Value Capitalization Effects of Golf Courses, Waterfronts, Parks, Open Spaces, and Green Landscapes—A Cross-Disciplinary Review

Authors  Jay Mittal and Sweta Byahut

Abstract  This article is a cross-disciplinary literature review of eight environmental amenities and their marginal price effect on nearby residential property values. The purpose of the article is to present variation in price contributing effects of amenities on home values and to identify most commonly used value capturing measurement variables, proximity to and view of, amenities. Additionally, variants of these variables are identified and are presented to showcase how they are used in different situations for different amenity types. Further, this article also highlights which variant of the variable is most suited to capture the marginal price effect by the amenity types. This is the first attempt to compile a comprehensive review of the literature from five disciplines across eight amenity types and provides a useful base for scholars and practitioners interested in the topic.

Substantial literature exists on the relation between various environmental amenities such as farmlands (Geogheghan, Lynch, and Bucholtz, 2003), forests (Ham, Champ, Loomis, and Reich, 2012), public parks and open spaces (Crompton, 2001; 2005; 2007; NAR, 2001; Troy and Grove, 2008), waterfronts (Lansford and Jones, 1995; Benson, Hansen, Schwartz, and Smersh, 1998; Mahan and Adams, 2000; Shultz and Schmitz, 2008; Conroy and Milosch, 2011; Walsh, Milton, and Scrogin, 2011), and many other environmental amenities (Simons, 1999; Boyle and Kiel, 2001; Bourassa, Hoesli, and Sun, 2004; McConnell and Walls, 2005; Simons and Saginor, 2006). The literature in this area is quite extensive and past scholars, for example, McConnell and Walls (2005), reviewed 60 published studies, where 40 hedonic studies focused on the effect of open spaces, parks, natural areas, green buffers, greenbelts, wildlife habitats, wetlands, forest preserves, farmlands, and golf courses on home values and concluded a positive effect. Similarly, Crompton (2001) reviewed 30 studies of parks and open spaces, of which 25 studies reported a positive impact on property prices. Focusing on the role of view, Bourassa, Hoesli, and Sun (2004) reviewed 30 studies of amenities with “scenic view” and their effects on home values, while Boyle and Kiel (2001) reviewed 35 hedonic studies in relation to pollution point sources and their effect on home values. Other noteworthy reviews include Freeman III (1979)

Most past studies have focused on a particular type of amenity, or have emphasized a particular method, or have focused on a particular methodology to create value capturing variables that capture the price contributory effect—best—predominantly, using the hedonic framework. Scholars have little or no consensus on a reliable range of marginal price effects for various amenities and there is a vast variation. These variations are due to a diverse range of amenity types studied, the characteristics of the local real estate markets and the reference data used, the forms and types of measurement variables used in the past studies, and the diversity of models and their forms that were used to capture the effect.

In this review, we present key variables and their variants used in measuring the value capturing effect, and also provide a comparison of capitalization effects by amenity types. For ease of understanding, these environmental amenities have been grouped into two broad categories: the recognizable amenities and the less recognizable amenities. The recognizable amenities are those that are clearly recognizable and are well known as amenities to the local amenity seekers and often offer benefits of quality views, and passive recreational values to the amenity seekers. The less recognizable amenities are those that are rather thinly spread-out throughout the local housing market like tree canopy covers, land uses and land covers, and miscellaneous open spaces.

We examine peer-reviewed journal articles from five disciplines: real estate, land economics, geography, natural resource management, and urban and land use planning, to understand this relation between amenity and home prices. A few articles were also chosen from those journals that either overlap or are closely associated with these five disciplines. The reviewed studies focus on a variety of land use types (environmental amenities) that externalize the price contributory effect as absorbed by the neighboring housing market. Google Scholar, ScienceDirect, Web of Science, and EBSCO Host were primarily used to identify articles using the following key words in search terms: real estate + environmental amenity; hedonic + environmental amenity; hedonic + open space + property value; parks; golf courses; waterfronts, views, viewshed + hedonic. Article search also included combinations of these search terms and using the references from the papers.

Characterizing Environmental Amenities

In this section, we present the characteristics of amenities studied in the past. Several environmental amenity generating land uses have been studied in the past (Exhibits 1 and 2). These amenities are characteristically different from one another as shown in Exhibit 1. The environmental amenities studied have a wide range of internal characteristics and thus have greater variation in their marginal price contribution to the effect on the neighboring property prices. Eight amenity types have been predominantly studied in the past, which are presented in Exhibits 1 and 2 based on whether they are recognizable or not to the homeowners. Further,
### Exhibit 1 | Characterizing Environmental Amenities

<table>
<thead>
<tr>
<th>Amenity Characteristics by Amenity Types</th>
<th>Golf Course</th>
<th>Water Fronts</th>
<th>Greenways</th>
<th>Surrounding Greens / Low Density Open Spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognizable amenities</td>
<td></td>
<td>Ocean Fronts and Near</td>
<td>Lake Fronts and Near</td>
<td>River / Stream</td>
</tr>
<tr>
<td>Not so clearly recognizable amenities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Edge / Perimeter / Size of the Amenity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mega size</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Large size</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Medium size</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Small size</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Spatial shape</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area acreage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linear length / frontage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>True point location</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply of amenity feature in a defined search radial distance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 to 5 amenities per 5 mile</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 to 5 amenities per 2 mile</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 to 5 amenities per 1 mile</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 to 5 amenities per ½ mile</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 to 5 amenities per ¼ mile</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 to 5 amenities / abutting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Exhibit 1 | (continued)

#### Characterizing Environmental Amenities

<table>
<thead>
<tr>
<th>Amenity Characteristics by Amenity Types</th>
<th>Golf Course</th>
<th>Water Fronts</th>
<th>Greenways</th>
<th>Surrounding Greens / Low Density Open Spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Ocean Fronts and Near</td>
<td>Lake&lt;sup&gt;a&lt;/sup&gt; Fronts and Near</td>
<td>River / Stream</td>
</tr>
<tr>
<td>Type of amenity</td>
<td>Natural</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Manmade</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Type of activities</td>
<td>Active use</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Passive use</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Use types allowed</td>
<td>Recreation / leisure / scenic</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Conservation / natural</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>View</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Proximity</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Home premiums by amenity type</td>
<td>+++</td>
<td>+++++</td>
<td>+++</td>
<td>++</td>
</tr>
</tbody>
</table>

#### Notes:

<sup>a</sup>Lakes may vary in size: Great lakes to city level and smaller lakes.

<sup>b</sup>The four size categories include Mega size amenity defined as > 200 acres size or > 20 miles in edge perimeter; Large size amenity defined as 50 to 200 acres size or > 5 miles perimeter; Medium size includes 5 to 50 acres or > 1 mile perimeter; and Small size includes < 5 acres size or < 0.25 mile perimeter amenity.

<sup>c</sup>Linear length is defined as perimeter or edge of the environmental amenity.
### Exhibit 2 | Summary of All Environmental Amenities

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Environmental Amenity by Land Use Type</th>
<th>% Price Effect on Home Values Due to Proximity to Amenity</th>
<th>% Price Effect on Home Values Due to Aesthetic View of Amenity</th>
<th>Studies with Reference of Amenity (Nos.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Oceanfront and Ocean Near</td>
<td>1.7%</td>
<td>47%</td>
<td>Conroy &amp; Milosch (2011) / Bin et al. (2008) / Benson et al. (1997) / 8+7</td>
</tr>
<tr>
<td>3</td>
<td>Lakefront and Lake Near</td>
<td>1.24%</td>
<td>7.5%</td>
<td>Benson et al. (1998) / 223%—empty lots / Wyman et al. (2014) / 8+7</td>
</tr>
<tr>
<td>4</td>
<td>Rivers / Streams</td>
<td>1%</td>
<td>9.6%</td>
<td>Cho, Kim, Roberts, &amp; Jung (2009) / Bowman et al. (2009) / 7+3</td>
</tr>
</tbody>
</table>
### Exhibit 2 | (continued)

Summary of All Environmental Amenities

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Environmental Amenity by Land Use Type</th>
<th>% Price Effect on Home Values Due to Proximity to Amenity</th>
<th>% Price Effect on Home Values Due to Aesthetic View of Amenity</th>
<th>Studies with Reference of Amenity (Nos.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min.</td>
<td>Max.</td>
<td>Min.</td>
</tr>
<tr>
<td>5</td>
<td>Trails and Greenways</td>
<td>2.4%</td>
<td>14.0%</td>
<td>2%-5%</td>
</tr>
<tr>
<td>6</td>
<td>Large Urban Parks</td>
<td></td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Misc. Surrounding Greens / Low Density</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Open Spaces</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Farms and Forests</td>
<td>19.0%-35.0%</td>
<td>8-5</td>
<td>Thorsnes (2002)</td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>49%</td>
<td>78+49</td>
<td></td>
</tr>
</tbody>
</table>

Notes: The table provides a summary of all environmental amenities by type, and their effects on surrounding home values due to “proximity to” and aesthetic “view of” from reviewed studies. Data extracted from +100 published studies. Many studies that are listed under proximity, also included view variable, similarly, one study may have more than one amenity type.
amenities differ in their characteristics such as their size, shape, and their availability in the local housing market. Exhibit 1 presents a matrix with the most defining characteristics of amenities (in rows) across eight amenity types (in columns) as synthesized from the past studies. This variation in the amenity types and their characteristics are quite complex, and comparability across studies is challenging, because real estate markets are unique with varying preferences for open space and availability of substitutes (Ham, Loomis, and Champ, 2015). This is another reason why scholars have found a very wide range of marginal price effect of amenities on the neighboring home prices.

The last row in the Exhibit 1 shows a generic summary of the relative price premiums paid for homes in relation to the environmental amenities as found from the reviewed articles. More details of these effects by individual amenity type are presented below. In general, the premium paid for amenities was found to be highest for ocean front or ocean nearing properties (47%–147%) followed by lakefronts (7.5%–126.7%), and rivers and streams (3%–4.4%). Amongst the human-made amenity types, golf courses commanded the highest premium (7%–28%), followed by trails and greenways (3.5%–20.2%), and then parks (0.1%–20%) and miscellaneous open spaces had a much lower price premium.

As shown in Exhibit 1, a few land use types are clearly recognizable environmental amenities (owing to their size, distinct edge, or clear boundary characteristics), while others are less clearly recognizable amenities in the local housing market. Such land use types are more evenly distributed and may lack the physical characteristics that the other recognizable amenities have.

**Well Defined Clearly Recognizable Amenity**

Amenities with discreet boundaries are the recognizable amenities and include manicured landscapes such as parks and golf courses, waterfronts (ocean, lakes, and rivers/streams), trails, and riparian greenways. Well defined recognizable amenities have clear definitions, clear boundaries, and are generally fixed and in short supply in the local housing market. Such amenity-generating land uses attract amenity-seeking homeowners. The direct benefits from such amenities are clear to the homeowners—leisure and recreational benefits, or scenic views. Amenity-seeking homeowners receive the greatest benefit from these amenities if their homes are located right on the edge to avail the convenience of proximity and easy access, and benefit from scenic views. This location choice creates a spatially clustered demand market, driving up the house prices around the edges of such amenities. These amenities include golf courses, ocean fronts, lakefronts and rivers/streams, trails, and riparian greenways.

**Less Distinctly Recognizable Amenities**

The less distinctly recognizable amenities include an assortment of surrounding landscapes such as green spaces, diverse land uses/landcovers, and other open spaces surrounding homes as studied in the past. These include miscellaneous land uses differentiated by their use, type, ownership, and their land development potential. These landscapes also include undeveloped open spaces and even natural
landscapes, such as naturally preserved areas, forests and farmlands, tree canopy covers or greenness of vegetation and scenic landscapes surrounding homes. These may also include miscellaneous low-density land uses. Often homes are surrounded by such amenities. These amenities are often thinly spread uniformly in the local landscape and are often available in low-density suburban areas in abundance. While the wide spread presence of open space amenities are valuable for the local community and homeowners, such amenities do not provide direct recreational opportunities, or explicit view benefits. This is reflected in the relatively lower premium for homes near such amenities. Notably, however, in localities where such green amenities are in short supply, such green areas command a significant price premium as in arid Tucson, Arizona, in those localities that have well-irrigated greenspaces, parks, and open spaces, such green areas command a significant price premium (Bark, Osgood, Colby, and Halper, 2008). These less distinctly recognizable green areas include miscellaneous open spaces, land uses and land covers, tree canopies, farms and forests, etc.

**Location of Homes vs. Amenities and Measurement Variables Used**

In this section, we discuss how the location of homes relative to the subject amenity in a local housing market are important in measuring the capitalized values, and how proximity, view, and surrounding land use characteristics relative to the location of homes and amenities can be used in developing measurable variables.

**Location of Home Relative to Amenities in Hedonic Studies**

The hedonic modeling framework has been frequently been used to separate the marginal price effect of environmental amenities on neighboring house prices. The marginal implicit price effect varies depending on the home’s location in the local housing market relative to the location of the amenity. The location of homes relative to the environmental amenity becomes critical in these hedonic studies. In general, there are five potential location choices that are available for amenity-seeking homeowners as shown in Exhibit 3.

**Exhibit 3** | Five Location Options of Homes Relative to Amenity Location

1. **Option 1:** Home located inside the amenity area.
2. **Option 2:** Home located near the amenity area.
3. **Option 3:** Home located on the border of the amenity area.
4. **Option 4:** Home located on the opposite side of the amenity area.
5. **Option 5:** Home located far from the amenity area.
1. House is located within/inside the environmental amenity; for example, homes surrounded by trees, forests, or other miscellaneous open spaces (home surrounded by amenity–HS)

2. House is abutting the environmental amenity and located on its edge; for example, homes on the lake, ocean, or riverfront (home abutting amenity and has both proximity to and view of amenity (has amenity–HA)

3. House is located near the environmental amenity (home near amenity or in proximity–HN)

4. House has a view of the environmental amenity (home with a view–HV)

5. House is located far from environmental amenity with no view or far view to the amenity (home far–HF)

These five location options have been the key determinants of how the marginal effect be measured. Below are key variables used to capture this in past hedonic studies.

_Homes in “Proximity to” Amenity._ “Proximity to” in its simplest form is the distance from a house to the amenity. Homes and real properties located close to recognizable and desirable environmental amenities such as golf courses, waterfronts, and other planned urban parks and open spaces frequently sell at a premium price. The increased home values represent a “capitalization” effect of environmental amenities to proximate homeowners. This phenomenon is termed “the proximate principle” (Crompton, 2001, 2005, 2007; Crompton, and Nicholls, 2006). Frederic Law Olmstead in 1857 pioneered the concept of the proximity based property value enhancement principle while successfully planning and implementing the 843-acre Central Park in New York City (Crompton, 2001).

Relative to home locations to the subject amenity, proximity has been defined in several ways in the hedonic function. In general, there are four potential location choices that are available for the amenity-seeking homeowners as explained below and presented in Exhibit 4.

1. House is located at certain distance (straight line distance) from the environmental amenity.

2. House is located within a drive time distance from the environmental amenity.

3. House is abutting the environmental amenity and located on its edge.

4. House within distance bands (buffer distances) from the environmental amenity.

For the buffer distance, past studies have used locational dummies to represent proximity. These buffer distances are either concentric disks or donut-shaped areas of ¼ mile, ½ mile or more from the edge of the amenity.

_Homes “Surrounded by Amenity.”_ There are situations when homes are surrounded by land uses that throw amenity characteristics. This situation is same as the situation when house is located within/inside the environmental amenity; for example, homes surrounded by trees, forests, or other miscellaneous open spaces (home surrounded–HS). In such situations, pre-specified distant buffers are
Exhibit 4 | Proximity to Amenity from Home Defined in Past Studies

Exhibit 5 | Viewsheds from Homes

drawn from each home sample to quantify the presence of amenity characteristics, and are measured as land use areas, proportions of land uses, size or characteristics of amenities in the vicinity of the home. Several other factors are also important here; for example, the characteristics of the home and its parcel (how big is the land parcel itself, and if the parcel itself has enough amenity-generating characteristics present on it), and characteristics of the immediate surrounding land uses within a fixed circular distance.

When the visual characteristics of the amenity in the vicinity are important, often fixed search distance-based GIS viewsheds from each sample home are created to measure the visible land use characteristics of amenities as shown in Exhibit 5. The quantities measured in such cases are, “percentage areas of amenity as compared to other uses, or “area of amenity in acreage,” or proportions of land use/land cover by types within the predefined buffer area from each homes.
Homes with “View of” Amenity. When homes are located right on the edge of a recognizable environmental amenity either abutting them or fronting them, “proximity to,” and “view of” amenity from homes both become synonymous with each other. This is also the location that fetches highest premium price for amenities providing the highest hedonic benefits to the homeowners. There can be more sub-variants of the view variables measured on the quality scale, such as view can be a near view, or a far view, view can be unobstructed full view or a partial view. All of these affect the marginal implicit prices as absorbed in home values.

In general, there are four potential location choices that are available for the amenity-seeking homeowners as explained below and presented in Exhibit 6.

1. House has a direct view, is abutting the environmental amenity, and located on its edge.
2. House either has a view or is located such that it does not have the view to the environmental amenity.
3. House has a view with varying quality and is expressed as angular extent of view, full uninterrupted view, or partial view to the environmental amenity.
4. House has access to the view of amenity in the vicinity within a predefined distance band and is measured using the viewshed analysis. The exhibit shows how predefined search distance via viewshed are used to measure visible amenity characteristics noted either by area, size, percentage or proportions of land uses to quantify the effect of the visual surroundings.

Summary of Variables Used to Define Proximity and View in Hedonic Studies

As discussed above, and as explained from reviewed studies, several variants have been used in the past and are documented in Exhibit 7. The variables above and their variants are a palette of options available; however, a few of them are more suited than others depending on the amenity types and location of homes relative to the amenity. When there are multiple amenities available, either a dummy for each amenity type is created in the model and then distances are measured, or...
Exhibit 7 | Variables Used to Define Proximity and View of Subject Property to Environmental Amenity

<table>
<thead>
<tr>
<th>Variant of “Proximity of”</th>
<th>Reference Figure</th>
<th>Variants of “View of”</th>
<th>Reference Figure</th>
</tr>
</thead>
<tbody>
<tr>
<td>House to amenity direct (crow flying, Euclidean) distance.</td>
<td>Exhibit 4a</td>
<td>Amenity visible or not visible from home (binary dummy: yes/no).</td>
<td>Exhibit 6a</td>
</tr>
<tr>
<td>House to amenity road network distance.</td>
<td>Exhibit 4b</td>
<td>Extent of view as angular view from home to amenity (site inspection + viewshed).</td>
<td>Exhibit 6b</td>
</tr>
<tr>
<td>House adjacent, abutting, or fronting amenity (same as view).</td>
<td>Exhibit 4c</td>
<td>House adjacent, abutting, fronting amenity (same as proximity).</td>
<td>Exhibit 4c</td>
</tr>
<tr>
<td>Houses at a fixed buffer distance from amenity (200’, ¼ mile, ½ mile, 1 mile) buffer or location dummies). Buffer is drawn around amenity, if it is a recognizable amenity, otherwise buffers are drawn around each home to capture amenity surrounding homes that is not distinctly identifiable as amenity.</td>
<td>Exhibit 4d</td>
<td>Extent and visible area covered using GIS viewsheds (locations visible/not visible as binary); total visible acreage of amenity such as ocean area, lake area, green areas, tree canopy cover).</td>
<td>Exhibits 5 and 6c</td>
</tr>
<tr>
<td>Gravity-based distance/accessibility indices as a weighted average of inverse distances, by size, type, for example: $A_i = \sum_{j=1}^{n} CE_{ij} / d_{ij}$</td>
<td></td>
<td>Home to amenity, GIS-based viewsheds within a predefined buffer distance to measure (View scores; total viewable surface areas, percentage visible open spaces with types; percentage of visible desirable land uses or land covers; measuring land use diversity index).</td>
<td>Exhibit 5</td>
</tr>
</tbody>
</table>

*Viewshed is a term used to indicate the entire area an individual can see from a given point.*
often in the case of multiple amenities if they are spatially spread out, amenity sizes, acreage or percentage areas are used in the model to define the extent of the amenity characteristics around the homes.

**Variables by Amenity Types in Hedonic Studies**

Exhibit 8 is a summary table of the most appropriate variables (both proximity and view and their variants) that are used in studying the particular amenity type.

**Literature Review on View Methods and Value Capitalization Effect by Amenity Type**

**View Measurement Methodologies**

Exhibit 9 presents a list of key studies by amenity type where various view capturing measurement methodologies used in evaluating marginal price effect were studied. These studies also include those where amenity values from desirable surrounding land use were evaluated. This exhibit also includes studies that used GIS-based viewshed analysis in capturing views of amenity from homes.

Benson, Hansen, Schwartz, and Smersh (1997, 1998) physically inspected home sites and recorded both quality of views and types of views. Similarly, Wolverton (1997) inspected individual home sites and recorded scenic view in degree angle from 10 to 160 degrees. Researchers have used dichotomous variables for capturing view values as “visible” or “not visible” amenity from each home and used yes/no binary dummy variables in the hedonic equations (Rodriguez and Sirmans, 1994; Seiler, Bond, and Seiler, 2001; Cho, Kim, and Roberts, 2011). In other studies, “view of” amenity is recorded as a qualitative variable measured on a 3- or 5-point quality scale to grade the “view of” amenity from home samples. “View of” amenity is also used as dummy variables to define more than one type of amenity visible from home including quality of view. For example, Wyman and Sperry (2010) and Wyman, Hutchison, and Tiwari (2014) studied views of three kinds of amenities: golf courses, lakes, and mountain views, and for each of the amenity types ranked views qualitatively. In this study, golf course views were defined as (prime golf view, or inferior interior lot view), similarly, lakefront views included views from peninsular lots, deep water lots with unobstructed lake view, cove lots with restricted views, and lots with both lake and mountain views. “View of” amenity is also defined as a combined measure of both proximity and visibility; for example, when homes are on the edge of the amenity or abutting/fronting waterfronsts (Lansford and Jones, 1995; Bowman, Thompson, and Colletti, 2009) or golf courses (Shultz and Schmitz, 2009; Bark, Osgood, Colby, and Halper, 2011) or parks, homeowners benefit from both proximity to and view of amenity.

More advanced GIS-based view automation techniques started in early 2000s studies and techniques continued to improve methodology over time (Lake, Lovett, Bateman, and Langford, 1998; Lake, Lovett, Bateman, and Day, 2000; Sander and
### Exhibit 8 | Measurement Variables Used by the Amenity Type

<table>
<thead>
<tr>
<th>Amenity Type / Variables Used</th>
<th>Water Fronts</th>
<th>Surrounding Open Spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Golf Course</td>
<td>Ocean</td>
</tr>
<tr>
<td>Proximity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home to amenity direct distance (feet / miles)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Buffer distance from amenity to home</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Buffer distance from home to amenity</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Proximity / View</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home abutting amenity (Y / N)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Home abutting amenity (front length)</td>
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<td>✓</td>
</tr>
<tr>
<td>View Measured Via Site Inspections Viewshed</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Visible / Not visible (Y / N)</td>
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<td>✓</td>
</tr>
<tr>
<td>View of angular extent from home</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Visible area (acreage) from home</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Visible use (percentage) from home</td>
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<td>✓</td>
</tr>
<tr>
<td>Visible area (proportion) from home</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
### Exhibit 9 | Studies with View Measurement Methodology (top articles)

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Authors (Year)</th>
<th>Journal</th>
<th>Disciplines</th>
<th>Amenity Studied</th>
<th>Methodological Contributions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Benson et al. (1998; 1997)</td>
<td>JREFE and JRER</td>
<td>RE</td>
<td>Ocean, lake</td>
<td>Physical inspection to classify view type/quality</td>
</tr>
<tr>
<td>2</td>
<td>Bin et al. (2008)</td>
<td>Land Economics</td>
<td>Econ</td>
<td>Ocean</td>
<td>LIDAR, ViewScapes (angular view)</td>
</tr>
<tr>
<td>4</td>
<td>Hamilton &amp; Morgan (2010)</td>
<td>Comp Env Urb Sys</td>
<td>Comp/Geog</td>
<td>Ocean</td>
<td>Angular view: LIDAR-based viewshed in 1 km</td>
</tr>
<tr>
<td>5</td>
<td>Lake et al. (1998, 2000)</td>
<td>Comp Env Urb Sys</td>
<td>Comp/Geog</td>
<td>Land use (rail/road)</td>
<td>Building shape, height, location in viewshed</td>
</tr>
<tr>
<td>6</td>
<td>Llobera (2003)</td>
<td>Inter J of GIS</td>
<td>Comp/Geog</td>
<td>OS survey</td>
<td>GIS based visual space—A critical synthesis</td>
</tr>
<tr>
<td>7</td>
<td>Mittal (2014)</td>
<td>J of Sustain RE</td>
<td>RE/GIS</td>
<td>Conserved lands</td>
<td>3D GIS, building heights, viewshed, DEM</td>
</tr>
<tr>
<td>8</td>
<td>Poudyal et al. (2010)</td>
<td>S J of Appl Forestry</td>
<td>NR/GIS</td>
<td>Forest</td>
<td>3D GIS viewsheds overlaid on forest covers</td>
</tr>
<tr>
<td>9</td>
<td>Sander &amp; Polasky (2009)</td>
<td>Land U Policy</td>
<td>Plan/GIS</td>
<td>Land use/land cover</td>
<td>Viewshed (view richness, areal extent, % cover)</td>
</tr>
<tr>
<td>10</td>
<td>Shultz &amp; Schmitz (2008)</td>
<td>Appraisal Jnl</td>
<td>RE/GIS</td>
<td>Lake</td>
<td>Developing complex DEM + ground check</td>
</tr>
<tr>
<td>11</td>
<td>Sanders &amp; Manson (2007)</td>
<td>Land &amp; Urb Plan</td>
<td>Plan/GIS</td>
<td></td>
<td>Incorporates buildings in viewshed; add VLATE</td>
</tr>
<tr>
<td>12</td>
<td>Wolverton (1997)</td>
<td>J of Prop Inv Val</td>
<td>RE/GIS</td>
<td>View</td>
<td>Physical inspection, lot width view angle, quality</td>
</tr>
<tr>
<td>13</td>
<td>Walls et al. (2015)</td>
<td>Land Economics</td>
<td>Econ/NR/GIS</td>
<td>Land cover</td>
<td>% of NLCD land covers in viewshed buffers</td>
</tr>
<tr>
<td>14</td>
<td>Yin and Hastings (2007)</td>
<td>J of Urban Tech</td>
<td>Geog/Plan/RE</td>
<td>Niagara Falls</td>
<td>3D visualization, hotel site, view of Niagara Falls</td>
</tr>
</tbody>
</table>

Notes:
RE = Real Estate; NR = Natural Resource; Geog = Geography; Plan = Planning; Econ = Economics, Comp Computers or GIS.
NLCD is National Land Cover Database.
Manson, 2007; Shultz and Schmitz, 2008; Sander and Polasky, 2009; Hamilton and Morgan, 2010; Poudyal, Hodges, Fenderson, and Tarkington, 2010; Mittal, 2014; and others as listed in Exhibit 9). GIS has been extensively used in automating measurement of view. Where amenities are not clearly recognizable, value contributing quality aesthetic landscapes surrounding homes are also used as a proxy of pleasant scenic surroundings. A few researchers have used surrounding land use characteristics within a predefined viewable distance of 200 feet, a 1/4 mile or 1/2 mile or more from homes as a proxy to capture both “proximity to” and “view of” pleasant surroundings (Conway et al., 2010; Sander and Haight, 2012). These easily accessible (within walking distance) and aesthetic landscapes (scenic views) surrounding homes are usually measured using remotely sensed land use/land cover aerial data and involved GIS viewshed analysis. Poudyal, Hodges, Fenderson, and Tarkington (2010) used view of forest areas within a viewable radius of ¼ mile to ½ mile circle from each home using viewshed. The captured variables are defined as a percentage of aesthetic land covers visible from homes. Other view measures included proportion of land cover visible from homes, or number of different land type visible from homes that surround the housing market studied. Land use diversity indices are also used as a measure of view richness (Sander and Polasky, 2009). Shannon’s index of diversity, a mathematical measure of (land use, plants, or species) diversity in a community that accounts for both abundance and evenness of presence of spatial characteristics, has been used with the GIS viewsheds and the visible areal extent of land uses, or acreage of land cover types are measured.

A few real estate studies have attempted more sophisticated methods in their view quantitation, especially that relates to build environment. These studies incorporated 3D digital elevation models (DEM) and digital terrain models (DTM) of the study area by combining topographic and all the view impeding built structures data in the viewshed analysis (Lake, Lovett, Bateman, and Langford, 1998; Sanders and Manson, 2007; Mittal, 2014). Other studies have used 3D LIDAR data technology and introduced view automation in calculating a true angular view of an amenity from individual homes using viewshed (Bin, Crawford, Kruse, and Landry, 2008; Hamilton and Morgan, 2010). These two studies by Crawford, Kruse, and Landry (2008) and Hamilton and Morgan (2010) are especially notable. These studies used high precision LIDAR-based GIS viewshed and provide a clear methodology to estimate the angular extent of the view of amenity from each home. Another notable study is by Yin and Hastings (2007). They focused on a new real estate hotel project site near Niagara Falls and developed visualscape for the hotel site. Such studies are useful to provide feedback to project design teams and in evaluating a site’s view based location potential, and evaluate whether the proposed hotel height on the site will have the view of Niagara Falls from hotel rooms or not.

**Value Capitalization Effect of Amenities: Review of Studies**

In this section, we present a review of easily recognizable legible amenities such as golf courses, three types of waterfronts (ocean fronts, lake fronts, and rivers/streams), and trails and greenways. This section of the review also covers
amenities that are relatively less clearly recognizable and include miscellaneous open spaces, land uses, and land covers surrounding homes and various types of undeveloped lands (developable, preserved, farms, and forest reserves lands), vegetation, and greenspaces including tree canopy coverage near homes in the local housing market.

**Marginal Price Effect of Golf Courses.** Proximity to a golf course is a price contributory attribute for amenity-seeking homeowners, and the premium for this convenience ranged from 1.8% to 28% for homes that have this benefit. There could be five scenarios of house and its location with respect to golf course as listed below:

1. House located on the edge of the golf course (*Nr. + Prime View*): ++++ + Highest Premium
2. House located on the edge of the golf course (*Nr. + Non-Prime View*): ++++ Very High Premium
3. House located in the golf course subdivision (*Nr.*): +++ High Premium
4. House located near golf course, but outside of subdivision (*Nr.*): + Some Premium
5. House away from golf course: Asymptotic 0 or No Premium

The greatest real estate property values rest on the edges of scenic environmental amenities because of best view and easy access, and so was true for golf course facing homes. The marginal price impact of a golf course on home values ranged from a low of 1.8% (Cho, Clark, Park, and Kim, 2009; Cho, Kim, and Roberts, 2011) to a high of 25.8% (Nicholls and Crompton, 2007) in College Station, Texas and 28% in Omaha, Nebraska (Shultz and Schmitz, 2009) due to direct proximity to golf course green, clear view, and high degree of course’s maintenance. The highest premium was observed for those houses that abut the golf course edge and the marginal value ranged from 7.6% (Do and Grudnitski, 1995; Grudnitski and Do, 1997) to a high of 28% for homes abutting the course with a premium view of golf course, and were also located on a privately managed golf course (Shultz and Schmitz, 2009). Since view of a golf course is important, the physical design, size, and layout of a golf course are highly significant (Crompton, 2000). The names used for the golfing community such as “Country Club” are important too. For example, in Baton Rouge, Louisiana, homeowners paid a 4.2% premium for living in “XYZ Country” and an additional 5.1% premium for “XYZ Country Club” (Zahirovic-Herbert and Chatterjee, 2011).

Premiums for homes within ¼ mile of golf course ranged from 10.5% (Bolitzer and Netusil, 2000) in Portland, Oregon, but increased to 13.4% (Lutzenhiser and Netusil, 2001) when homes were within 200 feet from the edge of the course. This premium is in comparison to homes that were farther away. When comparing the price effect for the homes located on the golf course with those not on the golf course, the price premium was found to be relatively lower at 4.81% in San Diego (Grudnitski and Do, 1997) and 8% in Tucson, Arizona (Bark, Osgood, Colby, and Halper, 2011). The price effect also varied by golf course ownership. It ranged from 5.7% for a public golf course to 12.5% for a private golf course (Grudnitski, 2003) in Las Vegas, Nevada.
It is also noteworthy that the ability to generate price premiums on a golf course home is very site specific. For example, a study of vacant lots in a master planned community in South Carolina revealed that lots with prime golf view (>350 feet unobstructed view) of fairway and putting greens have much greater price premium than lots with a less than a prime fairway view (<350 feet before being obstructed) (Wyman and Sperry, 2010; Wyman, 2014). This premium on lot prices ranged from 42% for inferior view lots to a high of 85% for prime golf view lots (Wyman and Sperry, 2010).

It is important to note that these premiums as percentage terms are relative to the house prices of the samples chosen. Samples could be a subset of the reference housing markets, and can be a bit misleading. So, if in a given study, if the marginal implicit price paid for an amenity as a premium is lower than in another study for a similar amenity (with similar attributes, but for a different housing market), it is only because the geographic extent of the housing market chosen for the study, the conditions in the local housing submarket, and the average prices compared are from different geographic submarkets. If golf course fronting homes are compared with other homes that are located on the golf course, but not exactly fronting it, the comparison is within a smaller submarket, and thus the reported comparable premium will be a lower percentage as compared to a study where similar golf fronting houses are compared to houses located outside the golf course community and are far from golf course or have been compared using median home price in the rest of the city.

Marginal Price Effect of Ocean Nearing and Ocean Fronts. Water views are valuable. View of the ocean is the most important price contributor. Bourassa, Hoesli, and Sun (2005) found a 4.6%–13.3% premium for ocean water views in New Zealand, even when views are distant views. There are few researchers who used just the proximity to the ocean as a variable; however, there were a greater number of studies emphasizing the view of the ocean. Proximity of public beach access points also served as a proxy to the distance from oceanfront (Hamilton and Morgan, 2010). Conroy and Milosch (2011) compared house prices within the 500 feet from ocean fronts in San Diego, California and compared ocean premiums with similar homes six miles away from the coast. They found a premium of 102% for ocean nearing homes within 500 feet of the coast. This premium declined to 63% for homes located within 500 to 1000 feet of the coast. Landry and Hindley (2011) studied beach nearing homes in Tybee Island, Georgia and concluded that moving away by 100 meters from a quality beach, home values declines by 21%, and it declines 39% if 200 meters away, and 50% if 300 meters away. The quality of beaches is important for fetching higher price premiums. Gopalakrishnan, Smith, Slott, and Murray (2011) studied coastal properties within 550 yards of the ocean in 10 towns in North Carolina and found a $8,800 premium for every unit increase in the beach width (in feet) for ocean front homes.

Uninterrupted direct view of an oceanfront is the most price contributory factor in the ocean nearing housing market. The highest premiums of 10%–147% for ocean fronting homes were noted by Benson, Hansen, Schwartz, and Smersh (1997). They found a 147.2% premium for ocean frontage view, 32% for an unobstructed ocean view, and 10.3% for partial ocean view, relative to no view.
in Point Roberts, Washington. Benson, Hansen, Schwartz, and Smersh (1998) found that an ocean view premium ranged from 8% to 59% depending on if it has ocean frontage, full view of ocean, or a partial view of the ocean. Bourassa, Hoesli, and Sun (2004) concluded in their study in Auckland, New Zealand that the oceanfront premium ranged from 59% to 68% for homes with a wide ocean view and 33% to 40% for homes that have medium view in coastal properties. Hamilton and Morgan (2010) focused on a smaller sample of homes in Pensacola, Florida for the ocean nearing real estate sub market and concluded that just because of the oceanfront view, ocean front homes commanded an additional premium of 38% for the best ocean views as compared with those homes that did not have the ocean view in the same submarket. They used ocean nearing homes in their sample.

Ocean views are important for both single-family homes and condominiums. Gordon, Winkler, Barrett, and Zumpano (2013) examined the impact of expansive waterfront views in oceanfront condominium communities in a hedonic study of 1,051 sales along the Gulf Coast in Alabama. They concluded that higher premiums are associated with upper floor and corner units that offer more views. The premium was 12% higher for condos located above the 16th floor compared to the ground floor units, and the corner condos earned a 3% premium compared to the interior condos. Bin, Crawford, Kruse, and Landry (2008) studied ocean nearing and ocean front homes in North Carolina. Data included houses sold from 1995 to 2002 with a mean price of $297,968. Using GIS viewshed, viewscape were created to measure the degree of ocean view from each home, within a one-mile distance. Average homes in the sample had an 18 degree of angular ocean view available. They concluded the willingness-to-pay (WTP) for sound ocean frontage is 47% ($141,022) higher, and this WTP varies with the degree of viewscape. Home prices increased by $995 for every one degree increase in the ocean view angle. However, it is important to note that for ocean front properties, the risks of floods also significantly reduce home values by 11%, and the WTP to avoid such risky location within a Special Flood Hazard zone is 12.2% ($36,082). Poor pedestrian safety, noxious land uses, or threat of floods near waterfronts or in flood zones was also examined (Paterson and Boyle, 2002; Bin and Kruse, 2006; Bin, Crawford, Kruse, and Landry, 2008). Bin and Kruse (2006) study coastal Carteret County, North Carolina and found that average property values are 5%–10% lower if located within a flood zone; however, it can be higher if the property is located in the wave zone.

**Marginal Price Effect of Lake Nearing and Lake Fronts.** Similar to oceans, homes near the Great Lakes and other large lakes have a significant proximate premium. Lansford and Jones (1995) studied lake fronting homes near Austin Lake, in the city of Austin, Texas and found that homeowners pay a 32% premium for a lake view, and an 8% premium for a scenic view of a lake, bluff or city, when compared with homeowners located within 4,100 feet from the lake that do not have the view. Seiler, Bond, and Seiler (2001) found a $115,000 premium for homes that front Lake Erie in Cuyahoga County, Ohio. They compared home prices with other homes that were near the Great Lake. A later study by Bond, Seiler, and Seiler (2002) for Lake Erie found an 89% ($256,545) premium for
homes fronting and abutting the Great Lakes when compared with houses that did not have any view of the lake. This significant difference in the two studies is because of the data used. Seiler, Bond, and Seiler (2001) used tax assessment values, while Bond, Seiler, and Seiler (2002) used sales transaction values. Benson, Hansen, Schwartz, and Smersh (1998) found a premium of 126.7% for homes that are on lakefront and with full water view in Bellingham, Washington. In another study of a 3,900-acre master planned community with lakefront and a signature golf course in South Carolina, Wyman and Sperry (2010) compared price premiums for undeveloped vacant lots. They found a hierarchical pattern in price premiums for view types and view categories. They concluded that vacant lots with lake views commanded a premium of 94%–133%; this premium ranged from 124% to 287% for lots located on the lakefront. A later study by Wyman, Hutchison, and Tiwari (2014) found an average premium of 91% for vacant lots in a master planned community in South Carolina with lake views; however, this premium further increased depending on the spatial arrangements of the lots around the lake and the physical location of the lots relative to the lake’s perimeter. This premium ranged from 89% to 223% for lots with more than 300 feet of unobstructed lake view of greater than 45 degrees: these lots were on the peninsular land form of the lake, thus have a greater view of waterfront.

A house with a view, whether it is a lake view, or other scenic view, is found to sell for a significantly higher price premium than a house without this attribute (Lansford and Jones, 1995). However, it is important to note that all lakes are not alike. For example, Shultz and Schmitz (2008) utilized viewshed analysis for two non-recreational lakes (storm water ponds) near Omaha, Nebraska and found a lower price premium of only 8% for the lake view homes. Loomis, Rameker, and Seidl (2004) study undeveloped land parcels in Colorado with access to river/lake and found a premium of 6.9% ($937/acre), while those undeveloped parcels that were adjacent to park/open space commanded 80.9% ($11,039/acre) premium.

Marginal Price Effect of Rivers/Steams Nearing and Rivers/Steams Fronts. The studies that included rivers and streams include Anderson and West (2006), who concluded that home values increased by 0.0342% for every 1% decrease in distance to the nearest lake and 0.0273% for a river in Minneapolis. Mahan, Polasky, and Adams (2000) found $259 premium per 1,000 foot proximity to stream in Portland, Oregon. Bowman, Thompson, and Colletti (2009) found a 9.6% premium for homes next to streams in a subdivision. Mooney and Eisgruber (2001) found a 7% premium for stream frontage for treed riparian buffers in Oregon, and noted that additional widths of trees functions as a buffer along the stream and creates a visual obstruction and negatively affect home values by 3%. Bowman, Thompson, and Colletti (2009), Cho, Clark, Park, and Kim (2009), and Cho, Kim, and Roberts (2011) found approximately a 23% premium for homes with water views of river/streems. In the case of waterbodies, being on the waterfront is important for homeowners. Greater premiums on frontage also mean that homeowners have direct private access to recreational opportunities and scenic views.

Marginal Price Effect of Trails and Greenways. Greenways are linear corridors of open space along rivers, streams, historic rail lines, or other natural or human-made features (Lindsey, Man, Payton, and Dickson, 2004). Asabere and Huffman
Mittal and Byahut (2009) study neighborhood trails, greenbelts, and trails with greenbelts in San Antonio, Texas using a dummy variable of presence/not present within a neighborhood, revealed a 2% premium for trails, 4% premium for greenbelts, 5% premium for trails with greenbelts, using 9,710 sales. Bark, Osgood, Colby, and Halper (2011) also studied neighborhood amenities in Tucson, Arizona with a focus on riparian corridors and found a 5.6% premium for houses near the greenest riparian corridor. Lindsey, Man, Payton, and Dickson (2004) studied seven multiuse urban greenways in Marion County, Indiana using 9,348 homes sale data for year 1999 and a semi-log model. Both publicly accessible trails (2.3–22.8 miles) and seven greenways with conservation corridor designation (4.4–11.5 miles) that had river and streams in the corridor and the Monon Trail (a converted rail-trail). They found a 14% ($13,056) premium for homes located within a half mile of the Monon, and a 2.4% ($2,239) premium for homes within a half mile of a greenway conservation corridor.

Nicholls and Crompton (2005) studied multi-use, publicly accessible urban greenways and trails in Austin, Texas. Their study included three sets of home sales data for homes transacted in 1999 within a half mile buffer from a 7.5-mile long trail/greenway. They found an average 12.2% premium for adjacency. This premium was even higher for one section of the greenway where it was even more desirable to live adjacent to the greenway and there was a premium of 20.2% ($44,332) for homes adjacent to this section of the greenway. They also noted that home value declined by $3.97 per square foot moving away from the trail.

Crompton (2001b) suggested that, “the presence of a trail had a neutral impact on the salability or value of property.” Lindsey and Nguyen (2004) studied five Indianapolis trails and used automated trail user counts. This user count provided some insight on disamenity effect of active usage of trail with greater number of footfalls on home prices. Many studies from 1978 to 1995 were presented in Nichollas and Crompton (2005, 325–326). These studies as per authors found a mixed effect of trails and greenways both positive and negative. View of a greenbelt in general was found to be non-contributory, however, but being located next to the greenway commanded a premium of 12.2% on average. Aesthetic value of greenbelts was measured using two variables in this study, homes directly adjacent to the greenbelt and with direct view of greenbelt, which contributed a 12.2% to 20.2% premium. They found that on one section of the greenway in Austin, Texas, view of greenways contributed a 6.3% ($13,760) premium. Mooney and Eisgruber (2001) found a premium of 11% for homes near a riparian stream; however, amenity premium reduces and becomes a disamenity once the thickness of treed buffer grows wider.

Marginal Price Effect of Parks and Open Spaces. Owing to the lack of definition for parks and open spaces, this amenity type was a bit challenging from the review perspective. While we focus on reviewing effect of the amenity in this paper, we also examine how past studies have defined parks and open spaces. A few researchers have attempted to classify and categorize open spaces. Lutzenhiser and Netusil (2001, 294) defined three types of parks: urban park (as 50% manicured and developed for non-natural recreation), natural area park (over 50% park is preserved with native vegetation with passive recreation), and specialty
park. Similarly, Netusil (2005) defined open space types into 12 different types based on their physical characteristics such as golf, cemetery, wetland, tree canopy, and slopes etc. and provided definitions for each of these open space types. Cho, Kim, Roberts, and Jung (2009) grouped open spaces into three categories as developed open space, forested open space, and agriculture wetlands, while Maruani and Amit-Cohen (2007) provide a classification of five types of open spaces—urban open space, agriculture land, rural non-agriculture lands, countryside natural areas, and wilderness areas—based on accessibility, use, and location. Other open space classifications system remotely sensed land use and land cover data in GIS. Li, Saphores, and Gillespie (2015) provided a list of several hedonic studies of urban green spaces that employed aerial images in capturing greens spaces as land cover around homes. Panduro and Veie (2012) categorized open spaces into eight different types of green spaces based on aerial photos and GIS data. Bark, Osgood, Colby, and Halper (2011) used different types of green spaces based on the spectral characteristics of vegetation within the home lots, their immediate surroundings, and riparian vegetation. This spectral characteristics of vegetation was based on remote sensing vegetation data. The study used the normalized difference vegetation index (NDVI) to measure the greenness of chlorophyll. Swanwick, Dunnett, and Woolley (2003) classified urban areas as buildings and the external environment between buildings. The external environment is two distinct urban spaces: grey space and green space. The grey spaces are functional public spaces, are impermeable, “hard” concrete or tarmac, while green spaces are unsealed, permeable, “soft” surfaces such as soil, grass, shrubs, trees, and water. Walls, Kousky, and Chu (2015) used the National Land Cover Database (NLCD) land cover classification, which included barren land, developed land by intensity, shrubs, moss, forests, and open waters. Saphores and Li (2012, 375) focused on land cover surrounding individual homes and they documented 14 similar urban land cover studies from 2001 to 2011. Other notable contributions in this category included Sander, Polasky, and Haight (2010, 1647–48), who focused on urban tree canopies and provided a summary of 22 related studies to value the effect of urban trees. Parks in general create value that can be as high as 20%, which declines with increasing distance (Crompton, 2001a, 2005).

The size of parks matter and the activities surrounding parks matter. Poudyal, Hodges, and Merrett (2009) found that within a mile radius of homes, for every 1% increase (in square footage area of park) home premium increases by 0.03% or $80 for every 100 square foot increase in park size, but Weiss et al. (2011) found that poor maintenance of parks or neighborhood disamenities such as crime near parks might negatively impact home values (Troy and Grove, 2008). Depending on use intensity, time and type of usage, and user itself, some uses may have an abutting nuisance value effect, but homes nearby still have premium. Maximum benefit in such cases may be just nearby, not to the abutting homes.

**Marginal Price Effect of Miscellaneous Open Spaces Surrounding Homes.** The miscellaneous surrounding open space (OS) category is rather ambiguous and included land uses and land covers surrounding homes, and was measured as acreage, as % open spaces, by use type, cover type, and ownership and
development potential type. Some studies also included tree canopy covers (TCC) near homes either as tree counts or as TCC areas around homes, while others examined whether the land uses are desirable or not and defined as visible open spaces, visible percentage open space, or as visible diversity of land use types (Paterson and Boyle, 2002). It can be concluded that on average, the marginal implicit price on home values due to “proximity to” different open spaces ranged from none in cases where there is no recognizable amenity to a value of 32%.

Generally for homeowners, surrounding landscapes affect their quality of life if land use and land cover have esthetic value (e.g., scenic views), or when the quality and quantity of the landscapes are attractive for recreational activities. From the homeowner’s perspective, land cover offers esthetic value, convenience value or productivity value of land uses (Cho et al., 2011). Spatial configuration of open spaces and green landscapes relative to home locations have been studied to quantify the marginal implicit value effect of these environmental characteristics. Past studies focused on the land use patterns or land cover mosaics, spatial ecological features as amenity-generating characteristics of surrounding areas (Acharya and Benett, 2001). Similar to the parks and open spaces, miscellaneous open spaces in the vicinity of homes have been classified by scenic land use, desirable land covers, by ownership types, by development potentials, and by geographic location, and each of these land characteristics surrounding homes may have different contributions to home values (Irwin, 2002; Irwin and Bocksteal, 2001). These surrounding characteristics include percentage of local land cover by development potential (Irwin and Bocksteal, 2001; Borchers and Duke, 2012), by ownership (Irwin, 2002; Netusil, 2013; Ham, Loomis, and Champ, 2015) and by land cover types (Kadish and Netusil, 2012; Li and Saphores, 2012; Saphores and Li, 2012; Walls, Kousky, and Chu, 2015). Studies also included urban tree coverage (Sander, Polasky, and Haight, 2010; Sander and Haight, 2012), tree canopy cover (Conway et al., 2010), presence of street trees near house (Donovan and Butry, 2010), urban greenspace (Conway et al., 2010), and diversity of land use/covers surrounding homes (Sander and Polasky, 2009); diverse land uses such as rural, semi-rural, and urban and rural land covers including open space, forest cover, water, fields, and agriculture lands (Acharya and Bennett, 2001) around a house and even on the internal characteristics of a subdivision (Towe, 2009).

Bark, Osgood, Colby, and Halper (2011), who studied arid Tucson Arizona, concluded that greenness around home create a 21.4% premium ($45,729) for houses with greenness in their neighborhood and 8.4% premium ($17,860) for houses with lot-level greenness. Bowman, Thompson, and Colletti (2009), who studies homes in Cedar Rapids, Iowa, concluded there is a 3.9% ($8,688) price premium for homes in the subdivision with more conservation features in the subdivision. Cho, Kim, and Roberts (2011) found a 4.3% to 6.2% premium (~$14,000) per 10% increase in developed open space. Conway et al. (2010) found that a 1% increase in greenspace near downtown Los Angeles yields an increase of 0.07% ($171 in median price).

Count of street trees fronting each house and tree canopy coverage (TCC) is price contributory. Donovan and Butry (2010) found that in Portland, Oregon street trees
added 3% ($8,870) to the mean ($297,115) home values and reduced time on market by 1.7 days. Additionally, a tree with a 312 square foot canopy cover influenced the price of homes within 100 feet from the tree by $12,828. Li and Saphores (2012) found a $790 (0.12%) premium for every 1% increase in TCC surroundings multifamily properties in Los Angeles. Sander, Polasky, and Haight (2010) found a 10% increase in the tree cover yields a 0.48% ($1,371) premium within 100 meters and 0.29% ($836) premium within 250 meters of homes. Saphores and Li (2012) found that 97% homeowners in Los Angeles like trees in neighborhoods, but not so much on their own parcels; 88% of analyzed properties increased in value, with additional amounts of irrigated land (lawn) in the parcel and 89% for neighborhood lawns.

**Marginal Price Effect of Farms and Forests.** Generally, the amenity premium effect of farms and forests is found to be relatively smaller when compared to other recognizable amenities presented earlier. Most studies based on the characteristics of farms and forests used distance to, view of, and percentage visible area of farms and forests from homes in estimating the amenity effect. Borchers and Duke (2012) focused on developable versus protected agricultural and natural lands in Delaware and used proportion of “developable” and “protected” agricultural and natural land in proximity of homes. This was defined within a 200-meter radius buffer from each home parcel. They concluded that if all lands within the 200-meter buffer around homes included preserved agriculture lands, the home value increased by 2.7%.

Thorsnes (2002) studied forest preserves and used distance measurement of vacant lots abutting the preserve, and concluded there is a 19%–35% premium for vacant lots that border the forest preserve. This high premium is attributed to the fact that homeowners have an opportunity to access scenery and wildlife viewing being near the preserve. Tyrväinen and Miettinen (2000) examined forested area in semi-rural Finland and found that with the increasing linear distance, home values decline 5.9% per kilometer. Homes with a forest view command 4.9% view premium. Geoghegan, Lynch, and Bucholtz (2003) studied the effects of agricultural easements on property tax revenues and found that by increasing preserved agricultural land by 1% (144 acres) in Calvert and Howard Counties in Maryland, counties can generate sufficient tax revenues from the incremental housing values (from properties within a one-mile radius of the preserved parcel) to purchase an additional 88 and 110 acres respectively, in just the first year. Payton et al. (2008) studied urban forest lands and developed the Normalized Difference Vegetation Index (NDVI) to find the neighborhood greenness impact in Indianapolis and found homeowners have $15 and $92 WTP annually for a permanent 1% increase in the surrounding vegetation density within a two-acre patch from each home.

Walls, Kousky, and Chu (2015) measured physical proximity to natural areas (farmlands, grassy recreational areas, and forests) within a 200-meter buffer of each home using the national land cover data and identified percentage surrounding lands in buffer around homes in St. Louis County, Missouri. GIS based views were developed on 10 m DEM using a 360 degree viewshed for 0.1-mile to 1-mile buffers. Viewsheds were used to quantify the percentage areas of
visible land cover types from each home in those buffers. They found that the forest views negatively affected home prices, whereas farmland views had a positive effect. A 10% increase in farmland area, recreational grasslands, and forest cover in the buffer increased home values by 2%, 1.4%, and 0.6%, respectively. Similarly, a 10% increase in the amount of farmland in a home’s viewshed led to an increase of almost 3% in home price.

**Discussions on Findings from the Review**

Exhibit 10 is a summary of all the environmental amenities reviewed in this article, by type, and by their marginal effects on the surrounding home values. Both the maximum and minimum values of marginal price effect are presented in the Exhibit 10 attributed to “proximity premium” and “view premium” of the amenity studied.
Exhibit 10 also presents the maximum and minimum range of the marginal price effect on home values. This range is large depending on how well the amenity is kept and maintained. These maximum and minimum premium values are only for those homes that abut or have a clear view and direct access to the environmental amenity.

Exhibits 11 and 12 present proximity premium as capitalized in nearby home values. As Exhibits 11 and 12 show, this premium declines with the increasing distance and this premium varies by different environmental amenity types. This premium is highest for the oceanfront homes and was found to be 147% for natural, quieter, ocean-facing homes offering greater hedonic value to amenity seekers. From the amenity type perspective, the second highest premium was for the large lakefront homes (126.7%), followed by 54.4% for rivers and stream. Alike waterfront homes, the premium for homes near a well-managed privately owned golf course was found to be 28%, which declined for those golf course facing homes that were not so well managed. This issue of maintenance of the
Amenity, safety, quieter, and scenic characteristics surrounding amenity are important as it creates greater desirability to live in the proximity of well-managed, quieter public parks, or less dense land uses such as near neighborhood green patches, undeveloped lands, miscellaneous open spaces, farms, and forests. In general, as is clear from Exhibits 11 and 12, the effect of an amenity reduces rapidly with the increasing distance; however, the limitation of this review is that a distance decline formula cannot be devised with full confidence as the amenity studied, spatial distribution of home samples included, and the local housing market characteristics including the demand and supply characteristics of amenities in those markets.

**Conclusion**

This paper provides useful insights to planners, real estate professionals, and appraisers on the value capitalization effect of environmental amenities as observed on home sales prices. Planners can confidently plan environmental land uses and estimate incremental gains in value and local property taxes. Real estate developers and investors can also use the synthetic insights and plan their new developments around such amenities to capture the hedonic values and pass to their end users. Appraisers can use this information in valuation adjustments in appraising homes around such amenities.
The value capitalization effect for an amenity is a function of its relative supply in the local housing market. Constrained supply of the amenity fetches a greater price premium from amenity seekers. The quality of the environment, scenic view, recreational opportunities, easy access, and size of the amenity matters to homeowners. Tree cover, smaller undeveloped size, opens spaces, and smaller parks are widely present amenities in local housing markets and have a lower price effect than the larger more recognizable amenities. Clearly recognizable environmental amenities, such as large lakes, safe and quality ocean fronts, and well-maintained golf courses have higher price premium on home values than other amenities, such as green coverage or tree canopies. “Proximity to” environmental amenity offers convenience value to homeowners and is measured by “distance to” amenity from homes. Proximity of golf courses, waterfronts, parks, and naturally preserved areas with passive recreational opportunities, urban parks are highly valued by amenity-seeking homeowners. Proximity of such amenities offers convenience values to homeowners as they can easily access and participate in the activities that are housed in the environmental resource without incurring any extra time, costs or additional efforts. “View of” environmental amenity offers aesthetic value to homeowners and is measured by “view of” amenity by quality of view, extent of view available or not, both in terms of angle of view and span of view. When the two measures—“proximity to” and “visibility of” environmental amenity are combined, then they have the greatest effect on the marginal implicit price of homes (paid as amenity premium) for consuming such amenity benefits.

Endnote

1 A high percentage of premium in this study is just a reflection that % premium on vacant lots is bound to be higher than % premium on single-family homes, just because of the mean price difference.

References


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Jay Mittal, Auburn University, Auburn, AL 36849 or jay.mittal@auburn.edu.

Sweta Byahut, Auburn University, Auburn, AL 36849 or sweta.byahut@auburn.edu.