

Distance from Neighborhood Green Infrastructure (GI) in Detroit and Impact on Perception of Safety

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**Distance from Neighborhood Green Infrastructure (GI) in Detroit
and Impact on Perception of Safety**

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Abstract

In Detroit, green infrastructure (GI) projects are seen as an opportunity to increase both the livability and sustainability of the city. From a livability perspective, GI could help alleviate flooding. Over the last few years there was an increasing intensity of storms in Detroit due to climate change (Li & Davis, 2009). In addition to stormwater management, GI is a component of broader revitalization efforts in the city to improve the environment, quality of life, enhance safety and beautification of the city. Current study draws on data gathered as part of a larger transdisciplinary investigation of GI in Detroit (Nassauer et al. 2015). This investigation considers the effects of distance from project pilot GI sites on the perception of safety. To understand the effectiveness of the GI projects, Professor Nassauer et al surveyed nearby residents about their perceptions of four pilot bioretention flower gardens and their potential effects on the surrounding neighborhood. The survey included visualizations of six vacant lots within two clusters approximately 1.5 miles apart in Detroit's Warrendale neighborhood. The current study investigates how safe the pilots of design look after installation of the four bioretention flower gardens, and also, how these pilots of design will affect the perception of safety in the whole neighborhood. Results of the study showed that residents found bioretention flower garden design appeared safer than mowed lots and control sites which were an image of a typical vacant lot in Detroit. Furthermore, compared to the control sites, results of the survey showed that, residents believed that the perception of safety would improve after installation of the bioretention flower gardens in the neighborhood. However I did not find a difference in perception of safety between 100 meters and 100 to 200 meters radii from each garden . I considered other factors such as social support in the neighborhood, observation of crime and demographic variables, that may have affect the perception of safety in a neighborhood as well.

Introduction

A new perspective on the subject of landscape, which takes all the aspects of the landscape and its human connections into account, is very essential in today's post-industrial cities. Citizens of today's post-industrial cities are experiencing a different experience with nature. Following the de-industrialization and the large-scale migration, these cities such as Detroit have rapidly lost their population and economic activity, that resulted in high vacancies throughout these cities (Morrison & Dewar, 2012). With high rates of vacancy in different neighborhoods, these cities face another problem in the area of planning practices as well. These neighborhoods despite all of the problems, usually are not the center of focus of the planning ideology and practices (Johnson, Hollander & Hallulli, 2014; Morrison & Dewar, 2012). These cities like Detroit face several issues related to flooding and stormwater management (Li & Davis, 2009).

Green Infrastructure (GI) is a promising strategy in legacy cities that uses natural processes to manage stormwater where it falls rather than removing it through the old stormwater systems (US Environmental Protection Agency, 2016). There are differences in national perspectives of GI, with the UK for example seeing GI as a means of promoting biodiversity in urban areas, as well as, social cohesion in cities (Ashley and Evans, 2011), GI in developing countries emphasizes on restoration of urban productivity such as urban farms and gardens (Viljoen & Howe, 2012). These different forms of GI may share a goal, to promote residents' well-being and safety, particularly in depopulating neighborhoods where vacant lots pose threats to health and safety. Research indicates that GI has potential to improve attractiveness, safety and well-being of residents as well as managing stormwater issues (Everett et al., 2016; Larson et al, 2016; Rink & Arndt, 2016; Bastien, Arthur & McLoughlin, 2012; McCormack et al, 2010). When GI is concentrated in distressed neighborhoods, it may have a potential to improve urban water quality, reduce air pollution, improve public health, enhance urban aesthetics and safety, and facilitate urban food security (Dunn, 2010). Some studies suggest that GI can contribute to a higher perception of safety among residents in the post-industrial cities through increased opportunities for physical activity and social connections in the neighborhood (Lichten et al, 2016; Zhou & Rana, 2012; Wolf & Robbins, 2015). GI may also be linked to reductions in different crimes, which is a common issue in many post-industrial cities (Branas et al., 2011; Garvin et al., 2013; Kuo & Sullivan, 2001a, 2001b).

The objective of the current study is to investigate how GI projects can contribute to creating safer cities. Using data from a GI project in Detroit by Nassauer et al, 2015, this study examines if distance from GI projects has an effect on the perception of safety among residents in a neighborhood. NEW-GI project (Neighborhood, Environment and Water research collaboration for Green Infrastructure) by Nassauer et al is an innovative project to manage stormwater in the city of Detroit through linking Detroit's vacancies with new forms of GI (Nassauer et al, 2015). The pilot sites for NEW-GI, consist of four bioretention flower gardens in a distressed neighborhood in Detroit (Nassauer et al, 2015). Bioretention, a method of GI, is the capture of stormwater to be retained on-site (US Environmental Protection Agency, 2016). This study investigates whether the distance of the houses in this neighborhood from four bioretention flower gardens pilot sites had an effect on perception of safety of the residents in the neighborhood and the pilot sites. Specifically, this study examines the impact of distance (100 meters and 100 to 200 meters) from these gardens on the perception of safety in the whole neighborhood and in each bioretention flower garden.

Green Infrastructure and Perception of Safety

Recent residential vacancies in urban areas in different cities in US such as Detroit due to historical and physical factors has contributed to negative effects in these cities. Negative effects of vacancies which may cause by degrading social networks in the neighborhoods is associated with higher crime rates in these neighborhoods (Lichten et al, 2016; Arcaya et al., 2013; Garvin et al., 2013; McLaughlin et al., 2012; Pollack et al., 2009; Pollack et al., 2011). Research reports that greening of urban areas may affect social and physical networks of the neighborhoods, may enhance health and safety in the neighborhood through providing opportunities for physical activity, social connections among the residents in the neighborhood and stress reduction (Lichten et al, 2016; Zhou & Rana, 2012; Wolf & Robbins, 2015). Some studies suggest that greening neighborhoods in legacy cities will increase residents' concerns about their living environment as well as their concerns about the quality of life of the residents of that particular neighborhood, which leads to higher perceived level of safety (Baba & Austin, 1989). A study by Guite et al (2006), in London, on 2696 adults aged over 18 years showed that residents' perceptions of their neighborhood were indirectly associated with mental health. They identified five neighborhood factors associated with poor mental health: noise from neighbors; perceptions of crime and safety; feeling of overpopulating in the home; access to green spaces; and community facilities. (Guite et al, 2006).

Literature also suggest that greening vacant lands in legacy cities may be linked to reductions in different crimes (Branas et al., 2011; Garvin et al., 2013; Kuo & Sullivan, 2001a, 2001b). For instance, Branas et al (2011) analyzed the vacant lot greening practices such as removing trash, preventing dumping, creating a park-like setting, and installing low wooden fences around each lot in Philadelphia over one decade. They conclude that these practices are associated with reduction in gun assaults, vandalism and criminal activities in the city (Branas et al, 2011). In another study by Kuo et al., (2003) they found a negative interaction between the level of greenness and the number of negative activities per building, for both property crimes and violent crimes, since a higher level of greenness signals a more well-cared space. Alternatively, the greater use of green spaces may present more "eyes on the street", and so less crime and more safety (Kuo et al., 2003). One study in Jefferson County, Kentucky, suggests that there is a strong positive connection between green space and crime, (Chan, 2015). Another study in Philadelphia, PA, also showed that greening of vacant lots to be associated with reduction in gun crimes and increase in residents' perceived safety, (Garvin et al, 2013). Furthermore, in a city with high crime rates, New Haven, CT, tree canopy cover was associated with lower rates of violent, property and total crime, particularly in disadvantaged neighborhoods, (Gilstad-Hayden et al, 2015).

In another study by Kondo et al., (2015), the vacant-lot greening program in Youngstown, Ohio, was associated with statistically significant reductions in felony assaults, burglaries, and robberies. The lot stabilization treatment was associated with reduction in burglaries, while the community reuses treatment, that transform lots into community gardens or orchards, showed more reduction in violent crimes, perhaps due to providing more opportunity for developing place attachment and as a result, social cohesion in the neighborhood (Kondo et al, 2015). Results of a study by Maas et al (2009) showed that green space in people's living environment is generally associated with enhanced feelings of social safety. They suggest that greening of vacant lot helps to make them feel safer in their living environment (Maas et al., 2009).

Furthermore, residents may express more dissatisfaction with their living environment if they feel unsafe in their neighborhood, and so, the living environment may have an influence on fear of crime and perception of safety directly, by reducing feelings of threat or stress (Lorenc et al, 2012). Physical disorder which refers to a neighborhood's overall physical appearance and signs of negligence, also contribute to the fear of crime and perception of safety. This includes abandoned buildings, vacant properties, unmaintained green spaces, trash, and dumping in the neighborhood. Physical disorder may lead to fear and stress because it signals crime as a sign of neighborhood decline (Sreetheran & van den Bosch, 2014). So, good planning and maintenance of green spaces is key for attracting a variety of visitors to a neighborhood and reducing feeling of stress and fear in urban areas (Każmierczak, 2013). Although social support in the neighborhood reduces physical disorder, different studies show that disorder also reduces social support and as a result reducing perception of safety in the neighborhood (Markowitz et al, 2001, Schroeder & Anderson, 1984, Snelgrove et al., 2004). In a study in Louisville, Kentucky, results showed that residents in neighborhoods that suffer from signs of physical disorder feel unsafe in their neighborhoods. Authors suggest that this may be because, neighborhoods are sources of social support and signs of physical disorder might threaten residents' feelings of support, and as a result feeling of safety (Austin et al, 2002).

In addition, how these green spaces look also affect the perception of safety. In this regard, there are two thoughts. The first is the belief that urban green spaces help negative activities to occur because it hides these activities. The second is that the presence of vegetation might actually deter negative activities by encouraging greater use of green spaces (Hartig, Mang, & Evans, 1991; Kaplan, 1987; Kuo & Sullivan, 2001). Many researchers by different studies have showed that a well-cared appearance for green spaces is the key for deterring negative activities and improving perception of safety in a neighborhood (Donovan & Prestemon, 2012; Kuo & Sullivan, 2001; Nassauer, 1995; Nassauer, 2011). Much literature suggest that a well-cared appearance for green spaces with short plants and tall trees, which do not block the view, can increase maintenance activities in a neighborhood, and as a result increase the effects of "eyes on the street" in the neighborhood and improving perception of safety (Jacobs, 1961; Kuo, 2003; Kuo & Sullivan, 2001).

A well-cared green space in the neighborhood creates opportunities for interaction at different levels by attracting different visitors and neighbors (Holtan et al, 2015), which indirectly would have an impact on the reduction of crime and on enhancing the perception of safety in a neighborhood. In a study in Baltimore, Maryland, results show that tree canopy cover improves social health by increasing use of sidewalks and outdoor spaces (Holtan et al, 2015). In another study conducted in a residential neighborhood in Chicago by Sullivan et al (2004) results indicate that, the level of tree and grass cover in an outdoor space is associated with enhancing the amount of social activity among neighbors by 83% on average (Sullivan, Kuo, & Depooter, 2004). A study by Leyden (2003), show that there is a higher chance of interacting with neighbors and trusting among residents who live in walkable neighborhoods, which will reduce the frequency of crime in those neighborhoods (Leyden, 2003). A number of studies in Chicago public housing neighborhoods found positive relationship between green space and neighborhood social connection. Results showed that residents who had more level of nearby green spaces had more social activities, and as a result had a higher perception of safety in their neighborhoods (Coley, Kuo, & Sullivan, 1997; Kuo, Sullivan, et al., 1998; Sullivan, Kuo, & Depooter, 2004). Since stronger social connections among residents in a neighborhood is a key to creating safer neighborhoods; a well-cared green space can also affect the perception of safety in the neighborhood by creating a setting, in which residents can trust their neighbors (Kuo, 2003), (Table 1).

Distance to GI projects, perception of safety and other factors:

There are only a few studies that investigate the relationship between safety and distance to the greening lots. One study by Troy et al (2016), in Baltimore, Maryland, analyzing the relationship between residential yard management and crime, shows reduction in crime in a 150 meters distance from the greening lots. They conclude that at the neighborhood scale, greening and maintaining of green spaces in disadvantaged neighborhoods could be a topic for managing to reduce crime in these neighborhoods (Troy et al., 2016). In another study by Krusky et al (2015), researchers investigate if greening vacant lots in the neighborhood have a positive effect on the surrounding residential parcels. They analyzed maintenance of 215 occupied, residential parcels within 100 meters of a produce garden and a comparison sample of 627 occupied, residential parcels within 100 meters of an undeveloped vacant lot in Flint, Michigan. Their results showed that residential parcels close to produce gardens had better maintenance (Krusky et al, 2015). This aligns with other findings on greening and crime reduction throughout neighborhoods (Kuo & Sullivan, 2001; Kou, 2003; Wolfe & Mennis, 2012; Troy et al., 2012). In one study, authors analyzed how many crimes were committed in 50 meters, 100 meters, and 200 meters buffers around each house in a sample of 2,813 single-family homes in Portland, Oregon. Results showed that tree canopy cover within 100 meters is associated with a reduction in total crime, and those within 50 meters had the greatest effect (Donovan & Prestemon, 2012).

Some literature suggest that benefits of greening vacant lots may not be evenly distributed across demographic categories such as age and gender. Richardson and Mitchell (2010) suggest that urban green space has a positive impact on perception of safety for men, but not for women in the UK (Richardson & Mitchell, 2010). Furthermore, several studies report that women feel less safe and experience higher levels of stress than men in areas with less green spaces (Roe et al., 2013; Maas et al., 2009; Ho et al., 2005). In a review by Sreetheran & van den Bosch, (2014) results from reviewing 48 papers demonstrate that personal characteristics, especially gender, are indeed a significant predictor of safety in urban green spaces, with women feel less safe in green spaces than men (Sreetheran & van den Bosch, 2014). Age is also observed as a factor in fear of crime and feeling safety in urban areas with less green spaces and less social activities due to physical and social vulnerability of elderly (Gilleard, Hyde, & Higgs, 2007; Phillipson, Bernard, Phillips, & Ogg, 1999).

In the current study, I focus on the effect of a particular type of green infrastructure, bioretention flower gardens, on the perception of safety on nearby residential parcels. Using data drawn from Nassauer et al, 2015 study, I compare the perception of safety on 100 meters and 100 to 200 meters radii of residential parcels located in these areas of each four bioretention flower gardens.

Distance from Neighborhood Green Infrastructure (GI) in Detroit and Impact on Perception of Safety

<i>Researchers</i>	<i>GI Intervention</i>	<i>Location</i>	<i>Benefits</i>
<i>Ashley & Evans, 2011</i>	Water Management	UK	Multifunctionality
<i>Austin et al, 2002</i>	Cleanliness and Greening	Louisville, Kentucky	Perception of Safety
<i>Baba & Austin, 1989</i>	Neighborhood upkeep	Oklahoma city, Oklahoma	Reduction in fear of crime
<i>Branas et al., 2011</i>	Vacant lot greening	Philadelphia, Pennsylvania	Safety
<i>Coley, Kuo, & Sullivan, 1997</i>	Tree canopy cover	Chicago, Illinois	Social activities
<i>Chan, 2015</i>	Street vegetation	Jefferson County, Kentucky	Reduction in crime
<i>Donovan & Prestemon, 2012</i>	Tree canopy cover	Portland, Oregon	Reduction in crime
<i>Garvin et al., 2013</i>	Vacant lot greening	Philadelphia, Pennsylvania	Individual health & safety
<i>Gilstad-Hayden et al, 2015</i>	Tree canopy cover	New Haven, Connecticut	Reduction in crime
<i>Guite et al, 2006</i>	Street vegetation	Greenwich, London	Mental health
<i>Holtan et al, 2015</i>	Tree canopy cover	Baltimore, Maryland	Social capital
<i>Lichten et al., 2016</i>	Bioretention Flower Garden	Detroit, Michigan	Multifunctionality
<i>Kaźmierczak, 2013</i>	Local parks	Manchester, UK	Social ties
<i>Krusky et al, 2015</i>	Produce garden	Flint, Michigan	Yard maintenance
<i>Kuo & Sullivan, 2001</i>	Neighborhood vegetation	Chicago, Illinois	Reduction in crime
<i>Kou, 2003</i>	Tree canopy cover	Chicago, Illinois	Social connection & Reduction in crime
<i>Kondo et al, 2015</i>	Vacant lot greening	Philadelphia, Pennsylvania	Reduction in crime
<i>Kuo, Sullivan, et al., 1998</i>	Neighborhood vegetation	Chicago, Illinois	Social activities & Sense of safety
<i>Leyden, 2003</i>	Neighborhood vegetation	Galway, Ireland	Social capital
<i>Maas et al., 2009</i>	Neighborhood vegetation	Netherlands	Social contacts & Health
<i>Nassauer et al, 2015</i>	Bioretention Flower Garden	Detroit, Michigan	Multifunctionality
<i>Pollack et al., 2009</i>	Urban green space	Philadelphia, Pennsylvania	Health benefits
<i>Pollack et al., 2011</i>	Urban green space	Philadelphia, Pennsylvania	Health benefits
<i>Richardson & Mitchell, 2010</i>	Urban green space	UK	Health benefits & Gender difference
<i>Schroeder & Anderson, 1984</i>	Urban recreation sites	Chicago, Illinois- Atlanta, Georgia	Perception of safety
<i>Sreetheran & van den Bosch, 2014</i>	Urban green space	Review	Reduction in fear of crime
<i>Snelgrove et al., 2004</i>	Urban green space	Austin, Texas	Reduction in crime
<i>Sullivan, Kuo, & Depooter, 2004</i>	Tree canopy cover & grass	Chicago, Illinois	Social ties
<i>Troy et al., 2012</i>	Tree canopy cover	Baltimore, Maryland	Reduction in crime
<i>Troy et al., 2016</i>	Residential yard	Baltimore, Maryland	Reduction in crime
<i>Wolf & Robbins, 2015</i>	Urban green space	Review	Health benefits
<i>Zhou & Rana, 2012</i>	Urban green space	Review	Social health

Table 1: Benefits of the GI intervention projects in different cities.

Study

The study area, Warrendale Neighborhood, a subset of the Cody Rouge neighborhood, which is located along the Rouge River in Detroit, is a residential neighborhood with a high number of vacant lots, (Figure 1). With high rates of vacancy in this neighborhood the perception of safety may suffer from the appearance of these vacancies. NEW-GI project by Professor Nassauer et al, is an innovative effort to manage stormwater by using vegetation and soils to soak up and store stormwater to reduce the risk of flooding in the neighborhood, (Figure 2). The pilot project consisting of four bioretention flower gardens are designed to capture stormwater and allow it to soak into the soil. In the NEW-GI project, design of the bioretention flower gardens was based on many factors including safety, as well as, beautification of the neighborhood. The bioretention flower gardens in NEW-GI project have been designed with flowering shrubs and perennials without any trees to avoid creating hiding places in the neighborhood and to deter crime in this way (Nassauer et al, 2015). To understand the effectiveness of the GI projects, Nassauer et al conducted a survey in an attempt to see how residents would respond to these four bioretention flower gardens in their neighborhood.



DETROIT CITY

Figure 1: Public owned vacancies in the city of Detroit and the location of Cody Rouge Neighborhood

Distance from Neighborhood Green Infrastructure (GI) in Detroit and Impact on Perception of Safety

The objective of the current study is to see if distance to these four bioretention flower gardens has an effect on the perception of safety among residents in the Detroit's Warrendale neighborhood. Two research questions have been developed based on the survey and to address the main objective of the study for determining the interaction between distance from GI projects and perception of safety in the neighborhood. Using computer-generated visualizations, this study investigates these questions: (1) how safe the pilots of design look after installation of bioretention flower gardens? And, (2) how these pilots of design will affect the perception of safety in the whole neighborhood. The hypothesis is that GI installation within 200 meters of the gardens is positively associated with perceived level of safety and within 100 meters has a greater effect. This study expects to see that residents who live in 100 meters radii of the gardens have higher level of perception of safety than residents living in 100 to 200 meters radii.

I also considered if other factors such as social support in the neighborhood, neighborhood characteristics, observation of crime and demographic variables affect the perception of safety in this particular neighborhood. These factors may have higher influence on safety among residents of the Warrendale neighborhood than distance to the pilots of design in NEW-GI project.

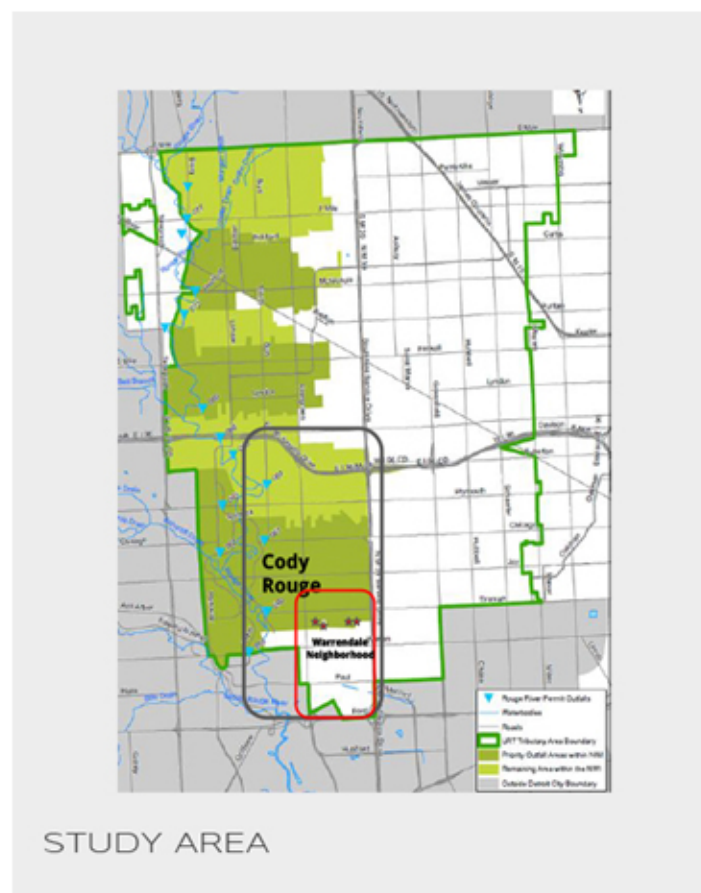


Figure 2: Location of the Warrendale Neighborhood and pilots of designs in the Cody Rouge, (Nassauer et al, 2015)

Methods:

Few studies have surveyed distance from GI projects and its impact on perception of safety in the neighborhood. For measuring the impact of the GI on the perception of safety in the residential areas, Nassauer et al conducted a household survey (n=163) with residents living near the sites of GI interventions between November 2014 and April 2015. This survey is part of a larger transdisciplinary research collaboration, NEW-GI—Neighborhood, Environment, and Water research collaborations for Green Infrastructure in legacy cities. The neighborhood survey was in two study areas, East cluster and West cluster gardens, which contains a control site and two pilot garden sites. This thesis uses a subset of those sample data to investigate the effects of residents' home distance from pilot GI sites on their perceptions of safety in their neighborhoods and the safety of the garden sites.

The survey included visualizations of six vacant lots within two clusters approximately 1.5 miles apart in Detroit's Warrendale neighborhood. Each cluster included a control site and two GI intervention sites. Residents were asked about the effect of these three sites on the safety in their corresponding cluster (n=82 East cluster, n=81 West cluster), (Figures 3 & 4). They were presented with three of six images, a control site, which is an image of a typical vacant lot in Detroit with annual mowing; computer-generated visualizations of one nearby pilot site with frequent mowing and with a bioretention garden installed. Residents answered different questions in the survey, but the questions that have been used as part of the current study are: "Please describe how safe or unsafe each of the lots look, as shown in the image?" and "Please describe how safe or unsafe each of the lots look in the neighborhood?", (Table 1). Residents rated each image with five responses: dangerous, somewhat dangerous, nor safe or dangerous, somewhat safe and safe.

For the current study I produced different graphs to investigate the number of the respondents who rated each of the three images from dangerous to safe in their corresponding cluster, (Figure 6 & 7). Furthermore I investigated the change in the perception of safety using different graphs to compare control site and bioretention flower garden, as well as, Mowed lot and bioretention flower garden in a 100 meters radii and 100 to 200 meters radii of each garden. Different GIS maps as well as mean and median of the responses in the survey in each radii from four pilot sites helped to measure the perception of safety in each pilot site and in the whole neighborhood from 100 meters and 100 to 200 meters of the pilots of design. Giving different scores from 1 to 5 based on the mean and median to 100 meters and 100 to 200 meters radii from each pilot site helped to compare different sites as well as east and west cluster neighborhood gardens for the change in perception of safety among residents of the Warrendale neighborhood.

Distance from Neighborhood Green Infrastructure (GI) in Detroit and Impact on Perception of Safety

To investigate other factors that may have higher influence on the perception of safety, other questions of the NEW-GI survey by Nassauer et al have been reviewed. These questions were age and gender that may be significant predictors of safety in urban areas; residents' satisfaction with the demolition of the lots, respondents' opinion about the garden design, experiencing and observation of negative activities in the neighborhood and social support and neighborhood attachment. However, this revision is limited to the respondents whom installation of bioretention flower gardens appeared less safe to them than control sites and mowed lots, (Table 2).

<i>Questions in the survey</i>	
<i>Questions in the survey used for study</i>	Neighborhood- East or West?
	Demographic Variables
	Please describe how safe or unsafe each of the five look, as shown in the picture?
	Please describe how safe or unsafe each of the five look in the neighborhood?
<i>Questions in the survey used for Discussion</i>	Neighborhood- East or West?
	Please describe how safe or unsafe each of the five look, as shown in the picture?
	Please describe how safe or unsafe each of the five look in the neighborhood?
	How satisfies are you with the demolition on this lot? Why satisfies or not satisfies?
	What do you think about this garden design?
	Have you seen any negative activity on this lot since the house was demolishes?
	Would you miss this neighborhood if for some reason you had to move from it?
	Have you participated in a neighborhood activity like clean up or beautification project in the last year?
	How agree or disagree with this statement? People in this neighborhood can be trusted.
	How agree or disagree with this statement? People in this neighborhood don't get along with each other.

Table 2: Questions in the survey used for study and discussion. For the discussion part review is limited to the respondents whom installation of bioretention flower gardens appeared less safe to them than control sites and mowed lots.

Distance from Neighborhood Green Infrastructure (GI) in Detroit and Impact on Perception of Safety



Visualization
Control Site



Visualization
Evergreen site: Mowed lot



Visualization
Evergreen site: Flower garden



Visualization
Vaughan Site: Mowed lot



Visualization
Vaughan Site: Flower garden



Figure 3: Computer-generated visualizations of the western pilots of design (Nassauer et al., 2015)
Visualizations: Brad kazberg, Qiuling Chen, Alex Kinzer

Distance from Neighborhood Green Infrastructure (GI) in Detroit and Impact on Perception of Safety



Visualization
Control Site



Visualization
Greenview site: Mowed lot



Visualization
Greenview Site: Flower garden



Visualization
Stahelin Site: Mowed lot



Visualization
Stahelin Site: Flower garden



Figure 4: Computer-generated visualizations of the eastern pilots of design (Nassauer et al., 2015)
Visualizations: Brad kazberg, Qiuling Chen, Alex Kinzer

Results:

As Nassauer et al (2015) reports, respondents were on average 42 years of age, ranging 19 to 82 years. They were more often female (63.0%), and 93.0% reported their race/ethnicity as African American. Approximately 75.0% of respondents reported annual household income levels below \$27,000, approximately 12.0% were unemployed, and 73.5% reported a high school education or higher (Nassauer et al, 2015). With regard to the perception of safety, in general, respondents felt bioretention flower gardens as appearing safer than mowed lots and control sites, (Figures 5 & 6).

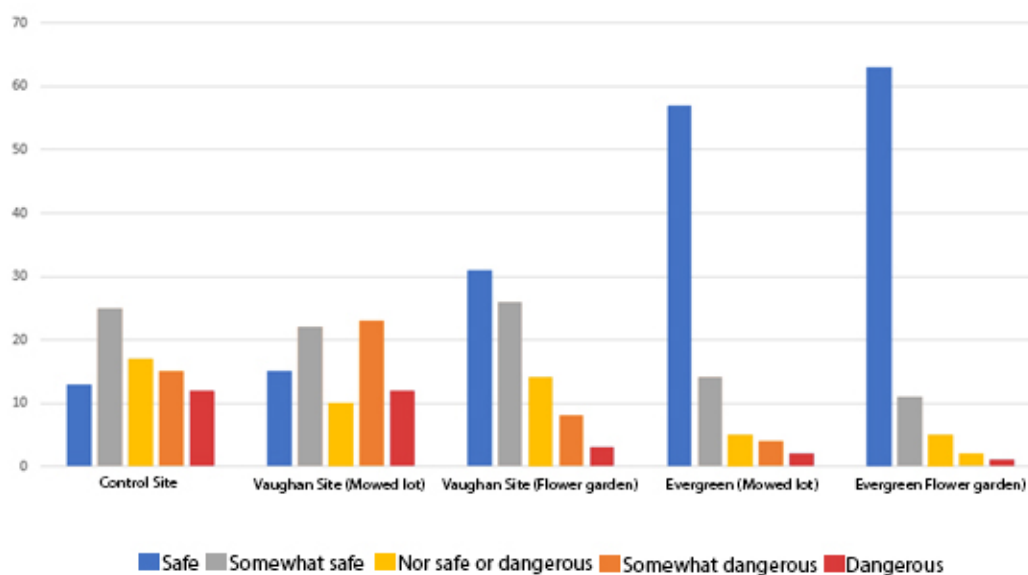
Compared to the control site, which was an image of a typical vacant lot in Detroit with annual mowing, results indicated that, residents believed that safety would improve after installation of the bioretention flower gardens in the neighborhood, (Figure 7 & 8). Results showed more than 75% change in the perception of safety among residents after installation of bio retention flower gardens. Through analyzing the number of respondents that changed from feeling unsafe to safe after installation of bioretention flower gardens, this study has shown a positive relationship between GI projects and perception of safety in a neighborhood. Results of the study also indicated that regular mowing can be a significant predictor of safety in the neighborhood, as mowed lot images, which were four pilot sites with turf grass with regular mowing appeared safer than control sites, although this change was not very significant in Vaughan St mowed image.

In both western cluster gardens (Vaughan St and Evergreen St), residents felt the bioretention flower gardens appeared safer than the mowed lots and control sites. The perception of safety in the mowed lots and bioretention flower garden is similar, suggesting that a well-cared, maintained landscape can have a high impact on perception of safety. But results indicated that residents in Warrendale neighborhood perceived Evergreen bioretention flower garden safer than the Vaughan flower garden, and both of these gardens appeared safer than the control sites. In the eastern cluster gardens, control site appeared very unsafe to the residents that would impact on the perception of safety in the whole neighborhood. Results showed that residents strongly preferred mowed lots and bioretention flower gardens in regard to the safety. Although the perception of safety in the bioretention flower garden was not significantly different than the mowed lots. Furthermore, residents felt the eastern gardens appeared safer than the western gardens.

Distance from Neighborhood Green Infrastructure (GI) in Detroit and Impact on Perception of Safety



	<i>Control Site</i>	<i>Vaughan Site Mowed lot</i>	<i>Vaughan Site Flower garden</i>	<i>Evergreen Site Mowed lot</i>	<i>Evergreen Site Flower garden</i>
Safe	13	15	31	57	63
Somewhat safe	25	22	26	14	11
Nor safe or dangerous	16	9	13	4	4
Somewhat dangerous	15	23	8	4	2
Dangerous	12	12	3	2	1
Total	81	81	81	81	81



RESULTS

Perception of safety (west gardens)

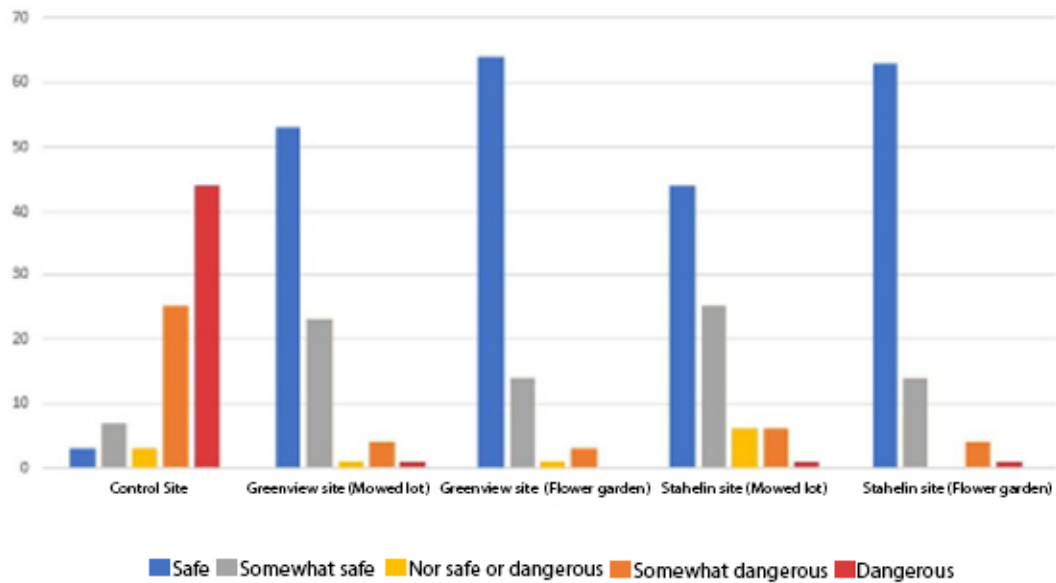
Figure 5: Perception of safety results in the western cluster gardens



Distance from Neighborhood Green Infrastructure (GI) in Detroit and Impact on Perception of Safety



	<i>Control Site</i>	<i>Greenview Site Mowed lot</i>	<i>Greenview Site Flower garden</i>	<i>Stahelin Site Mowed lot</i>	<i>Stahelin Site Flower garden</i>
Safe	3	53	64	44	63
Somewhat safe	7	23	14	25	14
Nor safe or dangerous	3	1	1	6	0
Somewhat dangerous	25	4	3	6	4
Dangerous	44	1	0	1	1
Total	82	82	82	82	82



RESULTS

PERCEPTION OF SAFETY (EAST GARDENS)



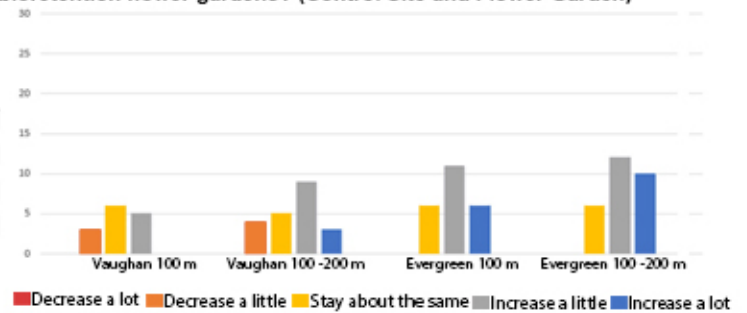
Figure 6: Perception of safety results in the eastern cluster gardens

Distance from Neighborhood Green Infrastructure (GI) in Detroit and Impact on Perception of Safety



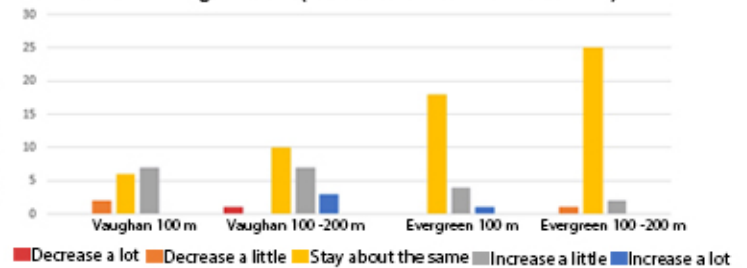
How safe the pilots of design look after installation of bioretention flower gardens? (Control Site and Flower Garden)

	Vaughan 100 m	Vaughan 100- 200 m	Evergreen 100 m	Evergreen 100- 200 m
Decrease a lot	0	0	0	0
Decrease a little	3	4	0	0
Stay about the same	7	7	7	8
Increase a little	5	8	10	11
Increase a lot	0	2	6	9
Total	15	21	23	28



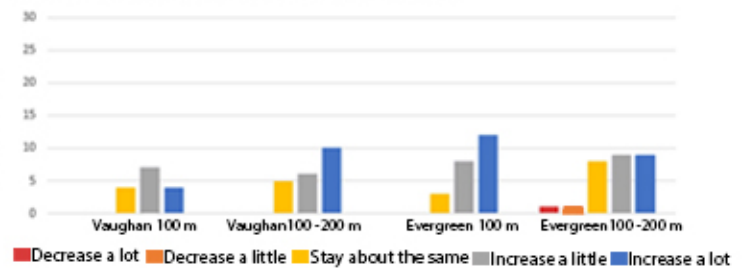
How safe the pilots of design look after installation of bioretention flower gardens? (Mowed lot and Flower Garden)

	Vaughan 100 m	Vaughan 100- 200 m	Evergreen 100 m	Evergreen 100- 200 m
Decrease a lot	0	1	0	0
Decrease a little	2	0	0	1
Stay about the same	6	7	18	25
Increase a little	7	10	4	2
Increase a lot	0	3	1	0
Total	15	21	23	28



How these pilots of design will affect the perception of safety in the neighborhood?

	Vaughan 100 m	Vaughan 100- 200 m	Evergreen 100 m	Evergreen 100- 200 m
Decrease a lot	0	0	0	1
Decrease a little	0	0	0	1
Stay about the same	4	6	5	8
Increase a little	7	6	8	9
Increase a lot	4	9	10	9
Total	15	21	23	28



RESULTS

CHANGE IN THE PERCEPTION OF SAFETY (WEST GARDENS)

Figure 7: Change of the perception of safety results in the western cluster gardens



Distance from Neighborhood Green Infrastructure (GI) in Detroit and Impact on Perception of Safety

Control Site

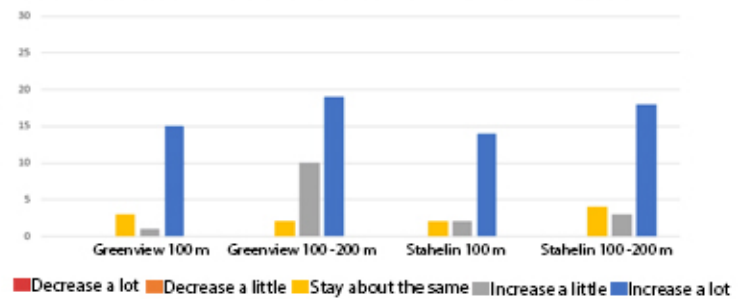
Greenview Site

Stahelin Site



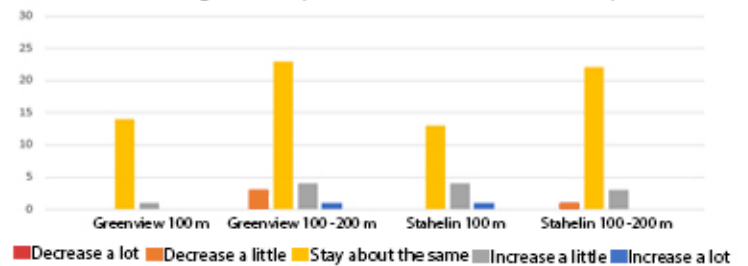
How safe the pilots of design look after installation of bioretention flower gardens? (Control Site and Flower Garden)

	Greenview 100 m	Greenview 100- 200 m	Stahelin 100 m	Stahelin 100- 200 m
Decrease a lot	0	0	0	0
Decrease a little	0	0	0	0
Stay about the same	3	2	2	5
Increase a little	1	10	2	3
Increase a lot	15	19	14	18
Total	19	31	18	26



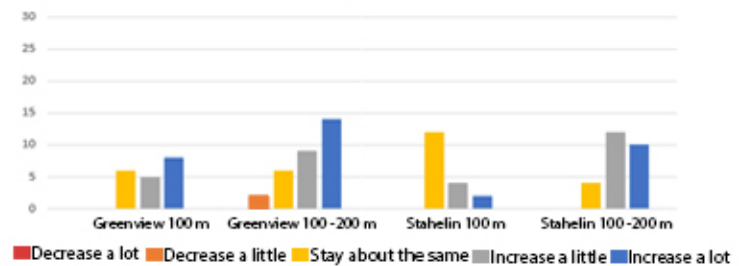
How safe the pilots of design look after installation of bioretention flower gardens? (Mowed lot and Flower Garden)

	Greenview 100 m	Greenview 100- 200 m	Stahelin 100 m	Stahelin 100- 200 m
Decrease a lot	0	0	0	0
Decrease a little	0	3	0	1
Stay about the same	18	23	13	22
Increase a little	1	4	4	3
Increase a lot	9	1	1	0
Total	19	31	18	26



How these pilots of design will affect the perception of safety in the neighborhood?

	Greenview 100 m	Greenview 100- 200 m	Stahelin 100 m	Stahelin 100- 200 m
Decrease a lot	0	0	0	0
Decrease a little	0	2	0	0
Stay about the same	6	6	12	4
Increase a little	5	9	4	12
Increase a lot	8	14	2	10
Total	19	31	18	26



RESULTS

CHANGE IN THE PERCEPTION OF SAFETY (EAST GARDENS)

Figure 7: Change of the perception of safety results in the western cluster gardens



Distance from Neighborhood Green Infrastructure (GI) in Detroit and Impact on Perception of Safety

In the eastern portion of the Warrendale neighborhood, almost all residents, especially in the Greenview Ave have high level of perception of safety in each garden as well as neighborhood. However the western portion has overall lower level of perception of safety. This difference between eastern and western cluster gardens can be an indicator of the influence of other factors such as neighborhood characteristics on the perception of safety. This demonstrates that other variables may have subtle effect on a GI project to appear safe or unsafe among residents in an urban area, (Table 3). In general, Vaughan garden in the western cluster has the lowest percentage of safety in the Warrendale neighborhood. And as this garden has similar design characteristics with Greenview Ave garden, other factors may affect this result such as the context of the neighborhood in this part of the Warrendale neighborhood.

For measuring the perception of safety in each site and in the whole neighborhood from 100 meters and 100 to 200 meters distance of the gardens to answer the questions of the study, GIS maps and mean and median of the survey responses in each site, showed that in the western cluster, the Evergreen site, safety perception has not been changed in 200 meters from the site than 100 meters. In fact, in both 100 meters and 100 to 200 meters, residents felt equally safe in the neighborhood. Although results of the perception of safety between control site and flower garden and mowed lot and flower garden showed a higher difference between 100 meters distance from the garden and 100 to 200 meters distance. Residents clearly had higher perception of safety in 100 meters from the bioretention flower gardens, (Figures 9, 10 & 11).

GIS maps showed a higher perception of safety in the Vaughan Ave site similar to the Evergreen St site, both 100 meters and 100 to 200 meters of the site in the neighborhood. But surprisingly, based on the average of the responses in each garden, residents felt safer in 100 to 200 meters distance of the Vaughan site than 100 meters distance. And median showed a lower rate of safety in both 100 meters and 100 to 200 meters between control site and bioretention flower garden as well as mowed lot and flower garden, (Figures 12, 13 & 14).

	<i>Gender: Female</i>	<i>Gender: Male</i>	<i>Mean How long current location</i>	<i>Mean How long neighborhood</i>	<i>Experiencing Negative activities</i>
<i>East</i>	58	24	6 years 7 months	9 years 9 months	4
<i>West</i>	46	35	6 years	9 years 5 months	2
<i>Total sample</i>	104	59	6 years 3 months	9 years 7 months	6

Table 3: Other factors may impact perception of safety in eastern and western clusters.

Distance from Neighborhood Green Infrastructure (GI) in Detroit and Impact on Perception of Safety

In general, results showed a higher perception of safety in the eastern cluster gardens than the western gardens. In the Greenview site, perception of safety in 100m distance from the site in the neighborhood was lower than 100 to 200 meters of the site, but higher than 100 to 200 meters from the site between control and flower garden and mowed lot and flower garden, (Figures 15, 16 & 17). Results in the Stahelin site did not appear to be different between 100 meters and 100 to 200 meters distance from the site. And surprisingly, although the perception of safety between mowed and flower garden is not different between 100 meters and 100 to 200 meters of the site, both showed a lower rate of safety than other sites. But results between control and flower garden showed a higher rate of safety in both distances from the Stahelin site, (Figures 18, 19 & 20).

100 meters radii

		<i>Sample size</i>	<i>Mean</i>	<i>Median</i>	<i>Range</i>
<i>West Gardens</i>	Evergreen Site (Control site- Flower garden)	23	4.00	4.00	3 - 5
	Evergreen Site (Mowed lot- Flower garden)	23	3.43	3.00	3 - 5
	Evergreen Site (Neighborhood)	23	3.39	4.00	3 - 5
	Vaughan Site (Control site- Flower garden)	15	2.73	3.00	2 - 4
	Vaughan Site (Mowed lot- Flower garden)	15	3.33	3.00	2 - 4
	Vaughan Site (Neighborhood)	15	4.00	4.00	3 - 5
<i>East Gardens</i>	Greenview Site (Control site- Flower garden)	18	4.66	5.00	3 - 5
	Greenview Site (Mowed lot- Flower garden)	18	3.30	3.00	3 - 4
	Greenview Site (Neighborhood)	18	3.40	3.00	3 - 5
	Stahelin Site (Control site- Flower garden)	19	4.47	5.00	3 - 5
	Stahelin Site (Mowed lot- Flower garden)	19	3.05	3.00	3 - 5
	Stahelin Site (Neighborhood)	19	4.10	4.00	3 - 5

100 - 200 meters radii

		<i>Sample size</i>	<i>Mean</i>	<i>Median</i>	<i>Range</i>
<i>West Gardens</i>	Evergreen Site (Control site- Flower garden)	28	3.14	4.00	3 - 5
	Evergreen Site (Mowed lot- Flower garden)	28	3.03	3.00	2 - 4
	Evergreen Site (Neighborhood)	28	3.85	4.00	1 - 5
	Vaughan Site (Control site- Flower garden)	21	3.52	3.00	2 - 5
	Vaughan Site (Mowed lot- Flower garden)	21	3.52	3.00	1 - 5
	Vaughan Site (Neighborhood)	21	3.95	4.00	3 - 5
<i>East Gardens</i>	Greenview Site (Control site- Flower garden)	26	4.38	5.00	3 - 5
	Greenview Site (Mowed lot- Flower garden)	26	3.07	4.00	2 - 5
	Greenview Site (Neighborhood)	26	4.20	3.00	2 - 5
	Stahelin Site (Control site- Flower garden)	31	4.54	5.00	3 - 5
	Stahelin Site (Mowed lot- Flower garden)	31	3.09	3.00	2 - 4
	Stahelin Site (Neighborhood)	31	4.12	4.00	3 - 5

Table 4: Mean and Median of 100 meters and 100 to 200 meters from each site.

Distance from Neighborhood Green Infrastructure (GI) in Detroit and Impact on Perception of Safety

SITE Evergreen Ave (Control - Flower garden)

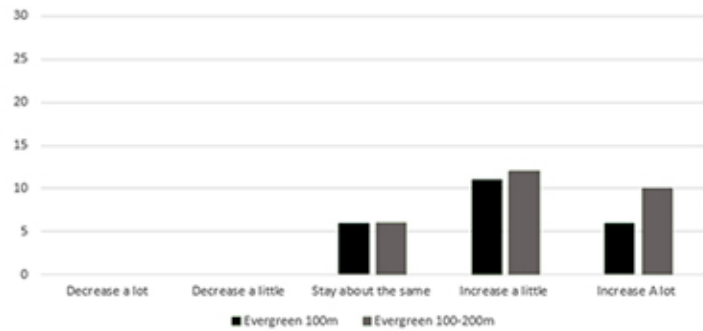


Figure 9: Change of the perception of safety in Evergreen Site between control and bioretention flower garden.

Distance from Neighborhood Green Infrastructure (GI) in Detroit and Impact on Perception of Safety

SITE Evergreen Ave (Mowed - Flower garden)

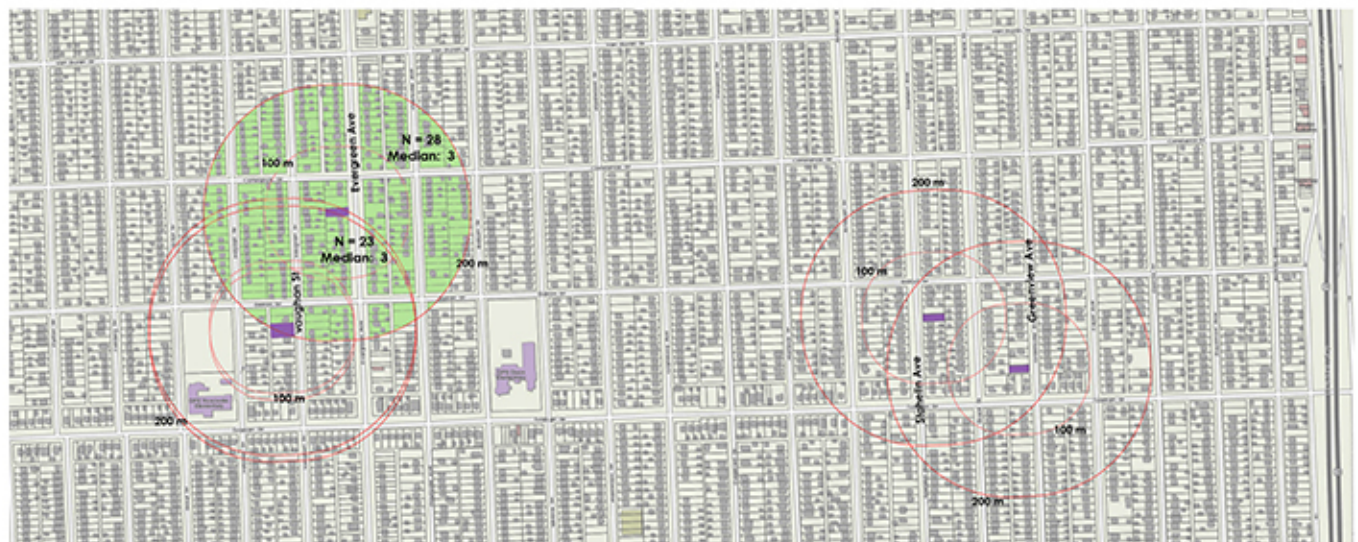
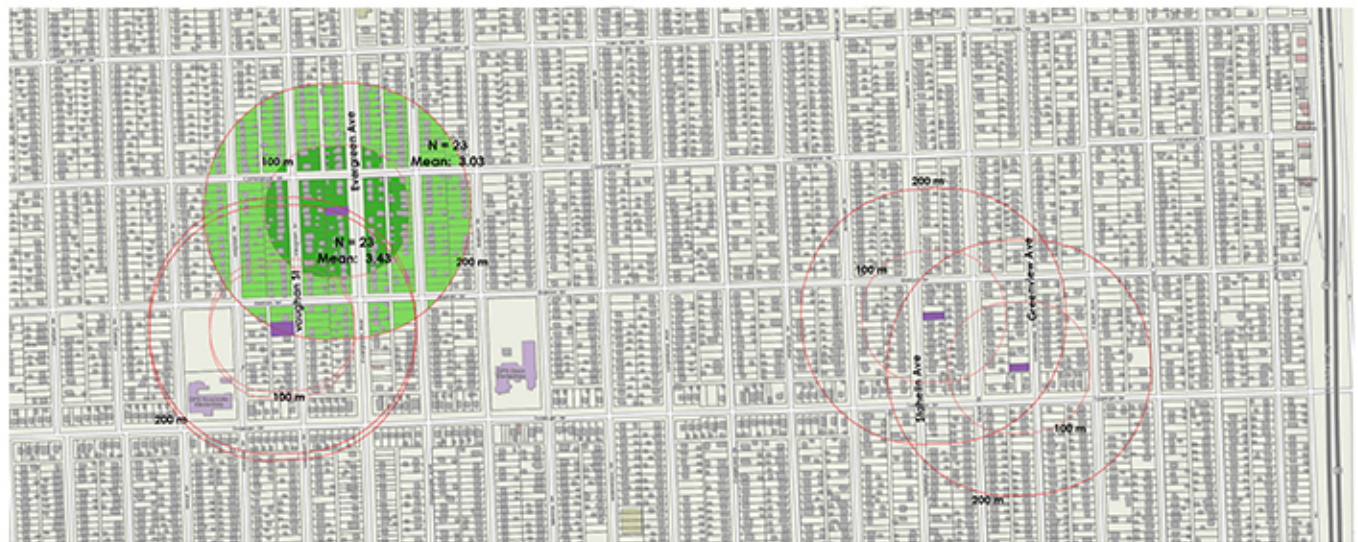
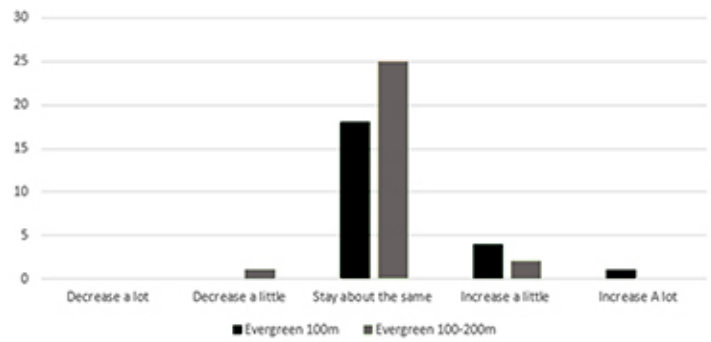


Figure 10: Change of the perception of safety in Evergreen Site between mowed site and bioretention flower garden.

Distance from Neighborhood Green Infrastructure (GI) in Detroit and Impact on Perception of Safety

Neighborhood Evergreen Ave

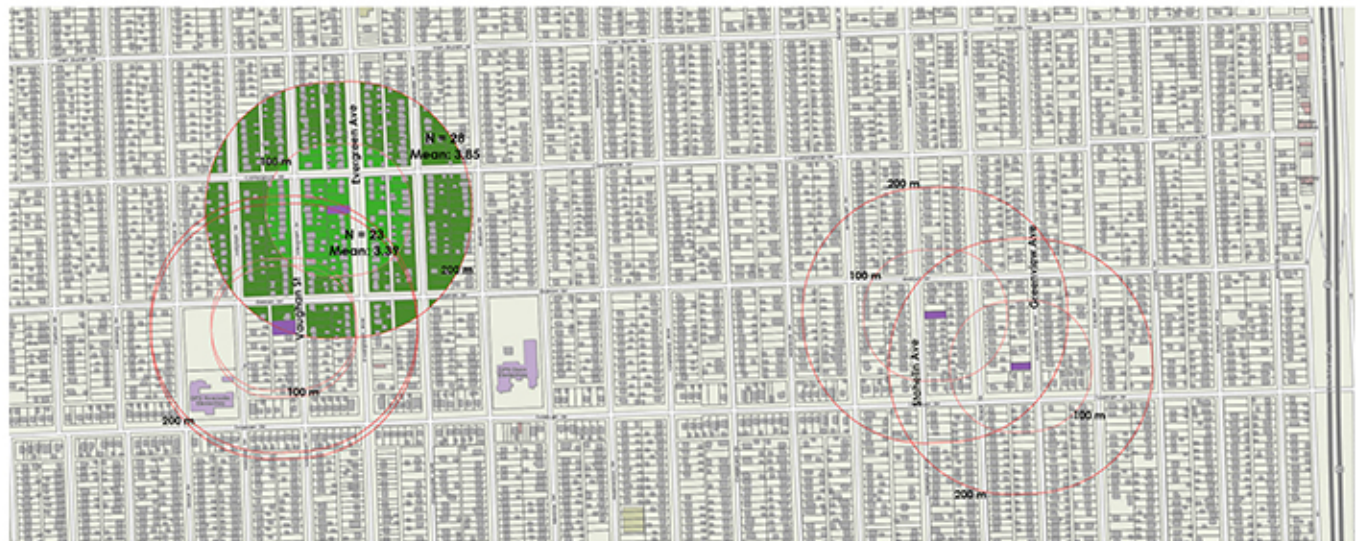
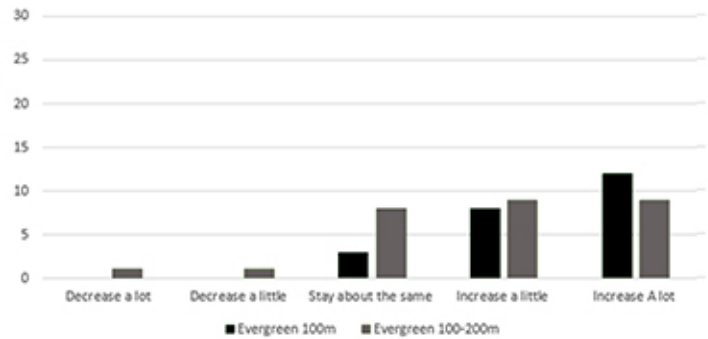


Figure 11: Change of the perception of safety in the neighborhood.

Distance from Neighborhood Green Infrastructure (GI) in Detroit and Impact on Perception of Safety

SITE Vaughan St (Control - Flower garden)

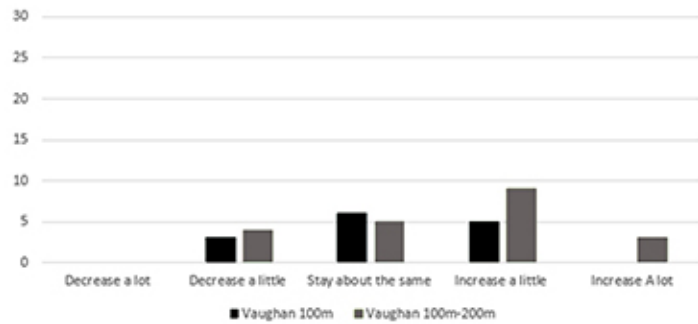


Figure 12: Change of the perception of safety in Vaughan Site between control and bioretention flower garden.

Distance from Neighborhood Green Infrastructure (GI) in Detroit and Impact on Perception of Safety

SITE Vaughan St (Mowed - Flower garden)

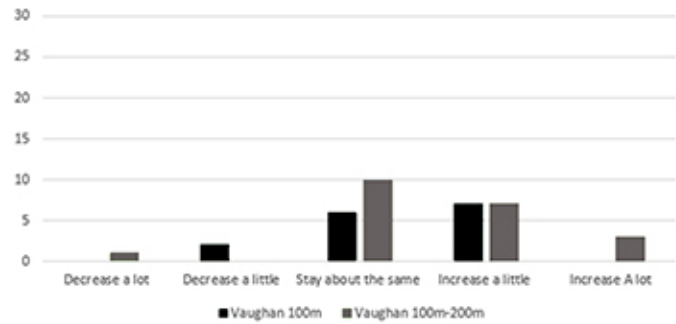


Figure 13: Change of the perception of safety in Vaughan Site between mowed site and bioretention flower garden.

Distance from Neighborhood Green Infrastructure (GI) in Detroit and Impact on Perception of Safety

Neighborhood Vaughan St

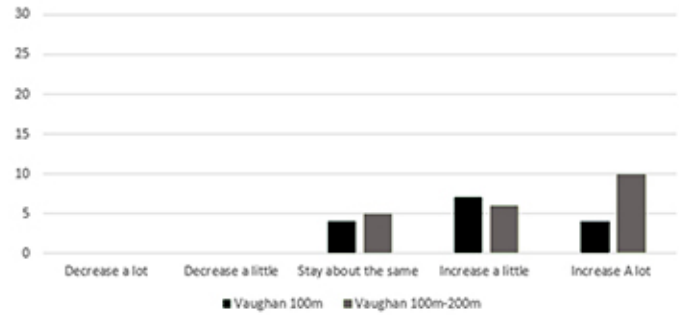


Figure 14: Change of the perception of safety in the neighborhood.

Distance from Neighborhood Green Infrastructure (GI) in Detroit and Impact on Perception of Safety

SITE Greenview Ave (Mowed - Flower garden)

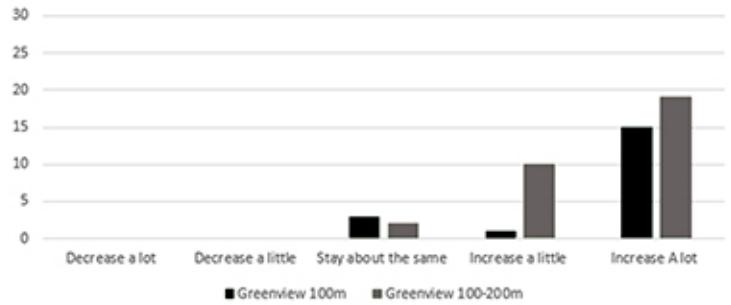


Figure 15: Change of the perception of safety in Greenview Site between control and bioretention flower garden.

Distance from Neighborhood Green Infrastructure (GI) in Detroit and Impact on Perception of Safety

SITE Greenview Ave (Mowed - Flower garden)

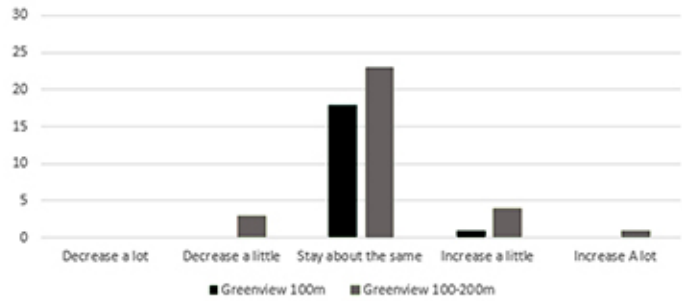


Figure 16: Change of the perception of safety in Greenview Site between mowed site and bioretention flower garden.

Distance from Neighborhood Green Infrastructure (GI) in Detroit and Impact on Perception of Safety

Neighborhood Greenview Ave

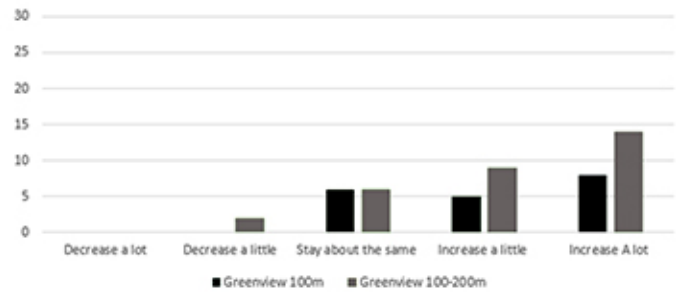


Figure 17: Change of the perception of safety in the neighborhood.

Distance from Neighborhood Green Infrastructure (GI) in Detroit and Impact on Perception of Safety

SITE Greenview Ave (Mowed - Flower garden)

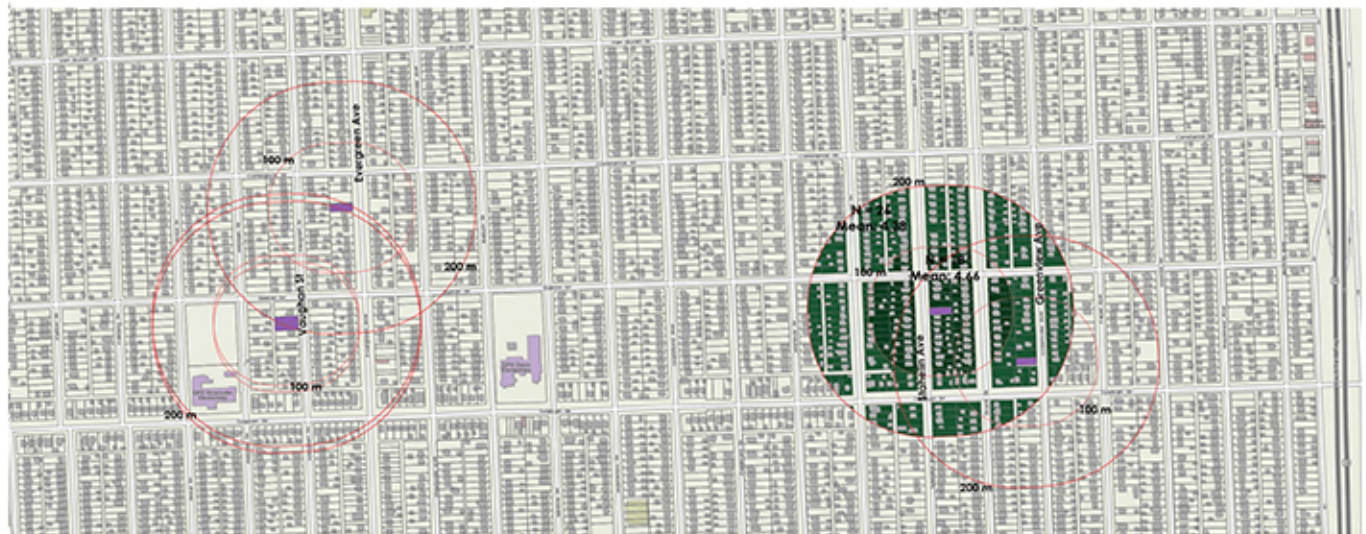
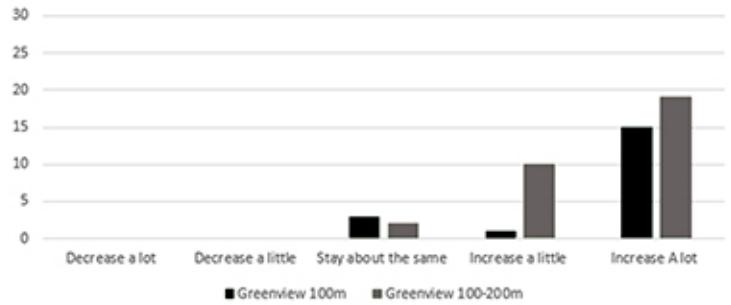


Figure 18: Change of the perception of safety in Stahelin Site between control and bioretention flower garden.

Distance from Neighborhood Green Infrastructure (GI) in Detroit and Impact on Perception of Safety

SITE Stahelin Ave (Mowed - Flower garden)

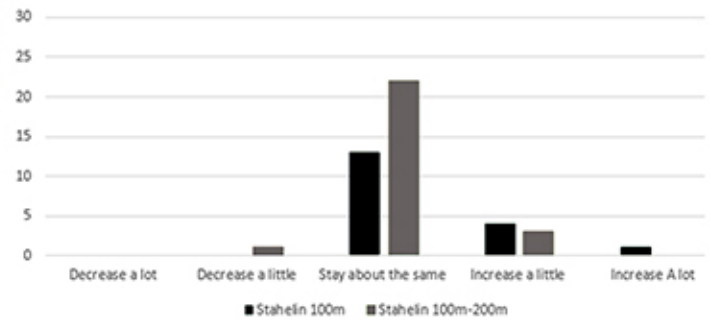


Figure 19: Change of the perception of safety in Stahelin Site between mowed site and bioretention flower garden.

Distance from Neighborhood Green Infrastructure (GI) in Detroit and Impact on Perception of Safety

Neighborhood Stahelin Ave

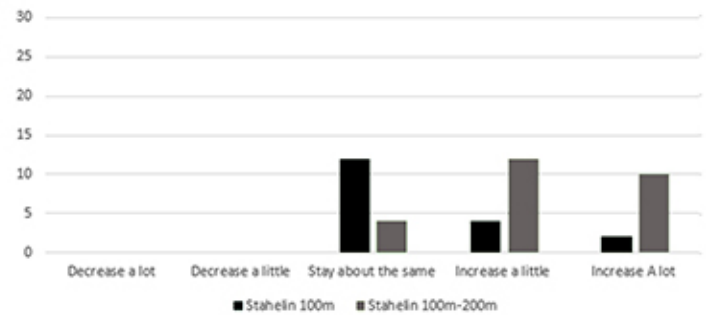


Figure 20: Change of the perception of safety in the neighborhood.

Discussion:

Analyzing the results of the current study to assess how residents in the Detroit's Warrendale neighborhood will respond to the four bioretention garden design with colorful planting design and a well-cared appearance showed that residents' perception of safety in the eastern cluster gardens was higher than the western cluster gardens; and that may be related to residents' perception of safety in their neighborhood which was higher before the installation of the bioretention flower gardens (Figures 3,6,9,12). The eastern cluster appeared as a busier neighborhood, with the NEW_GI survey results suggesting higher levels of physical activities and social support for both elderly and children. That can be a potential explanation for a higher perception of safety among residents before installation of bioretention flower gardens. This is align with other studies that say a stronger social network in the neighborhood can improve residents' concern with the appearance of their neighborhood which leads to higher perceived level of safety (Lichten et al, 2016; Zhou & Rana, 2012; Wolf & Robbins, 2015; Baba & Austin, 1989).

After careful reviewing the responses, it appeared that a few responses that were strongly disagreed with the statement of "the installation of bioretention flower gardens improved the safety in each garden and in the whole neighborhood" had a strong influence on the analysis and shifted the results of the study. These responses lead to a lower mean rating of perception of safety in 100 to 200 meters distance from Evergreen garden, as well as, 100 meters from the Vaughan garden, which was surprising, regardless of other responses in the survey. Similarly, for the eastern cluster gardens, a few responses affected the mean ratings and resulted in getting the surprising results of having a higher levels of perception of safety in 100 to 200 meters than 100 meters.

Although the small number of respondents within each radii of the pilot sites could be the potential explanation for some of the surprising results in different gardens, after carefully assessing the responses of the residents who disagreed that "the installation of bioretention gardens will improve safety in each site and in the neighborhood", there was a common answer for the question of if they can trust or if they are able to get along with their neighbors. The interesting finding was that, these residents disagreed with the statement that "they can get along with their neighbors regardless of the duration of living in the current location or the neighborhood". Another interesting finding was that the range of the living in this neighborhood among these residents was from 6 months to 24 years. Degrading the social network of the neighborhood among these respondents may be a reason for feeling unsafe in the neighborhood. And this finding is align with other research, as many studies found a positive relationship between social network in a neighborhood and perception of safety through creating opportunities for interaction among neighbors at different levels (Holtan et al, 2015; Coley, Kuo, & Sullivan, 1997; Kuo, Sullivan, et al., 1998; Sullivan, Kuo, & Depooter, 2004; Leyden, 2003).

Based on the literature review experiencing negative activities in a neighborhood also could be a reason for feeling insecure and stress in that neighborhood. And that could lead to dissatisfaction with the neighborhood and as a result lower levels of perception of safety among residents (Branas et al., 2011; Garvin et al., 2013; Kuo & Sullivan, 2001; Gilstad-Hayden et al., 2015; Kondo et al., 2015). So frequency of negative activities observation could be a potential reason for the surprising results of the current study among those respondents who disagreed that installation of flower gardens would improve safety in their neighborhood. Reviewing the survey indicated that some of the residents experienced different negative activities such as dumping, loitering and drinking in the street in both eastern and western cluster gardens. However reviewing the responses showed that among the residents who disagreed with the improvement of safety through installation of bioretention flower gardens, only one of them experienced negative activities in that particular neighborhood.

Furthermore, based on the literature review benefits of GI projects may not evenly distributed among demographic categories. These studies observed demographic variables such as age and gender as a significant predictor of safety in urban green spaces, and as a result they suggested that green space has a positive impact on men but not women or elderly people due to social and physical vulnerability (Richardson & Mitchell, 2010; Roe et al., 2013; Maas et al., 2009; Ho et al., 2005; Sreetheran & van den Bosch, 2014; Gilleard, Hyde, & Higgs, 2007; Phillipson, Bernard, Phillips, & Ogg, 1999). However in the current study reviewing the demographic variables of the respondents whom bioretention flower gardens appeared less safe than mowed lots or control sites to them, age and gender were not different from other residents who lived in the 100 meters and 100 to 200 meters radii of each garden.

Analyzing the responses of residents who disagreed with the statement that “installation of bioretention flower gardens would improve perception of safety” to the other questions of the survey showed that, in general these residents agreed with having the bioretention flower gardens in their neighborhood. Most specifically, they agreed that demolition of vacant houses and having a garden with colorful plantings would improve the appearance of their neighborhood, and as a result their satisfaction with their neighborhood. They agreed that these gardens would make a better and safer place for children to play. They agreed that this design would reduce the risk of fire in the neighborhood and would improve the safety in this regard. Most of the residents satisfied with the design of the gardens due to colorful plantings and less trees for a safer appearance. Only a few of the residents dissatisfied with the gardens because of removing more trees. These findings align with the literature that suggests good planning and design of the GI projects is the key to improve satisfaction among residents about their neighborhood (Kaźmierczak, 2013; Markowitz et al., 2001, Schroeder & Anderson, 1984, Snelgrove et al., 2004).

Conclusion:

This project investigated how distance from GI project can affect the perception of safety among residents. It demonstrated how different greening projects in a depopulating city, can impact the safety and crime, as well as the beautification of the city. The study area, Warrendale Neighborhood located along the Rouge River in Detroit, is a residential neighborhood with high rates of vacant lots. The current project rooted in a larger transdisciplinary research collaboration, NEW-GI—Neighborhood, Environment, and Water research collaborations for Green Infrastructure in legacy cities. To understand the effectiveness of the GI projects, Nassauer et al assessed the effects of the four bioretention flower gardens as the pilot sites on resident's satisfaction in surrounding neighborhoods. The survey included visualizations of six vacant lots within two clusters approximately 1.5 miles apart in Warrendale neighborhood. Each cluster included a control site and two GI intervention sites. The current study investigates how safe the pilots of design look after installation of the four bioretention flower gardens, and also, how these pilots of design will affect the perception of safety in the whole neighborhood.

Results of the study showed that there is a positive relationship with GI projects and residents' perception of safety. However, results indicated that other variables such as neighborhood characteristics, social network, experiencing negative activities, and demographic categories can have an influence on the perception of safety in a neighborhood as well. It is important to note that the small number of the respondents in 100 meters and 100 to 200 meters distance of each garden can be a limitation for the results of the current study, which could be the cause of some of the surprising results in one of the gardens that showed a lower levels of perception of safety for the mowed lot than the control site which was an image of a typical vacant lot in Detroit.

This study adds to the broad literature that suggest greening vacant lots in today post-industrial cities is associated with perception of safety in different levels in urban areas. This study can be beneficial for policy makers and practitioners in the area of planning to take in to account the multi-functionality of GI projects and influence of them on the perception of safety in disadvantaged neighborhoods.

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