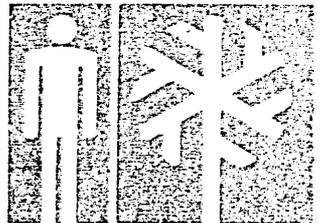


special study - summary
capacity analysis/water management alternatives
april 1978

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GRAND CANYON
SOUTH RIM DEVELOPED AREA



NATIONAL PARK/ARIZONA

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CAPACITY ANALYSIS/WATER MANAGEMENT ALTERNATIVES

Grand Canyon National Park
South Rim Developed Area

4/78

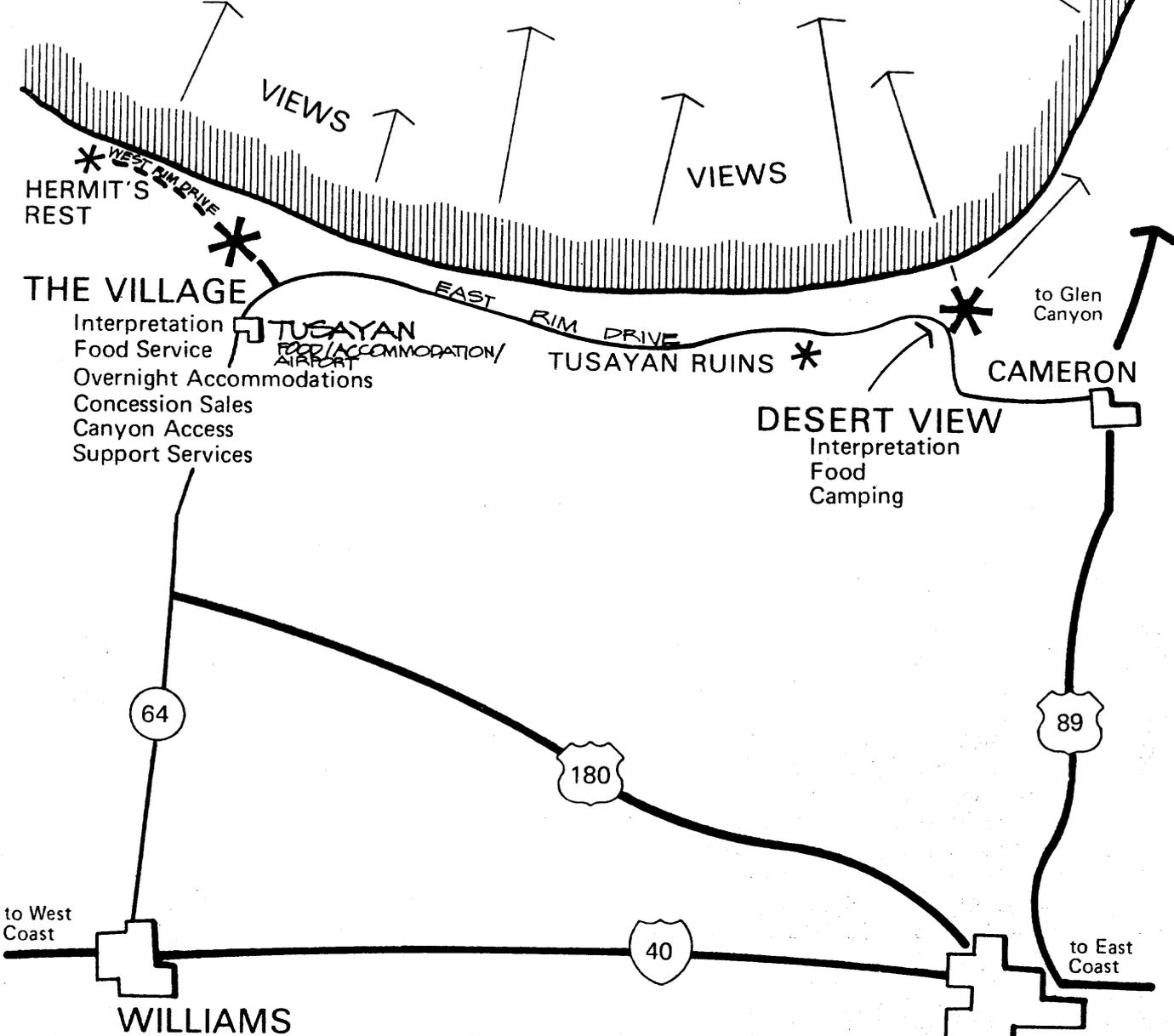
SUMMARY -- RECOMMENDATIONS

The vast and diverse areas of Grand Canyon National Park are seen by a relatively small percentage of visitors. Within the 1.2 - million acre park, approximately 2 percent of the canyon rim is readily accessible to the average visitor. The developed areas consist of the relatively small scale development on the North Rim in the Bright Angel Point area and the more extensive developed area on the South Rim extending from Hermits Rest east to Desert View. The future capacity of this South Rim developed area was the subject of a study during 1977.

Assumptions--The General Management Plan for the park, the Development Concept Plan and Comprehensive Plan for Grand Canyon Village on the South Rim have been approved and offer basic guidelines and assumptions for the capacity study. These documents stated that all visitors who wished to see the Grand Canyon from the South Rim would be accommodated within the present developed area. Overnight accommodations (lodging and camping) in the Village would be limited to present authorized levels; the Desert View campground could be expanded up to a total of

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GRAND CANYON



- THE VILLAGE**
- Interpretation
 - Food Service
 - Overnight Accommodations
 - Concession Sales
 - Canyon Access
 - Support Services
- TUSAYAN**
FOOD/ACCOMMODATION/AIRPORT

- DESERT VIEW**
- Interpretation
 - Food
 - Camping

WILLIAMS
Information / Orientation
Accommodations

FLAGSTAFF
Information / Orientation
Accommodations

South Rim

Grand Canyon Village
Grand Canyon National Park



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150 sites if there is a proven demand. Private vehicle use would be eliminated from the Village and West Rim during the peak visitor use season. Other facilities -- food services, interpretive centers, employee housing, etc. -- would be allowed controlled expansion to meet the needs presented by increasing levels of visitation. These facilities will be developed in accordance with the Comprehensive Plan for Grand Canyon Village and a proposed comprehensive plan for the entire East Rim/Desert View area.

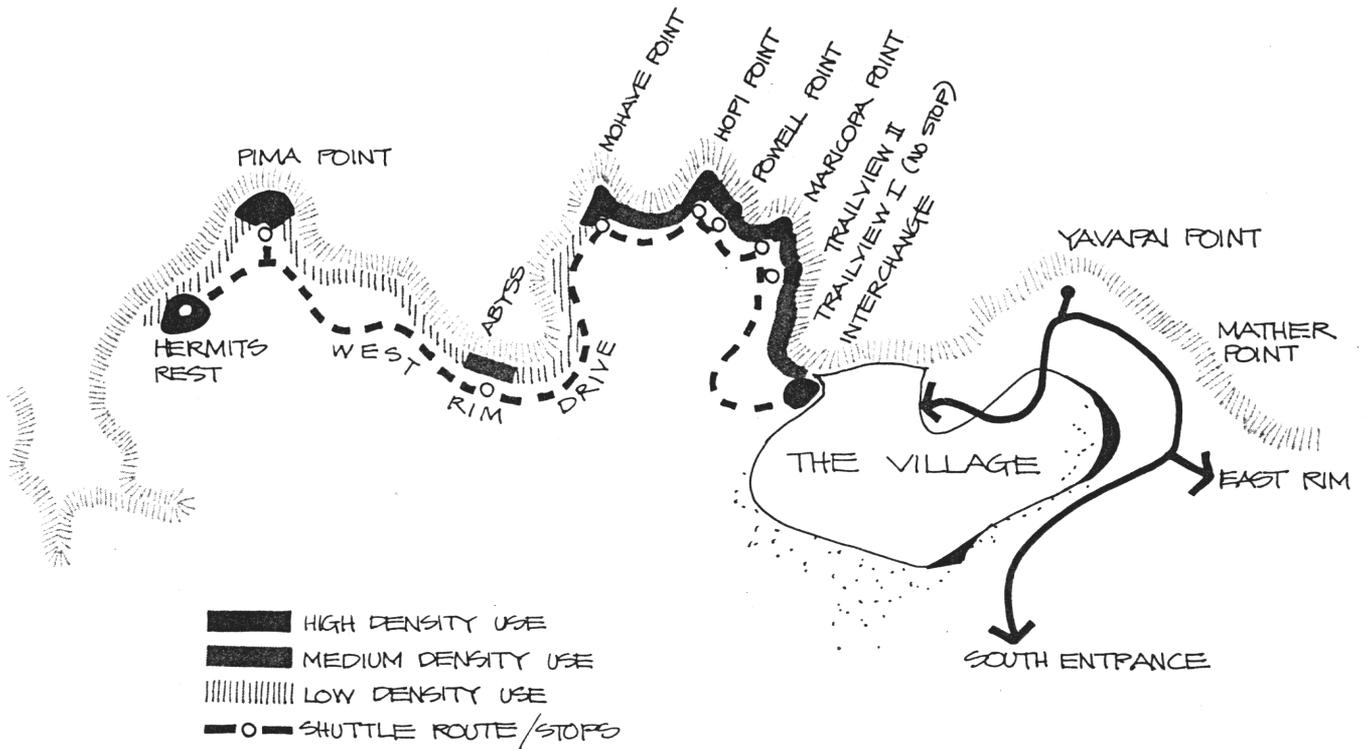
It was recognized that unlimited visitation may not be possible -- water, access, physical space, the quality of the experience, could separately or in combination dictate a maximum capacity for the South Rim. The 1977 study developed theoretical capacities for the South Rim which will be further refined through monitoring and evaluation.

The previously approved plans for Grand Canyon Village call for the elimination of private vehicles within the Village area during the peak visitor use season. The West Rim would continue to be served by the shuttle system and the Village shuttle system would be expanded to serve a central parking/reception center where day-visitors to the West Rim/Village would leave their cars. The implementation of this concept is a key element in the future capacity and quality of the visitor experience in this area of the park. Under this concept, visitation (based upon capacity) to the West Rim/Village area would be regulated by the phased, incremental construction of a central parking facility. When this facility is full, visitors would be directed to the East Rim Drive -- a change from present visitor use patterns which could significantly increase visitation to the East Rim.

The following sections (1) summarize the main elements of the Capacity Analysis/Water Management Alternatives study for the South Rim Developed Area of the park, (2) present an outline water management plan, and (3) make recommendations for further actions to assure an orderly progression towards implementation of the various concepts.

West Rim/Village Capacity

The physical capacity of the presently developed rim areas from Mather Point to Hermits Rest is substantial -- approximately 200,000 people per day could view the canyon from a point on the rim if they could get there. The capacity of the existing and proposed facilities (interpretive centers, restaurants, etc.) is also substantial. At any single moment, nearly 19,000 people could be in the various facilities and at the major viewpoints along the rim. Additional visitors would be in the less developed areas and on the transit systems.



SHUTTLE STOPS	INFO-EXHIBIT	TALKS*	WATER	FOOD	TOILET	BIKE RENTAL	MAXIMUM CAPACITY	FEATURE**
INTERCHANGE	■						NO SET LIMIT	START OF WEST RIM SHUTTLE - CONNECTS WITH VILLAGE SHUTTLE
TRAILVIEW II		■					80-100	BRIGHT ANGEL TRAIL - VILLAGE VIEW
MARICOPA POINT		■		■	■		900-1000	THE BATTLESHIP FORMATION
POWELL MEMORIAL	■			■			200	TWO MEMORIALS
HOPI POINT		■					600	SUNSET - CLOSEST POINT TO NORTH RIM
MOHAVE POINT		■					800-900	RAPIDS
ABYSS							100	VERTICAL DROP - GREAT MOHAVE WALL
PIMA POINT	■						250+	RIVER RAPIDS - TONTO PLATEAU
HERMIT'S REST			■	■	■	■	200-300+	WATER - TOILETS - FOOD - CURIOS - ARCHITECTURE - TRAILHEAD

* Location of scheduled talks may vary

** Feature presently emphasized

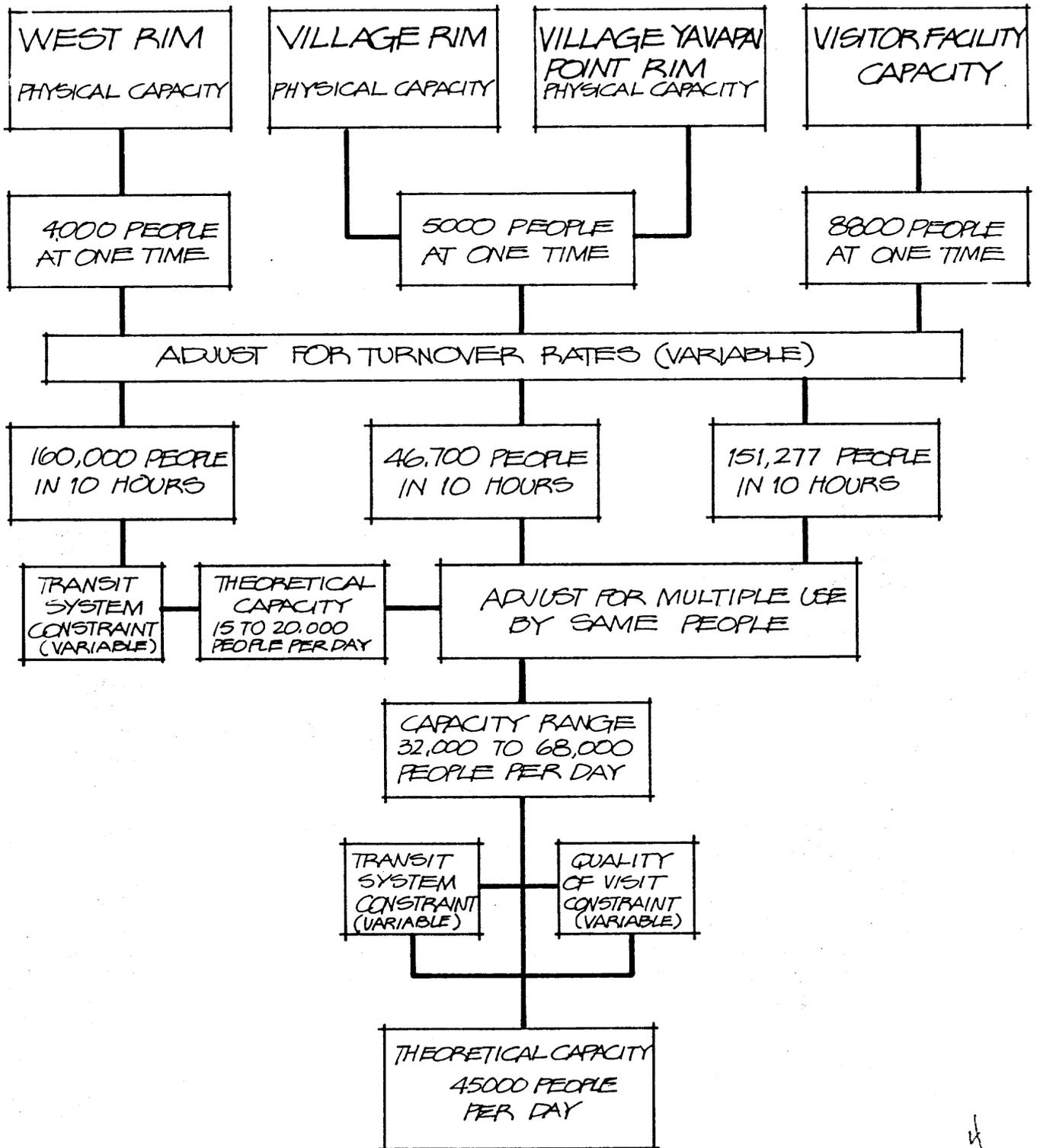
EXISTING CONDITIONS

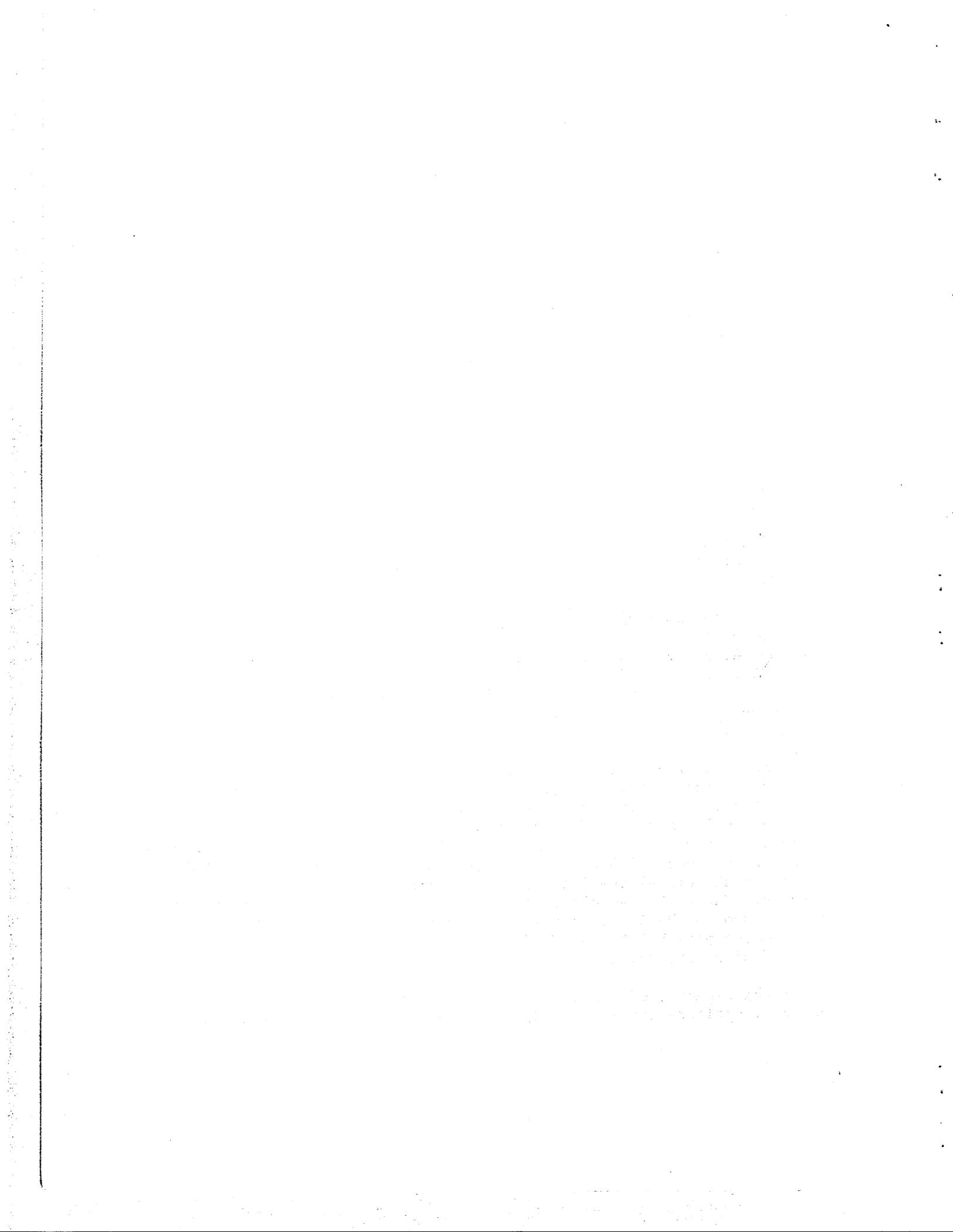
WEST RIM DRIVE
 GRAND CANYON VILLAGE/ARIZONA
 UNITED STATES DEPARTMENT OF THE INTERIOR/
 NATIONAL PARK SERVICE

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FLOW DIAGRAM WEST RIM / VILLAGE - CAPACITY ANALYSIS





In theory, over 350,000 "visits" to the rim and facilities could occur over a ten-hour period. By adjusting the single moment capacity for a typical visitor experience -- one where the visitor spends from four to seven hours at various points on the rim, in the gift shops, restaurants and interpretive centers -- the daily capacity drops to a range of 32-68,000 visitors/day depending upon the use pattern and turnover rate selected.

Two other main factors enter into the capacity calculations: the quality of the visitor experience and the capability of the transit systems to deliver the visitors to their destinations. The capacity figures were adjusted to assure that a visitor would have the opportunity to get away from the crowds -- but, the popular viewpoints and some facilities would be crowded at various times during the day. When the central parking/reception center is in operation, the visitors will be able to plan their visit based upon time available and their particular interests. It is intended that this trip planning assistance will help the visitor avoid crowds and have a rewarding experience. (It should be noted that visitors surveyed in 1977 complained about parking problems, food service and other annoyances but, they did not allow these problems to detract from their overall appreciation and enjoyment of the Grand Canyon.)

The Village and West Rim shuttle systems were evaluated for the potential to expand to serve the maximum number of visitors. Until the central parking concept is implemented and the Village is free of private vehicles, a high capacity transit system cannot be placed in operation and a true capacity determination cannot be made. Based on ideal operating conditions, the transit systems still become the limiting factor in the capacity of the West Rim/Village area.

With the constraints of the transit system governing, the theoretical capacity of the West Rim/Village area is 35-45,000 visitors per day, of which approximately 5,000 would be overnight visitors. The West Rim shuttle system would carry 15-20,000 visitors daily with the balance of the visitors spending their time in the Village area. It was estimated that an additional 10-15,000 visitors per day could be accommodated if all systems are operating efficiently but, the quality of the visit would undoubtedly suffer.

The study calls for future evaluation of visitor use patterns after the central parking/reception center concept has been implemented. Through evaluation and experimentation with various ways to reduce congestion and improve the quality of the visitor experience, the theoretical capacity can then be reevaluated.

East Rim Capacity

The entire East Rim was studied to determine the capacity of existing developed areas, the potential for their expansion, and the potential for the development of new areas and/or experiences which would allow maximum levels of use. Traffic counts and visual observations were used to evaluate existing visitor use patterns. Based on present use patterns, the present capacity of the East Rim is approximately 52,000 visitors per day (approximately 3½ times current peak use levels). However, occasional overcrowding occurs at Grandview Point and Tusayan Ruins and consistent overcrowding occurs at Desert View. Developing existing and potential viewpoints and other features to their maximum would increase the capacity of the East Rim to approximately 198,000 visitors per day.

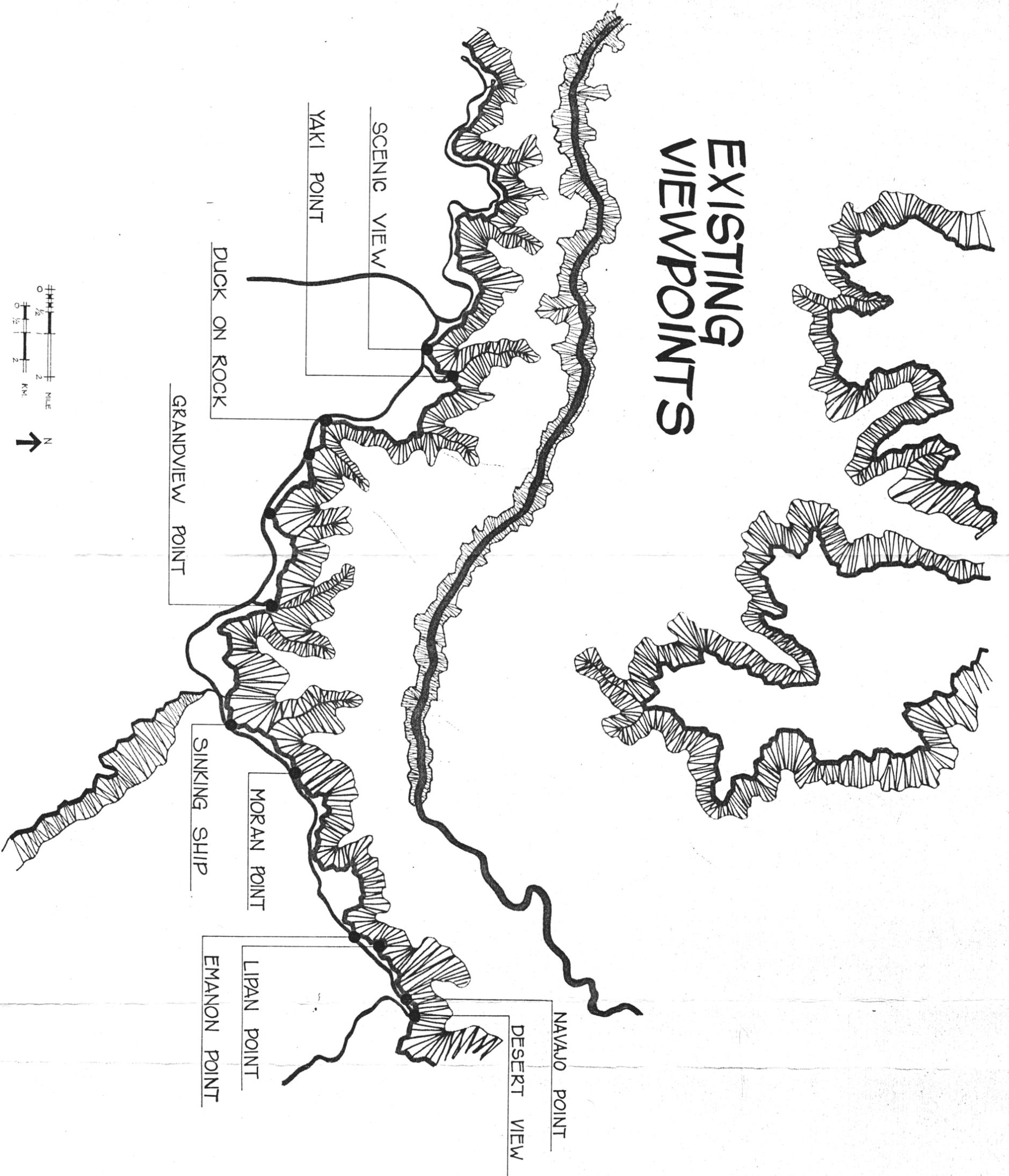
Two basic alternatives were explored to guide future use on the East Rim. Alternative I would accommodate as many visitors as possible by maximizing the capacity of developed areas. Alternative II stresses information and interpretive services providing visitors an opportunity to plan their visit based on personal interests, objectives and time constraints -- similar to the concepts for visitors to the West Rim/Village area. Alternative II would include the development of new areas to take advantage of the diverse natural and cultural resources of which many visitors are unaware.

The study recommends that a Comprehensive Plan for the entire East Rim be developed along with an Interpretive Plan for the entire South Rim Developed Area. Such a plan would address the mounting problems at Desert View and give direction to future visitor use along the East Rim Drive. The plan would combine elements of the two basic alternatives to provide for both high visitation capacity and varied, quality experiences.

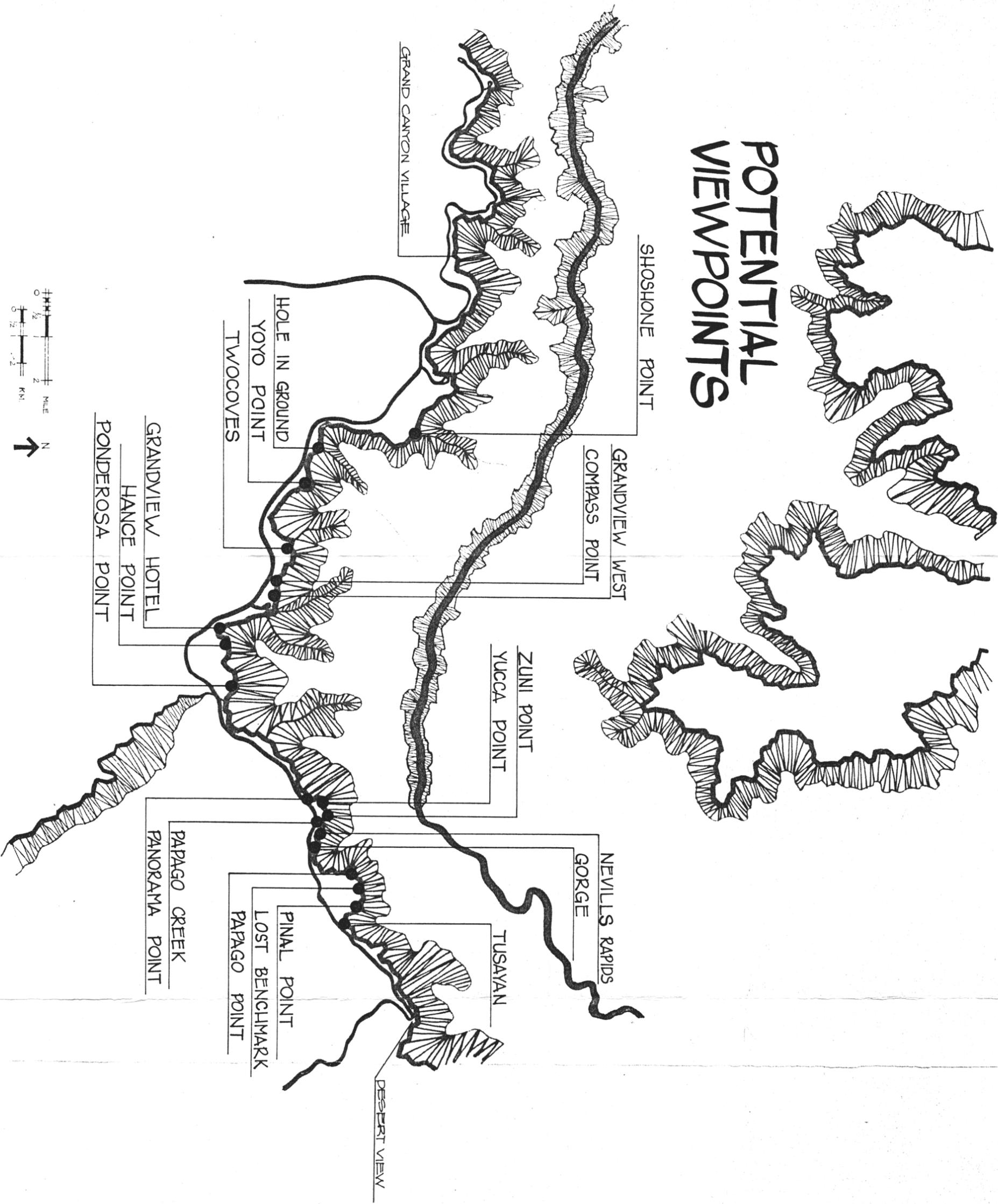
The capacity of the East Rim is not limited by the physical capacity of the rim. The East Rim Drive -- a relatively slow, two-lane road -- becomes the limiting factors. While some modifications to the present alignment would improve safety and could possibly increase capacity, the basic alignment and road standard limits capacity to approximately 1,250 cars per hour (625 in each direction). Approximately 40-50,000 visitors could travel the drive in a ten-hour day based on present use patterns. Under the two alternatives explored, the daily capacity was the same due to the limiting road capacity; however, Alternative I explores the possibility of an additional 10,000 visitors daily at the western end of the drive in the Yaki-Shoshone Points area.

The actual capacity of the East Rim Drive is complicated by the fact that many visitors drive part way or all of the way along the drive

EXISTING VIEWPOINTS



POTENTIAL VIEWPOINTS



and then return. If all visitors did this, the drive capacity would be reduced by 50 percent. Accurate figures on the percentage of visitors turning around at some point on the drive could not be derived from the traffic counts. The study assumed a conservative figure of 20 percent turn-around, reducing the theoretical daily capacity to approximately 32-40,000 visitors.

South Rim Capacity

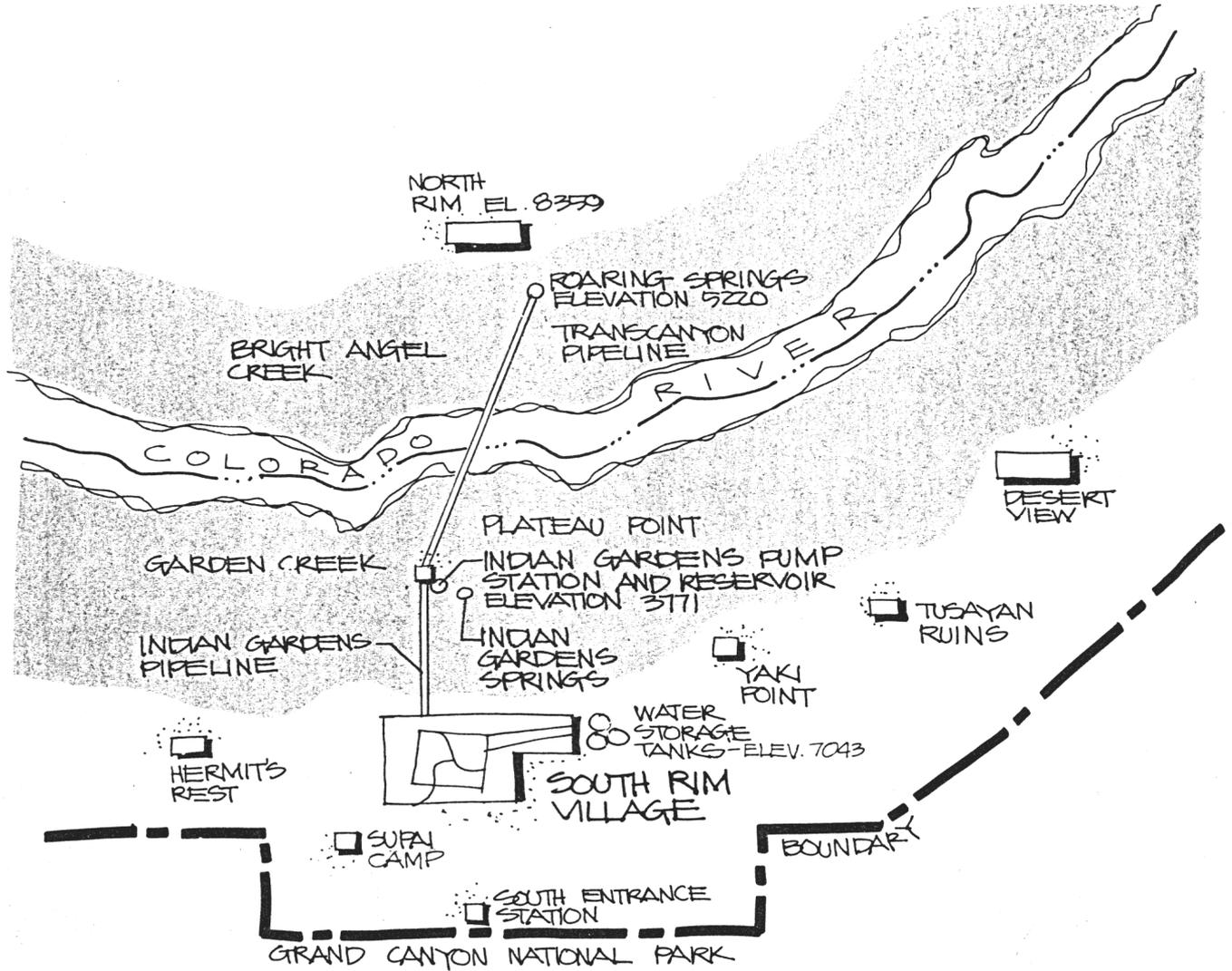
The theoretical capacity of the South Rim is between 67,000 and 85,000 visitors daily, depending upon the average length of stay and other visitor use patterns. It should be anticipated that the daily capacity would go down as the quality of the experience improves. It might be possible to accommodate an additional 25,000 on a peak day, but, the quality of the experience would be expected to suffer.

Environmental Impacts

A formal environmental assessment was not prepared as a part of the study since no physical actions requiring NEPA compliance are proposed. The study presents a program which may lead to future actions requiring NEPA compliance. Some of the possible future actions have been covered in previous documents and, throughout the study, environmental affects were a basic consideration in assessing the capacity of the South Rim. In the presently developed areas, most of the trails, overlooks, and other facilities were developed many years ago. There is a need for improvements to retain visitors on designated trails in the heavy use areas and to upgrade facilities to meet existing use patterns. With these improvements, impacts on surrounding areas should be reduced even with increased levels of visitation. Should new areas be developed along the East Rim, environmentally sensitive areas and cultural sites would be avoided. While additional parking areas, trails and viewpoints would impact areas which presently receive minimal use, the impacts would generally be on or back from the rim and not in the prime resource -- the canyon. As stated in the approved (1975) General Management Plan, the South Rim Developed Area would be designed to accommodate maximum visitation levels with the remainder of the South Rim left undeveloped. Under this concept, additional impacts from increased visitation and subsequent development are recognized as a necessary trade-off to assure preservation of the greater area of the park.

Water Management Alternatives

In relation to the physical capacity studies for the South Rim, it was essential to determine if sufficient water could be made available to serve potential visitation levels. During the peak summer



□ U.S.F.S. RANGER STATION

□ MOQUI LODGE

GRAND CANYON AIRPORT

□ TUSAYAN COMMUNITY

□ TEN-X-CAMPGROUND

SCHEMATIC MAP

GRAND CANYON VILLAGE/ARIZONA
 UNITED STATES DEPARTMENT OF THE INTERIOR/
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visitation months water reserves drop below desired level and, at times, water has been hauled into the park to replenish supplies.

The present water source for the South Rim is Roaring Springs on the north side of the Colorado River. Water is piped by gravity to Indian Gardens where it is then pumped to the South Rim for storage and distribution. The present pumping capacity is less than the capacity of the transcanyon pipelines and less than the daily use rate in the summer. Storage tanks in the Village and at other use points provide equalization storage to make up this deficiency, but, the present storage capacity (13.3 million gallons in the Village) is not adequate to meet demands and provide necessary fire and emergency reserves. In addition, the water distribution system is old and accounts for a considerable annual water loss.

Alternatives studied covered repairs to the pipelines and distribution system, extended use of reclaimed water and other conservation methods, and additional sources or methods to increase water supply ranging from deep wells to an additional or expanded transcanyon pipeline. While a detailed economic and environmental assessment on the hundreds of alternative combinations was not prepared, a majority of the alternatives would obviously be very costly and/or result in significant environmental impacts.

The capacity study indicated a theoretical capacity range of 67-85,000 visitors daily during the peak summer season. For the purposes of formulating a water management plan, an average daily visitation of 70,000 during the peak visitation season has been used. The study emphasizes that the water use rates used in projecting future needs are based on a thorough analysis of available water use records.

Improved record keeping and metering methods are needed to minimize discrepancies to more accurately determine future water needs.

The study concluded that sufficient water can be supplied -- at high cost -- from the existing Roaring Springs source to serve the potential levels of visitation. The following actions would be required to assure an adequate water supply:

Phase I

- Construct 500,000 gallon storage tank in the Village to provide fire reserves to the upper pressure zone (Yavapai Lodge - Mather Center).
- Construct 500,000 gallon storage tank at Desert View.

- Construct an additional 2 million gallons storage in the Village unless distribution system loss can be eliminated almost immediately.
- Extend reclaimed water to all new facilities (Motor Lodge - employee residences, etc.) and increase reclaimed water storage.
- Test transcanyon/Indian Gardens pipelines, repair to withstand residual pressure and begin cyclic maintenance program to increase reliability of the lines.
- Modify or replace pumps to provide 700 GPM (gallons per minute) pumping capacity. (Additional power capacity to Indian Gardens may be required.)
- Extend transcanyon (Indian Gardens) pipeline directly to storage tanks to improve distribution system efficiency and improve circulation within the storage tanks.
- Begin phased replacement of Village distribution system to eliminate loss through leaks, reduce maintenance costs, and improve distribution system efficiency -- if feasible, use old distribution system lines to extend reclaimed water service to areas not presently served.
- Continue installation of water conserving fixtures and enforcement of water conserving practices.
- Improve water metering methods and equipment to validate water use rates used to project future needs.

Phase I would provide water to serve approximately 1.3 million overnight and 3.5 million day-visitors. The summer months could remain critical until additional storage is constructed, the major distribution system leaks have been eliminated, and the use of reclaimed water is significantly expanded.

Phase II

- Continue replacement of Village distribution system and extension of reclaimed water to older facilities.
- Construct additional storage in Village based on demand projections.
- Extend water line to Desert View and repair/replace existing line unless future studies prove that hauling water remains the most practical approach and will not cause significant inconvenience to visitors. (This could be moved to Phase I to reduce demand on the Village storage system and/or to reduce eventual cost.)

- Construct additional storage at Desert View and other locations if future studies indicate a need.

Upon completion of Phase II the water system would be able to serve an annual visitation level of over 23 million if visitation were spread evenly throughout the year.

The following table illustrates a theoretical supply and demand summary at a point-in-time when visitation approaches an average of 70,000 day-visitors/day during the peak summer season. The table assumes an increase in off-season visitation as predicted in previous studies. The Base Demand includes an overnight visitation of 1.3 million annually and also assumes an increase in resident population and the development of facilities has coincided with increased visitation.

ANNUAL SUPPLY/DEMAND SUMMARY WITH VISITATION APPROACHING THEORETICAL CAPACITY DURING PEAK VISITATION SEASON							
Bi-Monthly Period (number of days)	Feb-Mar (59)	Apr-May (61)	June-July (61)	Aug-Sept (61)	Oct-Nov (61)	Dec-Jan (62)	Annual
% of Annual Day Visitors	.05	.20	.33	.28	.06	.08	100%
Average Day-Visitors/Day	11,017	42,623	70,328	59,672	12,787	16,774	13,000,000
Supply in Millions of Gallons Adjusted for Pumping Efficiency	53.53	55.34	53.25	49.62	55.34	56.25	323.33
BASE DEMAND--overnight + residents + other facil.	16.32	24.26	37.22	40.18	19.68	28.52	166.18
DAY-VISITOR DEMAND @6.5 gallons	4.23	16.90	27.89	23.66	5.07	6.76	84.51
TOTAL DEMAND	20.55	41.16	65.11	63.84	24.75	35.28	250.69
SUPPLY less DEMAND (neg. no. indicates water from storage)	32.98	14.18	-11.86	-14.22	30.59	20.97	72.64
Replaced in Storage					26.08		26.08
Unpumped	32.98	14.18	-0-	-0-	4.51	20.97	72.64
REQUIRED STORAGE:	10.0 million gallons fire and emergency reserves						
	+27.0 equalization storage (rounded up)						
	37.0 million gallons						
	-13.3 existing storage						
ADDITIONAL STORAGE REQUIRED	23.7 million gallons						

The preceding table illustrates that the South Rim would be approaching capacity during the peak summer visitation period and that "unpumped" water (72.64 million gallons) could be available to serve an additional 11 million day-visitors if they come in the off-season. (The exact number of visitors served would depend upon the ratio of day and over-night visitor increases.)

The preceding water management plan was selected after considering the economic and environmental consequences of the various alternatives and the trade-offs associated with them. The plan would require construction of a massive water storage tank farm in the vicinity of the Grand Canyon Village as opposed to the construction of additional or expanded water lines within the Grand Canyon -- an environmental trade-off which appears more acceptable. The plan is only an outline. A detailed engineering study will be needed to determine the costs and the proper phasing of the various elements.

It should be noted that, when the Village is at capacity, all additional visitors will be directed to the East Rim Drive. The capacity analysis indicates the need for a comprehensive plan for the East Rim and Desert View. Until such a plan is completed, the water needs for day-visitors along the East Rim are projected at 6.5 gallons per visitor. If water is available at more places and especially if additional food services are provided, the rate of water consumption will increase, requiring additional storage capacity and reducing the total visitation which could be accommodated. In addition, the storage requirements provide 10 million gallons reserve for fire protection and emergencies in the Village -- roughly a ten day supply. If use rates prove to be higher or a longer reserve supply is needed, additional storage capacity will be needed.

RECOMMENDATIONS

The following programming actions are recommended to provide for present and future visitors to the South Rim of Grand Canyon National Park.

- Implement the comprehensive Plan for Grand Canyon Village--with emphasis on development of the central parking/reception center facility and the vehicle-free Village.
- Schedule/complete an Interpretive Plan for the entire South Rim recognizing the distinct differences between the future visitor experiences on the East Rim and in the West Rim/Village areas.
- Schedule/complete archeological and cultural resources studies for the East Rim.
- Schedule/complete a Comprehensive Plan for the East Rim/Desert View area.
- Develop/implement programs to monitor and evaluate visitor use patterns on the entire South Rim following implementation of the central parking/reception center concept.
- Program/complete detailed engineering studies for the Water Management Plan.
- As part of the above studies, determine costs, facilities, staffing, and other needs to implement the various projects and services.

THESE RECOMMENDATIONS WERE APPROVED BY THE REGIONAL DIRECTOR, WESTERN REGION, ON FEBRUARY 7, 1978.

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