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RECREATION CARRYING CAPACITY HANDBOOK
METHODS AND TECHNIQUES FOR PLANNING, DESIGN, AND MANAGEMENT

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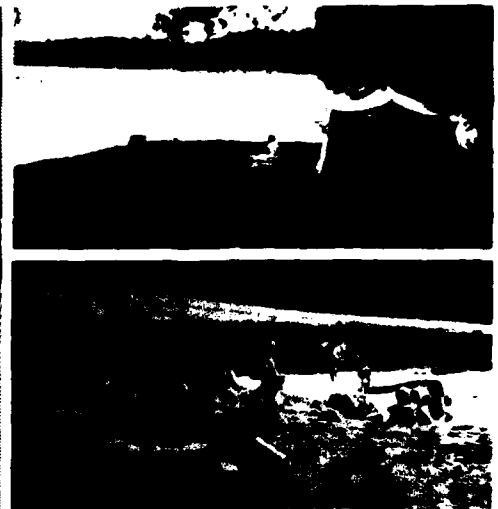
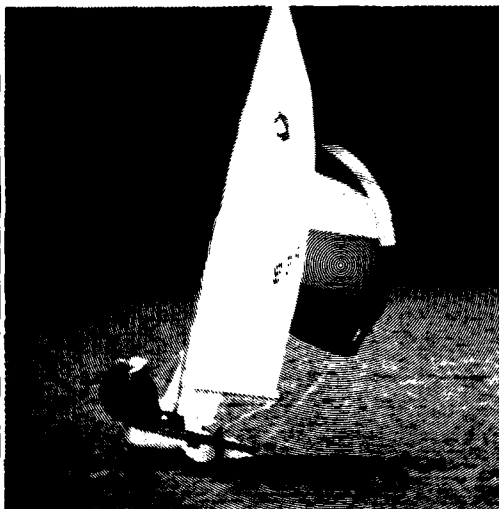
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20. ABSTRACT (Continued).
Based on the results of user surveys and site analyses, carrying capacity planning, design, and management techniques are included for use in preventing and correcting problems of overcrowding, overuse, and underuse of recreation resources. Demonstrations are used to show how carrying capacity guidelines can be developed and applied.

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PREFACE

This report presents a methodology developed by the Urban Research and Development Corporation (URDC) at Corps of Engineers project areas for determining recreation carrying capacity levels based on the results of manager interviews, user surveys, and site analyses. Carrying capacity design and management techniques are explored for use in preventing and correcting problems of overcrowding, overuse, and underuse of recreational resources. The study was conducted under contract with the U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Mississippi, Contract No. DACW39-78-C-0096. A technical report (TR R-80-1) has been prepared detailing study findings and recommendations.

Mr. Donald R. Detwiler, President of URDC, was the Principal-In-Charge of this study, assisted by Mr. Martin C. Gilchrist, Executive Vice-President, and Mr. David H. Humphrey, Vice-President. Mr. B. Thomas

Palmer, Project Director, had major responsibility for technical project direction; Messrs. Phillip D. Hunsberger and Paul L. Sabrosky were involved in site analysis, conducting surveys, and survey analysis; and Mr. Timothy A. Fluck was involved in conducting surveys, survey analysis, and development of methodologies.

Mr. R. Scott Jackson (WES) was the project monitor. Mr. William J. Hansen was Leader, Recreation Research Team. Dr. Adolph Anderson, WES, was program manager of the Environmental Laboratory (EL) Recreation Research Program. The study was supervised by Dr. Conrad J. Kirby, Chief, Environmental Resources Division, EL, and under the general supervision of Dr. John Harrison, Chief, EL.

Commanders and Directors of WES during this study were COL John L. Cannon, CE, and COL Nelson P. Conover, CE. Technical Director was Mr. F. R. Brown.

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FOREWORD

PROBLEM AND NEED

Use of Corps lakes and recreation areas has grown substantially over the years and is expected to increase even more in the years to come. Problems of recreation area overcrowding and recreation resource overuse are already realities at many Corps projects. Users are encountering conflicts regarding where and how they conduct their recreation activities, thus causing unpleasant recreation experiences. Resources are being damaged, and often destroyed, by continued heavy use.

Resource overuse and overcrowding will continue to increase unless a conscious, systematic approach is taken to manage Corps recreation areas based upon their recreation carrying capacity.

PURPOSE AND USE OF THIS HANDBOOK

Many Corps of Engineers personnel who must address overcrowding and overuse problems believe that recreation carrying capacity analysis should play a major role in resource management. Recreation carrying capacity can no longer be an academic exercise but should be of concern to all who have responsibility for implementing recreation planning and management in the field.

This Handbook offers practical guidelines which Corps planners, designers, and managers can use for determining appropriate recreation carrying capacity levels and for achieving and maintaining those levels. The Handbook is not a manual containing rigid requirements which are applied in every situation. Rather, it offers practical guidance to help analyze and solve real-life problems.

The Handbook can be useful to Corps personnel at all stages of the recreation decisionmaking process:

- **Planning.** Evaluating the recreational potential of alternative areas and preparing resource plans.
- **Site Planning and Design.** Designing areas for their appropriate carrying capacities, foreseeing management implications of site plans, and achieving the proper balance between the capacity of recreation areas and their support facilities.
- **Management.** Predicting and identifying problems of overuse and overcrowding, determining

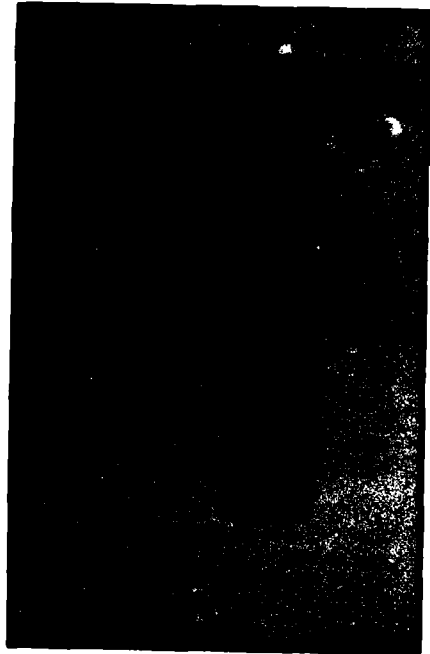
the appropriate level of carrying capacity at which to manage an area, deciding when controls should be exercised, determining the level of remedial action necessary to correct existing problems of overuse and overcrowding, and evaluating the effectiveness of recreational programs and facilities over time.

Although this Handbook is a carrying capacity guide designed for use by the Corps of Engineers, recreation policymakers, planners, designers, and administrators outside the Corps might find it useful in conducting carrying capacity research and in making day-to-day and longer range decisions about recreation resource use.

FOUNDATION OF THIS HANDBOOK

The Handbook is one part of the Corps' Recreation Carrying Capacity Design and Management Study. It is based upon that extensive research and surveys: more than 2,000 users were surveyed at 182 activity areas and resource managers, staff, and recreation areas were surveyed at 11 selected Corps project areas across the Nation. The overall findings from these surveys were published by the U. S. Army Engineer Waterways Experiment Station (Technical Report R-80-1).

**UNDERSTANDING
CARRYING
CAPACITY**



CARRYING CAPACITY AS VIEWED IN THIS HANDBOOK

Recreation carrying capacity means different things to different people. Environmentalists, ecologists, and biologists tend to view carrying capacity primarily in terms of resource degradation and restoration. Sociologists and psychologists are concerned mainly with the quality of user experiences and the effects of crowding on human behavior. Site planners often view capacity in terms of the physical space required to effectively and safely conduct an activity. And administrators frequently consider capacity as it relates to management policies, costs, personnel, user demand, and the feasibility of exercising controls on the use of resources.

All of these perspectives on carrying capacity are important when viewing carrying capacity at Corps recreation areas. However, this Handbook addresses carrying capacity primarily in terms of social overcrowding and resource overuse. Specific physical space requirements and administrative details are considered, but not included as an integral part of the systems suggested to determine appropriate social and resource capacity levels. These details should be addressed when specific needs, demands, management objectives, and cost constraints are known for each situation.

It would be next to impossible to develop an easy-to-use method of determining carrying capacity that would include all possible factors affecting carrying capacity and its management. Therefore, this Handbook follows these guideposts in presenting methods and techniques for use at Corps recreation areas:

Outdoor Recreation Activities.

Only selected outdoor recreation activities are considered: boating, boat fishing, boat launching, camping, hiking, off-road vehicle riding, picnicking, shoreline fishing, sunbathing, swimming, and waterskiing. (Activity definitions and descriptions are provided in Appendix A.)

Social Capacities in Terms of Instant Capacities. Social capacity is expressed in "instant capacity" terms, i.e., the number of recreation units (e.g., users or picnic tables) a recreation area should accommodate at any single point in time. Instant capacities can be converted to daily and seasonal capacities with the use of turnover rates being experienced at Corps recreation areas.

Instant Capacity Units of Measurement. The Handbook expresses instant capacities in terms of distances between recreational units (e.g., users or picnic tables) and/or in terms of the number of recreational units per acre.

Social Capacity Guidelines for Recreation Areas Only. The social capacity guidelines in this Handbook pertain only to the spacing of recreation units in activity areas--they do not deal with the additional space required for parking lots, buffers between activity areas, maintenance and utility structures, and other support facilities.

Resource Capacity Guidelines.

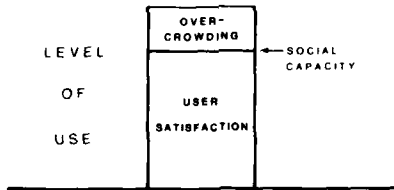
The resource capacity guidelines in this Handbook are necessarily simple because of: (1) the complexities involved in dealing with degradation which is cumulative over a recreation season and from season to season, and (2) the highly variable factors which affect resource capacity.

Single-Activity and Multiple-Activity Areas. Guidelines are provided for determining capacities for each separate activity so that capacity levels can be established for single-activity areas and can be combined to set capacity levels for multiple-activity areas.

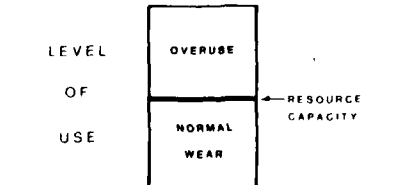
THE CONCEPT OF CARRYING CAPACITY

Two components make up carrying capacity: social capacity and resource capacity.

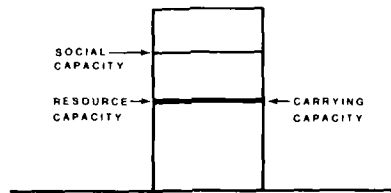
Social capacity is the level of use of a recreation resource beyond which the user does not achieve a reasonable level of satisfaction. Overcrowding occurs when social capacity is exceeded:



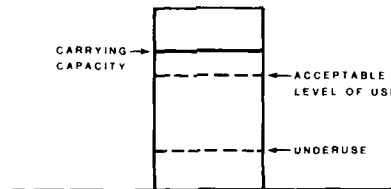
Resource capacity is the level of use of a recreation resource beyond which irreversible biological deterioration takes place or degradation of the resource makes it unsuitable or unattractive for recreational use. Overuse occurs when resource capacity is exceeded:



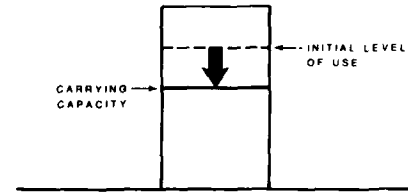
If there is a difference between resource and social capacities, then carrying capacity would be determined by the lesser of the two.



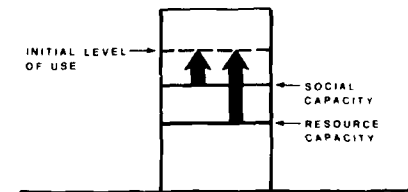
Carrying capacity is the maximum potential level of use which avoids overcrowding and overuse. The level of use at carrying capacity need not be achieved, but an area is underused if the level of use is significantly below the carrying capacity of the area:



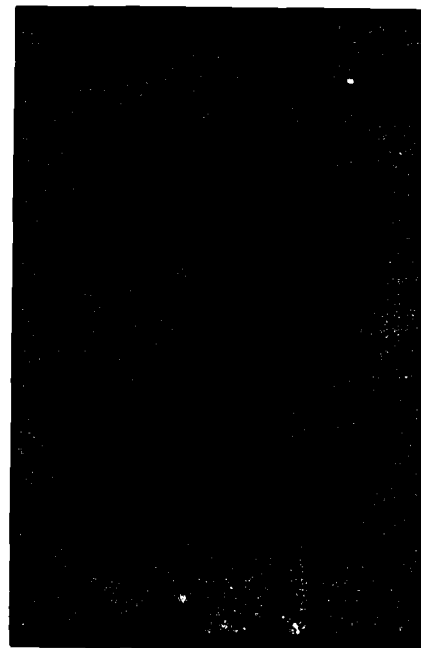
However, the level of use should not exceed the carrying capacity of an area. If it is exceeded, (1) the level of use can be decreased:



and/or (2) the social capacity, resource capacity, or both can be increased:



**DETERMINING
CARRYING
CAPACITY**



INTRODUCTION

The Value Of Carrying Capacity

This Part of the Handbook offers a systematic and easy-to-use method for determining the recreational carrying capacities of individual activity areas. The method can be used at all stages of the recreation planning, design, and management process.

Planning

- Evaluating alternative sites and choosing the most appropriate size and character of a site.
- Predetermining the optimum levels of use for various locations of selected sites, evaluating the suitability of an area for different activities, and examining the implications of exceeding carrying capacities.

Site Design and Development

- Assigning activities to areas according to relevant natural assets and limitations.

- Determining the suitable proximity and level of interrelationship between different activity areas.
- Designing with management objectives and costs in mind.
- Balancing the capacity of recreation areas with the capacity of their respective support facilities.

Administration and Operations

- Determining appropriate use levels in order to assess the need to encourage, discourage, or restrict usage or to expand or diminish capacity levels, both at recreation areas and at their respective support facilities.
- Making more realistic estimates of usership when actual user counts cannot be made.
- Serving as a basis for a program of continued evaluation of the carrying capacities of individual areas.

Carrying Capacity Guidelines

This Part contains three sections:

Social Capacity Guidelines

The social capacity guidelines generate information on the distance/density levels that users prefer. A knowledge of these user preferences provides the first step in determining the carrying capacity of an area.

Resource Capacity Guidelines

The resource capacity guidelines furnish information on the potential impact that various factors will have on the resource base. This information provides recreation planners and management with an awareness of the implications of development and management decisions that, combined with the social capacity guidelines, results in the carrying capacity guidelines for an area.

Monitoring Guidelines

A monitoring program provides information for making decisions about both the social capacity and resource capacity of an area. Monitoring enables the user of this Handbook to evaluate and refine capacity figures developed through the use of this carrying capacity determination method.

Using Carrying Capacity In Decisionmaking

A knowledge of the carrying capacity of an area is the first step in making decisions concerning the planning, design, and management of an area, not the final step (see Figure 1).

The carrying capacity of an area indicates the level of use that an area could provide, given a certain set of factors. But this is not to say that the area should be developed for the level of use at that carrying capacity. There may not be sufficient user demand to sustain the level of use at carrying capacity. Such a level of use may also not be cost-effective.

The Handbook presents carrying capacity guidelines to serve as guideposts during decisionmaking, not as rigid requirements that must be applied in every case. It is expected that these guidelines will need to be modified in light of such considerations as demand and cost.

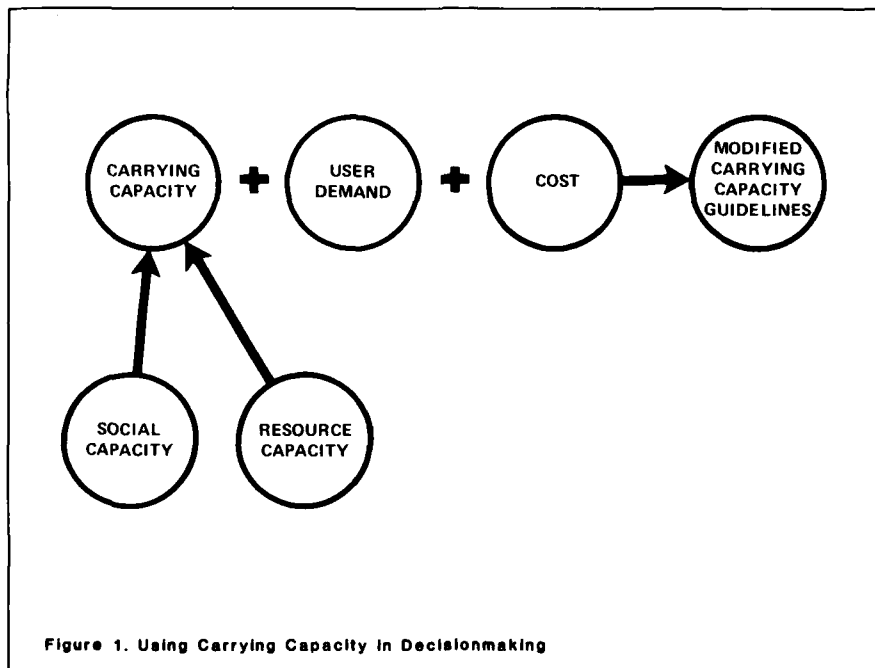


Figure 1. Using Carrying Capacity in Decisionmaking

SOCIAL CAPACITY GUIDELINES

The purpose of this section is to provide a general description of the system used to determine social capacity. A more detailed step-by-step description including an example is provided, beginning on page 12. Other examples are included in Part 4, beginning on page 69.

The intent of this system is to provide a step-by-step process to determine the distance between groups that users prefer. However, once guidelines are determined using the system, the results should be evaluated against other factors such as resource capacity (page 36), management objectives (page 43), and other social capacity factors (Step 5 page 13). The guidelines can then be adjusted to fit individual cases based on the results of this evaluation process.

The System

Two elements serve as a basis for the social capacity guidelines system. These elements are preference distributions and social capacity factors. They were developed based on a survey of visitors at select Corps projects located across the Nation.

Preference distributions have been developed for each recreation activity under consideration. The preference distributions define for each activity the range of distances (planning range) that a great majority of users have indicated they prefer to be from other users (see Figure 2a). Preference distributions for the eleven activities considered in this study are provided (pages 14-35).

Each preference distribution is further divided into several preference groupings (see Figure 2a). Each grouping identifies the percentage of users who prefer to be in the distance range of that grouping. In Figure 2a, preference grouping A illustrates that 25 percent of the users prefer spacing of 1-2 units of distance; grouping B illustrates that 20 percent prefer spacing of 2-4 units; grouping C illustrates that 30 percent prefer spacing of 4-6 units; and grouping D illustrates that 25 percent prefer spacing of 6-8 units.

The preference distribution for each activity illustrates a generalized planning range. In order to tailor the preference distribution to an individual activity area, one must use the table of social capacity factors provided on pages 14-35 for each activity.

The social capacity factors for each activity consist of a list of site and user characteristics that affect the spacing preferences of users (see Figure 2b). Each factor has different levels (e.g., in Figure 2b, the factor "Level of Development" has 3 levels: "High," "Moderate," and "Limited"). These levels are defined in either the social capacity factors tables or in Appendix B.

Each factor level has a variance value, which is the number of the units of distance which that factor level will shift the preference distribution (e.g., in Figure 2b, a "High" level of development has a variance value of -2), which means the planning range would be shifted to the left two units indicating that less spacing between user groups is required.

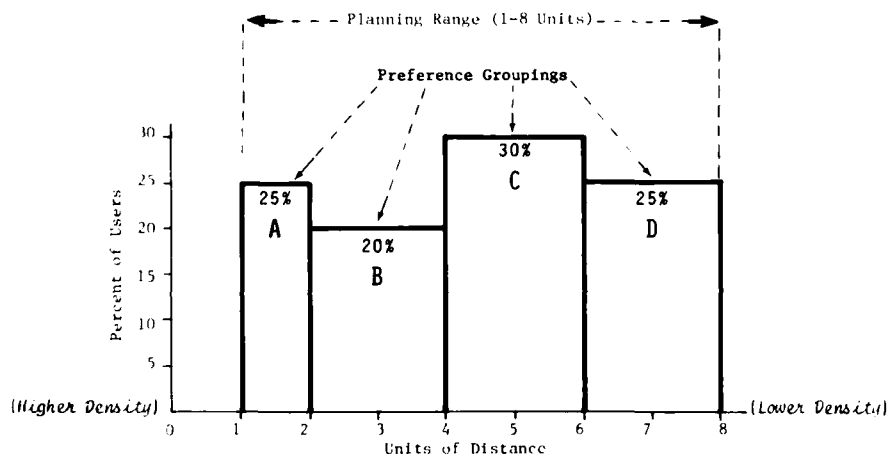


Figure 2a. Preference Distribution

Site Characteristics	Variance	User Characteristics	Variance
Level of Development		Age of Users	
High	-2	<25 (20%)	+2
Moderate	0	26-55 (65%)	0
Limited	+1	56+ (15%)	-1
Distance from Highway Access		Travel Time to Project Area	
0-5 miles	-1	<30 min (40%)	0
>5 miles	+2	>30 min (60%)	+2
Maintenance of Facilities		Number of Other Activities Engaged In	
Pleasant	0	1-3 (65%)	0
Unpleasant	+1	4+ (35%)	+1

Figure 2b. Social Capacity Factors

Using The System

The system for determining the social capacity guidelines of an activity area contains five steps.

Step 1 - Acquire the Necessary Information. After becoming familiar with this system, acquire the information needed to use it. The factors tables and Appendix B will guide the information collection. Information on site characteristics should pertain to the area as it will be finally developed, not as it exists before development. Figure 3b lists a hypothetical, observed condition for each factor in Figure 2b.

Step 2 - Determine the Effect of the Observed Conditions. Compare the observed condition of each site characteristic with the levels of each site characteristic in the social capacity factors table. Select the level which best represents the observed condition and identify the variance value for each level selected.

Determine if the percentage of users included for each factor level of each user characteristic in the factors table differs significantly from the users expected to use the area. If the percentage of users expected to use the area differs significantly from the percentages in the factors table, then select the level representing the greatest percentage of

users expected to use the area and identify the variance value for each level selected.

Figure 3b contains the variance values from Figure 2b that pertain to each observed condition. Because the percentages of users expected to use the area does not differ significantly from the percentages identified with each factor level for "Age" and "Number of Other Activities," no variance value is identified for these user characteristics. But because the percentage of users expected to use the area differs significantly from the percentages identified with each factor level for "Travel Time," the variance value for ">30 min" is used.

Step 3 - Modify the Preference Distribution. Total the variance values identified for the observed conditions to obtain the net effect (-1 in Figure 3b). Then, shift the preference distribution by the number of distance units equal to the net effect.

A positive net effect will shift the preference distribution to the right (to greater spacing and lower density); a negative net effect will shift the preference distribution to the left (to closer spacing and higher density). For example, shifting the preference distribution in Figure 2a by the net effect of the factors of Figure 3b (-1) produces the modified preference distribution in Figure 3a.

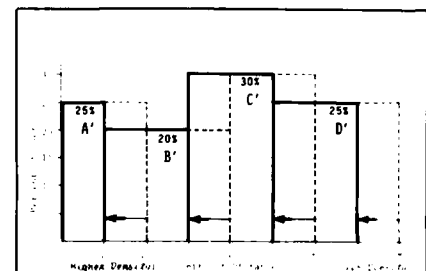


Figure 3a. Modified Preference Distribution

Work Space			
Factors	Observed Conditions (Step 1)	Effect of Observed Conditions (Step 2)	
Site Characteristics			
Level of Development	High	-1	
Distance From Highway	2 miles	-1	
Access			
Maintenance of Facilities	Pleasant	0	
User Characteristics			
Age	All Ages	0	
Travel Time	>30 min	-1	
Number of Other Activities	>3 activities	0	
		Net Effect	-1
		(Step 3)	
Modified	A'	B'	C'
Group Ranges (Step 1)	0-1	1-3	3-5
Midpoints	0.5	2	4
Area/Densities*	0.5	2	4

*A distance/area density conversion table is provided in Appendix C.

Figure 3b. Work Space

Step 4 - Establish Distance/Density Guidelines. Select a midpoint (the average) in the distance range of each modified preference grouping to serve as a distance guideline. Figure 3b contains the distance guidelines for this example.

It is important to recognize that the system will yield a guideline that will satisfy the preferences of each preference grouping. Thus, in this example, 25 percent of the users will prefer spacing of $\frac{1}{2}$ unit, 20 percent will prefer 2 units, 30 percent will prefer 4 units, and 25 percent will prefer 6 units. Ideally, areas should be developed to meet these preferences, but each recreation area need not provide for each preference grouping.

Distance guidelines can be converted to area guidelines by squaring the number of units in the distance guideline. (A distance/area/density conversion table is provided in Appendix C.) Figure 3b contains the area guidelines in this example [$\frac{1}{4}$ square units ($\frac{1}{2} \times \frac{1}{2}$), 4 square units (2×2), 16 square units (4×4), and 36 square units (6×6)].

Area guidelines can be converted to density guidelines by dividing the area guideline into 1 unit of area. Figure 3b contains the density guidelines in this example [4 sites per square unit ($1 \div \frac{1}{4}$), 0.25 sites per

square unit ($1 \div 4$), 0.06 sites per square unit ($1 \div 16$), and 0.03 sites per square unit ($1 \div 36$)].

Step 5 - Evaluate the Distance/Density Guidelines. The guidelines should be evaluated in several ways:

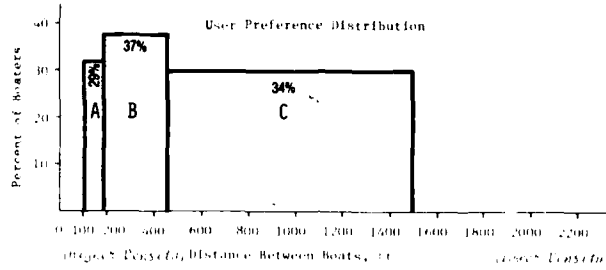
- Determine if the social capacity guidelines are acceptable based upon prior experience. If the guidelines seem unacceptable, review the table of additional factors and determine if the guidelines need to be modified because of special conditions not taken into account in the factors used.
- Determine if the social capacity guidelines are acceptable based on the resource capacity of the area. This evaluation method is outlined in the Resource Capacity Guidelines section of this Part. Social capacity guidelines that are acceptable based on the resource capacity guidelines serve as the carrying capacity guidelines for the area.
- Determine if the carrying capacity guidelines are acceptable for meeting projected recreation demand. If the guidelines seem unacceptable, evaluate different development and management strategies for modifying the carrying capacity of the area

to meet demand, and evaluate the implications of not meeting projected demand.

Social Capacity Guidelines By Activity

Preference distributions and social capacity factors are provided for boating, boat fishing, boat launching, camping, hiking, ORV riding, picnicking, shoreline fishing, sunbathing, swimming, and waterskiing in Figures 4 to 14, respectively (on pages 14 to 35).

BOATING

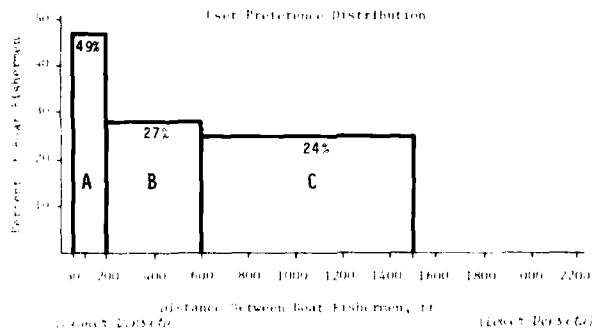


Social Capacity Factors Table

Site Characteristics	Variance	User Characteristics	Variance
Type of Area Boat		Number of Other Activities	
Power	0.5	< 3 (48%)	0.36
Nonpower	0.166	> 3 (52%)	0.25
		Experience	
		Some (44%)	0.36
		None (56%)	0.25
		Much (54%)	0.25
		Little (46%)	0.36
		> 30 (44%)	0.36
		< 30 (56%)	0.25
		Age	
		< 26 (52%)	0.36
		26-55 (48%)	0.25
		> 55 (48%)	0.25
		Group Size	
		1-2 (47%)	0.25
		> 2 (53%)	0.25

Figure 4. Social Capacity Guidelines-Boating

BOAT FISHING



Social Capacity Factors Table

Site Characteristics	Variance	User Characteristics	Variance
Amount of water used		Number of other Activities	
Facilities		<10 (12%)	+195
Therapist	-25	20-30 (30%)	-10
Inpatient	+200	>30 (58%)	+215
Access to water		Equipment	
Boat	0	Power Boat <25hp (31%)	+15
Motorized	+15	Power Boat >25hp (69%)	+70
Other type		Boat type	
Pier only	-5	1-2 (33%)	+20
No pier	+190	>2 (67%)	+85
		Experience	
		None/Little (Some) (31%)	+100
		Much (69%)	+25
		Age	
		18-24 (11%)	+90
		25-34 (33%)	+20
		35-44 (29%)	-10
		45-54 (27%)	-10
		55-64 (11%)	-10
		65-74 (9%)	-10
		>74 (2%)	-10

Figure 5. Social Capacity Guidelines-Boat Fishing



Worksheet

Factor	Condition	Effect
Net Effect		
Modified	A'	B'
Range		
Comments		
Area		
*A distance-area dosage conversion table is provided in Appendix C.		

Additional Social Capacity Factors	Impact*
Site Characteristic Factors	
Compatibility of Nearby Activities	-
Proximity to Other Activity Areas	-
Size of Fishing Area	+
Multiple Uses in Area	+
Configuration of Area (Irregularity)	-
Location of Lake (Rural)	+
Number, Type, and Degree of Man-Made Intrusions or Disturbances	+
Scenic Views	-
Charging of Fees	+
Maintenance of Facilities	-
Distance from Highway Access	+
User Characteristic Factors	
Type of Fishing (Nonpower + Power Boat)	+
Similarity of Visitor Groups	-

**+ Indicates a Positive Relationship - as the factor increases, the spacing preferred by users increases.

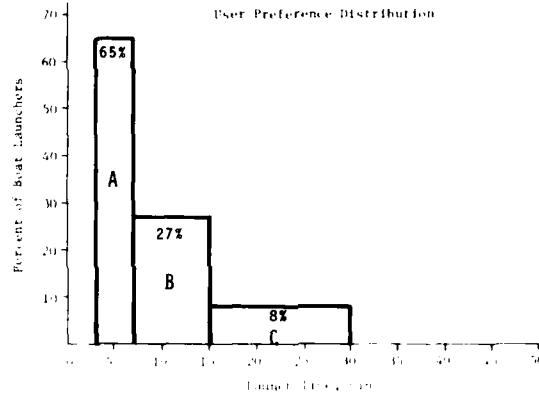
** - Indicates a Negative Relationship - as the factor increases, the spacing preferred by users decreases.

Notes:

BOAT FISHING



BOAT LAUNCHING

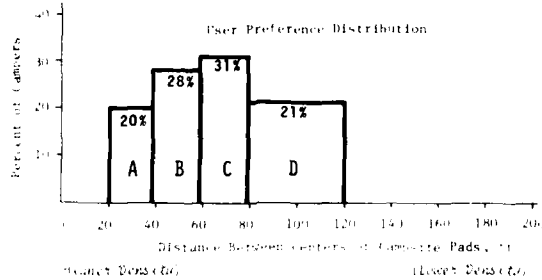


Based on the user preference distribution responses, 65 percent of respondents prefer a launch duration of 0-5 minutes. A table has not been developed for this preference.

Figure 6. Social Capacity Guidelines-Boat Launching



CAMPING



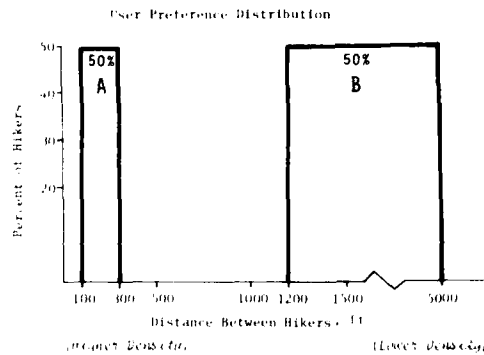
Social Capacity Factors Table

Site Characteristics	Variance	User Characteristics	Variance
Access to water body		Age	
Constructed	+8	<25 (15%)	+6
Unconstructed	+6	26-35 (39%)	-3
Distribution of water body		> 36 (46%)	-7
Constructed	+7	Travel time	
Unconstructed	+9	<30 min (12%)	+12
None	+3	30 min-1 hr (22%)	+2
Lowly developed	+2	> 1 hr (66%)	-1
Moderately developed	+4	Group size	
Highly developed	+3	1-2 (26%)	-3
Moderately developed	+4	3-8 (63%)	+1
Highly developed	+3	8+ (9%)	+5
Availability of facilities		Number of other activities	
Present	+1	1-3 (22%)	-4
Not present	-1	3+ (78%)	+3
Present	+1	Equipment	
Not present	-1	Tent (28%)	+5
Present	+1	Carpenter, Trailers, Vans, etc. (72%)	-2
Present	+1	Experience	
Not present	-1	None (11%)	+1
Present	+1	1-10 years (63%)	-1
Present	+1	11-20 years (26%)	+1
Present	+1	21+ years (0%)	+1

Figure 7. Social Capacity Guidelines-Camping



HIKING

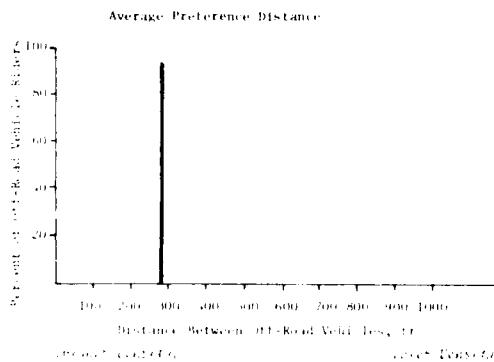


Because of the low number of preferred distance responses from hikers, a D.C. table has not been developed for hiking. For a listing of factors which may affect the social capacity of hiking trails, see opposite page. See also, Guidelines for Understanding and Determining Urban Recreation Carrying Capacity, prepared by Urban Research and Development Corporation for the Bureau of Outdoor Recreation (now BORS), U. S. Department of the Interior, Washington, D. C., January 1977.

Figure 8. Social Capacity Guidelines-Hiking



ORV RIDING



Because of the low number of preferred distance responses from off-road vehicle riders, a Preference Distribution has not been developed. Instead, the mean of the preferred distance responses is provided.

CAUTION: Because of the low number of preferred distance responses, a Factors Table has not been developed. For a listing of factors which may affect the social capacity of ORV trails and areas, see opposite page. See also, *Guidelines for Understanding and Determining Optimum Recreation Carrying Capacity*, prepared by Urban Research and Development Corporation for the Bureau of Outdoor Recreation (now BORS), U. S. Department of the Interior, Washington, D. C., January, 1977.

Figure 9 Social Capacity Guidelines-ORV Riding



Factor	Condition	Effect
Net Effect		
Modified	A'	B'
or Ranges	C'	D'
Weights		
Area Density*		

*A distance area for the coverage table is provided in Appendix 3.

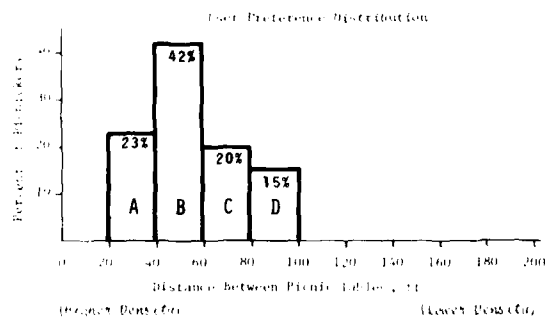
Additional Social Capacity Factors	Impact*
<u>Site Characteristic Factors</u>	
Configuration of Area (Vehicle Speed)	+
Charging of Fees	+
Degree of Control	-
Size of Area/Length of Trail	+
Distance from Highway Access	+
Level of Development	-
Amount/Location of Facilities	+
Multiple Use Recreation Area	-
Vegetation	-
Number, Type, & Degree of Man-Made Intrusions or Disturbances	+
Proximity to Other Activity Areas	-
Scenic Views	-
Proximity to Water	-
Compatibility of Nearby Activities	-
<u>User Characteristic Factors</u>	
Similarity of Visitor Groups	-
Travel Time	+
Experience	-
Origin of User (Urban)	-

*" +" Indicates a Positive Relationship - as the factor increases, the spacing preferred by users increases.
 " - " Indicates a Negative Relationship - as the factor increases, the spacing preferred by users decreases.

Notes:

ORV RIDING

PICNICKING

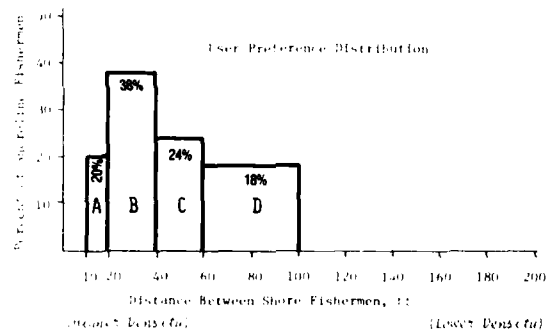


Social Capacity Factors Table

Site Characteristics	Variance	User Characteristics	Variance
Vegetation		Number of other Activities	
open	+2	1 (13%)	+10
Moderate	-1	>1 (87%)	-1
Dense	-9	Group Size	
Amount/Location of Facilities		1-2 (9%)	-1
Pleasant	+2	3-8 (71%)	0
Unpleasant	+5	>8 (20%)	+1
Relationship to other Activity Areas		Age	
Adjacent	-1	<25 (21%)	-1
Separate	+6	>25 (79%)	+1
Accessibility to Water Body		Experience	
Obstructed	-3	None/Little (9%)	+2
Unobstructed	+2	Some (27%)	-1
Degree of control		Much (64%)	-2
High	-1	Travel Time	
Moderate/Limited	+1	≤ 30 min (54%)	+2
Visibility of Water Body		> 30 min (46%)	-2
Obstructed	-2		
Unobstructed	+2		

Figure 10. Social Capacity Guidelines-Picnicking

SHORELINE FISHING

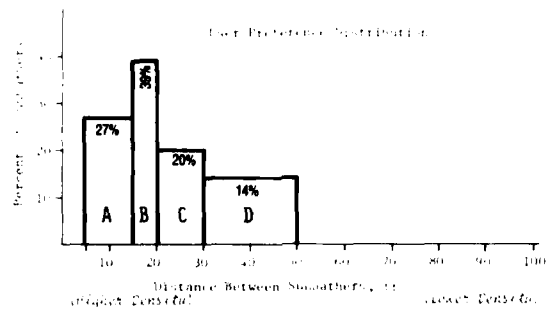


Social Capacity Factors Table

Site Characteristics	Variance	User Characteristics	Variance
Degree of Control		Avg	
Moderate	-5	< 26 (25%)	-8
Little/None	+10	26-35 (60%)	+2
Grouping Fish		> 35 (15%)	+7
Pleasant	+2	Experience	
Unpleasant	+10	None/Little/Some (32%)	-5
Amount/Location of Fish		None (68%)	+2
Facilities		Group Size	
Pleasant	+7	1-2 (66%)	+1
Unpleasant	+2	> 2 (34%)	-1
		Travel Time	
		≤ 1 hr (72%)	0
		> 1 hr (28%)	+1

Figure 11. Social Capacity Guidelines—Shoreline Fishing

SUNBATHING

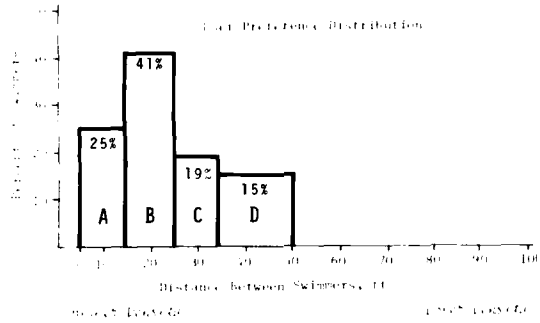


Social Capacity Factors Table

Site Characteristics	Variance	User Characteristic	Variance
Level of Development		Number of other Activities	
High	-2	1-2 (50%)	-3
Moderate/Limited	+2	3-4 (60%)	-1
Degree of Control		>5 (90%)	+3
High	-2	Travel Time	
Moderate/Limited	+2	< 30 min (60%)	-1
Amount/Convenience of Facilities		30 min-1 hr (70%)	+1
Pleasant	-1	> 1 hr (80%)	+3
Unpleasant	+1	Group Size	
Water Quality		1-2 (60%)	-1
Pleasant	-1	3-8 (70%)	0
Unpleasant	+1	> 8 (80%)	+3
Maintenance of Facilities		Experience	
Pleasant	0	None/Little/Some (60%)	+2
Unpleasant	+2	Much (70%)	-1
		Age	
		\$25- (50%)	-1
		\$25+ (70%)	+1

Figure 12. Social Capacity Guidelines-Sunbathing

SWIMMING



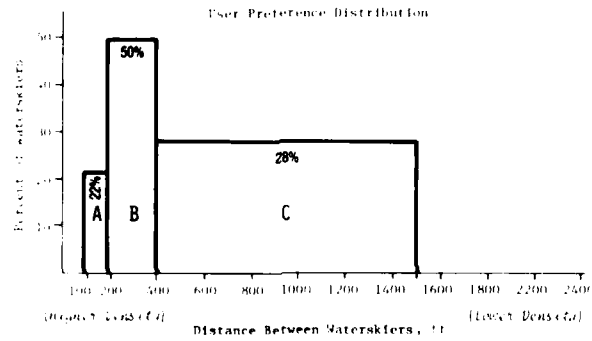
Social Capacity Factors Table

Site Characteristics	Variance	User Characteristics	Variance	
Number of swimmers with swimming equipment on site		Age		
		< 25 (50%)	+2	
		> 25 (50%)	-2	
	Number of other activities		Number of other activities	
			1 (50%)	+1
			2 (50%)	-1
Group Size		Group Size		
		1-2 (50%)	0	
		3+ (50%)	-1	

Figure 13. Social Capacity Guidelines-Swimming



WATERSKIING



Social Capacity Factors Table

Site Characteristics	Variance	User Characteristics	Variance
Amount/Location of Facilities	+150	Travel Time	-90
		< 1 hr (57%)	+120
Level of Development	+75	Number of Other Activities	+80
		1 (14%)	+20
Moderate/Intertid	+5	Experience	+60
		> 5 (88%)	-20
		Age	-20
		5-25 (47%)	+20
		Group Size	0
		1-8 (88%)	-15
		> 8 (12%)	

Figure 14. Social Capacity Guidelines-Waterskiing

RESOURCE CAPACITY GUIDELINES

Introduction

One goal of resource managers is to provide satisfactory recreation experiences for users. Another goal is to protect recreation resources so that the quality and quantity of recreational opportunities are protected for the future.

Because management has both user satisfaction and resource protection goals, both social capacity and resource capacity must be considered in determining the carrying capacity of an area. In these considerations, resource capacity may likely be a constraint to the development and use of an area at its social capacity.

Resource capacity is a function of environmental and other site characteristics. The development of a resource capacity model is difficult because a large number of factors affect resource capacity, each factor has many variations, and the factors interact with each other in a complex manner. In addition, many factors which have a significant impact on resource capacity cannot be controlled or modified by management.

The resource capacity guidelines in this section offer a system for identifying the impact that various resource capacity factors could have on the resource base. This information creates an awareness of the implications of development and management decisions and serves as a foundation for implementing a program of carrying capacity monitoring.

Identifying Potential Impacts

Figure 15 shows potential impacts that various factors have on the resource base. The left column includes five groups of factors (e.g., Environmental, Development/Physical). Each factor has an impact on some aspect of the resource base.

The remaining columns of Figure 15 are organized into five aspects of the resource base (e.g., Water Body, Soils). Each aspect is divided into areas of concern; some are problems, while others are the subject of problems.

The information in Figure 15 is not all-inclusive; the user of this system should feel free to develop additional factors and aspects of the resource base.

Figure 15 is used as follows:

Identify Resource Capacity Factors. When the social capacity guidelines for an area are developed, review the resource capacity factors listed in Figure 15 and identify those that are relevant. Include any other relevant factors which are not included in Figure 15.

Identify Areas Impacted. Identify those areas of concern of the resource base listed in Figure 15 which will be impacted. Include any other relevant impacted areas.

Analyze Impacts. Analyze the type, level, and duration of each of the potential impacts.

Consider Implications of Impacts. Review the existing use level and the factors for the area and consider modifications where warranted, or consider the implementation of a monitoring program (see the following section).

Figure 15. Resource Capacity Guidelines

RESOURCE BASE CONCERNS

FACTORS AFFECTING RESOURCE CAPACITY	WATER BODY					SOILS		ANIMALS			VEGETATION			OTHER						
	Particulate Matter	Chemical Pollution	Eutrophication/Bacteria	Obstacles/Hazards	Type and Amount of Vegetation	Flow	Temperature	Compaction	Erosion	Type, No., and Habits			Type, No., and Condition			Excessive Wear to Corps Facilities	Level of Scenic Quality	Amount of Usable Space	Noise Level	Air Quality
										Endangered Species	Game	Other	Ground Cover	Understory	Trees					
ENVIRONMENTAL																				
Type of Wildlife			0	0						●	●	●	●	●	●	●	●	0	0	
Type of Vegetation	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amount of Tree Cover/Shade																				
Type of Ground Surface	●				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Slope/Drainage		0			●	0							0	0						
Wind/Amount of Wave Action	●			0		0												0	0	
Climate/Microclimate		●			●	0	●			●	●	●	●	●	●	●	●	0	0	0
DEVELOPMENT/PHYSICAL																				
Level of Development	0	0	0	0	0	0	0	0	0	●	●	●	0	0	0	0	0	0	0	0
No. of Activity Areas	0									0	0	0	0	0	0	0	0	0	0	0
Activity Area Size	0									0	0	0	0	0	0	0	0	0	0	0
Activity Area Shape										0	0	0	0	0	0	0	0	0	0	0
Activity Area Design	0	0	0				●	●		0	0	0	0	0	0	0	0	0	0	0
WATER BODY																				
Depth of Water	0	0	0	0	0	0				●	●	●								
Shoreline Configuration	0			0	0	0			0	0	0							0	0	
Pool Fluctuation	●	0		●	0	●		●										●	0	0
Water Quality	0	0	0	0	●	0				●	●	●						0	0	
MANAGEMENT																				
Degree of Control	0	0	0	0			●	●		0	0	0	●	0	0	●	0	0	●	●
Degree of Maintenance			0				0	●		0	0	0	●	0	0	●	0	0	0	0
Degree of Off-Season Restoration	0	0	0				0	●		0	0	0	●	0	0	●	0	0	0	0
USER																				
Type of Activity	●	0	0				●	0		●	●	●	0	0	0	0	0	0	0	0
Type of Equipment	0	0					●	●		0	0	0	●	0	0	0	0	0	0	0
Group Size							0	0					0	0	0	0	0	0	0	0

MONITORING GUIDELINES

Introduction

A monitoring program can be used to provide information for making decisions concerning both the social capacity and resource capacity of an activity area.

A monitoring program permits the evaluation of an area under real-life conditions. Such a system can be selectively employed at those areas where problems are believed to exist. A monitoring program can be relatively inexpensive, especially when conducted during routine patrolling, inspection, and administration.

Monitoring social capacity is important for two reasons:

- 1) Monitoring enables management to refine social capacity base figures developed through use of the guidelines system.
- 2) Both short-term and long-term changes in site characteristics, user characteristics, and user preferences may warrant an adjustment of the carrying capacity for individual areas.

Monitoring resource capacity is important for three reasons:

- 1) While it is difficult to make accurate projections of resource capacity figures, resource monitoring offers a method for determining the resource capacity of a particular recreation activity area.
- 2) Short-term and long-term changes in environmental, site, and user characteristics may warrant an adjustment of the resource capacity for individual areas.
- 3) It is important to detect problems of overuse at the earliest possible stage in order to avoid intensification and/or spreading of the problem.

A monitoring program must be administered diligently to be effective. To anticipate and prevent problems, attention should be given to the threshold levels of the indicators which are used.

Approaches

Types of Information

Monitoring programs can be used to collect three types of information:

use levels, impacts of use levels, and user attitudes towards use levels (see Figures 16 and 17). In most cases, use levels and one or both of the other types of information should be collected. This will provide a basis for determining not only when problems occur, but also what problems occur.

Indicators

Various indicators can act as units of measure for each type of information (see Figures 16 and 17). To be effective, indicators should be:

1. Predictive. They should occur sufficiently before serious problems develop so that actions can be taken to prevent such problems.
2. Certain. They should always precede serious problems, and serious problems should always result if preventative measures are not undertaken after an indicator occurs.
3. Easy-to-use. They should be phenomena which are readily observed and are capable of objective measurement by non-expert personnel.

Since many indicators are themselves capacity problems, it is important to determine as early as possible when they are increasing in frequency or intensity.

Figures 16 and 17 are not intended to be exhaustive lists of indicators for each type of information. Other factors should be considered for use as indicators, and the moni-

toring program should be tailored as closely as possible to the specific needs and the sources of information available.

Type of Information	Indicators	How to Obtain Information		
		Field Observation	Management Records	User Surveys
Use levels	Ball counts	*	**	
	User characteristics	**		**
	Existence of overflow areas	**	*	
	Metered water usage		**	
	Sales of fuel and supplies at stores and markets	*	**	
	Use levels of support facilities	**	**	*
	Conflicts between users/units	**	*	*
	Violations of regulations	**	*	*
	Vandalism	**	*	*
	Recreation in unauthorized areas	**	*	*
User attitudes toward use level	Misuse of vehicles (extra vehicles on site, parking on grass, etc.)	**	*	*
	Litter/trash	**	**	*
	User complaints	*		**
	User suggestions			**
User opinions			**	

*Good method.
**Better method.

Figure 16. Approaches to Social Capacity Monitoring Programs

Type of Information	Indicators	How to Obtain Information		
		Field Observation	Management Records	User Surveys
Use levels	Ball counts	*	**	
	User characteristics	**	*	**
	Metered water usage		**	
	Sales of fuel and supplies at stores and markets	*	**	
	Use levels of support facilities	**	**	*
	Conflicts between users/units	**	*	*
Impacts of use levels	Condition of ground cover (soil paths created)	**		*
	Damage of trees/vegetation	**		*
	Compaction of soils	**		*
	Initial signs of erosion	**		*
	Absence change in wildlife	**		*
	Change in water quality	**	**	*
User attitudes	User complaints	*		**
	User opinions	*		**

*Good method.
**Better method.

Figure 17. Approaches to Resource Capacity Monitoring Programs

Methods

Figures 16 and 17 also include three general methods for obtaining the information embodied in the indicators: user surveys, field observations, and management records.

User surveys can be tailored to the relevant information, type of user, and area. The information obtained can be reliable and the cost can be relatively low. But user surveys require the cooperation of users, can be misleading if improperly designed and analyzed, and there can be lags in the time between when the information is obtained and when it is analyzed.

User surveys can be conducted formally (questionnaires) or informally (give-and-take discussions with users). Questionnaires can vary in the type, amount, and detail of information they ask and can be administered by project personnel or filled out by users and returned to a central location (e.g., suggestion box or gate attendant).

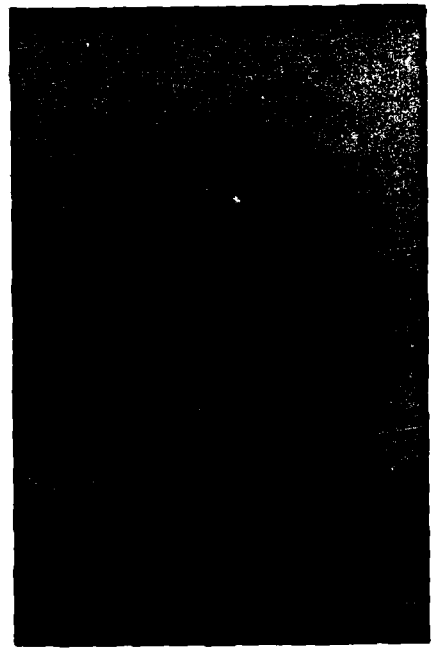
User surveys are less likely to be employed in a program for monitoring resource capacity than in one for social capacity. But user attitudes are helpful for determining the levels of resource depletion (e.g., the number of fish, the scenic quality, etc.) which are acceptable to users.

Field observations will most likely be the method used to obtain most of the indicators of overuse, but field observations can also be used to detect overcrowding. Field observations can be used to obtain diverse types of information, can be inexpensive (especially when conducted during routine patrol duties), and can provide reliable information (especially if the same personnel make the observations over time according to uniform standards).

The usefulness of field observations depends on the development of a standardized system: the information observed should be capable of being reported in an objective or standardized manner. Field observations can be conducted formally (recording observations based on a checklist for each area) or informally (noting significant observations in a log book).

Management records can be used to provide selected types of information reliably and inexpensively (since the information has been compiled already). Management records cannot be used to obtain all types of information, and care must be taken that information from records is not misinterpreted or misapplied.

**PLANNING, DESIGN
& MANAGEMENT
TECHNIQUES**



INTRODUCTION

Many And Varied Techniques

Every aspect of planning and management affects recreational carrying capacity in some way. Techniques for capacity planning and management can be considered at all levels of decisionmaking.

Some techniques are easy to apply and administer and direct in their effect; others are difficult to apply and administer and subtle in their effect. Various carrying capacity problems, conditions, and situations may require the application of different techniques.

Three types of techniques are presented:

1. General Planning and Activity Relationships
2. Site Planning and Design
3. Management Techniques
 - Rules and Regulations
 - Policies
 - Services

This Part introduces the techniques and provides examples of their application. A summary table listing each technique and its major features is provided at the end of this Part.

Identifying And Clarifying Management Objectives

Thorough identification and clarification of management objectives pertaining to recreation resource use at Corps projects can avoid subsequent problems of overuse and overcrowding. Management objectives should receive early, consistent, and comprehensive attention in the recreation master planning and plan updating process.

Carrying capacity analysis should be an integral part of the process of developing management objectives. In almost all cases, management objectives will have some effect on the carrying capacity of an area. Also, carrying capacity information can be used to help formulate management objectives.

Carrying capacities should be calculated and carrying capacity options should be considered in formulating appropriate, realistic management objectives to determine what an appropriate level of use should be. Once desired carrying capacity levels are decided upon, their implications for such items as operation and maintenance costs, personnel, and public acceptability should be considered before finalizing capacity guidelines and the master plan.

Thorough identification and clarification of management objectives requires maximum cooperation and coordination between recreation planners and resource managers early in the master planning process and throughout the process.

A few examples of carrying capacity management objectives are listed here to show the various subjects and levels of specificity that management objectives can address and how master plans can be more clearly defined using more definitive management objectives.

- Provide for the greatest variety of recreation opportunities possible, given the capability of resources to sustain such activities.
- Maximize use of the area consistent with the objective of retaining normal maintenance levels.
- Plan for use of the resource at the highest possible density level, regardless of the levels of control and maintenance required to do so.
- Plan areas so that resource use and capacity controls can be initiated with a minimum of cost, effort, and public displeasure.

- Emphasize controlling vehicle use rather than correcting overuse through increased maintenance.
- Plan so the capacity of each support facility is equal to the carrying capacity of the area it serves.
- Avoid overcrowding and overuse, even if it is necessary to close recreation areas.
- Use public information and education to maximize user satisfaction and resource protection rather than increased regulation.
- Ensure user satisfaction for all types of boaters, even if lake zoning must be used.
- Plan for overflow situations by providing carefully selected overflow areas.
- Reduce user conflicts on the lake regardless of the costs of improved enforcement of Corps regulations.

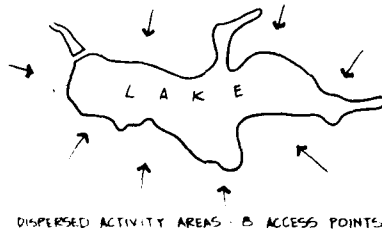
GENERAL PLANNING & ACTIVITY RELATIONSHIP TECHNIQUES

General planning and activity relationship techniques generally prevent problems of overuse, overcrowding, and underuse from occurring. They tend to be readily accepted by users, less costly, and more easily applied than remedial, problem-solving techniques.

The Corps master planning process can provide an overall framework for addressing carrying capacity at both the project area, recreation area, and activity area levels. The guidelines in Part 2 of this Handbook are tools for use in this planning process.

Dispersing Activity Areas to Reduce Overcrowding and Overuse

Dispersed activity areas can help prevent overcrowding and overuse. Master planners can disperse recreation areas throughout a project area (rather than concentrating them at one or a few locations) to more evenly distribute use of the resource.



DISPERSED ACTIVITY AREAS - 8 ACCESS POINTS



CONCENTRATED ACTIVITY AREAS - 2 ACCESS POINTS

While dispersing activity areas throughout a project may be advantageous from a carrying capacity standpoint, operation and maintenance costs will probably be higher than

when activity areas are concentrated in a few locations. This technique can be evaluated during the initial recreation planning process for each area.

Varying Levels of Accessibility to Reduce Overcrowding and Overuse

Different levels of use can be achieved by discouraging or encouraging access. Making vehicular access to areas more difficult by providing only narrow dirt or gravel entrance roads (rather than wide paved roads) and locating areas far from a highway (rather than near a highway) will tend to discourage heavy use of an area.

However, making vehicle access less convenient is unacceptable to many users. Limiting access to areas might work best when trying to achieve a desired carrying capacity for nonintensive activities, such as walk-in tent camping or nature study, at more remote locations.

Making access inconvenient is a technique that is not widely used by the Corps, although ditches, berms, and other barriers have been used to protect areas from unwanted vehicles and users. Accessibility can be addressed during project master planning.

Providing Selected Impact Areas to Reduce Overuse and Overcrowding

Overuse, overcrowding, and user conflicts can be reduced or eliminated by directing activities which tend to be more punishing to the environment (e.g., group camping, ORV riding, and group picnicking) to specially selected impact areas.

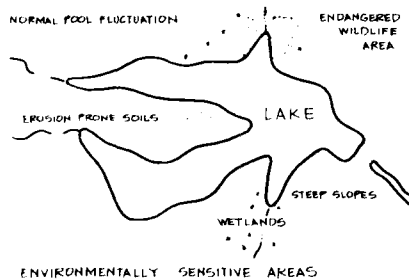
This technique involves carefully selecting impact areas for heavy use: areas capable of sustaining intense and more destructive use. These areas can be identified and mapped during the initial planning stages when environmentally sensitive areas are being identified.

Areas which have already experienced degradation or those which have limited recreational value could be potential impact areas. Management should be prepared to consider these areas as ones which can be sacrificed in order to protect and enhance user experiences in other areas.

Some projects have designated old sand and gravel quarry areas (where the natural resource has already been heavily scarred or destroyed) for ORV riding. Excavation areas for dam construction or road materials could also be used for ORV sites.

Planning Activity Areas Outside Environmentally Sensitive Areas to Prevent Overuse

Recreation areas should be located away from environmentally sensitive areas (such as flood-prone areas, steep slopes, and erosion prone soils) to avoid or minimize the potential for resource overuse. Applying this technique in the initial development of an area can avoid costly problems of resource overuse. Applying this technique involves identifying and mapping the sensitive areas and the more resilient areas within the project.

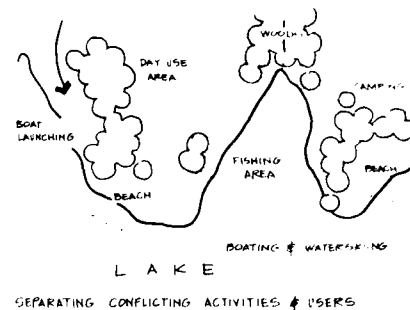


Unfortunately, some of the more sensitive areas are also the more attractive recreation resources. The most sensitive areas can be avoided or used for less intense activities such as nature study, hiking, or wildlife preservation. Resilient areas can be planned for more intense

activities such as trailer camping, picnicking, and group activities.

Separating Conflicting Activities to Reduce User Conflicts

User conflicts can be reduced by separating incompatible recreation activities. By separating conflicting activity areas, each activity area can achieve a higher carrying capacity. User satisfaction will also be increased because of fewer conflicts.



Application of this technique requires knowledge of the basic incompatibilities of activities and participants. Although the technique of separating major conflicting activities can be used remedially to eliminate activity conflicts, it is advantageous to separate potentially conflicting activity areas during initial project planning.

Zoning Areas on the Lake Surface to Reduce User Conflicts

Designating separate areas on the lake for activities which normally conflict (e.g., boat fishing, water-skiing, general boating, and swimming) can increase the carrying capacity of the lake and reduce user conflicts.

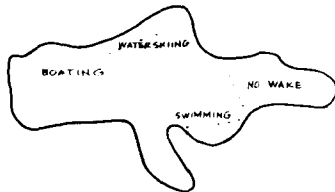
The disadvantages of this technique are: the difficulty of enforcement, the cost of enforcement, and the lack of acceptance by some users. Zoning could be most acceptable if applied to newly developed project areas where boating patterns have not yet been established.

Examples of how this technique can be applied include:

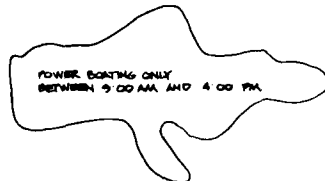
- Designating the type of boating over the entire lake.



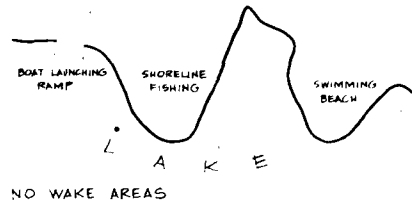
- Designating portions of the lake surface for different activities.



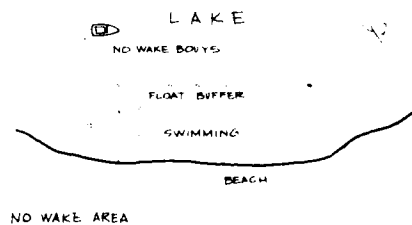
- Restricting certain uses of the lake to certain times of the day.



- Establishing a no wake area around marinas, boat ramps, and shoreline fishing areas.



- Installing a double line of floats and no wake buoys around a swimming area to reduce conflicts between swimmers and boaters. The no wake area reduces waves in swimming areas that are sometimes a problem for children.



Planning for a Variety of User Experiences to Increase Social Capacity

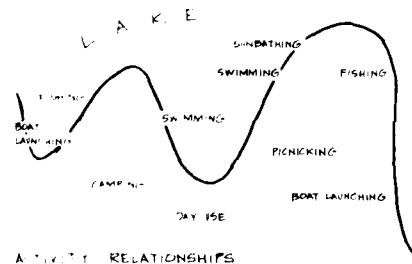
Planning different areas to provide for different user experiences can reduce overcrowding and increase an area's social capacity. Areas used by similar socioeconomic, age, and interest groups can generally be developed at higher carrying capacities than areas used by dissimilar groups, because similar types of users generally tend to have fewer conflicts than dissimilar user groups. The preparation of planning goals and objectives and efforts to obtain public input to the planning process should address the various experiences desired by users.

Situations where this technique could be applied include:

- Providing separate areas for group camping and picnicking.
- Providing separate areas for tent and trailer camping, multi-family camping, walk-in tent camping, semiwilderness camping, and other camping experiences.
- Providing areas for handicapped recreators.
- Providing areas which meet the needs of teenagers and young adults and other areas for more family-oriented recreation experiences.

Locating Functionally Related Activity Areas Close Together to Increase Use

Most people who come to Corps lakes participate in a variety of activities. Some Corps recreation areas are underused, especially picnic areas and hiking trails, because they are not located in close proximity to other activity areas. Higher levels of use can result by locating functionally related activity areas close together.



Consideration should be given to planning picnic areas near beaches and hiking trails near major activity areas. Most Corps hiking trails are interpretive trails which do not connect activity areas together. In addition to better location of interpretive trails, pathways can be provided for general hiking to and from activity areas. These pathways should especially provide walking for pleasure opportunities near the water or within view of the water.

Using Information and Exposure to Increase or Decrease Use

Informing people about recreation opportunities (through the use of signs, maps, brochures, billboards, and other media) could help to increase the use of underused areas and to better distribute use among recreation areas within a project. This technique can also be used to direct recreators away from overcrowded and overused areas.

Making an area's existence more obvious (e.g., locating recreation areas where there is good visual exposure from highways) reduces the potential for underuse, but inadvertently might increase the potential for overcrowding and overuse.

Making the area's existence less obvious to the general public as a result of few signs and/or poor visual exposure may help to prevent or solve overcrowding and overuse by discouraging recreational use. However, some Corps recreation areas are already difficult to find, and fewer signs and directions would probably benefit only local users.

Making an area seem more or less attractive by the name given to it can either increase or decrease use. For example, the name Rattlesnake Knob could be given to an area to decrease use, while Meadow Valley could be used to name an area where increased use is desired.

SITE PLANNING AND DESIGN TECHNIQUES

While site planning and design techniques are best considered during the initial design concept and site planning stages to prevent problems of overcrowding, overuse, underuse, and user dissatisfaction, they are also very effective when applied to remedy such problems. Generally, they are more direct than general planning techniques and affect carrying capacity at a much more site specific level.

This section describes a wide variety of site planning and design techniques to achieve and control recreational carrying capacity. Some techniques are easy to apply; others are difficult. Some techniques require very noticeable changes in the physical environment; others are subtle and not easily noticed.

Siting Activities and Facilities to Increase Resource Capacity and Social Capacity

Proper site selection for a given activity can preclude or minimize resource overuse. Steep or sensitive areas should be avoided or carefully developed to minimize negative environmental impacts. Some activities need to be on level, well-drained ground (picnicking and sunbathing), and some can take advantage of upland and marshy areas (hiking, horseback riding, hunting).

Arranging sites and facilities in a manner which recognizes user preferences can enhance the recreation experience and increase the social capacity of an activity area. If applied during initial site planning and design, this technique is not costly and can be very effective. Rearranging sites and facilities to solve overcrowding and overuse will be more costly and less popular with users. Some examples of siting techniques include:

- Situating picnic and campsites (as well as access drives and paths) in a place where the soil is neither easily eroded nor too steep, in a place offering good views of the lake, and away from stagnant, mosquito-producing water.
- Arranging tables in picnic areas so they are spaced at different

distances to provide for individual family, multifamily, and group picnic experiences.

- Siting picnic and camping areas in wind-sheltered areas.
- Locating beaches on south facing slopes for best solar exposure, sheltered from prevailing winds and away from heavily used boating areas. Areas which are likely to be eroded should be avoided. Also, beaches could be located outside isolated cove areas to ensure cleansing by water action.
- Orienting campsites to reduce negative impacts such as headlight glare from vehicles.
- Providing common open space areas along the lakeshore, rather than letting these areas be monopolized by a few. Picnic sites and campsites could still be located relatively close to the lakeshore (e.g., 50 to 100 feet away).
- Aligning hiking trails on generally stable soil offering diversity of terrain, plant materials, animal habitats, water features, and views and providing trails linking activity areas.
- Situating boat ramps adjacent to but outside other use areas to reduce conflicts between boat

launchers and other recreators or activities.

Redesigning Areas to Reduce Overuse and Overcrowding

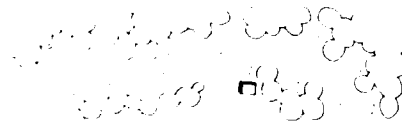
Areas can be redesigned to deal with overuse and overcrowding. This technique includes rearranging sites within an activity area. Where overcrowding or overuse occurs, campsites, picnic tables, and other recreation facilities could be spaced farther apart or relocated to new, more resilient areas. Also, overcrowded and overused activity areas can be redesigned for less intense activities such as walk-in tent camping or nature study.

Although the technique of redesigning is effective in solving problems of overcrowding and overuse, it generally is costly and is likely to be unpopular with users if the redesign results in fewer recreation sites. It is a remedial technique that can be avoided if social and resource capacity are addressed during the initial site planning stage.

Examples of how this technique can be applied include:

- Relocating closely spaced campsites or picnic sites to new or adjacent areas and arranging them farther apart to prevent overcrowding and overuse

- Converting a tent and trailer camping area to a tent camping area to reduce resource overuse.



TENT & TRAILER CAMPING - BEFORE

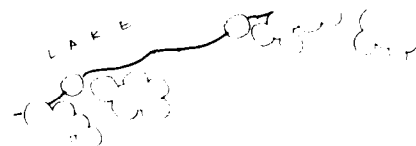


TENT CAMPING - AFTER

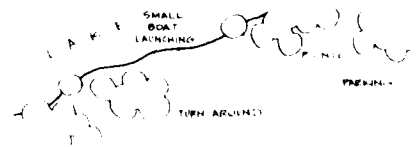
- Changing an activity area from one activity to another (such as from camping to picnicking) could result in fewer users and less use.
- Expanding the size of an area or its facilities (such as a beach area, lengthening a hiking trail to accommodate more hikers, adding more launching lanes to an existing ramp to reduce overcrowding, etc.).
- Providing a swimming dock which could separate younger swimmers from more experienced swimmers, where children could

swim without having access to deep water.

- Changing the type of facilities in activity areas, such as replacing permanent concrete picnic tables with movable wooden tables. Tables could then be moved by picnickers to achieve preferred distances and groupings and the amount of resource wear would be more evenly distributed throughout the area.
- Upgrading abandoned roads near popular boat fishing areas to reduce fishermen's use of the ramps in or near campgrounds or day use areas. This reduces conflicts between the fishermen (with quickly launched boats) and the pleasure boaters (with less easily launched craft).

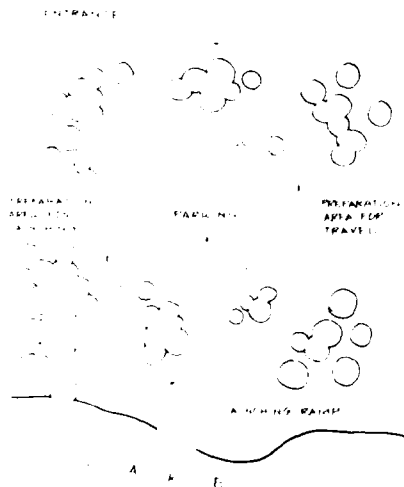


ABANDONED ROAD - BEFORE



ABANDONED ROAD - AFTER

- Redesigning or arranging water-ski docks and/or water-ski lanes, launching ramps, systems of buoys, etc., to encourage boating activities in appropriate areas on the lake.
- Redesigning recreation areas so boat ramps are adjacent but outside other activity areas to reduce conflicts between boat launchers and other recreators.
- Redesigning boat launching facilities by designating areas to prepare boats for launching and to secure boats for travel after retrieval.



Reducing the Number of Recreation Sites or Units to Reduce Overuse and Overcrowding

Reductions in the number of recreation units or support facilities can be a very effective solution to overuse and overcrowding problems. Techniques which call for reductions in existing opportunities to use recreation resources and facilities can be very expensive and are generally disfavored by users. Therefore, project managers should not overdevelop an area with the idea that selective cutbacks can be accomplished later.

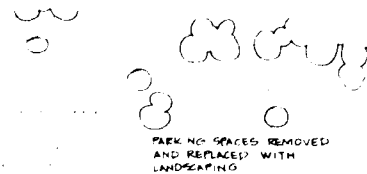
Some examples of how this technique can be applied are:

- Eliminating recreational units that are spaced too close and a problem of overcrowding or resource overuse is evident.



- Making a campground more primitive by removing support facilities such as individual water and electric hookups at each site, shower buildings, and visitor parking lots.

- Reducing the number of parking spaces at a day use area, boat launching ramp, or hiking trail. The spaces can be replaced with plantings or other landscape elements.



PARKING AREAS BEFORE & AFTER

Using Various Methods and Materials For Controlling Circulation To Reduce Overuse and Overcrowding

One of the best techniques for preventing and correcting overuse and overcrowding is regulating and channeling vehicle and pedestrian traffic. Numerous methods and materials can be used to control circulation and channel traffic. The most appropriate and effective methods will vary from project to project and will depend upon the materials and resources at hand.

Examples of some methods and materials to control circulation and channel traffic include:

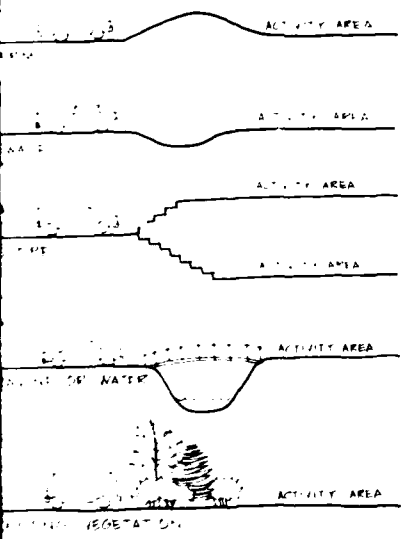
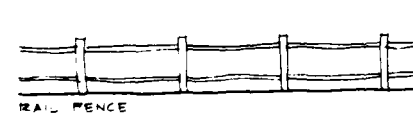
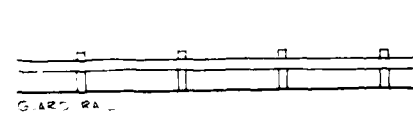
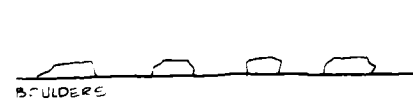
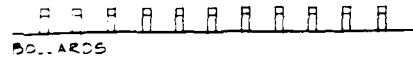
- Providing a gate attendant who controls access to an activity

area such as a campground, picnic area, or boat launching ramp.

- Using Corps rangers to help control circulation and direct traffic during heavy use periods.

- Using a wide variety of materials as physical barriers to channel traffic and control circulation.

MAN MADE CONTROLS

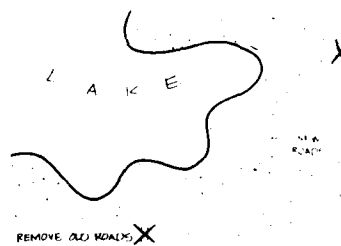


- Limiting the number of boat launching ramps and other lake access points when overcrowding of the lake surface is evident. In using this technique, care should be taken to avoid causing congestion at remaining launch ramps.



REDUCING ACCESS POINTS

- Limiting the number of access points and entrance roads to activity areas.



IMPROVE CONTROL BY REDUCING THE NUMBER OF ACCESS POINTS

- Controlling boat circulation on the lake through a well-planned system of buoys.
- Requiring boat circulation on the lake to be in one general direction (e.g., counterclockwise).
- Using buoys to mark designated lanes for waterskiing.
- Posting directional and informational signs at strategic locations to guide recreators.

Hardening Natural Surfaces to Reduce Overuse

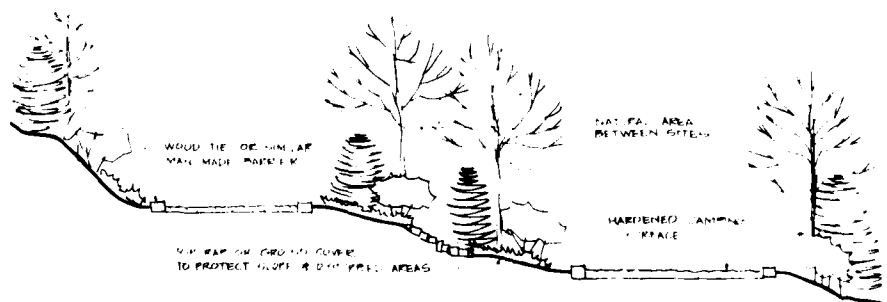
Changing natural surfaces by hardening them to withstand more use can increase resource capacity and prevent overuse. Worn grass and muddy conditions can be alleviated and maintenance reduced. Hardening the sites also defines them better, which tends to psychologically contain users on the hardened areas, reducing overuse and user conflicts.

The technique works better when applied initially in the more sensitive recreation resources where overuse is likely. These more sensitive areas can be identified and mapped during the initial planning of project recreation areas.

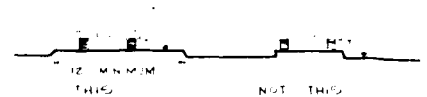
Hardening can be costly and is mildly acceptable with users. People surveyed indicated a greater preference for surfaces of wood, fine pea gravel, or small stones than for concrete and asphalt paving.

Examples of how this technique can be applied include:

- Using impact sites consisting of a gravel "floor" contained by pressure-treated timber ties. Use of this type of site is suited for wooded and/or sloping areas; impact sites are easily fitted to the terrain and result in little overuse of offsite resources. Impact sites work well initially where overuse can be expected such as at waterside sites, at shaded sites, at electric and water serviced sites, and where soil and slope conditions are sensitive (see Demonstration 4, page 84).



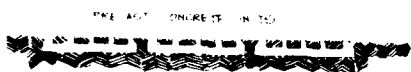
- Paving camper pads. Travel trailers are easier to level on paved pads and overuse is reduced where the vehicle rests. Because the edges of the pad are susceptible to wear, this can be prevented by having wide pads edged with a hardened material.



- Terracing a sloping site with steps of pressure-treated timber ties and putting stone and/or concrete riprap around fixtures and pads subject to being washed out by seasonal high water will help reduce overuse.

- Hardening an erodible site with precast concrete and seeding over it.

HARDENING SITE REQUIRED



- Hardening the area around picnic tables and grills by using gravel, concrete, or asphalt prevents overuse around the unit.

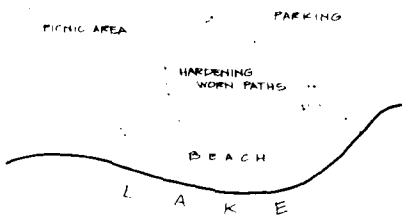
HARDENING OPEN SURFACES

PARKING

- Hardening the "yard areas" around restroom, shower, and bathhouse building with gravel, wood chips, paving, or sand to prevent overuse.

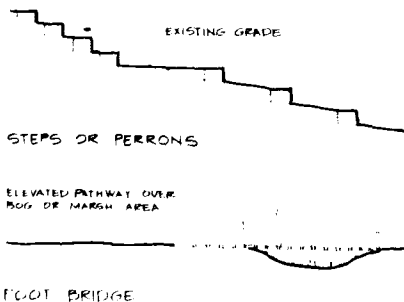


- Hardening worn pathways to prevent further overuse.



- Providing steps down a bluff or steep bank to the water from picnic or campsites to eliminate worn paths, erosion, and the trampling of ground cover.

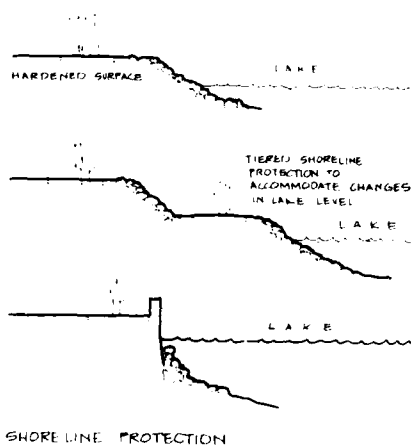
- Hardening interpretive trail surfaces by installing wood steps, perrons, or boardwalks where poor soil and/or slope



conditions result in overuse. Hardening makes the trail less susceptible to adverse weather influences, and the hardened surface makes the trail more accessible to physically handicapped and elderly people.

- Paving overflow parking lots when wear reaches the point beyond regeneration of grass.

- Stabilizing eroding shorelines with rock riprap, wood bulk heading, plantings, and soil cement to prevent shoreline erosion. These techniques are generally very costly.



- Replacing grass with sand at sunbathing areas to reduce overuse and muddy conditions.
- Using resilient plant materials, grasses in particular, to reduce or delay overuse in heavily used areas and along shorelines of water fluctuation.
- Reseeding ditches and swales to minimize erosion and installing gravel and/or wood, concrete, or asphalt at critical areas such as around culverts, inlets, and outflow pipes to prevent erosion.

Using Buffers to Increase Social Capacity

Conflict-reducing buffers can help prevent overcrowding and can increase the carrying capacity of an area. Buffers can be man-made, man-planted, or natural plant materials, topography, or extra land or water between areas.

Buffers perform many functions: they give privacy, control soil erosion, screen views, reduce noise, offer visual relief, provide shade, control wind, and channel vehicular and pedestrian traffic. Buffers can serve as barriers between incompatible activity areas and between individual sites.

Planted buffers can be costly, but little cost is incurred by retaining

natural cover when initially developing areas. The possibility for using natural buffers can be evaluated when new recreation areas are being planned.

Many users cite the use of buffers as an acceptable solution to overcrowding problems. Some users indicate that buffers are not acceptable because (1) they screen views of the lake or recreators, (2) they block breezes which cool campsites, and (3) they harbor ticks and other undesirable insects.

Examples of how buffers can be applied include:

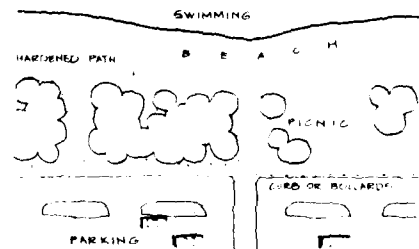
- Purposely locating campsites and picnic grounds in areas with sufficient vegetation to serve as buffers or in areas which offer good potential for planting new materials where necessary.
- Screening negative or undesirable features from recreators such as screening utility structures and buildings and blocking noise, dust, and headlight glare from vehicles.



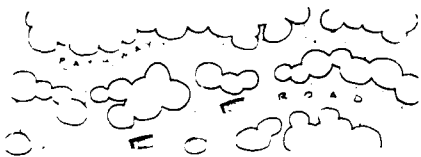
- Spacing campsites closer together in a wooded area. This can result in a higher campsite density but does not necessarily add to overcrowding. Vegetation between sites provides privacy and makes closer spacings acceptable.



- Using one activity area as a buffer between others, such as situating a grass area with picnic tables and shade trees between a beach and the parking area. This approach buffers sunbathers from traffic and discourages driving on the beach.



- Providing an adequate buffer of vegetation and/or distance between potentially conflicting activity areas, such as between a hunting area and a campground or a horseback riding trail and sunbathing area.
- Using buffers to channel traffic and reduce circulation conflicts between walkers and vehicles.



Increasing Facilities and Site Amenities to Increase Use

An activity area is typically underused because of its lack of certain site amenities desired by users or its remote location relative to the lake. The installation of certain services and facilities at the site may help to increase the use and enjoyment of underused areas and could relieve overcrowding and overuse in other activity areas. Improvement to areas must be done carefully--possibly in stages--to keep from creating an overcrowded condition.

This technique is likely to be very effective and acceptable to users,

but could be costly. Increasing the number of facilities and site amenities might not help activity areas that are underused because of poor visual exposure, a remote location, poor accessibility, or poor signage.

Examples of this technique include:

- Providing electric and water service to campsites.
- Providing showers, amphitheater programs, and outdoor activities for campers.
- Constructing a bathhouse or food concession facility at a beach.
- Providing floating docks for use by waterskiers or swimmers.
- Installing fish-cleaning facilities.
- Situating more picnic tables and campsites closer to the water to facilitate access and visibility without monopolizing the shoreline.
- Offering activities within or near campgrounds and picnic areas such as ballfields, basketball courts, field game areas, and horseshoe pits. Additional facilities would serve users who desire ancillary activities, especially programs and activities for teens.
- Developing additional parking spaces, if necessary.
- Paving access roads and adding pathways to and within activity areas.
- Installing steps down embankments to the outlet areas to improve access for fishermen.
- Providing shade trees and shelters if heat is a major reason for underuse.

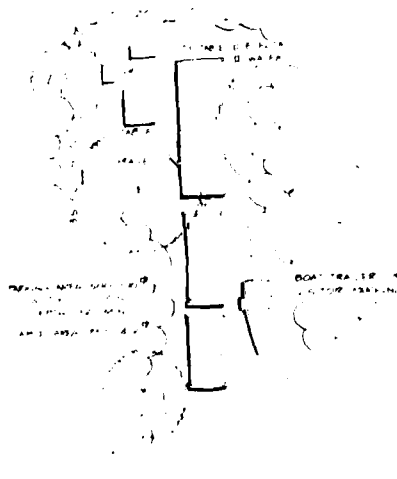
Employing Certain Site Planning and Design Principles to Increase User Satisfaction

The carrying capacity of activity areas can be increased by applying certain site planning and design principles. Sites which cater to the desires and requirements of users and their equipment can ensure users of an enjoyable stay. The application of this technique requires an awareness of user preferences which can be considered during the initial site planning stages of an activity area.

Some examples of this technique for increasing carrying capacity are:

- Situating support facilities directly serving the camper on an area hardened to sustain extra wear. The area should provide for: camper parking, a table,

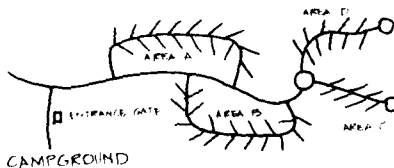
grill, fire ring, lantern post, service hookups, and trash containers. Campsite amenities should be arranged to allow maximum convenience and minimum overuse. When looking from the vehicle entrance of the campsite, the patio area, table, grill, fire ring, lantern post and trash receptacle should be on the left-hand side. The service hookups should be on the back right-hand side of the pad.



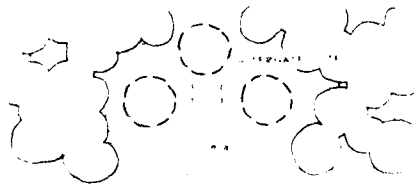
The tent pad should be approximately where a camping vehicle would be parked. The boat

trailer or extra vehicle space should be a hardened area near the front of the site. Facilities should be situated away from the rear of the pad so that units can be backed in all the way.

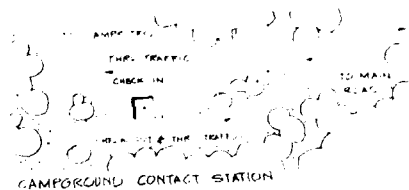
- Using the "spine" type of road in a picnic area or campground so people don't have all traffic passing their site.



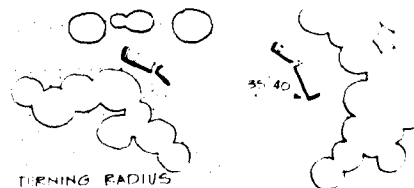
- Laying out tent sites for greater convenience. A designated tent site pad should have no more than a three percent cross slope. Tenting sites or areas of grass should have sufficient space with proper slope for a tent to be pitched in a different place than previous campers have used.



- Providing two traffic lanes on each side of the control gate to expedite traffic flow, particularly for users who do not need to stop each time.



- Accommodating long recreational vehicles and cars pulling trailers by providing an adequate turning radius so vehicles are not forced to leave the paved surface at intersections, control gates, dumping stations, campsites, boat ramps, parking, and turnaround areas.



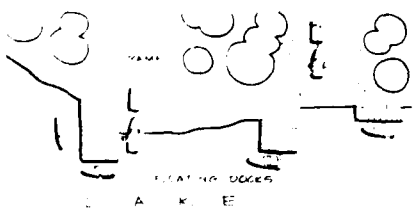
- Retaining or planting trees while developing campsites in such a manner that there will be adequate distance to easily back a trailer into a site or use

an awning on a travel trailer. Trim trees, where necessary, to avoid vehicle damage from low branches.

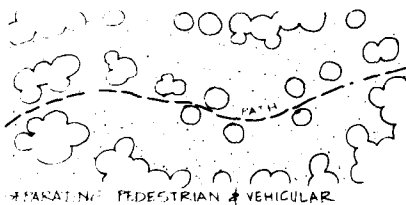
- Providing places for storing boat trailers within or near campgrounds where they would be secure at night and would not contribute to overuse.



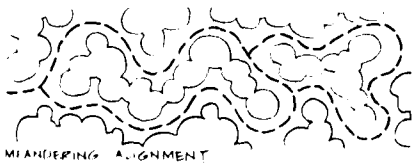
- Providing courtesy docks to expedite boat launching, especially for boaters who are alone.



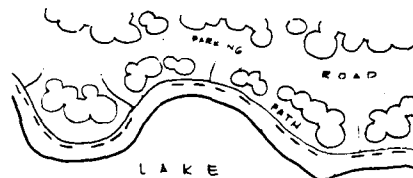
- Providing pathways and bicycle trails that are totally separate from roadways or marked on roads to reduce circulation conflicts in campgrounds.



- Designing a trail in a meandering alignment which allows more people to use an area at one time, limits visibility to other people, and permits hikers to see more and varied features along the trail.



- Providing benches, parking areas, walkways, and other support facilities at popular shore fishing areas.



MANAGEMENT TECHNIQUES

Rules And Regulations

Rules and regulations are generally enforced by Corps rangers and are authorized under Title 36, "Rules and Regulations Governing Public Use of Corps of Engineers Water Resource Development Projects."

Stricter Enforcement to Reduce Overcrowding and Overuse

Stricter enforcement of regulations can help reduce and prevent overcrowding and overuse and allow the carrying capacity of an activity area to be achieved. For example, more patrol boats and stricter enforcement of existing regulations can help reduce the number of boater conflicts and increase the carrying capacity of a lake.

Application of this technique to solve carrying capacity problems might be costly (especially when additional vehicles and patrolling rangers are required) and sometimes difficult to administer, but it is effective.

Imposing New Rules and Regulations to Reduce Overcrowding and Overuse

Additional rules and regulations could help reduce overcrowding and overuse. Rules and regulations re-

lating to resource protection (e.g., "walk-in tenting only", "no parking on the grass") and the preferred distances between users (e.g., rules of courtesy which encourage preferred distances between boats, fishermen, or hikers) could help achieve a desired carrying capacity.

Additional rules do result in higher administrative and enforcement costs. Some rules could be difficult to administer or enforce. New rules are generally unacceptable to users, but are more acceptable if overuse and/or overcrowding problems are apparent to them.

Limiting the Number of People per Group to Prevent Overcrowding and Overuse

Limiting the number of people per group or site and the number of vehicles and/or camping units per site can help prevent overcrowding and overuse in campgrounds and picnic areas. While this technique is effective and not expensive, it is difficult to administer and is unpopular with users. It is most feasible when applied to camping and picnicking activities. Limiting the people per group is more easily justified when separate group activity areas are provided within the project area.

Policies

Administrative policies, strategies, and courses of action can be effective techniques for achieving carrying capacity and preventing problems of overuse and overcrowding. Certain procedures can reduce user dissatisfaction and frustrations. Some of the following techniques may require changes in present policy or legislation.

Closing the Gate to Prevent Overcrowding

This technique is now being used in both Corps camping areas and day use areas and has proven to be a very effective capacity control technique. This technique is easy to use, inexpensive, and accepted by most users.

Some project areas have difficulty deciding when to close the gate. Sometimes entrance gates are closed because of crowded (underdesigned) support facilities (e.g., parking lots), rather than because of overcrowding of recreation areas. Ideally, the gate should be closed when or shortly before an activity area's social capacity is reached. The guidelines in Part 2 of this report provide a sound basis for determining carrying capacity and for justifying the closing of gates.

Closing Areas to Prevent Overuse

Closing down areas when natural resource destruction reaches a critical point will prevent further resource overuse. If this technique is to be effective, it is important for resource managers to be knowledgeable about the best indicators or signs of potential overuse. The monitoring of resource change by managers will enable an area to be closed and restored before restoration becomes infeasible. Most users consider this technique to be very acceptable when its need is apparent.

A number of the Corps projects have used this technique. In some cases, an entire recreation area was closed down for restoration. In other cases, only selected areas such as overused campsites were closed.

Some examples of related techniques include:

- Rotating use to different areas each recreation season.
- Closing down a different loop of a campground or section of a picnic area for a full season.
- Opening some recreation areas later in the season than others. Generally, it is not necessary to have all the recreation activity areas open during the

early and later periods of the recreation season. Shortening the recreation season of areas which are showing signs of overuse will allow more time for natural restoration and reduce maintenance and restoration costs.

Requiring Permits to Reduce Overcrowding and Overuse

Allocating a limited number of recreational spaces to users in a fair and efficient manner may be called for when there is overcrowding and overuse. These conditions may require a permit system.

Permits could be issued on a lottery, price, advanced reservation, merit, or first come first served basis. Each method has certain disadvantages and advantages that project managers must carefully consider prior to its application.

Although a permit system could be effective, it is more costly, requires more administrative time, and can be unpopular with users. Most users consider this technique to be unacceptable as a solution to overcrowding or overuse.

Most activities at the projects do not require a permit and most activities are used on a first come first served basis. Corps projects use permit systems at fee campgrounds, for

some group activities (such as group camping or group picnicking), and for monitoring and controlling the number of people visiting campers.

Permit systems are most appropriate and feasible when applied to capacity problems involving boating, camping, picnicking, and off-road vehicle riding. For example, if overcrowding occurs or is anticipated:

- Boaters could be required to obtain a permit prior to using the lake each season. The fee might only pay for the administrative costs incurred to issue the permit. When a person purchases the permit, he could receive a map of the project area showing the lake and buoy system, a list of boating rules and regulations, and be made aware of any social capacity guidelines regarding preferred boat spacings.
- Some campgrounds or portions of campgrounds could be selected for prior reservations; this could reduce the frustration of travelling a long way only to find a full campground. If a reservation system is implemented, special care must be taken to ensure that such a system is administered impartially and that users believe it is impartial.

- Permits could be required for group picnicking, family reunions, group camping, organized group ORV races or activities, fishing contests, and other special events.

Charging or Increasing Fees to Reduce Overcrowding and Overuse

Charging or increasing fees may discourage some people from using an activity area, thus reducing overcrowding or overuse. Conversely, eliminating or reducing fees could help solve underuse.

Charging fees simply to solve overcrowding or overuse is unacceptable to most users. Many users indicate a willingness to pay fees for increased levels of service.

Charging or increasing fees may cause users to be more sensitive to and demanding about the level of development and services they receive. Also, fees could provide revenue for additional maintenance and services.

Differential pricing of campsites (e.g., sites with electric service have higher fees than the others) is presently being used and is being accepted by Corps campers. Perhaps higher fees could be charged where sites are most popular or vulnerable.

Creating User Turnover to Reduce Overcrowding and Increase Carrying Capacity

This technique involves limiting the length of time a user may engage in an activity. This technique is currently used in Corps campgrounds; the length of time a camper can stay is no longer than 14 days during any 30-day period. Also, the Corps prohibits the placing of camping equipment on a campsite or intermittent personal appearance at the campsite for the purpose of reserving a designated campsite for future occupancy. This technique is intended to keep campsites available to many users and to reduce campsite poaching by local residents.

In addition to camping, this technique might also be feasible if used to solve overcrowding at small Corps lakes. The type of boating activity on the lake could be varied (sail boating, power boating, water skiing) at different time intervals and the number of boats using the lake at any one time could be controlled by creating and regulating turnover.

The turnover technique might also be used to eliminate congestion at launching ramps. For example, a flag could be raised at launching ramps indicating it is a good, uncongested time to use the ramp.

Services

Services which help maintain and restore recreation resources and inform users about how resources can be protected are effective ways of reducing overcrowding and overuse. In addition to being effective, management service related techniques are generally well accepted by users.

Increasing Maintenance and Restoration to Permit Increased Use

Increasing maintenance and restoration can allow for more use, help prevent overuse, and provide more enjoyable recreation experiences. The success of this technique depends upon the severity of the problem and the degree of maintenance and restoration applied. Increasing maintenance and restoration is a technique for solving overuse is acceptable to users. Perhaps its major disadvantages are its cost and the risk that areas may have to be temporarily closed for this technique to be applied.

Some overuse problems can be solved simply by more aggressive maintenance and restoration efforts such as reseeding where grass has worn away. Other overuse situations might require bringing in topsoil and seeding, utilizing a hydro-seeder, or carrying out an intensive restoration program.

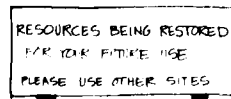
Providing More and Better Information to Reduce Overcrowding and Overuse

Providing more and better information on how to use the area properly may help to reduce overcrowding and overuse. Corps projects provide information regarding Title 36 and project area rules and regulations relating mostly to the proper use of campgrounds and day use areas. More and better information could be provided to boaters, fishermen, and other recreators.

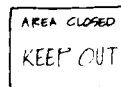
Additional materials could be directed toward educating recreators and making them aware of their role in protecting resources and helping ensure that other recreators have an enjoyable experience. They can explain why carrying capacity controls are necessary. Also, information presented to users regarding social capacity and preferred spacings could be an effective way of achieving carrying capacity.

Signs should have positive wording and explanatory messages, so people will better understand the purpose of the sign and have more respect for it.

THIS



NOT THIS



Carrying capacity information could also be presented during interpretive programs, movies, and slide shows. Brochures or "handouts" could be placed at well-selected sites such as activity area entrance points, boat ramps, comfort stations, etc.

Most users surveyed indicated that this technique was very acceptable, although some questioned its effectiveness in actually solving problems of overcrowding and overuse.

APPLICABILITY OF TECHNIQUES

Figure 18 on the following page is a summary of the carrying capacity techniques, their major features, and their applicability.

Figure 18. Carrying Capacity Techniques

Technique	Activities Most Influenced by the Technique	Primary Problems/ Conditions That Could be Prevented or Solved as a Result of Using the Technique	Primary Application of the Technique: <ul style="list-style-type: none"> ● Preventive ● Corrective ● Both- Could be used as both a preventive or corrective technique 	Major Advantages	Major Disadvantages
GENERAL PLANNING AND ACTIVITY RELATIONSHIP TECHNIQUES Dispersing activity areas	Camping, picnicking, boat launching, marina activities, shore fishing	Overcrowding, overuse	Preventive	<ul style="list-style-type: none"> ● Spreads use throughout the project ● Likely to be accepted by users ● Easily addressed during project area master planning 	<ul style="list-style-type: none"> ● Could increase maintenance and patrol costs
Varying levels of accessibility	Camping, picnicking, fishing, boat launching	Overcrowding, overuse, underuse	Both	<ul style="list-style-type: none"> ● Very effective ● Costs are saved if used during initial planning 	<ul style="list-style-type: none"> ● Limiting is unacceptable to users surveyed ● Costs could be high if applied to correct problems
Providing selected impact area	Camping, picnicking, ORV riding	Overuse, underuse, overcrowding	Preventive	<ul style="list-style-type: none"> ● Many Corps projects have areas which are scarred and could well serve as a selected impact area ● Could reduce overcrowding and overuse in other activity areas and help to provide more of a variety of activity situations 	<ul style="list-style-type: none"> ● The sacrificed area gets abused, sometimes overused and overcrowded
Planning activity areas outside environmentally sensitive areas	Camping, picnicking, ORV riding	Overuse	Mostly preventive but could be used as both	<ul style="list-style-type: none"> ● Easily addressed during project area master planning ● Not costly ● Environmentally sensitive areas could be used for nonintensive activities 	<ul style="list-style-type: none"> ● Some environmentally sensitive areas are very attractive (visually) locations

Technique	Activities Most Influenced by the Technique	Primary Problems/ Conditions That Could be Prevented or Solved as a Result of Using the Technique	Primary Application of the Technique: <ul style="list-style-type: none"> ● Preventive ● Corrective ● Both- Could be used as both a preventive or corrective technique 	Major Advantages	Major Disadvantages
Separating conflicting activities	Camping and day use; ORV and other activities	Overcrowding, user dissatisfaction	Both	<ul style="list-style-type: none"> ● Easily addressed during project area master planning ● Accepted by users surveyed ● If done initially not costly 	<ul style="list-style-type: none"> ● Could be costly if applied remedially
Zoning areas on lake surface	Boat fishing, water-skiing, nonpower/limited power boating, power boating, sailing, swimming	Boating conflicts, overcrowding	Both	<ul style="list-style-type: none"> ● Very effective ● Acceptable to users surveyed ● Speed zoning can be accomplished by signs 	<ul style="list-style-type: none"> ● Difficult to enforce ● Requires additional patrol boats and rangers
Planning for a variety of user experiences	Camping, picnicking, hiking, ORV riding, fishing	Overcrowding, user dissatisfaction	Preventive	<ul style="list-style-type: none"> ● Easily addressed during initial project area planning ● Not costly 	
Locating functionally related activity areas close together	Camping, hiking, swimming, boat launching, picnicking, sunbathing, shore fishing	User dissatisfaction, underuse	Preventive	<ul style="list-style-type: none"> ● Easily addressed during project master planning ● Not costly 	<ul style="list-style-type: none"> ● Could result in heavy use, overuse, or overcrowding
Using information and exposure	Camping, picnicking, fishing	Overuse, underuse, overcrowding	Both	<ul style="list-style-type: none"> ● Easy to address the visual exposure of areas during initial site planning ● Could be effective ● Likely to be acceptable to users 	— —
SITE PLANNING AND DESIGN TECHNIQUES					
Siting activities and facilities	Camping, picnicking, boat launching, swimming areas	Overuse, overcrowding	Preventive	<ul style="list-style-type: none"> ● Easily addressed during initial site planning ● Effective ● Not costly 	— —

Figure 18. Continued

Technique	Activities Most Influenced by the Technique	Primary Problems/ Conditions That Could be Prevented or Solved as a Result of Using the Technique	Primary Application of the Technique: <ul style="list-style-type: none"> ● Preventive ● Corrective ● Both - Could be used as both a preventive or corrective technique 	Major Advantages	Major Disadvantages
Redesigning areas	Camping, picnicking	Overuse, underuse, overcrowding	Corrective	<ul style="list-style-type: none"> ● Effective 	<ul style="list-style-type: none"> ● Could be costly ● Could disrupt recreation use ● Unacceptable if used to reduce recreational use
Reducing the number of recreation sites or units	Camping, picnicking	overcrowding, overuse	Corrective	<ul style="list-style-type: none"> ● Very effective 	<ul style="list-style-type: none"> ● Unacceptable to users
Using various methods to control circulation	Camping, hiking, picnicking, ORV riding, horseback riding, waterskiing	overuse, overcrowding	Both	<ul style="list-style-type: none"> ● Very effective ● Various materials can be used ● Very cost-effective 	<ul style="list-style-type: none"> ● Could be unpopular
Hardening natural surfaces	Camping, picnicking, hiking, shore fishing	overuse	Both	<ul style="list-style-type: none"> ● Very effective in reducing overuse ● Acceptable to users 	<ul style="list-style-type: none"> ● Costly ● Asphalt and concrete less acceptable than fine gravel, wooden, and other more natural material
Using buffers	Camping, picnicking, hiking, ORV riding	overcrowding	Both	<ul style="list-style-type: none"> ● Very effective in affording privacy ● Acceptable to most users ● When developing new areas it is easy to leave natural vegetation 	<ul style="list-style-type: none"> ● Could block view of lake ● Some users do not like buffers between campsites because it screens views and increases heat and insects ● Plantings may be costly
Increasing facilities and site amenities	Camping, picnicking, hiking, shore fishing	Underuse	Corrective	<ul style="list-style-type: none"> ● Could be effective ● Likely to be well accepted by users 	<ul style="list-style-type: none"> ● Could result in overcrowding or overuse if not applied carefully

Figure 18. Continued

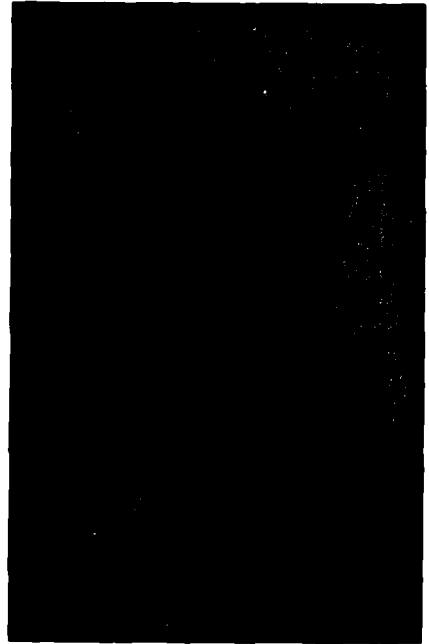
Technique	Activities Most Influenced by the Technique	Primary Problems/ Conditions That Could be Prevented or Solved as a Result of Using the Technique	Primary Application of the Technique: <ul style="list-style-type: none"> ● Preventive ● Corrective ● Both - Could be used as both a preventive or corrective technique 	Major Advantages	Major Disadvantages
Employing certain site planning and design principles	Camping, picnicking, hiking	Overcrowding, overuse, underuse	Both	<ul style="list-style-type: none"> ● Easy to consider these principles during initial site planning stage ● Likely to be well accepted by users 	
MANAGEMENT TECHNIQUES Rules and regulations Stricter enforcement	Boating, camping, picnicking, fishing	Overuse, overcrowding	Preventive	<ul style="list-style-type: none"> ● Could be very effective in reducing overuse and overcrowding ● Most users want rules to be enforced 	<ul style="list-style-type: none"> ● Could be costly and require additional patrolling rangers ● Use of discretion may lead to unpopular results
Imposing new rules and regulations	Boating, camping, picnicking, swimming	Overcrowding, overuse	Preventive	<ul style="list-style-type: none"> ● Provides guidance for users in specific situations 	<ul style="list-style-type: none"> ● Rules often violated ● More rules to be enforced ● Users must know rules ● Some limitations because of Title 36
Limiting the number of people per group	Camping, picnicking, ORV riding	Overuse, overcrowding	Both	<ul style="list-style-type: none"> ● Effective in reducing overcrowding and overuse ● Works best if group areas are also provided 	<ul style="list-style-type: none"> ● Unpopular with users ● Difficult to enforce an exact number
Policies: Closing the gate	Camping, picnicking, boat launching, swimming, sunbathing	overcrowding, overuse	Preventive	<ul style="list-style-type: none"> ● Very effective control ● Easy to administer ● Acceptable to users 	<ul style="list-style-type: none"> ● Use must be monitored ● Requires knowledge of overcrowding indicators ● Might be difficult to administer if there are several access points

Figure 18. Continued

Technique	Activities Most Influenced by the Technique	Primary Problems/ Conditions That Could be Prevented or Solved as a Result of Using the Technique	Primary Application of the Technique: <ul style="list-style-type: none"> ● Preventive ● Corrective ● Both - Could be used as both a preventive or corrective technique 	Major Advantages	Major Disadvantages
Closing areas	Camping, picnicking, hiking, swimming, sunbathing, power boating, boat fishing	Overuse	Preventive	<ul style="list-style-type: none"> ● Cost-effective (vs. rehabilitation) ● Acceptable to users 	<ul style="list-style-type: none"> ● Requires knowledge of critical point
Requiring permits to use recreation areas	Camping, picnicking, boating, ORV riding	Overcrowding, overuse, user frustrations	Both	<ul style="list-style-type: none"> ● Guarantees out-of-towners will have a spot ● Reservations could be applied only to some sites or activity areas ● Very effective 	<ul style="list-style-type: none"> ● Does not control carrying capacity per se ● Is unpopular with users surveyed ● Costly to administer ● Limited by Title 36 ● May deny opportunity when no need to
Charging or Increasing fees	Picnicking, swimming, camping	Overcrowding	Both	<ul style="list-style-type: none"> ● Could be very effective ● Equity ● Provides money ● Many ways to apply this technique 	<ul style="list-style-type: none"> ● Effective only when fee is set by market demand ● Equity ● Limited by Title 36 ● Unpopular to users
Creating user turn-overs	Camping, boating, boat launching	Overcrowding	Both	<ul style="list-style-type: none"> ● Could be very effective ● Not costly 	<ul style="list-style-type: none"> ● Could be unpopular ● Could be difficult to administer
Services: Increasing maintenance and restoration	Camping, picnicking, shore fishing	Overuse	Both	<ul style="list-style-type: none"> ● Very acceptable with users ● Effective 	<ul style="list-style-type: none"> ● Could be costly ● Could require closing recreation resource
Providing more and better information	Boat launching, boating, fishing, camping, ORV riding, picnicking, water-skiing	Overuse, overcrowding, underuse	Both	<ul style="list-style-type: none"> ● Very acceptable with users ● Could be very effective 	<ul style="list-style-type: none"> ● Could be costly

Figure 18. Continued

**APPLYING
CAPACITY
METHODS AND
TECHNIQUES**



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INTRODUCTION

This part contains demonstrations of:

- How the carrying capacity guidelines (Part 2) can be used in different activity situations.
- How the carrying capacity techniques (Part 3) can be used to control carrying capacity.

While the demonstrations are representative of carrying capacity problems observed at actual Corps project areas, hypothetical areas and problems are used in presenting each demonstration. Although each demonstration involves one or more selected activities, the use of the carrying capacity guidelines and techniques may be equally applicable to other activities.

The demonstrations are organized under the following headings:

CAPACITY MANAGEMENT FOR SINGLE USE AREAS

- 1** Identifying And Solving Overcrowding And Overuse (Camping)

- 2** Identifying And Solving Underuse (Picnicking)

- 3** Maximizing Carrying Capacity (Boat Launching, Shoreline Fishing, Hiking)

- 4** Maximizing Resource Capacity (Camping)

CAPACITY MANAGEMENT FOR MULTIPLE USE BOATING AREAS

- 5** Determining The Social Capacity Of A Lake

- 6** Controlling The Carrying Capacity Of A Lake

CAPACITY MANAGEMENT FOR MULTIPLE USE LAND AREAS

- 7** Determining Social Capacity And Using Support Facilities Based On Capacity

- 8** Combining Techniques For Capacity Control

CAPACITY MANAGEMENT FOR SINGLE USE AREAS

1 Identifying And Solving Overcrowding And Overuse (Camping)

Purpose

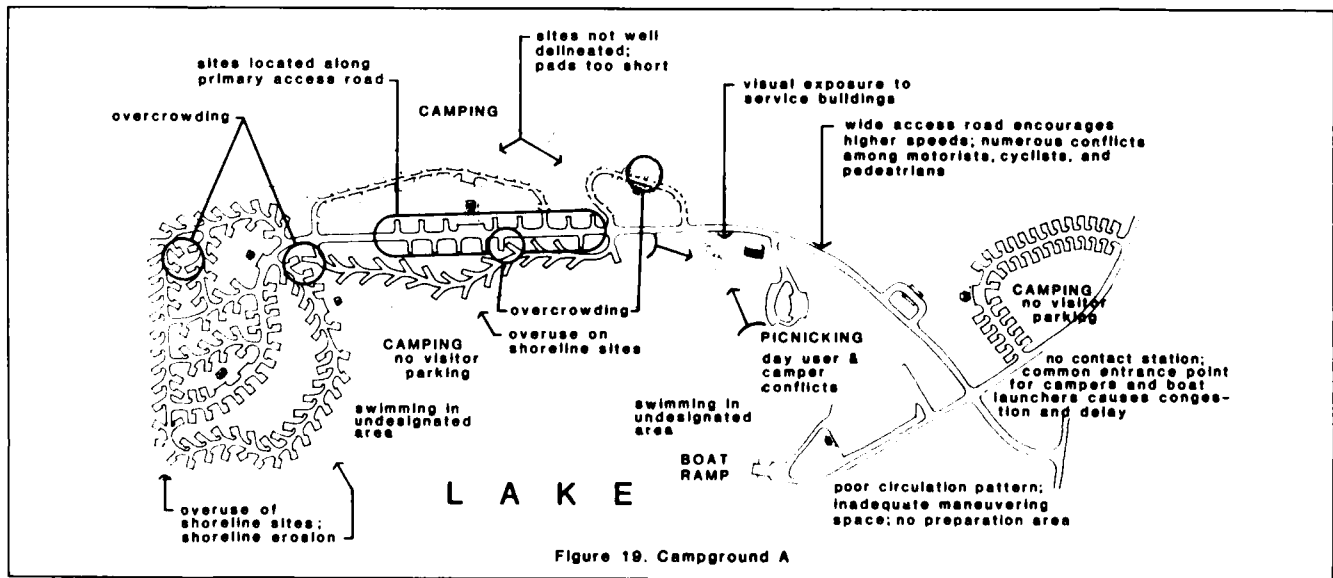
This demonstration provides two examples of how to identify and deal with problems of overcrowding and

overuse using the carrying capacity guidelines and techniques.

Example 1 - Redesigning a Campground Using the Social Capacity Guidelines

Campground A provides 332 fee sites. Landscape buffers serve as a visual screen between some of the sites. Approximately one fourth of

the sites are heavily wooded; the other sites are in mostly open areas with little tree cover or shade. The distance between camp pads ranges from 15 ft to 50 ft; the average spacing has resulted in overcrowding and overuse. In addition, several other planning and design problems exist at this campground (see Figure 19).



The project management chooses to establish carrying capacity levels for the campground as the first step in remedial planning and redesign. Applying the five-step process outlined in Part 2 for determining social capacity guidelines (see Figure 20) yields the following:

- A 20 percent of the campsites
26 ft apart
- B 28 percent of the campsites
46 ft apart
- C 31 percent of the campsites
66 ft apart
- D 21 percent of the campsites
97 ft apart

Factor	Condition	Effect		
Accessibility to Water Body	Obstructed	- 8		
Visibility of Water Body	Obstructed	- 7		
Slope	Level	- 3		
Level of Development	Moderate	+ 3		
Distance from Highway Access	0-5 miles	- 1		
Maintenance of Facilities	Pleasant	0		
Degree of Control	High	- 1		
Vegetation	Moderate	+ 1		
Condition of Trees/Grass	Unpleasant	+ 2		
Amt./Location of Facilities	Pleasant	0		
Age	(same)	-		
Travel Time	<30 min.	+ 12		
Group Size	3-8 (90%)	+ 1		
Number of Other Activities	(same)	-		
Equipment	Trailers	- 2		
Experience	(same)	-		
Net Effect		- 3		
Modified	A'	B'	C'	D'
Group Ranges	17-36	37-56	57-76	77-117
Midpoints	26'	46'	66'	97'
Densities*				

*A distance/area/density conversion table is provided in Appendix C.

Figure 20. Work Space for Campground A

After reviewing the resource capacity guidelines (outlined in Part 2) and the carrying capacity techniques (in Part 3), project management decides that impact campsites, together with aggressive maintenance and restoration, can be used to achieve the social capacity guidelines without creating resource overuse. Also, plans are made to institute a monitoring program to evaluate the effectiveness of their plans to curb overuse.

Figure 21 illustrates how Campground A might look if the carrying capacity guidelines are applied and the other problems are solved as a result of remedial planning and design.

Figure 22 illustrates how Campground A might have looked if the same guidelines and techniques were applied during initial planning and design.

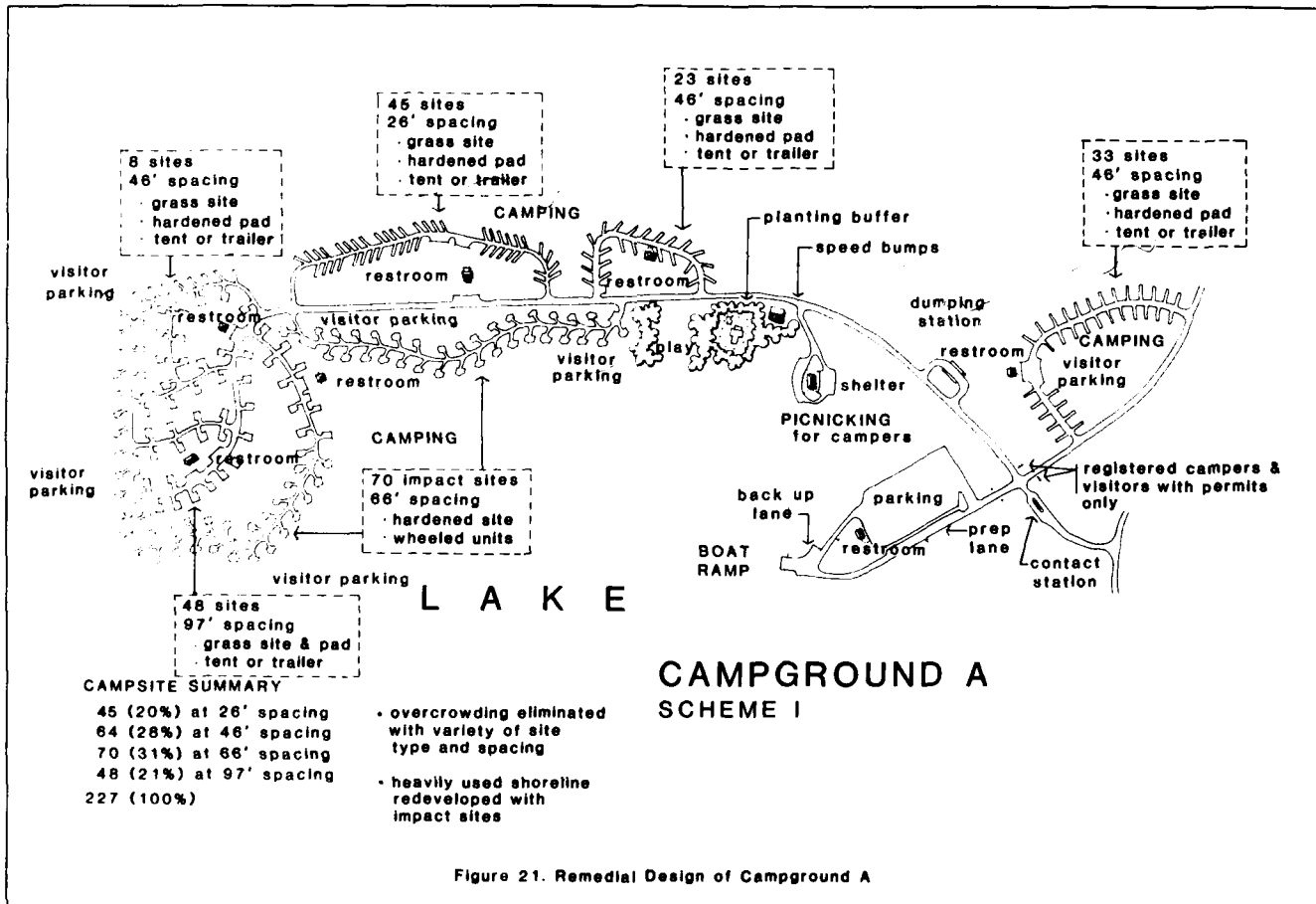


Figure 21. Remedial Design of Campground A

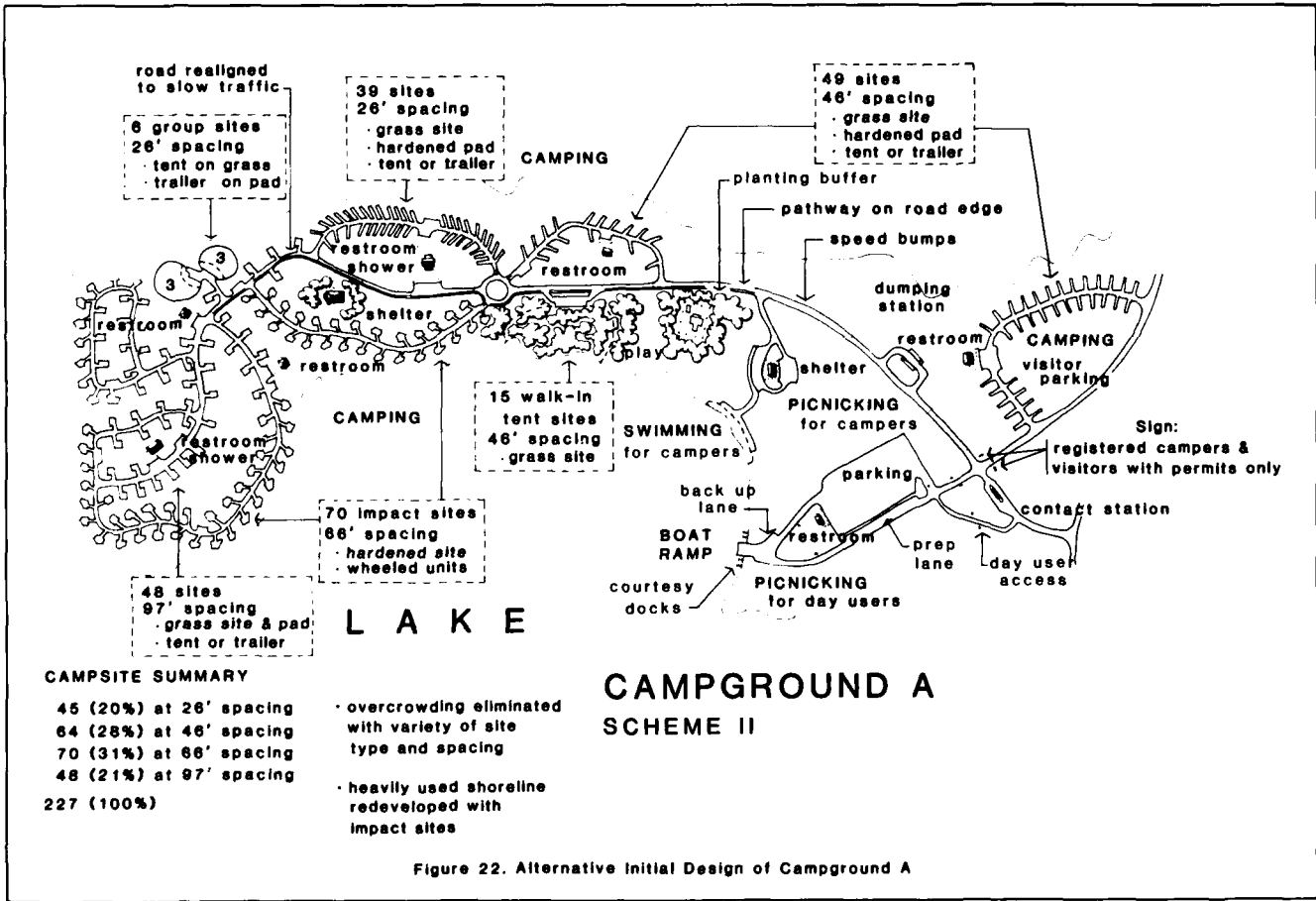


Figure 22. Alternative Initial Design of Campground A

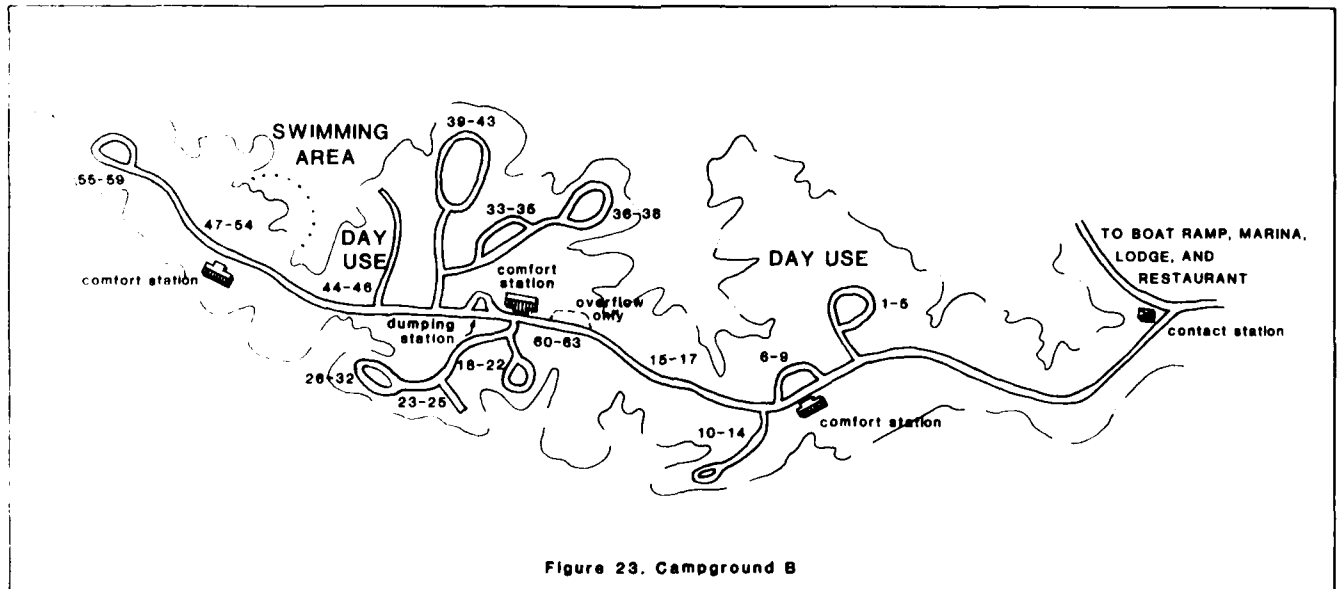
Example 2 - Redesigning a Campground Using Modified Social Capacity Guidelines

Campground B is primarily a camping area, but also contains several small day use activity areas (see Figure 23). The campground consists of approximately 20 developed acres. The area is very popular and is overused and overcrowded. The steep terrain and shallow soil are extremely susceptible to erosion, and

the narrowness of this recreation resource has made site planning difficult. The campground offers 63 designated campsites (without hardened pads). Campsites are spaced about 25 ft apart, but are not well delineated.

Project management is in the process of updating the master plan to solve overuse and overcrowding at this campground. Using indicators to monitor the area, project managers

have already identified overuse and overcrowding as a problem. Major indicators of overuse included compacted soils, erosion, damaged trees, and worn vegetation. Social capacity problems were discovered largely as a result of users complaining about the spacing between campsites (40 percent of the campers interviewed felt they were "too close"). The next step is to solve these problems through remedial planning.



Applying the five-step process outlined in Part 2 for determining social capacity guidelines (see Figure 24) yields the following:

- A 20 percent of the campsites
45 ft apart
- B 28 percent of the campsites
65 ft apart
- C 31 percent of the campsites
82 ft apart
- D 21 percent of the campsites
114 ft apart

After examining these social capacity guidelines and evaluating their impact on the resource base (see resource capacity guidelines section), project area managers are still concerned about the potential for resource overuse.

As a result of this concern they have decided not to provide sites spaced for preference group A (which calls for 45 ft between campsites). By not providing for this group, they realize that some campers may not find sites with the most desirable size. But protecting the resource base will provide for the future use of the area by all campers.

Figures 25, 26, and 27 show alternative ways the carrying capacity guidelines can be applied, keeping the following preference groupings in mind.

- Preference Group B (34%)*
65 ft between sites
- Preference Group C (40%)*
82 ft between sites
- Preference Group D (26%)*
114 ft between sites

* (Percentages are higher than shown in Figure 24 because the Preference Group A Percentage was allocated to the other groups)

Two of the schemes show more campsites than the 63 that presently exist at Campground B. Opportunities for tent and trailer camping, and group camping, are provided in each scheme. The concepts of impact campsites, common parking areas, and walk-in tenting are used in the environmentally sensitive areas and are aimed at reducing overuse. More specific information is noted on each scheme.

After redesigning Campground B based on one of the three schemes (Figures 25, 26 and 27), project management begins reseeding and fertilizing those areas that have been overused in the past. Also, during the recreation season, project management plans to periodically monitor the campground to identify signs (indicators) of overuse and overcrowding and to determine any changes needed in the design or management of the campground.

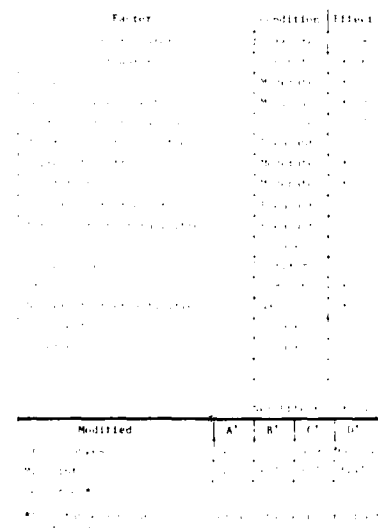
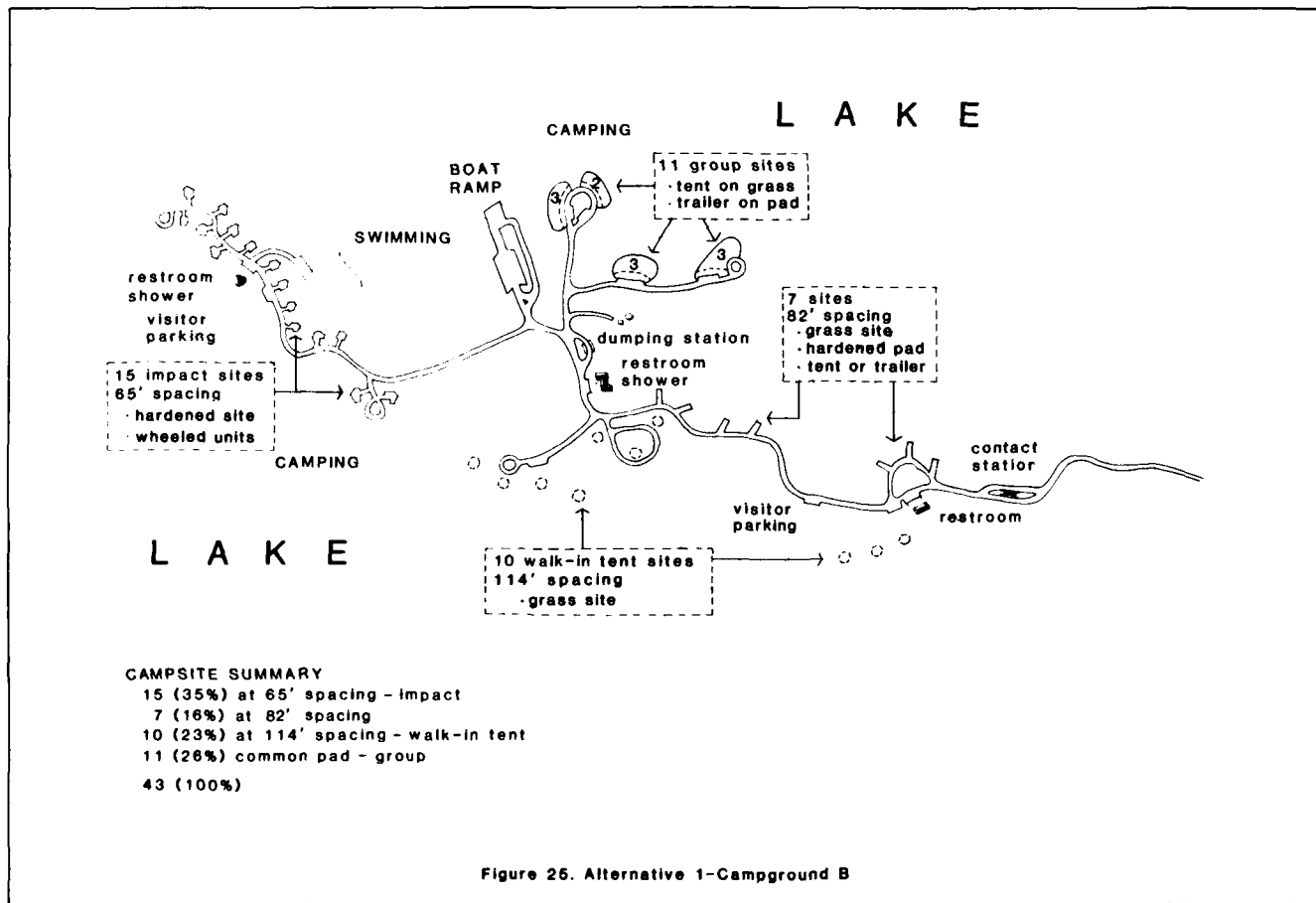


Figure 24. Work Space for Campground B



2 Identifying And Solving Underuse (Picnicking)

Purpose

This demonstration points out reasons why some activity areas are underused and shows how the level of use at an existing underused picnic area can be increased.

Situation

Some Corps project areas have recreation activity areas which are not being used to their full potential.

Underuse situations are found mostly on remotely located hiking trails; in picnic areas located away from the lake; and in some camping areas which are far from the lake or lack electric/water hookups.

Typically, underused activity areas have one or more of the following characteristics: a relatively remote location in regard to the lake, project users, or other activity areas; poor road access to the area; relatively unknown (lack of signs, etc.); difficult access within the area; a limited number of support facilities; or few shade trees.

In this demonstration, project management is concerned about an underused picnic area, and they have decided to encourage more use

of the area using the process outlined in Figure 28.

The first step in improving this condition involves identifying the reasons that are causing underuse.

The second step is identifying the various techniques which can help solve these problems and improve use.

The third step involves evaluating the merits of each technique and the feasibility of implementation.

The fourth step involves actually applying the techniques to solve the problems and to improve the under-use condition of the areas.

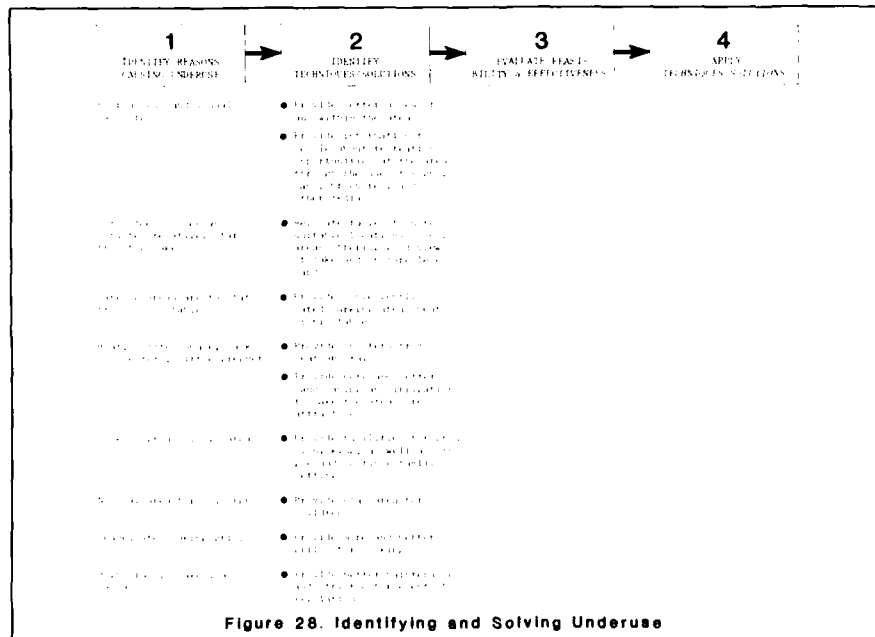


Figure 28. Identifying and Solving Underuse

3 Maximizing Carrying Capacity (Boat Launching, Shoreline Fishing, Hiking)

Purpose

This demonstration shows how to maximize the carrying capacity of boat launching ramps, shoreline fishing areas, and hiking trails by utilizing various planning and design techniques.

Boat Launching Ramp

This demonstration includes two typical boat ramps: (1) a poorly designed boat launching facility with limited development and control; and (2) a well-designed one with a high level of development and control, sufficient parking, and space for expansion.

Example 1: A Poorly Designed Launching Area. The boat ramp in Figure 29 illustrates how a facility of poor design and layout can result in congestion and low carrying capacities.

- The swimming beach is situated directly adjacent to the ramp. Swimmers and boaters are likely to interfere with each other, causing accidents and user dissatisfaction.

- Boat wake from uncontrolled boat speeds and prevailing wind-driven waves may injure boaters or damage boats during the launching and retrieving process; launching time is also increased.
- Insufficient space for maneuvering and parking (which is random) causes slower launching, parked-in vehicles, accidents, and arguments.
- Absence of a courtesy dock hinders the ability to launch and retrieve boats, especially if boaters are alone and have no one to tend the boat while the trailer is being parked or retrieved.
- Erosion-checking, rock riprap prevents pulling a boat onshore and could damage boats if they are washed against the rocks.

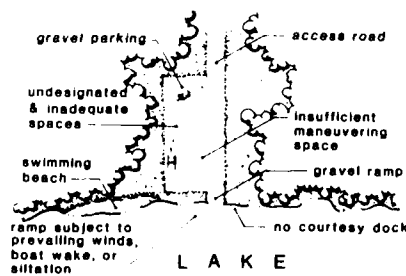


Figure 29. Poorly Designed Ramp

- No restroom building, drinking water, or night lighting is provided.

Example 2: A Well-Designed Launching Area. The boat ramp in Figure 30 shows how a well-designed launching area possessing a high level of control and development can facilitate launching, reduce the potential for conflicts, and result in higher daily carrying capacities.

The layout is intended to minimize launch time and conflicts among launchers and to ease traffic flow, making the launching-retrieval procedure smooth and quick.

The layout of drives and parking should be in harmony with the natural terrain and need not be as geometric and parallel as the example shown; however, the site chosen for a ramp should facilitate short walks from parking area to ramp and not be of such grades as to require large amounts of cut and fill, which not only increase construction costs but also require exposure of more soil leading to unnecessary erosion and sedimentation.

Features of the overall layout include:

- one-way circulation.
- room for maneuvering vehicles and trailers.

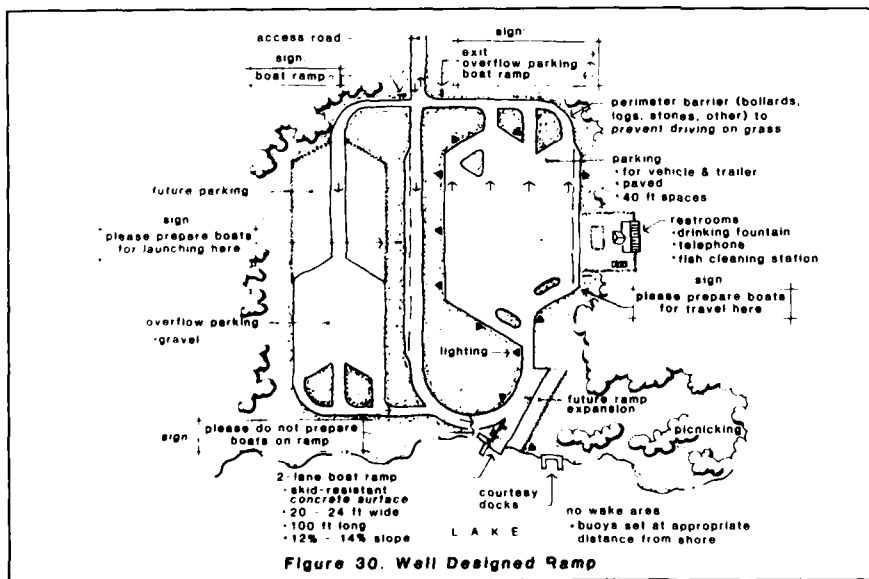
- pull-through, full length (40 ft) parking spaces to ease flow and eliminate backing up in parking lot.
- space for expansion of parking and ramps.
- a location not adjacent to swimming and fishing areas to reduce conflicts.
- no wake area marked with buoys and a posted speed limit.

- gradients of drives and parking areas not exceeding 4 percent
- ramps with a continuous slope of 12 to 14 percent.
- a slope at the shoreline that does not contribute to erosion.
- an orientation such that prevailing winds do not create a dangerous wake or contribute to erosion.

- retention of natural landscape (vegetation and topography) in and around the developed area.

The level of development and degree of control is high:

- parking - main lot is paved and striped, overflow lot is gravel; future expansion area can be moved and used as additional overflow.
- a bathroom building, drinking water, telephone, and fish cleaning station are provided.
- signs provide information and directions.
- area lighting provides security for trailers left in the lot and for those who arrive or depart in the dark.
- a skid-resistant surface texture is provided on the concrete ramp.
- room for expanding the number of ramps is provided.
- courtesy docks at the ramp aid in launching and retrieving--especially for those people who are alone; the dock away from the ramp enables boats picking up or dropping off people to be clear of boats being launched.
- an informal sitting area is provided for use by boaters who wish to picnic.



Shoreline Fishing Areas

Situation. Basically, there are two types of shoreline fishing situations: fishing along the lakeshore and fishing at the outlet. Generally, fishing is most popular at the outlet areas especially where easy access is afforded. Some project areas have

not provided easy access or site improvements to shoreline fishing areas.

Application of techniques. Figure 31 shows various techniques that can be used to increase the social and resource capacity of shoreline fishing areas.

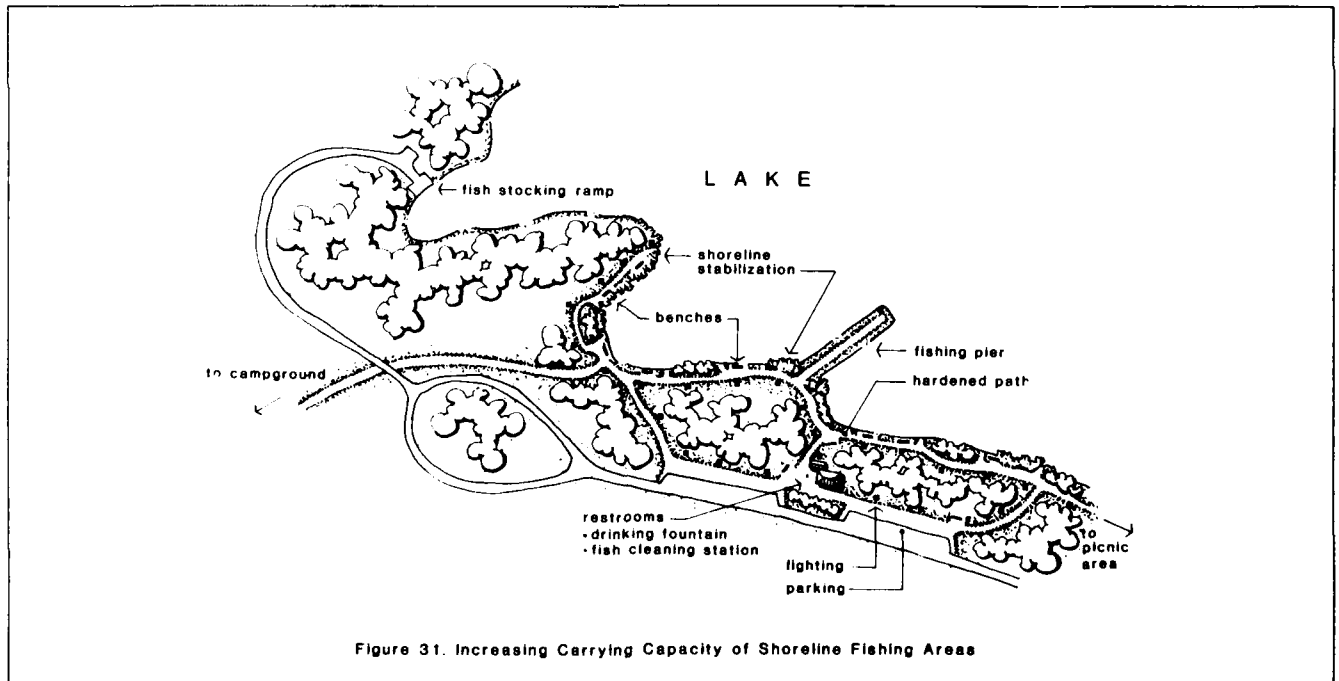


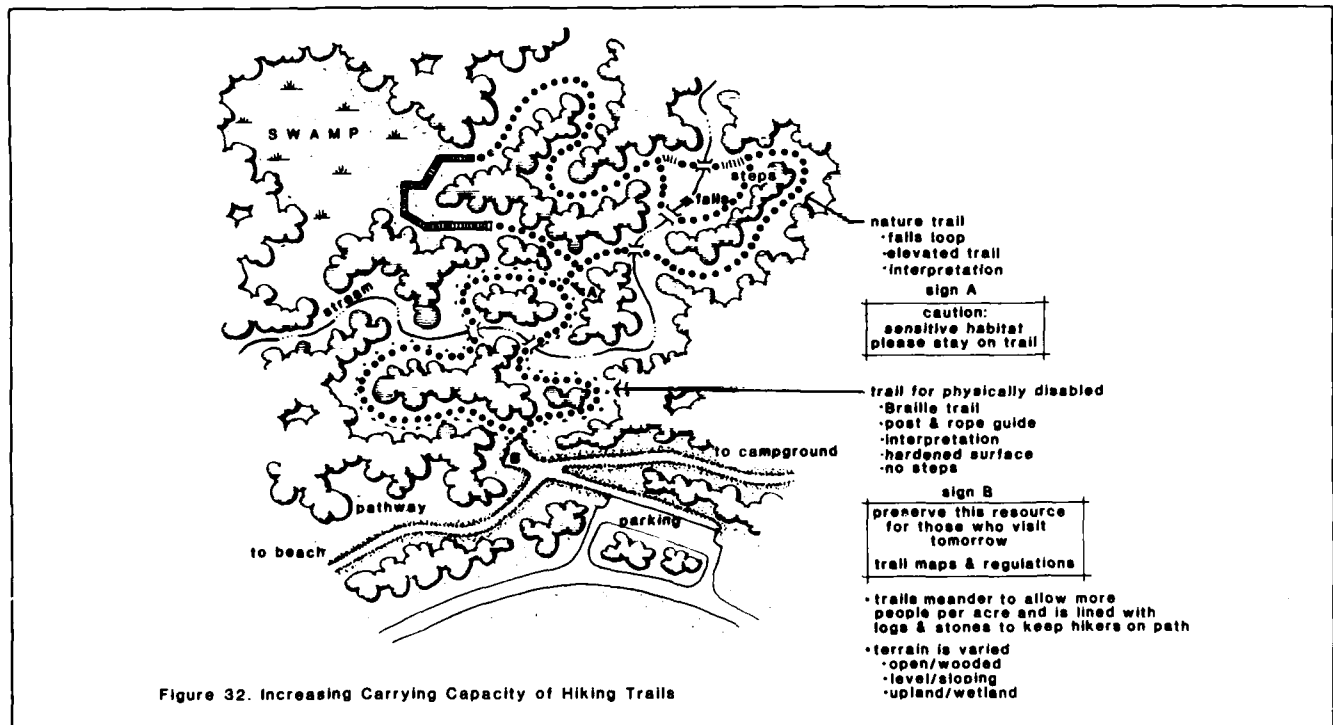
Figure 31. Increasing Carrying Capacity of Shoreline Fishing Areas

Hiking Trails

Situation. Many Corps hiking trails are underused. Many trails are interpretive, few lead from one activity area to another, and some are difficult to find. Yet some trails are

overused because of their location in sensitive areas.

Application of techniques. Figure 32 demonstrates techniques for maximizing the carrying capacity of a hiking trail.



4 Maximizing Resource Capacity (Camping)

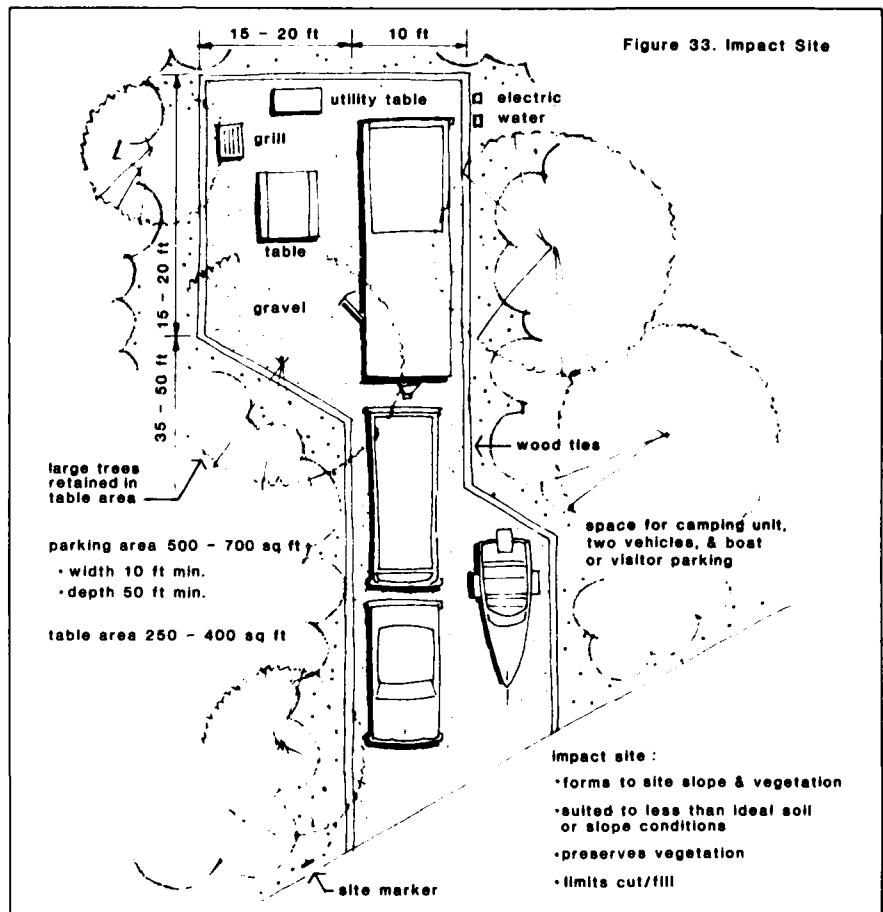
Purpose

In most cases, an area's social capacity is different from its resource capacity. When an area's resource capacity is lower than its social capacity, management can: (1) restrict the level of use so that it does not exceed the resource capacity, and/or (2) increase the resource capacity of the area to allow for a level of use at the area's social capacity. While the first alternative may be necessary in the short term, management may wish to provide for a greater level of use in the long term by employing techniques to increase the resource capacity of the area. This demonstration provides greater detail on the use of such techniques in designing a campsite.

Situation

Project management is concerned about overuse at a popular campground that receives little sunlight and has shallow, erosion-prone soils.

Impact campsites can increase the resource capacity of the area (see Figure 33). Use on an impact site is concentrated on the hardened pad away from vulnerable plant growth and erodible soil. Generally, campers recognize the timber border as a barrier that is not to be crossed.



CAPACITY MANAGEMENT FOR MULTIPLE USE BOATING AREAS

5 Determining The Social Capacity Of A Lake

Purpose

This demonstration focuses on the use of social capacity guidelines to determine the social capacity of a multiple use boating area. Determination of social capacity is the first step in using a carrying capacity approach to recreation resource management.

Situation

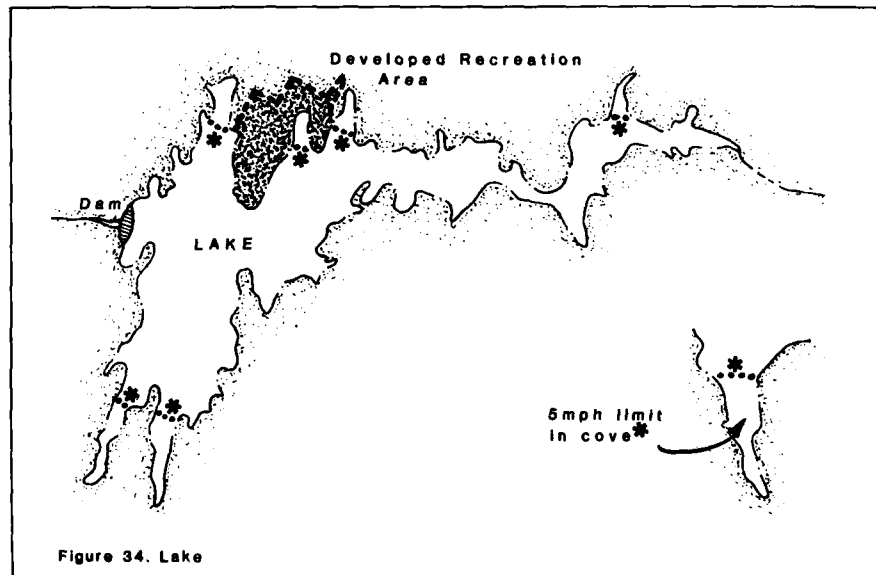
A lake is heavily used and reportedly is at the threshold of being overcrowded (see Figure 34). There are conflicts between power boats, waterskiers, and fishermen. Some of the cove areas of the lake have maximum speed limitations of 5 mph.

Before initiating revisions to the master plan, project management wants to determine the social capacity of the lake to evaluate the scope of the problems.

Determining Area/Density Guidelines For Each Lake Activity

Determining the social capacity of the lake involves a two-step proce-

dure: (1) developing area/density guidelines for each activity (boating, waterskiing, and boat fishing); and (2) applying these guidelines to areas of the lake.



Boating. To determine the area/density guidelines for boating, steps 1 and 2 of the guidelines system are performed, resulting in the following factors, observed conditions, effects, and net effect:

Factors	Observed Conditions	Effects of Observed Conditions
Amount/Location of Facilities	Pleasant	+35
Level of Development	Moderate	-70
Net Effect		-35

Next, the preference distribution for boating (see page 14) is shifted by the distance equal to the net effect (-35 ft). This results in new preference group ranges of 65 to 164 ft for A, 165 to 414 ft for B, and 415 to 1465 ft for C.

The approximate midpoint of each preference group range is then calculated. The figures for this example would be: 115 ft for A, 290 ft for B, and 940 ft for C. Group area figures are then calculated by squaring these midpoints. The resulting area figures are: 13,225 sq ft per boat for A (115 ft x 115 ft), 84,100 sq ft per boat for B (290 ft x 290 ft), and 883,600 sq ft per boat for C (940 ft x 940 ft).

Finally, the average area for boating is calculated by: (1) multiplying the area figure for each preference group times the percentage of users in that preference group and (2) totaling these products [(13,225 x 0.29) + (84,100 x 0.37) + (883,600 x

0.34)]. This average area equals 335,376 sq ft (7.70 acres) per boat, which corresponds to a density of about 0.129 boats per acre.

Waterskiing. To determine the area/density guideline for waterskiing, steps 1 and 2 of the guidelines system are followed, resulting in the following factors, observed conditions, effects, and net effect:

Factors	Observed Conditions	Effects of Observed Conditions
Amount/Location of Facilities	Pleasant	+5
Level of Development	Moderate	+5
Net Effect		0

Since the net effect is 0, the preference distribution (see page 34) is not modified, and the preference group ranges remain 100 to 199 ft for A, 200 to 400 ft for B, and 401 to 1500 ft for C. The approximate midpoints of these ranges are 150 ft for A, 300 ft for B, and 950 ft for C.

The group area figures are calculated by squaring the midpoints, resulting in area figures of 22,500 sq ft per boat for A (150 ft x 150 ft), 90,000 sq ft per boat for B (300 ft x 300 ft), and 902,500 sq ft per boat for C (950 ft x 950 ft). The average area for waterskiing in this example would then be 302,650 sq ft (6.95 acres) per boat [(22,500

x 0.22) + (90,000 x 0.50) + (902,500 x 0.28)], which corresponds to a density of about 0.144 boats per acre.

Boat Fishing. To determine the area/density guidelines for boat fishing, steps 1 and 2 of the guidelines system are followed, resulting in the following factors, observed conditions, effects, and net effect:

Factors	Observed Conditions	Effects of Observed Conditions
Catching Fish	Pleasant	+65
Amount/Location of Facilities	Pleasant	+25
Degree of Control	Moderate	-125
Net Effect		-95

The preference distribution for boat fishing (see page 16) is shifted by the distance equal to the net effect (-95 ft). This results in the following preference group ranges: 0-104 ft for A, 105-504 ft for B, and 505-1405 ft for C. The approximate midpoints of these ranges are 52 ft for A, 305 ft for B, and 955 ft for C.

The group area figures are calculated by squaring the midpoints: 2704 sq ft per boat for A (52 ft x 52 ft), 93,025 sq ft per boat for B (305 ft x 305 ft), and 912,025 sq ft per boat for C (955 ft x 955 ft). The average area for boat fishing in this example is 245,328 sq ft (5.63 acres) per boat [(2704 x 0.49) + (93,025 x 0.27) + (912,025

x 0.24)], which corresponds to a density of about 0.178 boats per acre.

Applying Area/Density Guidelines to Lake Areas

Having computed social capacity area/density guidelines for boating, waterskiing, and boat fishing, these guidelines are now applied to those lake areas being analyzed.

Management has divided the lake into two types of areas: (1) seven coves in which a maximum speed limit of 5 mph is enforced (totaling approximately 250 acres), and (2) the main body of the lake (approximately 2870 acres).

Because of the speed restriction, it is assumed that the cove areas will not be used for waterskiing, that 90 percent of the cove area users will be boat fishermen, and that the remaining 10 percent of users will be boaters. A cove area figure is calculated by: (1) multiplying the area figure for each of the activities times the expected percentage of users for that activity and (2) totaling these products [(5.63 x 0.90) + (7.70 x 0.10)]. This results in a cove area figure of 5.84 acres per boat, which corresponds to a density of about 0.171 boats per acre.

Dividing the area of the cove (250 acres) by the cove area figure (5.84

acres per boat), or multiplying the area of the cove (250 acres) by the cove density figure (0.171 boats per acre), yields 43 boats as the social capacity of the cove areas.

About 60 percent of the users of the main body of the lake are boaters, 35 percent are waterskiers, and 5 percent are boat fishermen. A main body area figure is calculated by: (1) multiplying the area figure for each of these activities times the expected percentage of users for that activity and (2) totaling these products [(7.70 x 0.60) + (6.95 x 0.35) + (5.63 x 0.05)]. This results in a main body area figure of 7.33 acres per boat, which corresponds to a density of about 0.136 boats per acre.

Dividing the area of the main body of the lake (2870 acres) by the main body area figure (7.33 acres per boat), or multiplying the area of the main body of the lake by the main body density figure (0.136 boats per acre), yields 392 boats as the social capacity of the main body of the lake.

Totaling the social capacity of the cove areas (43 boats) with the social capacity of the main body (392 boats) yields a total lake social capacity of 435 boats.

These social capacity guidelines developed for the lake are evaluated by the project management to deter-

mine if they represent an appropriate level of use based upon prior experience, resource capacity, and the expected recreational demand.

Using the Social Capacity Guidelines

After the guidelines are evaluated, they can be used for at least three purposes.

First, the guidelines indicate at what level of use overcrowding could begin to create problems, either for the lake as a whole or for separate areas (e.g., individual coves). This enables management to initiate techniques to prevent problems of overcrowding from occurring.

Second, since the social capacity guidelines establish the maximum number of boats that can use the lake before problems of overcrowding occur, the guidelines provide a standard for evaluating the maximum level of support facilities that should be developed.

Finally, because overcrowding of the lake surface usually occurs before overuse of the lake resource, the guidelines are used for early warning as to where resource overuse might occur. The guidelines also serve as the basis for initiating a program for lake use monitoring.

6 Controlling The Carrying Capacity Of A Lake

Purpose

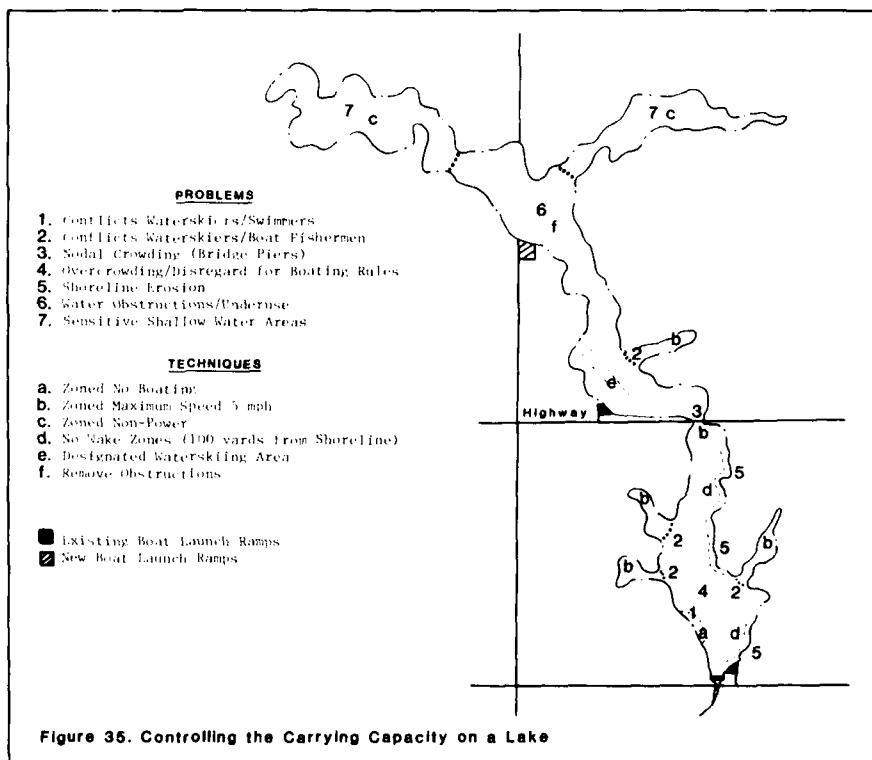
This demonstration illustrates the application of various techniques to control the carrying capacity of a lake that has numerous capacity problems (Figure 35).

Selection and Application of Techniques

In selecting which techniques to apply, management first determines what the problems really are. In the case of conflicts between boaters and swimmers, the actual operation of boats presents the greatest danger. In other cases, it is only the speed, the wake, or the type of boat that really creates or aggravates the problem. In each case, management seeks to apply the technique that is most narrowly tailored to the real problem, is easiest to administer, and is most acceptable to users.

Many of the problems at the lake can be dealt with by different types of lake zoning (see Figure 35). Problems such as disregard for boating rules call for increased education of users and increased lake patrol/enforcement. Problems such as underuse of one portion of the lake

(which may be related to the overcrowding in other portions of the lake) may call for certain improvements such as removal of obstructions and new boat launch ramps.



CAPACITY MANAGEMENT FOR MULTIPLE USE LAND AREAS

7 Determining Social Capacity And Using Support Facilities Based On Capacity

Purpose

This demonstration focuses on three points: (1) the use of the social capacity guidelines to determine the social capacity of a multiple use land area, (2) the use of the social capacity guidelines to develop parking areas and other support facilities at the appropriate level, and (3) the use of appropriately developed support facilities to determine when the social capacity of the area has been reached.

Situation

Recreation facilities at this demonstration day use area include a 300-ft beach, a boat launching ramp, parking areas, and picnic areas (see Figure 36). The area is heavily used; overcrowding and overuse

occur in several picnic areas. On several occasions the entrance gate had to be closed to control what was believed to be overcrowding.

Project management has decided to determine the carrying capacity of this day use area so the area can be better managed during the upcoming recreation season.

Determining the Social Capacity of a Multiple Use Land Area

A two-step procedure is used to determine the social capacity of the area: (1) developing area/density guidelines for each activity (picnicking and sunbathing) in each setting, and (2) applying these guidelines to the area.

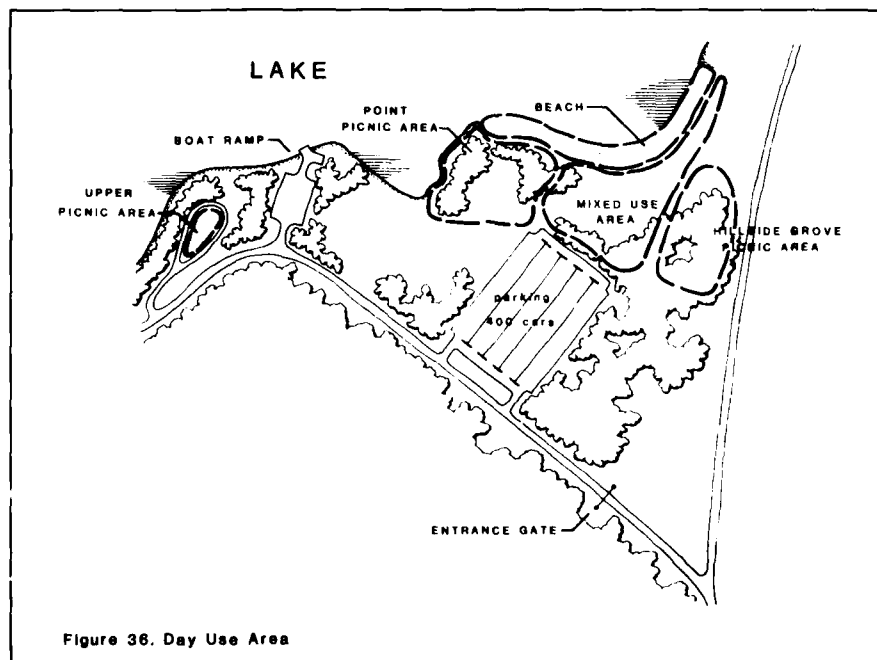


Figure 36. Day Use Area

Sunbathing Area/Density Guidelines. The area guidelines for sunbathing are determined by using steps 1 and 2 of the guidelines system, resulting in the following factors, observed conditions, effects, and net effect for sunbathing for the beach and mixed use areas:

Factors	Observed Conditions	Effects of Observed Conditions
Preference for sunbathing	0 to 9 ft	0 to 9 ft
Preference for sunbathing	10 to 15 ft	10 to 15 ft
Preference for sunbathing	16 to 26 ft	16 to 26 ft
Preference for sunbathing	27 to 44 ft	27 to 44 ft

The preference distribution for sunbathing (see page 30) is then shifted by the distance equal to the net effect (-6 feet), resulting in new preference group ranges of 0 to 9 ft for A, 10 to 15 ft for B, 16 to 26 ft for C, and 27 to 44 ft for D.

The approximate midpoint of each preference group is calculated to be: 5 ft for A, 13 ft for B, 21 ft for C, and 36 ft for D.

Group area figures are then determined by squaring the midpoints. The area figures are 25 sq ft for A, 169 sq ft for B, 441 sq ft for C, and 1296 sq ft for D.

The average area figure for sunbathing is calculated by: (1) multiplying the area figure for each preference group times the percent-

age of users in that preference group, and (2) totaling these products. The average area is 342 sq ft per group [(25 x 0.27) + (169 x 0.39) + (441 x 0.20) + (1296 x 0.14)], which corresponds to a density of about 128 groups per acre.

Applying Area/Density Guidelines to Activity Areas. Having computed social capacity area/density guidelines for picnicking and sunbathing, these guidelines are now applied to the areas being analyzed. This day use area has three areas where only picnicking exists (Upper, Point, and Hillside Grove), one area where only sunbathing exists (beach), and one area where 80 percent of the users are sunbathers and 20 percent of the users are picnickers (Mixed-Use Area).

The social capacity of each picnic-only area is calculated by dividing the area of each setting by the area guideline developed for each setting:

Setting	Area, sq ft	Area Guideline, sq ft/group	Capacity, groups
Upper	22,500	250	90
Point	197,520	912	216
Hillside Grove	96,210	363	265

The social capacity of the beach is determined by dividing the total area of the beach (80,000 sq ft) by the area figure developed for sunbathing (342 sq ft/group), which results in a capacity of 234 groups.

The social capacity of the Mixed Use area is calculated by developing a combined picnicking/sunbathing area figure. This involves: (1) multiplying the area figure for each of these activities times the expected percentage of users for that activity and (2) totaling these products [(342 x 0.80) + (3911 x 0.20)]. The area figure in this example is 1056 sq ft per user. The area (161,620 sq ft) is then divided by the combined picnicking/sunbathing area figure (1056 sq ft/group). The result is 153 user groups (122 groups of sunbathers and 31 groups of picnickers.)

Thus, the social capacity of the total day use area is 96 groups of picnickers (9 + 28 + 28 + 31) and 356 groups of sunbathers (234 + 122). Project management determines that the social capacity guidelines represent an appropriate level of use based upon prior experience, resource capacity (i.e., with periodic reseeding, normal maintenance, and strict circulation controls the resource can sustain the social capacity), and expected recreational demand. The social capacity guidelines, therefore, are the carrying capacity guidelines to be applied to this day use area.

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Developing and Using Support Facilities Based on Capacity

Using Capacity Guidelines to Develop Support Facilities. Determining the appropriate level of support facilities requires that the social capacity guidelines be converted to number of users. To accomplish this, the number of groups in the guideline for each activity is multiplied by the average number of people in each type of activity group:

Activity	Activity Setting	No. of Users Per Activity Group	Carrying Capacity guideline	No. of Users
Swimming	Upper Picnic Area	10	10	100
Swimming	Point Picnic Area	10	10	100
Swimming	Hillside Grove	10	10	100
Swimming	Mixed Use Area	10	10	100
Swimming	Beach	10	10	100

The average group size is determined from observation, user surveys, and regional guidelines.

The maximum number of different support facilities that should be developed is determined by dividing the total number of users by the development guideline for each type of support facility (i.e., the number of users per support facility). The location of support facilities can take into account the recreational capacities of the different settings.

Using Appropriately Developed Support Facilities as Capacity Measures.

If a support facility is developed at an appropriate level based on recreation carrying capacity, project management can monitor the use of that support facility and use it to determine when the social capacity of the area has been reached and when the entrance gate should be closed.

In many cases, parking facilities are the best support facility to monitor because: (1) all types of users use parking areas, (2) a high percentage of users drive to Corps areas, (3) the duration of use of the parking area corresponds to the duration of use of the recreation area, and (4) overcrowding of parking areas is itself a problem that can aggravate overcrowding and overuse of recreation areas.

The following tabulation indicates the number of parking spaces that should be provided if parking facilities are developed to meet the recreational capacity of each area in this demonstration.

Activity Setting	No. of Users	Load Factor users/auto	No. of Spaces
Upper Picnic Area	65	3.3	14
Point Picnic Area	140	3.3	42
Hillside Grove	140	3.3	42
Picnic Area	521	3.3	158
Beach	702	3.3	213
Total			469

The day use area currently provides the following parking facilities:

- Main Parking Area - 400 spaces
- Upper Picnic Area - 18 spaces
- Boat Ramp Area - 30 spaces

The 18 parking spaces already provided at the Upper Picnic Area will meet the needs of users of that area (14 spaces), and parking at the Boat Ramp Area (30 spaces) will be restricted to boaters only.

The Main Parking Area should be expanded by 55 spaces (469 - 14 - 400 = 55), if the capacity of the parking areas is to correspond to the capacity of the recreation areas. When the capacities do correspond, the parking area will be a measuring device to determine when the capacity of the recreation area is being exceeded.

8 Combining Techniques For Capacity Control

Purpose

This demonstration combines various techniques to control the carrying capacity of a recreation area. However, it does not apply all possible techniques available.

Situation

Numerous carrying capacity related problems exist at the recreation area shown in Figure 38. The major problems include: overuse and overcrowding of the campground and picnic area, traffic congestion and uncontrolled circulation conflicts between campers and day users, overcrowding at the boat ramp, and

boaters and swimmers in the same area.

Most of these problems can be solved and the area's carrying capacity can be controlled through the use of several of the techniques discussed in Part 3. Figure 39 shows some of the techniques that can be used to control carrying capacity and achieve well-balanced use.

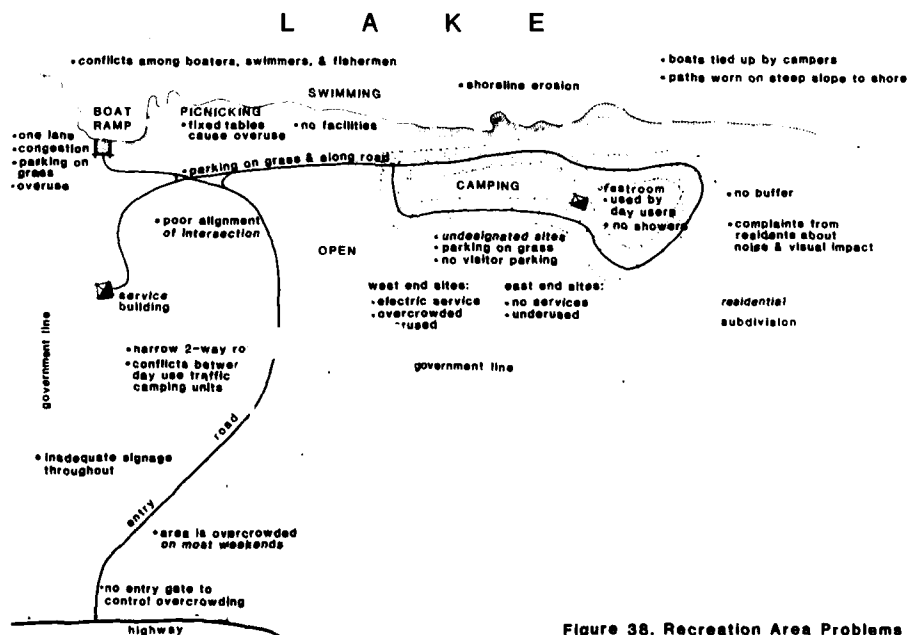


Figure 38. Recreation Area Problems

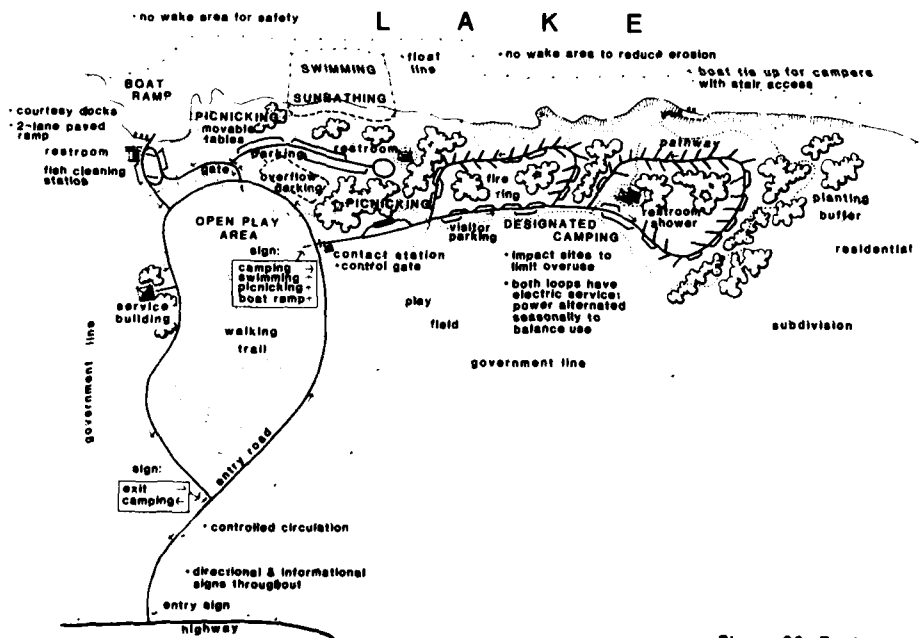
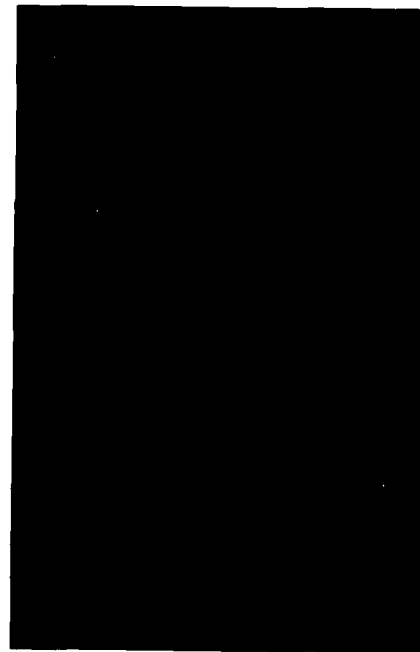


Figure 39. Techniques

APPENDICES



APPENDIX A
GLOSSARY

ACTIVITY AREA - The specific area where an individual primary activity occurs (e.g., a campground, the lake, a hiking trail, a picnic area, etc.).

CAPACITY, RECREATIONAL CARRYING - The capability of a recreational resource to provide opportunity for certain types of satisfactory recreation experiences over time without significant degradation of the resource. Inherent in this view of carrying capacity are resource (biophysical) and social (psycho-social) capacities.

CAPACITY, RESOURCE - The level of recreational use of a resource beyond which irreversible biological deterioration takes place or degradation of the physical environment makes the resource no longer suitable or attractive for that recreation use.

CAPACITY, SOCIAL - The level of recreational use of a resource or area beyond which the user's expectation of the experience is not realized and he/she does not achieve a reasonable level of satisfaction.

CARRYING CAPACITY GUIDELINES - The levels of use and the methods used to obtain and achieve them that are recommended in this Handbook.

FACTORS - The characteristics and phenomena that influence carrying capacity.

INDICATORS - The phenomena that can be used to identify or measure the degree of overcrowding or overuse, and that can be used in conjunction with a monitoring system to help predict when problems of overuse and overcrowding will occur if preventive measures are not taken.

MONITORING - The periodic assessment of the impact that use levels have on the social capacity or resource capacity of an area.

OVERCROWDING - A condition where the user does not achieve a satisfactory recreational experience because of too many people, inadequate distances between sites, etc.

OVERUSE - A condition where (during the course of a season/year) degradation of the physical environment makes the resource no longer suitable or attractive for recreational use.

PLANNING RANGE - The range of spacing distance for an activity which satisfies the spacing preferences of the majority of recreators participating in that activity, and accounts for other considerations (e.g., cost, safety, equity, etc.).

PREFERENCE DISTRIBUTION - The set of preference groupings for an activity which can be modified to develop the social carrying capacity of an area.

PREFERENCE GROUPINGS - The range of spacing distances for an activity which satisfies the similar spacing preferences of a group of recreators participating in that activity.

PROJECT/PROJECT AREA - The land and water area of the total Corps of Engineers project.

PROJECT MANAGEMENT - The project area staff, District personnel, and other people involved with project management.

RECREATION ACTIVITIES -

- **Boating.** Riding watercraft on a body of water for pleasure; including nonpower, limited power, and unlimited power boating. Carrying capacity

guidelines pertain to lake boating (rather than on a flowing river or stream) and are expressed in distances between boats.

- **Boat Fishing.** Taking of aquatic animals from bodies of water while in an anchored boat. Carrying capacity guidelines are expressed in terms of distances between anchored boats. This excludes water surface areas designated solely for waterskiing, swimming, etc.
- **Camping.** Temporary, overnight housekeeping away from one's permanent residence, set up either solely for the enjoyment derived from this activity or for the opportunity to participate in other activities. Capacity guidelines are more applicable to tent and trailer camping than to wilderness or group camping situations. Guidelines are expressed in terms of distances between the centers of campsite pads.
- **Hiking.** Walking along improved trails. This activity is often done in conjunction with nature study activities such as wildlife, flora, and bird observation along with camping. Guidelines are expressed in terms of distances between groups of hikers and do not apply to

backpacking along primitive trails.

- **Off-road Vehicle Riding (ORV).** Riding powered vehicles (motorcycles, jeeps, dune buggies, all terrain and four-wheel drive vehicles) on designated trails and off-road areas. Guidelines pertain to the distance between riders.
- **Picnicking.** Outdoor eating and drinking activities set up either solely for the enjoyment of eating outdoors or also to participate in other outdoor recreation activities. Guidelines pertain to family picnicking (rather than group picnicking) and are expressed in terms of distances between picnic tables.
- **Shoreline Fishing.** Taking of aquatic animals from bodies of water while on the shoreline. Capacity guidelines are in terms of the distance between fishermen.
- **Sunbathing.** Lying in the sun for the main purpose of enjoying the warmth and tanning effects of the sun's rays and for relaxation. Sunbathing can occur on almost any type of site. But for purposes of this study, sunbathing applies to beach areas only. Guidelines are expressed in terms of the

distance between groups of sunbathers.

- **Swimming.** Propelling oneself through water at a freshwater beach. Recreation carrying capacity guidelines are expressed in terms of the distance between swimmers.
- **Waterskiing.** Riding over water on skis pulled by a boat to which the participant is tethered. Capacity guidelines are expressed in terms of distances between boats.

RECREATION AREA - Corps-managed areas specifically identified for recreational use within the total Project Area; usually named.

RECREATION DAY - A standard unit of use consisting of a visit by one individual to a recreation development or area for recreation purposes during any reasonable portion or all of a 24-hour period.

RECREATION ENVIRONMENT - An activity area together with its various recreation settings.

RECREATION RESOURCE - The land and/or water areas, with associated facilities, that provide a base for outdoor recreation activities.

RECREATION SETTING - The physical, development/control, activity/use relationship components of an activity area; taken as a whole, the various settings comprise a particular recreation environment for each activity area.

RECREATION UNIT - A campsite, picnic table, boat, off-road vehicle, user group, or other unit which when spaced together with other units represents a use level or density.

TITLE 36 - Part 327, Chapter III, of Title 36 of the Code of Federal Regulations which provides rules and regulations governing the public use of water resource development projects administered by the Army Corps of Engineers.

UNDERUSE - A condition where use of a recreation resource is significantly less than the carrying capacity of the resource.

WELL-BALANCED USE - The level of use which reflects the carrying capacity of a particular area.

APPENDIX B RECREATION SETTINGS

INTRODUCTION

During the Recreation Carrying Capacity Design and Management Study, activity areas were examined in terms of their physical settings, development/control settings, and activity/use relationship settings. Many of these settings and their features are factors (in Part 2) which may affect the carrying capacity of a particular recreation environment. This appendix describes and provides the guidelines that were used in the study to examine features:

- Vegetation.
- Accessibility to water body.
- Visibility to water body.
- Level of development.
- Degree of control.
- Relationship to other activity areas.

VEGETATION

The extent of existing vegetation was judged in terms of its effective-

ness as a visual screen. Three degrees of vegetative screening were identified, according to the eye-level density of tree trunks, branches, and/or leaves:

- **Open:** An area that contains very little of any view-blocking vegetation is termed "open." Sight lines are clear and unobstructed.
- **Moderate:** Where views are partially obscured by vegetation making viewing through it somewhat difficult a "moderate" degree of cover exists.
- **Dense:** Significant growth, which is difficult or impossible to see through, would constitute a "dense" degree of cover.

ACCESSIBILITY TO WATER BODY

Accessibility to the lake is based upon the time required to get there from one's location in the recreation area. That length of time is dependent upon four basic factors: terrain, course of access, mode of access, and distance.

Each activity area was examined based on these four basic criteria and designated:

- Easily accessible - 1 to 10 min required to reach water body.

- Moderately accessible - 10 to 25 min required to reach the water body.
- Relatively inaccessible - 25+ min required to reach the water body.

VISIBILITY OF WATER BODY

The three main factors that determine the degree of visibility of the water body are vegetation, landforms, and distance.

On the basis of these factors, each activity area was determined to have one of the following degrees of visibility to the water body:

- Unobstructed view (0 percent to 20 percent obstructed).
- Partially obstructed view (20 percent to 80 percent obstructed).
- Obstructed view (80 percent to 100 percent obstructed).

LEVEL OF DEVELOPMENT

Level of development increases with the incidence of a greater amount and/or better quality of facilities and services that a particular activity area has. Each activity area studied was assigned one of the following levels of development:

- High.
- Moderate.
- Limited.

For example, a campground having a contact station, impact sites, electric and water hookups, flush toilets, showers, amphitheater, playground, and beach would receive a "high" level of development rating. If that same campground were to offer only periodic patrol, poorly defined gravel pads, electric hookups, community water hydrants, and flush toilets, it would receive a "moderate" rating. If the sites were of worn grass and the only services provided were vault toilets and a hand pump for water, it would be rated as being "limited" in development.

This camping illustration is analogous to the type of development commonly associated with other activity areas such as picnicking, beaches, boat launching ramps, fishing areas, and hiking trails.

DEGREE OF CONTROL

Degree of control increases with the employment of a greater amount and/or better quality of means to control people and vehicles in a particular activity area.

Each of the activity areas studied was designated as having one of the following degrees of control:

- High.
- Moderate.
- Little.
- Undesignated.

A "high" degree of control would exist at a fee campground having: one access point with a manned contact station; numbered and clearly defined (likely hardened) campsites; and limitations on the number of people and vehicles or units per site. Controls regarding where and how camping units, boat trailers, and towing vehicles may be parked and other controls directing vehicular and pedestrian traffic along designated roads and pathways (keeping them off of grassed and out of wooded areas) would also be typical of a highly controlled area.

A "moderate" degree of control would be present at this campground if campers were permitted to set up on a numbered site with the fee being collected later by a patrolling ranger, and if camping units and boat trailers would be permitted within the generally defined campsite area. There would be some traffic and parking controls through the use of signs, bollards, timber edging, or other forms.

"Little" degree of control would exist if this campground had no fee, poorly defined sites and parking areas, and virtually no other control measures in effect.

An "undesignated" area would likely be an open area where day and overnight use is allowed (without fees or controls) but is not designated for any particular uses.

For water-based activities, degree of control would be measured by the manner in which particular portions of the lake surface were designated for certain uses. The more measures used, the higher the degree of control. This type of control, when applied to the lake, is often referred to as lake zoning. Typical examples of lake zoning are:

- Placing buoys and float lines around swimming areas.
- Designating no wake areas around boat ramps and swimming areas.
- Limiting boat speeds for safety and conflict-reducing purposes.

- Designating particular areas for waterskiing, boat fishing, or other uses.

RELATIONSHIP TO OTHER ACTIVITY AREAS

These relationship settings were defined based on the distance and travel time between activity areas. Each study activity area was categorized as being either:

- Separate.
- Isolated.

An area is "separate" where it is separated by a distance of up to 1 mile or a walking time of up to 15 min. from other activity areas.

An activity area is "isolated" if it is separated from other areas by more than 1 mile or a walk of more than 15 min. An area is also considered "isolated," regardless of the distance or time involved, if a physical barrier exists between them (vegetation, landform, water, a fence, etc.).

APPENDIX C DISTANCE/AREA/DENSITY CONVERSION TABLE

To determine area or density, first locate the relevant distance figure in the distance column of the following tables. If the exact distance figure is not listed, use the listed distance figure that best approximates the exact figure. The relevant area and density figure appears in the relevant column to the right of the distance figure used.

If a uniform minimum (or maximum) site depth is to be used, multiply the distance guideline times the minimum (or maximum) depth to determine the area and density when the distance guideline is less than a minimum depth (or larger than a maximum depth).

DISTANCE/AREA/DENSITY CONVERSION TABLE*

Distance (ft)	Area sq ft/unit	Density units/acre	Distance (ft)	Area sq ft/unit	Density units/acre	Distance (ft)	Area sq ft/unit	Density units/acre	Distance (ft)	Area sq ft/unit	Density units/acre	Distance (ft)	Area sq ft/unit	Density units/acre
0	0	0	10	100	435.6	20	400	108.9	30	900	48.5	40	1600	27.2
1	1	43,560	11	121	360	21	441	98.8	31	961	45.3	41	1681	25.9
2	4	10,890	12	144	302.5	22	484	90	32	1024	42.5	42	1764	24.7
3	9	4,860	13	169	257.8	23	529	82.3	33	1089	40	43	1849	23.6
4	16	2,722.5	14	196	222.2	24	576	75.6	34	1156	37.2	44	1936	22.5
5	25	1,742.4	15	225	193.6	25	625	69.7	35	1225	35.6	45	2025	21.5
6	36	1,215	16	256	170.2	26	676	64.4	36	1296	33.6	46	2116	20.6
7	49	864	17	289	150.7	27	729	59.8	37	1369	31.8	47	2209	19.7
8	64	680.2	18	324	134.5	28	784	55.6	38	1444	30.2	48	2304	18.9
9	81	538.2	19	361	120.7	29	841	51.8	39	1521	28.6	49	2401	18.1

Distance (ft)	Area sq ft/unit	Density units/acre	Distance (ft)	Area sq ft/unit	Density units/acre	Distance (ft)	Area sq ft/unit	Density units/acre	Distance (ft)	Area sq ft/unit	Density units/acre	Distance (ft)	Area sq ft/unit	Density units/acre
50	2500	172.8	60	3600	121.1	70	4900	8.89	80	6400	6.81	90	8100	5.38
51	2601	167.1	61	3721	117.7	71	5041	8.65	81	6561	6.64	91	8281	5.26
52	2704	161.7	62	3844	113.3	72	5184	8.40	82	6724	6.48	92	8464	5.13
53	2809	156.6	63	3969	109.0	73	5329	8.17	83	6889	6.32	93	8649	5.00
54	2916	151.6	64	4096	104.8	74	5476	7.95	84	7056	6.17	94	8836	4.87
55	3025	146.8	65	4225	100.7	75	5625	7.74	85	7225	6.03	95	9025	4.81
56	3136	142.1	66	4356	96.6	76	5776	7.54	86	7396	5.89	96	9216	4.73
57	3249	137.6	67	4489	92.7	77	5929	7.35	87	7569	5.76	97	9409	4.63
58	3364	133.2	68	4624	88.9	78	6084	7.16	88	7744	5.63	98	9604	4.54
59	3481	129.0	69	4761	85.1	79	6241	6.98	89	7921	5.50	99	9801	4.44

Distance (ft)	Area sq ft/unit	Density units/acre	Distance (ft)	Area sq ft/unit	Density units/acre	Distance (ft)	Area sq ft/unit	Density units/acre	Distance (ft)	Area sq ft/unit	Density units/acre	Distance (ft)	Area sq ft/unit	Density units/acre
100	10,000	43.6	110	12,100	36.0	120	14,400	30.1	130	16,900	25.8	140	19,600	22.2
101	10,201	42.7	111	12,321	35.6	121	14,641	29.8	131	17,161	25.5	141	19,881	21.9
102	10,404	41.9	112	12,544	35.2	122	14,884	29.5	132	17,424	25.0	142	20,164	21.6
103	10,609	41.1	113	12,769	34.8	123	15,129	29.2	133	17,689	24.6	143	20,449	21.3
104	10,816	40.3	114	12,996	34.5	124	15,376	28.9	134	17,956	24.3	144	20,736	21.0
105	11,025	39.6	115	13,225	34.2	125	15,625	28.7	135	18,225	24.0	145	21,025	20.7
106	11,236	38.9	116	13,456	33.9	126	15,876	28.4	136	18,496	23.6	146	21,316	20.4
107	11,449	38.2	117	13,689	33.6	127	16,129	28.2	137	18,769	23.3	147	21,609	20.2
108	11,664	37.5	118	13,924	33.3	128	16,384	28.0	138	19,044	23.0	148	21,904	19.9
109	11,881	36.7	119	14,161	33.0	129	16,641	27.7	139	19,321	22.7	149	22,201	19.6

*NOTES: 1 acre = 43,560 sq. ft.
For the purpose of this table the word "unit" means recreation unit such as a campsite, picnic table, boat, user group, or other unit which when spaced together with other units represents a use level or density.

Dis- tance (ft)	Area sq ft/ unit	Density units/ acre	Dis- tance (ft)	Area sq ft/ unit	Density units/ acre	Dis- tance (ft)	Area sq ft/ unit	Density units/ acre	Dis- tance (ft)	Area sq ft/ unit	Density units/ acre	Dis- tance (ft)	Area sq ft/ unit	Density units/ acre
150	27,400	1.54	160	27,600	1.50	170	28,000	1.51	180	27,400	1.44	190	26,200	1.21
151	27,800	1.54	161	27,921	1.68	171	29,241	1.49	181	32,761	1.33	191	36,481	1.19
152	28,100	1.59	162	28,244	1.66	172	29,388	1.57	182	33,124	1.32	192	36,984	1.18
153	28,400	1.59	163	28,369	1.65	173	29,529	1.56	183	33,389	1.30	193	37,289	1.17
154	28,700	1.58	164	28,496	1.62	174	30,276	1.54	184	33,856	1.29	194	37,646	1.16
155	29,000	1.58	165	28,625	1.60	175	30,625	1.52	185	34,225	1.27	195	38,025	1.15
156	29,300	1.59	166	28,756	1.58	176	30,976	1.51	186	34,596	1.26	196	38,416	1.14
157	29,600	1.57	167	28,889	1.56	177	31,329	1.49	187	34,969	1.25	197	38,809	1.13
158	29,900	1.57	168	29,026	1.54	178	31,686	1.47	188	35,346	1.23	198	39,206	1.12
159	30,200	1.57	169	29,164	1.53	179	32,044	1.46	189	35,724	1.22	199	39,604	1.11

Dis- tance (ft)	Area sq ft/ unit	Density units/ acre	Dis- tance (ft)	Area sq ft/ unit	Density units/ acre	Dis- tance (ft)	Area sq ft/ unit	Density units/ acre	Dis- tance (ft)	Area sq ft/ unit	Density units/ acre	Dis- tance (ft)	Area sq ft/ unit	Density units/ acre
200	30,500	1.59	210	30,400	1.59	220	30,400	1.59	230	30,400	1.59	240	30,400	1.59
201	30,800	1.59	211	30,521	1.68	221	30,841	1.60	231	31,361	1.52	241	31,981	1.25
202	31,100	1.60	212	30,644	1.67	222	31,284	1.58	232	31,884	1.51	242	32,604	1.24
203	31,400	1.59	213	30,769	1.66	223	31,709	1.58	233	32,389	1.50	243	33,329	1.23
204	31,700	1.58	214	30,896	1.64	224	32,136	1.57	234	32,886	1.49	244	34,049	1.22
205	32,000	1.57	215	31,026	1.62	225	32,566	1.56	235	33,386	1.48	245	34,766	1.21
206	32,300	1.57	216	31,156	1.60	226	32,996	1.55	236	33,886	1.47	246	35,486	1.20
207	32,600	1.56	217	31,289	1.58	227	33,429	1.54	237	34,389	1.46	247	36,209	1.19
208	32,900	1.56	218	31,426	1.57	228	33,866	1.53	238	34,886	1.45	248	36,926	1.18
209	33,200	1.55	219	31,564	1.55	229	34,304	1.53	239	35,384	1.44	249	37,644	1.17

Dis- tance (ft)	Area sq ft/ unit	Density units/ acre	Dis- tance (ft)	Area sq ft/ unit	Density units/ acre	Dis- tance (ft)	Area sq ft/ unit	Density units/ acre	Dis- tance (ft)	Area sq ft/ unit	Density units/ acre	Dis- tance (ft)	Area sq ft/ unit	Density units/ acre
250	33,600	1.55	260	33,600	1.55	270	33,600	1.55	280	33,600	1.55	290	33,600	1.55
251	33,900	1.54	261	33,721	1.64	271	34,041	1.57	281	34,481	1.56	291	34,921	1.54
252	34,200	1.54	262	33,844	1.63	272	34,484	1.56	282	34,924	1.55	292	35,364	1.53
253	34,500	1.53	263	33,969	1.62	273	34,929	1.55	283	35,369	1.54	293	35,809	1.52
254	34,800	1.53	264	34,096	1.60	274	35,376	1.54	284	35,816	1.53	294	36,249	1.51
255	35,100	1.52	265	34,226	1.58	275	35,826	1.53	285	36,266	1.52	295	36,686	1.50
256	35,400	1.52	266	34,356	1.57	276	36,276	1.52	286	36,716	1.51	296	37,126	1.49
257	35,700	1.51	267	34,489	1.55	277	36,729	1.51	287	37,169	1.50	297	37,569	1.48
258	36,000	1.51	268	34,626	1.54	278	37,186	1.50	288	37,616	1.49	298	38,016	1.47
259	36,300	1.50	269	34,764	1.53	279	37,634	1.49	289	38,064	1.48	299	38,464	1.46

260

Distance (ft)	Area sq ft/unit	Density units/acre	Distance (ft)	Area sq ft/unit	Density units/acre	Distance (ft)	Area sq ft/unit	Density units/acre	Distance (ft)	Area sq ft/unit	Density units/acre
300	122,000	.36	350	122,000	.36	400	180,000	.54	450	202,000	.61
305	122,000	.36	355	122,000	.36	405	180,000	.54	455	202,000	.61
310	122,000	.36	360	122,000	.36	410	180,000	.54	460	202,000	.61
315	122,000	.36	365	122,000	.36	415	180,000	.54	465	202,000	.61
320	122,000	.36	370	122,000	.36	420	180,000	.54	470	202,000	.61
325	122,000	.36	375	122,000	.36	425	180,000	.54	475	202,000	.61
330	122,000	.36	380	122,000	.36	430	180,000	.54	480	202,000	.61
335	122,000	.36	385	122,000	.36	435	180,000	.54	485	202,000	.61
340	122,000	.36	390	122,000	.36	440	180,000	.54	490	202,000	.61
345	122,000	.36	395	122,000	.36	445	180,000	.54	495	202,000	.61

Distance (ft)	Area sq ft/unit	Density units/acre	Distance (ft)	Area sq ft/unit	Density units/acre	Distance (ft)	Area sq ft/unit	Density units/acre	Distance (ft)	Area sq ft/unit	Density units/acre
500	360,000	.12	600	360,000	.12	700	490,000	.16	800	620,000	.21
510	360,000	.12	610	360,000	.12	710	490,000	.16	810	620,000	.21
520	360,000	.12	620	360,000	.12	720	490,000	.16	820	620,000	.21
530	360,000	.12	630	360,000	.12	730	490,000	.16	830	620,000	.21
540	360,000	.12	640	360,000	.12	740	490,000	.16	840	620,000	.21
550	360,000	.12	650	360,000	.12	750	490,000	.16	850	620,000	.21
560	360,000	.12	660	360,000	.12	760	490,000	.16	860	620,000	.21
570	360,000	.12	670	360,000	.12	770	490,000	.16	870	620,000	.21
580	360,000	.12	680	360,000	.12	780	490,000	.16	880	620,000	.21
590	360,000	.12	690	360,000	.12	790	490,000	.16	890	620,000	.21

Distance (ft)	Area sq ft/unit	Density units/acre	Distance (ft)	Area sq ft/unit	Density units/acre	Distance (ft)	Area sq ft/unit	Density units/acre	Distance (ft)	Area sq ft/unit	Density units/acre
1000	1,200,000	.40	1000	1,200,000	.40	1100	1,200,000	.40	1200	1,200,000	.40
1010	1,200,000	.40	1010	1,200,000	.40	1110	1,200,000	.40	1210	1,200,000	.40
1020	1,200,000	.40	1020	1,200,000	.40	1120	1,200,000	.40	1220	1,200,000	.40
1030	1,200,000	.40	1030	1,200,000	.40	1130	1,200,000	.40	1230	1,200,000	.40
1040	1,200,000	.40	1040	1,200,000	.40	1140	1,200,000	.40	1240	1,200,000	.40
1050	1,200,000	.40	1050	1,200,000	.40	1150	1,200,000	.40	1250	1,200,000	.40
1060	1,200,000	.40	1060	1,200,000	.40	1160	1,200,000	.40	1260	1,200,000	.40
1070	1,200,000	.40	1070	1,200,000	.40	1170	1,200,000	.40	1270	1,200,000	.40
1080	1,200,000	.40	1080	1,200,000	.40	1180	1,200,000	.40	1280	1,200,000	.40
1090	1,200,000	.40	1090	1,200,000	.40	1190	1,200,000	.40	1290	1,200,000	.40

1. The data in this table are based on a 10' grid system. The density units are based on the number of units per acre. The area is based on the number of units per acre. The distance is based on the number of units per acre.

In accordance with letter from DAEN-RDC, DAEN-ASI dated 22 July 1977, Subject: Facsimile Catalog Cards for Laboratory Technical Publications, a facsimile catalog card in Library of Congress MARC format is reproduced below.

Urban Research and Development Corporation.
Recreation carrying capacity handbook; methods and techniques for planning, design, and management / by Urban Research and Development Corporation, Bethlehem, Pa. Vicksburg, Miss. : U. S. Waterways Experiment Station ; Springfield, Va. : available from National Technical Information Service, 1980.

iv, 104 p. : ill. ; 27 cm. (Instruction report - U. S. Army Engineer Waterways Experiment Station ; R-80-1)
Prepared for Office, Chief of Engineers, U. S. Army, Washington, D. C., under Contract No. DACW39-78-C-0096.

1. Carrying capacity. 2. Recreation. 3. Recreational facilities. 4. U. S. Corps of Engineers. I. United States Army. Corps of Engineers. II. Series: United States Waterways Experiment Station, Vicksburg, Miss. Instruction report ; R-80-1.
TAY:W81 1978-80-1

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