A computerized visual resource analysis system based on landscape view preferences as tool in recreation subdivision planning
by Roger Rae Sandiland

A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE in Agronomy
Montana State University

Abstract:
In recognizing the need of resource managers and developers for quantitative assessment of the visual resource, a sample population of Bozeman, Montana area residents was surveyed as to view preference using a set of photographs taken from the Story Hills Planned Unit Development. Through statistical analysis the significant differences in the order of preference of landscape scenes based on landscape zones was determined. The most preferred photographs had all three landscape zones. The next preferred photographs had two of the landscape zones present, either immediate and intermediate zones or immediate and distant zones. Least preferred were photographs containing only the immediate zone.

Using this preference ranking, two computer programs were written that produced a printout which was made into an overlay for a map of a portion of the Story Hills Planned Unit Development. The overlay outlines areas that have preferred vistas from them.

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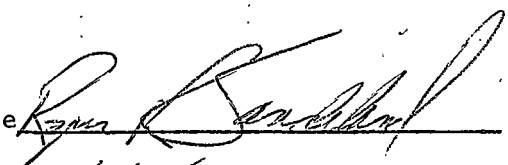
Signature 

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES continued

ABSTRACT

In recognizing the need of resource managers and developers for quantitative assessment of the visual resource, a sample population of Bozeman, Montana area residents was surveyed as to view preference using a set of photographs taken from the Story Hills Planned Unit Development. Through statistical analysis the significant differences in the order of preference of landscape scenes based on landscape zones was determined. The most preferred photographs had all three landscape zones. The next preferred photographs had two of the landscape zones present, either immediate and intermediate zones or immediate and distant zones. Least preferred were photographs containing only the immediate zone.

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INTRODUCTION

Too often in the past the visual resource has been treated in a most superficial manner. Time and time again it is not even mentioned in natural resource inventories or environmental impact statements. A few sentences describing "beautiful" views or the number and distance of the possible views from an area have been considered as a treatment of the visual resource. The other side of the coin, what the public will have to look at after a proposed development or action, has often been inadequately treated. Today with the public's awakened environmental awareness and the fact that environmental degradation is often first mirrored in the visual resource, numerous visual analysis systems are being developed.

This research effort concerned the problem of predicting or modeling preferred landscape vistas. Through a survey, preferences for landscapes based on zones visible and landscape components of the zones were to be established. A computer program to analyze the vistas from a study area in the Story Hills Planned Unit Development northeast of Bozeman, Montana and printout a formula of the visible landscape from the study area was then needed. The formula was to contain the area of the zones visible from the study area and the landscape components of the immediate zone. Using the formula, the computer was then to produce a printout to be made into an overlay of the Story Hills Planned Unit Development. The overlay was to identify the quality of the vistas from potential home sites in the development.

LITERATURE REVIEW

"Eighty-seven percent of man's perception is based on sight". (U. S. Department of Agriculture, 1973).

Assuming this statement to be true or even a rough estimate, the paucity of research devoted to discovering just what constitutes an aesthetic vista is appalling. The need for research in the visual resource field has been expounded on by persons ranging from philosophers and psychologists to resource managers and landscape architects. (Thayer 1974, Shafer 1969, National Science Foundation 1973, Hamill 1971, Craik 1971, Diffey 1967).

Man's activities, almost without exception, have some effect on the visual resource and as Litton (1972) points out, "Neither extractive industries in particular nor resource management efforts in general have given much recognition to the visual modifications in the landscape that are the outcome of their actions or decisions". Litton goes on to explain the awakened environmental awareness in the general public today and that critic's charges of insensitivity and environmental degradation is most often triggered by effects on the visual resource. "Yet all the while the notion of a landscape as a special kind of visual composition that creates an environment seldom emerges with clarity". (Litton 1972).

The evaluation of non-monetary benefits of man's activities is difficult at best. At the same time economic analysis of man's activities that lend themselves to cost-benefit comparisons are common place. (Leopold 1969). Recently, however, this field of

economic intangibles is being explored. Economic models for the intangible benefits are being developed and used. (Coomber 1973, VanderRyn 1963, Washington Environmental Research Center 1973, National Science Foundation 1973).

Thayer (1974) in his opening remarks at the National Recreation and Parks Association Annual Convention in Denver referred to "years of total neglect by the behavorial sciences" in the study of man in his physical environment. He further states, "In the wide field of planning and design for recreation, the need for predicting human response to the environment is paramount". The rest of Thayer's presentation outlined thirteen major areas of research which make up the field of environmental psychology, one of which is outdoor recreation and response to landscape.

Craik (1971) gives a brief review of five components to be studied in the comprehensive analysis of places (environments). The five components are: 1) physical-spatial properties, 2) organization of entities and components, 3) traits of places, 4) behavorial attributes of places and 5) the institutional attributes of places. Craik also includes an extensive bibliography of researchers in each of these fields.

Craik (1972) in his studies of human response to landscapes distinguishes among three types of reactions: descriptive assessments, evaluative appraisals, and preferential judgements. The rest of this work detailed development of Landscape Rating Scales and Graphic Land-

scape Typology which are examples of descriptive assessments of landscapes but can be related to the two other reactions.

In recognizing the need for quantitative analysis of the landscape various techniques have come about for landscape inventorying and description (Litton 1968). The U. S. Forest Service in trying to manage its vast acreages in the multiple use concept has developed management tools based on analysis of the visual resource (Litton 1973, U. S. Department of Agriculture 1971, 1973, 1974).

Quantitative measurement and assessment of the visual resource is being developed in many diverse fields of study. Physically, pupillary response to forest scenes has been used to measure aesthetic reactions (Wenger 1968). The comparison of different factors among river scenes has been used to quantify the visual resource (Leopold 1969). Leopold considered physical, biological, and human interest and use factors, and then developed uniqueness ratios of these factors to compare river scenes.

Hecock (1970) in his discussions of behavior patterns of beach users at Cape Cod analyzed many different factors: availability, development of nearby beaches, and demographic data of users, along with the physical characteristics of the beaches. Peterson (1960) in analyzing Lake Michigan beaches was specifically interested in the user response to the visual environment and developed methodologies to predict and model this response. Peterson first analyzed photographs of the beaches for gross visual characteristics and used user's free

responses and semantic differentials (the ranking of each photograph from good through bad) in constructing his models.

Shafer (1969) used photographs from around the United States of various natural landscape scenes to construct a mathematical model for predicting human response to the landscape. Photographs were ranked by interviewees and a preference score was computed. Through factor analysis and multiple repression analysis an equation was developed using six measurable components of the photographs that accounted for 66% of the variation among preference scores.

Carls (1974) using Shafer's methodology predicted the effects of man and his activities on preferences for landscape scenes. He concluded that the presence of man or his actions in photographs of outdoor scenes diminishes preference for those scenes.

Needed research and developed methodologies in the forementioned categories are outlined and analyzed in Coomber (1973), Washington Environmental Research Center (1973) and National Science Foundation (1973).

Research in measuring the visual resource in the urban environment has been done by VanderRyn (1963). The conclusions reached after this research were: that people do have a consistent value structure when rating views of the urban landscape, and economically "quantitative value differences can be obtained in cases where only one or very few significant changes are made in the visual surroundings".

MaGill (1965) has published a guideline for the photographic

recording of aesthetic and biologic changes. The guideline suggests a method of setting up permanent camera points, recording and analyzing visual conditions over a period of time, and the keeping of photographic records.

Amidon (1968) developed a computer program (VIEWIT) which can quickly and accurately predict the area visible from a given point. Elsner (1971) applied the VIEWIT program to a resource study in the Black Hills National Forest, South Dakota. The program produced overlay maps of visible areas from proposed scenic tramline routes and existing highway scenic vista lookouts.

METHODS AND MATERIALS

The area selected for the study of landscape view preferences was the Story Hills Planned Unit Development. The development is located in Sections 2, 3, 4, and 5 in Township 2S, Range 6E and is situated northeast of Bozeman, Montana (Figure 1). The area has been utilized primarily for livestock grazing with the exception of about 200 acres in the south portion of Section 4 which has been intermittently cropped (Overturf, Strand & Assoc., 1974). The area has also been used by local residents for hiking and horseback riding.

The development provides many diverse landscape types and features ranging from relatively flat native grasslands and sagebrush hills to steep wooded hillsides and coolies with thick pockets of shrubs and deciduous trees. There are also many diverse vistas from the Story Hills.

Familiarization of the area with air photographs and topographic maps, and on site inspection yielded various sites to take photographs. The sites were chosen for landscape variability and high probability of becoming future homesites. The sites were permanently marked with wooden survey stakes and small blue flags, and were recorded on an air photograph. All but four pictures were taken between June 13 and June 18, 1974 and from 8:35 A.M. to 2:30 P.M. Mountain Daylight Time. Photographs facing westerly and northerly were taken in the morning and those facing easterly and southerly were taken in the afternoon. The four other pictures were taken on July 10 and were retakes of evergreen tree close-ups. To keep light intensity a relative constant and to reduce the

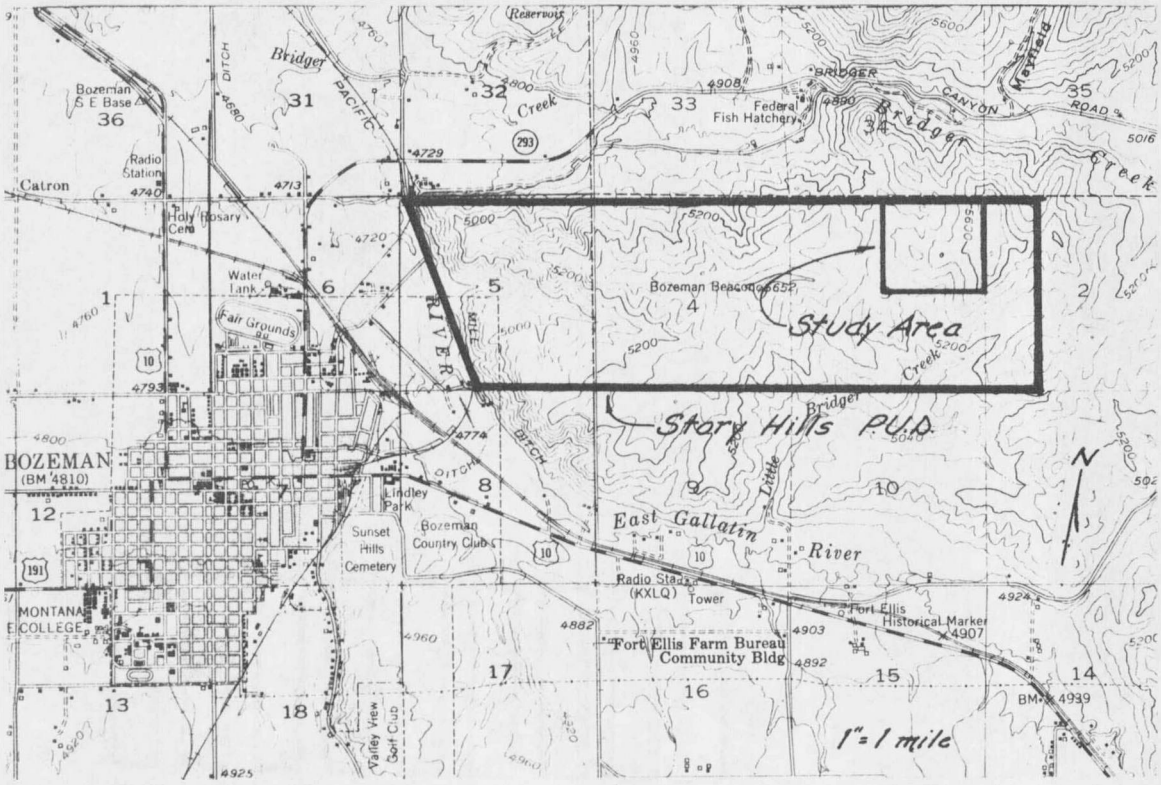

Figure 1. Story Hills Planned Unit Develop (P.U.D.), location of view preference study area northeast of Bozeman, Montana, 1974. (From U.S.G.S. 15 minute series topographic map, Bozeman Quadrangle, Montana - Gallatin County. 1953).

complexity of photographs, no photographs were taken when cloud cover was greater than 10%. The photographs were taken with a Pentax Spotmatic II, 35 mm single lens reflex camera with Pentax lenses, 50 & 28 mm. The camera was mounted on a surveyor's transit and as each photograph was taken the horizontal and vertical angles read from the instrument were recorded. A diary was thus kept for each photograph recording: site number, date, time of day, percent cloud cover, horizontal angle, vertical angle, lens, and camera setting (f-stop and shutter speed). Notes were added recording the landscape zones that were in each photograph. A total of 77 photographs were taken at 19 sites. This number was reduced to 20 photographs during preliminary screening. A set of 10 photographs was finally selected that would be representative of different landscape zones. Photographs 1 and 2 represented only the immediate landscape zone (see Figures 2 and 3); photograph 4 represented the immediate and intermediate landscape zones; photographs 5, 6, and 7 represented the immediate and distant landscape zones (see Figure 4); and photographs 3, 8, 9, and 10 represented all landscape zones (see Figures 5, 6, and 7). The landscape zones were modelled after Shafer's (1969) where in the immediate zone the characteristics of individual leaves, bark, stems, or needles were distinguishable; in the intermediate zone the outlines of individual trees and shrubs are recognizable, and in the distant zone, groves or areas of vegetation cover are discernible but individual plants are not. The ten 35 mm Ektachrome X slides were enlarged to 8" by 10" for the preference survey.