads of household that left Louisville were males and the people who went to rural places worked as farmers or laborers, which is another reason why they may have moved to rural places. The moves did not seem to be economically advantageous for all households, but two people became homeowners between 1930 and 1940. Conversely, one household changed from being a homeowner to a renter, two people's homeownership status were unknown, and three remained renters. Except for the household that moved to Allensville, Kentucky, in Todd County, African American migrants did not move in as far of a range as the White households.

The six White households that left Louisville but stayed in Kentucky in 1940 mostly went to rural areas and included two women. Two households moved to the area surrounding Springfield, Kentucky, which is where these people were evacuated to during the flood. The White migrant with the shortest move went to Jeffersontown, which was also the place that he was evacuated to during the flood. Taking refuge in these places during the flood likely gave these people a strong connection to these places and would have made it a likely place for them to move to once they decided to leave Louisville. Clarence Fowler moved to Mayfield, Kentucky, which was the farthest migration for the sample of people who stayed in Kentucky. One White woman moved to Bullitt County, which is directly south of Jefferson County and Louisville, and the other went to Magnolia, which is in rural LaRue County in Central Kentucky. Both women were divorced in 1940, which was similar to the African American women that left Kentucky in 1940.

There were almost an equal number of African American and White households that left Kentucky after the flood, but the spatial patterns are different for each racial subgroup. African American heads of household went to Jeffersonville, Indiana; Nashville, Tennessee; and Detroit,

Michigan. Jeffersonville, Indiana, is directly north of Louisville on the northern bank of the Ohio River and is the shortest out of state move. One Black female moved to Nashville, and a Black male moved to Detroit. All the women that left Kentucky in 1940 were African American, which seems counterintuitive because they had the lowest income in the sample (Table 5.4). However, literature on the Great Migration found that African American women had a high level of mobility as they sought better opportunities in urban areas (White et al. 2005). Most of the moves that Black people made during the Great Migration were between urban areas and mostly occurred within the same state or within the South (Adams 2006), which is exemplified in the results of this migration study. Many of the White households lived in Louisville prior to the 1937 flood, unlike the African American households, who typically had a much broader range of origins in 1930. Most of the White households that left Kentucky after the flood had also lived in Louisville in 1930, which indicates that the flood may have been a driving force behind White people leaving the West End of Louisville in the 1930's. Conversely, African American households left the city in equal numbers but typically did not live in Louisville for an extended time before moving again. The data shows that African Americans seemed to have a high level of mobility between places, and that having already moved prior to the flood was correlated with a higher likelihood of moving again.

Discussion

These results indicate the widespread influences the flood had on Louisville and its residents, while the movement pattern of flood refugees fits in seamlessly with the overarching socio-economic conditions that were present in the 1930s in America. White people in Louisville had higher incomes, more valuable property, better protections against flooding, and more options on where to go after being impacted by flooding. The White refugee spatial footprint is

much larger than the African American's and includes over 100 more places to which refugees relocated over the evacuation and relocation period during the flood. When refugees were examined at the household level, the sample revealed that White heads of household made more money on average than African American heads of household, had higher home ownership rates with higher average home values, and had more options when migrating after the flood. White households mostly moved to rural areas within the state, while African American households almost exclusively moved to urban areas. Black households that were outliers to this trend either had connections to these places before the flood or moved to historically Black neighborhoods. Every household sampled that left the state went to an urban area, which relates back to one of the earliest theories on migration, that longer distance moves are typically to urban areas (Ravenstein 1885). Although this flood was unique to the Ohio River Valley in terms of scale and catastrophe, it induced predictable refugee flows and relocation patterns, which further supports common migration theories and provides insight into planning for future natural disasters in the region.

Every household included in the sample has a unique story that contributed to the history of Louisville before and after the Great Flood of 1937. Unfortunately, many of these stories have been lost in time, but many archival resources exist that allow researchers to build as clear of an understanding as possible. This project created this story through tabulating flood lists, collecting microdata on flood refugees, and GIS visualization. This research investigated the following questions: 1) where refugees lived before the flood and how race was connected to evacuation outcomes during the 1937 flood; 2) how the 1937 flood may have impacted migration patterns out of Louisville at the end of the 1930s; and 3) how Jim Crow legislation and societal norms impacted outcomes for African American refugees after the flood. In all aspects of the flood,

African Americans had different outcomes when compared to White people. They were affected by the flooding earlier than White people (Table 5.1), went to fewer destinations (Figure 5.2), did not travel as far when relocating during the flood (Figure 5.4), made less money annually than White people (Table 5.4), and did not move as far when migrating after the flood occurred (Figures 5.13, 5.14, and 5.15). Human movements triggered by this flood aligns with research conducted on trends in the Great Migration and flood displacement literature, even when compared to modern examples like Hurricane Katrina or extreme river flooding that has occurred recently in the United States. Using Louisville as an example, there are many broad takeaways that can be derived from this research. Both historical and modern flooding outcomes are affected by race, with racial minorities consistently being disadvantaged in dealing with these disasters. No matter what flood infrastructure exists or mitigation plans are in place, there will inevitably be a new record flood or faults in flood infrastructure that will lead to disaster. The 1937 flood, along with the Great Depression and World War II, brought sweeping changes to the demographic structure of Louisville's West End that has inevitably only made African American communities more vulnerable than ever. *De facto* segregation is still present in Louisville, and it has been proven that predominantly Black communities have shorter life expectancies and higher rates of certain cancers due to their proximity to hazardous industries (Gilderbloom et al. 2020). As climate change causes record flash flooding and Louisville's flood wall system ages, the threat of another "Great Flood" looms ahead. This research highlights a historical example of flooding in which outcomes were vastly different based on race, and can be used to inform future policy initiatives, hazard mitigation, and disaster planning.

Chapter 6: Conclusions

This research investigated the way the 1937 Ohio River flood impacted residents in Louisville during and after the disaster occurred. Refugees were predominantly evacuated to destinations in Kentucky and southern Indiana but ranged from Georgia in the south to Michigan and New York in the north. African American refugees relocated to fewer destinations and had a smaller spatial footprint than their White counterparts. In fact, all but nine African American households relocated in Kentucky during flood evacuations. This pattern remained true for a sample of households that were traced between 1930 and 1940. Even though White and African American households had equal representation in sample, African American households were clustered in a few neighborhoods of Louisville before the flood and moved to places closer to Louisville than White households. Most African American migrants moved to urban areas, but those that did not typically were found in historically Black neighborhoods. This reflects how, even without legalized segregation of housing, African Americans were still likely to live in areas that experienced a high level of racial segregation.

Most households included in the sample stayed at the same address from 1930 to 1940 or changed addresses but stayed in Louisville after the flood. Despite the negative psychological impacts associated with natural disasters, a majority of the residents returned to their neighborhoods after the flood waters receded. This result was expected since refugees typically prefer to return to their homes after natural disasters. There is comfort in living in a place where people are familiar, and communities tend to flourish after disasters occur due to residents' shared experiences. The social networks present in these peoples' homes were likely instrumental in their decision to stay and some communities have even adapted to consistent flooding because leaving their homes to live in a more environmentally secure area would

remove them from the socio-economic networks that they rely on. Social networks are typically important influencing factors that encourage environmental refugees to stay in their place of origin both in the United States and abroad.

A growing body of literature has demonstrated that climate change is likely going to impact migration flows by producing more rapid-onset displacement events due to an increased risk of flooding, wildfires, and tornadoes (Jayawardhan 2017; Birpinar 2022). Climate change is also expected to negatively impact the food supply and increase tensions between countries as forced international displacement becomes more common. In the Ohio River Valley, there have already been signs of increased flooding due to climate change that have caused concerns for the efficacy of aging flood infrastructure. Some of the levees that were built along Louisville's riverfront have the same design as the levees that failed in New Orleans, Louisiana, during Hurricane Katrina, which could cause a large displacement of vulnerable populations from the neighborhoods with the highest poverty rates. If Louisville's infrastructure failed during a flood similar in proportion to the 1937 flood, the impacts would be detrimental to communities in the West End. There is still a high level of segregation in the West End due to redlining and racial segregation norms that persisted in Louisville as late as the turn of the 21st century. West End communities are inhabited by minorities and experience poverty at a higher rate than the rest of Jefferson County, which has led to negative outcomes in education and residential mobility. Another "Great Flood" would force these people to evacuate their homes and possibly migrate out of the floodplain, which would likely cause an undue financial burden on those residents.

Policymakers should investigate the effectiveness and suitability of flood control infrastructure other than levees and flood walls in future flood mitigation planning. Research has shown that flood control infrastructure is effective at reducing the short-term threat of a flood,

while flood adaptation can be more effective at building resilience against floods (Liao 2014). This could be accomplished by building greenspace along the floodplain, building natural floodplain ecosystems, flood-proofing housing and business units up to 2 meters above the maximum expected depth of a 100-year flood, and building "amphibian" transportation networks that would allow for the movement of people to continue during a flood (Liao 2014). Many of these techniques are novel and offer a perspective opposite that of flood control: using technology to exist with and adapt to flooding rather than using technology to prevent flooding altogether. This is not currently the case in Louisville. The most recent Louisville Metro Hazard Mitigation Plan does not place a high priority in flood adaptation techniques; rather, it set dam, levee, and flood pumping station reconstruction as high priority flood control measures (Louisville Metro Emergency Services 2023). In future planning, the Louisville Metro should prioritize flood adaptation over flood control infrastructure.

Policymakers should also consider the demographic component of the West End constituents who may be affected by more frequent flooding under a changing climate. Demographic analysis on coastal areas that are expected to be impacted by sea level rise showed that young people were more likely to leave as flooding becomes more common, which is expected to result in an "aging" in the populations that stay (Hauer et al. 2022). Elevating houses, which is a common flood mitigation practice, may not be a viable solution for a more elderly population. A similar phenomenon could occur in the West End in Louisville, where younger populations leave flooded areas in search of better opportunities and places with less constant environmental stress. These migrants would likely stay close to Louisville but move out of the flood plain or move to different cities altogether. Another inundation could occur in these neighborhoods without proper flood adaptation practices and cause a demographic shift to occur

which could render some flood control infrastructure less effective. Environmentally-induced migration from increased flooding could lead to flood control infrastructure becoming even less effective and more harmful for floodplain residents.

This research highlights how economic and social contexts are integral in building an understanding of the impacts of historical flooding in the United States. The spatial pattern of refugee origins and destinations are predicated by histories of racial segregation and urban disinvestment. Minority and low-income populations are more likely to be more vulnerable to natural disasters and be forcibly displaced from their homes. They also tend to have fewer resources when evacuating or moving after the flood that limits their options for relocating. Climate change is expected to exacerbate the frequency and intensity of flooding, which may disproportionately impact environmentally vulnerable communities, who are typically socio-economically vulnerable as well. The patterns of migration that were observed in refugees of the 1937 flood in Louisville, Kentucky, could be used to predict what groups of people will be at risk in the next major flood, issues in flood evacuation procedures, and possible migratory patterns for refugees of future natural disasters in this region. Placing these results in the context of climate change makes the results of this research even more impactful because the threat of another "Great Flood" is imminent, and city and state governments should employ results from previous flooding events to assess where flood mitigation measures are needed and what communities are most at risk in the case of another flood event. Lawmakers should consider passing legislation to address flooding abatement and infrastructure before flooding occurs. Many of the key issues that have been addressed in previous flood control policy include the funding mechanism for infrastructure, the regulatory agencies responsible for maintaining infrastructure, and how flooding is defined or what types of flooding should be regulated

(USACE 1988). These details should be clarified before flooding occurs to prevent widespread displacement, death, and destruction of property in future flooding events.

Future Research

This research is the first project of its kind to use manuscript census data at the household level to investigate how residents of different racial and economic backgrounds were affected by the 1937 Great Flood in Louisville, as well as the migration patterns that emerged after the flood occurred. There are many ways to build on this research to build a better understanding of historical flooding events in the Ohio River Valley. Louisville was not the only city that was negatively impacted by the 1937 flood; similar methods could be used to analyze the impacts of the flood on cities ranging from Pittsburgh, Pennsylvania, to Cairo, Illinois. Historical newspapers would need to be investigated to see if flood refugees were enumerated in a similar way to the Louisville *Courier-Journal* flood lists. Investigating cities located farther north could illustrate how migration patterns differed between urban areas in the South like Louisville and urban areas farther north like Pittsburgh, Pennsylvania.

Louisville also experiences flooding relatively frequently and has had multiple states of emergency declared due to flooding. Other notoriously destructive floods occurred in 1884, 1913, and 1945 (Louisville MSD n.d.). Manuscript census data for 1950 were not made publicly available until 2022, so the 1945 flood could be investigated using the same methodology as that of this research. Similar methodologies could also be applied to a wider study area by analyzing demographic changes at the county or census tract level, as has been done in studies like Hornbeck and Naidu (2014) and Schlichting et al. (2015). Though these studies would not provide as fine-grained of an analysis of flood victims, investigating a larger area could illustrate how patterns varied across different regions of the Ohio River.

Despite the fact that this project investigated a historical flooding event in Louisville, there are many opportunities to use this research in modern applications. There were shortcomings in the record-keeping process for evacuated refugees, as well as unclear guidelines for flood evacuation procedures. By analyzing the 1937 flood lists, scholars can build a framework to create a more efficient system of record keeping. Also, there are similar conditions present in the West End of Louisville that create socio-economic and environmental vulnerability for residents. The results of this study, paired with modern studies of out-migration after flooding disasters like that of Hurricane Katrina, can be synthesized to predict what groups will be most greatly affected by a large flood and the implications for West End neighborhoods after the flood waters recede.

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Appendix A

Blank 1930 Census form

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STATE	Form 15-6	ENUMERATION DISTRICT NO.	SHEET NO.
COUNTY	DEPARTMENT OF COMMERCE — BUREAU OF THE CENSUS	SUPERVISOR'S DISTRICT NO.	
TOWNSHIP OR OTHER DIVISION OF COUNTY	**FIFTEENTH CENSUS OF THE UNITED STATES: 1930**	ENUMERATED ON	
INCORPORATED PLACE	**POPULATION SCHEDULE**	ENUMERATOR	
WARD OF CITY	BLOCK NO. / UNINCORPORATED PLACE	INSTITUTION	

	PLACE OF ABODE				NAME	RELATION	HOME DATA				PERSONAL DESCRIPTION					EDUCATION		PLACE OF BIRTH		
	Street, avenue, road, etc.	House number (in cities or towns)	Number of dwelling house in order of visitation	Number of family in order of visitation	of each person whose place of abode on April 1, 1930, was in this family. Enter surname first, then the given name and middle initial, if any. Include every person living on April 1, 1930. Omit children born since April 1, 1930	Relationship of this person to the head of the family	Home owned or rented	Value of home, if owned, or monthly rental, if rented	Radio set	Does this family live on a farm?	Sex	Color or race	Age at last birthday	Marital condition	Age at first marriage	Attended school or college any time since Sept. 1, 1929	Whether able to read and write	Place of birth of each person enumerated and of his or her parents. If born in the United States, give State or Territory. If of foreign birth, give country in which birthplace is now situated. Distinguish Canada-French from Canada-English, and Irish Free State from Northern Ireland. PERSON	FATHER	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
1																				1
2																				2
3																				3
4																				4
5																				5
6																				6
7																				7
8																				8
9																				9

NOTES:

(SEE REVERSE FOR CODING INSTRUCTIONS ON NATIVITY AND OCCUPATION CODES)

NATIONAL ARCHIVES AND RECORDS ADMINISTRATION

NA Form 14117 (Front) (11/01)

STATE	Form 15-6	ENUMERATION DISTRICT NO.	SHEET NO.
COUNTY	DEPARTMENT OF COMMERCE — BUREAU OF THE CENSUS	SUPERVISOR'S DISTRICT NO.	
TOWNSHIP OR OTHER DIVISION OF COUNTY	**FIFTEENTH CENSUS OF THE UNITED STATES: 1930**	ENUMERATED ON	
INCORPORATED PLACE	**POPULATION SCHEDULE**	ENUMERATOR	
WARD OF CITY	BLOCK NO. / UNINCORPORATED PLACE	INSTITUTION	

	NAME of each person whose place of abode on April 1, 1930, was in this family. Enter surname first, then the given name and middle initial, if any. Include every person living on April 1, 1930. Omit children born since April 1, 1930	PLACE OF BIRTH (See instructions above columns 18 and 19) — MOTHER	MOTHER TONGUE (OR NATIVE LANGUAGE) OF FOREIGN BORN: Language spoken in home before coming to the United States	CODE (For office use only. Do not write in these columns) (See note below): State or M.T.	Country	Nativity	CITIZENSHIP, ETC.: Year of immigration to the United States	Naturalization	Whether able to speak English	OCCUPATION AND INDUSTRY: OCCUPATION — Trade, profession, or particular kind of work, as spinner, salesman, riveter, teacher, etc.	INDUSTRY — Industry or business, as cotton mill, dry-goods store, shipyard, public school, etc.	CODE (For office use only. Do not write in this column) (See note below)	Class or worker	EMPLOYMENT: Whether actually at work yesterday (or the last regular working day): Yes or No	If not, line number on Unemployment Schedule	VETERANS: Whether a veteran of U.S. military or naval forces: Yes or No	What war or expedition?	Number of farm schedule	
	5	20	21	A	B	C	22	23	24	25	26	D	27	28	29	30	31	32	
1																			1
2																			2
3																			3
4																			4
5																			5
6																			6
7																			7
8																			8
9																			9

CODES

These codes provide no additional information. After the Bureau collected the census schedules, the staff, not the enumerators, coded the information on occupations and nativity using codes established for the 1930 census. The Bureau staff tabulated this data to create the statistical summaries for its reports to Congress.

Nativity codes (columns A, B, and C following column 21)

These codes were derived from the information reported in columns 18, 19, and 20.

Occupation codes (column D following column 26)

These codes reflect the occupation reported in column 25.

For additional information on these codes, see
1930 Federal Population Census
(National Archives Trust Fund Board: Washington, DC 20001)

NATIONAL ARCHIVES AND RECORDS ADMINISTRATION

NA Form 14117 (Back) (11/01)

*U.S. GPO: 2002-488-978/69027

Appendix B

Blank 1940 Census Form

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STATE		ENUMERATION DISTRICT NO.	SHEET NO.
COUNTY	**1940 Federal Census**	SUPERVISOR'S DISTRICT NO.	
TOWNSHIP OR OTHER DIVISION OF COUNTY		ENUMERATED BY ME ON , 1940	
INCORPORATED PLACE		, ENUMERATOR	
WARD OF CITY	BLOCK NO. / UNINCORPORATED PLACE	INSTITUTION	

Line No.	LOCATION: Street, Avenue, road, etc.	LOCATION: House Number	HOUSEHOLD DATA: No. of Household in order of visitation	HOUSEHOLD DATA: Home owned (O) or rented (R)	HOUSEHOLD DATA: Value of home or Monthly rental if rented.	HOUSEHOLD DATA: Farm? (Yes or No)	NAME: Name of each person whose *usual* place of residence on April 1, 1940, was in this household. BE SURE TO INCLUDE: 1. Persons temporarily absent from household. Write "Ab" after names of such persons. 2. Children under 1 year of age. Write "Infant" if child has not been given a first name. Enter (x) after name of person furnishing information.	RELATION: Relationship of this person to the head of the household, as wife, daughter, father, mother-in-law, grandson, lodger, lodger's wife, servant, hired hand, etc.	CODE (Leave Blank)	PERSONAL DESCRIPTION: Sex	PERSONAL DESCRIPTION: Color or Race	PERSONAL DESCRIPTION: Age at Last Birthday	PERSONAL DESCRIPTION: Marital Status	EDUCATION: Attended school or college at any time since March 1, 1940?	EDUCATION: Highest grade of school completed	CODE (Leave Blank)	PLACE OF BIRTH: If born in U.S. give state, territory or possession. If foreign born, give country in which birthplace was situated on Jan. 1, 1937. Distinguish: Canada-French from Canada-English and Irish Free State from Northern Ireland.	CODE (Leave Blank)	CITIZENSHIP: Citizenship of the foreign born	RESIDENCE, APRIL 1, 1935: In what place did this person live on April 1, 1935? For a person who lived in a different place, enter city or town, county, and State. City, town, or village having 2,600 or more inhabitants If less, enter "R."	RESIDENCE, APRIL 1, 1935: County	RESIDENCE, APRIL 1, 1935: State (or Territory or foreign country)	RESIDENCE, APRIL 1, 1935: On a Farm? (Y or N)	RESIDENCE, APRIL 1, 1935: CODE (Leave Blank)
	1	2	3	4	5	6	7	8	A	9	10	11	12	13	14	B	15	C	16	17	18	19	20	D
1.																								
2.																								
3.																								
4.																								
5.																								
6.																								
7.																								

Line No.	PERSONS 14 YEARS OLD AND OVER – EMPLOYMENT STATUS: Was this person AT WORK for pay or profit in private or nonemergency Govt. work during week of March 24-30? (Y or N)	If not, was he at work on, or assigned to, public EMERGENCY WORK (WPA, NYA, CCC, etc.) during week of March 24-30? (Y or N)	If neither at work nor assigned to public emergency work. ("No" in cols. 21 & 22): Was this person SEEKING WORK? (Y or N)	If not seeking work, did he HAVE A JOB, business, etc.? (Y or N)	For persons answering "No" to questions 21-24: Indicate whether engaged in home housework (H), in school (S), unable to work (U), or other (Ot).	CODE	If at private or nonemergency Govt. work. "Yes" in col. 21: Number of hours worked during week of March 24-30, 1940.	If seeking work or assigned to public emergency work. "Yes" in col. 22 or 23: Duration of unemployment up to March 30, 1940 – in weeks.	OCCUPATION, INDUSTRY, AND CLASS OF WORKER. For a person at work, assigned to public emergency work, or with a job ("Yes" in col. 21, 22, or 24), enter present occupation, industry, and class of worker. For a person seeking work ("Yes" in col. 23): (a) if he has previous work experience, enter last occupation, industry, and class of worker; or (b) if he does not have previous work experience, enter "New worker" in Col. 28, and leave Cols. 29-30 blank. OCCUPATION: Trade, profession, or particular kind of work, as – *Frame spinner, Salesman, Laborer, Rivet heater, Music teacher*	INDUSTRY: Industry or business, as— *Cotton mill, Retail grocery, Farm, Shipyard, Public school*	Class of Worker	CODE (leave blank)	Number of weeks worked in 1939 (Equivalent full-time weeks)	INCOME IN 1939 (12 months ending Dec. 31, 1939.): Amount of money, wages or salary received (including commissions)	INCOME IN 1939 (12 months ending Dec. 31, 1939.): Did this person receive income of $50 or more from sources other than money wages or salary (Y or N)	Number of Farm Schedule
	21	22	23	24	25	E	26	27	28	29	30	F.	31	32	33	34
1.																
2.																
3.																
4.																
5.																
6.																
7.																

SUPPLEMENTARY QUESTIONS		FOR PERSONS OF ALL AGES									FOR PERSONS 14 YEARS OLD AND OVER								FOR ALL WOMEN WHO ARE OR HAVE BEEN MARRIED		
For Persons Enumerated on Lines 14 and 29.		PLACE OF BIRTH OF FATHER AND MOTHER			MOTHER TONGUE		VETERANS				SOCIAL SECURITY			USUAL OCCUPATION, INDUSTRY, AND CLASS OF WORKER. Enter that occupation which the person regards as his usual occupation and at which he is physically able to work. If the person is unable to determine this, enter that occupation at which he has worked longest during the past 10 years and at which he is physically able to work. Enter also usual industry and usual class of worker.								
Line No.	Name	If born in U.S. give state, territory or possession. If foreign born, give country in which birthplace was situated on Jan. 1, 1937. Distinguish: Canada-French from Canada-English and Irish Free State from Northern Ireland.		CODE (leave blank)	Language spoken in home in earliest childhood.	CODE (leave blank)	Is this person a veteran of the United States military forces: or the wife, widow, or under 18-year-old child of a veteran?				Does this person have a Federal Social Security Number? (Yes or No)	Were deductions for Federal Old-Age Insurance or Railroad Retirement made from this persons wages or salary in 1939? (Yes or No)	If so, were deductions made from all, ½ or more, part but less than ½, of wages or salary?	Usual Occupation	Usual Industry	Usual class of worker	CODE (leave blank)			Has this woman been married more than once? (Yes or No)	Age at first marriage.	Number of children ever born. (Do not include stillbirths.)
		Father	Mother				If so enter "Yes"	If child, is veteran-father dead? (Y or N)	War or Military Service												
	35	36	37	G	38	H	39	40	41	I	42	43	44	45	46	47	J			48	49	50
14																						
29																						

Appendix C

ArcGIS Wind Rose Report of Desire Lines for All Households

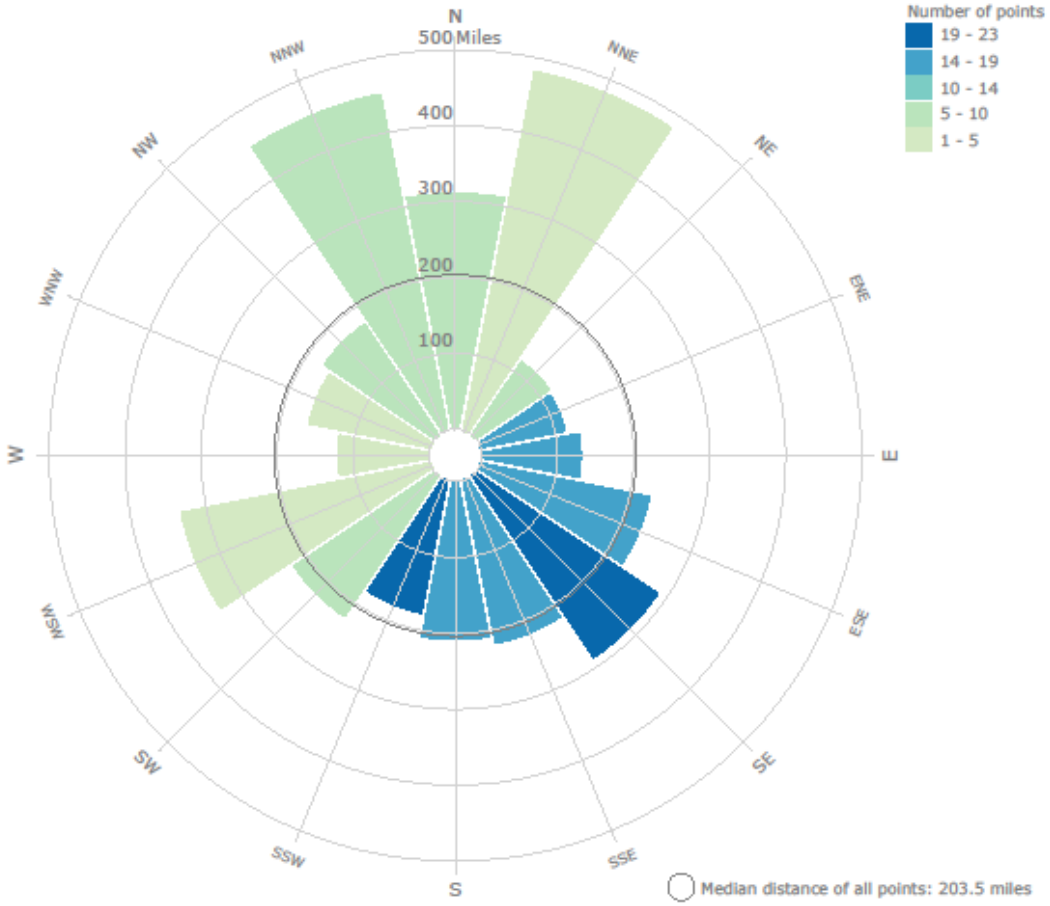
esri
THE SCIENCE OF WHERE

Wind Rose Report

Louisville

DesireLines

Number of points and direction



About the chart

This report describes the distribution and direction of location points (e.g. customers or patients) around a site (e.g. store or facility). The **length** of the sector represents the median distance of the location points from the site per sector and the **color** represents the number of location points in that sector.

The largest number of location points are in the South East (13.2%).

Location points have the largest median distance in the North North East.

 Learn more...

Appendix D

Wind Rose Report of Desire Lines for African American Households

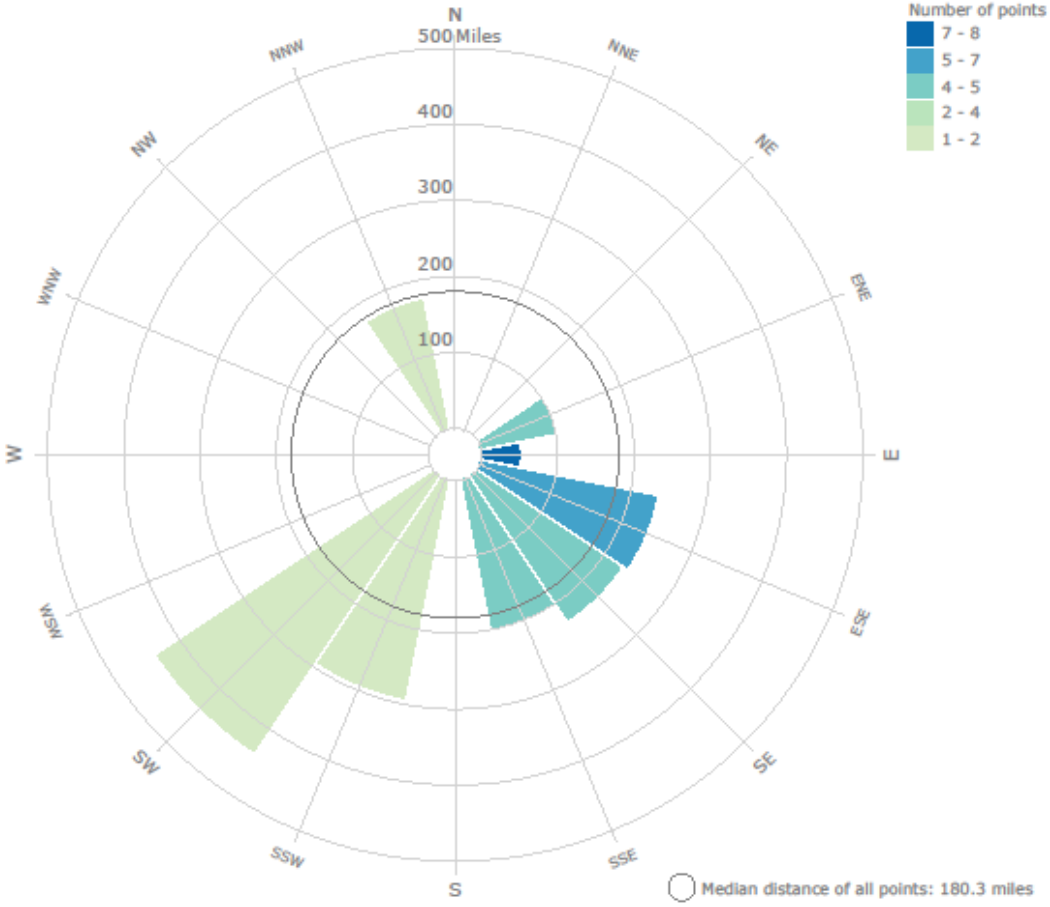
esri
THE SCIENCE OF WHERE

Wind Rose Report

Louisville

Black_desire

Number of points and direction



About the chart

This report describes the distribution and direction of location points (e.g. customers or patients) around a site (e.g. store or facility). The **length** of the sector represents the median distance of the location points from the site per sector and the **color** represents the number of location points in that sector.

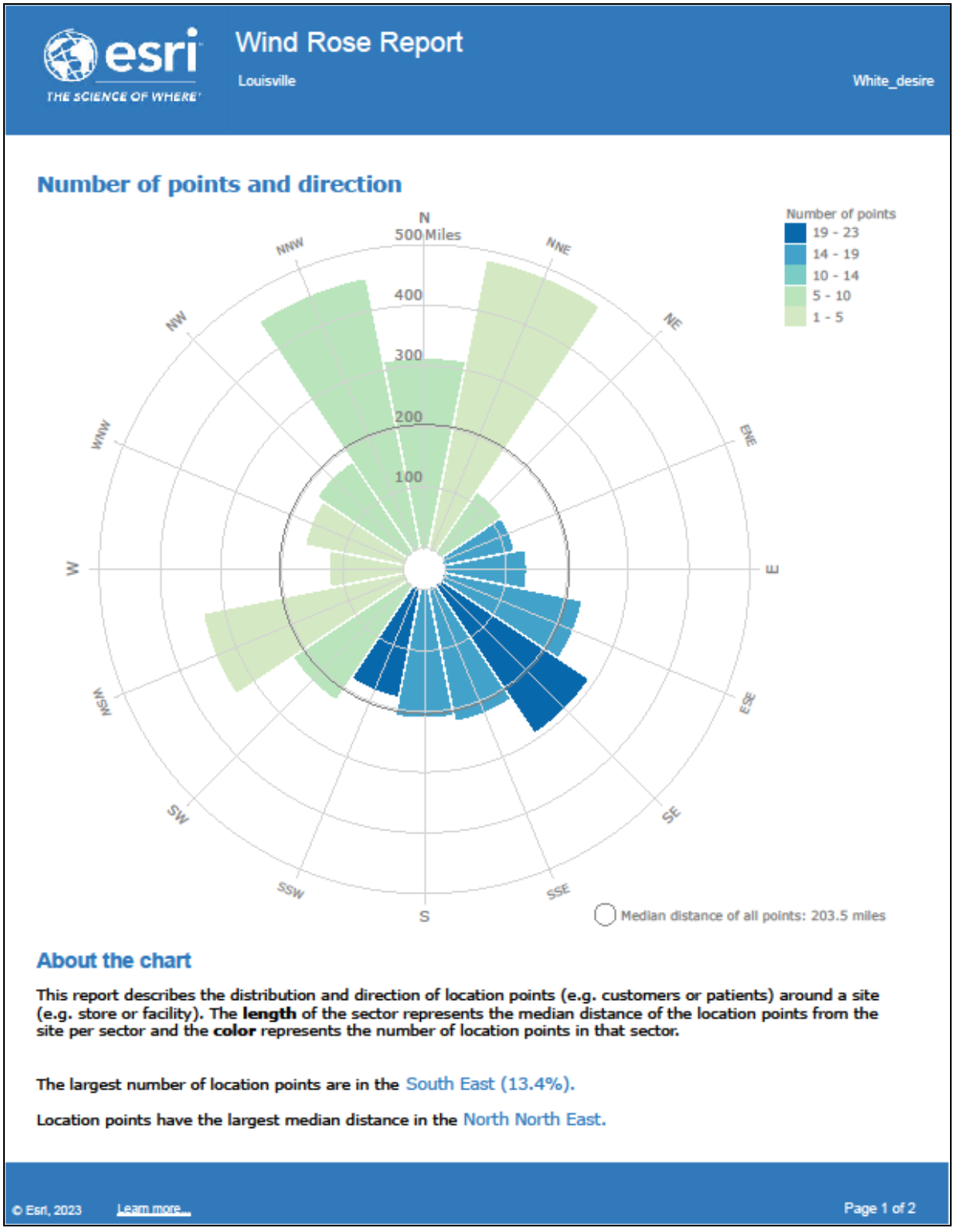
The largest number of location points are in the East (22.6%).

Location points have the largest median distance in the South West.

 Learn more...

Appendix E

Wind Rose Report of Desire Lines for White Households



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