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Gauging the Relationship between Contextual Growth and Structural Neglect

*Dr. **GALEN NEWMAN** [1] , Dr. **MICHELLE MEYER** [2], Dr. **BOAH KIM** [3] and Dr. **RYUN JUNG LEE** [4]
[1, 3, 4] Department of Landscape Architecture and Urban Planning, Texas A&M University, USA
[2] Department of Sociology, Louisiana State University, USA
E MAIL: gnewman@arch.tamu.edu E mail: mmeyer@lsu.edu , E mail: boah.kim@gmail.com E mail: ryunjunglee@gmail.com

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ABSTRACT

Population and land use out-migrations from urban to peripheral areas can result in non-functional, unmaintained historic structures which deteriorate to the point where removal is cheaper than removal – or demolition by neglect. The increasing rate of neglected historic structures is a growing concern. There is a need for research investigating connections between urban growth management and its effect on neglect. This paper applies Newman's (2013) conceptual model of measuring neglect to Geographic Information Systems, comparing rates of neglect in historic Doylestown, Quakertown, and Bristol boroughs in Pennsylvania, USA utilizing different amounts of peripheral agricultural preservation. Comparisons are made examining descriptive statistics on existing conditions, a Polychoric correlation evaluating relationships between drivers of neglect, and a cross-comparative GIS spatial analysis. Results indicate as amounts of peripheral preserved farmlands increase, neglect can be lowered.

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1. Urban Dynamics and Heritage Neglect

Forrester (1969) theorizes that the city is a living organism whose form takes its shape as the result of a combination of external forces. Further, actions and interactions of cultures are a product of the desires, necessities, and values of a city's actors and give meaning to its form (Newman, 2015). This theory presupposes that comprehension of the built environment must be considered in conjunction with the understanding of both exogenous and endogenous factors and their causal relations (Ben-Hamouche, 2013). Listokin (1997) takes this theory a step further, positing that growth management and preservation of the built environment are fundamentally connected; he also states that these connections are, however, not fully understood. Local policies do not conserve built heritage fully (Pickerill & Pickard, 2007). For example, evidence from historic areas in Germany has shown that contextual economic and political changes significantly impact historically preserved buildings (Alberts & Brinda, 2005).

Historic preservation has a primary objective to protect structures and districts of historic prestige

***Corresponding Author:**
Department of Landscape Architecture and Urban Planning, Texas A&M University, USA
E-mail address: gnewman@arch.tamu.edu

from alteration, degradation, and demolition (Ben-Hamouche, 2013). Historic urban areas require high levels of support to retain structural viability, safeguard the integrity of heritage structures, and stimulate local economies. Urban spatial change is largely tied to alterations in contextual land uses, threatening many elements within the historic built environment. Simultaneously, many urban fringe areas (such as farmlands), the settings of historic urban buildings, are also threatened. As such, regulations now go beyond local preservation policies and include larger scaled contextual approaches for heritage management (Collins, Waters, & Dotson, 1991).

Centrifugal development has effected many urban historic buildings, in many cases resulting in their removal. Urban sprawl can create a uniform spatial form across cities and destroy much structural heritage in its wake (Treib, 2008; Yahner & Nadenicek, 1997). Urban expansion can accelerate the loss of historic buildings because of a lack of utility, a process referred to as demolition by neglect (DBN). DBN is the removal of a historic building or structure due to prolonged vacancy and extreme maintenance issues (Leatherbarrow & Mostafavi, 1993).

The capabilities of historic preservation policies to assist in retaining historic character and function in heritage buildings is highly dependent on the examination of process and changes within urbanized areas and their surrounding contexts (Alderson, 2006; Cook, 1996). Since urban contexts are constantly in flux, form and function rarely coincide in any environment for an extended period of time (Jackson, 1997). Contemporary historic preservation theory gives priority to form through the pursuit of historic integrity. An unfortunate outcome of this position is that if a historic building loses its function in contemporary society, it can also eventually be removed. Luckily, adaptive reuse and rehabilitation efforts have increased recently, leading to small upsurges in historic structure retainance in some localities (Newman, 2015).

Many U.S. historic structures are policed on a unit-by-unit basis and are then analyzed based on whether or not they appear as they once did at a given historical time (or based on their historic integrity). Jigyasu (2002), notes that historic structures have two fundamental dimensions: historic integrity, and a relationship to the contextual environment with which they interact. A vital approach to the preservation of historic buildings lies with the ability to managing the individually with local policy (internally) and successful management of regional land use changes (externally). Therefore, the examination of the individual structure and its dynamic setting must occur if neglect can be fully understood. (Listokin, Listokin, & Lahr, 1998; Pickerill & Armitage, 2009).

The shift toward a more dynamic management of historic structures must focus on adaptive reuse, rehabilitation, and land use management. American historic preservation can differ from European approaches due to a stronger emphasis on local regulations in the U.S., while many European cities practice an area-based approach (Doratli, 2005). Area-based strategies can increase non-government funding, allow for greater expansions in historic districts, increase private sector investment in historic regeneration projects, and increase heritage rehabilitation in marginalized neighborhoods (Pickerill & Armitage, 2009). In the U.S., broader heritage management approaches are typically regulatory or incentive-based. Regulatory measures, such as state regulated monetary penalties, generally involve punishment for allowing neglect to occur or continue. South Dakota statutes makes willful neglect a misdemeanor; in West Virginia, local landmark commissions enforce standards for the maintenance of landmarks; San Francisco, California can assess a $500 per day penalty to owners who allow neglect to occur (National Trust for Historic Preservation, 2008).

Listokin (1997) theory suggests that local polices, when used in a singular approach, will not adequately result in conserved built heritage in the long-term (Alberts & Brinda, 2005; Pickerill & Pickard, 2007). Contemporary research reinforces this position, but shows a separation between historic preservation and external land use management (Avrami, 2012). Historic buildings are just one component within a larger, ever-changing system; if both aims are focused to align to one goal, only then will the system be mutually beneficial properly (Newman & Saginor, 2014).

Cassar (2009) suggests that historic preservation requires new research to aid in the understanding of how traditional buildings behave in environmental systems, if structural performance is to be improved.

Newman's (2013) conceptual model for measuring neglect takes a systems approach to measuring areas of the historic built environment. It is a method to begin to compare neglect rates across cities and historic districts to initialize the exploration of the effects of strategies for managing contextual growth and techniques to preserve the historic built environment. It is a framework for measuring neglect, based on Listokin's (1997) theory of urban dynamics. The model is a means to begin to examine area based approaches for regulating historic areas through the surveyance and analysis of neglect of the built environment, specifically in regards to historic buildings. Newman's model (2013) uses dimensions of integrity and viability from Listokin's (1997) theory to measure the rate of demolition by neglect. It is the only model currently utilized to measure this phenomenon. A synergetic relationship between urbanization and historic preservation can be eventually realized through increased application of the model. While the original model was developed and assessed through qualitative analysis, newer methods of analysis using Geographic Information Systems (GIS) should also be employed for more thorough spatial analyses.

2. Geographic information Systems in Heritage Management

GIS are powerful spatial tools using computational technologies which allow for storing altering, creating,, displaying and overlaying spatial data (Limp, 1999). They offer the possibility to simultaneously store, organize, map and represent, manage, and analyze data concerning geographic locales and their context while. This allows for a much more thorough spatial analysis of an historic urban area (Burrough & McDonnell, 1988). While information obtained from surveyance or research can be applied to generate new databases, the innovative tools involved with the program have been used too sparingly in historic built environment studies, typically involving analyses involving chronological historical spatial data combined with statistical assessments (Kvamme, 1993).

The field of archaeology, studying human activities of the past and their resultant material culture, has dominated the used of GIS in regards to historic preservation based research (Kaimaris, Sylaiou, Georgoula, & Patias, 2011). While archaeologists globally have recognized the possibilities GIS can offer and applied its analytical tools in countries outside of America such as Scotland (Murray, 1995), France (Guillot & Leroy, 1995) and Holland (Roorda & Wiemer, 1992), preservationists applying GIS to solve the issues of current development patterns on neglected heritage structures are nearly non-existent. Remote sensing applications, satellite imagery set the stage for initial historic structure analysis (Doneus, 2001) but as data sources have grown, new statistical analysis and multi-scalar analyst tools have been created to move beyond traditional GIS based approaches. Cultural resource management professionals have relied upon these databases for years to ensure the protection and preservation of valuable historic information (Box, 2003). GIS data can also be used as a way of distilling priorities for management decisions. For example, the Almería Province in Spain utilizes its cultural and heritage inventory data to assess the rehabilitation potential of buildings and has established a priority order for their reuse for a 'decision index' which corresponds to the considerations of each building (Cano, Garzon, & Sanchez-Soto, 2013). This makes each management decision unique to its corresponding heritage structure.

In regards to the historic built environment, GIS have been primarily applied for landscape visualization, viewshed impact assessment, multi-scale synthesis, spatial sampling, and forecast modelling. GIS must become more common in urban heritage studies to help synthesize efforts land use planning, environmental management and a variety of historic analyses; a new set of methods needs to be developed which may require preservationists to alter the way asses the historic built environment through expanding its scope beyond individual built units (Limp, 1999).

3. Research Questions and Methodology

This research uses GIS to determine if contextual land use management helps deter neglect within the historic built environment. It seeks to answer the question, what relationship does farmland preservation have on neglect within historic urban areas? It is hypothesized that preserving fringe farmlands as a policy for external land use management can aid in increasing viable buildings within historic urbanized boroughs.

The urban boroughs analyzed – Bristol, Quakertown, and Doylestown – are all historic colonial cities in Bucks County, Pennsylvania, USA. Pennsylvania uses farmland preservation to aid in the conservation of the historic character of its boroughs and townships as a means of countering the effects of sprawl. Bucks County lost 70% of its agricultural properties from 1950-1997 (U.S. Department of Agriculture, 2005). The entire region was ranked second in the U.S when ranked according to areas with farmlands threatened to conversion (Olson & Lyson, 1999) (Bourke, Jacob, & Luloff, 1996). Bucks Count, is a contested landscape characterized by rapid land consumption and conversion. It is in southeast Pennsylvania within an area suffering from threatened farmland and concentrations of historic teardowns. From 1985 to 1995, Pennsylvania lost an area of farmland the size of Delaware to development while populations declined in many inner cities (Hylton, 1995). To counteract decentralization, the state enacted agricultural preservation as a primary means of managing growth

Each borough under investigation is listed on the National Register of Historic Places (National Trust for Historic Preservation, 2008) and is approximately two-square-miles in size; similar polices for preserving farmlands are also practiced (purchase of development rights). Evaluating units of analysis within an identical county with analogous geographic sizes, populations, and ages helps to control for other intervening variables. We utilized the central place theory (King, 1984) to outline an external boundary for each borough to determine the highest impacted areas for the context according to town centers with this particular size and population (Table 1). Within this boundary, we calculated the total quantity of preserved agricultural lands which encircled each borough.

Newman's model (2013) of calculating neglect is applied using (Figure 1) GIS based tools. It combines dimensions of integrity and viability using five factors: 1) timeframe of construction (when the building was built), 2) architectural modification (how much the building has been altered since construction), 3) land use change (how much the building's function has changed), 4) physical condition (the condition of each building), and 5) assessed value (the fair market value). A 95% confidence level was reached based on the sample size and clustered, multistage area random sampling was utilized to survey each building (Montello & Sutton, 2006). Each factor was then measured by scoring three characteristics.

Table 1. Similarities of Cases under Investigation

Variable	**Doylestown**	**Quakertown**	**Bristol**
Population	8227	8688	9923
Size	2.2m2	2.0 m2	1.9 m2
Date Founded	1745	1803	1720
# of Preserved Farms	46	13	1
Total Acreage of Preserved Farmland	3323.38	1057.27	99.9
Agricultural Preservation Strategy	Purchase of Development Rights	Purchase of Development Rights	Purchase of Development Rights
National Register Listing	Yes	Yes	Yes

The evaluation of conservation planning requires measurement on multiple scales for meaningful analysis (Nijkamp, 1991). The research utilized three scales of analysis: an inventory presenting descriptive statistics of the measures utilized to assess variables, a Polychoric correlation to assess relationships of variables, and GIS spatial analyses which combining geocoding, reclassification of attributes, Hot Spot Analysis, Inverse Distance Weighted (IDW) interpolation, Weighted Suitability overlays. The inventory describes conditions on a building by building scale; the correlation examined which variables impacted DBN significantly; and the comparison analyzed the relationship between DBN and amount of preserved agricultural lands. An ordinal scale was used in the inventory and GIS analyses to assign attributed to each building surveyed. Higher overall totals in summed scores indicated a lower occurrence of neglect. Characteristics accepted of each measure per variable were then evaluated using percentages as a means of inventorying conditions.

The scores for the five variables were then summed to evaluate structural neglect on a building scale. The total score of a given building could range from 5 to 15. Neglected buildings had point ranges from 5 to 8, transitory buildings had score ranges from 9 to 12, and viable structures had scores ranging from 13 to 15. The relationship with each factor contributing to DBN neglect was assumed to be (as sums were greater, DBN was lessened), a Polychoric correlation was utilized to test correlation. The variables utilized to assess neglect were correlated with their overall impact in a specific location within the sample frame.

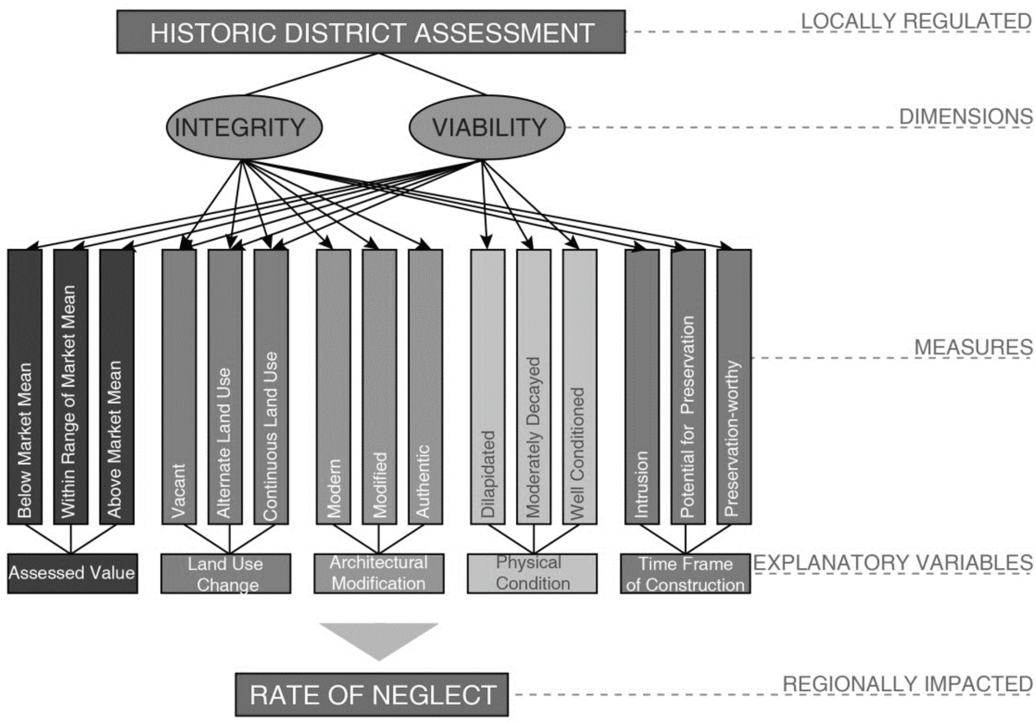

Figure 1. Newman's Model of Measuring Neglect.

After individual building totals were mapped as point values, the cross-case comparison used GIS analyses to identify and map larger-scaled areas of the built environment which were neglected. Hot spot analysis was performed for each spatially located variable and an IDW was performed from the hot spot analysis. Each hot spot analysis map was then overlaid using suitability modeling which was weighted to identify both neglected and viable spaces.

4. Findings

4.1. Inventory of Conditions

Each borough under investigation displayed analogous patterns during the building-scaled inventory (Table 2). The largest percentage of buildings built from 1971 to present was occupied by Doylestown (60%), but a large proportion of these buildings were also vacant (69%). Over one-half of the sampled buildings were provided new land uses through adaptive reuse (60%); simultaneously Doylestown has a large proportion of its buildings in good condition (86%). Quakertown had a large percentage of its buildings erected from 1940 to 1970 (36%) and also show a large degree of vacancy (64%). Relatedly, a large proportion of its built environment was also experiencing dilapidation (74%). The assessed value of structures with occupants was generally above market average (47%). Bristol, has the lowest proportion of newly erected buildings (44%) but the highest vacancy percentage (80%). While 65% were renovated, 67% were considered dilapidated. Bristol, on the other hand, had a relatively high amount of buildings above market mean value (93%). The lowest proportion of buildings that were neglected belonged to Doylestown (1.5%), Quakertown had 3.1% of its buildings neglected and Bristol had 9.1% (Table 3). The portion of transitory structures were all extremely similar across boroughs while Bristol had a low proportion of buildings that were viable (9.1%.)

4.2. Correlational Results

We performed polychoric correlation analyses for ordinal variables to measure the relationship between the five variables (Table 4). We notice an interesting result – the variables show positive and negative correlations. Specifically, land use change and building condition are negatively correlated with time frame of construction and architectural modification. This result is intuitive when we consider how the variables are measured. For example, this result means that newer buildings are more likely to have continuous land use and be well-composed. The only statistically significant correlations are between architectural medication and time frame of construction (0.697)—indicating that buildings that are modern are more likely to be newer buildings—and architectural modification and land use change (-0.094)—indicating buildings that are modern structures are more likely to have continuous land use.

Table 2. Inventory of measures accepted for structures sampled per town.

		Doylestown		Quakertown		Bristol		Overall	
		Count	Rate	Count	Rate	Count	Rate	Count	Rate
Time Frame of Construction	a1 = 1971-present	12	0.185	17	0.258	11	0.200	40	0.215
	a2 = 1941-1970	14	0.215	17	0.257	20	0.364	51	0.274
	a3 = 1900-1940	39	0.60	32	0.485	24	0.436	95	0.511
	Total	65	1	66	1	55	1	186	1
Land Use Change	b1 = Vacant	2	0.031	7	0.106	8	0.146	17	0.091
	b2 = Alternate Use	18	0.277	17	0.258	5	0.091	40	0.215
	b3 = Continuous	45	0.692	42	0.636	42	0.764	129	0.69.4
	Total	65	1	66	1	55	1	186	1
Architectural Modification	c1 = Modern	11	0.169	15	0.227	10	0.182	36	0.194
	c2 = Modified	39	0.600	43	0.652	35	0.636	117	0.629
	c3 = Authentic	15	0.231	8	0.121	10	0.182	33	0.177
	Total	65	1	66	1	55	1	186	1
	d1 = Dilapidated	0	0	1	0.015	5	0.091	6	0.032

Physical Condition	d2 = Moderate	8	0.123	13	0.197	14	0.255	35	0.188
	d3 = Well Composed	57	0.877	52	0.788	36	0.655	145	0.780
	Total	65	1	66	1	55	1	186	1
Assessed Value	e1 = $0 - 81,000	52	0.800	31	0.470	51	0.927	134	0.720
	e2 = $82,000 - 162,000	9	0.139	25	0.379	1	0.018	35	0.188
	e3 = $163,000 - 243,000	4	0.061	10	0.151	3	0.055	17	0.092
	Total	65	1	66	1	55	1	186	1

Table 3. Neglected and viable structures per town.

	Doylestown		**Quakertown**		**Bristol**	
	n	**%**	**n**	**%**	**n**	**%**
Neglected (5-8)	1	1.5	2	3.1	5	9.1
Transitory (9-12)	52	80	51	78.5	45	81.8
Viable (13-15)	12	18.5	12	18.5	5	9.1

Table 4. Polychoric Correlation Analysis Output.

		Land Use Change	**Architectural Modification**	**Building Condition**	**Assessed Value**
Time Frame of Construction	Polychoric Correlation	-0.016	0.697**	-0.014	0.126
	Sig. (2-tailed)	0.065	0.000	0.110	0.792
Land Use Change	Polychoric Correlation	1	-0.094**	0.241	-0.248
	Sig. (2-tailed)		0.000	0.019	0.969
Architectural Modification	Polychoric Correlation		1	-0.211	-0.047
	Sig. (2-tailed)			0.592	0.383
Building Condition	Polychoric Correlation			1	-0.026
	Sig. (2-tailed)				0.750

**a<0.01; *a<0.05

Table 5. Explanation of Variances.

Measure	**Eigenvalue**	**Variance Explained**	**Cumulative Variance Explained**
1	1.77	0.354	0.354
2	1.3	0.259	0.614
3	1.01	0.203	0.817

To understand how these five variables can be combined into, we ran polychoric principle component analysis. In Table 5, we notice that the selected variables explain three underlying aspects of neglect with Eigenvalues above 1 for three factors. These three factors together explain over 80 percent of the variance in the neglect scores among units. As expected from the correlation matrix, the variables Time Frame of Construction and Architectural Modification indicate one similar factor of neglect and load on the first factor. The other three variables, Land Use Change, Building Condition, and Assessed Value, load onto both factors 2 and 3.

Because all five variables relate to our conceptual understanding of neglect and the lack of one clear factor, we choose to combine them into one rate of neglect. There are various methods to create a combined index score, including weighting variables based on the correlation matrix or polychoric factor analysis results. Because of the limited ordinal scaling of the variables (i.e., only values of 1, 2, and 3) and the smaller sample size (n=186), we are concerned about strongly interpreting these results. Thus, we chose simplicity in this exploratory analysis of neglect rating and sum the scores of the five variables. We reverse code timeframe of construction and architectural modification because of their negative correlations with the other variables. The scores could range from 5 (a building scored 1 on every variable) to 15 (a building scored 3 on every variable). Overall, our actual rate of neglect scores range from 6 to 15, with a mean of 11 and standard deviation of 1.61. In Table 6, we show the rates of average neglect for each town. All three towns have similar rates of neglect, but Bristol shows the highest rates with an average score per structure of 10.55. Only 1 building in our study scored the maximum of 15, and it is in Doylestown (Table 6).

Table 6. Output of IDW and Neglect Rate Comparisons.

Output of IDW and Neglect Rates		Doylestown	Quakertown	Bristol
Neglected (Black)	(<-2.58)			
	(-2.58 - 1.96)	22.21%	18.37%	37.58%
	(-1.96 - 1.65)			
Grey (Transitory)	(-1.65 - 1.65)	29.41%	57.45%	60.20%
Viable (White)	(1.65 - 1.96)			
	(1.96 - 2.58)	48.38%	24.18%	2.22%
	(> 2.58)			
Range		15-8	14-8	13-7
Mean per Structure (SD) Total Score/Sample Size		11.28 (1.57)	11.11 (1.54)	10.55 (1.68)
Rate of Avg. Neglect (Mean/15) – 100%		24.80%	25.90%	29.70%

4.3. Cross-Case GIS Analysis

Each building surveyed was geocoded using its address, new fields were created as attributes using the data obtained, maps were created according the attributed developed, and then Hotspot and IDW tools were applied. High z-scores, hot spots, designated areas which with clustered neglect. The IDW combined points created from each building surveyed and suitability models were then run with equal weighting. The suitability maps read where darker areas represent and lighter areas are less neglected (Figure 2, 3, and 4). Doylestown has nearly one half of its area as viable and a very low proportion of neglected area (48.38% and 22.21%, respectively) (Table 6). Quakertown has nearly one quarter of its space as viable and nearly one fifth neglected (24.18% and 18.37%, respectively) and Bristol has relatively no viable space and over one third of its area neglected (2.22% and 37.58%, respectively) (Table 6).

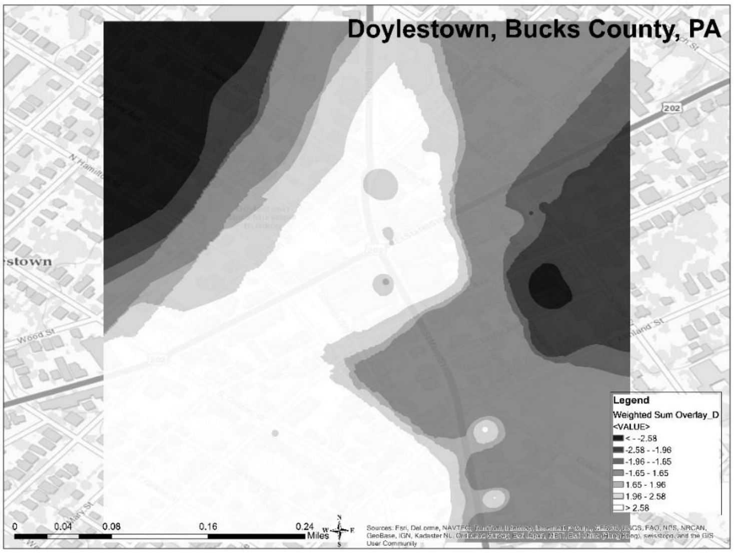

Figure 2. Doylestown Hot Spot Analysis.

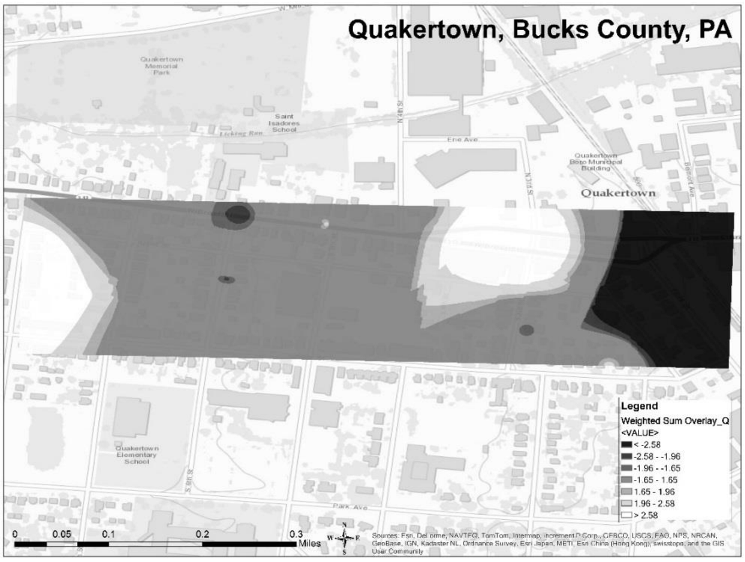

Figure 3. Quakertown Hot Spot Analysis.

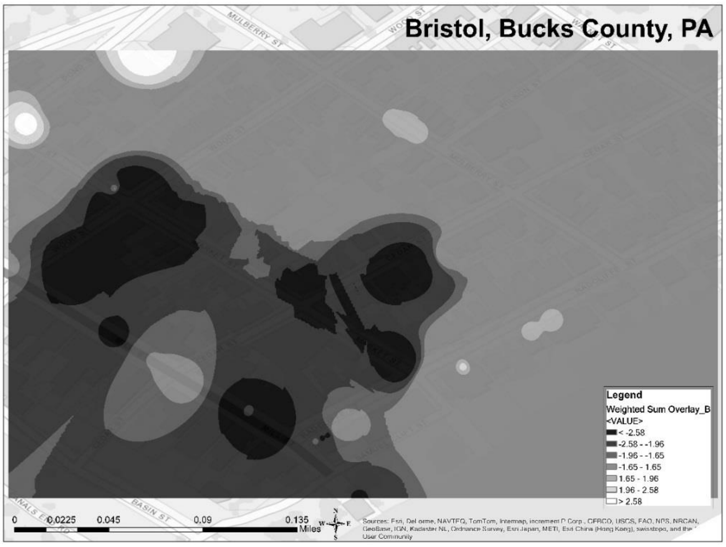

Figure 4. Bristol Hot Spot Analysis.

5. Conclusions and Outlook

This research sought to determine if external land use management could help deter the process of demolition by neglect in the historic built environment, specifically focusing on the alteration of viability rates and the characteristics of neglect as land preservation increased or decreased. Results indicate as amounts of peripheral preserved land increased, viable areas increase while rates of neglect decreased. As fringe farmland preserves increased by city, the overall ratio of viable structures increased, the structures had changed over time in an effort to keep them viable. However, each borough also displayed a high proportion of vacancies, with Bristol experiencing the highest. The relationship of timeframe of construction and architectural modification indicates if historic structures are present, modification of the area's structural integrity may be necessary to keep it vital through time. This presents preservationists with a tough predicament– a battle between integrity and viability.

Historic buildings and vacancy rates were relatively high across all cases. Also, while amount of retained historic buildings was larger as amount of farmland preserves increased, changes in function per retained building were also quite high, suggesting that if a town is to retain heritage structures, adaptive reuse could be a key factor in decreasing the neglect of these retained structures while contributing to their viability. This condition suggests that that while external land use management can help contain cities to retain historic buildings, population stability and land use consistency cannot be soundly proclaimed to be heavily affected.

For these reasons, it cannot be soundly stated that external land preservation has a direct influence on increasing viability in historic areas. However, exogenous approaches to managing the historic built environment are a necessary to deter the process of neglect, but need to be implemented as part of a multi-combinational approach involving adaptive reuse and land use and incentive policies. Studies linking heritage preservation to broader regional land use strategies need to be continually explored, and the current paradigm shift should be accepted as amount of individual neglected structures decreased, the rate of average neglect decreased, but the overall proportion of the area of the built environment in need of immediate regeneration was not necessarily smaller.

This suggests that external land use management strategies can have an indirect effect on neglect rates in historic areas. Hot Spot Analyses supported the hypothesis - as amount of agricultural preservation increased, there was an increase in viability. While all three towns had high ratios of historic structures, many of the land uses in these a pliable avenue of examination. Local preservation policies need to begin to determine which broad-scale practices fit best into their smaller scale preservation efforts to produce a multi-combinational/multi-scalar approach.

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