

Visual Absorption Capability¹

Lee Anderson^{2a/}

Jerry Mosier^{2b/}

Geoffrey Chandler^{2c/}

Abstract: Visual absorption capability (VAC) is a tool to assess a landscape's susceptibility to visual change caused by man's activities. This paper explores different descriptive approaches to VAC and addresses in depth the development of the VAC process used on the Klamath National Forest. Four biophysical factors were selected to assess VAC for the lands within the Klamath National Forest. These factors are slope, vegetative pattern and screening, site recoverability, and soil color contrast with the surrounding landscape. By combining this VAC analysis with Forest Service visual quality objectives, it has been possible to develop suitability assessments for Forest Service activities which impact the visual resource.

INTRODUCTION

"The progress of true civilization is best shown by the increasing thought which each generation takes for the good of those who are to come after.

"You can ruin its forests, you can dry up its streams, you can hack and scar its surface until its marvelous beauty is gone.

"The preservation of the forest resources . . . is of vital importance to the common wealth. I go farther. No state can be judged

to be really civilized which in the treatment of its natural resources does not take account of, or aim to, preserve the beauty of the land in which its people live. An aesthetic as well as economic factor is involved in the problem of conservation.

"Poor, indeed, is the conservation which does not also conserve beauty."

Theodore Roosevelt

Scenery is the most universally enjoyed natural resource in the United States today. Driving for scenic pleasure is our most popular recreational activity. Scenery contributes to our spiritual, emotional and physical well being. However, consumptive demands of society threaten the balance between conservation of scenic values and the efficient use of our natural resources. This dilemma emphasizes the need for resource utilization which considers the sensitive treatment of our visual resources. As environmental designers, our challenge is to facilitate development which is in harmony with the visual resource visual absorption capability (VAC) is a tool which helps us achieve this objective. Visual

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^{2a/}Forest Landscape Architect, Klamath National Forest, Yreka, California.

^{2b/}Landscape Architect, Klamath National Forest, Yreka, California.

^{2c/}Landscape Architect, Lassen National Forest, Susanville, California.

absorption capability may be considered as an element of the site analysis process which environmental designers have used for centuries. One objective of site analyses has been to harmonize man's activities with the natural elements. VAC is a way to apply this consideration to activities which impact the visual resource.

VAC is an analytical process which identifies the landscape's susceptibility to visual change. It is a measure of the land's ability to absorb alteration yet retain its visual integrity.

BACKGROUND

During the last decade, scenery has become a recognized resource of the National Forests of the United States. The public continues to demand amenity values in the National Forests, as well as a supply of products such as timber and range. These demands for visual resource management led to the establishment of the Forest Service Visual Management System in 1974. The Visual Management System establishes methods for inventorying and mapping variety classes and sensitivity levels and determining visual quality objectives. Visual quality objectives (VQO's) express the relative importance of visual resources in the National Forests based on the land's intrinsic scenic quality (variety classes) and its sensitivity to public viewing pressures (sensitivity levels). The development of visual quality objectives is just the first step in visual resource management of National Forest lands. The land manager must also know how difficult or easy it may be to achieve those visual quality objectives on one unit of land compared to another.

Visual absorption capability establishes such a methodology. It provides the basis from which an interdisciplinary team of field experts can determine the relative costs of meeting a particular visual quality objective. Visual absorption capability assists Forest Service landscape architects in determining where to locate such things as roads, utility lines, structures, fuel breaks, and rock quarries with the least visual impact. It also helps determine priorities for specialist involvement in project planning by identifying areas which are most visually vulnerable.

Some other uses of visual absorption capability are to develop visual resource management guidelines, to supplement site analyses and provide data for the development of various design and planning solutions, and to assess a landscape's potential for scenic degradation.

The VAC concept has predictive and prescriptive applications. For predictive purposes, VAC will forecast the visual impact on the landscape for a particular activity. Generally, a landscape with high absorption capability will accept alteration with less visual impact. For prescriptive purposes, VAC identifies a landscape's visual suitability for various development activities.

Visual absorption capability also serves as a leveling influence. Many people incorrectly assume that visual quality objectives of "retention" and "partial retention" are always extremely difficult or costly to attain. A high visual absorption capability rating in such areas would suggest the opposite and thus obviate restrictions which might otherwise be imposed. On the other hand, a low visual absorption capability rating would suggest management caution even in areas of lenient visual quality objectives, such as "modification" and "maximum modification." For these reasons, VAC was added to the Visual Management System in 1977.

VAC has been discussed and used for over 10 years. It has only been in the last couple of years that the concept has gained a solid foothold as a tool for landscape assessment and management in our National Forests. Several analytical approaches have been applied on various National Forests. This paper will discuss some of the different descriptive approaches as well as the approach used on the Klamath National Forest, headquartered in Yreka, California.

VAC FACTORS

In our literature review, 3 major groupings of VAC factors have been identified. Different terminology has been used to describe these 3 groupings, such as:

- 1) biophysical factors (biophysical variables, physical factors, biogeophysical factors, physical land types).
- 2) perceptual factors (observer-related variables, social variables, observer position factors).
- 3) proposed activities factors (target variables).

Biophysical factors refer to naturally occurring objects and processes of an area, such as geologic landform attributes, vegetation attributes, soil attributes, etc. They are relatively static except through human actions or natural disasters.

Perceptual factors pertain to how people view the landscape and include such things as viewing distance, viewing angle, duration of view, visual magnitude, etc. They are subject to rapid change as the observer moves through the landscape.

Proposed activities factors deal with specific landscape alteration activities and the associated impacts, such as a timber harvest and its deviation from form, line, color and texture in the surrounding landscape. These factors may be mitigated with increased planning, design, and implementation costs.

VAC analyses vary according to project requirements. Flexibility is accomplished by careful selection of the factors to be considered. Given current data manipulation technology, the approaches including dozens of factors would be cumbersome when applied to broad-scale planning levels, but efficient and effective when used in project scale work. Conversely, the approaches involving just one group of factors lend themselves more readily to broad-scale land planning efforts. Obviously, the planning and design of project scale work may require data concerning just one or several factors to determine visual absorption capability, depending upon project requirements and sensitivity.

The following list identifies examples of these factors.

Biophysical Factors

- Slope
- Vegetative pattern & diversity
- Vegetative screening ability
- Site recoverability
- Soil color contrast
- Landform diversity
- Waterform diversity
- Land stability
- Soil erodibility

Proposed Activities Factors

- Scale
- Configuration
- Duration
- Frequency

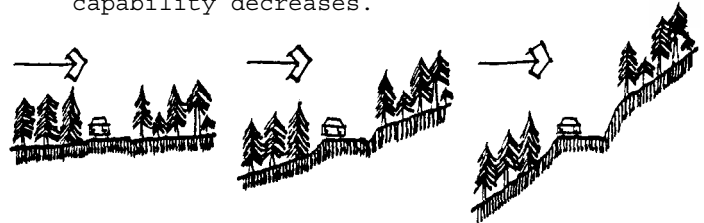
Perceptual Factors

- Distance
- Visual magnitude
- Slope relative to observer
- Aspect relative to observer
- Number of times seen
- Number of viewers
- Duration of view
- Focal point sensitivity
- Lighting
- Seasons

The effect of each factor, such as slope, can be expressed in a continuum or range of visual absorption capability from low to high.

Biophysical Factors

Figure 1--The most universally accepted biophysical VAC factor is slope. As slope ratio increases, the visual absorption capability decreases.



Vegetative pattern and diversity increase visual absorption capability. As vegetative screening increases, VAC increases. (figs. 2, 3)



Figure 2--Brush covered hills with no pattern and little screening ability have low VAC, ratings



Figure 3--Tall dense stands of conifers interspersed with barren areas and rock outcrops have high VAC due to the screening ability of the trees and the pattern in the landscape.

Lands with the highest contrast between soil color and the surrounding landscape have the lowest VAC. (fig. 4)

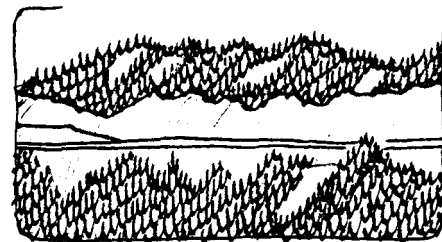


Figure 4--Disturbed landscapes that can revegetate quickly usually will have a high absorption capability. This is known as site recoverability.

Perceptual Factors

The most frequently used perceptual factor is observation distance. As distance from the observer to the activity increases, VAC generally increases.

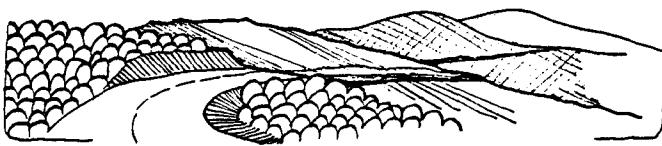


Figure 5--A road appears differently in foreground, middleground and background distances.

Visual magnitude is a VAC factor that combines slope relative to observer, aspect relative to observer and distance. It is capable of numerical measurement by computer

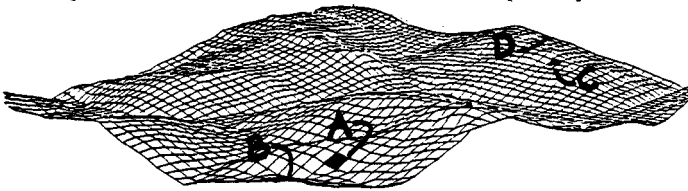


Figure 6--Cell A has a very low absorption capability because of its close proximity and its tilt toward the observer.

Cell B, although closer, has a higher absorption capability since it is tilted nearly on edge to the observer.

Cell C has a lower absorption capability than Cell B, despite its greater distance because it is tilted toward the observer.

Cell D has the highest absorption capability because of its distance and its tilt away from the observer. However, Cell D also appears to be on the ridge line. Care must be taken not to disrupt the silhouette against the skyline.

The amount of planning and design input necessary for a landscape activity will be indicated by the VAC rating. For instance, these landscapes (fig. 7, 8) have relatively low VAC with moderate slopes, little vegetative screening, high soil color contrast and close scrutiny by large numbers of concerned viewers.

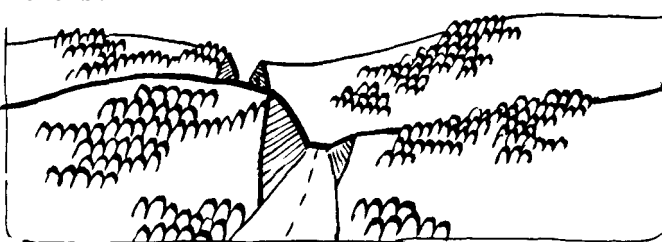


Figure 7--A standard road design introduces disruptive focal points. The early recognition

of the low VAC of this landscape would identify the need for special design consideration.

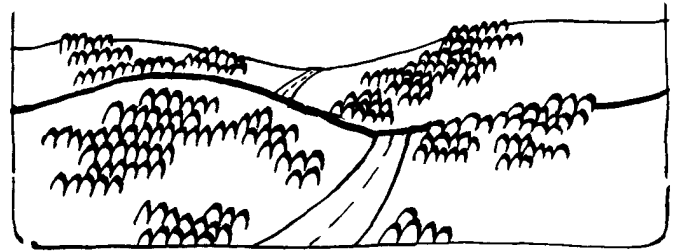


Figure 8--A well-planned, sensitively designed road can harmonize with the surrounding landscape.

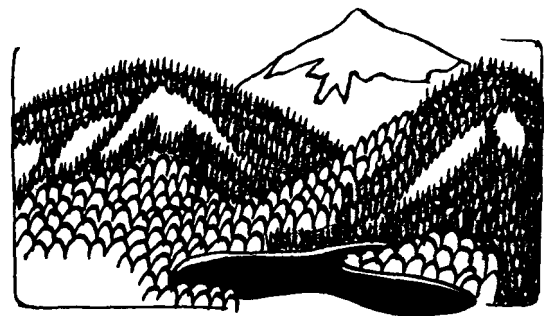


Figure 9--Areas near landscape focal points have lower capabilities to absorb alterations because they are subjected to closer viewer scrutiny.

Proposed Activities Factors

VAC varies with the visual characteristics of the landscape alterations, such as trail construction, clearcutting, or strip mining.

The scale, configuration, predicted contrast, duration and frequency of a proposed activity interacts with the biophysical and perceptual factors of the landscape to indicate how much impact the activity will have and/or how much planning and design will be required to blend the activity in with the landscape.

Generally, as the size of an activity (such as a clearcut) increases, the project area's VAC decreases. As the duration of the visual impact increases, VAC decreases. For example, the impact of a hydroelectric dam and reservoir may last virtually forever, while a wildlife habitat improvement which crushes existing brush to stimulate lower growing browse may visually impact an area for only a year or two. The reservoir changes VAC completely, whereas the habitat improvement would probably not alter VAC.

VAC APPLICATION ON THE KLAMATH NATIONAL FOREST

The Klamath VAC inventory was designed in 1977 to provide input to the 10-year Timber Management Plan for the entire Forest. The issues which were to be addressed by the plan included intensive development of new road systems and intensive timber management activities such as clearcutting and broadcast burning. The visual quality objective inventory was underway during the formulation stages of the T.M. plan. However, there was no indication of the practicality of meeting the VQO's. An overview of the visual absorption capability of the entire Forest indicated that it would be easier to meet VQO's in the Northeast Volcanic province than in the Klamath-Siskiyou province. This was due in large part to the rugged topography in the Klamath-Siskiyou. Because of the site specific nature of the various resource inventories which were being prepared for the T.M. plan, a detailed VAC and VQO analysis was undertaken for the entire Forest.

A determination of appropriate factors was the first step in the VAC inventory. Factor selection is determined by many things, including the planning level, time, money and manpower available, and the desired final product or interpretation. Factors for a VAC analysis of urban development in New England landscapes would obviously be different than factors for a VAC analysis of timber management in Northern California. Generally, the larger the area to be studied and the shorter the planning period, the fewer the number of VAC factors which can be incorporated into the study.

We chose to limit ourselves to only biophysical factors on the Klamath National Forest. There are several reasons for this decision.

First, we know that perceptual factors were already included in the visual quality objective mapping process (user sensitivity and viewing distance). Since our end product is a merge of VQO's with VAC ratings, we think that inclusion of perceptual factors in the VAC process would lead to unnecessary duplication and double weighting of these particular factors.

Secondly, we wanted to develop a VAC system which utilizes biophysical factors that are responsive to activities addressed in the T.M. plan; i.e., intensive timber harvesting, broadcast burning, and road construction on steep mountainous terrain. Additionally, the data for these biophysical factors were readily available and were cost effective to use; they could be assembled into a VAC map in a timely fashion for the T.M. plan as well as for land management planning and project planning.

The four biophysical factors we used to determine visual absorption capability are: 1) slope, 2) vegetative screening and pattern, 3) site recoverability, and 4) soil color contrast. The arithmetic formula to determine VAC is as follows:

$$\text{Slope} + \text{Vegetative Pattern and Screening} + \text{Site Recoverability} + \text{Soil Color Contrast} = \text{Visual Absorption Capability}$$

As an example of the Klamath VAC process, if a particular landscape has 1) flat slopes, 2) interesting vegetative patterns and tall trees for visual screening, 3) good vegetative recoverability after a disturbance, and 4) low soil color contrast, then this landscape has high visual absorption capability. Conversely, a landscape with steep slopes, a uniform brushfield with no patterns, poor site recoverability, and white or red soil colors in a green landscape, would have low VAC. Of course, many possible combinations exist for these four factors.

To arrive at VAC ratings for Klamath National Forest lands, arithmetic values were assigned to the four VAC factors. For example, slope was stratified into four classes with VAC values ranging from 0 to 9. Vegetation pattern and screening were determined from the timber type maps and given values from 0 to 6. Site recoverability and soil color contrast were interpreted by the soil scientists from their Soil Resource Inventory and were classified for VAC from 0 to 3 and 0 to 4, respectively.

These ranges of values were selected after extensive analysis and field verification. Slope received the most points because of the steep nature of the Klamath-Siskiyou mountains, where slopes can vary from 0 to 150%. The 4 slope classes were chosen because they approximate distinct visual slope breaks and because they correspond to various road building and timber harvesting techniques.

Vegetative pattern and screening data were only on a Forest-wide basis on the existing timber type maps. Tree species and size classes, which is the height of trees, give information about the screening ability of that vegetation. Crown closure percentages were the best approximation of vegetative patterns forest-wide. Differences exist in the patterns and screening ability of various commercial tree species, non-commercial hardwoods and brush. Based upon repeated field investigations, we stratified vegetation pattern and screening according to species, size class, and crown closure with values ranging from 0 to 6.

After the factor selection and evaluation process was completed for the T.M. plan, the four factors were then mapped at the same scale as the VQO's (1:24,000). A composite score based on the aggregate of the values was assigned to that piece of land for its various biophysical characteristics. Following are the criteria and values for each of the VAC factors:

SLOPE	VAC Value
0-20%	9
20-40%	7
40-60%	4
60% +	0

VEGETATION PATTERN and SCREENING				
Pine/Douglas Fir/Mixed Conifer				
Crown Closure:		0-30%	30-70%	70% +
Size Class	0-1	0	0	0
	2	1	3	2
	3	2	4	3
	4-5	3	5	4
Red Fir/White Fir				
Crown Closure:		0-30%	30-70%	70% +
Size Class	0-1	0	0	0
	2	1	3	2
	3	3	5	4
	4-5	4	6	5
Hardwood				
Crown Closure:		0-30%	30-70%	70% +
Size Class	0-1	0	0	0
	2	1	3	2
	3	2	4	3
Brush/Grass/Barren/Open				
Crown Closure:		0-30%	30-70%	70% +
S.C.	0-1	0	0	0

SITE RECOVERABILITY		
Duncan Dunning	Recoverability from S.R.I.	VAC Value
A	High	3
I		
II		
III	Moderate	2
IV	Low	1
V	Non-Commercial	0
Non-Comm.		

SOIL COLOR CONTRAST	
	VAC Value
Least: Dark-gray, blue-black or dark brown on green landscape.	4
Some: Light-gray, brown, or red-brown on green landscapes; or red on red landscapes.	2
Most: White or red on green landscapes.	0

For example, if a particular landscape has the following characteristics:

Slope = 20-40%
 Veg. = Red Fir, 30-70% crown density, medium sawtimber
 Site = Duncan-Dunning Site Class 2
 Soil Color Contrast = dark brown on green,

then the VAC = 7 (slope) = 6 (veg.) = 3 (site) + 4 (soil color contrast) = 20.

The VAC rating can range from a low of 0 to a high of 22. VAC ratings have been stratified into four general categories, High (17-22), Moderate (11-16), Low (7-10), and Very Low (0-6). Originally, there were only 3 categories of VAC: High (17-22), Moderate (11-16), and Low (0-10). Our field investigations highlighted the need for a further breakdown within the low category. There is a significant difference between VAC ratings of 0 to 6 and 7 to 10. Therefore, a very low category was created.

These breakdowns are responsive to visual differences in absorption capabilities of the landscape, rather than statistical rankings or bell curve distributions.

On the Klamath National Forest, we have mapped VAC primarily for broadscale planning. Consequently, our cost estimates are based on this level of work. Our experience on the Klamath is based upon two different VAC mapping techniques, one in which we assembled our own data base using existing information, and another in which we utilized a data base originally developed for land management planning.

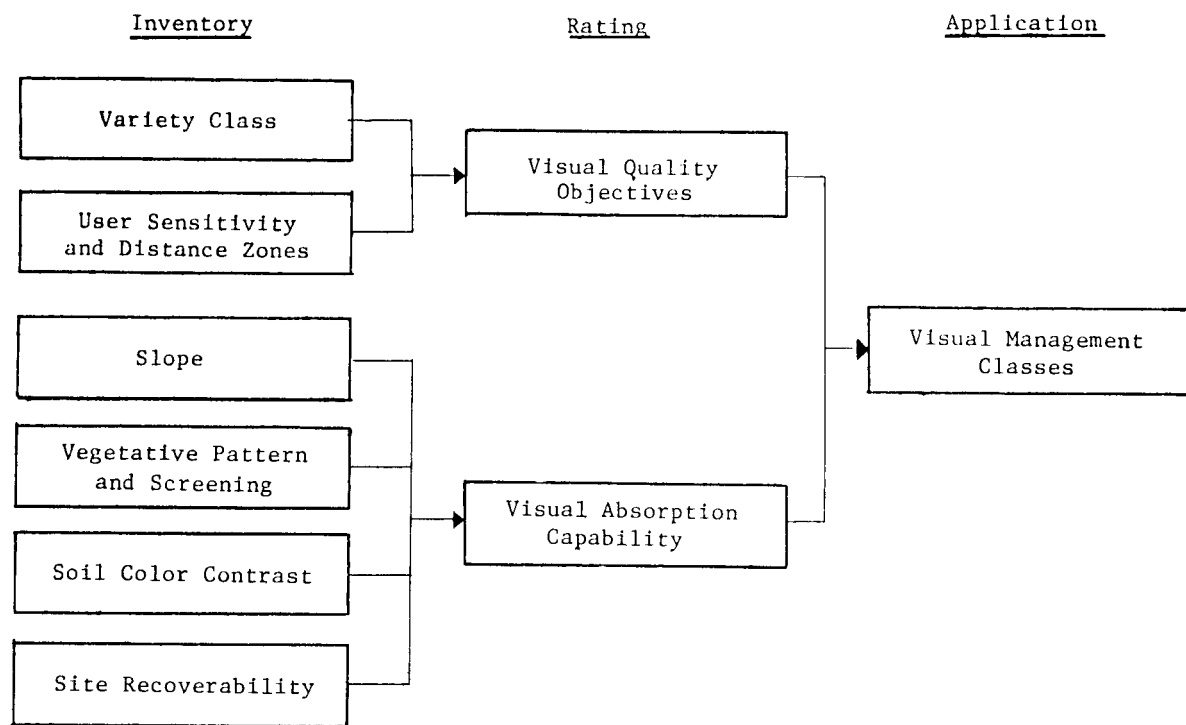
We were able to map a range of 5,000 to 10,000 acres per person-day, assembling our own data base using existing information. As the landscape complexity increases, the number of acres/day mapped for VAC decreases. Other factors affecting cost of VAC mapping are the number of factors considered, the availability of data, and accessibility into the landscape.

Utilizing a soil vegetation data base developed for forest planning, we were able to make VAC interpretations at the rate of 50,000 acres/person-day. All of the biophysical factors required for Klamath National Forest VAC mapping

process were assembled into soil-vegetative response units by Forest Soil Scientists at our request. Our interpretations were made from these response units and field checked for accuracy. This procedure is cost-effective only when variables necessary for a VAC analysis are included in an existing data base. It is imperative to spot field check areas for accuracy and consistency.

For project level work, we would expect the number of acres/day mapped to decrease, but the level of accuracy to increase, due to additional VAC factors which will be analyzed and the specific site and type of activity planned.

The end product of the visual resource analysis on the Klamath is a visual management class (VMC) map and guidelines for visual resource management. A VMC map consists of a discrete visual quality objective, distance zone and visual absorption capability rating. Visual management classes stratify landscapes in a continuum from visually vulnerable to visually tolerant. The most visually vulnerable landscape is "retention-foreground-very low VAC," and the most visually tolerant landscape is "maximum modification-seldom seen with a high VAC." The following diagram explains the relationship between VQO's, VAC, and VMC's.



CONCLUSION

Based on our experience in mapping and using VAC for the Forest land and resource management plan. In the future, we will consider vegetative pattern separately from vegetative screening. This is because the crown density from the timber type maps is not the best evaluation of pattern. Aerial photos, orthophoto maps, and field checking are better sources of vegetative pattern rankings.

On the Klamath National Forest, the VAC system utilizes a data base which is common to all disciplines involved in land management planning. This has allowed us to integrate and coordinate our concerns with other disciplines involved in the planning process. It has also been effective in the Klamath National Forest land management planning process because it has allowed timely consideration of the visual impacts associated with various resource activities.

The Klamath VAC system has been extensively field checked for accuracy and applicability by U.S. Forest Service landscape architects representing a variety of experience and geographical location. It has been effective in identifying lands with both low and high absorption capability. This has allowed us to emphasize increased resource utilization in areas with high absorption capability and decreased utilization in areas with low absorption capability. The end result is further resource utilization compatible with visual resource values.

VAC offers land managing agencies the opportunity to assess the intrinsic and extrinsic characteristics of an area of land to

absorb visually various resource activities. We expect it to become a standard inventory item in future landscape assessment projects.

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