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Appendix of the Draft Environmental Impact Statement for Tusayan Growth

Kaibab National Forest

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APPENDIX
of
DRAFT ENVIRONMENTAL IMPACT STATEMENT
for
Tusayan Growth
Coconino County, Arizona

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Introduction

This appendix includes three documents that are referenced throughout the Draft Environmental Impact Statement for Tusayan Growth. They are:

The “Assessment of Hydrogeologic Conditions and Potential Effects of Proposed Groundwater Withdrawal for Canyon Forest Village, Coconino County, AZ” was produced by Errol L. Montgomery and Associates, Inc., Consultants in Hydrogeology. This document provides the results of the hydrogeological study that was conducted for this analysis.

The “Tusayan Area Plan”, which was adopted by the Coconino County Board of Supervisors in June 1995, outlines policy and direction for future development in the Tusayan area.

The “Tusayan Growth Environmental Impact Statement Economic Analysis” was prepared by Young Nichols Gilstrap, Inc. and Warnick & Company and provides an overview of the existing and projected future socioeconomic condition of the areas affected by this analysis. It also presents a study of the potential socioeconomic impacts of the alternatives presented in the Draft Environmental Impact Statement.

HYDROGEOLOGIC STUDY

July 5, 1996
REPORT

ASSESSMENT OF HYDROGEOLOGIC CONDITIONS AND POTENTIAL EFFECTS OF PROPOSED GROUNDWATER WITHDRAWAL FOR CANYON FOREST VILLAGE COCONINO COUNTY, ARIZONA

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July 5, 1996
REPORT

ASSESSMENT OF HYDROGEOLOGIC CONDITIONS AND POTENTIAL EFFECTS OF PROPOSED GROUNDWATER WITHDRAWAL FOR CANYON FOREST VILLAGE COCONINO COUNTY, ARIZONA

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ASSESSMENT OF HYDROGEOLOGIC CONDITIONS AND POTENTIAL EFFECTS OF PROPOSED GROUNDWATER WITHDRAWAL FOR CANYON FOREST VILLAGE COCONINO COUNTY, ARIZONA

EXECUTIVE SUMMARY

This report gives results of a hydrogeologic investigation and computer-based groundwater flow modeling for a proposed development near Tusayan, Arizona. Groundwater has been selected as the principal source of water for the proposed development; therefore, one or more deep wells would be constructed to yield groundwater from the Redwall-Muav aquifer. The chief purpose of this investigation was to characterize groundwater conditions on the Coconino Plateau and to project the potential effects of groundwater withdrawal for the proposed development on the discharge from springs along the south rim of the Grand Canyon. A pumping rate of 300 gallons per minute (gpm) was assumed for the proposed development for the modeling investigation.

The model was designed to simulate groundwater conditions in the Redwall-Muav aquifer in the Coconino Plateau groundwater sub-basin. A conceptual model for the groundwater flow system in the sub-basin was developed based on review of previous hydrogeologic investigations and on field observations and work conducted for this investigation by experts in the hydrogeology of the Grand Canyon area. To project potential changes in the discharge from springs resulting from groundwater withdrawals, a groundwater flow model of the sub-basin was constructed using MODFLOW, which is a computer-based, finite-difference, numerical groundwater flow modeling

program developed by the U.S. Geological Survey (USGS) (McDonald and Harbaugh, 1988).

The Redwall-Muav aquifer is the only aquifer of regional extent that is capable of consistently yielding large quantities of groundwater to wells and springs in the model area. The model area extends over the Coconino Plateau groundwater sub-basin for the Redwall-Muav aquifer. This sub-basin is bounded on the north by the Grand Canyon, on the east and south by a groundwater divide, and on the west by the Toroweap and Aubrey Fault systems.

Groundwater enters the Redwall-Muav aquifer chiefly from downward conduit flow via vertical fractures in overlying strata. After groundwater enters the saturated zone in the Redwall-Muav aquifer, lateral groundwater movement is believed to occur chiefly via fracture and solution openings that are concentrated along principal structural features. Conduits with large storage capacity and transmissivity are believed to have developed in response to the hydraulic gradient towards Havasu Canyon. Nearly all groundwater in the regional Redwall-Muav aquifer in the sub-basin converges toward and discharges at Havasu Spring, which is located where a fault in the trough of the Havasu downwarp intersects Havasu Canyon. About 98 percent or 29,000 gpm of reported groundwater discharge from the Redwall-Muav aquifer in the sub-basin occurs at Havasu Spring; about 1 percent or 300 gpm discharges at Hermit Spring; about 1 percent or 300 gpm discharges at Indian Garden Spring; and less than 1 percent discharges at several small springs and seeps.

Discharge from other springs in the Redwall-Muav Limestone along the south wall of the Grand Canyon in the groundwater sub-basin is small and is believed to result chiefly from infiltration of precipitation in local drainage basins along the rim of the Grand Canyon. The sources of these other springs are believed to be poorly connected or unconnected to the regional Redwall-Muav aquifer system.

Groundwater is being withdrawn from the Redwall-Muav aquifer at two wells in the vicinity of Tusayan, Arizona, one well at the Canyon Mine site near Tusayan, and at two wells in the vicinity of Valle, Arizona. Groundwater withdrawal is also planned to occur from a well constructed recently in the Redwall-Muav aquifer near Supai, Arizona. Prior to 1989, when the first public water supply well in Tusayan to penetrate the Redwall-Muav aquifer was constructed, the groundwater flow system in the Redwall-Muav aquifer in the Coconino Plateau sub-basin was considered to be in dynamic equilibrium (steady-state). Under steady-state conditions, average rate of groundwater discharge at the springs was equal to average rate of recharge to the aquifer. However, present and proposed pumping from the Redwall-Muav aquifer will alter this equilibrium. Under conditions of short-term pumping from a well, pumped groundwater would be derived from storage in the aquifer near the well, and little or no reduction of discharge would occur at distant springs. Under conditions of long-term pumping, groundwater would be drawn from more distant parts of the aquifer, particularly along and adjacent to fracture and solution features. Long-term pumping would progressively intercept groundwater that, in the absence of pumping, would have discharged at selected springs. If pumping would continue for a sufficiently long period, a new condition of dynamic equilibrium would be established where average rate of groundwater discharge at the springs would be equal to the average rate of recharge minus the average rate of groundwater pumping at the wells, and groundwater levels would slowly re-stabilize in the aquifer.

To simulate equilibrium or steady-state aquifer conditions, the groundwater flow model was calibrated to geologic structural features, reported groundwater levels at existing wells, and reported discharge from Havasu, Indian Garden, and Hermit Springs. The model was calibrated for steady-state conditions by adjusting distribution of recharge and transmissivity in the model, within reasonable ranges, until simulated discharge from springs and patterns of groundwater levels were similar to measured or estimated pre-pumping values. Transient conditions were then simulated to project potential effects of groundwater withdrawal at selected durations, locations, and pumping rates. The transient conditions were simulated by: 1) using the equilibrium conditions computed from the calibrated steady-state flow model as the initial conditions; 2) applying pumping stresses to the model at selected locations and pumping rates; and 3) computing the drawdown in groundwater levels and decrease in discharge from springs after 5, 50, and 100 years of pumping. Sensitivity analyses were conducted to evaluate the effects of varying model input parameters on steady-state and transient model results.

Important pathways for transmission of groundwater may occur between some of the major structural features in the model area that do not appear to be connected based analysis of visible features at land surface. Therefore, model simulations were conducted with four different configurations of fault interconnections to investigate the potential occurrence of such hidden pathways. Input parameters for each of these simulations were adjusted as necessary to achieve acceptable agreement between simulated and measured pre-pumping groundwater levels and discharge from springs. The simulated configuration of fault interconnections that best represents the conceptual model for groundwater movement in the model area is referred to herein as the "base case." The simulations for the other three configurations of fault interconnections are referred to herein as "alternate calibrations."

Results from more than 100 steady-state simulations, which were conducted to analyze various configurations of model input parameters to achieve acceptable calibration of the base case and alternate calibrations, indicate the following:

1. Computer-based numerical modeling using MODFLOW adequately simulates existing steady-state groundwater movement in the Redwall-Muav aquifer on the portion of the Coconino Plateau where groundwater originating as recharge from infiltration of precipitation is believed to discharge eventually at Havasu, Hermit, and Indian Garden Springs.

2. Although data for groundwater level and transmissivity data for the Redwall-Muav aquifer are not abundant in the sub-basin, available data, especially discharge data for springs, are sufficient to develop a groundwater flow model that is in acceptable agreement with the conceptual model for groundwater flow in the sub-basin.

3. A large-transmissivity conduit through much of the model area along the Havasu downwarp, together with a network of medium-transmissivity zones along principal faults, are required to transmit large volumes of groundwater to Havasu Spring, which discharges about 29,000 gpm, and to

drain the regional aquifer system so that simulated groundwater level altitudes are in acceptable agreement with measured groundwater levels in the model area.

4. The base case simulation conforms closely to the conceptual model, and results are in acceptable agreement with measured groundwater levels and rates of discharge from springs in the model area. Simulated groundwater levels resulting from alternate calibration no. 2 are in better agreement with measured groundwater levels; however, alternate calibration no. 2 is in poor agreement with the conceptual model.

Potential effects of groundwater withdrawal were projected for two areas considered to be favorable for groundwater development from the Redwall-Muav aquifer for Canyon Forest Village, Inc.: 1) the Airport Graben at Tusayan; and 2) the vicinity of Valle, Arizona. Canyon Forest Village, Inc., has selected the Valle site for development of a groundwater supply because the groundwater modeling investigation indicates that projected decrease in discharge from springs is substantially smaller for the Valle site than for the Airport Graben site.

Potential effects on discharge from springs were projected for different pumping regimens by varying location, pumping duration, and pumping rate for the pumped well. Results indicate that projected decreases in the discharge from Indian Garden and Hermit Springs are substantially larger for a pumping center at the Airport Graben than for a pumping center at Valle. Projected decrease in the discharge from Havasu Spring is slightly larger for a pumping center at Valle than for a pumping center at the Airport Graben; however, for a pumping rate of 300 gpm, both decreases are very small. For a pumping rate of 300 gpm, projected decreases in the discharge from each spring for a pumping center at Valle are small, are less than the typical accuracy associated with streamflow measurements, and are believed to be less than the natural variability in discharge rate from the three springs. Consequently, the projected effects for a pumping center at Valle are sufficiently small that it may be difficult to distinguish decreases in the discharge from springs due to the pumping from apparent decreases due to common error of streamflow measurements or actual decreases due to natural variability in discharge rate.

The relation between pumping rate and projected decrease in discharge from springs is linear for all springs and both simulated pumping centers. Therefore, effects on discharge from springs for pumping at rates other than 300 gpm at either of the simulated pumping centers can be projected easily. For example, doubling the simulated pumping rate from 200 gpm to 400 gpm would double the projected decrease in discharge from springs for the same pumping duration and well location.

Due to the limited available data for selected hydrogeologic parameters and the regional scale of the groundwater flow model, projections of effects on discharge springs are considered approximate, and likely are only accurate for Havasu, Hermit, and Indian Garden Springs, which discharge large quantities of groundwater and are known to be in good hydraulic connection with the regional Redwall-Muav aquifer. Therefore, the groundwater flow model was not used to quantify projected effects of pumping on the many small springs in the model area. However, hydrogeologic data and general conclusions from the modeling investigations can be used to estimate reasonable and worst-case effects of pumping on these smaller springs. Small amounts of groundwater that issue from the Redwall-Muav aquifer at other seeps and small springs along the south wall of the Grand Canyon are believed to result from recharge in local drainage basins along the canyon rim; these seeps and small springs likely neither influence nor are influenced by regional patterns of groundwater movement and pumping in the Redwall-Muav aquifer. Perched aquifers are the sources for springs and seeps that issue from formations overlying the Redwall-Muav aquifer in the Coconino Plateau groundwater subbasin. These perched aquifers and associated springs and seeps are not in hydraulic connection with the Redwall-Muav aquifer, and are not influenced by groundwater levels or movement in the Redwall-Muav aquifer. Therefore, pumping from wells completed solely in the Redwall-Muav aquifer can not influence discharge from springs that issue from overlying formations.

The Bright Angel Shale strongly retards movement of groundwater between the Redwall-Muav aquifer and the underlying Tapeats Sandstone and Precambrian rocks. However, the Bright Angel Shale, Tapeats Sandstone, and Precambrian rocks are saturated and discharge small quantities of groundwater to seeps and springs in the Coconino Plateau groundwater sub-basin, suggesting that small amounts of groundwater move slowly downward through the Bright Angel Shale. Drawdown of groundwater level in the Redwall-Muav aquifer resulting from pumping a well or well field would slightly reduce the downward vertical hydraulic gradient through the Bright Angel Shale and, therefore, might have a small effect on groundwater flow in underlying formations. However, because the springs that issue from the Bright Angel Shale, Tapeats Sandstone, and Precambrian rocks are in poor hydraulic connection with the Redwall-Muav aquifer, effects on these springs from pumping in the Redwall-Muav aquifer would likely be much smaller than effects on springs that issue from the Redwall-Muav aquifer. Therefore, pumping from wells in the Redwall-Muav aquifer is not expected to have a substantial effect on springs that issue from underlying formations.

Following are the salient conclusions regarding results of transient flow model sensitivity analyses and alternate calibrations:

1. Despite large variations in model input parameters for the sensitivity analyses and alternate calibrations, the range of projected decreases in discharge from springs resulting from pumping a well at 300 gpm for 50 years, for either the Airport Graben site or the Valle site, is relatively small. If the well would be located at the Airport Graben site, the projected decrease in discharge from springs is in the range from about 2 to 25 percent of pre-pumping discharge for Hermit and Indian Garden Spring, and is less than 1 percent of pre-pumping discharge for Havasu Spring. If the well would be located at the Valle site, the projected decrease in discharge from springs is in the range from about 1 to 4 percent of pre-pumping discharge for Hermit and Indian Garden Springs, and less than 1 percent of pre-pumping discharge for Havasu Spring.

2. The groundwater flow model is most sensitive to changes in transmissivity for grid cells representing unfractured matrix rocks and for grid cells representing the Havasu downwarp and the Markham Dam fracture zone. The groundwater flow model is least sensitive to changes in transmissivity for grid cells representing fault zones, changes in storage coefficient, and changes in recharge distribution.

3. With two notable exceptions, hydraulic heads resulting from the base case steady-state simulation are in better agreement with the calibration targets than are hydraulic heads resulting from the sensitivity analyses and alternate calibrations. The exceptions are alternate calibration no. 2 and the adjusted sensitivity analysis simulation with increased transmissivity for grid cells that represent the Havasu downwarp and the Markham Dam fracture zone. For each of these exceptions, however, the improved match between simulated and measured groundwater levels at the calibration targets is negated by larger calibration error in discharge from springs and poor agreement with the conceptual model for groundwater flow in the region.

July 5, 1996
REPORT

ASSESSMENT OF GROUNDWATER CONDITIONS AND POTENTIAL EFFECTS OF PROPOSED GROUNDWATER WITHDRAWAL FOR CANYON FOREST VILLAGE COCONINO COUNTY, ARIZONA

INTRODUCTION

This report gives results of a hydrogeologic investigation and computer-based groundwater flow modeling conducted on the behalf of Canyon Forest Village, Inc., for a proposed development near Tusayan, Arizona. Groundwater has been selected as the principal source of water for the proposed development; therefore, one or more deep wells would be constructed to yield groundwater from the Redwall-Muav aquifer. The chief purpose of this investigation was to characterize groundwater conditions on the Coconino Plateau and to project the potential effects of groundwater withdrawal for the proposed development on the discharge from springs along the south rim of the Grand Canyon. The model area for this investigation is shown on **Figure 1**, and was designed to simulate groundwater conditions in the Redwall-Muav aquifer in the Coconino Plateau groundwater sub-basin.

Potential effects of groundwater withdrawal were projected for two areas considered to be favorable for groundwater development from the Redwall-Muav aquifer for Canyon Forest Village, Inc.: 1) the Airport Graben at Tusayan; and 2) the vicinity of Valle, Arizona. Canyon Forest Village, Inc., has selected the Valle site for development of a groundwater supply because the groundwater modeling investigation indicates that projected decrease in discharge from springs is substantially smaller for the Valle site than for the Airport Graben site. Changes in groundwater discharge were projected for

Havasu, Indian Garden, and Hermit Springs, which issue from the Redwall-Muav aquifer along the south rim of the Grand Canyon. More than 99 percent of the groundwater that discharges from the Redwall-Muav aquifer in the Coconino Plateau groundwater sub-basin discharges at these three springs.

A conceptual model for the groundwater flow system in the sub-basin was developed based on review of previous hydrogeologic investigations and on field observations and work conducted for this investigation by experts in the hydrogeology of the Grand Canyon area. To project potential changes in the discharge from springs resulting from groundwater withdrawals, a groundwater flow model of the sub-basin was constructed using MODFLOW, which is a computer-based, finite-difference, numerical groundwater flow modeling program developed by the U.S. Geological Survey (USGS) (McDonald and Harbaugh, 1988).

To simulate equilibrium or steady-state aquifer conditions, the groundwater flow model was calibrated to geologic structural features, reported groundwater levels at existing wells, and reported discharge from Havasu, Indian Garden, and Hermit Springs. Transient conditions were then simulated to project potential effects of groundwater withdrawal at selected durations, locations, and pumping rates. The transient conditions were simulated by: 1) using the equilibrium conditions computed from the calibrated steady-state flow model as the initial conditions; 2) applying pumping stresses to the model at selected locations and pumping rates; and 3) computing the drawdown in groundwater levels and decrease in discharge from springs after 5, 50, and 100 years of pumping. Sensitivity analyses were conducted to evaluate the effects of varying model input parameters on steady-state and transient model results.

PREVIOUS INVESTIGATIONS

Hydrogeologic conditions on the Coconino Plateau have been reported by many authors. The following reports provide an excellent foundation for understanding hydrogeologic conditions in the model area. Numerous other authors are cited herein where their specific works are pertinent to this investigation.

Metzger (1961) discusses relations between geology and groundwater resources along the south rim of the Grand Canyon and gives preliminary conclusions for quantity and rate of recharge and discharge. A compilation of data for groundwater discharge at springs along the Colorado River in the Grand Canyon is given by Johnson and Sanderson (1968). Brown and Moran (1979) prepared an inventory of surface water resources in Grand Canyon National Park. Huntoon (1982) reports results of investigations on groundwater movement in the plateau regions adjacent to the Grand Canyon. Loughlin and Huntoon (1983) compiled available water quality data for sources within the Grand Canyon. The Grand Canyon National Park Water Resources Management Plan (1984) provides a summary of hydrogeologic and hydrochemical data for the National Park and adjacent areas. McGavock and others (1986) reported on surface and groundwater resources of southern Coconino County, Arizona. Excellent descriptions of the geologic features of rock units in the Grand Canyon region are given by several authors in publications edited by Jenney and Reynolds (1989) and by Beus and Morales (1990).

HYDROGEOLOGIC CONDITIONS

The lithology and structural deformation of the rock units on the Coconino Plateau are principal controls for movement and storage of groundwater. Outcrop areas for geologic units and the principal structural features in the model area are shown on **Figure 2 (oversized illustration in pocket)**. Data for springs that discharge groundwater from the Redwall-Muav aquifer along the south wall of the Grand Canyon and its southern tributary canyons in the Coconino Plateau groundwater sub-basin are given in **Table 1**; locations for springs are shown on **Figure 2**. Records for wells that yield groundwater from the Redwall-Muav aquifer in the model area are summarized in **Table 2**; well locations are shown on **Figure 2**. The Arizona Department of Water Resources (ADWR) well numbering system is used in this report, and is described and illustrated in **Appendix A**. A generalized hydrogeologic section illustrating stratigraphic relations and hydrogeologic features of geologic units in the model area is shown on **Figure 3**; the line of section is shown on **Figure 2**.

STRATIGRAPHY AND HYDROGEOLOGIC CHARACTERISTICS

The principal geologic units that crop out and/or occur in the subsurface in the model area, in descending order, are:

1. alluvial deposits
2. volcanic rocks
3. Moenkopi Formation
4. Kaibab Formation
5. Toroweap Formation
6. Coconino Sandstone
7. Hermit Formation

8. Supai Group: Esplanade Sandstone
   Wescogame Formation
   Manakacha Formation
   Watahomigi Formation
9. Surprise Canyon Formation
10. Redwall Limestone
11. Temple Butte Formation
12. Tonto Group: Muav Limestone
    Bright Angel Shale
    Tapeats Sandstone
13. Precambrian rocks

Alluvial Deposits

The alluvial deposits comprise a heterogenous mixture of unconsolidated to consolidated sediments ranging in grain size from silt and clay to boulders. The alluvial deposits are Quaternary and Tertiary in age, and crop out chiefly in valley floors and along the margins of volcanic rocks (Figure 2). Where exposed in valley floors, the alluvial deposits commonly range in thickness from a feather edge to a few tens of feet. Thickness of older alluvial deposits may be more than 100 feet at the margins of volcanic rocks.

Alluvial deposits that occur in the valley floors are permeable and transmit precipitation and stormwater runoff from the land surface to underlying formations. Where alluvial deposits overlie less permeable rocks, temporary perched groundwater zones may occur in the lower part of the alluvial deposits. Such perched groundwater zones are thin and discontinuous, and are generally ephemeral; the stored water is gradually lost via evapotranspiration and slow downward seepage during periods of precipitation deficit.

Volcanic Rocks

The volcanic rock sequence in the model area comprises lava-flow rocks, dikes, plugs, and pyroclastics, including volcanic ash and cinders that are Quaternary and Tertiary in age. The thickness of the volcanic rocks ranges from about 20 feet at the edge of some lava flows to more than 1,000 feet near the centers of past volcanic eruptions (Montgomery and Harshbarger, 1989). Surficial cinder cover provides an excellent infiltration medium. The subsurface sequence of volcanic rocks commonly has small vertical permeability and retards the downward movement of water, except where extensively fractured. Thin, discontinuous perched groundwater zones occur locally in the volcanic rocks and discharge at seeps and springs. These perched groundwater zones have been penetrated by wells and yield small, and often poorly reliable, quantities of water for domestic and stock use (Montgomery and Harshbarger, 1989).

Moenkopi Formation

The Moenkopi Formation consists chiefly of thin-bedded, fine-grained, red sandstone, siltstone, and mudstone (Blakey, 1989) and is Triassic in age. Although the Moenkopi Formation has been completely eroded in most of the model area, scattered and discontinuous outcrops of the formation occur in the south and west parts of the model area (**Figure 2**). These outcrops are generally less than 100 feet in thickness, and typically occur where the formation is capped by volcanic rocks or where remnant Moenkopi strata fill structural depressions, such as breccia pipes. The fine grain size and poor sorting of the Moenkopi strata cause the unit to function as a basal confining layer that retards the downward movement of percolating groundwater from overlying formations, except where the unit is extensively fractured (Cosner, 1962). The Moenkopi Formation is reported to yield small quantities of groundwater outside of the model area at wells near Winslow and Flagstaff (McGavock and others, 1986).

Kaibab Formation

The Kaibab Formation consists chiefly of thick- to thin-bedded, jointed, cherty, and sandy dolomitic limestone (McKee, 1974), but also contains dolostone, sandstone, evaporites, and redbeds (Hopkins, 1990). The formation is Permian in age, crops out over large areas of the Coconino Plateau and, at most locations, forms the rim rock of the Grand Canyon **(Figure 2)**. Where exposed at land surface and where penetrated by wells in the model area, the Kaibab Formation ranges in thickness from about 300 to 450 feet.

The Kaibab Formation is brittle and is extensively fractured in areas where geologic structural deformation has occurred. Water circulation through these fractures has enlarged the openings by solutioning and, at many places, has created extensive cavern systems (Montgomery & Harshbarger, 1989). Caverns in the Kaibab Formation have been observed at many locations in northern Arizona, including Wupatki National Monument (Cosner, 1962), Babbitt Ranch (Harshbarger & Associates, Inc., 1973), and the Grand Canyon. Where the Kaibab is exposed, surface water infiltrates readily downward via the fractures and solution openings; therefore, the unit comprises an important recharge medium. On the Coconino Plateau, the Kaibab Formation is above the regional groundwater table. However, the unit is reported to yield small quantities of groundwater to a few wells in the model area and to wells near Cameron, Arizona (McGavock and others, 1986), located outside of the model area and about 40 miles east from Grand Canyon Village.

Toroweap Formation

In the model area, the Toroweap Formation, which is Permian in age, consists of an upper evaporite and red sandstone and shale member, a middle massive limestone member, and a lower fine-grained sandstone and evaporite member (McKee, 1974). Due to variability in composition, the topographic expression of the Toroweap ranges from a weak slope-former to a cliff-former. Where exposed at land surface and where penetrated by wells in the model area, the Toroweap Formation ranges in thickness from about 100 to 300 feet.

The sandstone in the upper and lower members of the Toroweap is similar to the sand of the Coconino Sandstone, described in the following section; however, the cementation in the Toroweap is weaker.

Fine-grained strata in the upper and lower members of the formation are basal confining layers for the local accumulation of thin, discontinuous perched groundwater zones in overlying sandstone strata. The middle massive limestone member of the Toroweap is brittle and is extensively fractured. Fractures in the limestone have commonly been enlarged by solution activity and solution openings are abundant in this member. Groundwater percolates downward readily via fractures and solution openings in the limestone member. The Toroweap is considered to be a minor aquifer and yields small quantities of groundwater to wells from thin, discontinuous perched groundwater zones. The Toroweap Formation is reported by McGavock and others (1986) to yield "less than 5 gallons per minute to a few wells near Grand Canyon Village."

Coconino Sandstone

The Coconino Sandstone, which is Permian in age, is a very fine- to fine-grained, cross-bedded sandstone composed chiefly of subangular to well rounded, frosted quartz grains (Metzger, 1961). The Coconino Sandstone is commonly a cliff-former in outcrops, is a well-lithified and brittle rock unit, and is extensively fractured near faults and folds. Where exposed at land surface and where penetrated by wells in the model area, the Coconino Sandstone ranges in thickness from about 500 to 600 feet.

The Coconino Sandstone is the principal aquifer for water wells throughout much of northern Arizona at locations where the regional groundwater table occurs above the base of the formation. Municipal water supply wells for the City of Flagstaff obtain groundwater from the Coconino aquifer and hydraulic coefficients have been computed from results of pumping tests (Montgomery and DeWitt, 1975). At the Woody Mountain well field near Flagstaff, the permeability of the formation is large due to the occurrence of abundant fractures, and pumping rates from individual wells are as large as 1,000 gallons per minute (gpm). Where the Coconino is not abundantly fractured, permeability is small and pumping rates from individual wells are commonly less than 100 gpm.

Along the south rim of the Grand Canyon on the Coconino Plateau, the regional groundwater table occurs below the base of the Coconino Sandstone and the formation does not contain groundwater at most locations. Where favorable structural conditions occur and where mudstone strata in the underlying Hermit Formation provide a basal confining layer that retards the downward movement of groundwater, thin, discontinuous perched groundwater zones may occur in the lower part of the Coconino and may supply small quantities of groundwater to springs and wells for domestic and stock use.

Hermit Formation

The Hermit Formation consists of red sandy shale and fine-grained friable sandstone (Metzger, 1961). Where the Hermit crops out, it forms a slope between the overlying cliff-forming Coconino Sandstone and the underlying ledge- and slope-forming Supai Group. Where exposed at land surface and where penetrated by wells in the model area, the Hermit Formation ranges in thickness from about 100 to 300 feet; the formation thickens to the west (Blakey and Knapp, 1989). Due to its fine-grained lithology, the Hermit Formation generally retards the downward percolation of groundwater and is considered to be an important basal confining layer for overlying thin, discontinuous perched groundwater zones.

Supai Group

The Supai Group is Permian and Pennsylvanian in age and is comprised of four formations, which are, in descending order: the Esplanade Sandstone; the Wescogame Formation; the Manakacha Formation; and the Watahomigi Formation (McKee, 1982). The Supai Group consists of alternating siltstone and fine-grained sandstone units, with some limestone beds (Metzger, 1961).

Where the Supai Group crops out in the Grand Canyon, it is a ledge- and slope-forming unit. Where exposed at land surface and where penetrated by wells in the model area, the Supai Group ranges in thickness from about 900 to 1,000 feet. The siltstone units are red and occur in flat, lenticular beds. The sandstone units are commonly light brown, but in many places are stained red by the overlying siltstone. Because the Supai Group is composed chiefly of siltstone and fine-grained sandstone, groundwater does not move readily through the fine-grained, unfractured rock matrix, although some downward percolation of groundwater does occur (Metzger, 1961). The upper part of the Supai contains sandstone units that yield small quantities of water from local thin, discontinuous perched groundwater zones to seeps in the Grand Canyon; the Supai Group is reported to yield small quantities of groundwater to wells. However, the Supai functions chiefly as a basal confining layer, retarding downward water movement to the more permeable underlying formations.

Surprise Canyon Formation

The Surprise Canyon Formation is comprised of isolated, lenticular deposits of clastic and carbonate rocks that fill erosional valleys, caves, and other local karst features in the top of the Redwall Limestone (Beus, 1990a). The Surprise Canyon Formation is Mississippian in age and can be divided into three units: 1) an upper unit that consists chiefly of marine siltstone and silty, sandy, or algal limestone; 2) a middle unit that consists of marine skeletal limestone; and 3) a basal unit that consists of terrestrial conglomerate and sandstone. The Surprise Canyon Formation is probably the least visible rock unit in the Grand Canyon due to the discontinuous nature and extreme remoteness of outcrops; the formation was not identified formally until 1985 (Billingsley and Beus, 1985).

Redwall Limestone, Temple Butte Formation, and Muav Limestone

The Redwall Limestone, Temple Butte Formation, and Muav Limestone comprise a sequence of carbonate rocks referred to herein as the Redwall-Muav aquifer. The Redwall Limestone is Mississippian in age and consists of thick-bedded, cliff-forming, fine-grained limestone and dolomite (Metzger, 1961). The Redwall forms massive vertical cliffs 500 to 800 feet in thickness in the Grand Canyon; thickness increases to the northwest. The Redwall Limestone is stained red by iron oxide material washed down from red beds in the overlying Supai group (Beus, 1990a).

The Temple Butte formation underlies the Redwall and consists chiefly dolomite or sandy dolomite with minor beds of sandstone and limestone (Beus, 1990b). The Temple Butte is Devonian in age, crops out as thin ledges, and occurs in channels cut into the underlying Muav Limestone. Thickness of the formation ranges from about 100 feet in scattered channel-fill lenses to more than 450 feet west of Grand Canyon; westward from Hermit Creek, the Temple Butte forms a continuous band of dolomite above local basal channel-fill deposits (Beus, 1990b).

The Muav Limestone is Cambrian in age and consists chiefly of thin- to thick-bedded dolomitic and calcareous mudstone and packstone, with intraformational conglomerate (Middleton and Elliott, 1990). The Muav forms resistant cliffs above the underlying Bright Angel Shale in the Grand Canyon. The contact with the Bright Angel Shale is gradational and is characterized by complex intertonguing of the formations. Bedding and formation thickness increase to the west; thickness of the Muav, where penetrated by wells in the model area ranges from about 200 to 400 feet.

In the model area, the Redwall-Temple Butte-Muav sequence of carbonate rocks lies below or partly below the regional water table and comprises the regional aquifer. Results of pumping tests for well (A-29-3)20bcd, located at the Canyon Mine southeast of Tusayan, indicate the transmissivity of the Redwall-Muav aquifer in relatively unfractured areas is about 1,000 gallons per day per foot width of aquifer (gpd/ft) at a 1:1 hydraulic gradient

(Montgomery & Associates, 1993). In the model area, total thickness of the formations that make up the Redwall-Muav aquifer at wells and at the south rim of the Grand Canyon ranges from about 500 to 1,000 and at the south rim of the Grand Canyon ranges from about 500 to 1,000 feet; average thickness is about 750 feet. Although the permeability of unfractured rock in the Redwall-Muav aquifer typically is very small, solution openings that have developed along fractures related to large extensional faults and flexures provide for the transmission of large quantities of groundwater. Extensive cavern systems occur in the Redwall-Muav aquifer, particularly along large faults (Montgomery and Harshbarger, 1989).

Bright Angel Shale and Tapeats Sandstone

Together with the overlying Muav Limestone, the Bright Angel Shale and Tapeats Sandstone comprise the Tonto Group which is Cambrian in age. The Bright Angel Shale consists chiefly of mudstone and shale, with minor thicknesses of sandstone and limestone (Metzger, 1961). Metzger (1961) reports that thickness of the Bright Angel Shale ranges from 0 to 325 feet. The unit functions as an effective basal confining layer for the overlying Redwall-Muav aquifer. The Tapeats Sandstone consists of cross-bedded, poorly-sorted, coarse sandstone and conglomerate. Metzger (1961) reports that thickness of the Tapeats Sandstone ranges from 0 to 300 feet; thickness typically ranges from 100 to 325 feet (Middleton and Elliot, 1990). Because the Tapeats Sandstone is overlain by the Bright Angel Shale, only small quantities of groundwater issue from seeps in the Tapeats Sandstone. The Bright Angel Shale and the Tapeats Sandstone are not known to yield groundwater to wells in the Grand Canyon region, except for exploration water well (A-25-2)27aba, which was constructed for Black Mesa Pipeline, Inc., about 18 miles north from Williams, Arizona (McGavock and others, 1986). Water quality and yield from this well are considered poor; therefore, the well is not presently used. The discharge from springs in the Bright Angel Shale and Tapeats Sandstone commonly is saline and small in quantity.

Precambrian Rocks

The occurrence of sedimentary, metamorphic, and igneous rocks of Precambrian age below the Tapeats Sandstone in the model area is indicated from geologic relations in the Grand Canyon and from analysis of deep oil test boreholes in the Flagstaff vicinity. The permeability and porosity of the Precambrian rocks exposed in the Grand Canyon are very small and these rocks are expected to function as the basal confining layer to the overlying rock sequence.

STRUCTURAL FEATURES

The principal structural features in the model area are a series of north- to northeast-trending faults, including the Bright Angel, Redlands, Red Horse, and Vishnu Faults; and north to northwest trending faults and folds, including the Supai and Grandview-Phantom Monoclines (**Figure 2**). The Markham Dam fracture zone (**Figure 2**) is an area of intense structural deformation where oblique sets of extensional faults are readily visible at land surface and can be identified by the surface water drainage patterns, which are caused by preferential erosion along the fractured rocks of the fault traces. Satellite images indicate that the trace for the Vishnu Fault may extend into the Markham Dam fracture zone.

The rocks underlying the Coconino Plateau are folded into a gentle northwest-plunging syncline, referred to as the Havasu downwarp. The regional dip for the northern limb of the Havasu downwarp south from the Grand Canyon ranges from 1/2 to 1-1/2 degrees to the southwest (Huntoon and others, 1986).

Near the south rim of the Grand Canyon, the Eremita Monocline, the Grandview-Phantom Monocline, and other monoclines cause beds to dip locally northward toward the Grand Canyon (Huntoon and others, 1986). The north-dipping beds and bedding offsets associated with the monoclines and faults near the south rim result in local areas where recharge collects along fracture systems, moves northward along bedding planes, and discharges at small springs and seeps where faults and fracture systems intersect canyon walls. The source of recharge for the small springs and seeps is the small, local drainage basins at the canyon rim; these springs and seeps are considered to be poorly connected or unconnected hydraulically from the regional Redwall-Muav aquifer.

Fracture systems associated with major structural features function as conduits for recharge, transmission, and discharge of groundwater in the Redwall-Muav aquifer. Recharge from precipitation and ephemeral streamflow infiltrates downward through fracture systems associated with major structural features. The groundwater has dissolved some of the carbonate rock in the Redwall-Muav aquifer to form cavernous conduits that transmit large quantities of groundwater. These conduits are referred to in this report as solution-enhanced permeability features or solution features. Solution features preferentially develop parallel to the direction of the hydraulic gradient between points of recharge and points of discharge, especially along extensional fractures, faults, and folds that are aligned with the hydraulic gradient. Most groundwater discharged from the Redwall-Muav aquifer issues from springs located near major structural features in the Grand Canyon and its tributary canyons.

GROUNDWATER OCCURRENCE AND MOVEMENT

Groundwater moves from areas of recharge to areas of discharge. In the model area, groundwater recharge occurs from infiltration of precipitation and ephemeral streamflow. The Grand Canyon and its larger tributary canyons function as groundwater drains; groundwater from the regional Redwall-Muav aquifer in the model area discharges chiefly at Havasu Spring. Recharge from localized areas along the south rim of the Grand Canyon is discharged at many small springs and seeps, and at a few large springs within the Grand Canyon or its tributary canyons. A summary of reported discharge from springs along the south wall of the Grand Canyon and its southern tributary canyons is given in Table 1.

Recharge

Average precipitation measured at Grand Canyon Village, in the northern part of the Coconino Plateau groundwater sub-basin, during the period from 1941 through 1970 is about 14.5 inches per year (Sellers and Hill, 1974). Normal annual precipitation for 1961 through 1990 measured at Williams, in the southern part of the sub-basin, is 21.17 inches (Owenby and Ezell, 1992). Metzger (1961) estimated average annual recharge to the principal aquifer to be about 0.3 inch per year, which is about 2 percent of the average annual precipitation at Grand Canyon Village.

Most of the precipitation is lost via evaporation, transpiration, and surface water runoff. The remaining fraction infiltrates through permeable surficial deposits, volcanic rocks, and through fractures and solution openings in the Kaibab Formation. This infiltrated water moves downward until it encounters a confining rock layer with sufficiently small permeability to detain the water. Where the water is detained, a thin saturated zone, referred to as a perched groundwater zone, may form above the confining layer and lateral groundwater movement may occur. Because the confining layers are not completely impermeable, part of the perched groundwater eventually seeps downward through the confining layer. The remaining perched groundwater moves laterally until: 1) it encounters fractures that permit downward movement through the confining layer; 2) it discharges along canyon walls at seeps and springs; or 3) it is withdrawn from small-yield, perched aquifer wells.

Groundwater Occurrence in Perched Aquifers

In areas where fractures are sparse, groundwater may be perched above confining layers. In the model area, these conditions occur most commonly in the Toroweap Formation, where groundwater is perched in sandstone units that overlie fine-grained confining strata, and at the base of the Coconino Sandstone, where groundwater may be perched on fine-grained strata of the Hermit Formation. At these locations, the perched aquifers may yield small quantities of groundwater for domestic and stock use. These perched reservoirs are commonly small, thin, and discontinuous. If the groundwater stored in these perched reservoirs is not replenished annually by rainfall and snowmelt, wells and springs that discharge from the perched aquifers may fail. Because the perched aquifers overlie and have no hydraulic connection to the deep regional Redwall-Muav aquifer, withdrawal of groundwater from the regional aquifer can have no impact on the perched aquifers.

Discharge from Perched Aquifer Springs

Several springs issue from fractures or sandstone strata in perched aquifers in the Toroweap Formation, Coconino Sandstone, and the Supai Group along the south wall of the Grand Canyon and its southern tributary canyons. Records available for these springs **(Table 1)** indicate that the groundwater discharge for each spring is small. The chemical quality of groundwater discharged from perched aquifer springs ranges widely from location to location.

Groundwater Occurrence and Movement in the Redwall-Muav Aquifer

The Redwall-Muav aquifer is the only aquifer of regional extent that is capable of consistently yielding large quantities of groundwater to wells and springs in the model area. The model area extends over the Coconino Plateau groundwater sub-basin for the Redwall-Muav aquifer. As shown on **Figure 2**, this sub-basin is bounded on the north by the Grand Canyon, which is deeper than the base of the Redwall-Muav aquifer; saturated thickness in the aquifer thins to extinction toward the Grand Canyon (Metzger, 1961). The sub-basin is bounded on the east by a groundwater divide; east from this divide, groundwater drains to Blue Springs along the Little Colorado River (Huntoon, 1982). The sub-basin is also bounded on the south by a groundwater divide; south from this divide, groundwater drains southward to the Verde River basin (Cooley, 1963). The model area is bounded on the west by the Toroweap and Aubrey Fault systems, where saturated thickness in the aquifer thins to extinction (Twenter, 1962; Montgomery & Associates, 1992).

Groundwater enters the Redwall-Muav aquifer chiefly from downward conduit flow via vertical fractures in overlying strata. After groundwater enters the saturated zone in the Redwall-Muav aquifer, lateral groundwater movement is believed to occur chiefly via fracture and solution openings that are concentrated along principal structural features (Huntoon, 1982). Conduits with large storage capacity and transmissivity are believed to have developed in response to the hydraulic gradient towards Havasu Canyon. Nearly all groundwater in the regional Redwall-Muav aquifer in the sub-basin converges toward and discharges at Havasu Spring, which is located where a fault in the trough of the Havasu downwarp intersects Havasu Canyon. About 98 percent or 29,000 gpm of reported groundwater discharge from the Redwall-Muav aquifer in the sub-basin occurs at Havasu Spring; about 1 percent or 300 gpm discharges at Hermit Spring; about 1 percent or 300 gpm discharges at Indian Garden Spring; and less than 1 percent discharges at several small springs and seeps **(Table 1)**.

Discharge from Redwall-Muav Aquifer Springs

Discharge from the Redwall-Muav aquifer in the sub-basin occurs chiefly at Havasu Spring, which has a discharge rate of about 29,000 gpm (Johnson and Sanderson, 1968). Indian Garden and Hermit Springs have substantial discharge rates and also issue from fractures or solution openings in the Redwall-Muav aquifer. Indian Garden Spring discharges about 300 gpm from the base of the Muav Limestone, where the Bright Angel Fault intersects Garden Creek Canyon, a tributary of the Grand Canyon (Metzger, 1961). Hermit Spring discharges about 300 gpm from a series of springs in the Muav Limestone along Hermit Creek, immediately west from Hermit Fault **(Table 1; Figures 1 and 2)**.

The chemical quality of groundwater discharge from springs in the Redwall-Muav aquifer is generally good; reported total dissolved solids content is generally less than 500 milligrams per liter (Loughlin and Huntoon, 1983). Dominant cations are calcium and magnesium; dominant anions are bicarbonate and sulfate.

Other springs that discharge from the Redwall-Muav Limestone along the south wall of the Grand Canyon in the groundwater sub-basin include Miner's, O'Neill, Cottonwood, Grapevine, Pipe, Burro, Horn, Boucher Creek, Elves Main and Joint, and Matkatamiba Springs **(Table 1)**. Discharge from these springs is small and is believed to result chiefly from infiltration of precipitation in local drainage basins along the rim of the Grand Canyon. The sources of these springs are believed to be poorly connected or unconnected to the regional Redwall-Muav aquifer system.

Several other springs with substantial discharge, most notably Warm, Diamond, Upper Diamond, and East Diamond Springs, issue from the Redwall-Muav aquifer along the south wall of the Grand Canyon **(Table 1)**. However, these springs are outside of the Coconino Plateau groundwater sub-basin and are not believed to be influenced by groundwater movement in the sub-basin.

Yield from Redwall-Muav Aquifer Wells

Groundwater is being withdrawn from the Redwall-Muav aquifer at two wells in the vicinity of Tusayan, Arizona, one well at the Canyon Mine site near Tusayan, and at two wells in the vicinity of Valle, Arizona. Data for wells in the model area that are capable of yielding groundwater from the Redwall-Muav aquifer are summarized in **Table 2**; selected data include:

WELL IDENTIFIER	GENERAL LOCATION	REPORTED PUMPING CAPACITY OR PUMPING RATE (gallons per minute)	OWNER
(A-25-2)27aba	Quivero	unused	Black Mesa Pipeline, Inc.
(A-26-2)01cdd	Valle	41	Grand Canyon Equipment
(A-26-2)11ddc	Valle	85	Grand Canyon Valle Corp.
(A-29-3)20bcd	Canyon Mine	5	Energy Fuels Nuclear, Inc.
(A-30-2)24bac	Tusayan	80	Halvorson Seibold
(A-30-2)24caa	Tusayan	80	Southwestern Ground Water
(B-32-4)24c	near Supai	50	unknown

Valle wells (A-26-2)01cdd and (A-26-2)11ddc were constructed in 1994. Reported water use for the Valle wells is public supply. Tusayan wells (A-30-2)24bac and (A-30-2)24caa were constructed in 1994 and 1989, respectively. Well (A-30-2)24caa supplies groundwater to the Canyon Squire Inn. The Tusayan and Valle wells fully penetrate the Redwall-Muav aquifer. Owners of the Tusayan and Valle wells were contacted, and ADWR records were reviewed for well and pumping test data; however, data provided by the well owners or available in ADWR records are sparse regarding quantity of groundwater discharged, specific capacity, or results of pumping tests. The chemical quality of groundwater yielded from the Tusayan and Valle wells is reported to be good; one of the Valle wells supplies groundwater for a commercial bottled water operation.

Well (A-29-3)20bcd was constructed in 1986 as a monitor/supply well for the Canyon Mine site, located about 6 miles south-southeast from Tusayan. The Canyon Mine well fully penetrates the Redwall-Muav aquifer. The well is pumped infrequently at an estimated rate of about 5 gpm (U.S. Forest Service, 1985); pumping may continue, if the mine becomes operational. Results of pumping tests for the Canyon Mine well were given previously in this report. The chemical quality of groundwater yielded from the Canyon Mine well is good.

Exploration water well (A-25-2)27aba was constructed in 1969 for Black Mesa Pipeline, Inc., near Quivero, Arizona. The well fully penetrates the

Redwall-Muav aquifer, Bright Angel Shale, and Tapeats Sandstone, and penetrates 200 feet into Precambrian granite. Water quality and yield from the well are considered poor; therefore, the well is not presently used.

Oil and gas exploration well (B-28-1)35ac was drilled for Sinclair Oil & Gas Company. The well fully penetrated the Redwall-Muav aquifer and Bright Angel Shale, and penetrated 54 feet into the Tapeats Sandstone. The well failed to produce oil or gas; therefore, the lower part of the well was filled with drilling mud and a cement plug was set at 1,236 feet below land surface in the Supai Group. The upper part of the borehole was left open for possible future development as a water well.

Well (B-32-4)24c is being constructed under the direction of the USGS, U.S. Bureau of Reclamation, and U.S. Bureau of Indian Affairs near Supai, Arizona. According to USGS personnel (verbal communication with Don Bills, USGS Flagstaff office, June 19, 1996), the well was drilled to a total depth of 3,110 feet below land surface. The top of the Redwall Limestone was encountered at about 2,500 feet below land surface; groundwater level measured in the well was about 2,380 feet below land surface. Based on results of a borehole flowmeter investigation in the well, the USGS estimates that the well may be capable of producing groundwater at a rate of 50 gpm or more. It should be noted that development and pumping test operations for the well are scheduled for Fall 1996, and that no information about the well was on file with ADWR at the time this report was submitted. Therefore, the available data regarding well (B-32-4)24c are considered preliminary and incomplete, and were not incorporated into the groundwater flow modeling operations described in this report.

DRILLING TARGETS FOR WATER WELLS FOR CANYON FOREST VILLAGE

Drilling targets for water wells considered by Canyon Forest Village included the Airport Graben at Tusayan and the vicinity of Valle. A graben is an elongate block, bounded by parallel faults, that has moved downward relative to the surrounding rocks. The rocks within a graben commonly are abundantly fractured and, at the Airport Graben, are believed to be associated with solution-enhanced permeability in the Redwall-Muav aquifer. The Airport Graben was preferred initially as a drilling target due to close proximity to the proposed development and favorable structural features. However, reports indicated that two successful water wells were recently constructed in the Redwall-Muav aquifer in the vicinity of Valle, located about 25 miles south from Tusayan; Valle is easily accessible to the proposed development. Canyon Forest Village selected the Valle site over the Airport Graben because results of the groundwater modeling investigation indicate that projected decrease in discharge from springs in the Grand Canyon is substantially smaller for the Valle site than for the Airport Graben site.

Valle is located near two faults that have substantial displacement and that intersect the Williams fault zone, which is believed to be a major conduit for groundwater flow in the Redwall-Muav aquifer. Therefore, a well or wellfield near Valle may be capable of producing a substantial quantity of groundwater.

CONCEPTUAL MODEL FOR THE REDWALL-MUAV AQUIFER SYSTEM

The Redwall-Muav aquifer is the only aquifer of regional extent and regional importance in the model area (Montgomery & Associates, 1992). A conceptual model for hydrogeologic conditions in the Coconino Plateau groundwater sub-basin was developed to provide a prior framework for construction of the subsequent computer-based groundwater flow model. The conceptual model incorporated available regional hydrogeologic data pertinent to understanding the movement of groundwater in the sub-basin, together with conclusions and observations made by hydrogeologic experts.

The Redwall-Muav aquifer comprises three geologic formations, which, in descending order, are the Redwall Limestone, Temple Butte Formation, and Muav Limestone (Montgomery and others, 1988). The most abundant rock-forming minerals in the Redwall-Muav aquifer are calcium and magnesium carbonates. Thickness of the aquifer in the model area ranges from about 500 to 1,000 feet; average is about 750 feet. Depth to groundwater level in the Redwall-Muav aquifer near Tusayan is about 2,500 feet. The aquifer is overlain by a thick sequence of geologic strata that are mostly not saturated; however, at some locations, the overlying strata contain thin and discontinuous perched aquifers. The Redwall-Muav aquifer is underlain by the Bright Angel Shale, which consists of a thick sequence of clay, silt, and sandstone strata that functions as an aquitard and forms an effective barrier to further downward movement of groundwater.

Recharge to the Redwall-Muav aquifer in the model area is derived chiefly from infiltration of precipitation and ephemeral streamflow. The majority of recharge reaches the aquifer by downward movement through fracture systems that breach overlying aquitards. The fracture systems are commonly related to major faults and folds. Approximately 75 percent of the surface area of the groundwater sub-basin drains into ephemeral stream channels that converge in the area of the Markham Dam fracture zone to form major tributaries to Cataract Canyon. Cataract Canyon is formed along the approximate axis of the Havasu downwarp. Sinkholes along stream channels indicate that surface runoff is captured along faults and that large amounts of recharge to the groundwater system may occur in the area of the Markham Dam fracture zone. A smaller amount of recharge reaches the Redwall-Muav aquifer by slow downward movement through overlying non-fractured strata.

More than 99 percent of the reported discharge from the Redwall-Muav aquifer in the sub-basin occurs at Havasu, Hermit, and Indian Garden Springs. The overwhelming majority, about 98 percent or 29,000 gpm, of discharge from the Redwall-Muav aquifer in the model area occurs at Havasu Spring. Substantial discharge from the Redwall-Muav aquifer also occurs at Hermit and Indian Garden Springs; base rate of discharge at each of these springs is about 300 gpm (Metzger, 1961). Small amounts of groundwater that issue from other seeps and small springs along the south wall of the Grand Canyon are believed to result from recharge in local drainage basins along the canyon rim; therefore, these seeps and small springs are not believed to influence or to be influenced by regional patterns of groundwater movement in the Redwall-Muav aquifer.

Primary permeability of the carbonate rock units of the Redwall-Muav aquifer typically is small. The most common secondary openings in carbonate rock formations comprise open fractures and solution features. Such secondary openings provide zones of large permeability, transmissivity, and storage. Solution features and associated solution-enhanced permeability in carbonate rocks of the Redwall-Muav aquifer are formed chiefly by the natural process of dissolution of carbonate minerals preferentially along pre-existing fractures in the direction of the hydraulic gradient. The large magnitude and relatively constant rate of groundwater discharge at Havasu Spring indicate that the discharge is from an extensive interconnected network of fracture systems and solution-enhanced permeability features with large transmissivity and storage (Metzger, 1961). A substantial part of the fracture and solution feature network is believed to occur along the Havasu downwarp and in a large area of abundant faulting in the Markham Dam fracture zone (**Figure 2**). The Vishnu Fault, Red Horse Fault, Bright Angel Fault, and a zone of extensive faulting and fracturing northwest from Williams, Arizona

(Figure 2), referred to in this report as the Williams fault zone, are believed to be part of this network.

Prior to 1989, when the first public water supply well in Tusayan to penetrate the Redwall-Muav aquifer was constructed, the groundwater flow system in the Redwall-Muav aquifer in the model area was considered to be in dynamic equilibrium (steady-state). Under steady-state conditions, average rate of groundwater discharge at the springs was equal to average rate of recharge to the aquifer. However, present and proposed pumping from the Redwall-Muav aquifer will alter this equilibrium. Under conditions of short-term pumping from a well, pumped groundwater would be derived from storage in the aquifer near the well, and little or no reduction of discharge would occur at distant springs. Under conditions of long-term pumping, groundwater would be drawn from more distant parts of the aquifer, particularly along and adjacent to fracture and solution features. Long-term pumping would progressively intercept groundwater that, in the absence of pumping, would have discharged at selected springs. If pumping would continue for a sufficiently long period, a new condition of dynamic equilibrium would be established where average rate of groundwater discharge at the springs would be equal to the average rate of recharge minus the average rate of groundwater pumping at the wells, and groundwater levels would slowly re-stabilize in the aquifer.

COMPUTER-BASED GROUNDWATER FLOW MODEL

Computer-based groundwater modeling was conducted to project effects from a pumping well or well field for the proposed Canyon Forest Village development on other wells and on discharge from major springs in the Redwall-Muav aquifer. Modeling investigations began with analytical models that assume homogeneous, isotropic conditions and progressed to a sequence of increasingly more sophisticated numerical models.

MODEL SELECTION

Initial attempts to simulate the effects of a pumping well or well field on the groundwater flow system were conducted with analytical models using the Theis equation for non-equilibrium groundwater flow (Theis, 1935) and image well theory. The analytical models were used to project decreases in hydraulic head at nearby wells in the Tusayan area, but could not be used to project potential effects on the discharge from springs. The analytical models could accept input only for a homogeneous, isotropic aquifer system; therefore, large contrasts in transmissivity between fracture systems and unfractured rocks could not be simulated. Results indicated that analytical solutions for homogeneous, isotropic aquifers were not sufficiently sophisticated to simulate the complexities inherent in the groundwater flow system for the Redwall-Muav aquifer.

To project potential decreases in discharge from springs resulting from proposed pumping of groundwater from the Redwall-Muav aquifer, a computer-based numerical groundwater flow model for the sub-basin was constructed using MODFLOW, a finite-difference groundwater flow model developed by the USGS (McDonald and Harbaugh, 1988). MODFLOW is frequently used in groundwater resource investigations, more commonly for simulation and analysis of porous media aquifers, but also for simulation and analysis of fractured rock aquifers (Huntoon, 1994a; Bubey and Prudic, 1991; Hsieh and Shapiro, 1994; Mercer and Faust, 1981).

The first numerical model grid for this investigation included the northern half of the Coconino Plateau groundwater sub-basin, including Havasu, Hermit, and Indian Garden Springs. The Vishnu, Bright Angel, and Redlands Faults, and the Supai Monocline were incorporated into the model as solution-enhanced permeability features with large transmissivity and storage. All structural features were assigned the same value for transmissivity; northeast-trending faults were cross-connected with hypothetical northwest-trending faults. Results from all attempts at steady-state calibration of the numerical model were in poor agreement with reported groundwater levels and for discharge rates from the three major springs in the Redwall-Muav aquifer.

The initial numerical modeling efforts were reviewed by Dr. James Yeh, (Department of Hydrology, University of Arizona). Dr. Yeh supported the use of MODFLOW to simulate groundwater movement in fractured rock aquifers using large-transmissivity flow paths to represent fractures within relatively unfractured, small-transmissivity matrix rock. Dr. Peter W. Huntoon (Department of Geology, University of Wyoming) reviewed the numerical model and suggested expanding the model to include the entire groundwater drainage basin that supplies groundwater to Havasu, Hermit, and Indian Garden Springs. Dr. Huntoon also identified many previously unmapped geologic structures, shown on **Figure 2**, from aerial photographs and field investigations for the model area (Huntoon, 1994b). Several of these structures are believed to be conduits for groundwater movement in the Redwall-Muav aquifer.

A second, larger numerical model grid was constructed to encompass the entire groundwater sub-basin. In addition to the Vishnu, Bright Angel, and Redlands Faults, the new grid included the Red Horse Fault, the Markham Dam fracture zone, several unnamed faults mapped by Dr. Huntoon, a large structure along the approximate axis of the Havasu downwarp, and the Williams fault zone.

MODEL BOUNDARIES AND GRID DESIGN

The revised computer-based numerical groundwater flow model was constructed to encompass the area of the Redwall-Muav aquifer where, under pre-pumping (steady-state) conditions, groundwater originating as recharge from infiltration of precipitation is believed to discharge eventually at Havasu, Indian Garden, and Hermit Springs. The model area is 5,246 square miles and extends about 62 miles south-southwest from the south rim of the Grand Canyon and about 85 miles west-northwest from near the Kaibab Monocline to the confluence of Havasu Canyon and the Colorado River **(Figure 1)**. The finite-difference grid applied to the model area is shown on **Figure 4**.

Smaller grid cells were used to provide improved resolution of projected hydraulic head and flow between cells in the area of principal interest, which includes Havasu, Hermit, and Indian Garden Springs, Tusayan, and Valle **(Figure 4)**. The model grid consists of one layer with 77 rows and 117 columns; total number of finite-difference grid cells is 9,009. Areal dimensions of grid cells range from a minimum of 3,000 by 3,000 feet in the area of principal interest, to a maximum of 20,000 by 20,500 feet near the model boundaries.

Variable-head grid cells were used to represent the Redwall-Muav aquifer in the active model area. Inactive (no-flow) grid cells were used to represent areas outside of the boundaries of the groundwater sub-basin for the Redwall-Muav aquifer **(Figure 4)**. Constant-head grid cells were used to represent Havasu, Hermit, and Indian Garden Springs. Transmissivity for each grid cell is assumed to remain constant during the geologically brief period of time simulated.

It is possible that the groundwater divides that comprise the southern and eastern boundaries of the Coconino Plateau sub-basin for the Redwall-Muav aquifer would move outward from the present sub-basin boundaries in response to withdrawal of groundwater from the Redwall-Muav aquifer in the model area. Groundwater divides are not permanent, stationary barriers to groundwater movement. In time, the areas of hydraulic influence for existing and future water wells in the model area may expand beyond the pre-pumping locations of the groundwater divides and, therefore, cause the south and east boundaries of the sub-basin to move. If the sub-basin would expand in this manner, total volume of recharge to the sub-basin would increase and the potential effects on the discharge from springs resulting from groundwater pumping in the Redwall-Muav aquifer would be reduced. The boundaries of the computer-based groundwater flow model are immobile; therefore, the model may tend to over-estimate effects of pumping on the discharge from springs in the Redwall-Muav aquifer.

Comparison of **Figure 2**, which shows mapped geologic structures in the model area, to **Figure 4**, which shows the finite-difference grid applied to the model, indicates that many of the minor faults and folds in the model area were not explicitly represented in the computer-based groundwater flow model. Faults or folds were not represented in the model if they met one or more of the following criteria:

1. stratigraphic throw across the fault is small, generally less than 50 feet;

2. the fault or fold is hydrologically or geologically isolated from other hydrogeologic features that transmit substantial quantities of water to Havasu, Hermit, or Indian Garden Spring; or,

3. the fault or fold is distant from principal areas of interest, including Tusayan, Valle, and springs and wells in the Redwall-Muav aquifer.

The principal effect of excluding these geologic structures from the numerical model is that simulated movement of groundwater in the Redwall-Muav aquifer may be more restricted and slower than actual groundwater movement in the south and west parts of the model area, where most of the excluded structures occur. In response to restricted groundwater flow in the south and west, simulated pumping wells may obtain more groundwater from the northern part of the sub-basin than existing or future wells would actually obtain. Potential effects of this condition are: 1) the model may overestimate the effects of pumping on discharge from springs along the south rim of the Grand Canyon; and 2) the model may underestimate drawdown of groundwater levels in the south half of the model area.

STEADY-STATE FLOW MODEL: INPUT PARAMETERS AND CALIBRATION PROCEDURES

The steady-state flow model represents the groundwater flow system in dynamic equilibrium, where groundwater levels are stable and the rate of recharge is constant and equal to the rate of discharge at the springs. The model was calibrated for steady-state conditions by adjusting distribution of recharge and transmissivity in the model, within reasonable ranges, until simulated discharge from springs and patterns of groundwater levels were similar to measured or estimated pre-pumping values.

Groundwater Level

Groundwater level data for the Redwall-Muav aquifer in the model area were limited to measurements at five wells: wells (A-26-2)01cdd and (A-26-2)11ddc in Valle (the "Valle wells"); wells (A-30-2)24bac and (A-30-2)24caa in Tusayan (the "Tusayan wells"); and well (A-29-3)20bcd at the Canyon Mine site (the "Canyon Mine well"). Groundwater level data are also available for well (A-25-2)27aba, drilled near Quivero as an exploration water well for the Black Mesa Pipeline Company (the "Black Mesa Pipeline well"). However, this well penetrated the Redwall-Muav aquifer, Bright Angel Shale, and Tapeats Sandstone; therefore, groundwater level data from this well are not considered to be representative for the Redwall-Muav aquifer.

The most reliable groundwater level measurement in the model area for the Redwall-Muav aquifer was obtained at the Canyon Mine well, located approximately 6 miles south-southeast from Tusayan (Figure 2). Surveyed altitude for land surface at the Canyon Mine well is 6,507 feet above mean sea level (feet msl). Depth to groundwater at this well measured on July 29, 1993, was 2,534 feet below land surface, or 3,973 feet msl. Additional groundwater level measurements for the Canyon Mine well during the period from 1987 through 1993 are consistent with this groundwater level measurement.

Groundwater level data summarized in this report for the Tusayan wells and Valle wells are from well driller reports filed with ADWR soon after construction of the wells. Methods used for groundwater level measurement were not reported and reliability of the groundwater level data for these wells is uncertain. Personal communications with the drilling contractor for these wells indicate that the measurements were obtained using pressure transducers. Altitude of land surface at the wells was estimated from topographic maps.

Groundwater level data obtained from wells for the Redwall-Muav aquifer in the model area are summarized as follows:

WELL IDENTIFIER	LOCATION	ALTITUDE OF LAND SURFACE (feet, msl)	DEPTH TO GROUNDWATER (feet)	GROUNDWATER LEVEL ALTITUDE (feet, msl)
(A-25-2)27aba	Quivero	6,165	2,838[a]	3,327[a]
(A-26-2)01cdd	Valle	6,050	2,500	3,550
(A-26-2)11ddc	Valle	6,000	2,550	3,450
(A-29-3)20bcd	Canyon Mine	6,507	2,534	3,973
(A-30-2)24bac	Tusayan	6,600	2,400	4,200
(A-30-2)24caa	Tusayan	6,575	2,420	4,155

[a] Groundwater level is not considered to be representative for the Redwall-Muav aquifer.

Measured groundwater levels in the model area were used to develop targets for calibration of the steady-state groundwater flow model. The two Valle wells are in the same vicinity and have similar measured water levels; therefore, the average of measured groundwater levels for these wells (3,500 feet msl) was the calibration target for the model in the Valle area. The groundwater level measured in July 1993 for the Canyon Mine well was the calibration target for the model at the Canyon Mine site. The two Tusayan wells are in the same vicinity and have similar measured water levels; therefore, the average of measured groundwater levels for these wells (4,200 feet msl) was the calibration target for the model in the Tusayan area. Measured groundwater level at the Black Mesa Pipeline well was used only qualitatively as a lowest reasonable groundwater level for calibration of the steady-state model, because the measured groundwater level is believed to be deeper than correct groundwater level for the Redwall-Muav aquifer at the well site.

Discharge from Springs

The lack of abundant groundwater level measurements for the model area is compensated by recognition that outflow from the regional Redwall-Muav aquifer in the model area is known to a degree that is remarkable for a large groundwater sub-basin. Under pre-pumping conditions, groundwater inflow, or recharge, is assumed to have been equal to groundwater outflow; more than 99 percent of the reported groundwater outflow occurred at Havasu, Indian Garden, and Hermit Springs. Typically, measurements of inflow and outflow for a groundwater system are not available, and must be estimated for groundwater flow models. Inaccurate estimates for groundwater inflow and outflow may cause large uncertainty in model results. In a fractured rock aquifer, site-specific or "point" data from wells is typically somewhat skewed from regional data by local heterogeneities (Huntoon, 1994a). For basin-wide modeling analyses, regional data, such as recharge and discharge for the groundwater flow system, are considered to be more valuable than point data at wells. Therefore, although few measurements are available for groundwater level and aquifer transmissivity, these few measurements, together with the remarkably good data for groundwater outflow from the sub-basin, are sufficient for the purposes of this modeling investigation. USGS is maintaining streamgaging stations on Indian Garden, Hermit, and Havasu Springs and reports data annually.

Johnson and Sanderson (1968) report that base discharge for Havasu Spring is about 64 cubic feet per second, or about 28,700 gpm. Measurements reported by the USGS (1996) for a period of 5 years for a streamgaging station on Havasu Creek corroborate the base discharge reported by Johnson and Sanderson (1968). For the computer-based groundwater flow model, a discharge rate of 29,000 gpm was the calibration target for Havasu Spring. Based on proximity to a surveyed benchmark in Havasu Canyon shown on USGS topographic maps, an altitude of 3,256 feet msl was assigned to Havasu Spring for the groundwater flow model.

Indian Garden Spring is reported to discharge about 300 gpm (Metzger, 1961), which was the calibration target for Indian Garden Spring for the groundwater flow model. Measurements reported by the USGS (1996) for a period of 1 year for a recently-constructed streamgaging station on Garden Creek tend to corroborate the discharge reported by Metzger (1961). Indian Garden Spring issues from the base of the Muav Limestone near the Bright Angel Fault in Garden Creek Canyon. The altitude for the base of the Muav Limestone in Garden Creek Canyon on the downthrown side of Bright Angel Fault is shown on geologic maps to be about 3,950 feet msl (Huntoon and others, 1986); this altitude was assigned to Indian Garden Spring for the groundwater flow model.

Several springs issue from the Muav Limestone near the Hermit Fault in Hermit Canyon; these springs contribute to streamflow in Hermit Creek and are collectively known as Hermit Spring. The uppermost of these springs is immediately below the Redwall Limestone and discharges about 5 gpm. Numerous springs occur downstream throughout the exposed section of the Muav Limestone (Metzger, 1961). Streamflow in Hermit Creek measured at the base of the Muav Limestone in 1958 by the USGS was about 210 gpm (Metzger, 1961). Streamflow in Hermit Creek was also measured by Goings (1985) during field investigations for his Masters thesis. Goings obtained monthly measurements of streamflow for a period of 14 months and reported streamflow rates ranging from 319 to 566 gpm; average rate was 386 gpm. Goings reported a direct temporal relation between precipitation and discharge from Hermit Spring.

For the 14-month period of measurements obtained by Goings, total precipitation at Grand Canyon Village was 25.1 inches (Goings, 1985), which is about 22 percent larger than the sum of reported monthly average precipitation at Grand Canyon Village for the same months during the period from 1941 through 1970 (Sellers and Hill, 1974). Assuming that groundwater discharge from Hermit spring was also 22 percent larger than average for the same period, a corrected average groundwater discharge for Hermit Spring was computed by decreasing the average streamflow rate measured by Goings for his 14-month study period by 22 percent. The average streamflow rate in Hermit Creek measured by Goings was 386 gpm; corrected average groundwater discharge from Hermit Spring is about 300 gpm. Measurements reported by the USGS (1996) for a period of 1 year for a recently-constructed streamgaging station on Hermit Creek tend to corroborate the corrected average groundwater discharge of 300 gpm. For the groundwater flow model, a discharge rate of 300 gpm was the calibration target for Hermit Spring.

Altitude of the base of the Muav Limestone exposed in Hermit Canyon is shown on geologic maps (Huntoon and others, 1986) to be about 3,200 feet msl. However, based on field investigations at Hermit Spring conducted by Montgomery & Associates personnel and Dr. Peter W. Huntoon in 1994, average altitude is estimated to be about 3,950 feet for the several springs that comprise Hermit Spring; this altitude was assigned to Hermit Spring for the groundwater flow model.

Data used in the groundwater flow model for altitude and discharge rate for Havasu, Indian Garden, and Hermit Springs are summarized as follows:

SPRING	ALTITUDE (feet, msl)	TARGET DISCHARGE RATE (gallons per minute)
Havasu Spring	3,256	29,000
Indian Garden Spring	3,950	300
Hermit Spring	3,950	300

Distribution of Recharge

During the early development of the groundwater flow model, 11 alternate distributions of recharge were simulated to evaluate the effects of recharge distribution on simulated hydraulic head and discharge from springs. The alternate recharge distributions are summarized as follows:

R1 100% of recharge distributed evenly over entire grid
Result: Simulated groundwater levels above land surface over most of the model area.

R2 70% distributed over highland areas, 30% into lowlands
Result: Simulated groundwater levels above land surface over most of the model area.

R3 70% distributed into Markham Dam fracture zone and Havasu downwarp, 30% into remaining area
Result: Simulated groundwater levels above measured groundwater levels near Tusayan, but improved from R2.

R4 70% distributed into Markham Dam fracture zone, Havasu downwarp, and Airport Graben; 30% into remaining area
Result: Improved simulated groundwater level altitudes.

R5 Same distribution as R4, but values for R4 corrected by multiplying by 0.82 to decrease total from 30,510 gpm to 29,600 gpm
Result: Improved total simulated discharge from springs.

R6 70% distributed into faults and Havasu downwarp, 30% into remaining area
Result: Improved agreement with conceptual model; distribution of recharge closely matches distribution of surface drainage area.

R7 Extreme case, 59% distributed into Airport Graben, 41% into remaining area
Result: Test case where 350 gpm is being recharged into grid block with pumping well - no change in simulated effect on springs.

R8 80% distributed into faults and Havasu downwarp, 20% into remaining area
Result: Increased simulated discharge at Indian Garden Spring, less agreement with distribution of surface drainage area, and less agreement with observed discharge from springs and groundwater levels.

R9 90% distributed into faults and Havasu downwarp, 10% into remaining area
Result: Increased simulated discharge at Indian Garden Spring, less agreement with distribution of surface drainage area, and less agreement with observed discharge from springs and groundwater levels.

R10 70% distributed into faults, 30% into remaining area including Havasu downwarp
<u>Result:</u> Reasonable simulated groundwater level altitudes, but does not fit conceptual model. Substantial recharge is believed to occur along Cataract Canyon and the Havasu downwarp.

R11 A refinement of R10 based on surface drainage areas of faults
<u>Result:</u> Same as R10.

Recharge alternatives R1 and R2 resulted in unreasonable simulated hydraulic conditions in unfractured, small-transmissivity areas of the aquifer; specifically, simulated groundwater level altitudes were above land surface. For recharge alternatives R3 through R6, simulated groundwater levels were below land surface over most of the model area.

Recharge alternatives R3, R4, and R5 were progressive refinements of concentrating recharge in solution features and evolved into recharge option R6. Recharge option R6, combined with appropriate assumptions for other aquifer parameters, produced the most reasonable results for altitude of groundwater level in most of the model area. Relative percentage of total surface drainage area for individual fracture zones compared favorably with relative distribution of recharge for the individual fracture zones.

When all other variables were held constant, changes in the distribution of recharge had no discernible effect on simulated decrease in discharge from springs or on simulated drawdown in the pumped well grid cell. Recharge option R7 represents an extreme case where 59 percent of the total recharge was distributed in grid cells that simulate the Airport Graben on the Vishnu Fault; the resulting recharge rate was equal to the pumping rate for the model grid cell that was being pumped. Results for a model run using recharge option R7 were compared with results for a model run using recharge option R6, where the grid cell with the pumped well received recharge at the rate of 29 gpm. Hydraulic head distribution and rates of discharge from springs under steady-state flow conditions for recharge options R6 and R7 were different; however, decrease in the discharge from springs and drawdown in the pumped well under pumping, or "transient," conditions were identical for these recharge options.

Recharge alternatives R8 and R9 shifted larger amounts of recharge from the matrix areas into the large transmissivity solution features. Increased recharge to solution features resulted in excessive discharge at Indian Garden Spring and would have required unreasonable increases in solution feature transmissivity to achieve good calibration. Simulated groundwater level altitudes were in poor agreement with measured groundwater level altitudes. Distribution of recharge for options R8 and R9 did not match distribution of surface drainage area as closely as option R6.

Recharge option R10 shifted recharge from the solution feature along the axis of the Havasu downwarp and to the other solution features. Option R10 was used to investigate the possibility that recharge along the Havasu downwarp might be smaller because fewer fractures occur along folds than faults. Option R11 was a refinement of the recharge distribution in R10 based on surface drainage area for the solution features associated with faults. However, the angular pattern of surface water drainage channels indicates faults and fractures are present and that substantial recharge likely occurs along Cataract Canyon. Simulated groundwater levels for recharge option R11 were in poor agreement with measured groundwater levels.

Evaluation of results of simulations using these various recharge options indicates that recharge option R6 yields reasonable rates of discharge from springs and groundwater levels. In addition, of the recharge options considered, recharge option R6 is believed to provide the best approximation of recharge distribution for the conceptual model. Therefore, recharge option R6, which distributes 70 percent of recharge into model grid cells that represent faults, fractures, and solution features, was selected as the appropriate recharge option for the model.

Fault Interconnections

Important pathways for transmission of groundwater may occur between some of the major structural features in the model area that do not appear to be connected based analysis of visible features at land surface.

Therefore, model simulations were conducted with four different configurations of fault interconnections to investigate the potential occurrence of such hidden pathways. Input parameters for each of these simulations were adjusted as necessary to achieve acceptable agreement between simulated and measured pre-pumping groundwater levels and discharge from springs. The simulated configuration of fault interconnections that best represents the conceptual model for groundwater movement in the model area is referred to herein as the "base case." The simulations for the other three configurations of fault interconnections are referred to herein as "alternate calibrations." Detailed input parameters for steady-state simulations for the base case and alternate calibrations are given in **Appendix B**. Key features for these simulations are summarized as follows:

<u>BASE CASE:</u> Bright Angel Fault and Redlands Fault are not connected to Markham Dam fracture zone; Vishnu Fault, Red Horse Fault, and Williams fault zone are connected to Markham Dam fracture zone (**Figure 4**). Transmissivity of grid cells representing Indian Garden and Hermit Springs is equal to transmissivity of grid cells representing Bright Angel and Hermit Faults.

<u>ALTERNATE CALIBRATION NO. 1:</u> All faults, including the Bright Angel Fault, Redlands Fault, Vishnu Fault, Red Horse Fault, and Williams fault zone, are directly or indirectly connected to the Markham Dam fracture zone. Transmissivity of grid cells representing Indian Garden and Hermit Springs is equal to transmissivity of grid cells representing Bright Angel and Hermit Faults.

<u>ALTERNATE CALIBRATION NO. 2:</u> The Vishnu Fault is broken into northern and southern segments, which are separated by a 3,000-foot gap. The Bright Angel Fault, Redlands Fault, and northern segment of the Vishnu Fault are not connected to the Markham Dam fracture zone; the Red Horse Fault, Williams fault zone, and southern segment of the Vishnu Fault are connected to the Markham Dam fracture zone. Transmissivity of grid cells representing Indian Garden and Hermit Springs is much smaller than transmissivity of grid cells representing Bright Angel and Hermit Faults.

<u>ALTERNATE CALIBRATION NO. 3:</u> Assumes the Redwall-Muav aquifer is homogeneous and isotropic; transmissivity and storage coefficient are constant and uniform throughout model area. This alternative did not yield reasonable values for simulated steady-state discharge from Indian Garden and Hermit Springs (**Appendix B**); therefore, projections for decrease in discharge from springs under transient conditions are not valid or useful.

Preliminary simulations were conducted without a connection between the Hermit Fault and Bright Angel Fault. However, additional geologic and topographic data for Hermit Spring obtained during 1994 and 1995 led to refinement of the groundwater flow model, including addition of a connection between the Hermit Fault and Bright Angel Fault. For the base case and alternate calibrations no. 1 and no. 2, the Hermit Fault was assumed to be connected to the Bright Angel Fault via direct fault connection, fractures, or solution-enhanced transmissivity features.

Results of Steady-State Simulations

Results from more than 100 steady-state simulations, which were conducted to analyze various configurations of model input parameters to achieve acceptable calibration of the base case and alternate calibrations, indicate the following:

1. Computer-based numerical modeling using MODFLOW adequately simulates existing steady-state groundwater movement in the Redwall-Muav aquifer on the portion of the Coconino Plateau where groundwater originating as recharge from infiltration of precipitation is believed to discharge eventually at Havasu, Hermit, and Indian Garden Springs.

2. Although data for groundwater level and transmissivity data for the Redwall-Muav aquifer are not abundant in the sub-basin, available data, especially discharge data for springs, are sufficient to develop a groundwater flow model that is in acceptable agreement with the conceptual model for groundwater flow in the sub-basin.

3. The altitude of 3,280 feet msl shown on geologic maps for the base of the Muav Limestone in Hermit Canyon is too low. Results of field investigation indicate that the altitude for Hermit Spring is about 3,950 feet msl; results of model calibration also indicated that the altitude should be higher than 3,280 feet msl.

4. A large-transmissivity conduit through much of the model area along the Havasu downwarp, together with a network of medium-transmissivity zones along principal faults, are required to transmit large volumes of groundwater to Havasu Spring, which discharges about 29,000 gpm, and to drain the regional aquifer system so that simulated groundwater level altitudes are in acceptable agreement with measured groundwater levels in the model area.

5. Removal of a hypothetical medium-transmissivity connection between the Hermit Fault and the Bright Angel Fault results in simulated discharge from Hermit Spring that is unacceptably smaller than observed discharge.

6. The base case simulation conforms closely to the conceptual model, and results are in acceptable agreement with measured groundwater levels and rates of discharge from springs in the model area. Simulated groundwater levels resulting from alternate calibration no. 2 are in better agreement with measured groundwater levels; however, alternate calibration no. 2 is in poor agreement with the conceptual model.

STEADY-STATE MODEL: RESULTS OF CALIBRATION

Each simulation conducted with the numerical groundwater flow model yields discharge rates for constant-head model grid cells and distribution of hydraulic head in the variable-head (active) model grid cells. The constant-head grid cells are used to represent Havasu, Hermit, and Indian Garden Springs. Calibration of the steady-state model was conducted using a trial-and-error process whereby model input values for recharge and transmissivity were varied until model output values for discharge from springs and hydraulic head were acceptably similar to calibration targets. The distribution of recharge and transmissivity in the model grid cells is considered to be the result of the calibration process for the steady-state model. Storage coefficient is also an important aquifer parameter; however, storage coefficient does not affect steady-state groundwater flow and, consequently, it was not necessary to consider storage coefficient during calibration of the steady-state model.

Model calibrations are not unique, and several distributions of recharge and transmissivity may produce similar model output. However, the number of other plausible solutions is severely limited when attempts are made to match both simulated discharge from springs and distribution of hydraulic head with measured values using model input parameters that fit the conceptual model for the aquifer system. The base case provided an acceptable steady-state calibration and conformed to the conceptual model. This base case comprised the starting point for transient simulations conducted to project effects of proposed groundwater withdrawals and for sensitivity analyses. Steady-state simulations using alternate distributions of transmissivity and recharge (alternate calibration nos. 1, 2, and 3) were conducted to evaluate the effects on groundwater flow resulting from less likely, but possible, configurations of faults in the model area. Results of the alternate calibrations are discussed in subsequent sections of this report.

Distribution of Recharge

For the base case, total simulated recharge is equivalent to the combined discharge from springs of 29,600 gpm and is distributed over the active grid cells of the model, which represent about 4,038 square miles. Average value for recharge in the model is about 0.2 inch per year, or about 1.5 percent of average annual precipitation. The Redwall-Muav aquifer in the sub-basin is believed to receive recharge chiefly from downward movement of infiltrated precipitation along fractures and solution features; therefore, 70 percent of the recharge is distributed evenly over grid cells representing fracture systems and solution features, and 30 percent is distributed evenly over the remaining active grid cells representing relatively unfractured matrix rocks. Results of steady-state model calibration indicate that this distribution of recharge yields acceptable values for discharge from springs and hydraulic head.

Distribution of Transmissivity

For the base case, grid cells that represent relatively unfractured matrix rocks are assigned a transmissivity of 1,000 gpd/ft. Results of steady-state calibration indicate that, for the base case:

1. grid cells representing solution-enhanced permeability features along the Havasu downwarp and in the Markham Dam fracture zone should be assigned transmissivity of 5,000,000 gpd/ft;

2. grid cells representing fracture zones and solution-enhanced permeability features along the Williams fault zone should be assigned transmissivity of 1,000,000 gpd/ft; and,

3. grid cells representing fracture zones along other principal faults in the model area, including the Bright Angel, Vishnu, Red Horse, and Redlands Faults, should be assigned transmissivity of 400,000 gpd/ft.

Comparison of Measured and Simulated Steady-State Groundwater Levels

Simulated altitude of groundwater level for the calibrated base case for the steady-state model is shown on **Figure 5.** Measured and base case simulated groundwater levels for wells that are completed in the Redwall-Muav aquifer in the model area are summarized as follows:

WELL IDENTIFIER	LOCATION	MEASURED GROUNDWATER LEVEL ALTITUDE (feet, msl)	SIMULATED GROUNDWATER LEVEL ALTITUDE (feet, msl)	CALIBRATION ERROR (feet)
(A-25-2)27aba	Quivero	>3,327[a]	3,770	---
(A-26-2)01cdd	Valle	3,550	3,762	212
(A-26-2)11ddc	Valle	3,450	3,762	312
(A-29-3)20bcd	Canyon Mine	3,971	3,844	-127
(A-30-2)24bac	Tusayan	4,200	3,843	-357
(A-30-2)24caa	Tusayan	4,155	3,843	-312

[a] Measured groundwater level is not considered to be representative for the Redwall-Muav aquifer.

Although differences occur between measured and simulated groundwater levels (the "calibration error"), the general trends and patterns of simulated groundwater levels are similar to trends and patterns of measured groundwater levels, and conform with the conceptual model for the region. The calibration error is computed as the difference between measured groundwater level and simulated groundwater level, divided by measured groundwater level.

Alternate calibrations achieved a closer match than the base case between simulated and measured groundwater levels in one or more individual areas, but resulted in a poorer match in other areas. Alternate calibration no. 2 achieves a closer overall match than the base case; however, the base case was selected because it conforms best to the conceptual model for the sub-basin and because the differences between simulated and measured groundwater levels are acceptable. It should be emphasized that the projected affects on the discharge from springs were essentially the same for the base case as for the alternate calibrations. Therefore, the projected effects are not considered to be sensitive to calibration error for groundwater levels. The base case provides a compromise that results in an intermediate calibration error for groundwater level in most areas of the model.

Comparison of Observed and Computed Discharge from Springs

Simulated steady-state discharge rates for Indian Garden Spring, Hermit Spring, and Havasu Spring are 294 gpm, 309 gpm, and 28,997 gpm, respectively. The calibration error associated with projections for discharge from each of the three springs is computed as the difference between observed discharge and simulated discharge, divided by observed discharge. For all three springs, the calibration error associated with simulated discharge is less than 4 percent. Calibration error for discharge from each spring was smaller for the base case than for the alternate calibrations.

TRANSIENT FLOW MODEL

The steady-state model represents the groundwater flow system at pre-pumping equilibrium, where average rate of groundwater discharge at springs is equal to average rate of groundwater recharge to the aquifer, and groundwater levels are stable. Present and proposed pumping from the Redwall-Muav aquifer will disturb this equilibrium. For the non-equilibrium or "transient" flow model, a stress is applied to the system in the form of a pumping well, and groundwater levels change over time in response to pumping from wells.

Distribution of Storage

Storage coefficient is a required model input parameter for transient simulations. Values for storage coefficient are assigned to model features based on the conceptual model for the groundwater flow system. Grid cells representing matrix rocks, in areas where major fracture systems and solution features are not believed to occur, are assigned a storage coefficient of 0.001 (dimensionless). Grid cells representing fracture- and solution-enhanced permeability features along the Havasu downwarp and simulated fault and fracture systems **(Figure 4)** are assigned a storage coefficient of 0.005.

Projected Effects of Pumping on Discharge from Major Springs

Potential effects on discharge from springs were projected for different pumping regimens by varying location, pumping duration, and pumping rate for the pumped well.

LOCATION: Potential effects on discharge from springs were projected for a well located at the Airport Graben site and for a well located at the Valle site **(Figure 2)**. Decrease in the discharge from springs is projected as follows for the base case for a well pumping 300 gpm of groundwater for 50 years at either of these locations:

LOCATION OF PUMPED WELL	DECREASE IN DISCHARGE: INDIAN GARDEN SPRING (gpm)	INDIAN GARDEN SPRING (percent)	HERMIT SPRING (gpm)	HERMIT SPRING (percent)	HAVASU SPRING (gpm)	HAVASU SPRING (percent)
AIRPORT GRABEN	42	14.3	25	8.1	186	0.6
VALLE	7	2.4	4	1.3	230	0.8

These results indicate that projected decreases in the discharge from Indian Garden and Hermit Springs are substantially larger for a pumping center at the Airport Graben than for a pumping center at Valle. Projected decrease in the discharge from Havasu Spring is slightly larger for a pumping center at Valle than for a pumping center at the Airport Graben; however, both decreases are very small. Projected decreases in the discharge from each spring for a pumping center at Valle are small, are less than the typical accuracy associated with streamflow measurements, and are believed to be less than the natural variability in discharge rate from the three springs. Consequently, the projected effects for a pumping center at Valle are sufficiently small that it may be difficult to distinguish decreases in the discharge from springs due to the pumping from apparent decreases due to common error of streamflow measurements or actual decreases due to natural variability in discharge rate.

For a well pumping 300 gpm of groundwater at the Airport Graben site for 50 years, projected groundwater level drawdown in the Redwall-Muav aquifer is shown on **Figure 6**. For a well pumping 300 gpm of groundwater at the Valle site for 50 years, projected groundwater level drawdown in the Redwall-Muav aquifer is shown on **Figure 7**.

It should be noted that the effects on the discharge from springs and regional groundwater levels resulting from pumping at several wells in a well field would be nearly identical to effects resulting from pumping at a single well, provided that the combined total pumping rate for the well field would be equal to the pumping rate for the single well. Near the pumping center, groundwater level drawdown caused by a well field would be less than drawdown caused by a single well pumping at the total pumping rate for the well field. However, with increasing distance from the pumping center, drawdown caused by a well field would approach the hypothetical drawdown for a single well pumping at the total pumping rate for the well field. Therefore, projections presented in this report for effects on the discharge from springs resulting from pumping at a single well would be effectively identical to effects on the discharge from springs resulting from pumping a well field with the same pumping center and at the same total pumping rate as the single well.

DURATION OF PUMPING: The relation between duration of pumping and projected decrease in discharge from springs is shown on **Figure 8** for a well pumping groundwater at a rate of 300 gpm and located at either the Airport Graben site or the Valle site. Inspection of **Figure 8** indicates that the projected rate of decrease in the discharge from springs occurs steadily during the first 10 years of pumping; the highest rates of decrease are projected for Indian Garden and Hermit Springs in response to pumping at Airport Graben, the lowest rates of decrease are projected for all three springs in response to pumping at Valle and for Havasu Spring in response to pumping at Airport Graben. From 10 to 50 years of pumping, the projected rate of decrease in discharge slows substantially. After 100 years of pumping, 80 to more than 90 percent of projected decreases in discharge from springs have already occurred and the groundwater flow system approaches a new state of dynamic equilibrium. In this new state of dynamic equilibrium, groundwater levels and rates of discharge from springs are stable, and the total decrease in discharge from springs is approximately equal to the pumping rate from the simulated pumping center. For a well pumping 300 gpm of groundwater at the Airport Graben site for 10, 50, and 100 years, decrease in discharge from springs is projected as follows:

DURATION OF PUMPING	DECREASE IN DISCHARGE						
	INDIAN GARDEN SPRING		HERMIT SPRING		HAVASU SPRING		TOTAL
(years)	(gpm)	(percent)	(gpm)	(percent)	(gpm)	(percent)	(gpm)
10	21	7.1	12	3.9	68	0.2	101
50	39	13.3	24	7.8	168	0.6	231
100	43	14.6	26	8.4	204	0.7	273

For a well pumping 300 gpm of groundwater at the Valle site for 10, 50, and 100 years, decrease in discharge from springs is projected as follows:

DURATION OF PUMPING	DECREASE IN DISCHARGE						
	INDIAN GARDEN SPRING		HERMIT SPRING		HAVASU SPRING		TOTAL
(years)	(gpm)	(percent)	(gpm)	(percent)	(gpm)	(percent)	(gpm)
10	2	0.7	1	0.3	154	0.5	157
50	6	2.0	4	1.3	241	0.8	251
100	8	2.7	5	1.6	266	0.9	279

PUMPING RATE: The relation between pumping rate and projected decrease in discharge from springs after 50 years of pumping is shown on **Figure 9**. This relation is linear for all springs and both simulated pumping centers. Therefore, effects on discharge from springs for pumping at rates other than 300 gpm at either of the simulated pumping centers can be projected easily using **Figure 9**. For example, doubling the simulated pumping rate from 200 gpm to 400 gpm would double the projected decrease in discharge from springs for the same pumping duration and well location.

Because the relation between decrease in discharge from springs and pumping rate is linear, effects of pumping at existing and potential future wells in Tusayan and Valle can also be projected using **Figure 9**. For example, the two Tusayan wells have a reported combined pump capacity of 160 gpm. Inspection of **Figure 9** indicates that the projected decrease in discharge from springs resulting from pumping 160 gpm from the Tusayan wells is about 7 percent for Indian Garden Spring, 4 percent for Hermit Spring, and less than 1 percent for Havasu Spring. The effects of pumping from different wells are additive; therefore, the cumulative decrease in discharge from springs resulting from any combination of pumping rates for existing and potential future wells in the Tusayan and Valle areas, for a particular time period, could be calculated by adding projected effects for each well (**Figure 9**).

Projected Effects of Pumping on Discharge from Other Springs

Due to the limited available data for selected hydrogeologic parameters and the regional scale of the groundwater flow model, projections of effects on discharge from springs are considered approximate, and likely are only accurate for Havasu, Hermit, and Indian Garden Springs, which discharge large quantities of groundwater and are known to be in good hydraulic connection with the regional Redwall-Muav aquifer. Therefore, the groundwater flow model was not used to quantify projected effects of pumping on the many small springs in the model area (**Table 1**). However, hydrogeologic data and general conclusions from the modeling investigations can be used to estimate reasonable and worst-case effects of pumping on these smaller springs.

Small amounts of groundwater that issue from the Redwall-Muav aquifer at other seeps and small springs along the south wall of the Grand Canyon are believed to result from recharge in local drainage basins along the canyon rim; these seeps and small springs likely neither influence nor are influenced by regional patterns of groundwater movement and pumping in the Redwall-Muav aquifer.

Perched aquifers are the sources for springs and seeps that issue from formations overlying the Redwall-Muav aquifer in the Coconino Plateau groundwater sub-basin. These perched aquifers and associated springs and seeps are not in hydraulic connection with the Redwall-Muav aquifer, and are not influenced by groundwater levels or movement in the Redwall-Muav aquifer. Therefore, pumping from wells completed solely in the Redwall-Muav aquifer can not influence discharge from springs that issue from overlying formations.

The Bright Angel Shale strongly retards movement of groundwater between the Redwall-Muav aquifer and the underlying Tapeats Sandstone and Precambrian rocks. However, the Bright Angel Shale, Tapeats Sandstone, and Precambrian rocks are saturated and discharge small quantities of groundwater to seeps and springs (**Table 1**) in the Coconino Plateau groundwater sub-basin, suggesting that small amounts of groundwater move slowly downward through the Bright Angel Shale. Drawdown of groundwater level in the Redwall-Muav aquifer resulting from pumping a well or well field (**Figures 6 and 7**) would slightly reduce the downward vertical hydraulic gradient through the Bright Angel Shale and, therefore, might have a small effect on groundwater flow in underlying formations. However, because the springs that issue from the Bright Angel Shale, Tapeats Sandstone, and Precambrian rocks are in poor hydraulic connection with the Redwall-Muav aquifer, effects on these springs from pumping in the Redwall-Muav aquifer would likely be much smaller than effects on springs that issue from the Redwall-Muav aquifer. Therefore, pumping from wells in the Redwall-Muav aquifer is not expected to have a substantial effect on springs that issue from underlying formations.

SENSITIVITY ANALYSES

Sensitivity analyses were conducted in two stages. The first stage was conducted to determine the effects on steady-state model results of varying input parameters. The second stage was conducted to determine the reasonable range of projected discharge from springs and drawdown of groundwater level that result from varying model input parameters for transient simulations. Results of sensitivity analyses are given in **Appendix B** and are discussed below.

Steady-State Flow Model Sensitivity

The first stage of sensitivity analyses consisted of a simple analysis conducted by substituting maximum and minimum values in place of the base case value for each input parameter to the steady-state model. These input parameters include: 1) transmissivity of matrix rocks; 2) transmissivity of fault zones; 3) transmissivity of the Havasu downwarp and Markham Dam fracture zone; 4) recharge rate into matrix rocks; and 5) recharge rate into fault zones, the Havasu downwarp, and the Markham Dam fracture zone. For each input parameter changed, a steady-state simulation was conducted to evaluate sensitivity of computed hydraulic head and computed discharge rates at Indian Garden, Hermit, and Havasu Springs to the changed input parameter.

TRANSMISSIVITY: Transmissivity values for grid cells that represent matrix rocks, fault zones, and the Havasu downwarp and Markham Dam fracture zone were changed individually by factors of 0.5 and 2.0 to evaluate model sensitivity to changes in transmissivity. Changes in transmissivity generally resulted in large changes in projected discharge at Indian Garden Spring and Hermit Spring, and small changes in projected discharge at Havasu

Spring, compared to the base case (Appendix B). Changes in simulated hydraulic head at the Canyon Mine well, Tusayan, and Valle calibration targets were small for changes in transmissivity for grid cells representing matrix rocks. Changes in simulated hydraulic head at the calibration targets were large for changes in transmissivity in grid cells representing fault zones and the Havasu downwarp and Markham Dam fracture zone.

RECHARGE DISTRIBUTION: For the sensitivity analyses, distribution of recharge to grid cells was changed to represent the following extreme cases: 1) recharge was distributed uniformly across the model grid; and 2) all recharge entered the model grid in grid cells representing faults, the Havasu downwarp, and the Markham Dam fracture zone (Appendix B). In both cases, the total amount of recharge applied to the model was equal to the combined discharge rate of 29,600 gpm for Havasu, Hermit, and Indian Garden Springs. Each of these recharge distributions yielded small to moderate changes in simulated discharge from springs, and moderate changes in hydraulic head at the calibration targets.

Transient Flow Model Sensitivity

Values for discharge from springs resulting from steady-state sensitivity analyses, described above, frequently were unrealistically large or small. For example, increasing the matrix transmissivity by a factor of 2.0 resulted in negative simulated discharge at Indian Garden and Hermit Springs, forcing water to flow into the model at these springs. Transient simulations based on such unreasonable steady-state model results would have been of dubious value and may have led to erroneous conclusions. Therefore, transient sensitivity analyses were conducted in a slightly different manner from steady-state sensitivity analyses. Following is a summary of the method used to conduct the transient sensitivity analyses:

1. The model input parameter of interest was assigned a new value; for example, matrix transmissivity would be doubled.

2. A second, related input parameter was changed; for example, fault transmissivity might have been halved.

3. Steady-state model simulations were conducted and repeated with adjusted values for the second input parameter to achieve a new steady-state model with reasonable simulated rates of discharge from springs. These simulations are referred to as "adjusted steady-state simulations" in this report.

4. Transient simulations, using input parameters from the adjusted steady-state calibrations, were conducted. Decrease in discharge from springs for the transient sensitivity analyses was calculated as the difference between rates of discharge from springs for the adjusted steady-state sensitivity analysis and the corresponding transient sensitivity analysis.

This method was also used to conduct the alternate calibrations described earlier in this report. However, the alternate calibrations consisted of different configurations of faults and fault connections, and more than one input parameter for the alternate calibrations was adjusted to achieve new steady-state calibrations with reasonable simulated rates of discharge from springs (**Appendix B**).

Transient sensitivity analysis simulations were conducted to determine effects of variation in transmissivity, storage coefficient, and recharge distribution on discharge from springs. For the transient sensitivity analyses, both the Airport Graben and the Valle well sites were considered; simulated pumping rate was 300 gpm and duration of pumping was 50 years. Results for transient sensitivity analyses and alternate calibrations are given in **Appendix B** and are summarized on **Figure 10**.

The adjusted steady-state calibrations conducted as part of the transient sensitivity analyses generally yield reasonable values for simulated steady-state discharge from springs. However, adjusted calibrations for increased values of matrix transmissivity and for uniform recharge distribution result in simulated steady-state discharge from Indian Garden and Hermit Springs of less than 200 gpm, which is unreasonably small compared to the reported discharge of 300 gpm from these springs. Therefore, projected effects on discharge from springs resulting from transient sensitivity analyses for increased matrix transmissivity and for uniform recharge distribution likely are inaccurate, and are excluded from the statistical analysis presented below for the transient sensitivity analyses.

Figure 10 shows projected decrease in discharge from springs as a percentage of simulated pre-pumping discharge at Havasu, Hermit, and Indian Garden Springs resulting from pumping 300 gpm for 50 years at either the Airport Graben site or the Valle site. Projected decrease in discharge from springs is substantially larger for the Airport Graben site than for the Valle site. Results are shown for the base case, the transient sensitivity analyses, and alternate calibration nos. 1 and 2. These simulations represent the reasonable range of model input parameters and configurations of faults and other hydrogeologic features that could be applied to the groundwater flow model, given the available hydrogeologic data. Therefore, the projected decreases in discharge from springs shown on **Figure 10** represent the reasonable range of effects on springs resulting from withdrawing groundwater at a rate of 300 gpm.

Inspection of **Figure 10** and **Appendix B** indicates that, for transient sensitivity analyses and alternate calibration nos. 1 and 2, with a well pumping 300 gpm from either the Airport Graben site or the Valle site for 50 years, projected decrease in discharge from springs is as follows:

	CHANGE IN DISCHARGE ....(percent decrease from base case)...............			
WELL LOCATION	INDIAN GARDEN SPRING (percent)	HERMIT SPRING (percent)	HAVASU SPRING (percent)	TOTAL (percent)
AIRPORT GRABEN SITE				
BASE CASE	14.3	8.1	0.6	0.9
MAXIMUM	25.4	21.6	0.8	0.9
MINIMUM	2.5	1.9	0.4	0.8
AVERAGE	14.8	9.8	0.6	0.8
STANDARD DEVIATION	6.6	4.5	0.1	---
VALLE SITE				
BASE CASE	2.4	1.3	0.8	0.8
MAXIMUM	3.8	3.2	0.9	0.9
MINIMUM	0.7	0.6	0.6	0.6
AVERAGE	2.0	1.5	0.8	0.8
STANDARD DEVIATION	0.9	0.7	0.1	---

Following are the salient conclusions regarding results of transient sensitivity analyses and alternate calibrations:

1. Despite large variations in model input parameters for the sensitivity analyses and alternate calibrations, the range of projected decreases in discharge from springs resulting from pumping a well at 300 gpm for 50 years, for either the Airport Graben site or the Valle site, is relatively small. If the well would be located at the Airport Graben site, the projected decrease in discharge from springs is in the range from about 2 to 25 percent of pre-pumping discharge for Hermit and Indian Garden Spring, and is less than 1 percent of pre-pumping discharge for Havasu Spring. If the well would be located at the Valle site, the projected decrease in discharge from springs is in the range from about 1 to 4 percent of pre-pumping discharge for Hermit and Indian Garden Springs, and less than 1 percent of pre-pumping discharge for Havasu Spring.

   It should be noted that typical measurement error and natural variability in discharge rate for Havasu, Hermit, and Indian Garden Springs likely are larger than the projected effects for pumping at the Valle site. Therefore, small decreases in discharge from springs projected to result from pumping at the Valle site may be difficult to observe and measure at the springs.

2. The groundwater flow model is most sensitive to changes in transmissivity for grid cells representing unfractured matrix rocks and for grid cells representing the Havasu downwarp and the Markham Dam fracture zone. The groundwater flow model is least sensitive to changes in transmissivity for grid cells representing fault zones, changes in storage coefficient, and changes in recharge distribution.

3. With two notable exceptions, hydraulic heads resulting from the base case steady-state simulation are in better agreement with the calibration targets than are hydraulic heads resulting from the sensitivity analyses and alternate calibrations. The exceptions are alternate calibration no. 2 and the adjusted sensitivity analysis simulation with increased transmissivity for grid cells that represent the Havasu downwarp and the Markham Dam fracture zone. For each of these exceptions, however, the improved match between simulated and measured groundwater levels at the calibration targets is negated by larger calibration error in discharge from springs and poor agreement with the conceptual model for groundwater flow in the region.

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TABLE 1. SUMMARY OF REPORTED DISCHARGE FROM SPRINGS ALONG THE SOUTH WALL OF THE GRAND CANYON AND ITS TRIBUTARY CANYONS FROM COTTONWOOD CREEK CANYON TO PEACH SPRINGS CANYON

SPRING IDENTIFIER	SOURCE ROCK	REPORTED DISCHARGE (gpm)
MINER'S SPRING	REDWALL-MUAV AQUIFER	---
O'NEILL SPRING	REDWALL-MUAV AQUIFER	---
COTTONWOOD SPRING	REDWALL-MUAV AQUIFER	5[a]
UNNAMED SPRING NO. 1	BRIGHT ANGEL SHALE	<1[a]
UNNAMED SPRING NO. 2	BRIGHT ANGEL SHALE	<1[a]
GRAPEVINE SPRING	REDWALL-MUAV AQUIFER	10[a]
BOULDER SPRING	BRIGHT ANGEL SHALE	<1[a]
LONETREE SPRING	BRIGHT ANGEL SHALE	<1[a]
PIPE SPRING	REDWALL-MUAV AQUIFER	1[a]
BURRO SPRING	REDWALL-MUAV AQUIFER	1[a]
UNNAMED SPRING NO. 3	PRECAMBRIAN ROCKS	<1[a]
INDIAN GARDEN SPRING	REDWALL-MUAV AQUIFER	300[a]
HORN SPRING	REDWALL-MUAV AQUIFER	---
SALT CREEK SPRING	TAPEATS SANDSTONE	<1[a]
CEDAR SPRING	TAPEATS SANDSTONE	<1[a]
MONUMENT SPRING	TAPEATS SANDSTONE	5[a]
DRIPPING SPRING NO. 1	COCONINO SANDSTONE	<1[a]
DRIPPING SPRING NO. 2	COCONINO SANDSTONE	<1[a]
SANTA MARIA SPRING	SUPAI GROUP	1[a]
FOURMILE SPRING	SUPAI GROUP	---
HERMIT SPRINGS (COMPOSITE)	REDWALL-MUAV AQUIFER	300[b]
BOUCHER CREEK	REDWALL-MUAV AQUIFER	20[c]
SEEP SPRING	COCONINO SANDSTONE	---
ELVES MAIN SPRING	REDWALL-MUAV AQUIFER	25[d]
ELVES JOINT SPRING	REDWALL-MUAV AQUIFER	15[d]
FOSSIL SPRING	COCONINO SANDSTONE	---
GREAT THUMB SPRING	COCONINO SANDSTONE	---
KEYHOLE SPRING	SUPAI GROUP	---
MATKATAMIBA SPRING	REDWALL-MUAV AQUIFER	30[d]
HAVASU SPRING	REDWALL-MUAV AQUIFER	29,000[e]
UNNAMED SPRING NO. 4	REDWALL-MUAV AQUIFER	---
UNNAMED SPRING NO. 5	SUPAI GROUP	---
UNNAMED SPRING NO. 6	SUPAI GROUP	---
UNNAMED SPRING NO. 7	COCONINO SANDSTONE	---
BACHATHAIVA SPRING	COCONINO SANDSTONE	---
HIGH WALL SPRING	SUPAI GROUP	---
SINYELLA SPRING	COCONINO SANDSTONE	---
NATIONAL CANYON SPRING	REDWALL-MUAV AQUIFER	---
HORSE HAIR SPRING	SUPAI GROUP	---
OVERHANG SPRING	COCONINO SANDSTONE	---
RED SPRING	COCONINO SANDSTONE	---
MOSS SPRING	COCONINO SANDSTONE	---
WARM SPRING	REDWALL-MUAV AQUIFER	3,000[f]
MOHAWK SPRING	REDWALL-MUAV AQUIFER	---
HONGA SPRING	SUPAI GROUP	<1[g]
CEMENT TANK SPRING	SUPAI GROUP	---
HELLS HOLLOW SPRING	SUPAI GROUP	<0.25[g]
BEECHER SPRING	SUPAI GROUP	0.25[g]
BIG SPRING	COCONINO SANDSTONE	2[g]
HOCKEY PUCK SPRING	COCONINO SANDSTONE	<1[g]
PUMPKIN SPRING	TAPEATS SANDSTONE	2[f]
THREE SPRINGS	REDWALL-MUAV AQUIFER	---
TWO-SEVENTEEN MILE SPRING	REDWALL-MUAV AQUIFER	---
TWO-TWENTY TWO MILE SPRING	REDWALL-MUAV AQUIFER (?)	---

TABLE 1. SUMMARY OF REPORTEO OISCHARGE FROM SPRINGS ALONG THE SOUTH WALL OF THE GRANO CANYON AND ITS TRIBUTARY CANYONS FROM COTTONWOOD CREEK CANYON TO PEACH SPRINGS CANYON

SPRING IOENTIFIER	SOURCE ROCK	REPORTEO DISCHARGE (gpm)
GRANITE SPRINGS	REOWALL-MUAV AQUIFER (?)	---
BUSHY SEEP	REOWALL-MUAV AQUIFER	---
ROCKY SPRING	TAPEATS SANOSTONE	---
ROBBERS ROOST SPRING	REOWALL-MUAV AQUIFER	---
OIAMONO SEEP	REOWALL-MUAV AQUIFER	---
DIAMOND SPRING	REDWALL-MUAV AQUIFER	300[h]
UPPER DIAMOND SPRING	REOWALL-MUAV AQUIFER	450[f]
EAST DIAMONO SPRING	REOWALL-MUAV AQUIFER	72[f]
BLUE MOUNTAIN SEEP	REOWALL-MUAV AQUIFER	---

NOTE: Data for source rock was verified with George Billingsley, U.S. Geological Survey, Flagstaff, Arizona (personal communication, June 1996).

[a] Metzger (1961)

[b] Calculated based on data from Goings (1985)

[c] Johnson & Sanderson (1968)

[d] Loughlin and Huntoon (1983)

[e] U.S. Geological Survey (1954)

[f] Huntoon (1977)

[g] Boyer (1977)

[h] Twenter (1962)

$<$ = Less than
--- = Not reported or unknown
(?) = Uncertain

TABLE 2. RECORDS FOR WATER WELLS IN THE REDWALL-MUAV AQUIFER
COCONINO PLATEAU GROUNDWATER SUB-BASIN
COCONINO COUNTY, ARIZONA

WELL IDENTIFIER	OWNER	DATE COMPLETED	DEPTH DRILLED (feet)[a]	CASING: DIAMETER (inches)	CASING: DEPTH INTERVAL (feet)[a]	REPORTED PUMPING RATE (gpm)[b]	LAND SURFACE ALTITUDE (feet msl)[c]	STATIC WATER LEVEL: DEPTH (feet)[a]	STATIC WATER LEVEL: DATE MEASURED	STATIC WATER LEVEL: ALTITUDE (feet msl)[c]	REPORTED USE[d]	REMARKS
(A-25-2)27aba	Black Mesa Pipleline Inc.	12- -69	3,685	7	0-2,880	---	6,165	2,838	12-16-69	3,327	U	Not used due to poor water quality and well yield; penetrates Tapeats Sandstone
(A-26-2)01cdd	Grand Canyon Equipment	12-28-94	3,200	8	0-2,630	41	6,050	2,500	12- -94	3,550	D	
(A-26-2)11ddc	Grand Canyon Valle Corp.	06-15-94	3,450	8	0-2,602	85	6,000	2,550	06- -94	3,450	M	
(A-29-3)20bcd	Energy Fuels Nuclear	11-30-86	3,086	5 1/2	0-3,086	5	6,507	2,534	07-29-93	3,973	I	Casing perforated from 2,584 to 2,960 feet below land surface
(A-30-2)24bac	Halvorson Seibold	05-03-94	3,000	8	2,306	80	6,600	2,400	05- -94	4,200	PS	
(A-30-2)24caa	Southwestern Groundwater	05-01-89	3,180	8	2,330	80	6,575	2,420	05- -89	4,155	PS	
(B-32-4)24c	---	- -96	3,110	---	2,560	---	5,620	2,380	- -96	3,240	---	Data supplied by U.S. Geological Survey; well construction not completed
(B-28-1)35cab	Sinclair Oil and Gas	05- -52	3,544	9 5/8	2,205	---	6,005	---	---	---	U	Oil exploration boring; cement plug set at 1,236 feet below land surface

NOTE:

[a] Feet below land surface

[b] Gallons per minute

[c] Feet above mean sea level

--- = Not known or not reported

[d] U = Unused
D = Domestic
M = Municipal
I = Industrial
PS = Public Supply

582\EIS.DFT\WATERLEV.TAB\07-05-96

582/LOC-MAP SRF/07-05-96

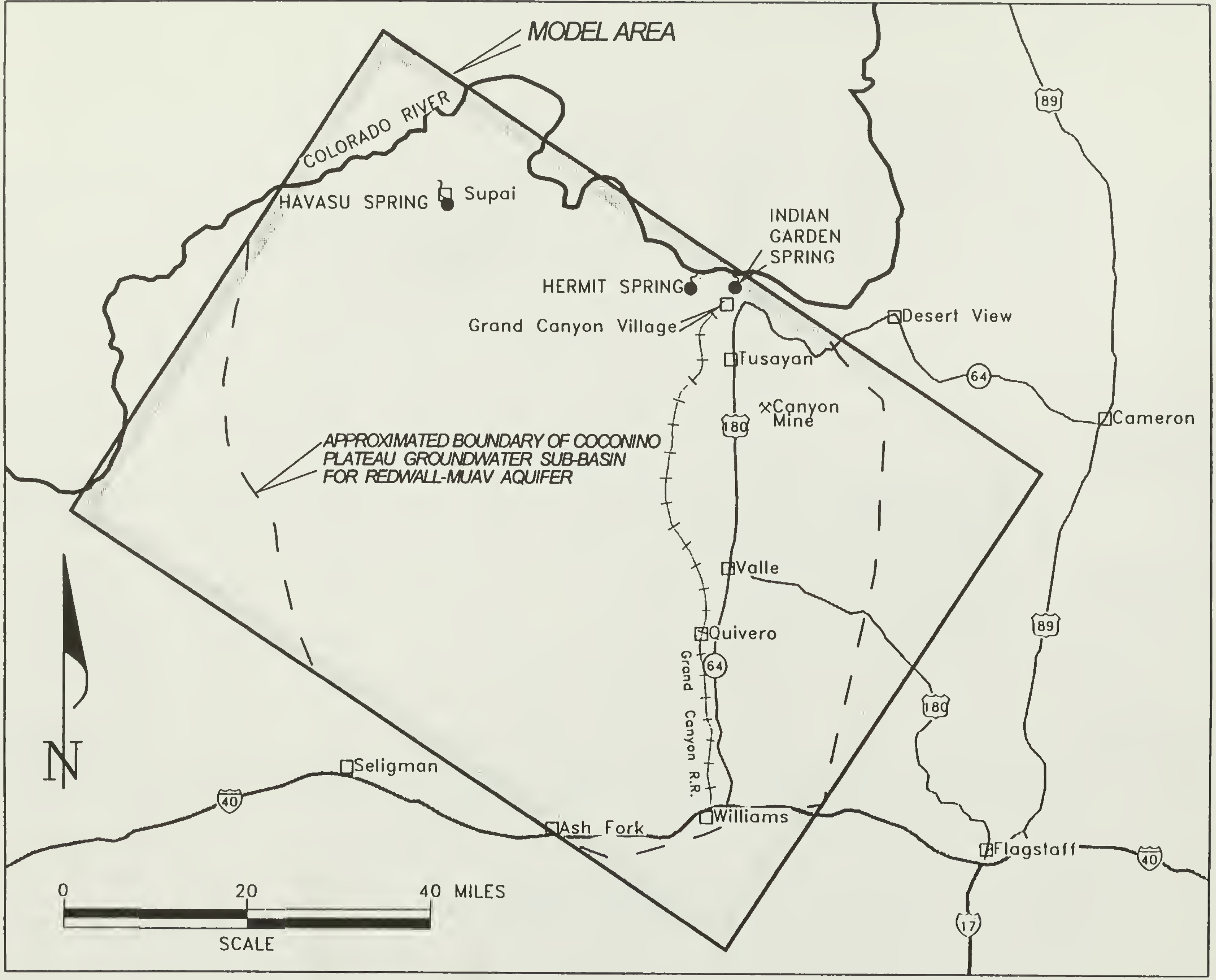

FIGURE 1. LOCATION MAP

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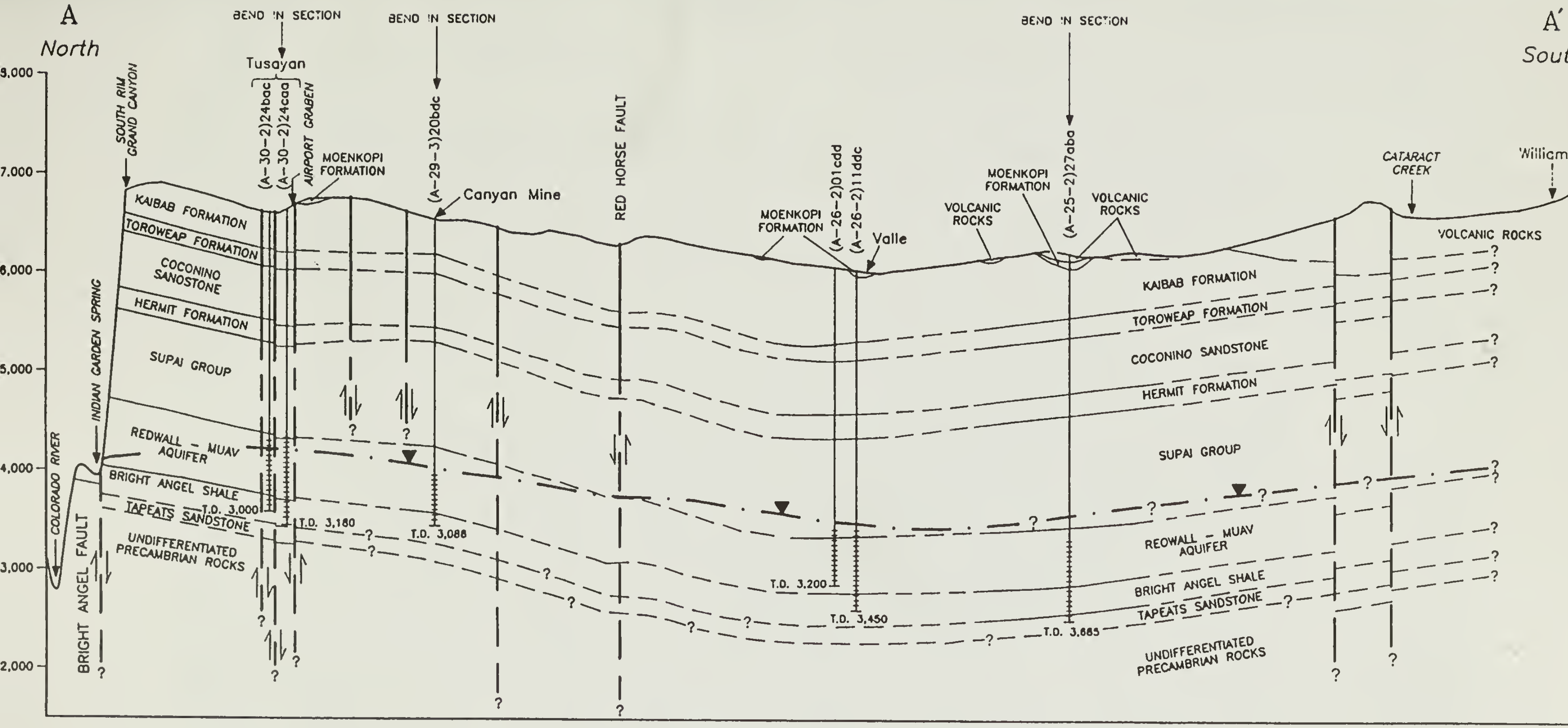

EXPLANATION

PRE–PUMPING GROUNDWATER LEVEL: Located approximately, queried where uncertain

GEOLOGIC CONTACT: Dashed where located approximately, queried where uncertain

FAULT: Dashed where located approximately, queried where uncertain

(A–30–2)24bac — STATE WELL NUMBER

PERFORATED CASING OR OPEN HOLE

T.D. 3,000 — TOTAL DEPTH DRILLED, IN FEET

0 5 10 15

MILES

VERTICAL EXAGGERATION 20.84:1

FIGURE 3. GENERALIZED HYDROGEOLOGIC SECTION A–A′

TUSAYAN/YSAA–SIJ/07–05–98

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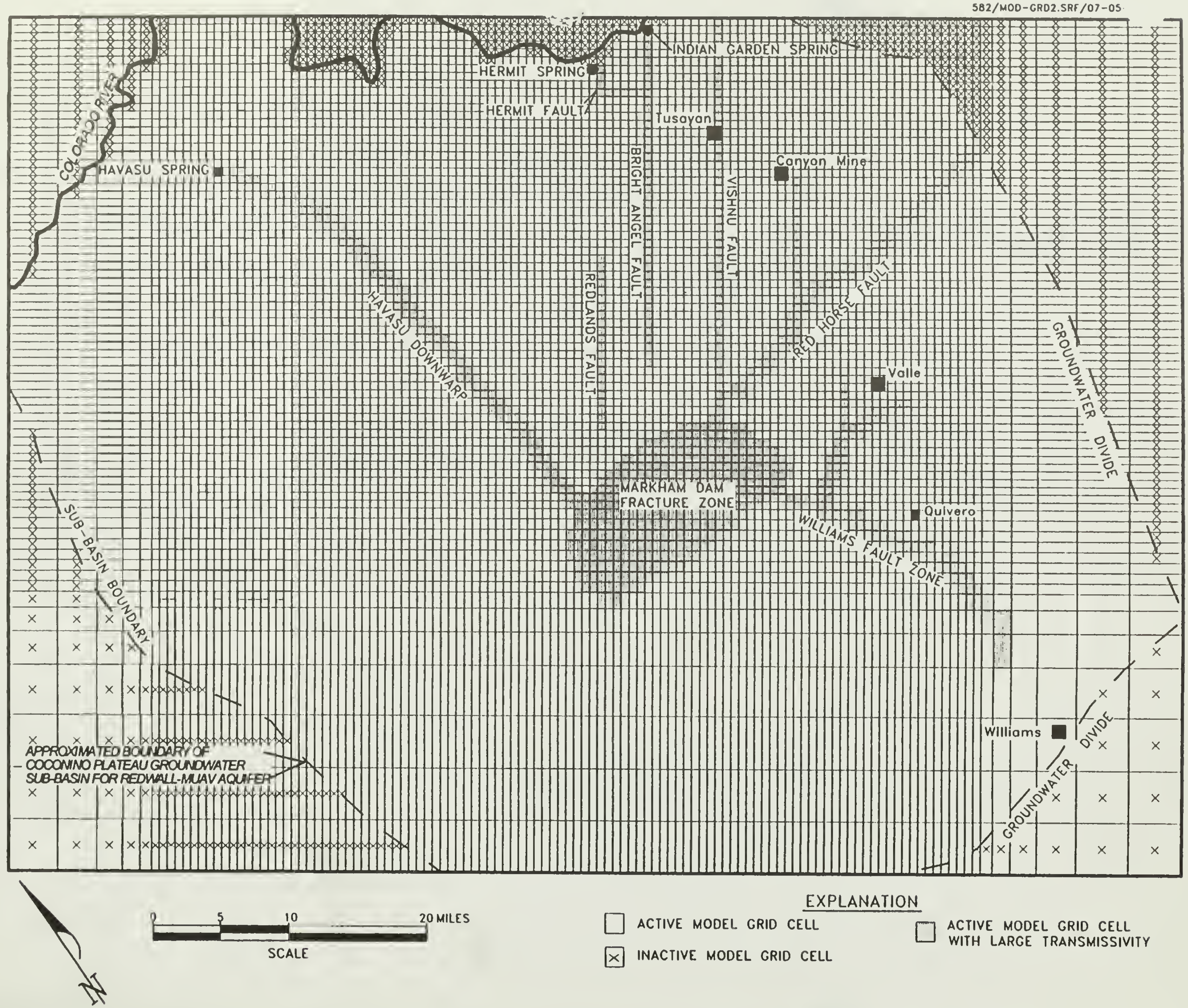

FIGURE 4. FINITE-DIFFERENCE MODEL GRID

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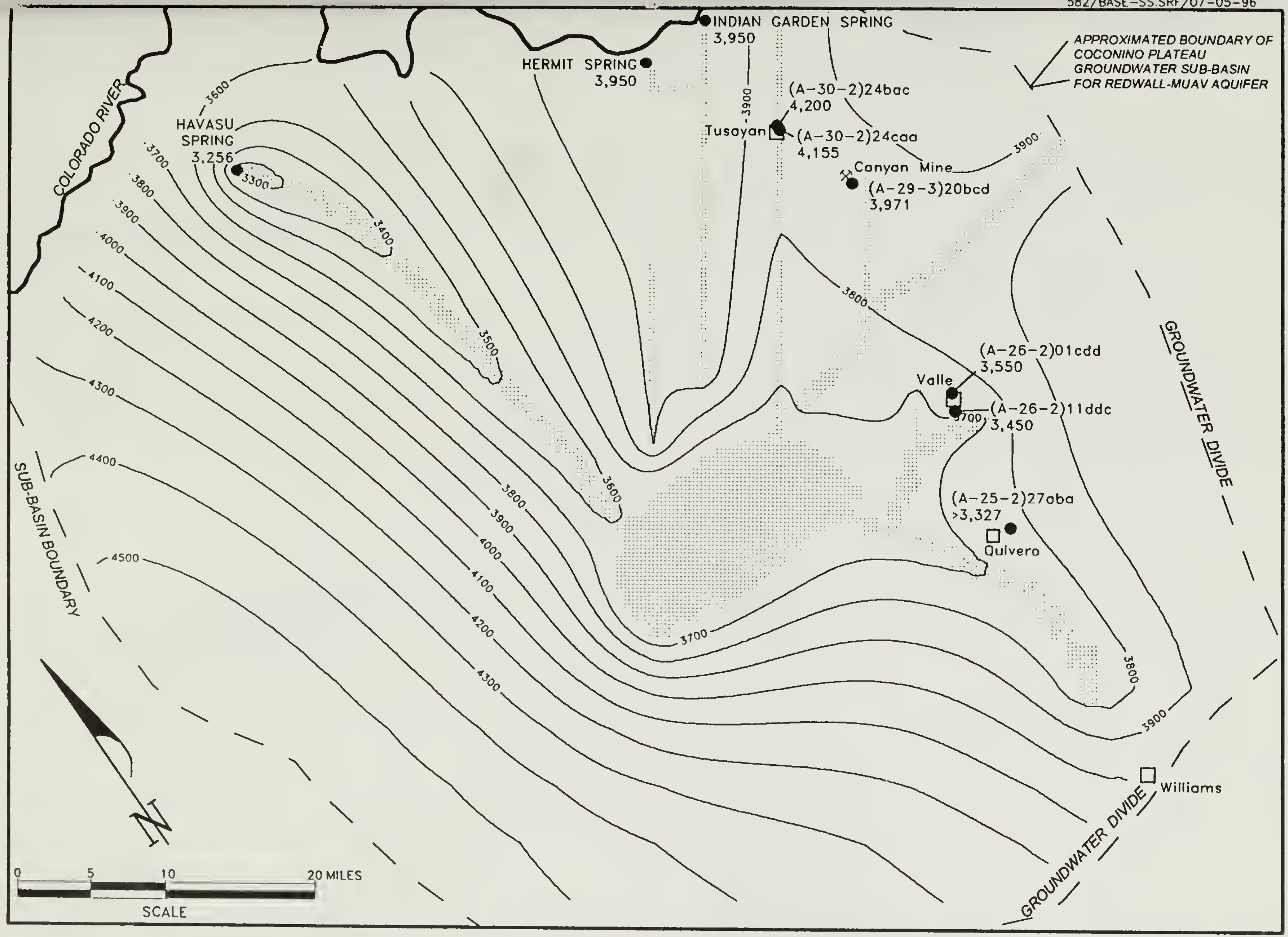


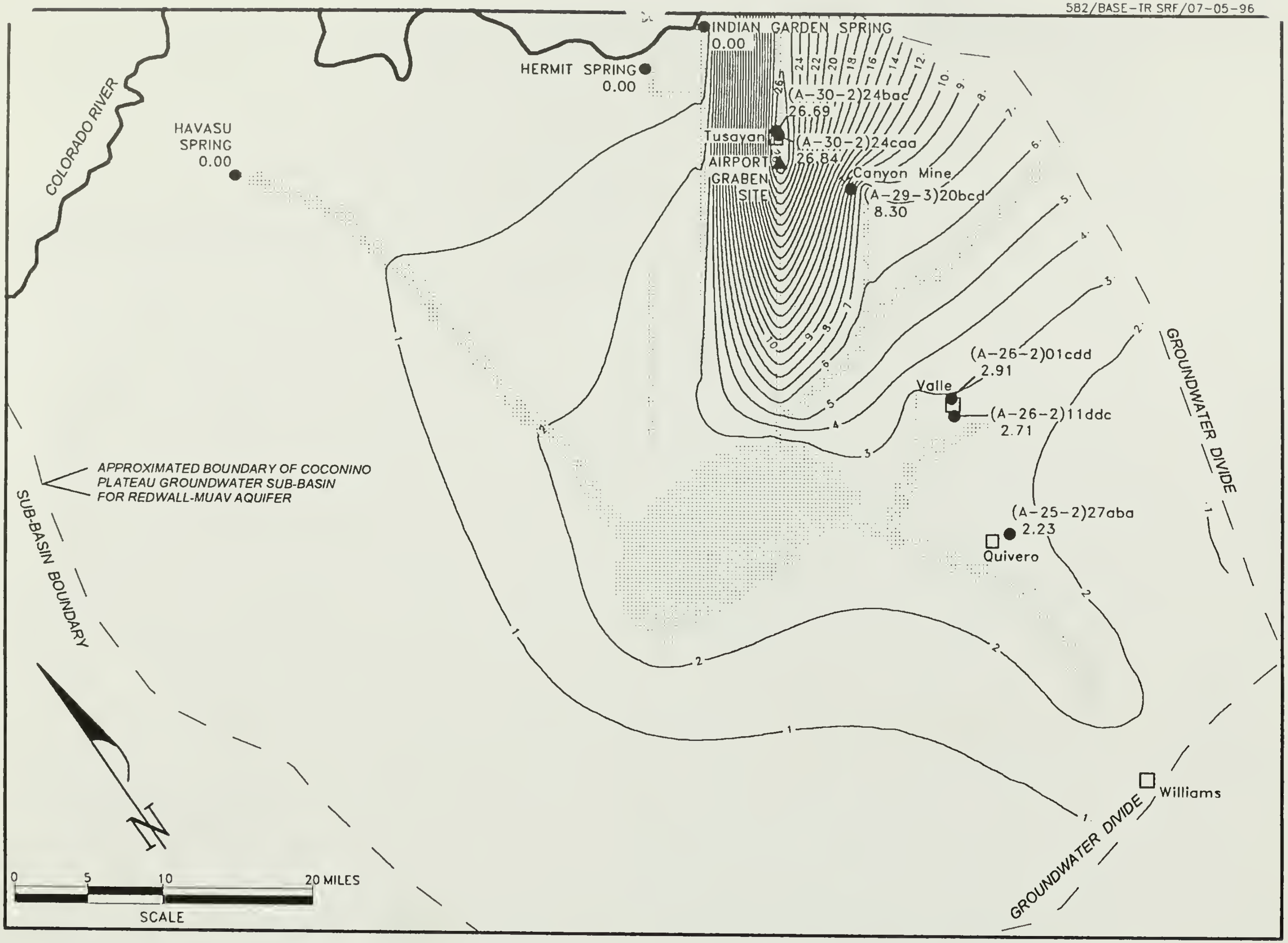
HERMIT SPRING ● 3,950 — SPRING OR GROUNDWATER WELL AND IDENTIFIER; MEASURED GROUNDWATER LEVEL ALTITUDE IN REDWALL-MUAV AQUIFER, IN FEET MSL

——3700—— SIMULATED STEADY-STATE GROUNDWATER LEVEL CONTOUR

ZONE OF LARGE TRANSMISSIVITY

FIGURE 5. SIMULATED STEADY-STATE (PRE-PUMPING) GROUNDWATER LEVEL

ERROL L. MONTGOMERY & ASSOCIATES, INC.



HERMIT SPRING ● SPRING OR GROUNDWATER WELL AND IDENTIFIER
0.00 —— PROJECTED DRAWDOWN, IN FEET

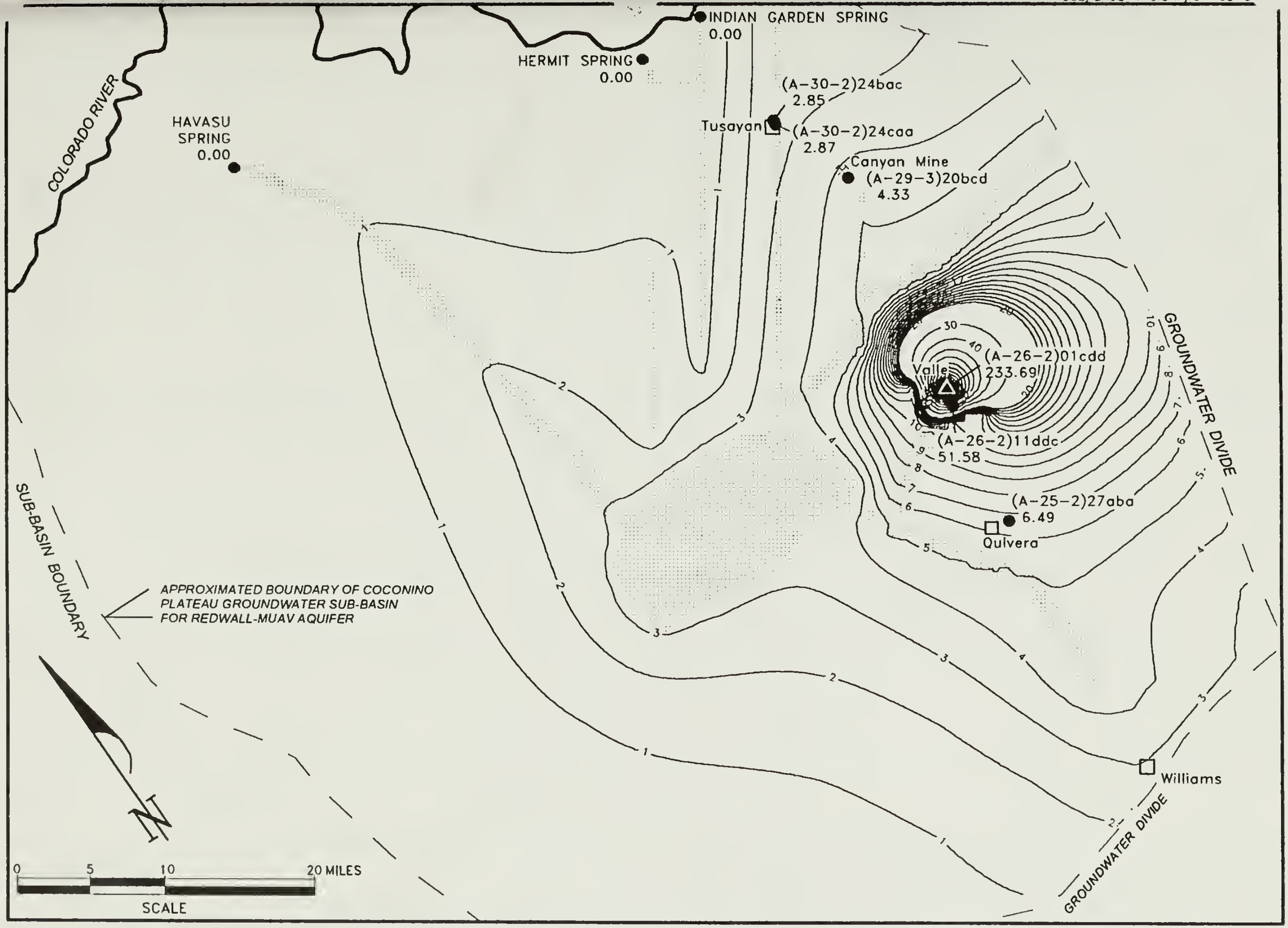
▲ SIMULATED PUMPING WELL LOCATION

——2—— PROJECTED TRANSIENT GROUNDWATER LEVEL CONTOUR

ZONE OF LARGE TRANSMISSIVITY

FIGURE 6. PROJECTED DRAWDOWN RESULTING FROM PUMPING 300 GALLONS PER MINUTE FOR 50 YEARS AT AIRPORT GRABEN

ERROL L. MONTGOMERY & ASSOCIATES, INC.



HERMIT SPRING ● SPRING OR GROUNDWATER WELL AND IDENTIFIER
0.00 —— PROJECTED DRAWDOWN, IN FEET

▲ SIMULATED PUMPING WELL LOCATION

——2—— PROJECTED TRANSIENT GROUNDWATER LEVEL CONTOUR

ZONE OF LARGE TRANSMISSIVITY

FIGURE 7. PROJECTED DRAWDOWN RESULTING FROM PUMPING 300 GALLONS PER MINUTE FOR 50 YEARS AT VALLE

ERROL L. MONTGOMERY & ASSOCIATES, INC.

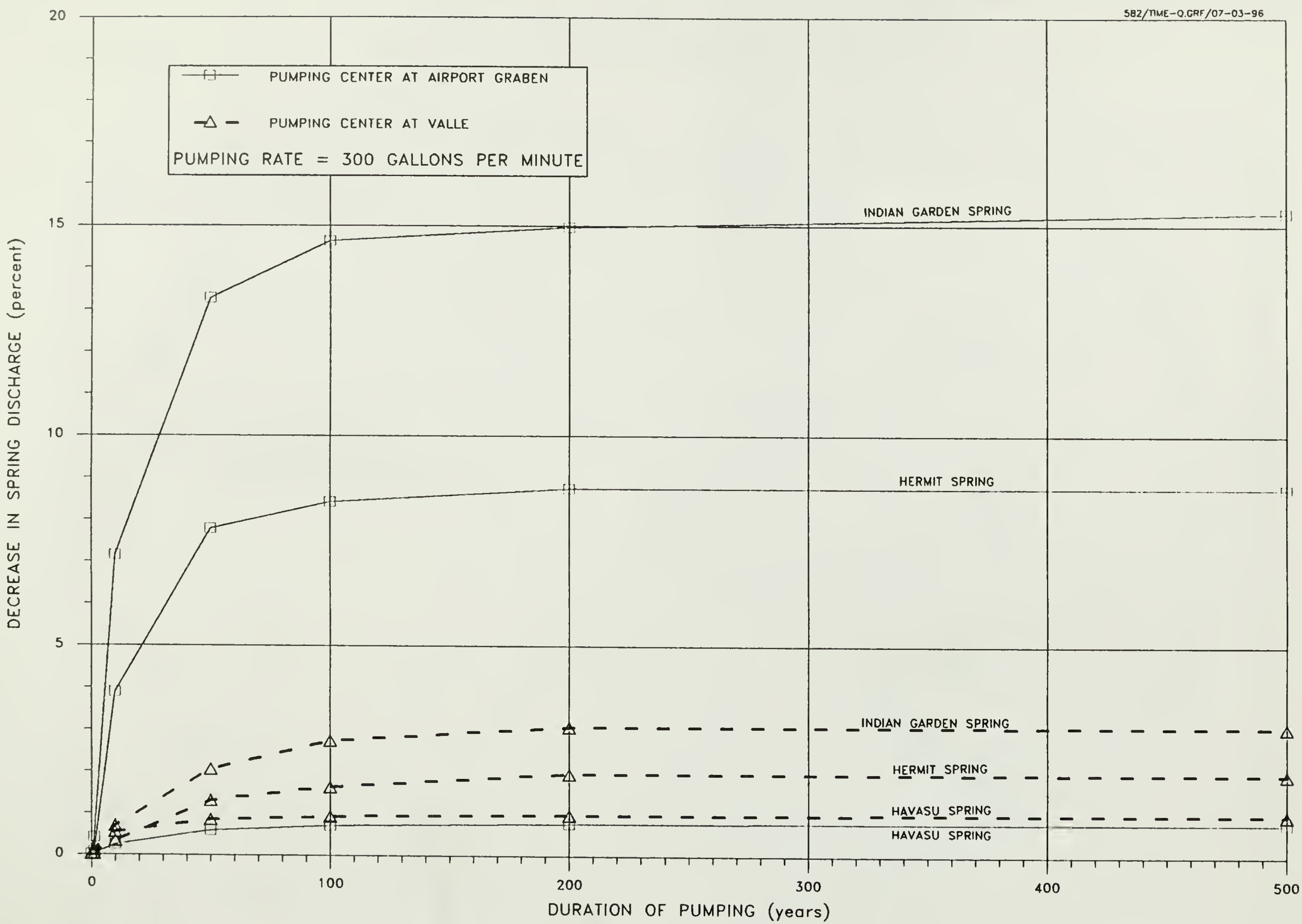


FIGURE 8. PROJECTED DECREASE IN DISCHARGE FROM SPRINGS VERSUS DURATION OF PUMPING

ERROL L. MONTGOMERY & ASSOCIATES, INC.

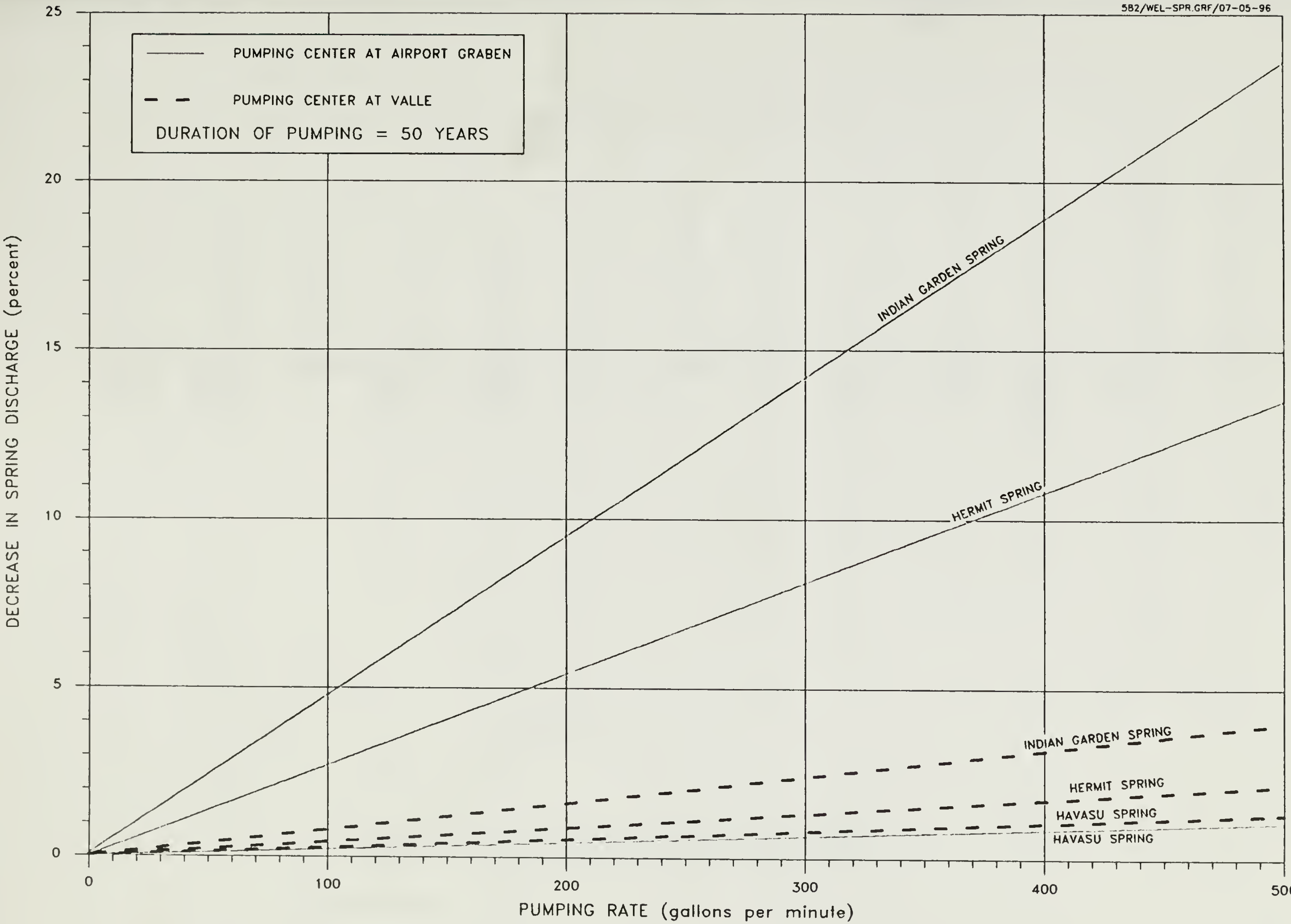


FIGURE 9. PROJECTED DECREASE IN DISCHARGE FROM SPRINGS VERSUS PUMPING RATE

ERROL L. MONTGOMERY & ASSOCIATES, INC.

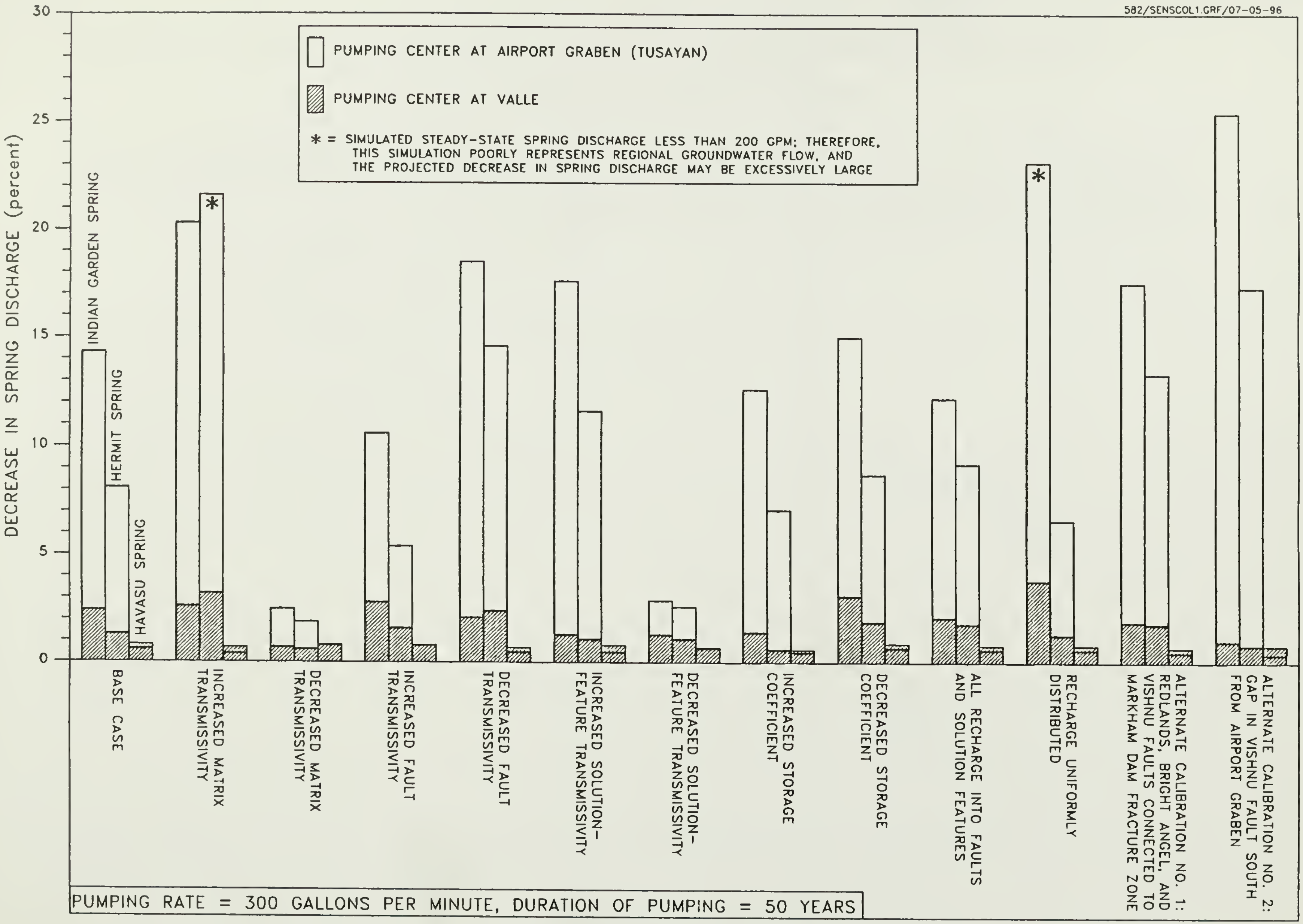


FIGURE 10. PROJECTED DECREASE IN DISCHARGE FROM SPRINGS FOR SENSITIVITY ANALYSES AND ALTERNATE CALIBRATIONS

ERROL L. MONTGOMERY & ASSOCIATES, INC.

APPENDIX A

WELL NUMBERING SYSTEM

The well numbers used in this study are in accordance with the Bureau of Land Management's system of land subdivision. The land survey in Arizona is based on the Gila and Salt River meridian and base line, which divide the State into four quadrants. These quadrants are designated, counter-clockwise, by the capital letters A, B, C, and D. All land north and east of the point of origin is in quadrant A; all land north and west of the point of origin is in quadrant B; all land south and west is in quadrant C; and all land south and east is in quadrant D. The first digit of a well number indicates the township, the second digit the range, the third digit the section in which the well is located. The lowercase letters a, b, c, and d after the section number indicate the well location within the section. The first letter denotes a particular 160-acre tract or quarter section; the second letter denotes the 40-acre tract or quarter-quarter section; the third letter denotes the 10-acre tract or quarter-quarter-quarter section. These letters are also assigned in a counter-clockwise direction, beginning in the northeast quarter. As **Figure A-1** shows, well number (A-26-2)01cdd designates the well as being in the SE1/4, SE1/4, SW1/4, Section 1, Township 26 North, Range 2 East.

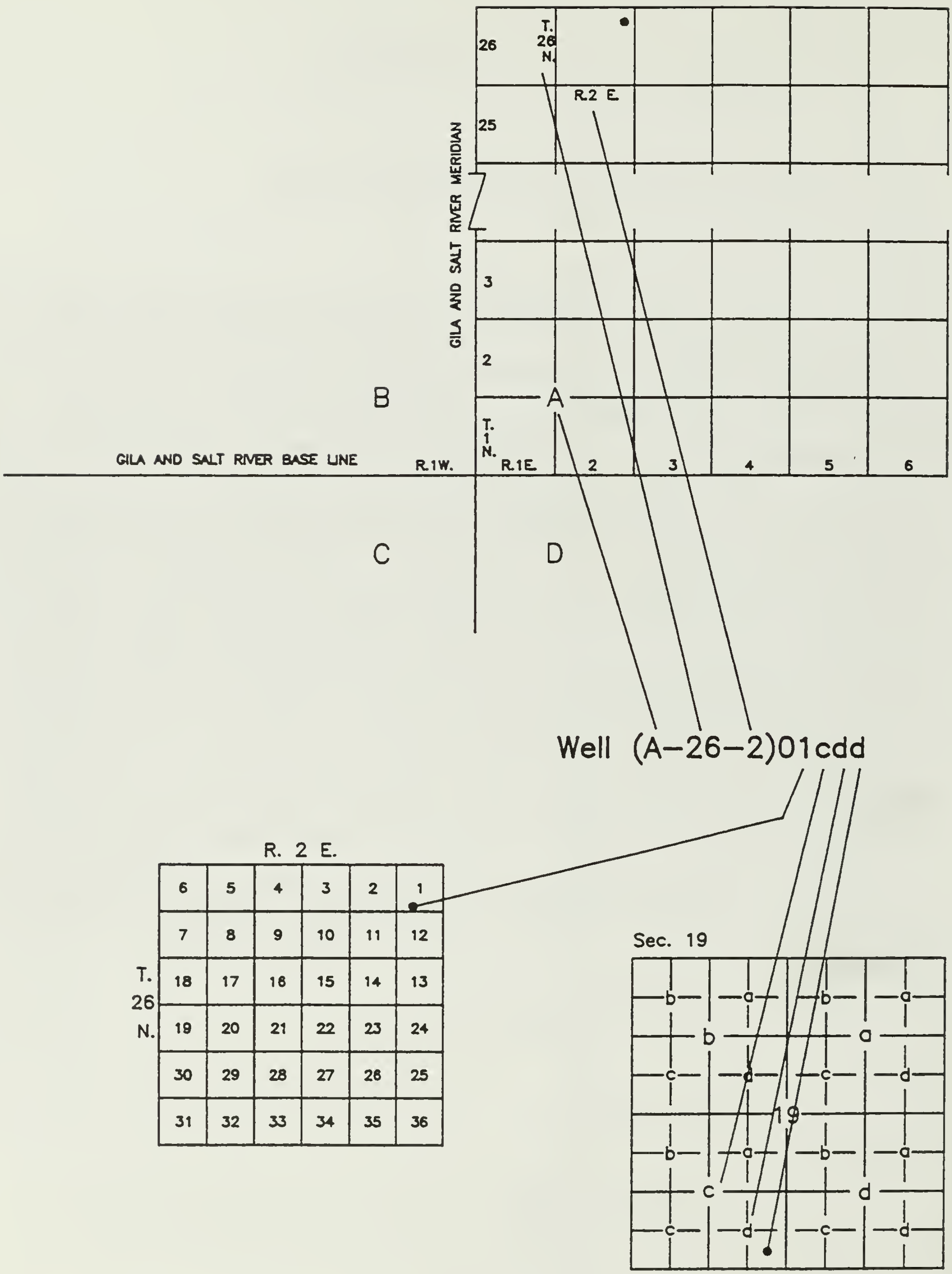


FIGURE A-1. WELL NUMBERING DIAGRAM

ERROL L. MONTGOMERY & ASSOCIATES, INC.

TUSAYAN\WELLA\06-26-96

SUMMARY OF SENSITIVITY ANALYSES AND ALTERNATE CALIBRATIONS

INPUT PARAMETERS:

PARAMETER	MAXIMUM VALUE	CONTROL CASE	MINIMUM VALUE
TRANSMISSIVITY (gallons per day per foot)			
Matrix	2,000	1,000	500
Faults	600,000	400,000	200,000
Williams fault zone	1,000,000	1,000,000	1,000,000
Havasu downwarp	10,000,000	5,000,000	1,000,000
STORAGE COEFFICIENT			
Matrix	0.002	0.001	0.0005
Faults and Havasu downwarp	0.010	0.005	0.0025
RECHARGE RATE (percent of total in each zone; total=29,600 gallons per minute)			
Matrix	100%	30%	0%
Faults and Havasu downwarp	100%	70%	0%

RESULTS SHOWN FOR TRANSIENT SIMULATIONS ARE BASED ON 50-YEAR STRESS PERIODS.

Sensitivity analyses were conducted in two stages. First, a simple sensitivity analysis for each parameter was conducted by substituting a maximum (max) or minimum (min) value for the control value of the parameter undergoing sensitivity analysis. These sensitivity analyses typically yielded incorrect or impossible steady-state spring discharges and head distributions; therefore, transient runs of these simple sensitivity analyses were not conducted. The second stage of sensitivity analysis were conducted by adjusting the value to be analyzed for sensitivity and (if necessary) a second parameter (generally transmissivity of faults or matrix), such that spring discharge rates were reasonable or as close to reasonable as possible. Results of steady-state and transient adjusted sensitivity analyses were used to calculate change in spring discharge resulting from changes in input parameters.

In addition, four alternative configurations of geolgic structures were simulated. Each of these model configurations were calibrated as closely as possible to the known spring discharges. These alternative cases are summarized as follows:

BASE CASE: Vishnu Fault (and Airport Graben) connected to Markham Dam Fracture Zone (MDFZ), Redlands and Bright Angel Faults not connected to MDFZ.
ALTERNATE CALIBRATION #1: Redlands, Bright Angel, and Vishnu Faults all connected to MDFZ.
ALTERNATE CALIBRATION #2: Gap present in Vishnu Fault south from Airport Graben, Redlands and Bright Angel Faults not connected to MDFZ.
ALTERNATE CALIBRATION #3: Transmissivity uniform throughout model area

SIMPLE SENSITIVITY ANALYSIS (Steady-state simulations with only one changed parameter)

					INDIAN GARDEN SPRING			HERMIT SPRING			HAVASU SPRING			CANYON MINE		TUSAYAN		VALLE	
VARIED PARAMETER	RUN ID	VALUE FOR BASE CASE	VALUE FOR VARIED PARAMETER	RELATIVE INPUT CHANGE (percent)	SIM. SPRING FLOW (gpm)	RELATIVE CHANGE (percent)	SENS. FACTOR (factor)	SIM. SPRING FLOW (gpm)	RELATIVE CHANGE (percent)	SENS. FACTOR (factor)	SIM. SPRING FLOW (gpm)	RELATIVE CHANGE (percent)	SENS. FACTOR (factor)	HEAD (feet)	RESIDUAL (feet)	HEAD (feet)	RESIDUAL (feet)	HEAD (feet)	RESIDUAL (feet)
BASE CASE	162R6-SS	---	---	---	294	---	---	309	---	---	28997	---	---	3844	-129	3843	-357	3762	262
TRANSMISSIVITY																			
Matrix - max	162D3-SS	1,000	2,000	100%	-138	-147%	-1.47	-113	-137%	-1.37	29851	2.9%	0.029	3836	-135	3858	-342	3747	247
- min	162D1-SS	1,000	500	-50%	613	109%	-2.17	596	93%	-1.86	28391	-2.1%	0.042	3857	-116	3824	-376	3801	301
Faults - max	162C1-SS	400,000	800,000	100%	140	-52%	-0.52	216	-30%	-0.30	29244	0.8%	0.008	3753	-220	3749	-451	3734	234
- min	162C3-SS	400,000	200,000	-50%	488	66%	-1.32	425	38%	-0.75	28687	-1.1%	0.022	3993	20	3984	-218	3817	317
Havasu downwarp - max	162B1-SS	5,000,000	10,000,000	100%	-88.9	-130%	-1.30	27	-91%	-0.91	29662	2.3%	0.023	3684	-289	3705	-495	3588	88
- min	162B6-SS	5,000,000	2,500,000	-50%	1000	240%	-4.80	830	169%	-3.37	27770	-4.2%	0.085	4137	164	4096	-104	4084	584
STORAGE COEFFICIENT	Storage coefficient is not a parameter for steady-state flow; therefore, steady-state sensitivity analysis for storage coefficient is neither possible nor necessary.																		
RECHARGE RATE																			
Recharge equally distributed into faults, matrix, and Havasu downwarp	162F1-SS	30%	100%	233%	162	-38%	-0.16	380	23%	0.10	29037	0.1%	0.001	3846	-125	3806	-394	3849	349
All recharge into faults and Havasu Downwarp	162F2-SS	70%	100%	43%	336	14%	0.33	283	-8%	-0.20	28980	-0.1%	-0.002	3842	-131	3857	-343	3730	230

ADJUSTED SENSITIVITY ANALYSIS (Steady-state and transient simulations based on recalibration by adjusting one or more parameter)

PRIMARY VARIED PARAMETER	RUN ID	SECOND VARIED PARAM.	VALUE FOR SECOND PARAMETER	RELATIVE INPUT CHANGE (percent)	IND. GRD. SPRING SIM. SPRING FLOW (gpm)	IND. GRD. SPRING TRANS. FLOW CHANGE (percent)	HERMIT SPRING SIM. SPRING FLOW (gpm)	HERMIT SPRING TRANS. FLOW CHANGE (percent)	HAVASU SPRING SIM. SPRING FLOW (gpm)	HAVASU SPRING TRANS. FLOW CHANGE (percent)	CANYON MINE STEADY-STATE HEAD (feet)	CANYON MINE RESIDUAL (feet)	TUSAYAN STEADY-STATE HEAD (feet)	TUSAYAN RESIDUAL (feet)	VALLE STEADY-STATE HEAD (feet)	VALLE RESIDUAL (feet)
BASE CASE																
Steady-state	182R6-SS	None	---	---	294	---	309	---	28997	---	3844	-129	3843	-357	3782	262
Transient, well at Tusayan	182R6-TR	None	---	---	252	-14.3%	284	-8.1%	28611	-0.6%						
Transient, well at Valle	182R6-C	None	---	---	287	-2.4%	305	-1.3%	28770	-0.6%						
TRANSMISSIVITY - MATRIX																
Max - steady-state	182D4-SS	T - faults	150,000	-62.5%	344	---	190	---	29066	---	4010	37	4011	-169	3822	322
Max - transient, Tusayan well	182D4-TR	T - faults	150,000	-62.5%	274	-20.3%	149	-21.6%	28941	-0.4%						
Max - transient, Valle well	182D4-C	T - faults	150,000	-62.5%	335	-2.6%	164	-3.2%	28855	-0.7%						
Min - steady-state	182D2-SS	T - faults	1,000,000	150.0%	263	---	324	---	28994	---	3751	-222	3723	-477	3771	271
Min - transient, Tusayan well	182D2-TR	T - faults	1,000,000	150.0%	276	-2.5%	316	-1.9%	28746	-0.6%						
Min - transient, Valle well	182D2-C	T - faults	1,000,000	150.0%	281	-0.7%	322	-0.6%	28780	-0.6%						
TRANSMISSIVITY - FAULTS																
Max - steady-state	182C2-SS	T - matrix	650	-15.0%	254	---	313	---	29033	---	3753	-220	3743	-457	3740	240
Max - transient, Tusayan well	182C2-TR	T - matrix	650	-15.0%	227	-10.6%	296	-5.4%	28615	-0.6%						
Max - transient, Valle well	182C2-C	T - matrix	650	-15.0%	247	-2.6%	308	-1.6%	28801	-0.6%						
Min - steady-state	182C4-SS	T - matrix	1,500	50.0%	335	---	254	---	29011	---	3970	-3	3973	-227	3802	302
Min - transient, Tusayan well	182C4-TR	T - matrix	1,500	50.0%	273	-18.5%	217	-14.6%	28670	-0.5%						
Min - transient, Valle well	182C4-C	T - matrix	1,500	50.0%	328	-2.1%	246	-2.4%	28794	-0.7%						
TRANSMISSIVITY - SOLUTION FEATURES																
Max - steady-state	182B2-SS	T - faults	150,000	-62.5%	313	---	277	---	29010	---	3931	-42	3945	-255	3662	162
Max - transient, Tusayan well	182B2-TR	T - faults	150,000	-62.5%	256	-17.6%	245	-11.6%	28657	-0.5%						
Max - transient, Valle well	182B2-C	T - faults	150,000	-62.5%	309	-1.3%	274	-1.1%	28771	-0.6%						
Min - steady-state	182B7-SS	T - faults	1,000,000	150.0%	308	---	351	---	28942	---	4079	106	4068	-134	4078	578
Min - transient, Tusayan well	182B7-TR	T - faults	1,000,000	150.0%	299	-2.9%	342	-2.8%	28751	-0.7%						
Min - transient, Valle well	182B7-C	T - faults	1,000,000	150.0%	304	-1.3%	347	-1.1%	28752	-0.7%						
STORAGE COEFFICIENT (S for all cells was doubled and halved, respectively, for max and min simulations. Storage coeff. is not a parameter for steady-state solutions; therefore, steady-state calibration comprises control case.)																
Max - steady-state	182R6-SS	None	---	---	294	---	309	---	28997	---	3844	-129	3843	-357	3782	262
Max - transient, Tusayan well	182E2-TR	None	---	---	257	-12.6%	287	-7.1%	28852	-0.5%						
Max - transient, Valle well	182E2-C	None	---	---	290	-1.4%	307	-0.6%	28817	-0.6%						
Min - steady-state	182R6-SS	None	---	---	294	---	309	---	28997	---	3844	-129	3843	-357	3782	262
Min - transient, Tusayan well	182E1-TR	None	---	---	250	-15.0%	282	-8.7%	28766	-0.7%						
Min - transient, Valle well	182E1-C	None	---	---	285	-3.1%	303	-1.9%	28739	-0.9%						
RECHARGE DISTRIBUTION																
All recharge into faults and Havasu downwarp																
- steady state	182F2-SS	None	---	---	336	---	283	---	28960	---	3842	-131	3857	-343	3730	230
- transient, Tusayan well	182F2-TR	None	---	---	295	-12.2%	257	-9.2%	28794	-0.6%						
- transient, Valle well	182F2-C	None	---	---	329	-2.1%	278	-1.6%	28754	-0.6%						
Recharge uniformly distributed into matrix, faults, and Havasu downwarp																
- steady state	182F1-SS	None	---	---	182	---	380	---	29037	---	3848	-125	3806	-394	3849	349
- transient, Tusayan well	182F1-TR	None	---	---	140	-23.1%	355	-6.6%	28851	-0.6%						
- transient, Valle well	182F1-C	None	---	---	175	-3.8%	375	-1.3%	28611	-0.6%						

ALTERNATIVE CALIBRATIONS (Effects of alternate configurations of geologic structure on steady-state and transient spring discharge)

DESCRIPTION	RUN ID	SECOND VARIED PARAM.	VALUE FOR SECOND PARAMETER	RELATIVE INPUT CHANGE (percent)	IND. GRD. SPRING SIM. SPRING FLOW (gpm)	IND. GRD. SPRING TRANS. FLOW CHANGE (percent)	HERMIT SPRING SIM. SPRING FLOW (gpm)	HERMIT SPRING TRANS. FLOW CHANGE (percent)	HAVASU SPRING SIM. SPRING FLOW (gpm)	HAVASU SPRING TRANS. FLOW CHANGE (percent)	CANYON MINE STEADY-STATE HEAD (feet)	CANYON MINE RESIDUAL (feet)	TUSAYAN STEADY-STATE HEAD (feet)	TUSAYAN RESIDUAL (feet)	VALLE STEADY-STATE HEAD (feet)	VALLE RESIDUAL (feet)
BASE CASE: Vishnu Fault (and Airport Graben) connected to Markham Dam Fracture Zone (MDFZ); Redlands and Bright Angel Faults not connected to MDFZ.																
Steady-state	162R6-SS	None	---	---	294	---	309	---	28997	---	3844	-129	3843	-357	3762	262
Transient, well at Tusayan	162R6-TR	None	---	---	252	-14.3%	284	-8.1%	28811	-0.6%						
Transient, well in Valle	162R6-C	None	---	---	287	-2.4%	305	-1.3%	28770	-0.8%						
ALTERNATE CALIBRATION #1: Redlands, Bright Angel, and Vishnu Faults all connected to																
Steady-state	160R6-SS	T - faults	120,000	-70.0%	309	---	225	---	29066	---	4124	151	4082	-118	3868	368
Transient, Tusayan well	160R6-TR	T - faults	120,000	-70.0%	255	-17.5%	195	-13.3%	28930	-0.5%						
Transient, Valle well	160R6-C	T - faults	120,000	-70.0%	303	-1.9%	221	-1.8%	28858	-0.7%						
ALTERNATE CALIBRATION #2: Gap present in Vishnu Fault south from Airport Graben; Redlands and Bright Angel Faults not connected to M																
Steady-state	163R6-SS	T - faults and Havasu downwarp (Hd):			307	---	254	---	29036	---	3873	-100	4029	-171	3645	145
Transient, Tusayan well	163R6-TR	T - faults	200,000	-50.0%	229	-25.4%	210	-17.3%	28927	-0.4%						
Transient, Valle well	163R6-C	T - Hd	10,000,000	100.0%	304	-1.0%	252	-0.8%	28794	-0.8%						
ALTERNATE CALIBRATION #3: Transmissivity and recharge uniform throughout model area.																
Steady-state	165R1-SS	T - matrix	70,000	6900.0%	1032	---	-132	---	28700	---	4021	48	3997	-203	4068	568
Transient, Tusayan well	165R1-TR	T - faults	70,000	-82.5%	935	-9.4%	-223	-68.9%	28616	-0.3%						
Transient, Valle well	165R1-C	T - Hd	70,000	-96.6%	958	-7.4%	-210	-59.1%	28597	-0.4%						

TUSAYAN AREA PLAN

AREA PLAN

TUSAYAN AREA PLAN

PLANNING COMMITTEE

Sheryl Carrick, Chair
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John Vest
Ann Wren
Tom DePaolo, Ex-officio
Brad Traver, Ex-officio

ADOPTED BY COCONINO COUNTY BOARD OF SUPERVISORS
JUNE 19, 1995

ADOPTED BY COCONINO COUNTY PLANNING AND ZONING COMMISSION
APRIL 25, 1995

ADOPTED BY TUSAYAN PLANNING COMMITTEE
APRIL 7, 1995

Amended May 5, 1997

COCONINO COUNTY PLANNING STAFF

William L. Towler, Director
Sue E. Pratt, Principal Planner
John P. Aber, Planner II

TUSAYAN AREA PLAN

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TUSAYAN VISION STATEMENT

As the principal gateway to the Grand Canyon, the community of Tusayan plays an important role in the provision of goods, services, and information to tourists and visitors. In addition to having a tourist focus, Tusayan is home for approximately 550 residents and employees. Because the private land base is severely restricted, to a mere 144 acres in the developed core, and is surrounded by U.S. Forest Service and Park Service lands, interaction with other agencies plays a key role in growth and development.

Tusayan as a Model Gateway

This vision foresees Tusayan as a major orientation and staging center for visitors to Grand Canyon National Park. As travel into the park by automobile becomes more difficult or impossible, Tusayan may want to provide the means for tourists to stop, park, become educated about the Park and its resources, and be transported into the Park by a variety of transit modes.

The aesthetic quality of Tusayan would be very high to present a favorable impression with tourists as the stop or pass through. Appropriate architectural designs, excellent and extensive landscaping, and restricted signage will provide the much improved appearance desirable for a major park entry.

As an information center, Tusayan would contain diverse tourist services especially related to the natural, cultural, and historic aspects of the area. Education rather than entertainment would be the focus.

Tusayan would be a world model community that leads the way in environmental consciousness. The protection of existing natural resources ant the use of technological innovation in managing water, wastewater, and solid waste would be a high priority.

Tusayan as a Community

The needs of the community's residents are also important. It should be a place where people can live a long time, raise families, and have the foundation and fabric that hold a community and neighborhood together. Facilities such as schools, churches, parks, and a library would be readily available, as would such accepted town service as police and fire protection and emergency medical services.

The provision of decent, affordable housing for all employees as close as is feasible to the employment centers is the most basic community and resident need. New commercial projects shall provide housing as they are developed. Existing housing shall be continuously upgraded to improve the overall sense of community.

Goods and services essential to the daily life of residents should be provided. Small businesses that do not change the small-town character of Tusayan are appropriate. To some extent, support services for the community's residents should be separate from visitor services.

Citizens will have a voice in the planning and future development of Tusayan and representation in the processes and plans affecting the community. Residents will have pride in being part of the community and in being involved.

Tusayan as Provider of Visitor Services

Tusayan will proved a positive visitor experience, leaving tourists glad that they stopped. The community will continue to provide a range of opportunities for lodging, eating, and limited shopping. The addition of new educational attractions such as museums or cultural and historic centers is encouraged, including those with a focus on native peoples.

Additional trails and bike paths would improve visitors; enjoyment of the natural resources as would orientation and educational facilities which are "resource-based."

While Tusayan will continue to provide essential services to Park visitors and while the quality of these services will be improved and some services may be expanded as Park visitation increases, the uniqueness of Tusayan, including its restricted land base, lack of water, and rural environment, must be recognized in establishing reasonable limits on future growth.

Tusayan as Cooperator with Other Agencies

The community of Tusayan is surrounded by lands controlled by the U.S. Forest Service, National Park Service, and Arizona Department of Transportation. Each of these agencies and private land owners have plans, management policies, and operations that significantly affect Tusayan. This vision foresees Tusayan playing a major role in the plans and actions undertaken by these entities.

Because the Park Service is currently preparing a new General Management Plan for Grand Canyon National Park which may recommend moving functions and services out of the Park to Tusayan, the community should continuously interact with Park officials.

Similarly, Forest Service management plays a significant part in shaping Tusayan. The Tusayan District of the Kaibab National Forest envisions a model district for interpretation and educational opportunities. In addition, major projects have been proposed for which the Forest Service will actively seek comments from local residents.

The ADOT-owned Grand Canyon Airport also has a major influence on Tusayan. Tusayan residents and ADOT officials and the aviation industry must work together as the airport grows to meet increasing demands.

With cooperation and coordination, Tusayan and the other major governmental entities will work together to solve common problems and to improve the level of services for both visitor and resident.

INTRODUCTION

On February 16, 1993, the Board of Supervisors appointed a nine-member citizens Committee, with two ex-officio members, to study various planning-related issues and to develop policies to guide future growth and development in the Tusayan Community. With two resignations and four new appointments within the first couple of months, the Committee ended up with eleven voting members and two non-voting members. The committee identified the issues of concern including infrastructure, housing, community, public safety, transportation, area planning, natural resources and environmental quality, and land use. The committee conveved for the first time on March 3, 1993 and 40 times over the following two year period, concluding on April 7, 1995.

Study Area

The study area was established by the committee at its first meeting. The area extends three miles north to the Grand Canyon National Park boundary, and four miles south of the existing community and five miles on either side of Highway 64 (*see map on page 5*).

Resident Survey

In June, 1993 the Committee developed, administered, and tabulated a resident survey which included not only Tusayan residents but residents of Grand Canyon Village, Woodland Ranch, and Valle. The results are included after the History Section of this Introduction and are referred to throughout this plan.

Flexibility and the Dynamics of a Plan

During the two year process of developing the plan, several new projects were approved and there were a considerable number of changes in and around the community. As an example, a second water well was drilled in Tusayan and two wells were installed in Valle. The Holiday Inn Express, an adjacent all suites hotel, and employee housing projects were all approved by the Board of Supervisors during the planning process. The text preceding the goasl and policies in each section may not represent an up to the minute statement of conditions as they exist on the date of plan adoption.

The plan has no established time period. The last Tusayan plan, the South Grand Canyon Specific Area Study, was adopted by the Board in 1978. Ideally, this plan will be updated and amended regularly. A major rewrite of the plan would most likely require the appointment of another citizens' committee. A "minor" amendment could be requested by an individual and processed in conjunction with a zone change application. It is possible, in fact likely, that not all policies have been perfectly formulated, necessitating, the need for reassessment and amendment.

Implementation

The Tusayan Area Plan contains goals and policies. The goals provide a direction for the community. The policies were designed by the planning committee to support, and be complementary to, the goals. The policies are statements of intent to accomplish the goals. Upon adoption, this Plan becomes a part of the Coconino County Comprehensive Plan and serves as the official guide for future development. The Coconino County Zoning Ordinance and Subdivision Ordinance contain provisions that decisions made by the Planning and Zoning Commission and Board of Supervisors shall be consistent with the General Plan. In order to approve development projects, the following findings must be met:

For zone changes:

That the change is consistent with the goals, objectives, and policies of the General Plan and this ordinance.

For conditional use permits:

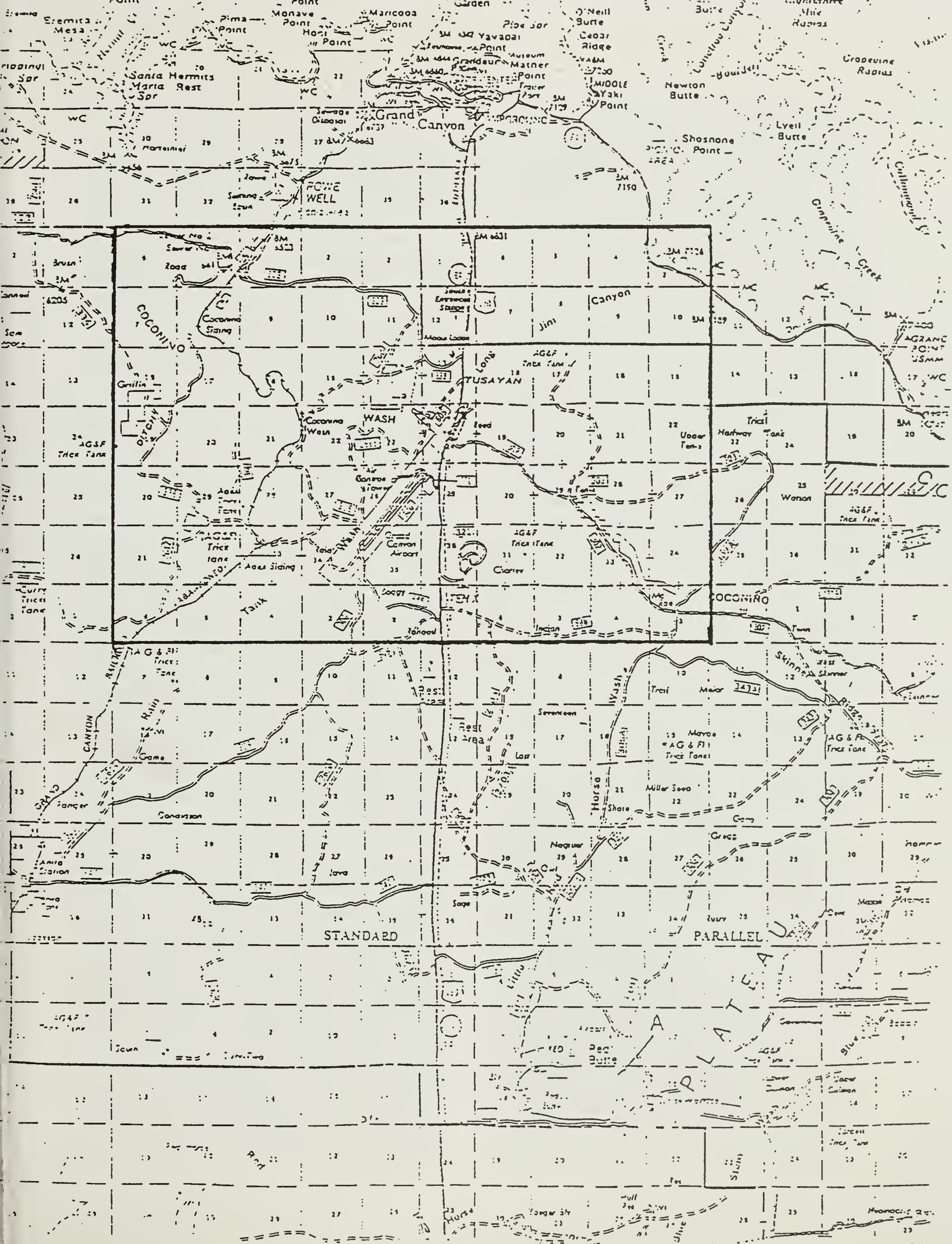
That the proposed conditional use is consistent with and conforms to the goals, objectives, and policies of the General Plan or specific plan for the area.

For subdivisions:

That the proposed subdivision conforms to the goals, objectives, and policies of the Coconino County Comprehensive Plan and its amendments.

Most decisions concerning zoning changes, subdivisions, and conditional use permits made by the Planning and Zoning Commission and Board of Supervisors contain conditions of approval which must be met either prior to or during construction. These typically include acquisition of necessary health and building permits, landscaping, lighting, roads, parking, grading and excavation, drainage, and signs.

Implementation of the Plan can be achieved through the application of conditions of approval which address the goals and policies in the plan.



Eremita Mesa
Pima Point
Mohave Point
Hopi Point
Maricopa Point
Yavapai Point
Grandeur Point
Mather Point
O'Neill Butte
Cedar Ridge
Yaki Point
Newton Butte
Grapevine Rapids
Santa Maria Spr
Hermits Rest
Grand Canyon
Shoshone Point
Lyell Butte
WELL
COCONINO
Coconino Siding
Jim Canyon
TUSAYAN
Coconino Wash
WASH
Grand Canyon Airport
Rest Area
STANDARD
PARALLEL
COCONINO
P L A T E A U
Red Butte

Tusayan: Then and Now

By Ronald L. Warren

No history of Grand Canyon National Park would be complete without mention of the enclave of private property at the National Park's south boundary which is now known as Tusayan. The community's history dates back almost to the beginning of Grand Canyon National Park in 1919.

From 1905 to 1919, George Reed was one of the few forest service rangers working in the Tusayan Forest Reserve (now called the Kaibab National Forest). Stationed at Hull Tank Cabin, he patrolled the forest south of the Grand Canyon. In a remote corner of the forest, the Iowa-born Reed saw potential for a successful vegetable farm in the rich soil of the Coconino Wash. Reed quit the forest service and in April 1920, the same month that Grand Canyon was formally dedicated as a National Park, homesteaded a 160 acre tract of land in Sections 23 and 24 of Township 30, some seven miles south of the Grand Canyon Village.

Along with his wife, Mable, the 40-year old Reed grew whatever would grow, primarily potatoes, in the natural clearing along the Coconino Wash. He was a good farmer. In addition to feeding his own family, he sold his surplus crop to the hotels in the National Park. Reed's fresh vegetables were soon in such demand that, in March 1927, he applied to the forest service for a five acre permit to farm on government land west of his homestead and on portions of four other homestead entries.

But getting his vegetables to Grand Canyon Village was more of a problem. The nearest "highway" connecting Grand Canyon with the "outside world" followed the railroad tracks from Williams by way of Anita Station and Rowe's Well. Another came from Maine (Maine, Arizona -- not the state!) and connected with the Desert View road near Grand View Point. Branching off the road from Williams to Grand Canyon, a dirt trail led east, up the Coconino Wash, to the Reed Homestead. The trail was the handiwork of one of the mining and lumbering camps which operated in the forest south of Reed's farm. Since George Reed didn't have an automobile (few people did) during his first years of farming, he made the seven mile journey to the Grand Canyon Village by horseback or in a mule drawn wagon.

Reed's transportation problem was solved in 1928, when the federal government agreed to build a new highway to the Grand Canyon from Williams as part of a deal for the National Park Service to acquire ownership of the Bright Angel Trail which was, at the time, owned by Coconino County. Unlike today, in the 1920s and 1930s, there were many "inholdings" of private and County property inside the boundaries of Grand Canyon National Park. At a total construction cost of $750,000, the June 1928, road alignment skirted across the west edge of the Reed Homestead and provided paved access to Reed's farm. Today, parts of the old roadbed are still visible running through the Canyon Pines Mobile Home Park and north through Long Jim Canyon toward the Grand Canyon Village. The Park's South Entrance is now approximately one mile northwest of its 1928 location.

With the new highway came new neighbors for the Reeds. The first was Rudolph "Chick" Kirby who opened a store and campground in August 1928, on 10 acres of land leased from the forest service approximately where the Moqui Lodge is today. Kirby would no doubt have preferred to build his campground closer to the Grand Canyon Village, but was unable to secure a permit from the National Park Service. A few years after building the campground, Kirby sold his business to Charles Green and, by 1934, the place was known as "Moqui Camp." In the late 1930s, Civilian Conservation Corp workers constructed the first rock cabins of the present Tusayan District

Administrative Office of the forest service.

Not everyone thought moving outside the National Park was a good idea though. In January 1929, Grand Canyon Postmaster Art Metzger had asked the forest service to survey a 10 acre parcel adjacent to Kirby's store for a place to build an American Legion Clubhouse. Park Service rules prohibited even civic associations like the Legion from building inside the Park's boundaries. The "Legion Hut" was never built, however, because of objections from members who felt it was too remote!

When the 21st Amendment to the U.S. Constitution ended the nation-wide prohibition on the sale of alcohol, Tony Galindo leased a portion of the Reed Homestead to build a bar and tourist motel. The site chosen was along the east side of the new highway on a rocky outcropping above the Coconino Wash which periodically flooded from summer thunderstorm downpours. Besides, George Reed considered the good meadow farmland too valuable to waste on a bar and auto court. The new business, which Galindo named the "Tusayan Bar" (after the surrounding National Forest) was a popular "watering hole" for Santa Fe Railroad employees and neighboring ranch cowboys on paydays. The State of Arizona, in accordance with its custom, installed a sign alongside the highway to identify the private property. They could have used Reed's name, but instead posted a sign adjacent to the bar identifying the area as "Tusayan." After being open only a few years, however, the bar was burned to the ground by a fire of mysterious origin. The business was never rebuilt, but its rock fireplace still stands in the middle of what is now known as the Canyon Pines Mobile Home Park.

Farming the land was hard work under the best of conditions. As George Reed grew older, the rigors of his farming life became less tolerable to him. So, when the Ten X Cattle Company offered to buy his homestead in the 1930s, Reed called it quits and sold out. For the next decade, Reed's homestead was used as a cattle ranch. Not much happened in Tusayan, or for that matter, the Grand Canyon, during the war years of the 1940s. Automobile gasoline was rationed because of the war and tourist visitation to the Park declined to almost nothing. After the war, though, visitation to Grand Canyon quickly exceeded its pre-war levels. Both locals and returning veterans were quick to see the business potential of tourism to the National Park.

One of those who saw potential at the Grand Canyon was Ed Montgomery who owned Arizona Helicopter Service, one of the first helicopter businesses in the United States. Headquartered in Tucson, Montgomery would take his Bell Model 47 helicopters wherever there was business. In 1948, he had been hired by an Episcopal missionary to "sling load" a surplus military quonset hut to Havasupai Canyon to be used as a chapel. The charter didn't go well as Montgomery's under-powered helicopter crashed (neither pilot nor quonset hut were hurt) some mile and a half north of the Red Butte airfield, but the idea of carrying tourists (who weighed less than the quonset hut!) on sightseeing tours over the Grand Canyon stuck with him and in May 1950, Montgomery leased the site of the old Tusayan Bar for a summer helicopter sightseeing business. It was soon a popular diversion for Canyon visitors and local residents alike. Getting spare parts to Grand Canyon, and the pursuit of other more profitable business interests, combined to close the fledgling air tour company within two years, however.

Indeed, the early to mid-1950s was a time of changing directions for Tusayan. The Ten X Cattle Company realized that more money could be made by selling off the land than by ranching on it. One of the first organizations to move there was the Grand Canyon Post of the American Legion, still without a permanent home inside the National Park. Buford Belgard had been elected president of the local chapter in 1950 and was determined to find a place for the Legion Post to call home. As one of his first official duties, he began negotiation with the Ten X Cattle Company to buy a part, or even all, of Tusayan. After two years of wheeling and dealing, the Legion finally bought two acres, including George Reed's original home, in 1952. The house was converted into the

Legion Hut, but is today the site of the Quality Inn Grand Canyon. Belgard himself bought land adjacent to the Legion Hut and built a house which he later sold to Franz Rotter, owner of the Quality Inn.

As a side note, buying the property was easier than getting clear ownership to it. Due to the death of some of the principals in the Ten X Cattle Company, and the snaillike pace of the legal process, it took Belgard over eight years to finally clear the title to the land.

The biggest population boom in the 30-plus year history of Tusayan came a year later in 1953, when the Golden Crown Mining Company, owners of the "Hogan's Orphan" uranium mine on the rim of the Canyon near Powell Point, purchased a 10 acre parcel on the northwesterly side of the meadow for a campsite to house their mine employees. After the mine closed, the campsite was used as a religious retreat for a few years. Later, in the 1980s, the "U" shaped campsite building somehow became known locally as "Ed's Beds," a nondescript name since there was never a person named "Ed" involved with the property. The Quality Inn office and restaurant now cover the site of the retreat.

A corner of the campsite property, fronting on Highway 64, was leased by "Preacher" Paul Milton, a former manager for Grand Canyon Airlines, and his wife Kay, for a gift shop they named "The Western Village." In 1967, the entire 10 acre campsite (and the "Orphan" mine adjacent to Powell Point inside the National Park) was sold to the Cotter Corporation, another uranium mining business. It was resold in 1982 to airline owners John Seibold and Elling Halvorson.

The balance of the Reed property was bought from the Ten X Cattle Company by R.P. "Bob" Thurston, a prominent Williams businessman and rancher, who had been ranching in the area west of the Reed Homestead since the 1920s. R.P. Thurston's acquisition of the property, and his family's foresight, would prove to be a key factor in the development of Tusayan.

In 1951, the State of Arizona decided to improve Highway 64 to accommodate the ever increasing number of cars traveling to the National Park. Bob Thurston offered to "sell" the state a right-of-way for $1 if they would realign Highway 64 to run directly north through the middle of the homestead. Having served on the Coconino County Road Commission, Thurston knew the value of highway frontage. The Highway Department quickly agreed, and in 1953-54 the new highway was built where it is today. It was this realignment that provided enough roadside frontage for Tusayan to be developed.

With a modern new highway bringing tourists to the Canyon, the Thurston family built the Red Feather Lodge in 1963-64 on a small rise in the middle of the valley. On the opposite side of the highway from the Lodge, they built the "White Service Station," selling fuel and providing vehicle maintenance. The service station site is now occupied by the TWA Services Trading Post and McDonald's Restaurant. To the south of the Lodge a new "Tusayan Bar" finished the first of Thurston's tourist ventures. This "new" Tusayan Bar, after operating under several managements (Kay and Pete Jennings, Jim and Regina Clift, Tom and Regina Jaworski, John Thurston, Clarinda Vail, and possibly others) and names ("The Tusayan Steak House and Social Club," "The Spot"), finally closed in 1993 and is now the site of a Holiday Inn Express hotel expected to open in 1995.

Even before the highway was built through Tusayan, the U.S. government announced plans in the spring of 1952 to build a new public, all-weather airport to serve the Grand Canyon National Park. At the time, the only two airfields in the South Rim area, one at Red Butte and the other at Valle, were both privately-owned, and neither was an all-weather facility. Good intentions, however, didn't get the airport built. Not until 1964 did the State of Arizona actually start construction on a new airport. The site chosen was a meadow alongside Highway 64 stretching southward over a mile from the edge of the Reed (now Thurston) property to the edge of "Rain Tank" property. Primarily on forest service land, a portion of the property needed at the north end ran onto Thurston property. Bob Thurston immediately realized a new airport would increase the value of his neighboring land and once again cooperated with the state in getting the property needed for the airport.

After the new airport was built, tourist-oriented businesses were quick to lease or buy land in Tusayan from "Bob" Thurston and his family.. Among the first were two Bonanza Airlines (later Hughes Air West) pilots, brothers Boyce and Royce Fish, who built a small, single story motel at the south end of Tusayan on property purchased from Bess (Mrs. R.P.) Thurston. Their initial building is now the "100" building for the Grand Canyon Squire Inn Best Western. The most ambitious project, a 200-plus space RV park, general store, and restaurant complex, was started within a few years on the east side of the highway by the Babbitts, a pioneer Coconino County ranching and mercantile family. Catering to locals and tourists alike, Jack and Betty Settles opened a small grocery market which they named the "Food Mart" (now known as "Stix Food Mart"). At the same time, the Thurston family, together with Bob Kendall as the manager, opened the South Rim Mobile Home Park for housing employees of the new businesses. "South Rim," as the mobile home park was known locally, was later split and sold to Wayne Learn who kept the original park name, and Elling Halvorson who kept the smaller "front" parcel, known locally as "Halvorson Park" and used exclusively by Halvorson's employees.

An innovative young contractor, Elling Halvorson had come to the Grand Canyon in 1964, the successful bidder on a massive Park Service project to rebuild the Park's trans-Canyon water pipeline. Needing a site to park the helicopters used on the project, Halvorson Lents Construction acquired a small parcel of land adjacent to R.P. Thurston's White Service Station in the spring of 1965. When not being used on the pipeline project, the helicopters were used for sightseeing air tours. Papillon Grand Canyon Helicopters, as Halvorson's business is now known, occupies the site. Soon, two other air tour companies tried to join in the aerial sightseeing business, neither successfully. With private land available after the realignment of Arizona Highway 64, more growth occurred in Tusayan between 1964 and 1969 than in its entire history up to that point.

Tusayan continued to grow. Local hotel development continued in an effort to keep up with increasing tourist demand for accommodations, including expansions of the Grand Canyon Squire Inn Best Western in 1974 and again in 1992, construction of the Quality Inn -- Grand Canyon by the Rotter family, and construction of the Seven Mile Lodge by the Slayton family, both in the 1980s. In the summer of 1994, ground was broken on a 129 guest room expansion of the Red Feather Lodge. In 1995, a Holiday Inn Express hotel, mentioned earlier, is also expected to open.

A McDonald's fast food restaurant came in to existence in the early 1980s to complement the various hotel restaurants, as did a pizza restaurant. The "Tusayan Steak House" moved from its original location to a new facility on the site of the former forest service district headquarters and directly across from the IMAX Theatre. In 1993, a Taco Bell Express opened at the IMAX Theatre and, in 1994, the Red Feather Lodge restaurant became a Denny's Restaurant franchise.

The Grand Canyon IMAX Theatre opened in 1984 on the site of the old "Western Village" gift shop. Towering above the Tusayan skyline, the massive IMAX Theatre featured a 35 minute movie, Grand Canyon -- The Hidden Secrets, and quickly became one of the most popular tourist attractions at Grand Canyon.

The expression "people go where the jobs are" holds true for Tusayan, notwithstanding there was no place for them to live. Unlike more established communities, very little housing has ever existed due to the shortage of privately-owned property. Though thousands of acres of undeveloped forest service land surround it, none of the public land has yet become available for residential housing. As a result, some Tusayan area employees chose to commute from the City of Williams. Most, however, took residence in one of the several employer-owned mobile home parks or apartment buildings. The first of the employer-owned facilities was built for Red Feather Lodge employees. Since that first "apartment building," three others have been constructed by McDonald's Restaurant, the Galaxy ("Domes"), and the Canyon Squire Best Western. In 1985, Grand Canyon Airlines built the 28-unit "Canyon Pines Mobile Home Park" for its employees.

That most lived in employer-provided housing does not mean that there were, or are, no privately-owned residences in Tusayan. All of the privately-owned residential housing in the community is clustered on a shaded hillside on the west edge of Tusayan, generally in the area of the original Reed cabin. The Franz Rotter family purchased the home originally built by Buford Belgard.

As the owners of the majority of the Tusayan property, the Thurston family built a rambling brick ranch-style residence adjacent to the Belgard/Rotter home. In the early 1960s, Bess Thurston sold a one acre parcel on the westerly side of the meadow to Emery Kolb, owner of Kolb Studios inside the National Park. Kolb only got as far as excavating a basement vault for storing his photographs in the rocky outcropping before dropping the house-vault idea. The home of John Thurston, grandson of R.P. Thurston, now occupies the Kolb site. Another acre site was sold to Mrs. Betty Verkamp (who, in 1994, sold the property to the Rotter family). Three one acre parcels were sold to the widow of the Thurston's South Rim Mobile Home Park manager, Bob Kendall, but the properties were never developed. In the 1980s, Bill Thurston, R.P. Thurston's son, sold two more acres west of the Thurston family home to Franz Rotter, who built two homes on them for his grown children. A third lot was sold to Joe Babbitt, owner of the Babbitt RV Park, who constructed an expansive log cabin-style home and guest house. The Babbitt home is now owned by Tom & Regina Jaworski, owners of the "new" Tusayan Steak House and operators of the Tourist Center owned by Elling Halvorson. Finally, the Slayton family, owners of the Seven Mile Lodge, constructed a personal residence southwest of the Thurston and Rotter homes.

In addition to lack of residential housing, a second limiting factor on new development in Tusayan has been water, not having enough of it locally to supply the residents and visitors, and what to do with the water after it has been used. Historically, the ranchers and farmers, like George Reed, made do with the rainwater and snow-melt they could capture in tanks. Since there was so little drinking water, getting rid of wastewater was not a problem. Commercial developments, on the other hand, require a great deal more water. The problem of an adequate water supply was originally solved by R.P. Thurston, who set up a trucking business to haul water the 60 miles from Williams to Tusayan. Later, businesses either bought water from Thurston, or hauled their own. Some water was sold to the community by the National Park Service through an intermediary non-profit association, the Tusayan Water Development Association, but even then the cost of water was extremely high. In 1987, using a combination of practical "guesswork" and sophisticated satellite photos, a partnership consisting of several local businessmen drilled the first successful water well in Tusayan. While a vast improvement over hauling water from Williams by truck, the amount of water in the quarter-mile deep well is unknown and water conservation continues to be a high priority for Tusayan residents and businesses.

The problem of what to do with Tusayan's wastewater resulted in privately-funded construction of a sanitary treatment facility in 1972. Later, operation of the facility was taken over by the locally elected South Grand Canyon Sanitary District. Since the original construction the facility has been enlarged twice to accommodate on-going community growth.

Visitation to the National Park grew rapidly in the 1980s and the State of Arizona widened Highway 64 (US 180) to four lanes of traffic through Tusayan in 1987. Part of the multi-million dollar project included installation of sidewalks, but not the community requested street lights. Through the lobbying and self-help of Tusayan residents and businesses, street lights were finally installed by the Tusayan Lighting District.

During 1991-1992, a major improvement project at the Grand Canyon National Park Airport added new access roads and increased automobile parking to meet the needs of the growing air tour industry and to provide a new location for helicopter sightseeing companies which were being squeezed out of Tusayan by continued commercial development. It is expected that the two helicopter companies operating in the Tusayan community (Papillon Grand Canyon Helicopters and Kenai Helicopters) will have moved to the Grand Canyon Airport by 1997 to join a third helicopter company (AirStar Helicopters) already operating there.

A frequent question by visitors to Tusayan is "what" are the large domes located directly across Highway 64 from the Grand Canyon Squire Inn Best Western? Intended originally as an Omnimax movie theatre, the project, originally known as the "Galaxy Theatres," languished after completion of the competing IMAX Theatre a half mile away. The unusual looking structure has been used at various times as a gift shop, restaurant, arcade, and bar.

In a narrow view, the very existence of Tusayan can be attributed to federal money to improve public road and air access to the Grand Canyon National Park. With a wider perspective, however, Tusayan should be seen as a community of opportunity and enterprise. Had George Reed not homesteaded the meadow in the Coconino Wash, had R.P. Thurston not understood the value of frontage on public highways, and had numerous entrepreneurs not been willing to take a business risk on the continued growth of tourism to Grand Canyon, there would be no Tusayan, at least not as it exists today, nor as it will be tomorrow.

The author wishes to extend recognition to Sheryl Carrick, Jack Verkamp, Buford Belgard, and Teri Cleeland, for their assistance in the preparation of this article.

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Thurston Family Pioneered the Community of Tusayan

As printed in the Williams-Grand Canyon News on October 6, 1994

Any historical celebration of Grand Canyon National Park would be remiss without mention of the small community of Tusayan, located one mile south of the park's south entrance station.Tusayan was pioneered by R.P. Thurston, who moved from Williams to the area in the early 1930s, after purchasing a ranch located 12 miles west of the park.

R.P. "Bob" Thurston first moved to Williams from Ash Fork in 1927. He was previously employed as a signalman and at one time, had worked for all three of the State's railroads.After his move to Williams, he began selling automobiles at Bill Wilson Ford. According to his daughter, Roberta Fain, he also took care of the garage. When owners of the garage went on vacation, they never returned and Thurston started running it.

In 1929, Thurston built the Whiting Brothers Hotel next to the Sultana Bar, and also constructed 18 stone cottages, complete with hot and cold running water. He worked as a distributor for Shell Oil, and at one time, owned a service station, garage, car dealership and hotel. According to his son, Bill, in a taped interview conducted on Aug. 26, 1981, his dad was Mayor of Williams when he was "framed for bootlegging." Bill said his dad was the middle man and bought a bottle of whiskey for two men, who turned out to be federal agents. They wanted him to plead guilty to bootlegging, but R.P. refused. he spent the six months in the Prescott County Jail for his offense. During his incarceration, he still ran the City of Williams and every two weeks, city officials took the payroll to him for his signature. Elections came up while he was still in jail, and R.P. was re-elected as Mayor of William by the residents. In 1932, prohibition was repealed.

Thurston moved his family to the area that is now Tusayan in 1935. He loved the area and decided to buy the only private land closest to the park. Fain said that her father bought the "old Reed place" which was an old homestead consisting of 160 acres. Her mother also bought property adjacent to her husband's, which was located where Grand Canyon National Park Airport is now. According to Bob's granddaughter, Bess Thurston, old Tusayan was first located where the Canyon Pines trailer park is now. The dirt road from Williams to the Grand Canyon followed the railroad tracks. Later, her grandfather persuaded the state to build the highway right through the middle of his property so that he would have highway frontage on both sides of the new road.

The first businesses constructed in Tusayan around 1956-1957 were a Shell gasoline station and the Tusayan Steak House, which was a bar and a cafe combined. They were built by R.P. Thurston and his longtime friend, Jim Kennedy. Kennedy was reportedly one of the first employees of Grand Canyon Airlines. The twosome then built the Red Feather Lodge in 1963-1964, the first hotel built outside the national park's boundaries in Tusayan. Bo Fain, Thurston's grandson, recalls that the Red Feather was built without any formal blueprints.

In the 1960s, Bob convinced the state to build Grand Canyon National Park Airport in its present location. They had originally intended to build near what is now Valle. The forest service wanted the airport to be closer than Valle, and they worked a trade with Bess Thurston (Bob's wife) for her land and, thus, the airport was constructed one mile south of Tusayan. R.P.'s son Bill and his wife Bonnie arrived in Tusayan about the same time the Red Feather was built. Bonnie ran the office and served as the hotel's only maid. Bill hauled water back and forth from Williams. Bonnie and Bill, who both died in the late 1980s, have three children: John, Bess, and Clarinda, who along with their uncle, Chris, who was born when R.P. was 72 years old, are the only Thurstons who still reside in Tusayan. R.P.'s daughter (Bill's sister) Roberta Fain, shares business interests in Tusayan. The Fain family still resides in Williams. Bess concluded, "It's a wonder any of us kids were ever conceived! Dad was always driving truck and Mom was working at the hotel--their paths hardly ever crossed!"

TUSAYAN AREA PLANNING COMMITTEE
TUSAYAN-GRAND CANYON RESIDENT/WORKER SURVEY RESULTS
JULY 1993

	Total	Tusayan	Forest Service Housing	Park Service Housing	Williams	Concession Housing	Woodland Ranch	Valle	Other
1. In which area do you live?	303	111	12	61	8	41	27	22	21
2. Do you Rent or Own?									
1. Rent	56	18	4	18	1	5	3	0	7
2. Own	72	11	4	2	7	5	15	19	9
3. Employee Housing	167	79	4	41	0	31	8	3	1
3. How long have you lived in the area?									
(average # of years)	6.7	5.1	5.2	6.6	12.4	8.0	2.8	10.6	8.3
# of individuals responding:									
0 - 1 years	51	31	2	5	0	2	9	1	1
1 - 3 years	64	26	2	14	0	7	4	3	8
3 - 10 years	105	26	8	28	3	19	6	9	6
10 + years	75	24	0	14	4	12	8	8	5
4. Why did you choose to live in the area?									
1. Employment	155	38	9	36	4	23	9	5	31
2. Family	18	8	1	1	0	1	4	2	1
3. Liked the area	87	30	2	10	3	12	1	10	12
4. Other	22	10	0	0	1	3	1	4	3

5. What are the main problems and issues that you see in Tusayan?

	1st Choice	2nd Choice	3rd Choice	4th Choice
1. Housing	86	30	18	2
2. Traffic problems	14	7	8	7
3. Water Problems	40	42	13	3
4. Prices/cost of living	13	7	8	3
5. Lack of services (recreational facilities, restaurants, police, fire, banks, laundry, etc.)	32	52	36	19
6. Child Care	0	3	3	0
7. Other	83	74	50	28

5. (cont.)

The majority of "Other" responses concerned the appearance of Tusayan, (lack of architectural building codes), the lack of planning and zoning in Tusayan, and the noise and safety problems caused by the helicopters not being located at the airport. Some of the other answers included: the lack of business opportunities, drugs, lack of quality telephone service, the adversarial relationship that exists between the park and Tusayan, and profits over park concerns.

6. Which of the following do you think are important environmental concerns?

	Overall Rank	Total	Tusayan	Forest Service Housing	Park Service Housing	Williams	Concession Housing	Woodland Ranch	Valle	Other
1. None										
2. Air Quality	2	3.55	3.24	2.50	3.51	3.20	4.72	3.60	3.72	3.17
3. Water Quality	1	2.84	2.36	2.64	3.53	2.50	3.11	2.38	3.44	3.00
4. Dust	8	6.49	6.36	6.00	6.91	7.25	7.29	6.17	5.47	6.11
5. Light Pollution	9	6.58	6.44	6.80	6.14	7.75	7.09	6.93	7.07	6.22
6. National Park Protection	3	3.75	4.44	5.17	2.10	4.80	4.00	4.19	4.81	2.91
7. National Forest Protection	5	3.89	4.07	5.17	3.46	4.17	3.96	4.06	3.94	3.38
8. Vegetation	6	4.42	4.49	3.88	4.75	5.00	4.53	4.00	3.50	4.45
9. Wildlife	4	3.76	3.76	4.00	4.40	4.20	3.65	2.81	2.94	4.00
10. Noise	7	4.83	4.56	2.78	4.82	2.75	5.09	6.06	5.67	5.89

7. Which of the following do you think are important lifestyle concerns and how are these issues currently being addressed?

	Level of Satisfaction		
	Poor	Adequate	Good
1. Rental Housing	226	43	6
2. Home Ownership	214	26	9
3. Employment Opportunities	41	136	86
4. Seasonality of Employment	44	148	55
5. Medical/Dental Facilities	82	123	56
6. School Facilities	62	118	63
7. Police Services	56	143	61
8. Fire Services	90	123	47
9. Houses of Worship	61	123	54
10. Recreation/Parks	116	81	59
11. Neighborhood Retail	162	76	17
12. Air Transportation	73	109	61
13. Domestic Water	151	91	18

8. Which of the Following uses do you think would be appropriate in Tusayan?

	Yes	No
1. Single Family Homes	221	52
2. Apartments	256	26
3. Trailer Home	170	88
4. Condominium	117	141
5. Cooperative	88	134
6. More Motel Rooms	117	129
7. More Restaurants	147	103
8. More Gift Shops	55	188
9. Junk Yards	30	217
10. Travel Trailers for Employees	112	135
11. Day Care Facilities	228	36
12. Convention Center	94	149
13. Auto Repair Center	223	45
14. Laundry	246	22
15. Helicopter Tour Operations	96	151

9. What types of commercial uses would be appropriate?

The majority of those that answered this question responded with facilities for the residents, such as laundry, banks, shopping, inexpensive restaurants, movie theater, auto repair shop, day care centers, mini-storage, etc. Some of the other answers were more hotel rooms, and more activities for the tourists.

10. Are there uses that are definitely not appropriate?

The most common answer to this question was no manufacturing or industrial businesses. In addition, the respondents do not want to see casinos, amusement parks, auto dealers, or adult stores.

11. Are there uses (or services) which are needed in Tusayan?

Most of those from the area would like to see banks, laundry facilities, auto repair shops, and entertainment such as movie theaters and recreational centers for the residents.

12. Currently, the only commercially zoned land in the study area is in Tusayan. Would you be opposed to additional commercial development in the area if, as a condition of this zoning, community needs such as housing, parks, schools and other public services could be provided?

1. Yes 119
2. No 163

13. If an expansion of facilities for the area were proposed (retail, service, housing, etc.) would you like to see them:

	Yes	No
1. Adjacent to the existing community	191	53
2. Within one mile of Tusayan	159	68
3. Within three miles of Tusayan	110	108
4. Inside the National Park	21	208
5. Valle	128	91

14. Would you be opposed to industrially-zoned land in the study area? Examples of uses that might require industrial zoning might include: commercial laundry, storage facilities, manufacturing, lumber yards, etc.

1. Yes 154
2. No 120

What industrial uses would be appropriate?

While most responded that they would be opposed to industrially zoned land in the Tusayan area, many indicated that laundry and storage facilities would be acceptable.

15. Other than for single family homes are you in favor of more specific guidelines to control the architectural style, height and color of commercial buildings, as well as signs?
    1. Yes 231
    2. No 54

There were many remarks made about the appearance of Tusayan, specifically about the Domes.

16. Currently many of the signs in Tusayan are within county sign code requirement, some are grandfathered and some are illegal. Do you think there should be a unified sign system or program in Tusayan. 196
Or do you think the signs as they exist now are OK. 86

17. Should the County be more active or less active in the enforcing zoning regulations?
    1. More 153
    2. Less 36
    3. About the same 82

18. Do you think traffic on Highway 64 is a problem?
    1. Yes 189
    2. No 90

Do you have any thoughts on how traffic conditions may be improved?

Many had ideas about the area between Williams and the Grand Canyon, others mentioned their ideas about the strip in Tusayan, while others mentioned the entrance to the park.

The ideas on how to improve traffic from Williams to the Grand Canyon included widening the road to four lanes, making passing lanes, and making pull-off areas.

The most frequent responses on how to improve the traffic on the strip dealt with the speed of the traffic through town. Some of these included: adding a patrolmen for an increased police presence, put up a light so that pedestrians can cross Highway 64 without the threat of being hit by a car, and add flashing yellow lights to the speed limit signs.

Many respondents had ideas on how to improve traffic conditions at the park entrance. Two of these included: having a lane for locals only, and keeping all three lanes open during the busy season.

19. Do think there is a need for a park in the Tusayan area?
    1. Yes 176
    2. No 102

<u>If yes, where?</u>

The most common responses were:
a) the park should be placed between the IMAX theater and Moqui Lodge, and
b) the park should be placed in the vacant lot adjacent to Hit the spot.

20. <u>Are there any special characteristics of the Tusayan area which should be preserved?</u>
1. Yes 117
2. No 114

<u>If yes, what?</u>

Many believed that the small town atmosphere and rural setting were special characteristics which should be preserved.

21. <u>Do you believe tourism and environmental protection can co-exist?</u>
1. Yes 265
2. No 22

22. <u>If your employment places you in contact with tourists to the Grand Canyon National Park, what, if any, comments, criticisms or thoughts do you hear most frequently from them regarding their visit to the area?</u>

1.	Too crowded/too many lines	48
2.	Not enough parking	36
3.	Too expensive	75
4.	Other	53

Some of the "Other" responses included: the area needs better signs, better camping facilities, lack of rooms, lack of information on the area, and the lack of activities and restaurants. There were also positive responses stating how lucky we are to live in the area, how beautiful the area is, how spectacular the air view is.

23. <u>Do you have any thoughts as to how Tusayan, as a community working together, can make a visitors experience more pleasurable, more rewarding and a longer lasting experience?</u>

Many of these responses included: charging reasonable prices, and improving employees attitudes.

24. <u>Does the seasonality of the tourist season create any unique problems for the Tusayan community?</u>

Most who responded to this question, stated that the only problem was the lack of money during the slow season. Many went on to say that tourism has picked up so much that there is virtually no off-peak season.

25. Would increased tourism in the off-peak season (say, October through April) create any new problems for the Community of Tusayan?

Some responded that there would be more "burn-out" as a result of not having a break. However, as in question #24, many noted that tourism has increased during these slow months. As a result, there is almost no off-peak season remaining.

26. Should the County control the preservation of natural vegetation (for example, with a tree ordinance or landscape ordinance)?

1. Yes 228
2. No 51

27. There are a number of proposals that could cause major change in the future of Tusayan. Please indicate if you are in favor or opposed to the following. Please check "not sure" if you have no opinion or if you do not have enough information.

	Total	Tusayan	Forest Service Housing	Park Service Housing	Williams	Concession Housing	Woodland Ranch	Valle	Other
A. Proposed Railroad spur from the Williams/Grand Canyon rail line to Tusayan.									
1. In Favor	133	41	6	35	2	26	9	11	3
2. Opposed	99	34	6	10	5	7	12	9	16
3. Not Sure	60	30	0	15	0	7	3	2	2
B. Proposed paving of U.S. Forest Service Road 302 (dump road) from Tusayan to the basin south of Desert View.									
1. In Favor	110	43	2	21	3	16	9	7	9
2. Opposed	131	39	8	29	3	17	13	12	10
3. Not Sure	46	20	2	9	1	6	3	3	2

Tusayan Planning Committee
Survey Results
July 1993

	Total	Tusayan	Forest Service Housing	Park Service Housing	Williams	Concession Housing	Woodland Ranch	Valle	Other
C. Airport expansion, including a new runway.									
1. In Favor	161	61	6	26	5	24	15	10	14
2. Opposed	78	20	6	21	1	10	8	8	4
3. Not Sure	50	21	0	12	1	6	2	4	3
D. Tusayan Incorporation									
1. In Favor	143	59	6	23	3	18	16	10	8
2. Opposed	~~1~~41	14	1	8	0	11	1	3	3
3. Not Sure	101	29	5	27	4	11	7	8	10
E. Proposed land exchange									
1. In Favor	81	26	5	28	1	6	7	3	5
2. Opposed	90	29	3	14	4	14	5	13	8
3. Not Sure	113	45	4	16	2	19	13	6	8

INFRASTRUCTURE

Water

Water supply has historically been a limiting factor in the growth and development of Tusayan. There are no local sources of surface water available, and groundwater aquifers are located at such a depth that drilling wells has been cost prohibitive. Until recently, when the Canyon Squire successfully drilled a well in Tusayan, most of the water supplies have been hauled by truck from the Williams and Bellemont areas. Also, a limited amount has come from Grand Canyon National Park.

Prior to 1978, all of Tusayan's water supplies were provided by private suppliers in Williams and Bellemont. In 1978 the Tusayan Water Development Association (TWDA) was established as a non-profit organization to protect the town's water rights and as a legal entity to acquire water from the Park. The organization owns no assets other than a Certificate of Convenience and Necessity (CC&N). When and if Tusayan incorporates, the CC&N would transfer to the Town of Tusayan. Since its formation in 1978, it has been the responsibility of the TWDA to find alternate water sources and to communicate that information to its members. TWDA is under no legal obligation to provide water.

There are two existing privately-owned water systems in Tusayan, one owned by the Red Feather Inn and the other owned by the Canyon Squire Inn. The Red Feather system was built in the mid to late 1960's, and the Canyon Squire system was established in 1978. Existing storage capacity is 300,000 to 350,000 gallons for the Red Feather system, 3,650,000 gallons for the Canyon Squire, and an additional 500,000 gallons storage at Moqui Lodge which has its own separate system. The two water systems are interconnected to ensure water service to all customers in the event of a shut-down of either system. The Canyon Squire system serves Canyon Pines, Papillon Grand Canyon Helicopters, the Tourist Center, Union 76 station, Steak House, Halvorson Trailer Park, IMAX, Quality Inn, and John Thurston's house. The Red Feather serves everyone else.

In 1992, 44 million gallons of water were used in Tusayan. Almost half of that amount, 21 million gallons, was supplied by the Canyon Squire Well which is at a depth of 3,400 feet. Thirteen million gallons were hauled from Williams and Bellemont, and ten million came from Grand Canyon National Park. The Park provides water to Tusayan only during the winter months when they have a surplus.

The Park uses 600,000 gallons per day during mid-summer. There is 14 million gallons storage at the South Rim. The water supply is pumped from Roaring Springs in the Canyon by way of an eight inch pipeline. The Park also supplies water year-round to the U.S. Forest Service ranger station at Tusayan and the Ten-X campground. Grand Canyon Airport hauls water and also collects water through a catchment system at the end of the runway. The airport has 530,000 gallons of storage.

Water availability will continue to be an important factor in any new development proposals in Tusayan. Even with the Canyon Squire well, most of the water being used now is trucked in from outside sources. In addition, existing storage capacity is inadequate. Additional wells in the area may be a possibility. However, a detailed study is necessary to determine possible impacts of such wells, especially impacts on springs in Grand Canyon National Park and on Reservation lands.

Water Goals

1. To develop a permanent water supply and efficient distribution system for the community.

2. To develop adequate water storage capacity for the community.

3. To seek coordination and cooperation with the National Park Service and other agencies to develop permanent water supply alternatives in a manner that is sensitive to the area's resources.

4. To develop a water system for domestic use and fire protection.

Water Policies

1. Adequacy of water supply shall be considered in the review of all major developments requiring Commission or Board approval.

2. Water conservation measures shall be included in all major development proposals requiring Commission or Board approval. Such measures may include the use of reclaimed water for nonpotable uses, low water using plumbing fixtures and drought tolerant landscaping.

Wastewater

The South Grand Canyon Sanitary District owns and operates the wastewater treatment plant in Tusayan. The facility, for which an upgrade was approved by the Planning and Zoning Commission in 1990 and ADEQ in 1991, currently has a capacity of 150,000 gallons per day. The system utilizes an extended aeration process and ultraviolet light for treatment of wastewater. The system is designed to be expanded in phases up to an ultimate capacity of 600,000 gallons per day. It currently serves the airport as well as the community of Tusayan. The Forest Service ranger station compound and Moqui Lodge are on a separate system.

Reclaimed water from the treatment plant is available for sale, but there is a limited distribution system from the plant. Recent hotel additions have been double-plumbed to use reclaimed water for toilet flushing and landscaping. Reclaimed water from the Parkis also used. The Sanitary District is considering the possibility of constructing a reclaimed water storage tank as well as a distribution system for non potable uses.

Sludge disposal is an issue that must be addressed in the near future. The short-term solution is to haul it to landfills in Flagstaff or Bullhead City. However, ADEQ requires a long-term Sludge Management Plan. A possible solution is a composting system to convert the sludge to humus for agricultural and horticultural use, thereby converting a waste product into a marketable commodity.

Future development in Tusayan, especially intensive uses such as restaurants and hotels, will be dependent on adequate wastewater disposal activity. Also, the development of a reclaimed water storage distribution system will become increasingly important for non potable uses. and fire suppression as new development occurs.

Wastewater Policies

1. Approval of new developments shall be contingent on access to adequate community wastewater treatment facilities.

2. New commercial and industrial developments shall use reclaimed wastewater for nonpotable uses such as toilet flushing, landscape irrigation, and fire protection. New multiple family residential shall use reclaimed water if legally and reasonably available. *(Amended 5/97)*

3. Major new developments shall be required to construct their fair share of facilities for a reclaimed water storage and distribution system.

4. The South Grand Canyon Sanitary District shall be encouraged to establish a sludge composting system.

5. New development shall conform to all SGCSD policies, rules, and regulations.

6. Cooperation, common management, and joint sharing of wastewater facilities shall be encouraged for all new development.

Utilities

Electric service is provided by Arizona Public Service Co. (APS) with the primary power source being the Cholla Power Plant near Holbrook. Cholla is a coal-fired plant. According to APS, the Grand Canyon substation will probably never reach capacity, but the Tusayan substation will need to be upgraded as demand increases. The line into Tusayan is currently at 80% capacity, and APS estimates that the development of three more major hotels would put it at capacity. As development occurs and facilities gradually reach capacity, APS pays for the necessary upgrades as needed. However, when major new development occurs, such as a new planned community, the developer pays for the upgraded facilities.

U.S. West provides telephone service to the area. In 1991, they upgraded the switch that feeds the Park. They continue to work on various upgrades and lines in the area. However, with relatively few subscribers in the area, approximately 600, and millions of calls coming in, there are frequent problems with what U.S. West refers to as "inward call volume blockage." The problem will likely be exacerbated by future development.

Utility Policies

1. Wherever possible, the underground placement of utilities shall be required for all new developments.

2. Major new developments shall be encouraged to incorporate energy conservation measures through the use of passive solar design and appropriate site planning, landscaping, and building materials.

3. Major new developments shall be required to provide the necessary utility upgrades to telephone and electric services to service the development in a manner that will not egrade the environmental quality or adversely affect the existing community.

4. Major new developments that include high volume telephone usage shall be encouraged to locate their reservation number outside the area unless the developer can demonstrate that it will cause no significant impact on the community.

Solid Waste

The solid waste generated by the community is hauled to a County-operated transfer station on "Dump Road" approximately three miles southeast of town. The County then hauls it to the Cinder Lake landfill near Flagstaff. In 1992, 1,924 tons were hauled.

The transfer station is on Forest Service land, and operates under a special use permit. Tipping fees were recently implemented by the Board of Supervisors for all transfer station users. The station was primarily designed for residential users, but does allow commercial users, at least for the time being. Super Trash is the only commercial solid waste collection company in Tusayan. The Park has their own landfill.

The transfer station represents an annual cost to the County of $126,000. That includes $67,000 hauling costs to the Flagstaff landfill and $58,000 operating costs, including salaries for two employees. The facility cost $120,000 to build. By comparison, a new landfill would cost millions to establish.

As the City of Flagstaff's landfill approaches capacity, there is no guarantee that the City will continue to accept County-generated solid waste. The existing landfill has between eight and 25 years capacity left. Recycling is being promoted in the City of Flagstaff to reduce the waste flow into the landfill. Super Trash, working with DOW Chemical, has established a recycling program in the Park, which has already reduced the waste flow there.

As solid waste disposal costs increase, trash composting may become more economically feasible as an alternative to traditional landfill disposal. A composting system could include composting of sludge from the wastewater plant as well as municipal solid waste. Such a system could cost $2 to $3 million, but combined with a recycling program, would dramatically reduce the solid waste flow into the landfill.

Solid Waste Policies

1. Recycling shall be encouraged in order to reduce the solid waste flow into regional landfills.

2. New solid waste disposal facilities that require Commission or Board approval shall include a composting system, including sludge composting, if technically and economically feasible.

3. A regional approach to solid waste management and solid waste disposal between Tusayan, the National Park, and surrounding communities shall be encouraged.

HOUSING

When the South Grand Canyon Specific Area Study was written in 1977, approximately 30 acres of land within Tusayan proper were designated for low or high density residential development. According to the plan these areas were established "in response to local residents who realized that additional housing would be required for employees of proposed tourist-oriented operations." This acknowledgement for a need to house employees was far-sighted and profoundly accurate. Unfortunately, however, development did not occur in accordance with this plan. In fact, addressing employee housing is one of the primary problems the businesses in Tusayan must face when first establishing an operation and when expanding. The survey of residents completed in July, 1993 identified housing as the number one problem in Tusayan. Furthermore, the vast majority of respondents rated the current situation related to both rental housing and home ownership as "poor." Not surprisingly, there was great support by residents for the development of both single family homes and apartments in Tusayan.

The ability to provide employee housing in a manner consistent with the County's Zoning Ordinance requirements, in a manner that is adequate for employees' needs, and such that it satisfies the concerns and needs of the employer is a difficult task given the constraints in Tusayan. These constraints include the limited amount of private land available for development, the absence of a local community water source and limited water availability, and the landowners' priority for developing commercial uses first.

Also, due to the tourist-oriented nature of the businesses in Tusayan, there is a seasonal fluctuation in the number of employees. Most businesses cut back on the number of employees during the off-season and increase the number during the busy summer months. Some businesses close down completely during the winter months. This varying work force no doubt compounds the problem of providing adequate employee housing since it could result in vacancies for a period of several months. Also, employees who are only around a few months are no doubt more willing to put up with marginal living conditions than permanent year-round employees would be.

Since the focus on the housing situation is employees, it is important to know the size and source of the labor pool. The 1990 census counted 604 residents in the Tusayan area. Since this count is made in the spring (April) it does not account for the seasonal influx of workers during the peak summer months. Based on the estimates given by the employers surveyed this year, the year-round population is easily doubled if all seasonal employees were new additions to the community. However, since some of the seasonal work force is made up of local residents who already have a primary employer, spouses of employees who work inside the Park, teenagers from the community, and commuters from Flagstaff, Williams, and Valle, the impact may not be quite that drastic. However, if the commercial and service related uses continue to increase, the number of employees will also

Background

When the businesses in Tusayan were first established (starting in the late 1960's) employee housing was generally addressed by setting travel trailers to the rear of the business, but not on the same lot. These were generally approved by the County through a Conditional Use Permit and considered to be temporary arrangements until permanent housing was provided elsewhere. Unfortunately, some employee housing provided in this manner was not only substandard but would be considered intolerable by most standards.

Two mobile home parks were established in the late 1960's and early 1970's that were not on the same site as a commercial operation. These are the South Rim Mobile Home Park (UP-68-8) and Halvorson's Mobile Home Park (UP-71-12). Canyon Pines Mobile Home Park, located in the western end of Tusayan, is the only other residential housing development established in Tusayan which was not part of a commercial development. It was established in 1984 and 1986 in conformance with the County's Mobile Home Park Zone. Sage Valley Mobile Home Park is located approximately 17 miles south of Tusayan at Woodland Ranch. Established in 1985, this Park has taken much of the overflow housing from Tusayan.

There are only a handful of lots within Tusayan that are zoned for Single Family Residential use. The first residential subdivision in Tusayan was approved in 1992 (S-92-4) for nine lots on three acres. The existing Single Family Residential lots are primarily owned and occupied by local business owners.

Current Situation

In January and February, 1994, an informal telephone survey of the majority of businesses in the Tusayan area was conducted by Community Development staff. The purpose of this survey was to get a more accurate picture of the employee housing situation. The employers were asked for the number of employees during the peak season, if employee housing was provided, and where employees lived.

The survey included 22 local businesses, including the Moqui Lodge and businesses operating at Grand Canyon Airport. In addition to these private businesses, the Grand Canyon Airport, which is operated by the state, and the U.S. Forest Service (USFS) were also surveyed. The Forest Service rents to the Coconino County Sheriff, DPS, and FAA; these were all counted under USFS housing. The housing inside Grand Canyon National Park was not included, although spouses of many National Park Service employees work in Tusayan and live in the Park. A list of the employers surveyed is attached.

Just over half of the employers surveyed provide employee housing to some extent. This means that housing is made available (some on a limited basis) but does not necessarily mean that it is paid for by the employer. In general, most of the housing is rented to the employee or is considered through reduction in pay. Some employers who do not provide housing stated that they compensate employees for lack of housing with higher wages. Some employers who have employees commuting pay mileage or provide commensurate compensation.

The Airport is the only employer surveyed who currently has 100% of its employees housed on site. Moqui Lodge can accommodate 100% and possibly also the USFS, although the Forest Service has three employees who live in housing provided by their spouse's employer.
All of the seven major employers (over 70 peak season employees) provide some housing, ranging from 100% for Moqui to less than 30% for the IMAX complex (including Taco Bell and Gifts Ltd.). Most of the employers who don't provide any housing have less than 10 employees.

Housing is a real mixed bag, particularly for the larger employers. All of the major hotels have some form of dormitory housing supplemented by mobile homes either on site or in one or more of the area parks. Eight of the 12 businesses that provide employee housing maintain at least a portion on site or adjacent to the commercial use. The Canyon Squire has a 39-room dormitory and 22 trailers on site; the Red Feather leases the 12 apartments behind the domes, the Quality Inn has a 40-room dorm; McDonald's has six four-bedroom apartments behind it; the Trading Post has four apartments; the Tourist Center and gas station each have one mobile home; and Babbitts's has two mobile homes behind their store. In most situations housing involves putting anywhere between two to six employees in the mobile homes or apartments. However, most of the employers that provide housing appear to make arrangements for couples or families to have individual units.

The 1990 census identified 297 housing units in the area, which is consistent with the 301 units staff's survey indicated. The Sage Valley Mobile Home Park adds 45, for a total of 346 units. This figure does not include any of the Single Family Residential lots in Tusayan proper. What is significant is that out of these 346 units, only 136 are located off site from a commercial use. Of these 136, approximately 15% are privately owned; the majority are owned by area businesses.

Future

With the continuing expansion of existing businesses and proposals for new development, the employee housing situation can only become more strained. Providing back-lot housing in travel trailers or mobile homes is no longer consistent with the County's Zoning Ordinance. It also takes up area which property owners would no doubt rather utilize for revenue-generating businesses or necessary parking areas.

There have been several attempts to address the employee housing situation. Most of the proposals involve housing away from Tusayan; these include Tom Jaworski's request for rezoning (Z-93-12) at Woodland Ranch to accommodate high density residential (RM-10/A, maximum 10 units per acre). This request was denied by the Board of Supervisors due to inconsistency with the County Comprehensive Plan. A similar request is pending for 18 acres west of Tusayan south of Forest Road 328. This request is to rezone to RM-20/A, which allows a density of 20 units per acre, and for a Conditional Use Permit for 208 apartment units. Staff's initial review of this request found numerous inconsistencies with the County Comprehensive Plan which make this proposal undesirable as well. A third proposal which has been made is part of a conceptual master plan development at Valle Airport. The development proposal includes 67.81 acres for mobile home park and 145.31 acres for a Single Family Residential Subdivision in the RS-36,000 Zone (36,000 square foot minimum lot size).

One of the primary reasons Valle has not developed much residentially in the past, and which is a significant concern with this pending proposal, is the lack of a local water supply.

Another attempt at addressing employee housing is with the proposed development which may come about as the result of a pending Forest Service land exchange. The Canyon Forest Village project has been touted by its proponents as a means of addressing the housing problem, not only for Tusayan but the National Park as well. One of the ideas Canyon Forest Village has proposed includes setting aside an area for development by the NPS for employee housing outside the Park. There is also currently a request by Elling Halvorson to purchase 190 acres of State Trust Land approximately 11 miles south of Tusayan fronting on the east side Highway 64.

During the summer of 1994 Nava-Hopi tours initiated a commuter shuttle for a 90 day trial basis, operating between Flagstaff, Williams, Tusayan, and Grand Canyon National Park. The shuttle was meant to provide employees from Flagstaff and Williams transportation to the Tusayan and Grand Canyon area, thus reducing the need for employee housing locally. Unfortunately, according to the operator, the effort failed miserably. Such a service can only be successful with full cooperation from all participating employers.

Unfortunately none of the proposals currently on the table solves the housing problem in Tusayan. The proposals for high density residential in remote outlying areas is expanding the problem to new areas, not resolving anything. To rely heavily on bussing employees from outlying areas would make Tusayan a community lacking a central element -- residents.

Employers Surveyed for Housing Status

Canyon Squire
Red Feather
Quality Inn
Moqui Lodge
Canyon Area Shuttle
Papillon Grand Canyon Helicopters
Kenai
Airstar
Grand Canyon Airlines
Grand Air
Scenic Air
Air Nevada
Eagle Airlines
Air Vegas
Dollar Rental Car
Budget Rental Car
Transworld Express/South Rim Travel
Babbitt's
Tourist Center/Steak House
Trading Post
IMAX, Taco Bell, Gifts Ltd.
McDonald's
Forest Service
Grand Canyon Airport

GOALS

1. Providing adequate and affordable housing for employees, existing and future, shall be a priority of the community.

2. A comprehensive housing needs assessment shall be conducted to identify the current and future community needs.

POLICIES

1. All new developments shall be encouraged to provide employee housing as close as is feasible to employment centers (see also p. 40, paragraph 4).

2. In order to ensure that housing is available for employees, a plan shall be provided to limit the use of new housing to persons who are employed year-round or seasonally in the Tusayan/Grand Canyon area.

3. The existing trailers which are located on the site of commercial uses shall be phased out over time and replaced with housing in Tusayan or as close as is feasible.

4. Any proposal to house employees outside of the Tusayan community (e.g., Woodland Ranch, Valle) shall be evaluated to ensure that such proposals are in the best interest of both Tusayan and the area proposed.

5. High density residential uses shall be discouraged in remote areas and in areas where U.S. Forest Service roads provide the only access.

6. All residential developments shall be designed to be compatible with the character of the area and in consideration of their location in proximity to the Grand Canyon National Park.

7. Adequate open space areas and buffers from commercial uses shall be incorporated into development of residential areas.

8. A mix of housing types including dormitories, apartments, townhomes, and single family dwellings shall be provided to meet the employee housing needs.

9. Concurrently with rezoning areas presently zoned multiple family to commercial, alternate lands within the community must be provided for housing.

10. New housing developments and new subdivisions for employees and residents shall be favored over housing for second homes or recreational use.

ADDENDUM
TUSAYAN PLANNING COMMITTEE REPORT

For 22 months this committee has grappled with the numerous and wide-ranging problems facing Tusayan. The # 1 problem which consumed the majority of the committee's time is HOUSING.

Our committee is in total agreement to the scope of the problem. However, we have not offered any corrective actions and solutions continue to elude us. This situation is further exacerbated by current Coconino County Planing & Zoning Ordinances.

It is amazing the numbers of Tusayan area residents who have reacted to this housing shortage by purchasing land (fee simple and/or tax roll) in the Valle and Woodland Ranch areas and remote lands adjacent to Highways US 180 & AZ 64. Often time these purchases require considerable years of saving and most of these individuals' monies. Especially so when we are speaking of those which hold lower tier jobs. It is these situation where the current Ordinances are themselves an obstacle to the housing problems.

It appears that the majority of the Ordinances neglected to consider that these remote areas are not accessible to electrical power, water distribution systems or sewer systems as is found on county zoned lands adjacent to Flagstaff. These remote landowners must develop their own systems i.e. solar, generators, water tanks and septic systems at a tremendous cost for each system.

In a normal situation, a landowner that wants to build will approach a bank and obtain a loan secured by the property and home. Usually the loan amount will cover all expenses from design through occupancy. Remote land presents a classic "Catch 22" situation. When a banker hears you have to develop your own utilities it is the end of discussion. Consequently, these costs MUST be borne by out-of-pocket monies by the landowners. After you have developed your utilities and in many cases built the home, then the bank will consider a loan. In reality, a non-option.

The only option is to build on your own. The first requirement for receiving a Building Permit is a Septic Permit from the Health Department. In our area, a typical septic system installation will cost between $3,500 to $7,000 + . Secondary is a generator, costing $500 to several thousand. Solar system cost $2,500 to $10,000 + . And finally water tank and system $1,500 to $4,000 + . This situation and the expenditures required virtually assure an adversarial relationship between the landowner and Coconino County.

The writer of the ADDENDUM does not purport to know the solution to these issues. However, we must recognize the existing circumstances on these remote lands and search for workable resolutions. Our search should encompass both past policies and new options presented by emerging technology.

Looking backwards, a chapter from our pioneering forefather could further our goal of providing HOUSING while fulfilling the County's protection responsibilities. We should explore the possibility of passing a "HOMESTEAD ORDINANCE". An applicant under this ordinance should have 8 to 10 years to bring their property up to the standards in place at the time of application. Throughout the homestead period, the landowner should be able to occupy their property with minimal governmental interference. Most landowners given the time and opportunity desire to have quality improvement on their land. They realize the return on their investment will be directly in proportion to their efforts.

Ordinances must take into consideration the environment and its' use patterns. Ground water protection for areas where surface water is found within a few hundred feet is plainly understood. However, applying the same standards to areas where ground water is found over 3,000 feet down is ludicrous. Lets look to the future and explore compost toilets and equivalent systems developed elsewhere in the world. Likewise, most septic and sewer requirements are developed using typical water use found in a community. Rural water usage where the person is paying five cents ($0.05) per gallon of water versus community usage at $0.46 per hundred of gallons. A greater than 10 to 1 cost difference is two completely separate stories. Again, policies are developed on the community standards.

As stated earlier, this writer does not pretend to know the answers. He does however recognize many problems and feel the solution can only be found in debating these problems. The current status guo serves no one. We have County Ordinances extremely difficult to comply with. A Government which seems its' major function is to act as a policeman while not exploring alternatives. And a populace which finds itself in the role of law breaker because of their inability to comply.

THERE MUST BE A BETTER WAY.

Signed: Ron W. Williams

Ron W. Williams, Vice-Chairperson
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Ann Wren, Committee Member
Tusayan Planning Committee

COMMUNITY

The second section of the Tusayan Vision Statement, developed by the Committee in the initial stages of the planning process, addresses Tusayan as a community. Rather than serving only as a commercial core, the vision is of a community with residential neighborhoods and other services and amenities that tie a community and its inhabitants together. Besides decent, affordable housing and town services like police and fire protection and emergency medical services, which are addressed in other sections, desirable facilities include schools, churches, a library, parks, and a community center.

The Committee has wrestled with how to achieve a sense of community in an area with such a severely restricted land base where land values are extremely high. There appears to be a significant difference between what the residents want and what the property and business owners are willing to provide. While there are only a small number of major owners, Tusayan is not like one of the many company towns dotting Arizona. In current or former mining towns like Clarkdale, Bagdad, San Manuel, and Ajo, the mining company provided schools, parks, community pool, a clinic or hospital, a department store, and inexpensive housing. In other words, a community was created. The purpose was to attract and retain good employees. In Tusayan, individual business owners show little interest in providing amenities that do not generate income. While strides have been taken to improve employee housing, little has been done to offer other community features.

In the residential/worker survey there were several questions that revealed residents' desires. In Question 3, "What are the main problems and issues that you see in Tusayan?," housing ranked as number one. Lack of services such as recreational facilities, restaurants, police, fire, banks, laundry, etc., was about tied with water as the second most important. In Question 8, "Which of the following uses do you think would be appropriate in Tusayan besides additional housing?," a large majority supported day care facilities and such community commercial uses as auto repair center and laundry. A close majority opposed additional motel rooms, and large majorities did not favor more gift shops and helicopter tour operations. In Question 9, "What types of commercial uses would be appropriate?," those favored were facilities for the residents, such as laundry, banks, shopping, and a movie theater. In response to Question 19 a large majority thought there was a need for a park in the Tusayan area.

Either through an incorporated town government or through an association, creative alternatives need to be explored to provide facilities and services that residents want. In Tusayan the free enterprise system is not likely to work to provide these facilities. Funds will have to be raised, whether through business owner contributions or through taxation, to develop the amenities necessary to improve the sense of community.

In the following sections, certain specific community facilities are addressed. Most of these are now provided in Grand Canyon Village. In the future, with proposed and potential development, the population of Tusayan could easily surpass that of the South Rim, indicating that some of these facilities might better be located in Tusayan.

Schools

When the South Grand Canyon Specific Area Study was done in 1978, enrollment at the Grand Canyon schools was 220 students, of which approximately 55 were from Tusayan. The plan stated that the district had the capacity for 400 students, but that enrollment was declining. In August 1993, School Superintendent John Vest reported to the Planning Committee that enrollment was 366, with approximately half from Tusayan. Enrollment the previous year was 320; there had been a 60% increase in enrollment over the previous three years. He said that with new facilities being added as a result of a recently approved bond, the district should be in good shape for about eight years, after which they would likely be looking at a school in Tusayan, either on exchange land or on Forest Service land. In addition to Tusayan, he said there are students attending Grand Canyon schools from outside the district; for example, there are about 20 from Woodland Ranch because the parents work for businesses in Tusayan or at the Park. He added that there is a continual demand to expand services.

Churches

The community is currently served by an interdenominational facility inside the Park, the Shrine of the Ages. While a range of church choices is not likely in either Grand Canyon or Tusayan because of the low population, certainly it would be desirable for residents of Tusayan to be able to attend certain services in the community. This may not require church buildings, but could also be accommodated through use of other community buildings, schools, or even commercial buildings. Efforts could probably be made to offer meeting and church service locations.

Library

The community library was formerly located in the old Babbitt Trading Post building inside the Park until the building was recently destroyed by fire. In a letter to the Committee a library representative acknowledged the lack of library services to Tusayan and proposed a couple of alternatives which were either a branch library or a bookmobile. The former could be started in a corner of a store or in an office and possibly expand to a stand-alone library building at some point in the future. The Planning Committee supported working with the Library Board to improve service to Tusayan residents.

Parks

Sixty-three percent of respondents to the resident survey said there was a need for a park in the Tusayan area. The most frequently mentioned locations for a park were between IMAX and Moqui and adjacent to Hit-the-Spot. The survey did not follow up on the type of park desired or the types of facilities in a park. Typical community or city parks range from small or large grassy areas with a few benches and picnic tables, to playgrounds, to active recreational facilities such as baseball or soccer fields and tennis courts. The Sanitary District was at one point considering a park adjacent to the wastewater treatment facility. Proposed uses included picnic tables with barbecue facilities, a volleyball court, and restrooms. This site or a site on Forest Service land makes more sense than a location in the commercial core.

There are at least three proposals currently being discussed in the community that could address some or all of the community needs. The first is the Canyon Forest Village proposal which includes lands (40 acres) designated for such community facilities as library, post office, 400-student school, police station, fire station, medical clinic, three churches, and a community center. The second is the Townsite Act by which an incorporated municipality or other taxing authority or subdivision of the state could purchase U.S. Forest Service lands for community facilities. Such lands could be utilized for the same sorts of facilities as listed in the Canyon Forest Village proposal, as long as the facilities were town-owned. In addition to those listed, a park would be an additional possibility on Townsite Act land. The third is the American Legion's proposal to develop a large building with Legion facilities on the second floor and community center functions such as library, police, fire, visitor information, and offices on the first floor.

GOALS

1. The sense of community in Tusayan shall be retained, with a mix of uses in addition to commercial to include residential neighborhoods, school, library, churches, community center, and parks.

2. If and when the land base expands, lands shall be identified and set aside for all future community uses.

3. Development of a sense of community between Tusayan and Grand Canyon Village shall be encouraged.

POLICIES

1. Proposals to develop such community facilities as a school, library, or community park, etc. shall be strongly encouraged.

2. Major new developments on lands outside of the 144 acre core shall be required to set aside lands for community uses.

3. Development of community facilities and services shall occur at the same pace as commercial development.

PUBLIC SAFETY

Protection of the public health, safety, and welfare is the basis and justification for planning and zoning. During the information-gathering stages of the Planning Committee's work, major deficiencies in fire protection and the provision of emergency medical services were noted. Tusayan itself does not provide these services and so must rely on outside providers such as Grand Canyon National Park and Grand Canyon Airport to respond to fire and medical emergencies. These shortfalls were raised in the 1978 South Grand Canyon Specific Area Study, and have been exacerbated by major growth in population, numbers of tourists, and commercial activity since then.

Law Enforcement

The Coconino County Sheriff's Office is responsible for law enforcement services and protection in all unincorporated areas of the County which includes Tusayan. These services include, but are not limited to, patrol services, criminal investigations, civil process, maintenance and operation of the County jail, and search and rescue operations. There are currently three officers stationed in Tusayan, one more than when the previous plan was written in 1978. These officers work under the Williams substation.

According to Sheriff Joe Richards, a 1992 Activity Analysis showed that 7.71% of crime within Coconino County originated in Tusayan. In the Tusayan area theft is the highest activity and traffic accidents are second. These are followed by a variety of property crimes, DUIs, and domestic violence.

Tusayan accounts for 87% of the activity, Grand Canyon 11%, and other areas 2%. The Sheriff told the Committee that law enforcement activity is different in Tusayan than other small communities; in Tusayan the large transient population causes the majority of the problems. If Tusayan incorporates, the town government will have the option of establishing its own police department or contracting with the Sheriff's Office for continued service by the County. Without a contract, the Sheriff would reduce manpower and services in Tusayan.

Three other agencies provide law enforcement services in the area. The Department of Public Safety, which has one officer stationed at Tusayan, is primarily responsible for Highway 64, accidents, and the flow of traffic. The officer also assists the Park Service and Sheriff's Office on investigations and tactical and air rescue operations. There are about ten accidents per year in Tusayan that are investigated by DPS. One officer is not sufficient, but backup assistance is provided by Williams and Flagstaff.

The National Park Service has an Intergovernmental Agreement (IGA) with the Sheriff's Office for law enforcement. The primary role is inside the Park, but in 1992 Park Service rangers responded to 107 calls in Tusayan, a small fraction of the total 4,000 calls. If Tusayan incorporates, an IGA between the Park Service and the community would be appropriate and highly desirable.

The Kaibab National Forest provides law enforcement on U.S. Forest Service lands. They have a cooperative agreement with Coconino County and are establishing one with the Park Service. With increased use of forest lands, the law enforcement program is being re-evaluated.

Fire Protection

There is no organized fire protection officially serving Tusayan. Response to fires is made by outside agencies, all of which have primary responsibility elsewhere. These include the National Park Service, Grand Canyon Airport, Forest Service, and Grand Canyon National Park Lodges (Fred Harvey).

The Park Service will respond to structural fires as long as there is not a simultaneous call from within the Park. Response time is approximately 15 minutes. Grand Canyon Airport has three pieces of equipment, a 1,500 gallon foam truck for airplane incidents, a 750 gallon truck for structural fires, and a rescue vehicle used for backup. There are ten fire staff, five of whom are on duty at any given time. They can respond within the air traffic circle, which is about five miles, but must maintain a three-minute response for the airport to meet FAA requirements.

The primary responsibility of the Forest Service is wildland fires. They maintain two engines at the ranger station and an air tanker at the airport. There are about 15 fire staff during the summer fire season. Response will be made to structural fires but there must be a threat to national forest lands. Tusayan is small enough that every fire poses a threat to the forest.

Fred Harvey has a department in the park and also maintains older apparatus at Moqui Lodge. Fred Harvey would respond to a structural fire in Tusayan.

In the absence of Intergovernmental Agreements or Mutual Aid Agreements, all fire response to Tusayan is on a cooperative basis in the interests of protecting life and property. None of the agencies are comfortable with the lack of formal agreements.

If Tusayan incorporates, a municipal fire department would be a necessary service. Another option is the formation of a fire district. A district can be formed by petition of a majority of the property owners. It is funded principally through a property tax. The range of property taxes for fire districts in Coconino County is $.45 to $2.60 per $100 of assessed valuation. Districts can either form their own department complete with all their own equipment, either with volunteers or a paid staff, or a combination, or they can contract for fire services with another municipality or agency.

New construction is regulated and controlled by both planning and zoning ordinances and by building codes. Compliance with the Uniform Building Code and Uniform Fire Code is required in order to obtain a building permit. Requirements such as properly sized emergency exits, firewalls, smoke detectors, and fire sprinkler systems are designed to reduce damage potential. Zoning requirements such as minimum setbacks reduce the chance of fire spreading and allow access for emergency vehicles. For new subdivisions, water distribution systems, fire hydrants, improved all-weather access roads and streets, and street name signs all contribute to make fire protection more effective.

Emergency Medical Services

Like fire protection, there is no official emergency medical responder in Tusayan. Tusayan is served by Eddingfield Ambulance Service out of Williams, but their primary duties have been transport from the clinic at Grand Canyon to Flagstaff Medical Center. First response to emergency medical situations is typically made by the National Park Service which will dispatch an ambulance with basic life support. The Park Service is very concerned with the lack of Mutual Aid Agreements for service outside the Park. The Park Service also has a helicopter which is utilized to transport patients to Flagstaff, for which a fee is charged.

The Grand Canyon Clinic serves as a provider of primary care. The physician at the clinic told the Committee they do what they can before the patient is moved to the next level of care, usually to Flagstaff Medical Center. The clinic is operated by Samaritan Health Services as a concession within the Park. Under consideration is a part-time satellite facility located in Tusayan.

GOALS

1. There shall be municipal fire protection and emergency medical services in Tusayan, either through incorporation or through the formation of a fire district.

2. The danger from fire shall be reduced through improved fire protection services, adherence to fire codes, and voluntary measures designed to lessen the chance of wildland fires.

3. Lands shall be identified to fulfill the public safety needs of the community.

POLICIES

1. Absent an established fire department, all future commercial buildings shall be sprinklered.

2. Additional rezonings to commercial shall be discouraged until fire protection and emergency medical services are available.

3. Intergovernmental Agreements and Mutual Aid Agreements among the agencies with law enforcement, fire protection, and emergency medical capabilities are strongly encouraged.

4. Multiple access routes into major developments shall be strongly encouraged.

5. Adequate space shall be required between structures to inhibit the spread of fires.

6. Adequate emergency vehicle access shall be required by the Zoning Ordinance to all building sites through adoption and enforcement of appropriate property development standards.

7. Water storage shall be retained at a level that is adequate for fire fighting.

TRANSPORTATION

The transportation system in the Tusayan Study Area is unique in many respects compared to other study areas in Coconino County. There is one main arterial running north and south through the Tusayan business district. Highway 64 is under the jurisdiction of the Arizona Department of Transportation (ADOT). There are few other publicly maintained roadways in the study area and none in the County road system. The County does maintain Dump Road through a cooperative agreement with the Forest Service who owns the road. The Forest Service does minimal maintenance on the other roads under their jurisdiction. Canyon Pines Road is a paved, privately-owned and maintained road. Grand Canyon Airport maintains the roadways on their property. In addition to the roadway network of Forest Service, private, and State roads already mentioned, the transportation system in Tusayan includes the Grand Canyon Airport, an ADOT-owned facility, and the Grand Canyon Railway, a privately-owned historic railroad.

Major transportation issues facing the community of Tusayan include possible improvements or changes affecting the Highway 64 corridor, the possible paving of Forest Road 302, Grand Canyon Airport expansion, the proposed Grand Canyon Railway spur to Tusayan, and on-going regional transportation planning being coordinated by Northern Arizona Council of Governments (NACOG). The transportation element of the Grand Canyon General Management Plan is also extremely important in any discussion of transportation issues affecting Tusayan.

First, regarding the Highway 64 corridor, ADOT has no plans for major improvements in the Tusayan area in their current five year plan. The existing right-of-way is 200 feet wide, and there are five traffic lanes in Tusayan, including a center turn lane. There are sidewalks on both sides, but no designated or signalized crosswalks or pedestrian bridges. This, along with excessive speed, creates a dangerous situation for pedestrians, especially during the busy tourist season. Any future or on-going transportation planning should include provisions for enhancing pedestrian safety.

Also related to the ADOT right-of-way is that there has been some interest among certain property owners along Highway 64 about applying for an abandonment of a portion of the 200 foot right-of-way. Most recent information from ADOT is that they are not interested in abandoning any of their right-of-way at this time.

Another major transportation issue is the possible paving of Forest Road 302. The paving of any Forest Service road or the significant realignment of the State highway raises a myriad of issues especially related to potential environmental and land use impacts. An Environmental Impact Study (EIS) would be required to study potential impacts and identify a range of possible alternatives.

The Grand Canyon Airport is an ADOT-owned facility. It has one runway 150' x 9,000' designed to handle DC-9s and 737s. Recently $10,000,000 worth of improvements were completed, designed to increase efficiency of the facility. These improvements were realignment of, and expansion of parking, roadway, and infrastructure, which included site work for a new terminal and heliport facilities. Future improvements include heliport facilities which will enable the helicopter tour operations to relocate from the Tusayan business district.

The Grand Canyon Railway is a privately-owned historic railroad currently carrying passengers between Williams and Grand Canyon Village. Approval of the operation, which was initiated in 1989, was based on two primary considerations: the historic nature of the train service and its potential for helping to reduce vehicle congestion in Grand Canyon Village. An additional spurline has been proposed between Grand Canyon Airport and Grand Canyon Village. The EIS for the proposed spurline was completed in 1993, and the Record of Decision issued. The selected alternative features a turnaround loop at the Airport end, two depots, phased construction of 75 acres of parking, construction of a maintenance road, and storage tanks for fuel, water, and wastewater. According to the Record of Decision the proposed spurline is not the only solution to traffic problems in Grand Canyon Village, but it has the potential to significantly reduce traffic congestion in the Park.

The Grand Canyon Transportation Study is an on-going study being conducted by NACOG with the help of representatives of a variety of land management agencies and other organizations to address regional transportation planning needs and satisfy ISTEA (Intermodal Surface Transportation Efficiency Act) requirements. The study group developed a Vision Statement which states, "To provide appropriate access to the Grand Canyon region and that World Heritage Site while preserving and conserving the environmental integrity and regional cultural and community values for this and future generations." The committee meets every three or four months. The outcome of the study would likely have many direct and indirect effects on the community of Tusayan. One of the immediate effects is that requests for abandonment of Highway 64 right-of-way are on hold pending completion of the study.

The National Park Service is in the process of developing an updated General Management Plan for Grand Canyon. Transportation is the critical element that drives all of the alternatives under consideration. One of the biggest issues is where the interface will occur between private vehicles and public mass transit. It is quite possible that there may be a need for multiple staging areas both in Tusayan and within the Park and other possible locations. The great importance of this issue to the community of Tusayan illustrates the need for coordinated interagency planning and cooperation.

GOALS

1. To promote a safe, environmentally sensitive, and efficient circulation system which gives convenient access to existing and future residential areas, employment centers, commercial areas, public facilities, recreation areas, and public lands. Planning should be such as to minimize the impact to the surrounding forest.

2. To promote a transportation system that reduces energy consumption, and noise and air pollution.

3. To promote multi-modal transportation options.

POLICIES

1. Developers shall pay the cost of road improvements necessary to provide safe and adequate access to proposed developments.

2, Only very low density residential developments shall be encouraged in remote areas accessed by Forest Service roads.

3. All new major developments or major expansions of existing developments which require access or modification of access to Highway 64 shall require a traffic impact analysis pursuant to Arizona Department of Transportation requirements.

4. The visual appearance of Highway 64 in the Tusayan business district shall be improved through requirements for appropriate landscaping and signage for new developments and redevelopment or expansion of existing businesses.

5. The County, Forest Service, Park Service, and private entities shall support and promote the development of an improved bikeway system from Tusayan into Grand Canyon National Park.

6. The County shall encourage and promote cooperation between affected property owners, businesses, and ADOT to make the necessary improvements required to provide safe pedestrian crossing of Highway 64 in the Tusayan business district.

7. In order to help alleviate traffic congestion in Tusayan and Grand Canyon National Park, staging areas for public transit systems shall be developed at convenient and accessible locations in Tusayan and within the National Park and other appropriate locations.

8. Adequate off-street parking shall be required for all new developments, including accessible parking and bus parking where appropriate.

9. The County, Forest Service, Park Service, and private entities shall encourage the development of multi-modal transportation options such as bikeways, equestrian trails, railways, and other public mass transit systems.

10. The County shall continue to cooperate in interagency transportation planning efforts in the Tusayan/Grand Canyon region.

11. The County, Forest Service, and Park Service and private entities shall support and promote the development of Grand Canyon Airport as a mass transit provider for the National Park.

TOURISM

The growth of the Tusayan community over the past 25 years is directly related to the increasing tourism to Grand Canyon National Park. Tusayan relies on tourism to sustain the area businesses and residents. In this respect a healthy tourist economy is crucial to the existence of the community. However, there are impacts related to increasing tourism which can work to the detriment of the community as well. The Survey results and Vision Statement adopted by the Planning Committee reflect a desire to balance the needs of the residents with those of the tourists and also the ability to have a healthy tourist industry while maintaining environmental protection of the natural resources.

The Survey results of Tusayan-Grand Canyon residents/workers provides local insight to the issues affecting the tourist industry. The Survey results indicate that some of the most frequent criticisms of the area include: excessive costs, crowded conditions, not enough parking, and lack of information on the area. On the positive side were tourist comments relating to the natural beauty of the area.

The respondents felt that two main issues could improve the visitor experience; these were charging reasonable prices and improving employee attitudes. Some uses which were identified as inappropriate include casinos and amusement parks. With the trend toward providing more visitor services outside the National Park; i.e., lodging, restaurants, vehicle staging areas, and information/educational areas, Tusayan's role in the tourism industry will be all the more important in the future.

GOALS

1. Tusayan shall work to provide a high level of service to accommodate the visitors to Grand Canyon National Park while retaining an emphasis on preserving the natural resources of the area.

2. Local businesses and governmental agencies should work together to achieve a cooperative approach toward meeting the tourists' needs.

POLICIES

1. Development of tourist-related uses shall be limited to support services for Park and National Forest visitors. No new developments which would become tourist destinations themselves shall be permitted; e.g., amusement parks, casinos, convention centers, regional mall.

2. Development of educational-related tourist facilities in cooperation with other natural history related agencies and entities which focus on the local cultural, natural, and historic aspects of the area shall be encouraged.

3. Tusayan businesses shall work with the Grand Canyon National Park, Forest Service, and Grand Canyon Airport in coordinating the development of tourist support services.

4. Tusayan shall work toward developing and maintaining building design and landscaping standards which will create a favorable visual impression on tourists. The standards should be consistent with and complementary to the unique location of Tusayan at the gateway to the Grand Canyon National Park.

5. Development of programs to create regional coordination between various local and State tourism and visitor agencies should be strongly encouraged.

6. It is highly recommended that local businesses should work together to achieve a cooperative and noncompetitive approach for the betterment of the community and businesses.

NATURAL RESOURCES AND ENVIRONMENTAL QUALITY

With its location adjacent to a national park, the protection of natural resources and the preservation of environmental quality is essential to achieve the vision of a world model community. Environmental consciousness and the use of technological innovation in managing water, wastewater, and solid waste are declared priorities in the Vision Statement. In Coconino County the natural environment is important in fostering and attracting economic development, assuring continued growth in tourism, maintaining property values, and providing for a high quality life style. Elements for consideration include water quality, air quality, vegetation and wildlife, national forest issues, scenic highway designation, open space, aesthetics, and noise.

Water Quality

In the Tusayan Planning Committee Survey of area residents, water quality ranked number one out of nine potential environmental concerns.

Surface Water

The area covered by this planning document is located in the Colorado River Basin, thus all surface runoff ultimately drains into the Colorado River. The one major drainage affecting private land in the study area is Coconino Wash which bisects the Tusayan community in an east-west direction, paralleling Canyon Pines Road to the west. Coconino Wash is identified as Zone A by FEMA, which is defined as "Areas of 100-year flood; base flood elevations and flood hazard factors not determined." Some hydrology studies have been required in conjunction with new commercial development including the Red Feather expansion and the Holiday Inn Express. Since much of the private land lying west of the highway behind the commercial development is within the Coconino Wash floodplain, development will be restricted by meeting flood hazard reduction measures.

Given the amount and intensity of commercial development existing and contemplated in the Tusayan community, there are concerns related to non-point source pollution, particularly oil and other residue from parking lots and roadways. The airport, train, and parking staging areas could be significant contributors.

Ground Water

Groundwater resources have only recently been tapped within the Tusayan community; due to the depth (approximately 3,000 feet) and associated expenses, hauled water has historically been used. Given the depth, groundwater contamination is not a critical issue. However, quantity is a significant concern as there have been no hydrological reports made public identifying the resource. In this respect, quality is indeed tied to quantity.

Air Quality

Air quality problems within the study area can be classified as either regional or local. On a regional basis there have been visibility issues related to the migration of Los Angeles area smog from the west and the Navajo Generating Station in Page to the east. The haze in the region attributed to emissions at the Navajo Generating Station are being addressed with the addition of scrubbers, scheduled to be completed by August, 1999. This is the result of a lawsuit filed by the Environmental Defense Fund against the EPA in 1982 for failure to enforce the Clean Air Act.

Local air quality problems can be attributed primarily to exhaust from automobile and bus traffic. Dust from traffic on unpaved Forest Service roads also contributes to air quality problems. Smoke from woodstoves and fireplaces is probably not as significant as is found in other urban areas due to the limited number of residences. However, it could pose a problem in the future if Tusayan's land base is expanded. If the railroad spur to Tusayan becomes a reality, there is a potential for further degradation of air quality in the Tusayan community.

Vegetation and Wildlife

With the majority of the study area being undeveloped public lands, the human impact on native vegetation and local wildlife is probably relatively minimal. Preserving the natural environment is important and not only to provide an area for continued habitation by wildlife. By preserving the native vegetation and utilizing primarily indigenous plants with new landscaping, residents and visitors benefit as well. The development of a tree preservation ordinance and landscape requirements which emphasize indigenous plant materials will help maintain the natural atmosphere while also addressing issues such as water conservation, which would become a concern with the introduction of exotic plant species.

Forest Issues

The majority of the 70 square miles included in this study area are under the jurisdiction of the Kaibab National Forest. Issues related to Forest land include recreation opportunities, fuelwood gathering, special use permits, proposed paving of some Forest Service roads, and the pending land exchange proposal for Canyon Forest Village.

The Forest land is available to provide an alternative recreation experience to the National Park. Ten-X campground, including a proposed expansion of 250 spaces, provides formal camping opportunity, while dispersed camping on Forest land is also allowed. Other recreational uses include hunting, hiking, and biking.

The Forest Service will grant special use permits allowing private development on Forest Service land in certain cases. The Moqui Lodge is an example of an existing use, the proposed railroad spur and parking area is currently under consideration, and a community center to be built by the American Legion is also contemplated. Private development of Forest Service land is outside the scope of the County's zoning jurisdiction and until recently no such buildings required any plan review or permits by the County.

The issue of paving Forest Service roads has been discussed in conjunction with some alternatives for the Grand Canyon General Management Plan and also as a means of facilitating access to private inholdings in the area and the Havasupai Reservation.

Concerns related to the proposed paving include distributing more people on the Forest, thus increasing the potential for environmental degradation in areas which are fairly remote now, including the private inholdings.

By far, one of the most controversial issues related to Forest Service land at this time is the proposed land exchange for Canyon Forest Village. It is a matter of routine policy for the Forest Service to try to acquire private inholdings located within the National Forest. The method for doing so is through the land exchange process where the Forest Service identifies lands it wants to acquire as well as Forest Service land which they are willing to part with, generally lands which are near or adjacent to urbanized or developed areas. Currently the U.S. Forest Service is in the process of reviewing a proposal to acquire approximately 1,210 acres of private lands located in five places in the Tusayan District. In exchange, the Forest Service would release up to 650 acres, either north or south of Tusayan, for the development of a planned community. The land exchange process takes several years to complete and includes analysis through an Environmental Impact Statement, which considers possible impacts related to wildlife, vegetation, surface and groundwater, as well as transportation and regional issues.

National Park Issues

Protection of the National Park was rated number three by survey respondents, behind water and air quality as a local environmental goal. Clearly, what happens on the private land outside the Park as well as activities on the Kaibab National Forest can have major impacts on the ability of the Park to meet this goal. There are transboundary issues related to environmental concerns which, if not checked outside the Park, could have negative, if not devastating effects within the Park, regardless of what Park policies are adopted to deal with these issues.

Probably the two areas which are most critical are related to air quality and water quality and quantity. Although the Park is anticipating stringent requirements such as prohibition of wood burning stoves and fireplaces in new structures, and converting busses from diesel to cleaner alternatives (possibly electric or natural gas), particulate emissions created outside the Park will still migrate over the boundary and thus counteract the Park policies.

In regard to water, surface runoff which drains into tributaries feeding the Colorado River can pose pollution problems to streams within the Canyon. Also, the National Park Service has expressed great concern over the impact the new wells which are being developed in Tusayan will have on the springs located throughout the Canyon, which are in the same aquifer.

Clearly, it is to Tusayan's benefit to ensure that the natural resources in the Park are preserved and protected since they are, in essence, what brings tourists to the area.

Aesthetics

Given the location of Tusayan at the gateway to the South Rim of the Grand Canyon National Park, the aesthetic quality of the community is a very important aspect, as was reflected by the survey results. Although there are some exceptions, the general impression tourists get upon arrival in Tusayan is not consistent with its natural setting. The hodge podge of building styles, mobile homes along the highway, and amount of air traffic create an atmosphere of mass confusion. Although this is similar to how other gateway communities have evolved, the result is detraction from the National Park experience which the public is looking for.

Over 80% of the survey respondents supported the development of more specific guidelines to control the architectural style, height, and color of commercial buildings and signs. Many respondents expressed a desire to maintain a small town atmosphere and rural setting.

Methods of protecting this gateway from the inlux of unsightly and/or inappropriate distractions include the adoption of Desing Review Guidelines sensitive to the unique location of the area. These guidelines would address appropriate architectural style and design, materials, textures, colors, and lighting. These standards can then be applied to buildings, structures, signs, lanscaping, site layout, and use relationships for multi-family, commercial, and public or semi-public uses.

Lighting

Lighting is one of the more apparent environmental issues and one that is continuing to grow at an exponential rate. Although residents ranked it ninth out of nine environmental areas of concern, the amount of outdoor area lighting has no doubt increased substantially just within the year since the survey results were compiled. Also, the impacts of excessive lighting are more apparent to visitors to the area that are seeking an outdoor experience. Instead of stargazing and night sky viewing as it should be enjoyed in a remote location, there is a trespass of light from the strip of commercial activities. The impact and amount of light created in Tusayan is probably most apparent when viewed from the North Rim of the Grand Canyon.

Although safety concerns necessitate outdoor lighting of parking lots and walks, the excessiveness that has been the norm is inappropriate. The County's Lighting Ordinance was adopted in 1989 and was considered fairly elaborate and restrictive at the time. The impetus behind the Ordinance was maintaining low enough levels of illumination so that the observatories would still be functional. An amendment to the Lighting Ordinance which would place greater restrictions in areas adjacent to National Parks would be one way of addressing this problem.

Noise

Noise is a dominant part of the environment in Tusayan given its proximity to the airport and the location of helicopter tour operations right in the center of the community. The eventual relocation of the helicopter tour operations to the airport will work towards alleviating some of the most annoying noise in the commercial strip, but due to the amount and frequency of flights from the airport which follow flight paths directly over the central core, air traffic noise will continue to be a problem.

There have also been concerns raised related to the train whistle, particularly the fact that it can be heard in the Grand Canyon and the "piercing sound" when the train bleeds its boiler near Maswick. These concerns will be more relevant to Tusayan if and when the proposed railroad spur is developed.

GOALS

1. Water quality of all surface waters and groundwaters shall be protected to preserve or improve existing quality.

2. Every effort shall be made to preserve or improve air quality.

3. Every effort shall be made to minimize the amount of outdoor lighting in order to preserve the dark night sky without jeopardizing reasonable utility, safety, and security concerns.

4. The community shall make every attempt to protect and improve the aesthetic and audio quality of the environment and to prevent negative impacts on property values and quality of life.

5. The community, including public agencies, shall protect and preserve native vegetation and wildlife habitat areas and shall especially seek to protect unique natural areas, and rare endangered plant and animal species.

POLICIES

1. For major development projects that would impact drainage on adjacent properties or on roads or watercourses and which require action by the Planning and Zoning Commission, part of the application submittal shall be a drainage report which discusses how surface runoff will be accommodated and what impact it may have on adjacent property owners.

2. Developers shall be encouraged to conserve and re-use drainage or runoff water but not to the extent of decreasing natural flows.

3. Protection of the existing quality of ground and surface water resources shall be a priority factor in the consideration for approval of residential, commercial, and industrial developments within Tusayan. Applicants for major developments shall be required to show the impact of their proposed activities on the quality and quantity of surface and groundwater resources within the area.

4. Development and adoption of emission standards to mitigate the impacts of air pollution and to complement those adopted by the Park shall be pursued. Owners of commercial vehicles shall be strongly encouraged to meet or exceed the 1994 and subsequent Clean Air Act emission standards.

5. Protection of existing air quality shall be a major consideration in the review of plans for new industrial, commercial, and residential projects. Applicants for major developments shall be required to show the impact of their proposed activities on air quality within the area.

6. The County shall adopt, in conjunction with this Area Plan, a Design Review Overlay Zone which addresses architectural style, building materials, colors, signage, and other design aspects which are consistent with the character of the rural setting adjacent to the Grand Canyon National Park.

7. Landscaping standards emphasizing preservation of native vegetation and materials and the use of indigenous and low water consuming plants shall be applied to all new developments other than single family homes. Tree preservation shall be a major factor in the review and approval of new subdivisions and other major developments.

8. All new major developments shall include adequate open space area. On property consisting of one acre or less a ratio of 90/10 impervious surface/landscaped area shall be maintained, i.e., no more than 90% of the site can be covered in impervious surface with 10% landscaped; on one to three acres the ratio shall be 85/15; on three or more acres the ratio shall be 80/20.

9. The County shall rigorously enforce the Grading and Excavation Ordinance in order to prevent excess runoff, sedimentation, and channel modification in streams and washes, as well as preventing visual scars on hillsides and in other sensitive areas. For new subdivisions, a grading permit shall not be issued until after Preliminary Plat approval.

10. Revegetation of exposed steep dirt slopes and cut-and-fill areas shall be required for new subdivisions and other major commercial developments.

11. Wherever possible, the use of underground electric and communication lines shall be required in all new developments.

12. The County shall rigorously enforce the Sign Code and Zoning Ordinance in order to eliminate nonconforming signs.

13. Every effort shall be made to protect the night sky from unnecessary lighting and glare. The Tusayan Area shall conform to the provisions of Zone III of the Lighting Ordinance, but requiring that all fixtures be fully shielded.

14. The community and local agencies shall coordinate with State and Federal wildlife management agencies, conservation groups, and land management agencies to preserve important wildlife habitat areas.

15. Proposals for special use permits for development on Forest Service land should meet the standards set forth with these policies.

LAND USE

At the first Tusayan Planning Committee meeting held March 3, 1993, a 70 square mile study area was established (see Map 1). The predominant land uses in the study area are grazing, forestry, and recreation. In the less than quarter square mile private land core which constitutes the community of Tusayan, land uses include tourist commercial, retail commercial, and high and medium density employee housing. Adjacent to the community is the Grand Canyon Airport.

Land Ownership

Approximately 96% of the land in the study area is controlled by the National Park Service (14%) or U.S. Forest Service (72%). About 2% is controlled by the Arizona Department of Transportation which owns and operates the Grand Canyon Airport, and 2% (844 acres) is private. Land ownership is also shown on Map 1.

Existing Land Uses

Most of the private inholdings within the national forest are utilized for very low density residential. Within the community of Tusayan, there is a commercial strip on either side of Highway 64 containing the following businesses:

<u>West Side</u>

Canyon Squire Inn
Seven Mile Lodge
Holiday Inn Express (under construction)
Red Feather Lodge
Denny's Restaurant
Canyon Food Mart
Thurston's Gas and Service
IMAX Theatre

<u>East Side</u>

Galaxy Theaters
Kenai Helicopters
McDonalds
Grand Canyon Trading Post
Papillon Helicopters
Grand Canyon Tourist Center
Babbitt's Supermarket
Grand Canyon Fine Art Gallery
We Cook Pizza, Etc.
Steakhouse

Located off the highway on the west side is the Quality Inn and on the east side is Grand Canyon Camper Village.

There are three mobile home parks: South Rim Trailer Park, Halvorson Trailer Park, and Canyon Pines Mobile Home Park. In addition, up to 10 mobile homes have been allowed at the Camper Village RV Park and Canyon Squire has a mobile home park area for its own employees.

There are five multiple family residential developments: apartments behind Galaxy Theaters and McDonalds, two modular six-plexes adjacent to the Halvorson Trailer Park, and dormitory/apartments operated by the Canyon Squire and Quality Inn. The latter is under a lease and will revert to Red Feather in a few years. There is a sixth project approved for apartments for the Holiday Inn Express located on the north side of Canyon Pines Road.

There are eight single family dwellings, six of which are located in an approximately 15 acre area rezoned from General (10 acre minimum parcel size) to RS-10,000 (Residential Single

Family, 10,000 square foot minimum) in 1984. One is in the Commercial Zone and one in the Multiple Family Zone. A subdivision has been approved to allow nine additional houses in the RS-10,000 Zone area.

At the west end of Tusayan is 8.177 acres owned by the South Grand Canyon Sanitary District which contains the wastewater plant. Portions of their property have been leased to Super Trash and to the Grand Canyon Chamber Music Festival.

Background -- 1978 South Grand Canyon Specific Area Study

The 1978 area plan contained a proposed future land use map (see Map 2). Seven land use categories were identified:

1. Resort commercial, including hotels, motels, and restaurants.
2. General commercial, serving both tourists and residents and consisting of small nodes surrounded by open space.
3. RV parks and camping, for the existing RV park and possible future expansion.
4. Low density residential, defined as one to four units per acre.
5. High density residential, which would allow five to 10 units per acre.
6. Utilities, designated for the existing wastewater treatment ponds and other such facilities.
7. Open space, indicated on the map as corridors to separate the uses, and to be developed into roadways or pedestrian/bikeways.

The community has developed somewhat in conformance to this 1978 plan. The resort commercial area on the west side of the highway is developed with motels, restaurants, and the IMAX Theatre. On the east side the area so developed contains the domes. The general commercial on the east side includes the helicopter operations, restaurants, tourist centers, and the supermarket. The RV park is as shown, as is the site for utilities. There is low density residential on the west side where high density is shown, and there are other areas where high density residential at densities much greater than 10 units per acre have been developed. The open space corridors do not exist.

Tusayan-Grand Canyon Resident/Worker Survey

Several questions (numbers 8-14) in the resident survey which was administered at the beginning of the planning process addressed future land uses. Question 8 asked which uses would be appropriate in Tusayan. Those uses receiving a majority of votes in favor include single family homes, apartments, trailer homes, more restaurants, day care facilities, auto repair center, and laundry. Those receiving negative votes include condominiums, cooperatives, more motel rooms, more gift shops, junk yards, travel trailers for employees, convention center, and helicopter tour operations.

In terms of which commercial uses are appropriate (question 9), those that answered listed facilities for residents such as laundry, banks, shopping, inexpensive restaurants, movie theater, auto repair, day care, and mini-storage. Inappropriate uses (question 10) included manufacturing or industrial businesses, casinos, amusement parks, auto dealers, or adult stores. Listed services which are needed (question 11) included banks, laundry facilities, auto repair shops, and entertainment such as movie theaters and recreation centers for the residents.

A majority of respondents said they would not be opposed to additional commercial development if as a condition of the zoning, community needs such as housing, parks, schools, and other public services could be provided (question 12).

In a question (number 13) addressing where potential expansion of facilities in the area (retail, service, housing, etc.) should be located, a majority answered yes to "adjacent to the existing community" (78%), "within one mile of Tusayan" (70%), "within three miles of Tusayan" (50.4%), and "Valle" (58%). A large majority (91%) did not think an expansion of facilities should occur inside the National Park.

Fifty-six percent were opposed to industrially-zoned land in the study area (question 14). Of those who were not opposed, many indicated that commercial laundry and storage facilities would be appropriate.

Future Land Uses

There are a number of factors affecting future land use besides simple market demand for additional tourist accommodations and resident desire for improved housing and more service commercial opportunities. The management plan for Grand Canyon National Park which is currently in preparation will very likely advocate relocating certain nonessential services and possibly some employee housing outside the Park. Tusayan may be the logical place to locate some of these facilities. There is one land exchange proposal (Canyon Forest Village) under consideration and an alternate proposal (Grand Canyon Improvement Association) that has been put forward. Either one of these could radically affect future land uses because of the scope of the expansion in the private land base. In addition, a railroad spur line into Tusayan has been approved through the Environmental Impact Statement process by the U.S. Forest Service. The proposal is to construct the railroad station and a 2,000-car parking lot between the airport and Highway 64 at the south end
of the community. This could be one of several "staging areas" where tourists could park and take
a train, a bus, or other public transportation into the Park should there ever be vehicle restrictions in the Park. Finally, an obvious overriding issue affecting future land uses is water availability.

Single Family Residential

There is definitely an unmet need for owner-occupied, site-built single family homes. In the core community land is not available for this use. Many employees have purchased land in Woodland Ranch, Valle, or even Flagstaff, in order to own their own home. The County has long been supportive of the acquisition of Forest Service land through exchange for employee housing in the areas immediately adjacent to Tusayan. The inclusion of a certain number of single family homes would certainly seem to be sensible and is strongly supported by the survey results.

In much of the rural unincorporated County, other than a few subdivisions like Kachina Village, Mountainaire, and Pinewood, single family residential development has been at low densities (one unit per acre or less). Much of the development has been through the lot split process rather than through platted subdivisions, resulting in many substandard private access roads. This type of development characterizes Woodland Ranch which has private unimproved roads and is zoned for 10 acre parcels. In Tusayan, platted subdivisions with paved roads and all infrastructure (water, sewer, and utilities) at densities of four to six units per acre, which would fall under the County's RS-6,000 or RS-10,000 Zoning, probably make more sense given the scarcity and value of private land. This type of development also lends itself to the sense of community espoused in the Vision Statement.

If the proposed land exchange does not occur, there could be some interest in single family residential development on the private inholdings within the Kaibab Forest (for example, at Ten-X or Kotzin). While development of the infrastructure, which would necessarily include paving of the Forest Service access roads from the property to the highway, would be very expensive, such use of these private lands might be logical.

Manufactured Homes

Mobile and manufactured homes are a dominant employee housing choice in Tusayan. They are relatively inexpensive (very inexpensive if used rather than new) and are simple to establish. Mobile homes and travel trailers stuck behind the commercial businesses continue to be a major factor due to the lack of alternatives. Quality manufactured homes placed in well designed parks or subdivisions will continue to be a very viable housing choice for employers and employees whether located in Tusayan, on newly acquired exchange lands, or elsewhere, such as Valle.

The Coconino County Zoning Ordinance requires 4,000 square foot minimum spaces in rental mobile home parks, which can allow a density of up to 10 units per acre, and requires 5,000 square feet per space in mobile home subdivisions. Paved roads, landscaping, off-street parking, and recreation areas are some of the required improvements. Canyon Pines was developed under the current Zoning Ordinance standards.

Multiple Family Residential

Dormitories and apartments have historically played a major role in housing employees both inside the National Park and in Tusayan. Several of the businesses in Tusayan utilize either or both, including Canyon Squire, Quality Inn, Papillon Grand Canyon Helicopters, McDonalds, and Red Feather. An 8-unit apartment project was approved in conjunction with the Holiday Inn Express. With the exception of the latter, all multiple family housing is located directly behind or immediately adjacent to the business. In most cases this is far from ideal. While a classic zoning pattern would have commercial cores surrounded by multiple family which serves as a buffer between commercial and single family, the situation in Tusayan is different in that the multiple family is totally surrounded by commercial development. This does not create an ideal or appropriate family living arrangement nor does it necessarily improve the sense of community. If Tusayan were to be completely redeveloped, there would be a commercial core, and there would be a separate but nearby distinct, clustered area of multiple family residential development with adequate light, air, privacy, and open space, with protection from noise, direct illumination, odors, smoke, and other objectionable influences of commercial activity. This language is from the Residential Zones Section of the Zoning Ordinance under Purposes. Additional land would undoubtedly be required to achieve the goal of creating a true residential community.

The lack of additional apartment construction has not been due to unavailability of land, however. Several businesses or business owners have land which could have been, or could be utilized for housing, and there are several acres of undeveloped or underutilized land already zoned for multiple family. In addition, a recent zone change from General to RM (Multiple Family) for the Holiday Inn Express housing was approved without objection and was supported by the County. The reason for the lack of housing has more likely been that housing does not pay. In the past, employee housing has been viewed as a "necessary evil," something that has to be done, and it has been provided as inexpensively as possible. This resulted in the use of travel trailers and old mobile homes. It has long been the position of the County that decent and proper housing should be an employer responsibility even though it will increase the cost of doing business. Most employers now realize that decent housing also results in better, more loyal employees.

There is little question that additional apartments are needed. Because many, if not most, employees could not afford market rate apartments, they will likely have to be provided by employers. Another possibility is a housing authority which could subsidize housing costs. This could only happen through incorporation.

Multiple family developments require a significant level of infrastructure, including water and wastewater, utilities, paved roads and paved parking, fire protection, and landscaping and other amenities designed to make the projects residential in nature.

Multiple family also includes individually-owned condominiums. Although no application has ever been submitted for a condominium project, these may provide a very viable option for affordable owner-occupied housing.

Commercial Uses

There are essentially three types of commercial uses in the Tusayan area that exist or could exist: tourist businesses such as motels, gift shops, and helicopter and fixed-wing air tours; businesses serving both tourists and residents such as general retail (e.g., food markets), bank, gas sales, and laundry; and non-tourist support such as day care, solid waste collection, and professional services.

Along the commercial strip in Tusayan there is a supermarket and a convenience market that cater to both residents and tourists, there is a repair garage that serves mostly residents, and most of the remainder of the businesses are tourist-related.

There is commercially zoned land along the strip that is either vacant or subject to, and appropriate for, redevelopment. On the west side this includes the triangular parcel north of IMAX and the employee mobile home park at Canyon Squire. On the east side this includes the Kenai and Papillon sites after these operations move to the airport, the parcel between the Steakhouse and the old service station, the service station itself, and the domes. Tourist-related businesses are likely and probably most appropriate on all of these sites. Ideally, the non-tourist support businesses would be located off the highway.

Historically, the free market has determined the type and distribution of businesses in Tusayan. To a large extent this will continue to be the case. While a majority of residents seemed to oppose more motel rooms, there certainly seems to be a demand for additional accommodations. If the number of rooms inside the National Park remains constant and visitation increases, this demand will continue to grow. From the County's standpoint, what is most important is that future commercial development be accompanied by employee housing, infrastructure development, and the public facilities and services needed for the additional population. Besides housing, the County's concerns have included water adequacy, wastewater capacity, fire protection, landscaping and open spaces, and aesthetics.

The Forest Service land exchange proposed by Canyon Forest Village (CFV) is certainly a major factor in the consideration of future commercial uses, as is the alternate plan put forth by the Grand Canyon Improvement Association (GCIA). The CFV plan includes several thousand motel rooms and other lodging accommodations, numerous restaurants, several hundred thousand square feet of retail, neighborhood commercial uses, and a 100-acre experiential/educational center. The GCIA proposal includes several hundred additional motel rooms and a new area for shops, gas stations, etc. With the new motel rooms there would presumably be additional restaurants. The County's interest will be to insure that such future commercial development is in the best interest of the National Park, the community of Tusayan, and the County as a whole. A very high standard of development appropriate for park gateway communities will be expected. Because the property is currently public land zoned Open Space, the standard will probably be higher than for developments on land already zoned commercial.

Industrial Uses

Currently there is no industrially zoned land within the study area and no legally established industrial uses. A majority of respondents to the resident survey were opposed to industrially zoned land. The minority in favor thought a commercial laundry or storage facilities would be appropriate.

As Tusayan grows, or as the Park Service looks for sites outside the Park for nonessential services, there could be a need for some light industrial areas. While manufacturing is certainly unlikely and probably inappropriate, other uses such as bus or truck repair, or wholesale distribution could possibly be appropriate.

Public Buildings

At some point there will definitely be a need for a fire station. In addition, there could be a need for a municipal building, schools, and a visitor center or chamber of commerce which could be public or private. Clearly, a visitor information center which might be staffed by Park Service and Forest Service officials should be on or very near the highway, and probably preferably located at the south end of the community. The remainder of the public buildings are typically not on highway frontage and can be anywhere that access is good. Schools are best located within or at the periphery of residential areas.

Open Space/Parks

A majority of respondents (63%) to the resident survey were in favor of a park in the Tusayan area (question 19). The most frequently mentioned location was between IMAX and Moqui Lodge. A public park with grass (irrigated with wastewater effluent), playground equipment, picnic tables, and possibly active recreational facilities like baseball or soccer fields, could serve both residents and tourists. A very attractive public park not only adds to a sense of community but can leave a positive impression with visitors. Development of such a facility is not likely to occur without incorporation and subsequent acquisition of Forest Service land.

SPECIAL CONSIDERATIONS

Tusayan as Gateway

The Coconino County Comprehensive Plan contains specific discussion of future development of gateway communities (page 40):

> "National parks, monuments, and recreation areas in Coconino County include Grand Canyon, Walnut Canyon, Sunset Crater, Wupatki, and Glen Canyon. Development adjacent to, or on highways leading to these National Park Service areas deserves special treatment in order not to detract from tourists' overall experience. The Park Service has very strict controls over development within the boundaries of the parks, so County restrictions outside the parks are justified to prevent the creation of unsightly gateways to these tourist destinations.
>
> "The most significant of the gateway developments is Tusayan at the southern boundary of Grand Canyon National Park. The Grand Canyon is a World Heritage Site, designating it as one of the most unique resources in the world. The park was visited by four million visitors last year [1988], most of whom travelled through Tusayan. Completion of an update to the Tusayan specific area plan and possible adoption of a design review overlay zone containing site plan, architectural, and sign restrictions would allow for a better planned and more attractive community."

Land use policies in the Tusayan Area Plan should reinforce the concepts in the overall Comprehensive Plan.

Grand Canyon Airport

Use of Grand Canyon Airport is inextricably related to land use in Tusayan. A portion of the existing core community is in the direct flight path. Potential addition of a second runway would increase this sphere of influence. There are, or will be, land uses at the airport that complement activities in Tusayan, such as fire protection, car rental, fixed-wing air tours, and eventually helicopter tours. The airport, along with the adjacent approved railroad spur and depot, could serve as one of several staging areas for public transport into the Park.

Parking

The tourist commercial facilities in Tusayan necessarily require a great deal of parking not only for automobiles but for recreational vehicles and tour busses. Large areas of asphalt, unless broken by landscaping, do not present an attractive appearance and also make a community look more urban than rural. The County has been strictly enforcing the Zoning Ordinance landscaping requirements for parking lots. The standard is 10 feet in depth along the front property line (usually between the parking lot and the ADOT right-of-way) and 10 square feet per parking space to be located at the periphery or in the interior of the lot, including one 15 gallon tree per 10 spaces and per 2,000 square feet of area. It is possible that these standards do not go far enough in breaking up the asphalt expanses. From an aesthetic standpoint, a much more attractive way to handle parking is to have the businesses at the front and parking to the rear.

Another issue related to parking concerns variances. A number of variances have been granted by the Coconino County Board of Adjustment from the required number of spaces. The justification has been the number of tour busses and the shared use of facilities on a property; that is, the same clients would be eating in a restaurant as are staying at the motel. While the County is certainly not interested in more asphalt than is necessary, there is a concern that at some point in the future there will be a shortage of spaces. There is already considerable unauthorized use of state highway right-of-way for parking.

Densities -- Residential and Commercial

The Zoning Ordinance provides for a number of densities for residential development, from one unit per 10 acres in very rural areas to six units per acre for single family residential, 10 units per acre for mobile home parks, and 10 and 20 units per acre for multiple family residential projects. Higher densities may be possible or appropriate if enough parking, landscaping, and open space can be designed into the project.

There is no specified density for commercial projects, for example, motels. Prior to the Red Feather expansion and Holiday Inn Express, densities were as follows:

Motel	No. Units	Acreage	Density
Canyon Squire	250	11.8	21.2
Quality Inn	176	3.6	48.9
Seven Mile Lodge	16	0.3	47.1
Red Feather	101	2.48	40.73

The Red Feather expansion, with 129 units on 1.65 acres, represented a density of 78 units per acre. The Holiday Inn Express, with 164 units on 2.365 acres, had a density of 70 units per acre. Community Development staff was concerned with these proposed significantly higher densities. Controlling factors have been building height limitations, although height variances were granted for both projects, and parking and landscaping requirements. Combined with an impervious surface ratio, these may be the maximum densities possible unless allowed heights are increased. The concern with massive multi-story buildings is the urban appearance rather than a rural, park-like appearance that may be more appropriate for gateway communities.

Redevelopment

There are a number of parcels that could very likely be subject to redevelopment. This plan not only applies to redevelopment, but should perhaps recommend it for certain properties that have not been developed in accordance with the vision of an attractive gateway community.

The Kenai and Papillon helicopter operations are slated to relocate to the airport; these properties are ripe for redevelopment. The domes should be removed in favor of commercial development that is more architecturally compatible. At the north end on the east side of the highway, the Halvorson and South Rim Trailer Parks could either be relocated or upgraded to current standards. On the west side of the highway, the Canyon Squire mobile home park should be relocated for additional commercial development. The Canyon Food Mart and Thurston's Gas could be significantly improved and upgraded. The service garage should be removed or relocated. The dormitory behind the garage should also be removed or relocated to a more compatible residential setting. There are additional improvements that could be made off the highway as well, but to achieve the vision of an attractive gateway community, the visual impact of the highway frontage properties which create the visitor's impression are the most important.

GOALS

1. Every effort shall be made to expand the core 144 acre land base to allow controlled expansion of community facilities consistent with community needs.

2. To allow and provide for growth and development which has positive benefits to community residents and land owners, to the National Park, and to the County as a whole, and which is compatible with protection of the natural environment.

3. To provide a range of residential land uses which offer diverse housing opportunities.

4. To create a true residential community.

5. To minimize conflicts between adjacent land uses.

6. To improve the overall appearance of the community.

7. To balance new commercial development with community, National Park Service, and U.S. Forest Service needs such as housing and public services.

8. Any commercial and economic development should be sustainable.

POLICIES

Residential

1. The development of new single family subdivisions for Tusayan and Grand Canyon area residents is encouraged. Subdivisions shall be placed and designed with the goal of creating a sense of neighborhood and community. Waivers may be considered for minimum parcel size and road width if the purpose is protection of open space and preservation of natural resources.

2. Adequate buffering, screening, or fencing shall be required for new residential developments which are adjacent to commercial uses.

3. New residential development shall be discouraged in the airport approach zones where noise and safety may be overriding factors. Within noise impact zones, extra insulation shall be required per FAA specifications. Avigation easements may be required within certain airport noise zones.

4. Until there is an organized fire department, fire sprinklers shall be strongly encouraged in all new single family residential development.

5. New mobile home parks and subdivisions shall be constructed in accordance with the Zoning Ordinance; that is, paved roads, landscaping, adequate space sizes, shall be required. All units shall be HUD-approved manufactured homes.

6. Mobile homes shall not be utilized for multiple family residential purposes; that is, mobiles shall not be subdivided into separate apartment units.

7. New mobile home parks shall be located such that they are not incompatible with adjacent land uses and such that a sense of community is fostered.

8. New mobile home parks and other high density residential uses shall be discouraged in remote areas, in areas where unpaved U.S. Forest Service roads provide the only access, and in areas without adequate utilities.

9. New multiple family residential developments are encouraged. Projects shall be located in areas which are compatible with surrounding land uses. Adequate open space and landscaping shall be utilized to insure an attractive residential appearance. Densities may be waived if open space and a proper residential character can still be achieved. Multiple family projects shall be limited to no more than three stories in height.

10. Should Tusayan incorporate, new multiple family projects shall be encouraged to locate within close proximity of Tusayan in order to obtain municipal services, utilities, and fire protection.

Commercial

1. New commercial development, as well as redevelopment, shall conform to design standards that achieve the vision of an attractive gateway community.

2. New commercial uses shall be tourist-related or neighborhood commercial to serve local residents. Commercial uses which are attractions in and of themselves, such as casinos, amusement parks, factory outlet malls, and convention centers, shall be strongly discouraged.

3. Commercial rezonings shall be strongly discouraged which intrude into existing or future residential areas.

4. The creation of "spot zones," isolated zone changes which are inconsistent with uses of surrounding areas, shall be discouraged.

5. Strip commercial development along Highway 64 outside of or not adjacent to the existing community core shall be strongly discouraged. Preference shall be given for the development of commercial nodes or clusters of commercial activity. Future commercial activity shall be limited to within three miles of the existing core.

6. Environmental impacts shall be carefully considered in reviewing new development projects. Those showing sensitivity to the natural environment including preservation of trees and other native vegetation shall be favored.

7. Requests for commercial zoning shall be limited to the land area needed and site-planned for the planned use in order to eliminate speculative rezoning.

8. Commercial development shall be discouraged in remote areas, in areas where unimproved U.S. Forest Service roads provide the only access, and in areas without adequate utilities.

Industrial

1. Industrial rezonings are considered inappropriate in the study area unless they are considered necessary to achieve other goals in this plan.

Open Space/Parks

1. Development of a community park shall be strongly encouraged.

2. Open Space zoning shall be maintained for public (state or federal) lands. When such lands become private through exchange or purchase, a zone change shall be required prior to the commencement of any development.

3. To the extent possible, open space, greenway, or pedestrian/bicycle corridors shall be retained between commercial uses or clusters of commercial uses.

General Considerations

1. The County shall strongly encourage public participation in all County processes of planning, approving, monitoring, and evaluating residential, commercial, and industrial developments and land uses within the study area.

2. The County and the community shall actively seek participation in the land use planning and management processes of the National Park Service, U.S. Forest Service, Arizona Department of Transportation and Arizona State Land Department concerning administration of public lands.

3. The County shall consider the impact of its decisions on Native American peoples, cultures, lands, natural resources, and environment within and outside the study area.

REGIONAL PLANNING/INTERGOVERNMENTAL COOPERATION

The community of Tusayan is surrounded by lands administered by several different governmental agencies. The jurisdiction of the County Planning and Zoning Commission and Board of Supervisors only extends to the small amount of private land in the area. The U.S. Forest Service under the Department of Agriculture administers Kaibab National Forest lands. The National Park Service under the Department of Interior administers Grand Canyon National Park. The Arizona Department of Transportation controls Grand Canyon Airport and the Highway 64 right-of-way. The Arizona State Land Department controls numerous sections of land approximately eight miles south of the study area. Arizona Game and Fish and U.S. Fish and Wildlife Service policies and regulations, especially pertaining to endangered species such as the Mexican spotted owl, affect land management administration throughout the area. In addition, the Havasupai, Hualapai, Navajo, and Hopi Tribes have longstanding cultural interests in regional land use issues in and around the study area. Land use policies and decisions made by the various agencies often have impacts and implications extending beyond their jurisdictional boundaries. A high degree of intergovernmental cooperation and regional planning is necessary to prevent conflicts and to accomplish the goals and objectives of the different entities.

The Coconino County Comprehensive Plan identifies Tusayan as an area of special concern because of its location at the gateway to Grand Canyon National Park. Grand Canyon is a designated World Heritage Site that attracts nearly five million visitors annually. It is important that development in the nearest gateway community be compatible environmentally, aesthetically and culturally with one of the most unique natural resource areas in the world. Hopefully, implementation of the policies contained in this plan, including the design review guidelines, will result in a gateway community that is complimentary to and compatible with such an important site.

The Park Service is currently preparing a new General Management Plan for Grand Canyon. The plan may recommend moving certain functions and services out of the park and may include limitations on entry by personal vehicles. Any such policies or regulations will affect outlying communities, especially Tusayan. The possible relocation of employee housing, administrative services, visitor information services and transportation staging areas to locations outside the park will require regional planning and cooperation between the affected agencies, property owners and other interested parties.

By far, the majority of the 63 square mile Tusayan study area is under the jurisdiction of the U.S. Forest Service, and therefore, subject to the policies and provisions of the Kaibab National Forest Plan. Forest planning issues that have regional implications include recreational opportunities, special use permits, proposed paving of Forest Service roads, and the proposed Canyon Forest Village land exchange. These issues have already been discussed in the "Natural Resources and Environmental Quality" section of this plan, but it is appropriate to reiterate their importance in terms of regional planning. Recreational opportunities on forest land, including camping, hiking, biking and hunting, provide alternatives to recreational opportunities in the Park. This use of forest land can be complimentary to similar use in the National Park and will become increasingly important as an alternative if the Park Service adopts numerical limits or a reservation system for admission to the park.

Forest Service special use permits allow private development on Forest Service land in some cases. Special use permits can be obtained for a variety of uses including utility installations (APS substation), commercial lodging (Moqui Lodge), transportation facilities (proposed railroad spur and parking area), community facilities (proposed American Legion community center), and housing (possible Park Service employee housing), among others. Such development on Forest Service land is not subject to County Planning and Zoning Commission review, but clearly has community-wide and regional impacts. Interagency cooperation and coordination in the review of special use permit applications is desirable to avoid conflicts and accomplish common goals.

The possible paving of certain Forest Service roads is another issue that has region-wide implications. Such decisions should be made only after careful interagency review and approved only if consistent with regional land use and transportation planning goals.

The proposed Canyon Forest Village land exchange and other proposed alternatives currently under consideration by the Forest Service would undoubtedly have regional impact. The required Environmental Impact Study will consider possible impacts on wildlife, vegetation, surface and groundwater, transportation and other regional issues. While the Canyon Forest Village proposal may accomplish the goal of acquisition of private inholdings by the Forest Service in accordance with the Forest Plan, that accomplishment should be weighed against other potential regional impacts, both positive and negative, with a decision based on a comprehensive view.

National Forest land and resource management planning is an evolving process. Recent emphasis on ecosystem management and expected regulations pertaining to Mexican spotted owl habitat are bound to affect the use and management of forest lands. It appears likely that there will be less emphasis on extractive uses and more emphasis on recreational and interpretive activities. Land management policies implemented on the Tusayan District will play a significant role in shaping the future character of the study area.

The Arizona State Land Department is considering the sale of a section of state land on Highway 64 approximately eight miles south of Tusayan at the Kaibab National Forest boundary. Although outside the Tusayan study area, the possible sale of state land in the vicinity clearly has regional planning ramifications. Under state law, lands held in trust and administered by the State Land Department are to be managed for the benefit of state-funded educational institutions. While the state may not be mandated to address regional planning considerations, the numerous sections of state land do not exist in a vacuum, and any sale of such lands should be considered from a broader perspective.

The Grand Canyon Airport, owned and operated by ADOT, is a major component of the regional transportation network. Future expansion and development of airport property and facilities will affect the Tusayan community as well as the park and surrounding area. Airport planning and development should be considered in the context of regional transportation and land use planning.

NACOG (Northern Arizona Council of Governments) has taken the lead in organizing a group of community representatives from both public and private sectors to study regional transportation issues relative to the Grand Canyon National Park. After several meetings and much debate the area identified as the Grand Canyon region for purposes of the initial planning phase is the South Rim and its "nearby" communities. This study area extends south to Williams and Flagstaff and east to Cameron. The impetus behind this regional/sub-regional approach to transportation planning is related primarily to the ever-increasing visitation to the Park and inability of the Park to accommodate the additional vehicle traffic. The Grand Canyon National Park, in their General Management Plan update process, has identified alternatives for dealing with the increasing traffic. One alternative is to place a restriction on the number of vehicles that could enter the Park. This would result in the location of staging areas outside the Park boundaries to facilitate access by some means other than private autos (e.g.: rail, shuttle bus).

As stated in a draft scope of work dated May 25, 1994 the purpose of the NACOG project is to ultimately develop an "intermodal transportation plan which focusses on possible solutions to congestion problems at Grand Canyon National Park through: 1. development of staging areas in outlying areas such as Tusayan, Cameron, Valle, Williams, and Flagstaff, and 2. development of effective efficient systems of alternative modes of transportation to the South Rim." Given the complexity of issues related to transportation and the overlapping interest of the various communities the need for interagency cooperation and involvement, including financial support, is paramount to the ultimate success of this study and final plan implementation.

Some residents of the community of Valle have requested that a specific area plan be developed for their community. Although separated by approximately 22 miles, Valle and Tusayan are interrelated in the sense that both are located on the main highway corridor to Grand Canyon and share some common problems and planning issues. It would be mutually beneficial for the two communities to identify ways in which they can coexist and work together to accomplish regional goals.

Various Native American cultures, including Havasupai, Hualapai, Kaibab Paiute, Hopi and Navajo, have historic and prehistoric connections with the study area and surrounding region. Regional planning should be sensitive to cultural concerns and issues of Native American residents. Conversely, it should be recognized that tribal plans and developments have the potential to create regional impacts. The Hualapai Tribe recently developed a master plan for possible development of resort facilities along the western rim of Grand Canyon. Such development of resorts and/or gaming operations on reservation lands could cause a range of regional impacts. Any attempt at regional planning and interagency cooperation should include tribal representatives and tribal planning issues and should address Native American concerns to be truly comprehensive.

Secretary of Interior Bruce Babbitt recently announced a proposal to create a regional planning task force for the areas surrounding Grand Canyon National Park. Senator John McCain has expressed his support for the proposal, and has stated his belief that local participation and support for the process is vital to its success. Ideally, the task force should include all of the entities discussed in this report, other relevant state and federal agencies and local representatives from the cities of Page, Fredonia, Williams, and Flagstaff.
Environmental organizations, business groups, property owners and other interested parties should also be included if the task force is to be comprehensive in nature. It is likely that Coconino County would play a central role in facilitating such a task force.

All of the affected governmental agencies, interest groups and individuals have their own priorities and missions to accomplish. However, no single entity can pursue their own agenda without having impacts on the others. With cooperation and coordination between the various parties, an integrated approach may be taken towards addressing the needs of visitors and residents while preserving the essential environmental qualities that attract so many people to the area.

GOALS

1. To achieve intergovernmental cooperation and coordination of land management decisions in the context of regional planning for the Tusayan/Grand Canyon area.

POLICIES

1. The County shall actively seek and give due consideration to input from other affected agencies in the review of development proposals in Tusayan.

2. The County shall actively seek participation in other agencies' processes when their actions affect the Tusayan Area.

3. Regional impacts shall be assessed in the review of new development proposals. The County reserves the right to request additional and sufficient information to assess the regional impacts of the project.

TUSAYAN DESIGN REVIEW OVERLAY

ADOPTED BY THE COCONINO COUNTY BOARD OF SUPERVISORS
OCTOBER 16, 1995

ADOPTED BY THE PLANNING AND ZONING COMMISSION
AUGUST 29, 1995

ADOPTED BY THE TUSAYAN PLANNING COMMITTEE
JULY 12, 1995

DESIGN REVIEW OVERLAY ZONE FOR TUSAYAN

PURPOSE

In order to achieve the very high aesthetic quality identified in the Vision Statement it is desirable to establish design guidelines which would be adhered to for all new development and redevelopment of multiple family, commercial, industrial, and public or semi-public uses within the study area.

GOAL

The guidelines which are set forth in this document are designed to achieve the effect of a model gateway community which integrates the built environment with the existing natural environment. Since Tusayan's tourism economy relies primarily on Park visitors, it is desirable to adopt design guidelines which are complementary to and compatible with architectural and design standards which the Park Service has developed for the South Rim area. By developing compatible standards, an aesthetically harmonious transition from the Tusayan community into the Park should be realized.

NOTE: In light of the desirability for compatible standards, some of the terms and concepts found in the National Park Service Architectural Guidelines for the Grand Canyon National Park (1994) are included in the following standards, either specifically or by reference.

Although it is unreasonable and impractical to expect all new developments to adhere to all elements of the "Grand Canyon Rustic" style, the use of the Park Service guidelines as a reference source for designing new developments is highly recommended.

Architectural Style

There is no existing predominant architectural style found in Tusayan. A majority of the structures were built in the 1970's and are nondescript, cinder block construction. Probably many residents would agree that the most offensive architecture existing in the community is the Domes, located at the southern entrance to the community, which create an amusement park atmosphere. Although other recent developments don't include designs as objectionable, the adoption of minimum standards will help move the community toward a more cohesive appearance.

1. Architectural styles shall be respectful and compatible with the unique location of this community as a gateway to the South Rim of the Grand Canyon. Architectural building forms should express sensitivity to this unique environmental setting, while respecting the indigenous cultures. The goal is for designs which contribute to the character and quality of the built environment while in harmony with the natural environment.

   Examples of undesirable designs include whimsical architecture, such as the Domes, which has no relationship to the surrounding natural, cultural, or historical environment. Modernist architecture which clashes with the natural environment is also undesirable.

2. Scale and mass of developments should be compatible with the natural environment in which the community is located and not dominate over it. Architectural features which serve to break up the massive appearance of a structure should be utilized. These features can include variation in roof forms, the use of dormers, covered walkways, and patios. All features should be in proportion to the building. All sides of a structure shall receive design considerations. In some cases it may be deemed more appropriate and desirable to use smaller buildings which are clustered rather than a single massive structure.

Materials and Color

The use of natural materials, such as native stone, logs, and wood, is highly desirable due to the fact that these are most successful in integrating structures to the environment. However, conflicts arise between the promotion of these extractive resource materials and sound environmental policies. In an attempt at promoting the concept of sustainable development, the use of synthetic products, particularly those which are made from recycled materials, is also acceptable provided that such materials meet high quality standards as outlined. Although some synthetic or reprocessed materials may not be appropriate for major or primary structures, they may be highly desirable for ancillary uses such as street furniture.

1. External building materials should be predominantly those that fit the natural landscape such as native stone, logs, wood, broken-faced block, exposed aggregate concrete, and stucco. The use of other materials such as synthetic or reprocessed stone and wood may be considered, but will require that information be provided regarding manufacturing specifications, product samples, and examples of where the product has previously been utilized.

2. Earthtone colors that blend with local soils and vegetation are highly desirable. Various shades of browns and tans, subtle greens, as well as sandstone and limestone are encouraged. Bright colors such as oranges, limes, aqua blue, and white, which call undue attention to the buildings, are discouraged. Color schemes should be coordinated to complement the architectural style and mass of the buildings.

3. Roofs must meet the color requirements of the building. Aluminum, white, or reflective roofs are not acceptable. Screening of mechanical equipment is encouraged to maintain desirable aesthetic quality from street level or from adjacent structures.

4. The use of materials and colors to enhance the building design and break up the monotony of massive structures is encouraged.

Site Design

The overall community appearance envisioned by these standards is one which emphasizes open, landscaped areas which are pedestrian friendly. The development of a pedestrian path connecting the various uses is desirable. Such a feature becomes an integrated design element that ties the community together in a visual way while being utilitarian. The generous use of landscaping is of primary importance in achieving the desired effect. A good example of the benefits of ample landscaping is the Canyon Squire property. The landscaping provided within the 50 feet of ADOT right-of-way behind the sidewalk serves the dual purpose of buffering the development from the highway traffic while providing an appealing transition zone from the highway to the hotel. These are elements of good site design. Alternatively, examples of poor site planning are abundant within Tusayan, particularly the properties which have paved the 50 foot ADOT right-of-way as well as the front setback area. The impact of this approach to site development is traffic circulation problems and the appearance of a highly urbanized area. The circulation aspect of site design is of critical concern from a safety aspect as well as aesthetics. Due to the significant number and diversity of vehicles which visit Tusayan, the interaction between RV's, busses, passenger vehicles, and pedestrians is difficult to control.

Building height is another component of site design. Most commercial buildings have been developed under the CG-10,000 (Commercial General) Zone which limits the height to 35 feet, although variances of up to 40 feet have recently been approved. There have been rezonings to CH-10,000 (Heavy Commercial) in the past few years which allows a maximum height of 50 feet, though the only buildings which are in that range are the IMAX Theatre and the Domes.

1. Sufficient setbacks providing access to light, air, landscaping, and views shall be incorporated into site design. The 50 foot right-of-way flanking Highway 64 shall be fully landscaped in conjunction with all new development and redevelopment. If this area is abandoned by ADOT in the future, it shall remain as a landscape buffer/transition zone between the Highway and commercial businesses. The use of this transition zone for meeting some parking requirements may be appropriate, but not within the 30 feet closest to the Highway.

2. Vehicle and pedestrian ways shall be clearly delineated to prevent congestion and conflicts. Service vehicle and delivery areas shall be located such that they are screened from view and don't interrupt the flow of traffic.

3. Parking lots shall be designed to include adequate landscaping within the periphery and interior to break up the impermeable surface coverage. Methods for achieving this include the use of landscaped islands within the parking lot, clustering parking spaces into islands rather than long rows, and utilizing a variety of landscape materials, including a mix of vegetation types and sizes, and decorative fencing.

4. Where bus and RV traffic is anticipated, site design should take into consideration the maneuverability constraints, parking, and passenger unloading needs associated with these vehicles.

5. Orientation of buildings on the site should be "user friendly." Components which will be considered for meeting this standard include entrances which are well marked and located with a logical relationship to the parking area, pedestrian walks from parking areas to businesses, and outdoor areas for the public to sit and rest.

6. Building height shall not exceed three stories above ground and 40 feet above existing grade.

7. Landscaping shall consist of indigenous plants. Exotic ornamental plants which could "escape" to the surrounding area and displace native vegetation shall be prohibited.

8. Preservation of existing trees and vegetation is encouraged. All landscaping shall include a mix of landscape materials, including variations in sizes, deciduous, evergreen, trees, and shrubs.

9. The use of potable water as the <u>primary</u> irrigation source shall not be authorized. Irrigation systems shall be plumbed for the use of nonpotable water. The extension of reclaimed water lines shall be strongly encouraged as soon as possible. If landscape plans suggest a permanent source of irrigation is necessary, a permanent on-site water system providing complete coverage shall be required.

Signs

Although there are a number of existing signs which do not conform to current sign regulations, having been "grandfathered" in under previous Ordinances, by far the most problematic area is the extensive use of attention-getting devices which are not readily definable as signage. Examples include the indiscriminate use of flags, buckboards, tepees, cut-out figures, and Christmas lights year-round. When a number of properties participate in utilizing these attention-getting devices the atmosphere becomes cluttered and the advertising ineffectual. Developing guidelines which would define and limit the use of attention-getting devices would go a long way toward achieving the high aesthetic quality envisioned by this planning document.

1. All provisions of Section 16, <u>Signs</u>, shall be applicable except as may be modified herein.

2. Signs shall not be attached to or painted on natural objects such as trees or rocks.

3. Portable sandwich-type signs shall not be permitted except for real estate "open house" signs identifying property which is for sale or lease.

4. Signs with highly reflective surfaces or bright metal shall not be permitted.

5. The use of banners, pennants, whimsical attention-getting devices such as wooden cut-out figures, wagons, and tepees shall not be permitted, unless it can be demonstrated that the use of such is integral to a particular use.

6. Flags shall be limited to one Arizona

flag and one U.S. flag, maximum. Flag poles shall meet the 40 foot maximum structure height adopted through this DRO. This shall not apply to future public spaces such as transportation center, visitor center or roadway medians.

7. Outdoor internally illuminated signs shall be constructed with an opaque background and translucent letters and symbols. Such signs shall be turned off at 11:00 PM or when the business closes, whichever is later.

8. The use of lighting as an attention-getting device which is not related to an approved sign or for architectural illumination shall not be permitted.

9. Signs shall utilize and emphasize the same materials specified in the DRO for buildings. Colors such as "day-glo" shall be prohibited. Signs and the color of signs shall be compatible and consistent with the architectural style of the building or portion thereof to which it relates.

10. Externally lighted signs may be permitted for signs constructed of natural materials providing such lighting is directed and shielded so that direct rays do not project above the horizontal or reflect onto adjacent properties or rights-of-way.

11. The base of a freestanding sign shall be located in a planter box or landscaped area.

Lighting

Providing adequate lighting for safety purposes while protecting the night sky from invasive light pollution is a difficult balancing act. Both are critical concerns for achieving the community envisioned in this planning document. The Park Service has introduced some guidelines in their design plan (1994) which when applied in conjunction with the County's Lighting Ordinance should help achieve an acceptable balance.

1. All outdoor lighting shall comply with the provisions of Section 17 of the County Zoning Ordinance except as modified herein.

2. Outdoor lighting shall meet the regulations for Zone III except that all lighting that is permitted shall be fully shielded.

3. Poles and fixtures should be compatible to the architectural styles of the development.

4. Lighting should be designed to fit the development; poles should not be higher or lighting more extensive than is necessary.

5. Parking lot light standards should only be as high as required to accomplish the necessary illumination while being in scale with the surrounding landscape and structures. For example, pole heights could be 25-30 feet in areas where existing tree stands effectively camouflage the poles; lower standards would be more appropriate in open areas.

6. Light fixtures illuminating pedestrian walks or plazas should not exceed 12-15 feet in height in order to be appropriately scaled to the pedestrian and still out of reach of vandals.

7. Low level bollard type light fixtures should be considered where they can be effective without becoming too dominant in the landscape.

8. Ornamental luminaries with exposed light sources are not acceptable.

9. All exterior lighting, including landscape lighting, shall conform to the DRO standards.

Environmentally Sensitive Development

Since the DRO guidelines are applicable only to new development and redevelopment, they in essence acknowledge that further growth is inevitable. Sustainable growth is, however, a contradictory term. Sustainable implies maintaining a certain balance of resources used and resources replenished, a concept contrary to that of growth. However, since sustaining a true balance is not possible, the use of environmentally sound practices which minimize the use of finite natural resources and that consider the overall potential impacts of the development on the environment are the next best thing and are fully supported. Although the DRO guidelines could be interpreted as implying that the aesthetics of a development are of most importance, that is not the intent. The integration of energy efficient designs such as solar access, and methods of recapturing snow and rainwater for landscape irrigation are examples of environmentally sensitive measures that are encouraged to be incorporated into new development plans.

1. The use of these guidelines in designing development plans shall not be interpreted as discouraging or prohibiting designs which are environmentally sensitive. Developments which incorporate energy conservation measures, water reuse, and material recycling are strongly encouraged.

Implementation

The Tusayan Planning Committee expressed concerns regarding the implementation and enforcement of these DRO guidelines. The Committee recommends the following alternatives as possible mechanisms for resolving any potential conflicts.

1. The County should consider an amendment to the Zoning Ordinance to create a separate Design Review Committee to hear all DRO applications.

2. The County should consider continued use of the Tusayan Planning Committee for reviewing plans for conformance to the intent of these DRO standards whenever a dispute arises between an applicant and staff regarding conformance with the DRO guidelines.

KAIBAB NATIONAL FOREST

Tusayan Growth
Environmental Impact Statement
Economic Analysis

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1.0 Introduction and Summary of Findings

One of the most recognized National Parks in America, the Grand Canyon National Park ("GCNP"), has seen visitation increase dramatically over the past decade. The annual visitor count is currently approaching 5 million people and is taxing the carrying capacity of the GCNP's transportation and visitor systems. In an attempt to address these increasing visitor flows and provide an improved visitor experience in GCNP, the Kaibab National Forest is considering various alternatives involving the use or acquisition of National Forest System (NFS) lands to serve the needs of area residents and visitors to GCNP.

An Environmental Impact Statement ("EIS") is being undertaken by Kaibab National Forest to evaluate the implications of a range of alternatives. One of the key factors in the EIS process is the evaluation of the proposed mix, size and phasing of land use components. Land uses could include housing for area residents, visitor lodging facilities, visitor interpretive centers, support commercial facilities, parking/staging areas and community facilities such as churches and schools.

An understanding of the needs and desires of GCNP visitors is an important variable in evaluating these issues. While past studies of the GCNP have examined visitor profiles and satisfaction levels, they typically have not fully addressed visitor travel itineraries and their motivations for selecting certain travel itineraries. In order to more fully understand these issues, a Grand Canyon visitor survey was conducted to address these issues and to assist in developing a model to estimate demand for different land uses based on varying levels of visitation growth.

In addition to considering the implications of new development for Grand Canyon visitors, the potential economic impacts to surrounding communities is another major consideration. Many northern Arizona communities derive much of their economic health from tourism, of which the Grand Canyon is an important generator. An analysis of northern Arizona's current attraction of Grand Canyon visitors, as well as the associated economic impacts of future changes, is also considered in this report.

In summary, this study considers new development issues facing the Tusayan area and examines a variety of land uses, the associated level of demand for these uses and the implications of new development on surrounding northern Arizona communities. These findings will be used in evaluating a variety of alternatives being considered in the EIS process.

1.1 Report Format

In order to address the previously noted issues, a description of GCNP and Tusayan, as well as trends in visitation are outlined in Section 2.0, along with alternative visitation growth estimates for GCNP. Section 3.0 identifies the secondary research reviewed for this analysis and presents the results of a Grand Canyon visitor survey conducted for this EIS in 1994 and 1995. A summary of input from a variety of travel intermediaries (e.g., tour operators) is also presented in this section. This is followed by an extensive analysis of lodging performance in northern Arizona and its correlation to Grand Canyon visitation trends. Section 5.0 considers alternative growth scenarios and estimates the resulting development requirements for the Tusayan area. Section 6.0 concludes this analysis with a review of the prospective economic impacts to surrounding northern Arizona communities.

1.2 Summary of Findings

The following points summarize key findings of this study. These points are discussed more fully throughout this document.

- The GCNP has experienced strong growth in visitation, particularly since the mid-1980s. GCNP attracted 4.9 million visitors in 1996. Although there has been significant fluctuations in annual rates of growth, the GCNP has realized average growth of approximately 210,000 visitors annually since 1985, with an annual compound growth rate of 6.2%.

- The GCNP is anticipated to continue attracting increased levels of visitation in the future. Four different visitation levels have been developed for this analysis in order to consider the potential range of visitation and the associated implications. These visitation levels reflect annual growth rates ranging from 1.5 to 6.2 percent.

- In response to these increasing visitation trends, a variety of support facilities have evolved, both inside the GCNP, as well as in the community of Tusayan. There are approximately 2,000 hotel rooms 180,000 square feet of retail/food and beverage space and 839 campsites in the Grand Canyon/Tusayan area.

- Visitation to GCNP often overtaxes existing facilities in the area. As an example, according to results from a 1994/95 visitor survey, 35 percent of GCNP visitors who attempted to make reservations at GCNP lodges were unsuccessful. Visitors' lowest satisfaction rankings were associated with parking, retail and restaurants facilities.

- Communities outside the Grand Canyon/Tusayan area have also benefited from increased visitation trends. Survey findings indicate there is wide dispersion of where visitors stay the night before entering and the night after leaving the GCNP, as well as the length of stay at the respective locations.

- Las Vegas is the most significant recipient of room nights, attracting 29% of room night demand. By comparison, Flagstaff attracts 16%, while northern Arizona communities collectively attract 42% of GCNP related room nights.

- Northern Arizona communities currently have a base of approximately 12,500 hotel rooms. Reflecting the strong new development activity of the region, approximately 5,200 of these rooms have been developed in the last 10 years.

- In recent years, room night demand has increased within the northern Arizona region, however, supply has grown at an even faster rate, reducing average occupancies from 72% in 1990 to 63% in 1996. This occupancy rate is the lowest level experienced by the northern Arizona region throughout the 1990s.

- 1996 occupancy levels varied widely between various northern Arizona communities ranging from a low of 52% in Williams to a high of 78% at GCNP Lodges. A significant factor in lodging performance is the amount and velocity of recent supply additions within each community.

- In 1990, northern Arizona hotels on average have performed as much as 10 percentage points above US industry average occupancy rates. Influenced by recent lodging additions, they operated at approximately 3 percent below US averages for 1996.

- New lodging additions within northern Arizona are anticipated to slow in 1997, allowing for improving occupancy performance.

- No new hotel development has occurred in the GCNP in recent years; however, Tusayan has added 485 new hotel units since 1992, an approximately 50% increase in pre-1992 supply. While experiencing strong additions, both Tusayan and GCNP are operating substantially above northern Arizona averages, with a combined occupancy rate of approximately 75 percent.

- Future lodging additions could continue in this area, as there are approximately 1,371 additional units which could potentially be developed in the Grand Canyon/Tusayan area.

- Grand Canyon/Tusayan room inventories, occupancy rates and GCNP visitation levels have been used to estimate the level of visitor "penetration," or the percent of total

GCNP visitors accommodated at Grand Canyon/Tusayan hotels. This penetration level was estimated to be 29 percent in 1996. Based on seasonal variances and responses to visitor surveys, it is estimated that this level would need to rise to the mid-30 percent range in order to accommodate most persons desiring to stay in the Grand Canyon/ Tusayan area.

- A model was developed to estimate the potential range of visitor service needs considering a variety of underlying assumptions. This model served as a tool to evaluate various levels of development and other supply/demand relationships.

- Assuming a penetration rate similar to current levels (30%) in the Grand Canyon/ Tusayan area, the moderate visitor growth scenario and an occupancy rate in northern Arizona considered healthy (70%), the following land uses could likely be supported through the year 2010 in the Grand Canyon/Tusayan area.

Hotel Rooms	1,835
Retail Square Footage	128,000
Food and Beverage Square Footage	62,000
Employees	1,600
Residents	2,100
Housing Units	1,300

- Various alternatives in the EIS were evaluated by varying key assumptions in the model. Land Exchange Option 1 (Alternative B) proposes a level of development substantially above that proposed under the other alternatives. The 3,650 hotel units planned under Alternative B would likely be increased by development within the community of Tusayan and GCNP, potentially adding as many as 5,021 new hotel rooms on a collective basis to the Grand Canyon/Tusayan area.

- The 2,000 new hotel units proposed in Land Exchange Option 2 (Alternative C) more closely tracks with potential growth in demand from projected increased visitation at GCNP. Again, this number could be expanded by development within Tusayan and in GCNP, potentially adding a total of 3,371 rooms collectively to the Grand Canyon/Tusayan area.

- Under Alternatives A, D and E (No Action, Townsite Act, Transportation/Federal Housing) development within Tusayan and GCNP could potentially add 1,371 new lodging rooms. Under all three of these alternatives, this number could be expanded by potential development on Canyon Forest Village inholdings, particularly the Kotzin, Ten-X and Lower Basin properties, or other private, state or tribal lands in the area. While the ultimate level of development on these lands is uncertain, Canyon Forest Village may attempt to achieve development levels similar to that proposed under Alternative B on their private inholdings.

- Under any of the alternatives (A through E), there is the potential that more hotel rooms could be added to the Grand Canyon/Tusayan area than are actually supportable by likely visitation growth.

- Assuming a significant percentage of proposed visitor services are developed, as competition increases, prices will likely drop, service levels will likely increase and consumers will have a wider range of choices. In other words, the visitor experience should be enhanced.

- Under most development alternatives and visitation growth scenarios, northern Arizona communities will also need to add new lodging units to accommodate demand from increased Grand Canyon visitation. However, the number of new lodging units needed in northern Arizona varies by alternative. This new development would be needed even though some demand would be pulled or displaced to the Grand Canyon/Tusayan area. Thus, although economic impacts would be experienced by northern Arizona communities, these impacts would largely be in the form of a reduction in future growth in supply and the associated reduction in spending and taxes, rather than a long term reduction in the performance of existing facilities.

- The methodology employed in this study considered average annual visitation growth and reflects corresponding impacts over time. If increasing supply occurs at a faster pace than projected and/or if visitation growth drops substantially below the average in any given year, there would likely be a reduction in the performance of individual hotels in the region. Such reductions are likely to be short term in nature and will vary based on a number of factors such as age/condition of property, service, price, brand affiliation and location.

- Importantly, no matter what alterative is selected, there is strong likelihood that development will continue both within Tusayan and on other private, state or tribal lands in the Grand Canyon/Tusayan area, including the private inholdings controlled by Canyon Forest Village. This development will be influenced mainly by market forces, rather than any specific developer's conceptual plan.

2.0 Grand Canyon/Tusayan Description and Visitation Trends

In order to better understand current conditions and how these conditions might potentially change in the future, this section provides an overview of the Grand Canyon/Tusayan area. More specifically, as visitation to the Grand Canyon is the driving economic force in the region, historic visitation patterns are analyzed and potential Grand Canyon visitation growth estimates are outlined.

2.1 Grand Canyon/Tusayan Description

Stretching approximately 277 miles across the northern portion of the state of Arizona, the Grand Canyon is one of the world's most unique geological formations. The Canyon was established as a national monument in 1908 and later as a National Park in 1919. The Canyon is 277 miles long and 18 miles wide. It averages one mile in depth.

There are currently three main entrances to the Grand Canyon. They are located at the North Rim, South Rim and East Rim. The elevation at the National Park's North Rim entrance is approximately 8,300 feet. Due to snowfall, the North Rim entrance to the Park (along with its related facilities) is closed from December through April. The shorter season and more remote orientation of the North Rim limits its share of visitation, as it typically attracts approximately 10 percent of total Park visitors. The Grand Canyon Village (South Rim) and the East Rim entrance both have an elevation of approximately 7,000 feet and are open on a year-round basis. This analysis focuses on South Rim visitor activity because the bulk of visitation, as well as the proposed uses and/or acquisition of NFS lands, are concentrated in this region. A state map illustrating the location of the Grand Canyon within the State of Arizona is presented in Figure 2-1, and a map of the Grand Canyon itself is presented in Figure 2-2.

Over the years, the Grand Canyon has developed into a extremely popular destination and, as a result, a variety of facilities and amenities are now available to visitors, particularly at the South Rim. The Grand Canyon National Park is administered by the National Park Service which strives to maintain a balance in preserving the natural environment of the Park, while supporting visitor needs. As such, there are defined limits as to the number of lodging units, campsites, restaurant seats, retail facilities, etc., that are allowed within the Park boundaries. Because of development restrictions within the Park, and significant historic growth in canyon visitation, the existing visitor facilities can be severely taxed throughout much of the year. In fact, these facilities often fall short of satisfying visitor demand during the peak season periods. This has been recognized in the recently approved Grand Canyon National Park General Management Plan, which outlines proposed levels of development inside the Park boundaries.

Figure 2-1

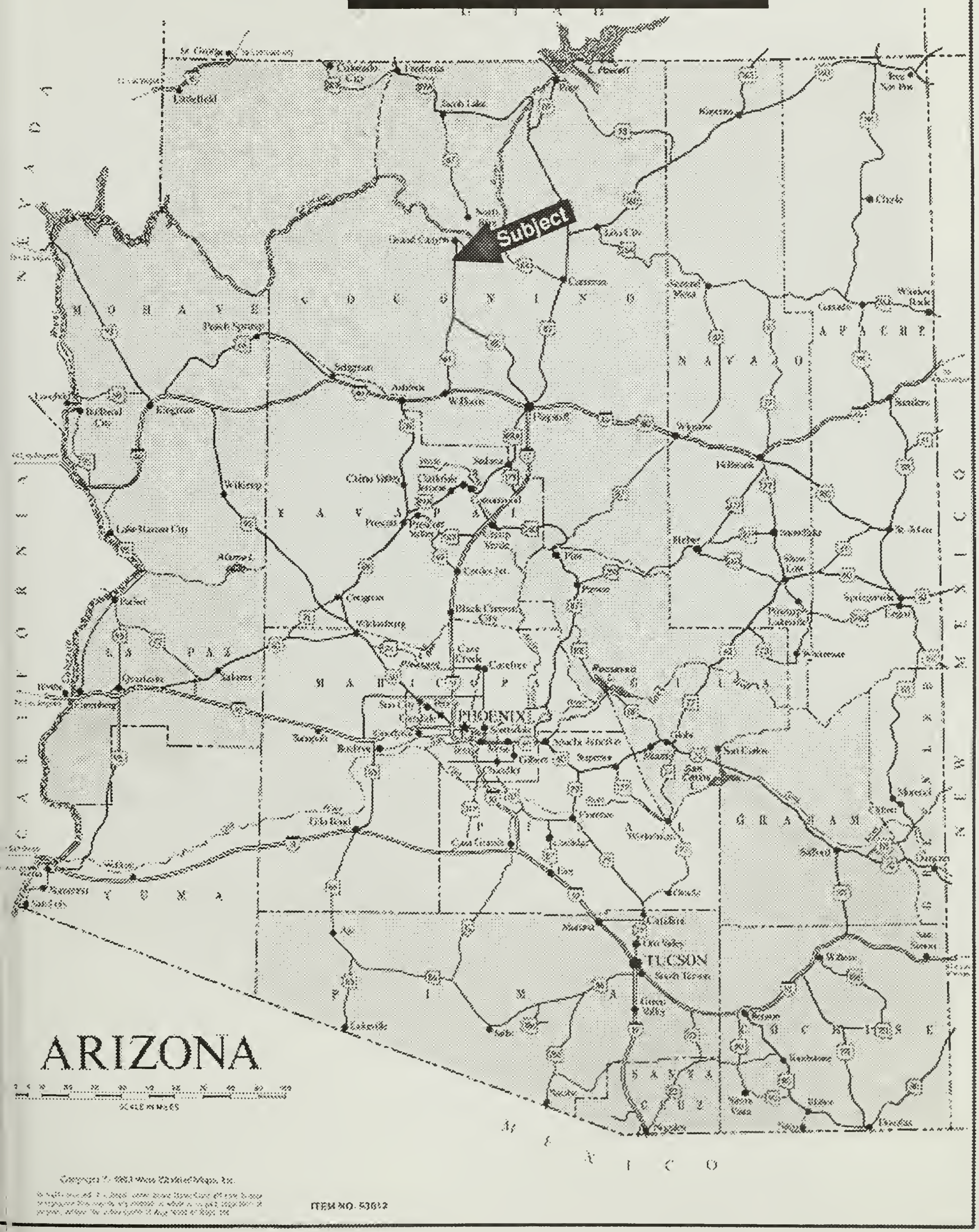
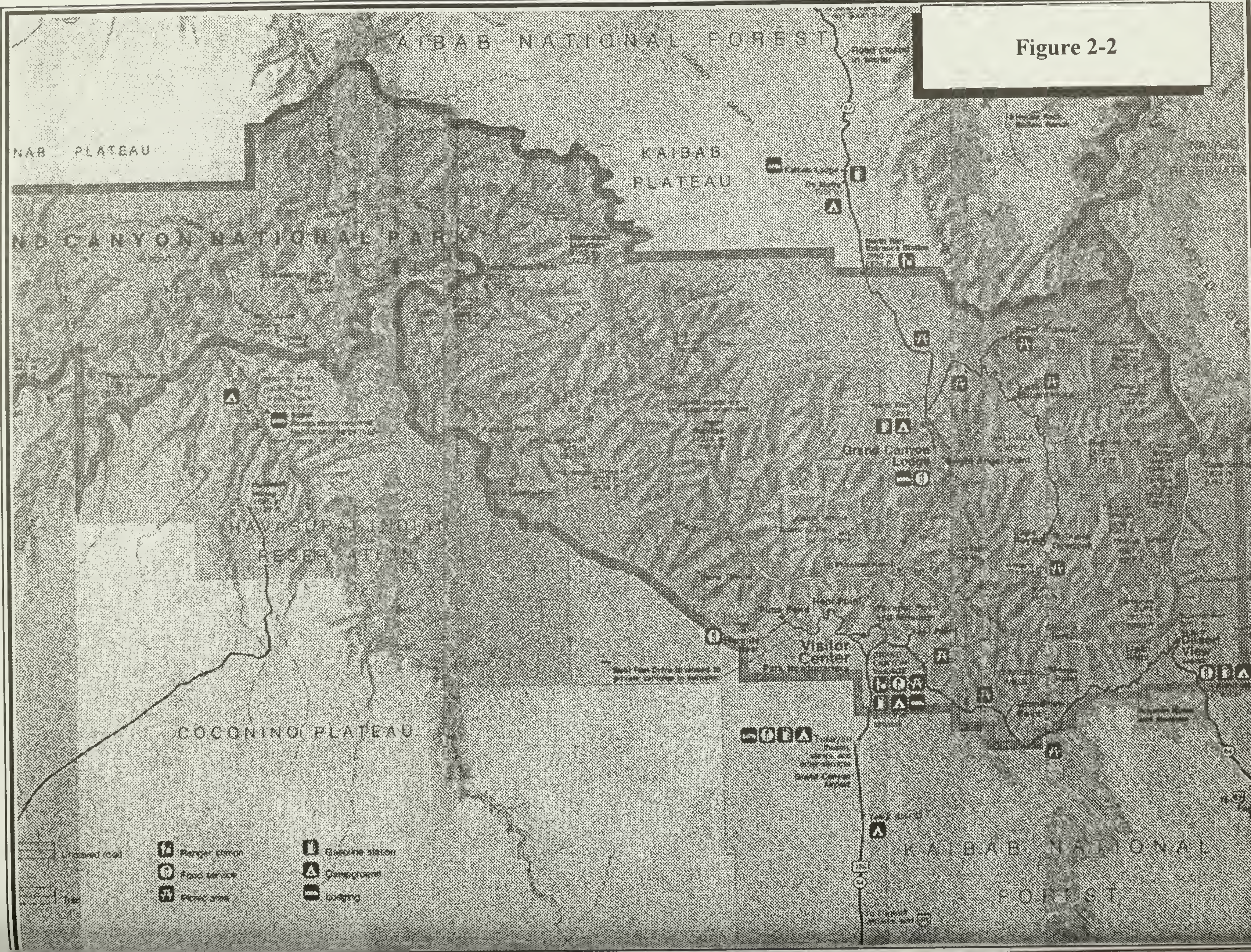


Figure 2-2


KAIBAB NATIONAL FOREST
KAIBAB PLATEAU
NAB PLATEAU
ND CANYON NATIONAL PARK
HAVASUPAI INDIAN RESERVATION
COCONINO PLATEAU
Grand Canyon Lodge
Visitor Center
KAIBAB NATIONAL FOREST
Unpaved road
Trail
Ranger station
Food service
Picnic area
Gasoline station
Campground
Lodging

When open for visitation, the North Rim features the Grand Canyon Lodge (a 200-room hotel with food and beverage facilities), campgrounds and a general store. In contrast to the limited facilities available at the North Rim, the more significant development at the Grand Canyon has occurred along the South Rim at Grand Canyon Village. The vast majority of those visiting the Grand Canyon utilize the South Rim entrance and ultimately end up in Grand Canyon Village. Grand Canyon Village is also the terminus of the Grand Canyon Railway, a historic steam passenger train providing service between Williams and the South Rim. A map of Grand Canyon Village is presented as Figure 2-3.

The unincorporated community of Tusayan is located approximately 3 miles south of the main southern entrance to the Grand Canyon National Park, and is positioned approximately 10 miles south of Grand Canyon Village. Tusayan encompasses approximately 144 acres of privately held land and is entirely surrounded by Kaibab National Forest lands at an elevation of approximately 6,600 feet. Tusayan is situated along State Highway 64, which provides access to the Grand Canyon from Interstate 40 at Williams, and from the city of Flagstaff. With the Grand Canyon as its focal point, Tusayan's economy is based almost entirely on tourism. Because of its location, the vast majority of those visiting the South Rim of the Grand Canyon pass though Tusayan in route to their destination. As the popularity of the Grand Canyon has increased, so has the demand for additional visitor accommodations and services. As such, Tusayan has emerged as an alternative for accommodations near the National Park. Tusayan also provides an employee housing base for those working in the community and within the Park.

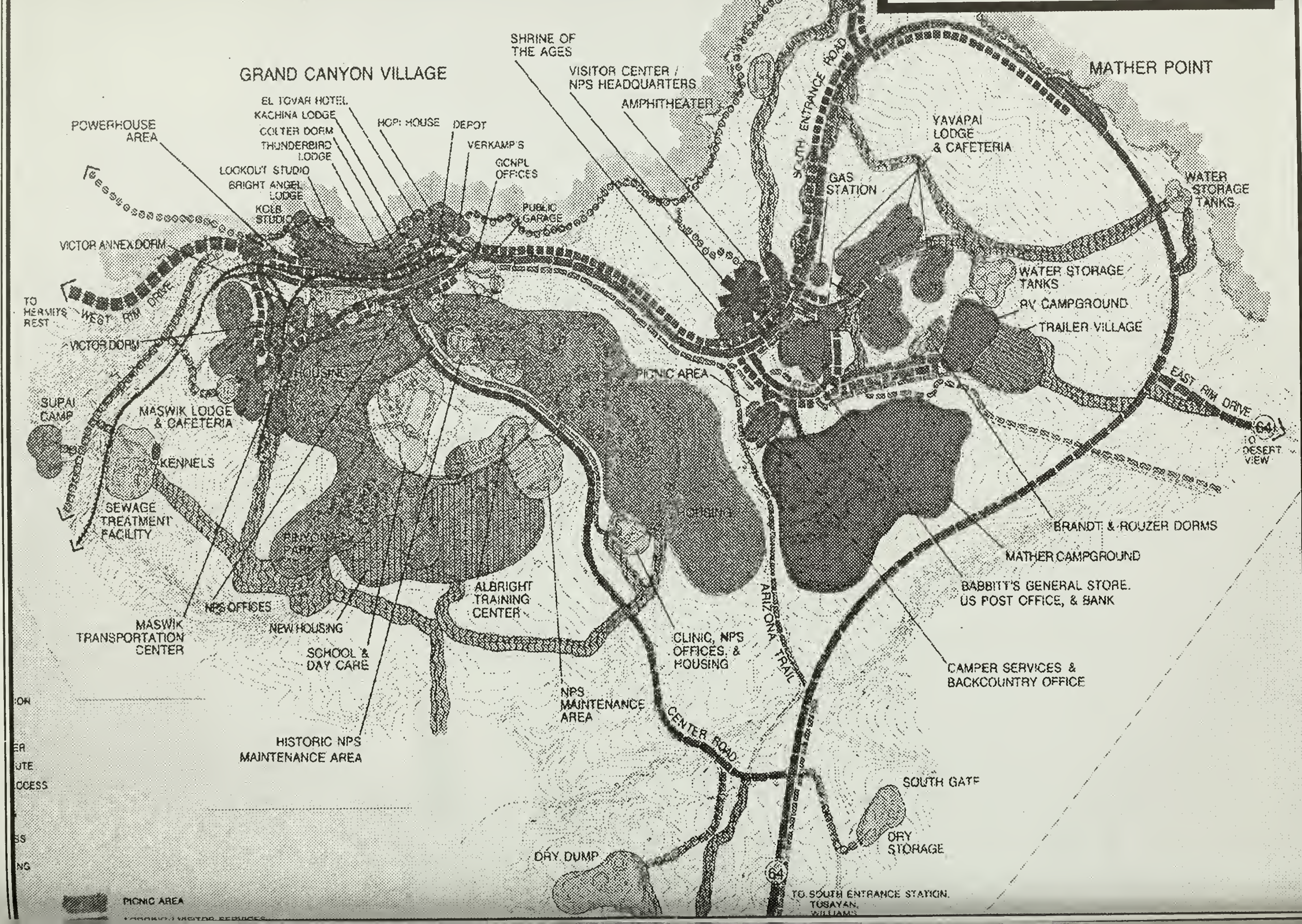
Grand Canyon Village possessed a population base of 1,499 persons in 1990. This 1990 base is estimated to have grown to approximately 2,100 persons through the addition of seasonal workers during the peak summer portions of the visitor season. As shown in Table 2-1, the Grand Canyon Village population base is projected to grow to 1,723 persons by the year 2000 and 1,977 persons by 2010. By comparison, Tusayan possessed a population base approximately one-third the size of Grand Canyon Village in 1990 (555 persons). This community is forecasted to grow to a level roughly one-half the size of Grand Canyon Village by 2010 (1,033 persons).

TABLE 2-1
POPULATION FORECASTS

Year	Grand Canyon Village	Tusayan
1990	1,499	555
1995	1,613	669
2000	1,723	779
2005	1,844	900
2010	1,977	1,033

Source: Arizona Department of Economic Security

Figure 2-3


GRAND CANYON VILLAGE
MATHER POINT
SHRINE OF THE AGES
VISITOR CENTER / NPS HEADQUARTERS
AMPHITHEATER
EL TOVAR HOTEL
KACHINA LODGE
COLTER DORM
THUNDERBIRD LODGE
LOOKOUT STUDIO
BRIGHT ANGEL LODGE
KOLB STUDIO
HOPI HOUSE
DEPOT
VERKAMP'S
GCNPL OFFICES
PUBLIC GARAGE
POWERHOUSE AREA
VICTOR ANNEX DORM
TO HERMITS REST
WEST RIM DRIVE
VICTOR DORM
HOUSING
SUPAI CAMP
MASWIK LODGE & CAFETERIA
KENNELS
SEWAGE TREATMENT FACILITY
NPS OFFICES
MASWIK TRANSPORTATION CENTER
NEW HOUSING
SCHOOL & DAY CARE
HISTORIC NPS MAINTENANCE AREA
ALBRIGHT TRAINING CENTER
NPS MAINTENANCE AREA
PICNIC AREA
CLINIC, NPS OFFICES, & HOUSING
ARIZONA TRAIL
CENTER ROAD
DRY DUMP
SOUTH ENTRANCE ROAD
GAS STATION
YAVAPAI LODGE & CAFETERIA
WATER STORAGE TANKS
WATER STORAGE TANKS
RV CAMPGROUND
TRAILER VILLAGE
EAST RIM DRIVE
64
TO DESERT VIEW
BRANDT & ROUZER DORMS
MATHER CAMPGROUND
BABBITT'S GENERAL STORE. US POST OFFICE, & BANK
CAMPER SERVICES & BACKCOUNTRY OFFICE
SOUTH GATE
DRY STORAGE
64
TO SOUTH ENTRANCE STATION. TUSAYAN.
PICNIC AREA

Currently, there are 7 lodging facilities available at the South Rim totaling 1,033 rooms. A more detailed description of these lodging facilities is provided later in this report. The South Rim also offers a variety of food and beverage alternatives, retail facilities, galleries, campgrounds, a museum and visitor center, automotive service facilities, a grocery and general store, community service facilities and organized recreational activities (hiking, horseback riding, etc). A summary of development within Grand Canyon Village, as well us within the community of Tusayan is presented in Table 2-2. The lodging and food/beverage facilities within the Park are operated by Fred Harvey Corporation which is under contract with the National Park Service. Virtually all other facilities and services within the Park are administered by the National Park Service.

TABLE 2-2
EXISTING DEVELOPMENT SUMMARY

	Grand Canyon Village	Tusayan
Hotel Rooms	1,033	931
Retail Square Footage	58,872	35,000
F&B Square Footage	63,121	25,000
Housing Units	1,200	346
Campsites	456	383

Source: GCNP General Management Plan. YNG, Coconino County Assessor

Currently there are six lodging facilities in Tusayan with a total of 931 rooms. With the exception of restaurants located within two of the hotels, the community offers somewhat limited food and beverage service alternatives, including a Taco Bell, a McDonald's, the Grand Canyon Steak House and a pizzeria. Additionally, the community offers a visitor center, post office, retail facilities, automotive service facilities, an RV Park and a general store. Recreation/visitor attractions include helicopter tours, horseback riding and the IMAX Theater. The Grand Canyon Airport is located on the south side of Tusayan and provides commuter airline service on a regional basis, along with airplane tours of the Grand Canyon. While possessing a mix of facilities, new development in Tusayan has mainly occurred within the lodging market.

2.2 *Grand Canyon Visitation Trends*

According to Grand Canyon National Park ("GCNP") data, visitation to the Grand Canyon has grown rapidly, particularly during the past decade. As shown in Table 2-3 and depicted in Figure 2-4, visitation typically averaged between 2.5 and 3.0 million visitors through the early-1970s to mid-1980s. During the second half of the 1980s, visitation increased at rates far surpassing that of earlier periods. By the early 1990s, visitation approached 4.0 million persons and increased further to approximately 5.0 million persons by 1993. Since 1993, GCNP visitation has maintained a level of approximately 4.7 to 4.9 million visitors.

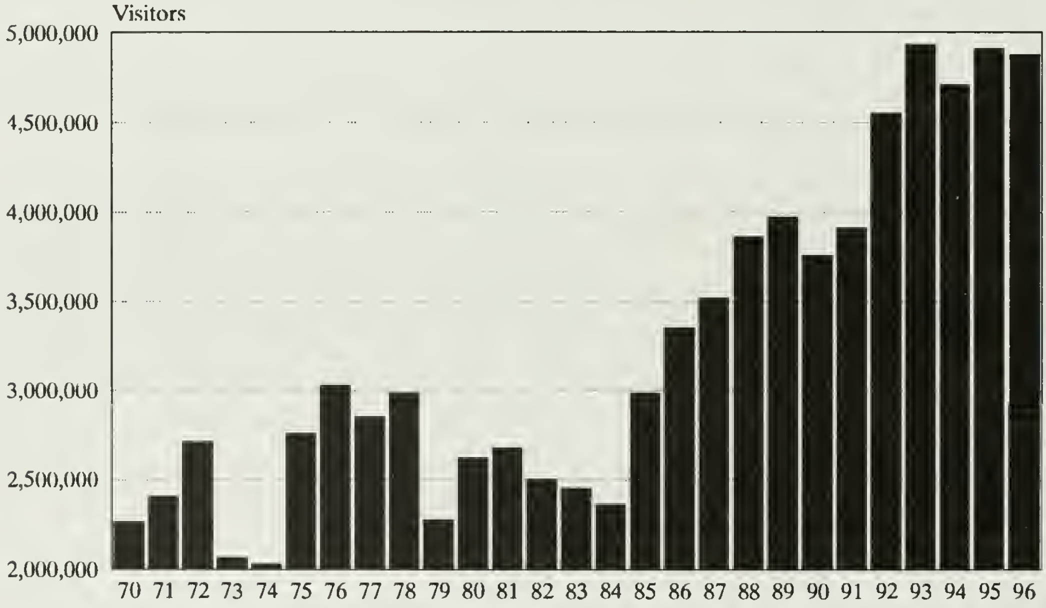
While there are no specific estimates of the source of this visitation growth, a variety of factors are often cited as likely generators. The growth and expansion of Las Vegas and its increasing role as a family destination has spurred activity at the Canyon, as has the growth of the Phoenix and general Southwest tourism markets. Increased foreign visitation, influenced by periods of a weak U.S. dollar, has also stimulated visitation. Additionally, increased Canyon media coverage has apparently increased general public recognition of the Park and its attributes.

TABLE 2-3
ANNUAL TOTAL VISITATION
GRAND CANYON NATIONAL PARK

Year	Visitors	% Change
1970	2,258,195	3.0
1971	2,402,058	6.4
1972	2,707,516	12.7
1973	2,064,300	-23.8
1974	2,028,194	-1.7
1975	2,754,791	35.8
1976	3,026,235	9.9
1977	2,848,419	-5.9
1978	2,984,138	4.8
1979	2,275,712	-23.7
1980	2,618,713	15.1
1981	2,674,117	2.1
1982	2,499,799	-6.5
1983	2,448,545	-2.1
1984	2,360,767	-3.6
1985	2,983,436	26.4
1986	3,347,872	12.2
1987	3,513,084	4.9
1988	3,858,708	9.8
1989	3,968,605	2.8
1990	3,752,901	-5.4
1991	3,905,989	4.1
1992	4,547,027	16.4
1993	4,928,509	8.4
1994	4,702,989	-4.6
1995	4,908,073	4.4
1996	4,877,210	-0.6

Source: Grand Canyon National Park

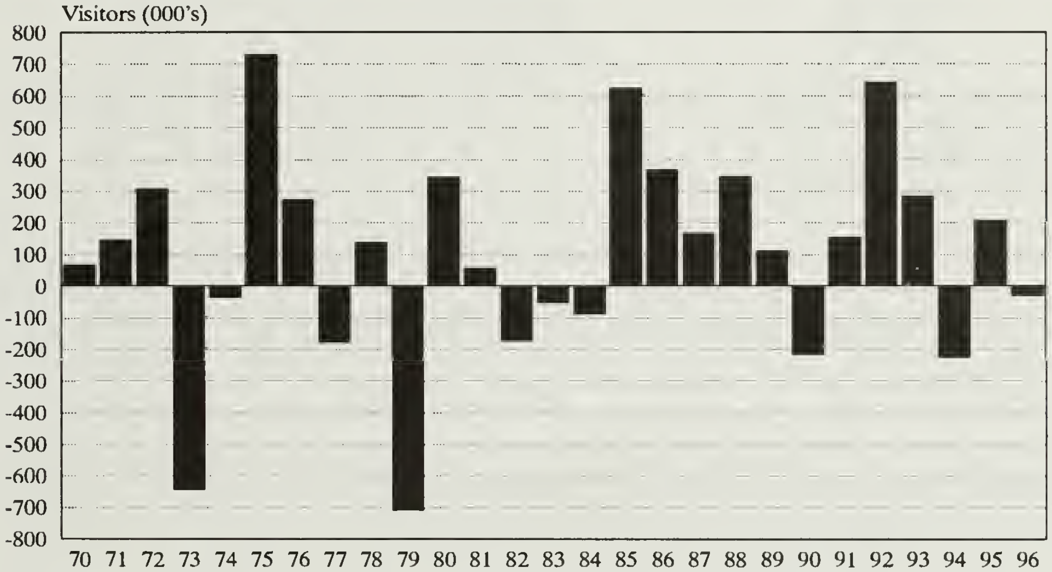
FIGURE 2-4
Annual Grand Canyon Visitation
1970 - 1996



Source: Grand Canyon National Park

The ever increasing visitor growth trends of the last decade have led to a general perception that consistent Grand Canyon visitation growth is the "norm." However, in looking over past years, the variance in Grand Canyon visitation is evident. As shown in Figure 2-5, a decrease in Grand Canyon visitation (when compared to the previous year) has occurred in ten of the past twenty-seven years. These decreases were particularly prominent during energy/gas shortages (i.e., 1973 and 1979).

FIGURE 2-5
Annual Change in Grand Canyon Visitation
1970 - 1996



Source: Grand Canyon National Park

There has been substantial speculation as to reasons for the decrease in visitation experienced in 1994. These explanations have included the declining California economy, the diversion of visitors to the American hosted World Cup soccer games, international concerns with violence and publicity related to overcrowding in the Park. While all of these reasons are plausible, it should be noted the 1994 decrease was very similar to that which occurred in 1990 (approximately 5 percent) and was far less than those experienced in the 1970s. Additionally, this came after a very strong increase in 1992. The slight decline in visitation during 1996 was likely influenced by the summer Olympics, which were held in Atlanta and significant fires which occurred in northern Arizona. Even with the losses in 1990, 1994 and 1996, the 1990-1996 period has averaged growth of 129,800 visitors annually, which equates to a 3.0 percent annual compound growth rate.

These historical trends are useful in considering visitation forecasts currently being projected for the Park. Over the 26 year time period 1971-1996, visitation has grown at an average annual rate of approximately 101,000 persons or a 3.0 percent annual compound growth rate (Table 2-4). As previously noted, growth rates since 1984 (the year prior to significant growth increases) were substantially higher than earlier years, averaging 210,000 new visitors annually for a 6.2 percent annual compound rate of growth. Currently, the Park Service is estimating visitation will reach 6,859,000 persons by the year 2010. This would imply an average annual increase of 141,000 persons annually, or a 2.5 percent annual compound growth rate for the 14 year period 1997-2010.

TABLE 2-4
GRAND CANYON NATIONAL PARK
AVERAGE ANNUAL GROWTH IN VISITATION

Year	# Average Annual Increase	Average Annual CAG*
1971-1996	100,731	3.0%
1985-1996	209,703	6.2%
1997-2010 **	141,556	2.5%

* Compound Annual Growth
** Forecasted
Source: Grand Canyon National Park

While this visitation forecast is being used by the Park Service in their General Management Plan (GMP), much higher forecasts have been suggested by other groups. As an example, the Grand Canyon Trust has estimated visitation could approach 10 million persons by 2005 if recent growth trends continued.

In considering these future forecasts, it is helpful to contrast Grand Canyon visitation to that of other National Parks. As shown in Table 2-5, 1995 Grand Canyon recreational visitation was the 7th highest in the nation and was generally consistent with most of the top 10 National Parks, which averaged between 4 to 6 million visitors annually. Only the Great Smoky Mountains National Park and Lake Mead National Recreational Area exceeded these averages, at approximately 9 to 10 million visitors annually. In considering these top attractions, it should be noted that the Great Smoky Mountain estimate is influenced by the large surrounding population base and the ease of access to the Park. Additionally, the Lake Mead count includes 1,000 to 2,000 area homeowners whose daily travel is currently included in counts.

Table 2-6 expands on this top 10 list and identifies visitation at western region National Parks. As indicated in the table, Grand Canyon visitation exceeded all other western region National Parks and was approximately 15 percent above the next closest, Yosemite. Most of these Parks are operating at between 2 to 3 million visitors annually. It should be noted the National Park Service Statistical Digest utilizes recreational visits (i.e., non-business related) in their comparisons. These numbers are slightly below the total visitation figures cited earlier.

TABLE 2-5
TOP 10 NATIONAL PARK SERVICE AREAS
1995 RECREATIONAL VISITS

#	Park	Recreational Visits
1	Lake Mead National Recreation Area	9,838,700
2	Great Smoky Mountain National Park	9,080,400
3	Gateway National Recreation Area	6,064,300
4	National Capital Parks	5,513,000
5	Cape Cod National Seashore	5,141,000
6	Delaware Water Gap National Recreation Area	4,726,300
7	**Grand Canyon National Park**	**4,557,600**
8	Gulf Islands National Seashore	4,520,400
9	Statue of Liberty National Monument	4,244,700
10	Yosemite National Park	3,958,400

Source: National Park Service Statistical Digest - 1995

TABLE 2-6
WESTERN REGION
TOP NATIONAL PARK SERVICE AREAS
1995 RECREATIONAL VISITS

Park	Recreational Visits
Grand Canyon	**4,557,600**
Yosemite	3,958,400
Olympic	3,658,600
Yellowstone	3,125,300
Rocky Mountain	2,878,200
Grand Tetons	2,731,000
Zion Grand Canyon	2,430,200
Glacier (Montana)	1,839,500
Bryce Grand Canyon	994,500

Source: National Park Service Statistical Digest - 1995

These comparisons show only a very few National Parks approach the 9 to 10 million visitor mark. Those that do are proximate to major population centers, are typically in areas that have strong shoulder seasons and have the carrying capacity to support high visitor flows. In contrast, the bulk of National Parks are operating at the 2 to 3 million person level, with a limited number in the 4 to 6 million visitor range.

In order to consider the potential range of visitation which could occur at the Grand Canyon and the associated implications, four visitation scenarios have been developed (Table 2-7). It is important to note that these alternative visitation growth scenarios will be used as a tool to evaluate prospective visitor support levels and their implications. By providing a range of visitation estimates rather than a single forecast, the bounds of required support facilities can be better evaluated by reflecting a range of needs.

Scenario One, the highest visitation level, assumes the rate of growth experienced since 1985 (6.2%) will continue through 2010. As this growth rate is applied to an increasingly larger base, the average annual growth in visitation reaches 460,000. That would be approximately 2.2 times the absolute level since 1985. While substantially above the average of the past decade, this level of unprecedented growth has been experienced in the past (i.e. the 1971-1984 average annual increase in visitation of 7,326 visitors compared to the 1985-1996 average of 210,000). This rate of growth would result in the Grand Canyon experiencing approximately 11 million visitors a year by 2010. This would require strong continued growth of population in the southwest, as well as continued increases in foreign visitations. Repeat visitation to the Park would also need to increase substantially and changes in Park management allowing increased carrying capacity would have to occur. Even if these levels of demand were present, the ability to accommodate this level of visitation is unclear. Accommodation would depend heavily on the implementation of transportation solutions and the ability to better disperse visitation throughout the year.

Scenario Two assumes a more moderate rate of growth (4.5%) is experienced over the 1997-2000 time period. This rate of growth further moderates during 2001-2005 to 4.0 percent and 3.5 percent between 2006-2010 (recognizing the increased visitation base). These rates of growth would be approximately one-third to one-half of the levels experienced since 1985. It recognizes the projected growth of the southwest U.S. and more specifically, Las Vegas and Phoenix. At these growth rates, visitation would increase to 8,404,000 by 2010. This would position the Grand Canyon at levels slightly below other top National Parks. It would additionally imply average annual visitation growth of 252,000, a level somewhat above what has been experienced over the past decade (210,000 visitors annually). This growth scenario assumes Park visitation is more effectively managed, that staging areas are developed outside the Park, that traffic limitations are imposed within the Park and that additional visitor facilities are provided.

Scenario Three assumes the Park Service's visitation forecast of 6,859,000 is reached by 2010, the estimate used in the GMP. This level of visitation implies absolute annual increases drop to levels approximately 32 percent below what has been experienced since 1985.

TABLE 2-7
GRAND CANYON NATIONAL PARK
AVERAGE ANNUAL GROWTH IN VISITATION

Scenario	# Average Annual Increase	Average Annual CAG*
1. High Growth[1] 1997-2010 (2010 Visitation = 11,322,000)	460,342	6.2%
2. Moderate Growth[1] 1997-2010 (2010 Visitation = 8,404,000)	251,914	4.0%
3. GCNP[2] 1997-2010 (2010 Visitation = 6,859,000)	141,556	2.5%
4. Low Growth[1] 1997-2010 (2010 Visitation = 6,008,000)	80,771	1.5%

* Compound Annual Growth
Source: [1] Young Nichols Gilstrap, Inc. and Warnick & Company, [2] Grand Canyon National Park Alternative 2

Scenario Four is the lowest estimate and assumes limited staging solutions are implemented and the general capacity constraints of the Park limit visitor plans. This low scenario would imply annual visitation increases approximately 37 percent below the Park Service forecast. Even with this lower growth rate, the Grand Canyon would serve approximately 6 million visitors by 2010.

3.0 Visitor Characteristics and Traveling Patterns

In order to derive an understanding of the composition and orientation of visitors to the Grand Canyon, a variety of existing studies were reviewed. A primary research effort was also undertaken. This section identifies the secondary studies reviewed and, more specifically, outlines findings of the primary survey effort.

3.1 Secondary Studies Reviewed

A variety of existing research has been undertaken over the years relating to the Grand Canyon and surrounding areas. The following reports were reviewed to evaluate their potential use in addressing issues relevant to this study.

- Grand Canyon National Park - General Management Plan Environmental Impact Statement, July 1995
- Winter Sports Visitors to Flagstaff: Visitor Profile and Analysis of Economic Impact, July 1993
- Grand Canyon Railway, Inc. Passenger Rail Service - Grand Canyon Airport to Maswik Transportation Area, Grand Canyon Village Environmental Impact Statement, August 1993
- National Park Service Statistical Abstract, 1995
- Metro Tucson Visitor Study - Metropolitan Tucson Convention & Visitors Bureau, Annual Report 1995
- Arizona International Visitor Profile - Northern Arizona University Hospitality Research & Resource Center, April 1994
- The Williams 1995-96 Visitor Study - University of Arizona - College of Agriculture
- 1992 Kaibab Visitor Survey - Northern Arizona University
- Grand Canyon National Park Housing Report, November 1993
- The Northern Arizona and Southern Utah Visitor Information and Interpretation Assessment, April 1992
- A Study of the Perceptions, Expectations and Satisfaction Levels of Visitors to Grand Canyon National Park

- The 1990-91 Arizona Visitor Profile - Northern Arizona University

- TravelScope

While all studies possessed useful information (some of which is cited in this report), the data often was not current and typically did not fully address visitor itineraries (i.e., where they stayed prior to and after leaving Grand Canyon) or the decision factors regarding location choices. The 1992 Kaibab Visitor Study addressed a number of these points and was utilized in the development of the primary survey effort, which updated and expanded on these visitor characteristics.

3.2 Review of Primary Research Efforts

In an effort to better understand the trip orientation, travel party characteristics and satisfaction levels of Grand Canyon visitors, a series of surveys were conducted during 1994 and 1995. The surveys addressed where and why a visitor stayed: 1) prior to arriving at the Grand Canyon; 2) upon arriving at the Grand Canyon; and 3) after leaving the Grand Canyon. Visitor satisfaction levels regarding a variety of Grand Canyon related facilities/amenities were also explored, along with visitor thoughts regarding the need to expand these facilities. Questions relating to transportation access within the Grand Canyon, attitudes regarding the use of mass transportation facilities and the cost and length of traveling time completed the survey.

Results of the survey were utilized in estimating future demand for visitor facilities in the Grand Canyon/Tusayan area, as well as considering the potential impacts of new development to surrounding communities.

The survey utilized a combination of on-site interviews and mailback questionnaires, a format initially used by Northern Arizona University in their 1992 Kaibab Visitor Study. By utilizing a similar design and format, comparisons to this earlier survey effort be made. The survey methodology and questionnaire were developed in conjunction with representatives from the Kaibab National Forest, the Grand Canyon National Park and SWCA.

The survey effort featured personal intercepts. Potential respondents were asked if they worked or resided in the Grand Canyon/Tusayan area. If they did not, the effort progressed and a series of questions were asked regarding the visitor's name, address and travel party characteristics. Once this material was obtained, a survey booklet was distributed. The visitors completed the questionnaires at a later date and returned them in stamped, self-addressed envelopes. To enhance response rates, a series of follow-up letters were sent utilizing the names and addresses obtained during the initial intercept.

Because the Grand Canyon experiences seasonal peaks and valleys, three separate survey efforts were undertaken. They included a Fall 1994 survey conducted in late September and early October, a Spring 1995 survey in late April and early May and a Summer 1995 survey in late July and early August. As the winter months experience the lowest level of visitation and there is an adequate capacity of available facilities, a separate survey was not undertaken for the winter period. Within each period, surveys were conducted on randomly selected days.

A total of 1,950 surveys were distributed through the three sampling periods with 422 responses returned during the fall of 1994, 460 during the Spring of 1995 and 447 during the summer of 1995. An overall response rate of 68 percent was obtained with the survey effort. The survey forms were coded and tabulated by Analytical Computer Services, Inc., a nationally recognized market analysis and research firm. A variety of cross tabulations and an analysis of variances were conducted in the tabulation process.

The findings outlined in this section present responses for the Fall, Spring and Summer surveys, as well as aggregate responses for all three surveys. An adjusted total is also presented, which weights the surveys at levels corresponding to visitation during those periods (Fall 27%, Spring 31%, Summer 42%).

Three different sampling locations were utilized in the survey. Visitors exiting the Park in personal vehicles (i.e. no buses) were routed to a stopping area along Highway 64 near the Moqui Lodge. As visitors traveling by bus were not intercepted in this process, a separate survey of tour operators was conducted as outlined in Section 3.4. Because the Moqui Lodge location is just south of the Park's southern entrance, a wide range of visitors were intercepted (i.e., domestic, international, families, etc.) on a random basis. The Ten X Campground, a Kaibab National Forest facility located just south of Tusayan, was also utilized to ensure camping oriented visitors were considered. Finally, a variety of surveys were distributed at the Grand Canyon Airport to consider those visitors flying into the Tusayan area or taking flights over Grand Canyon. These results are subject to errors due to non-response bias, recall bias, etc. While the confidence interval varies by question, the overall accuracy of the results presented here are usually within plus or minus five percent.

3.3 Grand Canyon Visitor Survey Findings

The following points summarize key findings of the survey. These points, as well as other general findings, are expanded on throughout this section.

- There is a high percentage of first time visitors at Grand Canyon.
- Grand Canyon is often only part of a larger travel plan.
- Visitors typically stay at Grand Canyon/Tusayan for a short duration.
- One-third of visitors who attempted to make reservations at Grand Canyon Park lodges were unsuccessful, indicating substantial unsatisfied market demand for lodging accommodations.

- The one-third denial rate is similar for Tusayan lodging accommodations during the summer months.

- Almost one-quarter to one-third of those survey respondents who did not stay overnight noted a desire to stay at Tusayan if hotels were available or were lower priced. This further substantiated the unmet demand for lodging accommodations in the Grand Canyon/Tusayan area.

- There is wide geographic dispersion of visitors the night before and night after entering the Grand Canyon. Visitors are not concentrated in northern Arizona, as Flagstaff and Williams collectively attract only 28 percent of Grand Canyon visitors the night before, and 12 percent the night after.

- The average length of stay is substantially longer for visitors staying the night before or after in Phoenix and Las Vegas, as compared to Flagstaff and Williams.

- The availability and cost of rooms are the most important factors in a visitor's decision of where to spend the night.

- Parking, hotels and restaurants were noted as the most important additional facilities desired in the Grand Canyon/Tusayan area.

- Concerns regard the pricing of hotels and food and beverage facilities were often noted in open-ended responses.

- Although open-ended questions noted a variety of concerns - visitors in general were quite satisfied with their overall experience at the Grand Canyon.

Question 1

How many times have you previously been to the Grand Canyon?

The dominance of first time visitors is clear as approximately two-thirds of survey respondents noted this was their first time visiting the Grand Canyon. Further illustrating the limited amount of repeat visitation, only 18 percent had visited the Park more than once before. The high visitor growth rates experienced at Grand Canyon since 1985 (approximately 6.2% annual compound growth) would have been even higher if repeat visitation increased.

Q.1 NUMBER OF TIMES PREVIOUSLY BEEN TO THE GRAND CANYON

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	1329 100.0	1329 100.0	422 100.0	460 100.0	447 100.0
FIRST TIME	828 62.3	830 62.5	262 62.1	296 64.3	272 60.9
ONCE BEFORE	255 19.2	252 19.0	72 17.1	87 18.9	93 20.8
TWICE BEFORE	75 5.6	73 5.5	28 6.6 D	14 3.0	31 6.9 D
THREE TO FIVE TIMES BEFORE	78 5.9	79 5.9	24 5.7	30 6.5	25 5.6
MORE THAN FIVE TIMES BEFORE	83 6.3	85 6.4	33 7.8	27 5.9	25 5.6
NO ANSWER	9 0.7	10 0.8	3 0.7	6 1.3	1 0.2

Question 2

Which of the following best summarizes the type of trip you are taking?

Grand Canyon is often only one of several destinations planned for a vacation, as approximately 70 percent of visitors noted Grand Canyon was part of a larger travel plan. This average is influenced by the larger percentage of responses from summer visitors, which is significantly higher than that of the fall or spring. Only 12 percent noted it was their primary destination, while 13 percent noted it was a day or weekend outing.

Q.2 SUMMARY OF THE TYPE OF TRIP TAKEN

	ADJUSTED TOTAL (A)	TOTAL (B)	FALL 1994 (C)	SPRING 1995 (D)	SUMMER 1995 (E)
TOTAL	1329 100.0	1329 100.0	422 100.0	460 100.0	447 100.0
VACATION WITH THE GRAND CANYON AS PART OF A LARGER TRAVEL PLAN	929 69.9	917 69.0	279 66.1	296 64.3	342 76.5 CD
VACATION WITH THE GRAND CANYON AS THE PRIMARY DESTINATION	164 12.4	166 12.5	55 13.0	60 13.0	51 11.4
A WEEKEND OUTING OR SHORT TRIP	99 7.4	103 7.8	41 9.7 E	38 8.3	24 5.4
A DAY OUTING	77 5.8	78 5.9	18 4.3	38 8.3 CE	22 4.9
OTHER MENTIONS	49 3.7	53 4.0	25 5.9 E	21 4.6 E	7 1.6
NO ANSWER	11 0.8	12 0.9	4 0.9	7 1.5	1 0.2

Question 3

During <u>this</u> visit/vacation, how much time did you spend at the <u>Grand Canyon and/or Tusayan</u>?

The length of stay of visitors at Grand Canyon and/or Tusayan varies, with approximately one-third staying for a single day or less (no overnight stay), while 50 percent of visitors stay for a one to two night stay. Longer stays are generally limited, as only 16 percent stay for more than two nights.

Q.3 AMOUNT OF TIME SPENT AT THE GRAND CANYON AND/OR TUSAYAN
DURING THIS VISIT/VACATION

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	1329	1329	422	460	447
	100.0	100.0	100.0	100.0	100.0
DAY TRIP/NO OVERNIGHT STAY/ LESS THAN 1 DAY	422	423	121	165	137
	31.7	31.8	28.7	35.9	30.6
				C	
1 - 2 DAYS/NIGHTS STAY	672	669	206	230	233
	50.6	50.3	48.8	50.0	52.1
3 - 4 DAYS/NIGHTS STAY	172	173	69	48	56
	12.9	13.0	16.4	10.4	12.5
			D		
5 OR MORE DAYS/NIGHTS STAY	40	40	17	10	13
	3.0	3.0	4.0	2.2	2.9
NO ANSWER	24	24	9	7	8
	1.8	1.8	2.1	1.5	1.8

Question 4

If you stayed overnight at the Grand Canyon and/or Tusayan, what type of accommodations did you use?

Of those staying overnight, roughly one half stayed in hotels, while 40 percent stayed in public or private campgrounds.

Q.4 TYPE OF ACCOMMODATIONS USED WHEN STAYING OVERNIGHT AT THE GRAND CANYON/TUSAYAN

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	883	882	292	288	302
	100.0	100.0	100.0	100.0	100.0
HOTEL/MOTEL	452	458	147	173	138
	51.2	51.9	50.3	60.1	45.7
				CE	
PUBLIC CAMPGROUND	304	293	80	86	127
	34.4	33.2	27.4	29.9	42.1
					CD
PRIVATE CAMPGROUND/RV PARK	68	69	29	19	21
	7.7	7.8	9.9	6.6	7.0
CABIN	40	41	17	13	11
	4.5	4.6	5.8	4.5	3.6
STAYED WITH FRIENDS OR	7	7	4		3
RELATIVES	0.8	0.8	1.4		1.0
CAMPED/NO FACILITIES	4	5		5	
	0.5	0.6		1.7	
OTHER MENTIONS	37	38	17	10	11
	4.2	4.3	5.8	3.5	3.6
NO ANSWER	25	27	21		6
	2.9	3.1	7.2		2.0

Question 5

Please note the name of the facility you stayed at.

Hotel properties offering the largest number of rooms (Yavapi Lodge, Squire Inn, Red Feather, etc.) were most frequently cited as the facility chosen for a visitor's stay.

Q.5 NAME OF FACILITY STAYED AT

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	883	882	292	288	302
	100.0	100.0	100.0	100.0	100.0
HOTELS/MOTELS (NET)	497	503	168	182	153
	56.3	57.0	57.5	63.2	50.7
				E	
BEST WESTERN SQUIRE INN	82	85	31	32	22
	9.3	9.6	10.6	11.1	7.3
MASWIK LODGE	78	79	29	26	24
	8.8	9.0	9.9	9.0	7.9
YAVAPAI LODGE	64	68	24	31	13
	7.3	7.7	8.2	10.8	4.3
			E	E	
MOQUI LODGE	50	50	15	18	17
	5.7	5.7	5.1	6.2	5.6
RED FEATHER LODGE	45	44	10	16	18
	5.1	5.0	3.4	5.6	6.0
QUALITY INN GRAND CANYON	41	42	12	20	10
	4.6	4.8	4.1	6.9	3.3
				E	
BRIGHT ANGEL LODGE	39	40	16	14	10
	4.4	4.5	5.5	4.9	3.3
EL TOVAR HOTEL	32	33	14	9	10
	3.7	3.7	4.8	3.1	3.3
OTHER MENTIONS	97	96	36	23	37
	11.0	10.9	12.3	8.0	12.3
DON'T KNOW	7	8	5	2	1
	0.8	0.9	1.7	0.7	0.3

Question 5 continued

Q.5 NAME OF FACILITY STAYED AT

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
CAMPGROUNDS/RV PARKS (NET)	383	376	117	113	146
	43.4	42.6	40.1	39.2	48.3
					CD
U.S. FOREST SERVICE TEN X CAMPGROUND/(SOUTH OF TUSAYAN)	216	203	41	61	101
	24.4	23.0	14.0	21.2	33.4
				C	CD
GRAND CANYON (SOUTH RIM): MATHER	76	79	36	23	20
	8.6	9.0	12.3	8.0	6.6
			E		
GRAND CANYON CAMPER VILLAGE (TUSAYAN)	44	43	15	11	17
	5.0	4.9	5.1	3.8	5.6
TRAILER VILLAGE (SOUTH RIM)	16	17	9	5	3
	1.8	1.9	3.1	1.7	1.0
GRAND CANYON (SOUTH RIM): DESERT VIEW	14	15	8	4	3
	1.6	1.7	2.7	1.4	1.0
OTHER MENTIONS	59	61	20	25	16
	6.7	6.9	6.8	8.7	5.3
DON'T KNOW	4	4	2	1	1
	0.4	0.5	0.7	0.3	0.3
NO ANSWER	24	25	17	2	6
	2.7	2.8	5.8	0.7	2.0

Question 6

If you did not stay overnight, would you have stayed at Tusayan or another location within close proximity to Tusayan (i.e. 2 miles) if:

Approximately one-quarter of those visitors not staying overnight noted they would have stayed if hotel rooms were available in Tusayan. The price sensitivity of these visitors is illustrated, as approximately 30 percent noted they had an interest in staying if hotel rooms were lower priced. This price sensitivity was most pronounced during the summer survey. A wider range of support services and better access, in and around the Park, were noted by less than 10 percent of visitors. Only 13 percent of these visitors specifically noted they preferred not to stay in the Tusayan area.

Q.6 WOULD HAVE STAYED AT TUSAYAN OR ANOTHER LOCATION WITHIN PROXIMITY TO TUSAYAN IF:

	ADJUSTED TOTAL (A)	TOTAL (B)	FALL 1994 (C)	SPRING 1995 (D)	SUMMER 1995 (E)
TOTAL	422 100.0	423 100.0	121 100.0	165 100.0	137 100.0
HOTEL ROOMS WERE LOWER PRICED	121 28.7	119 28.1	36 29.8	37 22.4	46 33.6 D
HOTEL ROOMS WERE AVAILABLE	98 23.3	99 23.4	34 28.1	34 20.6	31 22.6
I PREFER NOT TO STAY IN THE TUSAYAN AREA	57 13.5	58 13.7	11 9.1	31 18.8 C	16 11.7
CAMPGROUNDS WERE AVAILABLE	50 11.8	48 11.3	12 9.9	15 9.1	21 15.3
A WIDER CHOICE OF FOOD SERVICES WERE AVAILABLE	37 8.7	38 9.0	15 12.4	14 8.5	9 6.6
IF PARKING WITHIN THE PARK WAS MORE CONVENIENT AND AVAILABLE	33 7.9	33 7.8	10 8.3	11 6.7	12 8.8
HOTEL ROOMS WERE OF A BETTER QUALITY	26 6.1	25 5.9	7 5.8	8 4.8	10 7.3
IT WERE EASIER TO GET IN AND OUT OF THE PARK	21 5.0	21 5.0	5 4.1	9 5.5	7 5.1
IT WERE EASIER TO GET AROUND IN THE PARK	17 4.0	16 3.8	3 2.5	6 3.6	7 5.1
A WIDER RANGE OF RETAIL SHOPPING ALTERNATIVES WERE AVAILABLE	15 3.6	17 4.0	6 5.0 E	10 6.1 E	1 0.7
A WIDER VARIETY OF TRAVELER SERVICES WERE AVAILABLE	15 3.6	15 3.5	4 3.3	6 3.6	5 3.6
A WIDER RANGE OF MUSEUMS/ EDUCATION CENTERS WERE AVAILABLE	12 2.8	12 2.8	5 4.1	3 1.8	4 2.9
OTHER MENTIONS	81 19.1	82 19.4	26 21.5	32 19.4	24 17.5
NO ANSWER	72 17.1	73 17.3	22 18.2	29 17.6	22 16.1

Questions 7 and 8

(7) Did you attempt to make room reservations at the Grand Canyon or in Tusayan?

Approximately 30 percent of visitors attempted to make room reservations at the Grand Canyon, with approximately 35 percent of those attempts being unsuccessful, thus indicating unsatisfied demand for hotel accommodations at the Grand Canyon and Tusayan.

(8) Were you successful?

Q.7 ATTEMPTED TO MAKE ROOM RESERVATIONS AT THE GRAND CANYON

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	1329	1329	422	460	447
	100.0	100.0	100.0	100.0	100.0
YES	375	379	126	135	118
	28.2	28.5	29.9	29.3	26.4
NO	852	848	265	286	297
	64.1	63.8	62.8	62.2	66.4
NO ANSWER	101	102	31	39	32
	7.6	7.7	7.3	8.5	7.2

Q.8 WERE YOU SUCCESSFUL IN MAKING ROOM RESERVATIONS AT THE GRAND CANYON

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	375	379	126	135	118
	100.0	100.0	100.0	100.0	100.0
YES	235	239	84	84	71
	62.7	63.1	66.7	62.2	60.2
NO	134	134	41	49	44
	35.6	35.4	32.5	36.3	37.3
NO ANSWER	6	6	1	2	3
	1.7	1.6	0.8	1.5	2.5

While a lower percentage (approximately 10 percent) attempted to make room reservations in Tusayan, as many as 37 percent were unsuccessful during the peak summer months.

Q.7 ATTEMPTED TO MAKE ROOM RESERVATIONS IN TUSAYAN

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	1329	1329	422	460	447
	100.0	100.0	100.0	100.0	100.0
YES	139	139	47	46	46
	10.4	10.5	11.1	10.0	10.3
NO	908	903	278	308	317
	68.3	67.9	65.9	67.0	70.9
NO ANSWER	282	287	97	106	84
	21.2	21.6	23.0	23.0	18.8

Q.8 WERE YOU SUCCESSFUL IN MAKING ROOM RESERVATIONS IN TUSAYAN

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	139	139	47	46	46
	100.0	100.0	100.0	100.0	100.0
YES	103	106	36	42	28
	74.5	76.3	76.6	91.3	60.9
				CE	
NO	32	30	9	4	17
	23.4	21.6	19.1	8.7	37.0
					D
NO ANSWER	3	3	2		1
	2.1	2.2	4.3		2.2

Question 9

How far in advance did you make or attempt to make reservations?

Most visitors attempted to make reservations in advance. More than half of those who answered noted they attempted to make reservations one month or farther in advance.

Q.9 HOW FAR IN ADVANCE MADE OR ATTEMPTED TO MAKE RESERVATIONS

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	425 100.0	428 100.0	138 100.0	153 100.0	137 100.0
1 WEEK OR LESS	83 19.6	85 19.9	34 24.6	26 17.0	25 18.2
3 - 4 WEEKS	66 15.5	72 16.8	35 25.4 E	28 18.3 E	9 6.6
1 - 6 MONTHS	166 39.0	168 39.3	60 43.5	56 36.6	52 38.0
MORE THAN 6 MONTHS	26 6.2	26 6.1	7 5.1	9 5.9	10 7.3
NO ANSWER	83 19.6	77 18.0	2 1.4	34 22.2	41 29.9

Question 10

During your current visit, where did you stay the night before you entered the Grand Canyon or Tusayan?

The geographic dispersion of visitors immediately prior to coming to Grand Canyon is evident, as Flagstaff was the most frequently noted location, but still only accounted for 18 percent of visitors. Collectively, the top five locations only accounted for 57 percent of responses. The remaining visitors were widely spread as presented on the following page. It should be noted that Phoenix had a significantly smaller percentage capture during the summer survey.

Q.10 WHERE DID YOU STAY THE NIGHT BEFORE ENTERING THE GRAND CANYON OR TUSAYAN

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	1329	1329	422	460	447
	100.0	100.0	100.0	100.0	100.0
FLAGSTAFF	242	243	75	88	80
	18.2	18.3	17.8	19.1	17.9
LAS VEGAS	189	186	48	67	71
	14.3	14.0	11.4	14.6	15.9
WILLIAMS	141	138	44	40	54
	10.6	10.4	10.4	8.7	12.1
PHOENIX	107	112	45	42	25
	8.1	8.4	10.7	9.1	5.6
			E	E	
SEDONA	81	83	23	39	21
	6.1	6.2	5.5	8.5	4.7
				E	
PAGE	29	26		9	17
	2.2	2.0		2.0	3.8
OTHER MENTIONS	523	525	181	170	174
	39.4	39.5	42.9	37.0	38.9
NO ANSWER	16	16	6	5	5
	1.2	1.2	1.4	1.1	1.1

OTHER MENTIONS

Question 10: During your current visit, where did you stay the night before you entered the Grand Canyon or Tusayan?

ARIZONA

26	Holbrook
14	Kingman
17	Kayenta
11	Cameron
11	Prescott
11	Tuba City
10	Lake Havasu
9	Lake Powell
8	Winslow
7	Monument Valley
6	Bullhead City
5	Arizona
5	Tucson
4	Gray Mountain
4	Seilegman
4	Valle
3	Camp Verde
3	Kaibab
3	Lake Mead
3	Tsegi
3	Yuma
2	Black Canyon City
2	Cottonwood
2	Grand Canyon
2	Jacob Lake
2	Marble Canyon
2	Showlow
2	Tusayan
1	Ashfork
1	Canyon De Chelly
1	Chinle
1	Cranberg
1	Havasupai Havasu Cyn
1	Jerome
1	Joseph City
1	Kohl's Ranch
1	Lee's Ferry
1	Meteor City
1	Meteor Crater
1	Munds Park
1	Navajo Indian Res.
1	Navajo Nat'l Monument
1	Payson
1	Peach Springs
1	Petrified Forest
1	Pinetop
1	Pinewood
1	Ream Canyon
1	Red Lake C.G.
1	Safford
1	San Marcos
1	St. Johns
1	Supai
1	Tec No Pass Indian Res.
1	Thousand Trails
1	White River
1	Wickenburg
1	Window Rock
211	

UTAH

14	Monument Valley
12	Bryce Canyon
8	Zion National Park
6	Moab
5	Kanab
5	Mexican Hat
4	Cedar City
4	Mt. Carmel Junction
4	St. George
3	Bluff
3	Gouldings
3	Panguitch
3	Utah
2	Blanding
2	Monticello
1	Arches
1	Cambridge Blm
1	Cameron
1	Flaming Gorge
1	Hatch
1	Hurricane
1	Kingston
1	Pink Sand Dunes S.P.
1	Nephe
1	Salt Lake City
1	St. Charles
1	Tropic
90	

COLORADO

9	Durango
7	Cortez
7	Mesa Verde
2	Denver
2	Dolores
1	Bluff
1	Boulder
1	Del Monte
1	Grand Junction
1	Pink Sand Dunes S P.
1	Salida
1	Steamboat
34	

NEW MEXICO

12	Albuquerque
10	Gallup
5	Grants
2	Farmington
2	Silver City
1	Aby
1	Blue Water S.P.
1	Cortez
1	Deming
1	Las lunas
1	Moriarity
1	Navaho Lake St. Park
1	Red Rock
1	Rio Rancho
1	Santa Rosa
1	Taos
1	Tucumcari
1	Whites City
44	

CALIFORNIA

10	Needles
11	Los Angeles
6	San Diego
4	Barstow
2	Anaheim
2	Joshua Tree
1	29 Palms
1	Berkeley
1	Fontana
1	Arrin
1	California
1	Campbell
1	Carlsbad
1	Garden Grove
1	La Canada
1	Mission Viejo
1	Oakland
1	Ontario
1	Orange
1	Pasadena
1	Redlands
1	Redondo Beach
1	Sacramento
1	San Francisco
1	Santa Monica
1	Wasco
1	Whittier
1	Woodland
57	

OTHER

39	Other

NEVADA

12	Laughlin
4	Boulder City
1	Ely
1	Reno
18	

BACKCODED

20	Phoenix
2	Flagstaff
1	Williams
24	Page
47	

Question 11

What type of accommodations did you use at that location?

Hotels/motels were most frequently chosen by visitors as their accommodations the night before entering Grand Canyon. Approximately two-thirds of all visitors selected hotels/motels, while 17 percent chose a private or public campground.

Q.11 TYPE OF ACCOMMODATIONS USED AT THAT LOCATION

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	1329 100.0	1329 100.0	422 100.0	460 100.0	447 100.0
HOTEL/MOTEL	840 63.2	837 63.0	251 59.5	297 64.6	289 64.7
YOUR PERSONAL RESIDENCE	121 9.1	124 9.3	45 10.7	44 9.6	35 7.8
PRIVATE CAMPGROUND/RV PARK	117 8.8	118 8.9	41 9.7	40 8.7	37 8.3
PUBLIC CAMPGROUND	115 8.6	112 8.4	42 10.0 D	24 5.2	46 10.3 D
STAYED WITH FRIENDS OR RELATIVES	57 4.3	57 4.3	13 3.1	26 5.7	18 4.0
CABIN	6 0.4	6 0.5	3 0.7	2 0.4	1 0.2
BED & BREAKFAST	5 0.4	5 0.4		4 0.9	1 0.2
OTHER MENTIONS	48 3.6	49 3.7	21 5.0	13 2.8	15 3.4
NO ANSWER	20 1.5	21 1.6	6 1.4	10 2.2	5 1.1

Question 12

How long did you stay at that location?

The majority of visitors (64%) stayed only a single night at their location prior to entering Grand Canyon. On a weighted average basis, visitors had an average length of stay of 1.7 nights. When cross-tabbed by where they stayed, the length of stay ranged as follows: Phoenix 2.8 nights, Las Vegas 2.4, Sedona 2.0, Flagstaff 1.5 and Williams 1.2.

Q.12 LENGTH OF TIME AT THAT LOCATION

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	1187	1184	371	406	407
	100.0	100.0	100.0	100.0	100.0
1 NIGHT	765	758	234	251	273
	64.4	64.0	63.1	61.8	67.1
2 NIGHTS	219	216	68	67	81
	18.4	18.2	18.3	16.5	19.9
3 NIGHTS	85	88	33	34	21
	7.1	7.4	8.9	8.4	5.2
			E		
4 NIGHTS	43	45	14	22	9
	3.6	3.8	3.8	5.4	2.2
				E	
5 OR MORE NIGHTS	65	66	15	32	19
	5.5	5.6	4.0	7.9	4.7
				C	
NO ANSWER	11	11	7		4
	0.9	0.9	1.9		1.0

Q.12 LENGTH OF TIME AT THAT LOCATION

Q.10 WHERE STAYED THE NIGHT BEFORE YOU ENTERED THE GRAND CANYON

	TOTAL	FLAGSTAFF	WILLIAMS	SEDONA	PHOENIX	LAS VEGAS	PAGE	OTHER
TOTAL	1184	237	136	83	71	182	26	444
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1 NIGHT	758	167	112	42	30	66	18	319
	64.0	70.5	82.4	50.6	42.3	36.3	69.2	71.8
2 NIGHTS	216	41	17	22	9	50	6	71
	18.2	17.3	12.5	26.5	12.7	27.5	23.1	16.0
3 NIGHTS	88	16	3	7	8	33	1	19
	7.4	6.8	2.2	8.4	11.3	18.1	3.8	4.3
4 NIGHTS	45	5	2	5	5	12	1	15
	3.8	2.1	1.5	6.0	7.0	6.6	3.8	3.4
5 OR MORE NIGHTS	66	7	1	7	16	20		15
	5.6	3.0	0.7	8.4	22.5	11.0		3.4
NO ANSWER	11	1	1		3	1		5
	0.9	0.4	0.7		4.2	0.5		1.1

Question 13

Approximately how much did the accommodations cost per night (lodging only)?

Most visitors chose moderately priced overnight accommodations (camping/hotels, etc.) with almost one-half spending less than $50 per night. Conversely, only 10 percent spent more than $100 a night.

Q.13 APPROXIMATE COST OF ACCOMMODATIONS PER NIGHT (LODGING ONLY)

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	1187	1184	371	406	407
	100.0	100.0	100.0	100.0	100.0
UNDER $25	233	232	77	75	80
	19.6	19.6	20.8	18.5	19.7
$25 - $49	288	288	90	102	96
	24.2	24.3	24.3	25.1	23.6
$50 - $74	244	242	82	72	88
	20.6	20.4	22.1	17.7	21.6
$75 - $99	187	187	52	72	63
	15.8	15.8	14.0	17.7	15.5
$100 OR MORE	121	121	35	47	39
	10.2	10.2	9.4	11.6	9.6
NOT APPLICABLE	81	81	22	32	27
	6.8	6.8	5.9	7.9	6.6
NO ANSWER	34	33	13	6	14
	2.9	2.8	3.5	1.5	3.4

Question 14

Please rate the following factors as to their importance in your decision to stay at that location?

When considering the most important factors in a visitor's decision to choose their location of stay, the availability of accommodations was the most highly rated factor (3.96 on a scale of 1 (not important) to 5 (very important)). Cost of accommodations was the second most important factor, rated as 3.58, followed by proximity to the South Rim at 3.18.

Q.14 RATING OF FACTORS AS TO IMPORTANCE IN YOUR DECISION TO STAY AT THAT LOCATION:
-- SUMMARY OF MEANS --

	ADJUSTED TOTAL (A)	TOTAL (B)	FALL 1994 (C)	SPRING 1995 (D)	SUMMER 1995 (E)
COST OF ACCOMMODATIONS	3.58	3.56	3.45 B	3.50 BA	3.71 A
AVAILABILITY OF ACCOMMODATIONS	3.96	3.97	4.00 A	3.93 A	3.97 A
AVAILABILITY OF RESTAURANTS	2.63	2.63	2.58 A	2.73 A	2.59 A
PRICES OF FOOD & BEVERAGES	2.67	2.66	2.58 A	2.71 A	2.69 A
AVAILABILITY OF TRAVELER SERVICES	2.51	2.51	2.48 A	2.53 A	2.51 A
CONVENIENCE TO MAJOR TRANSPORTATION ARTERY	2.91	2.90	2.90 A	2.85 A	2.95 A
PROXIMITY TO THE SOUTH RIM OF THE GRAND CANYON	3.18	3.18	3.26 A	3.11 A	3.17 A
CONVENIENCE AS A BASE TO VISIT A VARIETY OF ATTRACTIONS	2.94	2.94	2.99 A	2.92 A	2.93 A
PROXIMITY TO FAMILY AND RELATIVES	1.48	1.49	1.41 A	1.59 A	1.46 A
TRAVEL FATIGUE	2.43	2.43	2.49 A	2.44 A	2.37 A
OTHER MENTIONS	3.05	3.04	2.93 A	3.05 A	3.10 A

Question 15

Where did you stay the first night <u>after</u> you left the Grand Canyon or Tusayan?

Similar to the dispersion patterns of visitors the night before entering, visitors stayed at many different locations after leaving Grand Canyon. Flagstaff moved from the most frequent location chosen for the night before (18%) to third place for the night after (9%). Las Vegas was the number one location (19% night after versus 14% night before), followed by Phoenix (11% night after versus 8% night before). A listing of other locations chosen follows Question 15.

Q.15 WHERE STAYED THE FIRST NIGHT AFTER YOU LEFT THE GRAND CANYON OR TUSAYAN

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	1329	1329	422	460	447
	100.0	100.0	100.0	100.0	100.0
LAS VEGAS	254	253	78	86	89
	19.1	19.0	18.5	18.7	19.9
PHOENIX	147	153	61	55	37
	11.1	11.5	14.5 E	12.0	8.3
FLAGSTAFF	115	116	39	40	37
	8.7	8.7	9.2	8.7	8.3
SEDONA	65	67	22	29	16
	4.9	5.0	5.2	6.3	3.6
WILLIAMS	44	47	20	18	9
	3.3	3.5	4.7 E	3.9	2.0
PAGE	40	37		18	19
	3.0	2.8		3.9	4.3
OTHER MENTIONS	636	629	195	204	230
	47.8	47.3	46.2	44.3	51.5 D
NO ANSWER	27	27	7	10	10
	2.1	2.0	1.7	2.2	2.2

OTHER MENTIONS

Question 15 Where did you stay the first night after you left the Grand Canyon or Tusayan?

ARIZONA

36	Kingman	2	Canyon De Chelly	1	Hopi Motel
17	Holbrook	2	Navajo Nat'l Monument	1	Joshua Tree Natl Park
15	Lake Havasu	2	Petrified Forest	1	Kaibab Nat'l Forest
15	Tucson	2	Sierra Vista	1	Lake Mead
10	Kayenta	2	Ten-X Campground	1	Lyman Lake
9	Lake Powell	2	Window Rock	1	Marble Canyon
9	Prescott	2	Wickenburg	1	Morman Lake
7	Camp Verde	1	Apple Valley	1	Munds Park
6	Chinle	1	Arizona City	1	Oak Creek Canyon
5	Bullhead City	1	Benson	1	Payson
5	Tuba City	1	Betatalvin-Runus	1	Parker
4	Jacob Lake	1	Casa Grande	1	Preston
4	Monument Valley	1	Chambers	1	San Marcos
3	Apache Junction	1	Chloride	1	Showlow
3	Cottonwood	1	Erhenberg	1	Tsegi
3	Valle	1	Flagstaff	1	Tuba City
3	Winslow	1	Grand Canyon	1	Young
3	Yuma	1	Gray Mountain	1	Miscellaneous
2	Cameron	1	Happy Valley	1	Arizona
		1	Heber	206	
		1	Hopi Cultural Center		

CALIFORNIA

				1	Hollywood
20	Los Angeles	1	Barksdale	1	Kings Natl Park
16	Needles	1	Berkeley	1	Mammoth
14	Barstow	1	Blythe	1	Marina Del Rey
9	San Diego	1	Calico	1	Mohave
8	San Francisco	1	Chico	1	Riverside
6	Bakersfield	1	Chow Chilla	1	San Bernadino
4	Joshua Tree	1	El Centro	1	Santa Barbara
3	Anaheim	1	Escondido	1	Santa Ana
2	Baker	1	Foster City	1	Upland
2	Death Valley	1	Ft. Irwin	1	Victorville
2	Fresno	1	Fullerton	1	Walnut
2	Palm Springs	1	Furnace Creek	1	Walnut Creek
2	Santa Monica	1	Garden Briar	1	Misc
2	29 Palms	1	Garden Grove	1	California
				121	

UTAH

15	Bryce Canyon	1	Farmington
12	Zion Nat'l Park	1	Hurricane
9	Kanab	1	Magna
9	Moab	1	Monticello
7	Utah	1	Mt. Carmel
6	Mexican Hat	1	Nephi
5	Monument Valley	1	Salt Lake City
4	St. George	1	Vanas
3	Gouldings	1	St. Park
2	Blanding	1	Aby
2	Springdale	1	Bloomfield
1	Antinony	1	Cortez
1	Arch Cyn.	1	Estancia
1	Beaver	1	Farmersville
1	Bluff	1	Los Lunas
1	Canyon Lands	1	Ruidoso
1	Cedar City	1	Thoreau
		1	Natural Bridges N P.
		98	

NEW MEXICO

15	Gallup
11	Albuquerque
5	Santa Fe
4	New Mexico
3	Santa Rosa
3	Tucamcari
2	Grants
2	Estancia
1	Aby
1	Bloomfield
1	Cortez
1	Farmersville
1	Los Lunas
1	Ruidoso
1	Thoreau
52	

OTHER

80	Other

BACKCODED

20	Phoenix
1	Sedona
11	Page
32	

NEVADA

31	Laughlin
4	Boulder City
1	Mesquite
1	Carson City
1	Indian Springs
1	Jackpoint
1	Las Vegas
1	Lake Mead
1	Mesquire
1	Miscellaneous
43	

COLORADO

8	Durango
6	Cortez
3	Mesa Verde
3	Denver
2	Dolores
1	Boulder
1	Cortez
1	Grand Junction
1	Colorado Springs
1	Gunnison
1	Pagosa Springs
1	Poncha Springs
1	Silverado
1	Silver City
1	Colorado
32	

Question 16

What type of accommodations did you use at that location?

Hotels were again the most frequently chosen type of accommodation, selected by 60 percent of visitors, followed by their personal residence and public and private campgrounds.

Q.16 TYPE OF ACCOMMODATIONS USED AT THAT LOCATION

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	1329 100.0	1329 100.0	422 100.0	460 100.0	447 100.0
HOTEL/MOTEL	803 60.4	799 60.1	240 56.9	282 61.3	277 62.0
YOUR PERSONAL RESIDENCE	154 11.6	157 11.8	53 12.6	59 12.8	45 10.1
PUBLIC CAMPGROUND	108 8.2	104 7.8	29 6.9	28 6.1	47 10.5 D
PRIVATE CAMPGROUND/RV PARK	107 8.0	109 8.2	43 10.2	35 7.6	31 6.9
STAYED WITH FRIENDS OR RELATIVES	77 5.8	78 5.9	27 6.4	26 5.7	25 5.6
CABIN	3 0.3	4 0.3	2 0.5	2 0.4	
BED & BREAKFAST	2 0.1	2 0.2		2 0.4	
OTHER MENTIONS	37 2.8	38 2.9	16 3.8	12 2.6	10 2.2
NO ANSWER	38 2.8	38 2.9	12 2.8	14 3.0	12 2.7

Question 17

How long did you stay at that location?

Similar to the night before averages, the majority of visitors (61%) stayed only a single night at their location after leaving Grand Canyon. On a weighted average basis, visitors had an average length of stay of 1.8 nights. When cross-tabbed by where they stayed the night after, the length of stay ranged as follows: Phoenix 2.5 nights, Las Vegas 2.1, Sedona 1.9, Flagstaff 1.6 and Williams 1.4.

Q.17 LENGTH OF TIME AT THAT LOCATION

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	1137	1134	357	387	390
	100.0	100.0	100.0	100.0	100.0
1 NIGHT	695	687	200	236	251
	61.1	60.6	56.0	61.0	64.4
					C
2 NIGHTS	232	234	82	77	75
	20.4	20.6	23.0	19.9	19.2
3 NIGHTS	89	89	28	31	30
	7.8	7.8	7.8	8.0	7.7
4 NIGHTS	41	42	20	10	12
	3.6	3.7	5.6	2.6	3.1
			D		
5 OR MORE NIGHTS	72	75	26	32	17
	6.3	6.6	7.3	8.3	4.4
				E	
NO ANSWER	8	7	1	1	5
	0.7	0.6	0.3	0.3	1.3

Q.17 LENGTH OF TIME AT THAT LOCATION

		Q.15 WHERE STAYED THE NIGHT AFTER YOU LEFT THE GRAND CANYON						
	TOTAL	FLAGSTAFF	WILLIAMS	SEDONA	PHOENIX	LAS VEGAS	PAGE	OTHER
TOTAL	1134	110	44	66	105	241	36	523
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1 NIGHT	687	63	35	33	55	109	24	362
	60.6	57.3	79.5	50.0	52.4	45.2	66.7	69.2
2 NIGHTS	234	32	5	22	12	62	8	91
	20.6	29.1	11.4	33.3	11.4	25.7	22.2	17.4
3 NIGHTS	89	7	3	4	10	35	3	26
	7.8	6.4	6.8	6.1	9.5	14.5	8.3	5.0
4 NIGHTS	42	5		2	7	15	1	12
	3.7	4.5		3.0	6.7	6.2	2.8	2.3
5 OR MORE NIGHTS	75	2	1	5	20	19		28
	6.6	1.8	2.3	7.6	19.0	7.9		5.4
NO ANSWER	7	1			1	1		4
	0.6	0.9			1.0	0.4		0.8

Question 18

Approximately how much did the accommodations cost per night (lodging only)?

Most visitors again chose moderately priced overnight accommodations (camping/hotels, etc.) with approximately one-half spending less than $50 per night. Conversely, only 10 percent spent more than $100 a night.

Q.18 APPROXIMATE COST OF ACCOMMODATIONS PER NIGHT (LODGING ONLY)

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	1137	1134	357	387	390
	100.0	100.0	100.0	100.0	100.0
UNDER $25	220	218	70	68	80
	19.4	19.2	19.6	17.6	20.5
$25 - $49	269	268	84	92	92
	23.6	23.6	23.5	23.8	23.6
$50 - $74	242	241	82	74	85
	21.3	21.3	23.0	19.1	21.8
$75 - $99	160	159	46	57	56
	14.1	14.0	12.9	14.7	14.4
$100 OR MORE	110	111	30	47	34
	9.7	9.8	8.4	12.1	8.7
NOT APPLICABLE	92	94	28	41	25
	8.1	8.3	7.8	10.6	6.4
				E	
NO ANSWER	44	43	17	8	18
	3.9	3.8	4.8	2.1	4.6

Question 19

Please rate the following factors as to their importance in your decision to stay at that location?

The availability of accommodations was the most important factor in a visitor's decision to choose their location of stay after leaving Grand Canyon (3.86 on a scale of 1 (not important) to 5 (very important). Cost of accommodations was the second most important factor, rated as 3.49, followed by convenience as a base to visit a variety of attractions at 2.92.

Q.19 RATING OF FACTORS AS TO IMPORTANCE IN YOUR DECISION
TO STAY AT THAT LOCATION:
-- SUMMARY OF MEANS --

	ADJUSTED TOTAL (A)	TOTAL (B)	FALL 1994 (C)	SPRING 1995 (D)	SUMMER 1995 (E)
COST OF ACCOMMODATIONS	3.49	3.48	3.38 A	3.49 A	3.55 A
AVAILABILITY OF ACCOMMODATIONS	3.86	3.86	3.87 A	3.79 A	3.90 A
AVAILABILITY OF RESTAURANTS	2.67	2.67	2.69 A	2.68 A	2.64 A
PRICES OF FOOD & BEVERAGES	2.53	2.54	2.55 A	2.61 A	2.46 A
AVAILABILITY OF TRAVELER SERVICES	2.44	2.44	2.40 A	2.48 A	2.44 A
CONVENIENCE TO MAJOR TRANSPORTATION ARTERY	2.83	2.83	2.96 A	2.72 A	2.83 A
PROXIMITY TO THE SOUTH RIM OF THE GRAND CANYON	2.10	2.13	2.18 BA	2.28 A	1.95 B
CONVENIENCE AS A BASE TO VISIT A VARIETY OF ATTRACTIONS	2.92	2.92	2.99 A	2.84 A	2.92 A
PROXIMITY TO FAMILY AND RELATIVES	1.56	1.56	1.46 A	1.60 A	1.59 A
TRAVEL FATIGUE	2.39	2.40	2.40 A	2.42 A	2.38 A
OTHER MENTIONS	3.21	3.24	3.37 A	3.42 A	2.39 A

Question 20

Please rate your satisfaction with the following facilities/amenities during your visit to the Grand Canyon.

Visitors were generally quite satisfied with the facilities and amenities available during their visit. Visitors rated their overall experience a 4.27, with 1 being very dissatisfied and 5 being very satisfied. The highest satisfaction was with the museums/educational facilities (4.16), while the lowest was 3.45 for parking facilities. No areas were rated on average a 1 or 2.

Q.20 RATING OF SATISFACTION WITH FACILITIES/AMENITIES
DURING YOUR VISIT TO THE GRAND CANYON:
-- SUMMARY OF MEANS --

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
HOTEL/MOTEL/CABIN ACCOMMODATIONS	3.82	3.84	3.95 A	3.85 A	3.71 A
CAMPGROUND/RV ACCOMMODATIONS	4.08	4.06	3.97 A	3.98 A	4.19 A
TRAVELER SERVICES	3.70	3.71	3.70 A	3.76 A	3.67 A
RESTAURANTS	3.51	3.52	3.63 A	3.49 A	3.45 A
RETAIL/SOUVENIR STORES	3.74	3.75	3.78 A	3.78 A	3.68 A
GROCERY/CONVENIENCE STORES	3.68	3.68	3.69 A	3.75 A	3.62 A
MUSEUMS/EDUCATION CENTERS	4.15	4.16	4.16 A	4.21 A	4.12 A
AREA INFORMATION CENTERS	4.13	4.14	4.11 A	4.19 A	4.11 A
PICNIC AREAS	3.89	3.90	3.86 A	4.04 A	3.81 A
TRAFFIC/ACCESS TO THE PARK	3.88	3.89	3.89 A	3.99 A	3.81 A
PARKING	3.42	3.45	3.46 BA	3.64 A	3.25 B
SHUTTLE BUSSES	3.91	3.90	4.01 A	3.52 A	3.96 A
OVERALL EXPERIENCE	4.27	4.28	4.30 A	4.28 A	4.25 A

Question 21

We would like your opinion as to how your travel experience to the Grand Canyon could be made more enjoyable. In that regard, how important would it be to have more of the following outside of the Park, but within close proximity (i.e. 2 miles) to the Park's southern entrance?

When questioned regarding what additional facilities and amenities would make their trip more enjoyable if placed outside the Park but within close proximity. More parking was the most frequently cited at 3.15 (1 being not important and 5 being very important).

This was followed by hotel/motels at 2.93 and restaurants at 2.92.

Q.21 IMPORTANCE OF HAVING MORE OF THE FOLLOWING OUTSIDE OF THE PARK, BUT WITHIN CLOSE PROXIMITY:
-- SUMMARY OF MEANS --

	ADJUSTED TOTAL (A)	TOTAL (B)	FALL 1994 (C)	SPRING 1995 (D)	SUMMER 1995 (E)
HOTEL/MOTEL/CABIN ACCOMMODATIONS	2.92	2.93	3.04 A	2.92 A	2.84 A
CAMPGROUND/RV ACCOMMODATIONS	2.61	2.59	2.52 BA	2.44 B	2.80 A
TRAVELER SERVICES	2.59	2.59	2.59 A	2.64 A	2.55 A
RESTAURANTS	2.91	2.92	2.92 A	3.00 A	2.84 A
RETAIL/SOUVENIR STORES	1.95	1.95	1.89 A	2.00 A	1.96 A
GROCERY/CONVENIENCE STORES	2.47	2.46	2.33 A	2.50 A	2.55 A
MUSEUMS/EDUCATION CENTERS	2.74	2.73	2.65 A	2.76 A	2.78 A
AREA INFORMATION CENTERS	2.69	2.68	2.63 A	2.65 A	2.76 A
PICNIC AREAS	2.38	2.36	2.25 B	2.35 BA	2.49 A
PARKING	3.17	3.15	3.11 A	3.04 A	3.29 A
SHUTTLE BUSSES	2.77	2.76	2.77 BA	2.60 B	2.90 A
OTHER MENTIONS (FIRST)	3.43	3.42	3.75 A	3.01 A	3.54 A
OTHER MENTIONS (SECOND)	2.92	2.89	3.11 A	2.49 A	3.14 A

Question 23

How did you travel to the Grand Canyon/Tusayan Area?

The vast majority of surveyed visitors traveled by car to the Grand Canyon/Tusayan area (87 percent), followed by plane at 11 percent.

Q.23 HOW TRAVELED TO THE GRAND CANYON/TUSAYAN AREA

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	1329 100.0	1329 100.0	422 100.0	460 100.0	447 100.0
AUTO	1150 86.5	1146 86.2	361 85.5	388 84.3	397 88.8 D
AIRPLANE	144 10.9	146 11.0	40 9.5	62 13.5	44 9.8
BUS/MOTORCOACH	35 2.6	36 2.7	13 3.1	13 2.8	10 2.2
RV/MOTOR HOME	23 1.8	24 1.8		19 4.1 E	5 1.1
TRAIN	14 1.1	14 1.1	6 1.4	3 0.7	5 1.1
OTHER MENTIONS	51 3.8	54 4.1	29 6.9 DE	15 3.3	10 2.2
NO ANSWER	26 2.0	26 2.0	8 1.9	9 2.0	9 2.0

Question 24

Please note what type of mass transit service was used (if any) while you were visiting the Grand Canyon/Tusayan Area?

Approximately two-thirds of visitors didn't use any mass transit while in the Grand Canyon/Tusayan area.

Q.24 TYPE OF MASS TRANSIT SERVICE USED
WHILE VISITING THE GRAND CANYON/TUSAYAN AREA

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	1329	1329	422	460	447
	100.0	100.0	100.0	100.0	100.0
DIDN'T USE ANY MASS TRANSIT SERVICE	879	903	297	369	237
	66.1	67.9	70.4	80.2	53.0
			E	CE	
USED SHUTTLE SERVICE WITHIN THE PARK	579	604	420	24	160
	43.5	45.4	99.5	5.2	35.8
			DE		D
USED SHUTTLE SERVICE FROM TUSAYAN TO THE PARK	23	22	6	5	11
	1.8	1.7	1.4	1.1	2.5
USED TOUR BUS FROM OUTSIDE THE GRAND CANYON/TUSAYAN AREA	37	38	14	14	10
	2.8	2.9	3.3	3.0	2.2
OTHER MENTIONS	56	58	31	12	15
	4.2	4.4	7.3	2.6	3.4
			DE		
NO ANSWER	62	61		40	21
	4.7	4.6		8.7	4.7

Question 25

If you didn't use mass transit service, what was your reason?

For those visitors not using mass transit, the most frequent reason cited was the desire to use their own vehicle (61%), followed by the lack of knowledge regarding mass transit availability (18%) and the inconvenience of mass transit (18%).

Q.25 REASONS FOR NOT USING MASS TRANSIT SERVICE

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	879 100.0	903 100.0	297 100.0	369 100.0	237 100.0
WANTED OWN VEHICLE	535 60.9	551 61.0	173 58.2	238 64.5	140 59.1
DIDN'T KNOW IT WAS AVAILABLE	160 18.2	168 18.6	62 20.9	71 19.2	35 14.8
INCONVENIENCE	154 17.5	154 17.1	50 16.8	53 14.4	51 21.5 D
COST	58 6.6	59 6.5	18 6.1	23 6.2	18 7.6
OTHER MENTIONS	174 19.8	177 19.6	66 22.2 D	59 16.0	52 21.9
NOT APPLICABLE	72 8.2	75 8.3	24 8.1	33 8.9	18 7.6
NO ANSWER	9 1.0	9 1.0	4 1.3	2 0.5	3 1.3

Question 26

In an effort to reduce congestion in the Park, would you favor limiting auto access if convenient public Parking was available outside of Park boundaries and convenient mass transit was available.

A majority of visitors (69%) noted they would be willing to limit auto access into the Park if convenient public parking and mass transit was available outside Park boundaries.

Q.26 WOULD FAVOR LIMITING AUTO ACCESS IF CONVENIENT PUBLIC PARKING WAS AVAILABLE OUTSIDE OF PARK BOUNDARIES AND CONVENIENT MASS TRANSIT WAS AVAILABLE TO REDUCE CONGESTION IN THE PARK

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	1329	1329	422	460	447
	100.0	100.0	100.0	100.0	100.0
YES	916	916	310	295	311
	68.9	68.9	73.5	64.1	69.6
			D		
NO	357	356	103	132	121
	26.9	26.8	24.4	28.7	27.1
NO ANSWER	56	57	9	33	15
	4.2	4.3	2.1	7.2	3.4

Question 27

How important are the following factors in your decision to use a mass transit service when visiting the Grand Canyon?

In noting what factors are important in their decision to utilize mass transit, all were rated between 4 and 5 (1 not important - 5 very important). The ability to access desirable points of interest was the highest rated at 4.58, followed by frequency of pick-ups at 4.42.

Q.27 IMPORTANCE OF FOLLOWING FACTORS IN DECISION TO USE A MASS TRANSIT SERVICE
WHEN VISITING THE GRAND CANYON:
-- SUMMARY OF MEANS --

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
COST OF SERVICE	3.90	3.91	3.95 A	3.93 A	3.85 A
LENGTH OF TRAVELING TIME	3.97	3.97	3.94 A	3.99 A	3.97 A
PROXIMITY TO YOUR LODGING ACCOMMODATIONS	3.99	4.00	4.07 A	4.04 A	3.90 A
FREQUENCY OF PICK-UPS	4.42	4.42	4.46 A	4.38 A	4.43 A
YOUR ABILITY TO ACCESS DESIRABLE POINTS OF INTEREST WITHIN THE PARK	4.58	4.58	4.61 A	4.56 A	4.58 A
OTHER MENTIONS	4.18	4.16	4.15 A	3.97 A	4.28 A

Question 28

How likely would you be to use a mass transit service to access the Park if it was within close proximity to Tusayan (i.e. 2 miles) and was priced at the following levels. These price levels are for transit cost only and do not include entrance fees to the Park.

The likelihood of using mass transit to access the Park is very closely related to its cost. Visitors are likely to use mass transit if priced less than $2.00 per person (4.28 on scale of 1 definitely would not use, to 5 definitely would use). However, if costs increased to between $4 and $5, the ranking drops to 2.70 and drops further to 1.93 at costs of $6 to $7.

Q.28 LIKELIHOOD OF USING MASS TRANSIT SERVICE TO ACCESS THE PARK
IF IT WAS WITHIN CLOSE PROXIMITY TO TUSAYAN AND WAS PRICED AT:
-- SUMMARY OF MEANS --

	ADJUSTED TOTAL (A)	TOTAL (B)	FALL 1994 (C)	SPRING 1995 (D)	SUMMER 1995 (E)
LESS THAN $2 PER PERSON	4.28	4.28	4.32 A	4.28 A	4.25 A
$2 TO $3 PER PERSON	3.66	3.67	3.76 A	3.71 A	3.56 A
$4 TO $5 PER PERSON	2.70	2.72	2.83 A	2.77 BA	2.57 B
$6 TO $7 PER PERSON	1.93	1.95	2.07 A	1.98 BA	1.80 B
$8 TO $10 PER PERSON	1.49	1.51	1.59 A	1.53 A	1.42 A
MORE THAN $10 PER PERSON	1.26	1.27	1.32 A	1.27 A	1.22 A

Question 29

What is the maximum amount of time you would be willing to wait at a bus pick-up point to travel to or from the Park?

The frequency of mass transit service heavily influences a visitor's willingness to utilize the service as 36 percent noted the maximum amount of time they would be willing to wait would be 10 minutes. Only 18 percent noted they would wait longer than 20 minutes at a bus pick-up point.

Q.29 MAXIMUM AMOUNT OF TIME WILLING TO WAIT AT A BUS PICK-UP POINT TO TRAVEL TO OR FROM THE PARK

	ADJUSTED TOTAL (A)	TOTAL (B)	FALL 1994 (C)	SPRING 1995 (D)	SUMMER 1995 (E)
TOTAL	1329 100.0	1329 100.0	422 100.0	460 100.0	447 100.0
10 MINUTES	484 36.4	474 35.7	132 31.3	158 34.3	184 41.2 CD
20 MINUTES	510 38.3	515 38.8	180 42.7 E	175 38.0	160 35.8
30 MINUTES	208 15.6	210 15.8	84 19.9 D	59 12.8	67 15.0
45 MINUTES	16 1.2	16 1.2	2 0.5	8 1.7	6 1.3
1 HOUR	8 0.6	9 0.7	6 1.4	3 0.7	
MORE THAN 1 HOUR	4 0.3	4 0.3		3 0.7	1 0.2
NO ANSWER	100 7.5	101 7.6	18 4.3	54 11.7	29 6.5

Questions 30-35

The following questions outline general demographic characteristics of survey respondents.

(30) Using the following categories, please note your age.

Q.30 RESPONDENT AGE

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	1329 100.0	1329 100.0	422 100.0	460 100.0	447 100.0
15 OR LESS	21 1.6	18 1.4	2 0.5	3 0.7	13 2.9 CD
16 - 24	115 8.7	111 8.4	29 6.9	34 7.4	48 10.7 C
25 - 34	375 28.2	372 28.0	121 28.7	117 25.4	134 30.0
35 - 44	288 21.7	279 21.0	71 16.8	91 19.8	117 26.2 CD
45 - 54	246 18.5	243 18.3	76 18.0	78 17.0	89 19.9
55 - 65	201 15.1	212 16.0	82 19.4 E	89 19.3 E	41 9.2
65 OR MORE	113 8.5	122 9.2	54 12.8 E	51 11.1 E	17 3.8
NO ANSWER	35 2.6	36 2.7	6 1.4	21 4.6	9 2.0

(31) Please note your sex.

Q.31 SEX OF RESPONDENT

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	1329	1329	422	460	447
	100.0	100.0	100.0	100.0	100.0
MALE	735	738	247	250	241
	55.3	55.5	58.5	54.3	53.9
FEMALE	692	692	213	246	233
	52.1	52.1	50.5	53.5	52.1
NO ANSWER	35	36	6	21	9
	2.6	2.7	1.4	4.6	2.0

(32) What best describes your ethnic background?

Q.32 ETHNIC BACKGROUND

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	1329	1329	422	460	447
	100.0	100.0	100.0	100.0	100.0
WHITE, NOT OF HISPANIC ORIGIN	1136	1136	370	383	383
	85.5	85.5	87.7	83.3	85.7
HISPANIC	53	49	11	10	28
	4.0	3.7	2.6	2.2	6.3
					CD
BLACK, NOT OF HISPANIC ORIGIN	10	10	2	4	4
	0.8	0.8	0.5	0.9	0.9
AMERICAN INDIAN	11	11	6	1	4
	0.8	0.8	1.4	0.2	0.9
ASIAN	45	44	10	17	17
	3.4	3.3	2.4	3.7	3.8
OTHER MENTIONS	44	49	24	21	4
	3.3	3.7	5.7	4.6	0.9
			E	E	
NO ANSWER	48	49	8	27	14
	3.6	3.7	1.9	5.9	3.1

(33) Which of the following would best describe your current employment status?

Q.33 CURRENT EMPLOYMENT STATUS

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	1329	1329	422	460	447
	100.0	100.0	100.0	100.0	100.0
EMPLOYED	872	863	268	280	315
	65.6	64.9	63.5	60.9	70.5
					CD
UNEMPLOYED	28	30	11	13	6
	2.1	2.3	2.6	2.8	1.3
RETIRED/SEMI-RETIRED	219	236	99	102	35
	16.5	17.8	23.5	22.2	7.8
			E	E	
STUDENT	128	121	28	35	58
	9.6	9.1	6.6	7.6	13.0
					CD
HOMEMAKER	63	61	17	18	26
	4.7	4.6	4.0	3.9	5.8
OTHER MENTIONS	36	36	11	12	13
	2.7	2.7	2.6	2.6	2.9
NO ANSWER	38	39	7	22	10
	2.9	2.9	1.7	4.8	2.2

(34) Which of the following would best describe the highest level of education you have completed?

Q.34 EDUCATION LEVEL

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	1329	1329	422	460	447
	100.0	100.0	100.0	100.0	100.0
8TH GRADE OR LESS	13	12	4	2	6
	1.0	0.9	0.9	0.4	1.3
SOME HIGH SCHOOL	48	49	17	18	14
	3.6	3.7	4.0	3.9	3.1
HIGH SCHOOL GRADUATE	286	290	96	108	86
	21.5	21.8	22.7	23.5	19.2
SOME UNIVERSITY	316	316	100	111	105
	23.7	23.8	23.7	24.1	23.5
UNIVERSITY GRADUATE	434	429	128	144	157
	32.6	32.3	30.3	31.3	35.1
GRADUATE SCHOOL	262	262	88	86	88
	19.7	19.7	20.9	18.7	19.7
NO ANSWER	51	53	14	26	13
	3.9	4.0	3.3	5.7	2.9

(35) Which income range describes your total 1993 household income before taxes?

GRAND CANYON/TUSAYAN AREA VISITOR SURVEY

Table 116

Q.35 TOTAL 1993 HOUSEHOLD INCOME BEFORE TAXES

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	1329	1329	422	460	447
	100.0	100.0	100.0	100.0	100.0
$0 - $19,999	144	143	44	49	50
	10.8	10.8	10.4	10.7	11.2
$20,000 - $39,999	296	291	95	83	113
	22.3	21.9	22.5	18.0	25.3
					D
$40,000 - $59,999	332	333	110	113	110
	25.0	25.1	26.1	24.6	24.6
$60,000 - $79,999	208	214	80	77	57
	15.7	16.1	19.0	16.7	12.8
			E		
$80,000 - $99,999	92	93	22	44	27
	6.9	7.0	5.2	9.6	6.0
				CE	
$100,000 +	122	121	33	44	44
	9.2	9.1	7.8	9.6	9.8
NO ANSWER	143	143	41	55	47
	10.7	10.8	9.7	12.0	10.5

Question A

What is the interviewee's name and place of residence?

Foreign visitors accounted for 30 percent of survey respondents, the largest segments coming from Germany, England and France. California was the most significant state of origin (12% of survey respondents), followed by Arizona (9%) and Texas (4%).

STATE OF RESIDENCE

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
TOTAL	1329 100.0	1329 100.0	422 100.0	460 100.0	447 100.0
ALABAMA	5 0.4	5 0.4	1 0.2	2 0.4	2 0.4
ARIZONA	121 9.1	123 9.3	45 10.7	41 8.9	37 8.3
ARKANSAS	6 0.5	7 0.5	3 0.7	3 0.7	1 0.2
CALIFORNIA	160 12.0	160 12.0	55 13.0	51 11.1	54 12.1
COLORADO	28 2.1	29 2.2	7 1.7	14 3.0	8 1.8
CONNECTICUT	7 0.5	7 0.5	2 0.5	3 0.7	2 0.4
DELAWARE	2 0.1	2 0.2	1 0.2	1 0.2	
WASHINGTON, D.C.	1 0.1	1 0.1		1 0.2	
FLORIDA	44 3.3	44 3.3	14 3.3	15 3.3	15 3.4
GEORGIA	8 0.6	7 0.5	2 0.5	1 0.2	4 0.9
IDAHO	1 0.1	1 0.1	1 0.2		
ILLINOIS	32 2.4	32 2.4	11 2.6	10 2.2	11 2.5

STATE OF RESIDENCE

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
INDIANA	12	13	4	7	2
	0.9	1.0	0.9	1.5	0.4
IOWA	3	3	1	2	
	0.2	0.2	0.2	0.4	
KANSAS	11	10	1	4	5
	0.8	0.8	0.2	0.9	1.1
KENTUCKY	7	8	4	3	1
	0.6	0.6	0.9	0.7	0.2
LOUISIANA	10	10	2	5	3
	0.7	0.8	0.5	1.1	0.7
MAINE	6	6	2	3	1
	0.4	0.5	0.5	0.7	0.2
MARYLAND	11	12	5	6	1
	0.8	0.9	1.2	1.3	0.2
MASSACHUSETTS	26	25	7	7	11
	2.0	1.9	1.7	1.5	2.5
MICHIGAN	29	30	8	15	7
	2.2	2.3	1.9	3.3	1.6
MINNESOTA	19	19	7	6	6
	1.4	1.4	1.7	1.3	1.3
MISSISSIPPI	2	2		2	
	0.1	0.2		0.4	
MISSOURI	14	13	4	2	7
	1.0	1.0	0.9	0.4	1.6

STATE OF RESIDENCE

	ADJUSTED TOTAL (A)	TOTAL (B)	FALL 1994 (C)	SPRING 1995 (D)	SUMMER 1995 (E)
MONTANA	2	2		1	1
	0.2	0.2		0.2	0.2
NEBRASKA	1	1			1
	0.1	0.1			0.2
NEVADA	13	13	4	5	4
	1.0	1.0	0.9	1.1	0.9
NEW HAMPSHIRE	4	4	1	1	2
	0.3	0.3	0.2	0.2	0.4
NEW JERSEY	18	18	4	8	6
	1.4	1.4	0.9	1.7	1.3
NEW MEXICO	23	21	4	5	12
	1.7	1.6	0.9	1.1	2.7
NEW YORK	45	46	15	17	14
	3.4	3.5	3.6	3.7	3.1
NORTH CAROLINA	20	20	8	5	7
	1.5	1.5	1.9	1.1	1.6
NORTH DAKOTA	1	1		1	
	0.1	0.1		0.2	
OHIO	22	21	9	3	9
	1.6	1.6	2.1	0.7	2.0
OKLAHOMA	9	9	2	3	4
	0.7	0.7	0.5	0.7	0.9
OREGON	18	19	10	5	4
	1.4	1.4	2.4	1.1	0.9

STATE OF RESIDENCE

	ADJUSTED TOTAL (A)	TOTAL (B)	FALL 1994 (C)	SPRING 1995 (D)	SUMMER 1995 (E)
PENNSYLVANIA	22 1.7	23 1.7	9 2.1	9 2.0	5 1.1
RHODE ISLAND	2 0.1	2 0.2		2 0.4	
SOUTH CAROLINA	9 0.7	9 0.7		7 1.5	2 0.4
SOUTH DAKOTA	1 0.1	1 0.1	1 0.2		
TENNESSEE	9 0.7	9 0.7	4 0.9	1 0.2	4 0.9
TEXAS	46 3.4	48 3.6	18 4.3	20 4.3	10 2.2
UTAH	4 0.3	5 0.4	2 0.5	3 0.7	
VERMONT	4 0.3	4 0.3		3 0.7	1 0.2
VIRGINIA	28 2.1	28 2.1	4 0.9	14 3.0 C	10 2.2
WASHINGTON	30 2.2	32 2.4	9 2.1	19 4.1 E	4 0.9
WEST VIRGINIA	5 0.3	4 0.3		1 0.2	3 0.7
WISCONSIN	13 1.0	14 1.1	3 0.7	8 1.7	3 0.7

STATE OF RESIDENCE

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
WYOMING	4	4	1	2	1
	0.3	0.3	0.2	0.4	0.2
ALASKA	1	1	1		
	0.1	0.1	0.2		
HAWAII	4	4	1	2	1
	0.3	0.3	0.2	0.4	0.2
ALBERTA	3	3		3	
	0.2	0.2		0.7	
BRITISH COLUMBIA	13	15	9	5	1
	1.0	1.1	2.1	1.1	0.2
			E		
MANITOBA	1	1			1
	0.1	0.1			0.2
NEWFOUNDLAND	1	1			1
	0.1	0.1			0.2
ONTARIO	7	7	2	4	1
	0.5	0.5	0.5	0.9	0.2
QUEBEC	2	2		2	
	0.1	0.2		0.4	
SASKATCHEWAN	1	1	1		
	0.1	0.1	0.2		
AUSTRALIA	14	16	8	8	
	1.1	1.2	1.9	1.7	
AUSTRIA	4	5	4	1	
	0.3	0.4	0.9	0.2	

STATE OF RESIDENCE

	ADJUSTED TOTAL	TOTAL	FALL 1994	SPRING 1995	SUMMER 1995
	(A)	(B)	(C)	(D)	(E)
BELGIUM	3 0.2	3 0.2	2 0.5	1 0.2	
DENMARK	2 0.1	2 0.2	1 0.2	1 0.2	
ENGLAND	34 2.5	39 2.9	29 6.9 D	10 2.2	
FRANCE	10 0.7	11 0.8	5 1.2	6 1.3	
GERMANY (UNSPECIFIED)	58 4.3	66 5.0	30 7.1	36 7.8	
HOLLAND	14 1.0	16 1.2	9 2.1	7 1.5	
ISRAEL	2 0.1	2 0.2	1 0.2	1 0.2	
ITALY	3 0.2	3 0.2	1 0.2	2 0.4	
JAPAN	3 0.2	3 0.2	2 0.5	1 0.2	
MALAYSIA	1 0.1	1 0.1		1 0.2	
MEXICO	1 0.1	1 0.1		1 0.2	
NEW ZEALAND	2 0.1	2 0.2	1 0.2	1 0.2	

STATE OF RESIDENCE

	ADJUSTED TOTAL (A)	TOTAL (B)	FALL 1994 (C)	SPRING 1995 (D)	SUMMER 1995 (E)
PHILLIPINES	1	1		1	
	0.1	0.1		0.2	
SINGAPORE	1	1		1	
	0.1	0.1		0.2	
SOUTH AFRICA	2	2		2	
	0.1	0.2		0.4	
SWITZERLAND	17	19	10	9	
	1.2	1.4	2.4	2.0	
GREAT BRITAIN/UNITED KINGDOM	6	7	2	5	
	0.5	0.5	0.5	1.1	
NORTHERN IRELAND	1	1		1	
	0.1	0.1		0.2	
SCOTLAND	4	5	4	1	
	0.3	0.4	0.9	0.2	
ARGENTINA	1	1			1
	0.1	0.1			0.2
ECUADOR	1	1			1
	0.1	0.1			0.2
AUSTRIA	6	5			5
	0.5	0.4			1.1
BELGIUM	10	8			8
	0.8	0.6			1.8
FRANCE	29	23			23
	2.2	1.7			5.1

STATE OF RESIDENCE

	ADJUSTED TOTAL (A)	TOTAL (B)	FALL 1994 (C)	SPRING 1995 (D)	SUMMER 1995 (E)
GERMANY	47 3.6	38 2.9			38 8.5
IRELAND	2 0.2	2 0.2	1 0.2		1 0.2
ITALY	5 0.4	4 0.3			4 0.9
NETHERLANDS	25 1.9	20 1.5			20 4.5
NORWAY	1 0.1	1 0.1			1 0.2
PORTUGAL	3 0.2	3 0.2	3 0.7		
SPAIN	5 0.4	4 0.3			4 0.9
SWEDEN	4 0.3	3 0.2			3 0.7
SWITZERLAND	16 1.2	13 1.0			13 2.9
UNITED KINGDOM	29 2.2	23 1.7			23 5.1
SOUTH AFRICA	1 0.1	1 0.1			1 0.2
ISRAEL	2 0.2	2 0.2			2 0.4
JAPAN	1 0.1	1 0.1			1 0.2
AUSTRALIA	10 0.8	8 0.6			8 1.8

3.4 Travel Intermediary Survey

The previously noted survey methodology did not target bus tours. As a result, representatives of several local tour companies providing day/overnight tours to the Grand Canyon were interviewed. These companies offer a variety of tour options. All originate from the Phoenix area. The tour companies which were interviewed are identified as follows:

- Open Road Tours
- Cactus Country Tours
- Southwest Custom Tours
- All Aboard America
- Greyline Tours
- Free Spirit Destinations

This survey entailed an open-ended structure in which general attitudes and impressions regarding visitation to Grand Canyon were identified, as well as thoughts regarding additional development in the general Tusayan region. The following summarizes the key issues from the interview process.

- Tours are offered to Grand Canyon on a year-round basis; however, there are fewer tours during the off-season (winter) months. Additionally, itineraries are changed during the off-season with more day trips than overnight stays.

- The bulk of the demand for the companies interviewed is generated through Phoenix area resort properties and retirees.

- Virtually all of the operators offer an overnight package to Grand Canyon, with various other stops on the itinerary (Sedona, Flagstaff, etc.). Most indicated that the overwhelming preference was for hotel accommodations inside the Park and along the rim. The visitor wants to fully experience Grand Canyon and, therefore, staying in hotels outside the Park (i.e., Tusayan) is not as desirable.

- Most indicated that there was a significant shortage of available hotel rooms along the Rim, especially during the peak season period. To secure ample rooms, especially for the larger tour groups, tour operators are required to reserve blocks of rooms at least one year in advance. Additionally, they are generally required to guarantee a certain number of rooms in order for their reservations to be honored by the Grand Canyon Lodges. Most feel they could offer more overnight tours to the Grand Canyon if more rooms were available, and the up-front restrictions/guarantees were lessened.

- Virtually all of the operators who utilize the various lodging facilities inside the Park were generally satisfied with the existing hotel facilities. However, all indicated that there is a shortage of quality food and beverage alternatives, especially during peak periods, or when the train (Grand Canyon Railway) arrives at the rim.

- Most indicated an unwillingness to utilize the lodging and food and beverage facilities available in Tusayan. The consensus is that there is no reason to stop in Tusayan other than the IMAX Theater. Many of the tour operators offer the IMAX as an optional attraction on the tour itinerary. Hotels and restaurants in Tusayan are viewed as overpriced, especially when considering that accommodations inside the Park are generally less expensive during most times of the year. As a result, many of the operators indicated that they utilize accommodations in Cameron, Williams and Flagstaff in lieu of Tusayan, mainly due to pricing and/or itinerary considerations.

- Many operators indicated that hotels in Tusayan are not generally willing to accommodate tour groups and, if rooms are made available, there is typically no discounting provided.

- Overnight group stays inside the Park are limited by the Grand Canyon Lodges to one night. Most of the tour operators indicated that a one night stay was all that was necessary, given the current lack of alternative attractions and activities in the area.

- With respect to new development, most tour operators indicated a willingness to consider Tusayan as an alternative to the South Rim if additional amenities (hotel, food and beverage) were available, and if the facilities were more reasonability priced. Additionally, there was almost universal agreement relative to the need of a transportation system (shuttle service, etc.) between Tusayan and the South Rim. This would make the Grand Canyon more accessible to tour participants staying in Tusayan and would likely enhance the overall visitor experience. This is especially true given recent tour bus entrance fee increases.

4.0 Northern Arizona Lodging Profile

In order to evaluate what recent Grand Canyon visitation trends have meant to surrounding northern Arizona communities, an analysis of historic lodging performance was undertaken. As previously noted, it is clear that the Grand Canyon is a major driving force behind statewide tourism and contributes significantly to economic activity and overall exposure for Arizona. Many of the communities in northern Arizona are directly or indirectly impacted by visitation to the Canyon and have developed facilities and amenities designed to attract/capture those visitors in the region. However, as explained more fully in this section, lodging performance in these communities often does not directly correlate with Canyon visitation trends, but is rather influenced by individual decisions undertaken by the community (i.e., new supply additions, price increases, developing amenities like Grand Canyon Railway, etc.).

This analysis incorporates lodging statistics gathered from eight northern Arizona communities including Flagstaff, Williams, Kingman, Winslow, Page, Holbrook, Sedona, and Fredonia. For the most part, each of these communities experience a large amount of tourist/transient activity, and all are influenced by the Grand Canyon. Combined, these communities also encompass the vast majority of the lodging supply within the northern part of the state. It should be noted that the performance of hotel facilities located within Tusayan and Grand Canyon National Park have been excluded from the performance summary of the northern Arizona lodging market, as these markets typically operate at levels substantially above the averages of other northern Arizona communities. Individual profiles of both Tusayan and the Grand Canyon National Park, along with the cities of Flagstaff and Williams, are presented later in this section.

4.1 Northern Arizona Lodging Historical Performance

This analysis utilizes lodging performance statistics provided by Smith Travel Research ("STR"). STR is a nationally recognized research firm specializing in monitoring the performance of the hospitality industry. The performance information provided by STR does not include every property in a given marketplace. Generally, the properties which are not included in the STR sample consist of smaller, independent hotels and motels which have chosen not to provide STR with their performance. However, because of the wide chain participation and accuracy of inputs, the sample of hotels utilized by STR for each of the markets is believed to provide a reliable indication of overall market performance.

As of year-end 1996, the eight northern Arizona communities collectively possess a lodging base which is estimated to be approximately 12,500 hotel rooms (Table 4-1). The STR performance data has been based on a sample of approximately 7,000 rooms or 56% of the community's inventory. Table 4-2 and Figure 4-1 illustrate the historical performance of this northern Arizona region between 1989 and 1996. As presented in the table, demand reflects the number of annual occupied room nights, while supply reflects the number of available room nights (i.e. number of rooms x 365 nights per year). The average daily room rate ("ADR") is the average actual room rate achieved by the properties.

TABLE 4-1
NORTHERN ARIZONA LODGING INVENTORY (1)

	Number of Rooms	Change In Number of Rooms
1986	8,413	
1987	8,640	227
1988	8,800	160
1989	9,162	362
1990	10,015	853
1991	10,431	416
1992	10,825	394
1993	11,063	238
1994	11,310	247
1995	11,970	660
1996	12,507	537

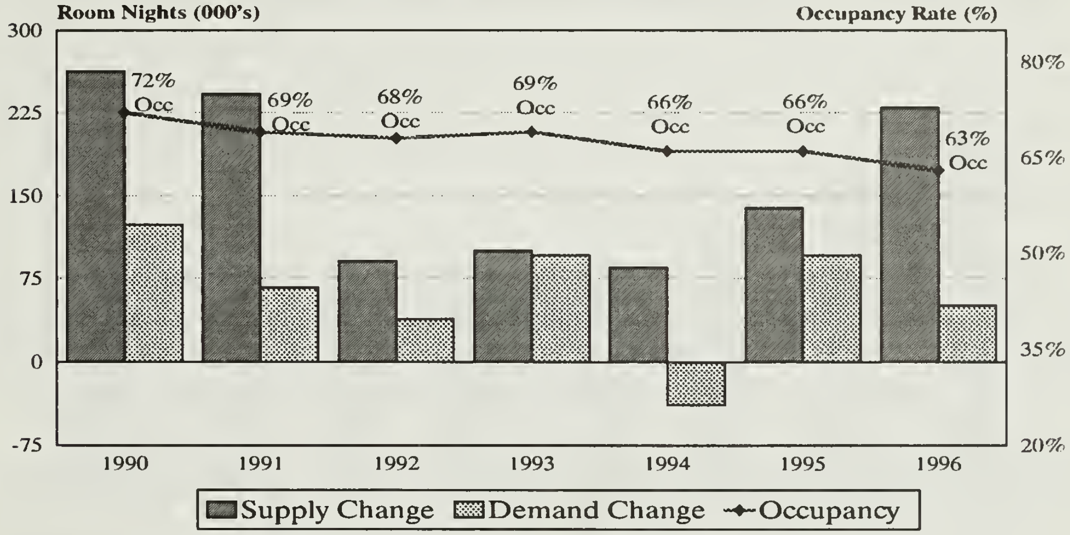
(1) Excluding rooms in Grand Canyon/Tusayan area.
Source: Young Nichols Gilstrap, Inc. and Warnick & Company

TABLE 4-2
NORTHERN ARIZONA LODGING PERFORMANCE: 1989-1996

Year	Demand (000s)	% Change Demand	Supply (000s)	% Change Supply	Market Occupancy	% Occ. Change	Market ADR	% ADR Change
1989	2,077	-	2,783	-	74.6%	-	$48.18	-
1990	2,197	5.8%	3,043	9.4%	72.2	-3.2%	$50.50	4.8%
1991	2,267	3.2%	3,292	8.2%	68.8	-4.7%	$52.11	3.2%
1992	2,308	1.8%	3,383	2.8%	68.2	-1.0%	$53.70	3.1%
1993	2,405	4.2%	3,482	2.9%	69.1	1.3%	$55.05	2.5%
1994	2,364	-1.7%	3,568	2.5%	66.2	-4.2%	$58.62	6.5%
1995	2,448	3.5%	3,710	4.1%	66.0	-.3%	$61.00	4.1%
1996(1)	2,499	2.1%	3,940	6.2%	63.4	-3.9%	$60.17	-1.4%
CAG 1989-96	2.7%	-	5.1%	-	-2.0%	-	4.0%	-
YTD Oct. 1995	2,167	-	3,073	-	70.5%	-	$62.52	-
YTD Oct. 1996	2,212	2.1%	3,264	6.2%	67.8%	-3.8%	$61.66	-1.4%

(1) Annualized based on YTD October 1996 performance.
Source: Smith Travel Research

FIGURE 4-1
Northern Arizona Lodging Market
Annual Change in Available vs. Occupied Room Nights



Source: Smith Travel Research

As outlined in the previous table, the northern Arizona region experienced solid occupancies during 1989 and 1990 ranging from approximately 72 to 75 percent. As a result of this strong performance, new supply entered the market at an extremely rapid pace, the vast majority of which was located in Flagstaff and the city of Williams. Approximately 1,300 rooms were added to the northern Arizona hotel inventory in 1990 and 1991 alone. Between 1992 and 1994, new supply continued to enter the region, albeit at a much more moderate growth rate. This resulted in improved occupancies in the region, which again led to accelerated supply growth in 1995 and 1996. Based on development information provided by the various communities in the region, it appears that the latest wave of new hotel development in northern Arizona has reached a pinnacle. Based on projects currently under construction and those which are proposed, supply growth is estimated to likely continue at approximately 4.5 percent in 1997 and then fall substantially in 1998 and 1999.

With the exception of 1993, lodging demand increased at a lower rate of growth when compared to supply, and actually experienced a slight decline during 1994. Demand growth came closest to keeping pace with new supply during 1995. Overall, demand increased at a compound annual rate of 2.7 percent between 1989 and 1996, compared to a 5.1 percent compound annual increase for new supply. Consequently, occupancies throughout the region fell from a high of 74.6 percent in 1989 to 63.4 percent in 1996.

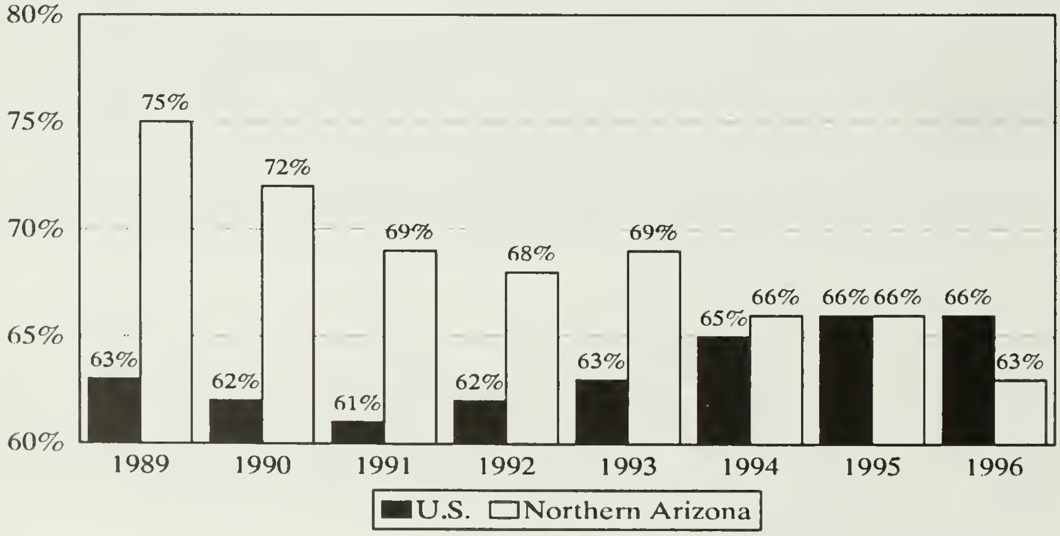
It should be noted that lodging demand in northern Arizona has generally not correlated with changes in Grand Canyon visitation. As examples, one of the strongest years of lodging demand growth occurred in 1990, a year when Canyon visitation was down by 5.4 percent. Conversely, the Canyon experienced very strong visitor growth in 1992 (up 16.4 percent), while lodging demand demonstrated only limited growth (up 1.8 percent).

The declining historic occupancy performance of the northern Arizona region has historically been partially offset by the consistent increases in ADRs achieved throughout the region between 1989 and 1995. This rate increase trend seems to be changing as ADRs in the region actually experienced a slight decline during 1996. As a result of the stronger rate growth achieved in 1990, 1994 and 1995, the region experienced an overall increase in ADR of 4.0 percent (compounded annually) between 1989 and 1996.

The performance of northern Arizona properties is contrasted to U.S. norms in Figures 4-2 and 4-3. As illustrated, properties in the northern Arizona region substantially outperformed U.S. average occupancies during the early 1990s. More recently, however, the variance has moderated, with both averaging occupancy rates in the mid 60 percent range.

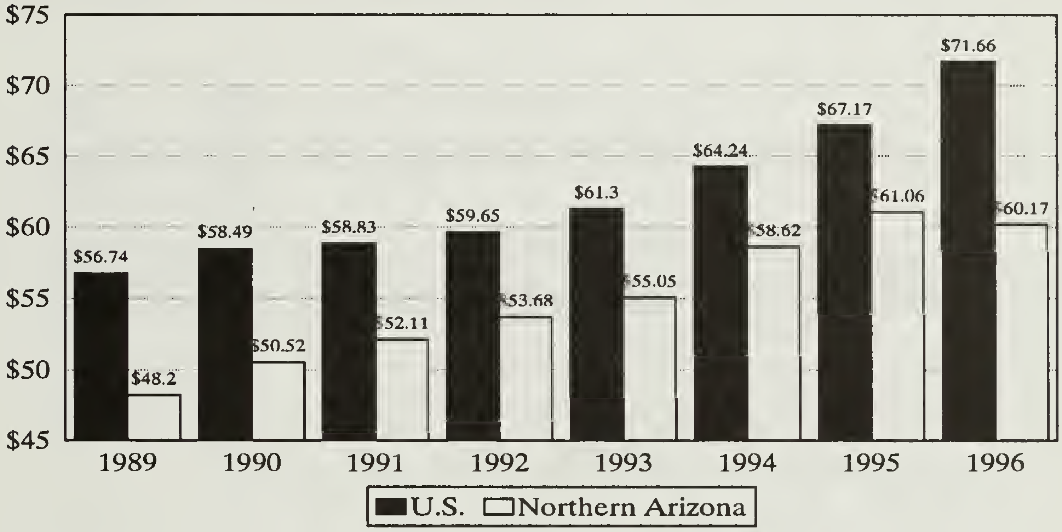
While outperforming national occupancy averages, properties in the northern Arizona region underperformed U.S. norms for ADRs. Currently, the aggregate ADR for properties in the northern Arizona region is approximately $11 below U.S. norms, a level which reflects the lack of higher priced properties more typical of urban areas.

FIGURE 4-2
U.S. vs. Northern Arizona Lodging Industry
Occupancy Rate 1989-1996



Source: Smith Travel Research, Young Nichols Gilstrap, Inc. and Warnick & Company

FIGURE 4-3
U.S. vs. Northern Arizona Lodging Industry
Average Room Rate 1989-1996



Source: Smith Travel Research, Young Nichols Gilstrap, Inc. and Warnick & Company

4.2 *Flagstaff Lodging Historical Performance*

Flagstaff offers, by far, the largest concentration of lodging accommodations in northern Arizona and represent the third largest hotel market in the state of Arizona behind Phoenix and Tucson respectively. As of year-end 1996, the lodging base in Flagstaff was estimated to be approximately 4,500 hotel rooms. The STR performance data has been based on a sample of approximately 3,000 rooms or 67 percent of the total hotel room inventory.

Flagstaff is considered to be one of the "Gateways" to Grand Canyon. The city is approximately 80 miles south of Grand Canyon Village (south rim) and provides direct access via State Route 180. In general, the majority of the Flagstaff lodging supply consists of smaller, limited service properties, which are both chain affiliated and/or independently owned and operated. Most of the smaller independent properties are older and in average to poor condition. For years, these properties dominated the overall lodging market. However, with the strong increase in demand experienced by Flagstaff during the early and mid 1980s, the market went through an evolution, experiencing significant new hotel development. Virtually all of the new product entering the market consisted of limited service properties, with national franchise affiliations. Much of this growth has occurred along Interstate 40, at the Butler and Milton Road interchanges. Notwithstanding the emergence of new product in the market, several of the older independent hotels remain in operation today. This portion of the hotel supply operates at a pronounced disparity (especially when considering average rates) when compared with the newer supply in the market.

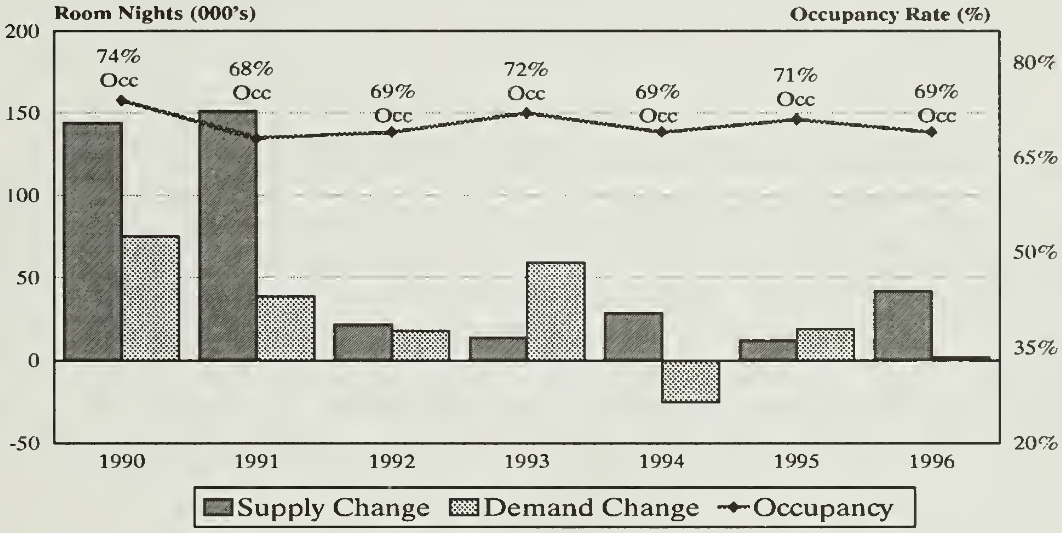
The overall occupancy performance of the Flagstaff marketplace has fluctuated over the past several years, mainly due to the emergence of new supply. Through the late 1980s, Flagstaff generally achieved the highest occupancy performance of any market in the state of Arizona. However, the advent of new supply has had an impact on occupancies in this market in recent years. For example, occupancies reached 77 percent in 1989, and trended downward to between 68 and 72 percent since 1991. Table 4-3 and Figure 4-4 illustrate the performance of the Flagstaff lodging market between 1989 and 1996.

TABLE 4-3
FLAGSTAFF LODGING PERFORMANCE: 1989-1996

Year	Demand (000s)	% Change Demand	Supply (000s)	% Change Supply	Market Occupancy	% Occ. Change	Market ADR	% ADR Change
1989	772	-	1,002	-	77.0%	-	$43.53	-
1990	843	9.2%	1,146	14.4%	73.5	-4.5%	$43.03	-1.1%
1991	885	5.1	1,297	13.2	68.3	-7.1	$44.39	3.2
1992	903	2.0	1,319	1.7	68.5	.3	$46.63	5.0
1993	962	6.6	1,334	1.1	72.2	5.4	$50.32	7.9
1994	937	-2.6	1,362	2.2	68.8	-4.7	$52.29	3.9
1995	972	3.7	1,374	.9	70.7	2.8	$53.90	3.1
1996(1)	974	.2	1,416	3.1	68.8	-2.6	$54.60	1.3
CAG 1989-96	3.4%	-	5.1%	-	-1.6%	-	3.3%	-
YTD Oct.1995	857	-	1,144	-	74.9	-	$55.29	-
YTD Oct. 1996	860	.3%	1,178	3.1%	73.0	-2.5%	$56.03	1.3%

(1) Annualized based on YTD October 1996 performance.
Source: Smith Travel Research

FIGURE 4-4
Flagstaff Lodging Market
Annual Change in Available vs. Occupied Room Nights



Source: Smith Travel Research

While experiencing solid demand increases during 1990-91, market occupancies declined to 68.3 percent as a result of significant increases in supply. Lodging demand continued to increase at positive levels during 1992-93 (outpacing new supply), resulting in an increase in occupancies to 72.2 percent in 1993. These positive trends reversed in 1994, with demand actually declining. This reduction in demand, combined with a slight increase in supply, caused market occupancies to fall to a level of 68.8 percent. Speculation regarding the reasons for this decline have focused on declining visitation levels at the Grand Canyon. However, Flagstaff's lodging performance has historically demonstrated limited direct correlation to Canyon visitation (1990-Canyon visitation down 5.4% and Flagstaff lodging demand up 9.2%; 1992-Canyon visitation up 16.4% and Flagstaff lodging demand up 2.0%). While variances in Canyon visitation are likely a part of the reason for historic changes in lodging demand, market performance has also been influenced by consistently increasing rate structures, the need for additional local attractions and amenities, and the absence of a unified marketing effort.

Room demand rebounded during 1995, up 3.7 percent when compared to 1994 levels. With demand growth exceeding new supply, the market achieved an occupancy rate of 70.7 percent during 1995, a 2.8 percent increase over the prior year. Based on the performance of the market through October, demand during 1996 remained similar to that achieved during 1995. This consistent level of demand teamed with new supply growth has resulted in market occupancies declining to 68.8%.

Similar to the overall region, Flagstaff suffers from distinct seasonality constraints with citywide hotel occupancies at their highest from mid-May through mid-September. Occupancies fall to their lowest levels between November and March. The market also experiences weekly variations in occupancy, with weekends outperforming weekdays during the shoulder and low seasons. As a result of seasonal factors, monthly market occupancies and average rates fluctuate rather significantly during the year, as indicated in Table 4-4.

TABLE 4-4
FLAGSTAFF MONTHLY LODGING PERFORMANCE: 1995

Month	Market Occupancy	Market ADR	Month	Market Occupancy	Market ADR
January	44.3%	$42.52	July	90.8%	$65.95
February	56.4	43.72	August	87.8	64.35
March	66.3	47.28	September	83.2	55.68
April	79.5	50.78	October	75.1	51.15
May	78.6	56.69	November	54.2	43.65
June	85.7	61.80	December	45.0	43.19
			Annual Ave.	70.7%	$54.60

Source: Smith Travel Research

As Table 4-5 illustrates, 458 new hotel rooms entered the market between 1992 and year-end 1996. This equates to an 11.4 percent increase over the five year period. This is in contrast to the significant development which occurred in the market between 1987 and 1991 when approximately 1,280 new rooms were added to the supply. The more moderate trend in new hotel development appears to be continuing in the market. There are two hotels that are in the formal development stages in the city of Flagstaff. These projects, along with those hotels opening in 1996, are described as follows.

1) A 127-room La Quinta Inn opened in June of 1996 and is located near the corner of Forest Meadows Drive and Beulah Drive in Woodlands Village. This property offers a limited-service orientation, a national franchise affiliation, and a mid-tier rate structure.

2) A 58-room Sleep Inn opened in June of 1996 and is located on the corner of Woodland Village Drive and Beulah Drive in Woodlands Village. The Sleep Inn is a limited-service property designed by Choice Hotels to compete within the economy and mid-tier rate groups.

3) The Embassy Suites (formally the Quality Suites) completed a 17-room expansion project in the summer of 1996.

4) A 90-room Hilton Garden Inn is currently under development and is located along Forest Meadows Drive between Beulah Drive and Route 66 in Woodlands Village. This property will offer a limited-service orientation, a national franchise affiliation, and a mid-tier rate structure. According to the Flagstaff Planner's Office, the Hilton Garden Inn is currently nearing completion with an anticipated opening in the Spring of 1997.

5) A 118-room Hampton Inn is under development along Beulah Drive in Woodlands Village. Hampton Inn is a well established national chain offering a mid-tier rate structure and caters mainly to the individual leisure and commercial market sectors. This will be the second Hampton Inn developed in the city of Flagstaff. The Flagstaff Planner's Office indicated that the property is now under construction and is expected to enter the market by Summer 1997.

TABLE 4-5
NEW LODGING SUPPLY: FLAGSTAFF

Property	Number of Rooms	Year Opened
La Quinta	127	1996
Sleep Inn	58	1996
Embassy Suites (expansion)	17	1996
Hampton Inn	50	1995
Amerisuites	118	1993
BW Woodlands Village (expansion)	58	1992
Super 8 (expansion)	30	1992
Total	458	

Source: Young Nichols Gilstrap, Inc. and Warnick & Company

According to the Flagstaff Planner's Office, there is only one other hotel project which is in the preliminary planning stages of development. The project is a 28-room limited-service motel located along Route 66 in the eastern portion of the city. The project received development planning approval by the city in November of 1995, but no action has since been taken by the developer.

Based on available market information, it appears that 208 new rooms will enter the Flagstaff market by the end of 1997 (Hilton Garden Inn, Hampton Inn). This would represent an 4.6

percent increase to the total available rooms inventory within the next 12-14 month period. It is important to note that all of the new rooms developed in the market since 1991 are of a limited-service orientation and the majority are situated in the Woodlands Village area on the west side of the city. Given current and projected market conditions, the addition of the two hotels now under construction will likely have minimal overall impact on the occupancy and ADR performance of the Flagstaff market. It is estimated that new hotel development in Flagstaff beyond those previously noted will be limited in the foreseeable future, primarily due to overall supply/demand conditions, the increasing lack of prime hotel sites, zoning constraints, and, to a lessor degree, the difficulty in obtaining financing.

In summary, the Flagstaff lodging market has historically been one of the strongest occupancy performers in the state of Arizona. While demand has increased over the past several years, significant supply growth, occurring mainly between 1987 and 1991, has impeded overall occupancy performance. Even with these declining occupancies, average rates in the Flagstaff market have consistently increased in recent years. Demand growth should keep pace with supply growth during 1997 and begin to outpace increases in supply from that point on (assuming no new wave of hotel development occurs in the near-term). This trend should enhance the potential for occupancy and ADR growth in the Flagstaff market in the foreseeable future.

4.3 Williams Lodging Historical Performance

The city of Williams is served by Interstate 40, an east-west transcontinental highway extending from southern California to North Carolina. Williams is also considered to be a Gateway to the Grand Canyon, as it represents the closest access point to the Park from Interstate 40 (59 miles south of the Park entrance). Direct access to the Grand Canyon from Williams is provided by State Highway 64. The city is located in the heart of the Kaibab National Forest and is approximately 30 miles west of Flagstaff.

The Williams economy is largely based on tourism, with the nearby Grand Canyon as its focal point. The vast majority of lodging demand in the city is comprised of tourist/ transient travelers in the region. With the South Rim open all year, a nearby ski area, miles of cross country ski trails, and proximate areas for fishing and hunting, Williams offers recreational opportunities for all seasons.

Williams was the last town in the United States on the historic Route 66 to be bypassed by Interstate 40. The city went through an adjustment phase economically after the Interstate 40 bypass. With the annexation of approximately 22 square miles of land for development in 1987, Williams focused on an economic development program which remains in effect today. While the plan includes consideration for industrial and commercial growth, it is primarily focused on continued year-round growth of the tourism industry.

Clearly the development of the Grand Canyon Railway has had the most dramatic impact on the lodging market in Williams in recent years. The Grand Canyon Railway began service

September 18, 1989, marking the return of the historic steam locomotive passenger train service from Williams to the South Rim of the Grand Canyon. The newly formed historic railway attracted approximately 97,000 passengers in 1990, its first full year of operation. The railway has experienced solid growth in ridership since that time and accommodated over 140,000 passengers during 1995. Overall, the railroad has had a very positive impact on Williams and has emerged as a significant demand generator for hotels in the area. The Grand Canyon Railway developed a master plan which includes both retail and hotel development, in conjunction with the railway station. The hotel component of this master plan will be discussed later in this section. Additionally, the city completed a redevelopment program in 1990-91 designed to enhance the image of the downtown area. Other economic development projects currently under consideration by the city include a proposed expansion to the Williams Ski area, a 9-hole addition to the municipal golf course, and an expansion of themed components to the Railway. The addition of any or all of these attractions would likely enhance the future need for lodging facilities in the city and would help to address the impact of seasonality on the market.

As indicated earlier, Interstate 40 bypassed Williams in 1984. Prior to that, all interstate traffic was routed through the city. Due to the significant level of transient traffic, numerous smaller motor hotels were developed along Bill Williams Avenue during the late 1950's and early 1960's. Many of these properties exist today and are in fair condition. Up until the late 1980's these properties satisfied the demand in the market due to its pronounced seasonality. However, with the advent of the Grand Canyon Railway, and the increasing visitation at the Grand Canyon itself, new hotel development again began to emerge in the market with the opening of the Quality Inn Mountain Ranch in 1987 and the Days Inn Williams in 1989. The city has experienced an economic rebound since the mid-1980s which has created further interest in hotel development in the area. This is evidenced by the number of new hotels which have entered the market since 1990.

TABLE 4-6
NEW LODGING SUPPLY: WILLIAMS

Property	Number of Rooms	Year Opened
Canyon Country Inn	13	1990
Park Inn	48	1990
Super 8	40	1991
Comfort Inn	51	1991
Motel 6	52	1992
Rodeway Inn	20	1992
Ho Jo Inn	56	1993
Comfort Inn (expansion)	22	1993
Best Western Williams	78	1994
Misc. B&B	8	1994
Fray Marcos Hotel	88	1995
Holiday Inn	110	1996
Fairfield Inn	105	1996
Total	691	

Source: Young Nichols Gilstrap, Inc. and Warnick & Company

It should be noted that, with the exception of the Fray Marcos Hotel and the Holiday Inn, all of the new properties entering the market since 1987 are limited service facilities and, with the exception of the Fray Marcos, all have a national franchise affiliation. These additions accounted for approximately 690 new rooms, approximately one-half of Williams' current room inventory.

As of year-end 1996, the lodging base in Williams was estimated to be approximately 1,350 hotel rooms. The STR performance data has been based on a sample of approximately 725 rooms or 54 percent of the total hotel room inventory.

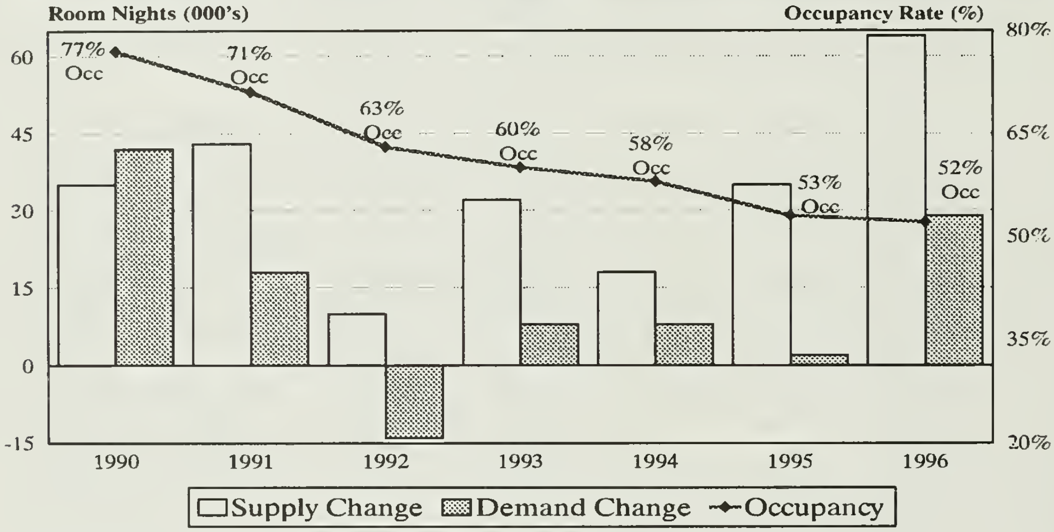
Notwithstanding the solid increases in demand, the significant growth in the rooms supply has had a noticeable impact on the occupancy performance of the Williams lodging market. Table 4-7 and Figure 4-5 illustrates the performance of the market between 1989 and 1996.

TABLE 4-7
WILLIAMS LODGING PERFORMANCE: 1989-1996

Year	Demand (000s)	% Change Demand	Supply (000s)	% Change Supply	Market Occupancy	% Occ. Change	Market ADR	% ADR Change
1989	131	-	191	-	68.7%	-	$55.38	-
1990	172	31.5%	226	18.2%	76.5	11.4%	$58.79	6.2%
1991	196	13.4	275	22.0	71.1	-7.1	$55.62	-5.4
1992	181	-7.6	285	3.7	63.4	-10.8	$57.37	3.1
1993	189	4.7	318	11.4	59.5	-6.2	$58.81	2.5
1994	196	3.8	336	5.7	58.4	-1.7	$58.80	0
1995	198	.7	371	10.5	53.3	-9.1	$58.13	-1.1
1996 (1)	227	14.7	435	17.3	52.1	-2.1	$55.00	-5.4
CAG 1989-96	8.2%	-	12.5%	-	-3.9%	-	-1.0%	-
YTD Oct. 1995	181	-	307	-	59.0	-	$59.80	-
YTD Oct. 1996	207	14.6%	359	17.2%	57.7	-2.2%	$56.56	-5.4%

(1) Annualized based on YTD October 1996 performance.
Source: Smith Travel Research

FIGURE 4-5
Williams Lodging Market
Annual Change in Available vs. Occupied Room Nights



Source: Smith Travel Research

The emergence of the Grand Canyon Railway in late 1989 was responsible for inducing a significant amount of demand into the Williams area. In 1990, demand increased by 31.5 percent, which outpaced supply and resulted in market occupancies climbing 11.4 percent to 76.5 percent. Strong ADR growth was also noted during this period, 6.2 percent. Solid demand growth continued in 1991, however, it was matched by even stronger increases in new supply, causing occupancies to decline to 71.1 percent. An increased competitive market was likely the cause for an ADR decline in 1991, the only substantial decline noted in ADR in recent years. As the initial peak attraction of the Railroad moderated, demand actually declined in 1992, causing occupancies to further decline to 63.4 percent. Notwithstanding a slight rebound in demand between 1993 and 1995, new supply continued to increase at a higher level, especially considering 1995 when new supply increased by 10.5 percent. This dramatic variance in supply versus demand forced occupancies in 1995 to drop to 53.3 percent. Strong demand growth was experienced in 1996 (14.7 percent), however, market occupancies fell to 52.1 percent, by far their lowest levels in the past 7 years. The continued decline was the result of a 17.3 percent increase in supply.

It appears that the increasingly competitive nature of the market over the past two years has also taken its toll on ADR. While the market ADR maintained a moderate growth rate during 1992 and 1993, it remained virtually unchanged throughout 1994 and 1995 and dropped 5.4 percent in 1996 to $55.00, virtually the same level the market was achieving in 1989.

As previously discussed, until 1987, virtually no new hotel development had occurred in Williams for the last twenty years. Coming off the strong increases in supply which have been evident in the market since 1990, it appears that a more moderate trend in hotel development in Williams is on the horizon. Based on research, it appears that only two hotels are in the preliminary development stages in the city of Williams, neither of which are expected to open within the next 12-18 months. These projects, along with those hotels opening in 1995 and 1996, are described as follows.

1) The 89-room Fray Marcos Hotel opened in July of 1995. The property is located on Grand Canyon Boulevard and Fray Marcos Street, adjacent to the existing train terminal, and is one of the components of the Grand Canyon Railway master plan (discussed earlier). This represents Phase One of the hotel development, with subsequent phases calling for a total of 250 to 500 rooms within the next five years. The property represents the mid to upper-end of the market and is expected to attract much of the demand generated by the historic railway. The property is being operated by the railway and is not affiliated with a national franchise. A City Planner in Williams indicated that a Phase Two expansion (# of rooms undetermined) of the Fray Marcos is expected to move forward in the planning stages sometime in 1997.

2) A 110-room Holiday Inn opened in May of 1996 and is located at the southeast corner of Grand Canyon Boulevard and Interstate 40. This property is a full service facility, with a national franchise affiliation, and offers a mid-tier rate structure. It should be noted that this represents Phase One of the hotel. A future development phase (already approved) will bring the property to a total of 250 rooms. The development timing for the second phase of the hotel has yet to be determined.

3) A 105-room Marriott Fairfield Inn opened in May of 1996 at the northwest corner of Grand Canyon Boulevard and Interstate 40. The Fairfield is a limited-service property with a national franchise affiliation, and offers a mid-tier rate structure.

4) A 70-room property is proposed for development along the south side of Route 66 near Rodeo Drive, in the eastern section of the city. The property is envisioned as a limited-service hotel with a national franchise affiliation. According to the Williams Planning Department the project has met with a series of delays, and no formal development plans or timetable have been established.

5) A 62-room limited-service property is also proposed for development along the south side of Route 66 near Rodeo Drive. Similar to the previously mentioned property, this hotel has received development approval by the

city of Williams; however, no formal plans or development timetable have been established.

Additionally, there is reported interest in the development of a resort oriented property to be located near the Williams ski area, just south of the city. The project, known as the Lost Canyon Ranch, will be a full-service property offering such year-round resort amenities as snow skiing and horseback riding. The project is in the concept planning stages and no formal development timetable has been established.

Based on preceding market information, it appears that no new rooms will enter the Williams hotel supply over the next 12-18 months. It appears that the curtailment of new supply, at least in the near-term, will enhance the potential for occupancy and ADR growth in the market, both of which are currently at record low levels. Given the current/projected performance of the market, it is likely that new hotel development in Williams will be remain very limited until such time as the market absorbs the most recent new round of supply and market occupancies and ADRs are again supportive of developer interest.

4.4 Tusayan and Grand Canyon National Park Lodges

Moving from these larger northern Arizona communities, the Grand Canyon National Park Lodges ("GCNPL"), operated by the authorized concessionaire Fred Harvey, are the most directly related lodging facilities to Grand Canyon visitation. As shown in Figure 4-4, these 7 properties account for 1,033 rooms. The most recent addition to these properties occurred in the mid-1960s, with the construction of the Moqui Lodge.

FIGURE 4-6
Grand Canyon and Tusayan Properties

Grand Canyon National Park Lodges

El Tovar Hotel	78
Kachina Lodge	49
Thunderbird Lodge	55
Bright Angel Lodge	89
Maswik Lodge	278
Yavapai Lodge	358
Moqui Lodge	136
	1033 Rooms

Tusayan

Red Feather Lodge	230
Grand Canyon Squire Inn	250
7 Mile Lodge	20
Quality Inn	232
Holiday Inn Express	166
Grand Canyon Suites	33
	931 Rooms

TOTAL ROOMS 1,964

Source: Young Nichols Gilstrap, Inc. and Warnick & Company

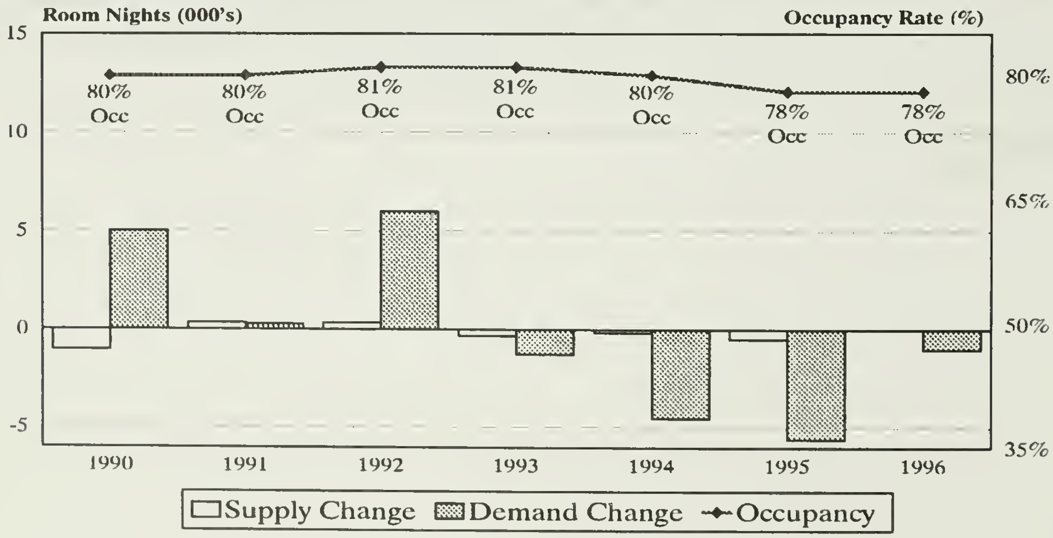
The inability of the GCNPL to service all visitors desiring to stay at the Park is evident through a review of recent performance, as well as from findings from the visitor survey. As depicted in Figure 4-7, over the past seven years, these seven properties have maintained occupancies at 78 to 81 percent, even though there were declines in Park visitation (approximately 5 percent) in both 1990 and 1994. The slight variations in annual supply depicted in the graphic are a result of a variance in the seasonal opening/closing dates of the properties.

TABLE 4-8
GRAND CANYON NATIONAL PARK LODGES
HISTORICAL PERFORMANCE 1989-1996

Year	Total Demand	Actual Change	% Change	Total Supply	Actual Change	Annual Occupancy
1989	262,808	-	-	336,932	-	78.0%
1990	267,385	4,577	1.7%	335,911	-1,021	79.6
1991	267,648	263	.1	336,242	331	79.6
1992	273,650	6,002	2.2	336,593	351	81.3
1993	272,381	-1,269	-.5	336,273	0320	81.0
1994	267,891	-4,490	-1.7	336,125	-148	79.7
1995	262,305	-5,586	-2.1	335,642	-483	78.2
1996	261,297	-1,008	-.4	335,642	0	77.8

Source: Grand Canyon National Park Lodges

FIGURE 4-7
Grand Canyon National Park Lodges
Annual Change in Available vs. Occupied Room Nights



Source: Grand Canyon National Park Lodges

Demand within the GCNPL was down slightly in 1994 (approximately 1.7 percent), partially influenced by the closing of Thunderbird Lodge in February for renovations and insufficient staffing availability in April. This decrease in demand was more importantly influenced by a drop in room demand by international visitors, a trend which actually began in 1993 (-9.5 percent) and carried through 1994 (-13.0 percent). The decline experienced in 1994 was particularly pronounced during the late spring and early summer months for reasons previously reviewed in Section 2.2.

Overall demand at GCNPL continued its downward trend during 1995, decreasing by approximately 2 percent for the year. This decrease in demand has been almost entirely attributed to the United States Government shutdown (Fall of 1995), and its related impact on the closure of the Grand Canyon National Park. While the actual closure of the Park was short-lived, visitor uncertainty as to available facilities and amenities within the park further compounded the problem for GCNPL. Demand fell an additional .4 percent during 1996. This decrease was mainly attributable to the impact brought on by the Atlanta Olympics and a number of severe fires which were centered in the northern Arizona region.

Although demand has trended downward for various reasons since 1993, significant "unsatisfied" demand still exists for lodging at GCNPL. While room denial rates are not tracked at GCNPL, they have historically experienced approximately 1.5 million busy signals on their room reservation lines annually.

In addition to the 1,033 rooms provided by the GCNPL, an additional 931 rooms exist in Tusayan (previously presented in Figure 4-6). These are generally newer properties, offering a wider range of rooms and facilities. It is important to note that 485 new rooms have been added to the Tusayan Hotel supply since 1992. A breakdown of the new rooms is presented in Table 4-9.

TABLE 4-9
NEW LODGING SUPPLY: TUSAYAN

Property	Number of Rooms	Year Opened
BW Squire (expansion)	100	1992
Red Feather Inn (expansion)	130	1995
Holiday Inn Express	166	1995
Quality Inn (expansion)	56	1996
Grand Canyon Suites	33	1996
Total	485	

Source: Young Nichols Gilstrap, Inc. and Warnick & Company

New development is continuing in the Tusayan marketplace. In addition to the most recent hotel openings, two existing properties are in the planning states for redevelopment as hotel sites. The former Kenai Helicopter site is planned to accommodate The Grand, a 160-room property. The property has been approved by Coconino County and development is expected to commence within the next 12-18 months. Camper Village Campground has plans to develop a 390-room facility which will likely be developed in phases. Rezoning has not yet occurred and this project remains in the preliminary planning stages. The Squire plans to add 100-160 rooms, and the Moqui Lodge could potentially add 221 units, however, no formal development timetable has been established for these expansions. Finally, the GCNP has plans to expand their lodging base through the conversion of existing dormitories by 240 units in future years and there have been discussions regarding potential redevelopment of the Dome property in Tusayan. Development on these properties would unlikely commence prior to the year 2000.

These inventories and occupancy rates can be considered, along with the previously noted Grand Canyon visitation trends, to provide an indication of the "penetration" or percent of total GCNP visitors currently being attracted to hotels in the Grand Canyon/Tusayan area. Table 4-10 presents the 1996 monthly South Rim visitation and correlates it with an estimated occupancy rate for the GCNPL and Tusayan properties. These occupancy rates reflect monthly performance three percent below GCNPL actual rates to account for the lower average occupancy rates of Tusayan properties. As shown in the table, penetration rates range from 21 to 43 percent, with an average annual level of approximately 29 percent. These average penetration rates were closer to the 25 percent range in earlier years, but has been upwardly influenced by the recent additions of new rooms in the Tusayan area.

These monthly penetration rates also provide an indication of the upper threshold of potential penetration. In a number of months, penetration rates approach the mid-30 percent range or higher. As these higher penetration rates often occur during months with significant vacancy rates, this mid-30 percent level provides an indication of the point in which most persons desiring to stay in the Grand Canyon/Tusayan area are accommodated.

TABLE 4-10
1996 GRAND CANYON LODGES AND TUSAYAN HOTEL PENETRATION OF VISITORS

Month	1996 South Rim Park Visits (1)	1996 Occupancy Rate (2)	1996 Occupied Rooms	Implied Penetration (3)
January	159,559	37.4%	22,771	32.7%
February	187,916	37.1%	21,130	24.9%
March	324,644	56.8%	34,582	24.4%
April	379,271	91.9%	54,147	32.7%
May	445,459	94.9%	57,779	29.7%
June	493,980	96.7%	56,976	26.4%
July	618,106	94.9%	57,779	21.4%
August	507,769	96.9%	58,997	26.6%
September	448,883	95.2%	56,092	28.6%
October	370,591	96.8%	58,936	36.4%
November	202,399	65.2%	38,416	43.5%
December	161,551	40.3%	24,536	34.8%
Total	4,300,128	75.5%	542,141	28.9%

(1) GCNP
(2) GCNPL and Young Nichols Gilstrap, Inc. and Warnick & Company
(3) Assumes 2.75 average party size, 1.2 days average length of stay - GCNPL
Source: GCNP, GCNPL, Young Nichols Gilstrap, Inc. and Warnick & Company

In addition to the lodging units, a variety of campground facilities exist in the Grand Canyon/Tusayan area which provide overnight accommodations. As shown in Table 4-11, there are 839 campsites in the area, with approximately one-third of the spaces being of a full service orientation (some mix of water, electric and sewer) and two-thirds limited service.

These facilities have historically experienced demand at or above capacity, particularly during the summer months. As an example, Table 4-12 provides occupancy performance for the Ten-X campground for the last seven years. As shown, average occupancies have historically ran at or above 95 percent during the summer months June through August. The evident drop in 1996 was particularly influenced by visitor concerns regarding the large number of forest fires and National Forest closures in northern Arizona.

Based on an analysis done by the Kaibab National Forest regarding a potential expansion at the Ten-X Campground, similar historical patterns exist in the other limited facility operations (Mather and Desert View), with the full service facilities (Trailer Village and Grand Canyon Camper Village) operating between 85 and 95 percent through these summer months.

The desire for campground facilities was also reflected in the 1994/95 visitor survey. The specific desire to camp at the Grand Canyon/Tusayan area was evident, as approximately 40 percent of overnight visitors noted they camped at the Grand Canyon/Tusayan, while only 15 percent of these visitors camped the night before or night after visiting the GCNP. Additionally, approximately 16 percent of surveyed visitors noted they would have stayed in the Grand Canyon/Tusayan area if more campground spaces were available.

This existing inventory of camping spaces in the Grand Canyon/Tusayan area will likely change in future years. The largest full service facility, Grand Canyon Camper Village, will likely transition to other uses (hotel, retail, etc.), thus eliminating 201 full service sites and 112 limited service sites. While these spaces will likely be eliminated, Kaibab National Forest is considering a 150 space expansion to its Ten-X campground facility. Considering these changes, a net reduction in the number of campground spaces will thus likely result, with no additional ability to meet excess summer demand, particularly as visitation grows.

TABLE 4-11
CAMPGROUND FACILITIES GRAND CANYON/TUSAYAN

Campground Facilities	Number of Spaces	Orientation	Ownership
Mather Campground	326	Limited Service	GCNP
Desert View Campground	50	Limited Service	GCNP
Trailer Village	80	Full Service	GCNP
Ten-X Campground	70	Limited Service	US Forest Service
Charley Tank Group Site (1)	--	—	US Forest Service
Grand Canyon Camper Village	201	Full Service	Commercial
	112 (2)	Limited Service	
	839		

(1) Maximum group size 100
(2) Tent camping and tepees
Source: Young Nichols Gilstrap, Inc. and Warnick & Company

TABLE 4-12
TEN-X CAMPGROUND OCCUPANCY FIGURES

Year	May	June	July	August	September	Average % Occupied
1990	75%	100%	100%	100%	67%	87%
1991	68%	100%	100%	100%	81%	90%
1992	86%	100%	100%	100%	97%	97%
1993	91%	100%	100%	100%	98%	98%
1994	78%	95%	100%	99%	74%	89%
1995	72%	96%	101%	84%	65%	84%
1996	62%	73%	79%	72%	49%	67%

Source: Kaibab National Forest

5.0 *Facilities/Land Use Demand Model*

In order to estimate the potential facilities, land uses and acreage requirements which could potentially be required to support future visitation at the Grand Canyon, a model was developed which quantifies a variety of land use variables at differing visitation levels. It is important to note the purpose of the model is not to attempt to quantify the "correct" sizing of various land-use components, but rather to provide a tool to evaluate various levels of development based on different GCNP visitation projections through 2010, key supply/demand factors and their relationships, and average requirements for various land uses.(Figure 5-1).

FIGURE 5-1
Analysis Process

5.1 Model Variables and Approach

A variety of individual assumptions are utilized in the model focusing on four main areas; Grand Canyon visitation, hotel facilities, retail facilities and food and beverage facilities (Figure 5-2). A list of key assumptions is presented in Table 5-1 and they are expanded on through this section. The process used to derive the estimates are visually depicted in Figures 5-3 through 5-5 and are explained in more detail in the following section. The numbers utilized in Figures 5-3 through 5-5 are meant to illustrate "one" potential scenario. As noted, this section considers a variety of scenarios and the results are used in evaluating varying alternatives in the EIS.

FIGURE 5-2
Model Impact Variables

VISITATION

Growth Forecasts

HOTEL

Occupancy
Penetration
Density
Employees Per Room

RETAIL

Sales Per Capita
Sales Per Visitor
Sales Per Square Foot
Employees Per Square Foot

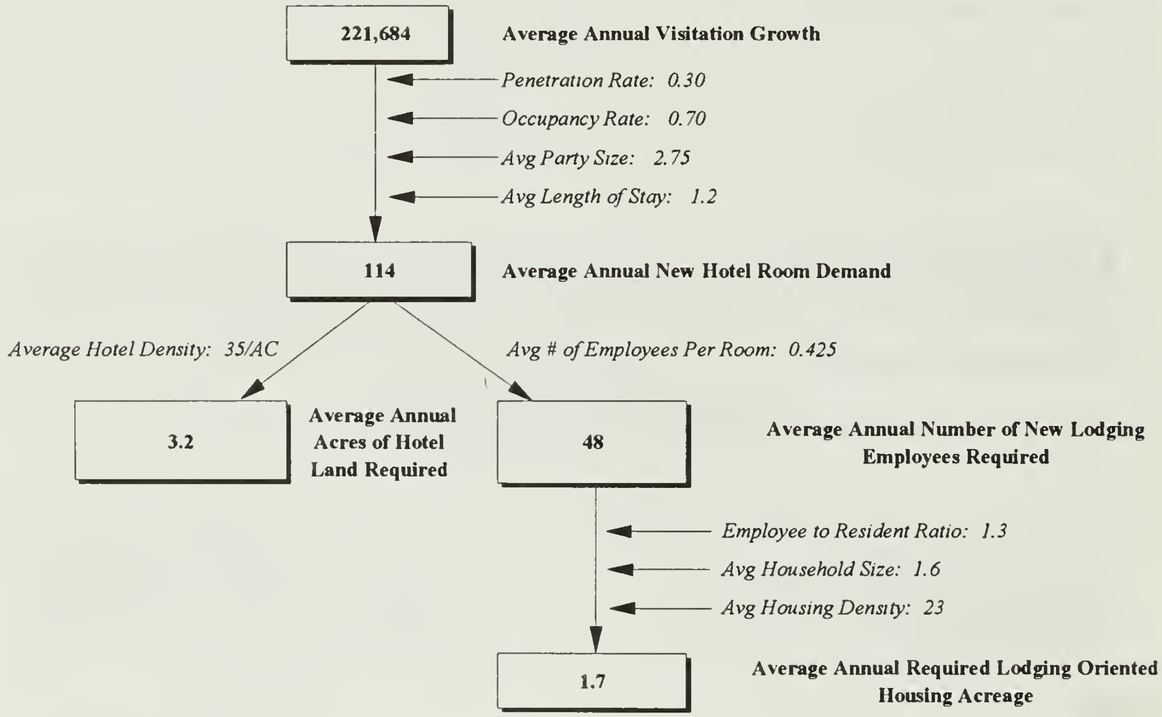
FOOD & BEVERAGE

Sales Per Visitor
Sales Per Square Foot
Employees Per Square Foot

TABLE 5-1
KEY ECONOMIC MODEL INPUTS (ASSUMPTIONS)

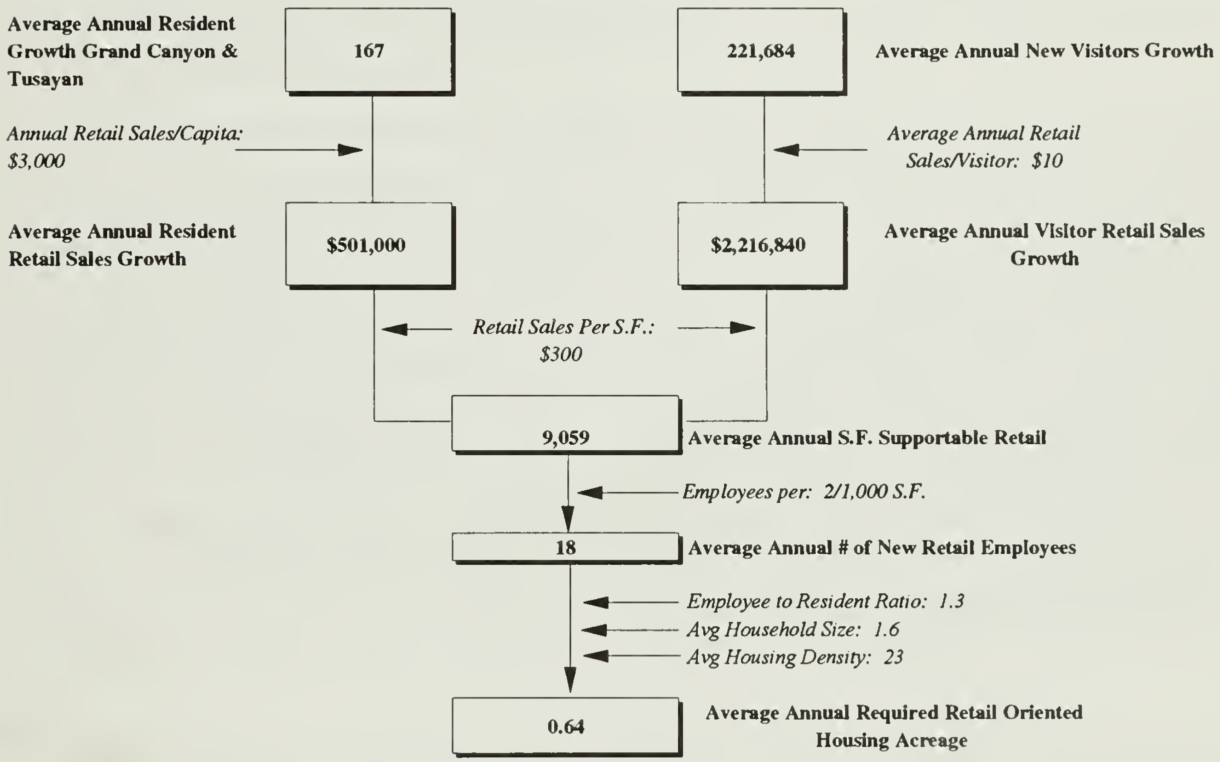
Input	Assumption	Source
1. Grand Canyon Visitation Growth	High, Moderate, GCNP-GMP, Low Scenarios	YNG/W&C and GCNP
2. Hotel Occupancy Rates	65%, 70%, 75%, 78%	YNG/W&C
3. Market Penetration Rates	25%, 30%, 35%	YNG/W&C
4. Average Length of Overnight Stay	1.2 days	GCNPL
5. Average Party Size	2.75 persons	GCNPL
6. Average Hotel Densities	35 units per acre	YNG/W&C
7. Average Hotel Employees Per Room	.425	YNG/W&C
8. Average GCNP/Tusayan Annual Retail Sales per Capita	$3,000	YNG/W&C and Sales and Marketing Management
9. Average Retail Spending Per Visitor Per Trip	$10	YNG/W&C and GCNP
10. Avérage Annual Retail Sales Per Square Foot	$300	YNG/W&C, Urban Land Institute and GCNP
11. Average Retail Employees Per Square Foot	1 per 500 square feet	International Council of Shopping Centers
12. Average Food & Beverage Spending Per Visitor Per Trip	$6	YNG/W&C, Urban Land Institute and GCNP
13. Average Annual Food & Beverage Sales Per Square Foot	$300	YNG/W&C and Urban Land Institute
14. Average Food & Beverage Employees Per Square Foot	1 per 125 square feet	YNG/W&C
15. Average Employee to Resident Ratio	1.3	YNG/W&C and 1990 Census
16. Average Household Size	1.6	YNG/W&C - Tusayan actual
17. Average Housing Density	23 units per acre	YNG/W&C and GCNP

FIGURE 5-3
LODGING RELATED
AVERAGE ANNUAL LAND USE REQUIREMENTS*



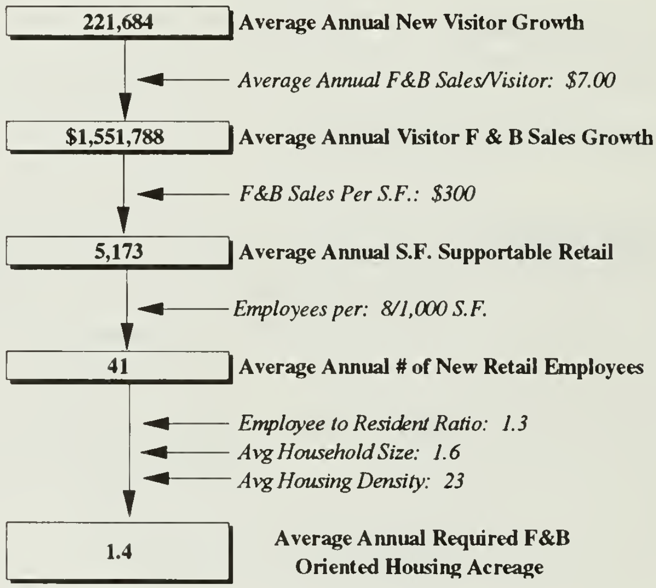
* This figure illustrates one potential assumption set and the resulting facilities required.

FIGURE 5-4
RETAIL RELATED
AVERAGE ANNUAL LAND USE REQUIREMENTS*



* This figure illustrates one potential assumption set and the resulting facilities required.

FIGURE 5-5
FOOD & BEVERAGE RELATED
AVERAGE ANNUAL LAND USE REQUIREMENTS*



* This figure illustrates one potential assumption set and the resulting facilities required.

5.2 Model Results

Using the processes outlined in Figures 5-3 through 5-5, a variety of scenarios can be analyzed and the resulting range of needed facilities can be estimated. Table 5-2 outlines the four visitation growth scenarios previously reviewed in Section 2 and estimates the resulting annual increase in visitation which would occur at the South Rim. This assumes 88 percent of total Grand Canyon visitation occurs South Rim, a percentage consistent with recent trends.

Table 5-3 translates this new visitor demand into the estimated number of new hotel rooms which could be supported. The table has two components; rooms to stabilize and new room demand. The rooms to stabilize estimates the number of new rooms needed to accommodate existing visitation levels. This estimate considers a variety of targeted occupancy and penetration levels and considers year-end 1996 conditions, the last full year of available data. This calculation further assumes an average party size of 2.75 persons and an average length of stay of 1.2 nights, levels consistent with the experience of GCNPL. If all rooms were targeted to achieve the occupancy performance of GCNPL facilities (i.e., 78 percent) and a penetration rate of 25 percent was considered (a level below 1996 actuals), the existing inventory of rooms would exceed the required number by 317 rooms. If 30 percent of visitors were to be accommodated at a 78 percent occupancy level (a level closer to 1996 actual penetration), an additional 13 rooms could be supported. A 35 percent penetration was also calculated to provide an estimate that recognizes a higher percentage of visitors would likely desire to stay at the Grand Canyon if the overall Park experience was improved and a wider range of facilities were available. At a 35 percent penetration, an additional 342 rooms could be supported.

Because new development has generally been restricted in the Grand Canyon/Tusayan area (land availability, GCNP restrictions), lodging properties have operated at occupancy levels above industry norms. The GCNPL average 78 percent occupancy rate is approximately 15 points above the 1996 northern Arizona average. As noted in Section 4.1, occupancy rates in the U.S., as well as northern Arizona, have averaged in the mid-60 percent range, while a 70 percent level is generally considered healthy occupancy. In order to recognize these variances, scenarios have also been developed with varying occupancy rates of 65, 70 and 75 percent. Considering these scenarios, the number of new rooms to stabilize would range from an oversupply of 317 rooms, to an undersupply of 803 rooms.

In addition to the rooms required to support existing Grand Canyon visitation, future visitor increases will also support the development of new rooms. The annual number of new rooms to support visitation growth considering the same penetration and occupancy scenarios, are also outlined in Table 5-3. These scenarios provide a basis to examine alternative assumptions and the resulting implications to new room demand.

In order to condense the range of potential new room demand scenarios, Table 5-4 considers a single demand estimate at the 70 percent occupancy level and reflects the total number of new rooms which would be required in the Tusayan area through the year 2010. The table also estimates the number of acres that would be required to develop the associated number of units. The required acreage assumes an average density of 35 units per acre. This density is based on actual averages in Arizona and assumes the majority of product (approximately 75 percent) is of a limited service orientation, with the balance being of a full service nature. As indicated in the table, a total of 1,829 units would be required (1,590 + 239) under the moderate visitation growth forecast and a 30 percent penetration level. These units would require approximately 52 acres of land for development.

Table 5-5 calculates the number of employees that would be required to support the new hotel rooms. An average of .425 employees per room was utilized in the analysis. This ratio utilizes industry standards of .3 employees per room for limited service properties, .8 employees per room for full service properties and a 75/25 mix of properties. Table 5-5 also estimates the number of needed employee housing units, as well as the land area required to support the housing development. This assumes an employee to resident ratio of 1.3, a level which is slightly above actual levels in Grand Canyon Village (1.1 per 1990 census) but below Williams (1.9) or Flagstaff (2.0). This recognizes most residents of Tusayan will be employed in the area. A household size of 1.6 persons is also utilized, an average which is consistent with current Tusayan norms. Finally, an average density of 23 units per acre was considered in developing the required land area for employee housing. This 23 unit per acre average considers densities and employment mixes consistent with GCNP and assumes dorms and apartments account for the bulk of housing, along with a limited percentage of single family homes.

Table 5-6 shifts from lodging related demand factors to retail related factors. In order to estimate the likely retail sales generated by residents of GCNP and Tusayan, an average retail sales per capita expenditure was estimated. This estimate is outlined in Table 5-7. Utilizing data from Sales and Marketing Management, a retail sales per capita estimate of $8,471 was calculated for all of Coconino County. Because of limited shopping alternatives in the Tusayan area, the percentage of expenditures which could be expected to occur in Tusayan was estimated by retail category (i.e., 75% of food expenditures by area residents would occur in the Tusayan/GCNP area, while only 10 percent of furniture and fixtures would take place in this region). By applying these estimates, approximately 35 percent or $3,000 of resident expenditures were estimated to occur in Tusayan. This average annual retail expenditure estimate was then applied to the additional residents expected to reside in the GCNP and Tusayan areas by the year 2010. The increase in GCNP residents considers the Arizona Department of Economic Security population forecasts presented in Section 2.1, while the new Tusayan residents reflect an estimate of potential residents based on the various visitation growth scenarios outlined in this model.

In addition to the resident-related retail sales, visitor-related sales were also estimated at $10 per visitor. This level considers actual retail related spending within the GCNP of approximately $31 million in 1995. As actual retail sales within Tusayan are difficult to quality, an estimate was developed considering the approximately 35,000 square feet of retail space in Tusayan (not including theater space) and a $300 per square foot sales estimate. In order to recognized the large annual visitor flows and high visibility of Tusayan, this sales per square foot estimate is below facilities in GCNP (over $500/square foot) but above sales averages as cited by the Urban Land Institute (approximately $200 per square foot) in the Dollars and Cents of Shopping Centers report. The total sales volume ($41,500,000) divided by the number of South Rim visitors (4.3 million) imply sales of $9.65 or approximately $10 per visitor per trip. These total expenditures were then divided by the estimate of retail sales per square foot ($300) to determine the amount of new retail square footage supported by these new retail expenditures. Table 5-8 estimates the number of employees required to staff the new retail space. This uses employee per square foot averages as cited by the International Council of Shopping Centers and utilizes the previously noted averages to estimate the housing needs of retail employees.

Table 5-9 calculates the same demand estimate for food and beverage operations. According to the GCNP, there was approximately $18.7 million of food and beverage sales within GCNP in 1995. Taking the 63,000 square feet of food and beverage square footage in GCNP into consideration, a sales per square foot factor of approximately $300 was generated. Considering averages cited by the Urban Land Institute, particularly as it relates to "fast food" oriented restaurants, this $300 factor is applied to the food and beverage space within Tusayan (approximately 25,000 square feet) implying total food and beverage sales of $26,200,000 or approximately $6 for each of the 4.3 million South Rim visitors. Table 5-9 considers these estimates and calculates the associated new food and beverage space requirements and Table 5-10 identifies the associated employees considering an industry average of 8 employees per 1,000 square feet of space.

Table 5-11 provides a summary of these scenarios (considering a 70% occupancy rate). While it is recognized that any of these assumptions could vary and result in a somewhat different outcome, these general assumption sets are believed to provide a reasonable basis on which to evaluate prospective alternatives.

TABLE 5-2
GCNP VISITATION SCENARIOS

1996 Total Visitation [1]	4,877,210
1996 South Rim Related Visitation [1]	4,298,875
1996 South Rim Related Percentage [1]	88%

High Growth Scenario [2]	
2010 Visitation	11,322,000
Growth Rate	6.2%
Average Annual Growth	460,342
South Rim Related Annual Growth	405,101

GCNP Scenario [3]	
2010 Visitation	6,859,000
Growth Rate	2.5%
Average Annual Growth	141,556
South Rim Related Annual Growth	124,569

Moderate Growth Scenario [2]	
2010 Visitation	8,404,000
Growth Rate	4.0%
Average Annual Growth	251,914
South Rim Related Annual Growth	221,684

Low Growth Scenario [2]	
2010 Visitation	6,008,000
Growth Rate	1.5%
Average Annual Growth	80,771
South Rim Related Annual Growth	71,078

(1) Grand Canyon National Park

(2) Young Nichols Gilstrap, Inc. and Warnick & Company

(3) Grand Canyon National Park - General Management Plan

TABLE 5-3
GCNP/TUSAYAN ANNUAL LODGING DEMAND

Existing Conditions	
1996 Existing Rooms (1)	1,964
1996 Total Visitation (2)	4,877,210
1996 South Rim Related Visitation (2)	4,298,875

Rooms to Stabilize (3)	At 78% Occ			At 75% Occ			At 70% Occ			At 65% Occ		
	Number of New Rooms to Stabilize at Varying Penetration Rates			Number of New Rooms to Stabilize at Varying Penetration Rates			Number of New Rooms to Stabilize at Varying Penetration Rates			Number of New Rooms to Stabilize at Varying Penetration Rates		
	25%	30%	35%	25%	30%	35%	25%	30%	35%	25%	30%	35%
Number of New Rooms to Stabilize	(317)	13	342	(251)	92	434	(129)	239	606	13	408	803

New Room Demand (3)		At 78% Occ			At 75% Occ			At 70% Occ			At 65% Occ		
	Projected Average Annual South Rim Related Visitation Increase (4)	Projected Annual New Room Requirements at Varying Penetration Rates			Projected Annual New Room Requirements at Varying Penetration Rates			Projected Annual New Room Requirements at Varying Penetration Rates			Projected Annual New Room Requirements at Varying Penetration Rates		
		25%	30%	35%	25%	30%	35%	25%	30%	35%	25%	30%	35%
High Scenario	405,101	155	186	217	161	194	226	173	208	242	186	224	261
Moderate Growth Scenario	221,684	85	102	119	88	106	124	95	114	133	102	122	143
GCNP Scenario	124,569	48	57	67	50	60	69	53	64	74	57	69	80
Low Scenario	71,078	27	33	38	28	34	40	30	36	42	33	39	46

(1) Young Nichols Gilstrap, Inc. and Warnick & Company
(2) Grand Canyon National Park
(3) Assumptions: 2.75 average party size, 1.2 day average length of stay
(4) Young Nichols Gilstrap, Inc. - Warnick & Company and Grand Canyon National Park - General Management Plan

TABLE 5-4
GCNP/TUSAYAN
LODGING DEMAND / REQUIRED ACREAGE THROUGH 2010

	Lodging Demand			Acreage			
	Required New Rooms Through 2010			Avg Density	Required Acreage Through 2010		
	25%	30%	35%	Acre [1]	25%	30%	35%
Rooms to Stabilize @ 70% Occ	(129)	239	606	35	(4)	7	17
New Visitation Demand @ 70% Occ							
High Scenario	2422	2912	3388	35	69	83	97
Moderate Growth Scenario	1330	1596	1862	35	38	46	53
GCNP Scenario	742	896	1036	35	21	26	30
Low Scenario	420	504	588	35	12	14	17

(1) Assumes mix 75% limited service - 25% full service and aveages densities in Arizona

TABLE 5-5
GCNP/TUSAYAN
NEW LODGING EMPLOYEES / HOUSING UNIT DEMAND

	New Lodging Employees					Housing Unit Demand				
	Average Employees Per Room (1)	Required New Employees Through 2010 25%	30%	35%	Employee To Resident Ratio (2)	Average Household Size (3)	Average Housing Density (4)	Required Housing Acreage Through 2010 25%	30%	35%
Rooms to Stabilize @ 70% Occ	0.425	(55)	102	258	1.3	1.6	23	(2)	4	9
New Visitation Demand @ 70% Occ										
High Scenario	0.425	1,029	1,238	1,440	1.3	1.6	23	36	44	51
Moderate Growth Scenario	0.425	565	678	791	1.3	1.6	23	20	24	28
GCNP Scenario	0.425	315	381	440	1.3	1.6	23	11	13	16
Low Scenario	0.425	179	214	250	1.3	1.6	23	6	8	9

(1) Assumes .3 employees/room limited service, .8 employee/room full service - 75/25 percent mix
(2) Young Nichols Gilstrap, Inc. and Warnick & Company considers actuals in Grand Canyon Village/Williams/Flagstaff
(3) Actual levels in Tusayan
(4) Young Nichols Gilstrap, Inc. - Warnick & Company considers densities - housing mix as outlined in Grand Canyon National Park - General Management Plan

TABLE 5-6
GCNP/TUSAYAN
NEW RETAIL DEMAND / REQUIRED SQUARE FOOTAGE

	Retail Demand							Square Footage	
	GCNP/Tus Retail Sales Per Capita [1]	New GCNP Residents By 2010 [2]	New Tus Residents By 2010 [3]	GCNP/Tus New Resident Retail Sales	GCNP/Tus Retail Sales Per Visitor [4]	GCNP/Tus New Visitors By 2010	GCNP/Tus New Visitors Sales By 2010	GCNP/Tus Retail Sales Per Sq. Ft. [5]	GCNP/Tus Req New Retail Sq. Ft.
High Scenario	$3,000	342	3700	$12,126,000	$10.00	5,671,414	$56,714,140	$300	229,467
Moderate Growth Scenario	$3,000	342	2100	$7,326,000	$10.00	3,103,576	$31,035,760	$300	127,873
GCNP Scenario	$3,000	342	1200	$4,626,000	$10.00	1,743,966	$17,439,660	$300	73,552
Low Scenario	$3,000	342	800	$3,426,000	$10.00	995,092	$9,950,920	$300	44,590

(1) Young Nichols Gilstrap, Inc. - Warnick & Company considers sales data from Sales and Marketing Management
(2) Arizona Department of Economic Security
(3) Young Nichols Gilstrap, Inc. - Warnick & Company based on model estimates at varying visitation levels
(4) Young Nichols Gilstrap, Inc. - Warnick & Company considers actual sales data form Grand Canyon National Park and estimate of Tusayan sales
(5) Young Nichols Gilstrap, Inc. - considers actual sales per square foot volumes in Grand Canyon National Park and averages form Urban Land Institute

TABLE 5-7
GCNP/TUSAYAN AREA
ESTIMATED RESIDENT EXPENDITURES

Coconino County Population **102,800** [1]

	Resident Expenditures [1]	Sales Per Capita		
		Sales Per Capita	% In GC/Tus [2]	Sales Per Capita in GC/Tus
Food	$221,499,000	$2,155	75%	$1,616
Eating/Drinking	$119,240,000	$1,160	50%	$580
General Merchandise	$113,361,000	$1,103	25%	$276
Furniture Fixtures	$37,229,000	$362	10%	$36
Automotive	$106,381,000	$1,035	10%	$104
Drug	$25,849,000	$251	50%	$126
Other	$247,309,000	$2,406	10%	$241
Total	$870,868,000	$8,472		$2,979

(1) Sales and Marketing Management

(2) Young Nichols Gilstrap, Inc. - Warnick & Company

CFVSUMM.XLS

TABLE 5-8
GCNP/TUSAYAN
NEW RETAIL EMPLOYEES REQUIRED / REQUIRED HOUSING UNITS

	New Retail Employees						Housing Units	
	Average Employee Per Sq. Ft. (1)	Average Employee Per Sq. Ft. Ratio	New Employees Through 2010	Employee To Resident Ratio (2)	Average Household Size (3)	Average Housing Density (4)	Required New Housing Units	Required New Housing Acreage
High Scenario	2/1000	0.002	459	1.3	1.6	23	373	16
Moderate Growth Scenario	2/1000	0.002	256	1.3	1.6	23	208	9
GCNP Scenario	2/1000	0.002	147	1.3	1.6	23	119	5
Low Scenario	2/1000	0.002	89	1.3	1.6	23	72	3

(1) International Counsil of Shopping Centers

(2) Young Nichols Gilstrap, Inc. and Warnick & Company considers actuals in Grand Canyon Village/Williams Flagstaff

(3) Actual levels in Tusayan

(4) Young Nichols Gilstrap, Inc. - Warnick & Company considers densities - housing mix as outlined in Grand Canyon National Park - General Management Plan

TABLE 5-9
GCNP/TUSAYAN
NEW FOOD &BEVERAGE DEMAND / REQUIRED SQUARE FOOTAGE

	Food & Beverage Demand			Square Footage	
	GCNP/Tus F&B Sales Per Visitor [1]	GCNP/Tus New Visitors By 2010	GCNP/Tus New Sales By 2010	GCNP/Tus F&B Sales [1] Per Sq. Ft.	GCNP/Tus Req New F&B Sq. Ft.
High Scenario	$6.00	5,671,414	$34,028,484	$300	113,428
Moderate Growth Scenario	$6.00	3,103,576	$18,621,456	$300	62,072
GCNP Scenario	$6.00	1,743,966	$10,463,796	$300	34,879
Low Scenario	$6.00	995,092	$5,970,552	$300	19,902

(1) Young Nichols Gilstrap, Inc. - considers actual sales per square foot volumes in Grand Canyon National Park and averages form Urban Land Institute

TABLE 5-10
GCNP/TUSAYAN
NEW F&B EMPLOYEES REQUIRED / REQUIRED HOUSING UNITS

	New F&B Employees						Housing Units	
	Average Employee Per Sq. Ft. [1]	Average Employee Per Sq. Ft. Ratio	New Employee Through 2010	Employee To Resident Ratio [2]	Average Household Size [3]	Average Housing Density [4]	Required New Housing Units	Required New Housing Acreage
High Scenario	8/1000	0.008	907	1.3	1.6	23	737	32
Moderate Growth Scenario	8/1000	0.008	497	1.3	1.6	23	404	18
GCNP Scenario	8/1000	0.008	279	1.3	1.6	23	227	10
Low Scenario	8/1000	0.008	159	1.3	1.6	23	129	6

(1) Young Nichols Gilstrap, Inc. - Warnick & Company

(2) Young Nichols Gilstrap, Inc. and Warnick & Company considers actuals in Grand Canyon Village/Williams Flagstaff

(3) Actual levels in Tusayan

(4) Young Nichols Gilstrap, Inc. - Warnick & Company considers densities - housing mix as outlined in Grand Canyon National Park - General Management Plan

TABLE 5-11
SUMMARY OF LAND USE DEMAND
70% OCCUPANCY

Visitation Scenarios	High Growth Scenario			Moderate Growth Scenario			GCNP Scenario			Low Growth Scenario		
Penetration Rates	25%	30%	35%	25%	30%	35%	25%	30%	35%	25%	30%	35%
Annual Visitation by 2010	11,322,000	11,322,000	11,322,000	8,404,000	8,404,000	8,404,000	6,859,000	6,859,000	6,859,000	6,008,000	6,008,000	6,008,000
Average Annual Visitation Growth	460,342	460,342	460,342	251,914	251,914	251,914	141,556	141,556	141,556	80,771	80,771	80,771
South Rim Related Annual Visitation Growth	405,101	405,101	405,101	221,684	221,684	221,684	124,569	124,569	124,569	71,078	71,078	71,078
New Hotel Rooms To Stabilize	(129)	239	606	(129)	239	606	(129)	239	606	(129)	239	606
Annual New Hotel Room Demand	173	208	242	95	114	133	53	64	74	30	36	42
Total Hotel Room Demand Through 2010	2,293	3,151	3,994	1,201	1,835	2,468	613	1,135	1,642	291	743	1194
Total Hotel Acreage Required Through 2010	65	90	114	34	53	70	17	33	47	8	21	34
New Retail Square Footage Through 2010	229,467	229,467	229,467	127,873	127,873	127,873	73,552	73,552	73,552	44,590	44,590	44,590
New F&B Square Footage Through 2010	113,428	113,428	113,428	62,072	62,072	62,072	34,879	34,879	34,879	19,902	19,902	19,902
New Hotel Employees Through 2010	974	1,340	1,698	510	780	1049	260	483	698	124	316	508
New Retail Employees Through 2010	459	459	459	256	256	256	147	147	147	89	89	89
New F&B Employees Through 2010	907	907	907	497	497	497	279	279	279	159	159	159
Total New Employees Through 2010	2,340	2,706	3,064	1,263	1,533	1,802	686	909	1,124	372	564	756

6.0 Alternative Review and Associated Economic Impacts

The development scenarios presented in Section 5 provide a benchmark to evaluate a variety of alternatives being considered in this EIS. As previously noted, Section 5 did not present a "correct" development scenario, but rather provided a range of scenarios in which the mix of assumptions which would be required to support a given level of development could be better understood.

6.1 Alternative Review

There are five alternatives being considered which are more fully described in the EIS. A brief summary of these alternatives follows:

Alternative A: No Action

No Action for this EIS means no use of Federal land for community expansion. However, new visitor facilities are being developed on private land in the area, and this is expected to continue. Land and business owners in Tusayan and elsewhere are expected to continue to develop new hotels, retail services, food and beverage outlets, and housing to meet increasing visitor demand. Up to 1,371 additional hotel rooms could be provided through the redevelopment of Tusayan and GCNP (outlined in Section 4.4), increasing the total number of hotel rooms to approximately 3,300 in the Grand Canyon/Tusayan area. This figure does not include potential development on the private inholdings currently controlled by CFV, in Valle, or at other state, tribal or private lands. Three of the CFV inholdings (Kotzin, Ten-X, and Lower Basin) are considered to hold the greatest development potential, although rezoning by Coconino County would be required under several of the development options for these inholdings. It is impossible to accurately estimate the level of development that would actually occur on these private inholdings under Alternative A. For instance, zoning conditions could change several times over a long-term planning horizon as a result of economic necessities and changes in elected officials. The level of desire to develop the private inholdings will be a product of such factors as market demand and the availability and cost of capital.

As outlined in Chapter 5, the economic model estimated that 1,835 new lodging units could be supported in the Grand Canyon/Tusayan area through the year 2010, with limited economic impact on existing area businesses. As noted, 1,371 lodging units could potentially be built on existing private land in Tusayan and within GCNP. If this number of rooms is constructed in Grand Canyon/Tusayan and development of rooms elsewhere (on CFV inholdings, in Valle, etc.) exceeds 464 lodging units (1,835 - 1,371) through the year 2010, economic impacts to the existing businesses in Grand Canyon/Tusayan would be expected.

While the number of potential new lodging units on these other lands is uncertain and impossible to accurately predict, it is possible that the developers of CFV, who control numerous private inholdings in the area, would strive to develop several of their inholdings, possibly meeting or exceeding the level of development proposed in Alternative B. Because the ability to achieve specific levels of development on the private inholdings is unclear, a range of development scenarios (100%, 75%, 50% and 25%) of the level of development proposed under Alternative B have been considered for the private inholdings. It should be noted that under typical commercial zoning for lodging in the Tusayan area, 3,650 units requires less than 100 acres; there is thus ample land area on the private inholdings to accommodate far more commercial development than is proposed under Alternative B.

In addition to hotel room development, Tusayan's planned expansion of retail and food and beverage facilities could add about 220,000 square feet to existing inventories. The cumulative amount of retail and food and beverage facilities could be much greater (thus exceeding the demand level under the moderate growth scenario) if CFV achieves some, or all, of the planned retail and food and beverage development on the private inholdings. These new facilities would substantially expand the range of options in the area, providing both residents and visitors a larger selection of goods. New campground facilities could also potentially be developed on these inholdings. Increased competition would likely lead to decreased prices and increased service, but could also result in the failure of less competitive and/or undercapitalized operations.

Alternative B: Land Exchange Option Number 1

Development on the NFS land under this alternative would include 3,650 lodging units and 425,000 square feet of community and visitor retail and food and beverage facilities. As outlined in Chapter 5, this amount of development is approximately twice that estimated to be needed during this time period in the Grand Canyon/Tusayan area under the moderate visitation growth rate scenario to maintain existing supply-demand relationships. This level of growth would likely result in increased competition among Grand Canyon/Tusayan area businesses to provide better services at lower prices. Should visitation increase at a level faster than that assumed under the moderate visitation growth scenario, fewer impacts to existing Grand Canyon/Tusayan area hotels would result, as long as new supply is added in concert with new demand. However, should visitation increase at a level slower than the moderate visitation growth rate scenario, greater impacts to Grand Canyon/Tusayan area hotels would result. The 425,000 square feet of retail and food and beverage facilities proposed by CFV would also be more than double the amount estimated by the model to maintain existing relationships. This level of development would lead to a more competitive environment, perhaps with some retail operations closing, and would likely result in increased competition among Grand Canyon/Tusayan area businesses to provide better services at lower prices. A 250 unit campground facility is also proposed in Alternative B. If the current visitor to campground space relationship was maintained, approximately 600 new spaces would need to be added to the Grand Canyon/Tusayan area by 2010 under the moderate growth scenario. As outlined in Chapter 4, Tusayan's Grand Canyon Camper Village is anticipated to be redeveloped to other uses thus increasing the number of needed spaces to approximately 900 to maintain current relationships. The "net" number of spaces added to the area's inventory of spaces through development of this facility would thus generally replace the lost spaces rather than adding new capacity to the area.

As described under Alternative A, lodging units proposed under this alternative would be in addition to those that might be constructed on existing private land in Tusayan or GCNP, bringing the total potential number of rooms to approximately 5,021 (3,650 from the CFV development, plus 1,371 from the redevelopment of Tusayan). It is reasonable to expect some level of redevelopment to occur in Tusayan and GCNP, potentially reaching a total of 1,371 new lodging units and 220,000 square feet of retail and food and beverage facilities. Therefore, the collective economic impacts to the Grand Canyon/Tusayan area businesses could be similar to those described under Alternative A. However under Alternative A, the quantity of hotel rooms that would be constructed is entirely speculative, while Alternative B is based on a definite plan to construct 3,650 new lodging units in a phased manner over a minimum 12-year period. It is reasonable to expect that such an increase in supply (an increase that is substantially above that estimated to be necessary to maintain the current supply and demand relationships) would result in increased competition, not only in the Grand Canyon/Tusayan area but in surrounding communities as well. The potential impacts to surrounding communities from this level of development are presented later in this section.

Alternative C: Land Exchange Option Number 2

Under this alternative, CFV would construct 2,000 lodging units on acquired NFS land in a phased manner over a minimum 12-year period. This number by itself is roughly equivalent to levels estimated in Chapter 5 to be necessary in the Grand Canyon/Tusayan area to maintain current visitor service supply/demand relationships under the moderate visitation growth rate scenario. New community and visitor facilities would add 304,000 square feet of retail and food and beverage space. As this level is above the approximately 200,000 square feet estimated to be needed to maintain current relationships, competition would increase, and some marginally profitable businesses could fail. A 250 unit campground facility would also be included in this Alternative, again generally replacing the units lost through the planned redevelopment of Grand Canyon Camper Village rather than adding to the area's capacity.

As under Alternative B, a certain level of redevelopment is expected in Tusayan, as well as a small amount of development in GCNP, potentially adding 1,371 lodging units in the Grand Canyon/Tusayan area. Therefore, under this alternative, new hotel construction could potentially reach an estimated 3,371 lodging units in the Grand Canyon/Tusayan area (2,000 from the CFV development, plus 1,371 from the redevelopment of Tusayan and GCNP), approximately 175% of the level estimated to be supportable under the moderate visitation growth rate scenario. This level of development would likely results in substantial increases in competition, which in turn could lower product pricing, increase levels of service, provide a broader array of products and services and result in failure of marginally profitable businesses.

Alternative D: Townsite Act/Special Use Permit

Under this alterative, the existing hoteliers in the Grand Canyon/Tusayan area could construct up to 1,371 lodging units and 220,000 square feet of retail and food and beverage facilities. Addition of 1,371 lodging units over an eight-year period would not be expected to substantially affect existing Tusayan businesses if visitation grows to a level similar to or slightly below the moderate visitation growth rate.

As there is no land exchange, some commercial development of the private inholdings controlled by CFV could occur. Again, the amount and type of development would be determined by market factors (availability of debt and equity capital) and by Coconino County through its zoning process. If development occurs on some of the private inholdings, the potential economic impact to Grand Canyon/Tusayan businesses would be a result of increased supply leading to increased competition in the lodging, retail, and food and beverage industries. Such competition could decrease prices and increase levels of service, but also could result in one or more hotels, and/or retail outlets going out of business. In addition, planned hotels or other retail businesses may not be constructed because of deteriorating market conditions. Collectively, these impacts could be similar to those described under Alternative A.

Alternative E: Transportation/Federal Housing

Under this alternative, the land exchange does not occur and no NFS land is made available to existing business owners and landowners in Tusayan. The additional population in the area associated with the proposed 100 units of new Federal housing would create some increased demand for retail and food and beverage services. Most likely, this demand would be met by the existing business in Tusayan. The transportation staging area proposed under this alternative includes limited retail and food and beverage services for customer convenience, which are not expected to significantly compete with the existing businesses in Tusayan.

Under the alternative, development would be expected on existing private lands in Tusayan and on selected inholdings controlled by CFV, as well as on outlying private or tribal lands. Therefore, the potential cumulative economic impact to the Grand Canyon/Tusayan area is similar to that described under Alternative A and D.

6.2 Economic Impact Analysis

In more fully evaluating the prospective impacts of any of the proposed alternatives, a variety of factors must be recognized. These include:

- The Grand Canyon/Tusayan area, as well as northern Arizona, will require new rooms to support ongoing visitation growth at GCNP.

- If the new supply of rooms within the Grand Canyon/Tusayan area exceeds supportable levels (based on historic penetration rates) demand will be pulled or "displaced" from other areas.

- While demand will likely be pulled from other regions, under most visitation and supply growth scenarios, positive room growth in a region (i.e., northern Arizona) will still be required to support GCNP visitation growth (i.e. accommodations the night before/night after visiting the GCNP).

- There are a range of potential demand/supply scenarios. This analysis identifies the ranges and reflects their sensitivities, rather than identifying a single prospective outcome.

- Given prospective growth in GCNP visitation, development levels in most alternatives could be expected to result in northern Arizona communities still needing to increase their room base, but at potentially lower levels.

Table 6-1 presents the potential level of development associated with Land Exchange Option Number 1 (Alternative B). As shown in the table, a total of 3,650 new lodging units would be developed within Canyon Forest Village. This would include a mix of economy, full service, conference, bed & breakfast and cabin facilities. These would be phased over a minimum 12 year period with the first units likely coming on-line in 1999.

In addition to the units within the Alternative B proposal, an additional 1,371 units could potentially be added if all prospective Tusayan and GCNP expansion/redevelopment projects were added (as outlined in Section 4.4). As the privately held inholdings would be traded as part of the proposal, no development could occur on those lands. The combination of Alternative B and Tusayan redevelopment efforts could potentially add 5,021 units to the Grand Canyon/Tusayan area. These prospective new additions are contrasted to a "base new room demand" level from Table 5-3. This base room demand considers the level of new rooms necessary in the Grand Canyon/Tusayan area to support visitation growth considering the moderate visitor growth forecast, a 75 percent occupancy level (Tusayan and GCNP hotels) and a 30 percent penetration rate (levels similar to current conditions). The variance between this base new room demand level and the prospective room supply provides an estimate of the demand which would need to be "displaced" from other areas which currently accommodate Grand Canyon visitors. As shown in Table 6-1, demand for 3,445 rooms (5,021 rooms added - 1,576 rooms supported) would need to be displaced in order for all prospective 5,021 rooms to operate at the above noted performance levels.

Table 6-2 (a) allocates this "required displaced demand" to different areas, specifically focusing on northern Arizona. This allocation utilizes findings from the visitor survey in which the travel itineraries of Grand Canyon visitors were investigated. Findings from this survey indicated that approximately 42 percent of visitor room nights from the night before entering the Grand Canyon and the night after leaving the Grand Canyon were accommodates within North Arizona (Figure 6-1 and

Table 6-3). Further allocations to individual cities within northern Arizona are also presented in Table 6-2, based on the visitor survey findings.

TABLE 6-1
GRAND CANYON/TUSAYAN
DISPLACED LODGING DEMAND
ALTERNATIVE B - LAND EXCHANGE OPTION NUMBER 1
MODERATE GROWTH SCENARIO

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	TOTAL
Canyon Forest Village 1															
Economy	0	0	350	250	210	180	280	180	250	180	180	180	150	150	**2,540**
Full Service	0	0	250	0	150	0	250	0	0	0	0	0	0	0	**650**
Conference	0	0	0	0	250	0	0	0	0	0	0	0	0	0	**250**
Bed & Breakfast	0	0	40	40	40	0	0	0	0	0	0	0	0	0	**120**
Cabins	0	0	30	30	30	0	0	0	0	0	0	0	0	0	**90**
Total	0	0	670	320	680	180	530	180	250	180	180	180	150	150	**3650**
Tusayan Redevelopment															
Quality Inn Expansion															**0**
G.C. Suites															**0**
The Grand	160														**160**
Camper Village Campground			250		140										**390**
Canyon Squire Inn Expansion		160													**160**
Moqui Lodge					110	111									**221**
G.C. National Park				50	50	50	50	40							**240**
Domes				200											**200**
Unspecified															**0**
Total Tusayan Redevelopment	160	160	250	250	300	161	50	40	0	0	0	0	0	0	**1371**
Inholding Development [1]															
Kotzin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
TenX	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Apex	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Others	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Prospective New Room Supply	160	160	920	570	980	341	580	220	250	180	180	180	150	150	**5,021**
Cumulative New Room Supply	160	320	1,240	1,810	2,790	3,131	3,711	3,931	4,181	4,361	4,541	4,721	4,871	5,021	**5,021**
Less Base New Room Demand [2]	198	106	106	106	106	106	106	106	106	106	106	106	106	106	**1,576**
Required Displaced Demand [3]	-38	54	814	464	874	235	474	114	144	74	74	74	44	44	**3,445**
Cumulative Displaced Demand	-38	16	830	1,294	2,168	2,403	2,877	2,991	3,135	3,209	3,283	3,357	3,401	3,445	**3,445**

(1) ND No Development
(2) New rooms required at Grand Canyon/Tusayan at 30% penetration, 75% occupancy and moderate growth rate
(3) Demand pulled from other areas to support new supply at Grand Canyon/Tusayan above base demand levels

TABLE 6-2 a
ALLOCATION OF DISPLACED LODGING DEMAND
ALTERNATIVE B - LAND EXCHANGE OTPION NUMBER 1

Northern Arizona Allocation	42%
Disproportionate Impacts	**100%**
Weighted Northern Arizona Impacts	42%

		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	TOTAL
Required Displaced Demand		-38	54	814	464	874	235	474	114	144	74	74	74	44	44	**3445**
Northern Arizona																
Northern Arizona Displacement (1)		-16	23	342	195	367	99	199	48	60	31	31	31	18	18	**1447**
GC Visitation Induced Demand (2)		284	284	284	284	284	284	284	284	284	284	284	284	284	284	**3982**
Adjusted GC Visitation Induced Demand (3)		300	262	(57)	90	(83)	186	85	237	224	253	253	253	266	266	**2535**
Flagstaff																
Flagstaff Displacement	39% (4)	-6	9	133	76	143	38	78	19	24	12	12	12	7	7	**564**
GC Visitation Induced Demand (2)		111	111	111	111	111	111	111	111	111	111	111	111	111	111	**1553**
Adjusted GC Visitation Induced Demand (3)		117	102	-22	35	-32	72	33	92	87	99	99	99	104	104	**989**
Williams																
Williams Displacement	15% (4)	-2	3	51	29	55	15	30	7	9	5	5	5	3	3	**217**
GC Visitation Induced Demand (2)		43	43	43	43	43	43	43	43	43	43	43	43	43	43	**597**
Adjusted GC Visitation Induced Demand (3)		45	39	-9	13	-12	28	13	35	34	38	38	38	40	40	**380**
Sedona																
Sedona Displacement	15% (4)	-2	3	51	29	55	15	30	7	9	5	5	5	3	3	**217**
GC Visitation Induced Demand (2)		43	43	43	43	43	43	43	43	43	43	43	43	43	43	**597**
Adjusted GC Visitation Induced Demand (3)		45	39	-9	13	-12	28	13	35	34	38	38	38	40	40	**380**
Page																
Page Displacement	8% (4)	-1	2	27	16	29	8	16	4	5	2	2	2	1	1	**116**
GC Visitation Induced Demand (2)		23	23	23	23	23	23	23	23	23	23	23	23	23	23	**319**
Adjusted GC Visitation Induced Demand (3)		24	21	-5	7	-7	15	7	19	18	20	20	20	21	21	**203**
Other																
Other Displacement	23% (4)	-4	5	79	45	84	23	46	11	14	7	7	7	4	4	**333**
GC Visitation Induced Demand (2)		65	65	65	65	65	65	65	65	65	65	65	65	65	65	**916**
Adjusted GC Visitation Induced Demand (3)		69	60	-13	21	-19	43	20	54	52	58	58	58	61	61	**583**
Total	100% (4)	-16	23	342	195	367	99	199	48	60	31	31	31	18	18	**1447**

(1) Demand pulled from other Northern Arizona areas to support new supply at Grand Canyon/Tusayan above base demand levels
(2) Room demand generated by Grand Canyon visitors in Northern Arizona (night before/night after visiting Grand Canyon)
(3) Net new room demand in Northern Arizona after considering demand pulled to Grand Canyon/Tusayan Area
(4) Makeup of Northern Arizona Allocation (i.e., 42%)

TABLE 6-2 b
ALLOCATION OF DISPLACED LODGING DEMAND
ALTERNATIVE B - LAND EXCHANGE OTPION NUMBER 1

Northern Arizona Allocation	42%
Disproportionate Impacts	**125%**
Weighted Northern Arizona Impacts	53%

		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	TOTAL
Required Displaced Demand		-38	54	814	464	874	235	474	114	144	74	74	74	44	44	**3445**
Northern Arizona																
Northern Arizona Displacement (1)		-20	28	427	244	459	123	249	60	76	39	39	39	23	23	**1809**
GC Visitation Induced Demand (2)		284	284	284	284	284	284	284	284	284	284	284	284	284	284	**3982**
Adjusted GC Visitation Induced Demand (3)		304	256	(143)	41	(174)	161	36	225	209	246	246	246	261	261	**2173**
Flagstaff																
Flagstaff Displacement	39% (4)	-8	11	167	95	179	48	97	23	29	15	15	15	9	9	**705**
GC Visitation Induced Demand (2)		111	111	111	111	111	111	111	111	111	111	111	111	111	111	**1553**
Adjusted GC Visitation Induced Demand (3)		119	100	-56	16	-68	63	14	88	81	96	96	96	102	102	**847**
Williams																
Williams Displacement	15% (4)	-3	4	64	37	69	19	37	9	11	6	6	6	3	3	**271**
GC Visitation Induced Demand (2)		43	43	43	43	43	43	43	43	43	43	43	43	43	43	**597**
Adjusted GC Visitation Induced Demand (3)		46	38	-21	6	-26	24	5	34	31	37	37	37	39	39	**326**
Sedona																
Sedona Displacement	15% (4)	-3	4	64	37	69	19	37	9	11	6	6	6	3	3	**271**
GC Visitation Induced Demand (2)		43	43	43	43	43	43	43	43	43	43	43	43	43	43	**597**
Adjusted GC Visitation Induced Demand (3)		46	38	-21	6	-26	24	5	34	31	37	37	37	39	39	**326**
Page																
Page Displacement	8% (4)	-2	2	34	19	37	10	20	5	6	3	3	3	2	2	**145**
GC Visitation Induced Demand (2)		23	23	23	23	23	23	23	23	23	23	23	23	23	23	**319**
Adjusted GC Visitation Induced Demand (3)		24	20	-11	3	-14	13	3	18	17	20	20	20	21	21	**174**
Other																
Other Displacement	23% (4)	-5	7	98	56	106	28	57	14	17	9	9	9	5	5	**416**
GC Visitation Induced Demand (2)		65	65	65	65	65	65	65	65	65	65	65	65	65	65	**916**
Adjusted GC Visitation Induced Demand (3)		70	59	-33	9	-40	37	8	52	48	56	56	56	60	60	**500**
Total	100% (4)	-20	28	427	244	459	123	249	60	76	39	39	39	23	23	**1809**

(1) Demand pulled from other Northern Arizona areas to support new supply at Grand Canyon/Tusayan above base demand levels
(2) Room demand generated by Grand Canyon visitors in Northern Arizona (night before/night after visiting Grand Canyon)
(3) Net new room demand in Northern Arizona after considering demand pulled to Grand Canyon/Tusayan Area
(4) Makeup of Northern Arizona Allocation (i.e., 42%)

FIGURE 6-1
Distribution of Visitor Room Night Demand
Nigh Before/Night After

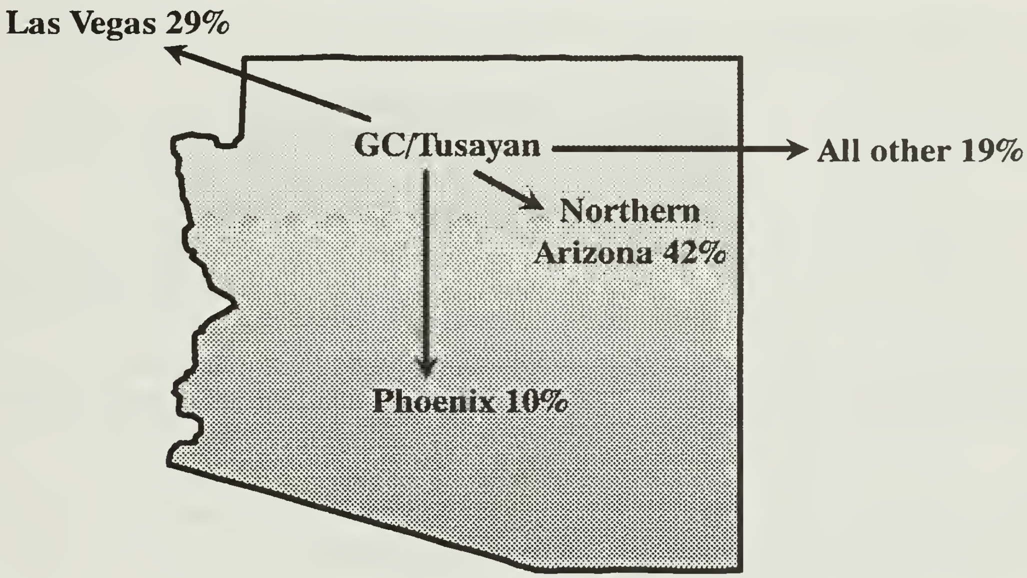


TABLE 6-3
LOCATIONS OUTSIDE OF THE GRAND CANYON/TUSAYAN AREA WHERE VISITORS STAYED THE NIGHT BEFORE AND AFTER VISITING GCNP

Location	Percentage of Visitor Room Nights within Northern Arizona	Percentage of Room Nights Total GCNP Visitors
Northern Arizona		42%
Flagstaff	39%	*(16%)*
Williams	15%	*(6%)*
Sedona	15%	*(6%)*
Page	8%	*(4%)*
Other	23%	*(10%)*
Las Vegas		29%
Phoenix		10%
Other		19%
Total		100%

Source: 1994/1995 Grand Canyon Visitor Survey

This allocation assumes the displaced demand over the next 14 years would be displaced in a manner consistent with these current visitation patterns. It is recognized that this displaced demand could vary from the current patterns depending on specific efforts of individual communities (i.e., Las Vegas reduces its focus on family visitors/northern Arizona communities develop more appealing accommodations/attractions). Given the difficulty of forecasting these changes and their prospective effects on displaced demand, it is believed that these current visitation patterns provide a reasonable indication of where this displaced demand would be pulled from. However, to illustrate how northern Arizona could potentially be impacted if they experienced a higher than proportional share of displaced demand, scenarios were also run at a 125 percent of fair share impact (Table 6-2 (b)).

While northern Arizona could expect to be impacted by this displaced demand, it should be recognized these communities will likely experience new room development to support future visitation growth at the GCNP (i.e. accommodating visitors the night before and night after visiting the Grand Canyon). This new offsite room demand (i.e., outside the Grand Canyon/Tusayan area) was estimated using a similar methodology as outlined in Section 5.0. This methodology is presented graphically in Figure 6-2. Table 6-2 (a) also considers this Grand Canyon "visitation induced demand" and nets this new room growth against the "displaced demand" estimate to develop an estimate of "adjusted Grand Canyon visitation induced demand." This adjusted figure thus provides an estimate of the room growth northern Arizona would likely require after considering the displaced demand associated with Alternative B: Land Exchange Option Number 1.

As shown in the table, considering Alternative B and its related displaced demand, northern Arizona would still need to add 2,535 new rooms over the 1997 to 2010 time period. These new additions would drop to 2,173 if northern Arizona experienced a higher than proportionate impacts (i.e., 125% of fair share).

The spending activity associated with each occupied room night is shown in Table 6-4. These expenditures were estimated considering per party daily spending of $140. This expenditure estimate considers spending patterns outlined in a 1995/96 visitor study in Williams which estimated approximately one-half of the party expenditure went to lodging, one-quarter to restaurants and the balance to groceries, gas and other retail purchases. These spending patterns were generally consistent with estimates in a Winter Sports Visitors to Flagstaff: Visitor Profile and 1994 Northern Arizona University International Visitor Profile.

Considering these average expenditure levels, new spending in northern Arizona communities could potentially be reduced by approximately $51 million annually by the end of the 14 year period of time (Table 6-5). While reflecting a reduction, northern Arizona communities would still realize approximately $90 million of new spending as a result of Grand Canyon related room demand.

Sales taxes associated with these expenditures would also be impacted. The city portion of bed taxes and sales taxes varies by community and these rates would likely change over the 1997-2010 time period. However, in order to provide a general estimate of the annual magnitude of taxes which would be displaced, an average 4.5 percent bed tax and 2.5 percent sales tax was considered. These averages consider current rates in Flagstaff, Williams, Sedona and Page. By the end of the analysis period (i.e., 2010), the collective northern Arizona communities would experience an annual reduction in bed and sales taxes of approximately $1.4 million (Table 6-6). Similar to spending trends, these communities would still realize $2.5 of new bed and sales taxes as a result of Grand Canyon indirect room demand in their communities.

A similar displaced room analysis was undertaken on the other alternatives being considered in the EIS. The results are summarized in Table 6-7. As shown, while the reduction in potential new lodging units in northern Arizona caused by this displaced demand varies by individual alternative, under the moderate growth visitation scenario additional northern Arizona lodging units are still required under any alternative. The number ranges from 2,535 to 3,685 units. It should be noted this net new rooms required in northern Arizona is influenced by visitation growth assumptions. As an example, net new room demand would be reduced to between 248 to 1,398 under the GCNP visitation growth scenario.

Table 6-8 provides more specific detail on how the rooms within northern Arizona would potentially be positioned considering Alternatives A-E, while Table 6-9 provides a similar breakdown of non-lodging expenditures.

In summarizing these potential economic impacts, it is important to recognize that under any of the alternatives (A through E) there is the potential that more hotel rooms could be added to the Grand Canyon/Tusayan area than are actually supported by market forces. Additionally, although there may be definitive plans to develop new visitor services (lodging, retail, food & beverage) in a alternative, there is no assurance that all proposed visitor services will ultimately be developed. Assuming a significant percentage of proposed visitor services are developed, as competition increases, prices will likely drop, service levels will likely increase and consumers will have a wider range of choices.

Similar to the Grand Canyon/Tusayan area, other northern Arizona communities will need to add lodging units to support demand from increased visitation at Grand Canyon. Under most development alternatives and visitation growth scenarios, northern Arizona communities will need to add new lodging units to accommodate increased Grand Canyon visitation, however, the number of new lodging units needed in northern Arizona vary by alternative. This new development would be needed even though some demand would be pulled or displaced to the Grand Canyon/Tusayan area. Thus, although economic impacts would be experienced by northern Arizona communities, these impacts would largely be in the form of a reduction in future growth needs and the associated reduction in spending and taxes.

Importantly, no matter what Alterative is selected, there is strong likelihood that development will continue both within Tusayan and other private, state or tribal lands in the Grand Canyon/Tusayan area, including the private inholdings controlled by Canyon Forest Village. Additionally, this development will be influenced much more by market forces, rather than any specific developer's conceptual plan.

FIGURE 6-2
NEW OFFSITE ROOM DEMAND
(OUTSIDE GRAND CANYON/TUSAYAN)

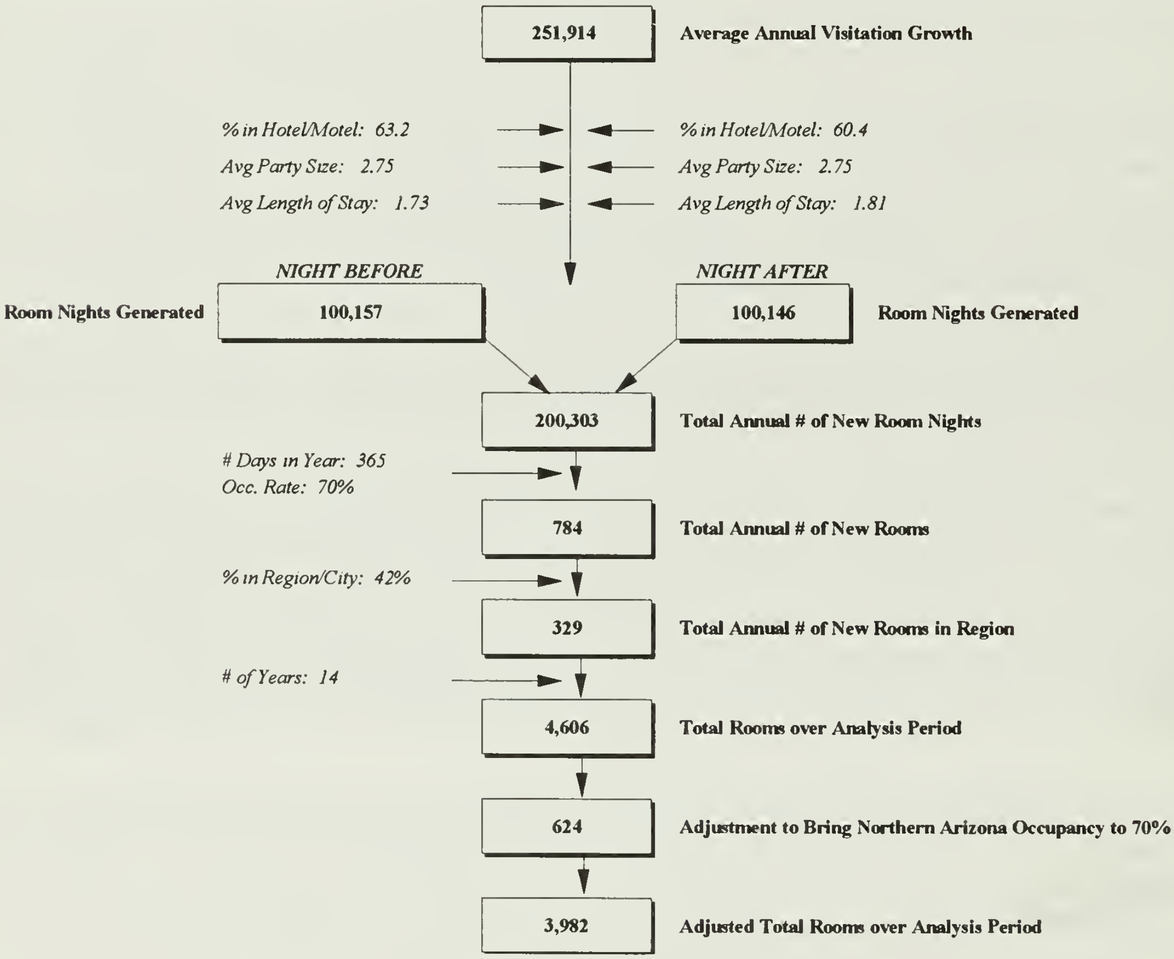


TABLE 6-4
AVERAGE EXPENDITURE PER OCCUPIED ROOM NIGHT

	Average Expenditure	Percent of Total Expenditure
Lodging	$67	48%
Restaurants	$34	24%
Grocery	$4	3%
Gasoline	$8	6%
Other Retail	$27	19%
	$140	100%

Source: Young Nichols Gilstrap, Inc./Warnick & Company and the Williams 1995/96 Visitor Study

TABLE 6-5
POTENTIAL ANNUAL VISITOR SPENDING [1]

Required Displaced Demand		Lodging	Restaurants	Groceries	Gas	Other Retail	Total
		Expenditures					
Northern Arizona							
Northern Arizona Displacement [1]	1447	$24,844,411	$12,422,206	$1,552,776	$3,105,551	$9,834,246	$51,759,190
GC Visitation Induced Demand [2]	3982	$68,369,347	$34,184,674	$4,273,084	$8,546,168	$27,062,867	$142,436,140
Adjusted GC Visitation Induced Demand [3]	2535	$43,524,936	$21,762,468	$2,720,309	$5,440,617	$17,228,621	$90,676,950
Flagstaff							
Flagstaff Displacement	564	$9,683,654	$4,841,827	$605,228	$1,210,457	$3,833,113	$20,174,280
GC Visitation Induced Demand [2]	1553	$26,664,389	$13,332,194	$1,666,524	$3,333,049	$10,554,654	$55,550,810
Adjusted GC Visitation Induced Demand [3]	989	$16,980,734	$8,490,367	$1,061,296	$2,122,592	$6,721,541	$35,376,530
Williams							
Williams Displacement	217	$3,725,803	$1,862,902	$232,863	$465,725	$1,474,797	$7,762,090
GC Visitation Induced Demand [2]	597	$10,250,251	$5,125,126	$640,641	$1,281,281	$4,057,391	$21,354,690
Adjusted GC Visitation Induced Demand [3]	380	$6,524,448	$3,262,224	$407,778	$815,556	$2,582,594	$13,592,600
Sedona							
Sedona Displacement	217	$3,725,803	$1,862,902	$232,863	$465,725	$1,474,797	$7,762,090
GC Visitation Induced Demand [2]	597	$10,250,251	$5,125,126	$640,641	$1,281,281	$4,057,391	$21,354,690
Adjusted GC Visitation Induced Demand [3]	380	$6,524,448	$3,262,224	$407,778	$815,556	$2,582,594	$13,592,600
Page							
Page Displacement	116	$1,991,674	$995,837	$124,480	$248,959	$788,371	$4,149,320
GC Visitation Induced Demand [2]	319	$5,477,102	$2,738,551	$342,319	$684,638	$2,168,020	$11,410,630
Adjusted GC Visitation Induced Demand [3]	203	$3,485,429	$1,742,714	$217,839	$435,679	$1,379,649	$7,261,310
Other							
Other Displacement	333	$5,717,477	$2,858,738	$357,342	$714,685	$2,263,168	$11,911,410
GC Visitation Induced Demand [2]	916	$15,727,354	$7,863,677	$982,960	$1,965,919	$6,225,411	$32,765,320
Adjusted GC Visitation Induced Demand [3]	583	$10,009,877	$5,004,938	$625,617	$1,251,235	$3,962,243	$20,853,910

(1) Constant Dollars - Based on cumulative room impacts over 1997-2010 time period
Source: Young Nichols Gilstrap, Inc./Warnick & Company

TABLE 6-6
ANNUAL DISPLACED SALES TAXES

		Bed Taxes	Sales Taxes	Bed and Sales Taxes
Northern Arizona [1]				
Northern Arizona Displacement [1]	1447	$ 1,117,999	$ 310,555	$ 1,428,554
GC Visitation Induced Demand [2]	3982	$ 3,076,621	$ 854,617	$ 3,931,238
Adjusted GC Visitation Induced Demand [3]	2535	$ 1,958,622	$ 544,062	$ 2,502,684

(1) Outside Grand Canyon/Tusayan area
Source Young Nichols Gilstrap, Inc./Warnick & Company

Table 6-7 Potential New Lodging Units in Northern Ariozna Related to GCNP Visitation through 2010

	GRAND CANYON/TUSAYAN DISPLACED DEMAND									REGIONAL IMPLICATIONS				
Alternative	Potential Total New Room Development at Grand Canyon/Tusayan		Estimated (1) Supportable New Rooms		Rooms Supported By Displaced Demand		Northern (2) Arizona Regional Share		Northern Arizona Rooms Lost To Displaced Demand	Total New Rooms (2, 3) Required in Northern Arizona to Support GCNP Visitation Growth		Northern Arizona Rooms Lost to Displaced Demand		Net New Rooms Required in Northern Arizona
Alternativies A/D/E														
100%	5,021	-	1,576	=	3,445	x	42%	=	1,447	3,982	-	1,447	=	2,535
75%	4,109	-	1,576	=	2,533	x	42%	=	1,064	3,982	-	1,064	=	2,918
50%	3,196	-	1,576	=	1,620	x	42%	=	680	3,982	-	680	=	3,302
25%	2,284	-	1,576	=	708	x	42%	=	297	3,982	-	297	=	3,685
Alternative B	5,021	-	1,576	=	3,445	x	42%	=	1,447	3,982	-	1,447	=	2,535
Alternative C	3,371	-	1,576	=	1,795	x	42%	=	754	3,982	-	754	=	3,228

(1) Excludes lodging units proposed in alternative and other potential developments in the Grand Canyon/Tusayan area
(2) From model, estimated number of lodging units needed in Grand Canyon/Tusayan area based on 30% penetration, 75% occupancy, ___ moderate growth rate. A 75% occupancy rate is used because it more closely _____ables industry performance in this area
(3) Number of loding units above what is estimated from the model to be supportable in the Grand Canyon Tusayan area. These units would be built in the Grand Canyon/Tusayan area instead of other areas
(4) Based on 1994/95 Grand Canyon Visitor Survey
(5) Assumes Northern Arizona lodging market operates at an average occupany levle of 70%
* Possible levels of devleopment as 1 percentage of devleopement under Alternative B

Table 6-8 Community Net New Rooms Required Through 2010

Alternative	COMMUNITY IMPLICATIONS: 1997 - 2010 Total Estimated New Lodging Units that Could be Built in Region to Support GCNP Visitation Growth		Reduction in Potential New Lodging Units in Region Caused by Displaced Demand		Net New Lodging Units that Could be Built in Region
FLAGSTAFF - 39% of total demand captured by northern Arizona communities					
A/D/E					
100%	1,553	-	564	=	989
75%	1,553	-	415	=	1,138
50%	1,553	-	265	=	1,288
25%	1,553	-	116	=	1,437
B	1,553	-	564	=	989
C	1,553	-	294	=	1,259
WILLIAMS - 15% of total demand captured by northern Arizona communities					
A/D/E					
100%	597	-	217	=	380
75%	597	-	160	=	438
50%	597	-	102	=	495
25%	597	-	45	=	553
B	597	-	217	=	380
C	597	-	113	=	484
SEDONA - 15% of total demand captured by northern Arizona communities					
A/D/E					
100%	597	-	217	=	380
75%	597	-	160	=	438
50%	597	-	102	=	495
25%	597	-	45	=	553
B	597	-	217	=	380
C	597	-	113	=	484
PAGE - 8% of total demand captured by northern Arizona communities					
A/D/E					
100%	319	-	116	=	203
75%	319	-	85	=	233
50%	319	-	54	=	264
25%	319	-	24	=	295
B	319	-	116	=	203
C	319	-	60	=	258
OTHER - 23% of total demand captured by northern Arizona communities					
A/D/E					
100%	916	-	333	=	583
75%	916	-	245	=	671
50%	916	-	156	=	759
25%	916	-	68	=	847
B	916	-	333	=	583
C	916	-	173	=	742
TOTAL NORTHERN ARIZONA					
A/D/E					
100%	3,982	-	1,447	=	2,535
75%	3,982	-	1,064	=	2,918
50%	3,982	-	680	=	3,302
25%	3,982	-	297	=	3,685
B	3,982	-	1,447	=	2,535
C	3,982	-	754	=	3,228

Table 6-9 Community Net New Spending Attributed Through 2010

Alternative	COMMUNITY IMPLICATIONS: 1997 - 2010 Total New Spending Attracted in Community to Support GCNP Visitation Growth		Community Spending Reduced Potential because of Displaced Demand		Net New Spending Attributed in Community
FLAGSTAFF - 39% of total demand captured by northern Arizona communities					
A/D/E (No Act./Townsite/Min. Act.)					
100%	$55,550,810	-	$20,174,280	=	$35,376,530
75%	$55,550,810	-	$14,844,550	=	$40,706,260
50%	$55,550,810	-	$9,479,050	=	$46,071,760
25%	$55,550,810	-	$4,149,320	=	$51,401,490
B (Canyon Forest Village)	$55,550,810	-	$20,174,280	=	$35,376,530
C (Canyon Forest Village A P)	$55,550,810	-	$10,516,380	=	$45,034,430
WILLIAMS - 15% of total demand captured by northern Arizona communities					
A/D/E (No Act./Townsite/Min. Act.)					
100%	$21,354,690	-	$7,762,090	=	$13,592,600
75%	$21,354,690	-	$5,723,200	=	$15,631,490
50%	$21,354,690	-	$3,648,540	=	$17,706,150
25%	$21,354,690	-	$1,609,650	=	$19,745,040
B (Canyon Forest Village)	$21,354,690	-	$7,762,090	=	$13,592,600
C (Canyon Forest Village A P)	$21,354,690	-	$4,042,010	=	$17,312,680
SEDONA - 15% of total demand captured by northern Arizona communities					
A/D/E (No Act./Townsite/Min. Act.)					
100%	$21,354,690	-	$7,762,090	=	$13,592,600
75%	$21,354,690	-	$5,723,200	=	$15,631,490
50%	$21,354,690	-	$3,648,540	=	$17,706,150
25%	$21,354,690	-	$1,609,650	=	$19,745,040
B (Canyon Forest Village)	$21,354,690	-	$7,762,090	=	$13,592,600
C (Canyon Forest Village A P)	$21,354,690	-	$4,042,010	=	$17,312,680
PAGE - 8% of total demand captured by northern Arizona communities					
A/D/E (No Act./Townsite/Min. Act.)					
100%	$11,410,630	-	$4,149,320	=	$7,261,310
75%	$11,410,630	-	$3,040,450	=	$8,370,180
50%	$11,410,630	-	$1,931,580	=	$9,479,050
25%	$11,410,630	-	$858,480	=	$10,552,150
B (Canyon Forest Village)	$11,410,630	-	$4,149,320	=	$7,261,310
C (Canyon Forest Village A P)	$11,410,630	-	$2,146,200	=	$9,264,430
OTHER - 23% of total demand captured by northern Arizona communities					
A/D/E (No Act./Townsite/Min. Act.)					
100%	$32,765,320	-	$11,911,410	=	$20,853,910
75%	$32,765,320	-	$8,763,650	=	$24,001,670
50%	$32,765,320	-	$5,580,120	=	$27,185,200
25%	$32,765,320	-	$2,432,360	=	$30,332,960
B (Canyon Forest Village)	$32,765,320	-	$11,911,410	=	$20,853,910
C (Canyon Forest Village A P)	$32,765,320	-	$6,188,210	=	$26,577,110
TOTAL NORTHERN ARIZONA					
A/D/E (No Act./Townsite/Min. Act.)					
100%	$142,436,140	-	$51,759,190	=	$90,676,950
75%	$142,436,140	-	$38,095,050	=	$104,341,090
50%	$142,436,140	-	$24,287,830	=	$118,148,310
25%	$142,436,140	-	$10,659,460	=	$131,776,680
B (Canyon Forest Village)	$142,436,140	-	$51,759,190	=	$90,676,950
C (Canyon Forest Village A P)	$142,436,140	-	$26,934,810	=	$115,501,330