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Scenic Assessment Methodology for Preserving Scenic Viewsheds of Virginia, USA

Patrick A. Miller [1], Jisoo Sim [2,*], Leighton Powell [3] and Lynn Crump [3]

[1] Landscape Architecture Program, Virginia Tech, Blacksburg, VA 24061, USA; pmiller@vt.edu
[2] Department of Landscape Architecture, Pusan National University, Miryang 50463, Republic of Korea
[3] Scenic Virginia, Richmond, VA 23219, USA; leighton.powell@scenicvirginia.org (L.P.); lynn.crump@scenicvirginia.org (L.C.)
* Correspondence: jisoosim@pusan.ac.kr; Tel.: +82-(55)350-5407

Abstract: The non-profit organization Scenic Virginia is dedicated to identifying and showcasing the state's scenic landscapes. Recently, the state incorporated a "scenic" element into its new Conserve Virginia land conservation strategy. Consequently, there is a need for a standardized assessment tool that both citizens and professionals can use to identify and evaluate the scenic value of publicly accessible viewsheds in Virginia. This paper outlines the rationale behind developing a scientifically robust protocol, which is based on an extensive literature review and photographs from Scenic Virginia's annual photo contest. The protocol serves as a scenic assessment tool designed to encourage local citizen participation in identifying significant scenic resources in Virginia. Local communities will utilize this new tool to help them identify and evaluate their scenic assets. The protocol was reviewed by a panel of experts, and its implementation is currently underway.

Keywords: scenic; viewshed; visual; assessment; landscape; VRM; communities

Citation: Miller, P.A.; Sim, J.; Powell, L.; Crump, L. Scenic Assessment Methodology for Preserving Scenic Viewsheds of Virginia, USA. *Land* **2024**, *13*, 1010. https://doi.org/10.3390/land13071010

Academic Editors: Richard Smardon and Brent Chamberlain

Received: 26 May 2024
Revised: 27 June 2024
Accepted: 4 July 2024
Published: 8 July 2024

1. Introduction

Evaluating scenic landscapes has been a crucial aspect of environmental planning, urban development, and conservation efforts for a long time. Throughout the years, numerous tools and methods have been developed to assess and manage landscapes efficiently, demonstrating a wide array of approaches influenced by both scientific research and aesthetic considerations. As landscape architecture continues to advance, the methodologies used to assess and protect these essential resources have also become more sophisticated.

Historically, research on landscape evaluation has assessed natural elements within the landscape by evaluating their physical characteristics through the formal aesthetic model [1], ecological value and rarity through the ecological model [2], observers' responses to elements within the landscape through the psychological model, and observers' overall preferences for the landscape through the psychophysical model [3]. These landscape evaluation models can be classified based on how experts or observers evaluate the components of the landscape or the landscape as a whole. One indicator not considered in traditional landscape evaluation models is the aspect of landscape use. External factors such as the users of the landscape are excluded from the aesthetic, psychological, and ecological evaluations of the landscape itself. Recently, as the use of landscape resources has increased, factors such as who uses the landscape and to what extent can also be considered as indicators in the evaluation of landscape resources.

Recent advancements in landscape assessment research reflect a shift towards more integrated and technologically driven approaches, recognizing the increasing complexity of landscapes and the multifaceted impacts of human activity on ecological and aesthetic values. The use of geographic information systems (GIS) and remote sensing technology has become prevalent, allowing for more precise and comprehensive data collection and analysis [4]. Increasingly, researchers are utilizing data from social media platforms as a

form of public input into landscape assessments. By analyzing geotagged photos and posts, researchers can gather large volumes of data on public usage and preferences concerning different landscapes [5]. Reflecting ongoing interest in the individual's experience of the landscape, phenomenological research continues to evolve. This approach is concerned with understanding the subjective and emotional responses individuals have towards landscapes [6].

Much of the research on landscape assessment is fundamentally based on traditional frameworks that have been historically studied. However, significant value can be added through the application of new analytical methods. An increasing reliance on data analysis means that using these assessment techniques can be challenging for individuals without specialized software skills. As such, there is a pressing need for research that develops user-friendly methods for evaluating and conserving valuable landscapes in practical settings.

Furthermore, complex assessment methods can present challenges in accurately capturing the opinions of local residents. This research emerged from a practical perspective, acknowledging Virginia's renowned natural beauty within the United States. When people hear that someone lives in Virginia, they often remark, "Oh, Virginia is so beautiful". The state boasts a diverse array of landscapes from the Chesapeake Bay shorelines to the Blue Ridge Mountains, enriched by a deep history of human habitation. These cherished landscapes are a heritage treasured by Virginians, yet they face threats from urban sprawl and uncontrolled development. What can be done to protect them? A scenic viewshed register might highlight the views valued by the Commonwealth's citizens. What would be required to achieve this? Both the state and its residents are dedicated to preserving these landscapes through various initiatives. Scenic Virginia, for instance, aims to identify and manage crucial scenic resources by creating landscape assessment models. This study lays the groundwork for developing models to discover and evaluate scenic resources in Virginia, facilitating more effective management and conservation decision making.

This paper is organized into four main sections: background, literature review, scenic viewshed assessment methodology, and results and discussion. The Background Section outlines the necessity of a viewshed assessment procedure, the role of Scenic Virginia, the significance of public involvement, the definition of a viewshed, details of the scenic viewshed research project, and the process by which Scenic Virginia will identify scenic viewsheds. The Literature Review Section highlights variables identified through literature review that were incorporated into the assessment methodology, using photographs from the Scenic Virginia View photograph contest for comparison. The Methodology Section explains and implements the final viewshed assessment methodology. The results of the project are presented, followed by a discussion of concluding observations.

2. Literature Review

2.1. Landscape Assessment

2.1.1. Landscape Assessment Theories

Many landscape assessment tools have been developed and used for a long period of time. Landscape assessment models have been classified in various ways by different researchers. Among them, classical models were reviewed. Arthur, Daniel, and Boster (1977) split them into descriptive inventories and public preference models [7]. Zube, Sell, and Taylor (1982) divided the models into four landscape perception paradigms: the expert, psychophysical, cognitive, and experimental [8]. Briggs and France (1980) used direct and indirect methods to divide scenery assessment into classificatory and non-classificatory methods [9]. Among these methods, this literature review section follows Daniel and Vining's classification. Daniel and Vining (1983) split the landscape assessment into four categories: formal aesthetic, psychophysical, psychological, and ecological models. Their classification logic is well suited to landscape architects who expect phenomenological models since the phenomenological models are focused on the individual's perception of their experiences rather than evaluation of the landscape [10].

Peng and Han (2018) categorized and summarized models for evaluating landscapes based on era, purpose (theoretical type and practical type), and methods. According to their research, landscape evaluation models have developed over three stages: The first stage, from 1967 to 1971, includes the phenomenological model, formal aesthetic model, and ecological model. The second stage, from 1971 to 1976, includes the psychology model and psychophysical model. The third stage, from 1973 to the present, includes the land use assumption and fuzzy logical system model [11]. In this study, landscape evaluation models are categorized based on the distinctions of purpose and method identified in Peng and Han's research, as shown in Table 1.

Table 1. Classification of Seminal Landscape Assessment Models.

Category	Evaluation	Preference
Theoretical	Ecological model -Unique ratio [2]	Psychological model -Information-processing theory [3]
Empirical	Formal aesthetic model -Forest landscape description and inventories [1] -Visual management system [10,12] -Scenery management system [13] -Combined landscape value [14]	Psychophysical model -Natural landscape preference prediction [15] -Scenic beauty estimation [16] -Predicting scenic beauty [17]

The formal aesthetic model is focused on inherent aesthetic values in the formal properties of the landscape. Landscape features such as essential forms, lines, colors, and textures can be evaluated for their contribution to intrinsic aesthetic quality. Landscape architects analyze interrelationships between essential elements such as the harmony, unity, contrast, and variety in assessing aesthetic value [10]. For this model, trained experts firstly analyze the formal visual characteristics of the landscape such as lines, forms, textures, and color. Then, they assess the interrelationships among the basic elements in terms of variety, unity, and integrity. This model requires understanding landscape elements and their relationship and can be applied to general landscapes. Application requires some knowledge or training.

The classical psychophysical model is the combination of two fields: the physical and the psychological. The theoretical background of this model is the relationships between physical features in the landscape and human perceptual responses [10]. The model seeks to identify mathematical relationships between the physical elements of the landscape and the psychological responses of human observers [15,18]. The physical elements are measured by experts and preferences are evaluated by empirical surveys. Psychophysical models have been used in many practical settings. For securing the validity of this model, many landscape scenes and multiple observers are employed. The purpose of this paper is to describe the development of a model that predicts a people's perceptions of landscape quality based on physical features of the landscape [10].

Unlike the formal aesthetic model, which emphasizes the viewer's understanding of the characteristics of the landscape, the psychophysical model prioritizes the viewer's perception and preference. In this model, the viewer's preference determines the value of the landscape. Thus, the overall preference for the landscape is more important than its specific features or major elements. A representative study within the psychophysical model is the information-processing theory, which is considered the most significant in landscape preference research [19]. According to this model, an individual's judgment of a landscape depends on two fundamental responses: understanding and exploration [3]. Kaplan and Kaplan (1989) identified four key informational characteristics based on these responses: coherence, complexity, legibility, and mystery. Coherence refers to the order within the landscape, while complexity denotes the variety of visual elements within a landscape. Legibility indicates how easily the landscape can be understood and remembered. Lastly, mystery is the quality that motivates an individual to take a step further into the landscape [3].

Ecological models originated from general concern for the protection of the natural environment. The environmental movement of the 1960s reinforced concern for pollution of the environment and warned about the harm of careless developments. Leopold was interested in inventorying river valleys to find an appropriate site for dam construction. Basically, Leopold believed that unique landscapes hold more significance than common landscapes. His rationale is that "landscape which is unique. . .has more significance to society" [2]. Also, the unique qualities enhance its value to society. He raised three questions to develop the model: (1) What criteria can be used to judge a given piece of the landscape? (2) What other landscapes or features can it be compared with? (3) How can any set of landscapes be ranked by priority [2]? Based on those questions, he proposed a methodology to present a unique ratio.

A review of key prior studies on landscape assessment theories reveals that evaluating landscapes involves both their physical characteristics and the emotional responses of users who view them. While the physical attributes of the landscape represent objective features, the perspective of the observers is more subjective. Therefore, it is essential to consider both objective and subjective perspectives in landscape evaluation.

2.1.2. Recent Trends in Landscape Assessment Tools

Recent advancements in landscape assessment theory have significantly integrated technologies, particularly geographic information systems (GIS), to enhance environmental management and decision-making processes [20–22]. These technologies provide robust solutions for utilizing diverse land data sources, aiding in the analysis of landscapes and developing sustainable planning strategies [23]. Methods such as viewshed and landform studies are employed to model landscape factors and create maps for spatial analyses, investment decisions, and monitoring landscape changes over time [24]. Furthermore, the application of landscape connectivity in suitability evaluations, especially in urban ecologically sensitive areas, has optimized ecosystem planning [25]. This is achieved by incorporating hydrological analysis tools in GIS, offering a more comprehensive assessment approach. These advancements underscore the evolving landscape assessment theories that leverage technological innovations for more effective and sustainable landscape management practices.

Ivantsova and AI-Chaabawi (2022) assessed agroforestry landscapes using GIS and remote sensing technologies to identify and mitigate negative factors leading to soil depletion. The use of innovative resource-saving technologies was emphasized to prevent degradation and restore soil fertility [20]. Roth, Nalim, and Krech (2018) provided a qualitative assessment of screening technologies for medicine quality assurance across ten countries, highlighting significant gaps in technology development, evaluation, and information dissemination. The study revealed wide variations in the understanding and usage of these technologies and identified the ideal qualities for the next generation of screening technologies [21]. It emphasized the need for objective technical reviews and better financial resource information. Chételat (2005) discussed the integration of landscape assessment theory with geographic information systems (GIS) for effective landscape evaluation and management strategies. The study proposed a participative multiscale landscape assessment method using GIS, emphasizing the importance of combining qualitative landscape evaluations with quantitative GIS systems to enhance environmental management and negotiation processes [22]. Ozimek and Ozimek (2017) examined the underutilization of digital technologies in landscape assessment and planning. By employing viewshed and landform studies, the research demonstrated the effectiveness of these methods in modeling landscape factors [23]. The findings suggested that these technologies can significantly enhance spatial analyses, decision making, and land management processes. Shaoyao (2013) applied landscape connectivity theory to urban ecology suitability assessment, utilizing hydrological analysis tools in ArcGIS to optimize suitability analysis. The study highlighted how this approach can improve the evaluation and optimization of land suitability, contributing to better urban ecological planning and management [24].

Through these studies, the development and utilization of GIS, remote sensing, and digital analysis tools for landscape evaluation methods have been reviewed. Previous research focused on studying the concepts of landscape evaluation and employed various methods to understand these concepts. In contrast, recent research has emphasized replacing traditional methods with various technologies based on concepts derived from earlier studies. Consequently, there is a growing gap between the approaches of lay people or experts unfamiliar with the latest technologies and that of recent research.

2.2. Viewshed Recognition Program

2.2.1. U.S. National Program

This section reviews two national-level landscape assessment and preservation tools in the United States: The National Scenic Byways Program and National Heritage Areas (NHA). Both programs aim to protect and promote the nation's significant scenic, cultural, and historical landscapes, albeit through different approaches and management structures (Table 2).

Table 2. National Viewshed Recognition Program.

Feature	National Scenic Byways Program	National Heritage Areas
Developed Year	1991	1984
Administered by	Federal Highway Administration (FHWA)	National Park Service (NPS)
Purpose	Recognize and promote roads with outstanding qualities	Preserve and promote cohesive, nationally important landscapes
Designation Criteria	Scenic, historic, cultural, natural, recreational, archaeological	National heritage significance, local support, feasibility
Management	Federal, state, and local partnership	Local coordinating entities with NPS assistance
Funding	Grants and funding from FHWA	Federal funds with matching local/state funds
Benefits	Tourism enhancement, economic development, resource preservation	Resource preservation, heritage tourism, community involvement

The National Scenic Byways Program, established in 1991 and administered by the Federal Highway Administration (FHWA), recognizes roads throughout the United States for their outstanding scenic, historic, cultural, natural, recreational, and archaeological qualities. This program aims to preserve and enhance these corridors, transforming them into travel destinations that offer unique and enriching experiences. Roads are nominated based on their exceptional qualities and require a comprehensive corridor management plan to maintain these attributes. The program promotes local and state involvement in the designation and preservation processes and provides grants and funding to support these efforts [26]. This tool emphasizes the program's role in boosting tourism and local economic development. By enhancing the travel experience, scenic byways attract visitors, which can lead to increased spending in local communities. Additionally, the program raises awareness about the importance of preserving scenic and cultural resources, contributing to broader conservation efforts [26].

In contrast, the National Heritage Areas (NHA) program, initiated in 1984 and managed by the National Park Service (NPS), focuses on areas where natural, cultural, and historic resources create a cohesive, nationally significant landscape. The NHA designation involves a thorough feasibility study and demonstrates widespread local support. Once designated, these areas are managed through local coordinating entities such as nonprofit organizations or local governments, with technical assistance from the NPS [27]. NHA emphasizes community involvement and partnership. The management strategy for these areas is collaborative, involving local communities, state and federal governments, and private organizations. This approach encourages sustainable economic development through heritage tourism and fosters a sense of pride and stewardship among residents. Funding

for NHA includes federal support, which must be matched by local or state contributions, promoting additional public and private investment [28].

While both programs share a common goal of preserving and promoting significant landscapes, their methodologies and focus areas differ. The National Scenic Byways Program is road-centric, emphasizing the preservation and enhancement of specific corridors with outstanding qualities. It relies heavily on state and local participation and provides federal grants to support these efforts. In contrast, NHA focuses on broader landscapes with cohesive natural, cultural, and historical significance, leveraging local partnerships for comprehensive management and preservation.

The literature highlights that both programs contribute significantly to conservation and sustainable tourism. However, their success relies on strong community involvement and effective collaboration among various stakeholders. By comparing these two programs, this review underscores the importance of tailored approaches to landscape preservation that address specific regional and community needs while promoting national heritage and tourism [29].

2.2.2. The U.S. State Program

This section examines various state-level landscape assessment and preservation tools in the United States, focusing on the California Scenic Highway Program, Colorado Scenic and Historic Byways, Oregon Scenic Byways, Virginia Scenic Roads and Byways, Florida Scenic Highways Program, and Texas Scenic Byways and Historic Highways. Each program is designed to protect and enhance the scenic, historical, and cultural values of specific routes or areas, thereby promoting sustainable tourism and local economic development (Table 3).

Table 3. State Viewshed Recognition Programs.

Program	Developed Year	Focus Areas	Administered by	Community Involvement
California Scenic Highway Program	1963	Scenic preservation, corridor protection	California Department of Transportation	High
Colorado Scenic and Historic Byways	1989	Scenic, historical, cultural, recreational values	Colorado Department of Transportation	High
Oregon Scenic Byways	1989	Scenic, historic, cultural significance	Oregon Department of Transportation, Travel Oregon	High
Virginia Scenic Roads and Byways	1966	Scenic, historical, cultural values	Virginia Department of Transportation	Medium
Florida Scenic Highways Program	1996	Natural, cultural, historical resources	Florida Department of Transportation	High
Texas Scenic Byways and Historic Highways	1995	Scenic, historical importance	Texas Department of Transportation	High

The California Scenic Highway Program, developed in 1963, aims to preserve and enhance the natural beauty along the state's highways. It encourages local governments to adopt ordinances that protect scenic quality, focusing on a corridor approach that assesses viewsheds from the highway. This program involves rigorous scenic corridor protection plans to maintain the visual appeal of these routes [30]. Similarly, the Colorado Scenic and Historic Byways program, established in 1989, promotes routes with exceptional scenic, historical, cultural, and recreational values through a community-based nomination process. This program integrates tourism, preservation, and education and is managed by the Colorado Department of Transportation in partnership with local communities [31].

In Oregon, the Scenic Byways program, also initiated in 1989, highlights roads with significant scenic, historic, and cultural importance. The program emphasizes enhancing

travel experiences while supporting local economies through comprehensive route planning and marketing efforts. It is a collaborative effort between the Oregon Department of Transportation and Travel Oregon [32]. The Virginia Scenic Roads and Byways program, established in 1966, identifies routes with significant scenic, historical, and cultural values. Scenic designations require an application process and approval by the Commonwealth Transportation Board. This program supports preservation efforts and promotes tourism, with the Virginia Department of Transportation working closely with localities for designation and promotion [33].

The Florida Scenic Highways Program, developed in 1996, focuses on showcasing the state's natural, cultural, and historical resources. It operates as a community-based program where local groups nominate roads for designation. The program provides grants and technical assistance for corridor management planning and is managed by the Florida Department of Transportation with significant local community involvement [34]. The Texas Scenic Byways and Historic Highways program, initiated in 1995, promotes routes with significant scenic and historical importance. It involves a state-designated process with criteria for scenic, historical, cultural, recreational, and natural qualities, encouraging preservation and enhancement of scenic resources. The program is managed by the Texas Department of Transportation with input from local communities and stakeholders [35].

Each of these programs shares the common goal of preserving scenic, historic, and cultural values while promoting sustainable tourism and local economic development. They differ mainly in their management structures and the specifics of their assessment and community involvement processes. The California, Colorado, Oregon, and Florida programs demonstrate high community involvement, integrating local groups into the nomination and management processes. In contrast, Virginia's program medium incorporates local community involvement with a more structured application and approval process. The Virginia program builds on what people like and prefer in their own communities. Despite these differences, all programs contribute significantly to conservation and sustainable tourism, underscoring the importance of tailored approaches to landscape preservation that address specific regional and community needs.

2.2.3. Implications from Viewshed Recognition Program

A successful viewshed recognition program requires two key components. First, there must be an understanding of visual assessment principles and previous research in the field. To this end, Scenic Virginia enlisted researchers from Virginia Tech University to conduct a literature review and identify the key concepts and variables that have been used to define what is "scenic". Second, a method for evaluating the viewsheds of local residents and communities is essential. Historically, most visual assessments have been conducted on public lands by agencies like the U.S. Forest Service and the Bureau of Land Management. However, viewshed management in Virginia will encompass both private and public lands, with an emphasis on preserving scenic quality.

Scenic Virginia, a non-profit organization, values the scenic beauty of Virginia's landscapes. Scenic Virginia plays a crucial role in the evaluation and preservation of the state's scenic landscapes, working to identify, celebrate, and protect Virginia's most beautiful and culturally significant vistas. For instance, Scenic Virginia has been instrumental in promoting scenic byways as tools for scenic resource protection. Their involvement in initiatives like the Virginia Scenic Byways program, which is managed in partnership with the Virginia Department of Transportation (VDOT) and the Department of Conservation and Recreation (DCR), underscores their commitment to preserving critical scenic resources. The Virginia Scenic Byways program, introduced in 1999, designates roads with exceptional scenic, historical, cultural, and recreational values, aiming to enhance travel experiences and support local economies by attracting tourists and fostering community pride.

Scenic Virginia plays a potentially crucial role in the proposed viewshed register program by representing the voices of Virginians who understand that the state's scenic landscapes are vital to their quality of life, essential for a robust economy, and key to

attracting jobs. Additionally, preserving these landscapes is a legacy for future generations. This paper outlines a protocol or scenic assessment tool developed from pertinent concepts and theories found in the literature, along with an assessment process that actively involves the local public in a viewshed register initiative.

(1) Public engagement

In the United States, several landscape photographic contests effectively engage public participation in landscape preservation and appreciation. The USA Landscape Photographer of the Year contest showcases the nation's diverse landscapes, from national parks to urban scenes, and includes a public voting component to encourage broader engagement. Similarly, the National Geographic Photo Contest invites photographers to capture stunning landscapes, featuring winning images in widely accessible publications and online platforms, thereby fostering public interest in environmental conservation. The Audubon Photography Awards, while primarily focused on bird photography, highlight significant natural landscapes and engage the public through exhibitions and online galleries, promoting habitat preservation.

A viewshed registry program needs to gain official recognition from the State of Virginia to be formally established. Consequently, involving the public in the identification of scenic viewsheds is critical for the program's success. Scenic Virginia stands out as the perfect organization to facilitate this public involvement. Additionally, landscape architects from the Virginia Department of Recreation and Conservation—responsible for the Virginia Scenic Rivers and Virginia Byways programs—will play a crucial role in aligning the program with state requirements.

Scenic Virginia will manage the viewshed registry process, leveraging its broad public support, built over years through initiatives like its annual scenic landscape photo contest. The organization has a proven track record of collaborating with both the public and local government officials to recognize and preserve scenic landscapes. It is expected that most viewshed nominations will come from non-experts, so the nomination form must include detailed descriptions to help Scenic Virginia decide if a nomination should advance to the scenic quality evaluation stage. Nominations will be accepted from a diverse range of sources, including citizens, landowners, government officials, and local grassroots groups.

The landscape assessment tool developed in this study uniquely integrated the perspectives of the general public by utilizing photographs taken by non-professional photographers. This approach ensures that the tool reflects the community perceptions and values unique to the scenic landscapes of Virginia rather than solely relying on the assessments of professional landscape architects, which might not capture the broader public's views. By developing an assessment tool that was evaluated by using photographs from general public through photographic contests, the study acknowledges and incorporates the everyday experiences and aesthetic appreciations of ordinary people. This method also mitigates potential conflicts of interest and pressures related to community economic development and regional planning shortcomings, providing a more democratic and comprehensive understanding of scenic resources. Thus, this approach not only enriches the landscape assessment by diversifying the input but also justifies the decision to forego exclusive reliance on professional experts, ensuring the results are more aligned with public sentiment and local cultural values.

(2) View and Viewshed

Visual perception significantly influences how individuals interpret and evaluate landscapes, particularly regarding "view" and "viewing" aspects. This foundational understanding is essential for appreciating both the aesthetic and functional values of landscapes. Appleton's (1975) "prospect-refuge" theory highlights that humans prefer landscapes offering both views (prospect) and shelter (refuge), reflecting deep-rooted evolutionary preferences [36]. Similarly, Kaplan and Kaplan (1989) developed the "preference matrix", identifying coherence, complexity, legibility, and mystery as crucial factors shaping landscape preferences [3]. These theories underscore that visual perception in landscape

interpretation is multifaceted, deeply rooted in psychological and evolutionary principles, and critical for contemporary landscape evaluation.

Recent studies have expanded on these foundational theories to address modern landscape assessment needs. Gobster and Chenoweth (1989) conducted a quantitative analysis, identifying naturalness, visual diversity, and maintenance as significant factors in landscape perception [37]. Nassauer (1995) emphasized the role of cultural norms and visual cues, arguing that orderly and well-managed landscapes are generally preferred [38]. Daniel and Vining (1983) explored various methodological approaches to landscape quality assessment, underscoring the importance of visual perception [10]. Sevenant and Antrop (2010) demonstrated the application of perception studies in landscape planning, showing how public perception can inform landscape identity development and enhance planning processes [39]. By integrating these insights into our study, we provide a more comprehensive discussion on how visual perception and public engagement in landscape image evaluation contribute to a nuanced understanding of landscape aesthetics and functionality.

The concept of "viewshed" is inspired by the idea of a watershed. A watershed is an area where all the rainfall converges and flows past a specific point. Similarly, a viewshed encompasses the entire 360-degree area visible from a particular point, known as a viewpoint. However, parts of this area are often obscured by elements like vegetation, terrain, or other obstacles (refer to Figure 1). A "defined viewshed" specifically refers to the visible segment from a certain viewpoint, characterized by its viewing direction, width, and distance. In this article, the term "viewsheds" is used to denote these "defined viewsheds".

Figure 1. The area visible from the viewpoint may be blocked by vegetation, topography or other objects. A viewpoint is defined by its view direction, view width, and view distance.

(3) Scenic Quality

Scenic quality, a crucial measure of the scenic importance of a viewshed, is based on human perceptions of the intrinsic beauty of landforms, water characteristics, and vegetation patterns. When combined, these attributes determine a landscape's intrinsic scenic beauty. Scenic quality, often described as the product of the landscape according to the reactions of a person experiencing that landscape [40–42], is a critical factor in landscape assessment. It depends upon perception and reflects the particular combination and pattern of elements in the viewshed [43]. When viewed by people, these are the essential attributes of landscape that evoke positive physiological and psychological reactions, thereby influencing society in general.

Regarding the qualitative aspects of the landscape, previous literature reviews have examined theories and concepts related to landscape elements, the components that constitute landscapes, and tools for evaluating landscape quality. Through this literature review, the necessary concepts and elements required for developing the landscape assessment tool in this study were identified and extracted. The following terms and concepts from the related literature were determined to be helpful in assessing scenic viewsheds:

- Physiographic province or region [44–47];
- Distance zones and scale [1,12,13,48];
- Diversity, variety, and visual complexity [7];

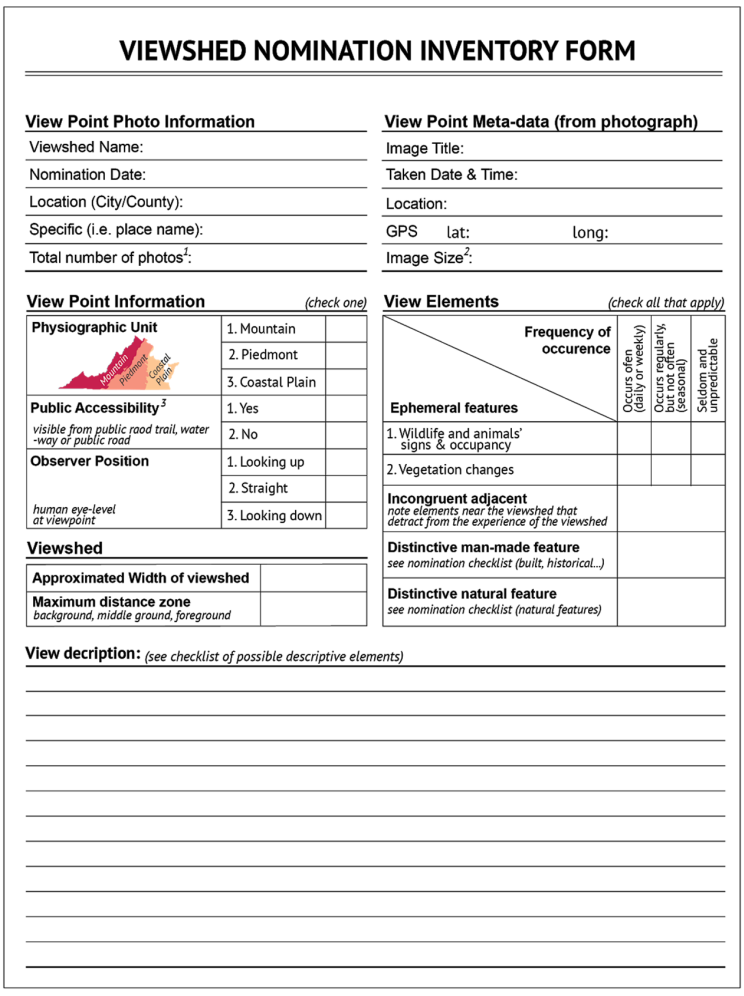
- Coherence and legibility [49];
- View type [50];
- Viewer position [50,51];
- Visual sensitivity or public awareness [52].

3. Scenic Viewshed Nomination and Scenic Assessment Process

3.1. Nomination Inventory

Nominators are not required to have knowledge of scenic assessment procedures. They might be government officials, landscape architects, or local citizens. They will use a nomination form and a checklist of potential landscape features. Figure 2 depicts the nomination form. The first part of the viewshed designation process is the viewshed nomination. The nomination should include the following basic descriptive information:

- Viewshed name (place name);
- Date of nomination;
- Location (city or county);
- Viewpoint location (GPS point and compass direction for the view angle);
- Physiographic unit;
- Viewshed physical area (approximate width and view distance).



VIEWSHED NOMINATION INVENTORY FORM

View Point Photo Information

Viewshed Name:	
Nomination Date:	
Location (City/County):	
Specific (i.e. place name):	
Total number of photos[1]:	

View Point Meta-data (from photograph)

Image Title:	
Taken Date & Time:	
Location:	
GPS lat:	long:
Image Size[2]:	

View Point Information *(check one)*

Physiographic Unit	1. Mountain	
	2. Piedmont	
	3. Coastal Plain	
Public Accessibility[3] *visible from public raod trail, water -way of public road*	1. Yes	
	2. No	
Observer Position *human eye-level at viewpoint*	1. Looking up	
	2. Straight	
	3. Looking down	

Viewshed

Approximated Width of viewshed	
Maximum distance zone *background, middle ground, foreground*	

View Elements *(check all that apply)*

Ephemeral features \ **Frequency of occurence**	Occurs often (daily or weekly)	Occurs regularly, but not often (seasonal)	Seldom and unpredictable
1. Wildlife and animals' signs & occupancy			
2. Vegetation changes			
Incongruent adjacent *note elements near the viewshed that detract from the experience of the viewshed*			
Distinctive man-made feature *see nomination checklist (built, historical...)*			
Distinctive natural feature *see nomination checklist (natural features)*			

View decription: *(see checklist of possible descriptive elements)*

1. up to three photos, one must be from viewshed view point
2. a minimum size of 1024 megapixels
3. must be accessible to be nominated (e.g. trails, roads, public recreation zones and other)

Figure 2. Scenic Viewshed Nomination Form. It is anticipated that this form may change as insights are gained from implementation of the procedure.

The viewshed must be accessible by the public (accessible from a public accessway). The nomination should include a maximum of three photographs, with one required photo from the viewshed viewpoint. Meta-data from the photographs should be included (1024 pixels is the minimum photograph resolution [53]) .

A written description of the viewshed should be included in the nomination. The description should identify distinctive natural features (including predictable and relatively frequent ephemeral qualities or qualities that change regularly over time, such as seasonal color and migratory birds), and positive manmade features should be identified and described (features that seem to be in harmony with the landscape or past use of the landscape). Incongruent or negative features (features that do not seem to fit in the landscape or feel out of place) visible from the viewshed should also be listed. Public awareness of and interest in the viewshed should be included in the nomination description as well as any potential threats to the scenic quality of the viewshed. This might include newspaper articles, public meetings, and concerns expressed over possible land development within the viewshed. Nominators will use a nomination form and a checklist of potential landscape features. Figure 2 depicts the nomination form.

3.2. Sample Photographs from the Scenic Virginia Landscape Photo Contest

Photographs from the Scenic Virginia photo contests were examined to determine if the variables identified earlier in the literature were adequate to assess the scenic quality of Virginia landscapes. The photographs from the Scenic Virginia photo contest were submitted by citizens of Virginia who believed that the photo captured a landscape that was scenic. Many photos were selected from past contests to represent the range of landscape types in Virginia. The final set of photographs used in this study was carefully selected to represent the landscapes of Virginia. Photographs that included mainly the photographer's artistic expression, such a light qualities, unusual content, or unnatural viewer position, were eliminated. The photos were then examined to determine if the variables identified earlier in the literature were adequate to assess the scenic quality in the photographs. It was determined that all of these variables were helpful in assessing the scenic quality of most of the landscapes in the photos. However, there were a few scenes that contained scenic value that could not be adequately explained by these criteria. By looking at these scenes, five additional variables were identified as contributing to scenic quality. These elements, found in the landscape (i.e., content), should be included in the assessment of scenic viewsheds in Virginia:

- The scenic value of historic content (see Figure 3);
- The scenic value of human-influenced landscapes that include cultural content (see Figure 4);
- The scenic value of human-influenced landscapes that include urban content in scenic viewsheds (see Figure 5);
- The scenic value of ephemeral qualities (changing content in the landscape that is predictable and reasonably frequent) (see Figure 6).

Figure 3. Example of historic scenic content.

Figure 4. Example of human-influenced (cultural) scenic content.

Figure 5. Example of human-influenced (urban) scenic content.

Figure 6. Scenic value of ephemeral qualities or changing content that changes expectedly and occurs on reasonably frequent period of time such as flowers (**left**) and livestock (**right**). Figure on the right side shows the ephemeral content of Figure 4.

3.3. Guidelines for Scenic Viewshed Assessment Protocol

The following guidelines were used in developing the quantifiable assessment methodology:

- Concepts, variables, and measures should have a history of use that indicates a high degree of acceptance and credibility among scholars in this field;
- Variables and measures should be intuitively meaningful and make sense to those using them;

- Measurement scales should:
  - Be as straightforward and uncomplicated as possible (understandable);
  - Use descriptive interval scales when possible (meaningful distinctions for measurement);
  - Contain no more than seven intervals (seven is considered the number of categories most people can distinguish between [54]);
  - Not use mathematical functions other than addition and subtraction (reduce variability in measurement);
  - Be capable of easy disaggregation when combined mathematically (i.e., understand how the parts contribute to the final product).

Following these guidelines ensures that the proposed nomination and evaluation methodology is credible and that users will be able to apply it consistently and with minimal variation.

3.4. Variables for Scenic Quality and Public Concern or Sensitivity

The viewshed scenic quality assessment has two parts: The first is the scenic quality of the viewshed, and second is the public concern or sensitivity of the viewshed. In order to gain public support for the viewshed program, it was important that the viewsheds be those that the pubic were most concerned about.

The viewshed scenic quality variables are as follows:

- Viewshed size [1];
- Variety and visual complexity [52];
- Coherence and legibility [52,55];
- Presence of ephemeral content (see Figure 6) [1];
- Presence of positive human-influenced content [56];
- Incongruence or distraction (often man-made elements in a natural environment) [1].

The viewshed public concern or sensitivity variables are as follows:

- Demonstrated public concern or sensitivity [14];
- Number of viewers [57,58];
- Viewer activity [57,58];
- Landscape content [52];
- Historical and cultural significance features [14,52,58].

4. Scenic Viewshed Assessment Protocol

4.1. Check Sheets for Scenic Quality and Visual Concern/Sensitivity

A checklist was created to evaluate the scenic quality and visual concern/sensitivity of a viewshed. This checklist incorporates six variables for scenic quality and five for concern/sensitivity, all of which were derived from the literature review or the previously described scenic photo analysis. Each variable is rated on a three-point scale: high, moderate, or low. The checklist enables the assessment and scoring of each variable, which are then summed to provide a total viewshed score for both scenic quality and concern/sensitivity. The assessment process is illustrated using the viewshed shown in Figure 7. Figure 8 demonstrates that the landscape in Figure 9 has a high scenic quality, with a total scenic quality score of 7.

SCENIC VIEWSHED EVALUATION AND DESIGNATION FORM

VIEWSHED SCENIC QUALITY	HIGH	MODERATE	LOW
1. Viewshed Size *How wide is the view?*	panoramic [a] 3	medium view [b] 2	limited view [c] 1
2.Variety and Visual Complexity *How much variation in the visual characteistics of the landscape (patterns, color, form, line and textures)?*	High 2	Moderate 1	Low 0
3. Coherence and Legibility *How the visual composition fits together, and is distinct and memorable?*	High 2	Moderate 1	low 0
4. Ephemeral qualities in foreground and middle ground *Are ephemeral qualities a common content of the viewshed?*	frequent/ predictable 2	not frequent but predictable 1	not predictable 0
5. Positive human-influenced content in viewshed *positive, human-influenced content in the views*	Visual Striking 2	noticeable but not visual striking 1	not visible 0
6. Incongruent or distracting content in viewshed *Are incongruent elements (powerlines, mines, junkyards) visible in the viewshed?*	Highly visible -2	Visible [d] -1	not visible 0
TOTAL SCORE			
CLASS	**H: 11 ~ 7**	**M: 6 ~ 3**	**L: 2 ~ -1**

a. wide view and includes all distance zones
b. includes at least two distance, but not wide
c. one distance zone and narrow
d. visible, but surbordinate to visual elements and characteristics of the landscape

PUBLIC CONCERN OR SENSITIVITY	HIGH	MODERATE	LOW
1. Demonstrated the public awareness *Example; media articles, tourism guides, public meetings and gov. public relations*	Highly awareness 2	Moderate awareness 1	Low awareness 0
2. Number of viewers *Estimated number of people who see the viewshed*	seen over 100/day 3	seen over 100/week 2	seen under 100/week 1
3. Viewer activity *What people are doing when they view the landscape*	visible while recreating 2	visible from residents 1	visible while passing 0
4. Incongruent or distracting content not in viewshed but visible *Can powerlines, minings, junkyards be seen near the viewshed*	Highly visible -2	Visible -1	not visible 0
5. Historical and cultural features *Does the viewshed contain historical and cultural features*	National 3	State 2	Local 1
TOTAL SCORE			
CLASS	**H: 10 ~ 7**	**M: 6 ~ 3**	**L: 2 ~ 0**

SCENIC VIEWSHED DESIGNATION

Scenic viewshed designation is based on scenic quality and public concern
- *I = INCLUDE (designate as a Scenic Viewshed)*
- *SC = SPECIAL CONSIDERATION (designate as a Scenic Viewshed if other special considerations merit*
- *N = NOT INCLUDE (not designate as a Scenic Viewshed)*

VIEWSHED SCENIC QUALITY	PUBLIC CONCERN OR SENSITIVITY: HIGH	MODERATE	LOW
HIGH	I	I	SC
MODERATE	SC	N	N
LOW	N	N	N

FINAL Viewshed DESIGNATION:

(See 'Definition of Terms' for additional information and literature related to each variable.)

Figure 7. Scenic viewshed evaluation and designation form.

VIEWSHED SCENIC QUALITY	HIGH	MODERATE	LOW
1. Viewshed Size *How wide is the view?*	panoramic [a] 3	medium view [b] 2	limited view [c] 1
2.Variety and Visual Complexity *How much variation in the visual characteistics of the landscape (patterns, color, form, line and textures)?*	High 2	Moderate 1	Low 0
3. Coherence and Legibility *How the visual composition fits together, and is distinct and memorable?*	High 2	Moderate 1	low 0
4. Natural Condition *How natural or undeveloped is the viewshed?*	natural/ undeveloped 2	scattered developed [d] 1	developed 0
5. Ephemeral qualities in foreground and middle ground *Are ephemeral qualities a common content of the viewshed?*	frequent/ predictable 2	not frequent but predictable 1	not predictable 0
6. Incongruent or distracting content in viewshed *Are incongruent elements (powerlines, mines, junkyards) visible in the viewshed?*	Highly visible -2	Visible [e] -1	not visible 0
TOTAL SCORE			
CLASS	**H: 11 ~ 7**	**M: 6 ~ 3**	**L: 2 ~ -1**

a. wide view and includes all distance zones
b. includes at least two distance, but not wide
c. one distance zone and narrow
d. scattered developed, but surordinate to natural characteristics of the landscape
e. visible, but surbordinate to visual elements and characteristics of the landscape

Figure 8. An example of assessing the "scenic quality" component of the viewshed in Figure 9. The sum of the scenic quality variables for this viewshed is 7, indicating that this this is a high-scenic-quality viewshed.

Figure 9. Depicts a Virginia viewshed used to demonstrate the viewshed scenic quality scoring (see Figure 8) and viewshed public concern scoring (see Figure 10).

PUBLIC CONCERN OR SENSITIVITY	HIGH	MODERATE	LOW
1. Demonstrated the public awareness *Example: media articles, tourism guides, public meetings and gov. public relations*	Highly awareness 2	Moderate awareness 1	Low awareness 0
2. Number of viewers *Estimated number of people who see the viewshed*	seen over 100/day 3	seen over 100/week 2	seen under 100/week 1
3. Viewer activity *What people are doing when they view the landscape*	visible while recreating 2	visible from residents 1	visible while passing 0
4. Incongruent or distracting content not in viewshed but visible *Can powerlines, minings, junkyards be seen near the viewshed*	Highly visible -2	Visible -1	not visible 0
5. Historical and cultural features *Does the viewshed contain historical and cultural features*	National 3	State 2	Local 1
TOTAL SCORE			
CLASS	**H: 10 ~ 7**	**M: 6 ~ 3**	**L: 2 ~ 0**

Figure 10. This figure is an example of the "public concern" assessment of the viewshed depicted in Figure 9. The sum of all the scored variables is 1, indicating a "low" sensitivity or concern score for the viewshed depicted in Figure 9.

4.2. Final Scenic Viewshed Designation

The scenic viewshed designation is determined by combining the scores for scenic quality and public concern (see Figure 11). A viewshed with a high scenic quality score and either a high or moderately high public concern score would be designated "include" on Scenic Virginia's Scenic Viewshed Register. Regardless of public concern, any viewshed with a low scenic quality score would not be designated inclusion in the Scenic Viewshed Register. Also, any viewshed with a moderate scenic quality score and either a moderate or low public concern score would not be included on the Scenic Viewshed Register.

SCENIC VIEWSHED DESIGNATION

Scenic viewshed designation is based on scenic quality and public concern

- *I = INCLUDE (designate as a Scenic Viewshed)*
- *SC = SPECIAL CONSIDERATION (designate as a Scenic Viewshed if other special considerations merit*
- *N = NOT INCLUDE (not designate as a Scenic Viewshed)*

PUBLIC CONCERN OR SENSITIVITY

VIEWSHED SCENIC QUALITY	HIGH	MODERATE	LOW
HIGH	I	I	SC
MODERATE	SC	N	N
LOW	N	N	N

FINAL Viewshed DESIGNATION: Special consideration

Figure 11. Scenic Viewshed Final Designation Form.

There are two situations that deserve "special consideration". The first is when the viewshed has a high scenic quality score and a low public concern score, and the second is when a viewshed has a moderate scenic quality score and a high public concern score. A "special consideration" designation acknowledges that there may be unforeseen factors that should be considered in the designation. For example, in the first scenario, a viewshed may have only a moderate scenic quality score but also possess a unique sense of place and meaning to local people that are not fully reflected in the score and thus might require additional consideration before a designation decision can be made. In the second scenario, a viewshed may have a high scenic quality score but a low public concern score that requires additional consideration before making a decision. For example, the viewshed may have unique visual qualities or content that the scenic rating framework could not adequately consider and, therefore, merit consideration for designation, even though there is low public concern. This could include things such as an ephemeral factor that is unique or rare or a historical or cultural feature with exceptional significance, even at the local level.

4.3. Expert Review and Feedback

The viewshed assessment and designation protocol underwent two rounds of review by expert panels. The first review included seven members from the Scenic Virginia Viewshed Committee and eight experts, all professionals with extensive experience in scenic landscape issues. This group provided numerous valuable comments and suggestions to improve the clarity of the wording on the nomination and assessment forms.

The second review involved a different group of seven experts with professional experience in scenic landscape issues and five individuals from Scenic Virginia. This meeting focused on applying the viewshed assessment protocol to two distinctly different viewsheds, one of which included urban elements. They provided several minor recommendations, which were incorporated as minor revisions into the nomination and assessment protocol.

5. Pilot Evaluation with Experts

Using the derived evaluation method, four pilot tests were conducted between 2018 and 2019. Three of these tests took place in 2018. The first was conducted at the annual conference of the Virginia Chapter of the American Society of Landscape Architects in Virginia Beach, 2018, with 30 landscape architects. In this test, experts were briefed on the evaluation's purpose and methodology and were shown sample photographs before evaluating the views based on the viewshed assessment and designation. The second pilot test involved 20 science teachers working in Virginia. The same pilot test was later conducted at the VRS (Visual Resource Stewardship) conference with 80 experts in related fields. The pilot test conducted in 2019 took place at the VRS 2019 symposium, involving a total of 60 experts.

The VRS 2019 symposium, held in October of 2019, was an event for sharing research and project results on landscape resources. The Visual Resource Stewardship Conference was held at Argonne National Laboratory, Lemont, IL, with the theme "Seeking 20/20 Vision for Landscape Futures". Conference presentations addressed the following topics:

- Landscape scale and context;
- Visual resource benefits;
- Visual analysis methods;
- Integrated visual resource planning and application.

The educational content and evaluation methods were refined through these pilot tests. Below are the results of the most recent pilot test from the VRS 2019 symposium.

A total of 60 experts, including government officials and researchers, assessed Virginia's landscape resources, focusing on Libby Hill and Walker Mountain. These two viewsheds were selected because they represent different viewshed contexts. The viewpoint for Libby Hill is located in an urban context, and the viewpoint for Walker Mountain is in a rural area of Virginia. Figure 12 shows the photographs used during this pilot

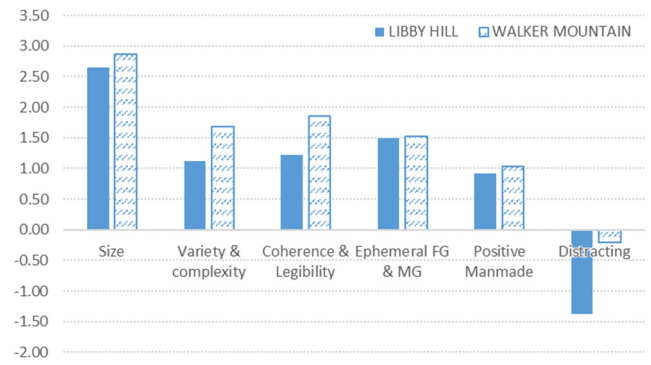
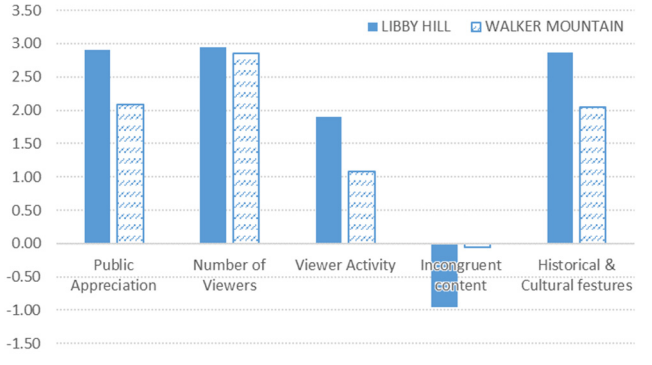
test. The Libby Hill viewshed is in Richmond, Virginia, and is sometimes referred to as the "view that made Richmond". It is a favorite viewpoint for many of those who live in Richmond. It does contain views of some developed areas in the valley below. The Walker Mountain viewshed is more typical of a rural Virginia landscape. The pilot test began with a brief introduction to the project and an explanation of the evaluation method, followed by separate assessments of Libby Hill and Walker Mountain. Participants were given ample time to individually evaluate Libby Hill after viewing its photograph. After the last expert completed their evaluation, the assessment of Walker Mountain proceeded similarly. Each landscape was assessed in less than 20 min.

Libby Hill	Walker Mountain
	

Figure 12. Photos of Libby Hill and Walker Mountain.

The evaluation results from the 60 participants were compiled as follows. For each component of viewshed scenic quality and public concern or sensitivity, averages were calculated and then summed. These summed averages formed the basis for determining the ranks of viewshed scenic quality and public concern or sensitivity. Based on these totals, viewshed scenic quality and public concern or sensitivity were ranked as high, moderate, or low. Finally, considering the ranks of each component, the overall importance of the landscape was determined. While Libby Hill received similar evaluations to Walker Mountain in the viewshed scenic quality component, it lost significant points in the distraction category. Libby Hill scored a total of 6.02 in viewshed scenic quality, ranking as moderate. In the public concern or sensitivity category, Libby Hill received higher scores than Walker Mountain but lost more points in the incongruent content category, as might be expected, because of the developed areas that were visible. Libby Hill's total average score of 9.67 in detailed categories ranked it as high in public concern or sensitivity (Table 4 and Figure 13). Overall, considering both categories' ranks, Libby Hill was classified as a landscape requiring special consideration (Table 5, left side) for inclusion on the Scenic Viewshed Register. Walker Mountain was similarly assessed in both categories. It received high scores in scale, diversity, and coherence and legibility in the viewshed scenic quality category, ranking high with a total score of 8.76. In public concern or sensitivity, it was also ranked high, with a total average of 8.03 (Table 4 and Figure 13). In summary, Walker Mountain was ranked high in both categories, receiving an "Include in the Scenic Viewshed Register" final rating. It would be considered among Virginia's special landscape resources (Table 5, right side) and requires no special consideration for inclusion on the register.

Table 4. Evaluation of Viewshed Scenic Quality and Public Concern or Sensitivity.

Viewshed Scenic Quality	Public Concern or Sensitivity
	

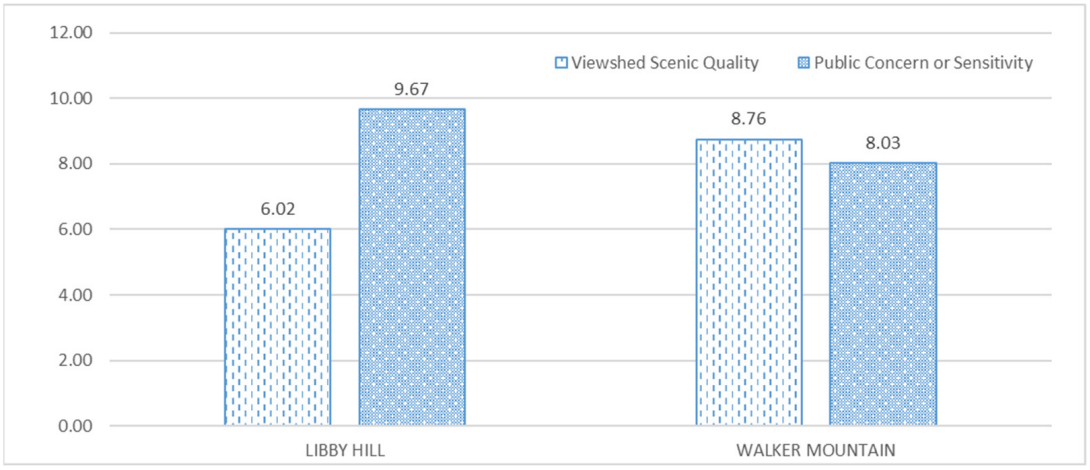


Figure 13. Total score of each category.

Table 5. Results of the pilot evaluation.

Libby Hill

Viewshed Scenic Quality	rank	score	Public Concern or Sensitivity: High (10~7)	Moderate (6~3)	Low (2~0)
High	High	11~7	I	I	SC
Moderate	Moderate	6~3	**SC**	N	N
Low	Low	2~-1	N	N	N

Result: Special Consideration

Walker Mountain

Viewshed Scenic Quality	rank	score	Public Concern or Sensitivity: High (10~7)	Moderate (6~3)	Low (2~0)
High	High	11~7	**I**	I	SC
Moderate	Moderate	6~3	SC	N	N
Low	Low	2~-1	N	N	N

Result: Include in Viewshed Register

The pilot test results showed that the experts quickly adapted to the evaluation method and provided relatively consistent assessments. This evaluation method demonstrated potential as a tool for identifying and managing scenic landscape resources in different areas.

6. Conclusions and Discussion

This project comprehensively outlines the essential requirements for establishing the Scenic Viewshed Register in Virginia, highlighting the crucial role that Scenic Virginia

will undertake in fostering community involvement. By engaging Virginia's citizens in the identification process, the initiative empowers them to nominate viewsheds that they believe warrant recognition and conservation. This inclusive approach ensures that the register reflects the values and preferences of the local population, making it a truly community-driven effort. The critical steps taken include detailing the specific information necessary to engage the public effectively and identifying key variables for scenic quality assessment based on extensive literature reviews on scenic and visual assessments.

Clearly, there are some aspects of landscape experience that cannot be captured in a photograph, such as the sound of birds chirping, the smell of pine trees, and the cool feeling of a breeze. This is why the protocol developed as part of this study has two parts: a local citizen nomination and an expert assessment. Obviously, someone nominating a local viewshed would be familiar with and have experienced the viewshed firsthand. It is envisioned that the expert assessment would also involve first-hand experience of the landscape being assessed. Photographs of the landscape are required in the nomination process as well as a written description. This assures that the expert will be able to accurately locate and assess the viewshed being nominated. The assessment criteria developed as part of this project include ephemeral qualities, which could help in identifying experiential aspects of the landscape that may not be captured in a photograph. Photographs of different landscapes that were used to determine the assessment criteria derived from the literature review could capture visual characteristics of example landscapes. In this case, the landscapes were not being assessed. The photographs were conveying the visual characteristics of the landscape and not the experience of the landscape. Humans are very good at reading scenic characteristics from a photograph. People are used to looking at visual representations on television, newspapers, and books and answering simple questions about the visual characteristics

The use of photographs from the Scenic Virginia archive was crucial in validating and refining these variables. This meticulous selection process resulted in the creation of a comprehensive assessment protocol specifically designed to accurately evaluate the scenic value of Virginia's viewsheds. The protocol's objective is to methodically determine if a viewshed meets the criteria for inclusion in Scenic Virginia's Scenic Viewshed Register, considering both aesthetic attributes and public interest. This systematic approach ensures that each nominated viewshed is assessed through a transparent and repeatable process, building trust and credibility in the results.

There is now a greater public interest and a heightened need to protect our vital scenic viewsheds. We can learn from the pioneering landscape architects who developed visual resource management systems for public lands. However, to succeed, we must also embrace new methods of assessing scenic viewsheds that incorporate positive elements from human use, including historic landscape features, cultural patterns of human use, urban characteristics, and transient elements. As new concepts and methodologies for scenic assessment are developed, they must be empirically tested to ensure they align with what Virginians perceive as scenic. This is the next step.

Author Contributions: Methodology, P.A.M.; Formal analysis, J.S.; Writing—review & editing, L.P. and L.C. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by a grant from Scenic Virginia in 2019.

Data Availability Statement: The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

Acknowledgments: An initial version of this paper was originally published in the Proceeding of the 2019 VRS (Visual Resource Stewardship) Conference as a panel. This version has undergone significant edits to update the content and include results of the expert evaluation. The proceedings for the 2019 Visual Resource Stewardship Conference are published here: https://digitalcommons.esf.edu/vrconference/, accessed on 1 April 2024. Thanks to Richard Gibbons, FASLA, Chair of the Scenic Virginia Viewshed Committee—for his support and encouragement in undertaking the Scenic

Virginia Viewshed Project; Scenic Virginia Board—for their support and feedback; Scenic Virginia Scenic Viewshed Committee—for their support and feedback on the Scenic Virginia Viewshed Project.

Conflicts of Interest: The authors declare no conflicts of interest. Two co-authors worked for Scenic Virginia but did not have a role in designing the study. They did participate in review of the study at different stages and provided feedback to the researchers.

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