A Model for Assessing the Visual Resources of River Basins as an Aid to Making Landuse Planning Decisions

Digital Object Identifier: https://doi.org/10.13023/kwrri.rr.166

Thomas J. Nieman  
*University of Kentucky*

Diane S. Meshako  
*University of Kentucky*

David Walters  
*University of Kentucky*

Molly M. Davis  
*University of Kentucky*

Cindy C. Elliot  
*University of Kentucky*

Click here to let us know how access to this document benefits you.

Follow this and additional works at: https://uknowledge.uky.edu/kwrri_reports

Part of the [Geographic Information Sciences Commons](https://uknowledge.uky.edu/gis_resources), [Geology Commons](https://uknowledge.uky.edu/geology), and the [Water Resource Management Commons](https://uknowledge.uky.edu/water_resource_management)

Repository Citation

https://uknowledge.uky.edu/kwrri_reports/39

This Report is brought to you for free and open access by the Kentucky Water Resources Research Institute at UKnowledge. It has been accepted for inclusion in KWRRI Research Reports by an authorized administrator of UKnowledge. For more information, please contact UKnowledge@lsv.uky.edu.
A MODEL FOR ASSESSING THE VISUAL RESOURCES OF RIVER BASINS AS AN AID TO
MAKING LANDUSE PLANNING DECISIONS

By

Thomas J. Nieman
Principal Investigator
Diane S. Meshako
Research Assistant
David Walters
Computer Programmer
Molly M. Davis
Cindy C. Elliot
Undergraduate
Assistants

Project Number:  G 908-04  G1019-04  (A-099-KY)
Agreement Number(s): 14-08-0001-G908 (FY 1984); 14-08-G1019 (FY 1985)
Period of Project:  July 1987-June 1986

Water Resources Research Institute
University of Kentucky
Lexington, Kentucky

The work upon which this report is based was supported in part by funds
provided by the United States Department of the Interior, Washington, D.C., as

July 1986
DISCLAIMER

Contents of this report do not necessarily reflect the views and policies of the United States Department of the Interior, Washington, D.C., nor does mention of trade names or commercial products constitute their endorsement or recommendation for use by the U.S. Government.
ABSTRACT

The visual quality of a river basin and its associated properties can be identified, evaluated and integrated into the landscape planning process. The model developed provides a quantitative methodology for determining visual quality on the basis of available Geographic Information System factors. These factors are utilized to develop the preference attributes, COLOR, FORM, TEXTURE and LINE, which are associated with the assessment of visual quality. The preference attributes are then combined through a decision making process into a continuum of DISTINCTIVE, GOOD, AVERAGE and MINIMAL visual quality and is expressed digitally in map format. By providing visual quality information in a digital format it can be treated as a discrete component of the planning process similar to physical, cultural and economic attributes.

DESCRIPTORS

Model Studies, Land Use, Water Policy, Water Resources Development

IDENTIFIERS

Planning, Visual Assessment, Decision Making, Computer Aided Modeling
# Table of Contents

<table>
<thead>
<tr>
<th>Chapter I</th>
<th>Introduction</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter II</td>
<td>Research Procedures</td>
<td>5</td>
</tr>
<tr>
<td>Chapter III</td>
<td>Data &amp; Results</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>Color</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>Form</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Texture</td>
<td>66</td>
</tr>
<tr>
<td></td>
<td>Line</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>Visual Quality</td>
<td>83</td>
</tr>
<tr>
<td>Chapter IV</td>
<td>Conclusion</td>
<td>92</td>
</tr>
<tr>
<td>References</td>
<td></td>
<td>94</td>
</tr>
</tbody>
</table>
List of Figures

Figure 1 Study Area 5
Figure 2 Stanton, KY 7
Figure 3 Elevation 11
Figure 4 Flood prone 13
Figure 5 Landform 15
Figure 6 Landuse 17
Figure 7 Roads 19
Figure 8 Rockout 21
Figure 9 Slope 23
Figure 10 Streams 25
Figure 11 Vegetation 27
Figure 12 Visual Quality Flowchart 29
Figure 13 Color Flowchart 38
Figure 14 Landuse Color 39
Figure 15 Vegetation Color 41
Figure 16 Landuse and Vegetation Color 43
Figure 17 Landuse, Vegetation and Stream Color 44
Figure 18 Color 46
Figure 19 Color Preference 49
Figure 20 Form Flowchart 58
Figure 21 Fldform 60
Figure 22 Mtform 62
Figure 23 Form Preference 64
Figure 24 Texture Flowchart 69
Figure 25 Texture Preference 72
Figure 26 Line Preference Continuum 78
Figure 27 Line Flowchart 79
Figure 28 Line Preference 81
Figure 29 Visual Quality 86
List of Tables

<table>
<thead>
<tr>
<th>Table</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1</td>
<td>WELD</td>
<td>84-5</td>
</tr>
<tr>
<td>Table 2</td>
<td>Color Visual Quality Assessment</td>
<td>87</td>
</tr>
<tr>
<td>Table 3</td>
<td>Form Visual Quality Assessment</td>
<td>87</td>
</tr>
<tr>
<td>Table 4</td>
<td>Texture Visual Quality Assessment</td>
<td>88</td>
</tr>
<tr>
<td>Table 5</td>
<td>Line Visual Quality Assessment</td>
<td>88</td>
</tr>
</tbody>
</table>
Chapter I - Introduction

The objective of this project was to develop a computer aided model, using digital data to assess visual quality along river corridors and to test the model using sections of the Kentucky River basin as the case study area.

The visual resources of a region, including river basins, can generally be categorized as: 1) those visual resource areas that are of such significance or "uniqueness" that they have or should be preserved or protected for the enjoyment of society as a whole; and 2) those which serve to enhance the quality of an area proposed for development. An assessment model is not needed for determining those areas that fall into category 1. Although the areas that fall in category 2 may be attractive, these resources are not so significant that they merit maintenance and protection for the benefit of the public at large. The visual resources of these areas are, however, important and the impact any development may have upon them needs to be considered as integral to the planning proposal.

The traditional technique for assessing the visual quality of an area is an on-site visit whereby an expert or group of experts list the characteristics that make up the so called area of "high visual quality." This assessment is translated into recommended categories of visual quality which is then used as the basis for visual resource planning decisions. There is, however, a lack of quantitative methodology for selecting and weighting the characteristics as they apply to various prospective landuse categories. Consequently, they are often not weighted, are arbitrarily weighted equally, or they may be selected and weighted such that their impact on a visual resource decision is entirely subjective. Because of weighting problems, the validity of resulting assessments are subject to challenge by planners and other interest groups, including the courts.

Existing physiographic and cultural data, along with the identification of new factors, were incorporated into a visual assessment model. This model can be included in the decision making process such that the visual aspect of the
land resource is considered as a unique aspect of landuse analysis. This can lead to the development of visual controls that are based on a more precise understanding of the role and impact of visual quality. The development of a model for assessing visual quality along water ways in Kentucky is important from the perspective that while there are areas of prime visual quality located along rivers, there exists no methodology that will allow existing data bases to be used to assess visual quality.

A review of the literature indicates general agreement that visual quality is a subjective impression of an objective property or combinations of properties (Nieman, 1980). Since the mid-1960's the issue of visual quality has developed into an important aspect of planning and was legitimized by the National Environmental Policy Act of 1969. As a result numerous researchers ranging from psychologists to planners, from public agencies to universities have investigated the area of visual quality. The primary findings were that descriptive attributes in various combinations account for visual quality—whether positive or negative. The major shortcoming of their methodologies appears to be that they used physical factors, e.g., water, slope, etc. or subjective evaluations, e.g., variety, ambiguity, etc., to describe the landscape in question, however, these factors were not weighted or integrated to provide an overall assessment value. Leopold (1968) for example did extensive inventories of the physical characteristics of riverscapes. He evaluated their visual quality on the basis of the impact should the physical characteristics be disturbed or changed. Morisawa (1969) did subjective evaluations by using photographs of various river scenes. Here the respondent was asked to select the area with the highest visual quality—"I like this scene better than that scene because"—. Neither the physical characteristics study nor the subjective evaluation study attempted to evaluate visual resources from both perspectives. This is typical of earlier visual resource research.

Another study which was state-of-art at the time is the Dearinger (1971) study. Dearinger utilized a "uniqueness ratio" to "evaluate relative uniqueness within a group of streams." It involved "the evaluation of a set of characteristics or factors" which were numerically rated for each site to give a "range of possible intangible values for that factor." In this case
physical and subjective factors were identified and used in consort as visual descriptors. There was no attempt, however, to utilize physical factors to evaluate subjective characteristics.

This study is important in that Dearinger and his colleagues recognized that the collection of data and the number of factors, 54, was a laborious and cumbersome process. Several key recommendations were made:

a. "Only the factors most directly related to stream uniqueness should be included in the inventory."

b. Computer technology should be used to examine a greater number of attribute combinations.

c. A basis should be developed for the comparison of objective, qualitative data and the subjective preference determinations.

With regard to "a". Zube et. al (1974) identified 6 primary landscape categories and dimensions, the fifth being water, and proposed specific criteria for measuring each, e.g., water edge density was found by measuring the length of water edge in feet and dividing by the area of view in square miles. The information mode was based on a manual manipulation of data with grid overlays. It was proposed that information of this type be incorporated into a data base to evaluate the visual character of a river basin. Categories and dimensions of the type identified by Zube were obtained from existing data bases. In addition assignment of approximate values did not require on-site evaluation.

In 1979 a conference titled "Our National Landscape: A Conference on Applied Techniques for Analysis and Management of the Visual Resource" was held to review the state-of-the-art of visual assessment. Approximately 100 presentations of theoretical concepts and applications explained various ways of dealing with visual quality. Several papers and reports relating to "b" of Dearinger's recommendations were presented in a session titled "Computerized and Quantitative Approaches" (see references). While computer technology was stressed none of the papers utilized a geographic information system data base to evaluate visual quality. Computer utilization recommendations generally fell within the realm of three dimensional surface visualizations, photographic analysis of specific scenes, and statistical models. It is important to note that in 1979 little in the way of inventory
information was available in a geographic information format; it is only recently that information of this type is gaining acceptance.

The most recent review of the state-of-the-art in visual quality assessment occurred in 1982. Zube et. al (1982) reviewed 160 articles published since 1980. He classified each article into one of four paradigms, namely: expert, psychophysical, cognitive and experiential and also presented an overview to aid in establishing a comprehensive theory of visual perception and assessment. One of the conclusions drawn concurs with "c". of the Dearinger recommendations, that comparing objective, qualitative data and the subjective preference determinations still needs further study. With regard to qualitative data and subjective preference determinations Feimer et. al (1979) defined 12 landscape descriptors as being applicable to general evaluations of landscapes.

The literature substantiates that the area of assessing visual quality is broad and complex. There is general agreement that methods for integrating the subjective with the objective needs to be explored. To date the major problem appears to be that it is very difficult to analyze and utilize objective data in an appropriate manner in order to represent subjective attributes.
CHAPTER II - RESEARCH PROCEDURES

The first step in developing the computer aided model for visual assessment was to identify the study area. Regional geographers use the land, the accumulation of cultural facilities, and the inhabitants as the primary factors that effect the character of a region. Thus regions of similar character can be defined in the physiographic sense. In this study the physiographic region was defined as the Kentucky River basin. Within physiographic regions exist homogeneous land units that are internally more similar than the larger region (Figure 1).

![Study Area Map](image)
These units are more site specific and can be identified on the basis of their similarity from a vegetative, landform, water and cultural objects, etc., perspective. The homogeneous unit selected to test the model was a 7,225 acre area located in the vicinity of Stanton, Kentucky which encompasses part of the upper reaches of the Red River. However, the size of the area and the resolution at which it is studied is flexible. In this case, the area is contained within the Means and Stanton 7.5 minute United States Geological Survey (USGS) quadrangles and was chosen because it satisfied the following 4 criteria:

1. it contained a 6th order river, the Red River,

2. it was within an one hundred mile radius of Lexington, therefore enabling the team to visit the site to obtain data and groundtruth both homogenous landscape elements and developed subjective attributes.

3. there existed an accessible digital elevation model (DEM)
Existing data in the form of digital elevation models identify the elevation at the centroid of each grid cell. The grid cell size in this case was one acre since this is as detailed as the existing geographic information data allowed. In addition it provides the greatest possible amount of data specificity and is consistant with the format that some of the data was originally encoded, i.e. Landsat data. The original data entry resolution ranged from 30 meters to 10 acres, therefore mathematical adjustments have been made to provide this consistant data base to be studied. This allows additional information about slope, aspect and physical features, such as rock outcroppings, to be compared among cells. The availability of this DEM information was important in selecting the study area, as it added a third dimension to the data (Figure 2).

4. The Kentucky Natural Resource Information System (KNRIS) contained information in its manuscripts I through IV in a format that could be gridded at an one acre resolution and transferred to our computer systems.
Figure 2.

STANTON, KY.
KNRIS (Croswell, et al.), 1982) is a geographic information system, developed and operated by the Kentucky, Department of Natural Resources and Environmental Protection. Physiographic and landuse collected from various state and federal agencies has been put into a data base and has application to a wide range of environmental investigations and planning efforts.

The scope of available data and its sources are:

<table>
<thead>
<tr>
<th>DATA</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevation recorded in meters</td>
<td>DEM</td>
</tr>
<tr>
<td>Aspect</td>
<td></td>
</tr>
<tr>
<td>Aspect with filters</td>
<td></td>
</tr>
<tr>
<td>Slope</td>
<td></td>
</tr>
<tr>
<td>Existing Landuse</td>
<td>Manuscript I</td>
</tr>
<tr>
<td>Floodprone areas</td>
<td></td>
</tr>
<tr>
<td>Geologic</td>
<td></td>
</tr>
<tr>
<td>Groundwater availability</td>
<td></td>
</tr>
<tr>
<td>Landform</td>
<td></td>
</tr>
<tr>
<td>Slope</td>
<td></td>
</tr>
<tr>
<td>Vegetation</td>
<td></td>
</tr>
<tr>
<td>Stream class</td>
<td>Manuscript II</td>
</tr>
<tr>
<td>Watershed class</td>
<td></td>
</tr>
<tr>
<td>Administrative</td>
<td>Manuscript III</td>
</tr>
<tr>
<td>Critical areas</td>
<td></td>
</tr>
<tr>
<td>County</td>
<td></td>
</tr>
<tr>
<td>Incorporated areas</td>
<td></td>
</tr>
<tr>
<td>Ownership</td>
<td></td>
</tr>
<tr>
<td>National forest</td>
<td></td>
</tr>
<tr>
<td>Recreation areas</td>
<td></td>
</tr>
<tr>
<td>Roads</td>
<td>Manuscript IV</td>
</tr>
<tr>
<td>Roads</td>
<td>USGS 7 1/2 quad</td>
</tr>
<tr>
<td>Rock outcrop</td>
<td>MAP elevation</td>
</tr>
<tr>
<td>Roadcuts</td>
<td>MAP slope/roads</td>
</tr>
</tbody>
</table>

This extensive list was analyzed both as to the nature of the data and its relevance to the study. Each map was viewed, the origin of the data and possible applications within and impacts on the model were discussed. Many of the maps such as ownership, groundwater availability and watershed class did not play a role in the model and therefore are not further discussed.
All of the preceding sources were used to obtain the following data in this homogeneous landscape unit. This information was put into map format and is accompanied by an explanation of its source and description. Each map represents one physical factor, hence the name Factor Maps (Figures 3 thru 11).

In addition to the data obtained from external sources, visual inspection/ground-truthing, was also utilized as a means of collecting information. This served as a check for reliability of existing data and enabled research teams to substantiate, correct and add new data. Examples of its value were evident on several occasions with regard to road locations, vegetation categories, and rock outcroppings. Visual inspection also allowed impressions of the study area to take on a less abstract meaning, which proved helpful in developing the model.

After becoming familiar with the study area through data analysis and ground-truthing procedures, manipulation of the KNRIS data began. At this point, the subjective aspect of visual assessment is introduced. After review of the literature and numerous discussions, a number of perceptual attributes that permit evaluation of the visual quality of a specific site were identified. These were form, line, color, and texture. These varied somewhat from those defined by Feimer, et al. (1979) in an earlier study:

- ambiguity
- color
- compatibility
- congruity
- form
- intactness
- line
- novelty
- texture
- unity
- vividness
- complexity

The changes occurred after an evaluation of the attributes, in regard to physiographic characteristics, indicated a lack of clarity in definition and an overly complex view of visual quality components. Another consideration was the limitations of the data base and the need for simplicity.
Factor Map: Elevation

Source: U.S.G.S., DEM

The original data was collected at 30 meter intervals from a 7 1/2 minute quadrangle. This data was recorded by the U.S.G.S. in the form of a Digital Elevation Model (DEM) and made available to the Kentucky Department of Environmental Protection. The data was adjusted to a one acre grid format to be consistent with our study resolution.

Code description: The data was renumbered and grouped for readability. Each category on the Elevation Factor Map represents an elevation change of 62 feet.

00 less than 648 feet
01 648 to 710 feet
02 710 to 772 feet
03 772-834 feet
04 834-896 feet
05 896-958 feet
06 958-1020 feet
07 1020 to 1082 feet
08 1082 to 1144 feet
09 1144 to 1206 feet
10 1206 to 1268 feet
11 1268 to 1330 feet
### Table: Elevation and Total No. of Cells

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>NO. OF CELLS</th>
<th>PCT. OF MAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>43</td>
<td>.60</td>
</tr>
<tr>
<td>1</td>
<td>3151</td>
<td>42.61</td>
</tr>
<tr>
<td>2</td>
<td>1570</td>
<td>21.73</td>
</tr>
<tr>
<td>3</td>
<td>797</td>
<td>11.03</td>
</tr>
<tr>
<td>4</td>
<td>464</td>
<td>6.42</td>
</tr>
<tr>
<td>5</td>
<td>307</td>
<td>4.28</td>
</tr>
<tr>
<td>6</td>
<td>219</td>
<td>3.03</td>
</tr>
<tr>
<td>7</td>
<td>185</td>
<td>2.56</td>
</tr>
<tr>
<td>8</td>
<td>153</td>
<td>2.15</td>
</tr>
<tr>
<td>9</td>
<td>133</td>
<td>1.84</td>
</tr>
<tr>
<td>10</td>
<td>149</td>
<td>2.04</td>
</tr>
<tr>
<td>11</td>
<td>29</td>
<td>.40</td>
</tr>
</tbody>
</table>

**TOTAL NO. OF CELLS = 7225**

**Figure 3.**
Factor Map: Floodprone

This map indicates areas that may be occasionally flooded, but provides no information on the frequency, depth, duration or other details of flooding.

Source: KNRIS

The primary source of this data was the U.S.G.S. Flood Prone Area maps at a scale of 1:24,000 which delineate 100 year flood boundaries. EPA 1978-70 aerial photography and U.S.G.S. maps at a scale of 1:24,000 were used as collateral data.

Code Description

01 Floodplain
Floodplain landform is a relatively flat surface which lies adjacent to a stream/river. It is composed primarily of unconsolidated depositional material derived from sediments being transported by the related stream/river and subject to periodic flooding by the parent stream or river.

02 Not Floodprone
Not in a floodprone area.
FLOODPRONE
SCALE: 208.0 FT PER CELL

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>LABEL</th>
<th>NO. OF CELLS</th>
<th>PCT. OF MAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>BBBB</td>
<td>1 FLOODPLAIN</td>
<td>3740</td>
<td>51.76</td>
</tr>
<tr>
<td>BBBBBBBB</td>
<td>2 NOT FLOODPRN</td>
<td>3485</td>
<td>48.24</td>
</tr>
</tbody>
</table>
| TOTAL NO. OF CELLS = 7225

Figure 4.
Factor Map: Landform

A landform is an element of the landscape characterized by a distinctive surface expression or by internal structure. The landform types were identified by a descriptive classification based upon general physiographic region, structure, genesis, and material.

Source: KNRIS

U.S.G.S. 7 1/2 minute topographic maps were used as the primary source of information for interpreting the landform types. U.S.G.S. topographic maps at the 1:250,000 scale were used as additional collateral information. Stereo paired 1978-79 EPA, 1:24000 aerial photographs were used to interpret landform types not clearly defined on the topographic base maps.

Code Description

01 Valley Bottom
The bottom of any hollow or low-lying land bound by hill or mountain sideslopes and usually traversed by a stream. Its material composition is either not stratified or exhibits poor stratification.

02 Floodplain
A product and a functional part of the whole stream/river environment which maintains the adjustment that a stream makes to the variable quantities of water, solubles, and solid particles imposed on it. It is a relatively flat surface which lies adjacent to a stream/river. A landform composed primarily of unconsolidated depositional material derived from sediments being transported by the related stream and subject to periodic flooding by the parent stream or river.

03 Terrace
Fluvial terraces are topographic platforms, benches, treads, flats, or steps in river valleys that usually represent former levels of the valley floor or floodplain. Two distinctive types of erosional terraces are: 1) carved out of the country rock (Bench) and 2) those notched in a preceding valley filled by alluvium. The depositional terrace is a result of upbuilding of the valley floor by deposition of alluvium from streams and rivers.

04 Toeslope
Also known as foet-slope, toeslopes are concave in plan and profile. The lower base section of the sideslope that gently slopes and flattens downward to meet the drainage floor. The part of the slope to which all elements descend.

05 Sideslope
These steep, inclined surfaces are rectilinear in plan and profile. This surface form consists of the aggregate inclined portions of the mountain.

06 Ridgetop
A linear topographic feature of high relief, usually an elongated upland area with a narrow crestal zone. It is rounded in cross profile with fairly straight sideslopes.
LANDFORM
SCALE: 208.0 FT PER CELL

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>LABEL</th>
<th>NO. OF CELLS</th>
<th>PCT. OF MAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>=======</td>
<td>----------------</td>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>BBBBBBBB</td>
<td>VALLEY BOTTOM</td>
<td>41</td>
<td>.57</td>
</tr>
<tr>
<td>SSSSSSSS</td>
<td>FLOODPLAIN</td>
<td>3750</td>
<td>51.90</td>
</tr>
<tr>
<td>LLLLLLLL</td>
<td>TERRACE</td>
<td>171</td>
<td>2.37</td>
</tr>
<tr>
<td>VVVVVVVV</td>
<td>TOESLOPE</td>
<td>154</td>
<td>2.13</td>
</tr>
<tr>
<td>&lt;&lt;&lt;&lt;&lt;&lt;&lt;&lt;&lt;&lt;</td>
<td>SIDESLOPE</td>
<td>2927</td>
<td>40.51</td>
</tr>
<tr>
<td>&lt;&lt;&lt;&lt;&lt;&lt;&lt;&lt;&lt;&lt;</td>
<td>RIDGETOP</td>
<td>182</td>
<td>2.52</td>
</tr>
</tbody>
</table>

TOTAL NO. OF CELLS = 7225

Figure 5.
Factor Map: Landuse

Source: KNRIS

The original data was derived from Environmental Protection Agency (EPA) Land use and Land Cover Maps, 1979, scaled 1:24,000, 1978 color transparency air photos (1:24,000), and 1:24,000 U.S.G.S. 7.5 minute topographic quad sheets were the primary collateral sources used.

Code Description:

01 Residential
Land use ranges from high density, represented by the multiple unit structures of urban cores, to the low density single family dwelling at the periphery of urban expansion. Isolated units for residential and rural residential areas are included since the land is almost totally committed to residential use.

02 Commercial, Services, or Institutional
Areas which are used predominantly for the sale of products and services. Components of these areas are urban central business districts; shopping centers usually in suburban and outlying areas; commercial strip developments along major highways and access routes to cities, junkyards, and resorts. Also, included are institutional land uses such as various educational, religious, health, correctional, and military facilities.

03 Railroads and Associated Facilities
Railroads and facilities include station, parking lots, roundhouses, repair and switching yards and related areas.

04 Pasture and Idle Land
Areas which lack evidence of activity or that reflect patterns of livestock grazing.

05 Cover and Row Crop
The chief indications of cover and row crop areas are distinguished by geometric field patterns.

06 Fallow or Otherwise Bare Agricultural Land
Areas which represent the condition of the land at the end of the growing season or during crop rotation sequence.

07 Extraction: Mines, Quarries, Gravel Pits
Extractive land encompasses both surface and subsurface mining operations such as strip mining, sand and gravel pits, stone quarries, metallic and non-metallic mineral mines. Surface structures and equipment may range from a minimum of one loading device and a truck to extended areas with access roads, processing facilities, stockpiles, equipment sheds, and numerous vehicles. Spoil materials and slag heaps are usually found within a short trucking distance of the major mine areas. These are also indicators of underground mining operations.

08 Logging
Lands from which trees have been removed to less than 10 percent density but
which have not been developed for other use. Forest rotation involving clear-cutting and block planting is evident. In these areas, when trees reach marketable size, patterns can be identified by the presence of cutting operations in the midst of a large expanse of forest.

09 Future Development
Comprised of areas designated for future intensive use and/or construction of structures. Included in this category are designations for residential, commercial services, industrial, extraction, transportation, communications, utilities, institutions, and agriculture.

10 Rangeland
These lands are more suitable for management by ecological rather than agronomic principles. Predominantly composed of grasses, grasslike plants, forbs and shrubs. Habitat area for natural herbivors and/or used for grazing.

11 Natural Vegetation
Areas of undisturbed indigenous vegetation with no apparent land use activity.
Factor Map: Roads

This digital data represents only the paved roads in the study area, both the 4 lane limited access road and the many state and county roads.

Source: U.S.G.S.

U.S.G.S. 7 1/2 minute quads of Means and Stanton were digitized and formatted to be compatible with the data transferred from the KNRIS data base. The road line data that was received was not verified by ground truthing which made it necessary to create a new roads map.

Code description:

01 Two Lane Paved
State and County roads which were identified on the U.S.G.S. Means and Stanton quadrangle maps.

02 4 Lane Limited Access
The Mountain Parkway, a four lane limited access highway.
ROADS
SCALE: 208.0 FT PER CELL

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>LABEL</th>
<th>NO. OF CELLS</th>
<th>PCT. OF MAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>------</td>
<td>0</td>
<td>6805</td>
<td>94.19</td>
</tr>
<tr>
<td>------</td>
<td>1 2 LANE PAVED</td>
<td>334</td>
<td>4.62</td>
</tr>
<tr>
<td>------</td>
<td>3 4 LANE LIM.ACCESS</td>
<td>86</td>
<td>1.19</td>
</tr>
<tr>
<td>------</td>
<td>TOTAL NO. OF CELLS</td>
<td>7225</td>
<td></td>
</tr>
</tbody>
</table>

Figure 7.
Factor Map: Rock out

This data represents all the visible shear vertical rock walls both man made (road cuts) and natural (cliffs).

Source: ON SITE OBSERVATION AND KNRIS

The natural rock cliffs were observed during site visits and were added to the data base on a new map using a point command.

The road cuts were found by combining steep slopes (35%) and existing roads.

These cells were then verified by ground truthing.

Code Description

03 Rock out cropping
04 Road cut
ROCKOUT
SCALE: 208.0 FT PER CELL

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>LABEL</th>
<th>NO. OF CELLS</th>
<th>PCT. OF MAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>NOT DEFINED</td>
<td>7194</td>
<td>99.57</td>
</tr>
<tr>
<td>3</td>
<td>ROCKOUT CROPPING</td>
<td>9</td>
<td>.11</td>
</tr>
<tr>
<td>4</td>
<td>ROADCUT</td>
<td>23</td>
<td>.32</td>
</tr>
<tr>
<td></td>
<td>TOTAL NO. OF CELLS</td>
<td>7225</td>
<td></td>
</tr>
</tbody>
</table>

Figure 8.
21
Factor Map: Slope

Slope is defined as the angle which any part of the earth's surface makes with a horizontal datum. The ratio between the vertical rise in elevation to the horizontal distance is the slope gradient. The categories are expressed as ranges of percent of slope which is derived by dividing the vertical rise by the horizontal distance covered (slope gradient) and multiplying by 100. The categories were selected to be consistent with slope ranges used by the U.S. Soil Conservation Service in Kentucky to delineate soil unit boundaries.

Source: KNRIS

The primary collateral source was topographic base maps, scaled 1:62,500, of the Eastern and Western Coal Field Regions.

Code Description:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Degree Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>0 to 2 percent</td>
<td>0 to 1.14 degrees</td>
</tr>
<tr>
<td>02</td>
<td>2 to 6 percent</td>
<td>1.14 to 3.43 degrees</td>
</tr>
<tr>
<td>03</td>
<td>6 to 12 percent</td>
<td>3.43 to 6.84 degrees</td>
</tr>
<tr>
<td>04</td>
<td>12 to 20 percent</td>
<td>6.84 to 11.31 degrees</td>
</tr>
<tr>
<td>05</td>
<td>20 to 35 percent</td>
<td>11.31 to 19.30 degrees</td>
</tr>
<tr>
<td>06</td>
<td>35 to 50 percent</td>
<td>19.30 to 24.22 degrees</td>
</tr>
<tr>
<td>07</td>
<td>Greater than 50 percent</td>
<td>greater than 24.22 degrees</td>
</tr>
</tbody>
</table>
Figure 9.
Factor Map: Streams

The surface hydrology data represents all of the streams in the study area. They are ranked according to the Strahler Stream Ordering System where the first order represents intermittent streams or the headwaters of a stream and progress down stream increasing in order number.

Source: KNRIS

U.S. G.S. 1/2 minute topographic maps were the primary source. Army Map Service 1:250,000 scale topographic maps were useful for stream ordering.

Code description:

01 First Order
   Intermittent streams or head waters

02 Second Order
   The body of water into which the first order stream flows

03 Third Order
   The body of water into which the second order stream flows

06 Sixth Order (Red River)
   The body of water into which the fifth order stream flows
STREAMS
SCALE: 208.0 FT PER CELL

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>LABEL</th>
<th>NO. OF CELLS</th>
<th>PCT. OF MAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>---------------</td>
<td>----------------</td>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>••••••••••</td>
<td>0 FIRST ORDER</td>
<td>6441</td>
<td>89.15</td>
</tr>
<tr>
<td>BBBBBBBB</td>
<td>1 SECOND ORDER</td>
<td>327</td>
<td>4.53</td>
</tr>
<tr>
<td>SSSSSSSSS</td>
<td>2 THIRD ORDER</td>
<td>244</td>
<td>3.38</td>
</tr>
<tr>
<td>◄◄◄◄◄◄◄◄◄►</td>
<td>6 RED RIVER</td>
<td>70</td>
<td>.97</td>
</tr>
<tr>
<td>TOTAL NO. OF CELLS =</td>
<td>7225</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 10.

25
Factor Map: Vegetation

Generalized patterns reflecting natural vegetation

Source: KNRIS

EPA Landuse and Land Cover Maps, 1979, scaled 1:24,000, 1978 color transparency air photos 1:24,000 U.S.G.S. 7 1/5 minute topographic quad sheets were the primary collateral sources used.

Code description:

01 Altered and Developed
Comprised of areas of intensive use. The structure and distribution of the earth's surface and biota changed by human endeavor. This process may be by man's physical or mechanical activity which alters the natural landscape.

02 Grassland
The land area where the growth is predominantly grasses, grass like plants and forbs. These grass regions generally represent a sequence of vegetation in a previously man-disturbed area.

03 Shrubland
Shrublands are typically former croplands or pasture lands. These areas were cleared from the original forest land and have grown up in shrubs in transition back to forest land. Many of these areas are grazed by livestock and provide wildlife habitat.

04 Mixed Grassland/Shrubland
When an intermixture of herbaceous and shrub species create a homogeneous area, it is classified as a mixed Grassland/Shrubland. Also, areas which intertwine small homogeneous patches, under the ten acre resolution, of grassland and shrubland into an identifiable area, are included in this classification.

05 Deciduous Forest
Deciduous forest land includes all forested areas having a predominance of trees that lose their leaves at the end of the frost-free season. As examples, hardwoods such as oak, maple, hickory, and "soft" hardwoods such as aspen are included.

06 Mixed Forest
Areas where both the deciduous and evergreen forest are present but neither predominates. Also, areas which can be identified as containing patterns of small homogeneous patches, under the 10 acre resolution, of evergreen and deciduous trees are placed under this classification.
<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>LABEL</th>
<th>NO. OF CELLS</th>
<th>PCT. OF MAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>BBBBBBBB</td>
<td>ALTERED AND DEVELOP</td>
<td>4008</td>
<td>55.47</td>
</tr>
<tr>
<td>2</td>
<td>GRASSLAND</td>
<td>31</td>
<td>.43</td>
</tr>
<tr>
<td>3</td>
<td>SHRUBLAND</td>
<td>52</td>
<td>.72</td>
</tr>
<tr>
<td>LLLLLLLL</td>
<td>MIX GRASS AND SHRUB</td>
<td>73</td>
<td>1.01</td>
</tr>
<tr>
<td>VVVVVVVV</td>
<td>DECIDUOUS FOREST</td>
<td>2018</td>
<td>27.93</td>
</tr>
<tr>
<td>&lt;&lt;&lt;&lt;&lt;&lt;&lt;&lt;</td>
<td>MIXED FOREST</td>
<td>1043</td>
<td>14.44</td>
</tr>
<tr>
<td>TOTAL NO. OF CELLS =</td>
<td>7225</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 11.
Using existing factors, maps were made for each of the defined perceptual attributes (form, line, color, and texture) and then each map was ranked according to the preference research findings. By introducing and working with the preference ranks of each attribute the compositional quality of each cell is included. Several of Feimers attributes such as compatibility, contrast, unity, vividness and complexity become an integral part of COLOR, FORM, TEXTURE and LINE PREFERENCE MAPS. (Figure 12)

Color preference as an attribute

Color is a visual experience that may be referred to as scales of hue, saturation-extension, and light-dark. Color, as a component of visual quality, is dynamic and occurs because of seasonal changes (fall, winter etc.), atmospheric conditions (sun, rain, fog, etc.), and water clarity (flooding, depth of stream, pollution etc.). Therefore, factor maps were used to identify color categories. The categories were selected on the basis of dominant color differences within the landscape of the study area. The color categories were then evaluated to develop the COLOR PREFERENCE map.

Form preference as an attribute

The descriptive adjectives of form (geometric-natural or organic, open-closed, and positive-negative) provides a vocabulary which enabled the identification and description of existing forms. Thus identified, forms were grouped into categories which exhibited similar qualities. These categories along with the results of form preference research led to the development of the FORM PREFERENCE map. This map is ranked on the basis of both the known and implied character inherent in each category. Character, in this case, refers to the compositional qualities identified in the research, namely, spaciousness, mystery, coherence, and complexity.

Texture preference as an attribute

Texture is defined as the surface quality of any material that can be seen or felt (Austin, 1982). Perception of different textures and textural preferences are dependent upon spaciousness, the textural gradient, and the
A MODEL FOR ASSESSING THE VISUAL RESOURCES OF RIVER BASINS AS AN AID TO MAKING LANDUSE DECISIONS

VISUAL QUALITY FLOW CHART
Figure 12.
textural contrast produced by elements derived from the G.I.S. system. The results are displayed on the TEXTURE PREFERENCE maps.

Line preference as an attribute

Line is considered an aesthetic line which is defined as the awareness of kinesthetic sensation (Pepper, 1949). It has the primary characteristics of length, attitude and degree of curvature, and also the secondary characteristics of movement, width, intensity and quality. The line map has categories which identify and locate the Red River and its tree lined banks, third order streams, tree lines between the farming and mountainous areas, roads, and ridge lines. A line continuum was developed and is reflected on the LINE PREFERENCE map.

The model includes four attributes that were determined on the basis of the data available from the KNRIS system. However, any number or type of attributes can be included depending on the intent of the investigation, the type of data available, and the condition of the area or region in question. With regard to intent it may be that only unique areas are important or areas that are really very ordinary are the issue. Regardless of intent once the goal is established attributes can be identified that will satisfy the condition. The next concern is to collect data of sufficient value so as to apply it to the attributes. Most G.I.S. data sets are sufficient, in fact, it appears that too much data is available more often than too little. With an abundance of data the tendency is to use nearly everything because it is there. The problem with this spacious approach is that it is almost impossible to identify and evaluate the salient perceptual factors that contribute to visual quality. Finally, landscapes vary a great deal from one geographic locale to another. In the area along the Red River there are numerous hills and small mountains that enclose valleys with relatively small floors. As a result of this enclosure a resolution of 1 acre appeared to be the most appropriate. If the terrain were very steep and varied it may be that a smaller investigative unit would be appropriate. Conversely, if the terrain were relatively flat and featureless an investigative unit of forty or more acres might be appropriate. As the landscape takes on a unity or sameness the number of acceptable perceptual attributes may decrease and yet
allow the landscape to be assessed for visual quality in an objective manner. It is important then that the object of the investigation and the physiographic condition of the area be thoroughly understood.

In this study, the individual cells have been evaluated as to their visual quality based on the attributes of line, form, color, and texture, and areas are identified that are likely to be of high visual quality. In addition if further specificity is desired, the degree to which each attribute effects the outcome can be determined. At this stage the visual assessment model is then ready to be incorporated into any typical landuse analysis. This allows for the development of visual controls that are based on a more precise understanding of the role and impact of visual quality in landuse planning decisions.
CHAPTER III - DATA AND RESULTS

Color, form, texture and line are attributes which were found to be most indicative of visual landscape quality. While twelve attributes were initially described by Feimer, et al. (1979), by developing preference ranks for the attributes, the compositional quality of each grid cell was included. As a result eight of the original attributes became an integral part of the color, form, line and texture attributes used in the study. These four attributes have been analyzed with regard to the role that factors play in identifying specific visual quality traits. To determine which factors are relevant and to what degree, each attribute was defined and a determination made as to how it was perceived. On the basis of perception the color, form, texture and line preference maps were developed. These were then subjected to a decision making process for final assessment.

COLOR ATTRIBUTE

DEFINITION

Color is an important attribute of the natural and man-made landscape. Regardless of the view or the viewer the incidence of color directly impacts the manner in which a landscape will be assessed. If the colors and their combinations are perceived as being visually pleasing they will help to invoke a positive attitude toward the landscape or view in question.

Scientifically "colors result from light waves, a particular kind of electromagnetic energy" (Itten, 1970). While seeing color is a physiological function that occurs when light is intercepted by the eye, most researchers agree that the stronger impact lies within the psychological realm. In analyzing the visual system Hubel (1963) discussed the intricate process that results in vision: "the transformation of the retinal image into a perception." He concluded that "the transformation occurs partly in the retina but mostly in the brain." Gerritsen (1975) concludes that "the beauty of the visual world around us exists only in ourselves" and Itten argues that
color strongly influences the way we perceive our everyday environment. With regard to the natural environment this is especially true. We speak of the deep blue sea and are enchanted by the mystery of water in general. The purple mountains majesty evoke thoughts of grandeur and greatness and the amber waves of grain gives a sense of well being and accomplishment. Varley (1980) notes that perceived color has three basic dimensions—hue, saturation, and lightness or darkness. Hue corresponds to the dominant wavelength of a color; saturation to its relative colorfulness (color can be pale or bright) and lightness to the amount of gray in it. Perceived color is similarly described by Itten with the exception of hue being subdivided into two categories, warm and cold.

Itten (1970) notes that perceived color effects the spatial components or composition of a scene primarily in the areas of: light-dark, saturation—extension, and cold-warm. An example of light-dark is that a light yellow against a dark background appears to advance while purple recedes into the background. The reverse occurs with a light background where violet appears to advance and the brilliance of the yellow blends in with the light background. In essence light tones on a black ground tend to advance according to their degree of brilliance while on a light ground the effect is reversed.

Color saturation also effects depth: "a pure color advances relative to a duller one of equal brilliance, but if light-dark or cold-warm contrast is also present, the depth relationship shifts accordingly." Extension is also a consideration with respect to depth, for example, "when a large red area bears a small yellow patch, the red acts as a background and the yellow advances." As the yellow extends there comes a point when it dominates the red. Yellow expands into a background and thrusts the red forward (Itten 1970).

PERCEPTION

Warm and cold colors or tones affect depth perception and emotional content. If there are equally brilliant cold and warm tones the warm advances and the cold retreats. When seen in conjunction with the light-dark contrast the directional forces are either accentuated, decreased, or canceled out. In
addition Renner sees the emotional content of colors as belonging to one of two groups—the warm group and the cool group. In the warm group belong yellow and red and various combinations. These colors are characterized as being hard, active, and major. The cool group consists of green and blue. These colors are characterized as being soft, passive and minor (Renner, 1964).

In addition to individual perceptions, colors have cultural implications. The symbolic content of color concerns the meaning which various cultures attribute to particular colors. Different cultures attach different meanings to the same color. In China, for example, yellow is the symbol of "supreme wisdom and enlightenment" (Itten, 1970), and it is sacred both in China and in Western culture. Though yellow is "cheerful, gay, and lively" and "emblematic of the sun", it is also "associated with sickness, disease, indecency, cowardice, jealousy, envy, deceit and treachery" (Graves, 1951).

Yellow is characterized as "the most light-giving of all hues" (Itten, 1970) and has a great deal of religious significance. Traditionally golden yellow has symbolized sun and light and is used to represent symbols of the beyond.

The color red symbolizes more primitive passions and emotions and is associated with rage, danger, courage, virility, and sex. Red-orange is very warm and symbolically related to the earth in that it promotes vegetative growth and organic function. In pre-Columbian art, a figure in red pertains to the eastern sky and signifies sunrise, birth, youth, and springtime.

Purple represents supreme majesty and is characterized as stately, rich, pompous, and impressive. It combines the spiritual and nobility attributes of blue and the primitive passions attributes of red. Blue on the other hand is characterized as more cool, serene, and passive than purple. While it connotes "positive spiritual and supernatural qualities" (Renner, 1964), it also signifies sincerity, hope, and serenity.

Green is characterized as relatively neutral in its emotional effect, tending to be more passive than active. For this reason it is often considered the most restful of colors (Graves, 1951). While green symbolizes "the calm of
vegetative life" (Renner, 1964), "in religion, (it) represents faith immortality, and contemplation" (Spengler in Graves, 1951).

White is characterized as positive and stimulating and is rich in symbolism and associations. In Western culture it stands for purity and is the traditional bridal color while in China white represents mourning and bereavement. The mellow richness of middle gray shows other colors to their best advantage and generally symbolizes sedateness, passive resignation and humility. Black is characterized as a subdued, solemn, and profound color which symbolizes sorrow, terror, and death.

PREFERENCE

Various cultural meanings are attached to different colors and individuals relate colors to personal feelings; however, there is general agreement as to which colors are most or least preferred. Color combinations based in analogous hues and opposite hues are most often preferred. Interestingly, analogous colors which are next to each other on the color circle are most often found in nature. A red rose because of shadows, highlights, and stage of development "will scale from red-orange through red to red-violet" (Birren 1961). Water color varies according to depth and light, and will often range from greenish to bluish to violet. These analogous colors appearing in nature evoke an emotional quality that tends to be soft and mellow and they inspire a precise mood—active when the arrangement is warm and passive when it is cool (Birren, 1961). Understanding that all adjacent color combinations are not preferred equally it is interesting to note that the analogous colors appearing in nature are most often subtle and elegant. They tend to be such colors as orange, violet, yellow-green, and blue green. So it is not surprising that an individual's preference for nature is so strong. Birren (1961) contends that for "frank attraction" the analogous colors based on blue, red, and green may prove best. These are the colors often experienced in man-made situations especially in advertising—they get attention, the message is clean.

While natural scenes are generally preferred over urban ones, studies have demonstrated that man-influenced natural scenes are more preferred than
natural ones. As far as color is concerned, man-made objects and man-influenced landscapes such as fences, barns, cultivated fields, and the like tend to consist of warm colors. A small amount of a light, warm, pure color will extend towards the viewer to the maximum amount possible while a large amount of dull, cool color will recede well into the background. Since warm colors are more dynamic in quality with stronger intensity and since "the eye can see more warm color than it can cool ones" (Birren, 1969) man's influence is easily observed in the landscape. Thus it is more preferred. In this case warm colors are juxtaposed against the cool, more subtle colors of nature. Birren (1969) has found that, opposite colors have a visual quality for they usually set a warm color against a cool one thus causing a positive quality to offset a passive one. An example, an orange sunset against a deep blue sky, or a field of ripening (yellow) grain against the green of a woods provide pleasing color arrangements.

Accepting that visual quality or beauty lies within the perception of the individual, it follows that color is individual to human experience. In this case an individual reaction to color is "remarkably independent of what takes place in the outer world by way of stimulation" (Birren, 1969). Regardless of the external stimulation, the mind will consistently see and identify color in a more or less constant manner.

In further defense of preference for man-influenced landscapes, Birren (1969), citing Munsell, notes that the eye actually becomes farsighted in its focus when it sees a warm color and nearsighted when it sees a cool color. Thus warm colors appear close and cool colors recede. Renner (1964) notes that "warm colors press forward," "they are active" whereas cool colors "retreat from us." He also notes that it is a universal phenomenon found in all color theories and calls it the "sensual-moral character" of color.

While colors maintain their independence, in the visual sense they are dependent parts of a colored whole. Nothing may be changed in a color scheme without changing the perception of the whole. In this respect seeing color is the same as seeing form. The emotional aspect of color partially explains why people get a sense of well being, awe, dramatics, etc. when viewing scenes.
Psychologically, it has a lot to do with the way we feel about the environment—either good or bad... like or dislike!

PROCEDURE

Color as a subjective attribute was considered in the visual assessment model. Rather than attempt to identify all of the colors in any one cell, the dominant color and inferred color combinations were the primary concern. Identifying the colors, developing categories, and ranking the preferences based on the distinctions between warm-cool, saturation-extension, and light-dark colors are an integral part of the model.

Litton (1982) made several important points which we took into account. He pointed out that in nature we see values and hues of many colors, seldom a pure color. When a pure hue is seen it is very distinctive, often occurring with the change of seasons or temporarily due to atmospheric changes. Furthermore, he states that when we see blue skies, red fall foliage, or grass in the spring, what we see are colors which become dominant in relation to the usual grayed hues around us. With regard to color in nature Litton lists "rough rules" (though there are exceptions):

1. grasslands are lighter than tree or shrub cover
2. soil is likely to be lighter than tree or shrub cover or only infrequently darker
3. disturbed soil (tilled, plowed, etc.) has a distinct value contrast compared to undisturbed soil or plant cover
4. hardwoods are lighter than coniferous trees.

In addition to natural elements man-made objects were also considered. In fact man-made objects are most likely to provide pure hue. The combination of natural and man-made elements then establish intricate patterns which play upon light-dark, saturation-extension, and warm-cool relationships.

Color preference is displayed in map form and depicts a continuum of colors occurring in the study area. Four factor maps including Landuse, Vegetation, Rock Outcroppings and Streams were utilized to develop the categories.
which are displayed on the COLOR map (Figure 13).

COLOR FLOWCHART

Figure 13

C1--Landuse Color (Figure 14). The following categories were developed:

- Residential and Commercial/Service/Infrastructure were combined to form Residential/Commercial/Service because there is no discernible value or hue difference between residential structures and commercial structures. These cells were likely to have more pure color and not as much warm-cool complements in contrast with cells containing both structures and natural elements.

- Cover and Row Crops remain as a separate color category because as Litton states, "disturbed soil has a distinct value contrast compared to undisturbed soil or plant cover". Land used for cover and row crops will be a distinctly different color than agricultural land because soil will be exposed, creating a more brown hue.

- Pasture/Idle Land and Fallow/Bare/Agricultural Land and Rangeland were combined into one category--Pasture/Idle/Fallow/Bare/Range/Agriculture Land because they share the characteristic of being undisturbed by human
Map Title: LANDUSE COLOR
Map Scale: 208.0 ft/cell

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>LABEL</th>
<th>NUMBER OF CELLS</th>
<th>PCT OF MAP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NOT DEFINED</td>
<td>3075</td>
<td>42.56</td>
</tr>
<tr>
<td></td>
<td>COMM. SER. RES.</td>
<td>920</td>
<td>12.73</td>
</tr>
<tr>
<td></td>
<td>COVER, ROW CROP</td>
<td>1513</td>
<td>20.94</td>
</tr>
<tr>
<td></td>
<td>FAST, FALLOW, RANGE</td>
<td>1670</td>
<td>23.11</td>
</tr>
<tr>
<td></td>
<td>EXTRACTION</td>
<td>39</td>
<td>.54</td>
</tr>
<tr>
<td></td>
<td>LOGGING</td>
<td>8</td>
<td>.11</td>
</tr>
</tbody>
</table>

TOTAL NO. OF CELLS = 7223

Figure 14.
intervention and therefore have a similar color value.

(Note: the American Heritage Dictionary defines fallow in the following way "plowed and tilled (land) . . . left unseeded during a growing season". By using this definition fallow land was grouped with other land which has not been disturbed by human intervention. It is assumed a natural succession would occur beginning with weeds and grasses and eventually cover the tilled area rendering it virtually the same as range, pasture, or idle land.

-Natural Vegetation was not utilized as a category on this map because it is dealt with more specifically on the vegetation map.

-Extraction Mining was left as a separate category as was Logging because each landuse had a distinctly different color value.

-Future Development was assigned a zero value and does not appear on the map because speculation as to what landuse is intended was not relevant to the study.

C2--Vegetation Color (Figure 15). The following categories were developed.

-Grassland was left as a separate category because it is a unique color. It contains no outstanding tree or shrub masses and cannot, therefore, be put into a category with them. As Litton states, "grasslands are lighter than tree or shrub cover" indicating that they are a different color than tree or shrub masses.

-Shrubland was also left as a separate category because it does not share similar characteristics of value or hue intensity with the tree or grass cover.

-the Mixed Grass/Shrubland was also left as it originally appeared on the Vegetation grid. Its color qualities are different from those which grassland alone or shrubland alone might have.

-Deciduous Forest is a separate category because forests which contain
Map Title: VEGETATION COLOR
Map Scale: 208.0 ft/cell

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>LABEL</th>
<th>NUMBER OF CELLS</th>
<th>PCT OF MAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>NOT DEFINED</td>
<td>4088</td>
<td>55.47</td>
</tr>
<tr>
<td>1</td>
<td>GRASSLAND</td>
<td>31</td>
<td>.45</td>
</tr>
<tr>
<td>2</td>
<td>SHRUBLAND</td>
<td>52</td>
<td>.72</td>
</tr>
<tr>
<td>3</td>
<td>MIXED GRASS AND SHRUB</td>
<td>73</td>
<td>1.01</td>
</tr>
<tr>
<td>4</td>
<td>DECIDUOUS FOREST</td>
<td>2018</td>
<td>27.93</td>
</tr>
<tr>
<td>5</td>
<td>MIXED FOREST</td>
<td>1043</td>
<td>14.44</td>
</tr>
</tbody>
</table>

TOTAL NO. OF CELLS = 7225

Figure 15.
primarily deciduous trees will differ in color in comparison to forests which contain both deciduous and nondeciduous trees. The presence of nondeciduous (evergreen) trees will radically alter the forest color in terms of hue intensity and season variation. They will make the forest more uniformly green year-round because evergreens do not experience transformation of foliage color in the fall.

-Mixed Forest remained a separate category because of the presence of evergreen trees. Color qualities are altered when compared with deciduous forests.

-Altered/Developed Land category was assigned a zero value and therefore does not appear on the map because the cells it concerns are dealt with more specifically on the landuse map.

The preceding two maps were added together. This created a map, Cl, C2--Landuse and Vegetation Color (Figure 16), in which all the cells were assigned a unique color classification. The conflicts that arose were Pasture, Fallow and Range Land with Grassland, Shrubland, and Mixed Grass-Shrubland. A new category was formed called Grass/Fallow which combined Grassland and Pasture, Fallow and Range Land since the color value and the degree of lightness or darkness among the Grassland, Fallow, Pasture, Bare and Rangeland were similar. The remaining conflicts were renumbered to retain their specific color characteristics namely Shrubland and Mixed Grass-Shrubland.

The Landuse and Vegetation Color Map, and the modified Stream Factor (C3) map were added together to create Cl, C2, C3--Landuse, Vegetation and Stream Color (Figure 17). This map consisted of the various landuse colors and vegetation colors combined with third and sixth Order Streams. When a conflict occurred the 3rd and 6th Order Streams took precedence because of the light-dark directional forces. The streams with their reflective qualities tend to move forward when compared to the darker areas created by the shade of the vegetation that line the banks. In other words, a category which consisted of Third Order and Mixed Forest becomes the category Third Order, rather than Third Order Stream in Mixed Forest.
Map Title: **LANDUSE AND VEGETATION COLOR**

Map Scale: 208.0 ft/cell

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>LABEL</th>
<th>NUMBER OF CELLS</th>
<th>PCT OF MAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>NOT DEFINED</td>
<td>14</td>
<td>.19</td>
</tr>
<tr>
<td>1</td>
<td>COM, SER, RES</td>
<td>920</td>
<td>12.73</td>
</tr>
<tr>
<td>2</td>
<td>COVER, ROW CROP</td>
<td>1513</td>
<td>20.94</td>
</tr>
<tr>
<td>3</td>
<td>GRASS, FALLOW</td>
<td>1545</td>
<td>21.38</td>
</tr>
<tr>
<td>4</td>
<td>DECIDUOUS FOREST</td>
<td>2018</td>
<td>27.92</td>
</tr>
<tr>
<td>5</td>
<td>MIXED FOREST</td>
<td>1043</td>
<td>14.44</td>
</tr>
<tr>
<td>6</td>
<td>SHRUBLAND</td>
<td>52</td>
<td>.72</td>
</tr>
<tr>
<td>7</td>
<td>MIX GRASS, SHRUB</td>
<td>73</td>
<td>1.01</td>
</tr>
<tr>
<td>8</td>
<td>EXTRACTION</td>
<td>39</td>
<td>.54</td>
</tr>
<tr>
<td>9</td>
<td>LOGGING</td>
<td>9</td>
<td>.11</td>
</tr>
</tbody>
</table>

**TOTAL NO. OF CELLS = 7225**

Figure 16.
Map Title: LAND USE, VEGETATION AND STREAM COLOR
Map Scale: 208.0 ft/cell

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>LABEL</th>
<th>NUMBER OF CELLS</th>
<th>PCT OF MAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>NOT DEFINED</td>
<td>14</td>
<td>.19</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>COM, SER, RES</td>
<td>420</td>
<td>12.72</td>
</tr>
<tr>
<td>2</td>
<td>COVER, ROW CROP</td>
<td>1438</td>
<td>19.90</td>
</tr>
<tr>
<td>3</td>
<td>GRASS, FALLOW</td>
<td>1425</td>
<td>19.72</td>
</tr>
<tr>
<td>4</td>
<td>DECIDUOUS FOREST</td>
<td>2004</td>
<td>27.74</td>
</tr>
<tr>
<td>5</td>
<td>MIXED FOREST</td>
<td>1037</td>
<td>14.38</td>
</tr>
<tr>
<td>6</td>
<td>SHRUBLAND</td>
<td>52</td>
<td>.72</td>
</tr>
<tr>
<td>7</td>
<td>MIX GRASS, SHRUB</td>
<td>72</td>
<td>1.01</td>
</tr>
<tr>
<td>8</td>
<td>EXTRACTION</td>
<td>39</td>
<td>.54</td>
</tr>
<tr>
<td>9</td>
<td>LOGGING</td>
<td>8</td>
<td>.11</td>
</tr>
<tr>
<td>10</td>
<td>RIVER, STREAM</td>
<td>213</td>
<td>2.95</td>
</tr>
</tbody>
</table>

TOTAL NO. OF CELLS = 7225

Figure 17.
The resulting map, C1, C2, C3--Landuse, Vegetation and Stream Color has the following categories:

- Residential-Commercial Service
- Deciduous Forest
- Grass/Fallow
- Shrubland
- Mixed Grass/Shrub Land
- Cover and Row Crops
- Mining
- Logging
- Mixed Forest
- Stream or River

The final map manipulation to identify color classifications involved adding C4--modified Rock Outcroppings and Road Cuts to the preceding map. The exposed rock, in the study area, was mostly a warm gray limestone and these warm tones in contrast to the cool green of the forests advanced. The play of reflected light against the darkness also added to the unique qualities of this color classification.

The classifications on this map, COLOR (Figure 18) are:

- Residential-Commercial-Service
- Deciduous Forest
- Grass/Fallow
- Shrubland
- Mixed Grass/Shrub Land
- Cover/Row
- Mining
- Logging
- Mixed Forest
- Stream or River
Map Title: LANDUSE, VEGETATION, STREAM AND ROCK OUTCROPPING COLOR
Map Scale: 208.0 ft/cell

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>LABEL</th>
<th>NUMBER OF CELLS</th>
<th>FCT OF MAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>NOT DEFINED</td>
<td>14</td>
<td>.19</td>
</tr>
<tr>
<td>1</td>
<td>COM, SER, RES</td>
<td>920</td>
<td>12.72</td>
</tr>
<tr>
<td>2</td>
<td>COVER, ROW CROP</td>
<td>1439</td>
<td>19.90</td>
</tr>
<tr>
<td>3</td>
<td>GRASS, FALLOW</td>
<td>1425</td>
<td>19.72</td>
</tr>
<tr>
<td>4</td>
<td>DECIDUOUS FOREST</td>
<td>1984</td>
<td>27.44</td>
</tr>
<tr>
<td>5</td>
<td>MIXED FOREST</td>
<td>1029</td>
<td>14.23</td>
</tr>
<tr>
<td>6</td>
<td>SHRUBLAND</td>
<td>52</td>
<td>.72</td>
</tr>
<tr>
<td>7</td>
<td>MIX GRASS, SHRUB</td>
<td>73</td>
<td>1.01</td>
</tr>
<tr>
<td>8</td>
<td>EXTRACTION</td>
<td>39</td>
<td>.54</td>
</tr>
<tr>
<td>9</td>
<td>LOGGING</td>
<td>8</td>
<td>.11</td>
</tr>
<tr>
<td>10</td>
<td>RIVER, STREAM</td>
<td>213</td>
<td>2.95</td>
</tr>
<tr>
<td>11</td>
<td>ROCKOUT, ROADCUT</td>
<td>31</td>
<td>.43</td>
</tr>
</tbody>
</table>

TOTAL NO. OF CELLS = 7223

Figure 18.
RANKING

This map was ranked according to preference based on: light-dark, warm-cool, and saturation-extension. The map COLOR PREFERENCE (Figure 19), displays these preferences and range from an eleven to one:

11-Row and Cover crops--this activity in Eastern Kentucky infers structures (outbuildings) and fences which implies distinctive light-dark contrasts, warm-cool color relationships and periodic saturation and extension.

10-Commercial, Service, and Residential--structures were considered to display distinctive light-dark areas, average warm-cool color relationships and potential for distinctive saturation-extension.

09-River-Stream--water and the implied banks were considered to have both distinctive light-dark, warm-cool relationships and average saturation-extension characteristics.

08-Mixed Forest--was classified as containing distinctive light-dark patterns and average warm-cool and saturation-extension qualities because of the ephemeral seasonal differences.

07-Mixed Grass and Shrubland were considered an average color experience in all three areas.

06-Deciduous Forest was considered to exhibit average light-dark and saturation-extension and only minimal warm-cool qualities. The seasonal qualities were considered, the colors were generally the same at one period in time, ie. summer-cool green.

05-Grass-Fallow contained rangeland as previously discussed. It was considered to have minimal light-dark color qualities and exhibited average warm-cool and saturation-extension relationships.
04-Rock Outcroppings and Road Cuts were considered to have average warm-cool qualities and minimal degrees of light-dark and saturation-extension characteristics.

03-Mining—in this area consists of strip mining. The warm-cool relationship was considered average and the light-dark and saturation-extension was considered to be minimal.

02-Logging—clear cut operations were considered to have average light-dark qualities and minimal warm-cool and saturation-extension properties.

01-Shrubland was classified as minimal in all three classifications.
COLOR PREFERENCE
SCALE: 208.0 FT PER CELL

SYMBOL VALUE LABEL NO. OF CELLS PCT. OF MAP

0 PROPOSED DEVELOPMENT 14 .19
1 SHRUBLAND 52 .72
2 LOGGING 8 .11
3 MINING 39 .54
4 ROCK OUTCROP-ROAD CUT 31 .45
5 GRASS-FALLOW 1425 19.72
6 DECID. FOREST 1984 27.44
7 MIXED-SHRUBLAND 73 1.01
8 MIX. FOREST 1028 14.23
9 RIVER-STREAM 213 2.95
10 COM-SER-RES 920 12.73
11 COVER-ROW CROP 1438 19.90

TOTAL NO. OF CELLS = 7225

Figure 19.

49
FORM ATTRIBUTE

DEFINITION

As part of everyday life form surrounds the environment in which we live. Within the realm of perception, mental images of the infinite variety of forms with which we come in daily contact are retained. "If there is no form, then space is all that remains" (Collier, 1963).

Form, according to Bevlin (1977), is synonymous with shape or mass. It refers to the general outline of something as in the form of a building or the complex forms of nature. According to Porter (1974), when a shape has depth along with length and width it is called form. Form then, involves three dimensional shapes or masses. In this study, the attribute is called form rather than shape since most objects in the landscape are three-dimensional (USDA 1972).

A review of the literature reveals that form can be classified from several similar yet different approaches. Bevlin (1977), for example, divides form into four categories—geometric, natural, abstract, and non-objective. Since she is concerned with form in the visual arts, Bevlin classifies form (and other elements) as they appear in the history of art. Two of these classifications geometric and natural, however, are also germane to the study of form in the landscape.

Geometric forms dominate the constructed environment. They appear in buildings, bridges, fences, and machines. Purely geometric forms such as the cube, sphere, pyramid, cone, and cylinder can be found in the man-made landscape and exist there by virtue of the fact that they are constructed by man. Natural forms are those that occur in the natural world. This is generally taken to mean overall human, animal, and plant shapes. Vegetation masses and geologic features such as rock outcroppings and mountains can be placed in this category. Bevlin's third and fourth divisions, abstract and non-objective forms apply to the visual arts and do not appear to fit the concept of form in the landscape.
In a similar manner, Porter (1974) divides form into two categories: geometric and organic. He further categorizes form as having angular or curvilinear qualities, open or closed qualities, and positive or negative qualities. Geometric shapes make up the majority of the built environment but can also be found in nature. Organic forms, while found in the built environment, are more common in nature. "They are non-geometric and characterized as having irregular contours or edges, plus a feeling of growth and movement" (Porter, 1974). Regardless of the environmental situation, geometric shapes exist in contrast to organic shapes because they express different qualities. The angular or curvilinear quality of various forms conveys different feelings and meanings. "Curved shapes are graceful" and facilitate rapid eye movement while "angular shapes suggest strength." "Angular shapes are straight-edged and lean away from a vertical position" which tends to suggest "movement and increases the power of the shape" (Porter, 1974).

The quality of being open or closed is another way of distinguishing between forms. "Openness occurs in any form which can be looked into or through. Closed forms are self-contained and solid in appearance" (Porter, 1974). For example, mountains, buildings and tree masses would be considered solid forms while grasslands and fenced pastures would be considered open forms.

Closely related to being open or closed is the degree to which forms are positive or negative. "Positive and negative shapes are the visual elements that make it possible to see and understand shapes and forms . . . for every positive shape there is a negative shape counterpart. These can be small in-between areas or a vast surrounding shape like the sky behind a tree" (Porter, 1974). On the basis of this definition, examples of both positive and negative forms, and closed and open forms are: positive closed forms--mountains, hills, semi-solid tree masses, cliffs, palisades, and ridges; open negative forms include valleys, sink holes, mining extraction sites, gorges, and swales.

These qualities of form are the basis for establishing the descriptive classifications on the map representing the attribute form. However, the existence of form does not imply positive or negative visual quality. Rather
it is a way of perceiving the total landscape in terms of forming a preference for the environment in question. In essence, a form "becomes a visually perceived figure only when seen against its ground" (Kepes, 1972).

PERCEPTION

How form is perceived is particularly pertinent to preference for various landscapes. Form is perceived both consciously and unconsciously through the senses. After all, "man is not the passive recipient of external stimuli that most people think he is" (Kepes, 1972). It is the perceived sense of form that allows an individual to organize visual stimuli from the environment. Perception begins with sight when the retina receives stimuli and the brain integrates this information into a visual image. This stimuli is initially unorganized. To make sense out of it, the brain picks out light, dark and color saturation in an attempt to organize the mental image into a foreground-background or three-dimensional image. This attempt to make sense out of the environment relates to the "basic need for internal unity as well as for harmony with the environment" (Kepes 1972).

Perception and recognition of form is part of the process of environmental orientation in that individuals have a difficult time dealing with chaos in their field of experience. Consequently, there is a dynamic tendency to restore balance after each disturbance from the outside and to keep the system in relative stability (Kepes 1972). As forms are selected, individuals visualize themselves as the central point and begin to become aware of space between them and the forms with which they are surrounded. Here they are responding to depth by sensing that the light quality of these forms is becoming less as the forms recede into the background. Thus, the image is mentally arranged into foreground-background and gives it its three-dimensional quality.

At this stage of perception an individual begins to unify the forms into a whole where "every image is based upon this dynamic dualism, the unity of opposites. While some images form a stable visual whole, others are unorganized and serve only as a background and are perceived as intervals" (Kepes 1972). In an attempt to see patterns, similar forms are viewed
concurrently and the spaces between them are seen as intervals which produce a rhythm. "Perception psychologists, investigating the dynamics of visual figure-ground relationships, discerned a dynamic hierarchy of gestalts--perceptual patterns moving toward larger, more inclusive patterns" (Kepes, 1972). "This organization of figures and backgrounds is repeated progressively until the whole visual field is perceived as a formed, ordered unity" (Kepes 1972). It might be considered "the landscape."

The ease with which individuals are able to make sense of visual impacts affects the ultimate conscious and unconscious response to form. Collier (1963), who defines form as "a particular organization of shape capable of arousing the emotional and intellectual participation of the individual," contends that the perception of form has three important aspects:

1. Form - structure - here we attempt to understand how the shape we see is constructed.
2. Form - function - we relate the shape to a certain function to gain a heightened perception of the significance of the shape of the object.
3. Aesthetic response - once the significance is understood we respond in the aesthetic sense.

Aesthetic experience essentially occurs when a distinction is made between what is commonplace and what is powerfully moving. "When form appears complete and unalterable, when we sense that any addition or subtraction would ruin this completeness, when form is charged with meaning, when it coincides with our desires, invites our physical or imaginative possession and the subsequent loss of our own identity in self-identification with the form - when we are affected in any of these ways, then for a moment we become involved with the mystery of an aesthetic response" (Collier, 1963). It is this visual aesthetic experience that heightens an individual's awareness of space sufficiently to become significantly involved.

The implication is that forms themselves create feelings and that the position of a form in space can generate feelings of repose and stability or movement and power. Vertical and horizontal positions tend to stabilize the visual qualities of forms while the triangle form (mountain form) is intrinsically stable because of its basic structure.
Since architectural forms utilize the vertical or horizontal position they are static (Porter, 1974). Organic forms, such as rocks, which abound in nature and are characterized as having irregular edges, impart a feeling of growth and movement. Curved forms imply gracefulness because the flow of the eye is uninterrupted and repeated curves set up a rhythmical pattern. Angular forms imply strength because they tend to depart from a vertical position which suggests movement and power. This structural quality of opposing shapes produces visual tension (Porter, 1974).

PREFERENCE

The fact that forms in and of themselves may be beautiful does not necessarily mean that a scene or landscape will be preferred. It is possible to have an overemphasis of one type of form such that a monotonous situation is created. It is also possible to have so many varied forms that a scene becomes cluttered and confusing. A balance of forms is needed to establish a scene that is generally considered to be of high visual quality. In this sense, familiar forms combined with some degree of new or different forms and/or different combinations of structural and organic forms appear to provide the form relationship most preferred. The fact that individuals in general prefer natural scenes that have a degree of man-made or man influenced forms is partially explained by this concept of form.

Human experience then plays a large role in what is seen and how it is perceived. If it is accepted that one sees only what one is taught to see and that seeing is as much psychological as physical, then it follows that preference is to a large degree predictable. To this extent memories and past experiences bring forth feelings about the form being seen. This is not to suggest that only certain forms or groups of forms will be preferred, rather, it is suggested that preferences can be generalized to the population. Also, it is recognized that learning is a dynamic action. Thus, as new knowledge is acquired preferences for certain forms or scenes may change. In addition, since individuals constantly strive for new and exciting happenings it would seem logical to conclude that they would also seek out new and dynamic scenes to appreciate or prefer. The sense of seeking the mysterious, making it knowable and then adding it to the knowledge base is a natural function. It
is obvious that individuals perceive what they know and that what is not known is ignored, but it is also true that they constantly strive to make the unknown known. As a result the dynamics of viewing are a fundamental part of aesthetic awareness.

Once a form or combination of forms is recognized, individuals respond from an aesthetic perspective. While the perception of landscape quality is an individual matter, research has demonstrated that there is consensus in matters of aesthetics (Michigan Law Review, 1972). Also, "Zube has shown substantial agreement across varying groups with respect to scenic preference" (R. Kaplan, 1985) regardless of sex or urban-rural background. Even though it can be argued that aesthetic evaluations are subjective, there is little doubt that certain forms or groups of forms can bring about a positive response from the viewer. From this perspective it seems possible that in terms of aesthetically pleasing characteristics and in terms of information provided about the landscape or the promise of more information that "the information it provides is likely to be helpful in discovering what underlies preference." (S. Kaplan, 1975). In order to determine preference, two events need to occur: first, the viewer and a scene perceived by the viewer; second, the viewer must be interested enough in the scene to make an effort to understand it. Understanding something is akin to acquiring information about it. Kaplan (1975) contends that "the acquisition of knowledge should also be related to environmental preference" and the information an individual gains by viewing a scene "aids in making sense out of the environment and is likely to be particularly salient."

In determining form preference, Kaplan (1975) found that the qualities of complexity, coherence, and spaciousness are necessary in a landscape scene for it "to be liked". If a scene was rated low on the existence of these features it was generally not preferred. As noted earlier, complexity can denote a wide array of form elements. Coherence, or a sense of organization, on the other hand, refers to the degree to which these elements are comprehensible. Scenes that did not "hang together" scored low on the preference ratings in Kaplan's study. They lacked organization; they were hard to grasp—quite apart from how readily one could tell what they depicted. A way of minimizing this problem was to include "elements that were identical or similar to each
other". By using "repeated elements, textures, and structural factors" (R. Kaplan, 1985) this problem was overcome.

Spaciousness or how open or large a scene seems to be, the third preference quality, is consistently preferred. "The high spacious-smooth texture dimensions have by far the highest preference ratings and the low spacious-coarse texture dimensions are clearly the lowest in preference" (Kaplan, 1975). Thus a scene which appears to be open and does not restrict the viewer is preferred. In addition, the spaciousness dimension appears to hold more importance than complexity or coherence. Within each content domain the dimensions were... quite uniform with respect to the spaciousness ratings: at one extreme are embankments or other obstructions limiting the sense of space; at the other extreme are scenes of relatively open spaces. In terms of the other predictive variables, coherence, mystery, and complexity, the dimensions showed no such consistency" (S. Kaplan, 1975). The existence of complexity, coherence, and spaciousness is not enough to determine that a scene will be preferred by viewers—"it appears to make little difference whether there is a little or a lot of any of these." Rather the three must be found in some degree and while they are "necessary conditions for preference" (S. Kaplan, 1975) they do not necessarily make a scene preferred.

Kaplan's research provides an additional key to determining form preference—mystery. He defines mystery as "the promise of further information based on a change in the vantage point of the observer... you would learn more if you could walk deeper into the scene" (R. Kaplan, 1985). In this respect the notion of mystery emerged as a compelling force in preference, especially in preference for nature scenes. It has been demonstrated that mystery is an effective preference predictor and that the "more mystery" (S. Kaplan, 1975) in a scene the more highly rated it was in terms of landscape quality. The implication of this research is that while a scene may be spacious, coherent, and complex, it does not necessarily mean it will be preferred over another scene unless it contains an element of mystery. Mystery, the perception that the scene promises "further information" (R. Kaplan, 1986) is an important ingredient. True, information gained on the basis of "mystery" may be inferential and what is mystery to one may not be mystery to another. However, there is general agreement that mystery is
pertinent with regard to landscape form preference.

Form is recognized as an important aspect in the identification of landscapes of high visual quality. As in other visual quality characteristics the existence of form is independent and it can be evaluated as such. However, it is also dependent in that it is part of the compositional whole. As the make-up of forms and their relationship with each other are identified there is general agreement as to how they will be perceived in the preferential sense. It is this commonality that has led to the identification of preference rankings utilized in this study.

PROCEDURE

FORM PREFERENCE (Figure 23) is displayed in map form which depicts a continuum of forms occurring in the study area and as such becomes a subjective attribute used in the visual assessment model. The descriptive adjectives of form (geometric-natural or organic, open-closed, and positive-negative) provide a vocabulary which enabled the identification and description of existing forms. Thus identified, forms were grouped into categories which exhibited similar qualities. These categories along with the results of form preference research led to the development of form preference ranks. The ranks were based on both the known and implied character inherent in each category. Character, in this case, refers to the compositional qualities identified in the research, namely, spaciousness, mystery, coherence, and complexity.

A combination of five factor maps were used to identify the forms and develop the categories which are displayed on the FORM PREFERENCE map they are: Vegetation, Landform, Landuse, Stream, and Roadcut-Rock Outcroppings. Research on form perception led to the decision to analyze the study area from two perspectives: floodplain and mountain. The implications of composition within each of these macro-forms are different. Structures on the floodplain and structures on the mountain are not perceived in the same manner and do not, therefore, have similar compositional impacts. Consequently, in the study area the negative open floodplain and the positive closed mountains were studied separately.
Floodplain Form

Landform — FF1

Vegetation — FF2

Stream — FF3

Landuse — FF4

Floodplain Form

Figure 20

FORM FLOWCHART

Mountain Form

Landform — MF1

Vegetation — MF2

Stream — MF3

Landuse — MF4

Rockoutcrop — MF5

FF1—Landform Factor—The colluvial valley, terrace and floodplain were identified and combined into one category as they are similarly described as negative, organic and open forms.
FF2--Vegetation Factor--The deciduous forests and mixed deciduous forests were designated as semi-solids which are described as positive, organic and closed forms.

FF3--Streams Factor--2nd and 3rd order streams were combined and the Red River remained separate as they exhibited differing degrees of negative organic forms.

FF4--Landuse Factor--The residential, commercial and service units were combined since they can be described as having positive, geometric and closed forms.

These factor maps were overlaid to create a map, FLDFORM (Figure 21) which represents the forms in the floodplain. The resulting conflicts were cells which contained two or more values. They were: Semi-solids with 2nd and 3rd Order Streams; Structures with 2nd and 3rd Order Streams; Red River with Semi-solids. The first (FF2,FF3) conflict was resolved by having the Semi-solids override the 2nd and 3rd Order Streams. The second (FF3,FF4) conflict was resolved by having the Structures override the 2nd and 3rd Order Streams and the final conflict was resolved by having the Red River dominate the Semi-solids (FF2,FF4).

Mountain Form

MF1--Landform Factor--The Mountain cells were the only cells to remain as a category on the new map. They were described as being positive, organic and closed.

MF2--Vegetation Factor--The Deciduous and Mixed Deciduous Forests were combined to form the Semi-solid category which was described as positive, organic and closed.

MF3--Streams Factor--The 2nd and 3rd order streams were identified as having organic, negative forms. The Red River does not flow through the mountains and the 1st order streams were not considered to produce a measurable visual impact, therefore, they were not considered
**Figure 21.**

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>LABEL</th>
<th>NO. OF CELLS</th>
<th>PCT. OF MAP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 FLOODPLAIN</td>
<td>3263</td>
<td>45.16</td>
</tr>
<tr>
<td></td>
<td>1 2ND-3RD ORDER ST</td>
<td>2630</td>
<td>36.40</td>
</tr>
<tr>
<td></td>
<td>2 RED RIVER</td>
<td>246</td>
<td>3.40</td>
</tr>
<tr>
<td></td>
<td>3 SEMI-SOLIDS</td>
<td>199</td>
<td>2.75</td>
</tr>
<tr>
<td></td>
<td>4 STRUCTURES</td>
<td>143</td>
<td>1.98</td>
</tr>
<tr>
<td></td>
<td>5 TOTAL NO. OF CELLS =</td>
<td>744</td>
<td>10.30</td>
</tr>
</tbody>
</table>

**FLDFORM**

SCALE: 208.0 FT PER CELL
pertinent on this map.

MF4--Landuse Factor--Provided information which enabled development of categories for structures which include commercial, residential and services and was described as positive, geometric, and closed. The log-stripmine category was created which combined logging cells and mining cells. They were considered to have the same form since the law requires strip mines to be returned to their original contours and the logging in this study area is usually a clearcut operation. This category was described as negative, geometric and open. In addition, a "man-influenced" category including rangeland and pasture was described as negative, organic and open.

MF5--Rockout Factor--The rock outcroppings and the road cuts were combined since their forms (strong vertical walls) are similar and were described as positive, geometric and closed.

These maps were overlaid in order to obtain a composite mountain form map, MTFORM (Figure 22). Some cells contained more than one value which created conflicts. One of these conflicts was a group of cells that contained both Rock Outcappings and Semi-solids (vegetation). The rock outcappings, whose form is characterized by strong vertical walls, dominated the semi-solids in the mountains. Therefore, these cells were placed in the existing category of Rock Outcroppings. Another conflict was a group of cells that contained Rock Outcroppings and Man-Influenced cells which represented Road Cuts. Again, the strong vertical form dominated each cell. Therefore, they too were placed in the existing category of Rock-Outcroppings.

The composite forms map was an overlay of the Floodform map (FLDFORM) and the Mountain Forms map (MTNFORM). Since one is the compliment of the other, there were no conflicts. However, the 2nd and 3rd Order Streams were combined because their forms were described similarly in both the mountain and floodplain and the perception of them is not dependent upon whether they are located in the floodplain or mountain.
<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>LABEL</th>
<th>NO. OF CELLS</th>
<th>PCT. OF MAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>/\</td>
<td>MT-PAST-RANGELAND</td>
<td>3942</td>
<td>54.64</td>
</tr>
<tr>
<td>\</td>
<td>MT-SEMISOLID</td>
<td>192</td>
<td>2.70</td>
</tr>
<tr>
<td>/\</td>
<td>MT-STREAM 2ND, 3RD</td>
<td>2779</td>
<td>39.34</td>
</tr>
<tr>
<td>?? ??????</td>
<td>LOG-STRIP</td>
<td>44</td>
<td>.61</td>
</tr>
<tr>
<td>---</td>
<td></td>
<td>47</td>
<td>.65</td>
</tr>
<tr>
<td>-----</td>
<td></td>
<td>176</td>
<td>2.44</td>
</tr>
<tr>
<td>#</td>
<td>ROCK-CUT</td>
<td>31</td>
<td>.43</td>
</tr>
</tbody>
</table>

**TOTAL NO. OF CELLS = 7225**

**Figure 22.**
Kaplan (1975) indicates that mystery and complexity share the common quality of the "promise of new ... information". In order to be perceived and preferred complexity requires "more time and inspection" while mystery requires "a change in vantage point". Complexity was "the primary predictive variable" and mystery "seemed more continuous and less content specific and appeared in a variety of different settings."

The concept of coherence deals with "order or structure ... and play(s) an important functional role in orientation." The lack of coherence or organization leads to an inability to identify a scene. Thus identifiability or legibility is important as it allows a viewer to perceive the elements as groups.

In addition to qualities which promise further information about a scene, e.g. complexity and mystery, and the quality of coherence, which is dependent upon the present legibility of a scene, the element of spaciousness must be considered. Spaciousness is "the visible availability of options for locomotion, of places to go" (S. Kaplan, 1975).

The FORM PREFERENCE MAP (Figure 23) displays the following ranked categories:

10-Floodplain--spaciousness and coherence were distinctive because the floodplain created a large open negative form. The land use (rangeland, cropland, pastureland) was characterized by an average amount of complexity and a minimal amount of mystery.

09-Red River--displayed a distinctive degree of coherence within a given one-acre cell, but exhibited average amounts of spaciousness, complexity, and mystery.

08-Mountain Structures--displayed distinctive amounts of both complexity and mystery due to the isolated nature of the structures. They showed an average amount of coherence and a minimal amount of spaciousness because of the strong definition of space which the mountains provide.
### Form Preference
**Scale:** 208.0 ft per cell

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>VALUE</th>
<th>LABEL</th>
<th>NO. OF CELLS</th>
<th>PCT. OF MAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROCK-CUT</td>
<td>31</td>
<td>.43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOG-STRIP</td>
<td>47</td>
<td>.65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FL SEMI-SOLIDS</td>
<td>199</td>
<td>2.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MT SEMI-SOLIDS</td>
<td>2770</td>
<td>38.34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2ND-3RD ORD ST</td>
<td>290</td>
<td>4.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FL FL STRUCTURES</td>
<td>744</td>
<td>10.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MT PAST-RANGELAND</td>
<td>195</td>
<td>2.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MT STRUCTURES</td>
<td>176</td>
<td>2.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RED RIVER</td>
<td>143</td>
<td>1.98</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FLOODPLAIN</td>
<td>2650</td>
<td>36.40</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total No. of Cells:** 7225

---

**Figure 23.**

---

64
07-Mountain Pasture-Rangeland—exhibited a distinctive degree of coherence and spaciousness, but minimal amounts of mystery and complexity.

06-Floodplain Structures—exhibited a distinctive degree of coherence because the structures are located in close proximity to one another. They showed an average amount of complexity and minimal spaciousness and mystery.

05-Mountain Semi-solids—displayed a distinctive amount of coherence because the vegetative cover was uniformly distributed throughout the cell. They displayed an average amount of mystery and minimal amounts of spaciousness and complexity.

04—Second and Third Order Streams—showed a high degree of mystery because they appear, disappear, and reappear again leaving the viewer to speculate where they go. They also displayed an average amount of coherence. By their very nature they can either convey a sense of unity or a sense of discord depending upon the size of the area being viewed. They showed minimal amounts of both spaciousness and complexity due to their relatively small scale.

03-Logging-Strip Mining—showed average amounts of coherence and spaciousness and minimal amounts of complexity and mystery.

02-Floodplain Semi-solids—exhibited average amounts of both mystery and coherence because what occurs beyond the vegetation can be seen. They displayed minimal amounts of spaciousness and complexity due to the lack of space that continuous, uninterrupted vegetation produces without interference.

01-Rock Outcroppings and Road Cuts—displayed an average amount of complexity and minimal amounts of coherence, spaciousness, and mystery because they are isolated elements with strong vertical walls.
TEXTURE ATTRIBUTE

DEFINITION

Within a landscape, whether it is depicted in a painting or in real life, the totality of characteristics give it its aesthetic appeal. One of the characteristics which has been demonstrated to be of importance in the identification of areas of high landscape quality is texture. Texture refers to the "surface quality" (Austin, 1982) of objects and is generally described in terms of a smoothness/roughness continuum. The term can also be used in the broader sense where an entire scene or view might be said to have certain textural characteristics which are produced by variations of light and dark. In the sense that texture as defined here is more visual than tactile, it is often used as "... a matter of comparison between objects" (Austin, 1982) and, therefore, in conjunction with form, color, and line as an approach to determining visual quality.

It is commonly accepted, much like color, that changes in texture add variety and greater interest to a design composition. It is also accepted that textural changes or variations add interest to a landscape scene. From a more technical perspective, texture "can be interpreted as the character of the physical surface qualities as determined by form, size, and the aggregation of the general character of the minor units of which it is composed" (Austin, 1982). In this sense there is an inherent textural quality, determined by form, size, and the compositional units, that exists in all material independently of the viewer/perceiver. This quality is "created by the manner of construction of the material" (Emerson, 1957).

Textures which occur in the landscape can be attributed to a number of factors. According to Forest Service research (USDA, 1975), "textures in the landscape are determined by geology, soils, topography, and vegetation." In addition to textures which result from the influence of nature, elements such as coal tipples, houses, factories, and bridges reflect human influence on the textural quality of the environment. The resulting textures that are viewed in the environment can thus be studied as variations produced by both natural and man-made forces.
Texture in the landscape can be smooth, coarse, regular, uneven, harsh, or sensuous (Bevlin, 1977) or have any of a number of other qualities. It results from different forces and is perceived in situations where specific forms are not evident within a continuous surface. In this study, textures were identified and categorized to include those which are coarse (roadcuts and residential and commercial areas), those which have a medium texture (deciduous and mixed forests), and those with a fine texture (grass lands and water).

PERCEPTION

Texture is perceived as the characteristic surface quality of an object. However, texture undergoes a transformation as the viewer moves into the scene. For example, at a distance of one foot "the individual boughs of trees form texture", in the middleground "texture normally is characterized by the masses of trees in stands of uniform tree cover", and in the background "texture is seen as groups or patterns of trees" (USDA, 1974). The distance from what is being viewed determines what is perceived as texture and, upon close examination, whether "it is a form or a textural component" (Meilach, 1975).

Three distance zones, foreground, middleground, and background, are "divisions of a particular landscape being viewed ... they are used to describe the part of a characteristic landscape that is being inventoried or evaluated" (USDA, 1974). Different textures act to create unique effects. "Fine ground textures--moss, monolithic pavement, or close-cropped grass--tend to emphasize the shape and mass of the underlying ground and to increase its apparent size. They act as a background for the objects that rise from them. Coarse textures--rough grass, cobble, bricks, or blocks--work in the opposite way, calling attention to the surface itself rather than to the underlying mass or the objects above it" (Lynch, 1971).

PREFERENCE

It is generally accepted that certain textures are preferred over others. In addition Collier (1963) notes that "strongly contrasting textures have
considerable power to arouse a strong aesthetic response--attraction or repulsion. Given that contrasting textures can evoke a strong preference opinion, it is expected that texture could act as a predictor of preference. That specific textural preferences exist has been substantiated by Gallagher (1977) who suggests that "as texture of the ground plane becomes finer, it can be expected that preference will increase." This is also inferred from Kaplan's (1975) finding that "fineness of texture is a legibility component; the finer the texture the more clearly the figures are distinguished from the ground." It appears that preference for finer textures has its roots in the evolution of man. Finer textures enabled man, an animal dependent on hunting for survival, to distinguish figures from the ground plane, thereby providing for his continued existence.

Kaplan's theory is supported by his study (1975) which found a high preference for a "high spacious-smooth texture" scene. Gallagher (1977) proposes that scenes which portray "early successional natural landscapes composed of tall grass, forbs, and small shrubs that make visibility and movement difficult" are "particularly low in preference". Using the same rationale, he suggests that "mature stands of trees with shaded understories, having ground surface covered only with fallen leaves would have high preference." Other studies have revealed additional factors relevant to texture preference. Zube's study (1975), for example, suggests that "as landform becomes more rugged and more pronounced scenic resource value increases." This appears to support Collier's suggestion that it is contrast between textures which becomes one factor in determining whether a scene has high or low preference. Brush and Shafer (1975) maintain that it is "the sense of depth in a view, as established by textural gradients and overlapping landforms that is... a major factor in scenic preference."

Thus, texture provides further explanation of a scene and can be identified as an independent subjective attribute in the attempt to map visual quality. Texture can be described as the surface quality (uniform or disjointed, fine or coarse) which adds emphasis to form, color, and line definition and description. Therefore, perception of different textures and textural preferences are dependent upon spaciousness (amount of visibility), the textural gradient, and the textural contrast produced by the elements within
the cells.

PROCEDURE

TEXTURE PREFERENCE (Figure 25) is displayed in map form and depicts a continuum of the textures occurring in the study area and as such becomes a subjective attribute in the visual assessment model. The degree of spaciousness, smoothness, and textural contrast was used to describe and evaluate texture preferences. The composite of these indicators was the basis for the ranks on the TEXTURE PREFERENCE map.

A combination of five factor maps were used to indentify various textures and to develop the categories which are displayed on the texture map. They were:

Vegetation T1
Landuse T2
Streams T3
Roads T4
Rock-Out T5

TEXTURE FLOWCHART
Figure 24

Vegetation Factor--This factor map displayed significant vegetative texture categories specifically--Grassland, Shrubland, Mixed Grass and Shrubland, Deciduous Forests and Mixed Forest. However, the Altered and Developed category on this map included agriculture as well as infrastructures,
a category too broad thus requiring modification and refinement by the addition of other data (T1).

Landuse Factor--The categories on this map that contributed additional information pertinent to texture were Residential, Commercial, Service, Mining, and Logging. Residential, Commercial and Service were considered to be similar in texture and were placed in one category. The Stripmined cells and clearcut Logging cells were combined and placed in another category to be included in the final computations (T2).

Streams Factor--The 2nd and 3rd Order Streams were grouped together into one category since the size of these channels and the stream banks were similar. The Red River with steep banks was texturally different from the 2nd and 3rd Order Streams and was, therefore, designated as a separate category. The first order streams were not categorized because they are intermittent and have stream beds dominated by surrounding vegetation. Therefore, the textural quality of the stream bed is not greatly different than the rest of the cell (T3).

Roads Factor--Recognizing that the data resolution of the study area is one acre, the only road which contributed significantly to textural quality was the four lane Mountain Parkway (T4).

Rock Outcropping and Roadcuts Factor--These factors were placed in one category as they exhibited similar textures (T5).

The modified factor maps (T1 thru T5) were overlaid in the following manner to create a map, TEXTURE, which identifies the textures in the study area. Cells which contained two or more values represented potential conflicts and were analyzed independently. In addition to the conflicts some categories remained reasonably similar and were combined in the interest of simplification and clarity.

T1 and T2, the modified Vegetation and Landuse maps, identified conflicts between the Altered and Developed category and the Residential, Commercial and Service. The cells in the Altered and Developed category that conflicted with
the Residential, Commercial and Service cells were placed in one category called Residential, Commercial and Service while the remaining cells in the Altered and Developed category became a second category, Agriculture-Row Crops. Additional specificity was obtained with the Logging and Stripmining designation which overrode any other conflicting designation.

T3, the modified Streams map, when overlaid created additional conflicting textural designations. The 2nd and 3rd Order Streams in the Agricultural-Row Crop cells and in the Grasslands affect similar textural contrasts and were placed in a new category 2nd and 3rd Order Streams and Agriculture. Also, the size and intermittent character of these streams when compared to the magnitude and mass of Shrubs, Deciduous and Mixed Deciduous Forest led to the decision to eliminate the categories of 2nd and 3rd Order Streams and Shrub, Mixed Grass and Shrub, Deciduous and Mixed Deciduous Forest. In the interest of clarity, whenever these conflicts arose the cells were placed in the Vegetation category. Similarly, conflicts between 2nd and 3rd Order Streams and Infrastructure, Residential, Commercial and Service were assigned to the Infrastructure category. The conflicts that arose from the Red River were placed into two new categories, Red River and Agriculture-Row Crop and Red River and Forest (both deciduous and mixed deciduous) land. The forest types were combined because the textural contrast between the river and tree masses was similar.

T4, modified Roads, was overlaid and all the conflicting cells were analyzed and placed in the Infrastructure category since their surface texture was considered to be similar to the man-influenced structures.

The final overlay includes T5, the modified Rock Outcrop map. The rock outcroppings and roadcuts other than those along the Mountain Parkway were included in the category of Strip Mined Land and Clear Cut Logging since, at this scale, there are some textural similarities. Since the road cuts along the Mountain Parkway were not severe they were included in the Infrastructure Highway category.
TEXTURE PREFERENCE
SCALE: 208.0 FT PER CELL

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>VALUE</th>
<th>LABEL</th>
<th>NO. OF CELLS</th>
<th>PCT. OF MAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>BBBBBBBB</td>
<td>2</td>
<td>MINING-ROCKOUT-LOG</td>
<td>61</td>
<td>.84</td>
</tr>
<tr>
<td>SSSSSSSSSS</td>
<td>3</td>
<td>INFRA-HOUSES AND HIGHWAY</td>
<td>999</td>
<td>13.23</td>
</tr>
<tr>
<td>LLLLLLLLLL</td>
<td>4</td>
<td>DECID FOREST</td>
<td>1934</td>
<td>26.77</td>
</tr>
<tr>
<td>VVVVVVVVVV</td>
<td>5</td>
<td>SHRUBLAND</td>
<td>52</td>
<td>.72</td>
</tr>
<tr>
<td>&lt;&lt;&lt;&lt;&lt;&lt;&lt;&lt;&lt;&lt;&lt;&lt;</td>
<td>6</td>
<td>MIXED FOREST</td>
<td>1028</td>
<td>14.23</td>
</tr>
<tr>
<td>XXXXXXXXXX</td>
<td>7</td>
<td>2ND-3RD ORDER-AGR ROW</td>
<td>233</td>
<td>3.25</td>
</tr>
<tr>
<td>0000000000</td>
<td>8</td>
<td>AGR ROW CROP</td>
<td>2679</td>
<td>37.08</td>
</tr>
<tr>
<td>YYYYYYYYYY</td>
<td>9</td>
<td>RED RIVER IN AGR-ROW</td>
<td>126</td>
<td>1.74</td>
</tr>
<tr>
<td>/////////////</td>
<td>10</td>
<td>MIXED GRASS-SHRUB</td>
<td>73</td>
<td>1.01</td>
</tr>
<tr>
<td>TOTAL NO. OF CELLS = 7225</td>
<td>11</td>
<td>RED RIVER IN FOREST</td>
<td>13</td>
<td>.18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GRASSLAND</td>
<td>23</td>
<td>.33</td>
</tr>
</tbody>
</table>

Figure 25.
Preference decisions, predicated upon the research, revolved around three variables which were spaciousness, a texture continuum—fine to coarse, and the degree of textural contrasts within the cell. They are displayed on TEXTURE PREFERENCE map (Figure 25).

11-Grassland—exhibited distinctive qualities of spaciousness, texture and textural contrast continuums.

10-Red River in Forests—exhibited an average degree of spaciousness and distinctive degrees of texture and textural contrast.

09-Mixed Grass/Shrub Land—distinctive spaciousness, average texture continuum and distinctive textural contrasts.

08-Red River in Agricultural Row Crop—Average spaciousness, average on the texture continuum and distinctive textural contrasts.

07 Agriculture-Row Crop—distinctive spaciousness, average texture continuum and textural contrasts.

06-2nd and 3rd Order Stream in Agriculture/Row Crop—exhibited average qualities in all categories, spaciousness, texture and textural contrast.

05-Mixed Forest—exhibited a minimum degree of spaciousness, average on the texture continuum and distinctive textural contrast.

04-Shrubland—exhibited average degrees of spaciousness, texture and textural contrast.

03-Deciduous Forest—exhibited a minimal degree of spaciousness, minimum rank on the texture continuum and an average degree of textural contrast.

02-Infrastructure, Residential, Commercial, Service and Highways—exhibited an average degree of spaciousness, a minimum degree on the texture continuum
and a minimal degree of textural contrast.

OL-Mining, Logging and Rock Outcropping--exhibited minimal degrees of spaciousness, texture and textural contrast.
LINE ATTRIBUTE

DEFINITION

Along with form, color and texture, the landscape is viewed or seen in terms of line. Line contributes to the above elements to make up what is viewed. Therefore, the arrangement of lines, textures, forms, and colors is largely responsible for the "visual expressiveness" of the scene (Beam, 1958). "We do not let a line remain only a line. Grouped with other lines in a pattern, or combined with certain textures and colors, it assumes a recognizable form" (Beam, 1958).

Line can be defined as a "series of things arranged in continuous or uniform order" (Merriam-Webster Thesaurus, 1978) or as "anything that is arranged in a row or sequence" (USDA, 1975). It delineates what is there. It expresses an edge by demarcating the spaces where two different events occur. For example, "a row of trees may imply a line or boundary and points in close proximity may communicate a line" (Van Dyke, 1982). This orderly arrangement of points or objects is not static, since they give a "sensation of direction" (Dondis, 1973). In addition, a line is "restless, probing ... it has direction and purpose, is going somewhere, and is doing something definitive" (Dondis, 1973).

A line also serves the purpose of describing form (Dondis, 1973). According to Collier (1963), line provides an awareness of the structure of the form. Bevlin (1977) defines line as being closely related to shape and form—"we cannot have shape without the lines that indicate its edges or without the space from which the lines carve a shape." In addition to defining form, line delineates colors and textures by expressing an edge. "The contrasts between values may create an edge or line" (Van Dyke, 1982). Finally, line can lead an individual's eye, enable that individual to perceive space, and invoke a response in the individual.

PERCEPTION

It is universally accepted that line is a product of mathematical definition
thus a geometric line can be understood in terms of pure concept. In a more obtuse sense line can be perceived aesthetically as an awareness of kinesthetic sensation with the curvature, and secondary characteristics of movement, width, intensity, and quality (Pepper, 1949). A line can be structural in that it implies strength, delicacy, and movement (Selleck, 1975) or a line can be implied where it does not actually exist such as a line that delineates textures and creates patterns.

Research in the visual cortex of the brain indicates that the brain "perceives" more clearly in terms of edges (Kepes, 1972). Studies of human eye movement when viewing photographs and paintings have shown that the attention of the viewer is most often focused at points along edges (Brush and Schaefer, 1975).

With regard to how line is perceived Collier (1963) has drawn several conclusions:

1. When an area is not completely contained by lines—when space penetrates it from neighboring areas—the area recedes.
2. The heavier the weight of line, the more frontal dominance it and the surrounding space will have.
3. The quality of a line may also relate to depth... sharp, incisive lines come forward; broken, blurred or gray lines recede.

The perception of line is important to the assessment of visual quality because "we recognize most things by their shapes... although space is everywhere, we cannot perceive it until it has been limited, or demarcated, by lines and shapes" (Bevlin, 1977).

PREFERENCE

Line preference studies indicate that scenes which express a strong sense of edge and a sense of mystery are preferred. According to studies reported by Brush and Shafer (1975) the lines preferred are "the prominent edges between the forest canopy and open ground or water, edges that separate masses of contrasting texture and tone." Horizontal lines tend to suggest "serenity and calm" (Van Dyke, 1982) and "repose and stability" (Bevlin, 1977) which is seen
in the line of a tree canopy and an adjacent body of water.

The perception of line, therefore, does not rest solely within what is immediately seen. It can also imply qualities that cause an emotional response in the viewer (Bevlin, 1977). Direction is one way that line can effect perception. Vertical lines tend to suggest strength and support, while at the same time a defiance of gravity, especially in contrast against horizontal lines. Diagonal lines, on the other hand, become agitating as their proportion increases. They tend to be "dynamic and energetic ... throw us off balance, demanding our attention. Vigorous, ragged, curving lines may imply terror or turbulent emotions in general" (Bevlin, 1977). The arc or segment of a circle has an equal and constant change of direction. Because of this repetition, it is the most unified of curves but also the most monotonous and uninteresting, because of lack of variety" (Graves, 1951). The spiraling curves seen in living, growing things are more dynamic. The zigzag, jagged, or crooked line with its sudden, abrupt change of direction, is nervous and jerky. The rhythm is spasmodic and staccato. The line is excited, erratic; it suggests electrical energy of lightning, agitated activity or conflict, battle, and violence" (Graves, 1951).

As discussed previously in the Form Preference section, mystery, or the promise of further information from a scene if you could enter into it, has been shown to be of importance in determining preference. In line preference, mystery once again appears to play an important role. It is line that leads the viewer into a scene—a trail through the woods, a road around a bend, etc. It is also proposed by Whyte (1970) and Dasmann (1968) that edges are particularly attractive to people because of evolutionary ties. A cleared meadow allows the eye to quickly scan an area in search of food or enemies. The cleared meadow or field will result in a line which demarcates the cleared from the uncleared area. It is for this reason that edge (i.e. the demarcating line) is preferred (Gallagher, 1977).

In the visual quality assessment model, therefore, line can be identified as an important subjective attribute. Commonly it occurs in man-made features and elements such as overhead power lines, above ground pipelines, fences, highways, access roads and buildings. In a slightly less precise sense line
results from man-influenced elements such as row crops, contour farming and strip cropping. In a more informal sense a line can also be made up of natural elements such as the edge of a meadow, a ridgeline, a treeline, a stream or a river. Whether a line is an articulator of form (Dondis, 1973) or is implied and evokes a sense of perception it must be considered in the development of a visual assessment model.

PROCEDURE

A line preference continuum (Figure 26) was developed using the information above, which ranks by preference the variety of lines found in the study area. At the low end of the spectrum, in the least preferred position, is an absence of line, followed by jagged lines, diagonal lines and, at the mid-point of the continuum, arched or curved lines. Continuing toward the most preferred line are vertical lines, and then spirals, followed by horizontal lines. In the most preferred category, is gentle curves which relate more fully to a sense of mystery.

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>J</td>
<td>D</td>
<td>S</td>
<td>A</td>
<td>V</td>
<td>S</td>
<td>H</td>
<td>G</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>A</td>
<td>I</td>
<td>T</td>
<td>R</td>
<td>E</td>
<td>P</td>
<td>O</td>
<td>E</td>
<td>U</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>A</td>
<td>R</td>
<td>C</td>
<td>R</td>
<td>I</td>
<td>R</td>
<td>N</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>G</td>
<td>G</td>
<td>A</td>
<td>H</td>
<td>T</td>
<td>R</td>
<td>I</td>
<td>T</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>E</td>
<td>O</td>
<td>I</td>
<td>E</td>
<td>I</td>
<td>A</td>
<td>Z</td>
<td>L</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>D</td>
<td>N</td>
<td>G</td>
<td>D</td>
<td>C</td>
<td>L</td>
<td>O</td>
<td>E</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>A</td>
<td>H</td>
<td>A</td>
<td>N</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>T</td>
<td>L</td>
<td>T</td>
<td>Y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>S</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>T</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LINE PREFERENCE CONTINUUM

Figure 26.
The aesthetic and geometric lines that manifest themselves in the study area, are the Red River and the corresponding tree line, the third order streams in the floodplain, the tree line around the forest, roads and ridge tops. The four Factor maps that were used are Streams, Vegetation, Landform and Roads (Figure 27).

L1-- modified Streams Factor map--developed by isolating the Red River and then using a neighborhood function within the software package to assign values to the cells on either side of the river thus identifying the tree lines along the banks. A second modification included the addition of the 3rd order streams in the floodplain. All other streams were excluded from this map.

L2-- modified Vegetation Factor map--identified one category, tree masses, which combined the deciduous and mixed deciduous categories. This was done in order to develop and display the tree line between this category and all other categories. It was necessary to develop a subroutine for the MAP package which compared the values in the cell immediately to the left of the each cell and then recorded and printed the absolute value of this operation. A similar operation was written to evaluate the cell immediately above each cell and when a composite map was examined (the
addition of these two maps) the tree line around the tree masses was identified.

L3-- modified Landform Factor map--includes a line category and ridgetops since they formed the skyline in the study area. However, the transitions between the toeslopes, sideslopes and terrace were gradual, not crisp lines, and therefore they did not form a line category.

L4-- modified Road Factor map--has two categories: the first category includes the circuitous secondary roads and the second category contains the straighter, wider, more dramatic Mountain Parkway.

RANKING

The preceding maps were overlaid creating a LINE map. Each line category was identified and the composite map was displayed and then ranked according to the LINE PREFERENCE CONTINUUM (Figure 24). The LINE PREFERENCE Map (Figure 28) is further explained by the following labels:

10--Red River--A 6th order stream creates gently curved lines that imply a great deal of mystery.

09--Tree Lines--created by the interface of the forest masses and man influenced activities. The tree line also includes those tree lines along the banks of the Red River.

08--Third Order Streams--in the floodplain produced irregular curving lines. However they are not strongly defined nor do they imply mystery.

07--Secondary roads--exhibited curved, spirals and also developed some irregular patterns.

05--Ridgeline--exhibited an arched line which defines the skyline in the study area.
**Figure 28.**

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>VALUE</th>
<th>LABEL</th>
<th>NO. OF CELLS</th>
<th>PCT. OF MAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>LLLLLLLLLL</td>
<td>0</td>
<td>MOUNTAIN PARKWAY</td>
<td>5311</td>
<td>73.51</td>
</tr>
<tr>
<td>VVVVVVVVVV</td>
<td>4</td>
<td>RIDGE LINE</td>
<td>86</td>
<td>1.19</td>
</tr>
<tr>
<td>XXXXXXXXXX</td>
<td>5</td>
<td>SECONDARY ROADS</td>
<td>182</td>
<td>2.52</td>
</tr>
<tr>
<td>GGGGGGGGGGGG</td>
<td>7</td>
<td>THIRD ORDER STREAMS</td>
<td>527</td>
<td>4.53</td>
</tr>
<tr>
<td>YYYYYYYYYY</td>
<td>8</td>
<td>TREE LINE AROUND VEG+RR</td>
<td>1579</td>
<td>15.63</td>
</tr>
<tr>
<td>///////////////</td>
<td>9</td>
<td>RED RIVER</td>
<td>133</td>
<td>1.94</td>
</tr>
<tr>
<td>TOTAL NO. OF CELLS =</td>
<td></td>
<td></td>
<td>7225</td>
<td></td>
</tr>
</tbody>
</table>
04--Mountain Parkway--exhibited a strong arching curved line. It is also a slicing line which could be considered horizontal diagonal.

00--No lines that could be identified with the available data and at the designated cell resolution.
The VISQUAL map (Figure 29) is an overlay of the weighted attributes COLOR, FORM, TEXTURE AND LINES PREFERENCES and represents the visual quality value of each grid cell under consideration. Establishment of weights was accomplished by utilizing a decision making program, Weighted Eigenvector for Landuse Decisions (WELD) (Nieman and Meshako, 1985). WELD, an interactive computer program, is executed on the HP3000 minicomputer and was developed at the University of Kentucky, Department of Horticulture and Landscape Architecture and is available upon request. It enables the user to determine the relative importance (weights) for 3 or more attributes, the results of which are represented by two unit vectors (Table 1). The first vector reflects the intuitive preference perceptions of the decision makers. In this study perceptions as to preference for the attributes of visual quality were very similar. The second vector is the result of comparisons of the attributes considered and weighted two at a time (evaluations). These evaluations are the elements of a reciprocal comparison matrix which when evaluated with respect to the maximum eigenvalue is the second unit vector. The unit vectors are then averaged, and since there are 4 attributes, they are multiplied by 4 times 10 and truncated to become integers. These integers are the weight coefficients used to determine visual quality in the homogeneous unit, including the waterways.

The VISQUAL map represents a continuum of visual quality as determined by the application of land use factors to the attributes of color, form, texture and line. The four categories selected were: 04--DISTINCTIVE, 03--GOOD, 02--AVERAGE, 01--MINIMAL. Except for the GOOD category these descriptors are the same as those used by the USDA, Soil Conservation Service (1978) in their visual resource quality approach.

04--DISTINCTIVE--represents the highest value on the visual quality continuum. The predominant cell designations on each of the preference maps are as follows:

COLOR (Table 2)--Cover-Row Crop and River-Stream.
Enter title of proposed landuse -- VQ

Enter number of landuse attributes to be weighted -- 4

Enter title for attribute # 1 COLOR
Enter title for attribute # 2 FORM
Enter title for attribute # 3 TEXTURE
Enter title for attribute # 4 LINE

Enter relative degree of importance (0.0 to 1.0) for COLOR .5
Enter relative degree of importance (0.0 to 1.0) for FORM .5
Enter relative degree of importance (0.0 to 1.0) for TEXTURE .3
Enter relative degree of importance (0.0 to 1.0) for LINE .4

Begin Paired Comparison of Attributes

More Important -- 1) COLOR OR 2) FORM ? 2
How Important (1 to 9) ? 4

More Important -- 1) COLOR OR 2) TEXTURE ? 1
How Important (1 to 9) ? 3

More Important -- 1) COLOR OR 2) LINE ? 1
How Important (1 to 9) ? 3

More Important -- 1) FORM OR 2) TEXTURE ? 1
How Important (1 to 9) ? 5

More Important -- 1) FORM OR 2) LINE ? 1
How Important (1 to 9) ? 3

More Important -- 1) TEXTURE OR 2) LINE ? 2
How Important (1 to 9) ? 2

WEIGHTED EIGENVECTORS FOR LANDUSE DECISIONS (WELD)

Table 1
Eigenvalue Scalar = 4.20586

The WELD Application Formula for VQ is:

\[ \frac{(11 \times \text{COLOR} + 17 \times \text{FORM} + 5 \times \text{TEXTURE} + 7 \times \text{LINE})}{40} \]

**VECTOR 1** = NORMALIZED VECTOR FROM SUBJECTIVE INPUT

**VECTOR 2** = UNIT EIGENVECTOR

**COEFF** = THE AVERAGE OF VECTOR1 AND VECTOR2 MULTIPLIED BY 10N, WHERE N IS THE NUMBER OF ATTRIBUTES.

WEIGHTED EIGENVECTORS FOR LANDUSE DECISIONS (WELD)

Table 1 (cont.)
**VISUAL**

**SCALE:** 208.0 FT PER CELL

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>VALUE</th>
<th>LABEL</th>
<th>NO. OF CELLS</th>
<th>PCT. OF MAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>M M M M M M M M</td>
<td>1</td>
<td>MINIMAL</td>
<td>57</td>
<td>.79</td>
</tr>
<tr>
<td>..............</td>
<td>2</td>
<td>AVERAGE</td>
<td>5428</td>
<td>75.13</td>
</tr>
<tr>
<td>G G G G G G G G</td>
<td>3</td>
<td>GOOD</td>
<td>1293</td>
<td>17.90</td>
</tr>
<tr>
<td>D D D D D D D D D D D D D D D D</td>
<td>4</td>
<td>DISTINCTIVE</td>
<td>447</td>
<td>6.19</td>
</tr>
</tbody>
</table>

**TOTAL NO. OF CELLS = 7225**

**Figure 29**
### Table 2

<table>
<thead>
<tr>
<th>Visual Quality Designation</th>
<th>DISTINCTIVE</th>
<th>GOOD</th>
<th>AVERAGE</th>
<th>MINIMAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 Cover-Row Crops</td>
<td>314</td>
<td>996</td>
<td>128</td>
<td></td>
</tr>
<tr>
<td>10 Commer-Service-Res.</td>
<td>133</td>
<td>6</td>
<td>74</td>
<td></td>
</tr>
<tr>
<td>9 Red River-Streams</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Mixed Forest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Mixed Grass and Shrubland</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Deciduous Forest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Grassland/Fallow</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Rock Outcropping or Roadcut</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Mining</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Logging</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Shrubland</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 Proposed Development</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 3

<table>
<thead>
<tr>
<th>Visual Quality Designation</th>
<th>DISTINCTIVE</th>
<th>GOOD</th>
<th>AVERAGE</th>
<th>MINIMAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Floodplain</td>
<td>314</td>
<td>1278</td>
<td>1038</td>
<td></td>
</tr>
<tr>
<td>9 Red River</td>
<td>133</td>
<td>6</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>8 Structures in Mountain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Mountain Pastures, Rangeland</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Structures in Floodplain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 2nd-3rd Order Streams</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Semisolids in Mountain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Semisolids in Floodplain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Logging, Stripmines</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Rockout Crops and Roadcuts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### COLOR (Figure 19)

VISUAL QUALITY ASSESSMENT

Table 2.

### FORM (Figure 23)

VISUAL QUALITY ASSESSMENT

Table 3.
### Visual Quality Designation

<table>
<thead>
<tr>
<th>Preference Categories</th>
<th>DISTINCTIVE</th>
<th>GOOD</th>
<th>AVERAGE</th>
<th>MINIMAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 Grassland</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 Red River in Forest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 Mixes Grass-shrubland</td>
<td>11</td>
<td>1</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>8 Red River in Row Crop</td>
<td>122</td>
<td>4</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>7 Row Crops</td>
<td>314</td>
<td></td>
<td>1082</td>
<td></td>
</tr>
<tr>
<td>6 2nd-3rd Order Streams</td>
<td></td>
<td></td>
<td>235</td>
<td></td>
</tr>
<tr>
<td>5 Mixed Forest</td>
<td></td>
<td></td>
<td>1028</td>
<td></td>
</tr>
<tr>
<td>4 Shrubland</td>
<td></td>
<td></td>
<td>51</td>
<td>1</td>
</tr>
<tr>
<td>3 Deciduous Forest</td>
<td></td>
<td></td>
<td>1934</td>
<td></td>
</tr>
<tr>
<td>2 Infrastructures and Highways</td>
<td></td>
<td>982</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>1 Mining, Rockout and Logging</td>
<td></td>
<td>22</td>
<td>39</td>
<td></td>
</tr>
</tbody>
</table>

**TEXTURE (Figure 25)**

**VISUAL QUALITY ASSESSMENT**

Table 4.

<table>
<thead>
<tr>
<th>Preference Categories</th>
<th>DISTINCTIVE</th>
<th>GOOD</th>
<th>AVERAGE</th>
<th>MINIMAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Red River</td>
<td>133</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 Tree Line around vegetation and Red River</td>
<td>231</td>
<td>299</td>
<td>599</td>
<td></td>
</tr>
<tr>
<td>8 3rd Order Streams</td>
<td>83</td>
<td>7</td>
<td>231</td>
<td>6</td>
</tr>
<tr>
<td>7 Secondary Roads</td>
<td></td>
<td></td>
<td>180</td>
<td>2</td>
</tr>
<tr>
<td>5 Ridge Line</td>
<td></td>
<td></td>
<td>69</td>
<td>17</td>
</tr>
<tr>
<td>4 Mountain Parkway</td>
<td></td>
<td></td>
<td>4292</td>
<td>32</td>
</tr>
<tr>
<td>0 No Line</td>
<td>987</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**LINE (Figure 28)**

**VISUAL QUALITY ASSESSMENT**

Table 5.
FORM (Table 3)--Flood Plain and Red River.

TEXTURE (Table 4)--Agriculture and Row Crop and Red River in Agriculture and Row Crop.

LINE (Table 5)--Red River, Tree Lines around vegetation masses, along Railroads, and along secondary Roads.

Based on the WELD decision making model used, the combination of the above categories within the attributes provided 447 cells or 5.2% of DISTINCTIVE visual quality. It is interesting to note that the high categories on the TEXTURE PREFERENCE were not included in the distinctive area. While TEXTURE was not weighted high in the WELD model several upper, mid-range values, (Red River in Agriculture and Row Crops) were selected. Only 10 of the total continuum categories were selected in the overlay of the attributes. The reason that these cells came out as distinctive was that the majority of the values were located in the same cells.

03-GOOD--represents the next highest value on the visual quality continuum. Cells in this category are recognized as being of good but not exceptional visual quality. The designations on each of the preference maps are generally as follows:

COLOR (Table 2)--Cover-Row Crop and some of the lower ranked Grass-Fallow category.

FORM (Table 3)--nearly all of the cells were in the high valued Floodplain category.

TEXTURE (Table 4)--nearly all of the cells were in the upper range Agriculture and Row Crops category.

LINE (Table 5)--approximately three fourths of the cells contained no discernable line with approximately one fourth falling into the highly ranked Tree Line around Vegetation Masses and Tree Line along Railroad category.
The combination of categories within the attributes provided 1293 cells or 17.9% of GOOD visual quality. The highest valued cells occurred in the color preference and the form preference categories. Texture values were mid-range, while line values were very low. In the GOOD visual quality category 15 of the continuum categories were selected. Also, they were spread along the continuum to a much greater degree than that of the DISTINCTIVE. This indicates that fewer high quality values occurred in the same cells, thus indicating areas of lower visual quality.

02-AVERAGE--represents the mid-range value in the visual quality continuum. Cells in this category are determined to be ordinary, with few or no distinguishing characteristics. The designations within each of the preference maps are widely spread as follows:

COLOR (Table 2)--the majority of the cells occurred within the mid-range categories with some of the cells in the two upper levels.

FORM (Table 3)--the majority of the cells occurred within the mid-range of the continuum with a large grouping occurring in the high range.

TEXTURE (Table 4)--the major grouping of cells occurred in the lower mid-range of the continuum with a large number occurring at the lower end of the scale.

LINE (Table 5)--the majority of the cells contained no distinguishable line with a few cells distributed throughout the mid-value range of the continuum.

The combination of the categories within the attributes provided 5428 cells or 75.1% of AVERAGE visual quality. In this case the cells are widely scattered, in fact 37 of the 40 continuum categories are represented. This indicates that only a moderate number of high quality values occurred in the same cells. There was little that would distinguish these cells from each other. While they may have some high value characteristics they also have several low quality characteristics.

01-MINIMAL--represents the lowest value on the visual quality continuum.
Cells in this category are determined to be of relatively low visual quality with little to distinguish them. The designations within each of the preference maps are as follows:

COLOR (Table 2)—the majority of the values occurred in the low ranked Rock Outcrop-Road Cut and the Mining categories.

FORM (Table 3)—all but one of the values occurred at the two lowest categories of the continuum. These are Logging-Strip mining and Rock Outcrop and Road Cut.

TEXTURE (Table 4)—as in FORM all but one of the values occurred at the low end of the preference continuum—Infrastructure, Houses, Highways, and Mining, Rock Outcrop, Logging.

LINE (Table 5)—better than one half of the preference values were in the No Line category with the remainder being in the next three lowest categories.

The combination of values within the four attributes provided 57 cells or 0.8% of MINIMAL visual quality. The cells are located consistently at the low end of each attribute spectrum. In a manner similar to the DISTINCTIVE rating there are few categories utilized (15 in this case) and the lower valued categories were grouped in these cells.

The resultant visual quality map (Figure 29) indicates the composite of the COLOR, FORM, TEXTURE and LINE preference attributes. From this map along with the associated descriptor categories it is possible to identify and assess the general visual quality of each cell in question.

In this study area the Red River and the area immediately associated with it tended to contain most of the high valued aspects of the attributes associated with visual quality. On this basis a planning recommendation might indicate that while this section of the Red River does not contain areas so "unique" that it should be preserved, care should be taken in the planning process to recognize that the river does contain visual quality worth consideration.
CHAPTER IV - CONCLUSIONS

The most significant result generated from this study is that data retrieved from existing Geographic Information Systems and other available physiographic and cultural data can readily be incorporated into a visual assessment model. As in the case with other computer-aided planning models data or factors such as slopes, vegetation, man-made features, etc. can be analyzed for their ability to identify and rank visual quality.

From the available visual quality and design research it was determined that certain fundamental perceptual attributes exist which enable the evaluation of visual quality in a homogeneous landscape unit. In this respect our research concluded that the applicable perceptual attributes were color, form, texture and line. It appears that these attributes account for sufficient preference to make an assessment of a landscape for visual quality in an objective sense a real possibility. The terms color, form, texture and line were defined very specifically to prevent any misunderstanding as to the intent in their use or preference attributes. Basically it was the compositional character and not overriding dominance that formed the attributes.

COLOR identifies color preferences which were based on the qualities of light-dark, warm-cool, and degree of saturation within each cell.

FORM identifies form preferences based on the compositional qualities of each cell namely, spaciousness, mystery, coherence and complexity.

TEXTURE identifies texture preferences dependent upon spaciousness, the textural gradient, and textural contrast produced by the elements within each cell.

LINE identifies the line preferences based on a continuum whose scope transverses the domain from no line through jagged, diagonals, arched, vertical, spirals, horizontal, to gentle curved lines implying mystery.
Once the factors that make up the four attributes are defined and analyzed with regard to their role in the visual assessment process, the decision making process is involved. The decision maker is asked, via the WELD process, to rank the preference attributes to determine the degree to which they act as a descriptor of visual quality. Once this is accomplished the attributes are overlaid in a manner consistent with WELD weights to provide data and a visual quality assessment map that can be used in the making of planning decisions.
REFERENCES


Crosowell, Peter et al. 1982. User Guide to the Data and Capabilities of Kentucky Natural Resources Information System. Lands Unsuitable for Mining Program, Kentucky Department for Natural Resources and Environmental Protection. Frankfort, Kentucky.


Kaplan, Rachel. 1975. Some Methods and Strategies in the Prediction of Preference in Landscape Assessment. ed. by Zube, Brush, Fabos. Stroudsburg,
Pennsylvania: Dowden, Hutchinson, and Ross Inc.


Kentucky Natural Resources Inventory System. 1980. Lands Unsuitable for Mining Program, Kentucky Department for Natural Resources and Environmental Protection. Frankfort, Kentucky.


National Environmental Policy Act, 1969. PL-19-190, Sec. 102 (2) (C).


