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REVIEW ARTICLE

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The contribution of scenic views of, and proximity to, lakes and reservoirs to property values

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Abstract
Water is arguably the world's most critical resource, although its aesthetic and recreational functions typically receive less attention than its consumptive uses. Views of, and access to, attractive water resources are capitalized into property prices in the form of sales price and rental premiums, measured since the 1970s with the hedonic pricing technique. This study synthesizes the evidence to date with respect to the value of lakes and reservoirs as aesthetic and recreational resources to nearby residents. Findings are reported relating to the effects of scenic views of, and proximity, to reservoirs and large artificial lakes, the North American Great Lakes, and other smaller inland lakes. Of the 44 distinct reviewed studies that included tests of statistical significance, only two failed to produce any significant findings in the directions anticipated (i.e., a positive impact of water frontage or view and/or negative impact of increasing distance). Improvements in methodological approaches—from early studies employing anecdotal observation and visual comparison to more recent investigations employing advanced geographical information systems and rigorous spatially explicit regression techniques—are traced. The potential implications of climate variability and changes for property values are addressed, as is the growing movement towards the adoption of green infrastructure. The need to consider changes to aesthetic and recreational values, in addition to outcomes for more traditional consumptive uses during cost–benefit analyses associated with proposed (re) developments, is emphasized.

KEYWORDS
hedonic, property value, proximity, view

1 | INTRODUCTION

Water is arguably the world's most critical resource, providing a multitude of essential agricultural, environmental, industrial, household and transportation services to humanity around the world. Indeed, some media sources have suggested wars may be fought over this vital resource in the future (Goldenberg, 2014; Judge, 2013; Soloman, 2010).

Although generally not considered as critical a service as those previously listed, perhaps due to their non-consumptive nature, water also serves important aesthetic and recreational functions; Klessig (2001) stresses the additional and often overlooked cultural, spiritual and emotional values of waterbodies. Oceans, lakes, ponds, wetlands, rivers and streams are typically pleasant to view, and also to be on or near, providing the setting for a variety of active and passive experiences and opportunities for both solitary and social pursuits. Thus, access to and views of attractive water resources are typically capitalized into property prices in the form of sales price and rental premiums. The therapeutic and human benefits of pleasant aesthetic views and access to recreational opportunities are well established. More than three decades ago, pioneering work by Ulrich (1979, 1981, 1984) demonstrated not only the human preference for scenic views containing natural elements such as vegetation and water over urban scenes, but also that hospital patients with such possibilities had shorter postoperative stays and fewer negative evaluative comments from nurses and took fewer moderate and strong analgesic drug doses than patients with a view of only a brick wall outside their window. Kaplan and Kaplan (1989) similarly described water as "a highly prized element in the landscape." The variety of economic, environmental, social and health benefits associated with parks have also been documented (Crompton, 2008a,b; Harnik & Crompton, 2014).

Consideration of non-market values is critical for resource planners and managers. In their synthesis of the literature pertaining to non-market values of freshwater ecosystem services in the United States between 1971 and 1997, Wilson and Carpenter (1999) noted that "if such values are left out of policy analysis, resulting policy will tend to overestimate the role of use values, and underestimate the role of nonuse values. Without efforts to quantify the nonuse benefits associated with freshwater ecosystem goods and services, policy and managerial decisions could potentially be skewed in favor of environmentally-degrading practices by neglecting the diffuse social interests that benefit from the many nonuse oriented characteristics of such systems."

This study reviews the evidence to date regarding the value of areal bodies of water as aesthetic and recreational resources to nearby residents. Specifically, findings relating to the effects of scenic views of, and access to, three types of areal waterbodies are reported. These include reservoirs and large artificial lakes, the Great Lakes and smaller, natural inland lakes. Studies focusing on multiple, undifferentiated types of waterbodies (e.g., the effect of the nearest lake, river or stream or of the nearest waterbody of undefined type) are excluded from this study to maximize comparability. Similarly, the impacts of wetlands are not included, not only because they represent fundamentally different resources from a hydrogeological and aesthetic perspective, but also because several reviews of this amenity type already exist (e.g., Boyer & Polasky, 2004; Brander, Florax, & Vermaat, 2006; Chaikumbung, Doucouliagos, & Scarborough, 2016; Woodward & Wui, 2001).

2 | APPROACH

The search for relevant research materials was extensive, including the JSTOR, AGRICOLA, CAB Abstracts and Hospitality and Tourism Complete databases, as well as a more general Google search for technical reports, working papers, theses and dissertations, etc. The keywords "lake," "reservoir," "hedonic," "property price" and/or "property value" were employed. English-language contributions from all nations and from both the economics and resource/amenities domains were sought, the latter being a substantive contribution as the crossover between these two spheres has been relatively minimal to date. Studies considering the values of scenic water views, or access, as secondary to some other primary focus were also incorporated. Given the wide variety of dependent and independent variables employed across the reviewed studies, and that key summary statistics were not reported in many of the earlier cases, a formal quantitative meta-analysis was not considered feasible.

Chronological presentation of findings within each of the three subsections (reservoirs and large artificial lakes; the North American Great Lakes; and smaller, natural inland lakes) allowed for improvements in methodological approaches to be highlighted. Naïve early studies that employed anecdotal observations and visual comparisons have evolved into more recent investigations employing advanced geographical information systems (GIS) and rigorous spatially explicit regression techniques. A tabular summary of the studies referenced is included in each of the following three sections. All results referenced in the tables and text were statistically significant unless noted otherwise, and the numeric values associated with scenic views and proximity are cited for all cases in which they were stated in the original source.

3 | RESERVOIRS AND LARGE ARTIFICIAL LAKES

In the first portion of this review, the effects of reservoirs and large artificial lakes are considered, including waterbodies that are man-made and publicly managed for the purposes of power production, irrigation, flood control and/or recreation. These factors produce meaningful differences in ambience, relative to the smaller, less managed lakes considered in the third subsection.

3.1 | Effect of shore frontage and proximity

The earliest study of the impacts of water resource development projects on surrounding property values focused on reservoirs in the Tennessee Valley in the United States (Knetsch, 1964; Knetsch & Parrott, 1964). As anticipated, significant positive relationships were identified between both reservoir waterbody frontage and proximity and property values. When these premiums were applied to the site of a proposed new reservoir, the predicted increase in land values due to creation of the reservoir amounted to $1.96 million (1,960 dollars), an 85% increase.

The construction of the Pearl River Reservoir in the state of Mississippi—approved by voters in 1958 and officially announced in 1959—had a substantial speculative effect on surrounding land prices. The average yearly increase in land prices from 1950 to 1958 was 9% per year. In 1959, however, the annual increase was 116%, or 107 percentage points above normal, rising to increases above the historical norm of 151, 196 and 227 percentage points in the 3 years subsequent (Mann & Mann, 1968). Schutjer and Hallberg (1968) confirmed the speculative influence of the announced development of a 2,250 acre water-based state park, including a 340 acre lake, in rural areas in the state of Pennsylvania by comparing sales prices before and after the announcement. Prices of undeveloped properties of less than two acres sold after the announcement were shown to decrease $293 with each mile from the park (% not reported), indicating the existence of a "proximity" effect, although there was no significant impact on properties of two acres or more, or on those with buildings. The authors also noted the changing structure of the rural land market around the park, most notably in terms of a sharp rise in sales of smaller land parcels without buildings, and a definite shift from agricultural to residential use.

In the state of Colorado, the observed increase in land value attributable to the construction of three reservoirs exceeded $5.1 million, increasing to over $8.1 million when improvements and new facilities were also considered (Milliken & Mew, 1969). In Oregon, property prices surrounding five reservoirs were on average $2,689 (15%) higher than those of properties not in similar proximity (Boodt, 1978). In Toronto, Canada, Day and Gilpin (1974) found no significant relationship between assessed values and distance to the G. Ross Lord Dam/Reservoir, which was under construction at the time of analysis. A subsequent survey, however, indicated 94% of the area residents did not know about the project when they bought their property, curtailing the potential for any value associated with it to have been capitalized into the price they paid.

The first of only three reservoir studies to employ a more sophisticated hedonic multiple regression analysis focused on the Lower Colorado River Authority's Highlands Lakes system in the great state of Texas. As reported by Lansford and Jones (1995a,b), lakefront properties on Lake Austin commanded a premium of $83,262 (or 35.5% of the average sales price for lakefront properties of $234,600), although frontage properties on a high bluff experienced a reduced premium of $8,160. Lakefront properties on Lake Travis enjoyed a premium of $79,000–$102,000, depending upon lot elevation (or 37.4%–48.2% of the average lakefront home, which sold for $211,500). Properties not adjacent to, but with a scenic view of, Lake Travis saw a $12,663 premium. Proximity to the lake was highly significant in both cases, although this value declined much more rapidly with distance from Lake Travis, suggesting the recreational value imbued in proximity was greater for Lake Austin. Loss in sales price with each foot in distance from the lake was $18 and $10 at 300 feet from Lake Austin and Lake Travis, respectively, being about $8 in both cases at 1,000 feet, and $4 and $6, respectively, at 2,000 feet.

The most recent reservoir studies have confirmed the positive impacts of this type of feature on surrounding property prices. In northern California, price premiums of 108% for properties on, 68% for properties near (i.e., across the street from) and 28% for properties with a view of two such sites were generated (Kruse & Ahmann, 2009). Muller (2009) also differentiated between frontage, distance and view in his analysis of two reservoirs in the states of Indiana and Connecticut. When only distance from the lake was considered, both sites exhibited a significant negative relationship between distance and price. When the view was introduced as an additional independent variable, however, the coefficients on the distance variables declined in absolute value by 40% and 55%. In the third specification, when frontage was added to the distance and view factors, there was minimal change in the distance coefficient, compared to the second specification, and a significant change in the view variable in one of the two cases (a 75% reduction). Adding the view and frontage variables to the original distance variable translated into substantial variations in total lake amenity value, ranging from $3.3 million to $2.4 million and $2.4 million in the Indiana case, and from $10.4 million to $7.1 million and $8.9 million in Connecticut.

3.2 | Summary

The studies reviewed in this section include most of the earliest known analyses of the impacts of water features (of any type) on property prices. With a few exceptions, the relatively simplistic nature of their approach limits their broader utility, making generalizations beyond the generic statement that "frontage on, views of and proximity to large lakes and reservoirs do appear to have positive effects on prices" somewhat tenuous (Table 1). The preponderance of reservoir studies in the 1960s and 1970s, during and soon after the height of reservoir construction in the United States, is intuitive. Nevertheless, for many reasons discussed in more detail in the discussion section, new analyses of the influences of reservoirs on nearby property values, using modern GIS-based and spatially explicit techniques, would appear to be of great utility.

4 | THE NORTH AMERICAN GREAT LAKES

The aesthetic and recreational values of coastal areas on the US/Canadian Great Lakes are not characteristic of those of other inland lakes due to their uniqueness and sheer scale. The Great Lakes constitute the largest body of fresh water in the world. Covering 94,000 square miles and with 10,000 miles of shoreline, they hold approximately 20% of the world's surface fresh water and provide numerous critical ecological services in addition to supporting substantial agricultural, fishing, manufacturing, transportation and recreation/tourism industries (Sustain Our Great Lakes, 2017). Although not enumerated in any of the studies referenced in this study, an additional value of the Great Lakes is their moderating influence on climate that characterizes such large waterbodies. The studies reviewed in this section are summarized in Table 2.

4.1 | Effect of frontage and scenic view

The statistically significant, positive impacts of an unobstructed view of Lake Michigan on residential values in Chicago, Illinois, have been demonstrated on a number of occasions, although the magnitude of this impact was either unspecified or indeterminable in terms of dollar values (Blomquist, 1988; Pollard, 1980; Smith, 1994). Studies that are more recent have both quantified and qualified the value of a Great Lakes scenic view. Seiler, Bond, and Seiler (2001) found that properties in Cuyahoga County, Ohio, with a view of Lake Erie were assessed at values $115,000 more than non-view properties, a premium of 56%. A later study employing sales prices in the same area found lake view houses sold

TABLE 1 Summary of studies relating to reservoirs and large artificial lakes (presented in chronological order)

Author (year)	Study site/location	Dependent variable	Year(s) analysed	Method, sample size, functional form and (adjusted) R^2	Key findings regarding water feature impacts on property values
Knetsch (1964)[a] Knetsch and Parrott (1964)[a]	Tennessee Valley Authority Reservoirs, USA	Per-acre sales prices of improved and unimproved parcels of land	1946 to 1962	Two linear regression models—one for 519 properties on or near one of 11 TVA reservoirs and one for 103 properties not near a reservoir, .58–.77	Reservoir frontage commanded a per-acre premium of $65; price decreased $87 per acre with each mile away from the reservoir. For a hypothetical new reservoir completed in 1963, increased surrounding land value was calculated to be $1.96 million, an 85% increase
Mann and Mann (1968)[a]	Pearl River Reservoir, Jackson, MS, USA	Sales prices of (un)improved parcels of suburban farm land (>10 acres)	1950 to 1963	Median prices per acre pre- and post-1959 announcement of the construction of the reservoir (277 sales), compared to prices in a nearby control area (94 sales)	Price per acre increases in the reservoir area were 107 (in 1959), 151 (1960), 196 (1961) and 227 (1962) percentage points higher than the 9% per year increase in the control area
Schutjer and Hallberg (1968)[a]	Water-based state park in PA, USA	Per-acre sales prices of properties	1950 to 1965	Linear regression; four models to account for properties < or >2 acres and with (or without) buildings; total of 283 sales; .10–.57	Announcement of park in 1956 had a positive impact on prices of parcels <2 acres without buildings ($293 reduction in price with each mile from the park); no significant impact on other types of properties
Milliken and Mew (1969)	Reservoirs in CO, USA	Assessed and sales values of (un) improved parcels of land	1946 to 1968	Prices pre- and post-reservoir construction, compared to prices in nearby control areas	Increase in land value attributed to construction of three reservoirs estimated to exceed $5.1 million; inclusion of value of improvements and new recreation facilities saw total increase rise to over $8.1 million
Day and Gilpin (1974)[a]	G. Ross Lord Reservoir, Toronto, Canada	Assessed values of single-family and duplex houses	1972	Multiple regression, 455 properties, linear form, .41	Effect of distance from reservoir insignificant
Boodt (1978)	Western OR, USA	Sales prices of rural residential property	1970 to 1974	Two regression models; one for 61 reservoir-influenced properties, one for 108 non-influenced	Prices in reservoir model $2,689 (15%) greater than in general model; reservoir size had no influence on price

(Continues)

TABLE 1 (Continued)

Author (year)	Study site/location	Dependent variable	Year(s) analysed	Method, sample size, functional form and (adjusted) R^2	Key findings regarding water feature impacts on property values
Lansford and Jones (1995a)	Lower Colorado River Authority's Highlands Lakes chain, TX, USA	Sales prices of single-family houses	1988 to 1990	Hedonic pricing model, 609 properties on Lake Austin and 593 properties on Lake Travis, nonlinear Box–Cox transformation, .79–.88	Lake Austin: Lakefront properties commanded a premium of $83,262, although for those on bluff premium reduced by $8,160; view premium (of lake, hills or both) $12,702; total market value of recreational benefits nearly $66 million
Lansford and Jones (1995b)[a]					Lake Travis: Lakefront properties commanded a premium (of $79,000 to $102,000 depending on lot elevation), although premium declined $3,200–8,000 with a six foot drop below long-term average lake level; lake view premium $12,702; marginal value of proximity declined rapidly with distance ($56/ft at the waterfront, $12/ft at 150 feet, $5/ft at 3,000 feet); total market value of recreational benefits >$49 million
Kruse and Ahmann (2009)	Iron Gate and Copco Reservoirs, northern CA, USA	Sales price per acre of properties (<10 acres, developed and undeveloped)	1998 to 2006	Hedonic pricing model, 590 properties, semi-log form, .70	Significant price premium per acre for properties on (108%), near (across the street from, 68%) and with a view of (28%) reservoir
Muller (2009)	Lake Monroe, IN, and Candlewood Lake, CN, USA	Sales prices of residential properties	IN: 1999 to 2001 CN: 1999 to 2003	Six hedonic pricing models, 330 properties in IN, 320 in CN, log-linear form, .63–.76	Effect of distance to lake negative and significant in all 6 models (although only up to distance of 1.7–1.8 miles). Water view premium positive and significant in 3 of 4 models. Water front premium positive and significant in 1 of 2 models, insignificant in other. Magnitude of distance effect declined substantially when view and frontage variables added

[a]Refereed article.

TABLE 2 Summary of studies relating to the great lakes (presented in chronological order)

Author (year)	Study site/location	Dependent variable	Year(s) analysed	Method, sample size, functional form and (adjusted) R^2 (as applicable)	Key findings regarding water feature impacts on property values
Diamond (1980)[a]	Lake Michigan, Chicago, IL, USA	Appraised value of land of sold single-family houses	1969 to 1971	Multiple regression, 414 properties, multiple specifications, .75	Location within 5 miles of Lake Michigan (without view) worth average of $2,219, more in areas with higher income residents
Pollard (1980)[a]	Lake Michigan, Chicago, IL, USA	Rental rates of apartments	1975	Housing supply model, 232 units, .77–.86	View of Lake Michigan increased rent by 7%; rent decreased 8.5% with each mile from the lake
Grimes (1982)	Lake Michigan, IN and MI, USA	Sales prices of residential land	1966	Multiple regression, 294 properties within one mile of Lake Michigan, log-log form, .44	Land price decreased 0.14% with every 1% increase in distance from the shores of Lake Michigan, distance to the lake accounted for 19% of variation in land prices
Blomquist (1988)[a]	Lake Michigan, Chicago, IL, USA	Monthly housing expenditure of view residences	1981	Hedonic pricing model, 159 residences, Box–Cox form, .85	Positive impact of increasing residence height and of size of unobstructed lake view
Smith (1994)[a]	Lake Michigan, Chicago, IL, USA	Sales prices of single-family houses within 2 miles of lake	1982 to 1984	Hedonic pricing model, 547 properties, two functional forms	View of Lake Michigan (positive), distance from waterfront (negative) and setback (positive) all highly significant according to both forms
Seiler et al. (2001)[a]	Cuyahoga County, OH, USA	Assessed values of single-family houses	1998	Hedonic pricing model, 1,172 properties, linear form, .76	Properties with a view of Lake Erie assessed at $115,000 more than non-view properties, a premium of 56%
Bond et al. (2002)[a]	Cuyahoga County, OH, USA	Sales prices of single-family houses	1999 and 2000	Hedonic pricing model, 190 properties, linear form, .28	Properties with a view of Lake Erie sold for $256,545 more than non-view properties, a premium of 90%
Colwell and Dehring (2005)[a]	Emmet County, MI, USA	Sales prices of vacant lots on Lake Michigan	1990 to 2003	Four hedonic pricing models, 80 lots, log form, Cobb–Douglas specification, .83–.83	Bluff lots sold for 200% more than non-bluff lots. Lots on an "undesirable" stretch of beach sold for 38% less than others. Relationships between price and lot frontage or depth not linear

[a]Refereed.

for $256,545 more than non-view properties, a premium of 90% (Bond, Seiler, & Seiler, 2002). The substantial difference between the two figures, however, was not directly addressed, although three possibilities exist. One might be a rapid escalation of property values between the two study periods (although these periods were 1998 and 1999–2000, making this explanation unlikely). A second might be a substantive change in the nature of the market (e.g., a large volume of teardown houses replaced with very expensive new construction), although the short time frame again makes such a sudden shift doubtful. A third possibility might be a vast discrepancy between assessor appraisals and homebuyer opinions as to the value of a Lake Erie scenic view. Colwell and Dehring (2005) addressed the impacts of lot frontage (and also depth) on vacant lakefront lots on Lake Michigan. The relationship between frontage and value was found to be neither linear nor proportional, with elasticities of between 0.55 and 0.63.

4.2 | Effect of proximity to the lakes

Several analyses have demonstrated the inverse relationship between property prices and distance to a Great Lake. Every study that includes a proximity/distance variable has found the relationship to be statistically significant, although each was based on a different measure of proximity and/or value. Diamond (1980) employed a dummy variable to represent location, finding a significant positive effect of location within 5 miles of Lake Michigan (no properties with views were included), and that this premium rose for higher income residents. Three other studies used continuous measures of distance from the lake, but different types of property values. Pollard (1980) reported that apartment rents declined by 8.5% per mile as one moved inland from Lake Michigan, compared to a decline of 4% per mile from the Loop (Chicago's central business district). Grimes (1982) reported a 0.14% decrease in per square foot land prices with every 1% increase in distance from Lake Michigan shores, and that the distance to the lake accounted for 19% of all land price variations. Most recently, Smith (1994) demonstrated the negative (although unspecified) effect of distance from Lake Michigan on sales prices of single-family houses.

4.3 | Summary

The literature on the positive effects of Great Lakes frontage, views and proximity is conclusive. Evidence suggests scenic view premiums range up to 90%, although the extent of the view and quality appear not to have received as much attention as they have in ocean settings wherein the differential values of full versus partial views have been calculated. More ocean-based studies have also factored in length or depth of beach frontage, enabling calculation of the interaction effects between frontage and distance. This approach recognizes increasing beach length and/or depth provides more space, therefore also additional recreational benefits. Increasing depth (width) also offers augmented storm protection to frontage properties. Consideration of these factors would be a useful addition to future Great Lakes studies, especially given the increasing levels of climate variability noted in the discussion section.

5 | OTHER NATURAL INLAND LAKES

Although less expansive in extent, and often less dramatic in visual impact, smaller lakes may nevertheless offer a range of aesthetic and recreational benefits to proximate residents. Again, these values have been conceptualized and measured in a variety of ways and the specifics of the waterbody in question (size, depth, etc.) were not articulated in the respective publication in many cases (Table 3). The studies reviewed in this section, however, do exemplify the increasing attention to more qualitative attributes (e.g., a shift from the analysis of the value of the simple (dichotomous) presence or absence of a view) to determine the value of different levels or extents of view.

5.1 | Effect of frontage and views

In Florida's Kissimmee River Basin, Conner, Gibbs, and Reynolds (1973) calculated a sales price premium of $3,232 (64%) for vacant lakefront lots. The premium increased to $4,040 (69%) for those with lake and canal frontage. Cassel and Mendelsohn (1985) reported that full and partial views of Lake Washington, Lake Sammamish and Lake Union, all located in Seattle, had positive impacts on property values. In nearby Bellingham, two related studies (Benson, Hansen, Schwartz, & Smersh, 1998; Benson, Hanson, & Schwartz, 2000) reported that lakefront property enjoyed a 127% premium, while properties with a lake view exhibited an increase of 18%. Moreover, the value of frontage increased over time, from an 80%–90% premium in 1984–86 to a 120%–130% premium in 1988–93. Lake frontage premiums were larger than ocean view dividends, ranging from 8% (poor partial view) to 59% (full view). The authors attributed this differential to the nature of the oceanfront in Bellingham, which is dominated by railroad tracks along much of its length, thereby diminishing the view and preventing immediate ocean frontage, as well as the additional benefits afforded by lake frontage, including direct access to multiple (non-)motorized recreation activities, the presence of waterfowl and the possibility of a beach and/or dock. In Ramsey County, Minnesota (MN), home to the St. Paul urban area, a lake view was worth $45,949, representing 44% of the average value of all properties in the study area (Doss & Taff, 1996). Luttik (2000) noted premiums of 5% and 7% for adjacency to a lake, and 8% and 10% for lake view, in the Netherlands. In the only developing country analysis identified across any water resource type, Udechukwu (2010) reported an 8.6% property price premium for a view of a lagoon in Victoria Garden City, Lagos, Nigeria.

Other authors have investigated the impacts of lake adjacency and/or view in more rural areas. In upstate South Carolina, Espey, Fakhruddin, Gering, and Lin (2007) calculated premiums of 52%–61% for lake frontage, 34%–39% for lake access and 26%–36% for lake view (these categories were mutually exclusive, thereby not being

TABLE 3 Summary of studies relating to natural inland lakes (presented in chronological order)

Author (year)	Study site/location	Dependent variable	Year(s) Analysed	Method, sample size, functional form and (adjusted) R^2 (as applicable)	Key findings regarding water feature impacts on property values
Conner et al. (1973)[a]	Kissimmee River Basin, Florida, USA	Sales prices of vacant residential lots	1966 to 1970	Two linear regression models (total sales price and price per front foot), 316 lots; .63–.68	Lakefront lots commanded a total sales price premium of $3,232 (64%); canal-front lots commanded a premium of $809 (31%); premium for lots with lake and canal front $4,040 (69%)
Darling (1973)	Three parks containing water features in CA, USA	Assessed values and sales prices of vacant lots, single-family houses and apartments	Not stated	Multiple regression models, sample sizes not stated, .55–.98	Lake Merritt: positive impact of proximity found in most models. Lake Murray: impact of proximity negative within 3,000 feet, positive within 1,500 feet. Santee Lakes: proximity insignificant
Brown and Pollakowski (1977)[a]	Three lakes in Seattle, WA, USA	Sales prices of dwelling units	1969 to 1974	Two regression models, 90 and 89 properties, linear form with log of distance, .78–.84	Prices fell with distance from lake, rose with increasing width of setback; decline with distance greater in the case of no setback
Plattner and Campbell (1978)[a]	Eastern MA, USA	Sales prices of condominium units	1973 to 1976	Comparison of prices for condos with and without water views	Condos with a view of a pond sold for 4%–12% more than similar condos without a view
Cassel and Mendelsohn (1985)[a]	Seattle, WA, USA	Not stated	Not stated	Hedonic pricing model, n not stated, multiple forms, .56–.69	View of Puget Sound and full and partial views of lakes commanded a premium
Doss and Taff (1996)[a]	Ramsey County, MN, USA	Assessed values of single-family houses	1990	Hedonic pricing model, 32,417 properties within 1 km of a wetland, linear form, .76	Lake view premium: $45,949 (average value of all properties $104,956); value declined $188 per 10 m from a lake
Benson et al. (1998)[a] Benson et al. (2000)[a]	Bellingham, WA, USA	Sales prices of single-family houses	1984 to 1994 (1998) or 1993 (2000)	1998 study: Hedonic pricing models, 7,305 sales of 5,095 properties, log-linear form, .74–.83 2000 study: Hedonic pricing model, 6,949 sales of 4,931 properties, log-linear form, .74–.78	Lakefront premium: 127%. Lake view premium: 18%. Value of lake frontage increased over time (from 80% to 90% premium in 1984–86 to 120%–130% in 1988–93)
Luttik (2000)[a]	Eight towns/regions in the Netherlands	Sales prices of houses	1989 to 1992	Hedonic pricing model, nearly 3,000 properties	Adjacency to a lake (2 cases): premiums of 5% and 7%. View of a lake (2 cases): 8% and 10%. Lake "in the vicinity" of the residential area (2 cases): 5% and 7%. Lake in the vicinity of the area bordering the residential area (3 cases): 5%, 7% and 10%. Presence of a lake in the region (1 case): 6%
Mahan et al. (2000)[a]	Portland, OR, USA	Sales prices of single-family houses	1992 to 1994	Hedonic pricing model, 14,485 properties, log-log form, .76	Decrease in distance to nearest lake or stream by 1,000 ft increased property value by $1,644 and $259, respectively (relative to average house at one mile)

(Continues)

TABLE 3 (Continued)

Author (year)	Study site/location	Dependent variable	Year(s) Analysed	Method, sample size, functional form and (adjusted) R^2 (as applicable)	Key findings regarding water feature impacts on property values
Anderson and West (2006)[a]	Minneapolis–St. Paul, MN, USA	Sales prices of single-family houses	1997	Hedonic pricing model, 24,862 properties, log-log form, .88	Sales price increased 0.034% for each 1% decrease in distance to nearest lake. Lake proximity premium larger than those for parks (0.004), special parks (0.025) or golf courses (0.006)
Espey et al. (2007)[a]	Anderson, Pickens and Oconee counties, SC, USA	Sales prices of single-family houses	1999 to 2001	Traditional and spatially explicit hedonic pricing models, 3,052 properties, semi-log form, .78–.80	Lake frontage, access and view all positively impacted prices in all models. In spatial models: lake frontage premium was 52%–61% ($68-80,000); lake access premium was 34%–39% ($44-67,000); lake view premium was 26%–36% ($34-47,000)
White and Leefers (2007)[a]	Wexford County, MI, USA	Sales prices of single-family houses	2000 and 2001	Hedonic pricing model, 256 properties (split into two categories, subdivision and non-subdivision), linear form, .47–.65	Non-subdivision model: proximity to lake insignificant Subdivision model: adjacency to Lake Mitchell commanded premium of $108,000
Phaneuf et al. (2008)[a]	Wake County, NC, USA	Sales prices of single-family houses	1998 and 1999	Hedonic pricing model, 26,305 properties, semi-log form, .93	Significant premium for properties within one-half mile of nearest lake
Hodgkinson and Valadkhani (2009)[a]	Lake Illawarra, New South Wales, Australia	Sales prices of single-family houses	2006	Hedonic pricing model, 521 properties, semi-log form, .45	Distance to lake had sig. nonlinear negative relationship with price (average loss of AU$24 with each metre)
Sander and Polasky (2009)[a]	Ramsey County, MN, USA	Sales prices of single-family houses	2005	Hedonic pricing model, 4,918 properties, log-log form, .79	View of water more highly valued than view of grass or forest. Proximity to lake more highly valued than to park, trail or stream
Heinrich and Kashian (2010)[a]	Muskego, WI, USA	Sales prices of single-family houses	2002 to 2008	Hedonic pricing model, 1,285 properties, log-linear form	Lake frontage positively impacted prices (by an order of magnitude more than frontage on a golf course). Premium declined for shallower lake.
Jiao and Liu (2010)[a]	Wuhan, China	Sales prices of apartments (per square metre)	2007 to 2008	Geographical field-based spatial lag hedonic pricing model, 304 properties, .62	Proximity to East Lake positive and sig. (21.261 Yuan/m^2 for each percentage increase in proximity index from maximum distance of 800 m). Proximity to other lakes insignificant
Nelson (2010)[a]	Deep Creek Lake, western MD, USA	Weekly rental rates for detached houses	2008	Traditional, spatial lag and spatial error hedonic pricing models, 610 (summer model) and 577 (winter model) properties, semi-log form, .88–.92	Effect of lake frontage positive (sig. at 95%) in all ten models tested (generating premiums of 43%–44% in summer and 21% in winter). Effect of location across the road from lake front positive (sig. at 95%) in all five summer models tested (premiums of 11%–12%)

(Continues)

TABLE 3 (Continued)

Author (year)	Study site/location	Dependent variable	Year(s) Analysed	Method, sample size, functional form and (adjusted) R^2 (as applicable)	Key findings regarding water feature impacts on property values
Stetler et al. (2010)[a]	Northwest Montana, USA	Sales prices of houses	1996 to 2007	Hedonic pricing models, 18,785 properties, semi-log form, .82–.83	Distance to nearest lake had sig. negative impact on price (squared and cubed distances also sig.). Access to a navigable waterfront, access to Flathead Lake or Whitefish Lake, and water frontage without navigable access, all generated sig. premiums
Udechukwu (2010)	Victoria Garden City, Lagos, Nigeria	Property value	Not stated	Hedonic pricing model, 83 properties, linear form, .79	View of lagoon commanded premium of 8.6%
Sander, Polasky & Haight (2010)[a]	Dakota and Ramsey Counties, MN, USA	Sales prices of single-family houses	2005	Simultaneous autoregressive hedonic pricing model, 9,992 properties, double-log form	Distance to lake negative and highly sig. (at 0.001)
Tapsuwan et al. (2012)[a]	Murray–Darling Basin, South Australia	Sales prices of single-family houses	Not stated	Traditional and spatially explicit hedonic pricing models, 752 properties, semi-log form, .67–.68	Both models: effect of distance to two local iconic lakes insignificant
Larson and Perrings (2013)[a]	Phoenix, AZ, USA	Sales prices of single-family houses	2000	Traditional and spatial lag hedonic pricing models, 47,586 properties, double-log form, .77–.88	Distance to nearest lake negative and sig. in both models
Clapper and Caudill (2014)[a]	Near North Ontario, Canada	Sales prices and sales prices per square foot of lakefront cottages	2010	Six hedonic models, 253 properties, linear, log-linear and log-log forms, .14–.57	Frontage positive and sig. in all models
Wen et al. (2014)[a]	Hangzhou, China	Average housing price within gated communities	2011	Six spatial lag hedonic pricing models, 660 communities, log form, .64–.70	Proximity to West Lake sig. in all models. Price elasticity varied with geographical direction from the lake and with distance
Yoo et al. (2014)[a]	Prescott, AZ, USA	Sales prices of residential properties	2002 to 2005	Traditional, spatial lag and spatial error hedonic pricing models, 8,301 properties, semi-log form	All models: travel time to nearest lake sig. and negative, travel time squared sig. and positive
Tapsuwan et al. (2015)[a]	Murray–Darling Basin, South Australia	Sales prices of single-family houses	2000 to 2011	Traditional and spatially explicit hedonic pricing models, 31,706 properties, double-log form for distance variables, .41–.42	Both models: effect of distance to nearest lake sig. and negative. Marginal implicit price of moving 1 km to a lake (at the mean distance of 6.7 km) AU$1,160.83

sig., significant.
[a]Refereed.

additive). White and Leefers (2007) differentiated between subdivided and non-subdivided parcels in rural Michigan. Frontage on a lake had no sales price impact on non-subdivided parcels, whereas adjacency to Lake Mitchell (described as the premier lake in the study region) commanded a premium of $108,000 for subdivided parcels (a mean selling price was not provided, although ranging from $14,000 to $475,000). Heinrich and Kashian (2010) demonstrated the positive impacts of lake frontage in rural Wisconsin, noting the lake premium was an order of magnitude more substantial than frontage on a golf course, although the premium declined for shallower lakes. In northwest Montana, access to a navigable waterfront generated a premium of $214, 034 relative to the average sales price of $260,000, with navigable access to Flathead Lake or Whitefish Lake adding an additional premium of $117,295. Properties with frontage on non-navigable water saw an increase of $35,291 (Stetler, Venn, & Calkin, 2010). Clapper and Caudill (2014) found the length of frontage was positively related to the price of lakefront cottages in North Ontario, Canada.

In the only study focusing on rental rates, rather than sales prices, Nelson (2010) demonstrated that lake frontage imbued a large premium (of 43%–44%, or $1,110–1,200 per week) in the summer season in western Maryland. In winter, when the effect of access to ski slopes was also considered, the lake frontage premium retained its statistical significance, although at a reduced magnitude (about 21%, or $450–475, compared to 27%–28% ($600) for ski slope access). Rentals separated from the lakefront by a road exhibited an 11%–12% premium in the summer season.

5.2 | Effects of proximity

Darling (1973) considered the property price impacts of three parks containing water features in California, with the impacts of proximity being mixed. They were mostly positive in one case. They were negative within 3,000 feet, but positive within 1,500 feet in a second case, and insignificant in a third case. The naïve measures used in this early study make it likely the variability between the parks studied, and in the types of properties surrounding them, accounted for most of the variability. Brown and Pollakowski (1977) reported that sales prices decreased with increasing distance from three Seattle lakes and rose with increasing width of setback. The rate of distance-related declines (i.e., loss of amenity value) was greatest for the lake with no setback, suggesting homebuyers place value on the opportunities for recreational access provided by public setbacks.

A pair of more recent studies provide snapshots of the influences of resources such as parks and lakes in China. In Wuhan (Jiao & Liu, 2010), increasing proximity to East Lake was found to have a positive impact on apartment prices. Compared to an apartment 800 m from East Lake, those 400 m away exhibited premiums of 1,063 Yuan/m^2, while those next to the area exhibited premiums of 2,126 Yuan/m^2 (the average price of all apartments in the sample was 5,918 Yuan/m^2). Proximity to one of 23 other lakes, however, exhibited no price influence. Proximity to West Lake had a positive price impact in Hangzhou (Wen, Bu, & Qin, 2014). Prices declined by 0.159% with each 1% increase in distance from the lake (or by 3.91% per km). Further analysis demonstrated the decline was neither linear (prices fell most quickly within a short distance) nor directionally homogenous (prices fell at different rates in different geographical directions).

Other analyses have been less explicit in their description of the study area, focusing simply on one or more lakes, with less specific characterization of the settings. Mahan, Polasky, and Adams (2000) demonstrated an increase in sales price of $1,644 with each 1,000 ft closer in distance to the nearest lake in Portland, Oregon (relative to the average $122,570 house one mile from a lake). Anderson and West (2006) showed that sales price increased 0.034% for each 1% decrease in distance to the nearest lake in Minneapolis–St. Paul. This was a more substantial premium than found for parks or golf courses. In Ramsey County, Minnesota, assessed property values were found to decline by $188 with each 10 m increment in distance from a lake (Doss & Taff, 1996). Sander and Polasky (2009) also found the marginal implicit price for reducing the distance to the nearest lake by 100 m generated a $216 increase in sales price in Ramsey County (for the average-priced home located 1 km from the nearest lake), this being the largest premium of all resource types considered (others being parks, trails and streams). A later analysis that included more sales from a larger, two-county study area similarly found a highly significant negative relationship between distance from the lake and the property price (Sander, Polasky & Haight, 2010).

In the western United States, Stetler et al. (2010) reported a significant, nonlinear relationship between distance to the nearest lake and house prices in northwest Montana, as did Yoo, Simonit, Connors, Kinzig, and Perrings (2014) in Prescott, Arizona. Distance to the nearest lake was also influential in Phoenix, Arizona, although considerably less so than proximity to a golf course (Larson & Perrings, 2013).

Moving to the Murray–Darling Basin in South Australia, the distance to either a perennial or ephemeral lake had no significant impacts on sales prices in one study, although the distance to the Murray River did (Tapsuwan, MacDonald, King, & Poudyal, 2012). In contrast, a later study with a far larger dataset identified a significant negative relationship between increasing distance to the nearest lake and sales value (Tapsuwan, Polyakov, Bark, & Nolan, 2015).

Several studies used a dummy rather than a continuous variable, to assess the effects of distance from a lake on sales prices. Luttik (2000) detailed a variety of impacts in and around towns in the Netherlands. The presence of a lake "in the vicinity" of two residential areas, for example, generated premiums of 5% and 7%. A lake in the vicinity of the area bordering three residential areas was associated with premiums of 5%, 7% and 10%, and the presence of a lake "in the region" resulted in a premium of 6%. Phaneuf, Smith, Palmquist, and Pope (2008) demonstrated a significant premium for properties located within one-half mile of the nearest lake in Wake County, North Carolina.

Plattner and Campbell (1978) suggested that condominiums with a view of a pond sold for 4%–12% more than similar condos without such a view, although this conclusion was based solely on visual comparison of sales prices for similar units. Despite its naïve methodology, this study did illustrate the important conceptual principle that a view premium appeared greater for lower-priced than for higher-priced units. This finding is intuitive if a view accrues to the position of a housing unit, rather than its size, meaning that as the value of the structure increases, the proportionate value of the view is likely to decline. One might also surmise, however, that a larger unit could have "more" view (i.e., a view from a larger number of windows and rooms, which could invalidate this conjecture).

5.3 | Summary

As noted for reservoirs, the variety of study areas, measures and methodologies employed do not allow for definitive generalizability in numeric terms. Nevertheless, lake frontage and/or scenic view does appear to consistently imbue a property premium, ranging from 5% to 100%, depending on the setting. Factors influencing the magnitude of the premium include lake size, depth and access (i.e., whether or not the frontage allows the owner to install a dock or otherwise access the lake for recreational purposes). Many of the more recent studies have considered multiple amenity types, thereby allowing direct comparisons of the relative magnitudes of the benefit of water features to those of parks, golf course and trails. In all but one case, the premiums associated with water features exceeded those of land-based amenities.

6 | DISCUSSION

As a whole, the 47 publications (representing 44 distinct studies) reviewed consistently demonstrated the value of lake and reservoir scenic views and access to homeowners, as capitalized into residential property prices. Among those studies that conducted tests of statistical significance, only a handful generated any insignificant findings, and none exhibited any significant findings contrary to expectations (i.e., that reported a negative impact of water adjacency or view or a positive impact of increasing distance). Of the six studies that reported insignificant results, three demonstrated significance in other model specifications, with the likely causes of the anomalies in most cases convincingly explained by the authors in terms of study area characteristics. Despite a comprehensive search, only nine of the 44 studies located were conducted outside of the United States (three in Australia; two in Canada and China; one in the Netherlands and Nigeria). The Great Lakes are a uniquely North American feature that offered special opportunities for analysis. The lack of studies from outside the United States on other types and sizes of lake and reservoir, however, was surprising. Possible explanations for this absence of studies include the likely lack of the property records and accompanying GIS data necessary to conduct hedonic analyses in less developed nations, and an insufficient number of sales around lakes and reservoirs in remote rural regions to produce valid and reliable hedonic results.

The positive effect of a scenic water view does hold across a variety of water feature types, including reservoirs, the North American Great Lakes and other inland lakes. More recent studies have demonstrated the variability of a view premium with size, distance or extent. Given the fixed supply of waterfront and view property, the latter studies appear to inform controversies relating to planning regulations, particularly with respect to new construction that might reduce or eliminate existing property views. In such cases, the addition to the property tax base of any new construction should be balanced against potential losses due to diminished views from existing properties. The decay impacts of increasing distance from a lake on property values are also conclusive, and the effects of water feature size, setback, frontage and water level fluctuations have also been analysed. The studies reviewed here, therefore, demonstrated that recreational and aesthetic factors—and the associated cultural, spiritual and emotional benefits that water access and view can also provide—can be a major source of land value increases around water-based features. As demand for the packages of amenities offered by waterside properties increases, prices of, and premiums for, these properties are likely to rise even further, with the tendency of the proportion of value added by a water view to increase through the time period of the studies reviewed reflecting the inelasticity in the supply of water amenities.

As competition over finite water resources grows, and the need for their equitable and efficient allocation between multiple consumptive and non-consumptive uses escalates, knowledge of the value attributed to water views and access by nearby homeowners holds much significance for resource planners and managers. The body of empirical evidence provides convincing confirmation of the price and associated property tax premiums associated with water view and access. Surprisingly, however, only one of the reviewed studies took the additional step of translating the demonstrated premiums into the overall contributions of reservoir or lake properties towards the local property tax base, incredibly powerful numbers that have been calculated in other contexts (e.g., Crompton and Nicholls (2006) for greenways).

6.1 | Advances in methodological approaches

The present review provides a useful longitudinal profile of the considerable improvement in analytical technique that occurred throughout the period of the identified studies. The earliest work, commencing in the 1960s, was essentially anecdotal, consisting of studies that compared prices prior to, and following, an announced or actual reservoir development, or prices near a development with those in a control area. In both cases, the entirety of any price changes observed between the two time periods or locations was by default attributed to the water feature's development (i.e., any other potential effects on prices through time or space were not considered).

After the publication of Rosen's (1974) seminal work on the hedonic pricing method, multiple regression analyses became the standard. This approach eliminated criticism of the circumstantial nature of prior studies, providing quantifiable estimates of the value of water views and proximity, simultaneously also accounting for the variety of other structural, locational, neighbourhood and environmental factors that influence property prices. Using multiple regression techniques introduced the issue of functional form which, as noted by Halvorsen and Pollakowski (1981), is typically not prespecifiable on theoretical grounds. While earlier studies (i.e., those conducted in the 1960s and 1970s) tended to adopt a linear approach, later work experimented with nonlinear (primarily semi-log/log linear) and Box–Cox forms that allowed the decay function of distance from a water amenity to be enumerated. The choice of functional form represents a balance between adequate representation of the complex relationships among variables, and ease of interpretation of resulting coefficients, with the latter issue being especially important within the context of providing utility to practitioners and policymakers.

Most recently, the advent of GIS has allowed for a greater variety of proximity and accessibility variables to be incorporated easily (e.g., quicker identification of waterfront properties; ability to measure walking/driving distances [versus earlier use of straight-line measurements]; determining the existence and extent of a view using 3D modelling techniques). The study of Muller (2009), however, is the only one to emphasize the need to consider multiple forms of amenity (i.e., location directly on a lake, distance to a lake, *and* view) to avoid model misspecification. The bias introduced by omission of relevant variables directly impacts parameter estimates and, therefore, overall amenity valuations. To this end, as noted by Muller (2009), "specification is critical."

The emergence of spatially explicit regression techniques allowed for the effects of spatial heterogeneity to be considered, thereby allowing highly sensitive analyses of the ways in which property price premiums can vary across even relatively small study areas. These latter studies served to illustrate the uniqueness of every location, in terms of its water resources and its housing market. Although critical to identifying nuanced variations within and between study locations, these approaches do highlight the difficulties associated with attempts at generalization to larger regions. Tapsuwan et al. (2015) demonstrated the need for spatial heteroskedasticity and autocorrelation consistent (SHAC) estimators in models in which error terms indicate both spatial autocorrelation and heteroskedasticity (per Kelejian & Prucha, 2010). Although their models did not incorporate consideration of any water features, Helbich, Brunauer, Vaz, and Nijkamp (2014) provided empirical comparisons and evaluations of various global and locally weighted hedonic approaches to modelling spatial heterogeneity. Such studies emphasize the need for entities operating at the local level, including policymakers, mortgage lenders and property appraisers, to become more cognizant of the implications of spatial variation. Similarly, they place responsibility on researchers to adequately address such issues.

6.2 | Implications of social and environmental changes

Case studies of specific areas remain essential, both for understanding the individual location at hand and for building a larger body of comparable evidence from which broader understanding of water's value as a recreational and aesthetic asset might be established. This is especially true in the light of the increasing recognition of the importance of lifestyle amenities in people's and businesses' location decisions, and in the general trend towards the preference for the acquisition of experiences over products. Places that offer access to natural resource-based amenities such as water, and to all of the activities and associated benefits, including pleasant memories, that such resources provide, are rapidly proving to have more success in attracting and retaining young talent and footloose firms (e.g., McGranahan, Wojan, & Lambert, 2008). Much nature-based tourism is also based on, in or near water resources such as lakes and reservoirs, and in the United States, paddle sports, including stand-up paddle boarding and kayaking, are some of the fastest growing outdoor recreation activities (Outdoor Foundation, 2016).

In areas where water diversions occur (e.g., for irrigation), the non-market view value that might be detrimentally impacted when deciding whether or not to implement this practice upstream of residential communities should be considered. This suggests the desirability of renewed attention to the effects of reservoirs on surrounding properties, a feature type that has rarely been addressed using the more advanced methods that have emerged since the mid-1990s. Similar attention to these values should be paid in areas where larger-scale water diversions for multiple uses are increasingly debated (e.g., North American Great Lakes). In Great Lakes areas prone to storm damage and erosion, the value of maintaining appropriate setback should be incorporated into any cost–benefit analysis of potential erosion control and beach nourishment measures. Moreover, if surrounding landowners are aware of the quantitative value of setback to their property, they are more likely to be supportive of protective measures, and to engage in behaviour supporting beach maintenance or improvement, which reinforces the value of efforts to provide appropriate educational messaging to those owners. Bell, Lindenfeld, Speers, Teisl, and Leahy (2013) and Snell, Bell, and Leahy (2013) have emphasized the value of informal local institutions such as lake associations with respect to stakeholder participation in lake management, particularly in terms of more effective dissemination of information and the ability to influence behavioural changes. To this end, the value of a scenic view and/or proximity should also be considered in any decision relating to the preservation of a water-based amenity when its conversion to another use is being considered (Mahan et al., 2000; Tapsuwan, Ingram, Burton, & Brennan, 2009).

Understanding the impacts of water-related entities on property values becomes even more essential in the light of the threat of climate change. In addition to sea level rise, climate change is likely to lead to more, and possibly more intense, droughts, extreme precipitation events, floods and storm surges, as well as ecosystem changes (e.g., lake, river, stream and wetland levels and temperatures) and, in the geographical ranges, seasonal activities, migration patterns, abundances and species interactions of terrestrial, freshwater and marine species. Potential responses range from ecosystem management practices (e.g., maintenance of wetlands; coastal afforestation;

watershed and reservoir management) to structural and engineered options (e.g., coastal protection structures; flood levees) to institutional approaches (e.g., financial incentives; insurance; catastrophe bonds; new laws and regulations relating to land use; building standards: water use; Intergovernmental Panel on Climate Change, 2014). All the aforementioned impacts and adaptations can be related to the relative attractiveness, and associated property price premiums, and consequent tax base enhancements or reductions, of water-based amenities. The impacts will not be consistent, however, with already-arid regions likely to experience declining water levels. Projections for other regions, however, are more ambivalent, confounding attempts to generalize effects on home values. Rather than seeing uniform changes in capitalized values, it is instead more likely that the relative values of areal waterbodies will vary with location, size, type (e.g., natural versus man-made), etc.

While the evidence with respect to the impacts of water-based amenities on residential property prices continues to grow, little if any attention has been paid to commercial and industrial property prices (only one of the reviewed studies focused on short-term rental rates). If business owners are to be convinced of the aesthetic and environmental value of blue or green over grey, studies of the manner in which property prices, rents and room rates in commercial districts and industrial developments can be enhanced by water features and green infrastructure should be encouraged.

Finally, understanding premiums associated with water-based amenities should encourage developers to maintain and promote the existence of features already present in project areas, and to create artificial features to add further value. A well-established phenomenon in this regard is the integration of home sites into golf courses, to generate an additional source of revenue for developers. The evidence presented here suggests that developers also stand to gain from inclusion of artificial lakes in their housing schemes. Should these features then pass into public hands, it is quite feasible to expect the increased property tax revenue attributable to their presence to be more than sufficient to cover the cost of ongoing maintenance, thereby representing a benefit to private homeowners at no cost to public authorities. In the context of restoration projects, however, Polyakov, Fogarty, Zhang, Pandit, and Pannell (2016) noted that as the costs and benefits of such projects accrue to different parties, institutional arrangements must also be considered.

7 | LIMITATIONS

It should be noted that the hedonic approach underestimates the total recreational and/or aesthetic value of any amenity. While it can capture the price surrounding homebuyers or renters are willing to pay for proximity to, or a view of, a water resource, it does not include three important elements of value, including (i) aesthetic and recreational benefits accruing to day and overnight visitors from outside the local area; (ii) option and existence values (i.e., the values placed on water resources by non-residents who might never visit, but nevertheless place value on the presence of the amenity, in and of itself and for the benefit of others); and (iii) any amenities or services that are not (fully) recognized by homebuyers, therefore not being capitalized into the prices. Other methods, such as travel cost, willingness to pay and contingent valuation, exist to measure some of these benefits. Their use with respect to the value of water, however, is less prevalent than hedonic pricing, and their inclusion is beyond the scope of this particular synthesis. Similarly, the hedonic approach does not capture direct spending and associated sales tax generation by residents or visitors on water-based recreation activities (e.g., equipment; entrance fees).

This review purposefully excluded consideration of materials focusing on water quality. Quality impacts can be both tangible (i.e., on the aesthetic appeal of a waterbody) and intangible (i.e., invisible influences on the suitability of a waterbody for drinking and recreation use). Given the variety and potential magnitude of these impacts, they are deserving of a similar, although separate, review.

The overwhelming preponderance of significant findings does raise the potential of publication bias, "the tendency on the part of investigators to submit, or the reviewers and editors to accept, manuscripts based on the direction or strength of the study findings" (Scholey & Harrison, 2003). According to one review of 221 social science research projects, significant results were 60 percentage points more likely to be written up and 40 percentage points more likely to be published than null results (Franco, Malhotra, & Simonovits, 2014; Peplow, 2014). The extent of this bias with respect to the discussion presented herein is, of course, indeterminable. Nevertheless, its potential existence must be acknowledged.

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