

PEDESTRIAN LEVELS OF SERVICE (LOS) AT MUIR WOODS NATIONAL MONUMENT (CALIFORNIA): AN INTRODUCTION TO MULTI-MODAL LOS FOR PARKS AND PROTECTED AREAS

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Abstract.—Historically, transportation planning and management have been guided largely by principles of efficiency. Specifically, the Transportation Research Board has utilized a levels of service (LOS) framework to assess quality of service in terms of traffic congestion, speed and travel time, and maximum road capacity. In the field of park and outdoor recreation management, on the other hand, indicators and standards of quality have emerged as an important conceptual framework for assessing the quality of visitor experience. This contemporary management-by-objectives approach provides a standard of quality based upon minimum acceptable conditions. While LOS is an effective utilitarian approach to transportation planning, application of an indicators-and-standards framework could prevent unacceptable negative impacts to park resources and the visitor experience. Past studies in Acadia National Park (Maine), Blue Ridge Parkway (Virginia), and Muir Woods National Monument (California) provide a means for exploring this conceptual bridge.

1.0 BACKGROUND

Transportation has been an integral element of visitor experience since the first National Parks were established. At the time of their inception, National Parks were promoted as tourist destinations to increase railroad ridership and broaden Western expansion (Runte 1997).

With the advent of the automobile, park visitation rates increased; today automobiles remain the primary means of getting to and experiencing National Parks. However, innovative transportation planning has led to the emergence of public transit systems in Acadia (Maine), Grand Canyon (Arizona), Yosemite (California), Zion (Utah), and other National Parks (National Park Service 1999). Given the inherent relationship between transportation and visitor experience, how can transportation be managed best in parks and related contexts?

This paper explores conceptual frameworks from both transportation and recreation fields of study in order to propose a new means of guiding transportation management in parks and protected areas. U.S. Department of Transportation (DOT) and National Park Service (NPS) objectives are used to construct a rational basis for the proposed framework. Muir Woods National Monument (California) provides the backdrop for this examination.

2.0 AGENCY OBJECTIVES

The DOT was established in 1966 with the following mission: to “[s]erve the United States by ensuring a fast, safe, efficient, accessible and convenient transportation system that meets our vital national interests and enhances the quality of life of the American people, today and into the future.” To carry out this mandate, the department focuses primarily on such variables as speed, safety, efficiency, accessibility, and convenience. The latter half of the statement considers vital national interests and quality of life for current and future generations. As parks may be considered of vital national interest and contribute to the quality of life of the American people, what is an appropriate measure of effectiveness for transportation plans within parks and protected areas?

The NPS Organic Act of 1916 offers insight into this issue. The Act states that the National Park Service’s

mission is “...to promote and regulate the use of the... national parks...which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.” While the definitive link between agency objectives is consideration of future generations, the NPS focuses on a different set of critical variables in its management regime. National Parks must be managed for conservation of scenery, natural and historic objects, and wildlife as well as for visitor enjoyment.

As transportation provides a vital link between people and place, it is important that the two agencies blend their goals with respect to transportation. How can the DOT and the NPS cooperate in ways that allow each agency to address its respective objectives?

3.0 LEGISLATIVE INTENT AND FEDERAL REGULATIONS

Legislative intent and the Code of Federal Regulations (CFR) call for innovative and interdisciplinary approaches to transportation planning within parks and protected areas. In 1982, the Surface Transportation Assistance Act created the Federal Lands Highway Program (FLHP), including the Park Roads and Parkways, Refuge Roads, and Public Highways Program. Its mission statement combines variables from both the NPS Organic Act and DOT’s mission: to “[i]mprove transportation access to and through Federal and Tribal lands through stewardship of FLH programs by providing balanced, safe, and innovative roadways that blend into or enhance the existing environment.” Accessibility and safety are part of DOT’s mission, while environmental considerations are part of the NPS mission. In 1983, the NPS and the FLHP established their first formal partnership in a Memorandum of Agreement (MOA).

A 1997 Memorandum of Understanding supplemented the 1983 MOA. It established the overarching goal of creating a mutually beneficial relationship to improve transportation in, and approaching, NPS facilities through five activities: 1) developing and implementing innovative transportation plans; 2)

establishing personnel exchange and information sharing systems; 3) establishing interagency project agreements for developing and implementing transportation improvement initiatives; 4) developing innovative transportation planning tools; and 5) developing innovative policy, guidance, and coordination procedures to implement safe and efficient transportation systems that are compatible with the protection and preservation of the NPS’ cultural and natural resources. As a result, the NPS began development of the Alternative Transportation Program and published the NPS transportation planning guidebook in 1999.

The Transportation Equity Act for the 21st Century (TEA-21, 1998) and the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU 2005) both promote concepts in NPS regulations. TEA-21 requires the DOT and the Department of Interior, which houses NPS and other federal land managing agencies, to conduct a comprehensive study of transportation needs on federal lands. It also introduced a requirement to develop planning procedures for congestion management systems (CMS). SAFETEA-LU initiated funding for multi-modal projects including mass transit, bicycle and pedestrian traffic, ferry facilities, visitor facilities, and intermodal terminals. These guiding legislative Acts have in turn created pragmatic implications through the CFR.

Multi-modal transportation systems have been proposed as a solution to congestion, and thus warrant research. The CFR explicitly states that “consideration shall be given to strategies that promote alternative transportation systems, reduce private automobile travel, and best integrate private automobile travel with other transportation modes.” It also suggests that alternative mode studies should be components of CMS and that methods for evaluating and monitoring the effectiveness of multi-modal transportation systems should be developed. When reflecting on the results of CMS, the NPS must also consider congestion mitigation strategies that “add value (protection/rejuvenation of resources, improved visitor experience) to the park.” The overt use of the words “visitor,” “experience,” “resources,” and “protection” illustrates the need to consider the Visitor Experience Resource Protection (VERP), a carrying-

capacity framework utilized by the NPS (National Park Service 1997, Manning 1999). CFR goes on to name a conceptual framework from traditional transportation planning that may be used to identify and document measures of congestion: levels of service (LOS). At this nexus of VERP and LOS is an innovative framework for transportation planning for parks and protected lands (CFR, Title 23 970.214).

4.0 INDICATORS AND STANDARDS OF THE QUALITY OF THE VISITOR EXPERIENCE

Indicators and standards are a fundamental focus of contemporary carrying capacity frameworks for parks and protected lands. Indicators are measureable, manageable variables affected by visitor-use levels and/or behaviors. These variables are important in influencing the quality of the visitor experience. Standards of quality define the minimum acceptable condition of indicator variables and are often derived from the normative standards of visitors and other stakeholders regarding the condition that should be maintained in National Parks and related areas. Normative standards may ultimately be codified into administrative rules and regulations, public policy, or even law. “Carrying capacity” can be defined as the level and type of recreation use that can be accommodated in a park or related area without violating standards for relevant indicator variables. The formulation of indicators and standards are critical elements of the VERP framework (Manning 2007).

VERP consists of nine elements and lends itself to cooperative planning processes. While VERP selects indicators and specifies standards, it also considers interdisciplinary approaches to project planning and integrates public involvement to illuminate salient indicators and standards. Along with analysis of existing park resources and visitor use levels, resource and social indicators may be monitored and ultimately managed for a high quality visitor experience (Manning 2007). Combined with the aforementioned legislative and regulatory intent, VERP thus becomes a critical element in transportation planning for parks and protected lands. But how does VERP coincide with conventional transportation frameworks?

5.0 HIGHWAY CAPACITY MANUAL AND LEVELS OF SERVICE

LOS is a carrying capacity framework from the Transportation Research Board’s Highway Capacity Manual (HCM) that has guided transportation planning across the United States. LOS is “a qualitative measure describing operational conditions within a traffic stream, based on service measures such as speed and travel time, freedom to maneuver, traffic interruptions, comfort, and convenience.” The HCM rates LOS with a letter system (A through F) where ‘A’ represents free-flowing traffic and ‘F’ is total gridlock. The HCM provides specific LOS measurements for multiple modes of transportation and is a critical element of transportation planning (Transportation Research Board 2000).

In the case of pedestrian walkways, LOS uses both spatial (in persons per meter squared) and temporal (in persons per minute per meter) flow rates. The HCM also provides a visual representation of LOS for pedestrian walkways (Fig. 1). The LOS was created, in part, to make the presentation of results easier to understand (Transportation Research Board 2000), and clear visual representations build upon a vital element of policy formulation – transparency in democratic decision-making (Barber 2000, Fischer 2000, Beierle and Cayford 2002). Again, concepts from VERP and LOS converge to create an innovative approach to transportation planning within parks and protected areas.

6.0 METHODOLOGY AND INTEGRATING FRAMEWORKS

Visual research methods (VRMs) provide an adaptable methodology for working in site-specific contexts and promote transparency in the planning process by illustrating alternatives to the public (i.e., the users of the system) from the early stages of the project (Manning 2007). By making the presentation of results easier to understand, VRMs achieve the goals of the original intent of LOS (Transportation Research Board 2000). VRMs have been utilized with a Limits of Acceptable Change (LAC) framework to manage for optimal visitor enjoyment (Stankey et al. 1985, Manning 2007).

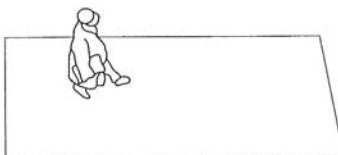
At Muir Woods National Monument, VRMs were used to measure normative standards for crowding on

EXHIBIT 11-8. PEDESTRIAN WALKWAY LOS

LOS A

Pedestrian Space > 60 ft²/p *Flow Rate* ≤ 5 p/min/ft

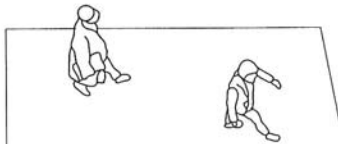
At a walkway LOS A, pedestrians move in desired paths without altering their movements in response to other pedestrians. Walking speeds are freely selected, and conflicts between pedestrians are unlikely.



LOS B

Pedestrian Space > 40–60 ft²/p *Flow Rate* > 5–7 p/min/ft

At LOS B, there is sufficient area for pedestrians to select walking speeds freely, to bypass other pedestrians, and to avoid crossing conflicts. At this level, pedestrians begin to be aware of other pedestrians, and to respond to their presence when selecting a walking path.



LOS C

Pedestrian Space > 24–40 ft²/p *Flow Rate* > 7–10 p/min/ft

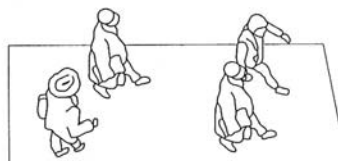
At LOS C, space is sufficient for normal walking speeds, and for bypassing other pedestrians in primarily unidirectional streams. Reverse-direction or crossing movements can cause minor conflicts, and speeds and flow rate are somewhat lower.



LOS D

Pedestrian Space > 15–24 ft²/p *Flow Rate* > 10–15 p/min/ft

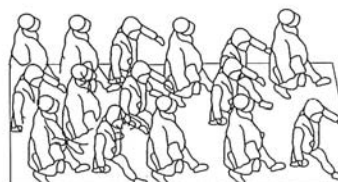
At LOS D, freedom to select individual walking speed and to bypass other pedestrians is restricted. Crossing or reverse-flow movements face a high probability of conflict, requiring frequent changes in speed and position. The LOS provides reasonably fluid flow, but friction and interaction between pedestrians is likely.



LOS E

Pedestrian Space > 8–15 ft²/p *Flow Rate* > 15–23 p/min/ft

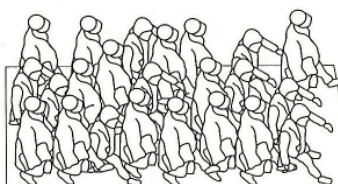
At LOS E, virtually all pedestrians restrict their normal walking speed, frequently adjusting their gait. At the lower range, forward movement is possible only by shuffling. Space is not sufficient for passing slower pedestrians. Cross- or reverse-flow movements are possible only with extreme difficulties. Design volumes approach the limit of walkway capacity, with stoppages and interruptions to flow.



LOS F

Pedestrian Space ≤ 8 ft²/p *Flow Rate* varies p/min/ft

At LOS F, all walking speeds are severely restricted, and forward progress is made only by shuffling. There is frequent, unavoidable contact with other pedestrians. Cross- and reverse-flow movements are virtually impossible. Flow is sporadic and unstable. Space is more characteristic of queued pedestrians than of moving pedestrian streams.



Source: Adapted from Fruin (2).

Figure 1.—Pedestrian walkway LOS diagram from the Highway Capacity Manual (Transportation Research Board 2000).

Table 1.—Normative standards for Muir Woods National Monument survey

	N	Photo (PPV) number (mean)	Equivalent Level of Service (ped/m ²)	Level of Service category
Acceptability	123-124	18.3	3.06	C
Preference	116	11.3	4.96	B
Displacement	101	39.4	1.42	D
Management action	101	23.6	2.37	C
Typically seen	115	13.6	4.12	B

pedestrian walkways. Research participants first viewed a set of computer-edited study photographs that illustrated a range of persons-per-view (PPV) on the park's primary walkway. Respondents were then asked to rate the acceptability of the photographs based on the number of visitors shown and to select the photographs that best represented other evaluative dimensions of preference, management action, and displacement (Park Studies Laboratory 2006). Specifically, respondents were asked to indicate how many PPV correspond with an ideal experience, how many PPV should be allowed before management actions are taken to regulate the number of users allowed on the walkway at one time, and at which point visitors would stop using the walkway based on an unacceptable number of PPV. Finally, respondents were asked to select the photograph that best represented the level of use during their visit. The results of the survey are in Table 1.

7.0 RESULTS

The results of this study provide pragmatic information for administrative decisionmaking. Furthermore, they can be presented in terms of both recreation and transportation frameworks. Table 1 illustrates PPV in terms of LOS. For each dimension, the mean number of PPV was divided into pedestrians per meter squared based upon the length of the boardwalk and number of users shown in the photographs. This calculation demonstrates the numerical pedestrian LOS that is also represented in terms of the letter-based categorical LOS. The same results are illustrated with a social norm curve in Figure 2.

Overlaying an LOS framework creates a Composite Level of Service that incorporates acceptable levels of

change in regards to visitor experience (Fig. 3). The data demonstrate that eight PPV is a highly acceptable condition. In terms of traditional transportation planning, this condition equates to high-flow and congestion-free traffic or LOS A. At the opposite end of the spectrum, 51 PPV on the boardwalk equates to LOS E, or an unacceptable impact upon visitor experience. Ultimately, managers may wish to accommodate between 12 and 19 PPV on the boardwalk as that range coincides with the neutral point of acceptability on the norm curve. This strategy can help avoid displacement of visitors from public lands and help maintain a visitor experience of acceptable quality.

8.0 CONCLUSION

For nearly 30 years, the NPS and DOT have worked cooperatively toward a sustainable framework for transportation systems within and surrounding parks and protected areas. Recently CMS and multi-modal planning regimes have emerged and been promoted through legislation and regulation. As a pragmatic means of measuring, monitoring, and ultimately managing transportation systems, the DOT and NPS may use this planning framework, integrating VERP and LOS, to satisfy the missions of both agencies.

Of course, this paper explores only pedestrian walkways. Legislative intent and the CFR strongly emphasize multi-modal transportation systems as a solution to congestion in national parks. Further research could investigate appropriate LOS measures for bicycle/pedestrian pathways, mass transit, ferries, and intermodal facilities, as well as roadways within and surrounding parks and protected areas.

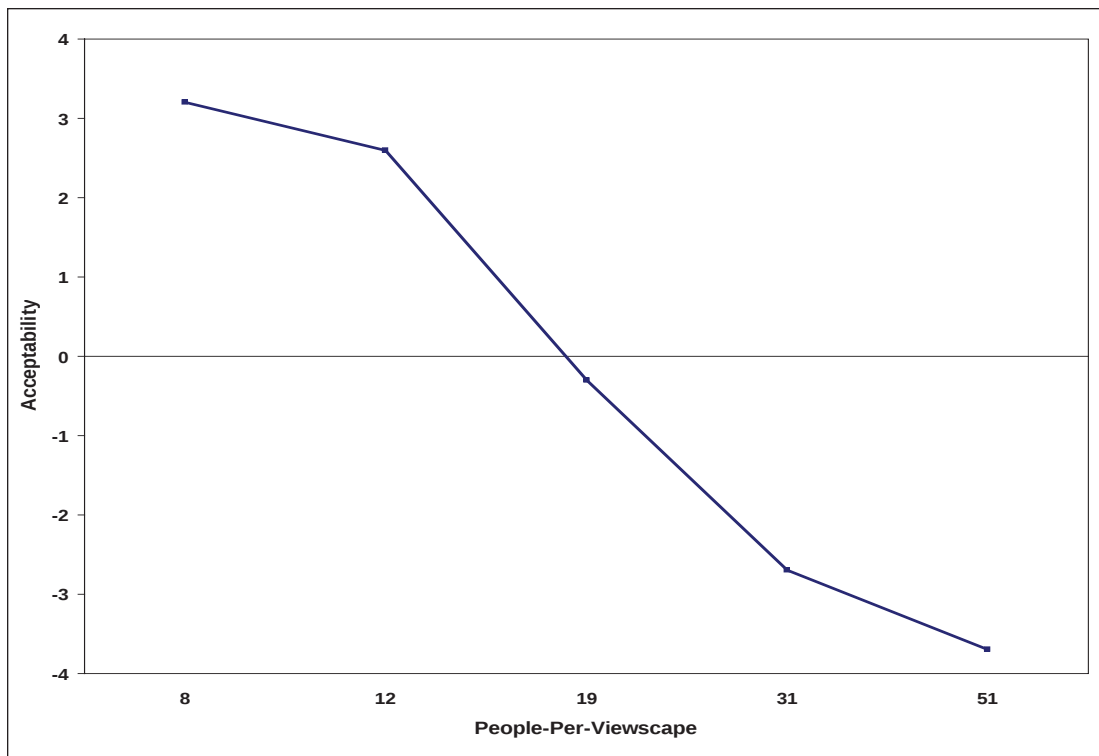


Figure 2.—Social norm curve of persons-per-viewscape (PPV) in the walkway study at Muir Woods National Monument.

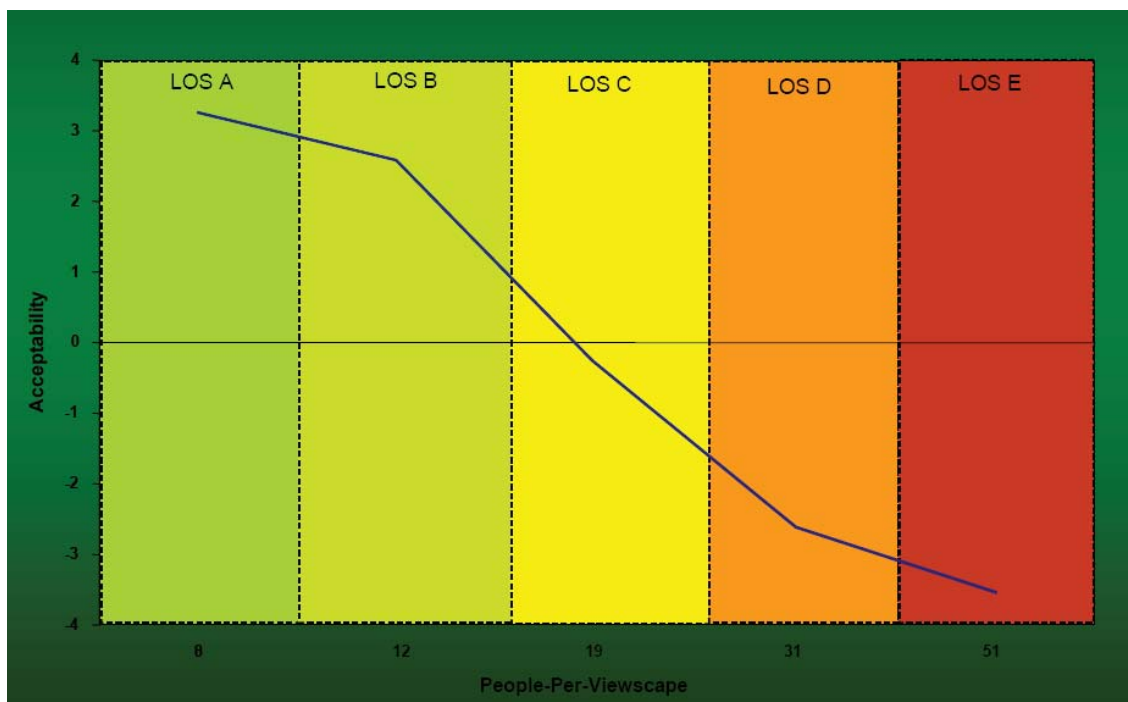


Figure 3.—Social norm curve from Figure 2 with LOS category overlays.

9.0 CITATIONS

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The content of this paper reflects the views of the authors(s), who are responsible for the facts and accuracy of the information presented herein.