ASSESSING VISUAL QUALITY CHANGE 25 YEARS AFTER POST-MINING HOUSING DEVELOPMENT IN PLYMOUTH, MINNESOTA[1]

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Abstract: Reclamation specialists are interested in scientifically based tools to assist in the evaluation of the post-mining surface mining environment. In this investigation, we compared twenty photographic pairs taken 25 years apart (1980 to 2005) to assess the changes in visual quality on a sand and gravel post-mining site developed for housing. To compare the photographs, we employed an equation that explains 67 percent of respondent preference, with an overall p-value for the equation ≤ 0.0001 and a p-value <0.05 for each regressor. Difference in scores of about 10 points indicates a perceived and detectable difference in visual quality. Regressors employed in the equation include an environmental quality index (which includes economic, cultural, and ecological predictors), plus other more typical physical landscape regressors. We used the Wilcoxon matched-pairs signed-rank test to statistically compare differences between the two sets of photographs. Since 2.71 was larger than 1.96, we rejected the null hypothesis and accepted the hypothesis that the two photographic pairs were statistically different, ($p \leq 0.05$). The photographic set from 2005 was measurably more aesthetically pleasing than the 1980 photographic set. The mean score for the 2005 photographic set was 6 points more pleasing than the set from 1980. This change in mean score meant that although the site was numerically more pleasing after 25 years, visitors to the site may not be able to perceive the difference in aesthetic quality.

Additional Key Words: landscape architecture, landscape planning, environmental psychology, landscape design, environmental indicators

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Introduction

Environmental specialists are interested in assessing the properties of the landscape to evaluate the impact of spatial treatments upon the environment, including surface mine reclamation planning and design projects. Consequently, investigators and practitioners are engaged in applying research-based preference prediction models to study the effects of specific landscape planning, design, and management treatments upon built and natural settings. These approaches often require the use of photographic images to assess the visual quality of the landscape. The objective of our investigation is to find visual quality changes on a sand and gravel post-mining site developed for housing, comparing matched photographic pairs taken 25 years apart.

Literature Review Overview

The modern era of visual quality assessment began with Elwood Shafer Jr. and colleagues by their publication of predictive visual quality equations (Shafer Jr. 1969; Shafer Jr., Hamilton Jr. and Schmid 1969; and Shafer Jr. and Tooby 1973). In this case "predictive" is means "predicting human preference" for a landscape. Since their initial investigations the assessment of the aesthetic qualities has been greatly advanced by an assortment of recreation scientists, landscape architects, and environmental scientists (Kaplan and Kaplan; 1989 Kaplan, Kaplan, and Brown 1989; Taylor, Zube and Sell 1987; and Smardon, Palmer, and Felleman 1986). In the 1990s and early 2000s, visual quality research often focused upon spatial modeling tools and techniques to simulate the three-dimensional qualities of the environment (Buhmann, Nothhelfer, and Pietsch 2002; Buhmann and Ervin 2002; Ervin and Hasbrouck 2001; Hagerhall 2001; Buhmann et al. 2000; Lothian 1999; Al-Kodmany 1998; Buckley, Ulbricht, and Berry 1998; Bishop and Hulse 1994; Crawford 1994; and Orland 1994).

In addition to these studies, Burley (1997) proposed a model to predict visual quality where the equation explains 67 percent of respondent preference, with an overall p-value for the equation ≤ 0.0001 and a p-value < 0.05 for each regressor. The regressors employed in the equation include an environmental quality index (which includes economic, cultural, and ecological predictors), plus other more typical physical landscape regressors. With this equation, low scores below about 40 are aesthetically pleasing and scores above 70 are less pleasing. This equation has been employed in surface mine reclamation assessment (Mazure and Burley 2007; Burley 2006a; Noffke and Burley 2005; and Burley 1999). The visual quality theories associated with this equation are recently described by Burley (2006b). Humans intruding upon one another are not well received by the humans being intruded upon. For example, our work indicates that buildings (up close and personal), no matter how highly acclaimed, are intrusions from one person onto another. In addition, an abundance of people, cars, pavement, eroding soil, and related features are signs of people intruding upon others. Landscapes that dominate with these features are not rated highly. In addition, people prefer those events from nature that are special and temporal (not easily seen), such as an animal in a scene or flowers on display. Animals move and flowers have a limited time for blooming. So when these features are present, they are appreciated and enhance the quality of the landscape. In addition, mountains, buttes, and buildings when viewed from a distance are also temporal landscape enhancements which can often be viewed only from specific locations or in specific directions, and appear to behave as variables in a similar manner to other temporal landscape enhancements. Also, common spatial elements (pre-civilization features) found in the natural and even rural landscape such as sky, clouds, green vegetation, and water comprise the neutral environment from which a landscape can be enhanced or de-valued. Landscapes that contain an abundance of neutral modifiers result in visual quality scores that are neither high nor low. They are significantly different from those landscapes with an abundance of intrusions. and landscapes with an abundance of enhancements.

Method

The study area is a housing development in Plymouth, Minnesota, developed by Centurion Company in the late 1970s. The site was an old sand and gravel pit. The project won a Minnesota Chapter ASLA award in the early 1980s. The houses on the site are primarily duplex townhomes. During this time numerous photographs were taken when the project was completed. In 2005, the site was visited again and 20 matching photographs were recorded to accompany the photographs taken in 1980.

Each photograph was measured according to the equation by Burley (1997), Equation 1. The photographs were statistically compared by employing the Wilcoxon matched-pairs signed-rank test (Daniel 1978). This test allows sets of paired observations that may not be normally distributed to be compared. The test examined for statistical differences at an alpha of 0.05. The test approximates a z-score distribution and is similar to the paired t-test.

$$
\begin{aligned}
Y = 68.30 &- (1.878*HEALTH) \\
&- (0.131*X1) \\
&- (0.064*X6) \\
&+ (0.020*X9) \\
&+ (0.036*X10) \\
&+ (0.129*X15) \\
&- (0.129*X19) \\
&- (0.006*X32) \\
&+ (0.00003*X34) \\
&+ (0.032*X52) \\
&+ (0.0008*X1*X1) \\
&+ (0.00006*X6*X6) \\
&- (0.0003*X15*X15) \\
&+ (0.0002*X19*X19) \\
&- (0.0009*X2*X14) \\
&- (0.00003*X52*X52) \\
&- (0.0000001*X52*X34)
\end{aligned} \qquad \mathbf{(1)}
$$

Where:

- *HEALTH*= environmental quality index (Table 1)
- *X1*= perimeter of immediate vegetation
- *X2*= perimeter of intermediate non-vegetation
- *X3*= perimeter of distant vegetation
- *X4*= area of intermediate vegetation
- *X6*= area of distant non-vegetation
- *X7*= area of pavement
- *X8*= area of building
- *X9*= area of vehicle
- *X10*= area of humans
- *X13*= area of herbaceous foreground material
- *X14*= area of wildflowers in foreground

- *X15*= area of utilities
- *X16*= area of boats
- *X17*= area of dead foreground vegetation
- *X19*= area of wildlife
- *X30*= open landscapes = *X2*+*X4*+(2*(*X3*+*X6*))
- *X31*= closed landscapes = *X2*+*X4*+(2*(*X1*+*X17*))
- *X32*= openness = *X30*-*X31*
- *X34*= mystery = *X30***X1***X7*/1140
- *X52*= noosphericness = *X7*+*X8*+*X9*+*X15*+ *X16*

Table 1. Environmental Quality Index

Variable		Score
A.	Purifies Air	+1 0 -1
B.	Purifies Water	+1 0 -1
C.	Builds Soil Resources	+1 0 -1
D.	Promotes Human Cultural Diversity	+1 0 -1
E.	Preserves Natural Resources	+1 0 -1
F.	Limits Use of Fossil Fuels	+1 0 -1
G.	Minimizes Radioactive Contamination	+1 0 -1
H.	Promotes Biological Diversity	+1 0 -1
I.	Provides Food	+1 0 -1
J.	Ameliorates Wind	+1 0 -1
K.	Prevents Soil Erosion	+1 0 -1
L.	Provides Shade	+1 0 -1
M.	Presents Pleasant Smells	+1 0 -1
N.	Presents Pleasant Sounds	+1 0 -1
O.	Does not Contribute to Global Warming	+1 0 -1
P.	Contributes to the World Economy	+1 0 -1
Q.	Accommodates Recycling	+1 0 -1
R.	Accommodates Multiple Use	+1 0 -1
S.	Accommodates Low Maintenance	+1 0 -1
T.	Visually Pleasing	+1 0 -1
	Total Score	__________

Table 2. Results from the computation of visual quality for 2005 and 1980.

2005	1980	Difference	Sign	Absolute Value Rank
50.6556	67.15688	-16.50128	-	19
56.38477	63.05807	-6.6733	-	11
63.64239	65.83106	-2.18867	-	6
44.44302	68.17908	-23.73606	-	20
65.05933	65.85372	-0.79439	-	2
56.43648	66.51749	-10.08101	-	13
62.12827	63.94648	-1.81821	-	4
67.60752	63.94648	3.66103	+	8
55.63139	64.33627	-8.70488	-	12
51.34463	67.66077	-16.31614	-	18
61.4666	63.33493	-1.86833	-	5
58.7202	60.36609	-1.64589	-	3
53.23326	57.20256	-3.9693	-	9
53.23326	63.39905	-10.16579	-	14
52.56869	58.16181	-5.59312	-	10
54.31077	64.67388	-10.36311	-	16
65.57875	55.39593	10.18282	+	15
60.47945	59.89069	0.58876	+	1
45.97061	60.77027	-14.79966	-	17
60.97948	58.69252	2.28696	+	7

Results and Discussion

Table 2 lists the visual quality scores for the photographic pairs based upon Equation 1 for 2005 and 1980. In the third, fourth and fifth columns of the table are the computed difference, the sign associated with the difference, and the rank of the difference based upon absolute values. This information can then be used in the application of the Wilcoxon matched-pairs signed-rank test (Daniel 1978), with the computation results yielding a value of 2.71. Since 2.71 was larger than 1.96, we rejected the null hypothesis and accepted the hypothesis that the two photographic pairs were statistically different, ($p \leq 0.05$).

In our study, the photographic set from 2005 was measurably more aesthetically pleasing than the 1980 photographic set. Over 25 years, the vegetation for much of the site had obscured views of buildings and other intrusions resulting in improved visual quality scores. Figure 1 illustrates the two photographic pairs, where the equation predicts that the 2005 image is more preferred than the 1980 image.

Figure 1. A photographic pair with 2005 on the left and 1980 in the right. Notice the buildings (intrusions) are almost completely hidden.

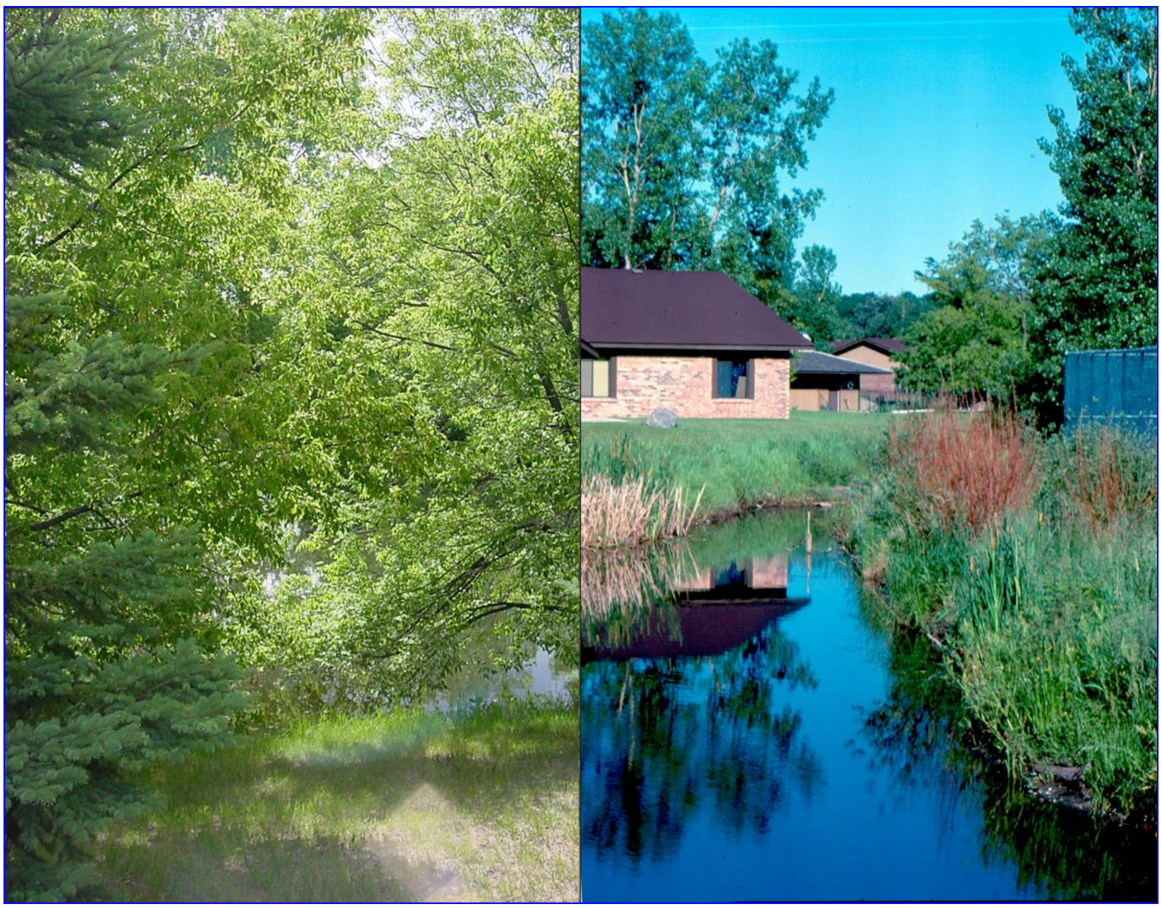

Figure 2. A photographic pair with 2005 on the left and 1980 on the right. Notice how the vegetation blocks a potentially interesting and somewhat pleasing landscape image from 1980.

The photos from 2005 had a mean score of 57.0 and the 1980 photographs had a mean score of 62.9. According to a graph prepared by Burley (1997:59), the two scores are not overall perceptually different to the respondents. The mean score for the 2005 photographic set was 6 points more pleasing than the set from 1980. This change in mean score meant that although the site was numerically more pleasing after 25 years, perceptually visitors to the site many not be able to perceive the difference in aesthetic quality. Figure 2 illustrates this concept. While the 2005 image was scored better, it is not necessarily better than the composition and structure of the image from 1980. Thus many of the 2005 images blocked views of buildings and other intrusions resulting in somewhat better scores; but other 2005 images blocked interesting and acceptable views. Nevertheless, after 25 years of vegetative growth, the project has changed somewhat, but a respondent would say that currently the overall character and environmental quality has remained similar.

When this project was built, the designer, James W. Hawks, ASLA had developed a vegetative framework for the project with the idea that residents would add perennials and annuals to the project, a visual quality predictor that greatly improves visual quality scores in Equation 1. However, such changes have not happened in any visually measurable manner. In addition, James W. Hawks considered the visual appeal of the project from the beginning, with views to water and vegetation, and with winding streets. The 1980 visual quality scores are not necessarily poor when compared to many urban areas, meaning that James W. Hawks prepared a thoughtful plan that was somewhat pleasing for the moment of initial installation. So perhaps it is not surprising that the visual quality has not perceptibly changed.

Conclusion

From our perspective, it seems that this approach has some merit for assessing landscapes and, in the planning and design stages, for development and natural resource protection, as illustrated by Burley (2006a). At a minimum, there is a science based statistical test to compare images and there are theories that may explain the existing model. However, it is interesting that after 25 years, and with substantial vegetation growth, the overall visual quality has not perceptibly increased.

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