GRAND CANYON
NATIONAL PARK
AIRPORT
MASTER PLAN,
FINAL REPORT

# Report

## GRAND CANYON NATIONAL PARK AIRPORT MASTER PLAN

FINAL REPORT
INVENTORY
AVIATION FORECASTS
DEMAND/CAPACITY ANALYSIS
AIRPORT REQUIREMENTS
AIRPORT PLANS
FINANCIAL PLAN
ENVIRONMENTAL REVIEW

Prepared For
ARIZONA DEPARTMENT OF TRANSPORTATION
AERONAUTICS DIVISION
ADAP Project No. 6-04-0019-13



March 1985

LEEDSHILL-HERKENHOFF, INC.

111 West Monroe
Suite 718 - Phone (602) 252-0412
Phoenix, Arizona 85003

ENGINEERS ARCHITECTS

We, the undersigned, hereby certify that these documents were prepared by us, or directly under our supervision, and are true and correct to the best of our knowledge and belief.

Registered Engineer No. 11174

Registered Engineer No. 15485

**LEEDSHILL-HERKENHOFF, INC.**
Arizona Title Building
111 West Monroe, Suite 718
Phoenix, Arizona 85003
(602) 252-0412

James L. Webster, PE

March 29, 1985

Mr. Sonny Najera, Director
Aeronautics Division
Arizona Department of Transportation
1801 W. Jefferson
Phoenix, Arizona 85007

RE: GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN, ADAP #6-04-0019-13

Dear Mr. Najera:

The accompanying report is the result of our study of the Grand Canyon National Park Airport and the development of a Master Plan for this facility. This introductory letter includes a brief summary of the proposed Master Plan for an overview of the entire study.

EXECUTIVE SUMMARY

Purpose

The purpose of this study is to identify short and long term aviation demands at the Grand Canyon National Park Airport (GCN) and to establish guidelines for improving or expanding facilities to accommodate that demand. The Master Plan is sponsored by the airport owner, The Arizona Department of Transportation, Aeronautics Division.

Existing Facility

The Grand Canyon National Park Airport is situated on a 859 acre site six miles south of the South Rim of the Grand Canyon National Park, near the community of Tusayan. The airport adjoins the Kaibab National Forest on the north, west, and south and Tusayan on the east. GCN is a certificated air carrier airport with regularly scheduled service by Republic Airlines using DC-9-10 aircraft. Currently, approximately 90% of arriving passengers utilize smaller commuter aircraft in association with sightseeing overflights of the Grand Canyon.

Projected Aviation Activity

Projected aviation activity including aircraft operations, passenger movements as well as secondary activity is developed from existing historic records. Usable passenger records are available for the preceding four years and usable aircraft operations records are available for the preceding ten years.

[illegible] HERRENHOFF, INC.

[illegible]

March 29, 1985

Mr. [illegible], Director
Aeronautics Division
Arizona Department of Transportation
[illegible] W. Jefferson
Phoenix, Arizona 85007

RE: GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN, ADAP [illegible]

Dear Mr. [illegible]:

The accompanying report is the result of our study of the Grand Canyon National Park Airport and the development of a Master Plan for this facility. This introductory letter includes a brief summary of the proposed Master Plan for an overview of the entire study.

EXECUTIVE SUMMARY

Purpose

The purpose of this study is to identify the present and future aviation demands at the Grand Canyon National Park Airport and to establish guidelines for improving or expanding facilities to accommodate the demand. The Master Plan is sponsored by the airport owner, the Arizona Department of Transportation, Aeronautics Division.

Existing Facility

The Grand Canyon National Park Airport is located [illegible] six miles south of the South Rim of the Grand Canyon National Park, near the community of Tusayan. The airport [illegible] on the north, west, and south [illegible]. The airport is a certificated air carrier airport with regularly scheduled service by [illegible] Airlines using DC-9-10 aircraft. Currently, [illegible] of arriving passengers utilize smaller commuter aircraft in association with sightseeing overflights of the Grand Canyon.

[illegible] Aviation Activity

Present aviation activity includes aircraft operations, passenger enplanements as well as secondary activity [illegible] from existing records. [illegible] records are available for the preceding four years and [illegible] records are available for the preceding ten years.

A forecasting model is developed from these records using multiple linear regression. The independent variables used in the model are the Gross National Product, Consumer Price Index, Foreign Travel Expenditures and Effective Exchange Rate with aircraft operations used as a dependent variable. Forecasts for the independent variable were obtained from Chase Econometrics. When combined with the regression analysis, they form the basis for projected aviation activity. Emplanement and operations forecasts are summarized in Table II-27 (page II-36).

In order to accommodate projected traffic, additional runway capacity is required; a parallel runway is proposed for the 1993-1996 time period.

Airport Requirements

Airport facilities to accommodate the projected demand can feasibly be developed at the present airport site. Additional property is required on the north for a future parallel secondary runway, on the southwest for future extension of the primary runway and south of the present terminal area for a heliport, air traffic control tower relocation and auxiliary airport uses. All of this property lies within the Kaibab National Forest.

The following table summarizes the existing airport facility and the ultimate proposed facility.

Major improvements include the following:

Heliport

Relocating the heliport from Tusayan onto airport property will provide better air traffic control and an opportunity to limit noise and exposure of the public to low-altitude helicopter operations.

Aircraft Parking

Expanded parking areas for commuter aircraft are configured to optimize passenger safety and provide adequate parking areas for present and projected commuter aircraft during daytime layovers. A new itinerant ramp extends southwest parallel to the existing runway from the existing ramp to the beginning of the slurry base property. A taxi lane, limited to small commuter aircraft, helps in traffic circulation and provides access to the ramp area from the major runway.

Terminal

Terminal expansion is based on a central terminal concept in the area of the present terminal which would serve the air carrier, occasional and smaller commuter operators, concessions such as rental cars, restaurant, etc. and administrative functions. Satellite mini-terminals along the itinerant ramp expansion are proposed. The commuter ramp would be divided into segments with

controlled passenger loading and unloading walkways or terminal fingers associated with the satellite mini-terminals for short term passenger holding. It is proposed that the commuter airlines lease these ramps and associated satellite facilities which can be configured for each operator's needs. Ground transportation to the satellite terminals would be provided by tour group transportation such as buses or vans or by an airport shuttle bus to the main terminal complex. Additional parking and access roads are provided.

Air Traffic Control Tower

The air traffic control tower (ATCT) is relocated to a site on the south side of Runway 3/21 to provide adequate visibility of the heliport as well as improved runway visibility and to remove the ATCT from the airspace of the proposed secondary runway. The site is located outside the existing airport boundary in National Forest land to allow adequate ATCT height for visibility of the taxilane.

Residences, Maintenance and Service Buildings

Residences, maintenance and service buildings have been relocated onto the new parcel of land to be acquired for the new heliport and ATCT. Residences are relocated outside the LDN 65 contour. A large area with suitable topography is available for maintenance and service buildings.

Water System

Upgrading and expansion of the water collection, storage and treatment system are proposed to provide adequate fire protection and treated consumable water. The water facilities are relocated into a central utility area south of the present terminal. The location is outside the present boundary in order to provide adequate elevated water storage height without penetrating the transitional airspace surface.

Runway

The present NE/SW runway is to be extended 1700 ft. to 10,700 ft. to accommodate B-727 class aircraft. A secondary parallel runway designed for light aircraft use is proposed to supplement the main runway and provide adequate capacity. The secondary runway will be located north of the present runway separated by adequate distance to allow independent visual approaches.

Access

Separate access from Arizona Highway 64 is provided for the FBO-General Aviation area and for the heliport. The heliport road also provides utility and ATCT access and both roads provide secondary access to the terminal areas. Direct access to the satellite terminals is provided by re-routing the present access road.

controlled passenger loading and unloading walkways or terminal fingers associated with the satellite mini-terminals for short term passenger holding. It is proposed that the commuter airlines lease these ramps and associated satellite facilities which can be configured for each operator's needs. Ground transportation to the satellite terminals would be provided by tour group transportation such as buses or vans or by an airport shuttle bus to the main terminal complex. Additional parking and access roads are provided.

Air Traffic Control Tower
The air traffic control tower (ATCT) is relocated to a site on the south side of Runway 3/21 to provide adequate visibility of the heliport as well as improved runway visibility, and to remove the ATCT from the airspace of the proposed secondary runway. The site is located outside the existing airport boundary on National Forest land to allow adequate ATCT height for visibility of the runways.

Residences, Maintenance and Service Buildings
Residences, maintenance and service buildings have been relocated onto the new parcel of land to be acquired for the new heliport and ATCT. Residences are relocated out of the line of contours. A large area with suitable topography is available for maintenance and service buildings.

Water System
Upgrading and expansion of the water collection, storage and treatment system are proposed to provide adequate fire protection and treated consumable water. The water facilities are relocated into a central utility area south of the present terminal. The location is outside the present boundary in order to provide adequate elevated water storage height without penetrating the transitional airspace surface.

Runway
The present NE/SW runway is to be extended 700 ft. to 6,700 ft. to accommodate B-737 class aircraft. A secondary parallel runway designed for light aircraft use is suggested to supplement the main runway and provide adequate capacity. The secondary runway will be located north of the present runway separated by adequate distance to allow independent visual approaches.

Access
Separate access from Arizona Highway 64 is provided for the FBO-General Aviation area and for the heliport. The heliport road also provides utility and ATCT access and both roads provide secondary access to the terminal area. Direct access to the satellite terminals is provided by relocating the present access road.

Initial Development

The initial development stages are clearly defined. Their implementation will correct existing deficiencies and meet short term needs. All short term developments should be compatible with the long term plan.

Land Use

Initiate modifications to Coconino County Zoning Ordinance to provide airport and community protection from excessive noise exposure. A combination of noise attenuating construction and some land use restrictions will ensure airport compatibility without unduly hampering Tusayan or surrounding development. A height limiting addition to the zoning ordinance is required to protect airport approaches from antennas or other tall structures.

Since the airport represents a large percentage of the privately owned land in the area it has a major contribution to activities. As airport owner, ADOT should work with the community of Tusayan, the Park Service, the Forest Service and Coconino County to maintain smooth operation of area activities.

Property

Initiate actions to obtain use or transfer of Kaibab National Forest lands for airport purposes. This will require an EIS and should encompass all proposed property.

Immediate Construction

Ramp expansion and obstruction removal should proceed immediately. Locations for satellite terminals and potential commuter leased ramp and loading facilities will be available adjacent to the currently designed commuter ramp.

Heliport

The heliport facility should be constructed as soon as the property is available. If undue delays occur in property transfer, available airport property should be developed into a interim heliport as soon as possible.

Water System

The water system improvement should be constructed to upgrade fire protection and provide service for the heliport facility as soon as the property is available.

Access

Construction of a second access from Arizona Highway 64 to service the heliport and adjacent airport facilities is required. Re-routing of the current access road to provide direct access to the commuter apron and a third access from Arizona Highway 64 to serve the FBO/GA area is all proposed.

Air Traffic Control Tower

The ATCT should be relocated to the proposed site as soon as the land is available. Since this is an FAA facility, funding coordination should be initiated as soon as feasible.

Air Carrier Terminal

The air carrier expansion with loading docks, associated terminal remodeling and utility improvements should be initiated as soon as funding can be arranged to eliminate crowded terminal conditions.

Fuel Facilities

The present fuel facilities require relocation from under the Runway 21 approach for added safety. In lieu of relocation, the above ground hydrant facilities could be relocated with the tanks remaining in their present location.

FBO/GA Apron

This additional parking area is proposed to accommodate both GA itinerant use as well as increased based commuter use.

Long Term Development

Long term developments such as the parallel runway, additional terminal space, additional ramp space and similar items are more conjectural than the initial developments. Need for these elements of the long range plan should be established before construction planning begins. Long lead time activities which are not irreversible such as land use controls and transfer of property should commence immediately to preserve the potential for ultimate airport development.

Accurate aircraft traffic and passenger movement records must be kept to provide a basis for updating the Master Plan which should be done before major airfield expansion is undertaken. Better Grand Canyon National Park records on visitor arrivals by air would also provide needed additional data. A random sampling survey to provide passenger trip data, aircraft use and other data to establish a reliable data base for updating the forecasting model in the Master Plan is recommended.

It has been a pleasure working with you and your staff on this project and we are confident the planning elements developed during the course of the study will assist in useful and orderly development of the airport. If there are any questions or comments concerning the data presented herein, please do not hesitate to contact us.

Sincerely,

Jas. L. Webster — Clinton Dodge

JAMES L. WEBSTER, P.E. — CLINTON F. DODGE, P.E.

bz

## AIRPORT FACILITIES (Cont'd.)

### Existing

Helicopter Operations Located in Tusayan

General Facilities:
- Fencing: Perimeter - Barb Wire
  Terminal Area - Chain Link
- Terminal Building: 9531 SF
- General Aviation Ramp: Area 17,000 SY
  Tiedowns 34
- Air Carrier and Commuter Ramp: Area 29,000 SY
- Fire and Rescue Building: 2100 SF
- Equipment & Shop Buildings: 4512 SF
- Residences: 6
- Water: Provided by airport
- Electrical: APS
- Wastewater: South Grand Canyon Sanitary District

### Ultimate

Heliport:
- Take off and Landing Area: 100 ft. x 100 ft.
- Peripheral Area: 20 ft. wide minimum
- Taxiway Width: 20 ft.
- Parking Spot: 65 ft. dia.
- Clearance: 10 ft. minimum
- Approach Surface Slope: 8:1

General Facilities:
- Fencing: Perimeter - Barb Wire
  Terminal Area: Chain Link
- Terminal Building: 102,000 SF
- General Aviation Ramp: 58,760 SY
- Air Carrier Ramp: 16,000 SY
- Commuter Ramp: 128,760 SY
- Fire and Rescue Building: 4000 SF
- Equipment & Shop Building: 9000 SF
- Residences: Potential relocation area
- Water: Provided by Airport
- Electrical: APS
- Wastewater: South Grand Canyon Sanitary District

Name: Grand Canyon National Park Airport
Ownership: State of Arizona
Operator: Arizona Department of Transportation
Aeronautics Division
Location: Airport Reference Point: Lat. 35°57'16"
Long. 112°08'37"
Airport Elevation: 6611.7' MSL
Mean Max Temp. - Hottest Month: 85.6°F - July
Magnetic Inclination: 13°48' ±E (from NOS, May 1980)
Total Land Area: 858.66 Acres
Air Traffic Control Tower: FAA - Hours 0800-1800 daily
Runway 3/21 (NE-SW):
- Length: 9,000 ft.
- Width: 150 ft.
- Effective Gradient: 0.844%
- Taxiway: Parallel, 75 ft. wide
- Wind coverage (15 MPH): - 98.8%
- Pavement: Asphaltic Concrete - 108,000 # Dual
- Lighting: MIRL-MITL
- Principal Subgrade Class: E-7
- Clear Zones: 3-50:1
  21-34:1
- Navigational Aids: VOR-DME, VASI, ILS, GS,
  LOC, MALSR
- Runway Category: 3 - Precision
  21 - Nonprecision

Name: Grand Canyon National Park Airport
Ownership: State of Arizona
Operator: Leased

Location: Airport Reference Point: Lat. 35°57'8.4"
Long. 112°08'51.4"
Airport Elevation: 6611.7' MSL
Mean Max Temp. - Hottest Month: 85.6°F - July
Magnetic Inclination: 13°48' ±E
Total Land Area: 1358 ± Acres
Air Traffic Control Tower: FAA (relocated)
Runway 3R/21L (NE-SW Primary Runway):
- Length: 10,700 ft.
- Width: 150 ft.
- Effective Gradient: 0.664%
- Taxiway: 75 ft. wide
- Wind coverage: (15 MPH): 98.8%
- Pavement: Asphaltic Concrete - 158,000 # Dual
- Lighting: MIRL-MITL
- Principal Subgrade Class: E-7
- Clear Zones: 3-50:1
  21-34:1
- Navigational Aids: VOR-DME, VASI, ILS, GS
  LOC, MALSR
- Runway Category: 3 - Precision
  21 - Nonprecision

Runway 3L/21R (NE-SW Seconary Runway)
- Length: 8,000 ft.
- Width: 75 ft.
- Effective Gradient: 0.887%
- Taxiway: Parallel, 50 ft.
- Wind Coverage (15 MPH): 98.8%
- Pavement: Asphaltic Concrete - 12,500 # Single
- Lighting: None
- Principal Subgrade Class: E-7
- Clear Zones: 3-20:1
  21-20:1
- Runway Category: Utility

## NOTICE

The material contained herein has been prepared under a grant provided by the Federal Aviation Administration of the Department of Transporation as provided by the Airport and Airway Development Act of 1970.

The contents of this report reflect the views of Leedshill-Herkenhoff, Inc., who is responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the offical views or policy of the FAA. Acceptance of this report by the FAA does not in any way constitute a commitment on the part of the United States to participate in any development depicted therein nor does it indicate that the proposed development is environmentally acceptable in accordance with Public Laws 91-190, 91-258, and/or 90-495.

The material contained herein has been prepared under a grant provided by the Federal Aviation Administration of the Department of Transportation as provided by the Airport and Airway Development Act of 1970.

The contents of this report reflect the views of Leedshill-Herkenhoff, Inc., who is responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the offical views or policy of the FAA. Acceptance of this report by the FAA does not in any way constitute a commitment on the part of the United States to participate in any development depicted therein nor does it indicate that the proposed development is environmentally acceptable in accordance with Public Laws 91-190, 94-353, and/or 90-495.

TABLE OF CONTENTS

List of Tables

Page

List of Tables (Cont'd.)



List of Figures

List of Figures (Cont'd.)



Appendices

# CHAPTER I

## INVENTORY

### A. GENERAL:

The Grand Canyon National Park Airport, situated on approximately 859 acres, is located just south of the town of Tusayan and six miles south from the rim of the Grand Canyon. It is accessible by automobile from State Highway 64 which connects to the East-West Interstate 40 from Williams, 50 miles south. The Canyon is visited by approximately 2.7 million tourists each year with more than ten percent of these arriving by plane or taking advantage of the numerous aerial tours available. Consequently, the Grand Canyon Airport is the third busiest air carrier airport in the State of Arizona, following Phoenix Sky Harbor and Tucson International.

The Grand Canyon area experiences cool temperatures in the 19 degree (low) to 50 degree (high) range in the winter and 40 degree (low) to 85 degree (high) range in the summer. The sun shines an average of 79 percent of the year with annual precipitation average of 14.46 inches of rainfall and 64 inches of snow.

The elevation of the Airport is approximately 6,600 feet, one mile above the bottom of the Canyon where the closest source of water lies. Although the Airport has a water catch basin, nearby Tusayan Village and Moqui Lodge must truck water in from Williams or Grand Canyon Village.

The town of Tusayan has a year-round population of approximately 260 residents. The area is oriented to tourism and is comprised primarily of motels, eating establishments and other seasonal facilities.

Grand Canyon Village has several hotels and tourist facilities, ranging from mule trips to the bottom of the Canyon to elegant dining at the lodges. There are hiking trails, a post office, recreational rentals and services, amenities for personal comfort, fuel and a campground.

The Airport is operational 24 hours per day and is currently staffed with an airport manager, a maintenance supervisor, five building and maintenance workers, a secretary and a janitor.

The 9,000 foot runway accommodates the Republic Airlines' DC9 as well as aircraft of over 40 commuter and air taxi operators. Annual aircraft operations have increased to 101,847 during fiscal 1982.

The State-owned and maintained physical facilities include:

1. Runway, taxiways and parking aprons
2. The terminal building
3. Six modular homes
4. A fire house
5. Workshop and storage area
6. An equipment storage building
7. A water catch basin system including one 125,000 gallon above-ground and a 475,000 gallon underground storage tank.

The Federal Aviation Administration (FAA) maintains and operates several facilities: Airport Traffic Control Tower, VOR-DME, VASI, MALS, RAIL and Localizer and glide slope equipment and antennas.

A fixed-base operator (FBO), Grand Canyon Airlines, provides transient services in accordance with the rates and fees established by Administrative Rule #R-17-2-06. The FBO occupies its own terminal and operates a maintenance hangar located on the extreme north end of the aircraft parking apron.

The Airport is a certificated Air Carrier Airport under Federal Aviation Regulation (FAR) Part 139 and is currently operating under an amended security plan (FAR Part 108, Category III). The Airport is presently (October 1983) operated by the Arizona Department of Transportation - Aeronautics Division. Plans are being implemented to lease the operations of the facility to a private operator.

B. EXISTING AIRFIELD FACILITIES:

The Grand Canyon National Park Airport (referred to in the report by the FAA identifier GCN) is the primary air facility serving the Grand Canyon National Park. Other airports in the vicinity include airports with scheduled air carrier service at Flagstaff and Page, Arizona; a general aviation airport at Williams, Arizona and various dirt strips in the general area including one on the north rim of the Grand Canyon.

The airport location is shown on Figure I-1, Location Map and the relationship of the airport with the south rim facilities of the Grand Canyon National Park is shown on Figure I-2, Vicinity Map. The physical airport facilities are shown on Figure I-3, Airport Facilities and Figure I-4, Airport Site and are summarized in the following table.

TABLE I-1
Airport Facilities

Name: Grand Canyon National Park Airport

Ownership: State of Arizona

Operator: Arizona Department of Transportation - Aeronautics Division (Current)

Location: Portions of Sections 23, 24, 25, 26, 27, 34 and 35, T30N, R2E and Section 3, T29N, R2E Gila and Salt River Base and Meridan.
Airport Reference Point: Lat. 35°57'16"
Long. 112°08'37"

Airport Elevation: 6611.12' MSL

Mean Max Temp. - Hottest Month: 85.6°F - July

Magnetic Inclination: 13°48'±E

Total Land Area: 858.66 Acres

Air Traffic Control Tower: FAA - Hours 0800-1800 daily

TABLE I-1 (Cont'd.)

Runway 3/21 (NE-SW):

Length: 9000 ft.

Width: 150 ft.

Effective Gradient: 0.844%

Taxiway: Parallel, 75 ft. wide

Wind Coverage (15 MPH): 98.8%
(only 1.2% of the time does the crosswind component exceed 15 MPH)

Pavement: Asphaltic Concrete - 108,000#Dual

Lighting: MIRL-MITL

Principal Subgrade Class: E-7

Clear Zones: 3-50:1
21-34:1

Navigational Aids: VOR-DME, VASI, ILS, MALSR

Runway Category: 3 - Precision Instrument Approach
21 - Nonprecision Instrument Approach

General Facilities:

Fencing: Perimeter - Barb Wire
Terminal Area - Chain link

Terminal Building: 9531 SF

General Aviation Ramp: Area 17,000 SY
Tiedowns 34

Air Carrier Ramp: Area 29,000 SY

Fire and Rescue Building: 2100 SF

Equipment & Shop Buildings: 4512 SF

Residences: 6

Water and Wastewater: See Sections D and E

Electrical: Vault in Terminal, supplied by 12 KV
Feeder Line from APS Distribution

Fixed Base Operator Facilities:

Terminal (Grand Canyon Airlines): 8384 SF

Fuel Storage: Jet-A - 24,000 gal.
Avgas 100/130 - 52,000

Hangar: 10,000 SF

The airport property was transferred from the United States Government on February 6, 1967 under Section 16 of the Federal Airport Act of 1946 as amended by the Federal Aviation Act of 1958 to the State of Arizona. The grantor was the United States Department of Agriculture, Forest Service. The property is surrounded on three sides by the Kaibab National Forest and abutted on the northeast by private property contained in the Village of Tusayan.

The property ownership in the vicinity of the airport is shown on Figure I-5, Property Ownership Map. Tract X-107 shown on this map and identified as Mining Claim 12108 on Figure I-3 is surrounded by airport property and contains the rain tank cattle pond. This property has been condemned by the State and title transfer is in process. Preliminary discussions between the State and the National Forest Service regarding acquisition of additional land by trade for the airport have been held. This additional property is beyond the scope of this report.

Initial airport construction was accomplished in 1967 and rapid facility expansion occurred during the 1970's. A partial list of improvements and their approximate date follows:

| | |
|---|---|
| 1965-1967 | FAAP No. 9-02-027-0402. Construct Runway 3/21, 150'x 5800' with 75' Parallel Taxiway, Drainage System, Perimeter Fence, MIRL, Access Road and Parking, and Aircraft Parking. |
| 1967 | TVOR by FAA. |
| 1968 | FAAP No. 9-02-027-03. General Aviation Parking Area. |
| 1968 | Terminal Building. |
| 1971 | Airport Manager Housing. |
| 1972 | ADAP No. 8-04-0019-01&02. Extend Runway 3/21 to 9000' with Parallel Taxiway. |

| | |
|---|---|
| 1973 | ADAP No. 8-04-0019-03. Runway and Taxiway Strengthening. |
| 1973 | ADAP No. 8-04-0019-04. Fire and Rescue Equipment Building. |
| 1974 | ADAP No. 8-04-0019-05. Air Carrier Ramp Expansion, Runway and Taxiway Strengthening and General Aviation Parking Apron Expansion. |
| 1977 | Grand Canyon Airline Terminal (Private). |
| 1977 | ADAP No. 8-04-0019-05. Air Carrier Ramp Expansion. |
| 1978 | ADAP No. 6-04-0019-08 (N-830-902). Equipment Storage Building. |
| 1980 | ADAP No. 6-04-0019-10. Porous Friction Course Overlay of Runway 3/21. |
| 1980 | ADAP No. 6-04-0019-11 (N-830-504). Entrance and Service Road Improvements and Additions and Remodeling of Terminal Building. |
| 1979-82 | Medium Intensity Approach Light System and Instrument Landing System by FAA. |
| 1982 | N-830-509. Staff Housing |

C. CURRENT PROJECTS:

Three current projects will have significant impact on the physical and operational aspects of the airport.

1. <u>Tree Removal</u>: Numerous trees penetrate the airspace surfaces identified in FAA Regulation Part 77. Recent installation and activation of the instrument landing system allows lower approaches to the airport in marginal visibility conditions rendering these obstructions much more serious

than previously when visual flight rules were in effect. The obstructions are located in virtually all quadrants of the airspace and in some cases are quite close to the runway. Thus it is not possible to alter operational procedures to minimize conflicts. ADOT has prepared plans and specifications for removal of the obstructions on airport property.

2. Ramp Expansion: A project to extend the aircraft parking ramp approximately 1500 ft. to the southwest is to be accomplished in the near future. This expansion should relieve present congestion on the parking ramp.

3. Operations lease: ADOT is planning to lease the operations and development of the airport facility to a private enterprise. The lease package includes operations of the existing facilities as well as potential expansion. Development of auxiliary facilities such as lodging, housing, resorts, etc. are also included.

D. WATER SYSTEM

1. Introduction: This section and the included graphics present the results of an inventory of the existing water system serving the Grand Canyon National Park Airport. The following paragraphs provide: (1) a basic description of the system including existing water sources and historical uses; (2) an inventory of the existing water facilities; and (3) the result of a condition survey of the facilities.

2. General Description: The water system presently serving the Grand Canyon National Park Airport is a combination of components designed and constructed over the past nineteen years. The basic backbone system is comprised of a precipitation collection basin, transfer pump station, a raw water reservoir and pump sump, a treatment system, the treated water reservoir, a hydropneumatic pressure system, and distribution piping and was constructed as part of the original airfield and terminal construction in 1965-1967. The period up to 1977 included only expansion of the distribution

system including fire hydrants and domestic services associated with the expansion of airport facilities. In 1977, a new ground storage reservoir, transmission main, and upgraded transfer booster station pump were constructed and installed as major additions to the system. A new water line to the Federal Aviation Administration's new control tower was also constructed. From 1977 to the present, components added to the system have been mainly distribution facilities associated with expansion of airport facilities. Figures I-7 and I-8 present a schematic and layout of the water system.

a. Water Sources: Probably the most scarce resource in the regional area in which the Airport is located is water. The Airport presently relies totally on two sources of supply: (1) storm water runoff and (2) imported (trucked) water.

Storm water runoff is captured in a catch basin located between the runway and taxiway adjacent to the terminal area and in a collection system from the roof of the terminal building. This is the primary source of supply and in wet or normal years, has met the majority of the water needs of the Airport operations.

The Airport has had to rely on imported water to supplement storm runoff. The imported water is purchased from the National Park Service facilities at the Grand Canyon National Park or from the Town of Williams, Arizona, located approximately 50 miles south of the Airport. This imported water is trucked to the Airport from either location.

b. Water Uses: Since water is such a valuable resource, two systems for the various water uses have been constructed at the Airport. One system supplies treated water for domestic uses such as drinking, personal washing and concessions in the terminal, employee housing, control tower, fixed base operations and equipment facilities. The second system is a raw water system for non-consumptive uses at the terminal building such as toilet flushing, landscape irrigation and fire protection (sprinklers and hydrants). Both of these systems will be described in detail later in this section.

The amount of water used over the years has been measured by recording water levels in three storage facilities: the two raw water reservoirs and the treated water reservoir. However, the available information does not include measurement of the quantities and timing of water that are transferred between the raw water storage facilities. It is not possible to determine exactly the historical amounts of water used for both domestic and non-domestic uses from the records.

A record of the amount of water treated, recorded by a totalizing meter located at the discharge end of the carbon filter, is available. The water conditioning process is generally initiated when the water level in the treated water reservoir falls below a level of 5 feet 7 inches. The process is stopped when the water level reaches 7 feet to 7 feet 6 inches. Since this procedure appears to be consistently followed, the meter records can provide a good approximation of historical domestic water use.

Table I-2, Record of Water Filtered, presents a monthly tabulation of meter readings since January 1970, as well as calculations of Average Day - Peak Month and Average Hour - Peak Month.

With the value placed on water by airport operations and the conservation measures implemented at the airport, it is estimated that domestic water use represents 70% of total water (treated and untreated) used. With this assumption, total historical water usage is estimated to be:

| | |
|---|---|
| 1971 | 1,072,200 gallons |
| 1975 | 1,001,300 gallons |
| 1980 | 3,185,200 gallons |
| 1982 | 1,781,700 gallons |

3. Existing Water Facilities Inventory:

a. Collecting System: The main collection system was constructed in 1965 to collect storm water runoff. The system consists of a dike and retention basin located at the north end of the runway, between the runway

TABLE I-2

Record of Water Filtered in Gallons

(Metered Flows in gals. x 1000)

| YEAR | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Totals | Average Day- Peak Month | Average H Peak Mont |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1970 | --- | --- | --- | --- | 50.8 | 76.4 | 120.6 | 87.2 | 74.6 | 60.1 | 41.4 | 51.0 | 562.1 | 3.89 | 0. |
| 1971 | 70.8 | 55.0 | 57.2 | 54.4 | 65.9 | 70.3 | 84.1 | 79.6 | 55.7 | 60.4 | 56.7 | 40.4 | 750.5 | 2.71 | 0. |
| 1972 | 38.6 | 27.0 | 54.3 | 49.5 | 60.2 | 67.6 | 104.9 | 95.5 | 40.4 | 44.7 | 22.8 | 38.5 | 644.0 | 3.38 | 0. |
| 1973 | 44.1 | 85.2 | 92.3 | 65.3 | 56.2 | 51.4 | 87.4 | 76.7 | 80.0 | 69.4 | 30.0 | 65.3 | 803.3 | 2.98 | 0. |
| 1974 | 40.6 | 31.0 | 52.7 | 56.5 | 60.0 | 75.5 | 135.3 | 85.1 | 66.3 | 62.0 | 75.0 | 97.0 | 837.0 | 4.36 | 0. |
| 1975 | 31.4 | 27.4 | 33.0 | 66.0 | 70.2 | 73.0 | 91.0 | 88.1 | 65.0 | 65.4 | 43.0 | 47.4 | 700.9 | 2.94 | 0. |
| 1976 | 40.3 | 33.3 | 54.2 | 57.0 | 107.4 | 92.4 | 103.1 | 131.0 | 106.3 | 81.4 | 71.2 | 55.4 | 933.0 | 3.46 | 0. |
| 1977 | 60.8 | 43.4 | 63.7 | 75.5 | 91.0 | 106.1 | 112.0 | 124.5 | 95.5 | 108.0 | 75.2 | 68.4 | 1024.1 | 4.02 | 0. |
| 1978 | 137.6 | 96.4 | 96.4 | 120.0 | 151.0 | 143.1 | 176.2 | 191.2 | 152.0 | 134.5 | 129.4 | 78.9 | 1606.7 | 6.17 | [illegible] |
| 1979 | 75.5 | 81.0 | 94.2 | 274.2 | 154.2 | 157.0 | 164.5 | 189.8 | 181.0 | 173.0 | 136.3 | 99.0 | 1779.7 | 9.14 | [illegible] |
| 1980 | 561.3 | 0.0 | 285.4 | 135.5 | 161.4 | 160.2 | 177.0 | 206.3 | 157.3 | 141.1 | 133.2 | 110.9 | 2229.6 | 9.21 | [illegible] |
| 1981 | 105.9 | 102.0 | 123.2 | 136.0 | 174.4 | 171.0 | 172.7 | 94.2 | 77.0 | 113.0 | 82.5 | 100.0 | 1451.9 | 5.63 | [illegible] |
| 1982 | 95.4 | 81.6 | 152.5 | 217.3 | 112.2 | 90.9 | 84.2 | 79.6 | 75.2 | 106.3 | 111.0 | 41.0 | 1247.2 | 7.24 | [illegible] |
| 1983 | 59.9 | 60.5 | 66.5 | 97.9 | 76.1 | 99.4 | 98.1 | 95.3 | --- | --- | --- | --- | 653.7 | 3.31 | [illegible] |

Source: Water Filter Records, Grand Canyon Airport, Arizona Department of Transportation, 1983.

and the taxiway. The dike provides a basin with a theoretic capacity for approximately 986,000 gallons on approximately 7.6 acres of basin before storm water passes over the dike.

Captured water flows into a three foot square by eight foot deep catch basin with a capacity of approximately 518 gallons located at the upstream foot of the dike. The catch basin serves as a suction sump for the transfer pump station located 14 feet away under the dike. A 20 horsepower horizontally mounted centrifugal pump pulls water from the catch basin through a six-inch pipe and pumps to storage at the rate of 350 gallons per minute.

b. Raw Water Storage: The existing system has two facilities for the storage of raw water; a steel ground storage tank with a capacity to overflow of 124,251 gallons and an underground rectangular concrete reservoir with a capacity to overflow of 379,701 gallons.

The transfer storage pump station lifts water from the catch basin to a ground storage reservoir located at an elevation of 6674.50 on a rise east of the terminal. The reservoir is a steel tank with a radius of 15 feet, a height of 24 feet, and a capacity (to overflow at elevation 6698.00) of 124,252 gallons. An altitude valve lies in a vault at the base of the tank, but it is not currently operational. This tank feeds water to the main raw water storage facility, by gravity head and through 1,460 feet of 10" asbestos cement pipe. Raw water is transferred from the 10" water main, through the fire hydrant at the northeast corner of the terminal building into the main raw water storage reservoir using fire hoses.

The main raw water storage facility is an underground rectangular concrete reservoir located just north of the terminal building. The reservoir is 90 feet in length, 47 feet in width, and 14.17 feet deep. With the bottom elevation sloped from 6598.88 feet to 6598.38 feet and an overflow elevation of 6610.63 feet, the capacity to overflow is approximately 379,701 gallons including the outfall sump at the south end. The reservoir is connected to a raw water sump, located under the west end of the terminal's mechanical room, via a 30" concrete pipe with 30" slide gate. The pipe has an inlet invert elevation in the raw water reservoir of 6600.88 feet and an outlet invert elevation in the raw water sump of 6597.88 feet and is approximately 63.67 feet in length.

The raw water sump is also a rectangular, concrete structure. It is 9 feet in length, 4.83 feet in width, and 16.83 feet in depth with bottom elevation of 6596.38 feet. Capacity is calculated to be 4,636 gallons, being controlled by the raw water reservoirs overflow elevation of 6610.63 feet.

The total capacity of raw water storage, including the steel tank, concrete underground reservoir, raw water sump and 30 inch connecting pipe is approximately 510,927 gallons considering respective overflows.

c. Water Treatment: Raw water is conditioned for domestic use in a three stage treatment process located in the mechanical room of the terminal. A 1/2 horsepower, 10 gallon per minute pump lifts water from the raw water sump to the first stage of conditioning which is sand filtration. Two 26 inch diameter steel tanks, each filled with 12 cubic feet of sand media (0.08 mm effective size) are set up in parallel for primary filtration.

All filtered water is then passed through one 26 inch diameter tank filled with approximately 9 cubic feet of activated carbon for secondary filtration. Finally, secondary filtered water is disinfected using a hypo-chlorinator. The treatment system's maximum capacity is 13 gallons per minute.

Treated water is stored in a rectangular concrete reservoir under the south end of the mechanical room. It is 36.33 feet in length, 14.00 feet in width, and 9.96 feet deep with bottom elevation at 6603.66 feet. Capacity is calculated to be 32,836 gallons to the overflow elevation of 6611.16 feet. The treated water reservoir also acts as the chlorine contact chamber for disinfection.

d. Domestic Water Pressure System: Treated water is distributed for domestic use throughout the terminal building, FAA control tower, employee housing, equipment buildings and other airport facilities using a hydropneumatic system located in the terminal building's mechanical room. The system is composed of a 4 foot diameter, hydropneumatic pressure tank (vertically mounted). The 130 cubic foot capacity, 1/4 inch steel tank is rated for a maximum working pressure of 75 psi and 150 psi maximum test pressure. With air supplied by a 1/2 horsepower air compressor, the pneumatic tank maintains an operating system pressure range of from 55 psi to 75 psi at the headworks of the system. The volume of water in the tank ranges from 263± gallons (35.2 cubic feet) at high water level to 122± gallons (16.3 cubic feet) at low water level.

The distribution to facilities other than the adjoining terminal building is through 2" PVC pipe.

e. Fire Protection System: The fire protection system for the terminal area is composed of a high head, direct discharge system for hydrants in front of the terminal building and along the aircraft apron, and a separate pneumatic pressure system for fire sprinklers in the terminal building.

When water is needed for fire fighting on the apron, a manually operated three stage, 75 horsepower, 1000 gpm vertical turbine pump, located over the raw water sump in the mechanical room, suctions water from the raw water sump and feeds the hydrants with an average working pressure of 95 psi at the pump. The hydrant and piping network includes 6 and 8 inches asbestos cement pipe feeding two hydrants on the east side of the terminal building and 6 hydrants on the west side of the terminal building along the east perimeter of the aircraft parking apron.

A separate, small hydropneumatic pressure system, also located in the mechanical room, provides raw water for the fire sprinkler network throughout the terminal building.

4. Condition Survey:

a. Physical Condition: A survey of the physical condition was conducted in September 1983. Major findings include the following:

(1) Collection System: The asphaltic surface of the catch basin is deteriorating with cracks and spalling is evident. Loose particles of debris are scattered throughout and could be carried with water flows to the drop inlet. The drop inlet has some sediment in the bottom but appears to have been cleaned periodically. The transfer pump station and pump appears to be physically in good condition.

(2) Raw Water Storage: Although inspection of the condition of the 1220 feet of 4-1/2" O.D. steel pipe was impossible without exposing it, reports indicated no apparent leakage problems (installed in 1965). Similar reports were indicated for the 6" (700 feet) and 10" (1,050 feet) asbestos cement pipe (installed in 1977) continuing to the 124,251 gallon storage tank.

The 124,251 gallon above ground storage tank appears to be in good condition. However, according to reports, the interior has not been cleaned of sediment or checked since installation in 1977. The overflow piping's screen was not attached. An inspection of the valve vault at the base of this tank was conducted. The concrete vault is in good condition. However, the altitude valve appears to be non-operational.

The interior of the main raw water storage facility located adjacent to the terminal building was inspected in 1981-82 by airport personnel. At that time, no evidence of cracks or leaks was found. Three inches of sediment was found in the bottom. The overflow outlet could not be located. The 30" slide gate is not operating and needs to be repaired in order to isolate the main raw water storage facility when required.

The raw water sump appears to be in good physical condition but has not been visually inspected for structural condition or cleaned of sediment (probably minimal due to hydraulic conditions). The sump is tied to the main underground reservoir and floats with its level. The float valve controlling water feed directly from the 124,251 gallon hill tank is not operational and has been dismantled. This indicates that the line valve is either closed or non-existent (it could not be located). The access hatch cover needs repair and a seal installed to prevent contamination by oils, grease, etc.

(3) Water Treatment: Equipment for conditioning water appear to be well maintained and in good condition. The interior of the sand and carbon filters could not be inspected. Media is being changed periodically and disinfection equipment is in good condition.

The treated water reservoir could not be inspected structurally due to the water level. The access hatch cover is in good condition. The original fresh water, vertical turbine pump is not operating and has been replaced with a smaller submersible pump. The Vertical turbine pump needs to be replaced or rebuilt and put back in the system as the primary pump for the pressure system.

(4) Domestic Water Pressure System: The hydropneumatic tank appears to be in good condition as there was no visible water leakage and air volume was being maintained. The air compressor is old but is in good condition and well maintained. Pressure gauges need to be removed and calibrated periodically.

(5) Fire Protection System: The high head fire pump located in the mechanical room of the terminal building appears to be in good condition. However, it was reported that this vertical turbine pump has not been actuated for any length of time over at least the last fourteen months. Likewise, the 6 and 8 inch fire line (1,550 feet) and hydrants (7) have not been exposed to pressures greater than the maximum 39 psi hydrostatic head produced by the 124,251 gallon hill tank. Given that the majority of these mains were constructed in 1965 of asbestos cement pipe, this system should be actuated to check the pump, pipe and hydrant performance.

The hydropneumatic fire sprinkler system is in excellent condition and reported to be inspected annually by the State Fire Marshall.

b. Pressure Testing: During the inventory and condition survey, pressure tests were taken at key points in the water system. The results are presented in Table I-3.

TABLE I-3

Static Pressure Test Results

RAW WATER SYSTEM[1] (gravity system normally and as tested, pressure system under fire conditions)

| Apron Hydrants (north to south) | Static Pressures (psi) |
|---|---|
| 1 | 29 |
| 2 | 29 |
| 3 | 30 |
| 4 | 32 |
| 5 | 33 |
| 6 | 32 |
| **Terminal Hydrants (north to south)** | |
| 1 | 28 |
| 2 | 27 |
| Terminal hose bibb | 30 |

DOMESTIC WATER SYSTEM[2] (pressure system)

| Employee Housing | |
|---|---|
| Unit 1 | 27 |
| Unit 5 | 34 |
| Equipment Shop | 44 |
| Terminal (sink in Manager's offices) | 57 |

[1]Water level elevation in raw water tank at time of test = 6689.50 feet

[2]Pressure gauge at pressure tank in mechanical room = 68 psi

E. WASTEWATER SYSTEM

1. Introduction: This section and the included graphics present the results of a general overview of the existing wastewater system serving the Grand Canyon National Park Airport. The following paragraphs provide a basic description of the system.

2. General Description: The wastewater system presently serving the Grand Canyon National Park Airport has developed over the past nineteen years from a septic tank type system with septic tanks located at various points around the airport, to a collection system with outfall to a larger, centralized treatment facility located in Tusayan. Figure 1-6 depicts the layout of the existing collection system.

The construction in 1965 of the initial airport facilities included a septic tank and leach field for disposal of wastewater. Expansion of facilities over the years to 1981 included additional septic tank and leach field facilities as listed below:

| | |
|---|---|
| Terminal Building | 1 - 2000 gallon |
| Crash, Fire & Rescue Bldg. & Grand Canyon Airlines Bldg. | 1 - 1000 gallon |
| Control Tower | 1 - 750 gallon |
| Employee Housing | 3 - 750 gallon |

In 1980, an 8 inch PVC collection system and outfall was constructed. Wastewater is collected and conveyed through this system to a lagoon type wastewater treatment facility located about one-half mile northwest of the Grand Canyon Squire Inn in Tusayan. This treatment facility is owned and operated by the South Grand Canyon Sanitary District to which the airport pays a monthly fee for treatment and disposal of all the airport's wastewater.

F. APPLICABLE LAWS AND ORDINANCES

1. Federal:

   a. Public Law 79-377 Federal Airport Act, May 13, 1956.

   b. Public Law 85-726 Federal Aviation Act, August 23, 1958.

   c. Public Law 91-190 Environmental Policy Act of 1969.

   d. Public Law 91-248 Airport and Airway Development Act of 1970.

   e. Public Law 970248 Airport and Airway Improvement Act of 1982, September 3, 1982.

2. State of Arizona:

   a. Arizona Revised Statutes 28-108(17) Operation and Maintenance of the Grand Canyon National Park Airport.

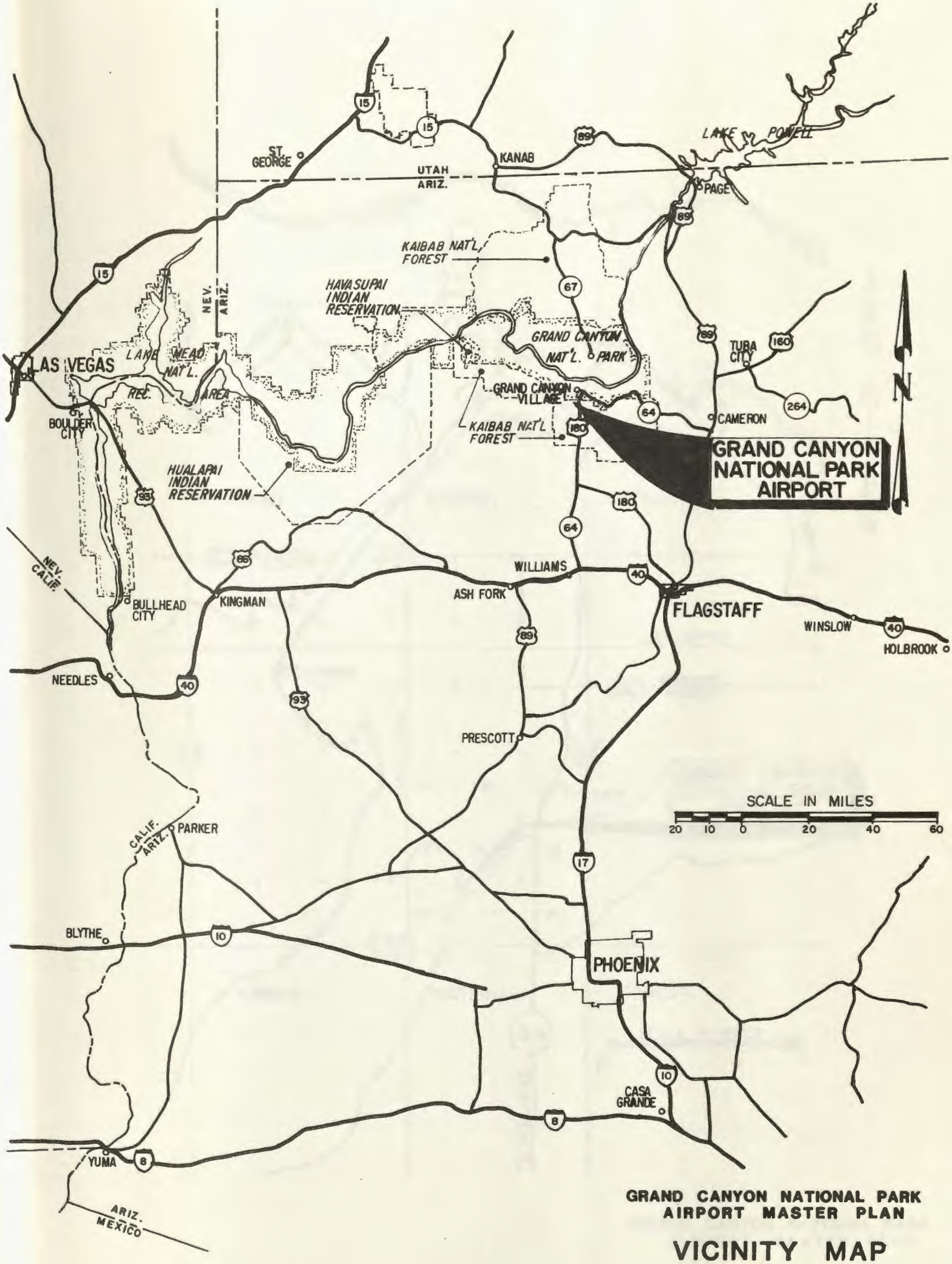
   b. ADOT - Aeronautics Division R17-2-02 Minimum Requirements for fixed base.

   c. ADOT - Aeronautics Division R17-2-04 Payment of Landing Fees for Commercial Aircraft landing at Grand Canyon Airport.

   d. ADOT - Aeronautics Division R17-2-06 Establishment of Fees and Charges for Services and Use of Facilities and Equipment at the Grand Canyon National Park Airport.

3. Local:

No municipal or county laws or ordinances covering land use, zoning or environmental protection specific to airport operations have been adopted.

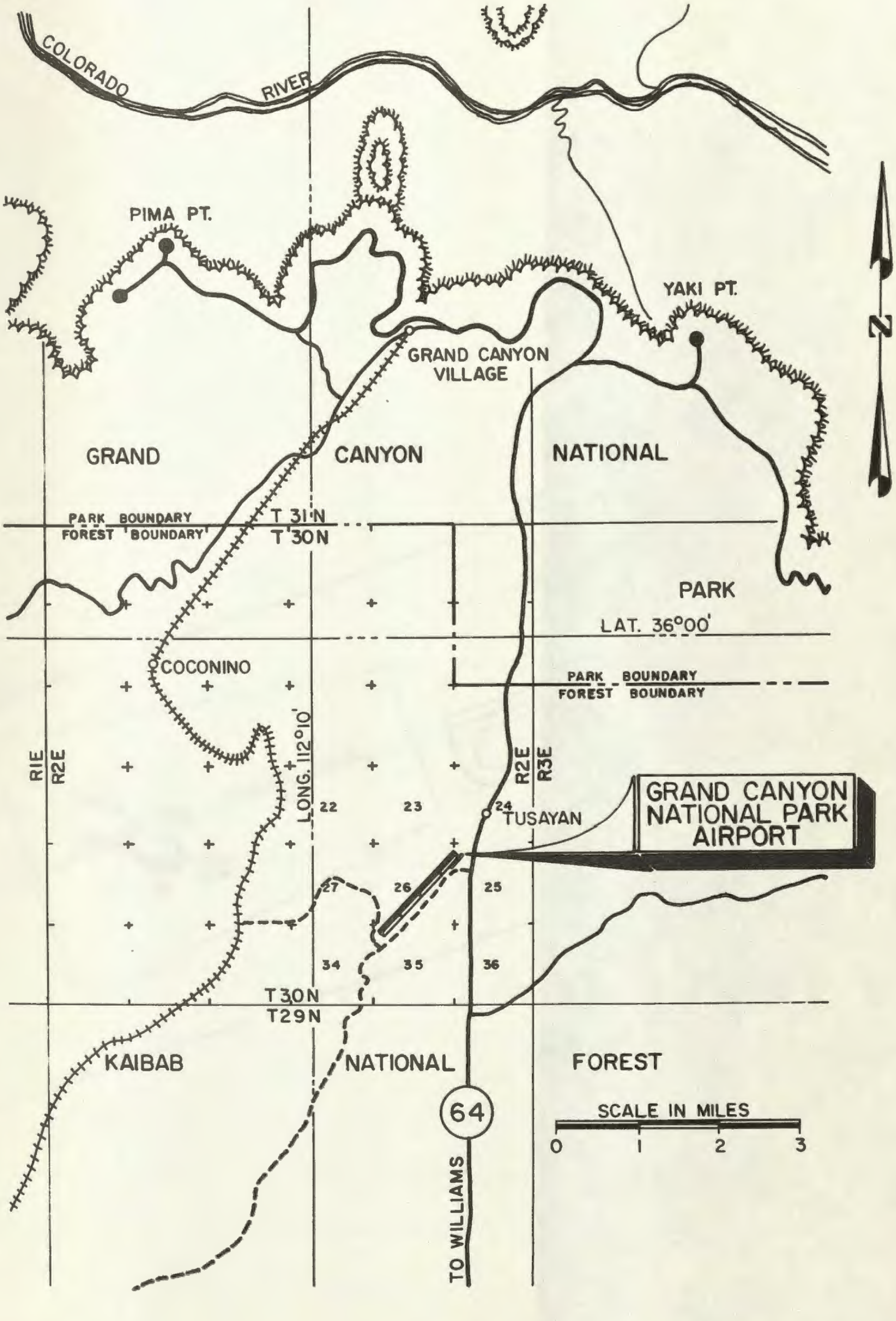



**GRAND CANYON NATIONAL PARK AIRPORT MASTER PLAN**

## VICINITY MAP

LEEDSHILL - HERKENHOFF, INC.

**FIGURE I-1**

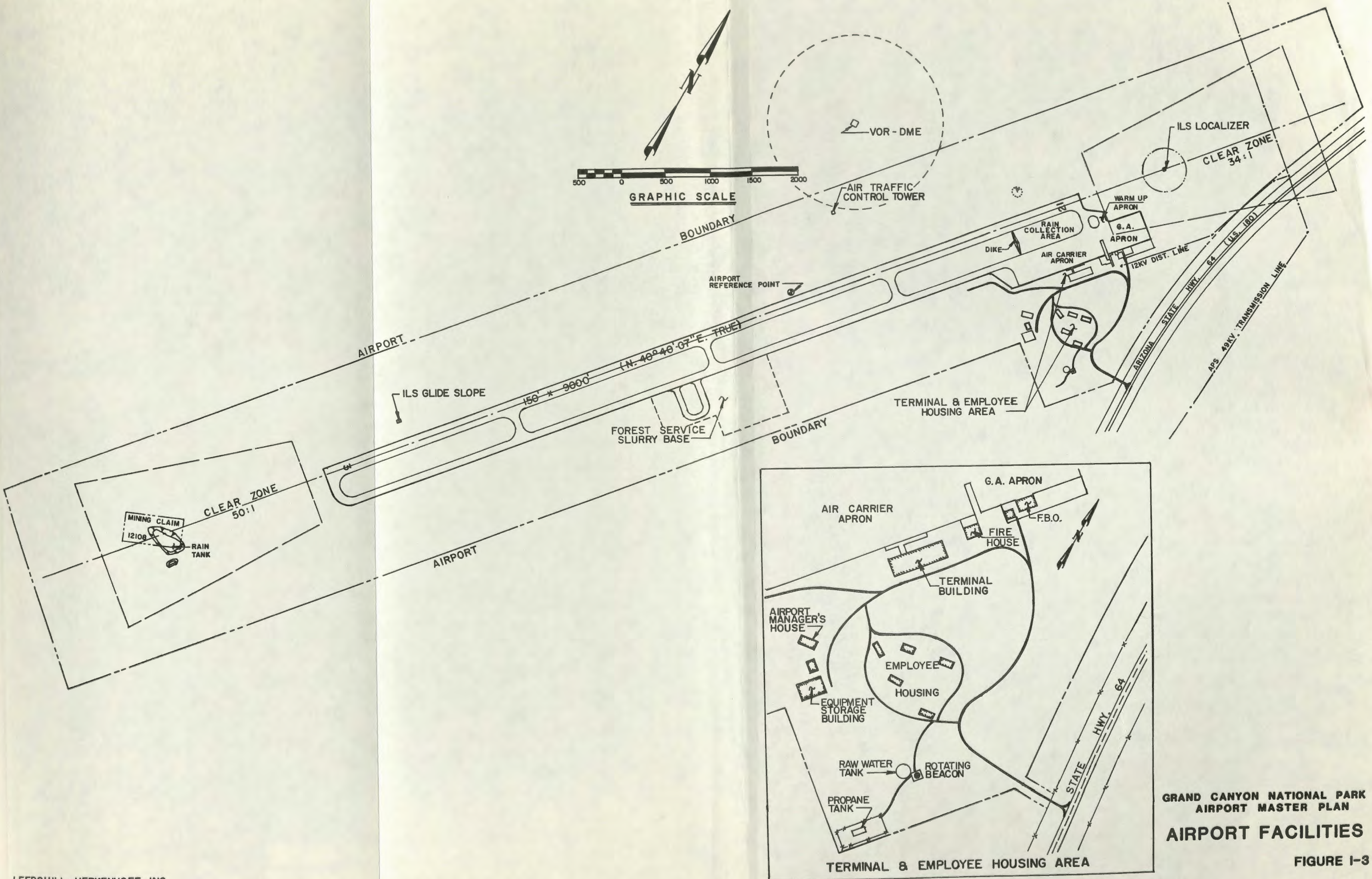



**GRAND CANYON NATIONAL PARK AIRPORT MASTER PLAN**

## LOCATION MAP

LEEDSHILL-HERKENHOFF, INC.

**FIGURE I-2**

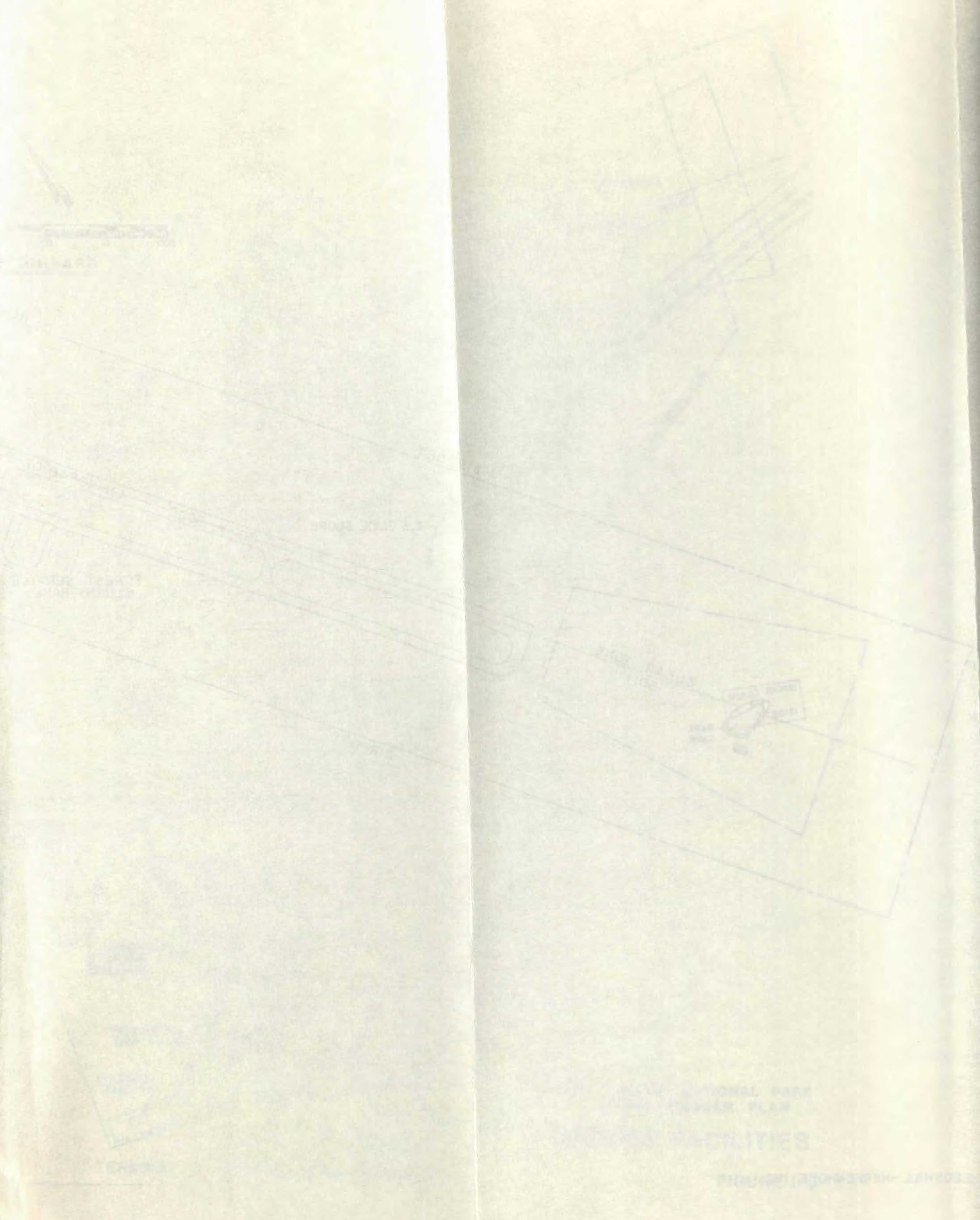


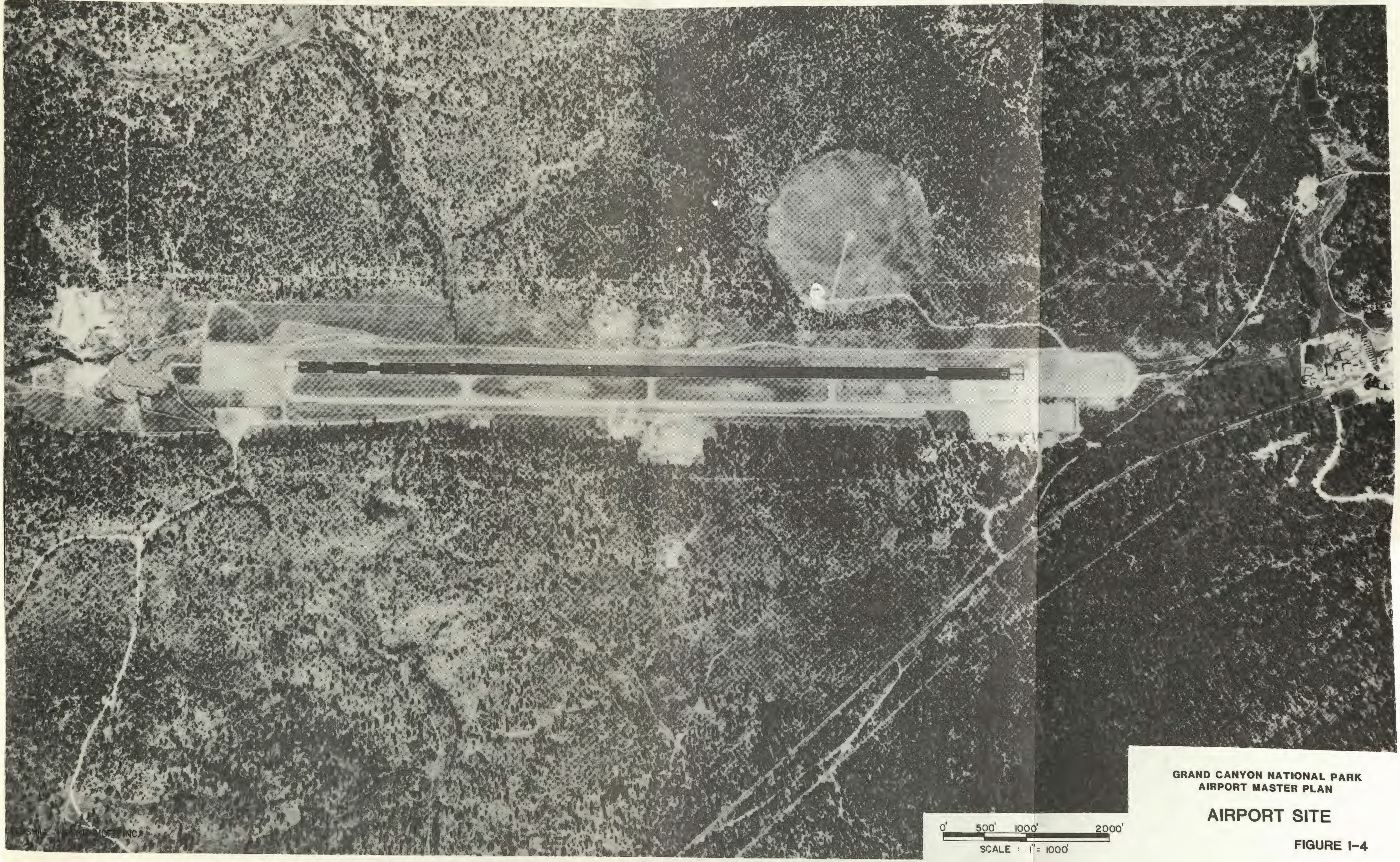

GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN

**AIRPORT FACILITIES**

FIGURE I-3

LEEDSHILL-HERKENHOFF, INC.


PLAN
FACILITIES




GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN

AIRPORT SITE

FIGURE I-4

| STATUS NO. | OWNER |
|---|---|
| X5, X15 | Gail Rivas<br>Sedona, Az. |
| | Eric Gueissaz<br>Grand Canyon, Az. |
| X19 | Marvin Hatch<br>c/o |
| X56, X58 | Marvin Hatch<br>c/o |
| X96 | Grover Kennedy Oil Co.<br>Oklahoma City, Ok. |
| X105 | Santa Fe R.R. Co. |
| X107 | Marvin Hatch<br>c/o |
| X40, X67 | Joseph & Theodore Kotzin<br>Los Angeles, Ca. |
| X68, X71, X72 etc. | R.P. Thurston<br>Grand Canyon, Az. |

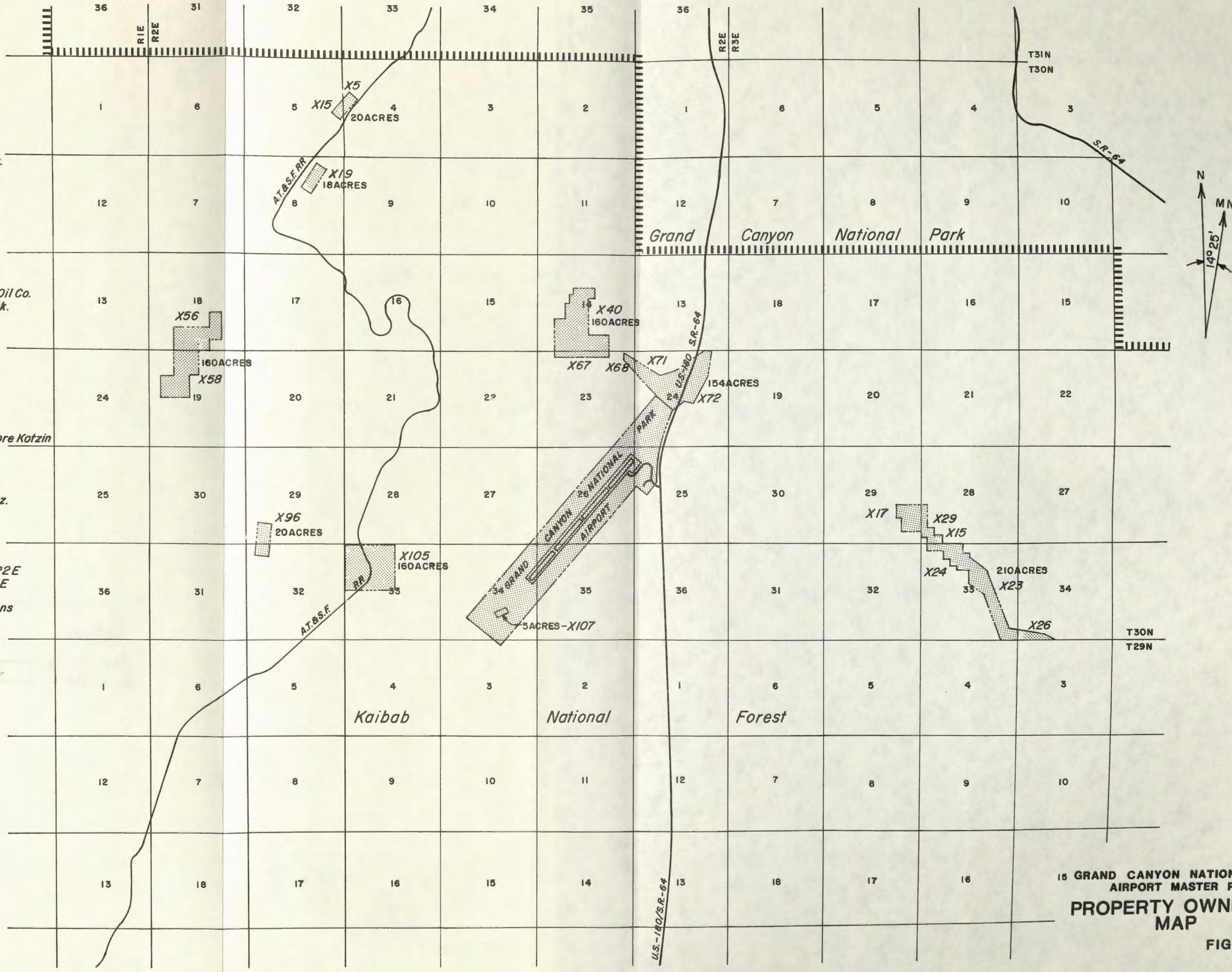
c/o = Ames Bros. Cattle Inc.
Winslow, Az.

The above lands are in T30N, R2E
The below land is in T30N, R3E

| | |
|---|---|
| X15, X17, X23, X24, X26 etc. | Gregg L. Gibbons<br>Rillito, Az. |

LEGEND

Private Land

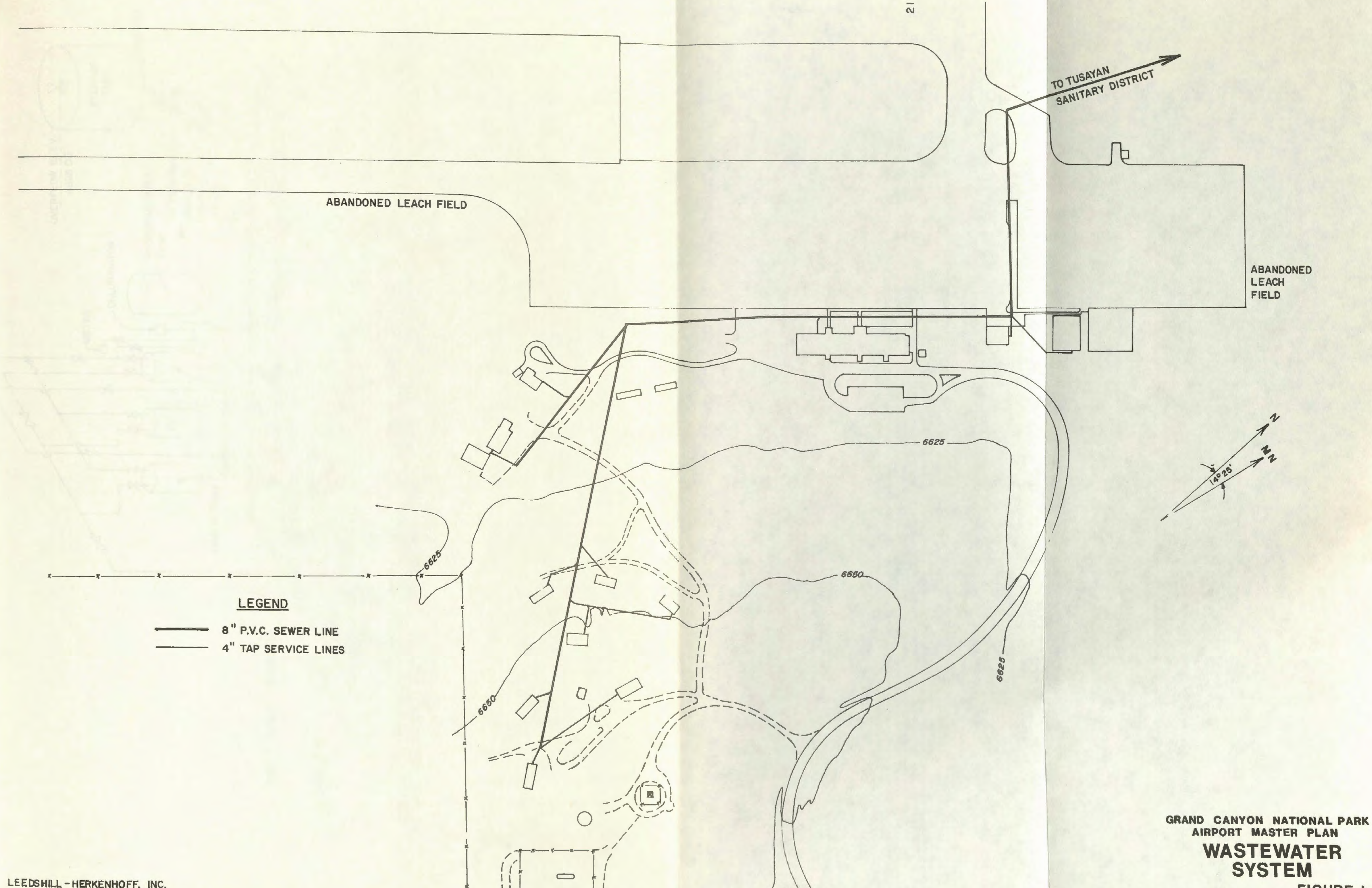



LEEDSHILL - HERKENHOFF, INC.

15 GRAND CANYON NATIONAL PARK AIRPORT MASTER PLAN

PROPERTY OWNERSHIP MAP

FIGURE I-5

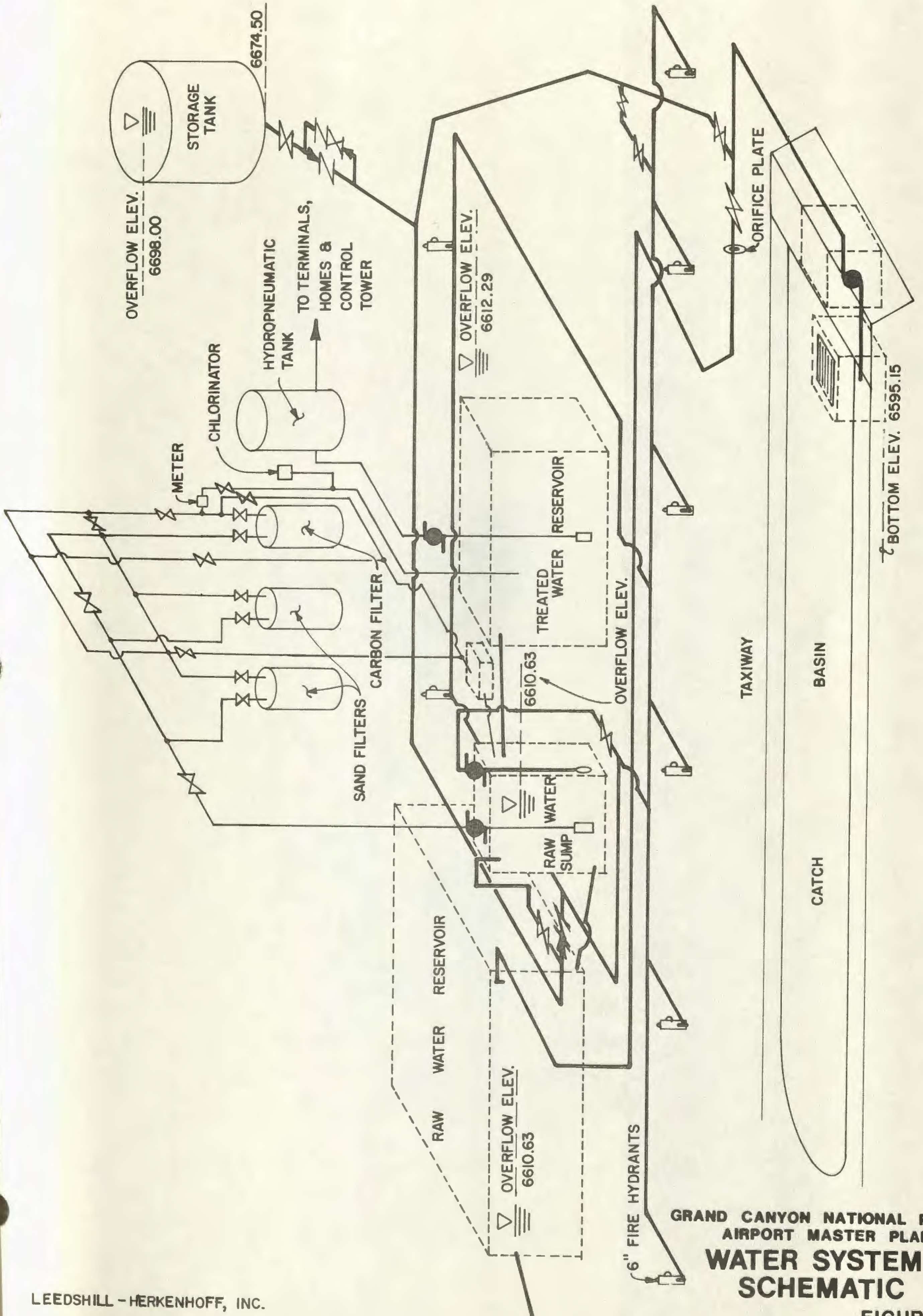



LEEDSHILL-HERKENHOFF, INC.

GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN

**WASTEWATER SYSTEM**

FIGURE I-6

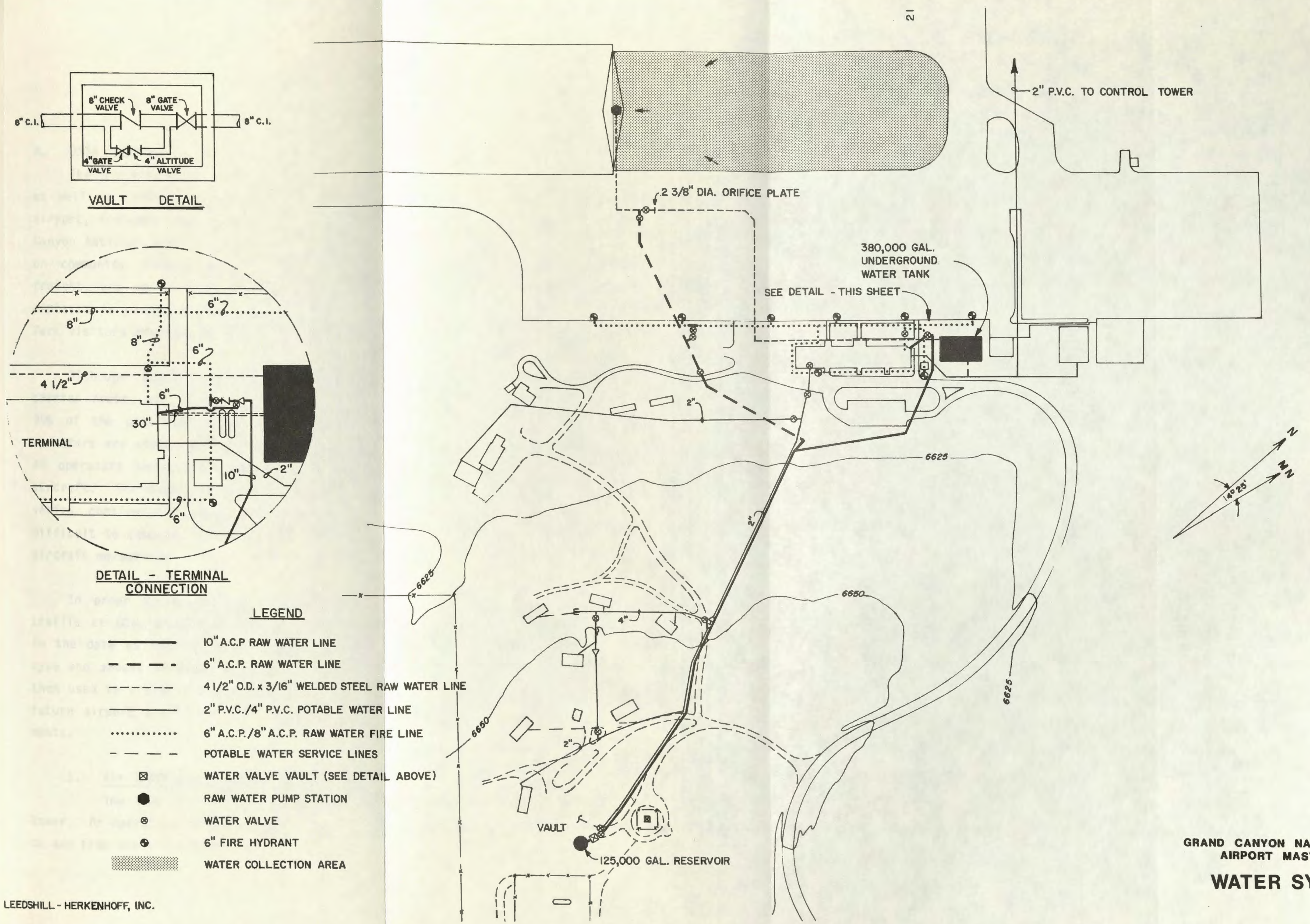



GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN

# WATER SYSTEM SCHEMATIC

FIGURE I-7

LEEDSHILL-HERKENHOFF, INC.




LEEDSHILL - HERKENHOFF, INC.

GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN

## WATER SYSTEM

FIGURE I-8

## CHAPTER II
## AVIATION DEMAND FORECASTS

### A. DATA RECORDS

The historic data records for aircraft operations and visitors to GCN, as well as information derived from other sources in the vicinity of the airport, indicate that the primary traffic generator for the airport is Grand Canyon National Park visitation. Traffic generators for a more typical urban or community airport such as business travel, flight training, and air freight, are not a major source of activity at GCN. Consequently, special emphasis is placed on data resources which categorize Grand Canyon National Park visitors arriving by air, or using the airport facilities.

Although Republic Airlines provides service on a certificated air carrier route; air taxi, commuter and charter operators carry approximately 90% of the passenger traffic. Typical aircraft which are used by these operators are single and twin engine airplanes with 7 to 10 seats. More than 40 operators serve this market, owning fleets of one to twenty or more aircraft. The availability and completeness of aircraft operation records varies considerably among the different carriers. As a result, it is difficult to compare records and arrive at accurate tallies for passenger and aircraft movements.

In order to develop an accurate profile of the type and amount of traffic at GCN, historical data was collected and tabulated. Discrepancies in the data as well as missing data were evaluated and an estimate for the type and amount of traffic was then developed. The entire body of data was then used to create a statistical model which would be useful for predicting future airport traffic at GCN and subsequently determining airport requirements.

#### 1. <u>Air Traffic Control Tower (ATCT) Data</u>

The FAA ATCT maintains records of each operation handled by the tower. An operation is any approach or any departure. Thus a typical flight to and from the airport comprises two operations. All air traffic is designated as either itinerant or local, based upon operations within a 25 mile radius. However, in actual operation, if the aircraft leaves the traffic pattern, it is typically counted as a itinerant operation. Helicopter flights from the helispots in Tusayan are incorporated in the traffic records as intinerant air taxi flights starting in May 1981. A tabulation of operations by month for 1980 through August 1983 is contained in Table II-1.

The FAA maintains annual operations records grouped by aircraft category and forecasts operations levels for manpower and funding plans. These historic records and the FAA projections from both the FAA Activity Report and the FAA Terminal Area Forecasts (TAF) are presented in Table II-2 and II-3. The forecasting methodology in the Activity Report (Table II-2) is a trend analysis based on historic aviation activity while the Terminal Area Forecasts also include national economic factors. The TAF is generally considered to be more reliable.

The historic data on Table II-1, II-2, and II-3 represent the actual aircraft served by the ATCT. The hours and periods of operation of the ATCT at Grand Ganyon, reported by the tower chief from available records, are as follows:

| Year | Hours | Period |
|---|---|---|
| 1973 | 7:00 a.m. to 7:00 p.m. | Open June 18 - September 30 |
| 1974 | 7:00 a.m. to 7:00 p.m. | Open May 1 - October 19 |
| 1975 | 7:00 a.m. to 7:00 p.m. | Open May 1 - October 15 |
| 1976-1980 | 7:00 a.m. to 7:00 p.m. Summer<br>8:00 a.m. to 6:00 p.m. Winter | Opened permanent ATCT May 1 |
| 1981 | 8:00 a.m. to 6:00 p.m. | Reduced hours year around started October 1, 1981 |

To utilize the ATCT records for forecasting, a common operational period or time has been established for all of the historical records. Currently the ATCT operates 10 hours each day and the best available daily data is based on these hours. Therefore, a 10 hour ATCT base day has been assumed, and the historical data has been adjusted to account for the varying

TABLE II-1

Monthly Operations at GCN

| | ITINERANT | | | | | LOCAL | | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| | A.C. | A.T. | G.A. | MIL. | TOTAL | CIVIL | MIL. | TOTAL | OPS. |
| 1980 | | | | | | | | | |
| JAN | 202 | 1964 | 492 | 10 | 2668 | 229 | | 229 | 2897 |
| FEB | 200 | 2332 | 818 | 127 | 3477 | 446 | 52 | 498 | 3975 |
| MAR | 277 | 3589 | 972 | 210 | 5048 | 224 | 34 | 258 | 5306 |
| APR | 264 | 5075 | 1062 | 33 | 6434 | 164 | | 164 | 6598 |
| MAY | 316 | 7695 | 1248 | 18 | 9277 | 422 | 26 | 448 | 9725 |
| JUN | 202 | 7810 | 1500 | 8 | 9520 | 298 | 28 | 326 | 9846 |
| JLY | 154 | 9192 | 1900 | 6 | 11252 | 455 | 12 | 467 | 11719 |
| AUG | 130 | 11485 | 1680 | 31 | 13326 | 422 | 2 | 424 | 13750 |
| SEP | 148 | 8511 | 1461 | 23 | 10143 | 154 | 22 | 176 | 10319 |
| OCT | 146 | 6118 | 1454 | 15 | 7733 | 184 | 4 | 188 | 7921 |
| NOV | 160 | 4523 | 1066 | 9 | 5758 | 124 | 4 | 128 | 5886 |
| DEC | 138 | 2730 | 776 | 16 | 3660 | 103 | 38 | 141 | 3801 |
| TOTAL | 2337 | 71024 | 14429 | 506 | 88296 | 3225 | 222 | 3447 | 91743 |
| 1981 | | | | | | | | | |
| JAN | 140 | 3270 | 940 | 26 | 4376 | 108 | 30 | 138 | 4514 |
| FEB | 116 | 3040 | 840 | 18 | 4014 | 140 | 6 | 146 | 4160 |
| MAR | 136 | 3334 | 778 | 24 | 4272 | 274 | 20 | 294 | 4566 |
| APR | 175 | 5798 | 1099 | 33 | 7105 | 387 | 18 | 405 | 7510 |
| MAY | 228 | 10004 | 1317 | 47 | 11596 | 300 | 8 | 308 | 11904 |
| JUN | 258 | 12054 | 1278 | 12 | 13602 | 244 | 22 | 266 | 13868 |
| JLY | 233 | 12667 | 1467 | 16 | 14383 | 284 | 2 | 286 | 14669 |
| AUG | 222 | 14275 | 1516 | 13 | 16026 | 226 | 12 | 238 | 16264 |
| SEP | 184 | 9735 | 1375 | 21 | 11315 | 240 | 22 | 262 | 11577 |
| OCT | 195 | 8286 | 1240 | 23 | 9744 | 130 | 14 | 144 | 9888 |
| NOV | 132 | 6900 | 1104 | 19 | 8155 | 106 | 4 | 110 | 8265 |
| DEC | 124 | 2872 | 756 | 18 | 3770 | 86 | 6 | 92 | 3862 |
| TOTAL | 2143 | 92235 | 13710 | 270 | 108358 | 2525 | 164 | 2689 | 111047 |
| 1982 | | | | | | | | | |
| JAN | 87 | 1794 | 474 | 35 | 2390 | 68 | 36 | 104 | 2494 |
| FEB | 109 | 2492 | 670 | 21 | 3292 | 56 | 4 | 60 | 3352 |
| MAR | 130 | 3592 | 650 | 49 | 4421 | 114 | 14 | 128 | 4549 |
| APR | 160 | 6663 | 1045 | 32 | 7900 | 134 | 12 | 146 | 8046 |
| MAY | 221 | 8992 | 1321 | 18 | 10552 | 126 | 2 | 128 | 10680 |
| JUN | 210 | 9254 | 1131 | 28 | 10623 | 174 | 2 | 176 | 10799 |
| JLY | 217 | 10615 | 1186 | 31 | 12049 | 244 | | 244 | 12293 |
| AUG | 186 | 13422 | 1144 | 28 | 14780 | 377 | 10 | 387 | 15167 |
| SEP | 176 | 8599 | 979 | 3 | 9757 | 150 | 10 | 160 | 9917 |
| OCT | 180 | 7748 | 1072 | 12 | 9012 | 126 | 28 | 154 | 9166 |
| NOV | 108 | 3629 | 839 | 42 | 4618 | 40 | 0 | 40 | 4658 |
| DEC | 105 | 2280 | 596 | 12 | 2993 | 58 | | 58 | 3051 |
| TOTAL | 1889 | 79080 | 11107 | 311 | 92387 | 1667 | 118 | 1785 | 94172 |
| 1983 | | | | | | | | | |
| JAN | 118 | 2378 | 569 | 33 | 3098 | 67 | | 67 | 3165 |
| FEB | 98 | 2825 | 526 | 16 | 3465 | 44 | 2 | 46 | 3511 |
| MAR | 108 | 3951 | 633 | 42 | 4734 | 68 | 8 | 76 | 4810 |
| APR | 132 | 5417 | 748 | 20 | 6317 | 200 | 10 | 210 | 6527 |
| MAY | 186 | 9054 | 1239 | 16 | 10495 | 129 | 4 | 133 | 10628 |
| JUN | 173 | 10088 | 1179 | 6 | 11446 | 90 | | 90 | 11536 |
| JLY | 184 | 10810 | 1406 | | 12400 | 134 | 4 | 138 | 12538 |
| AUG | 186 | 11539 | 1183 | 16 | 12924 | 211 | | 211 | 13135 |
| TOTAL | 1185 | 56062 | 7483 | 149 | 64879 | 943 | 28 | 971 | 65850 |

Source: Grand Canyon Airport ATCT Data not corrected for helicopter operations

TABLE II-2

AIRCRAFT OPERATIONS - GCN AIR TRAFFIC CONTROL TOWER

| ACTIVITY PERIOD | AIRCRAFT OPERATIONS: ITINERANT OPERATIONS: AIR CARRIER | AIR TAXI | GENERAL AVN | MIL | TOTAL ITINERANT | LOCAL OPERATIONS: GENERAL AVN | MIL | TOTAL LOCAL | TOTAL AIRCRAFT OPERATIONS | INSTRUMENT OPERATIONS: PRIMARY AIRPORT TOTAL | TOTAL INSTRUMNT OPERATIONS | TOTAL AIRCRAFT SERVICES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 1974 | 1670 | 9854 | 7112 | 172 | 18808 | 1177 | 20 | 1197 | 20005 | 516 | 516 | 22069 |
| FY 1975 | 1043 | 12343 | 7208 | 68 | 20662 | 368 | 24 | 392 | 21054 | 822 | 822 | 24342 |
| FY 1976 | 1578 | 15216 | 8986 | 151 | 25931 | 672 | 24 | 696 | 26627 | 1212 | 1212 | 31475 |
| FY 1977 | 2271 | 27210 | 14388 | 205 | 44074 | 1872 | 74 | 1946 | 46020 | 2566 | 2566 | 56284 |
| FY 1978 | 1923 | 33161 | 13066 | 313 | 48463 | 1250 | 80 | 1330 | 49793 | 2729 | 2729 | 60709 |
| FY 1979 | 1685 | 48208 | 14777 | 213 | 64883 | 1469 | 68 | 1537 | 66420 | 2395 | 2395 | 76000 |
| FY 1980 | 2377 | 70608 | 17390 | 683 | 91058 | 4971 | 268 | 5239 | 96297 | 1968 | 1968 | 104169 |
| FY 1981 | 1929 | 81069 | 14589 | 260 | 97847 | 2895 | 186 | 3081 | 100928 | 2132 | 2132 | 109456 |
| FY 1982 | 2009 | 84922 | 12749 | 293 | 99973 | 1744 | 130 | 1874 | 101847 | 2329 | 2329 | 111163 |
| FY 1983 | 1787 | 80006 | 10710 | 261 | 92764 | 1593 | 72 | 1665 | 94429 | 2447 | 2447 | 104217 |

Note: Data not corrected for Helicopter operations, after May 1981

CURRENT YEAR ACTIVITY GAIN/LOSS PERCENTAGE AND CURRENT YEAR PERCENTAGE OF REGIONAL ACTIVITY

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 83 +/- | -11.05 | -05.78 | -15.99 | -10.92 | -07.21 | -08.65 | -44.61 | -11.15 | -07.28 | 05.06 | 05.06 | -06.24 |
| % OF REG. | 00.91 | 21.76 | 00.33 | 00.71 | 02.41 | 00.05 | 00.09 | 00.05 | 01.34 | 00.31 | 00.31 | 01.02 |

ACTIVITY VOLUME AND TRENDS

| ACTIVITY | ACTUAL COUNT FOR FY/83 | BASE PERIOD | FY/84 | CUM CHANGE | FY/85 | CUM CHANGE | FY/86 | CUM CHANGE | FY/87 | CUM CHANGE | FY/90 | CUM CHANGE | FY/93 | CUM CHANGE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ITINERANT OPERATIONS | 92764 | | 97123 | + 04.6 | 101687 | + 09.6 | 106466 | + 14.7 | 111469 | + 20.1 | 133948 | + 44.3 | 140243 | + 51.1 |
| LOCAL OPERATIONS | 1665 | 4 | 1248 | - 25.0 | 935 | - 43.8 | 701 | - 57.8 | 526 | - 68.4 | 167 | - 89.9 | 126 | - 92.4 |
| AIRCRAFT OPERATIONS | 94429 | YEARS | 97073 | + 02.7 | 99791 | + 05.6 | 102585 | + 08.6 | 105457 | + 11.6 | 117771 | + 24.7 | 121068 | + 28.2 |
| INSTRUMENT OPERS | 2447 | | 2608 | + 06.5 | 2780 | + 13.6 | 2963 | + 21.0 | 3158 | + 29.0 | 4076 | + 66.5 | 4345 | + 77.5 |
| AIRCRAFT SERVICES | 104217 | | 107551 | + 03.1 | 110992 | + 06.5 | 114543 | + 09.9 | 118208 | + 13.4 | 134078 | + 28.6 | 138368 | + 32.1 |
| ITINERANT OPERATIONS | 92764 | | 110110 | + 18.6 | 130700 | + 40.8 | 155140 | + 67.2 | 184151 | + 98.5 | 365573 | +294.0 | 433935 | +367.7 |
| LOCAL OPERATIONS | 1665 | 7 | 1768 | + 06.1 | 1877 | + 12.7 | 1993 | + 19.6 | 2116 | + 27.0 | 2690 | + 61.5 | 2856 | + 71.5 |
| AIRCRAFT OPERATIONS | 94429 | YEARS | 111803 | + 18.3 | 132374 | + 40.1 | 156730 | + 65.9 | 185568 | + 96.5 | 364676 | +286.1 | 431776 | +357.2 |
| INSTRUMENT OPERS | 2447 | | 2466 | + 00.7 | 2485 | + 01.5 | 2504 | + 02.3 | 2524 | + 03.1 | 2604 | + 06.4 | 2624 | + 07.2 |
| AIRCRAFT SERVICES | 104217 | | 120057 | + 15.1 | 138305 | + 32.7 | 159327 | + 52.8 | 183544 | + 76.1 | 323256 | +210.1 | 312390 | +257.3 |
| ITINERANT OPERATIONS | 92764 | | 115769 | + 24.7 | 144479 | + 55.7 | 180309 | + 94.3 | 225025 | +142.5 | 545868 | +488.4 | 681243 | +634.3 |
| LOCAL OPERATIONS | 1665 | 10 | 2221 | + 33.3 | 2962 | + 77.8 | 3951 | +137.2 | 5270 | +216.5 | 16688 | +902.2 | 22261 | +236.9 |
| AIRCRAFT OPERATIONS | 94429 | YEARS | 117564 | + 24.4 | 146367 | + 55.0 | 182226 | + 92.9 | 226871 | +140.2 | 545073 | +477.2 | 678615 | +618.6 |
| INSTRUMENT OPERS | 2447 | | 2833 | + 15.7 | 3280 | + 34.0 | 3798 | + 55.2 | 4398 | + 79.7 | 7905 | +223.0 | 9153 | +274.0 |
| AIRCRAFT SERVICES | 104217 | | 128896 | + 23.6 | 159487 | + 53.0 | 197418 | + 89.4 | 244463 | +134.5 | 576693 | +453.3 | 715227 | +586.3 |

SOURCE: FAA Activity Report - FY 1983

## TABLE II-3
## FAA TERMINAL AREA FORECAST

| | ENPLANEMENTS | | | | OPERATIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Itinerant | | | | |
| | Air Taxi | Commuter | Air Carrier | TOTAL | Air Carrier | Air Taxi | GA & MIL | Local | Total |
| Actual | | | | | | | | | |
| FY 76 | 479 | 55783 | 25725 | 81987 | 1578 | 15216 | 9137 | 696 | 26627 |
| FY 77 | 53552 | 66722 | 27777 | 148051 | 2139 | 26757 | 14283 | 2060 | 45239 |
| FY 78 | 27498 | 72143 | 33882 | 133523 | 1770 | 39334 | 13706 | 1242 | 56052 |
| FY 79 | 27498 | 120394 | 28083 | 175975 | 1627 | 59070 | 16682 | 3180 | 80559 |
| FY 80 | 41230 | 124267 | 17524 | 183021 | 2318 | 72404 | 16443 | 4325 | 95490 |
| FY 81 | 94370 | 35235 | 27312 | 156918 | 2138 | 88558 | 14156 | 2800 | 107652 |
| FY 82 | 83192 | 167831 | 45171 | 296194 | 1947 | 79881 | 11995 | 1889 | 95712 |
| Forecast | | | | | | | | | |
| FY 83 | 100364 | 102676 | 39854 | 242894 | 2000 | 85089 | 12570 | 1967 | 101626 |
| FY 84 | 104860 | 108878 | 41639 | 255377 | 2036 | 90603 | 13329 | 2111 | 108079 |
| FY 85 | 110103 | 115770 | 43721 | 269594 | 2071 | 96519 | 14293 | 2278 | 115161 |
| FY 86 | 115334 | 122658 | 45802 | 283804 | 2107 | 102735 | 15100 | 2448 | 122390 |
| FY 87 | 120592 | 130238 | 47886 | 298716 | 2160 | 109454 | 16171 | 2640 | 130425 |
| FY 88 | 125090 | 137818 | 49672 | 312580 | 2196 | 109454 | 17329 | 2812 | 138906 |
| FY 89 | 129581 | 145398 | 51455 | 326434 | 2232 | 124088 | 18536 | 2971 | 147827 |
| FY 90 | 134077 | 152973 | 53240 | 340290 | 2268 | 132104 | 19714 | 3116 | 157202 |
| FY 91 | 138569 | 159168 | 55322 | 353059 | 2302 | 140730 | 20999 | 3280 | 167311 |
| FY 92 | 144112 | 167126 | 57535 | 368773 | 2348 | 149849 | 22303 | 3441 | 177941 |
| FY 93 | 149876 | 175482 | 59836 | 385194 | 2393 | 159514 | 23588 | 3624 | 189179 |
| FY 94 | 155871 | 184256 | 62229 | 402356 | 2439 | 109898 | 25115 | 3817 | 201269 |
| FY 95 | 162106 | 193469 | 64718 | 420293 | 2488 | 181128 | 26730 | 4022 | 214368 |

Source: FAA preliminary FY 84 Terminal Area Forecasts.

hours as well as the months of temporary ATCT operation (1973 through 1976). The monthly records of Table II-1 were used to establish the adjustment factors to arrive at a consistent 10 hour ATCT base day count. These base day counts are summarized in Table II-4.

TABLE II-4

ADJUSTED AIRCRAFT OPERATIONS

| Activity Period | Total A/C Operations Count | Adjust for Temporary Tower | Adjust For Hrs. | Deduct Helicopter Ops Count | Adjusted GCN Ops | Annual Change (%) |
|---|---|---|---|---|---|---|
| FY 1974 | 20,005 | 1.508 | .926 | | 27,935 | |
| FY 1975 | 21,054 | 1.508 | .926 | | 29,399 | 5.2 |
| FY 1976 | 26,627 | 1.508 | .926 | | 37,182 | 26.5 |
| FY 1977 | 46,020 | | .949 | | 43,673 | 17.5 |
| FY 1978 | 49,793 | | .949 | | 47,254 | 8.2 |
| FY 1979 | 66,420 | | .949 | | 63,033 | 33.4 |
| FY 1980 | 96,297 | | .949 | | 91,386 | 45.0 |
| FY 1981 | 100,928 | | | 14,096 | 86,832 | -4.9 |
| FY 1982 | 101,847 | | | 20,382 | 81,465 | -6.2 |
| FY 1983 | 94,429 | | | 18,530 | 75,899 | -6.8 |

Note: Adjusted GCN Ops represents annual fixed wing operations for a 10 hour ATCT day.

Data records for the helicopter operations at Tusayan are unavailable. An estimate for the number of these operations can be derived from the ATCT activity records by comparing air taxi operations after May 1981 to those prior to the start of counting the helicopter operations. Based upon this assumption, we estimate that helicopters comprise approximately 24% of the total current air taxi operations. Typically, these helicopters contain four passenger seats and service a minimum of three passengers. Therefore, we assume an average revenue passenger load of 3.5 per flight and calculate the following data.

TABLE II-5
Helicopter Operations

| | Helicopter Operations | Revenue Passengers |
|---|---|---|
| CY 1979 | 21,950 | 38,400 |
| CY 1980 | 22,430 | 37,250 |
| CY 1981 | 23,025 | 40,295 |
| CY 1982 | 18,980 | 33,200 |

2. Airport Administration Data

Commercial operators at the airport are charged landing fees in accordance with the following schedule.

TABLE II-6
GCN Commercial Landing Fees

| Landing Fees - Commercial Aircraft | | |
|---|---|---|
| Single Engine | 1-4 seats | $ 2.00 |
| Single Engine | 5-6 seats | 3.00 |
| Single Engine | 7-10 seats | 4.00 |
| Twin Engine | 4-6 seats | 3.00 |
| Twin Engine | 7-10 seats | 4.00 |
| Multi Engine | 11-15 seats | 5.50 |
| Multi Engine | 16-21 seats | 7.50 |
| Multi Engine | 22-29 seats | 10.00 |
| Multi Engine | 30 seats or more | 12.50 or 0.50 per 1000 lbs gross weight |

Monthly billing records since January 1980 have been summarized and the arriving flights by aircraft size category extracted. This data for commuter and air taxi operators carrying arriving passengers, excluding the local sightseeing air taxi operations of Air Grand Canyon and Grand Canyon Airlines, are shown in Table II-7. To distinguish between the two types of commuter/air taxi operations, Air Grand Canyon and Grand Canyon Airlines will be identified as "based" commuters.

The airport managers staff maintains flight arrival records by monitoring the ATCT radio frequency and recording the aircraft number of

TABLE II-7

GCN Commuter and Air Taxi Operations Data

| A/C Size | 1-4 | 5-6 | 7-10 | 11-15 | 16-21 | 21-29 | 30-39 | 40-59 | 60-99 | 100-150 | Total Flights | Total Revenue Seats |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CY 1980 | | | | | | | | | | | | |
| JAN | 49 | 51 | 452 | 72 | | | | | | | 624 | 4358 |
| FEB | 28 | 75 | 518 | 179 | | | | | | | 800 | 6054 |
| MAR | 34 | 62 | 682 | 320 | | | | | | | 1098 | 8706 |
| APR | 19 | 100 | 939 | 455 | 26 | | | | | | 1539 | 12577 |
| MAY | 7 | 129 | 1456 | 743 | 45 | | | | | | 2380 | 19796 |
| JUN | 8 | 155 | 1418 | 723 | 128 | | | | | | 2432 | 20854 |
| JLY | 17 | 199 | 1444 | 789 | 104 | | | | | | 2553 | 21601 |
| AUG | 13 | 176 | 1644 | 911 | 176 | | | 2 | | | 2922 | 25528 |
| SPT | 11 | 211 | 1450 | 672 | 100 | | | | | | 2444 | 20330 |
| OCT | 7 | 108 | 1306 | 570 | 60 | | | 1 | | | 2052 | 17037 |
| NOV | 4 | 155 | 1010 | 450 | 122 | | | 2 | | | 1743 | 14969 |
| DEC | 3 | 91 | 686 | 184 | 18 | | | 1 | | | 983 | 7640 |
| TOTAL | 200 | 1512 | 13005 | 6068 | 779 | 0 | 0 | 6 | 0 | 0 | 21570 | 179450 |
| CY 1981 | | | | | | | | | | | | |
| JAN | 25 | 44 | 672 | 241 | 74 | | | | | | 1056 | 8908 |
| FEB | 30 | 43 | 550 | 238 | 64 | | | | | | 925 | 7861 |
| MAR | 70 | 51 | 818 | 333 | 82 | | | 1 | | | 1355 | 11292 |
| APR | 55 | 91 | 1298 | 497 | 98 | | | 4 | | | 2043 | 17015 |
| MAY | 91 | 180 | 1672 | 524 | 154 | | | 11 | | | 2632 | 21743 |
| JUN | 90 | 151 | 1731 | 497 | 154 | | | 2 | | | 2625 | 21315 |
| JLY | 67 | 201 | 1539 | 517 | 130 | | | 3 | | | 2457 | 20008 |
| AUG | 92 | 156 | 1897 | 686 | 226 | | | | | | 3057 | 25723 |
| SPT | 56 | 112 | 1249 | 495 | 114 | | | 4 | | | 2030 | 17030 |
| OCT | 78 | 100 | 1340 | 495 | 122 | | | 3 | | | 2138 | 17765 |
| NOV | 91 | 63 | 765 | 222 | 116 | | | 1 | | | 1258 | 10401 |
| DEC | 29 | 38 | 383 | 133 | 34 | | | 2 | | | 619 | 5087 |
| TOTAL | 774 | 1230 | 13914 | 4878 | 1368 | 0 | 0 | 31 | 0 | 0 | 22195 | 184148 |
| CY 1982 | | | | | | | | | | | | |
| JAN | 27 | 45 | 387 | 47 | 36 | | | 1 | | | 543 | 4188 |
| FEB | 28 | 40 | 408 | 130 | 58 | | | 3 | | | 667 | 5688 |
| MAR | 77 | 39 | 432 | 229 | 44 | | | 14 | | | 835 | 7333 |
| APR | 64 | 51 | 1175 | 191 | 6 | | | 12 | | | 1499 | 11403 |
| MAY | 55 | 48 | 1292 | 449 | | | | 24 | | | 1868 | 15444 |
| JUN | 10 | 86 | 1015 | 474 | | | | 19 | | | 1604 | 13615 |
| JLY | 22 | 91 | 1216 | 460 | | | | 5 | | | 1794 | 14313 |
| AUG | 20 | 114 | 1435 | 583 | | | | 8 | | | 2160 | 17440 |
| SPT | 17 | 78 | 1047 | 340 | | | | 7 | | | 1489 | 11818 |
| OCT | 17 | 80 | 1014 | 408 | | | | 11 | | | 1530 | 12521 |
| NOV | 8 | 48 | 507 | 250 | | | | 11 | | | 824 | 7047 |
| DEC | 16 | 37 | 386 | 133 | | | | 2 | | | 574 | 4486 |
| TOTAL | 361 | 757 | 10314 | 3694 | 144 | 0 | 0 | 117 | 0 | 0 | 15387 | 125296 |
| CY 1983 | | | | | | | | | | | | |
| JAN | 19 | 41 | 351 | 161 | | | | 16 | | | 588 | 5194 |
| FEB | 22 | 78 | 558 | 142 | | | | 10 | | | 810 | 6364 |
| MAR | 18 | 49 | 564 | 197 | | | | 13 | | | 841 | 6986 |
| APR | 21 | 96 | 809 | 246 | | | | 12 | | 1 | 1185 | 9564 |
| MAY | 23 | 139 | 1001 | 266 | | | | 23 | | | 1452 | 11709 |
| JUN | 22 | 125 | 990 | 290 | | | | 25 | | | 1452 | 11911 |
| JLY | 31 | 132 | 1055 | 333 | 32 | | | 18 | | | 1601 | 13137 |
| AUG | 25 | 272 | 1325 | 261 | 75 | | | 34 | | | 1992 | 16352 |
| TOTAL | 181 | 932 | 6653 | 1896 | 107 | 0 | 0 | 151 | 0 | 1 | 9921 | 81217 |

Source: GCN Airport Manager Records    Data does not include based commuter operators.

arriving aircraft. The aircraft number is then used to obtain aircraft type and owner information contained in the operator records on file. Although cross checks of aircraft parked on the ramp as well as other administrative checks serve to verify these records, it is likely that some traffic is missed. We, therefore, estimate that these records constitute the lower bound of commuter operations.

The number of air taxi, commuter and charter operators as well as the total number of aircraft used by them fluctuates due to changing business conditions. This arena of aviation business is characterized by volatility which is compounded by the fluctuating and competitive nature of the tourist market. Table II-8 lists the air taxi, commuter and charter operators, operating to or from GCN and on record with the Airport Managers office as of August 1983.

TABLE II-8

GCN Air Taxi and Commuter Operators

As of August 1983

| Operator | No. or Aircraft |
|---|---|
| Advance | 16 |
| Air Cortez | 6 |
| Air Grand Canyon | 4 |
| Air Irvine | 6 |
| Air Med | 2 |
| Air L.A. | 9 |
| Air Nevada | 14 |
| Air Vegas | 12 |
| Arizona Air | 4 |
| Braswell Aviation | 1 |
| California Air Taxi | 8 |
| Corporate Jet | 16 |
| Commercial Air Charter | 2 |
| Desert Aire | 7 |
| Desert Southwest Airlines | 4 |
| Dixi Aviation | 1 |
| Dynamic Air Charter | 7 |
| Gold Coast Aire | 5 |
| Grand Canyon Airlines | 5 |
| Keilen Air Service | 4 |
| Key Airlines | 4 |
| Lake Mead | 12 |
| Long Air Service | 4 |
| Las Vegas Airlines | 6 |
| Martin Aviation | 6 |
| Madison Aviation | 5 |
| Monarch Aviation | 35 |
| National Executive Airlines | 7 |
| Pacific Executive Charter | 6 |
| Piper Air Center | 1 |
| Republic Airlines | 3 |
| Sawyer Aviation | 8 |
| Sedora Air Charter | 4 |
| Scenic Airlines | 42 |
| Skyway Air | 1 |
| Skywest | 20 |
| Southern Express Airlines | 2 |
| Superstition | 1 |
| Valko | 4 |
| Walls Aviation | 2 |
| Womack Aviation | 1 |
| Western Sun Aviation | 1 |

Source: GCN Airport Manager Records

3. FAA ACIS Data Base

Enplanement records for air carrier airlines are kept by the FAA. The complete records for 1979 through 1982 are contained in the appendix and are summarized as follows:

TABLE II-9

FAA Enplanement Data

| | Air Taxi Comm. Op. | Commuter Air Carrier | Certificated Route Air Car. | Scheduled Charter | Total |
|---|---|---|---|---|---|
| CY 1979 | 41,230 | 134,037 | 22,730 | -- | 197,997 |
| CY 1980 | 96,785 | 123,590 | 18,997 | -- | 239,372 |
| CY 1981 | 94,371 | 99,888 | 31,578 | 4,107 | 229,944 |
| CY 1982 | 74,183 | 93,870 | 32,830 | 4,378 | 205,262 |

These records are incomplete because only carriers operating aircraft with a gross weight greater than 6000 lbs are required to submit data. However, operators of smaller aircraft are encouraged to submit records and many do. By assuming that the enplanements are proportional to the aircraft mix from the billing records, the following adjusted enplanements can be derived:

TABLE II-10

Adjusted FAA Enplanements

| | % of Revenue Seats less than 6000 lbs | Adjusted Enplanements |
|---|---|---|
| CY 1979 | 4.6%* | 207,544 |
| CY 1980 | 4.6% | 250,775 |
| CY 1981 | 4.6% | 241,033 |
| CY 1982 | 3.9% | 213,560 |

*Estimated value for CY 1979

While these numbers do not take into account that the passengers carried in aircraft with gross weights of less than 6000 lbs may have already been incorporated into the reported data, the percentage is so small as to make it a negligible difference. This adjustment agrees with the FAA estimate that about 96% of total passengers are reported at GCN.

Data compiled by the Civil Aeronautics Board (CAB) was obtained for GCN from I. P. Sharp Associates, Inc., a computer timesharing service with the CAB records in their database. The CAB records are contained in the Appendix and include origin-destination data from CAB Table 12 and commuter and air carrier enplanement data. Air taxi enplanements are not monitored by the CAB. The CAB data was utilized in verification of the FAA database enplanements. The FAA ACIS data includes the CAB data as well as the air taxi data which is collected directly by the FAA.

4. Fred Harvey Transportation Company

Annual passenger data broken down by carrier and/or tour group was provided by the Transportation Division of the Fred Harvey Company. This data represents the passengers arriving at the Grand Canyon National Park Airport that are transported by Fred Harvey buses. Arriving passengers that rent automobiles, are transported by other carriers, or provide their own transportation are not included. In addition, GCN enplanements for Air Grand Canyon and Grand Canyon Airlines are not included.

To arrive at an estimate of the total enplanements using this data as a base, the following adjustments are made:

a. Differences between specific airline enplanements reported in FAA statistics and bus passengers are added. This applies primarily to Scenic and Air Nevada, which both have their own ground transportation facilities.

b. Enplanements on Air Grand Canyon and Grand Canyon Airlines which operate only local sightseeing flights are added.

c. Thirty percent of arriving Republic Airlines passengers are added. This is based on estimates from Fred Harvey Company and the Airport Manager that approximately 70% of arriving Republic passengers are served by Fred Harvey.

The following table summarizes these adjustments.

TABLE II-11

Enplanements from Bus Passenger Data

| | CY 1979 | CY 1980 | CY 1981 | CY 1982 |
|---|---|---|---|---|
| Total Fred Harvey Bus Passengers | 167,952 | 171,132 | 164,176 | 139,259 |
| Scenic* | +35,360 | +38,469 | +33,662© | +28,631 |
| Air Nevada* | -- | +11,876 | + 6,118© | + 5,749 |
| Republic® | + 6,642 | + 5,628 | + 5,531 | + 5,967 |
| Grand Canyon Airlines* | +37,710 | +42,806 | +79,240 | +60,316 |
| Nevada Airlines* | +16,901 | -- | -- | -- |
| Air Grand Canyon* | -- | -- | + 1,590 | + 6,375 |
| Estimated Total Airport Enplanements | 264,565 | 269,911 | 290,317 | 246,298 |

* Difference between Fred Harvey and FAA/TSC.
® Assumption that Fred Harvey serves 70% of Republic arrivals.
© Estimate by Leedshill-Herkenhoff.

5. Republic Airlines

The primary scheduled certificated air carrier serving GCN is Republic Airlines. Republic flies directly to Phoenix, Arizona and Las Vegas, Nevada twice daily during the winter months and three times daily during the summer. Calendar year traffic records are tabulated on Table II-12.

Republic currently operates DC-9-10 aircraft at GCN having an 80 passenger capacity. Republic is reported to be upgrading to DC-9-80 aircraft, a logical replacement aircraft to serve increased traffic.

TABLE II-12

Republic Airline Enplanements

| | 1978 | | 1979 | | 1980 | | 1981 | | 1982 | | 1983 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ON | OFF | ON | OFF | ON | OFF | ON | OFF | ON | OFF | ON | OFF |
| January | 896 | 941 | 778 | 751 | 805 | 845 | 584 | 616 | 691 | 713 | 1048 | 988 |
| February | 867 | 949 | 1252 | 1343 | 784 | 849 | 971 | 920 | 745 | 756 | 1257 | 1233 |
| March | 1566 | 1586 | 1379 | 1518 | 1565 | 1556 | 1187 | 1139 | 1070 | 1208 | 2331 | 2346 |
| April | 2101 | 2009 | 1683 | 1581 | 2024 | 1775 | 1251 | 1078 | 1171 | 1122 | 1981 | 1989 |
| May | 3705 | 3189 | 3201 | 3075 | 2289 | 1944 | 1632 | 1481 | 2051 | 1930 | 2506 | 2479 |
| June | 4023 | 3887 | 3152 | 3102 | 1855 | 1669 | 2236 | 2092 | 2296 | 2107 | 2664 | 2588 |
| July | 4338 | 3854 | 3267 | 3072 | 1869 | 1709 | 1887 | 1873 | 2617 | 2366 | 3085 | 2813 |
| August | 5848 | 5262 | 4545 | 4554 | 2427 | 2133 | 3161 | 2862 | 3375 | 3269 | 4260 | 4040 |
| September | 4507 | 4110 | 1133 | 958 | 1678 | 1488 | 1791 | 1650 | 2004 | 1873 | -- | -- |
| October | 4065 | 4306 | -- | -- | 1555 | 1404 | 1781 | 1594 | 2070 | 1838 | -- | -- |
| November | 1941 | 2184 | 893 | 762 | 1357 | 1442 | 1384 | 1360 | 1262 | 1307 | -- | -- |
| December | 1080 | 1017 | 859 | 948 | 553 | 556 | 573 | 564 | 539 | 587 | -- | -- |
| ON TOTAL | 34937 | | 22142 | | 18761 | | 18438 | | 19891 | | | |
| OFF TOTAL | | 32394 | | 26664 | | 17370 | | 17229 | | 17976 | | |

6. Park Visitor Data

Park visitor data obtained from the Grand Canyon National Park includes annual visitor data from 1915, monthly visitor summaries from January 1982 and visitor profile data for 1982. These are summarized in Table II-13 and II-14.

The number of park visitors is tabulated by the Park Service monthly using the following reported procedure. Auto entries are counted and reduced 15% for local resident traffic and visitors are computed on the basis of 3.5 passengers per auto based on sampling survey data. Bus passengers are counted directly from bus entry fees. Visitors which arrive by air are determined by counting bus receipts from airport originating buses such as Scenic Airlines, Air Nevada and Fred Harvey. The air visitor data kept by the Park correlates poorly with the enplanement records of the FAA and with the Fred Harvey bus passenger records.

TABLE II-13

Summary of Visitors to Grand Canyon National Park

| | Visitors | | | | |
|---|---|---|---|---|---|
| | Car | Bus | Boat® | Air© | Total |
| 1981 | | | | | |
| January | 85,879 | 10,708 | 7 | 20,700 | |
| February | 87,065 | 11,117 | 35 | 20,800 | |
| March | 117,735 | 14,237 | 76 | 22,830 | |
| April | 182,281 | 22,904 | 439 | 30,000 | |
| May | 231,483 | 33,283 | 2,523 | 35,000 | |
| June | 352,844 | 42,028 | 3,634 | 47,000 | |
| July | 386,749 | 43,676 | 2,290 | 37,684 | |
| August | 363,357 | 44,240 | 2,521 | 39,586 | |
| September | 277,160 | 37,279 | 1,255 | 28,750 | |
| October | 172,398 | 27,630 | 415 | 26,500 | |
| November | 75,354 | 15,712 | 52 | 14,700 | |
| December | 67,425 | 8,317 | 10 | 14,595 | |
| TOTAL CY 1981 | 2,399,730* | 311,131 | 13,257 | 338,145 | 2,724,118* |
| 1982 | | | | | |
| January | 42,587 | 7,035 | 0 | 4,201 | |
| February | 54,420 | 9,760 | 0 | 5,432 | |
| March | 102,087 | 14,666 | 66 | 7,096 | |
| April | 162,836 | 19,731 | 983 | 9,881 | |
| May | 200,922 | 28,900 | 2,741 | 7,953 | |
| June | 371,722 | 31,075 | 3,538 | 7,490 | |
| July | 363,941 | 33,817 | 2,532 | 8,380 | |
| August | 354,048 | 35,327 | 5,828 | 17,046 | |
| September | 244,354 | 27,587 | 2,652 | 10,990 | |
| October | 181,554 | 23,033 | 751 | 11,373 | |
| November | 88,505 | 11,518 | 90 | 7,437 | |
| December | 65,562 | 5,632 | 0 | 3,870 | |
| TOTAL CY 1982 | 2,232,538* | 248,081 | 19,181 | 101,149 | 2,499,800* |
| 1983 | | | | | |
| January | 47,020 | 7,036 | 0 | 4,790 | |
| February | 63,987 | 8,979 | 11 | 6,172 | |
| March | 118,211 | 13,156 | 187 | 6,748 | |
| April | 137,984 | 17,178 | 786 | 8,745 | |
| May | 230,035 | 23,065 | 2,511 | 12,075 | |
| June | 363,117 | 31,611 | 4,616 | 12,437 | |
| July | 386,101 | 43,087 | 5,644 | 13,204 | |
| August | 285,446 | 37,353 | 4,302 | 16,681 | |

Source: National Park Service

® Boat permit system changed in 1983.

© Air visitors are included in auto or bus visitors.

* Totals do not agree with National Park Service Totals.

TABLE II-14

YEARLY VISITATION TO GRAND CANYON NATIONAL PARK

| Calendar Year | Visitors | Calendar Year | Visitors |
|---|---|---|---|
| 1915 | 106,000 | 1950 | 665,281 |
| -- | --- | 1951 | 682,152 |
| 1919 | 44,173 | 1952 | 736,159 |
| 1920 | 71,601 | 1953 | 836,878 |
| 1921 | 69,485 | 1954 | 814,130 |
| 1922 | 85,474 | 1955 | 891,930 |
| 1923 | 108,500 | 1956 | 1,033,404 |
| 1924 | 113,106 | 1957 | 1,101,819 |
| 1925 | 136,527 | 1958 | 1,063,529 |
| 1926 | 133,880 | 1959 | 1,168,807 |
| 1927 | 162,542 | 1960 | 1,186,916 |
| 1928 | 164,665 | 1961 | 1,252,183 |
| 1929 | 188,204 | 1962 | 1,446,453 |
| 1930 | 166,711 | 1963 | 1,538,666 |
| 1931 | 154,871 | 1964 | 1,575,737 |
| 1932 | 117,700 | 1965 | 1,689,238 |
| 1933 | 108,823 | 1966 | 1,806,033 |
| 1934 | 146,850 | 1967 | 1,804,876 |
| 1935 | 214,407 | 1968 | 1,926,270 |
| 1936 | 272,253 | 1969 | 2,192,574 |
| 1937 | 304,794 | 1970 | 2,258,195 |
| 1938 | 334,039 | 1971 | 2,402,058 |
| 1939 | 405,585 | 1972 | 2,698,344 |
| 1940 | 369,234 | 1973 | 2,064,300 |
| 1941 | 436,566 | 1974 | 2,028,194 |
| 1942 | 132,584 | 1975 | 2,754,791 |
| 1943 | 72,100 | 1976 | 3,026,235 |
| 1944 | 64,568 | 1977 | 2,848,519 |
| 1945 | 169,960 | 1978 | 2,984,138 |
| 1946 | 486,834 | 1979 | 2,275,712 |
| 1947 | 622,363 | 1980 | 2,618,713 |
| 1948 | 618,033 | 1981 | 2,674,117 |
| 1949 | 600,448 | 1982 | 2,499,799 |

Source: National Park Service

Two reports have been prepared profiling the foreign visitor to the Grand Canyon (see Bibliography). They are summarized below.

TABLE II-15

GCNP FOREIGN VISITORS - 1982*

| | Total % | Day % | Overnight % |
|---|---|---|---|
| Australia | 6 | 58 | 42 |
| Canada | 7 | 41 | 59 |
| England | 12 | 51 | 49 |
| France | 11 | 36 | 64 |
| Germany | 19 | 36 | 64 |
| Holland | 4 | 34 | 66 |
| Italy | 3 | 57 | 43 |
| Japan | 13 | 75 | 25 |
| Sweden | 3 | 56 | 44 |
| Switzerland | 5 | 37 | 63 |
| Other | 17 | 60 | 40 |

* Note that 33% of total visitors are foreign according to this report.
Source: International Visitors to Grand Canyon National Park.

## 7. Economic Data

A variety of historic economic and travel indicators was examined. The objective was to identify a set of commonly forecasted and easily obtainable indicators for use in developing a statistical model of GCN aviation traffic.

The indicators which were selected for use in the model are contained in Table II-16. The evaluation of the indicators is contained in Section C of this Chapter, Forecasts. A compilation of the indicators not utilized in the forecast model is contained in the Appendix.

The Consumer Price Index (CPI), Gross National Product (GNP) and Foreign Travel Expenditures in the U.S. are variables which are compiled by

TABLE II-16

ECONOMIC DATA

| Calendar Year(CY) | Gross Natl.[1] Product(GNP) (Billions 1972) | Consumer Price[1] Index (CPI) (CY1967=100) | Foreign Travel[2] Expenditures (Billions 1972) | Eff. Exchange[3] Rate (US$) (1975=100) |
|---|---|---|---|---|
| Historical | | | | |
| 1974 | 1,248.04 | 147.7 | 4.05 | 104.60 |
| 1975 | 1,233.86 | 161.2 | 4.36 | 100.00 |
| 1976 | 1,300.35 | 170.5 | 4.96 | 103.69 |
| 1977 | 1,371.71 | 181.5 | 4.99 | 99.91 |
| 1978 | 1,436.87 | 195.3 | 5.32 | 92.79 |
| 1979 | 1,483.07 | 217.7 | 5.59 | 90.91 |
| 1980 | 1,480.75 | 247.0 | 5.89 | 91.58 |
| 1981 | 1,502.62 | 272.3 | 6.36 | 108.00 |
| 1982 | 1,477.50 | 289.3 | 5.59 | 119.90 |
| Forecast | | | | |
| 1983 | 1,513.60 | 304.1 | 5.05 | 126.30 |
| 1984 | 1,573.90 | 322.6 | 5.23 | 124.60 |
| 1985 | 1,626.10 | 343.3 | 5.41 | 122.60 |
| 1986 | 1,675.20 | 363.7 | 5.59 | 118.80 |
| 1987 | 1,725.70 | 384.1 | 5.74 | 114.60 |
| 1988 | 1,778.80 | 405.4 | 5.91 | 113.90 |
| 1989 | 1,832.70 | 427.8 | 6.10 | 113.70 |
| 1990 | 1,886.60 | 450.4 | 6.20 | 111.50 |
| 1991 | 1,943.70 | 472.9 | 6.45 | 111.70 |
| 1992 | 2,002.00 | 497.9 | 6.65 | 112.20 |
| 1993 | 2,062.10 | 524.8 | 6.85[4] | 112.30 |
| 1994 | 2,123.90 | 553.1 | 7.99[4] | 112.10 |
| 2003 | 2,772.00 | 888.0 | 9.12[4] | 108.00[4] |

[1]Source: Before 1977, Bureau of Labor Statistics, After 1977, Chase Econometrics November 1982. (FAA aviation forecasts, p. 67)

[2]Source: Chase Econometrics (Historic data compiled by U.S. Bureau of Economic Analysis).

[3]Source: Chase Econometrics.

[4]Extrapolated for forecast purposes by Leedshill-Herkenhoff.

the U.S. Bureau of Economic analysis and are readily available from public sources. The effective exchange rate is compiled by Chase Econometrics and represents the trade weighted-average exchange value of the U.S. Dollar for the top ten trade countries. The value is deflated by relative consumer prices to account for inflation. This statistic is similar to the weighted-average exchange value kept by the Federal Reserve Board except that different base years are used for the total trade share and for the base period. All forecasts of these variables were obtained from Chase Econometrics data.

## B. HISTORIC AVIATION DATA SUMMARY

The most reliable data available are the ATCT operations records. The best passenger counts available (FAA data base and Fred Harvey bus passengers) have inconsistencies. The airport billing records provide needed data on aircraft mix and trends in aircraft use, but correlate poorly with the above data as far as total movements or passengers is concerned. Other data such as the estimated air arrivals by the Park Service, are not adequately founded on actual counts to be utilized in a forecasting model.

### 1. Operations

Aircraft operations recorded by the ATCT for 1974 through 1982 are shown in Tables II-1, II-2 and II-3. The modifications to this data are the adjustments to the air taxi count after May 1981 to delete helicopter operations and the adjustments to a 10 hour base ATCT day. This data is summarized in the following table.

TABLE II-17

Historic Aircraft Operations Summary

| | CY 1979 | CY 1980 | CY 1981 | CY 1982 |
|---|---|---|---|---|
| Itinerant | | | | |
| Air Carrier | 1,500 | 2,337 | 2,143 | 1,889 |
| Air Taxi | 65,467 | 71,024 | 70,102 | 60,100 |
| General Aviation | 18,126 | 14,429 | 13,710 | 11,107 |
| Military | 410 | 506 | 270 | 311 |
| Helicopter[1] | 21,950 | 22,430 | 23,025 | 18,980 |
| Itinerant Total | 107,453 | 110,726 | 109,250 | 92,387 |
| Local Total | 4,181 | 3,447 | 2,689 | 1,785 |
| TOTAL | 111,634 | 114,173 | 111,939 | 94,172 |

Source: Grand Canyon ATCT.

[1]Helicopter operations estimated; not included as part of ATCT records until May 1981. Therefore, totals shown for earlier than May 1981 do not agree with ATCT records.

2. Enplanements

Sources of enplanement data include: FAA database records for CY 1979 through 1982; passenger pickup records from Fred Harvey Transportation Co.; and passenger enplanement records and estimates from specific airlines. The FAA records provide a lower bound on enplanements since a large number of small operators are not required to report. The enplanements estimated from the Fred Harvey data are probably high due to corrections made for apparent arrivals on Scenic Airlines, Air Nevada or other airlines already listed on the bus passenger records under a tour company name.

For purposes of providing a single historic data record to use in forecasting and evaluation, an estimate has been made from the above data of enplaned passengers as shown in Table II-18.

TABLE II-18

Historic Enplaned Passengers Summary[1]

| | Adjusted FAA Database | Estimated from Bus Passengers | Leedshill-Herkenhoff Estimate* |
|---|---|---|---|
| CY 1979 | 207,544 | 264,565 | 226,600 |
| CY 1980 | 250,775 | 269,911 | 257,200 |
| CY 1981 | 241,033 | 290,317 | 257,500 |
| CY 1982 | 213,560 | 246,298 | 224,500 |

[1]Revenue passengers excluding helicopter and private aircraft.
*Used as historic enplanements in remainder of study.

Enplanements not included in the above estimate include helicopter operations out of Tusayan and enplanements onto general aviation aircraft. These are included in breakdown of enplanements by type of carrier on Table II-19.

TABLE II-19

Historic Enplanements by Type of Carrier

| | Air Carrier[1] | Air Taxi/ Commuter | Local Air Taxi[2] | Helicopter[3] | Private G.A.[4] | Total |
|---|---|---|---|---|---|---|
| CY 1979 | 22,730 | 166,160 | 37,710 | 38,400 | 31,720 | 296,720 |
| CY 1980 | 18,997 | 195,397 | 42,806 | 39,250 | 25,250 | 321,700 |
| CY 1981 | 31,578 | 145,092 | 80,830 | 40,295 | 23,990 | 321,785 |
| CY 1982 | 32,831 | 124,978 | 66,691 | 33,200 | 19,440 | 277,140 |

[1]FAA ACIS Database.

[2]Grand Canyon Airlines and Air Grand Canyon.

[3]For explanation, refer to Section IIA1.

[4]Estimated by L-H from ATCT itinerant GA records at 3.5 bax/flt including pilot.

The itinerant general aviation count appears to be high based upon discussions with the FBO, and observed and reported usage of the GCN tiedown area. Some of these operations are probably charter or air taxi operations not recognized as such by the tower operator. Since these are typically smaller aircraft, the 3.5 passenger per flight estimate is still appropriate.

Comparison between enplanements and operations is made in Table II-20.

TABLE II-20

Enplanement-Operations Data

| | CY 1979 | CY 1980 | CY 1981 | CY 1982 |
|---|---|---|---|---|
| Air Carrier | | | | |
| Ops[1] | 1,500 | 2,337 | 2,143 | 1,889 |
| Pax[2] | 22,730 | 18,997 | 31,578 | 32,831 |
| Pax/flt. | 30.3 | 16.2 | 29.4 | 34.8 |
| Air Taxi/Commuter - Itinerant | | | | |
| Ops[1,3] | 65,467 | 71,024 | 70,102 | 60,100 |
| Pax[4] | 203,870 | 238,203 | 225,922 | 191,669 |
| Pax/flt. | 6.23 | 6.71 | 6.46 | 6.38 |
| Seats/flt.[5] | N.A. | 8.3 | 8.3 | 8.1 |
| Load Factor | -- | 81% | 70% | 79% |
| Total[6] | | | | |
| Ops[1,3] | 66,967 | 73,361 | 72,245 | 61,989 |
| Pax[4] | 226,600 | 257,200 | 257,500 | 224,500 |
| Pax/flt. | 6.77 | 7.01 | 7.13 | 7.24 |

[1]FAA ATCT Records.

[2]FAA ACIS Data Base.

[3]Does not include helicopter operations.

[4]Adjusted enplanements.

[5]Airport Manager Billing Records.

[6]Air Carrier and Commuter only.

## C. FORECASTS

Forecasts of aviation activity at GCN will form the basis of recommended improvements. Initial forecasts will be unrestrained by such limiting factors as funding availability, accessibility to adequate land for expansion and other potential growth factors. The chapters on airport development and financial planning will explore the costs required to satisfy the forecasted demand as well as the benefits which may or may not accrue from such development.

Several basic assumptions were made in the forecasts at GCN. They are as follows:

- o Grand Canyon Overflights: It is assumed that overflights of the canyon would continue to be unrestricted. This includes local sightseeing flights as well as commuter arrival paths through the canyon. Moderate limitations such as avoidance of heavily populated overlooks, etc. are assumed to have negligible effect on aviation traffic.

- o Grand Canyon National Park Limitations: It is assumed for these initial unrestrained forecasts that park visitation limits are not exceeded.

- o Resort Activity: Potential traffic generators such as a resort/convention complex or other new large scale resort activity outside the park boundary have not been included.

- o Economy: Sustained economic recovery from the recent recession is inherently assumed in the forecasts of national economic and aviation trends of Chase Econometrics and the FAA, both of which are utilized to some extent in these forecasts.

Due to the unique tourist oriented nature of this airport, the traditional aviation forecast model involving local population and business factors was not utilized.

A forecast technique using historic aviation activity at GCN and historic economic and other data is utilized to project future aviation demand at GCN. The technique is a multiple linear regression model which attempts to correlate historic activity with other pertinent variables. The model development was performed using the following guidelines:

- o Independent variables were limited to those socio-economic statistics for which adequate historic data is readily available.

- o Independent variables were also limited to those which reasonably could be expected to influence GCN traffic.

- o Independent variables were further limited to those for which independent forecasts based on large econometric models were available.

1. <u>Construction of a Model</u>

The construction of the statistical model began with a thorough study of the historical data. Based on the quality and quantity of the historical data, a selection of the best dependent variable for measuring aircraft activity was made. The following two variables were evaluated as a measure of the activity level at the GCN airport:

(1) Grand Canyon Enplanements
(2) Grand Canyon Aircraft Operations

The conventional approach to the master planning activity forecast would have been to project enplanements from the historical data, and subsequently determine the aircraft mix and future operations level from the projected enplanement levels. This could not be done at GCN due to the unacceptably small enplanement data sample, ambiguities between enplanement data sources, and the particular period of which enplanement data was available. This data was taken during 1979 thru 1982. Two unusual occurrences may have effected the GCN traffic which might not be accurately reflected in the statistics; the international recession and reduced Las Vegas visitation due to the advent of gambling at Atlantic City. For these reasons, enplanements were not used as a dependent variable.

Although the airport operations data was incomplete, there was substantially more available than for enplanements. In addition, by using some of the supplemental data available, such as aircraft mix by size and category, reasonable assumptions could be made to arrive at an overall picture of operations at GCN over the past 10 years. This larger sample period tends to proportionally reduce the effects of the 1979 thru 1982 recession period on the model, and Grand Canyon Airport operations have been used herein as the dependent variable.

Independent variables were evaluated in a manner similar to that used for the dependent variable. The initial selection of the variables to be tested (for inclusion in the forecast model) was based on the guidelines. A large pool of economic indices, population and visitor mix data was available for the U.S. A critical consideration, that of forecast availability, led to the elimination of most indicators which were not based on economic data.

The following are the independent variables which were chosen for inclusion in the forecast model. Note that independent variables are interchangeably called regressors.

TABLE II-21
GCN MODEL REGRESSOR

| Objective | Regressor |
|---|---|
| Measurement of the United States Productivity | Gross National Product (GNP) |
| Measurement of the United States Economic Health | Consumer Price Index (CPI) |
| Measurement of Foreign Tourism | Foreign Travel Expenditures (FTE) |
| Measurement of the International Economy Relative to the United States | Effective Exchange Rate (US$) (shifted one year for model usage) |

These regressors were chosen based on the statistical analysis which follows. Other regressors were also examined in the course of creating the model. A representative list of those considered include the following for which data is listed in the Appendix:

(1) The Fuel Price Index
(2) Foreign Visitors Arriving to the U.S. by Air
(3) Total Foreign Visitors
(4) Effective Exchange Rate Shifted 2 years and 0 years

It should be mentioned that the airport community at GCN expressed interest in incorporating the Las Vegas, Nevada visitation impact in the GCN model. Data was collected from the Las Vegas Convention and Visitors Authority (LVCVA), and the Las Vegas Chamber of Commerce for that purpose. However, a major shortcoming of the inclusion of that data in the model is the lack of regular and accessible forecasts for those specific regressors. In lieu of incorporating them in the Model, a separate Las Vegas Model has been created and is presented in the Appendix. This model should provide short term planning for such activity as aircraft charter operations, commuter and air taxi services. Annual supplemental data is available from the LVCVA.

## 2. Statistical Evaluation

The statistical evaluation of the dependent variable, Aircraft Operations and the regressors listed in Table II-21 was done by computer. A Least Squares-Multiple Linear Regression technique was used to determine the degree of correlation between the individual regressors and the GCN aircraft operations level by year from 1974 to 1982 (Multiple Linear Regression Techniques, Cooley & Lobnes, 1966). In addition, the sample correlation was determined. Confidence intervals were evaluated using "t" test and "F" test results provided by the program. Regressors listed in the paragraph following Table II-21 were eliminated based on this analysis with those listed in Table II-21 providing the optimum overall model. Table II-22 lists the correlation matrix for the model.

TABLE II-22

FORECAST MODEL - CORRELATION MATRIX (HISTORICAL DATA)

| | Regressors | | | | |
|---|---|---|---|---|---|
| | A/C Ops | GNP | CPI | FTE | $+1 |
| A/C Ops | 1.0000 | | | | |
| GNP | 0.8900 | 1.0000 | | | |
| CPI | 0.9400 | 0.8700 | 1.0000 | | |
| FTE | 0.9100 | 0.9300 | 0.8700 | 1.0000 | |
| $+1 | -0.5600 | -0.5700 | -0.3400 | -0.6800 | 1.0000 |

Table II-22 shows that:

(a) The Gross National Product (GNP), Consumers Price Index (CPI) and Foreign Tourist Expenditures (FTE) have a good positive correlation to GCN Airport Operations.

(b) The GCP, CPI, and FTE have a good positive correlation to each other.

(c) The Weighted Dollar Exchange Rate Advanced one year ($+1), has only a moderately good negative correlation with GCN Aircraft Operations (A/C Ops).

(d) The $+1 has only a moderately good negative correlation with the other regressors which are GNP, CPI and FTE.

While the correlation results provide an indication of whether a relationship exists between two variables, it says nothing about the quality of the data. One of the most accepted mothods used to evaluate this quality is to use the Student "t" test. The major underlying assumption of this method is that the distribution of probability of errors is statistically "normal" and described by a bell shaped curve. This "t" test value can then be used to provide an estimate in the confidence level between any regressor and the dependent variable.

Results from the modeling are summarized in Table II-23 where the "t" test and "F" test values are given. The reader need not be concerned with those values directly, since the confidence interval has been determined and included in the table.

TABLE II-23

FORECAST MODEL EVALUATION

Dependent Variable - Grand Canyon Ops

Determination Coefficient = 0.97

Correlation Coefficient = 0.99

"F" Test = 33.59 Confidence Interval $H_0$ Untrue >> 99%

Degrees of Freedom = 4

Sum of the Errors Squared = 5,997.25

| Regressor | Correlation "C" To Historical Ops | "t" test | Confidence Level |
|---|---|---|---|
| Gross National Product | 0.89 | 0.27 | > 50% |
| Consumer Price Index | 0.94 | 4.02 | 98% |
| Foreign Travel Expenditure | 0.91 | -0.83 | 53% |
| Dollar Exchange Rate Advanced One Year | -0.56 | -2.31 | 91% |

Note: $H_0$ is interpreted as the "No Relationship" condition. The Confidence Interval should be read as >> 99% confident that the change in aircraft operations with respect to the regressors is <u>not</u> by chance.

In examining Table II-23, the reader will notice the relatively low confidence levels for the Gross National Product and Foreign Tourist Expenditures. This may be interpreted as meaning that the change in aircraft operations with respect to each of those two regressors (and as predicted by the model), is relatively small compared to the variance between the data points themselves. On the other hand, a relatively high confidence interval exists for the Foreign Travel Expenditure and Weighted Dollar Variables because the data is relatively better distributed and tends not to have less unexplained deviations. The obvious question arises of why the less confident regressors where included. This was done to address the problem of balance, bias and sensitivity in the model. Failure to balance a model could create bias and sensitivity in a model that is not appropriate. Note that the overall correlation is 0.97 and that the confidence level exceeds 99% for the overall model. Optimum values would be 1.0 and 100%. It then appears that based on the limitations of the data and the constraints of the real world, that the model is viable. Table II-24 summarizes the results of the regression analysis and gives the mathematical model variables.

TABLE II-24

FORECAST MODEL

Dependent Variable: A/C OPS

| Independent Variable | Estimated Coefficient |
|---|---|
| $X_1$ = GNP | 16.08 |
| $X_2$ = CPI | 511.70 |
| $X_3$ = FTE | 11,030.29 |
| $X_4$ = $+1 | -1,522.30 |
| Constant | 136,310.75 |

The regression equation is defined as:

$$\text{GCP A/C OPS} = 16.08X_1+511.70X_2-11,030.29X_3-1,522.30X_4+136,310.75$$

Where: A/C OPS is the Total Unadjusted Projected Grand Canyon Operations.
GNP is the U.S. Gross National Product in Billions of 1972 Dollars.
CPI is the Consumer Price Index Based on 1972 = 100.
FTE is Foreign Tourism Expenditures in Billions of 1972 Dollars.
$+1 is the effective Exchange Rate of U.S. Dollars to Trade - Weighted International Currency Advanced one year and with 1975 = 100.

All of the historical data used to generate the model for GCN A/C OPS is available from governmental agencies or bureaus, except the U.S. Dollar Effective Exchange Rate. (See Section A.) This data is listed in Table II-25 along with the forecast A/C OPS level provided by the mathematical model.

TABLE II-25

MODEL FORECASTS

| Year | Unadjusted GCN OPS | GNP* ($x10^9$ 1972) | FPI* (1972+100) | FTE* ($x10^9$ 1972) | $+1* (1975=100) |
|---|---|---|---|---|---|
| 1984 | 79,326 | 1,573.90 | 322.60 | 5.23 | 124.60 |
| 1986 | 106,845 | 1,675.20 | 363.70 | 5.59 | 118.80 |
| 1988 | 133,777 | 1,778.80 | 405.40 | 5.91 | 113.90 |
| 1993 | 191,498 | 2,062.10 | 524.80 | 6.85 | 112.30 |
| 2003 | 370,269 | 2,772.00 | 888.00 | 9.12 | 108.00 |

* Input Data from Chase Econometrics Forecasts.

3. Model Adjustment for Aircraft Mix

These unadjusted forecasts derived directly from the forecast model do not represent the best estimate of future GCN operations. The model was developed from historical operations data which was compiled during a period of relatively stable aircraft size, expecially for the commuter segment. Thus, the operations forecasts represent anticipated levels if the aircraft mix remains essentially unchanged from the 1980-82 period. Changing aircraft sizes will be incorporated by the technique of calculating the enplanement based on projected operations and load factors and then utilizing expected seating capacities to forecast adjusted operations levels. Some segments of the traffic are not expected to be influenced by changing aircraft size such as general aviation and military. The actual calculations data is contained in Table II-28, Enplanement and Operations Forecasts.

a. Air Carrier: Republic Airlines currently utilizes DC-9-10 aircraft with system wide upgrading to the DC-9-80 probable. Other small to medium air carrier aircraft such as B-737 and B-727 are also suited to the short to medium haul routes which serve GCN. Interest in operating flights directly to and from Los Angeles was reported by the airport manager as well as others. Some of the Los Angeles interest stems from the 1984 Olympics but tour packages operating directly from Los Angeles would appear to be a feasible routing for foreign visitors entering the U.S. from the west. It is 169 miles to Las Vegas and 174 Miles to Phoenix by direct flight from GCN. Los Angeles is 381 miles away which would still be considered a short haul.

Demand for aircraft larger than B-727 or equivalent is not anticipated. For capacity analysis purposes, the following critical aircraft will be assumed.

1983 - DC-9-10
1988 - DC-9-80
1993 - B-727-200
2003 - B-727-200

Historic enplanements per flight for the air carrier operations ranged from 16.2 to 34.8 from 1979 to 1982 (Table II-20). A typical value of 30 enplanements per flight was utilized to develop the air carrier enplanement data. Increased demand is expected to increase load factors as well as lead to the use of larger aircraft sizes as shown on Table II-28.

The air carrier operations have declined slightly in total number from the maximum of 2,377 in FY 1980 to 1,787 in FY 1983. They have also steadily declined as a percent of total operations from a high of 6.0 in FY 1974 to 1.8 in FY 1982 and 1983. It is assumed that 2000 air carrier operations a year is representative of historic air carrier operations. In the forecasts, it is assumed that the market share served by the certificated air carrier(s) will increase over the forecast period resulting in a growth of the portion of the adjusted annual operations from 3 to 9.1 percent. (See Table II-28.) This assumes that the fluctuations and financial difficulties recently experienced by the air carrier industry will be resolved, and that stable competitive service is available at GCN. Several other factors also support the air carrier increase in the market share including possible carry on overflight restrictions which would make the smaller commuter aircraft less attractive, the world wide marketing organization of the air carriers and the potential for market development for destination points further from the GCN area such as Los Angeles, San Francisco, Denver and other locales.

b. Commuter and Air Taxi: Average historical commuter and air taxi aircraft seat per flight data is available for 1980 through 1982, when the average was 8.2 seats per flight (Table 11-20). In 1983 Scenic Airlines and Grand Canyon Airlines began the transition to the De Haviland DHC-6 Twin Otter aircraft with a 20 passenger capacity.

Several aircraft manufacturers are developing or are producing new aircraft for the commuter market. In the past, commuter operators were largely restricted to general aviation type aircraft. Today manufacturers are providing aircraft in the 20-50 seat class designed to efficiently serve commuter markets. Increased utilization of these aircraft at GCN is anticipated. The forecasted commuter and air taxi revenue seats per flight reflects this trend to larger aircraft due to their better economics and the trend towards more direct flight paths from Las Vegas.

Of course, with larger aircraft, flexibility to accommodate small tour groups and to use the aircraft for other charter operations is reduced. For these reasons, a large number of smaller (i.e. less than 10 seat) aircraft are expected to remain in the aircraft mix serving GCN. The load factor is the most sensitive connection between passengers and operations, and will require close monitoring during development phases to ensure balanced airfield, ramp and terminal capacity.

In 1982, Scenic Airlines alone averaged 9.3 revenue seats per flight and according to the FAA records carried approximately 30% of the arriving passengers. If Grand Canyon Airlines and Scenic Airlines alone complete 100 percent transition to the Twin Otter, the average revenue seats per flight for all commuters will increase from a recently experienced value of 8.1 to 14.9.

Average seats per flight for the commuter and air taxi operations used in these forecasts were as follows:

1983 - 9.0 seats/flight
1988 - 12.5 seats/flight
1993 - 14.0 seats/flight
2003 - 17.0 seats/flight

Note that the use of larger aircraft by the smaller airlines is a national trend as reported in the FAA Aviation Forecasts, FY 1983-1993.

Commuter, air taxi, and charter operations have increased from 52.4 to 82.7 percent of the total operations from FY 1974 to FY 1983. Moderate decline of the commuter operations to 63 percent is forecast through 2003. This forecasted decline in operations is due to the large load factor (more seats available per operation) and the smaller market share expected for commuter aircraft (takes up by air carriers - see section C)

The market share of the based commuter and air taxi operators depends to a large degree upon GCNP visitors who arrive via ground transportation and who presumably utilize local lodging. Due to the GCNP limit on new lodging construction, the limited amount of privately owned land, and the scarcity of water, significant constraints will be encountered in increasing lodging capacity. Therefore, the market share captured by the based commuter and air taxi operators that provide canyon sightseeing trips is reduced over the forecast period. The reduction is from 25 to 15 percent of the total commuter and air taxi enplanements. This represents approximately 5 percent annual growth over the planning period which correlates well with the recent increases in available lodging.

c. Helicopter: Helicopter operations were derived from forecasted emplanements. Enplanements were developed by assuming the historic ratio between commuter passengers and helicopter passengers continued to represent the market demand. Note that based commuter enplanements were restricted in growth due to foreseen problems in future lodging development per the previous paragraph, and that this same assumption affects the helicopter forecasts. Note that the passengers per flight for the helicopters are assumed to increase from the present 3.5 to 5.5 by 2003, reflecting the better economics and availability of larger helicopters.

d. Military: Military operations have typically ranged in the 0.3 to 0.6 percent range of total operations at GCN. It is anticipated that military operations will remain very low at less than 1% of total operations; 0.4 percent was used for forecasting purposes.

e. General Aviation: The percent of total operations attributed to general aviation has steadily declined from 37.8 in FY 1974 to 14.6 in FY 1983. These general aviation flights are presumed to be visitors to the Park who fly their own aircraft as well as other private pilots who stop at GCN to refuel. Due to the increased cost of aviation fuel and aircraft, pleasure flying has declined significantly in the U.S. since 1974. The decrease of general aviation operations at GCN is attributed to this national trend. Fuel prices are expected to continue to increase faster than the CPI according to the FAA Aviation Forecasts. Therefore, general aviation traffic is forecast to continue to decline, although at a slower rate than during the recent recession. A gradual reduction from 11.7 to 10.0 percent of total unadjusted A/C OPS was assumed from 1984 to 2003, respectively.

There is no available historic data concerning the mix of general aviation aircraft operations at GCN. Therefore, projections have been taken from FAA Aviation Forecasts with regard to aircraft type and were used in estimating the general aviation aircraft mix. The increased levels of larger aircraft were based on observations by the FBO of the historic mix, and the forecast operations are listed in Table II-26.

TABLE II-26

Forecast General Aviation Aircraft Mix

| | 1988 | | 1993 | | 2003* | |
|---|---|---|---|---|---|---|
| | Percent | Operations | Percent | Operations | Percent | Operations |
| Single Eng.Piston | 69.9% | 10,539 | 69.5% | 13,695 | 68.6% | 24,892 |
| Multi Eng. Piston | 18.1% | 2,728 | 17.7% | 3,489 | 17.2% | 6,241 |
| Turbo prop | 6.0% | 905 | 6.4% | 1,261 | 7.1% | 2,576 |
| Turbo jet | 6.0% | 905 | 6.4% | 1,261 | 7.1% | 2,576 |

*Extrapolated by Leedshill-Herkenhoff.

f. Local: Local operations such as flight training, proficiency check rides and similar flights in the traffic pattern or in a local training area have historically ranged from 1.8 to 6.0 percent of the total operations. Normally, a stable local population base is required to create a demand for these types of flight services. Such a population growth in the south rim area of the Grand Canyon is not expected and therefore this component of local operations is not expected to grow in importance. The installation of the instrument landing system could generate local instrument training operations by pilots from surrounding communities which do not have an ILS or possibly instrument check rides and proficiency flights by pilots of air taxi operators on layover at GCN. Approximately 1% of the total unadjusted operations are forecast to be local with an additional 1% allocated to increased local instrument training. This provides a total estimate for local operations of 2% of the unadjusted operations.

g. Based Aircraft: Based aircraft at GCN are comprised of the Grand Canyon Airlines, Air Grand Canyon fleet and private aircraft. As of September 1983, Grand Canyon Airlines had 5 aircraft, Air Grand Canyon had 4 aircraft, and four private aircraft were based at GCN. As Grand Canyon Airlines transitions to larger aircraft, the number of their aircraft may decrease somewhat. Based personal aircraft have historically been very low in number due to the small local population. The four small personal aircraft reported in September were not considered based at GCN by the FBO.

These, as well as other long term parked aircraft, are typically moved to other locales for maintenance and during the winter months. Forecasted based aircraft for the local air taxi and charter operators is derived from passenger forecasts. Based private aircraft are estimated from growth trends of general aviation aircraft in the southwest region.

TABLE II-27

Based Aircraft Forecast

| | Local Air Taxi/Charter | | | | | | |
|---|---|---|---|---|---|---|---|
| | Peak Day Pax[1] | Pax/ Flt | Total Flts | Based Aircraft | Private Aircraft | Total | FAA Forecast[2] |
| 1988 | 371 | 12.5 | 30 | 10 | 5 | 15 | 18 |
| 1993 | 473 | 14.0 | 34 | 11 | 6 | 17 | 23 |
| 2003 | 788 | 17.0 | 46 | 15 | 8 | 23 | NA |

[1]Peak day pax estimated from peak month at 200% of average monthly enplanements with a 13.5% peak hour factor: (See Chapter III for seasonal data.)

Source: National Airport Systems Plan.

Figures II-1 and II-2 illustrate the relative change in the forecast variables and the results of the model by using normalized data. In these figures the 1982 value of each item was used as the base year. Figures II-3 and II-4 show the forecast data produced by the model after adjustment for aircraft mix. The data in these two figures is not normalized.

TABLE II-28
Enplanement and Operations Forecasts

| | 1984 | 1986 | 1988 | 1993 | 2003 |
|---|---|---|---|---|---|
| **Enplanements** | | | | | |
| Air Carrier | 34,980 | 62,820 | 98,325 | 174,525 | 473,535 |
| Commuter-Itinerant | 175,387 | 221,079 | 284,373 | 416,118 | 804,089 |
| Commuter-Based | 55,298 | 62,356 | 66,705 | 85,229 | 141,898 |
| Total Fixed Wing Revenue Enp. | 247,665 | 346,255 | 449,403 | 675,872 | 1,419,522 |
| Helicopter Enp. | 35,833 | 40,406 | 43,225 | 55,228 | 91,950 |
| General Aviation Enp. | 15,918 | 21,256 | 26,384 | 34,484 | 63,500 |
| Grand Total | 299,416 | 407,917 | 519,012 | 765,584 | 1,574,972 |
| Annual Growth | -- | 16.7% | 12.8% | 8.1% | 7.5% |
| **Operations** | | | | | |
| Air Carrier | 1,982 | 3,471 | 5,315 | 8,513 | 18,941 |
| Commuter-Itinerant | 39,346 | 43,349 | 45,500 | 59,4459 | 94,600 |
| Commuter-Based | 13,825 | 12,226 | 10,673 | 12,176 | 16,693 |
| General Av.-Itinerant | 9,096 | 12,146 | 15,077 | 19,705 | 36,286 |
| Military | 311 | 419 | 524 | 751 | 1,451 |
| Local Operations | 1,587 | 2,137 | 2,676 | 3,830 | 7,405 |
| Total Fixed Wing Ops | 66,147 | 73,748 | 79,765 | 104,420 | 175,376 |
| Helicopter Ops | 19,907 | 21,266 | 21,612 | 24,545 | 33,436 |
| **Load Data** | | | | | |
| Air Carrier PAX/FLT | 35.3 | 36.2 | 37.0 | 41.0 | 50.0 |
| Commuter PAX/FLT | 8.0 | 10.2 | 12.5 | 14.0 | 17.0 |
| Gen. Aviation PAX/FLT | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| Helicopter PAX/FLT | 3.6 | 3.8 | 4.0 | 4.5 | 5.5 |

Totals may not add due to independent rounding.

4. <u>Conclusion:</u>

The forecasts generated in this chapter represent the best estimate of the anticipated growth demand at GCN. Several key assumptions are incorporated in these forecasts, most of which have been identified in the text. In summary, the factors which have been identified as having the greatest influence on these forcasts are:

a. Continued correlation between U.S. economic factors and GCN activity.

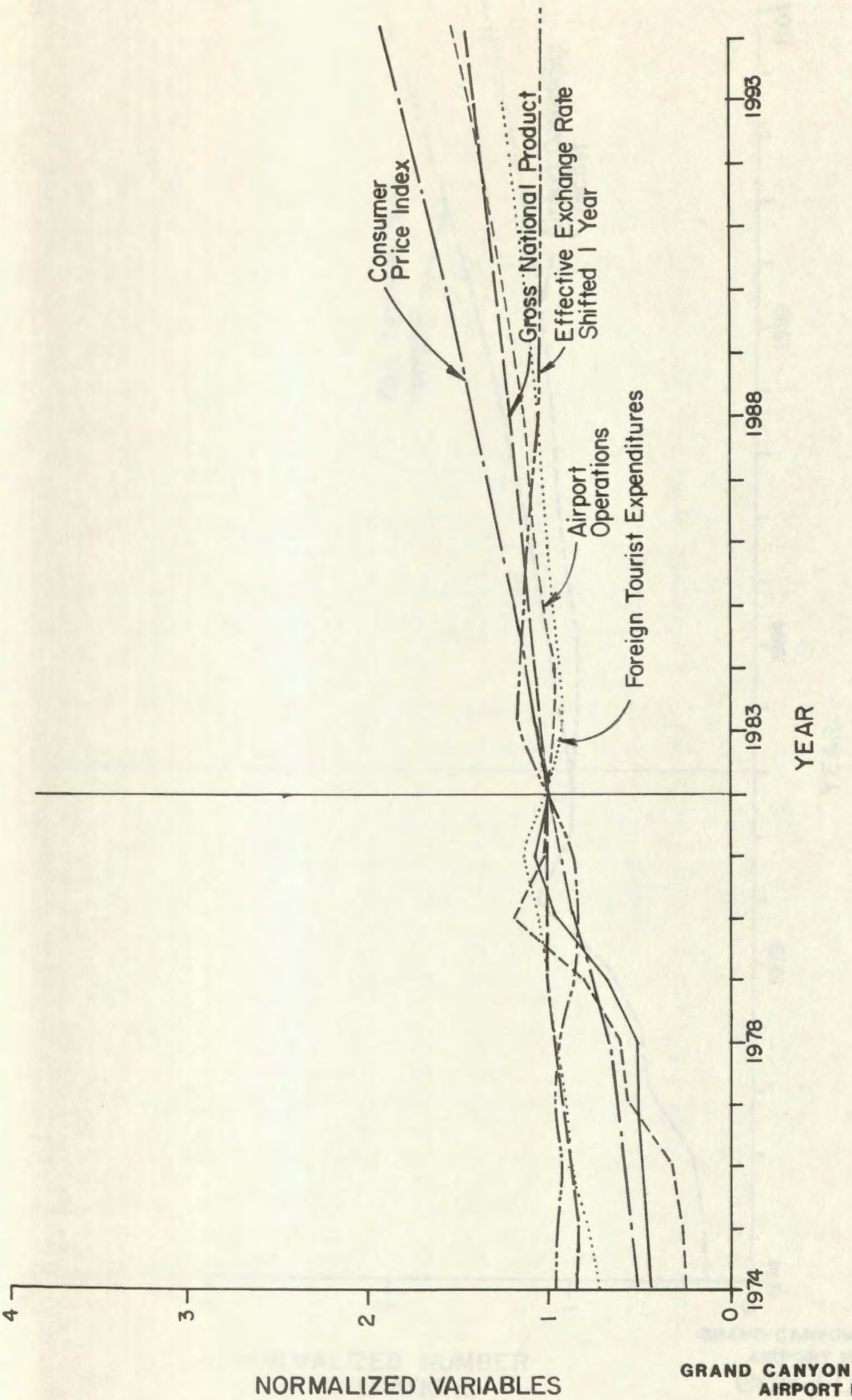
b. Commuter aircraft size, seats per flight and load factors.

c. Grand Canyon National Park overflight and/or visitor limitations.

d. Development of new major traffic generators such as resort or conventional facilities.

The development of the forecasts using this methodology was intended not only to predict the forecasts for this study but to also provide a system for future updating of the forecasts. During the forecast period, at periodic intervals or at crucial milestones in the development phasing, the econometric model can be verified against actaul GCN traffic using actual GNP, CPI, and FPI values. If the model is satisfactory, updated forecasts of economic data can then be used to adjust the GCN forecasts to represent existing conditions. Of course, if the model is not sufficiently accurate, either the coefficients will require recalculations or other independent variables may need to be included.

One of the difficulties encountered in performing and evaluating these forecasts was the scarcity of tangible verifiable data concerning passenger movements. The FAA data base records are the best available, but are incomplete due to the large number of smaller carriers and are available only back to 1979. To supplement the data sources used in this report, we recommend a random sampling monitoring program be established to provide statistically accurate future records of passenger volume, origin/destination, length of visit, etc. Perhaps a cooperative effort with Northern Arizona University (or other universities) or the U.S. Park Service could be arranged for mutual benefit.




GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN
**NORMALIZED FORECASTING VARIABLES**
FIGURE II-1

LEEDSHILL-HERKENHOFF, INC.

[illegible] represent the best estimate [illegible] Several key assumptions are [illegible] have been identified in the [illegible] been identified as having the [illegible]

[illegible] U.S. economic factors and GCA [illegible]

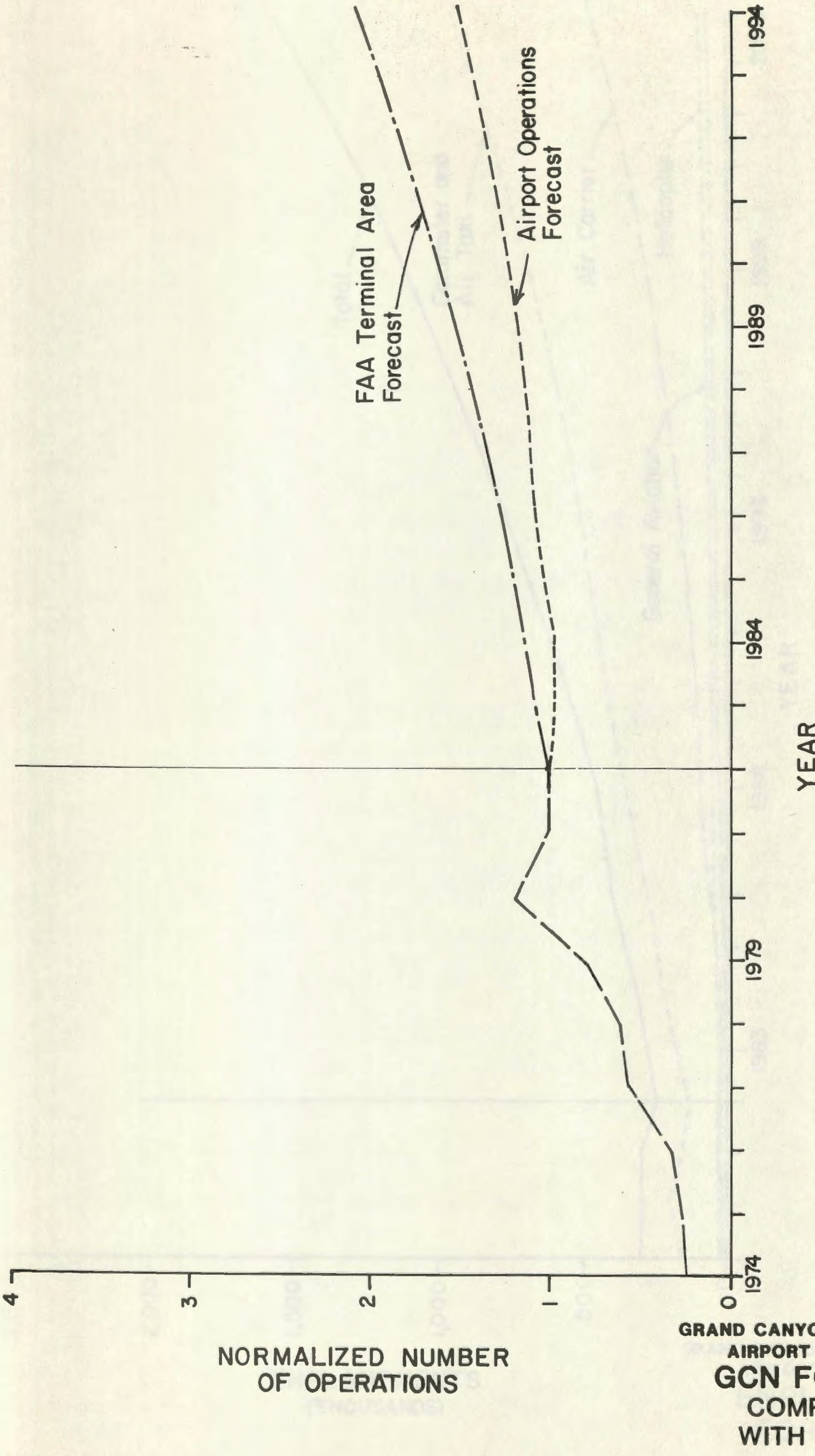
[illegible] seats per flight and load factors.

[illegible] Park overflight and/or visitor [illegible]

[illegible] traffic generators such as resort or [illegible]

[illegible] using this methodology was [illegible] for this study but to also provide [illegible] forecasts. During the forecast period, [illegible] milestones in the development planning, [illegible] actual GCA traffic using actual [illegible] is satisfactory, updated forecasts of [illegible] the GCA forecasts to represent [illegible] the model is not sufficiently accurate, [illegible] recalculations or other independent [illegible]

[illegible] encountered in performing and evaluating [illegible] tangible verifiable data concerning [illegible] records are the best available, but [illegible] of smaller carriers and are available [illegible] the data sources used in this report, we [illegible] program be established to provide [illegible] of passenger volume, origin/destina-tion, [illegible] Perhaps a cooperative effort with Northern Arizona University (or other universities) or the U.S. Park Service could be

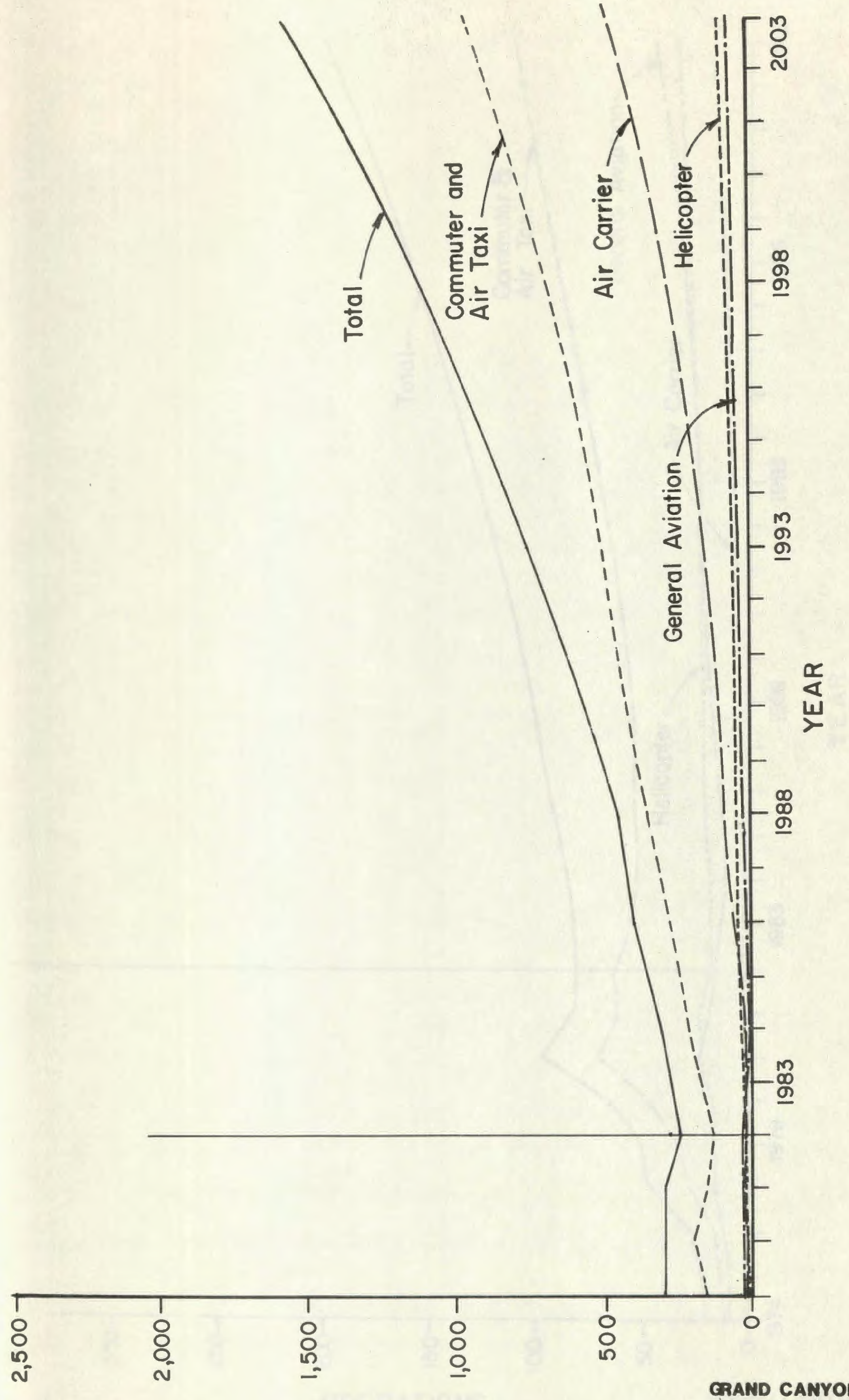



**GRAND CANYON NATIONAL PARK**
**AIRPORT MASTER PLAN**

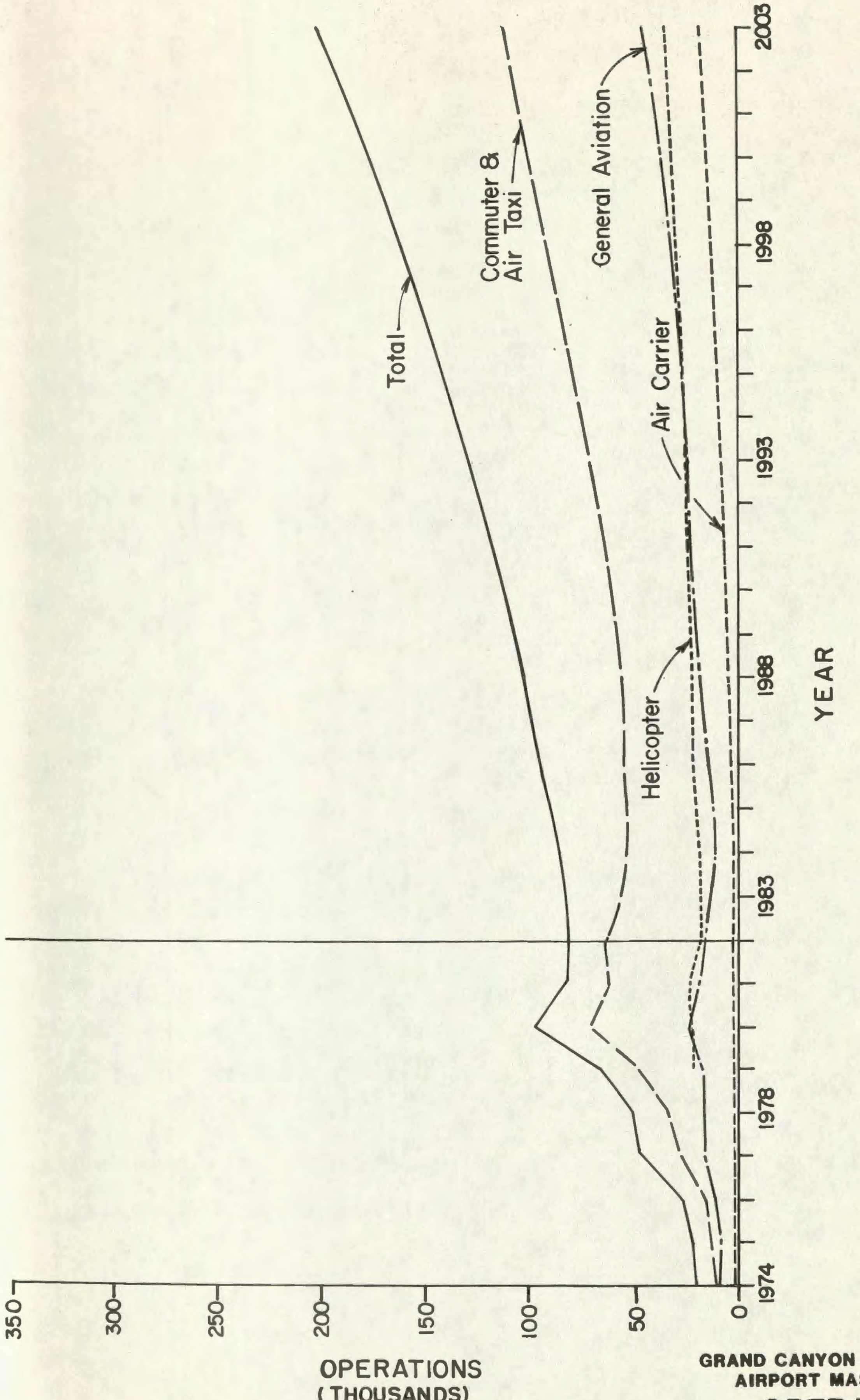
**GCN FORECAST**
**COMPARISON WITH FAA DATA**

**FIGURE II-2**

LEEDSHILL-HERKENHOFF, INC.




**GRAND CANYON NATIONAL PARK**
**AIRPORT MASTER PLAN**
**ENPLANEMENT FORECASTS**
**FIGURE II-3**




**GRAND CANYON NATIONAL PARK**
**AIRPORT MASTER PLAN**

## OPERATIONS FORECAST

**FIGURE II-4**

LEEDSHILL - HERKENHOFF, INC.

# CHAPTER III
# DEMAND-CAPACITY ANALYSIS

## A. GENERAL:

The runway capacity at GCN is considered the controlling airport physical constraint. This assumes that all other necessary airport elements are adequate, or can be expanded at less expense than that required to expand the runway capacity.

The runway capacity analysis has been based on the methodology of F.A.A. Advisory Circular 150-5060-5, AIRPORT CAPACITY AND DELAY.

## B. ANALYSIS OF OPERATIONS:

The procedures outlined in FAA A/C 150-5060-5 are based on typical airport configurations. The circular allows the planner to incorporate the effects of traffic mix, training operations, and taxiway exit availability into the determination of runway capacity.

1. Seasonal Fluctuations: Due to the tourist nature of this facility and to the severe winter weather at GCN, the aviation activity is strongly skewed towards the summer months. Monthly ATCT records show that in August, the busiest month, operations average 183% of the average month. Evaluating the monthly ACTC data, summer traffic (April through September) averages 69% of the total annual operations. Data supplied by Grand Canyon Airlines shows that local commuter enplanements in August average 218% of the average month and corresponds to a peaking factor for August of 202% for Republic Airline enplanements. A monthly seasonal peaking factor 200% of the annual average is used for enplanements in the analysis.

2. Daily Fluctuations: The typical scenario of operations at GCN during the two peak months of July and August was developed from ATCT records for 1983. Data for this peak 60 day period are contained in Table III-1.

TABLE III-1
Hourly Operations

| Time of Day | Monthly Operations July, 1983 | Monthly Operations August, 1983 | Average Daily Operations | Percent % |
|---|---|---|---|---|
| 8:00-9:00 | 1130 | 1038 | 35 | 8.44 |
| 9:00-10:00 | 1732 | 1737 | 56 | 13.51 |
| 10:00-11:00 | 1388 | 1482 | 46 | 11.18 |
| 11:00-12:00 | 1314 | 1405 | 44 | 10.59 |
| 12:00-13:00 | 1344 | 1416 | 45 | 10.75 |
| 13:00-14:00 | 1234 | 1390 | 42 | 10.22 |
| 14:00-15:00 | 1025 | 1036 | 33 | 8.03 |
| 15:00-16:00 | 1319 | 1396 | 44 | 10.58 |
| 16:00-17:00 | 1321 | 1408 | 44 | 10.63 |
| 17:00-18:00 | 731 | 827 | 25 | 6.07 |
| TOTAL | 12538 | 13135 | | 100 |

Source: GCN ATCT Records
Notes: 1. This table only reflects operations recorded from 8 a.m. to 6 p.m. There are operations before and after that time frame.

2. The peaking factor of 13.5% is based on the traffic during the ten hour period of ATCT operation and does not include the traffic during the remaining hours.

The peak hour activity consists primarily of commuter arrivals from Las Vegas, Nevada. Some departures occur during this period consisting of commuter aircraft returning to Las Vegas for additional passengers, based commuter flights leaving to tour the Grand Canyon, and general aviation flights. A 75/25 percent arrival/departure ratio was assumed based on data from aircraft operators and the ATCT.

Figure III-1 shows the daily traffic fluctuations discussed above. The peaking factor of 13.5% of the daily traffic is slightly lower than the FAA assumed value of 20% for this type of traffic mix. Also shown in Figure III-1 is a projected distribution with an 11% peak factor which will be discussed as part of the demand satisfaction.

3. Weather: Flying weather follows a pattern of excellent VFR weather in summer months with several non-flying weather days during the winter. Data provided by Grand Canyon Airlines shows the following average days per month of non-flying weather days.

TABLE III-2
Average Monthly Non-flying Weather Days

| Month | Days | Percent |
|---|---|---|
| January | 11.4 | 36.9% |
| February | 7.7 | 27.6% |
| March | 6.1 | 19.8% |
| April | 2.9 | 9.5% |
| May | 0.4 | 1.4% |
| June | 0.1 | 0.5% |
| July | 0.6 | 1.8% |
| August | 0.6 | 1.8% |
| September | 0.4 | 1.4% |
| October | 2.4 | 7.8% |
| November | 5.1 | 17.1% |
| December | 8.9 | 28.6% |

Source: Data provided by Grand Canyon Airlines - seven year period, days of limited or no operations due to weather.

Since peak traffic activity is in the summer, and IFR weather is observed less than 2% of the time, the capacity analysis does not correct for IFR conditions.

4. Training: As discussed in the previous chapter, very few training or touch and go operations are conducted at GCN. No training will be considered in determining the airport capacity requirements.

5. <u>Instrument Approaches</u>: The preferred traffic direction is on Runway 21 to the southwest because of prevailing southwesterly winds and the early turnout into the ramp and terminal area. However; due to terrain and property limitations, the ILS approach is on runway 03 to the northeast. Any practice instrument approaches, or check rides will probably be against the prevailing traffic direction. It is assumed that the airport control tower will minimize the effect of these operations on airport capacity by restricting them to non-peak hours.

## C. AIRPORT CAPACITY EVALUATION:

Peak hour capacities and adjusted annual capacities have been developed for several combinations of traffic mix and runway system improvements at Grand Canyon Airport. The following paragraphs outline the steps taken to determine these capacities.

1. <u>Traffic Mix</u>: The traffic mix at GCN was derived by separating air carrier and commuter service operations into relative percentages by aircraft size for each year of interest. Helicopter operations are included for completeness. Table III-3 lists the results of this analysis.

TABLE III-3

ANNUAL OPERATIONS FORECAST BY AIRCRAFT CLASSIFICATION

| Traffic Derivation | Aircraft Class A | B | C | Helicopter | Totals |
|---|---|---|---|---|---|
| **1984** | | | | | |
| General Aviation | 6,367 | 2,729 | 0 | 0 | 9,906 |
| Based Commuter | 1,230 | 12,551 | 44 | 0 | 13,825 |
| Itinerant Commuter | 3,498 | 35,721 | 127 | 0 | 39,346 |
| Air Carrier | 0 | 0 | 1,982 | 0 | 1,982 |
| Local Operations | 1,428 | 159 | 0 | 0 | 1,587 |
| Military | 0 | 0 | 311 | 0 | 311 |
| TOTALS | 12,523 | 51,160 | 2,464 | 19,907 | 86,054 |
| **1988** | | | | | |
| General Aviation | 10,539 | 4,538 | 0 | 0 | 15,077 |
| Based Commuter | 1,135 | 7,787 | 1,751 | 0 | 10,673 |
| Itinerant Commuter | 4,839 | 33,197 | 7,464 | 0 | 45,500 |
| Air Carrier | 0 | 0 | 5,315 | 0 | 5,315 |
| Local Operations | 2,408 | 268 | 0 | 0 | 2,676 |
| Military | 0 | 0 | 524 | 0 | 524 |
| TOTALS | 18,921 | 45,790 | 15,054 | 21,612 | 101,377 |
| **1993** | | | | | |
| General Aviation | 13,695 | 6,010 | 0 | 0 | 19,705 |
| Based Commuter | 1,436 | 8,225 | 2,515 | 0 | 12,176 |
| Itinerant Commuter | 7,008 | 40,157 | 12,280 | 0 | 59,445 |
| Air Carrier | 0 | 0 | 8,513 | 0 | 8,513 |
| Local Operations | 3,447 | 383 | 0 | 0 | 3,830 |
| Military | 0 | 0 | 751 | 0 | 751 |
| TOTALS | 25,586 | 54,775 | 24,059 | 24,545 | 128,965 |
| **2003** | | | | | |
| General Aviation | 24,892 | 11,394 | 0 | 0 | 36,286 |
| Based Commuter | 1,872 | 8,423 | 6,398 | 0 | 16,693 |
| Itinerant Commuter | 10,607 | 47,735 | 36,258 | 0 | 94,600 |
| Air Carrier | 0 | 0 | 18,941 | 0 | 18,941 |
| Local Operations | 6,665 | 740 | 0 | 0 | 7,405 |
| Military | 0 | 0 | 1,451 | 0 | 1,451 |
| TOTALS | 44,036 | 68,292 | 63,048 | 33,436 | 208,812 |

Based on the data in Table III-3, a mix-index has been determined as defined in A/C 150-5060-5. This index is defined as the percentage of Class-C aircraft operations, plus three times the percentage of Class-D aircraft operations. Since there are no anticipated Class-D Aircraft operations at GCN, the mix-index simply becomes the percentage of annual Class-C aircraft operations, and is applied to the airport capacity determinations. The aircraft types are listed below with their identifying characteristics.

TABLE III-4
AIRCRAFT CLASSIFICATIONS

| Aircraft Class | Max. Cert. T.O. Weight (lbs.) | Number of Engines | Wake Turbulance Classification |
|---|---|---|---|
| A | 12,500 or less | Single | Small(s) |
| B | 12,500 or less | Multi. | " |
| C | 12,500 - 300,000 | Multi. | Large(L) |
| D | Over 300,000 | Multi. | Heavy(H) |

Note: Table excerpted from AC 150/5060-5.

2. Taxiway Exit Rating: Optimum taxiway configurations are those which provide for an adequate number of exits from the runway which are located in a distance range from the runway threshold to efficiently serve the airport traffic mix. A/C 150-5060-5 provides an exit rating based on airport runway configuration, number of exits, location of exits, and percentage of arrivals.

The circular lists exit factors for airports with arrival streams of up to 60% of the peak hour operations. Because of the unusually high rate of arrivals at GCN during the peak demand period (75%), the exit factors were extrapolated for this report. It should be emphasized that an optimum taxiway exit rating is 1.0, with less desirable ratings declining to 0. The present taxiway exit factor at GCN is approximately 0.80. There is no advantage given to angled exits under the methodology.

3. Touch and Go Factor: As previously stated, the training utilization of GCN is insignificant. The touch and go factor is therefore 1.0 for all periods.

4. Peak Hour Capacity: The Hourly Capacity Base for Grand Canyon Airport was determined from charts in the Airport Capacity and Delay circular. In the preparation of the capacity figures, it was noted that aircraft in Class-C under the method incorporate a "typical" distribution of multiengine airplanes from 12,500 pounds to 300,000 pounds in gross weight. At the lower end of the scale are aircraft of the size of the deHavilland Twin Otter, a 20 passenger propeller driven airplane. At the upper end are aircraft similar in size to the Boeing-767, a wide-bodied turbofan. Because the preponderance of Class-C aircraft at Grand Canyon Airport are anticipated to be less than 50,000 pounds gross weight, the Hourly Capacity Base values from AC 150/5060-5 have been adjusted upward by 10 percent.

5. Runway and Taxiway Improvements: Preliminary evaluation of the required airport improvements can be derived by comparing the annual capacity figure shown in Table III-5 with the forecasted fixed wing operations in Table II-27. A summary of the demand-capacity analysis is shown graphically in Figure III-2. As shown, taxiway improvements are forecast for 1989. However, as delays become more prevalent, commuter and air carrier operators may elect to spread flights out to minimize delays. Analysis of the traffic distribution data in Figure III-1 reveals that if the hourly peaking factor can be reduced to 11.0 percent of the peak daily operations, the taxiway improvements will not be required until 1991, and the construction of an additional runway could be postponed from 1993 until 1996. Theoretically, this could be accomplished by shifting approximately 2-1/2 percent of the

operations back 60 minutes, with their arrival at GCN between 8:00 and 9:00 a.m. instead of from 9:00 to 10:00 a.m. However, shifting operations back 1 hour might not be feasible due to airline schedules and lack of demand for flights earlier in the morning. The FAA recommended base peaking factor for the GCN traffic mix is 20%. The GCN 13.5% factor indicates that some shifting of the traffic may have already occurred to avoid congestion. In any case, a full investigation of need should be conducted at the time of possible expansion of the airport.

Airport improvements will be fully evaluated in succeeding chapters. It is clear from the data developed here that an additional runway will be required if the unrestrained forecasted demand is to be satisfied.

TABLE III-5
Airport Capacity by Year as Limited
By Runway and Taxiway Development

| | 1984 | 1988 | 1988[2] | 1993 | 1993[2] | 2003[2] | 2003[3] |
|---|---|---|---|---|---|---|---|
| Peak Hour Capacity[1] (OPS/HR) | 70 | 60 | 75 | 49 | 73 | 66 | 119 |
| Mix Index | 3 | 19 | 19 | 23 | 23 | 36 | 36 |
| Touch and Go Factor | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Exit Factor | 0.80 | 0.80 | 1.00 | 0.67 | 1.00 | 1.00 | 0.89 |
| Projected Annual Capacity (P.F. = 13.5%) | 103,420 | 88,646 | 110,808 | 72,394 | 107,853 | 97,510 | 175,815 |
| Optimum Annual Capacity, (P.F. = 11.0%) | 126,925 | 108,793 | 135,991 | 88,847 | 132,365 | 119,672 | 215,772 |

[1]AC 150/5060-5 Quantity increased 10% to adjust for atypical Class-C aircraft mix.

[2]Existing Runway - Optimum taxiway exit system.

[3]Parallel runway - Constructed with 3 exits in critical range.

## D. FACILITY CAPACITY:

The demands placed on the operations area are related to average peak day and average peak hour passenger and aircraft movements. This includes such airfield elements as utilities, access, parking, terminal building and aircraft parking apron. The gross capacity necessary to meet the demand for these services will be developed from the peak activity forecasts contained in Tables III-6 and III-7.

TABLE III-6

Peak Enplanements Demand

| | A.C. | Itin. Comm. | Based Comm. | Hel. | G.A. | Total |
|---|---|---|---|---|---|---|
| 1982 | | | | | | |
| Annual | 32,831 | 124,978 | 66,697 | 33,200 | 19,440 | 277,140 |
| Avg.Day-Peak Mo.[1] | 183 | 694 | 370 | 178 | 108 | 1,533 |
| Peak Hour[2] | 60 | 188 | 100 | 48 | 28 | 424 |
| 1988 | | | | | | |
| Annual | 98,325 | 284,373 | 66,705 | 43,225 | 26,384 | 519,012 |
| Avg.Day-Peak Mo. | 546 | 1,580 | 371 | 240 | 147 | 2,884 |
| Peak Hour[3] | 80 | 426 | 100 | 64 | 40 | 710 |
| 1993 | | | | | | |
| Annual | 174,525 | 416,118 | 85,229 | 55,228 | 34,484 | 765,584 |
| Avg.Day-Peak Mo. | 969 | 2,312 | 473 | 307 | 192 | 4,253 |
| Peak Hour[3] | 194 | 624 | 128 | 82 | 52 | 1,080 |
| 2003 | | | | | | |
| Annual | 473,535 | 804,089 | 141,898 | 91,950 | 63,500 | 1,574,972 |
| Avg.Day-Peak Mo. | 2,630 | 4,467 | 788 | 511 | 353 | 8,749 |
| Peak Hour[3] | 500 | 1,206 | 212 | 138 | 96 | 2,152 |

[1]Peak month = 200% of average month.

[2]Single DC-9-10 AC departure with 75% load factor.

[3]Derived from expected operations per peak hour for mixed aircraft over 60 seats with 75% load factor.

[2,3]Peak hour requirements of traffic types other than air carrier were derived using a 13.5% peaking factor.

TABLE III-7

Peak Operations Demand

| | A.C. | Itin. Comm. | Based Comm. | G.A. | Hel. | Total |
|---|---|---|---|---|---|---|
| 1982 | | | | | | |
| Annual | 1,889 | 39,188 | 20,911 | 13,203 | 18,980 | 94,172 |
| Avg.Day-Peak Mo.[1] | 9 | 193 | 103 | 65 | 93 | 463 |
| Peak Hour[2] | 2 | 26 | 14 | 9 | 13 | 64 |
| 1988 | | | | | | |
| Annual | 5,315 | 45,500 | 10,673 | 18,277 | 21,612 | 101,377 |
| Avg.Day-Peak Mo. | 26 | 224 | 53 | 90 | 110 | 503 |
| Peak Hour | 4 | 30 | 8 | 16 | 17 | 75 |
| 1993 | | | | | | |
| Annual | 8,513 | 59,445 | 12,445 | 24,286 | 24,545 | 128,244 |
| Avg.Day-Peak Mo. | 42 | 292 | 60 | 119 | 125 | 630 |
| Peak Hour | 6 | 39 | 8 | 16 | 17 | 85 |
| 2003 | | | | | | |
| Annual | 18,941 | 94,600 | 16,693 | 45,142 | 33,436 | 208,812 |
| Avg.Day-Peak Mo. | 93 | 465 | 82 | 222 | 170 | 1,032 |
| Peak Hour | 13 | 63 | 11 | 30 | 23 | 140 |

[1]Peak month is 183% of average month.

[2]Peaking factor of 13.5% on 10 hr. base day.

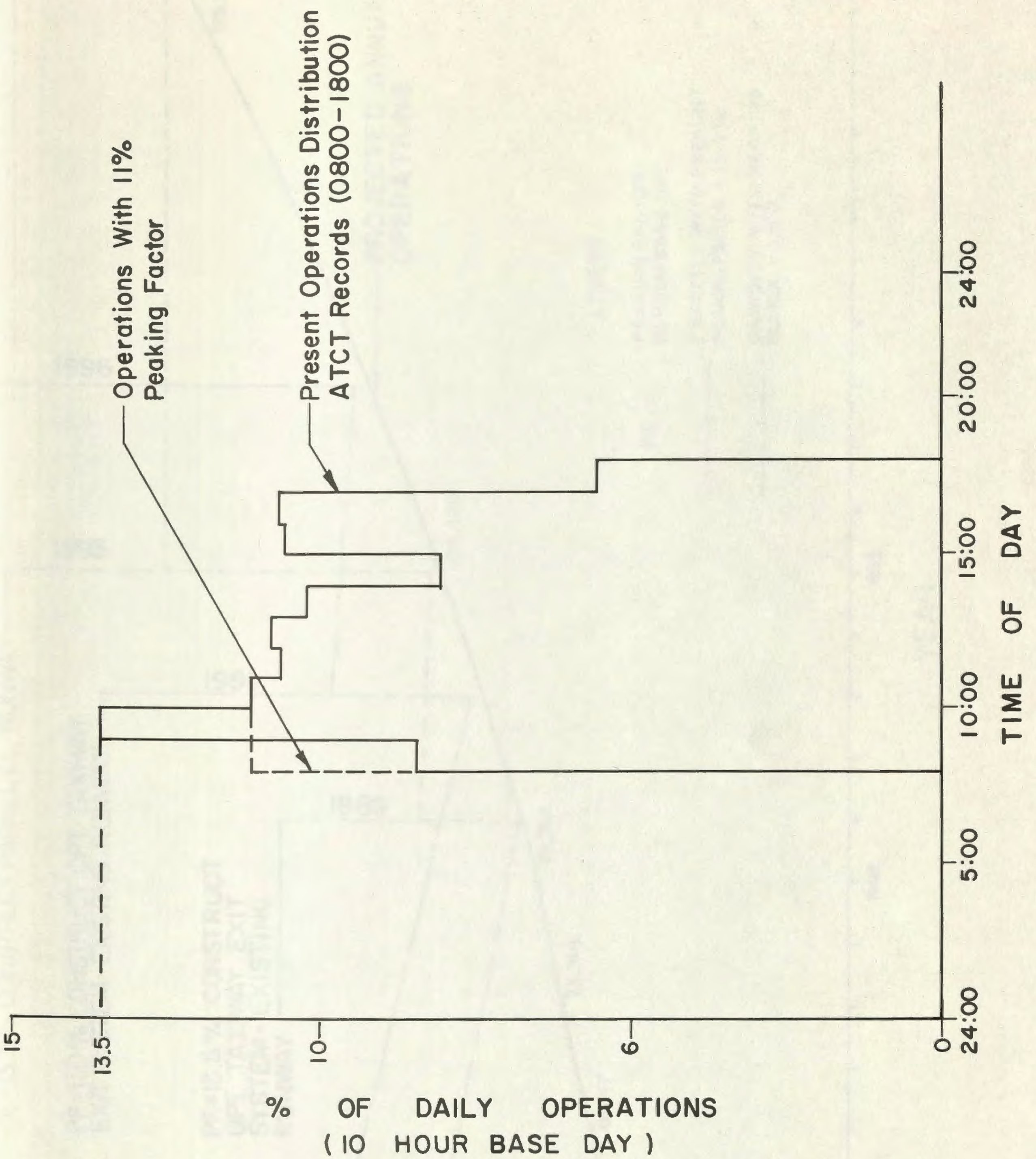
The loading factors and peaking factors have been previously discussed. The air carrier aircraft mix used to develop the peak hour passenger loading is presented in Table III-8.

From the peak activity forecasts and from the aircraft size data, facility capacity requirements are estimated. These requirements will be fully developed in Chapter IV.

TABLE III-8

Air Carrier Aircraft Mix

| | | | | |
|---|---|---|---|---|
| Revenue Seats | | 60-80 | 81-135 | 136-155 |
| Representative A/C | | DC-9-10 | B-737<br>DC-9-32 | B-727-200<br>DC-9-80 |
| Pax/Flt. (annual avg.) | | 35.3 | 67.5 | 82.3 |
| 1984 | Enplanements | 34,980 | -- | -- |
| | Operations | 1,982 | -- | -- |
| 1988 | Enplanements | 88,885 | 9,440 | -- |
| | Operations | 5,036 | 279 | -- |
| 1993 | Enplanements | 127,228 | 29,844 | 17,453 |
| | Operations | 7,206 | 883 | 424 |
| 2003 | Enplanements | 213,090 | 99,443 | 161,002 |
| | Operations | 12,077 | 2,948 | 3,916 |



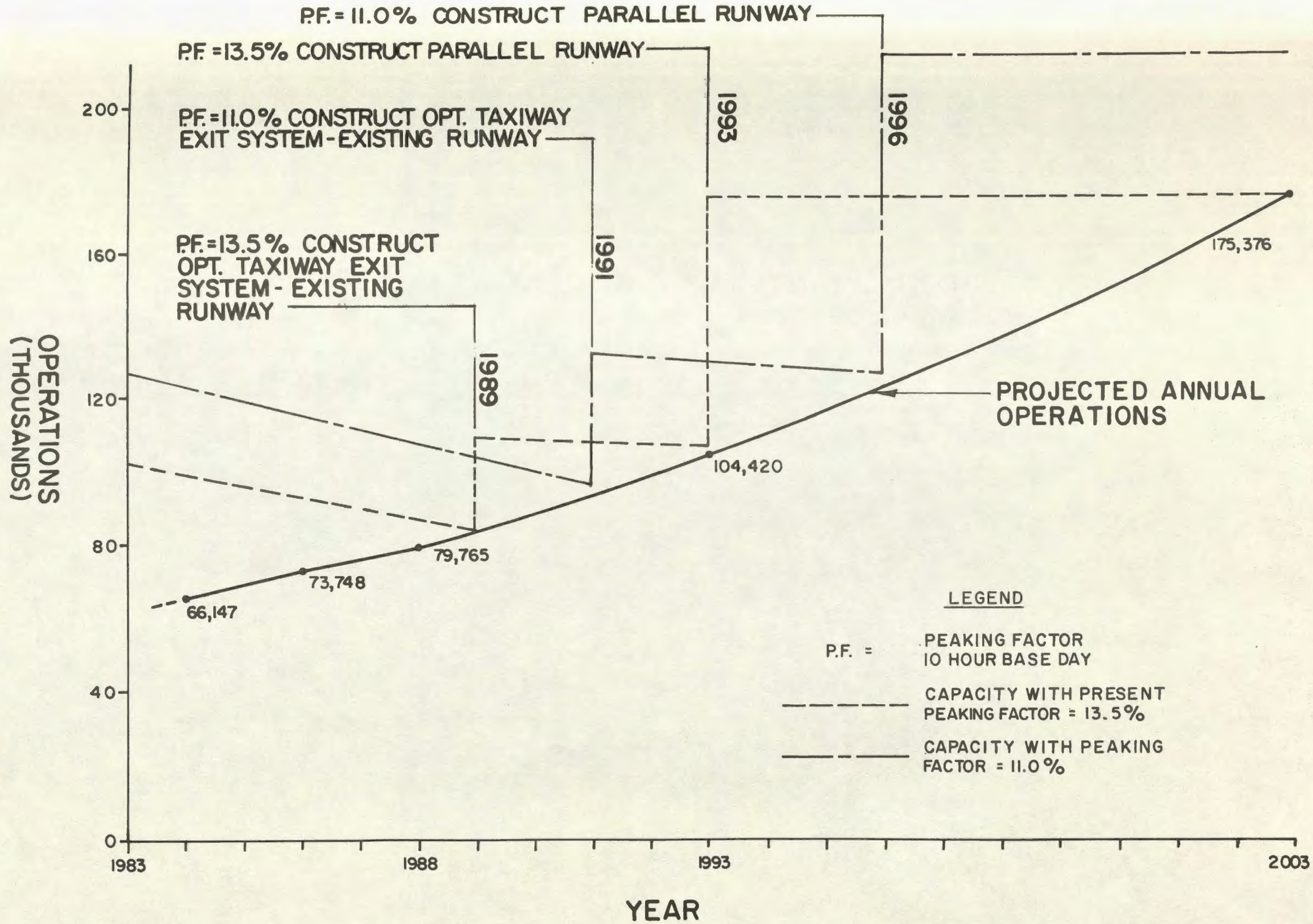

**GRAND CANYON NATIONAL PARK**
**AIRPORT MASTER PLAN**

## DAILY TRAFFIC DISTRIBUTION

LEEDSHILL-HERKENHOFF, INC.

**FIGURE III-1**

LEEDSHILL-HERKENHOFF, INC.




GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN

RUNWAY DEMAND AND
CAPACITY COMPARISON

FIGURE III-2

# CHAPTER IV

## AIRPORT REQUIREMENTS

A. GENERAL:

This chapter presents the criteria for planning facility expansion at GCN to accommodate the demand forecast in the previous chapters. Operational criteria for airfield development will be established. The existing facility and facility improvements will be evaluated in terms of the forecasted demand, the aircraft mix and the operational criteria to develop a definition of the total airport facility required. The existing Grand Canyon National Park Airport is described in Chapter I, Section A and B.

B. OPERATIONAL CRITERIA:

The development of guidelines used in preparing the physical layout of runways, taxiways, aprons, and related works at GCN is grouped under this heading.

1. Airplane Design Groups: The physical characteristics of the aircraft using the airfield affects the dimensional standards required. The FAA has established the following design groups defined in AC 150/5300-4 and -12 which are pertinent to GCN.

TABLE IV-1

Airplane Design Groups

| | I | II | III |
|---|---|---|---|
| Wingspan | Less than 49' | 49'-78' | 79'-118' |
| Representative Aircraft | Single engine propeller, Light twin propeller, Smaller Bus. Jets, Beech Baron, Piper Cheyenne, Cessna 402, Cessna Citation I | Twin Otter Cessna 441 Gulfstream II | F-27 B-727 DC-9 DC-3 Gulfstream I |

The Airplane Design Group for the primary runway at GCN is Group III which will accommodate the current air carrier aircraft and will also accommodate the projected aircraft types. The secondary parallel runway required to meet the projected demand will not be required to handle the larger air carrier aircraft and will serve Design Group II aircraft.

2. Safety Criteria: The term "Safety Criteria" refers primarily to the imaginary surfaces and other criteria designated to ensure the safe operation of aircraft on and in the vicinity of an airport. The Federal Aviation Regulations, Subpart C of Part 77, sets forth certain minimum standards for determining hazards to air navigation. Note that these are minimum standards; it is obligatory on the part of the airport planner to determine firstly, the desired type of air navigation for which the airport should be protected and, secondly, the standards by which such protection can be assured.

The F.A.R. Part 77 airspace surfaces are shown on Figure IV-1 for three runway categories. At present, Runway 3 is a precision instrument runway and Runway 21 is a non-precision runway and this is the recommended long range approach categories for these runways. Visual runway requirements are also listed which are appropriate for the parallel runway proposed in Chapter III, assuming the runway is limited to Design Group II aircraft.

In view of the lack of precise information as to the specific fleet mix expected to use the facility, no clearways have been used in developing recommended runway lengths. Extended safety areas are recommended for all runways. Statistics for air carrier operations show an occurrence of one overrun or undershoot for each 550,000 landings. Ninety percent of these occur within 1,000 feet of the runway end. Thus, extended safety areas (graded traversable safety areas extending 1000 feet beyond the runway end) are currently required for air carrier runways and are recommended for all runways at GCN.

The dimensions of the protection criteria are listed in Table IV-2 for each runway utilization. The horizontal, conical and transitional surfaces conform with F.A.R. Part 77.

TABLE IV-2

Safety Criteria Summary

| Item | Precision Instrument Runways | Non-Precision Instrument Runways | Visual Runways |
|---|---|---|---|
| Airplane Design Group | III | III | II |
| Primary surface width and approach Width at inner end | 1,000 ft. | 1,000 ft. | 250 ft. |
| Approach surface width at outer end | 16,000 ft. | 3,500 ft. | 1,250 ft. |
| Approach surface length | 50,000 ft. | 10,000 ft. | 5,000 ft. |
| Approach surface slope | 50:1, Inner 10,000'<br>40:1, Outer 40,000' | 34:1 | 20:1 |
| Runway safety area width | 500 ft. | 500 ft. | 150 ft. |
| Runway and approach obstacle free zone width | 400 ft. | 400 ft. | 250 ft. |
| Inner-transitional OFZ slope/max ht. | 3:1/150 ft. | -- | -- |
| Runway safety area length (beyond runway end) | 1,000 ft. | 1,000 ft. | 1,000 ft. |
| Clear zone width, start | 1,000 ft. | 1,000 ft. | 250 ft. |
| Clear zone width, end | 1,750 ft. | 1,425 ft. | 450 ft. |
| Clear zone length | 2,500 ft. | 1,700 ft. | 1,000 ft. |
| Taxiway safety area width | 171 ft. | 171 ft. | 80 ft. |
| Taxiway obstacle free area width | 200 ft. | 200 ft. | 132 ft. |
| Terminal taxilane width | 160 ft. | 160 ft. | 108 ft. |
| Visual Runway Separation | 700 ft. | 700 ft. | 700 ft. |
| Runway centerline to B.R.L. (recommended) | 1,000 ft. | 1,000 ft. | 750 ft. |
| Runway centerline to airport boundary | 1,000 ft. | 1,000 ft. | 750 ft. |
| Runway centerline to Taxiway centerline | 400 ft. | 400 ft. | 300 ft. |
| Runway centerline to Aircraft Parking | 500 ft. | 500 ft. | 500 ft. |

3. Runway Length Requirements: Runway lengths are determined from the operational requirements of those aircraft expected to operate at the airport which require the greatest runway length. Most airports derive runway length requirements from a group of aircraft types having similar operational characteristics. Where larger aircraft are expected, the most common practice is to determine the runway length required for a specific "critical" aircraft. Once the critical aircraft or aircraft group has been defined, application of site conditions affecting aircraft operation are applied to further define specific needs. The most significant of these site conditions are elevation above mean sea level, normal maximum temperature of the hottest month, and longitudinal runway gradient.

Runway length analysis is based on F.A.A. Advisory Circular AC150/5300-4, AC 150/5300-6, AC 150/5325-4, and the Airport Planning Manuals of Aircraft Characteristics published by the airframe manufacturers in conformity with NAS3601. The result of this analysis is presented on Table IV-3.

A majority of operations at GCN are and will continue to be aircraft weighing less than 12,500 pounds; however, the air carrier and business jet aircraft are most critical in determining runway lengths. Development phasing must approach this disparity with caution to yield maximum utilization consistent with minimum costs.

Characteristics at GCN affecting runway length requirements (i.e., pressure altitude, mean-maximum temperature, effective runway gradient) all increase the runway length required for takeoff. However, most jet aircraft are weight limited when operating at these altitudes by second stage climb gradient requirements. As engines with greater thrust are developed, this restriction will become less significant, but so will takeoff runway length requirements be reduced.

At the altitude and design temperature of GCN, the landing lengths are less than the takeoff requirements. For planning purposes, the recommended

## TABLE IV-3

### Runway Length Requirements

| Category or Aircraft Designation | Operating Data | Takeoff Runway Length (Ft.) |
|---|---|---|
| Basic Utility I | 75% Propeller Fleet - 12,500# | 5,700 |
| Basic Utility II | 95% Propeller Fleet - 12,500# | 8,000 |
| General Utility | All A/C - 12,500# | 8,000 |
| Basic Transport | 75% Fleet - 60% Useful Load | 7,900 |
| Basic Transport | 75% Fleet - 90% Useful Load | 9,500* |
| Basic Transport | 100% Fleet - 60% Useful Load | 12,600* |

| Air Carrier | Haul Distance (n.m.)[1] | Takeoff Weight (lb.) | Payload (lb.) | Takeoff Runway Length (Ft.) |
|---|---|---|---|---|
| DC-9-15 | 151 | 77,000 | 18,000[2] | 9,400 |
| (JT8D-1) | 151 | 73,500 | 17,000 | 9,000 |
| DC-9-80 | 151 | 107,000 | 25,000 | 9,000 |
| (JT8D-209) | 332 | 117,000 | 26,000 | 10,700 |
| | 332 | 123,500 | 31,000[2] | 12,200 |
| B-727-200 | 332 | 157,500 | 31,000[2] | 10,700 |

Conditions: Airport Elevation = 6611 M.S.L.
Temperature = 85.6°F
Effective Runway Gradient = 0.844%

Notes: *Aircraft is second segment climb or climb gradient weight limited.
[1]Haul distances to LAS and LAX.
[2]Max. passengers.

### Executive Turbojet Aircraft Included in 75% of Basic Transport Fleet Under 60,000 Pounds

| | |
|---|---|
| Gates Learjet Corp. | Learjet (20,30,50 Series) |
| Rockwell International | Sabreliner (40,60,75,80 Series) |
| Cessna Aircraft | Citation (I,II,III) |
| Dassault-Breguet | Fan Jet Falcon (10,20,50 Series) |
| British Aerospace Aircraft Group | HS-125 (400,600,700 Series) |
| Israel Aircraft Industries | 1124 Westwind |

ultimate length of the primary runway at GCN is 10,700 ft. This will accommodate a larger mix of DC-9 and B-727 type aircraft than the present 9000 ft. runway, although some model configurations may be load limited. The 10,700 ft. length will allow more than 75% of the basic transport turbojet fleet to operate at 90% useful load. Note that the actual runway length requirements for a specific operational aircraft will differ from those lengths given in the Table and specific air carrier aircraft must be considered at the time of any runway extension. Ultimate runway length for the parallel runway is 8000 ft. which will accommodate all light aircraft as well as 75% of the basic transport fleet at 60% useful load.

4. Pavement Widths, Clearances, Lateral Separation: The present Grand Canyon National Park Airport runway 3/21 accommodates a mix of aircraft ranging from light single engine propeller driven airplanes to the air carrier operated turbojet transport aircraft. The airport is classified as a transport airport serving aircraft in Approach Category "C" (i.e. DC-9, B-727). The proposed parallel runway will be sized to accommodate only Design Group I and II airplanes and will be limited to visual runway dimensional requirements (as defined in Table IV-1). However, even after construction of the parallel runway, the full mix of aircraft will still utilize the primary runway.

It is important to note that adoption of certain dimensional criteria is one of the most critical aspects of master planning. Specifically, spacing between parallel runways and between runway and parallel taxiway can ultimately limit the expansion potential of the runway systems. While operational surfaces can be strengthened, widened and lengthened, they usually cannot be moved.

Dimensional criteria for GCN are grouped in accordance with the predominate usage expected and the elements of the fleet to be accommodated. The primary precision instrument runway is expected to service general transport aircraft up to 175,000 pounds. The dimensional criteria is based on B-737, DC-9 and B-727 sized aircraft. The secondary parallel runway is expected to serve substantially all propeller aircraft less than 12,500 pounds and criteria is selected in accordance with visual utility runway classification.

Table IV-4 lists the dimensional criteria selected for each of the categories. The dimensions are not necessarily the minimums recommended by F.A.A. for the appropriate use, but may exceed those minimums where existing facilities or conditions warrant.

TABLE IV-4
Dimensional Criteria

| Item | Primary Instrument Runway | Secondary Visual Runway |
|---|---|---|
| Runway pavement width | 150 ft. | 75 ft. |
| Runway shoulder width | 20 ft. | 10 ft. |
| Taxiway pavement width, Tangents | 75 ft. | 40 ft. |
| Taxiway pavement width, curves | 90 ft. | 40 ft. |
| Taxiway shoulder width | 20 ft. | 10 ft. |
| Taxiway centerline curve radius | 100 ft. | 75 ft. |
| Runway centerline to taxiway centerline | 400 ft. | 300 ft. |
| Taxiway centerline to aircraft parking | 100 ft. | 70 ft. |
| Taxilane centerline to aircraft parking | 85 ft. | 60 ft. |

5. Surface Gradients: Airport surface gradients are relative variations in elevation usually expressed as a rate of change of any airport surface. Including unpaved areas as well as paved areas, surface gradient tolerances have been established to provide the best possible conditions of safety and efficiency for aircraft operations. Within these tolerances the airport should be planned and designed to render the best solution possible in terms of construction, operation and maintenance economy, and operational effectiveness. Generally, the flatter the surface gradient, the safer the

aircraft operating conditions. However, extremely flat grades may produce prohibitive earthwork construction costs. In addition, flat grades are restrictive to positive drainage and may produce impractical if not impossible drainage problems.

Another concern in surface gradient consideration is "line of sight" or the ability of pilots to see other aircraft within prescribed limits depending on the type of aircraft operating at the airport, degree of activity, number of runways and presence of an air traffic control tower. The F.A.A. has established design standards for surface gradients and line of sight for Transport Airports (AC 150/5300-12).

a. Surface Gradient Standards: Surface gradient standards for transport airports are depicted in Figure IV-2 for both longitudinal and transverse grades.

b. Line of Sight: For runways without 24 hour air traffic control towers but with full length taxiways, runway grade changes shall be such that there will be an unobstructed line of sight from any point 5 feet above runway centerline to any other point 5 feet above the runway centerline within a distance of half the runway length.

c. Aprons: Desirable maximum grade in any direction is one percent.

d. Runway Safety Area: Longitudinal grade between runway ends - same as runway; longitudinal grade of 200 feet beyond runway end, from 0 to -3 percent. Extend safety area from 200 feet to 1000 feet beyond runway end must be traversable, slopes upward must be smooth and not penetrate approach surface (or clearway if provided) and slopes downward must not exceed 5 percent.

C. RUNWAY AND TAXIWAY DEVELOPMENT:

The most obvious physical site restriction to the airport's future expansion is its location in a narrow valley. The valley width is approximately 1200 feet at the runway elevation, with the adjacent terrain rising to each side of the airport at the rate of about 1 vertical foot for each 5 to 10 horizontal feet. The difference in elevation between the airport and adjacent hills is typically 70 feet. Moderately heavy stands of timber vegetate the slopes around the facility.

Analysis of existing wind data taken from the existing Airport Layout Plan shows that the present orientation allows operations 98.86% of the time with a crosswind component of less than 15 mph. The wind data was collected between 1930 and 1945 and in 1960 at Grand Canyon. Measurements prior to 1940 were made at latitude 35°51', longitude 112°4' and after 1940 at latitude 36°3' longitude 112°8'. A crosswind runway is normally recommended when the wind coverage is less than 95%; no crosswind runway is proposed for GCN.

Forecasted demand, however, suggests that additional runway capacity will be required by the year 1994, assuming that the taxiway system for the existing runway has been optimized. To accommodate the additional demand at Grand Canyon National Park Airport, there are four alternatives.

1) Abandon the existing airport site and relocate the airfield to a place more suitable for expansion.

2) Construct another additional airport.

3) Construction of a parallel runway near and connected to the existing airport, but outside the valley occupied by the present airfield.

4) Construct a parallel runway adjacent to the existing runway.

Alternative number one is impractical due to the costs involved in abandoning and relocating the airfield. Although, there are alternative sites available in the area, they offer few apparent advantages over the existing location.

Alternative number two is a possible means of accommodating the projected demand. This alternate would be particularly applicable if the park visitation demand was not as concentrated toward the south rim as it is at the present time. However, this alternate depends on future development by the Park Service or other agencies beyond the control of ADOT and beyond the scope of this report. Therefore, this alternate will not be pursued and development, if feasible, at the present site will be explored.

Alternative number three is presented as an attempt to avoid large amounts of earthwork which would be required for facility expansion in the valley. To the north and to the south of the present site, hilly terrain fails to substantially reduce earthwork required for expansion. Additional factors of consideration in eliminating this alternative include constraints on terminal area expansion, and excessive taxiway construction requirements.

Alternative four then presents the most attractive option for the airport expansion. This is due to the proximity of existing facilities, comparatively moderate earthwork requirements, and modest property acquisition requirements.

1. Primary Runway: Present Runway 3/21 has adequate length to accommodate the current air carrier DC-9-10 class aircraft. Runway extension to accommodate larger DC-9, B-727 or comparable aircraft is projected for the intermediate planning period (1993). Note that the lengthening is projected to accommodate larger aircraft use, and is not capacity related. Larger aircraft use and the capabilities of the particular aircraft demand must be monitored to determine actual need and schedule for the proposed lengthening.

Tusayan is located immediately northeast of the present runway. Consequently, the runway extension is proposed for the 03 approach end. The MALSR approach lights and the ILS glide slope antenna will require relocation. Additionally, the rain tank water reservoir will require relocation.

The proposed runway extension with the parallel taxiway extension is shown on Figure IV-3.

2. Parallel Secondary Runway: A need for a parallel runway to provide adequate capacity is projected for the 1993-1996 time frame. The intent is to limit this runway to the smaller Design Group I and II aircraft to minimize costs. Examination of Table III-3, the projected general aviation aircraft mix in Chapter II and the projected seating capacity requirements yields the aircraft size data shown in Table IV-5.

The parallel secondary runway would be initially sized to handle Airplane Design Group I aircraft. A Basic Utility - Stage I runway length of 5700 ft. will accommodate approximately 75 percent of the single and twin-engine airplanes weighing less than 12,500 lbs. and is the recommended initial length.

The projected annual capacity of the primary runway for the mix anticipated in the 2000± time period is approximately 100,000 operations and Group II and III operations are projected to exceed the primary runway capacity. Therefore, some of the Group II traffic should be accommodated on the secondary runway and by 1998-2000, runway extension to a general utility length of 8000 ft. is recommended. This will accommodate virtually all of the aircraft weighing less than 12,500 lbs. including most of the expected traffic in Airplane Design Group II.

The parallel secondary runway is planned to be located longitudinally to minimize earthwork requirements based on USGS topographic 10 ft. contour interval data. Minor shifting can be expected during final design. Although

TABLE IV-5

Aircraft Mix by Size - Annual Operations

| | 1988 Airplane Design Group | | | 1993 Airplane Design Group | | | 2003 Airplane Design Group | | |
|---|---|---|---|---|---|---|---|---|---|
| Operational Category | I | II | III | I | II | III | I | II | III |
| Local Operations | 2676 | -- | -- | 3830 | -- | -- | 7405 | -- | -- |
| MIL. Operations | 175 | 175 | 175 | 250 | 250 | 250 | 484 | 484 | 484 |
| General Aviation | | | | | | | | | |
| Single Engine - Piston | 10539 | -- | -- | 13695 | -- | -- | 24892 | -- | -- |
| Multi Engine - Piston | 2590 | 140 | -- | 3315 | 175 | -- | 5930 | 312 | -- |
| Turboprop | 815 | 90 | -- | 1135 | 126 | -- | 2318 | 258 | -- |
| Turbojet | 724 | 181 | -- | 1009 | 252 | -- | 2061 | 515 | -- |
| Based Commuter | | | | | | | | | |
| *Class 'A' | 1135 | -- | -- | 1436 | -- | -- | 1872 | -- | -- |
| Class 'B' | 3938 | 3884 | -- | 2507 | 5725 | -- | 2797 | 5632 | -- |
| Class 'C' | -- | 1759 | -- | -- | 1809 | 708 | -- | 4633 | 1769 |
| Itinerant Commuter | | | | | | | | | |
| *Class 'A' | 4839 | -- | -- | 7008 | -- | -- | 10607 | -- | -- |
| Class 'B' | 16713 | 16483 | -- | 12239 | 27953 | -- | 15846 | 31919 | -- |
| Class 'C' | -- | 4546 | 2918 | -- | 8832 | 3459 | -- | 26256 | 10025 |
| Air Carrier | -- | -- | 5315 | -- | -- | 8513 | -- | -- | 18741 |
| TOTAL OPERATIONS | 44144 | 27258 | 8408 | 46424 | 45122 | 12930 | 74212 | 70009 | 31219 |

* See Table III-4 for definition.

the secondary runway is planned to be physically located on the present airport property, excavation beyond the present property limits is required to provide airspace clearance for the primary surface and the transitional surface. Figure IV-4 is a section taken through one of the areas requiring significant excavation. The air traffic control tower and probably the VOR will require relocation prior to the construction of the parallel runway.

3. <u>Runway Exits and Entrances:</u> To obtain the maximum utilization of the runway system necessary to accommodate the projected traffic, planning for adequate exits is essential. At GCN, the majority of the light aircraft are commuter and air taxi operations with professional pilots familiar both with the particular aircraft handling characteristics and familiar with the GCN airport layout and operating conditions. Due to the high number of commuter operations, angled exits would be well used and are recommended to minimize runway occupancy time. Angled exits would also be used efficiently by other aircraft at GCN.

Exit locations and/or taxiing distances can be determined from analysis of the touchdown speed and deceleration. Approach speeds are assumed at 1.3 times the stall speed in the landing configuration with an average deceleration (a) of 5 feet/sec$^2$; the distance (D) from touchdown to ideal exit location is determined from the formula:

$$D = \frac{(S1)^2 - (S2)^2}{2a}$$

Where S1 = the indicated touchdown airspeeds in feet/sec. and S2 = the desired initial exit speed in feet/sec. Table IV-6 gives this distance for several touchdown and initial exit speeds.

Exit configurations for the primary runway are shown on Figure IV-3 and details of recommended widths and radii are shown on Figures IV-5 through IV-8. As detailed, the widths and radii are adequate for all anticipated traffic although the width is less than the recommended Group III dimension since it is assumed that the air carrier will typically use the wider 90° exits because of the location of the angled exits. Additional fillet radii is provided at the runway ends to facilitate higher speeds on takeoff rollout.

TABLE IV-6

TYPICAL EXIT LOCATIONS

| Touchdown Speed | Assumed Touchdown Distance from Threshold | Speed at Start of Exit Maneuvering | Distance from Threshold to P.C. of Exiting Taxiway |
|---|---|---|---|
| 50 Knot (58 mph) | 500' | 30 mph | 1,100' |
| 50 Knot (58 mph) | 500' | 40 mph | 900' |
| 60 Knot (69 mph) | 500' | 30 mph | 1,500' |
| 60 Knot (69 mph) | 500' | 40 mph | 1,300' |
| 70 Knot (80 mph) | 500' | 30 mph | 1,900' |
| 70 Knot (80 mph) | 500' | 40 mph | 1,700' |
| 80 Knot (94 mph) | 600' | 30 mph | 2,500' |
| 80 Knot (94 mph) | 600' | 40 mph | 2,400' |
| 90 Knot (104 mph) | 600' | 30 mph | 3,100' |
| 90 Knot (104 mph) | 600' | 40 mph | 2,900' |
| 100 Knot (115 mph) | 600' | 30 mph | 3,700' |
| 100 Knot (115 mph) | 600' | 40 mph | 3,600' |
| 110 Knot (127 mph) | 700' | 30 mph | 4,600' |
| 110 Knot (127 mph) | 700' | 40 mph | 4,400' |

The bypass taxiway adjacent to the terminal ramp (Detail A1, Figure IV-5) and the two angled exits (Detail A3, Figure IV-7) at 3,000' and 3,800' from the runway 21 threshold are recommended for 1988 construction. The other angled exits may not be required if the amount of traffic on Runway 3 remains in the 10 to 15 percent range. The bypass taxiway (Detail A1) will require local grading to drain the paved areas northeast to avoid petroleum product contamination of the water system catchment area. Additional catchment basin and dike modifications will also be required.

The taxiway exits for the secondary parallel runway are located to provide optimum connections with the existing runway/taxiway system. Simple right angle exits as shown on Figure IV-8 are recommended to reduce costs and reflect the reduced anticipated demand for this runway.

A dual parallel taxiway on the south side of 3/21 is not topographically feasible. Current taxiway delays occasionally occur in the immediate vicinity of the terminal ramp. Departing aircraft on Runway 21 backup on the taxiway blocking access to the GA and Grand Canyon Airlines ramp area and when enough aircraft are queued on the taxiway, access to the terminal can be blocked for arriving aircraft taxiing northeast. While this is not a serious problem at present, additional traffic could make this area a real bottleneck for operations on Runway 21. A bypass taxiway and a holding bay are proposed at the entrance to Runway 21 to facilitate traffic movements onto the runway and to provide space for holding departing aircraft.

When Runway 3 is active, the potential for the taxiway system to be a limiting factor on operational capacity is much greater. Arriving aircraft in Groups I and II will frequently exit the runway in the 3000 to 5000 ft. range and taxi the remaining distance on the taxiway while departing aircraft will be taxiing southwest on the taxiway for departure. The frequency of use of Runway 3 is estimated to be approximately 15 percent. The hourly capacity is reduced about 30% but the effect on annual capacity is only 5 percent and is not considered significant. After the parallel runway taxiway system is constructed, arriving Group I, II, and III aircraft on Runway 3R can exit onto the secondary parallel taxiway allowing essentially unrestricted taxiway access for departing aircraft on the primary taxiway for both runways. If significant delays to traffic are encountered due to the single taxiway prior to development of the parallel runway, portions of the secondary 50' taxiway could be constructed to function as a dual taxiway. Figure IV-9 is a schematic representing taxiway traffic patterns for the short term and long term traffic conditions.

The parallel taxiway for 3L/21R extends northeast to allow departing aircraft on Runway 21R access without taxiing southwest on the primary taxiway.

## D. AIRSPACE OBSTRUCTIONS:

Airspace obstructions typically fall into two categories; those which limit approach departure paths to an airport such as mountain ranges and restricted airspace, and those in the immediate airport vicinity which compromise airport safety or limit instrument approach minimums.

There are no significant large airspace obstructions which limit long range approaches or departures to GCN. However, there are numerous obstructions in the immediate airport vicinity which effect both approach/departure and airport safety. The existing airspace obstructions are shown on Figure IV-10, a reduction of the NOAA obstruction map. The primary impact of the obstructions on flight operations is in the instrument approach procedures and at GCN the ILS approach minimums are uneffected by the existing obstructions. However, the nonprecession approach minimum descent altitudes are higher than the theoritical minimums for various conditions due to obstructions penetrating the FAR Part 77 surfaces. The overall effect of these limitations on operational capacity at GCN is minimal due to the availability of the precision instrument approach and the infrequent IFR weather days during peak operations periods.

The most significant effect of the existing obstructions is on aircraft safety. The FAR Part 77 surfaces (See Figure IV-1) provide maneuvering space for aircraft in emergency situations. Thus any penetrations of those surfaces render GCN more dangerous than a comparable airport without any penetrations of those surfaces. Generally the obstructions closer to the runway are the most critical.

ADOT currently is planning an obstruction removal project to eliminate those obstructions due to trees located on the airport property. Either Runway 3/21 lengthening or development of the parallel runway will require additional property and additional tree removal. Removal of the terrain obstructions northwest of the parallel runway will also be required. Approximate limits of obstruction removal are shown on Figure IV-11.

## E. HELIPORT

It is recommended that the helicopter operations presently originating from the Village of Tusayan be relocated onto the airport property for the following reasons:

(1) Tusayan is located directly beneath the approach path for Runway 21. There is a potential conflict between ascending helicopter traffic, and fixed wing aircraft using this airspace.

(2) Relocating the helicopter taxi service to the airport should simplify control tower operations by centralizing the arriving and departing air traffic. All aircraft would also be continuously visible to controllers, a vast improvement over the current situation.

(3) Relocation to the airport would insure access to adequate fire fighting equipment, as well as specialized services such as fueling and hangaring of aircraft.

(4) Access to facilities such as the instrument landing system would be routinely available, and obstacle free approaches would also be protected.

(5) Removal of the helicopter operations from the Tusayan Community would increase safety due to reduced exposure of the public in the event of a helicopter malfunction.

(6) Noise and exhaust emission exposure from the helicopters would be minimized at the village.

(7) Landing fees at the airport would provide additional operating revenue for maintenance and new construction.

A heliport is required to accommodate the helicopter traffic on the airport. The physical requirements for the GCN heliport are derived from the FAA Heliport Design Guide, AC 150/5390-1B. The design aircraft used for this derivation to establish minimum requirements is a combination of typical helicopter types anticipated at GCN. Current helicopter types included within the dimensions are the Bell 206-1 Longranger, Bell 212 Twin, Aerospatiale 330-G Puma and the Aerospatiale 360 Dauphin. Physical helicopter dimensions assumed for the heliport sizing are a rotor diameter of 50 ft., a wheel base of 25 ft. and an overall length of 65 ft. Facility area requirements were developed using the same peaking factors as observed for fixed wing activity (i.e., peak month operations are 186% of average month, peak month enplanements are 200% of average month and daily peak hour is 13.5% of total daily activity). This is a necessary assumption due to the lack of helicopter activity data. The physical and facility requirements are listed in Table IV-7.

TABLE IV-7
Heliport Requirements

| | | | |
|---|---|---|---|
| **Layout Dimensional Requirements** | | | |
| Takeoff & Landing Area | 100'x 100' | | |
| Peripheral Area | 20' wide min. | | |
| Taxiway width | 20' | | |
| Parking Spot | 65' dia. | | |
| Clearance (Rotor tip to Object) | 10' min. | | |
| Approach Surface: | | | |
| Length | 4000' | | |
| Inner Width | 65' | | |
| Outer Width | 500' | | |
| Slope | 8:1 | | |
| Number Required | 2 - greater than 90° separation | | |
| Transitional Surface (Lateral - Starts at edge of approach surface) | | | |
| Length | 250' | | |
| Slope | 2:1 | | |

| Facility Requirements | 1988 | 1993 | 2003 |
|---|---|---|---|
| Operations | 21,612 | 24,545 | 33,436 |
| Peak Month-Avg. Daily Ops | 112 | 127 | 173 |
| Avg. Flights per Helicopter | 8 | 8 | 8 |
| Based Helicopters | 14 | 16 | 22 |
| Helicopter Ramp (SY) | 11,700 | 13,400 | 18,400 |

TABLE IV-7 (Cont'd.)

| | | | |
|---|---|---|---|
| Enplanements | 43,225 | 55,228 | 91,950 |
| Peak Month-Avg. Daily Pax | 240 | 306 | 510 |
| Design Hour Pax | 64 | 82 | 138 |
| Gross Terminal Area (SF) | 4,800 | 6,200 | 10,000 |
| Public Automobile Parking (SY) | 1,000 | 1,300 | 2,200 |
| Employee Automobile Parking (SY) | 350 | 450 | 1,000 |

To evaluate different potential sites on the airport a basic module representing the heliport requirements was developed. The module is shown on Figure IV-12. The approach-departure paths of the heliport must be at least 700' from the runway centerline and not converging to allow independent VFR operations. This is a requirement to allow maximum utilization of the runway airspace and ground capacity. Due to this spacing requirement, a separate heliport with separate auto parking and terminal facilities is recommended. The dimensions shown on the module will accommodate the 1988 forecasted helicopter demand. Five potential sites were investigated by attempting to fit the module to the terrain and airspace and by applying other design criteria to the site. The sites are shown on Figure IV-13.

The site evaluation is as follows:

Site 1:

Advantages - Arriving and departing helicopters from the Grand Canyon would not cross the fixed wing arrival and departure streams close to the airport.

Disadvantages - Far from existing utilities. Poor access. Poor exposure to highway traffic. Requires additional property.

Site 2:

Not feasible due to inadequate clearance from the centerline of proposed parallel runway.

Site 3:

Advantages - Existing airport property. Direct access to runway airspace including ILS.

Disadvantages - Poor exposure to highway traffic. Requires helicopter arrivals and departures to cross fixed wing arrival and departure streams for many direct canyon routes.

Site 4:

Advantages - Good exposure to highway traffic. Short access and utility extensions. Potential access to G.A. ramp for runway airspace and ILS use.

Disadvantages - Requires helicopter arrivals and departures to cross fixed wing arrival and departure streams for many direct canyon routes. Limited site area with major drainage problems. Requires relocation of existing 12 KV power line.

Site 5:

Note that Site 5 is located off the present airport property near the highway. There are several topographically adequate sites in this general area which would meet the heliport requirements.

Advantages: Good access and good exposure to highway traffic. Significant separation of fixed wing and helicopter traffic.

Disadvantages: Requires additional property. No access to existing runway airspace or ILS.

The most important criteria in site evaluation is the 700' distance between helicopter approach and departure paths and the runway centerline. Any site which does not satisfy this criteria is discounted (site 2 for example). Major criteria in site evaluation include safety (keeping fixed wing traffic and helicopter traffic separated as much as possible) and control by the Air Traffic Control Tower. Other site evaluation criteria include potential access to GA ramp for runway airspace and ILS, cost of developing the site (utility relocations required, topography, access, airport or non airport owned property) and exposure to highway traffic. All criteria other than major criteria are given equal consideration.

Due to the better ground access, the availability of utilities and the proximity of the runway airspace and NAVAIDS, Site 4 is the recommended location for the heliport. The primary disadvantage of the crossing arrival streams can be offset by crossing helicopter traffic at mid-field for southwest arrival/departures and by establishing VFR control points to the northeast to ensure adequate vertical and horizontal separation between fixed wing and helicopter traffic. A preliminary configuration for a heliport in this location is shown on the terminal area plan.

Site 5 is a significantly better site topographically and would be the recommended site except for the availability of property. Thus Site 4 is shown as an immediately developable heliport. Efforts to acquire additional property for Site 5 should be pursued and Site 5 developed if the property can be obtained.

F. AIR TRAFFIC CONTROL TOWER (ATCT):

The present air traffic control tower is located in the safety area of the proposed parallel runway. Relocation of the ATCT will be necessary when the parallel runway is built and may be desirable before that time as discussed below.

Siting requirements for the ATCT include consideration of access, utilities, a minimum angle of viewing incidence to operating surfaces of 35 minutes, general visibility and air space obstructions. Three sites are identified on Figure IV-13. The following tower heights were computed based on a 15' tower structure above the controller eye level.

| Site | A(Existing) | B | C |
|---|---|---|---|
| Controlling Runway | -- | 21L | 21L |
| Runway Elevation | -- | 6611 | 6611 |
| Eye Level Elev. (Min.) | 6672± | 6642 | 6640 |
| Ground Elev. @ ATCT | 6625± | 6665 | 6650± |
| Recommended Eye Level Elevation | -- | 6690 | 6680 |
| Tower Elevation | 6695 | 6705 | 6695 |
| ATCT - Runway Separation | -- | 900' | 1300'± |
| Max. ATCT Elev Allowable | -- | 6700 | 6704± |
| Heliport Site 4 - Heliport Elevation 6655± | | | |
| Eye Level Elev. (Min.) | -- | 6694 | 6682 |
| Tower Elevation | -- | 6710 | 6697 |
| Heliport Site 5 - Heliport Elevation 6670 | | | |
| Eye Level Elev. (Min.) | -- | 6719 | 6690 |
| Tower Elevation | -- | 6734 | 6705 |

Site B is essentially relocating the tower from its present site further from the runway to accommodate the parallel runway. This site has several disadvantages, many of which are shared by the present site:

- o Poor access, additional maintenance and clearing of snow to gain access.

- o Southern exposure, airfield surfaces are in general direction of sun, especially critical in the winter.

- o Majority of traffic is VFR and approaches from the canyon which is behind the tower, requiring frequent shifting of attention from airport side to approach side.

- o Visibility to Heliport Sites 4 and 5 require ATCT penetrations of the Part 77 airspace transitional surface.

Site C negates all of the disadvantages of Site B and Site A. It has northern exposure, is close to access and utilities and the majority of the traffic is on one side of the tower. Visibility to either Heliport site is adequate.

Note that the recommended eye level for both sites is above the minimum necessary for proper viewing angle for the fixed wing runways only. This is due to the high natural ground elevation at these sites. The recommended level is 25 feet above ground level to allow sufficient clearance for trees, ground vehicles, etc.

Site C is the recommended ATCT site for long range development. Additionally, it is recommended that the relocation of the ATCT from its present site to Site C be implemented as soon as feasible as an economy measure to minimize the expense of maintaining access and utilities to the present site and to maximize airport safety. If the heliport is located at either site 4 or 5, the present tower will have limited visibility due to both elevation and obstructions.

G. TERMINAL BUILDING DEVELOPMENT:

1. General Area Requirements: The present terminal building provides services for both the air carrier and the commuter operators. One based commuter (Air Grand Canyon) currently operates from the public terminal. Grand Canyon Airlines, the other based commuter, operates from a private terminal which is associated with their FBO operations and fronts onto the FBO and GA ramp areas.

Gate positions and gross terminal area requirements are presented in Table IV-8. The data is derived from peak hour enplanement forecasts and the projected aircraft mix. Terminal area requirements are based on data from AC150/5360-7, Planning and Design Considerations for Airport Terminal Building Development modified to reflect the atypical terminal use at GCN. The itinerant commuter passenger terminal occupancy time is less than normally observed at other airports due to minimal ticketing at GCN and the short waiting times in the terminal. Most commuter passengers have pre-arranged ground transportation which provides pick-up and delivery. The preponderance of air carrier arrivals also are tour related and have pre-arranged ground transportation. It is estimated that approximately 85% of the passengers utilize pre-arranged ground transportation packages.

TABLE IV-8
Projected Terminal Requirements

| | 1982 | 1988 | 1993 | 2003 |
|---|---|---|---|---|
| **Design Hour Pax** | | | | |
| Air Carrier | 120 | 160 | 388 | 1000 |
| Itin. Comm. | 188 | 426 | 624 | 1206 |
| Based Comm. | 100 | 100 | 128 | 212 |
| Helicopter | 48 | 64 | 82 | 138 |
| **Gate Positions** | | | | |
| Air Carrier | 1 | 2 | 2 | 4 |
| Itin. Comm. | 2 | 4 | 5 | 8 |
| Based Comm. | 1 | 1 | 2 | 2 |
| Helicopter | 2 | 2 | 2 | 3 |
| **Gross Terminal Area (SF)** | | | | |
| Air Carrier | 4700 | 15,000 | 30,000 | 50,000 |
| Itin. Comm. | 4831 | 13,000 | 19,000 | 36,000 |
| Based Comm. | 8384 | 8,384 | 9,600 | 16,000 |
| Helicopter | -- | 4,800 | 6,200 | 10,000 |

Due to the shortened occupancy time and the reduced need for ticket and administrative space for the itinerant commuters, the present terminal gross area falls well below the rule of thumb space allocations. The FAA suggests a value of about 150 square feet per design hour passenger as a typical terminal area requirement while GCN presently has about 31 square feet per design hour passenger. The present terminal however would appear to be overcrowded during peak hours, particularly in the air carrier area. The gross terminal areas in Table IV-8 for itinerant commuters is approximately 30 sf/pax and for air carrier is approximately 95 sf/pax.

2. Terminal Locations: Due to the shallow depth available for ramp and terminal development, linear terminal concepts appear to be the most feasible. Two terminal expansion concepts were investigated which satisfy the planning criteria.

a. Satellite Terminals: A concept which entails building separate terminals to serve different sections of the ramp is shown on Figure IV-15A and IV-16. As shown, the present terminal would continue to be utilized by commuter operations and a new air carrier terminal would be constructed at the southwest end of the FY84 ramp area. Ultimate development would include a second commuter terminal located on the opposite end of runway 3/21 to serve the ramp areas located southwest of the Forest Service Slurry Base.

b. Central Terminal: A second concept is shown of Figures IV-15B and 15C which involves keeping the terminal building expansion in the vicinity of the current terminal. Passengers would be collected from loading/unloading areas located along the long linear ramp via group transportation and transported to the main terminal if necessary or if picked up by a tour or charter ground transportation system, may not require stopping at the main terminal at all.

Both of these concepts will be further explored and the impact on ramp development determined.

## H. RAMP DEVELOPMENT:

1. General: The existing aircraft ramp is divided into two areas, the general aviation/FBO ramp located at the northeast end of the runway and the commercial ramp in front of the terminal. The GA/FBO ramp is also utilized by Grand Canyon Airlines for enplaning and deplaning passengers. Air Grand Canyon, the other based commuter, utilizes the terminal ramp. Due to the traffic volume, commuter aircraft utilize taxi in - taxi out parking.

2. Commuter Ramp: Commuter passengers normally deplane and enplane at the aircraft parking location and traverse the ramp. They may or may not pass through the terminal, depending on ground transportation and other particulars. Generally speaking, this situation is not as safe as it could be. Additionally, prop wash and jet blast are nuisance factors. The safest commuter loading/unloading arrangement on a linear terminal/ramp is to allocate gates to carriers and park loading aircraft near to the terminal. Passengers are not then required to cross active ramp areas to get to the loading aircraft. This arrangement is not practical at GCN with the present ramp due to the number of carriers, volume of commuter flights, and the narrow and limited area available.

A possible configuration to separate passenger access and aircraft movements is to extend a terminal finger onto the ramp and park boarding aircraft adjacent to the finger. At GCN, the finger would be at ground level and covered. Aircraft would taxi in and park with the tail toward the finger allowing direct passenger access. A typical configuration is shown on Figure IV-14A (Loading Module I) for Group II airplanes (Twin Otter is used in the illustration). As shown 195' from the edge of the ramp to the edge of the taxiway OFZ is recommended for two aircraft loading positions. On the existing ramp, 188' is available and on the proposed 1984 ramp extension, 192' is available. Thus, with some limitations, two loading/unloading positions would be available for Group II aircraft on each side of the finger. Three Group I aircraft could be served on each side of the finger or one smaller Group III aircraft such as the DeHaviland Dash-8 could be served.

An alternate loading/unloading configuration is also shown on Figure IV-14A. Aircraft access to the parking locations is on a marked walkway while aircraft exiting the loading/unloading positions would taxi out away from the walkway. Aircraft loading would be from the rear of the aircraft, away from the propellers. Taxiing aircraft and passengers would occupy the same ramp area only on the marked walkway where aircraft traffic is one directional allowing adequate visual and aural identification. Passengers would be separated from starting aircraft although there is no physical protection from prop wash. Each loading/unloading walkway module is approximately 330' wide (centerline taxilane to centerline taxilane) accommodating four Group II or six Group I aircraft. For planning purposes, loading and unloading area allocations are based on this module.

As the ramp area develops further to the southwest, traffic flow on the taxiway system becomes more of a problem. Aircraft taxiing to parking on the FY84 ramp area after deplaning passengers at the terminal will be taxiing against the arriving stream if they must taxi on the taxiway. A taxilane is necessary for the FY84 ramp as presently configured but is not feasible with loading Modules I and II on the present ramp.

Figure IV-14B illustrates Module III which allows an independent commuter taxilane for back taxi following unloading at the present terminal ramp. As shown, four Group II and four Group I commuter aircraft can utilize the module at one time. The DC-9-10 is used to illustrate that adequate lateral separation is available for the larger Group III commuter aircraft to use this module also. This module and the accompanying air carrier terminal and A/C parking is shown on the conceptual ramp layout on Figure IV-15C utilizing the central terminal concept.

Use of a designated loading/unloading area enhances safety to passengers and allows better control of ramp security. Operationally, aircraft could be parked at the module if the module was remotely located or dedicated to one operator, or aircraft would be parked elsewhere on the ramp until time for departure. In allocating the ramp space requirements, a loading/unloading position occupancy time of 15 minutes per enplanement or deplanement is utilized with separate parking. Ramp allocations are listed in Table IV-9. The parking areas include ramp circulation taxilanes but do not include taxiway or major taxilane access requirements. For example, the proposed 1984 ramp expansion as shown on Figure IV-15 will require a taxilane adjacent to the ramp edge for access to the parking rows which is not accounted for in the average area allocation. Space allowed by airplane design group is as follows: Group I - 500 SY, Group II - 1400 SY and Group III - 4000 SY.

TABLE IV-9
AIR CARRIER AND
ITINERANT COMMUTER RAMP REQUIREMENTS

| | 1988 | 1993 | 2003 |
|---|---|---|---|
| Airplane Group I | | | |
| Annual Operations | 21,552 | 19,247 | 26,453 |
| Average Peak Hr Ops | 15 | 13 | 18 |
| Unloading Positions* | 3 | 3 | 4 |
| Unloading Area (SY) | 1,500 | 1,500 | 2,000 |
| Parked Aircraft | 26 | 29 | 32 |
| Parking Area (SY) | 12,900 | 11,400 | 16,000 |
| Airplane Group II | | | |
| Annual Operations | 21,029 | 36,785 | 58,175 |
| Avg. Peak Hour Ops | 14 | 25 | 40 |
| Unloading Positions* | 3 | 4 | 7 |
| Unloading Area (SY) | 5,400 | 7,200 | 12,600 |
| Parked Aircraft | 19 | 32 | 50 |
| Parking Area (SY) | 26,600 | 44,800 | 70,000 |
| Airplane Group III | | | |
| Annual Operations | 2,918 | 3,459 | 10,025 |
| Avg. Peak Hour Ops | 2 | 3 | 7 |
| Unloading Positions* | 1 | 1 | 1 |
| Unloading Area (SY) | 4,160 | 4,160 | 4,160 |
| Parked Aircraft | 2 | 2 | 5 |
| Parking Area (SY) | 8,000 | 8,000 | 20,000 |
| Air Carrier | | | |
| Avg. Peak Hours Ops | 4 | 6 | 13 |
| Gate Positions | 2 | 2 | 4 |
| Gate Area | 8,000 | 8,000 | 10,000 |
| Parking Area | -- | 4,000 | 4,000 |
| Totals | | | |
| Unloading Area (SY) | 11,060 | 12,860 | 18,760 |
| Parking Area (SY) | 47,500 | 68,200 | 110,000 |
| A.C. Gate Area (SY) | 8,000 | 8,000 | 16,000 |

* 15 minute occupancy.

Itinerant aircraft parking requirements are particularly sensitive to commuter aircraft mix and the percentage of arrivals which return for more passengers. As aircraft size increases, aircraft utilization becomes more economically significant and operators of larger aircraft will attempt to keep the aircraft productively flying in lieu of parking all day at GCN awaiting the return flight of the tour groups. For the space requirements developed in this report it was assumed that approximately 50% of Airplane Group I, 30% of Group II and 20% of Group III arrivals parked at GCN during the hours from 8:00 to 12:00 a.m.

3. Air Carrier Ramp: The air carrier ramp area requirements are listed on Table IV-9. The area shown are based on 4000 SY per gate. This is greater than the minimum area to park the DC-9 or B-727 aircraft to allow for auxiliary equipment, lost area due to loading docks, etc. Area for parking air carrier aircraft other than at the gate area is not allocated until 1993. Gate requirements are based on average peak hour operations with 80% gate utilization and an average gate occupancy of 30 minutes.

4. Based Commuter and General Aviation Ramp: Based aircraft area requirements were projected from the data in Chapter II and the aircraft mix developed in this Chapter. General aviation ramp requirements were estimated from average peak day operations projections allowing one itinerant parking position for every two arrivals. The FBO service area for general aviation is sized to accommodate one half of the peak hour arrivals, but not less than one aircraft position. These area requirements are contained in Table IV-10.

5. Apron Development: Apron area allocations are summarized on Table IV-11. The apron development is summarized by planning period as follows:

a. 1982 - The existing apron allocations and the requirements for the 1982 traffic were computed using the same rational as the projected requirements. As shown, the average peak day apron requirement in 1982 exceeded the available space by approximately 5000 square yards or 14 percent. Several assumptions in the area requirement calculations are not

TABLE IV-10

BASED COMMUTER AND GENERAL AVIATION[1]

RAMP REQUIREMENTS

| | 1988 | 1993 | 2003 |
|---|---|---|---|
| **Airplane Group I** | | | |
| Based A/C | 12 | 10 | 12 |
| Parking Area (SY) | 6000 | 5000 | 6000 |
| Commuter Avg. Peak Hr. Ops. | 4 | 3 | 4 |
| Unloading Slots [2] | 1 | 1 | 1 |
| Unloading Area (SY) | 500 | 500 | 500 |
| G.A. Avg. peak Day Ops. | 76 | 100 | 180 |
| G.A. Parking Area (SY) | 9500 | 12,500 | 22,500 |
| Service Area (SY) | 1500 | 2000 | 3000 |
| **Airplane Group II** | | | |
| Based A/C | 7 | 8 | 10 |
| Parking Area (SY) | 9800 | 11,200 | 14,000 |
| Commuter Avg. Peak Hr. Ops. | 4 | 6 | 8 |
| Unloading Slots [2] | 1 | 1 | 1 |
| Unloading Area (SY) | 1800 | 1800 | 1800 |
| G.A. Avg. Peak Day Ops. | 3 | 4 | 8 |
| G.A. Parking Locations | 1 | 1 | 2 |
| G.A. Parking Area (SY) | 1400 | 1400 | 1400 |
| Service Area | 1400 | 1400 | 1400 |
| **Airplane Group III** | | | |
| Based A/C | -- | 1 | 1 |
| Parking Area (SY) | -- | 4000 | 4000 |
| Commuter Avg. Peak Hr. Ops | -- | 1 | 2 |
| Unloading Slots | -- | 1 | 1 |
| Unloading Areas | -- | 4160 | 4160 |
| **TOTALS** | | | |
| Service Area (FBO) (SY) | 2900 | 3400 | 4400 |
| Unloading Areas (SY) | 2300 | 6460 | 6460 |
| Itinerant Parking (SY) | 10,900 | 13,900 | 23,900 |
| Based A/C Parking (SY) | 15,800 | 20,200 | 24,000 |

(1)Includes military

(2)15 min. occupancy

TABLE IV-11

APRON AREA ALLOCATION*

| | Area Req'd | Present Apron | Expanded Apron | Unmet Reqm't | Location |
|---|---|---|---|---|---|
| 1982 | | | | | |
| A.C. Gate Area | 4,000 | 3,000 | -- | -- | -- |
| Itin. Comm. Unloading | 2,800 | 2,800 | -- | -- | -- |
| Itin. Comm. Parking | 13,452 | 10,450 | -- | -- | -- |
| Based Comm. Unloading | 1,000 | 500 | -- | -- | -- |
| Based A/C Parking | 10,800 | 10,800 | -- | -- | -- |
| Itin. G.A. Park/Ser. | 8,200 | 8,200 | -- | -- | -- |
| TOTAL | 40,250 | 35,750 | -- | -- | -- |
| 1988 | | | | | |
| A.C. Gate Area | 8,000 | -- | -- | 8,000 | Air Carrier |
| Itin. Comm. Unloading | 11,060 | 12,470 | -- | -- | -- |
| Itin. Comm. Parking | 47,500 | 6,280 | 34,200 | 7,020 | Commuter I |
| Based Comm. Unloading | 2,300 | 2,300 | -- | -- | -- |
| Based A/C Parking | 15,800 | 8,800 | -- | 7,000 | G.A. Ramp I |
| Itin. G.A. Park/Ser. | 13,800 | 5,900 | -- | 7,900 | G.A. Ramp I |
| TOTAL | 95,560 | 35,750 | 34,200® | 29,920 | -- |
| 1993 | | | | | |
| A.C. Gate Area | 8,000 | -- | 8,000 | -- | -- |
| Itin. Comm. Unloading | 12,860 | 12,470 | -- | -- | -- |
| Itin. Comm. Parking | 68,200 | 6,280 | 41,220 | 20,700 | Commuter II |
| Based Comm. Unloading | 6,460 | 2,300 | -- | 4,160 | -- |
| Based A/C Parking | 20,200 | 8,800 | 7,000 | 4,400 | G.A. Ramp II |
| Itin. G.A. Park/Ser. | 17,300 | 5,900 | 7,900 | 3,500 | G.A. Ramp II |
| TOTAL | 133,020 | 35,750 | 64,120© | 32,760 | -- |
| 2003 | | | | | |
| A.C. Gate Area | 16,000 | -- | 8,000 | 8,000 | Air Carrier |
| Itin. Comm. Unloading | 18,760 | 12,470 | -- | 6,290 | Commuter II |
| Itin. Comm. Parking | 110,000 | 6,280 | 61,920 | 41,800 | Commuter II |
| Based Comm. Unloading | 6,460 | 2,300 | 4,160 | -- | -- |
| Based A/C Parking | 24,000 | 8,800 | 11,400 | 3,800 | G.A. Ramp II |
| Itin. G.A. Park/Ser. | 28,300 | 5,900 | 11,400 | 11,000 | G.A. Ramp II |
| TOTAL | 203,520 | 35,750 | 96,880¶ | 70,890 | -- |

* Areas do not include paved areas required for taxiway or taxilane access.
® Includes FY84 apron expansion.
© Includes FY84+88 apron expansion.
¶ Includes FY84+88+93 apron expansion.

currently practiced at GCN during peak periods; including designated loading/unloading area of the size recommended, full taxiway to parked aircraft clearance for Group III aircraft and taxi in - taxi out parking for all commuter aircraft. The 1982 area comparison does validate the assumptions used in calculating the apron area requirements.

b. Short Range - 1988. An expansion of the present air carrier/commuter apron is planned for 1984. Figure IV-15 shows this ramp expansion which consists of approximately 34,200 square yards of Group I and II parking and a taxilane. Table IV-11 shows an additional 29,920 square yard ramp requirement for 1988 allocated as 8000 SY for air carrier ramp, 7020 SY additional commuter parking and 14,900 SY additional GA and based aircraft parking. Figure IV-15 shows conceptual layouts of the additional areas. The proposed G.A. area is adjacent to the existing G.A. ramp and the air carrier and/or commuter area is adjacent to the 1984 expansion. Terminal area requirements listed in Table IV-8 for 1988 are 15,000 square feet for air carrier and 13,000 square feet for commuter compared to the approximately 9500 square feet in the present terminal. As shown, the air carrier terminal expansion is anticipated by 1988.

c. Intermediate Range - 1993. Additional ramp requirements beyond 1993 for commuter and G.A./FBO areas are proposed for the area southwest of the Forest Service lease plots and are shown on Figure IV-16. A second commuter terminal is required to service this area under the satellite terminal concept.

d. Long Range - 2003. Ramp expansion to service long range requirements are all located to the southwest of the 1993 ramp area except for additional air carrier requirements which will be adjacent to the Air Carrier terminal.

6. <u>Recommended Ramp Configuration</u>: The advantages of the full length dual parallel taxilane for commuter aircraft appear to outweigh the lost ramp area. Therefore, the recommended configuration is that shown on Figure

IV-15C with Module III utilized on the present ramp and a combination of either module I or II used on the FY84 and future expansions. As shown, the Module I and II area is configured to allow parking at the loading/unloading area and direct access to ground transportation.

The central terminal concept is recommended with possible mini-terminals with rest rooms and a small enclosed lobby at selected loading and unloading modules. The recommended air carrier terminal is located immediately southwest of the present terminal and includes ramp widening to accommodate nose dock parking of air carrier aircraft.

I. PAVEMENT REQUIREMENTS:

Pavement evaluation is contained in "Report of Pavement Evaluation for Ellis-Murphy Engineers, Inc. - Project: Grand Canyon National Park Airport: Parallel Taxiway to Runway 3-21 and Parking Apron" by Arizona Testing Laboratory which is on file with the Aeronautics Division of The Arizona Department of Transportation. For estimating purposes, the pavement section for the FY 84 ramp as developed in "Engineer's Report for Grand Canyon National Park Airport", ADAP 6-04-0019-09 and 10, F.C. 90592, 90597 and 90702 Carter Associates, Inc. have been used for full strength pavement areas. This section consists of 4 inches of asphaltic surface, tack coat, 8" asphaltic base, 12" soil-cement base and 12 inches compacted subgrade.

J. ACCESS AND PARKING:

Access and parking will be required for employees, local resident vehicles for possibly long range parking, rental vehicles parking, bus loading and parking, and parking for based commuter traffic. The following assumptions were utilized in developing the access and parking area requirements in Table IV-12.

| | | | |
|---|---|---|---|
| Air Carrier: | 85% of passengers utilize packaged ground transportation; 70% in buses at an average occupancy of 20 and 15% in vans at an average occupancy of 7 per vehicle. 15% of passengers utilize automobiles at an occupancy of 1.5 passengers per vehicle. | | |
| Itinerant Commuter: | Same as air carrier. | | |
| Based Commuter: | 50% of passengers utilize packaged transportation, 30% in vans and 20% in buses. 50% of passengers utilize automobiles at an average occupancy of 2 passengers per vehicle. | | |
| General Aviation: | 70% of passengers utilize automobile transportation at 1.5 passengers per vehicle. 30% utilize vans. | | |
| Area Requirements: | Buses | Loading - 250 SY | |
| | | Parking - 200 SY | |
| | Vans | Loading - 50 SY | |
| | | Parking - 40 SY | |
| | Automobiles | Loading - 50 SY | |
| | | Parking - 40 SY | |
| Parking Requirements: | Buses and Vans: Parking and loading equivalent to peak hour demand. | | |
| | Automobiles: Rental parking equivalent to 30% of total auto peak hour demand. | | |
| | Other passenger auto parking equivalent to 1.5 times peak hour demand. | | |
| | Employee parking at 1.2 passengers per vehicle. | | |

## TABLE IV-12
## ACCESS AND PARKING REQUIREMENTS

| | Avg. Peak Day Enpl. | Design Hour Pax | Access (VPH) | | | Loading | | | Parking | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Auto | Van | Bus | Auto | Van | Bus | Auto | Van | Bus |
| **1982** | | | | | | | | | | | |
| Air Carrier | 183 | 120 | 12 | 3 | 4 | 2 | 2 | 2 | 16 | 1 | 2 |
| Itin. Commuter | 694 | 94 | 9 | 2 | 3 | 2 | 1 | 2 | 11 | 1 | 1 |
| Based Commuter | 370 | 50 | 12 | 2 | 2 | - | 1 | 1 | 18 | 1 | 1 |
| General Aviation | 108 | 14 | 7 | 1 | - | - | - | - | 10 | 1 | - |
| Employee/Service | 21(1) | | | | | - | 1 | - | 17 | - | - |
| Rental Car | | | | | | - | - | - | 13 | - | - |
| Totals | | 278 | 43 | 8 | 8 | 4 | 5 | 5 | 85 | 4 | 4 |
| Area Requirement | | | | | | 1650 SY | | | 4360 SY | | |
| **1988** | | | | | | | | | | | |
| Air Carrier | 546 | 160 | 16 | 4 | 6 | 2 | 2 | 3 | 22 | 2 | 3 |
| Itin. Commuter | 1580 | 213 | 21 | 5 | 7 | 2 | 2 | 4 | 29 | 3 | 3 |
| Based Commuter | 371 | 50 | 12 | 2 | 1 | - | 1 | 1 | 18 | 1 | 1 |
| General Aviation | 147 | 20 | 9 | 1 | - | - | - | - | 13 | 1 | - |
| Employee/Service | 34(1) | | | | | - | 2 | - | 28 | - | - |
| Rental Car | | | | | | - | - | - | 17 | - | - |
| Totals | | 443 | 58 | 12 | 14 | 4 | 7 | 8 | 127 | 7 | 7 |
| Area Requirement | | | | | | 2550 SY | | | 6760 SY | | |
| **1993** | | | | | | | | | | | |
| Air Carrier | 969 | 388 | 39 | 8 | 14 | 4 | 4 | 6 | 54 | 4 | 8 |
| Itin. Commuter | 2312 | 312 | 31 | 7 | 11 | 4 | 3 | 5 | 43 | 4 | 6 |
| Based Commuter | 473 | 64 | 16 | 2 | 1 | - | 1 | 1 | 24 | 1 | 1 |
| General Aviation | 192 | 26 | 12 | 1 | - | - | - | - | 18 | 1 | - |
| Employee/Service | 60(1) | | | | | - | 2 | - | 50 | 2 | - |
| Rental Car | | | | | | - | - | - | 29 | - | - |
| Totals | | 790 | 98 | 25 | 26 | 8 | 10 | 12 | 218 | 12 | 15 |
| Area Requirement | | | | | | 3800 SY | | | 12,200 SY | | |
| **2003** | | | | | | | | | | | |
| Air Carrier | 2630 | 1000 | 100 | 21 | 35 | 10 | 8 | 12 | 140 | 13 | 23 |
| Itin. Commuter | 4467 | 603 | 60 | 13 | 21 | 8 | 5 | 8 | 82 | 8 | 13 |
| Based Commuter | 788 | 106 | 27 | 3 | 2 | - | 1 | 1 | 40 | 2 | 1 |
| General Aviation | 353 | 48 | 22 | 2 | - | - | 1 | - | 33 | 1 | - |
| Employee/Service | 132(1) | | | | | - | 2 | - | 110 | - | - |
| Rental Car | | | | | | - | - | - | 63 | - | - |
| Totals | | 1757 | 209 | 39 | 58 | 18 | 17 | 21 | 468 | 24 | 37 |
| Area Requirement | | | | | | 7000 SY | | | 27,080 SY | | |

(1) Estimated employees.

In 1982 the actual effective parking and loading area was approximately 5000 square yards compared to a requirement for 6010 square yards based on the assumptions listed. Parking requirements are dependent upon the characteristics of the ground transportation operations. For example, the Fred Harvey buses which presently transport the majority of the passengers are stored off site and are only at the airport for relatively short periods of time. If several smaller operators were providing ground transportation, interim parking of vehicles would be more prevelant and parking demand would increase. The areas listed in Table IV-12 do not include the primary access road nor do they include overflow parking provisions.

The access roadway will be required to provide efficient access to each terminal or ramp locale as well as provide means of circulation within the airport complex. Recommended access roadway design criteria are as follows:

TABLE IV-13
ACCESS ROADWAY DESIGN REQUIREMENTS

| | |
|---|---|
| Traffic (2003) | 306 vph |
| % trucks | less than 1% |
| % buses | 17-19% |
| Lane Width | 12 feet |
| Shoulder Width | 10 feet |
| Design Speed | 50 mph |
| Maximum Grade | 6% |
| Passing Availability | 40% |
| Service Capacity | 626 vph |
| Number of Lanes | 2 |

As shown, a two-lane access road will be adequate for airport purposes. Conceptually, the major circulation roadway road should be located away from the ramp areas as terrain and property permit. A conceptual location for the access road is shown on Figure IV-16.

Transportation from the distributed ramp loading/unloading areas to the central terminal must be provided. Initial ground transportation will likely be provided by tour group buses and vans as flights arrive and depart. Parking for these vehicles along the ramp as well as ramp access is shown on Figure IV-15C. Eventually, an internal airport ground transporation system may be required to shuttle passengers to and from the remote loading areas in lieu of or in addition to tour group ground transportation. Airport shuttle buses are the first step of such a service. Utilizing the assumptions of Table IV-12, approximately 12 shuttle buses per hour at 10 pax/bus would be required in 2003 to supplement tour ground transportation to transport passengers to the central terminal for rental cars, ticketing, etc. Three bus/vans could provide this level of service which is reasonable.

## K. NAVAIDS

In addition to the Air Traffic Control Tower discussed earlier in the Chapter, several other aids to air navigation are operated at or in conjunction with the Grand Canyon National Park Airport. These include the VOR-DME; the instrument landing system (ILS) for Runway 3 consisting of the glide slope, localizer and a medium intensity approach light system; and visual approach slope indicators (VASI); all of which are owned and operated by the FAA. Medium intensity runway and taxiway lighting and airport beacon operated by GCN provide nighttime operational capability.

### 1. VOR-DME

The VOR-DME is utilized both for long range navigation for cross country flights typically at altitudes which do not affect GCN and for guidance in making both precision and non-precision approaches to GCN. Construction of the parallel runway will probably require relocation of the VOR, either to the north of the present site or perhaps to a completely different site.

### 2. Instrument Landing System

GCN presently has two published instrument approach procedures: a Category I approach on Runway 3 to a decision height of 200 ft. (6754 MSL) with 1/2 mile visibility utilizing the ILS glide slope and localizer system and a non-precision approach to Runway 3 utilizing the VOR. These approaches are shown on Figure IV-17.

The ILS glide slope antenna will require relocation when Runway 3R/21L is extended. The glide slope antenna site requirements are defined in FAA AC 150/5300-3D, Site Requirements for Terminal Navigational Facilities. The critical area for the glide slope antenna is defined as a rectangular tract surrounding the GS antenna which should be graded and kept clear of objects which could derogate the signal. Longitudinally the tract begins 400' behind the antenna and may extend up to 3000' in front of the antenna. Transversely, the tract begins at the far edge of the runway and ends 400' outward from the antenna. Unattended vehicles and aircraft should not park within the criterical area and in some operational conditions, aircraft or vehicles may not be authorized to traverse the area.

The preferred antenna location is in the area 250' to 650' from the runway centerline and 700' to 1250' from the approach threshold. Siting the relocated glide slope facilities will not be a problem for the proposed facility improvements. However, the secondary taxiway traverses the critical area. Due to the rising adjacent terrain and the reported difficulty in obtaining required tolerances for the present ILS installation (apparently associated more with the localizer rather than the glide slope) it is possible that aircraft or vehicles on the secondary taxiway system in the critical area may cause unacceptable GC signal deviations. Since the secondary runway is a visual runway and most instrument weather will not coincide with high traffic demand, closure of that portion of the secondary taxiway during instrument weather conditions should create no adverse operational or capacity effects.

A microwave landing system for Runway 21 is being planned by the FAA along with a MALSR. This will increase the instrument landing capabilities of GCN and will facilitate instrument landings by STOL type aircraft. This system may or may not replace the existing ILS.

3. Visual Approach Slope Indicators (VASI)

The VASI system provides visual approach slope guidance which is particularly useful in inclement weather or in an airport environment where the visual clues to the pilot may be misleading or create a different perspective than the normal airport. CGN being located in the valley does have the possibility of creating a different perspective and the VASI system would assist in maintaining proper altitude especially for the pilot new to GCN.

Siting of the VASI units as the facility expands is not a problem.

4. Airfield Lighting

The present medium intensity runway lights (MIRL) should be adequate for normal night time operations for the foreseeable future. If scheduled air carrier operations increase, a potential need for high intensity runway lights (HIRL) might develop to aid scheduled operations during inclement weather. Since this requirement is not firm, HIRL will not be programmed into the facility.

5. Automated Weather Obervation Station (AWOS)

A type III Automated Weather Observation Station is proposed by the FAA for GCN. Siting requirements are as follows:

a. At least 400' from instrument runway centerline
b. Within 1000' of touchdown zone
c. 200' clear of trees
d. 300' frontal clear zone
e. 100' clear of extensive concrete
f. 500' clear of buildings, jet blast, etc.

The AWOS can be located west of the threshold area of Runway 3 both for the ultimate runway configuration as well as the current runway and meet all of the siting requirements.

L. UTILITY DEVELOPMENT

1. General

The following table summarizes the forecasted passengers and Airport employee data, developed in preceding chapters which is the basis for estimating utility requirements.

TABLE IV-14

PAX AND EMPLOYEE DEMAND

| Pax Data | 1982 | 1988 | 1993 | 2003 |
|---|---|---|---|---|
| Annual[1] | 277,140 | 519,012 | 765,584 | 1,574,972 |
| Avg. Day/Peak Month[1] | 1,533 | 2,884 | 4,253 | 8,749 |
| Design Hr. Pax[2] | 484 | 790 | 1,274 | 2,652 |
| Employee Data | | | | |
| Terminal[3] | 21 | 34 | 60 | 132 |
| Hel. Terminal[4] | - | 10 | 13.5 | 30 |

[1]From Table III-6
[2]From Table IV-8 plus twice GA from Table III-6
[3]From Table IV-12
[4]Calculated from Table IV-7

2. Water Utility

Water service for domestic use and for fire protection is presently provided for all facilities located at the Airport. Since the Airport relies on precipitation catchment supplemented by imported water transported by tanker, storage serves as the basis for the system operation and, likewise, improvement planning.

The following assumptions and guidelines were used in developing the water system requirements:

a. The airport would continue to provide on-site utilities for domestic use and fire protection independent of other adjacent uses.

b. Water supply will continue to be from precipitation supplemented by off site sources (Grand Canyon National Park and Williams). Due to current water rights litigation, the availability of surface water rights at the site are unclear. Therefore, storage requirements are based on 30 days of raw water and 7 days of treated water storage for the peak month useage. These storage amounts correlate well with the historic availability of water at GCN. This methodology was utilized in lieu of a rainfall statistical analysis due to the water right questions.

c. Water availability was not considered a development constraint. If surface water is not available at GCN, water can be imported from Williams or other adjacent areas at additional cost.

Water usage requirements are developed by estimating Annual, Average Day - Peak Month, and Design Hour (Peak Hour) rates of usage. Table IV-15 estimates the annual water requirement for the planning periods 1988, 1993 and 2003.

TABLE IV-15

TOTAL ANNUAL WATER SUPPLY REQUIREMENT[1]

| Year | Pax[2] | Employees[2] | Annual Water Requirement[3] |
|---|---|---|---|
| 1982 | 277,140 | 21 | 1,893,000 gals.( 5.8 AF) |
| 1988 | 519,012 | 44 | 3,596,000 gals.(11.0 AF) |
| 1993 | 765,584 | 74 | 5,404,000 gals.(16.6 AF) |
| 2003 | 1,574,972 | 162 | 11,223,730 gals.(34.4 AF) |

[1]Consumptive and non-consumptive uses excluding fire fighting
[2]From Table IV-14
[3]Pax (6 gals) + Employees (30 gpd) (365 days)

Table IV-16 projects the water usage for the average day of the peak month which relates to daily water usage. It is used to estimate raw water and treated water storage requirements for the Airport system since storage is the basis for system operation.

TABLE IV-16

AVERAGE DAY-PEAK MONTH WATER REQUIREMENTS[1]

| Year | Pax[2] | Employees[2] | AD-PM Demand[3] |
|---|---|---|---|
| 1982 | 1,533 | 21 | 9,830 gpd |
| 1988 | 2,884 | 44 | 18,620 gpd |
| 1993 | 4,253 | 74 | 27,740 gpd |
| 2003 | 8,749 | 162 | 57,350 gpd |

[1]Consumptive and non-consumptive uses excluding fire fighting
[2]From Table IV-14
[3]AD-PM Pax (6 gals.) + Employees (30 gpd)

Table IV-17 estimates the peak hour demand. It is used in sizing distribution pressure tanks, pumps and pipelines in order that the peak-hour or instantaneous demands of the Airport may be met.

TABLE IV-17
PEAK HOUR WATER DEMAND[1]

| Year | PH Pax[2] | Employees[2] | Peak Hour Usage Rate Consumptive[3] | Peak Hour Usage Rate Non-Consumptive[3] |
|---|---|---|---|---|
| 1982 | 484 | 21 | 63 gpm | 27 gpm |
| 1988 | 790 | 44 | 117 gpm | 50 gpm |
| 1993 | 1,274 | 74 | 193 gpm | 83 gpm |
| 2003 | 2,652 | 162 | 413 gpm | 177 gpm |

[1]Consumptive and non-consumptive uses excluding fire fighting
[2]From Table IV-14
[3]PH Pax (6 gals.)/(60min.) + Employee (2 gpm) assuming 70%-30% split between consumptive and non-consumptive use

Water requirements for fire protection must meet the criteria established by the National Fire Insurance Underwriters Association (NFIU). Fire protection water requirements for the airport are based on the maximum teminal area requirements (air carrier) defined in previous sections of this chapter and assumes that the construction will be Class 1: wood frame construction. Fire protection water requirements are as listed in Table IV-18.

TABLE IV-18
FIRE PROTECTION REQUIREMENTS

| Year | Max. Bldg. Area[1] | Flow(NFF)[2] | Duration[2] | Storage Requirement[3] |
|---|---|---|---|---|
| 1982 | 4,700 SF | 1500 gpm | 2 hrs. | 180,000 gals. |
| 1988 | 15,000 SF | 2700 gpm | 2 hrs. | 330,000 gals. |
| 1993 | 30,000 SF | 4000 gpm | 3 hrs. | 720,000 gals. |
| 2003 | 50,000 SF | 5000 gpm | 3 hrs. | 900,000 gals. |

[1]Maximum Building Area is Air Carrier Terminal from Table IV-8
[2]Need Fire Flow (NFF) as calculated using NFIU Manual
[3]NFF x duration

Table IV-19 lists the water system capacity requirements needed to meet the forecasted demand.

## TABLE IV-19

## WATER SYSTEM CAPACITY REQUIREMENTS

| Year | Annual Raw Water Requirement[1] | Domestic[2] | Raw Water Storage Capacities Fire Protection[3] | Total | Treatment Capacity[4] | Treated Water Storage Capacity[5] |
|---|---|---|---|---|---|---|
| 1982 | 1,892,790 gals | 294,900 gals | 180,000 gals | 474,900 gals | 4.6 gpm | 46,200 gals |
| 1988 | 3,595,870 gals | 558,600 gals | 330,000 gals | 888,600 gals | 8.6 gpm | 88,209 gals |
| 1993 | 5,403,800 gals | 832,200 gals | 720,000 gals | 1,552,200 gals | 12.8 gpm | 130,200 gals |
| 2003 | 11,223,730 gals | 1,720,500 gals | 900,000 gals | 2,620,500 gals | 26.6 gpm | 268,800 gals |

[1] From Table IV-15

[2] Consumptive & non-consumptive uses: 30 days @ Average Day, Peak Month

[3] From Table IV-18

[4] 70% of Average Day-Peak month rate (in gpm) due to conservation measures implemented at the airport

[5] 7 days @ treatment capacity for 24 hours

Recommended water utility system improvements for raw water storage, potable water treatment capacity and treated water storage at the Airport are shown on Figure IV-18, IV-19, and IV-20 respectively. As shown, the recommended facility development is based on the average day-peak month demand. The water storage requirements for annual average day demand is also shown on Figure IV-18 and IV-20 as a point of comparison to illustrate the effect of the peak demand factors.

The recommended initial increase in raw water storage will permit collection of precipitation which currently is wasted when the existing raw water storage is full. The present fire system is pressurized by a 1000 gpm fire pump located in maintenance room of the terminal. To meet the fire protection requirements, it is recommended that the one million gallon storage proposed for 1984-85 construction be elevated storage with the bottom of the tank at elevation 6694 and the top of the tank below elevation 6744, the FAR Part 77 transitional surface elevation at the location. The elevated tank with a properly sized fire distribution system will permit fire protection based on the static pressure and allow the fire pump which is presently undersized to be utilized in other capacities in the system. The present catchment basin system captures approximately 29% of the precipitation, the rest being lost to infiltraition or bypassed due to lack of storage. The basin and inlet/pumping configuration and construction would be modified to allow construction of the bypass taxiway (Taxiway Detail A-1) and to rehabilitate the catchment basin surface. Potable treated water distribution would continue to be pressurized by a small hydro-pneumatic system and the recommended treated water storage increase is intended to provide more flexibility in system operation and adequate storage for system maintenance.

3. Wastewater

Wastewater is presently carried from the Airport through an 8 inch outfall main to treatment facilities owned and operated by the South Grand Canyon Sanitary District in Tusayan. Table IV-20 lists the estimated annual wastewater flow projected to be produced at the Airport.

TABLE IV-20

TOTAL ANNUAL WASTEWATER FLOW

| Year | Pax[1] | Employees[1] | Annual Wastewater Flow[2] | Average Daily Flow |
|---|---|---|---|---|
| 1982 | 277,140 | 21 | 1,483,570 gals | 4,065 gpd |
| 1988 | 519,012 | 44 | 2,812,460 gals | 7,705 gpd |
| 1993 | 765,584 | 74 | 4,215,000 gals | 11,548 gpd |
| 2003 | 1,574,972 | 162 | 8,742,470 gals | 23,952 gpd |

[1] From Table IV-14
[2] Pax (4.8 gpd) + Employees (20 gpd) (365 days)

It is assumed that wastewater will continue to be piped to and treated by the South Grand Canyon Sanitary District. Table IV-21 lists the projected peak hour flows from the Airport. Since no holding basins are anticipated at the Airport to equalize flows to the treatment facilities in Tusayan, Table IV-21 lists the size of the outfall main required to carry the projected flows.

TABLE IV-21

PEAK HOUR WASTEWATER FLOW RATES

| Year | Peak Hour Pax[1] | Employees[1] | Peak Hour Flow Rate[2] | Required Outfall Size[3] |
|---|---|---|---|---|
| 1982 | 484 | 21 | 67 gpm | < 4" |
| 1988 | 790 | 44 | 122 gpm | 4" |
| 1993 | 1,274 | 74 | 200 gpm | < 6" |
| 2003 | 2,652 | 162 | 428 gpm | < 8 |

[1] From Table IV-14
[2] PH Pax (4.8 gals)/(60 min) + Employee (1.33 gpm)
[3] Assuming 3.5 ft./sec. average velocity

The existing 8" outfall is sufficient to handle the projected wastewater flows.

## M. CRASH, FIRE, AND RESCUE

The Grand Canyon National Park Airport must satisfy standards for aircraft fire fighting and rescue system needs for CAB certificated air carrier airports. FAR Part 139.49 establishes an index system based on aircraft size. GCN presently services index "B" aircraft; by 1993 when larger aircraft such as DC9-80's are expected to use the airport the index will change to "C". AC 150/5210-12 specifies the minimum quantity of fire extinguishing agents and equipment necessary for each aircraft index. Quantities are based on aircraft dimensions and their theoretical (TC) and practical fire areas (TC = Length x (100 + width) and Practical area = 2/3 TC). The goal is to obtain control in the practical critical area in one minute and to have continued control after that.

### 1. Existing

GCN presently owns 4 trucks complete with equipment for fire fighting and rescue. Data regarding this equipment was obtained from the GCN Operations Manual and the airport manager. One of the trucks (1979 FMC) is used for structural fires. The main aircraft fire and rescue truck is a 1975 Oshkosh 1500 which holds 1500 gallons of water with Aqueous Film Forming Foam (AFFF) solution and pumps 1000 gallons per minute; it also carries 200 lbs. of dry chemical agent. Two smaller trucks (1969 Ford and 1953 Dodge) together carry 600 lbs of dry chemical and 130 gallons of water. Table IV-22 compares minimum requirements from AC 150/5210-12 with GCN's capabilities.

TABLE IV-22

EXISTING EQUIPMENT AND FIRE EXTINGUISHING AGENTS

| Description | Requirement | GCN |
|---|---|---|
| Dry Chemical (lbs) | 300 | 800 |
| Water (gallons) | 1500 | 1630* |
| Solution Application Rate (gpm) | 750 | 1000 |

*Extra 750 gallons backup available from structural fire truck.

The AC recommends one combination water/foam dry chemical truck and one 1000 gallon water/foam truck or a light weight dry chemical truck and a 1500 gallon water/foam truck. GCN's system satisfies the second combination and all the quantity requirements.

2. Ultimate

Requirements for index "C" aircraft are shown in Table IV-23.

TABLE IV-23

FIRE EXTINGUISHING AGENTS AND EQUIPMENT FOR INDEX "C" AIRCRAFT

| Description | Requirements |
|---|---|
| Dry Chemical (lbs) | 500 |
| Water (gallons) | 3000 |
| Solution Application Rate (gpm) | 1500 |

The AC recommends one light weight dry chemical truck and two 1500 gallon water trucks (the light weight truck could be substituted with a combination foam and dry chemical truck). When GCN begins servicing index "C" aircraft (126'-160' in length) the airport will have to purchase another 1500 gallon water/foam truck to bring its fire force up to the requirements.

At that time, the Fire-Rescue Equipment Building will have to be enlarged or supplemented with another building to house the increased quantities of fire and rescue equipment.

As growth at GCN and the Tusayan area continues, increased importance should be placed on maintaining an up to date fire fighting force. It is recommended that at least one airport staff be assigned full time responsibility for the fire/rescue operation to ensure proper equipment maintenance and an adequate level of training and preparation. Structural fire equipment and personnel must keep pace with terminal growth and should be integrated with fire fighting needs of Tusayan and the surrounding community.

N. SUMMARY

The projected airport requirements and conceptual layouts presented in this chapter demonstrate that it is feasible to develop the Grand Canyon National Park Airport, in phases, to accommodate the forecasted traffic developed in Chapter II. The concepts presented will form the basis of the environmental analysis and the Airport plans which will investigate these concepts in more detail.

Table IV-24 contains a development summary of the items discussed in this chapter by stages of development and includes very preliminary estimates of cost, which will be refined in the airport plans portion of the Master Plan. The improvements for the initial development phase through 1988 are those shown on Figure IV-15C.

TABLE IV-24

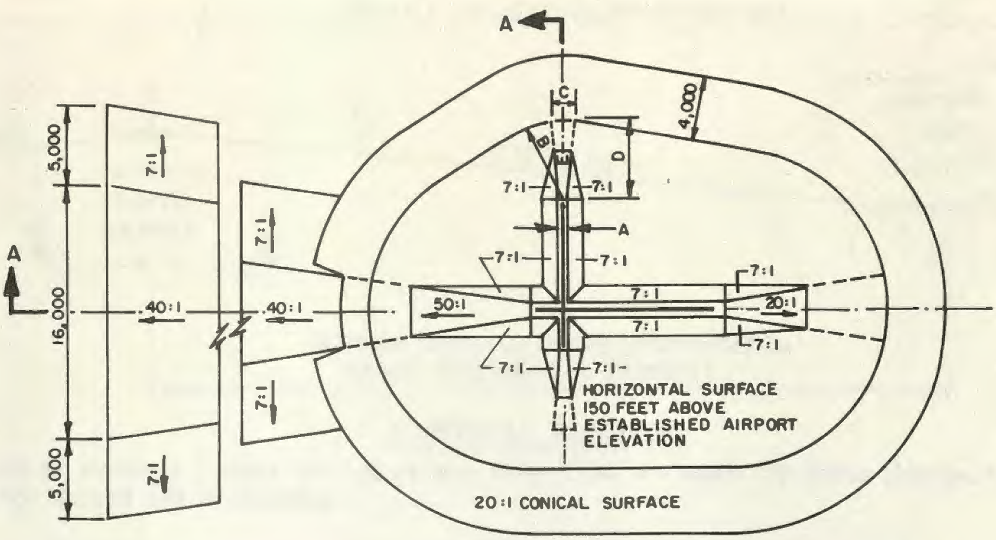
DEVELOPMENT SUMMARY

| Construction Period | Item | Projected Size | Projected Cost ($000) |
|---|---|---|---|
| 1984/85 | Commuter Ramp | 45,000 SY | $ 3,140 |
| | Tree Obstruction Removal | -- | |
| | Taxiway Overlay | -- | |
| | Raw Water Storage/System | 1,000,000 gal | 500 |
| | Treated Water Storage | 100,000 gal | 50 |
| | Catchment Basin Rehab/Reconfigure | LS | 100 |
| | TOTAL | | $ 3,790 |
| 1985/86 | Heliport | 13,000 SY | $ 650 |
| | Heliport Terminal | 4,800 SF | 360 |
| | Auto Parking - Heliport | 1,350 SY | 41 |
| | Access Roadway | 8,000 SY | 240 |
| | Auto Parking - Terminal | 3,000 SY | 90 |
| | TOTAL | | $ 1,381 |

TABLE IV-24 (Cont'd)
DEVELOPMENT SUMMARY

| Construction Period | Item | Projected Size | Projected Cost ($000) |
|---|---|---|---|
| 1987/1988 | Taxiway Improvements | 12,000 SY | $ 780 |
| | Air Carrier Terminal | 15,000 SF | 1,125 |
| | Air Carrier/Commuter Apron | 20,000 SY | 1,300 |
| | G.A. Apron | 19,000 SY | 944 |
| | Access Roadway | 17,000 SY | 521 |
| | Auto Parking - A.C. | 2,500 SY | 75 |
| | Commuter Terminal Remodel | 9,500 SF | 356 |
| | Relocate Fuel Farm | LS | 10 |
| | Relocate ATCT | LS | 80 (FAA) |
| | TOTAL | | $ 5,191 |
| 1988/1993 | Water Treatment Facilities | 15 GPM | $ 100 |
| | Treated Water Storage | 140,000 gal | 70 |
| | Raw Water Storage | 1,200,000 gal | 360 |
| | Commuter Ramp | 40,000 SY | 2,600 |
| | G.A. Ramp | 3,500 SY | 228 |
| | Air Carrier Terminal | 15,000 SF | 1,125 |
| | Commuter Terminal | 6,000 SF | 450 |
| | Based Commuter Terminal | 1,200 SF | 90 |
| | Helicopter Terminal | 1,400 SF | 105 |
| | Terminal Parking | 7,000 SY | 210 |
| | Helicopter Parking | 450 SY | 14 |
| | Access Roadway | 25,000 SY | 750 |
| | Helicopter Ramp | 1,700 SY | 51 |
| | Extend Rwy 3R/21L to 10,700' | 47,000 SY | 3,055 |
| | Stage 1 Rwy 3L/21R - 5,700' | 100,000 SY | 6,500 |
| | Exit Taxiway Improvements | 12,000 SY | 780 |
| | TOTAL | | $16,488 |
| 1993/2003 | Air Carrier Ramp | 8,000 SY | $ 600 |
| | Commuter Ramp | 70,000 SY | 4,550 |
| | G.A. Ramp | 11,000 SY | 715 |
| | Air Carrier Terminal | 20,000 SF | 1,500 |
| | Commuter Terminal | 17,000 SF | 1,275 |
| | Based Commuter Terminal | 6,400 SF | 480 |
| | Helicopter Terminal | 3,800 SF | 285 |
| | Terminal Parking | 18,000 SY | 540 |
| | Helicopter Parking | 1,450 SY | 44 |
| | Access Roadway | 5,000 SY | 150 |
| | Helicopter Ramp | 5,000 SY | 150 |
| | Stage 2 Rwy 3L/21R - 8000' | 46,000 SY | 3,000 |
| | TOTAL | | $13,289 |

The ultimate development concept is shown on Figure IV-22.



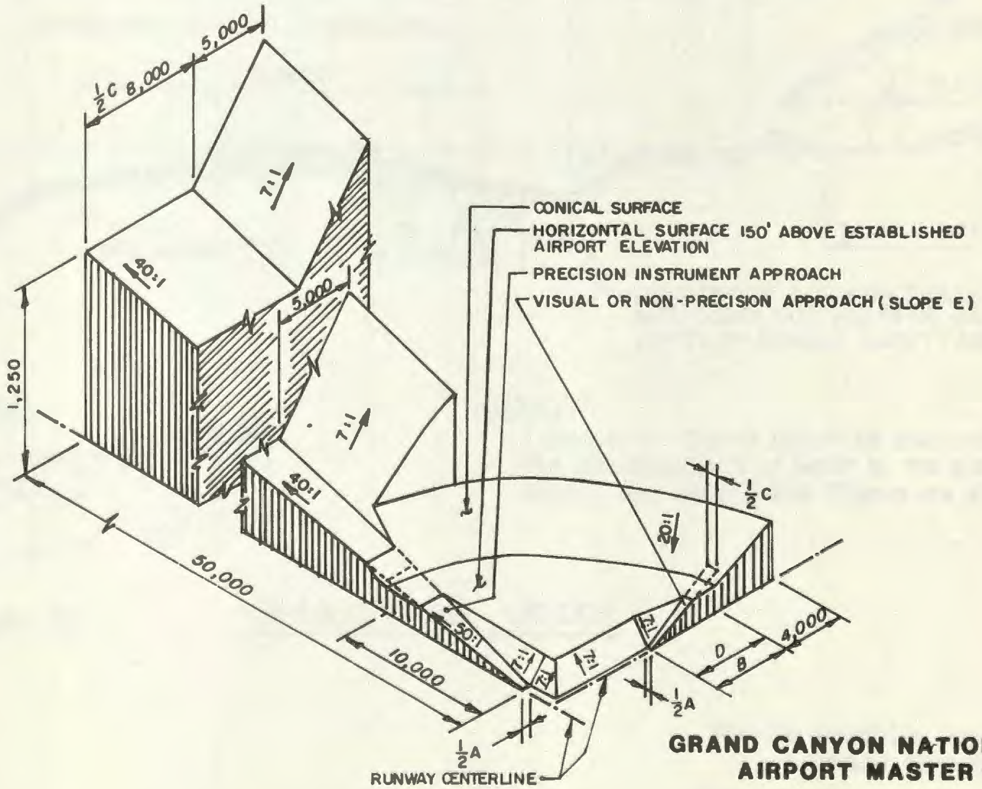

| DIM. | ITEM | DIMENSIONAL STANDARDS (FEET) | | |
|---|---|---|---|---|
| | | VISUAL RUNWAY (A) | PRECISION INSTRUMENT RUNWAY (B) | NON-PRECISION RUNWAY (C) |
| A | WIDTH OF PRIMARY SURFACE AND APPROACH SURFACE WIDTH AT INNER END | 250 | 1,000 | 1,000 |
| B | RADIUS OF HORIZONTAL SURFACE | 5,000 | 10,000 | 10,000 |
| | | VISUAL APPROACH (A) | PRECISION INSTRUMENT APPROACH | NON-PRECISION APPROACH |
| C | APPROACH SURFACE WIDTH AT END | 1,250 | 16,000 | 3,500 |
| D | APPROACH SURFACE LENGTH | 5,000 | 50,000 | 10,000 |
| E | APPROACH SLOPE | 20:1 | 50:1 * | 34:1 |

(A) = FUTURE PARALLEL RUNWAY 3L/21R (UTILITY)

(B) = EXISTING RUNWAY 03

(C) = EXISTING RUNWAY 21

* PRECISION INSTRUMENT APPROACH SLOPE IS 50:1 FOR INNER 10,000 FEET AND 40:1 FOR AN ADDITIONAL 40,000 FEET.



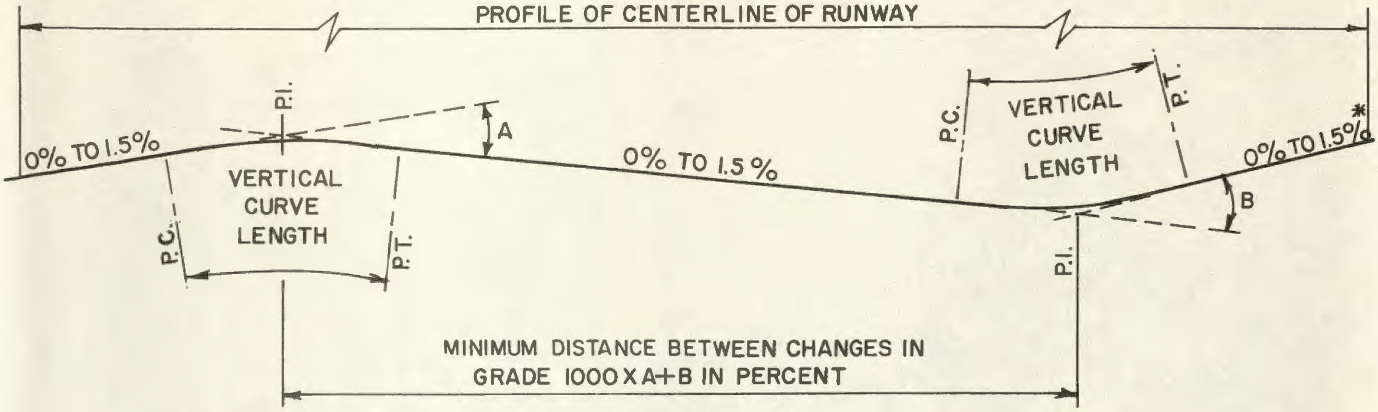

ISOMETRIC VIEW OF SECTION AA

**GRAND CANYON NATIONAL PARK AIRPORT MASTER PLAN**

## AIRSPACE SURFACES

**FIGURE IV-1**

LEEDSHILL-HERKENHOFF, INC.




## VERTICAL CURVES

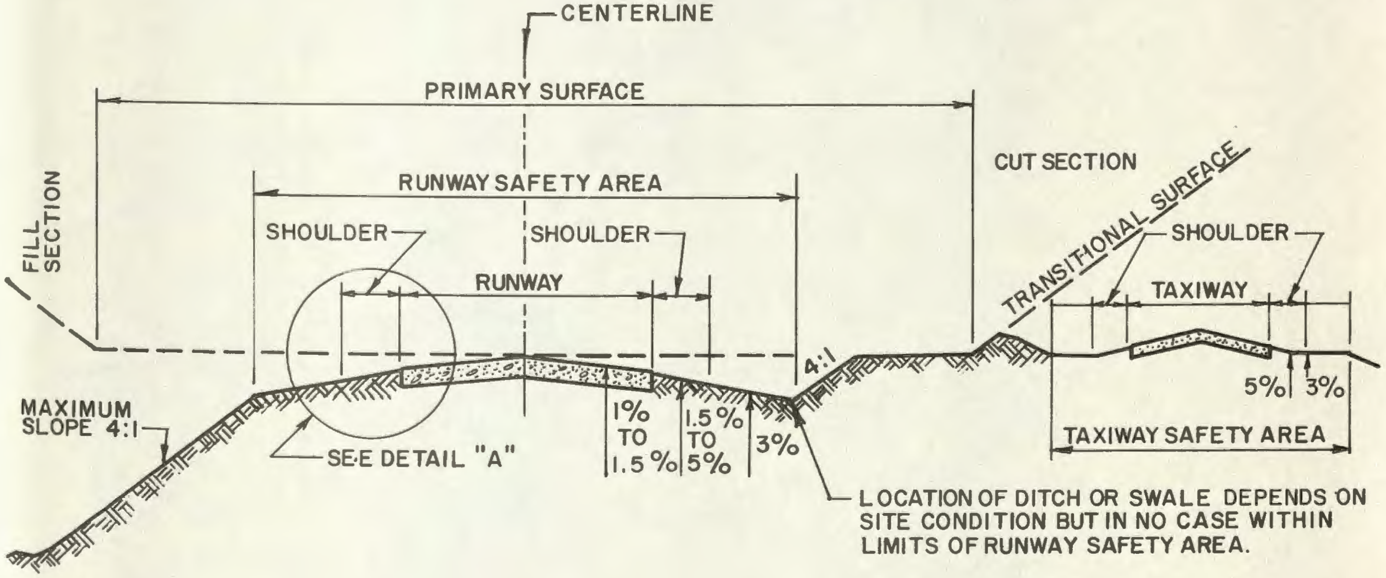
Length of Vertical Curves will not be less than 1000' for each 1% Grade change. No Grade change in last 1/4 of Runway.

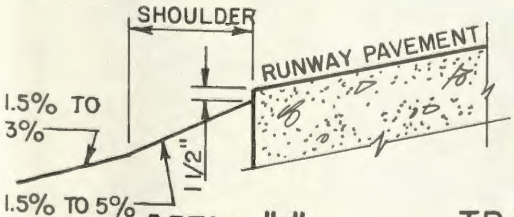
## GRADE CHANGE

Maximum Grade Change such as (A) or (B) should not exceed 1.5%.

* Grade in last 1/4 of Runway should not exceed 0.5%.

## LONGITUDINAL GRADE




DETAIL "A"

NOTE:

1. Transverse Slopes should be adequate to prevent the accumulation of water on the surface but should not exceed the Slopes as shown.

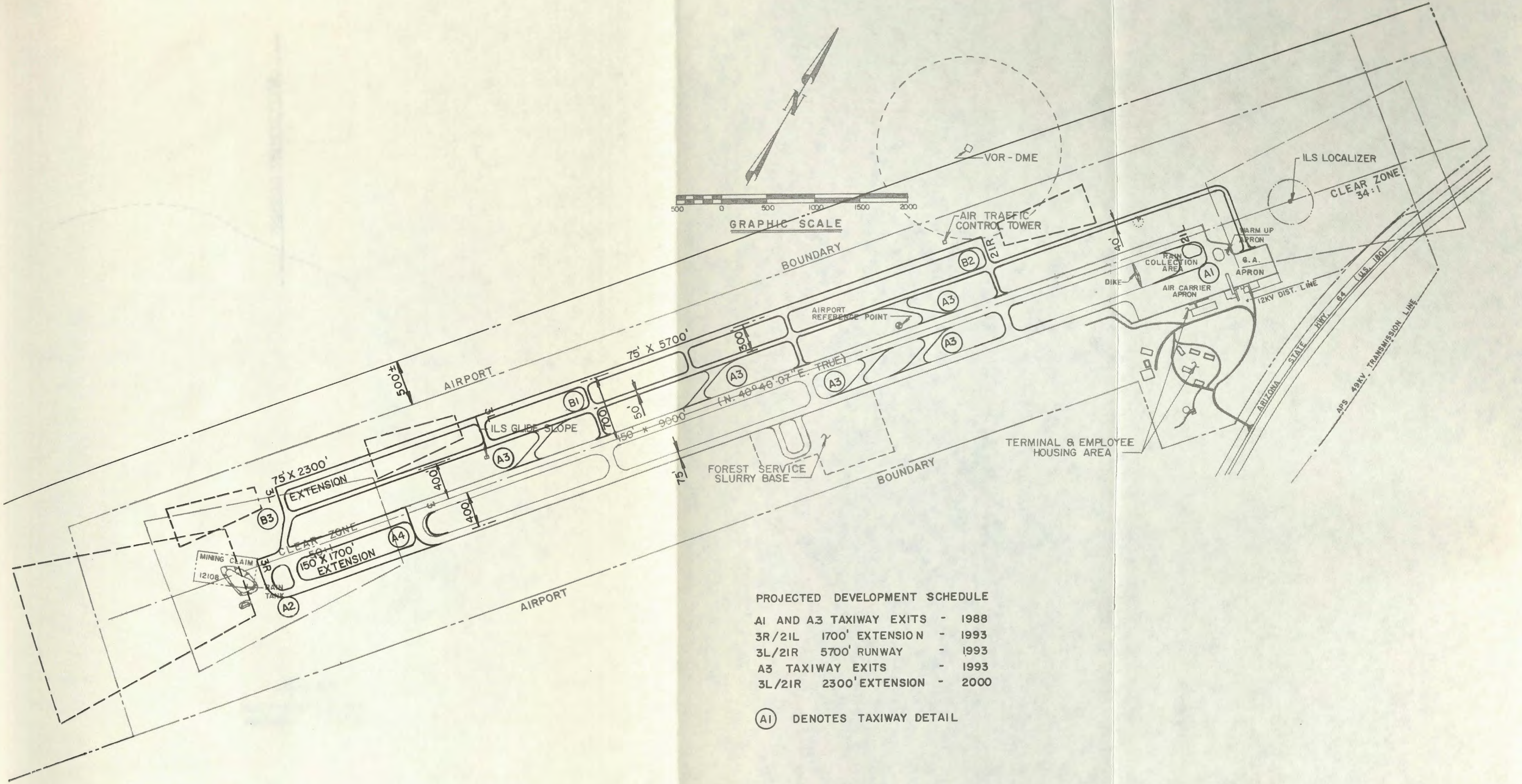
## TRANSVERSE GRADE

GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN

**TRANSPORT AIRPORT GRADIENT STANDARDS**

FIGURE IV-2

LEEDSHILL-HERKENHOFF, INC.




PROJECTED DEVELOPMENT SCHEDULE

| | | |
|---|---|---|
| A1 AND A3 TAXIWAY EXITS | - | 1988 |
| 3R/21L 1700' EXTENSION | - | 1993 |
| 3L/21R 5700' RUNWAY | - | 1993 |
| A3 TAXIWAY EXITS | - | 1993 |
| 3L/21R 2300' EXTENSION | - | 2000 |

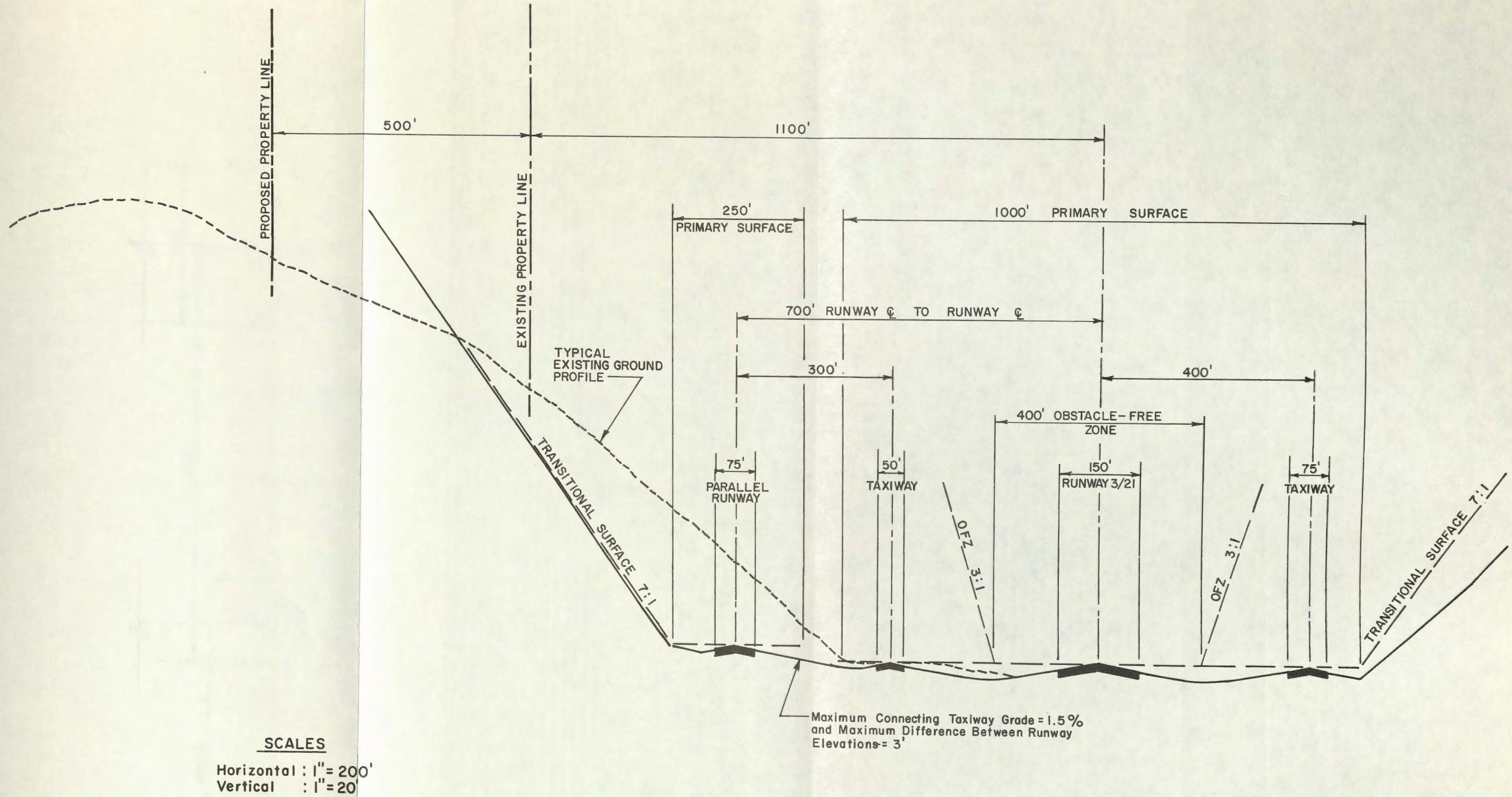
(A1) DENOTES TAXIWAY DETAIL

GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN

RUNWAY AND TAXIWAY DEVELOPMENT

FIGURE IV-3

LEEDSHILL-HERKENHOFF, INC.

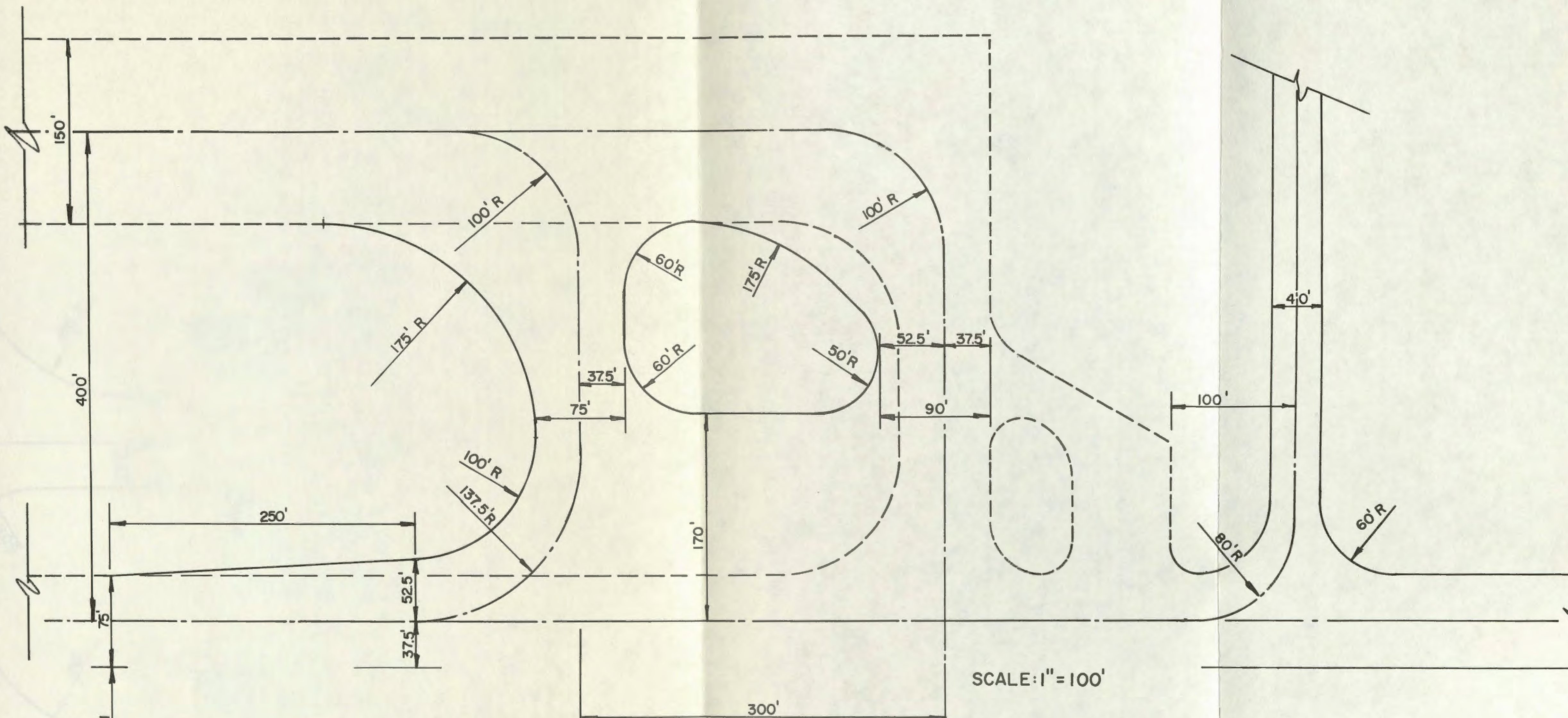



LEEDSHILL-HERKENHOFF, INC.

GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN

## TYPICAL RUNWAY SYSTEM SECTION

FIGURE IV-4




DETAIL A1

BYPASS TAXIWAY / HOLDING AREA

NOTE:

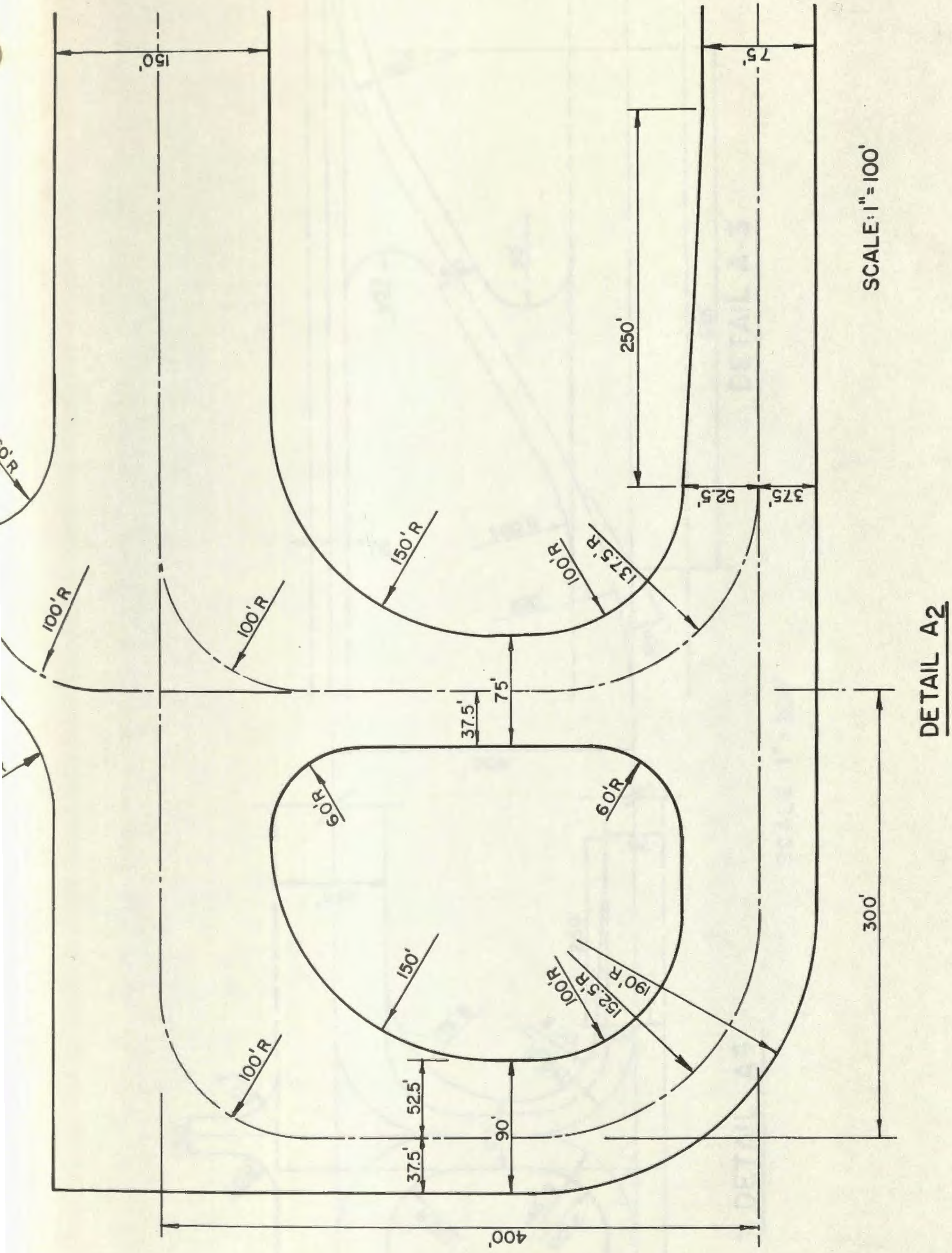
BYPASS TAXIWAY / HOLDING AREA TO BE GRADED TO DRAIN NORTHEAST TO PREVENT PETROLEUM CONTAMINATION FROM ENTERING WATER COLLECTION SYSTEM. ALSO REQUIRES MODIFICATION TO WATER COLLECTION AREA AND DIKE.

LEEDSHILL-HERKENHOFF, INC.

**GRAND CANYON NATIONAL PARK**
**AIRPORT MASTER PLAN**

**TAXIWAY EXIT**
**DETAIL A1**

**FIGURE IV-5**

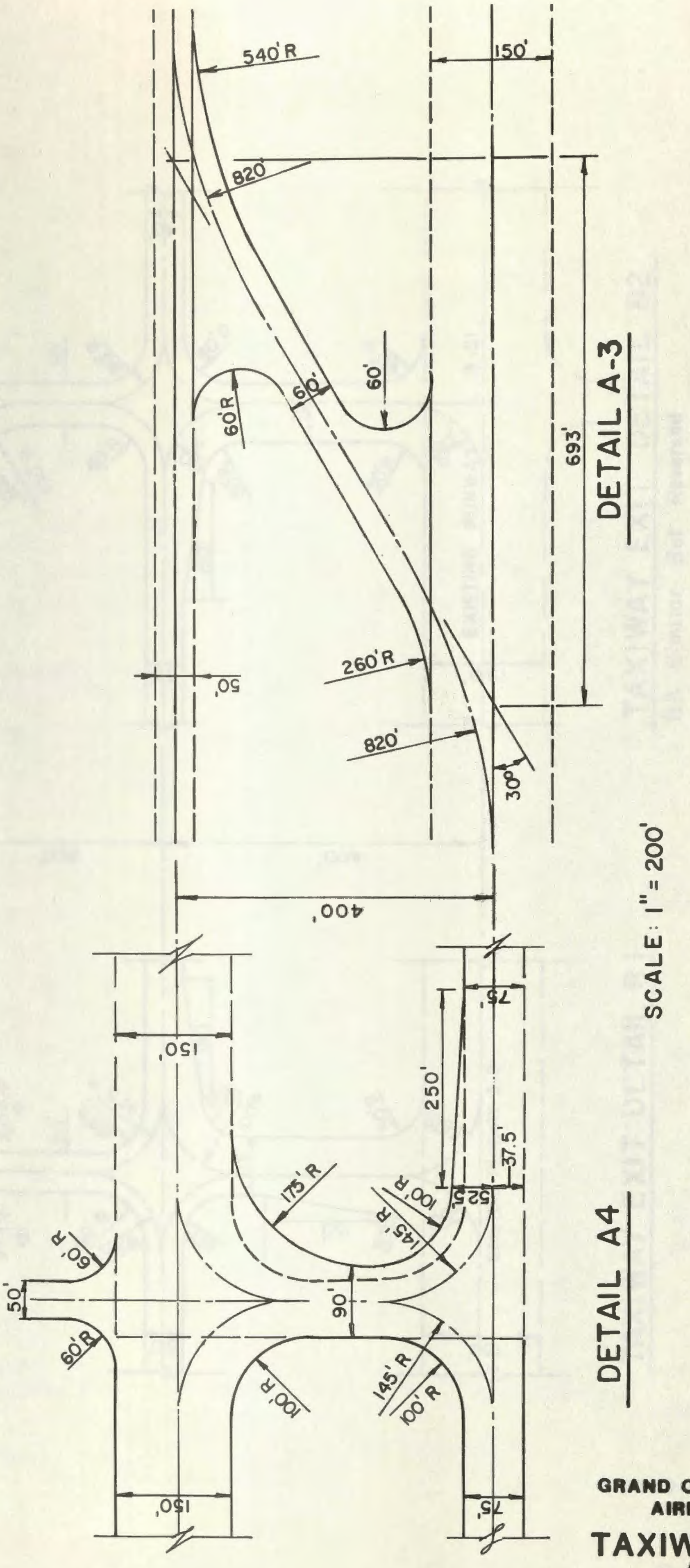



**GRAND CANYON NATIONAL PARK**
**AIRPORT MASTER PLAN**

## TAXIWAY EXIT
## DETAIL A2

LEEDSHILL - HERKENHOFF, INC.

**FIGURE IV-6**

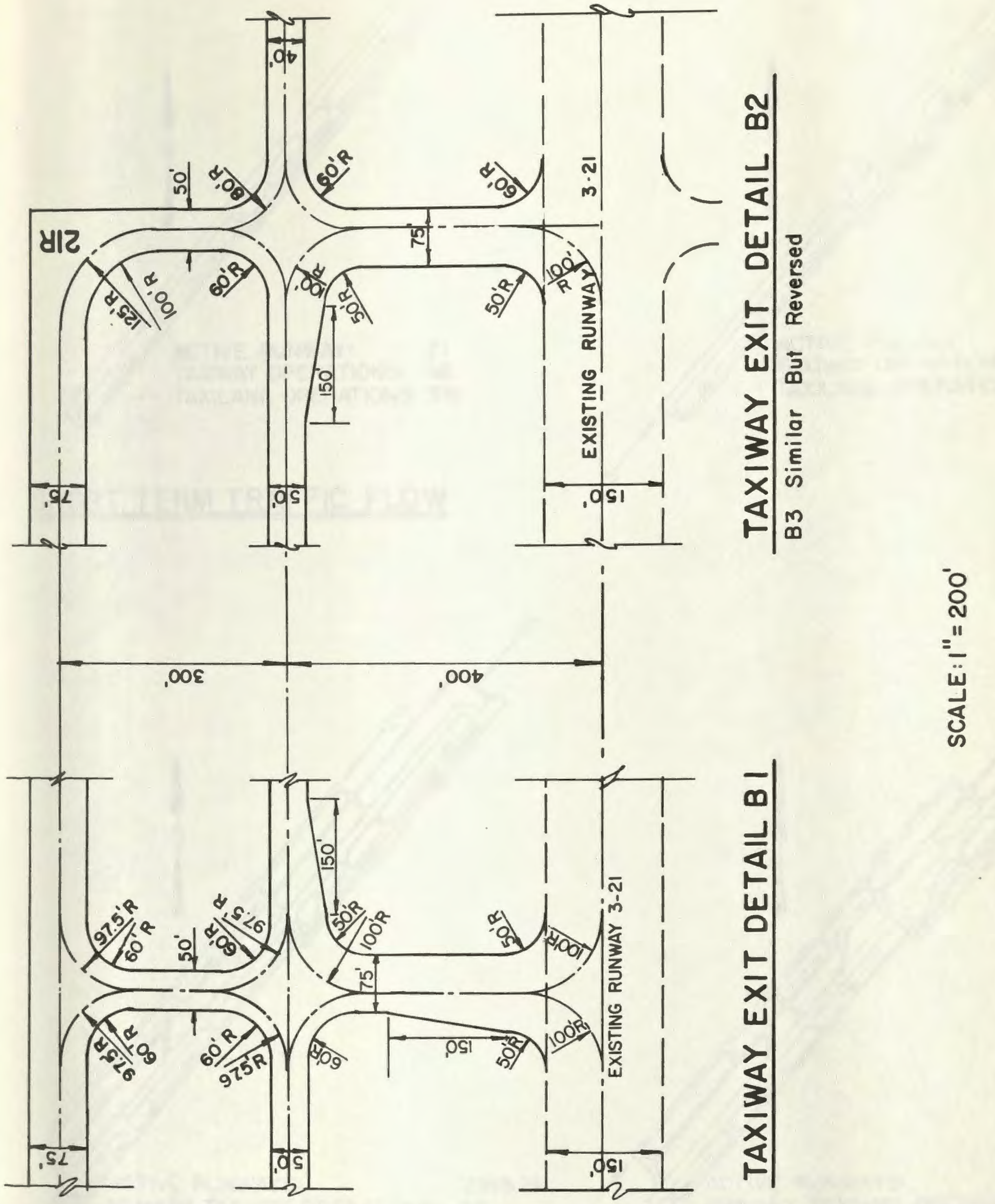



GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN

**TAXIWAY EXIT DETAIL A3 AND A4**

LEEDSHILL-HERKENHOFF, INC.

FIGURE IV-7

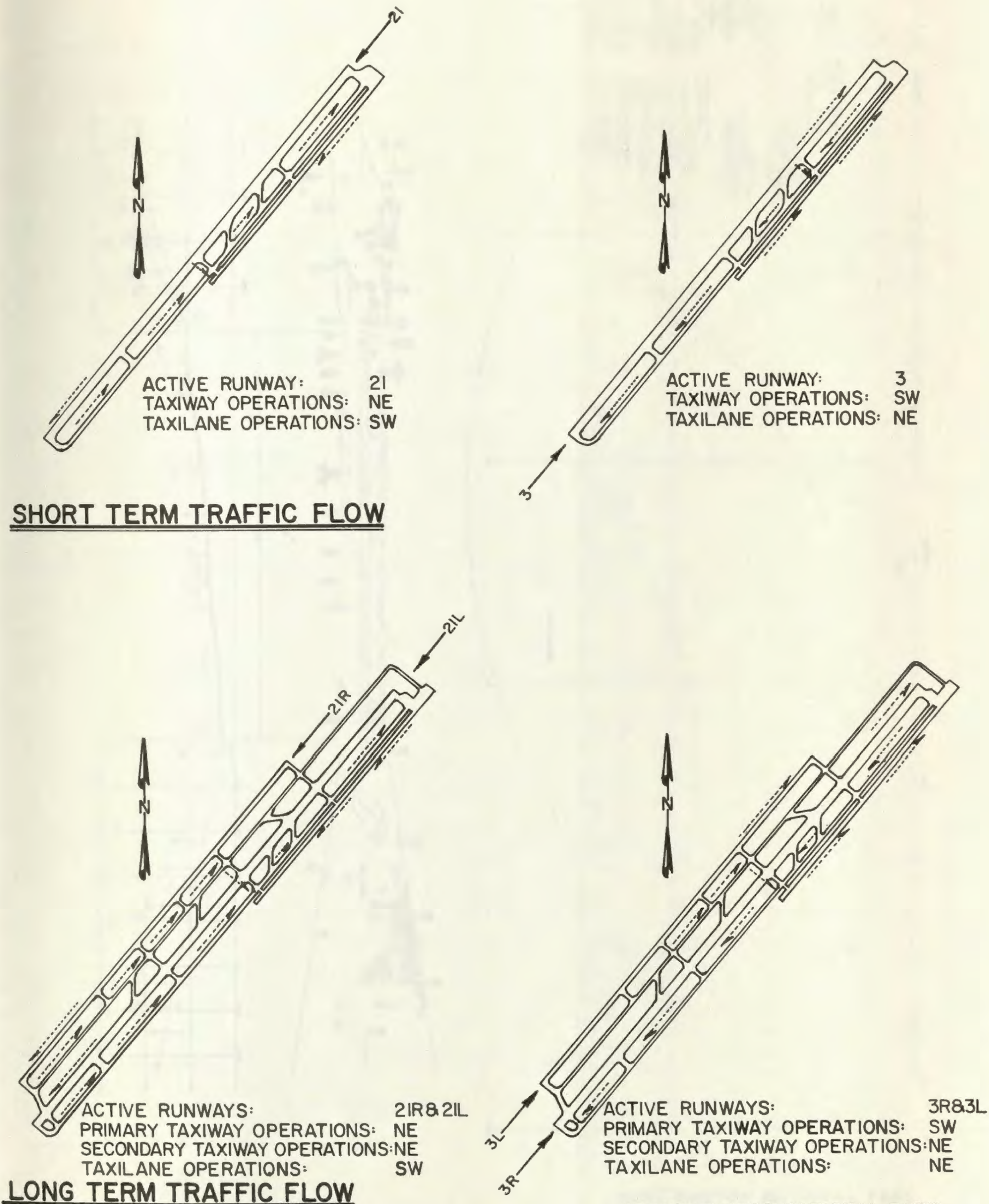



**GRAND CANYON NATIONAL PARK**
**AIRPORT MASTER PLAN**

## TAXIWAY EXIT DETAIL B1, B2, AND B3

LEEDSHILL-HERKENHOFF, INC.

**FIGURE IV-8**

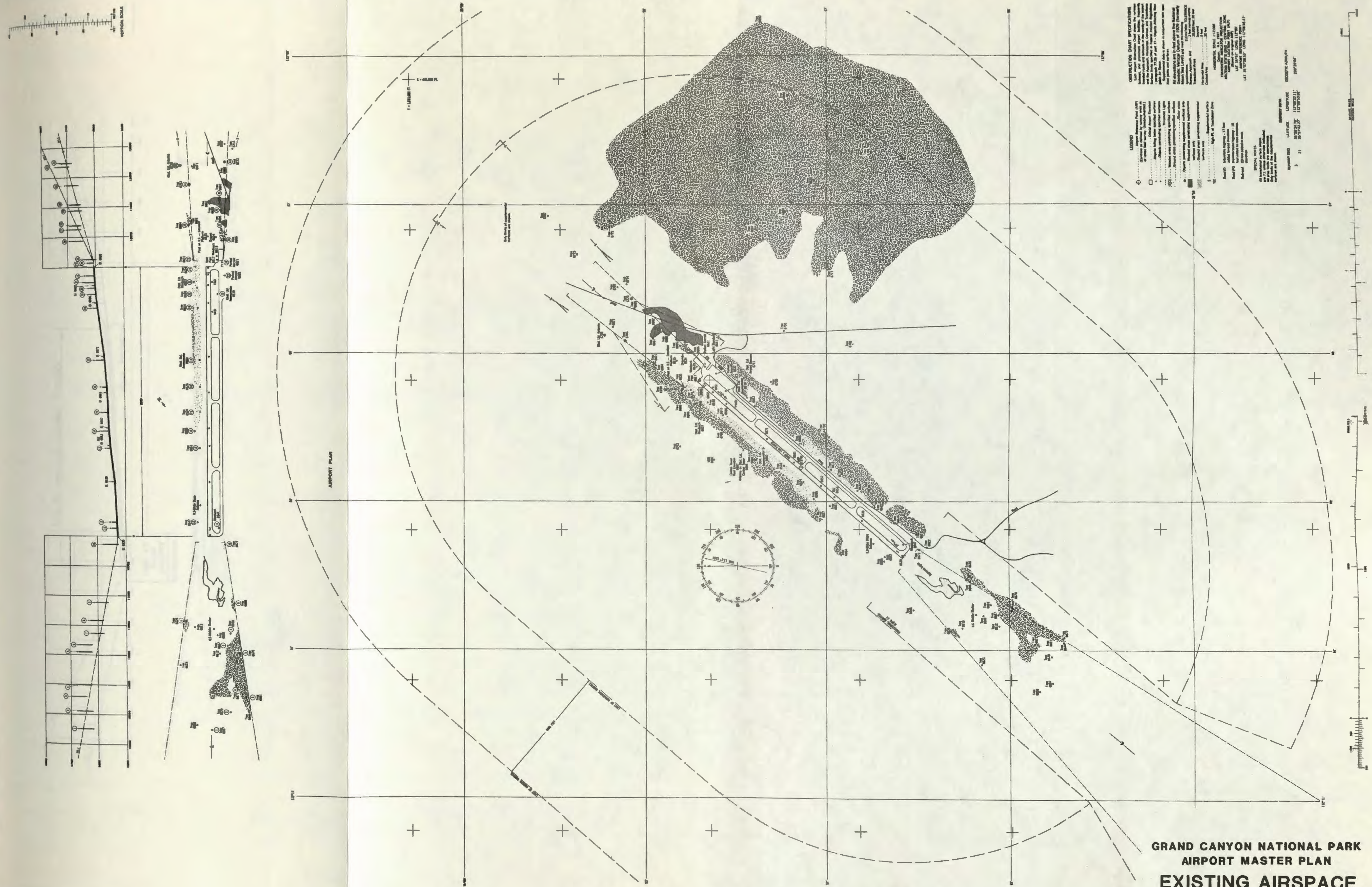



**GRAND CANYON NATIONAL PARK**
**AIRPORT MASTER PLAN**

**TAXIWAY TRAFFIC PATTERNS**

**FIGURE IV-9**

LEEDSHILL-HERKENHOFF, INC.

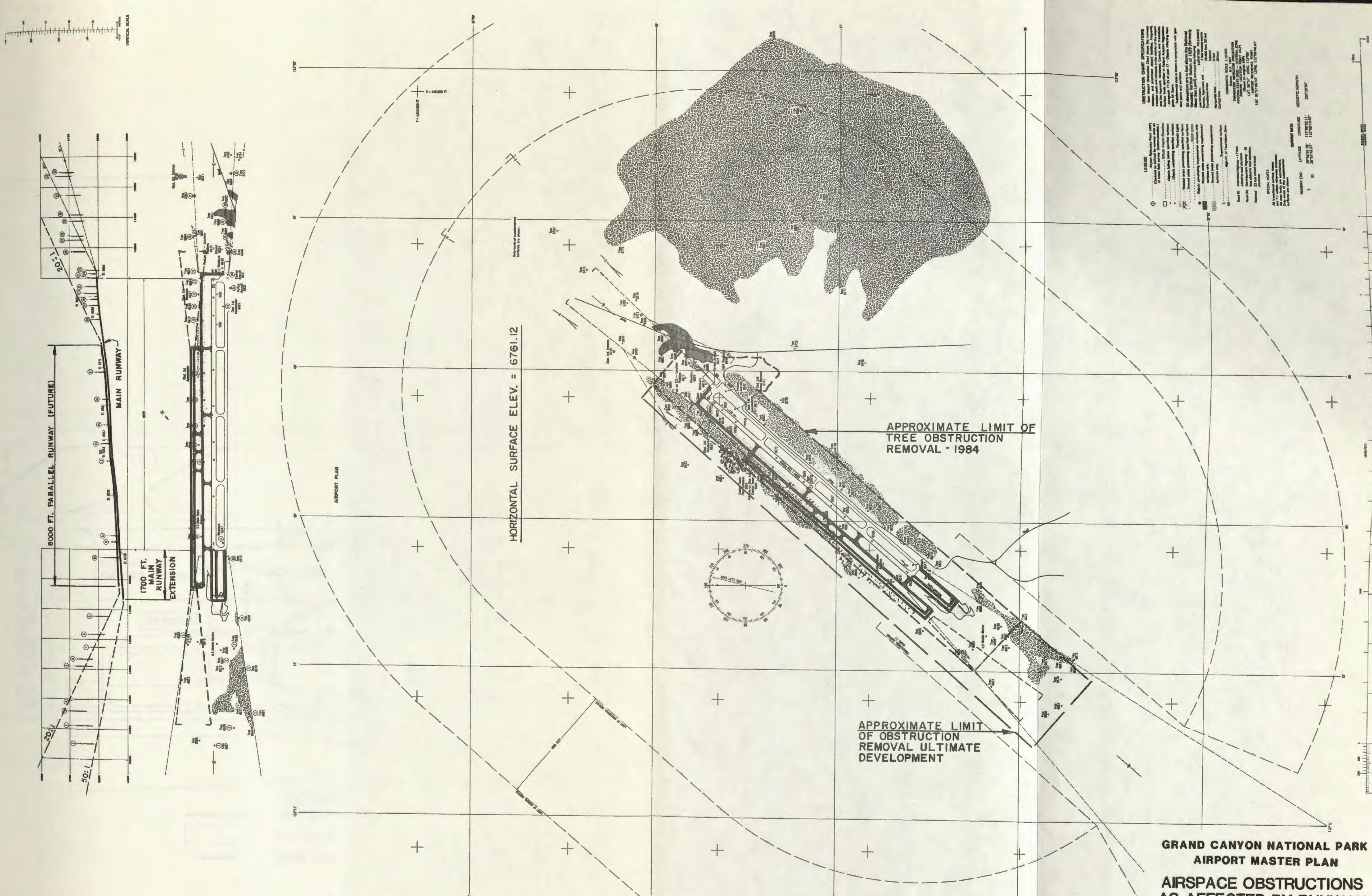



LEEDSHILL-HERKENHOFF, INC.

GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN

## EXISTING AIRSPACE OBSTRUCTIONS

FIGURE IV-10

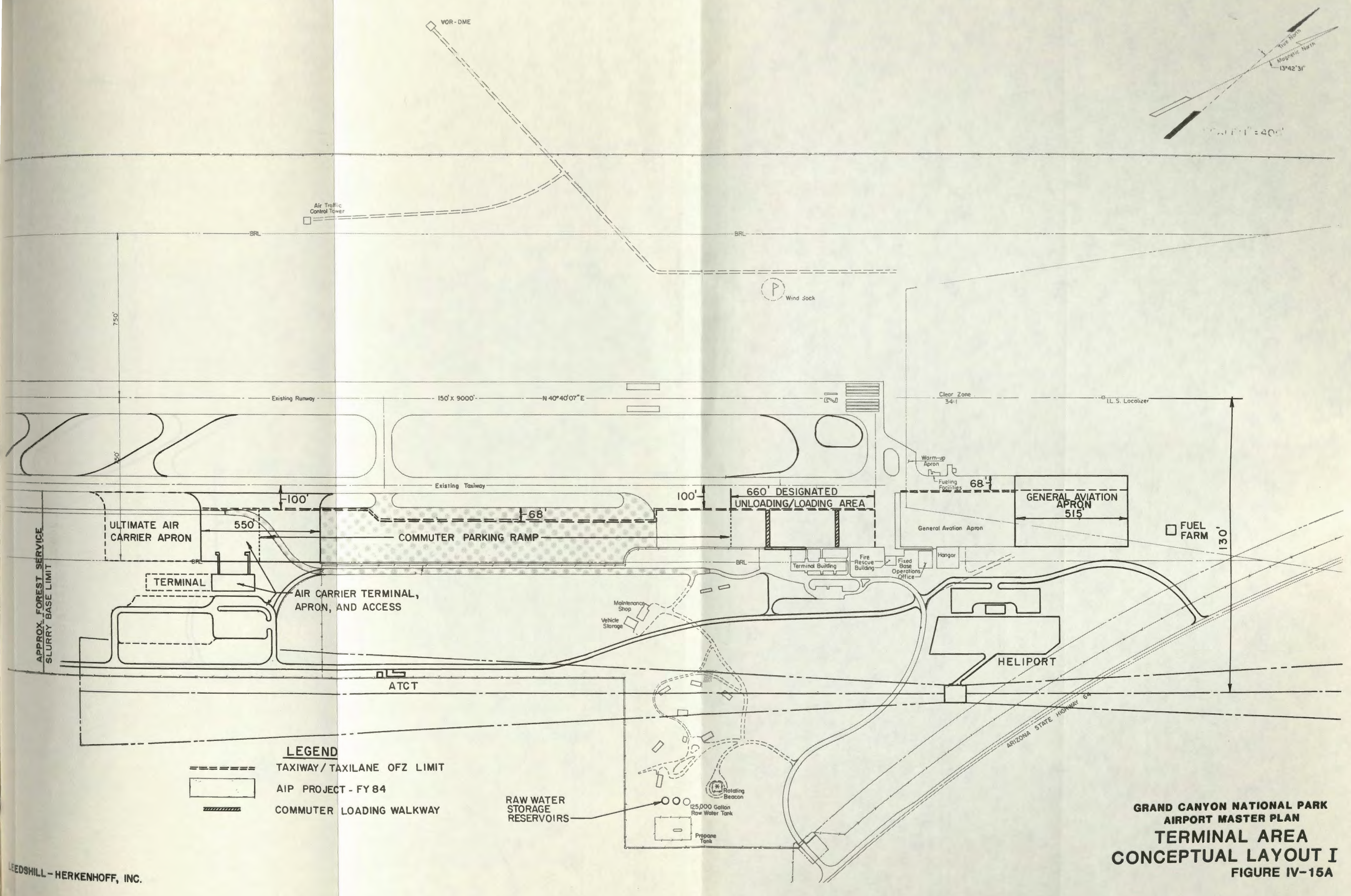



**GRAND CANYON NATIONAL PARK AIRPORT MASTER PLAN**

## AIRSPACE OBSTRUCTIONS AS AFFECTED BY RUNWAY & TAXIWAY IMPROVEMENTS

**FIGURE IV-11**

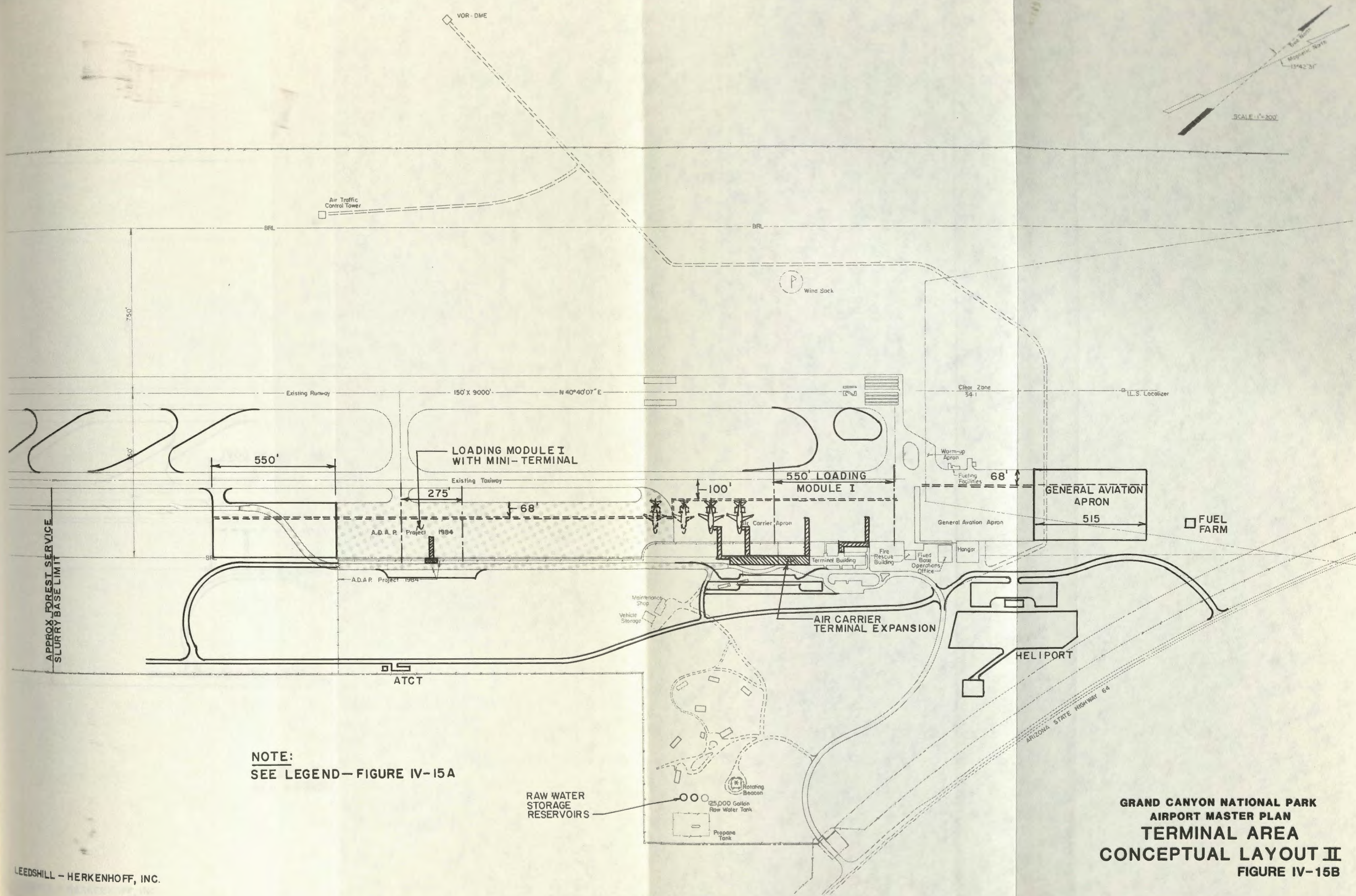
LEEDSHILL-HERKENHOFF, INC.




**GRAND CANYON NATIONAL PARK AIRPORT MASTER PLAN**

**TERMINAL AREA CONCEPTUAL LAYOUT I**

**FIGURE IV-15A**



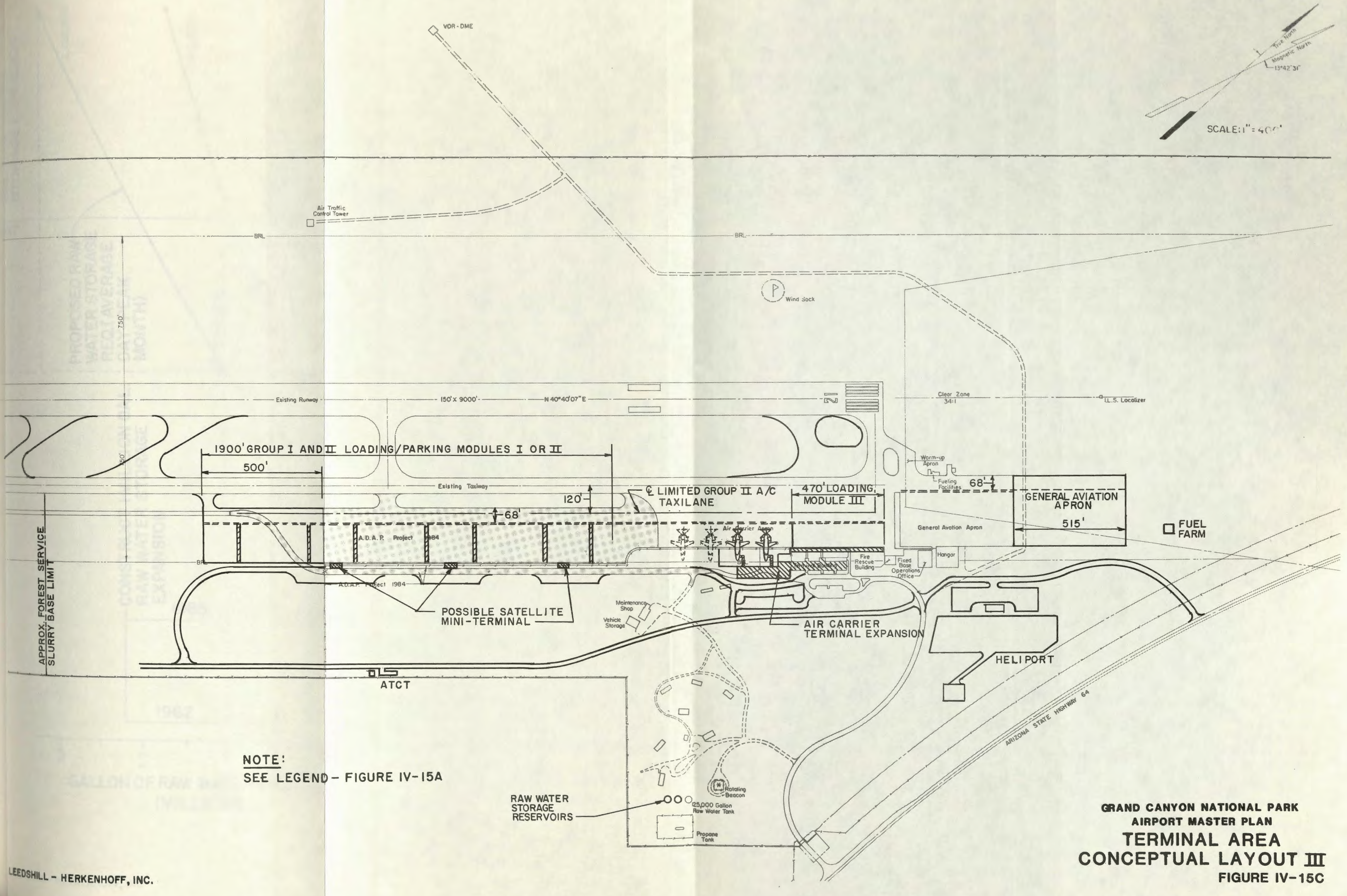

NOTE:
SEE LEGEND—FIGURE IV-15A

LEEDSHILL-HERKENHOFF, INC.

**GRAND CANYON NATIONAL PARK**
**AIRPORT MASTER PLAN**

## TERMINAL AREA CONCEPTUAL LAYOUT II

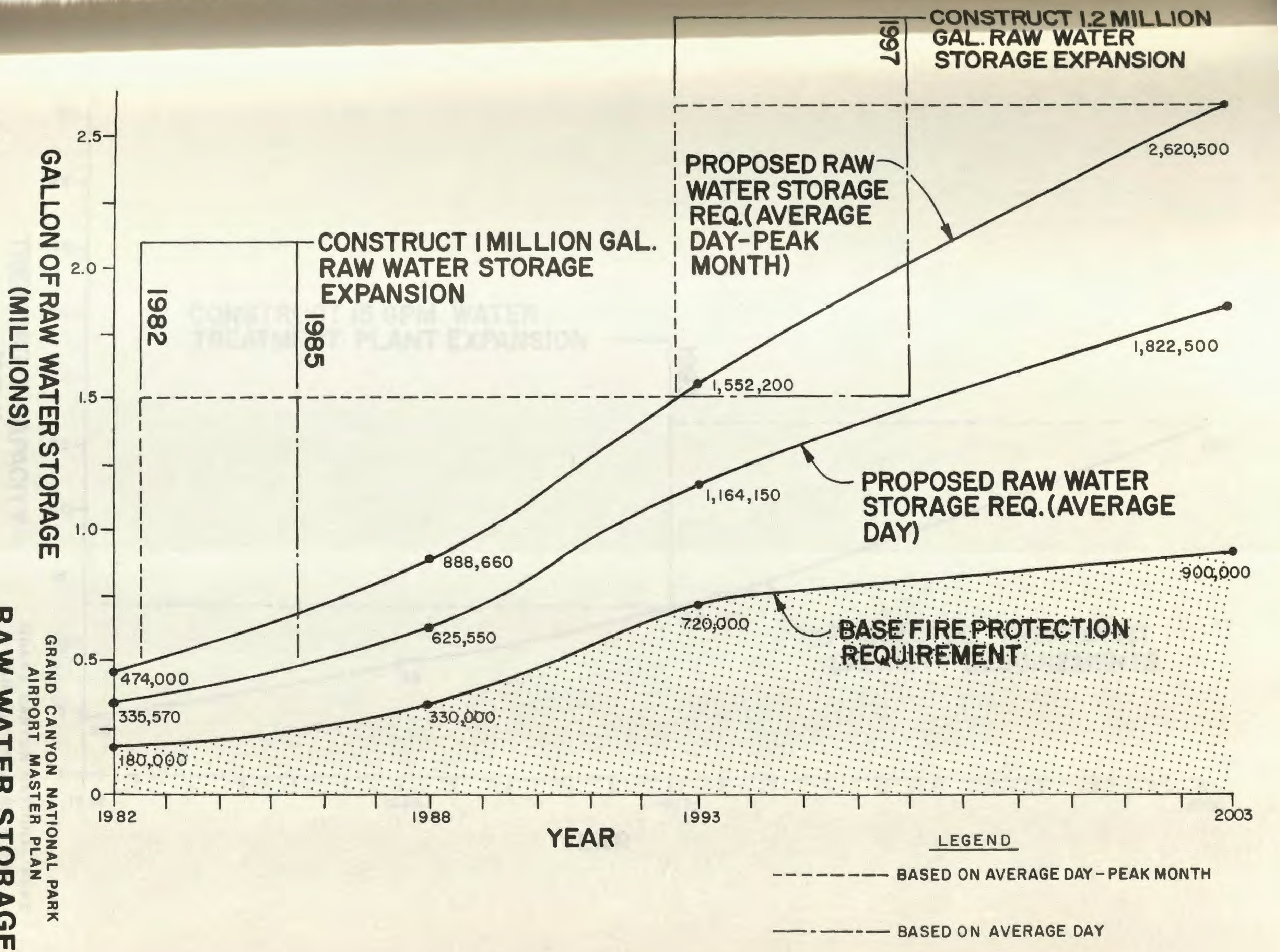
FIGURE IV-15B




GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN

**TERMINAL AREA CONCEPTUAL LAYOUT III**

FIGURE IV-15C

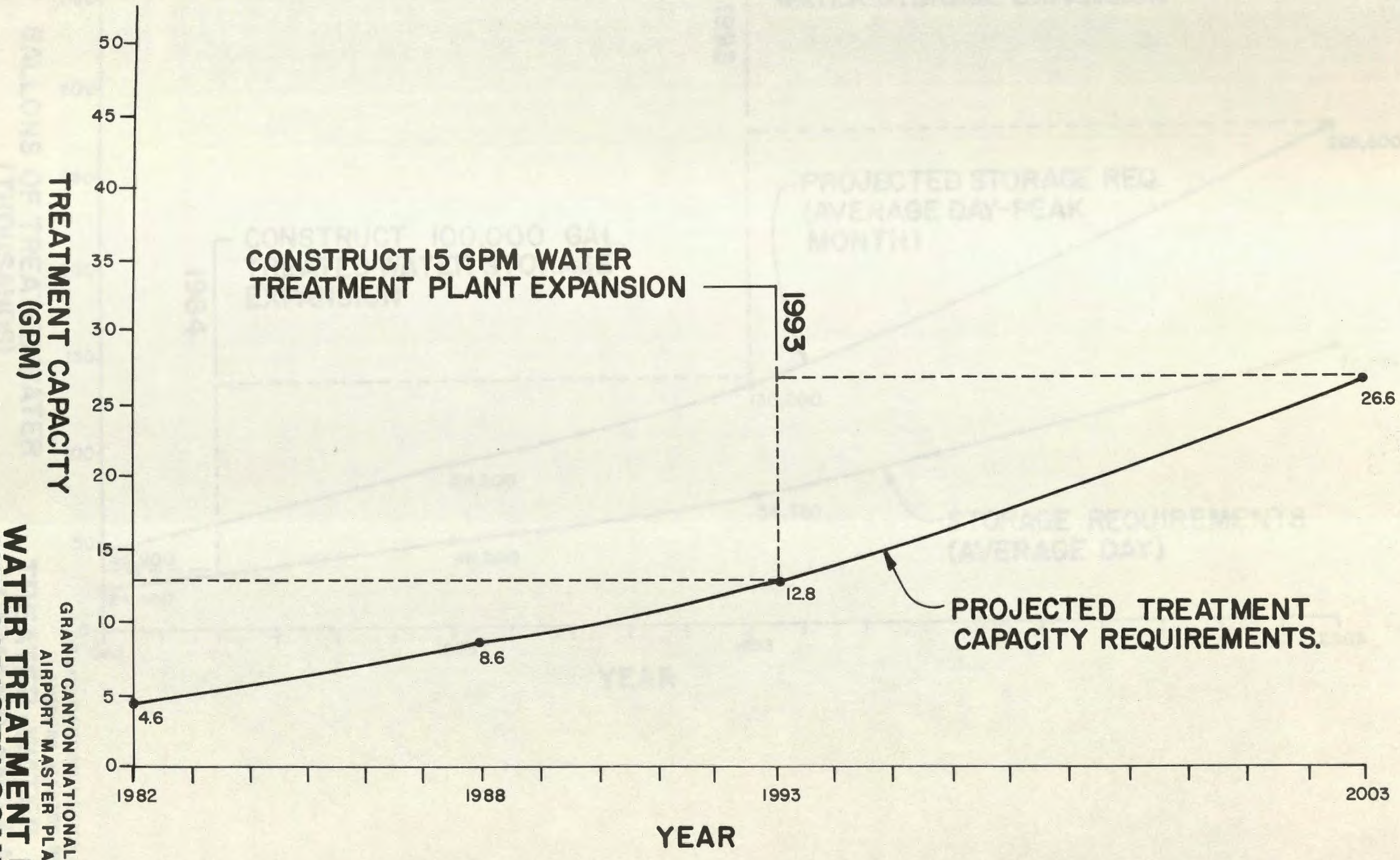



LEEDSHILL-HERKENHOFF, INC.

GRAND CANYON NATIONAL PARK AIRPORT MASTER PLAN

**RAW WATER STORAGE DEMAND AND CAPACITY COMPARISON**

FIGURE IV-18



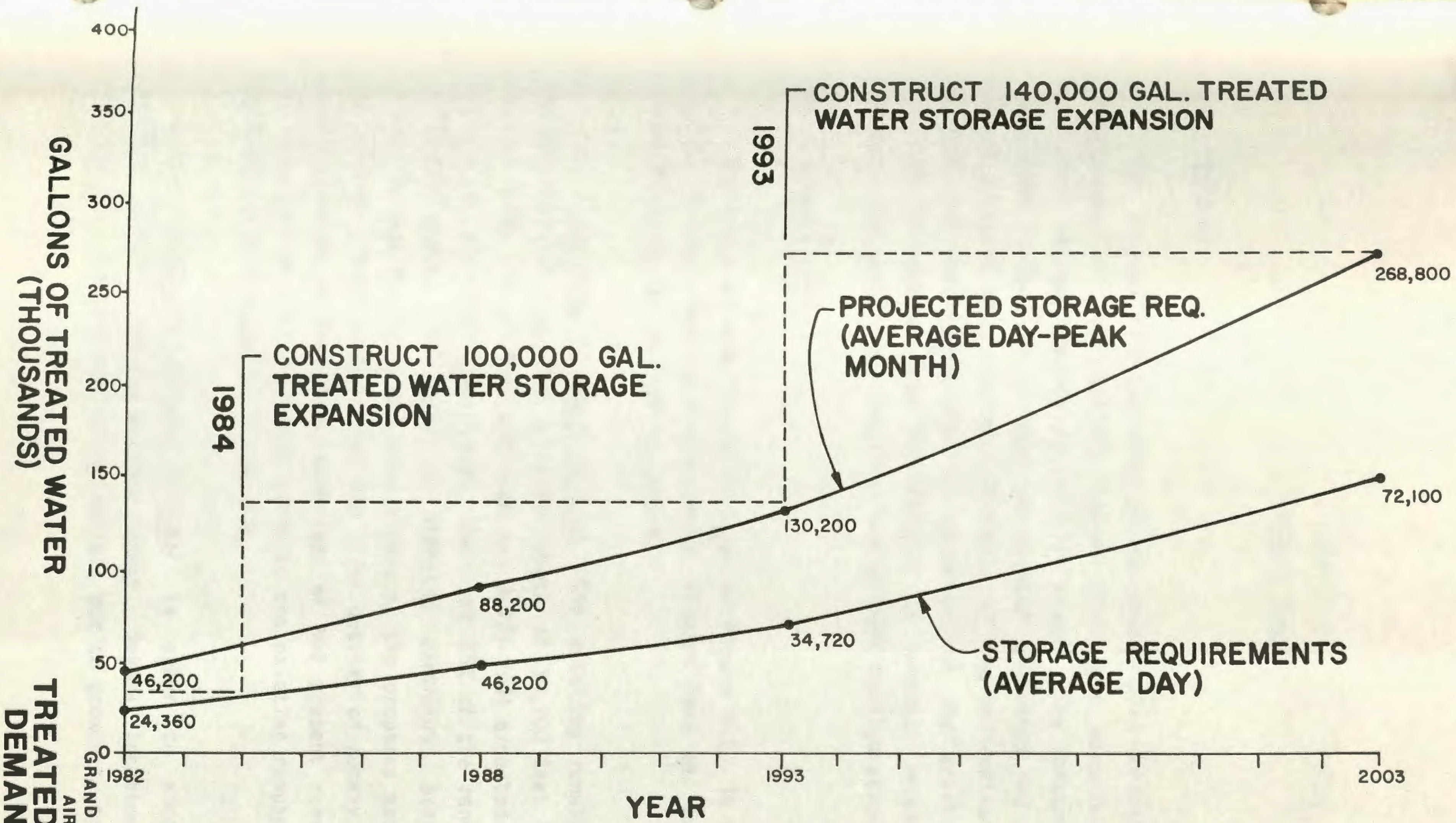

GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN

**WATER TREATMENT DEMAND AND CAPACITY COMPARISON**

FIGURE IV -19

LEEDSHILL-HERKENHOFF, INC.

LEEDSHILL-HERKENHOFF, INC.




GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN

**TREATED WATER STORAGE DEMAND AND CAPACITY COMPARISON**

FIGURE IV-20

# CHAPTER V

## AIRPORT PLANS

A. GENERAL:

The Airport Plans portion of the master plan consists primarily of the development of the Airport Layout Plan and associated terminal area, airspace, access grading and utility plans. The concepts and requirements developed in Chapter IV will be further evaluated and the feasibility of those concepts demonstrated. The bulk of the information developed in this portion of the master plan is contained on the drawings. Text will be limited to changes from the Chapter IV concepts necessitated by further analysis and additional detail on the airport configuration.

B. AIRPORT LAYOUT:

The basic airport layout is shown on Figure V-1. It provides a workable layout of the airport using existing airport land and surrounding areas to accommodate projected traffic growth.

1. Existing Runway, 3R/21L: The existing runway 3R/21L, will be lengthened 1700 feet for a total length of 10,700 feet in order to accommodate large air carriers (DC-9-80 and B-727-200) expected to begin using the airport in the 1993 time frame. The last 25% of the runway should be at a constant grade. In order to minimize earthwork, both for the runway extension and for the associated airspace, the proposed extension is elevated to provide a zero gradient for the first quarter of Runway 3R. This requires reconstruction of the first 1000 feet of the present runway to elevate the end and provide a transitional curve to the existing runway slope. A profile of the runway is shown in Figure V-2.

2. Secondary Runway 3L/21R: In order to accommodate increased traffic, GCN will require another runway. Several location alternatives were considered. The most attractive option, due to proximity to existing

facilities and comparative earthwork and property acquisition requirements and environmental considerations, was to locate the secondary runway parallel to the existing runway on existing airport property. The first stage in the construction of the secondary runway is scheduled for the 1988-1993 period, 5700 feet will be constructed. The second stage (extension to 8000 feet) is scheduled for the 1993-2003 period. The runway will be located parallel to 3R/21L starting at the northwest end and ultimately extending 8000 feet southeast. This location provides easy access for users of the parallel runway to ramp and terminal areas and the existing FBO, all of which are located on the northwest half of the property. The runway will accommodate general utility aircraft. The runway has been shifted northwest from the location shown in Chapter IV to provide better access from and to the main terminal area at essentially no increased cost due to earthwork. A profile of the secondary runway is shown in Figure V-2.

3. <u>Heliport Location</u>: Various sites were evaluated for a heliport location. The site proposed in Chapter IV of the master plan proved to be unsuitable due to the gradient of the terrain. The conclusion was that the site between State Highway 64 and existing airport land just south of the existing property line is the best site. The property (approx. 89 acres) is part of Kaibab National Forest and will have to be acquired. The site includes a buffer area for noise protection and the possibility of needing extra space for heliport operations. This 89 acres also includes land for the future ATCT and relocation of maintenance and service buildings, water tanks, utilities and residences from existing airport land.

The site has many advantages. It satisfies necessary airspace and safety criteria; there is adequate distance between the helipad and the runways and the heliport will be controlled by the ATCT. The existing topography makes it easy to establish reasonable grades without significant earthwork, drainage is easily accomplished, and there is direct access from Highway 64. One terminal building (5000 square feet), one parking lot (35 cars) and 11,700 SY of ramp will satisfy 1988 demands. For 1993 and 2003, ramp expansion, one more terminal building and an extra parking lot is proposed.

4. Air Traffic Control Tower (ATCT): The new parcel of land required for the heliport provides a good site for the new Air Traffic Control Tower. It provides for good visibility of runways, taxiways, and taxilanes as well as heliport operations. Access will be provided from the heliport secondary access road.

The eye level elevation is increased from that shown in Chapter IV to 6710' to provide taxilane visibility beyond the proposed air carrier building necessary for control of air carrier backing operations from the loading docks. The higher eye level required necessitates the shifting of the ATCT to the south of the Chapter IV location or to the new parcel.

C. TERMINAL AREA LAYOUT:

The terminal area plan (Figure V-3) provides an overall view of the terminal area including air carrier, commuter, general aviation and helicopter ramps, terminals, access roads, auto parking areas, and sites reserved for utilities, residences, airport service facilities and commercial uses in the ultimate development scenario.

1. Aircraft Ramp Layout: Modifications to the existing ramp and ramp expansion projects are proposed. The modifications to the existing ramp are presented in Chapter IV, illustrated on Figure IV-14B. Immediate plans are for a ramp expansion 1400 feet long and 260 feet wide southwest of the existing air carrier ramp. To satisfy 1988 and ultimate demand further expansion will be necessary. A wide ramp situated north of the existing Forest Service Slurry Base is proposed. This provides for a compact terminal area with ramps and central terminal areas close in proximity. Wider ramps are also a more effective use of ramp area. The wider ramps are a modification of the concept in Chapter IV which proposed ramp space the whole length of the runway. The steep hillsides south of the slurry base can now be left undisturbed. In order to use the ramp effectively and safely, marked pedestrian walkways or finger terminals are designated on the ramp. The location of the walkways shown on plans is only conceptual. Commuter

airlines would lease portions of the ramp area and configure the area (locate walkways and terminals) to match their needs. Additional commuter ramp area would also be reserved for overflow parking and for parking of aircraft using the main terminal area for loading and unloading.

2. FBO/GA Facilities: The general aviation apron will also be expanded to meet future demand. The first expansion will be northeast of the existing ramp. Area for hangars and related facilities is available adjacent to the apron expansion. An FBO/GA expansion area is also reserved just northeast of the Forest Service Slurry Base. The area southwest of the Slurry Base is relatively narrow and is reserved for T-hangars and aviation related facilities (i.e. maintenance hangar).

3. Air Carrier Apron: The existing air carrier apron is expanded to accommodate larger aircraft, loading docks, gates and an area for auxiliary equipment. The terminal building expansion is located back from the ramp to allow space between the obstacle free zone of the taxilane and the terminal for perpendicular parking of the aircraft. Loading docks or gates provide safe access for passengers from terminal to aircraft. The ultimate development provides four gates and an extra area southwest of the gates for auxiliary equipment and overflow parking.

4. Access Roads: A new primary access road is proposed to access satellite terminals and future FBO/GA facilities directly. The road connects to the existing road east of the air carrier and main itinerant commuter terminal cluster thereby bypassing these facilities and associated traffic. Long term parking is accessible from the primary access road. A profile and typical section are shown on Figure V-4.

The existing access road is routed to pass in front of both the existing terminal (future itinerant terminal) and the future air carrier terminal. This road is one way beginning and ending at the intersections with the primary access road. Two secondary access roads are proposed. Northeast of the existing access road on highway 64 is a secondary road directly to general aviation and FBO facilities. This road can also be used for access to terminal areas. South of the existing access road on highway 64 is the heliport access road for direct access to helicopter facilities. This road also provides access to the ATCT and proposed location for residences, maintenance and service buildings and utilities. This road also connects with the proposed primary access road.

5. Terminal Buildings: The existing terminal building at GCN is aesthetically suited to its location in the middle of National Forest Land. Care should be taken in the architecture of future buildings so they are also suited to the setting. Location of all buildings in the layout plan is conceptual. Exact locations will be determined in final design. Location of satellite terminals will probably be determined by leasing airlines. Central terminals will house major airline and car rental offices and concessions. Satellite terminals should be designed to handle tour group needs and shuttle buses will provide direct connections between satellites and central terminals.

The proposed air carrier terminal is shifted up the hillside to provide more ramp space for larger aircraft and gates or loading docks. Because of moving up the hillside, the building's floor is approximately 8 feet higher than the ramp elevation, thereby providing direct level access to air carrier doors through loading docks. Available space at ramp elevation under the terminal could be used to store service vehicles and equipment. The connection between the existing terminal and the proposed air carrier terminal could be made into a lounge with a viewing area. Further details for final design should conform to AC 150/5360-7, planning and design considerations for airport terminal building development.

6. Auto Parking: Auto, van, and bus parking is available at all terminals and at FBO sites. Parking lots should be laid out in final design, taking into account the aesthetics of the area, topography and forested areas. Irregular shaped parking clusters separated by forested or landscaped dividers provide the opportunity to fit parking into the hillside terrain and avoid a "shopping center" appearance. Figure V-5 shows a perspective of the future parking.

7. Operations Characteristics:

a. Air Carrier Terminal: Passengers arriving and departing on Air Carriers will use parking and ramp facilities adjacent to the new air carrier addition to the present terminal. An unloading zone and short term parking will be available directly in front of the terminal. Long term parking for buses, cars, vans, and rental cars will be located across the road and is accessible directly from the one-way terminal loop.

b. Itinerant Commuter Terminal: The existing terminal is planned for conversion into an itinerant commuter terminal primarily for use by occasional or smaller commuters. Aircraft loading areas are available immediately in front of the terminal but parking will be on the Itinerant Ramp. Passenger access is essentially the same as the air carrier terminal.

c. Satellite Terminals: Terminal and adjacent aircraft ramp to be leased by individual commuter airlines (or consortiums) for exclusive use. Direct access from Arizona 64 is available using the primary access road, by passing the main terminal area. Circulation between the main terminal complex and the satellite terminals for passengers having business at the main terminal (such as car rental) will be provided by shuttle buses.

d. Heliport: Ground access is available directly from Highway 64 and secondary access to the main terminal and satellite terminal areas is available with shuttle bus service possible.

e. FBO/GA Facilities: Existing FBO/GA areas will be accessible directly from Highway 64 as well as the primary access road. The FBO/GA expansion area southwest of the itinerant ramp will be accessible from the primary access road which also connects to the Forest Service primary road.

8. Development Phases: The various forecasted development phases at GCN are illustrated in Figure V-2 and listed in Table V-1. The commuter ramp is developed to maximize the use of flatter areas, first and only expand into

## TABLE V-1

### Airfield Facility Development Summary

| Item Description | Existing Facility | 1988 | 1993 | 2003 |
|---|---|---|---|---|
| Runway | 3/21 9,000'x 150' | N/C | 3R/21L 10,700'x 150'<br>3L/21R 5,700'x 75' | 3R/21L 10,700'x 150'<br>3L/21R 8,000'x 75' |
| Ramp Area (SY) | | | | |
| Air Carrier | 3,000 | 8,000 | 8,000 | 16,000 |
| Itinerant Com. | 13,250 | 58,560 | 81,060 | 128,760 |
| Based Com. & GA | 19,500 | 31,900 | 43,960 | 58,760 |
| Helicopter | --- | 11,700 | 13,400 | 18,400 |
| Terminal Area (SF) | | | | |
| Air Carrier | 4,700 | 15,000 | 30,000 | 50,000 |
| Itinerant Com. | 4,831 | 13,000 | 19,000 | 36,000 |
| Based Com. & GA | 8,384 | 8,384 | 9,600 | 16,000 |
| Helicopter | --- | 4,800 | 6,200 | 10,000 |
| Auto Parking (# of vehicles) | | | | |
| Air Carrier | 21 car/van<br>4 bus | 28 car/van<br>6 bus | 66 car/van<br>14 bus | 171 car/van<br>35 bus |
| Itinerant | 15 car/van<br>3 bus | 36 car/van<br>7 bus | 54 car/van<br>11 bus | 102 car/van<br>21 bus |
| Based Com. & GA | 31 car/van<br>2 bus | 34 car/van<br>2 bus | 45 car/van<br>2 bus | 78 car/van<br>2 bus |
| Helicopter | -- | 34 car | 44 car | 80 car |
| Employees | 18 car/van | 30 car/van | 54 car/van | 110 car/van |
| Rentals | 13 car | 17 car | 29 car | 63 car |

the more expensive earthwork areas in later phases when the need is established. The temporary road on the edge of the proposed 1984 ramp will be replaced in the long run by the primary access road bordering the edge of the proposed 500 foot wide ramp. Satellite terminals can be constructed as needed; a terminal constructed on the edge of the 84 Ramp could be accessed from the ultimate primary access road with a long entrance drive through ramp area.

The air carrier, helicopter, and general aviation ramps, as well as terminals, auto parking and access road can be developed by phases to meet forecasted demand as shown in Figure V-2.

## D. AIRSPACE AND CLEAR ZONE

Airspace and clear zone criteria as defined by F.A.R. Part 77 are shown on Figure IV-1. Runway 3R is presently a precision instrument runway and 21L is a non-precision instrument runway. This is the recommended ultimate designation as well. Runway 3L/21R is planned for a visual runway.

The Approach and Clear Zone Plan is shown on Figure V-6 for the ultimate airport configuration with the present approach surface shown in profile for Runway 3R. The major change is the lengthening of 3R/21L to the southwest by 1700 feet. The runway is elevated as much as feasible to balance earthwork and minimize excavation, but the 50:1 approach surface still requires some excavation to clear the rising terrain immediately south of the extended runway centerline. The parallel secondary runway also requires excavation along most of the runway to provide clearance of the 7:1 lateral transitional surface.

The only man-made obstruction of record is the lighted antenna in the approach zone for Runway 21L. The National Ocean Survey has surveyed the site and published on Obstruction Chart for GCN (OC 5381) in conjunction with the installation and commissioning of the ILS. This chart is reproduced as Figure IV-10 and also as shown affected by the proposed improvements as Figure IV-11. Tree obstructions on the airport property are to be removed by

ADOT under an existing project. Terrain obstructions along the primary runway identified on this chart are areas of slight penetration of the primary surface but are not major obstacles. These areas should be regraded at the earliest opportunity (i.e. during the next major construction contract). The extent of tree penetrations of the Runway 3R approach surface after extension is not known, however, it is expected to be significant due to the rising natural ground. The proposed property line encompasses the property under the approach surfaces until the surfaces clear natural terrain by at least 50' for primary surfaces and 35' for lateral surfaces. This should allow airport control of most vegetative obstructions.

E. SPECIAL PLANS LAYOUTS

1. Site Grading and Drainage: A generalized site grading and drainage layout is shown on Figure V-7. Areas of significant excavation and embankment associated with the future development projects are designated on the layout. It is estimated that a surplus of approximately 2.065 million cubic yards will be remaining for waste upon completion of all phases of construction as shown in Table V-2.

TABLE V-2
Estimated Earthwork

| Construction Project | Total Excavation (CY) | Total Embankment or Fill (CY) |
|---|---|---|
| 1. Rain Tank Relocation | 33,000 | 33,000 |
| 2. Commuter Apron | 65,000 | |
| 3. G.A. Apron Extension | 550,000 | |
| 4. Air Carrier Auto Parking | 45,000 | 45,000 |
| 5. Runway 3R/21L and Taxiway Extension and Raising | | 600,000 |
| 6. Runway 3L/21R and Taxiway | 1,800,000 | 175,000 |
| 7. SE Approach Surface Clearing | 500,000 | |
| 8. Misc. (Roadway) | 25,000 | 100,000 |
| Subtotal | 3,018,000 | 953,000 |
| Balance | 2,065,000 | |

The primary onsite area available for deposit of excess excavation is the area located at the southwest end of the runways to the boundary of the Airport site. The amount of excess excavation deposited in this area is controlled by the 50:1 approach surface to Runway 3R and drainage considerations. Considering these two factors, it is estimated that the area can hold up to 1.5 million cubic yards of the excess excavation. Therefore, prior to construction of the parallel Runway 3L/21R, offsite waste areas will be required for disposal of the estimated 565,000 cubic yards remaining.

The layout also indicates planned drainage patterns with estimated runoff quantities anticipated at completion of development projects. Airfield drainage facilities shown on the layout (e.g. drainage culverts) were sized based on the 5 year storm event in accordance with FAA criteria. Drainage facilities off of the air field (e.g. access road culvert and pipe culverts) were sized based on the 50 year event in accordance with Arizona Department of Transportation criteria for secondary systems.

2. Site Water System: The basic water system layout is shown on Figure V-8. It provides a workable layout for continuation of the existing water conservation concept by providing one system for delivery of potable water and one system for delivery of raw water for non-consumptive uses such as fire protection. The raw water system is configured so as to maximize the use of gravity to provide required pressures at points of use. Potable water is provided through hydropneumatic pressure systems.

The layout provides for a central water utility plant located on the new parcel of land between the proposed ATCT and heliport sites. This specific location was determined based on (1) maximizing the height of an elevated tank while not penetrating the 7:1 transition surface and (2) not obstructing the ATCT visibility of airport facilities and heliport. The plant site serves as the location for all the new raw water storage as well as water works required for the heliport and ACTC which include treatment works, treated water storage, hydropneumatic pressure tank, relocated 125,000 gallon raw water storage, and relocated 1000 gpm fire pump.

Expansion of potable water facilities for other than the heliport and ACTC is proposed to be located in the vicinity of the existing plant to maximize the use of the existing 380,000 gallon underground raw water storage facility.

The layout shows the rehabilitation and expansion of the existing catchment basin located between Runway 3R/21L and the Taxiway. This new configuration will provide for a capacity of approximately 2 million gallons before water crosses the western most dike. To maximize catchment, the drop inlets are connected below grade and running to the relocated pump station at which point it is pumped to storage. Acquisition of the Rain Tank and its water rights is seen as advantageous and would eliminate the need for expansion of the catchment basin. If the acquisition occurs, a pump station would be located at the relocated south Rain Tank and raw water would be pumped, after primary treatment, to the new storage facilities through a transmission line.

The various forecasted development phases of the water system are listed in Tables V-3 and V-4.

TABLE V-3
Water System Project Summary

| Item Description | 1985 | 1988 | 1993 | 2003 |
|---|---|---|---|---|
| **Catchment Basin** | | | | |
| Reconfiguration and Rehabilitation of Existing Basin | 22,800 SY | -- | -- | -- |
| Expansion, Pump Station Relocation and Inlet Piping | 23,750 SY | -- | -- | -- |
| **Raw Water Storage** | | | | |
| Construct Elevated Storage | 1 MG | -- | -- | -- |
| Relocate Existing Tank | -- | 0.125 MG | -- | -- |
| Construct Ground Storage | -- | -- | 1.2 MG | -- |
| **Treatment Systems** | | | | |
| Heliport System | -- | 5 GPM | -- | -- |
| Expansion of Existing System | -- | -- | 15 GPM | -- |

TABLE V-3 (Cont'd.)

Water System Project Summary

| Item Description | 1985 | 1988 | 1993 | 2003 |
|---|---|---|---|---|
| Treated Water Storage | | | | |
| Expansion of Existing Storage | 100,000gals. | -- | 140,000gals | -- |
| Heliport Storage | -- | 30,000gals | -- | -- |
| Raw Water Transmission and Distribution | | | | |
| 12" Main | 2,300LF | -- | 1,000LF | 2,100LF |
| 10" Main | 540LF | -- | -- | -- |
| 8" Main | 1,700LF | 2,000LF | -- | 1,130LF |
| 6" Main | -- | 700LF(ACTC) | 650LF | -- |
| Potable Water Distribution | | | | |
| 4" Main (Terminal Areas) | 1,250LF | -- | 1,400LF | 2,200LF |
| 2" Main (Heliport Areas) | -- | 2,000 | -- | -- |

TABLE V-4

Water System Facility Summary

| Item Description | Existing Facility | 1985 | 1988 | 1993 | 2003 |
|---|---|---|---|---|---|
| Raw Water Catchment (SY) | 22,800 | 46,550 | 46,550 | 46,550 | 46,550 |
| Raw Water Storage (Gal) | 511,000 | 1,511,000 | 1,511,000 | 2,711,000 | 2,711,000 |
| Treatment Systems (GPM) | 13 | 13 | 18 | 33 | 33 |
| Treated Storage (Gal) | 30,000 | 130,000 | 160,000 | 300,000 | 300,000 |

Fire protection and potable water distribution line extensions required for satellite terminal and apron expansions would be constructed as a part of the individual apron expansion projects. The layout shows the sizes necessary to provide the required quantities of fire flow and domestic water.

3. Site Utilities (Gas, Wastewater and Electric): Figure V-9 shows the layout for wastewater collection, gas and electric facilities. As facilities requiring wastewater collection are constructed southwest of the present terminal location, lift stations will be required to minimize depth of cuts and maintain appropriate grades to allow new wastewater collection mains to carry wastewater to the existing 8" outfall trunk main. Where shown under apron areas, collection mains should be constructed prior to apron construction to avoid pavement cuts, especially considering areas where greater depths are required. The configuration shown on the layout was determined based on a minimum depth of 4 feet at the high end of a section, and a minimum slope of 0.0033 feet per foot. Maximum cuts associated with a section were calculated to be 27.5 feet at the lift stations.

The layout shows a centrally located area designated for an electric substation with a new overhead distribution line from Arizona Public Services' existing 69KV transmission line.

## F. LAND USE:

1. Height Limitations: The Approach and Clear Zone Plan (Figure V-6) shows the airspace that must be protected in the existing and ultimate airport plans in order to provide for safe operations. The basis for height and hazard zoning is described in AC 150/5190-3, "Model Airport Zoning Ordinance". It is recommended that Coconino County amend the present zoning ordinance to include the height and hazard zoning.

2. Property Line: The proposed future property line encompasses the property under the ultimate airport approach surfaces until the surfaces clear natural terrain by at least 50 feet for primary surfaces and 35 feet for lateral surfaces. Under these guidelines the airport should have control of most vegetative obstructions. It is also proposed to acquire a parcel of land along highway 64 south of the existing access road. This land will be used for heliport operations, the new ATCT and relocation of water tanks and utilities, maintenance and service buildings and residences. The parcel

offers good terrain for all these facilities and an especially good site for heliport and ATCT as described in Section B, Airport layout Plan.

3. Noise Zoning: The noise environment created at GCN by airport operations is described in detail in the Environmental Review. It is recommended that Coconino County adopt a comprehensive zoning ordinance, which includes noise zoning and noise attenuation construction.

4. Land Use Plan: The location and configuration of the airport facilities were determined preliminarily in Chapter IV and in more detail in the airport plans section of Chapter V. Final choices are based on safety, cost, the environment and aesthetics of the area. While the responsibility for developing land uses within the boundaries of the airport lies with the airport owner developing land outside airport boundaries is the responsibility of governing bodies of all adjacent entities (Tusayan, Coconino County, Kaibab National Forest, and Grand Canyon National Park), in order to develop compatible land uses airport sponsors and the surrounding communities must work together to resolve noise, housing, transportation as well as other environmental problems.

a. Land Uses on the Airport: Land uses on airport property are designated on Figure V-1 Airport Layout Plan and V-3 Terminal Area Plan. Areas have been reserved for various facilities. A future fuel storage area is shown northeast of the extended GA apron. Relocation of the fuel facilities from under the runway 21 approach is necessary for safety reasons. In lieu of relocation, the above ground hydrant facilities could be relocated with the tanks remaining at the existing location. An area has been reserved for water tanks and utilities between the proposed ATCT and heliport sites. This area is within the noise contour and is therefore suited as a utility site as long as tanks do not create airspace height obstructions or obstruct viewing from the ATCT. All buildings within noise affected areas such as terminal buildings should contain sound attenuation. Residences should be located outside the LDN 65 contour. An area has been reserved for their relocation onto new land southwest of their existing location. In order to maintain the aesthetics of the area many areas should be kept in the natural existing landscaping, i.e., parking areas should be interspersed with natural vegetation.

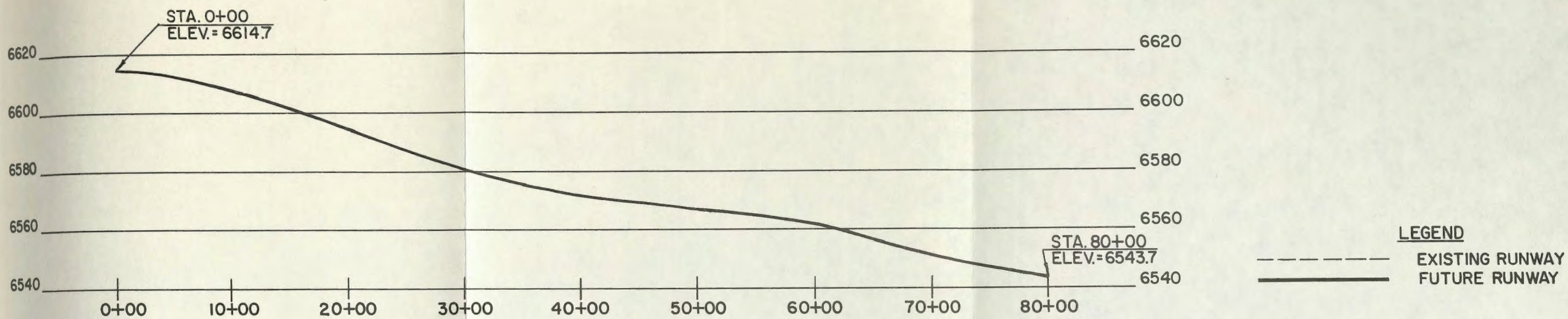
b. Land Uses Around the Airport: Coordination between the airport owner and Coconino County is important. The ultimate noise environment prediction for GCN is compatible with existing land uses. Future construction and development in the area should also be compatible, this can be assured by a comprehensive zoning ordinance.

[illegible] have space reserved for all these facilities and an especially good site [illegible] as described in Section B, Airport Layout Plan.

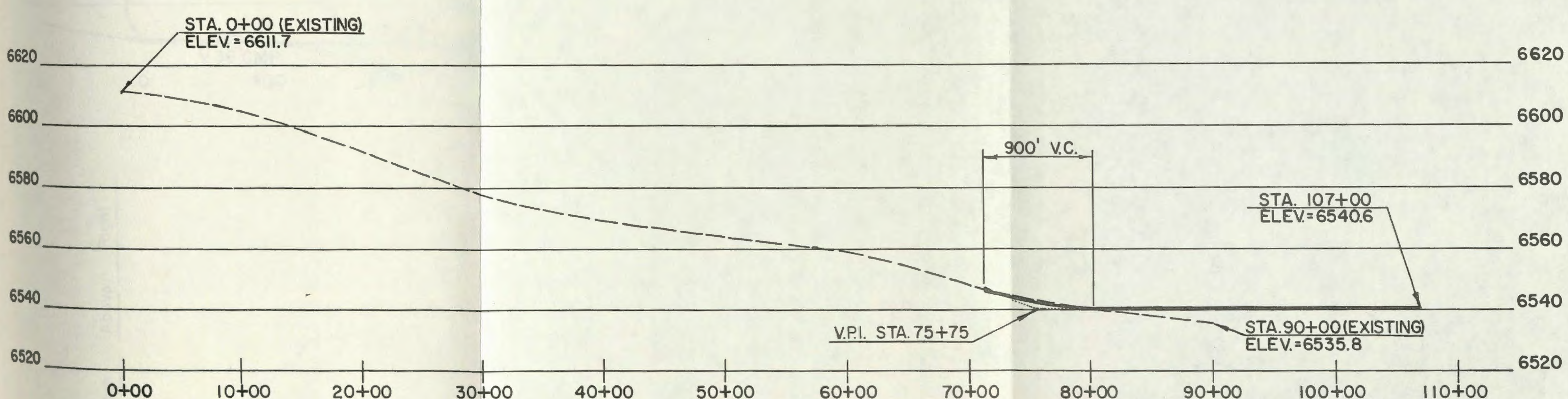
b. Noise Zoning. The noise environment created at GCN by air[illegible] [illegible] in detail in the Environmental Review. [illegible] Coconino County adopt a comprehensive zoning ordinance [illegible] zoning and noise attenuation construction.

c. Land Use Plan. The location and configuration of the air[illegible] [illegible] preliminarily in Chapter IV and in more detail [illegible] of Chapter V. Final choices are based on safe[illegible] [illegible] and aesthetics of the area. While the responsibi[illegible] [illegible] uses within the boundaries of the airport lies with [illegible] [illegible] land outside airport boundaries is [illegible] bodies of all adjacent entities (Tusa[illegible] [illegible] National Forest, and Grand Canyon National Park). [illegible] land uses airport sponsors and the surround[illegible] [illegible] together to resolve noise, housing, transportation [illegible] problems.

d. Land Uses on the Airport. Land uses on airport property [illegible] Airport Layout Plan and V-3 Terminal Area Pl[illegible] [illegible] various facilities. A future fuel storage a[illegible] [illegible] of the extended GA apron. Relocation of the fu[illegible] [illegible] the Runway 21 approach is necessary for safety reaso[illegible] [illegible] ground hydrant facilities could be relocat[illegible] [illegible] the existing location. An area has been reserv[illegible] [illegible] between the proposed ATCT and heliport site. [illegible] contour and is therefore suited as a utili[illegible] [illegible] airspace height obstructions or obstru[illegible] [illegible] All buildings within noise affected areas such [illegible] [illegible] sound attenuation. Residences should [illegible] [illegible] contour. An area has been reserved for the [illegible] [illegible] of their existing location. In order [illegible]




RUNWAY 3L/21R



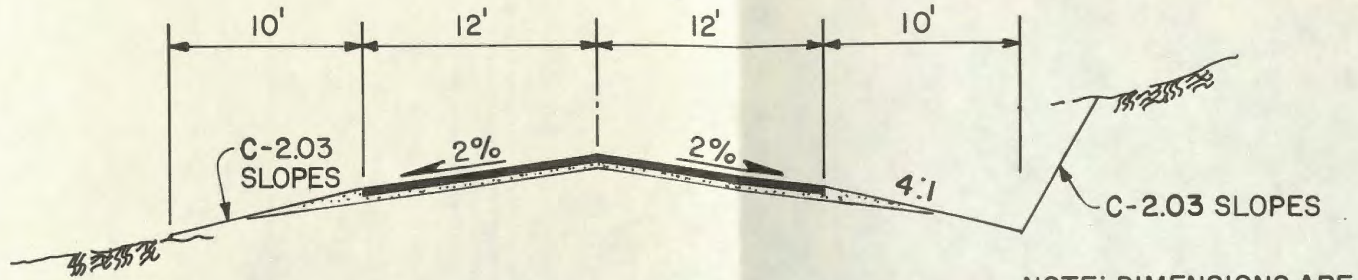

RUNWAY 3R/21L

LEEDSHILL-HERKENHOFF, INC.

**GRAND CANYON NATIONAL PARK**
**AIRPORT MASTER PLAN**

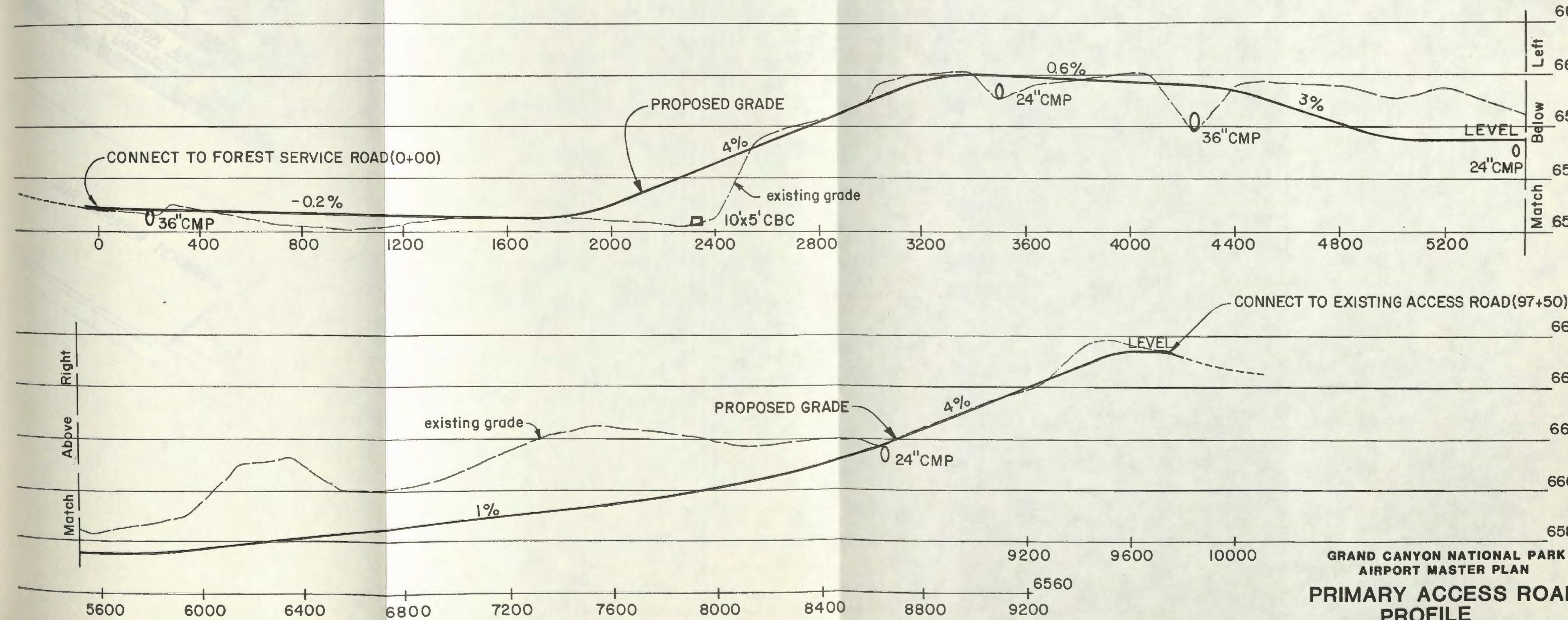
## RUNWAY PROFILES

**FIGURE V-2**




NOTE: DIMENSIONS ARE A MINIMUM.
CONSTRUCTION OF ROADWAY IN ACCORDANCE WITH A.D.O.T. CONSTRUCTION DETAIL STANDARD DRAWING C-2.03.

TYPICAL ROADWAY SECTION

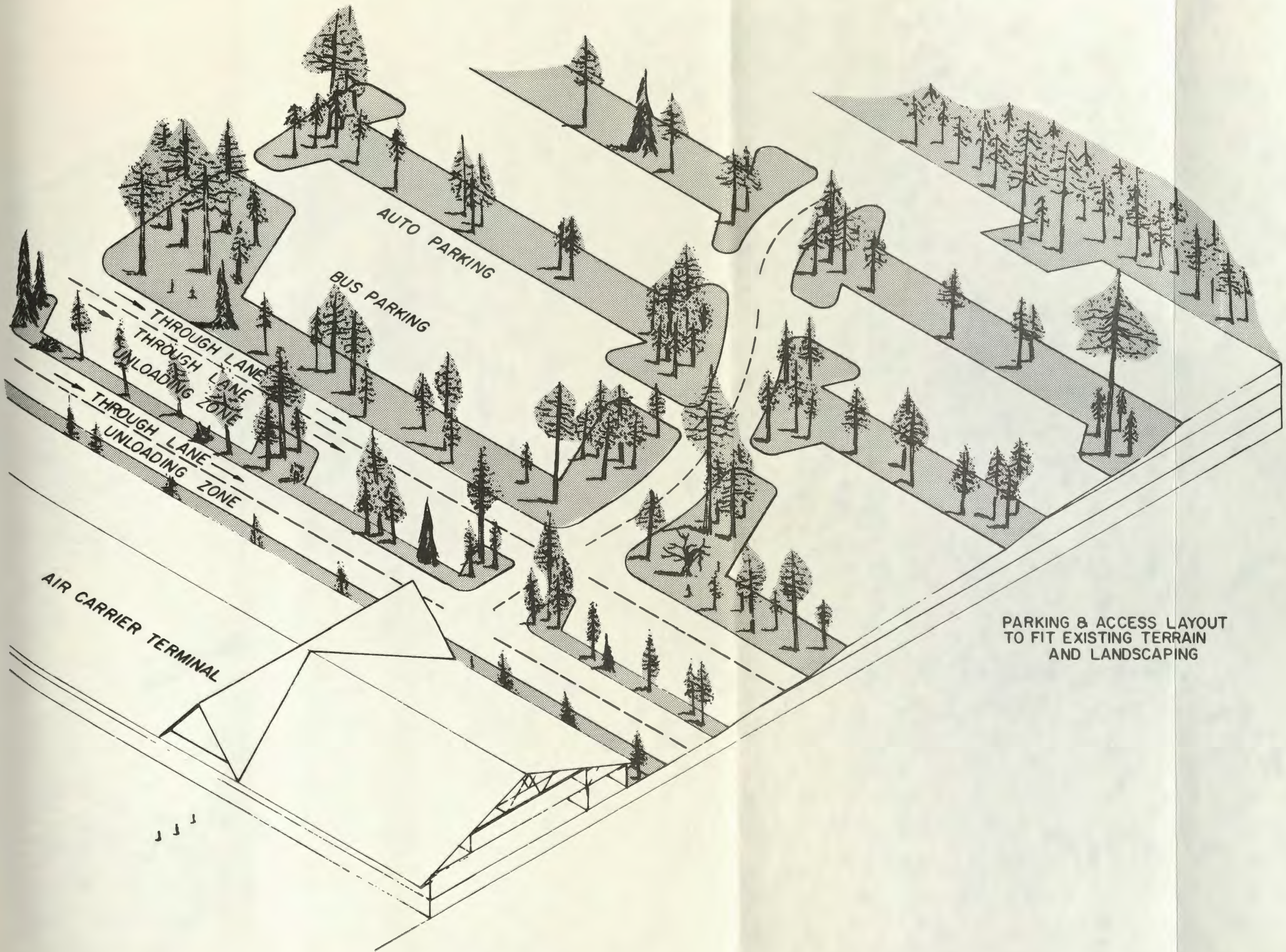



**GRAND CANYON NATIONAL PARK**
**AIRPORT MASTER PLAN**

**PRIMARY ACCESS ROAD PROFILE**

**FIGURE V-4**

LEEDSHILL-HERKENHOFF, INC.

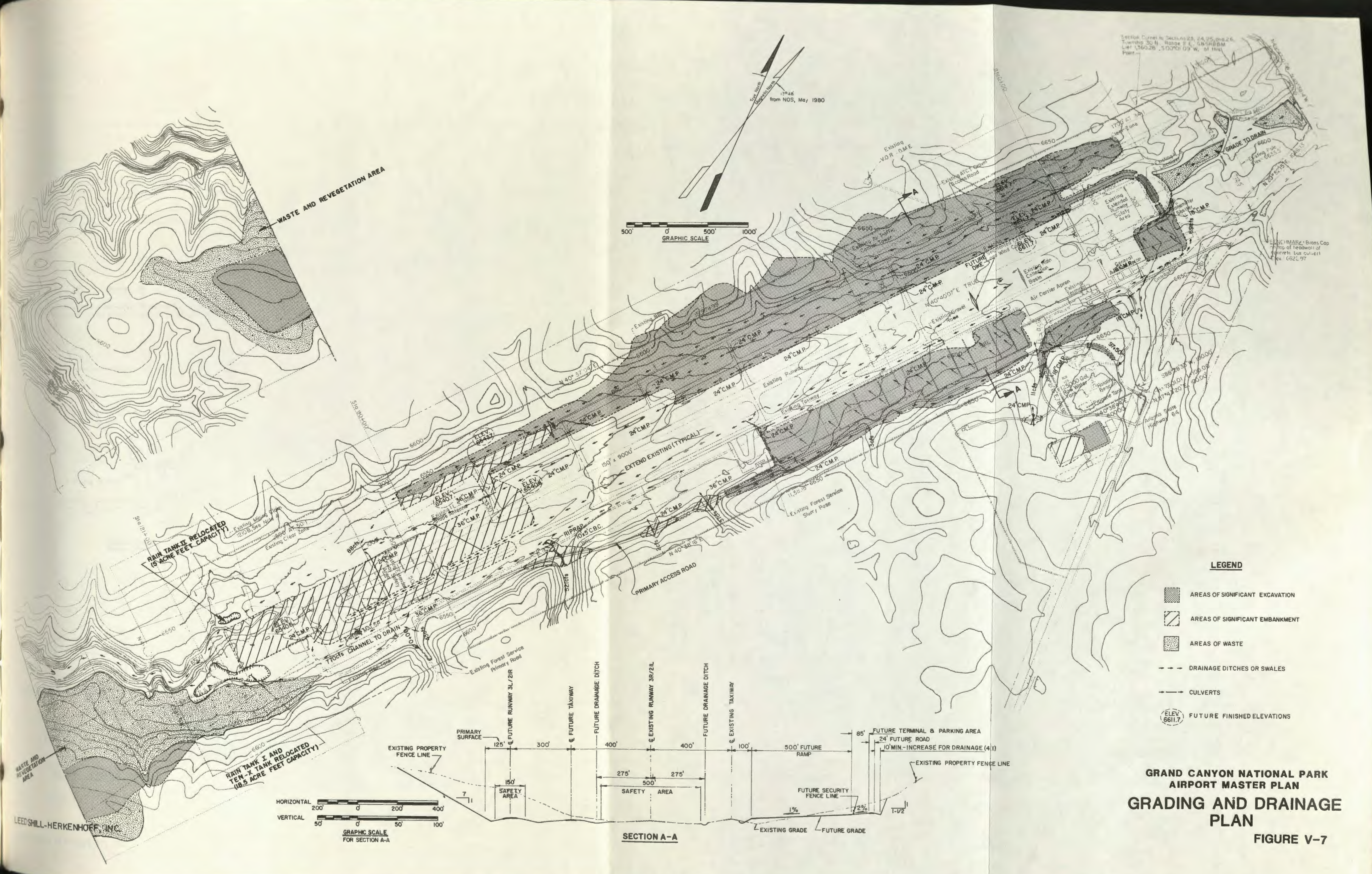



GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN

PERSPECTIVE OF TERMINAL BUILDING AND TERRACED PARKING

FIGURE V-5

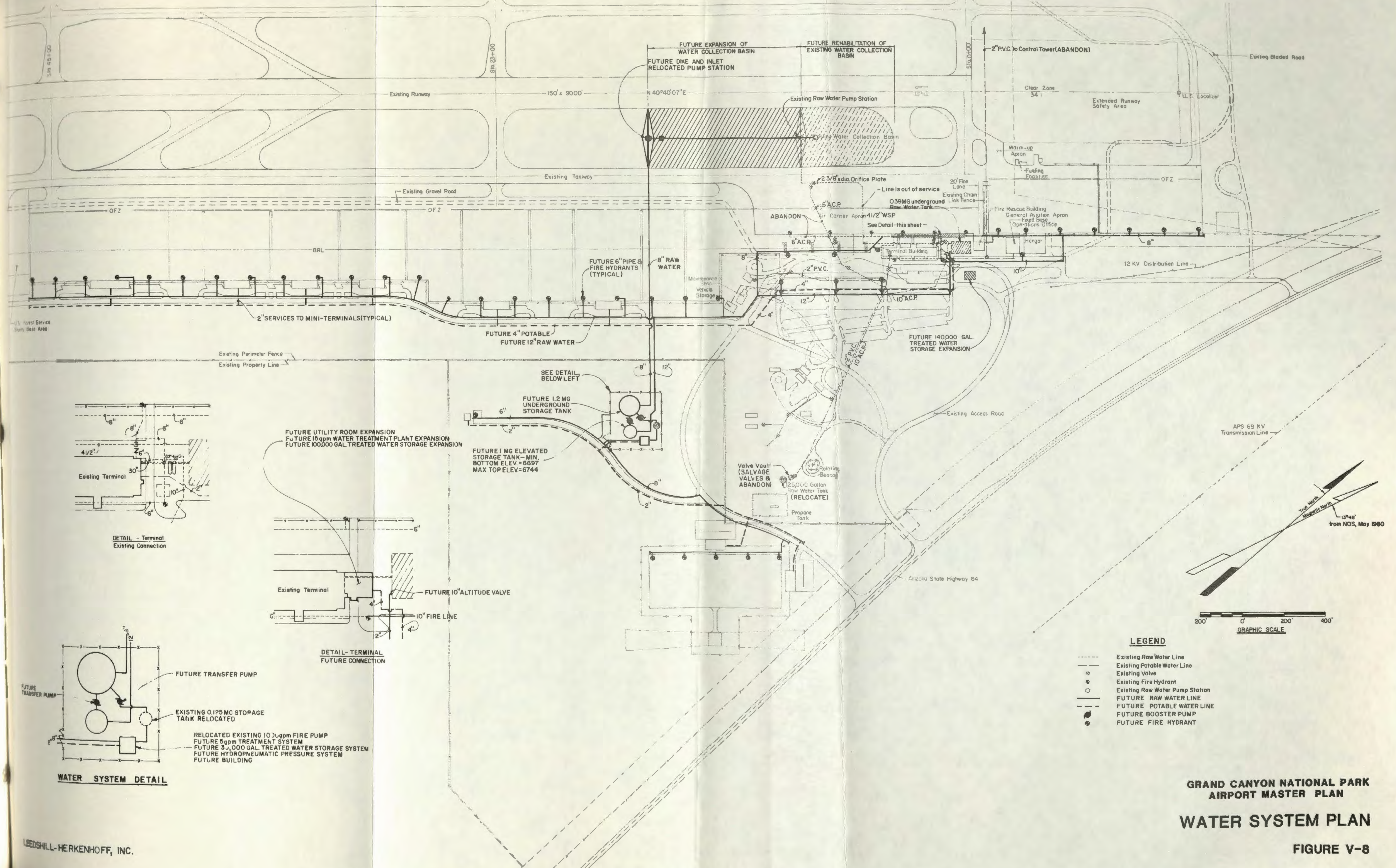
LEEDSHILL-HERKENHOFF, INC.




GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN

**GRADING AND DRAINAGE PLAN**

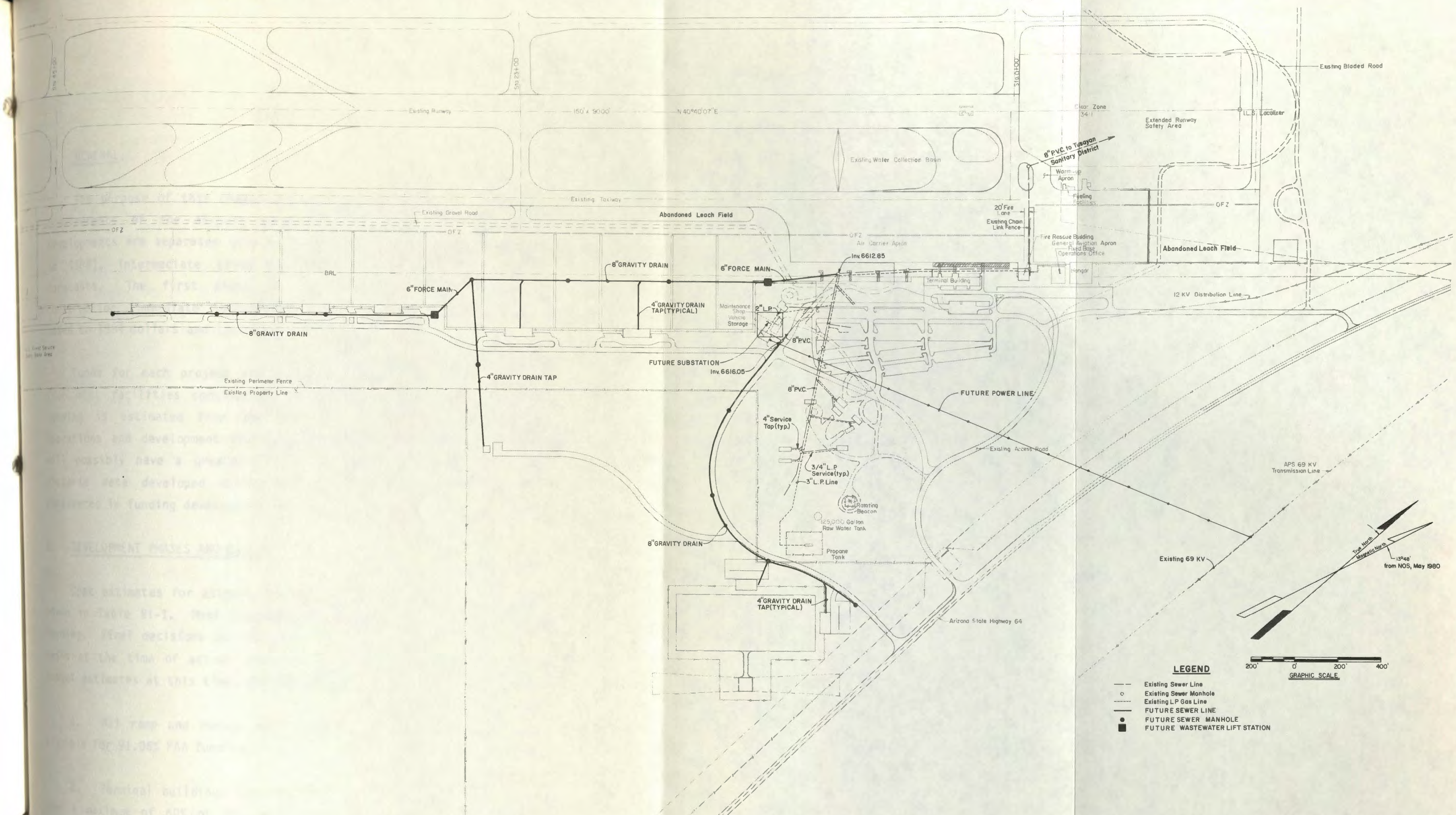
**FIGURE V-7**




GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN

WATER SYSTEM PLAN

FIGURE V-8




GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN

UTILITIES PLAN

FIGURE V-9

...HILL-HERKENHOFF, INC.

# CHAPTER VI
# FINANCIAL PLAN

## A. GENERAL:

The purpose of this chapter is to provide guidelines for the financial requirements of the airport developments outlined in the master plan. Developments are separated into 3 construction phases based on short (present to 1988), intermediate (1988 to 1993) and long range (1993 to 2003) forecasts. The first phase is further subdivided into 2 stages of construction (immediate 1984-1985 and longer term 1986-1988). Costs are based on 1984 dollars and include engineering and contingency fees.

Funds for each project are obtained from airport revenues, FAA grants (for most facilities constructed for public use) and local monies. FAA funding is estimated from the current 91.06% match rate. The airport operations and development are being leased to a private operator and this will possibly have a greater bearing on future funding and revenues than historic data developed during ADOT operations and must be ultimately considered in funding development for individual projects.

## B. DEVELOPMENT PHASES AND COSTS:

Cost estimates for airport developments outlined in the master plan are shown in Table VI-1. Most projects are eligible for varying amount of FAA funding. Final decisions on the amount of funding are made on an individual basis at the time of actual project funding. In order to make reasonable budget estimates at this time, several assumptions have been made:

1. All ramp and runway work as well as access road construction is eligible for 91.06% FAA funding.

2. Terminal buildings are only eligible for entitlement monies. Each year a maximum of 60% of the entitlement funds or $200,000, whichever is

larger, may be alloted. In addition only public areas of terminal buildings (baggage claim area, boarding areas, rest rooms, etc.) are eligible; revenue producing areas such as ticket counters and restaurant space are not eligible. The terminal funding assumed in Table VI-1 are based on 50% funding of 50% of the building space or 25%.

3. Auto parking is not eligible for any FAA funding.

4. Utilities may be eligible for FAA funding based on prorated public use. However, due to the terminal funding restrictions and usual low FAA priority, no FAA funds are utilized for utility development. This is the assumption used in developing Table VI-1.

5. Facilities required or relocated for safety reasons such as fuel storage and fire fighting equipment are assumed to be eligible for 91.06% FAA funding.

TABLE VI-1

SCHEDULES AND COST ESTIMATES OF PROPOSED DEVELOPMENTS

| Construction Period | Item | Units | Projected Size | Total Cost | FAA eligible 91.06% | Other Funds (Non FAA) |
|---|---|---|---|---|---|---|
| **Phase I** | | | | | | |
| 1984/1985 | Itinerant Commuter Ramp and Service Road | SY | 45000 | $3,463,900 | $3,154,227 | $309,673 |
| | Tree Obstruction Removal | LS | -- | $200,000 | $182,120 | $17,880 |
| | | | TOTAL | $3,663,900 | $3,336,347 | $327,553 |
| 1986/1988 | Helicopter Ramp, Taxiway and Landing Surface | SY | 12500 | $937,500 | $853,688 | $83,813 |
| | Heliport Terminal | SF | 5000 | $375,000 | $93,750 | $281,250 |
| | Heliport Auto Parking | SY | 1500 | $45,000 | $0 | $45,000 |
| | Access Road to Heliport and ATCT | LF | 2200 | $220,000 | $200,332 | $19,668 |
| | Relocate ATCT (100% FAA) | LS | 1 | $80,000 | $80,000 | $0 |
| | Air Carrier Ramp | SY | 4000 | $300,000 | $273,180 | $26,820 |
| | FBO/GA Apron Extension | SY | 18500 | $1,342,500 | $1,222,481 | $120,020 |
| | Itinerant Commuter Ramp | SY | 26700 | $1,968,500 | $1,792,516 | $175,984 |
| | Taxiway Overlay | | | -- | -- | -- |
| | Air Carrier Terminal | SF | 30000 | $2,250,000 | $562,500 | $1,687,500 |
| | Itinerant Commuter Terminal | SF | 3500 | $262,500 | $65,625 | $196,875 |
| | Existing Terminal Remodelling | SF | 9500 | $380,000 | $95,000 | $285,000 |
| | Auto Parking | SY | 6000 | $180,000 | $0 | $180,000 |
| | Secondary Access Road | LF | 1500 | $150,000 | $136,590 | $13,410 |
| | Terminal Road and Turnaround | LF | 1000 | $100,000 | $91,060 | $8,940 |
| | Relocate Fuel Farm | LS | 1 | $25,000 | $22,765 | $2,235 |
| | Elevated Raw Water Storage/System | GAL | 1000000 | $1,078,000 | $0 | $1,078,000 |
| | Treated Water Storage/System | GAL | 100000 | $58,000 | $0 | $58,000 |
| | Catchment Basin (Rehab,Reconfiguration/Expansion) | LS | 1 | $300,000 | $0 | $300,000 |
| | Heliport Water System | LS | 1 | $123,100 | $0 | $123,100 |
| | Sanitary Sewer System Expansion | LS | 1 | $428,000 | $0 | $428,000 |

TABLE VI-1 (CONT'D)

Phase II

| | | | | | | |
|---|---|---|---|---|---|---|
| 1988/1993 | Rwy 3R/21L Extension to 10,700' | SY | 47000 | $3,525,000 | $3,209,865 | $315,135 |
| | Stage 1 Rwy 3L/21R - 5700' | SY | 100000 | $13,000,000 | $11,837,800 | $1,162,200 |
| | Exit Taxiway Improvements | SY | 12000 | $900,000 | $819,540 | $80,460 |
| | Itinerant Commuter Ramp | SY | 29800 | $2,139,000 | $1,947,773 | $191,227 |
| | Helicopter Ramp Expansion | SY | 1700 | $127,500 | $116,102 | $11,399 |
| | Itinerant Commuter Terminal | SF | 6000 | $450,000 | $112,500 | $337,500 |
| | Auto Parking | SY | 7000 | $210,000 | $0 | $210,000 |
| | Primary Access Road and Connectors | LF | 13000 | $1,300,000 | $1,183,780 | $116,220 |
| | Water Treatment Facilities | GPM | 15 | $100,000 | $0 | $100,000 |
| | Treated Water Storage | GAL | 140000 | $70,000 | $0 | $70,000 |
| | Raw Water Storage | GAL | 1200000 | $420,000 | $0 | $420,000 |
| | Additional Fire Truck | LS | 1 | $330,000 | $300,498 | $29,502 |
| | Addition to Fire and Rescue Building | SF | 2000 | $150,000 | $136,590 | $13,410 |
| | | | TOTAL | $22,721,500 | $19,664,448 | $3,057,052 |

Phase III

| | | | | | | |
|---|---|---|---|---|---|---|
| 1993/2003 | Stage 2 Rwy 3L/21R - 2300' Extension | SY | 46000 | $5,930,000 | $5,399,858 | $530,142 |
| | Air Carrier Ramp | SY | 4000 | $300,000 | $273,180 | $26,820 |
| | Itinerant Commuter Ramp | SY | 37000 | $3,035,000 | $2,763,671 | $271,329 |
| | FBO/GA Apron | SY | 34000 | $2,370,000 | $2,158,122 | $211,878 |
| | Helicopter Ramp | SY | 5000 | $375,000 | $341,475 | $33,525 |
| | Air Carrier Terminal | SF | 20000 | $1,500,000 | $375,000 | $1,125,000 |
| | Itinerant Commuter Terminal | SF | 17000 | $1,275,000 | $318,750 | $956,250 |
| | Based Commuter Terminal | SF | 7600 | $570,000 | $142,500 | $427,500 |
| | Auto Parking | SY | 18000 | $540,000 | $0 | $540,000 |
| | Heliport Terminal | SF | 5000 | $375,000 | $93,750 | $281,250 |
| | Heliport Auto Parking | SY | 1800 | $54,000 | $49,172 | $4,828 |
| | | | TOTAL | $16,324,000 | $11,915,478 | $4,408,522 |

# APPENDICES

TABLE VI-[illegible] (Cont'd)

| | | | | | | |
|---|---|---|---|---|---|---|
| Phase II | | | | | | |
| 1988/1993 | Rwy 30/11L Extension to 10,200' | SY | 41900 | [illegible] | [illegible] | [illegible] |
| | Stage 1 Rwy 31/21R - 5700' | SY | 186000 | [illegible] | [illegible] | [illegible] |
| | Exit Taxiway Improvements | SY | 12800 | [illegible] | $609,440 | [illegible] |
| | Itinerant Commuter Ramp | SY | 28000 | [illegible] | [illegible] | [illegible] |
| | Helicopter Ramp Expansion | SY | [illegible] | [illegible] | [illegible] | [illegible] |
| | Itinerant Commuter Terminal | SF | 6000 | [illegible] | [illegible] | $337,500 |
| | Auto Parking | SY | 7000 | [illegible] | $0 | $210,000 |
| | Primary Access Road and Connectors | SY | 40000 | [illegible] | $1,183,780 | [illegible] |
| | Water Treatment Facilities | GPD | [illegible] | $100,000 | $0 | $100,000 |
| | Treated Water Storage | GAL | 1400000 | $70,000 | $0 | $70,000 |
| | Raw Water Storage | GAL | 12000000 | $420,000 | $0 | $420,000 |
| | Additional Fire Truck | EA | 1 | $330,000 | $300,498 | $29,502 |
| | Addition to Fire and Rescue Building | SF | 2000 | $150,000 | $136,590 | $13,410 |
| | | | TOTAL | $22,781,500 | $19,684,448 | $3,097,052 |
| Phase III | | | | | | |
| 1993/2003 | Stage 2 Rwy 31/21R - 2300' Extension | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | Air Carrier Ramp | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | Itinerant Commuter Ramp | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | FBO/GA Apron | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | Helicopter Ramp | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | Air Carrier Terminal | SF | [illegible] | [illegible] | [illegible] | [illegible] |
| | Itinerant Commuter Terminal | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | Based Commuter Terminal | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | Auto Parking | SY | 18000 | $540,000 | $0 | $540,000 |
| | Heliport Terminal | SF | 5000 | $375,000 | $93,750 | $281,250 |
| | Heliport Auto Parking | SY | 1800 | $54,000 | $49,172 | $4,828 |
| | | | TOTAL | $16,384,000 | $11,915,478 | $4,468,522 |

# APPENDIX A

# GLOSSARY OF ACRONYMS AND ABBREVIATIONS

APPENDIX A

## GLOSSARY OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| A/C | Aircraft |
| ADAP | Airport Development Aid Program (Federal) |
| ADOT | Arizona Department of Transportation |
| AIP | Airport and Airway Improvement Program (Federal) |
| ATC | Air Traffic Control |
| ATCO | Air Taxi - Commercial |
| ATCT | Air Traffic Control Tower |
| AT | Air Taxi |
| BRL | Building Restriction Line |
| CAC | Commuter Air Carrier |
| CFR | Crash, Fire and Rescue |
| CPI | Consumer Price Index |
| CRAC | Certificated Route Air Carrier |
| DME | Distance Measuring Equipment |
| EPNdB | Effective Perceived Noise in Decibels |
| FAA | Federal Aviation Administration, U.S. Department of Transporation |
| FAF | Final Approach Fix |
| FBO | Fixed Base Operator |
| FPI | Fuel Price Index |
| FSS | Flight Service Station |
| GA | General Aviation |
| GCN | FAA Identifier for Grand Canyon National Park Airport |
| GCNP | Grand Canyon National Park |
| GNP | Gross National Product |
| GS | Glide Slope |
| HIRL | High Intensity Runway Lights |
| IFR | Instrument Flight Rules |
| ILS | Instrument Landing System |
| LDIN | Lead-In Lighting System |
| Ldn | Day-Night Average Sound Level |
| MALSR | Medium Intensity Approach Light System with Runway Alignment Indicator Lights |
| MIRL | Medium Intensity Runway Lights |
| MITL | Medium Intensity Taxiway Lights |
| MSL | Mean Sea Level |

## GLOSSARY OF ACRONYMS AND ABBREVATIONS (cont'd.)

| | |
|---|---|
| NAVAIDS | Terminal Navigational Aids |
| NEF | Noise Exposure Forecast |
| OM | Outer Marker |
| PANCAP | Practical Annual Capacity |
| PAX | Passengers |
| RAIL | Runway Alignment Indicator Lights |
| REIL | Runway End Identifier Light |
| RNAV | Area Navigation |
| RVR | Runway Visual Range |
| SID | Standard Instrument Departures |
| STAR | Standard Terminal Arrival Routes |
| STOL | Short Take-Off and Landing |
| T9S | Scheduled Charter Carrier |
| TCA | Terminal Control Areas |
| TDZ/CL | Touchdown Zone, Exit and Centerline Lighting |
| TERPS | Terminal Instrument Procedures |
| TRACON | Terminal Radar Approach Control |
| VASI | Visual Approach Slope Indicator |
| VFR | Visual Flight Rules |
| VORTAC | Very High Frequency Omnirange Tactical Air Navigation |

# APPENDIX B

# BIBLIOGRAPHY

## APPENDIX B

## BIBLIOGRAPHY

Aerospace Medical Research Laboratory, Nov 1974
Community Noise Exposure from Aircraft Operations: Technical Review: AD/A-004-822.

Arizona Department of Transportation, 1980
Arizona State Airport System Plan - Technical Supplement, Vols. 1 and 2.

Arizona Department of Transportation, 1984
Request for proposals for the lease, operation and continued development of the Grand Canyon National Park Airport: Phoenix, Arizona.

Boeing Commercial Airplan Company, 1973
Boeing 737 Airplane Characteristics - Airport Planning.

Boeing Commercial Airplane Company, 1978
Boeing 727 Airplane Characteristics - Airport Planning.

Bui, X.T., 1982
Executive planning with basic: Sybex, Inc., Berkeley, California, p. 79-115.

DeHavilland Aircraft of Canada, Ltd. 1980
Dash 7 Aircraft Characteristics for Airport Planning: PSM 1-7-13, Issue 4.

DeHavilland Aircraft of Canada, Ltd. 1978
DHC-6 Twin Otter Series 300 Performance Data: AEROC 6.2.G.6-1, Issue 10.

Douglas Aircraft Company, 1978
DC-9 Airplane Characteristics - Airport Planning.

Freund, J.E., 1973
Modern elementary statistics, 4th ed.: Prentice-Hall, Inc., Englewood, Cliffs, N.J., P. 406-408, 420-426.

Las Vegas Convention Visitors Authority, 1975-1983
Las Vegas Visitor Profile Study - Annual.

Machlis, G.E., and Wenderoth, E.L., 1982
Foreign visitors at Grand Canyon National Park, a preliminary study: Cooperative National Park Studies Unit, University of Idaho, Moscow, Idaho.

National Park Service/University of Arizona, Oct 1982
Cooperative National Park Resources Studies Unit, Special Report No. 3 - Grand Canyon National Park Social Sciences Research Program.

National Recreation and Parks Association, 1982
Parks Service puts emphasis on tourism: Dateline: NRPA, V.5, No. 1, p.1-4.

Shaw, W.W., Carpenter, E., Danial, T., King, D.A., Neinaber, J., Saarinen, T., Underhill, A.H., and Zube, E.H., 1982
Grand Canyon National Park social sciences research program: Cooperative National Park Service, Univeristy of Arizona, Tucson, Special Report No. 3, 16p.

U.S. Congress, Congressional Budget Office, 1983
The outlook for economic recovery: A report to the SEnate and House Committees on the budget - Part I, 115p.

U.S. Congress, Congressional Budget Office, 1983
Baseline budget projections for fiscal years 1984-1988: A report to the Senate and House Committees on the budget - Part II, 126p.

U.S. Congress, Congressional Budget Office, 1983
Reducing the deficit, spending and revenue options: A report to the Senate and House Committees on the budget - Part III, 355p.

U.S. Congress, Congressional Budget Office, 1983
Statictical abstract of the United States, 103rd ed.: U.S. Government Printing Office, Washington, D.C., p. 240-241, 886-887.

U.S. Department of Commerce, U.S. Travel Service, 1978
Identify travel markets, research methodologies: Belden Associates, Dallas, Tex., 109p.

U.S. Department of Energy, Energy Information Administration, 1983
Monthly energy review: Washington, D.C., p. 84-85.

U.S. Department of Interior, National Park Service, 1976
Grand Canyon National Park final master plan: U.S. Government Printing Office, Washington, D.C. 35p.

U.S. Department of Transportation, Federal Aviation Administration
Airport Capacity Criteria Used in Preparing the National Airport Plan: Advisory Circular No. 150/5060-1A.

U.S. Department of Transportation, Federal Aviation Administration, 1980
National Airport System Plan, Revised Statistics 1980-1989: U.S. Government Printing Office, Washington, D.C., 446p.

U.S. Department of Transportation, Federal Aviation Administration, 1983
FAA aviation forecasts, fiscal years 1983-1994: U.S. Government Printing Office, Washington, D.C., 72p.

U.S. Department of Transportation, Federal Aviation Administration, Apr 1965
Runway Length Requirements for Airport Design: AC 150/5325-4

U.S. Department of Transportation, Federal Aviation Administration, Aug 1977 Heliport Design Guide: Advisory Circular 150/5390-1B.

U.S. Department of Transportation, Federal Aviation Administration, Aug 1977 A model Zoning Ordinance to Limit Height of Objects Around Airports: Advisory Circular No. 150/5190-4.

U.S. Department of Transportation, Federal Aviation Administration, Aug 1983 Noise control and compatibility planning for airports: Advisory Circular No. 150/5020-1, 60p.

U.S. Department of Transportation, Federal Aviation Administration, Dec 1969 Airport Capacity Criteria Used in Long-range Planning: Advisory Circular No. 150/5060-3A, 25p.

U.S. Department of Transportation, Federal Aviation Administration, Dec 1983 Noise Assessment Guildelines for New Heliports: Advisory Circular 150/5020-2.

U.S. Department of Transportation, Federal Aviation Administration, Feb 1983 Airport Design Standards - Transport Airports: Advisory Circular 150/5300-12.

U.S. Department of Transportation, Federal Aviation Administration, Feb 1984 Area Equivalent Method on VISICALL: Report No. EE-848.

U.S. Department of Transportation, Federal Aviation Administration, Jan 1973 Aircraft Fire and Rescue Facilities and Extinguishing Agents: Advisory Circular 150/5210-6B.

U.S. Department of Transportation, Federal Aviation Administration, Jan 1975 Federal Aviation Regulations Part 77 - Objects Affecting Navigable Airspace.

U.S. Department of Transportation, Federal Aviation Administration, Jul 1975 Aircraft Data: Advisory Circular No. 150/5325-5B, 68p.

U.S. Department of Transportation, Federal Aviation Administration, Jul 1976 United States Standard for Terminal Instrument Procedures (TERPS).

U.S. Department of Transportation, Federal Aviation Administration, Jun 1975 Utility Airports - Air Access to National Transportation: Advisory Circular 150/5300-4B.

U.S. Department of Transportation, Federal Aviation Administration, Mar 1979 Airport Fire and Rescue Vehicle Specification Guide: Advisory Circular 150/5220-14.

U.S. Department of Transportation, Federal Aviation Administration, Mar 1980 Airport Design Standards - Site Requirements for Terminal Navigational Facilities: Advisory Circular 150/5300-2D.

U.S. Department of Transportation, Federal Aviation Administration, Mar 1983
Building for Storage and Maintenance of Airport Snow Removal and Ice Control Equipment: Advisory Circular 150/5220-15.

U.S. Department of Transportation, Federal Aviation Administration, May 1977
Impact of Noise on People.

U.S. Department of Transportation, Federal Aviation Administration, Nov 1982
Helicopter Noise Exposure Curves for use in Environmental Impact Assessment: Report No. FAA-EE-82-16.

U.S. Department of Transportation, Federal Aviation Administration, Oct 1974
Standards for Specifying Construction of Airports: Advisory Circular 150/5370-10.

U.S. Department of Transportation, Federal Aviation Administration, Oct 1976
Planning and Design Considerations for Airport Terminal Building Development: Advisory Circular 150/5360-7.

U.S. Department of Transportation, Federal Aviation Administration, Oct 1982
INM, integrated noise model, version 3, user's guide: CACI, Inc. - Federal, Arlington, V.A., 186p.

U.S. Department of Transportation, Federal Aviation Administration, Sept 1983
Airport Capacity and Delay: Advisory Circular No. 150/5060-5.

Underhill, A.H., and Fonken, A.H., 1983
International visitors to Grand Canyon National Park: national Park Service/University of Arizona, Tucson, Technical Report No. 12, 40p.

# APPENDIX C

# FAA ACIS DATABASE

# APPENDIX C
# FAA ACIS DATABASE

SOURCE: DOT/TSC CALENDAR '82 ACIS DATABASE    REPORT DATE: September 20, 1983

ENPLANEMENTS BY INDIVIDUAL CARRIERS FOR CALENDAR YEAR 1982 AT GCN/GRAND CANYON NATIONAL PARK, GRAND CANYON, AZ

| SCHEDULE TYPE | CARRIER CODE | CARRIER NAME | ENPLANEMENTS |
|---|---|---|---|
| ATCO | NV086 | SCENIC AIRLINES, INC. | 60,316 |
| ATCO | NV001 | AIR VEGAS. | 6,830 |
| ATCO | NV058 | VALKO EXECUTIVE AIR CHARTER. | 5,300 |
| ATCO | UF15 | AIR LOS ANGELES. | 532 |
| ATCO | UF11 | CANYON EXPRESS AIRLINE | 458 |
| ATCO | NV037 | DESERT SOUTHWEST | 371 |
| ATCO | CA442 | PACIFIC EXECUTIVE CHARTER. | 240 |
| ATCO | AZ043 | LAKE POWELL AIR SERVICE. | 22 |
| ATCO | CA481 | CHRYSLER AVIATION, INC. | 7 |
| ATCO | MO061 | OZARK SKYWAYS INC. | 7 |
| ATCO | CA407 | COMMANDAIR | 0 |
| ATCO | TOTAL | | 74,183 |
| CAC | HSZ | SCENIC AIRLINES INC. | 61,233 |
| CAC | ANE | AIR NEVADA AIRLINES, INC. | 18,201 |
| CAC | LVA | LAS VEGAS AIRLINES | 10,834 |
| CAC | SIA | SILVER STATE AIRLINES. | 3,602 |
| CAC | TOTAL | | 93,870 |
| CRAC | 02750 | REPUBLIC AIRLINES, INC. | 19,828 |
| CRAC | 06016 | AIR NEVADA AIRLINES, INC. | 12,767 |
| CRAC | 06075 | ASPEN AIRWAYS, INC. | 236 |
| CRAC | 06715 | GOLDEN WEST AIRLINES CO. | 0 |
| CRAC | TOTAL | | 32,831 |
| T9S | LW | AIR NEVADA AIRLINES, INC. | 4,378 |
| TOTAL FOR THIS AIRPORT | | | 205,262 |

SOURCE: DOT/TSC CALENDAR '81 ACIS DATABASE    REPORT DATE: September 20, 1983

ENPLANEMENTS BY INDIVIDUAL CARRIERS FOR CALENDAR YEAR 1981 AT
GCN/GRAND CANYON NATIONAL PARK, GRAND CANYON, AZ

| SCHEDULE TYPE | CARRIER CODE | NAME | ENPLANEMENTS |
|---|---|---|---|
| ATCO | AZ033 | GRAND CANYON AIRLINES INC. . . . . . . . . . . | 79,240 |
| ATCO | NV001 | AIR VEGAS. . . . . . . . . . . . . . . . . . . . | 8,575 |
| ATCO | NV064 | LAS VEGAS AIRLINES, INC. . . . . . . . . . . . | 4,140 |
| ATCO | AZ095 | MONARCH. . . . . . . . . . . . . . . . . . . . . | 1,316 |
| ATCO | NV085 | LAKE MEAD AIR , INC. . . . . . . . . . . . . . | 530 |
| ATCO | CA442 | PACIFIC EXECUTIVE CHARTER. . . . . . . . . . . | 324 |
| ATCO | CA428 | GREATER PACIFIC AIRWAYS INC. . . . . . . . . . | 220 |
| ATCO | CA329 | STEELE-BURNAND ASSOCIATES. . . . . . . . . . . | 20 |
| ATCO | CA440 | MCCARTHY AVIATION. . . . . . . . . . . . . . . | 6 |
| ATCO | TOTAL . . . . . . . . . . . . . . . . . . . . . . . . |  | 94,371 |
| CAC | HSZ | SCENIC AIRLINES, INC.(LAS VEGAS) . . . . . . . | 80,585 |
| CAC | SIA | SILVER STATE AIRLINES. . . . . . . . . . . . . | 16,823 |
| CAC | AFI | ARIZONA PACIFIC, INC. (AIRLINE). . . . . . . . | 1,816 |
| CAC | ATO | AIR TOURS (PACIFIC NATIONAL AIRWAYS) . . . . . | 624 |
| CAC | INA | INLAND EMPIRE AIRLINES, INC. . . . . . . . . . | 40 |
| CAC | TOTAL . . . . . . . . . . . . . . . . . . . . . . . . |  | 99,888 |
| CRAC | 02750 | REPUBLIC AIRLINES, INC.. . . . . . . . . . . . | 18,155 |
| CRAC | 06016 | AIR NEVADA . . . . . . . . . . . . . . . . . . | 12,262 |
| CRAC | 06075 | ASPEN AIRWAYS, INC.. . . . . . . . . . . . . . | 873 |
| CRAC | 07030 | COCHISE. . . . . . . . . . . . . . . . . . . . | 175 |
| CRAC | 01930 | WESTERN AIR LINES, INC.. . . . . . . . . . . . | 113 |
| CRAC | TOTAL . . . . . . . . . . . . . . . . . . . . . . . . |  | 31,578 |
| T9S | LW | AIR NEVADA AIRLINES, INC.. . . . . . . . . . . | 4,107 |
| TOTAL FOR THIS AIRPORT. . . . . . . . . . . . . . . . . . . . |  |  | 229,944 |

SOURCE: DOT/TSC CALENDAR '80 ACIS DATABASE    REPORT DATE: September 20, 1983

ENPLANEMENTS BY INDIVIDUAL CARRIERS FOR CALENDAR YEAR 1980 AT
GCN/GRAND CANYON NATIONAL PARK, GRAND CANYON, AZ

| SCHEDULE TYPE | CARRIER CODE | NAME | ENPLANEMENTS |
|---|---|---|---|
| ATCO | AZ033 | GRAND CANYON AIRLINES INC. | 42,806 |
| ATCO | NV061 | AIR NEVADA | 17,077 |
| ATCO | NV066 | ROYAL WEST | 9,530 |
| ATCO | NV050 | SILVER STATE AIRLINES. | 8,400 |
| ATCO | NV065 | PAR AIRLINES, INC. | 6,195 |
| ATCO | NV058 | VALKO EXECUTIVE AIR CHARTER. | 4,177 |
| ATCO | NV064 | LAS VEGAS AIRLINES, INC. | 2,729 |
| ATCO | CA442 | PACIFIC EXECUTIVE CHARTER. | 1,600 |
| ATCO | CA426 | AIR VACATIONS INC. | 1,289 |
| ATCO | NV001 | AIR VEGAS. | 1,000 |
| ATCO | AZ095 | MONARCH. | 939 |
| ATCO | NV043 | PACIFIC MOUNTAIN AIR LINES, INC. | 790 |
| ATCO | AZ083 | WILLIAMS FLYING SERVICE. | 80 |
| ATCO | AZ094 | SCOTTSDALE CHARTER INC.. | 60 |
| ATCO | CA272 | POMONA VALLEY AVIATION | 56 |
| ATCO | CA329 | STEELE-BURNAND ASSOCIATES. | 20 |
| ATCO | TX325 | BOHN-AIR | 16 |
| ATCO | NM036 | POST AVIATION SERVICE CO.. | 12 |
| ATCO | NM046 | SOUTHWEST AVIATION INC.. | 5 |
| ATCO | MN096 | PTC-EXECUTIVE AIR CHARTER. | 4 |
| ATCO | TOTAL |  | 96,785 |
| CAC | HSZ | SCENIC AIRLINES, INC.(LAS VEGAS) | 102,327 |
| CAC | ANE | AIR NEVADA | 8,699 |
| CAC | LVA | LAS VEGAS AIRLINES, INC. | 3,825 |
| CAC | SIA | SILVER STATE AIRLINES. | 3,598 |
| CAC | NEV | NEVADA AIRLINES. | 3,205 |
| CAC | ATO | AIR TOURS (PACIFIC NATIONAL AIRWAYS) | 1,936 |
| CAC | TOTAL |  | 123,590 |
| CRAC | 02390 | AIRWEST. | 15,230 |
| CRAC | 02755 | REPUBLIC WEST. | 3,379 |
| CRAC | 06075 | ASPEN AIRWAYS, INC.. | 205 |
| CRAC | 07030 | COCHISE. | 183 |
| CRAC | 06715 | GOLDEN WEST. | 0 |
| CRAC | TOTAL |  | 18,997 |
| TOTAL FOR THIS AIRPORT. |  |  | 239,372 |

.1Y AFCAF

SOURCE: DOT/TSC CALENDAR '79 ACIS DATABASE   REPORT DATE: September 20, 1983

ENPLANEMENTS BY INDIVIDUAL CARRIERS FOR CALENDAR YEAR 1979 AT
GCN/GRAND CANYON NATIONAL PARK, GRAND CANYON, AZ

| SCHEDULE TYPE | CARRIER CODE | NAME | ENPLANEMENTS |
|---|---|---|---|
| ATCO | AZ033 | GRAND CANYON AIRLINES INC. . . . . . . . . | 37,710 |
| ATCO | NV058 | NV058. . . VACKO . . . . . . . . . . . . | 3,500 |
| ATCO | CO021 | DENVER BEECHCRAFT INC. . . . . . . . . . | 5 |
| ATCO | CA405 | THE GREAT ATLANTIC & PACI. . . . . . . . | 5 |
| ATCO | FL224 | JET SOUTH, INC . . . . . . . . . . . . . | 5 |
| ATCO | CA319 | SKYWAY AIR CHARTER . . . . . . . . . . . | 5 |
| ATCO | TOTAL | . . . . . . . . . . . . . . . . . . . . | 41,230 |
| CAC | HSZ | SCENIC AIRLINES, INC.(LAS VEGAS) . . . . | 88,630 |
| CAC | NEV | NEVADA AIRLINES. . . . . . . . . . . . . | 31,757 |
| CAC | LVA | LAS VEGAS AIRLINES, INC. . . . . . . . . | 8,427 |
| CAC | ANE | AIR NEVADA . . . . . . . . . . . . . . . | 4,844 |
| CAC | INA | INLAND EMPIRE AIRLINES, INC. . . . . . . | 379 |
| CAC | TOTAL | . . . . . . . . . . . . . . . . . . . . | 134,037 |
| CRAC | 02390 | AIRWEST. . . . . . . . . . . . . . . . . | 22,078 |
| CRAC | 07030 | COCHISE. . . . . . . . . . . . . . . . . | 502 |
| CRAC | 06075 | ASPEN AIRWAYS, INC.. . . . . . . . . . . | 150 |
| CRAC | TOTAL | . . . . . . . . . . . . . . . . . . . . | 22,730 |
| TOTAL FOR THIS AIRPORT. | | . . . . . . . . . . . . . . . . . | 197,997 |

# APPENDIX D

# CAB ENPLANEMENT DATA

COMMUTER PASSENGERS FOR: PHOENIX→GRAND CANYON

| | | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| COC | COCHISE AIRLINES | 855 | 1,235 | 503 | 212 | 183 | 419 | | | | |
| HSZ | SCENIC AIRLINES INC. (LAS VEAGS) | | | | | | | 54 | 3,083 | 3,564 | 627 |

| | | 1983 |
|---|---|---|
| COC | COCHISE AIRLINES | |
| HSZ | SCENIC AIRLINES INC. (LAS VEAGS) | |

NOTE: 1983 INCLUDES ONLY FIRST TWO QUARTERS

COMMUTER PASSENGERS FOR: GRAND CANYON→PHOENIX

| | | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| COC | COCHISE AIRLINES | 515 | 806 | 317 | 321 | 71 | 337 | | | | |
| HSZ | SCENIC AIRLINES INC. (LAS VEAGS) | | | | | | | 64 | 3,545 | 3,580 | 596 |

| | | 1983 |
|---|---|---|
| COC | COCHISE AIRLINES | |
| HSZ | SCENIC AIRLINES INC. (LAS VEAGS) | |

NOTE: 1983 INCLUDES ONLY FIRST TWO QUARTERS

Source: I. P. Sharp and Associates

## CERTIFICATED CARRIER DATA FOR: LAS VEGAS+GRAND CANYON

| LAS-GCN | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|---|---|
| 9999 ALL TYPES | | | | | | | | | |
| LW AIR NEVADA | | | | | | | | | |
| REV. DEPARTURES PERF.- SCHD | | | | | | | | | 973 |
| REVENUE PASS. FST. CLASS+COACH | | | | | | | | | 6,269 |
| RC REPUBLIC | | | | | | | | | |
| REV. DEPARTURES PERF.- SCHD | | | | | | | | | 530 |
| REVENUE PASS. FST. CLASS+COACH | | | | | | | | | 18,017 |
| RW HUGHES AIRWEST | | | | | | | | | |
| REV. DEPARTURES PERF.- SCHD | 543 | 522 | 431 | 466 | 537 | 539 | 474 | 323 | |
| REVENUE PASS. FST. CLASS+COACH | 14,989 | 15,677 | 12,312 | 21,335 | 25,621 | 30,234 | 21,155 | 14,375 | |

| LAS-GCN | 1982 | 1983 |
|---|---|---|
| 9999 ALL TYPES | | |
| LW AIR NEVADA | | |
| REV. DEPARTURES PERF.- SCHD | 1,741 | |
| REVENUE PASS. FST. CLASS+COACH | 12,499 | |
| RC REPUBLIC | | |
| REV. DEPARTURES PERF.- SCHD | 516 | 236 |
| REVENUE PASS. FST. CLASS+COACH | 22,298 | 12,278 |
| RW HUGHES AIRWEST | | |
| REV. DEPARTURES PERF.- SCHD | | |
| REVENUE PASS. FST. CLASS+COACH | | |

## CERTIFICATED CARRIER DATA FOR: GRAND CANYON-LAS VEGAS

| GCN-LAS | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|---|---|
| 9999 ALL TYPES | | | | | | | | | |
| LW AIR NEVADA | | | | | | | | | |
| REV. DEPARTURES PERF.- SCHD | | | | | | | | | 922 |
| REVENUE PASS. FST. CLASS+COACH | | | | | | | | | 6,392 |
| RC REPUBLIC | | | | | | | | | |
| REV. DEPARTURES PERF.- SCHD | | | | | | | | | 533 |
| REVENUE PASS. FST. CLASS+COACH | | | | | | | | | 18,879 |
| RW HUGHES AIRWEST | | | | | | | | | |
| REV. DEPARTURES PERF.- SCHD | 648 | 708 | 630 | 660 | 541 | 527 | 530 | 335 | |
| REVENUE PASS. FST. CLASS+COACH | 17,089 | 20,683 | 17,817 | 29,396 | 26,927 | 30,521 | 21,807 | 14,841 | |

| GCN-LAS | 1982 | 1983 |
|---|---|---|
| 9999 ALL TYPES | | |
| LW AIR NEVADA | | |
| REV. DEPARTURES PERF.- SCHD | 3,174 | |
| REVENUE PASS. FST. CLASS+COACH | 22,788 | |
| RC REPUBLIC | | |
| REV. DEPARTURES PERF.- SCHD | 520 | 240 |
| REVENUE PASS. FST. CLASS+COACH | 22,470 | 11,106 |
| RW HUGHES AIRWEST | | |
| REV. DEPARTURES PERF.- SCHD | | |
| REVENUE PASS. FST. CLASS+COACH | | |

NOTE: 1983 INCLUDES ONLY JANUARY THROUGH JUNE

Source: I. P. Sharp and Associates

## CERTIFICATED CARRIER DATA FOR: PHOENIX→GRAND CANYON

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|---|---|
| PHX→GCN | | | | | | | | | |
| 9999 ALL TYPES | | | | | | | | | |
| DP COCHISE | | | | | | | | | |
| REV. DEPARTURES PERF.- SCHD | | | | | | | | | |
| REVENUE PASS. FST. CLASS+COACH | | | | | | | | | |
| RC REPUBLIC | | | | | | | | | |
| REV. DEPARTURES PERF.- SCHD | | | | | | | | | 353 |
| REVENUE PASS. FST. CLASS+COACH | | | | | | | | | 7,810 |
| RW HUGHES AIRWEST | | | | | | | | | |
| REV. DEPARTURES PERF.- SCHD | 176 | 204 | 320 | 461 | 458 | 335 | 224 | 336 | |
| REVENUE PASS. FST. CLASS+COACH | 3,096 | 4,034 | 5,640 | 11,684 | 10,146 | 8,797 | 4,155 | 6,334 | |

| | 1982 | 1983 |
|---|---|---|
| PHX→GCN | | |
| 9999 ALL TYPES | | |
| DP COCHISE | | |
| REV. DEPARTURES PERF.- SCHD | | |
| REVENUE PASS. FST. CLASS+COACH | | |
| RC REPUBLIC | | |
| REV. DEPARTURES PERF.- SCHD | 337 | 172 |
| REVENUE PASS. FST. CLASS+COACH | 11,461 | 6,135 |
| RW HUGHES AIRWEST | | |
| REV. DEPARTURES PERF.- SCHD | | |
| REVENUE PASS. FST. CLASS+COACH | | |

## CERTIFICATED CARRIER DATA FOR: GRAND CANYON→PHOENIX

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|---|---|
| GCN→PHX | | | | | | | | | |
| 9999 ALL TYPES | | | | | | | | | |
| DP COCHISE | | | | | | | | | |
| REV. DEPARTURES PERF.- SCHD | | | | | | | | | 6 |
| REVENUE PASS. FST. CLASS+COACH | | | | | | | | | 5 |
| RC REPUBLIC | | | | | | | | | |
| REV. DEPARTURES PERF.- SCHD | | | | | | | | | 346 |
| REVENUE PASS. FST. CLASS+COACH | | | | | | | | | 7,807 |
| RW HUGHES AIRWEST | | | | | | | | | |
| REV. DEPARTURES PERF.- SCHD | 175 | 23 | 117 | 264 | 450 | 343 | 168 | 323 | |
| REVENUE PASS. FST. CLASS+COACH | 3,164 | 279 | 1,576 | 5,066 | 9,805 | 11,504 | 3,770 | 7,501 | |

| | 1982 | 1983 |
|---|---|---|
| GCN→PHX | | |
| 9999 ALL TYPES | | |
| DP COCHISE | | |
| REV. DEPARTURES PERF.- SCHD | | |
| REVENUE PASS. FST. CLASS+COACH | | |
| RC REPUBLIC | | |
| REV. DEPARTURES PERF.- SCHD | 332 | 168 |
| REVENUE PASS. FST. CLASS+COACH | 12,042 | 7,375 |
| RW HUGHES AIRWEST | | |
| REV. DEPARTURES PERF.- SCHD | | |
| REVENUE PASS. FST. CLASS+COACH | | |

NOTE: 1983 INCLUDES ONLY JANUARY THROUGH JUNE

Source: I. P. Sharp and Associates

CONNECTION ANALYSIS REPORT

HUB CITY: GCN

DESTINATION CITY: LAS

| ORIGIN CITY | INBOUND CARRIER | OUTBOUND CARRIER | COUPONS 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|---|---|---|---|
| BOS | -- | YR | 0 | 0 | 6 | 0 | 0 | 0 | 0 |
| --BOS TOTAL -- | | | 0 | 0 | 6 | 0 | 0 | 0 | 0 |
| BUR | RW | RW | 6 | 0 | 0 | 55 | 0 | 0 | 0 |
| BUR | RC | RC | 0 | 0 | 0 | 0 | 0 | 0 | 22 |
| --BUR TOTAL -- | | | 6 | 0 | 0 | 55 | 0 | 0 | 22 |
| COS | -- | RW | 14 | 0 | 0 | 0 | 0 | 0 | 0 |
| --COS TOTAL -- | | | 14 | 0 | 0 | 0 | 0 | 0 | 0 |
| DEN | -- | YR | 0 | 0 | 0 | 5 | 0 | 0 | 0 |
| DEN | -- | RC | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| DEN | RC | RC | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| DEN | -- | RW | 0 | 4 | 0 | 0 | 0 | 0 | 0 |
| --DEN TOTAL -- | | | 0 | 4 | 0 | 5 | 0 | 0 | 13 |
| DRO | -- | RW | 6 | 0 | 8 | 0 | 0 | 0 | 0 |
| --DRO TOTAL -- | | | 6 | 0 | 8 | 0 | 0 | 0 | 0 |
| LAS | YR | YR | 11 | 0 | 6 | 34 | 17 | 0 | 5 |
| LAS | RW | RW | 203 | 91 | 257 | 242 | 227 | 83 | 0 |
| LAS | -- | YR | 0 | 0 | 6 | 0 | 0 | 0 | 0 |
| LAS | LW | LW | 0 | 0 | 0 | 0 | 0 | 9 | 0 |
| LAS | RC | RC | 0 | 0 | 0 | 0 | 0 | 77 | 152 |
| LAS | UK | UK | 0 | 7 | 0 | 0 | 0 | 0 | 0 |
| --LAS TOTAL -- | | | 214 | 98 | 269 | 276 | 244 | 169 | 157 |
| LAX | RC | RC | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| LAX | RW | RW | 0 | 0 | 0 | 22 | 17 | 0 | 0 |
| --LAX TOTAL -- | | | 0 | 0 | 0 | 22 | 17 | 0 | 7 |
| PHX | -- | YR | 0 | 0 | 0 | 0 | 0 | 9 | 0 |
| PHX | RW | RW | 20 | 25 | 11 | 22 | 5 | 9 | 0 |
| PHX | YR | YR | 0 | 0 | 0 | 0 | 8 | 0 | 0 |
| PHX | -- | RW | 0 | 0 | 7 | 4 | 0 | 0 | 0 |
| PHX | RW | YR | 0 | 0 | 0 | 0 | 5 | 0 | 0 |
| PHX | RW | -- | 0 | 0 | 0 | 12 | 10 | 0 | 0 |
| --PHX TOTAL -- | | | 20 | 25 | 18 | 38 | 28 | 18 | 0 |
| | | *** GRAND TOTAL *** | 260 | 127 | 301 | 396 | 289 | 187 | 199 |

Source: I. P. Sharp and Associates

CONNECTION ANALYSIS REPORT

HUB CITY: GCN

DESTINATION CITY: PHX

| ORIGIN CITY | INBOUND CARRIER | OUTBOUND CARRIER | COUPONS 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|---|---|---|---|
| LAS | RW | RW | 19 | 30 | 8 | 13 | 9 | 24 | 0 |
| LAS | RW | -- | 0 | 4 | 5 | 0 | 0 | 0 | 0 |
| LAS | YR | -- | 0 | 0 | 0 | 6 | 0 | 0 | 0 |
| LAS | YR | YR | 0 | 0 | 0 | 6 | 7 | 0 | 0 |
| LAS | RC | RC | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| --LAS TOTAL -- | | | 19 | 34 | 13 | 25 | 16 | 24 | 7 |
| PHX | DP | RW | 0 | 0 | 0 | 0 | 6 | 0 | 0 |
| --PHX TOTAL -- | | | 0 | 0 | 0 | 0 | 6 | 0 | 0 |
| | | *** GRAND TOTAL *** | 19 | 34 | 13 | 25 | 22 | 24 | 7 |

Source: I. P. Sharp and Associates

# APPENDIX E

# SOCIOECONOMIC DATA

## APPENDIX E

## SOCIOECONOMIC DATA

Historic socioeconomic data utilized in the forecasting analysis of Chapter II but not used in the final model is presented in Table E-1.

TABLE E-1

| Year | Fuel Price[1] Index (CY 1972=100) | U.S. Foreign[2] Air Travel (Millions) | U.S. Foreign[3] Travelers (Millions) |
|---|---|---|---|
| 1974 | 154.3 | -- | 3.700 |
| 1975 | 164.4 | 12.646 | 3.674 |
| 1976 | 171.1 | 14.369 | 4.456 |
| 1977 | 180.4 | 15.211 | 4.509 |
| 1978 | 181.6 | 16.955 | 5.764 |
| 1979 | 243.4 | 19.282 | 7.230 |
| 1980 | 339.4 | 20.262 | 7.706 |
| 1981 | 376.7 | 20.881 | 11.976 |
| 1982 | 353.2 | 22.187 | 10.909 |

Source: [1]Bureau of Labor Statistics.
[2]U.S. International Air Travel Statistics (total passengers).
[3]U.S. Bureau of Economic Analysis.

# APPENDIX F

# LAS VEGAS FORECAST MODEL

## APPENDIX F

## LAS VEGAS FORECAST MODEL

Data for Las Vegas, Nevada visitation was obtained to evaluate the possibility of using Las Vegas data as an element in the forecast model. This approach was investigated since the large percentage of GCN traffic originates in Las Vegas and conceptually, if Las Vegas visitation fluctuates due to economic, competitive or other factors, this may be reflected in the GCN operations data. Eight measures of Las Vegas visitation were analyzed using the same multiple linear regression technique described in Chapter II. This raw data is tabulated on Table F-1.

Grand Canyon Airport operations was utilized as the dependent variable and the data in Table E-1 statistically analyzed for best correlation and for model completeness. The variables chosen as generating the best model were total Las Vegas visitors, visitor dollar revenue, entertainment tax and third level enplanements at McCarran International Airport. The resulting regression equation is:

$$\begin{aligned}\text{GCN Ops} = {} & (1.7912 \times 10^{-5})(\text{visitor dollars}) - (0.0123)(\text{total visitors}) \\ & + (0.0045)(\text{entertainment tax}) + (0.2995)\ \text{3rd carrier enp.}) \\ & + 47{,}356.\end{aligned}$$

Neither this model nor the Las Vegas visitor was utilized in the GCN projections in Chapter II due to the unavailability of independent forecasts from sophisticated models. The data is presented here for use in short term projections and "what if" type analysis of GCN traffic where Las Vegas data can be estimated. The historic data is available from the Las Vegas Convention/Visitor Authority and the data can be readily updated.

TABLE F-1

LAS VEGAS DATA

| Year | McCarren Enplanements[1] (millions) | Third Level Enplanements[1] (thousands) | Precleared Internat'l Charter Enplanements[1] (thousands) | Entertainment Tax[2] ($ million) | Visitors to Las Vegas[2] (millions) | Visitor Dollars Revenue[2] ($ billion) | Las Vegas Visitors Arriving by Air[2] (millions) | Charter Passengers[2] (thousands) |
|---|---|---|---|---|---|---|---|---|
| 1974 | 2.985 | 27.7 | 15.0 | 9.119 | 8.353 | 1.891 | 2.972 | 877 |
| 1975 | 3.232 | 55.0 | 18.8 | 9.245 | 8.802 | 2.183 | 3.249 | 1034 |
| 1976 | 3.839 | 68.4 | 23.4 | 9.827 | 9.402 | 2.448 | 3.839 | 1467 |
| 1977 | 3.979 | 77.1 | 75.7 | 10.842 | 9.720 | 2.922 | 3.984 | 1729 |
| 1978 | 4.577 | 72.6 | 60.9 | 11.870 | 10.571 | 3.279 | 4.561 | 1763 |
| 1979 | 5.346 | 97.2 | 88.2 | 13.525 | 11.058 | 4.137 | 5.287 | 1432 |
| 1980 | 5.160 | 125.6 | 123.2 | 14.427 | 11.256 | 4.756 | 5.147 | 1122 |
| 1981 | 4.707 | 124.0 | 131.7 | 12.776 | 11.101 | 4.798 | 4.740 | 867 |
| 1982 | 4.693 | 103.4 | 125.2 | 12.081 | 10.824 | 5.185 | 4.723 | 736 |

Sources: [1]McCarren International Airport

[2]Las Vegas Convention/Visitor Authority

# APPENDIX G

# CORRESPONDENCE

NOTE: All correspondence relevant to both the Master Plan and the Environmental Review (Appendix H) are chronologically included in this Appendix.

MAJOR

**SIGNOFF**

OMB Approval No. 29–R0218

## FEDERAL ASSISTANCE

| | |
|---|---|
| 2. Applicant's application | a. Number 02231 |
| | b. Date 19 81 08 — Year Month |
| Leave Blank | SEP 18 1981 |
| 3. State application identifier | a. Number AZ 81-10-0402 |
| | b. Date Assigned 19 81 08 19 (Year month day) |

**1. Type Of Action** (Mark appropriate box)
- ☐ Preapplication
- ☐ Application
- ☒ Notification Of Intent (Opt.)
- ☐ Report Of Federal Action

**4. Legal Applicant/Recipient**
- a. Applicant Name : AZ Dept. of Transportation
- b. Organization Unit : Aeronautics Division
- c. Street/P.O. Box : 205 S. 17th Avenue
- d. City : Phoenix
- e. County : Maricopa
- f. State : AZ
- g. Zip Code : 85007
- h. Contact Person (Name & telephone no.) : Allan Samuels (602) 261-7778

**5. Federal Employer Identification No.**

**6. Program** (From Federal Catalog)
- a. Number 20.103
- b. Title Airport Planning Grant Program

DOT, FAA

**7. Title and description of applicant's project**

Master Planning Study to Identify Future Needs for Airport Development; Airport Layout; Land use, Terminal Area and Access Plans; Financial Plans; Environmental Assessment.

**8. Type of applicant/recipient**
A–State, B–Interstate, C–Substate District, D–County, E–City, F–School District, G–Special Purpose District, H–Community Action Agency, I–Higher Educational Institution, J–Indian Tribe, K–Other (Specify):
Enter appropriate letter: A

**9. Type of assistance**
A–Basic Grant, B–Supplemental Grant, C–Loan, D–Insurance, E–Other
Enter appropriate letter(s): A

**10. Area of project impact** (Names of cities, counties, states, etc.)
Tusayan Village, Coconino County, Arizona

**11. Estimated number of persons benefiting**
300,000/year

**12. Type of application**
A–New, B–Renewal, C–Revision, D–Continuation, E–Augmentation
Enter appropriate letter: A

**13. Proposed Funding**

| | | |
|---|---|---|
| a. Federal | $ | 102,000 .00 |
| b. Applicant | | 10,140 .00 |
| c. State | | .00 |
| d. Local | | .00 |
| e. Other | | .00 |
| f. Total | $ | 112,340 .00 |

**14. Congressional Districts Of:** a. Applicant — b. Project

**15. Type of change** For 12c or 12e
A–Increase Dollars, B–Decrease Dollars, C–Increase Duration, D–Decrease Duration, E–Cancellation, F–Other Specify:
Enter appropriate letter(s)

**16. Project Start Date** Year month day 19

**17. Project Duration** Months

**18. Estimated date to be submitted to federal agency** 19 81 08 06 (Year month date)

**19. Existing federal identification number**

**20. Federal agency to receive request** (Name, city, state, zip code)
FAA

**21. Remarks added** ☒ Yes ☐ No

**Section I - Applicant / Recipient Data**

**22. The Applicant Certifies That**

a. To the best of my knowledge and belief, data in this preapplication/application are true and correct, the document has been duly authorized by the governing body of the applicant and the applicant will comply with the attached assurances if the assistance is approved.

b. If required by OMB Circular A-95 this application was submitted, pursuant to instructions therein, to appropriate clearinghouses and all responses are attached:

| | No response | Response attached |
|---|---|---|
| (1) Arizona State Clearinghouse | ☐ | ☒ |
| (2) Region III Clearinghouse (NACOG) | ☒ | ☐ |
| (3) | ☐ | ☐ |

**23. Certifying representative**
- a. Typed name and title: Sonny Najera -Assistant Director
- b. Signature
- c. Date signed: 19 81 08 11 (Year month day)

**Section II - Certification**

24. Agency name

25. Application received 19 (Year month day)

26. Organizational Unit

27. Administrative office

28. Federal application identification

29. Address

30. Federal grant identification

**31. Action taken**
- ☐ a. Awarded
- ☐ b. Rejected
- ☐ c. Returned for amendment
- ☐ d. Deferred
- ☐ e. Withdrawn

**32. Funding**

| | | |
|---|---|---|
| a. Federal | $ | .00 |
| b. Applicant | | .00 |
| c. State | | .00 |
| d. Local | | .00 |
| e. Other | | .00 |
| f. Total | $ | .00 |

33. Action date 19 (Year month day)

34. Starting date 19 (Year month day)

35. Contact for additional information (Name and telephone number)

36. Ending date 19 (Year month day)

37. Remarks added ☐ Yes ☐ No

**38. Federal agency A–95 action**

a. In taking above action, any comments received from clearinghouses were considered. If agency response is due under provisions of Part 1, OMB Circular A-95, it has been or is being made.

b. Federal Agency A-95 Official (Name and telephone number)

**Section III - Federal Agency Action**

TO:

State Application Identifier (SAI)

AUG 1 9 1981 . State AZ No. 81-10-0402

Mary Alice Bivens, Director
State Liaison Officer
AORCC
1333 W. Camelback, Suite 206
Phoenix, AZ 85013

Game & Fish
Az Nat. Heritage
AORCC
Parks

Region III

FROM: Arizona State Clearinghouse
1700 West Washington Street, Room 505
Phoenix, Arizona 85007

RECEIVED
AUG 2 1 1981
AORCC

DEPT. OF TRANSPORTATION
SEP 2 1 1981
AERONAUTICS DIVISION

This project is referred to you for review and comment. Please evaluate as to the following questions. After completion, return THIS FORM AND ONE XEROX COPY to the Clearinghouse no later than 17 WORKING DAYS from the date noted above. Please contact the Clearinghouse at 255-5004 if you need further information or additional time for review.

☒ No comment on this project ☐ Proposal is supported as written ☐ Comments as indicated below

1. Is project consistent with your agency goals and objectives? ☐ Yes ☐ No ☐ Not Relative to this agency

2. Does project contribute to statewide and/or areawide goals and objectives of which you are familiar? ☐ Yes ☐ No

3. Is there overlap or duplication with other state agency or local responsibilities and/or goals and objectives? ☐ Yes ☐ No

4. Will project have an adverse effect on existing programs with your agency or within project impact area? ☐ Yes ☐ No

5. Does project violate any rules or regulations of your agency? ☐ Yes ☐ No

6. Does project adequately address the intended effects on target population? ☐ Yes ☐ No

7. Is project in accord with existing applicable laws, rules or regulations with which you are familiar? ☐ Yes ☐ No

Additional Comments (Use back of sheet, if necessary):

Reviewers Signature Mary Alice Bivens Date 8/31/81

Title Director/State Liaison Officer Telephone 255-5013

TO:

Mr. Robert Jantzen, Director
Game and Fish Dept.
2222 W. Greenway
Phoenix, Arizona 85023

State Application Identifier (SAI)

AUG 19 1981

State AZ No. 81-10-0402

Game & Fish
Az Nat. Heritage
AORCC
Parks

Region III

FROM: Arizona State Clearinghouse
1700 West Washington Street, Room 505
Phoenix, Arizona 85007

This project is referred to you for review and comment. Please evaluate as to the following questions. After completion, return THIS FORM AND ONE XEROX COPY to the Clearinghouse no later than 17 WORKING DAYS from the date noted above. Please contact the Clearinghouse at 255-5004 if you need further information or additional time for review.

☐ No comment on this project ☐ Proposal is supported as written ☒ Comments as indicated below

1. Is project consistent with your agency goals and objectives? ☐ Yes ☐ No ☒ Not Relative to this agency

2. Does project contribute to statewide and/or areawide goals and objectives of which you are familiar? ☒ Yes ☐ No

3. Is there overlap or duplication with other state agency or local responsibilities and/or goals and objectives? ☐ Yes ☒ No

4. Will project have an adverse effect on existing programs with your agency or within project impact area? ☐ Yes ☐ No X ?

5. Does project violate any rules or regulations of your agency? ☐ Yes ☒ No

6. Does project adequately address the intended effects on target population? ☐ Yes ☐ No

7. Is project in accord with existing applicable laws, rules or regulations with which you are familiar? ☒ Yes ☐ No

Additional Comments (Use back of sheet, if necessary): As planning progresses for this project, it is hoped that coordination will continue with our department, since there are some potential problems that will surface

Reviewers Signature Robert K. Weaver Date Sept. 10, 1981

Title Habitat Eval. Coordinator Telephone 942-3000

FROM: Arizona State Clearinghouse
1700 West Washington Street, Room [illegible]
Phoenix, Arizona 85007

This project is referred to you for [illegible] comments. Please [illegible]
to the following questions. After [illegible] please return [illegible]
XEROX COPY to the Clearinghouse [illegible]
the date noted above. Please contact [illegible]
need further information or additional [illegible]

As planning programs for this project, it is beyond
[illegible] information will [illegible] your [illegible]
[illegible] [illegible] on [illegible]

ARIZONA DEPARTMENT OF TRANSPORTATION

AERONAUTICS DIVISION

1801 W. Jefferson Phoenix, Arizona 85007

(602) 255-7691

BRUCE BABBITT
Governor

WILLIAM A ORDWAY
Director

SONNY NAJERA
Division Director

September 14, 1983

Mr. Jim W[illegible]ster, Manager
Leedhill-Herkenhoff, Inc.
Consulting Engineer
111 West Monroe
Suite 718
Phoenix, AZ 85003

Re: Grand Canyon National Park Airport
ADAP #6-04-0019-13
Fund Code 90594

Dear Jim:

Enclosed for your information is a letter from the Park Service discussing aircraft noise in the Canyon.

Sincerely,

Allan F. Samuels, P.E.
Airports Engineer

AFS:ee
Enclosure

United States Department of the Interior
NATIONAL PARK SERVICE
GRAND CANYON NATIONAL PARK
GRAND CANYON, ARIZONA 86023

IN REPLY REFER TO:

L3215

AUG 29 1983

Mr. Sonny Najera
Asst. Director
Arizona Dept. of Transportation
Aeronautics Division
205 S. 17th Avenue
Phoenix, Arizona 85007

Dear Mr. Najera:

We would like to take this opportunity to inform you of our continuing efforts to monitor aircraft use over Grand Canyon National Park. One of the greatest challenges facing park managers is the balancing of activities within a park with the preservation of its resources.

Congress anticipated potential conflicts resulting from aircraft flights over the canyon when it passed Public Law 93-620, better known as the "Grand Canyon National Park Enlargement Act." Section 8 of the law specifically states that for aircraft or helicopter activity within the park,

> "including the air space below the rims, which is likely to cause an injury to health, welfare, or safety of visitors to the park or to cause a significant adverse effect on the natural quiet and experience of the park, the Secretary (of the Interior) shall submit to the Federal Aviation Administration, the Environmental Protection Agency, or any other responsible agency such complaints, information, or recommendations for rules and regulations or other actions, as he believes appropriate to protect the public health, welfare, and safety of the natural environment of the park."

Based on this mandate, the National Park Service is reviewing overflights by military craft, private operators, major commercial airline carriers, and air-tour operators, as well as our own use.

Grand Canyon National Park has collected aircraft noise data sporadically for over 4 years. This summer, we will be expanding the data collection program. The expanded program will include a sociological study, as well as an expanded noise monitoring study. The sociological study will focus on user groups in heavily visited backcountry areas, along the river, and in developed areas along the rim to determine their perception of the aircraft issue. The noise monitoring study will be expanded to backcountry and river areas in addition to rim areas where data has been collected in the past. Noise monitoring will be accomplished using the GenRad Type II Sound Level Meter.

The National Park Service has no preconceived ideas on regulation of aircraft use. We know that many thousands of visitors each year thrill to the vast and colorful panorama of the Grand Canyon on aircraft overflights. We also know that quiet and solitude are important aspects of trips taken by thousands of persons into Grand Canyon's backcountry. We consider both groups as important user groups within the park.

We are sure you realize that this is a complex matter. We anticipate 1 to 3 additional years of data collection before any plans are formulated. We intend to keep members of the aircraft user community, as well as other interested citizens, fully involved during any plan development and implementation. It is our belief that with a natural understanding and with public participation, we will be able to develop a plan that will allow continued joint use of the airspace, while preserving the integrity of the Grand Canyon. We will keep you informed of our progress on this project.

Sincerely,

Richard W. Marks
Superintendent

United States Department of the Interior

Mr. [illegible]
Asst. [illegible]
Arizona [illegible]
Aeronautics [illegible]
205 [illegible]
Phoenix [illegible]

Dear Mr. [illegible]:

We would like to take this opportunity to inform you of our [illegible] efforts to monitor aircraft use over Grand Canyon National [illegible] the greatest challenges facing park managers is the balancing [illegible] ities within a park with the preservation of its resources.

Congress anticipated potential conflicts resulting from aircraft [illegible] over the Canyon when it passed Public Law 93-620, better known as the "Grand Canyon National Park Enlargement Act." Section [illegible] of the law [illegible] cifically states that for aircraft or helicopter activity within the park

> "including the air space below the rims, which is likely to [illegible] injury to health, welfare, or safety of visitors to the park or to cause a significant adverse effect on the natural quiet and [illegible] experience of the park, the Secretary (of the Interior) shall [illegible] to the Federal Aviation Administration, the Environmental Protection Agency, or any other responsible agency such complaints, information or recommendations for rules and regulations or other actions as he believes appropriate to protect the public health, welfare, and safety of the natural environment of the park."

Based on this mandate, the National Park Service is reviewing overflights by military craft, private operators, major commercial airline [illegible] and air-tour operators, as well as our own use.

Grand Canyon National Park has collected aircraft noise data sporadically for over 4 years. This summer, we will be expanding the data collection program. The expanded program will include a sociological study, as well as an expanded noise monitoring study. The sociological study will focus on user groups in heavily visited backcountry areas, along the river, and in developed areas along the rim to determine their perception of the aircraft issue. The noise monitoring study will be expanded to back-country and river areas in addition to rim areas where data has been collected in the past. Noise monitoring will be accomplished using the GenRad Type 31 Sound Level Meter.

MINUTES
Grand Canyon National Park Airport Master
Plan Advisory Group Meeting
Held September 14, 1983

The first meeting of the Grand Canyon National Park Airport Master Plan Advisory Group was held September 14, 1983 at the Hopi Room of the Grand Canyon Squire Inn in Tusayan, Arizona. Those in attendance were:

John Miller, National Park Service
John Babbitt, National Park Service
Ronald Warren, Grand Canyon Airlines
Ronald Gentry, Republic Airlines
Gary Maaske, Airport Manager
Kathy Davis, National Park Service
Thomas Chacon, USDA Forest Service
Nancy Lee, David Babbitt Industries
Sheryl Luckesen, Grand Canyon Squire Inn, South Grand Canyon Sanitary District & Tusayan Water Development Assoc.
Steven Luckesen, Coconino County
Bruce Madison, Madison Aviation
Jan Cutler, Fred Harvey Inc. & Fred Harvey Transportation
Joe Weidman, Northern Arizona Council of Governments
Clint Dodge, Leedshill-Herkenhoff, Inc.
Jim Webster, Leedshill-Herkenhoff, Inc.
Mel Paul, Leedshill-Herkenhoff, Inc.
Rick Bell, Leedshill-Herkenhoff, Inc.

The three principal topics presented by the consultants were:

1. Introduction of participants.
2. Outline and schedule of anticipated planning process.
3. Purpose of advisory group and sequence of developments.

An outline of the proposed planning process and a bar chart schedule was distributed.

Discussion by the various Group members included the following:

1. Due to significant traffic from Las Vegas based operators, they should have input into planning process.
2. Possibility of additional land exchange between ADOT and USDA Forest Service - currently beyond the scope of the master plan.
3. Due to federal participation, is an environmental or archeological inpact study necessary. An environmental analysis is part of the master plan, The primary purpose is to provide data for use in evaluating alternatives. Cultural values will be included in analysis, but analysis will not necessarily meet all NEPA or CEQ requirments as to detail.
4. Possibility of no further growth at the Park and current limits were discussed (including development limit at the South Rim and water limitations).

5. Winter meeting schedules and possible weather conflicts were discussed.

6. The difficulty in advisory group review considering the tight time schedule was discussed. It was agreed that review interim reports would be distributed in advance of meetings, if possible. In any event, review of the interim reports will be available following review submittal to ADOT.

7. The status of the advisory group comments was clarified as advisory in nature, but substantive comments, including minority views would be documented and responded to as appropriate.

8. The implementation of the resulting master plan is the responsibility of ADOT, as is the final acceptance.

9. Factors which may impact and could outweigh the master plan include airport operations lease and land exchange with NFS.

The meeting adjourned at 8:15 pm.

If we have neglected to list any substantive comments or have misinterpreted any comments, please let us know.

Clint Dodge
Jim Webster

GRAND CANYON AIRLINES

DATE: October 28, 1983

TO: Airport Master Plan file

FROM: RLW

SUBJECT: Comments on Draft Report # 1

| Page # | Comment |
|---|---|
| 1-3 | ATCT hours 0800-1800 not 6am-10pm |
| 1-4 | What does wind coverage mean? |
| | Hangar SF 10,000 (not listed) |
| 1-5 | Rain tank: consider effect on water collection if riparian rights upheld for Hatch |
| 1-6 | 1973 GCA Hangar (private) |
| | 1979 GCA Terminal--not in 1977 |
| | 1982 Equipment Storage building, not 1978 |
| | 1982 Airport housing |
| 1-7 | Question implied determination of ramp congestion: basis for determination? |
| 1-8 | Water sources: see 1-5 question |
| 1-11 | Asbestos water pipe??? |
| 1-16 | Shouldn't pressure system on fire be tested prior to completion of report; may be an area for planning? |
| 1-18 | Should be South Grand Canyon Sanitary District, not Tusayan Village Sanitary District |
| 1-19 | F.3. INCORRECT: Coconino County as well as ordinances of the SGC Sanitary District; County has design overlay review power, planning and zoning power and building permit powers. Should NOT assume that no laws exist for purpose of this Plan report; the existing ones could have major effect. |
| 11-4 | Trend already established toward larger (6 pax) helicopters |
| 11-5 | Air Grand Canyon not authorized "scheduled" ie commuter |
| | Question "some" traffic being missed; probably more than "some", but agree that count is baseline. |
| 11-6 | Where is text reference to Table 11-6 on page 11-7? |
| | Perhaps should update Table 11-6; some are out of business. |
| 11-10 | Question enplanement counts-GCA |
| 11-15 | Question: is Air Nevada certificated? |
| 11-20 | Should consider NPS and GC Enlargement Act re Noise restrictions; should consider possible county noise action in Tusayan. |
| | Is the assumption of unlimited Park visitation warranted? Consideration of limiting daily visitation has already been undertaken. Particularly in short water times. They have closed the ET once since I've been here. |
| 11-22 | Strongly disagree with non-correlation with foreign visitation; did planners consider the one year time lag? ******** Important |

GRAND CANYON AIRLINES

DATE:

TO:

FROM:

SUBJECT: Comments on Draft Report #1, page two:

| Page | Comments |
| --- | --- |
| 11-22 | Question "short" determination??? Means?? |
| 11-23 | Are planners aware of time delay on exchange rate and foreign visitation??? |
| 11-25 | Question assumption of "mix" remaining the same Twin Otter is 20-21 place, 19-20 pax seats. |
| 11-26 | 3. Forecasts: refers in body of text to operations primarily, but in master planning improvements, should consider increased pax usage of facilities (i.e. large aircraft require more facilities than small) I would put "local" operations, as defined in the report into a less than 1% category including IFR for the life of the forecast. |
| 11-27 | Agree with larger market share for certificated carriers Question assumption that "based" operations will drop from 25% to 8%. If anything, I believe that the % will stay static or increase due to economic conditions, particularly during the first two five year planning periods. Strongly question continued day trip increase!!! |
| 11-29 | Did they mean B-737 or B767?? |
| 11-30 | Disagree with Table 11-22 Forecast GA aircraft mix; low on t-prop and t-jet (and maybe on twin); hi on asel. |
| 111-2 | Question slightly the daily scenario on times |

General observations: Prelim Report #1 may be inaccurate in some important assumptions; if in error, almost all subsequent determinations will also be in error. Primarily, I see the lack of correlation in the Report to rate of exchange and foreign visitation to be a major flaw. I also see the lack of correlation to increased pax with fewer operations (big aircraft) to be a flaw. Lastly, the lack of consideration of local laws, growth of population in Tusayan (noise considerations), and possible/probable relocation of heliports during report period to be a flaw.

While Chase and the FAA may be a reliable guage in other areas, I do not believe that they can be relied on at GCN.

GRAND CANYON NATIONAL PARK AIRPORT MASTER PLAN

SECOND ADVISORY GROUP MEETING

The second meeting of the Advisory Group was held November 1, 1983 at the Squire Inn. The purpose of the meeting was to review the data contained in the Draft Report 1 dated October 1983 and to discuss the next phase of the planning study.

A list of those in attendance is attached.

Summary: Major findings of the meeting were:

1. FAA ATCT operations records for 1974, 75 and part of 76 are incomplete since the tower was in operation in the summer only.

   Data and forecasting model will require revision.

2. The forecasting model using GNP, CPI and FPI was considered highly suspect by most members present. Due to the impact of foreign tourism, factors relating directly to foreign tourism should be in the model as independent variables.

   Additional data evaluation will be performed to attempt definition of a model incorporating these factors.

3. The forecasts, particularly for operations, were felt to be too high.

   Historic operations growth FY 1977 through FY 1983 was 12.7% with peak years of 45% and 33%. Forecasted growth (Table II-21) for 1984 through 1988 is 9.5%. Recent leveling off (FY 1980 through FY 1983) in operations are attributed to general economic conditions. Thus the forecasting model, which inherently assumes economic recovery, predicts continued growth. If the market for foreign tourism to GCNP is saturated, a leveling off of growth may in fact be appropriate.

4. Commuter aircraft mix, which was forecasted to increase to 12.4 pax per flight by 2003, will probably increase faster due to economic forces.

   As discussed in the report, the aircraft mix is a critical element of the operations forecast. This factor will be reevaluated.

5. Havasuapi Airport - the airport reported to be under construction in conjunction with the reported hotel at Supai will have a definite effect on the traffic demand.

   Data regarding this facility which is not included in the report will be analyzed and incorporated.

A brief summary of the forecasting and capacity methodology and results was presented by the consultant. Written comments were received from Grand

Canyon Airlines, Grand Canyon National Park had not received their copy of the report and their comments are not included.

Discussion: Discussion of the data presented was held during and after the presentation, a summary of which follows:

1. Errata: Figure III-2, "Addition of Parallel Taxiway" should read "Addition of Parallel Runway".

   Table I-1, Air Traffic Control Tower hours should be "Hours 0800-1800 daily".

   Page II-31, Air Grand Canyon has 4 aircraft instead of 3.

2. ATCT Counts: ATCT figures for 1974-76 are for part-time tower operations in summer only. Permanent ATCT opened in May 1976. The figures used in the report (Table II-2) will be checked, adjusted if required and necessary modifications made.

3. Forecasting Model:

   a. National Park Service does not have GCNP visitor forecast. Discussion regarding validity of econometric model and other prior uses of similar models.

      The FAA forecasting is based on econometric models. The forecasts are only as good as the model derivation, and the assumptions utilized and the economic or other variable forecasts used to generate the dependent variable forecast. Obviously, if all of these factors are consistently accurate, the forecasts are good. On the contrary some studies have shown that econometric model forecasts are no better than judgmental forecasts for economic indicators. (See "A Comparison of Judgmental and Econometric Forecasts of the Economy: The Business Week Survey", Economic Review, September 1982.)

   b. Tourist nature of GCN was inadequately considered. Such things as: discretionary spending, not overall economic monies; unique traffic market, similar to Miami, Ft. Lauderdale, Nassau market which might be checked; trend in based commuter traffic (i.e. sightseeing) from middle income groups; should be foreign tourist factors as independent variables in model; consider the lag between changes in exchange rates and travel (estimated to be one year); massive foreign tourism in 78-82 not addressed; 76 GCNP visitors peaked but GCN traffic kept increasing.

      The tourist nature of GCN is recognized as discussed in various places in Chapter II. As discussed, readily available foreign tourism factors including exchange rates and foreign arrivals by air were evaluated. Correlation with historic GCN data was poor. Use of national U.S. economic indices is justified based on good historic correlation and the underlying concept that tourism is inexplicably tied to the economy. Re-evaluation of foreign visitor statistics and correlation analysis will be performed.

c. Fuel price index - why is it an independent variable?

FPI correlates well with historic data, while aviation fuel price did not. FPI does monitor transportation energy costs and is thus conceptually related to tourism.

d. Republic offices report that foreign tourists are wanting longer stays at GCNP including increased demand for overnight trips as well as extended southwestern tours (i.e. Marble Canyon, Monument Valley, Canyon De Chelly).

In the report we assumed overnight lodging at GCNP and immediate vicinity would continue to be a limiting factor which precludes large increases in overnight visitation. Incorporation of this short term demand into the long term forecasts is difficult. If demand for overnight tours continues, several possibilities are evident, including acquisition of land from the National Forest for local growth, Flagstaff, private resort type improvements in the vicinity, etc.

e. Growth at GCN in commuter traffic is tied to Republic going from F-27 with frequent flights to DC-9 with fewer flights and possibly to deregulation of commuter airlines in Arizona in 1979.

Route structures and flight frequency definitely effect individual airline enplanements and operations. For a macro forecasting model, the assumption is that competition will develop to satisfy the demand. For GCN, the assumption is that the market share between the commuter and air carrier type service will continue roughly corresponding to the historic pattern. If Republic can maintain the growth they have experienced in the last year or if other air carriers actively entered the GCN market, this assumption would not be valid.

4. <u>Constraints:</u>

a. Possible or potential constraints to growth not adequately addressed - such as possible noise abatement procedures at Tusayan, overflight of GCNP, available lodging, local economy, GCNP visitation limits, etc.

Constraints of lodging are incorporated in market share forecasts (i.e. reduction of market share of based commuter operations). Future limits placed by GCNP could effect GCN, but are not well defined and are beyond the scope of this study. If major constraints develop which are not incorporated in the forecasts, and this includes those mentioned as well as other things such as a major depression, significant shift of economic power, WW III, etc., the forecasting methodology will obviously be in error.

Possible noise abatement or noise avoidance procedures at Tusayan will be investigated in the environmental analysis. Noise zoning to prevent incompatible development in the immediate airport vicinity will be recommended and if adopted will prevent future noise sensitive developments in the noise impact areas adjacent to GCN.

b. Block times were discussed as a possible means of minimizing grouped arrivals at GCN with attendent slow turn around times, delays in arrival or departure and concentrated noise from overflights in GCNP.

Allocation of block times for aircraft departing Las Vegas would alleviate some of these problems. Increase in capacity could result as shown on Figure III-1.

5. Helicopter Ops-Heliport: Discussion regarding relatively slow forecasted increase of helicopter operations and the safety of the present helicopter operations in Tusayan. Helicopter operations have followed same trend as based commuters.

   Slow forecasted helicopter growth is based on assumption that lodging will be constraint to future overnight visitations. A heliport will be incorporated into the airport facilities requirements. Concerns for the heliport include ground access, visibility for marketing, interaction with other airport traffic, safety and noise. Concensus was that present location is hazardous and should be relocated but that helicopter operators will resist, primarily due to marketing advantage of high visibility location to drive through traffic.

6. Military: Military traffic consist primarily of helicopters arriving in flights of up to 15-16. Frequently they arrive at peak activity periods and cause parking problems and potential safety problems on the ramp. Additionally, asphalt pavement displacement by the skids is a problem. Also ATCT military count is misleading since tower count is for the flights only which may consist of several helicopters. If ramp space is full, difficult to park helicopter elsewhere due to debris problem.

   Heliport design should alleviate some of this problem. Adequate ramp space will also help.

7. Immediate Needs: Discussion regarding relationship of long term forecasts (i.e. 1993-2003) versus immediate needs. Operators at airport and airport management have unfilled requirements and continuing problems with present facility such as lack of tiedowns on main ramp, inadequate ramp space, layout of baggage handling area, passenger flow through terminal, problems in keeping up with maintenance, delays in repairs (especially CFR and maintenance equipment), etc.

   Agreed that existing problems need to be addressed in airport requirements section and pointed out that several projects are in design to alleviate some of these items. Long range airport requirements will identify the ultimate airport configuration and thus provide the requirements for short range improvements to avoid conflicts with future developments.

8. Airport Requirements: Ramp configurations should include effect of larger aircraft. Only location on present site for additional runway is on east side of present runway; requires ATCT relocation. Present facilities should be analyzed as to their expected life, functionality, etc. Manpower requirements for airport operation should be addressed including upgrading existing facilities versus expansion, state funding levels, additional manning for expanded facilities, etc.

   These topics are all to be included in future sections of the master plan.

9. Capacity: Peak hour traffic (i.e. grouped arrivals in A.M. and grouped departures in P.M.) is the capacity problem, not annual traffic.

   Both seasonal peaking and daily peaking are incorporated in the calculation of PANCAP. Peak hourly capacity is the variable used to evaluate airport capacity, delays, etc. However, annual or possibly seasonal total traffic is the macro variable which is smooth enough for forecasting and other evaluations.

10. Direction of Master Plan:

   Additional runway may not be needed due to other airport developments and perception that the forecasts are too high. Possibility of short parallel such as 5000±' to relieve main runway was discussed. High density altitude problems will limit usefulness as a departure runway.

   Additional Sites (or Different Sites) as possible relief for GCN could include an improved strip on the north rim, other strips in vicinity of GCN (including private strips in conjunction with developments), airport under construction at Havasupai, etc. Concensus of advisory group was that investigating alternate sites would be a step backward for GCN but that the Havasupai airport would possibly attract significant traffic from GCN.

   Re-evaluation of forecasts will be performed including revision of ATCT counts, consideration of Havasupai Airport, foreign tourism factors and local constraints.

Advisory Group Members in attendance at the second meeting held on November 1, 1982 from 7:00 p.m. to 10:30 p.m. at the Grand Canyon Squire Inn were as follows:

| | |
|---|---|
| Dan Lawler | -Air Grand Canyon |
| Joe Weidman | -NACOG |
| John Hyatt | -Fred Harvey |
| Bob Donaldson | -Grand Canyon Airlines |
| Nancy lee | -David Babbitt Industries |
| Ron Warren | -Grand Canyon Airlines |
| Jim Tokarski | -Grand Canyon Tower (FAA) |
| Gary Maaske | -Airport Manager |
| Jim Dellen | -Airport Supervisor (Maint.) |
| Tom Schafer | -Coconino County |
| Ron Gentry | -Republic Airlines |
| Kathleen Davis | -National Park Service |
| Clint Dodge | -Leedshill-Herkenhoff |
| Jim Webster | -Leedshill-Herkenhoff |

LEEDSHILL-HERKEN[illegible]F, INC.
Arizona Title Building
111 West Monroe, Suite 718
Phoenix, Arizona 85003
(602) 252-0412

1706-1955.12-83

James L. Webster, PE

November 9, 1983

Mr. Ron Warren
Grand Canyon Airlines, Inc.
P.O. Box 3038
Grand Canyon, AZ 85023

RE: GCN - Master Plan

Dear Ron:

Transmitted with this letter please find our response to your comments on Draft Report 1. We appreciate the time and effort you and your staff devoted to this review and will utilize the data contained in the comments.

I hope our response clarifies some of these items. If you have any questions, please do not hesitate to call us.

Sincerely,

Clint Dodge

CLINT DODGE

bz

Enc.

cc: Allan Samuel, ADOT

November 9, 1983

GRAND CANYON NATIONAL PARK AIRPORT MASTER PLAN
Response to Comments dated October 28, 1983 by
Grand Canyon Airlines on Draft Report 1

| Page No. | Response |
|---|---|
| I-3 | ATCT hours corrected. |
| I-4 | Wind coverage clarified as percent of time crosswind component is less than 15 mph. Hangar added. |
| I-5 | Water rights are important to future water collection and use. ADOT is currently pursuing the water issue as part of the condemnation and this data will be incorporated into the Master Plan when available. |
| I-6 | Added additions and correctons to improvement schedule. |
| I-7 | Ramp congestion several time during summer reported by airport manager. |
| I-8 | Water rights will be monitored - see 1-5. |
| I-11 | Asbestos cement water pipe is a common piping material. |
| I-16 | Fire system check-out as well as recommended testing interval and procedures will be included. |
| I-18 | Correction made. |
| I-19 | Existing laws and ordinances of course do have major impacts on airport activity and development. The listing here was intended to identify those ordinances which pertain directly to this airport. F.3 has been clarified to state that no restrictive land use or environmental protection of the community on the airport specifically directed towards airport activity have been adopted. |
| II-4 | Trend towards larger helicopters will be incorporated. |
| II-5 | Even though Air Grand Canyon not authorized for "scheduled" i.e. commuter, for practical purposes we will continue to identify commercial operations of locally based air taxi, charter and commuter flights as "based commuters".<br><br>Airport manager records were utilized primarily to identify aircraft mix with ATCT records used as the baseline for operations. |

| Page No. | Response |
|---|---|
| II-6 | The last sentence on page II-5 has been noted for correction. Table II-6, as noted on page II-5 is airport record of operators as of August 1983. The intent is to point out the diversity of operators of GCN, not to try and keep up with rapidly fluctuating carrier financial conditions which is fortunately beyond the scope of this report. |
| II-10 | Enplanement counts for GCA were taken directly from FAA/TSC database as enplanements reported to FAA by GCA. |
| II-15 | We have not researched the question of which operators have certificates for GCN. However, as noted in the computer printouts from the FAA (Appendix) Air Nevada reported enplanements in the CRAC (Certificated Route Air Carrier) category. The use of only in reference to Republic has been corrected. |
| II-20 | See meeting minutes discussion under constraints. |
| II-22 | Time lag will fall out of model if appropriate. See meeting minutes for further discussion. |
| II-22 | "Short" in the context used here refers to the availability of only 4 years of enplanement data during a period of variable national and international economic situations. For a forecasting model to conceptually make sense, the growth period as well as the recession period must correlate. Thus the enplanement data is short compared to the fluctuations in the data which are available for independent variables. |
| II-23 | The effect on correlation by the delay between international economic factors and foreign visitation will be investigated. |
| II-25 | Corrected Twin Otter data.<br>The assumption discussed on II-25 concerning the aircraft mix relates the historic mix to the <u>unadjusted</u> forecasts. The historic data was assumed to be based essentially on a period of relatively stable aircraft mix. From the comments at the meeting, this would appear reasonable. The changing mix of A/C is incorporated into the <u>adjusted</u> forecasts. We may have misinterpreted the intent of this comment; if so, please let us know. |
| II-26 | Operations tended to take on increased importance at this point of the study since that was the forecasting variable. Passenger movement and especially peak hour movements are of course of utmost importance for terminal and related facilities and will be identified as a function of A/C size, arrival peaking, etc. for use in developing airport requirements. |

| Page No. | Response |
|---|---|
| | The forecasted local operations including IFR training of 2% is more consistent with the historic range of 1.8-6.0% than is 1%. Either way, it does not appear to be a significant factor. |
| II-27 | Assumption that "based" commuter operations will decline over the 20 year forecast period from 25% to 8% stems from the dependency by the based commuters on GCNP visitors arriving by ground transportation and the known lodging scarcity and the difficulties and expense of building significant lodging in the immediate locale. From the comments at the meeting, it appears that these assumptions are acceptable. Forecasted growth of based commuter enplanements and operations are 230% and 130% during the 20 year period. |
| | Continued day trip increase is not a free standing assumption but the result of the previous assumptions i.e.<br>Ops related to independent variables, either national or international (unrestrained).<br>Pax related to ops.<br>Pax mix as defined. |
| | Increased day trips conceptually fits with limits on lodging. Comments at meeting concerning overseas marketing scouting reports that more visitors desire overnight GCNP trips would indicate that more lodging demand will be brought to bear and this could effect this conclusion. |
| II-29 | B-767 should be B-757. |
| II-30 | As noted, we had no data and will adjust estimates of GA A/C to conform to your estimates since you, as the FBO, have a lot better idea of the actual traffic. |
| III-2 | Data from ATCT on hourly ops will be incorporated. The 13.5% existing peak hour factor appears to be OK, but more traffic from 10:00 to 3:00 than we anticipated. |

General:

Concur with statement that forecasted data sets the scale for all subsequent planning. The most important aspect of the forecast is to plan for adequate long term growth but to construct only those elements for which demand is proven. In this sense, the initial goal of the forecasts is to define the ultimate airport function so that all intermediate development can be integrated. For this purpose, a "macro" forecasting model is required which allows forecast of reasonable ultimate requirements (i.e. it is better to plan on long range growth which may not occur than the reverse as long as development is keyed to known demand).

Correlation of historic aviation activity (ops) with foreign visitation is strictly a mathematical function. We will verify our data and check the analysis but do not intend to massage the data to obtain correlations. We have included larger A/C in the forecasts, perhaps not adequately. As more commuters go to larger A/C, with resultant fewer departure times and perhaps less emphasis on sightseeing aspects of flight to the canyon; will other commuters with smaller A/C move in to fill the void? As discussed at the meeting, this may have happened to Republic and is the historic growth model of the airline industry. Noise zoning, heliports, etc. will be included in the upcoming sections of the report.

# United States Department of the Interior

NATIONAL PARK SERVICE
GRAND CANYON NATIONAL PARK
GRAND CANYON, ARIZONA 86023

IN REPLY REFER TO:

L3215

DEC 12 1983

Leedshill-Herkenhoff, Inc.
Arizona Title Building
111 West Monroe, Suite 718
Phoenix, Arizona 85003

Dear Sirs:

We appreciate the opportunity to review the Grand Canyon National Park Airport Master Plan Draft Report Number 1. We believe that Leedshill-Herkenhoff, Inc., has done a very timely job of pulling together diverse sources of information for this report. The heart of the report - aviation forecasts - has been developed on a sound technical basis, but we are concerned that some of the underlying assumptions may not be correct. It is these underlying assumptions, and some of the conclusions reached, that are the focus of our comments on the report. Almost as important as what the report says, is what it does not say. Failure to address any constraints (i.e., land, water, accommodations, etc.) makes it impossible to determine the full implications of the study.

Page II-20 identifies the assumptions made in this analysis. The first assumption is that Grand Canyon overflights will continue to expand without restriction. Section 8 of the Grand Canyon National Park Enlargement Act, Public Law 93620, specifically states that the Secretary of the Interior shall act to protect the health, welfare and safety of park visitors, and the natural quiet and experience of the park where it is jeopardized by aircraft or helicopter activity over the park. While we cannot state how these values would be impacted by the almost 700 percent increase in aircraft operations forecasted for the next 20 years (Table II-20), we believe that this law should be recognized as a constraint.

The second assumption on this page is that park visitation opportunities are unlimited. This assumption is refuted by the 1977 Development Concept Plan for the South Rim Village which establishes a fixed capacity for overnight lodging units and calls for establishment of a day-use capacity on the South Rim. Because aircraft operations are so directly tied to park use, it is especially important to note these use limits. Park overnight lodging (including hotels and camping space), which is frozen at current levels by the 1977 plan, is currently full 100 percent of the time during the peak summer season.

As previously stated, the data collected is comprehensive, considering available information. Analysis techniques appear to be sound, but relying on data collected exclusively during the late 70's and early 80's may be unrealistic. This time period has been characterized by rapid growth for the airport, and it is not reasonable to expect this growth rate to continue indefinitely. Forecasts such as this which are based totally on past trends, and without constraints, can lead to nonsensical results. Unfortunately, this high rate of growth is built into the model by means of the correlation coefficients. While these projections may be real over the short term, 5 or at the very most 10 years, the longer term forecasts probably have little validity. We support the concept discussed on pages II-32 and 33 of continued revision of the coefficients over time.

While we do not take major exception to deviation of the critically important independent variables provided by Chase Econometrics, we do believe appropriate caution should be exercised in working within these difficult variables.

Another factor affecting the accuracy of these long-term use projections is found in the nature of the tourist market. Page II-5 of the report recognizes this and states that "this arena of aviation is characterized by volatility which is compounded by the fluctuating and competitive nature of the tourist market". Further, it is significant to note that park visitation peaked in 1976, whereas airport use did not peak until 6 years later. This obviously indicates that an increased percentage of park visitors is served by this facility annually. It also shows that the number of potential customers is finite and that use expansion is not a function of economic activity, but perhaps of increased supply.

Our other major concern is omission of any constraints on expansion of aircraft operations. Specifically, we are concerned about water use, land availability, safety considerations under an expanded use scenario, and the fact the helicopter use is not included in the report at all. We believe that the above considerations must be included to make this report viable.

Again, we appreciate the opportunity to comment. If you have further questions, please contact Mr. Steve Hodapp at (602) 638-7751.

Sincerely,

Richard W. Marks

Richard W. Marks
Superintendent

# Department of Community Development

County Courthouse, Flagstaff, Arizona 86001 Phone 779-6716


May 11, 1984

RECEIVED 5-14-84

Jim Webster
c/o Leedshill-Herkenhoff, Inc.
Arizona Title Building
111 West Monroe, Suite 718
Phoenix, Arizona 85003

Dear Jim:

Enclosed are the materials you requested regarding the Tusayan community. I checked our files on the two helicopter operations now situated within the community and have the following to pass on to you:

1. Grand Canyon Helicopters was originally granted a conditional use permit to operate from their current location in December 1966. (UP-66-14, Resolution 66-71) The permit was modified in September of 1980 and is good until September 30, 1990, conditional to compliance with F.A.A. regulations and operation in accordance with the approved site plan.

2. Madison Aviation was granted a conditional use permit (UP-79-4) in 1979. Their permit was also modified (UP-80-3) in 1980, and is set to expire on August 26, 1990. They also must be in compliance with F.A.A. regulations and their site plan.

We would appreciate it if you could check on the status of both operation's F.A.A. permits and compliance therewith and let us know what you find out. We'll check on the site plans for your information.

We would also be interested in F.A.A. permit requirements covering a change for Grand Canyon Helicopter's operations to incorporate the use of a Sikorsky S-58-T 14 passenger model. I've checked with the County Attorney and he advised that a modification to the use permit would be required given the change in characteristics of the operation.

Let us know what you find out and call if you need anything else.

Sincerely,

John P. O'Brien FOR TOM SCHAFER.

Tom Schafer
Principal Planner

TGS:sep

LEEDSHILL-HERKENHOFF, INC.
Arizona Title Building
111 West Monroe, Suite 718
Phoenix, Arizona 85003
(602) 252-0412

James L. Webster, PE

May 31, 1984

Mr. Sonny Najera, Director
Aeronautics Division
Arizona Department of Transportation
1801 West Jefferson
Phoenix, Arizona 85007

Re: Grand Canyon National Park Airport Master Plan
ADAP #6-04-0019-13

Dear Mr. Najera:

Accompanying this letter please find the following:

1. Draft Notice of Public Meeting for the Environmental Review

2. Completed A-95 process Standard Form 424

3. 30 copies of the Draft Environmental Review

As we discussed yesterday, the draft notice of the Public Meeting needs to be published by a newspaper(s) of general circulation in the Tusayan/Grand Canyon area. It is our understanding that the Aeronautics Division will take care of this item.

We will forward a copy to each member of the Advisory Group and extra copies to locations identified in the legal notice where copies will be available for public review.

In reference to the Standard Form 424, please attach this form to the ten copies of the Draft Environmental Review and submit to the Arizona State Clearinghouse for their distribution. They will coordinate with Northern Arizona Council of Governments.

If you have any questions, please contact me.

Very truly yours,
LEEDSHILL-HERKENHOFF, INC.

JAS L WEBSTER

James L. Webster
President
Arizona Regional Operations

JLW:mb

OMB Approval No. 29-R0218

# FEDERAL ASSISTANCE

| | |
|---|---|
| 1. TYPE OF ACTION (Mark appropriate box) | ☐ PREAPPLICATION<br>☐ APPLICATION<br>☐ NOTIFICATION OF INTENT (Opt.)<br>☐ REPORT OF FEDERAL ACTION |
| 2. APPLICANT'S APPLICATION | a. NUMBER<br>b. DATE Year month day 19 84 6 1 |
| 3. STATE APPLICATION IDENTIFIER | a. NUMBER<br>b. DATE ASSIGNED Year month day 19 |
| Leave Blank | |

**4. LEGAL APPLICANT/RECIPIENT**

- a. Applicant Name : State of Arizona
- b. Organization Unit : Aeronautics Division
- c. Street/P.O. Box : 1801 West Jefferson
- d. City : Phoenix
- e. County : Maricopa
- f. State : Arizona
- g. ZIP Code:
- h. Contact Person (Name & telephone No.) : Mr. Gary Adams (602) 255-7691

**5. FEDERAL EMPLOYER IDENTIFICATION NO.**

**6. PROGRAM (From Federal Catalog)**
- a. NUMBER 2 0 • 1 0 3
- b. TITLE Airport Planning Grant Program Dept. of Transportation

**7. TITLE AND DESCRIPTION OF APPLICANT'S PROJECT**

The Environmental Review of the Master Plan for the Grand Canyon National Park Airport which provides for the establishment of guidelines for airport development.

**8. TYPE OF APPLICANT/RECIPIENT**

A-State, B-Interstate, C-Substate District, D-County, E-City, F-School District, G-Special Purpose District, H-Community Action Agency, I-Higher Educational Institution, J-Indian Tribe, K-Other (Specify):

Enter appropriate letter: E

**9. TYPE OF ASSISTANCE**

A-Basic Grant, B-Supplemental Grant, C-Loan, D-Insurance, E-Other

Enter appropriate letter(s): E

**10. AREA OF PROJECT IMPACT** (Names of cities, counties, States, etc.)

Tusayan, Grand Canyon & Central Coconino County

**11. ESTIMATED NUMBER OF PERSONS BENEFITING**

**12. TYPE OF APPLICATION**

A-New, B-Renewal, C-Revision, D-Continuation, E-Augmentation

Enter appropriate letter: N/A

**13. PROPOSED FUNDING**

| | | |
|---|---|---|
| a. FEDERAL | $ -0- | .00 |
| b. APPLICANT | -0- | .00 |
| c. STATE | -0- | .00 |
| d. LOCAL | | .00 |
| e. OTHER | | .00 |
| f. TOTAL | $ -0- | .00 |

**14. CONGRESSIONAL DISTRICTS OF:** a. APPLICANT — b. PROJECT

**15. TYPE OF CHANGE** (For 12c or 12e)

A-Increase Dollars, B-Decrease Dollars, C-Increase Duration, D-Decrease Duration, E-Cancellation, F-Other (Specify): N/A

Enter appropriate letter(s):

**16. PROJECT START DATE** Year month day 19 N/A

**17. PROJECT DURATION** N/A Months

**18. ESTIMATED DATE TO BE SUBMITTED TO FEDERAL AGENCY ▶** Year month day 19 84 7 20

**19. EXISTING FEDERAL IDENTIFICATION NUMBER**

**20. FEDERAL AGENCY TO RECEIVE REQUEST** (Name, City, State, ZIP code)

FAA Southern Airports District Office, Hawthorne, CA 90261

**21. REMARKS ADDED** ☐ Yes ☒ No

**22. THE APPLICANT CERTIFIES THAT ▶**

a. To the best of my knowledge and belief, data in this preapplication/application are true and correct, the document has been duly authorized by the governing body of the applicant and the applicant will comply with the attached assurances if the assistance is approved.

b. If required by OMB Circular A-95 this application was submitted, pursuant to instructions therein, to appropriate clearinghouses and all responses are attached: No response / Response attached

(1) ☐ ☐
(2) ☐ ☐
(3) ☐ ☐

**23. CERTIFYING REPRESENTATIVE**

a. TYPED NAME AND TITLE: Mr. Sonny Najera, Director, Aeronautics

b. SIGNATURE

c. DATE SIGNED Year month day 19 84 5 31

**24. AGENCY NAME**

**25. APPLICATION RECEIVED** Year month day 19

**26. ORGANIZATIONAL UNIT**

**27. ADMINISTRATIVE OFFICE**

**28. FEDERAL APPLICATION IDENTIFICATION**

**29. ADDRESS**

**30. FEDERAL GRANT IDENTIFICATION**

**31. ACTION TAKEN**

☐ a. AWARDED
☐ b. REJECTED
☐ c. RETURNED FOR AMENDMENT
☐ d. DEFERRED
☐ e. WITHDRAWN

**32. FUNDING**

| | | |
|---|---|---|
| a. FEDERAL | $ | .00 |
| b. APPLICANT | | .00 |
| c. STATE | | .00 |
| d. LOCAL | | .00 |
| e. OTHER | | .00 |
| f. TOTAL | $ | .00 |

**33. ACTION DATE ▶** Year month day 19

**34. STARTING DATE** Year month day 19

**35. CONTACT FOR ADDITIONAL INFORMATION** (Name and telephone number)

**36. ENDING DATE** Year month day 19

**37. REMARKS ADDED** ☐ Yes ☐ No

**38. FEDERAL AGENCY A-95 ACTION**

a. In taking above action, any comments received from clearinghouses were considered. If agency response is due under provisions of Part 1, OMB Circular A-95, it has been or is being made.

b. FEDERAL AGENCY A-95 OFFICIAL (Name and telephone no.)

AERONAUTICS DIVISION

ARIZONA DEPARTMENT OF TRANSPORTATION
1801 West Jefferson
Phoenix, Arizona 85007

NOTICE OF PUBLIC MEETING

Notice is hereby given that a Public Meeting will be held on the 6th day of July 1984 in the Navajo Room of the Grand Canyon Squire Inn, Tusayan, Arizona, beginning at 7:00 p.m., at which place and time, Aeronautics Division of the Department of Transportation will receive oral and written comments on the Draft Environmental Review prepared for the Grand Canyon National Park Airport Master Plan, Grand Canyon National Park Airport, Tusayan, Arizona.

Copies of the Draft Environmental Review are available for public review at any of the following locations: (1) Airport Manager's Office, Grand Canyon National Park Airport, Tusayan, Arizona; (2) Planning and Zoning Department, Coconino County Courthouse, 219 East Cherry, Flagstaff, Arizona; or (3) Aeronautics Division, 1801 West Jefferson, Room 426, Phoenix, Arizona.

FEDERAL ASSISTANCE

Sedona, Grand Canyon & Central

FAA, Western Region District Office, Hawthorne, CA 90261

Ensperger 31 Aug 84

635-2681

**UNITED STATES DEPARTMENT OF AGRICULTURE**
**FOREST SERVICE**
Kaibab National Forest
800 South Sixth Street
Williams, Arizona 86046

5430
5480 MAY 25 1984

Mr. Sonny Najera
Director, Aeronautics Division
Arizona Department of Transportation
1801 West Jefferson
Phoenix, AZ 85007

DEPT. OF TRANSPORTATION
MAY 29 1984
AERONAUTICS DIVISION

Dear Mr. Najera:

We have reviewed your two draft reports for the Grand Canyon National Park Master Plan. It is our understanding that these two documents are intended to simply identify the future physical needs of the airport and subsequent environmental assessments will be based on the alternatives identified in these two reports.

In reading these reports it is apparent additional National Forest Lands will be required if airport expansion is to take place. This, plus the use of Federal funds places ADOT in the situation of needing to comply with the process outlined in the National Environmental Policy Act of 1969.

The intent of the NEPA process is to identifie and evaluate the consequences of various issues, concerns and alternatives, and is a prerequisite to possible future allocation of National Forest Lands for airport purposes.

For example, specific concerns of the Forest Service which need be addressed in subseuquent EA's or EIS's would include:

1. The effect of the acquisition of additional Forest Lands by the State of Arizona on:

   a. Park Service management objectives for the Grand Canyon National Park.

   b. Social and economic impacts of communities dependent of Grand Canyon tourism.

2. Identification of lands to be used for other than airport purposes. This second concern stems from previous meetings we have had with you (please see my May 28, 1983 letter to you). and phone calls received at my office from citizens expressing concern about this possibility.

We have also read newspaper accounts about a 180 unit motel which is to be constructed as part of the airport lease, although no specific location was given. Presumably, if these accounts were correct, this work would be on land already owned by the state.

3. Other items which need to be addressed would include:

   a. Resolution of public access to northwest side of airport - (see original deed to state reserving access across airport) or change in overall access and transportation needs.

   b. Air space obstructions and identification of same on National Forest lands

   c. Impacts on Forest Service and Air Tanker Base.

We will, of course provide any information we have which would expedite your preparation of either an EA or EIS. We realize no preferred alternatives have been identified at this point, however, we would be happy to meet with you at your convenience to review in detail your tentative plans, and to further clarify our specific concerns.

Sincerely,

LEONARD A. LINDQUIST
Forest Supervisor

Kaibab National Forest
800 South 6th Street
Williams, Arizona 86046 5430

MAY 20 1983

Arizona Dept. of Transportation
ATTN: Mr. Sonny Najera, Asst. Director
Public Transit Division
205 S. 17th Avenue
Phoenix, Arizona 85007

Dear Mr. Najera:

It has been some time since we have been in touch with you about the State's proposed acquisition of an additional 700-1300 acres of National Forest land adjacent to the Grand Canyon Airport. The delay was prompted, in part, by an administrative moratorium on initiating, negotating, or processing any new exchange proposals involving National Forest lands. This moratorium has been lifted to the extent that we can resume discussing the possibility of an exchange provided it can meet certain management, social, and economic criteria and there is early agreement on the relative acreages of both the Federal and non-Federal lands involved.

This particular land exchange proposal will require the preparation of an Environmental Impact Statement because of its potential significant impact on the social and economic structures on the communities of Tusayan, Williams, Flagstaff, and the Grand Canyon National Park.

Various laws dictate certain minimum standards and objectives be met for every exchange, if it is to be considered actionable. The General Exchange Act of March 20, 1922 is our basic authority for processing exchanges, but Congress has passed other laws which have had a significant effect on our exchange process in that specific minimum requirements have been identified. For example, each and every exchange must:

1. Comply with the following sections of Public Law 94-579 (FLPMA). Section 206 (A): "That the exchange will provide for better Federal land management and the needs of the State and local people, including needs for the economy, community expansion, recreation areas, food, fiber, minerals, fish, and wildlife."

Section 206 (D) states: "That the values of the lands exchange shall be equal. If not equal, the values shall be equalized by the payment of money to the grantor so long as payment does not exceed 25 percent of the total value of the lands transferred out of Federal ownership."

2. Comply with the Endangered Species Act of 1973.

3. Comply with the requirements of the National Historic Preservation Act of 1906, Executive Order 11593, and the Advisory Council on Historic Preservation.

4. Comply with the requirements of Executive Order 11988 (Flood Plain Hazard).

One of the early steps in preparing an EIS is identification of issues and the development of evaluation criteria which can be used to guide the process and to identify the data needed to evaluate the alternatives to resolve the identified issues. Tentatively we have identified the following list as potential issues which will have to be evaluated in an EIS:

1. Compatability with Park Service management objectives for Grand Canyon National Park.

2. Contribution to coordinated and orderly community development.

3. Social and economic impacts on communities dependent on Grand Canyon tourism.

The following general criteria have been developed for evaluating land exchange proposals so compliance can be demonstrated with the preceding laws.

Federal lands, in the Tusayan area, to be suitable for disposal from the National Forest System, are identified by meeting the following criteria:

1. Land essential for community expansion, including commercial forest lands.

2. Parcels that will serve a greater public need in State, county, city, or other Federal agency ownership.

3. Lands under special use permit and no longer desirable for public use.

4. Lands that are inconsistent with National Forest purposes and whose disposal would not conflict with existing laws and regulations.

Non-Federal lands which would be desirable for inclusion into the National Forest System are identified by using the following evaluation criteria:

A. Tracts that will increase resource outputs of National Forest and are needed to promote effective resource management outputs to meet specific needs of sustained-yield management, watershed management, research, public recreation, or other defined management emphasis.

B. Lands needed to block in or consolidate existing Forest lands and reduce the miles of interior boundaries and number of interior corners.

C. Lands needed to lower administrative costs by eliminating or reducing title claims, special uses, road and trail rights-of-way grants, and easements.

D. Lands having endangered or threatened fish, wildlife, or plant species habitats.

E. Key game management areas.

F. Lands having unique historical or cultural resources, when these resources are threatened by change in use or when management may be enhanced by public ownership.

G. Lands primarily of value for outdoor recreation purposes and lands needed for aesthetic protection.

H. Lands that ensure access to public lands and resources.

The preceding criteria are subject to change but they are representative of the considerations and levels of evaluation that would have to go into the preparation of an EIS. The Forest Service can evaluate the land management aspects needed in an EIS but an evaluation of the social and economic aspects, and some definition of acceptable change in each community, is beyond our capabilities and expertise. As we see it now, if this proposal is to develop beyond the talking stage, the State will have to assume the responsibility of identifying, collecting, and evaluating the necessary social and economic data needed to prepare the EIS. In effect, the State will have to act as a "contractor" for the Forest Service in preparing the EIS.

We have, during the past "moratorium," been working on two important aspects which have to be accomplished and resolved before we decide if this proposal is worth pursuing. First, we have tentatively identified the State owned lands located in alternate sections southwest of Flagstaff as those lands which would best meet the criteria describing lands suitable for inclusion into the National Forest System by "providing for better Federal land management."

Secondly, our land appraisers have arrived at some tentative estimates of value on which the following exchange acreages were developed. These acreages are based on the estimated land values for the selected lands around the Grand Canyon Airport and the State lands southwest of Flagstaff. It is their estimate, that to comply with the "equal value" provisions of law, it would take 7,500 acres of State land southwest of Flagstaff to balance a 700 acre State selection of land adjacent to the airport or 9,500 acres if 1,400 acres were selected.

I realize this has been a lengthly letter, however, before any more time or effort is spent on it by either party I feel it is essential some mutual understanding and agreement be reached on:

1. The need for an EIS, the issues it will identify and mitigate, and whose responsibility it will be to both obtain the necessary data to evaluate the alternatives and who will do the actual preparation of the EIS.

2. The lands and respective acreages to be involved in an exchange, if one is to take place.

3. Who will bear the costs for obtaining required archeological clearance reports.

4. And lastly, the understanding that the preparation and publication of an EIS will in no way imply or guarantee the completion of an exchange if it is determined the social and economical impacts will be unacceptable.

Please contact Dennis Lund if you feel it would be advantageous to continue with our preliminary ciscussions.

Sincerely,

LEONARD A. LINDQUIST
Forest Supervisor

CC: D-4
Coconino NF
Div. of Lands - R.O.
Dick Marks, Superintendent, Grand Canyon N.P.

DLUND/disk #6 misc. job #11

RP

United States Department of the Interior

NATIONAL PARK SERVICE
GRAND CANYON NATIONAL PARK
P.O. BOX 129
GRAND CANYON, ARIZONA 86023-0129

IN REPLY REFER TO:

L3215 (GRCA)

JUN 05 1984

RECEIVED 6-6-84

Messrs. James Webster and Clinton Dodge
Leedshill-Herkenhoff, Inc.
Arizona Title Building
111 West Monroe, Suite 718
Phoenix, Arizona 85003

Gentlemen:

We appreciate the opportunity to review and discuss with you Draft Report Number 2 of the Grand Canyon National Park Airport Master Plan. This version provides a much clearer and more comprehensive overview of the development program and a more accurate analysis of historical use data. The section of the document outlining alternative airport development schemes is especially clear and comprehensive. Our major concerns continue to be the assumptions involved in the projections and the potential environmental consequences of full development. We understand that the environmental consequences will be detailed in the next version of the plan and therefore will limit our discussion on that aspect to environmental issues we would like to see analyzed. The focus of our comments here will be the assumptions and process used to develop user projections.

As a bottom line, we would agree that the 56% decrease in projected aircraft operations to 175,376 operations in 2003 seems more realistic to us. However, while the mechanics leading to this bottom line are basically sound, there are several things which concern us.

1. Between draft report number 1 and draft report number 2 there are several assumptions which change without explanation; for instance the projected number of seats on commuter/air taxi flights is higher in draft 2, the general aviation aircraft mix (table II-25) is different, etc.

2. We identified several assumptions which appear to require additional support; for example: the assumption that air carrier operations will level off at 2,000 per year when they have declined 25% to 1,787 in 1983, that commuter operations will decline from 82.7% of aircraft operations in 1983 to 53% in 2003 when they have substantially increased in the recent past, etc.

3. Measures of aircraft operations were collected between 1974 and 1982. It seems obvious that this has been the period of most rapid growth for the airport. This introduces an equally obvious bias into the model. Forecasts developed by the model are substantially higher than if a longer, more

stable period had been studied. Common sense seems to indicate that airport operations will not continue to grow at their historically highest rate. This problem can be partially mitigated by periodically updating the model (say every 5 years) with the most current data on airport operations, then, developing new correlation coefficients and running the model again.

4. The one inconsistency we identified was the capacity of the helicopter. Page II-32 predicts the capacity to increase whereas the airport design (page IV-18) assumes that equipment utilized will not change.

5. Anyone who has followed national economic issues over the past decade must appreciate how risky it is to predict economic indicators like gross national product, consumer price index, foreign travel expenditures, and effective exchange rate. Yet the model forecasts are based on such predictions over the next 20 years. While the model may be relatively accurate over the short-term, its accuracy over a 20 year time period seems highly questionable.

6. As we have previously stated, the first two assumptions concerning Grand Canyon overflights and park visitation limits on page II-22 are not reasonable. We anticipate these issues will be more fully analyzed in the environmental review document.

In summary, we do not dispute the projections, and in fact feel the authors have done a good job considering the limited data available. We do feel these projections raise many questions and should be utilized with extreme caution.

Environmental issues we would like to see discussed in the environmental review document include:

1. An analysis of noise impacts to the park. This would include specific analysis of frequency of aircraft noise and noise volume along approach paths and along tour routes over the park. We would also like general information on aviation trends over the park.

2. An analysis of the projected water demand to include analysis of sources for additional water. This appears to be especially critical now that limitations have apparently been placed on capture of runway run-off water.

3. An analysis of visitor arrivals to Grand Canyon National Park to include review of arrival times, transportation modes to the park and demands on concession facilities related to lodging, food, etc.

We appreciate the opportunity to comment.

Sincerely,

Richard W. Marks

Richard W. Marks
Superintendent

GRAND CANYON AIRLINES
Since 1926
POST OFFICE BOX 3038 • NATIONAL PARK AIRPORT • GRAND CANYON, ARIZONA 86023

Grand Canyon AZ (602) 638-2407 | Cont U.S., Ex AZ (800) 528-2413 | Arizona Only (800) 528-2469 | Worldwide Telex 298025

June 25, 1984

Leedshill-Herkenhoff, Inc.
111 West Monroe, Suite 718
Phoenix, AZ 85003

RECEIVED 6-27-84

Re: Grand Canyon National Park Airport
Master Plan - Draft Final Report

Gentlemen:

While we have not completed our review of the Final Draft Master Plan for the Grand Canyon National Park Airport, one error and one observation merit our comment at this time.

In Section II of the Draft, Table II-11 reports enplanement data for this company far is excess of actual for CY1981 and CY1982. This was reported at the last advisory group meeting, but still appears to be included. I believe that our enplanement statistics may have been reversed with those of Scenic Airlines for those two years. You may wish to check your source on these two years' enplanement items.

The second item is a request for candor. In Section IV of the Draft, five sites are considered for future heliport development. Site 4 is recommended even with the admitted physical drawbacks to development. At the last meeting of the advisory group, your staff candidly admitted that Site 4 was recommended because of its highway frontage and "as an inducement" to the existing helicopter companies to relocate to the airport. If "exposure to highway traffic" and market advantage is a valid consideration for site selection, then I would ask that such considerations be admitted in the report as the motivating factors.

We note that the advisory group members did not support Site 4.

Very truly yours,

Ronald L. Warren

Ronald L. Warren
General Manager

RW:eh

LEEDSHILL-HERKENHOFF, INC.
Arizona Title Building
111 West Monroe, Suite 718
Phoenix, Arizona 85003
(602) 252-0412

832-1955.12-84

James L. Webster, PE

Jim Webster

RECEIVED 7-6-84

June 29, 1984

Mr. Richard Marks, Superintendent
Grand Canyon National Park
P.O. Box 129
Grand Canyon, AZ 86023-0129

RE: Grand Canyon National Park Airport Master Plan
Reponse to National Park Service Comments

Dear Mr. Marks:

Thank you for your comments on the Draft Report 2 dated June 5, 1984 (L3215 (GRCA)). In general, we concur with your concern about the assumptions and lack of adequate historical basis for the projection model. Also, we hope we have addressed the major environmental concerns in the environmental review.

1. Regarding unexplained changes between Draft Report 1 and 2, we tried to catch all of these but obviously did not.

   a. Projected number of seats on commuter/air taxi flights reflects the current and expected continuing aircraft fleet modifications as discussed in II.3.b The average seats/flights are probably already in excess of 12 due to the shift to the Twin Otter by Scenic. The change from Report 1 (page II-30) is very minimal reflecting slight computational differences.

   b. G.A. aircraft mix in Report 2 is correction of erroneous data in Report 1.

   If other unexplained changes are found, please let us know so we can clarify them.

2. Assumptions regarding operations split between different carrier types:

   a. Air carrier: The 2000 air carrier operations per year is representative of historic air carrier operations according to FAA records. The actual count ranges from 1043 in FY75 to 2377 in FY80. The number of air carrier operations is effected by airline schedules to a greater extent than by day to day enplanement demand.

   Projected air carrier operations are not assummed constant at 2000 but are projected to increase at a steady rate over the forecast period. (Table II-27) The critical assumption is the split between air carrier and commuter enplanements which is based on an assummed increase in the market share by the air carriers. Several things support this assumption including possible canyon overflight restrictions which would make the smaller commuter aircraft less attractive, the worldwide marketing organization of the air carriers and the potential for market development for destination points further from the GCN area such as Los Angeles, San Francisco, Denver, etc. The projected aircraft mix and load factors are then utilized to establish operations.

b. The decline in commuter operations, as a percent of the total operations reflects the enplanement assumption discussed above and the increase in commuter aircraft size. The same rationale which supports the air carrier market share increase supports the commuter market share decrease.

Note: We concur that section 3 of Chapter II could be more clearly presented and the assumptions better supported and will attempt to rectify these deficiencies in the final report.

4. We do not agree that the ATCT operating period from 1974 to 1983 necessarily represents the period of most rapid growth of the airport. The last three years have seen a decrease of aircraft operations varying between -4.9 to -6.8%. Additionally, the growth in aviation activity between the airport opening in 1967 and the first year of ATCT operations in 1974 averages in excess of 30% per year, assumming a uniform increase, compared to an average of 12% from 1974 through 1983.

We do concur that the forecasting model must be updated periodically and recommend in Report 1 an increased data collection effort (pages II-32 and 33). These recommendations were inadvertently left out of Report II but are in the executive summary of the draft final. The inital developments recommended in the Master Plan are improvements needed to accommodate existing and near term conditions. All irreversible long term improvements should be initiated only as a result of proven need based on updated or revised planning.

The heleport sizing is based on the Bell 206, typical of the anticipated helicopters.

The long range (i.e. longer than 5 year) projections in the Master Plan are not intended to form definitive construction items, but are intended to allow orderly present development which will be compatible with the long term development <u>if</u> the projections of activity are realized. The major conclusions which can be drawn from the long range portion of this master plan are: (1) the projected long range aviation activity at GCN can feasibly be accommodated at the present site without undue restraints, and (2) short range improvements can be accomplished without irreversible commitment of resources (including land) to satisfy unproven long range aviation demand.

Mr. Richard Marks, Superintendent
June 29, 1984
Page 3

The assumptions mentioned form the basis for unrestrained growth of aviation activity projections. Chapters III and IV investigate improving the airport to accommodate the unrestrained projections with the conclusion that it is feasible to develop airport facilities which are capable of handling the unrestrained traffic (i.e. no constraints were identified associated with the site development itself). GCNP overflight or visitation limits would impact aviation demand. A specific GCNP plan would be required to assess the possible impact on the projections contained in the Master Plan. Potential scenarios have been generally addressed in the Environmental Review.

Environmental Issues

1. Analysis of noise impacts to the park in the detail which GCNP would prefer is beyond the scope of the Master Plan. The overflight problem and potential resolutions have been addressed in a general way in the Environmental Review.

2. The water demend issue is addressed in both Chapter V of the draft final and in the Environmental Review. A run-off capture limit has not been established and the water rights issue has not been resolved to our knowledge.

3. GCNP visitor arrivals by air are poorly documented. For future model updating, we recommend improved visitor data profiles both at the airport and as GCNP visitors. A random sampling system is recommended to maximize data obtained for the cost. This is especially critical for relating visitor volume vs. aviation activity since airport enplanement and operations growth has not been reflected in increased GCNP visitation.

I hope this addresses your concerns. Please do not hesitate to call if you have further questions.

Sincerely,

[illegible] Dodge

[illegible] DODGE, P.E.

[illegible]nny Najera, ADOT - Aeronautics Division

PUBLIC MEETING

Grand Canyon National Park Airport Master Plan
Tusayan, Arizona
July 6, 1984

1. List of Attendees:

| NAMES | REPRESENTING | TELEPHONE |
|---|---|---|
| Tom Boswell | Aeronautic Division, ADOT | 252-7691 |
| Ron Gentry | Republic Airlines | 638-9541 |
| Ron Warren | Grand Canyon Airlines | 638-2463 |
| John Hyatt | Fred Harvey | 638-2237 |
| Steve Hodapp | National Park Service | 638-7751 |
| Nancy Lee | David Babbitt Industries | 638-2887 |
| Wayne Cook | Tusayan Broadcasting | 638-2278 |
| Joe Babbitt | Camper Village/Redleather Lodge | 638-9201 |
| Dorathy Scott | Ames Ford | 289-3354 |
| Gary Maaske | Airpot Manager | 638-2339 |
| Jim Dellen | Airport | 638-2339 |
| James Webster | Leedshill-Herkenhoff, Inc. | 252-0412 |
| Clint Dodge | Leedshill-Herkenhoff, Inc. | 252-0412 |
| Lucy Conley | Leedshill-Herkenhoff, Inc. | 252-0412 |

2. PURPOSE:

The purpose of the meeting was to gather comments from interested parties relating to information presented in the Preliminary Master Plan and accompanying Enviromental Review. The meeting was not a public hearing. Comments received were to be part of the published Master Plan.

3. COMMENTS:

All comments presented at the meeting were verbal with indications from some attendees that written comments would follow within 2 weeks or so.

4. SPECIFIC COMMENTS:

The general nature and relaxed atmosphere of the meeting generated an open forum whereby individuals making comments did not identify themselves. Therefore these comments remain generic in nature and no attempt made at identifying commenters. Also no specific questions were raised, rather multi-faceted general questions and comments were offered as discussion.

a. Budget figures presented are 1984 dollars and should be thought of as strictly general budgetary. Refinements of dollars associated with a Master Plan is not desire-able nor required due to the nature of the document. (Ron Warren, Grand Canyon Airlines)

b. Project priority: Some prioritization of projects are listed, however many other projects are non-prioritized due to the unknowns regarding timing, need and other ramifications. (Ron Warren, Grand Canyon Airlines)

c. Location of heliport/motel restaurant areas: Much dis-cussion was generated about the impact of locating the heliport where shown at Site 5. Areas of concern were disruption of future development of motel and restaurants in prime locations (now designated as heliport development) and road visibility of heliport, motel and restaurant areas. The slurry basin was supposedly the new heliport location as discussed 3½ years ago and its non-selection as a site now was noted by a commenter. All commenters were in general agreement to relocate heliport to airport. (Ron Warren, Joe Babitt)

d. Noise Level: Noise level concerns were voiced by several commenters. The program used to generate the noise level contours was discussed in general and its relevancy to the site at hand was questioned. The general concensus of the panel is that the program is by far the best and most widely accepted, although the analysis criteria and base may be "off" a bit. The noise levels should be conservative. (Ron Warren, Joe Babbitt, Ron Gentry, Gary Maaske, Steve Hodapp)

e. Water facilities: It was previously understood that the state has dropped the water litigation case and Mr. Hatch would pursue the riparian water right issue. This would impact the "sources of the water" issue in the Master Plan. Commenter felt this should be looked at more in depth. (Steve Hodapp)

f. Facility growth: Commenter does not agree that larger aircraft generate more noise and more pollution. A growth toward more sophisticated aircraft can impact less than estimated, because of the higher design standards required for this type craft. (Ron Warren)

g. Computer analysis of noise levels: Commenter suggests other programs be looked at to try to add in terrain ramifications, relook at traffic patterns using no night flights, August only, natural quiet, etc., and see what type of maximum noise levels are generated. (Steve Hodapp)

h. Car load: Discussion of car traffic increase of 300 cars does not relate to anything. Suggests a percentage be used to identify what magnitude the 300 increase is. (Steve Hodapp)

i. Community feedback: Notices to community do not seem sufficient for getting public input. Suggests other methods be utilized to generate public interest at these meetings. (Nancy Lee)

5. CLOSURE:

The meeting closed with a request from the panel that any written comments be submitted to Leedshill-Herkenhoff, Inc., within the following week in order to be incorporated into the final Master Plan.

GRAND CANYON AIRLINES
Since 1926
POST OFFICE BOX 3038 • NATIONAL PARK AIRPORT • GRAND CANYON, ARIZONA 86023

Grand Canyon AZ (602) 638-2407 | Cont. U.S., Ex AZ (800) 528-2413 | Arizona Only (800) 528-2469 | Worldwide Telex 298025

July 10, 1984

RECEIVED 7-12-84 NB

Leedshill-Herkenhoff, Inc.
111 West Monroe
Suite 718
Phoenix, AZ 85003

re: Grand Canyon National Park Airport Master Plan

Gentlemen:

First, I would like to thank you for the opportunity of serving on the advisory group for the Grand Canyon National Park Airport Master Plan. I feel that the process was mutually beneficial.

In reviewing the Final Draft and the Draft Environmental Report, I believe that most of my comments and observations have already been stated. I feel compelled, however, to restate my reservations on the thresh-hold issue of demand. Having been intimately involved with the airport for the last five seasons, I feel qualified to voice a reservation on the projected demand for use. Our records, some of which were incorporated into the report, speak for themselves. I do not believe that the forecast demand for airport operations will materialize. If anything, the airport may very well see a decline in operations, and perhaps passenger enplanements, over the forecast period in line with your graph of rate of exchange displaced one year. This year, 1984, seems to be proving this out. The total "pie" from Las Vegas has seen another decline this year. With the exchange rate at an all time high, foreign visitation is continuing to drop. And, foreign visitation has accounted for the vast majority of Las Vegas originating traffic.

Should this trend continue, the validity of the Plan may be in serious doubt.

Compounding the issue is the announced withdrawal of Republic Airlines from regular service to the Grand Canyon. This withdrawal has far reaching ramifications on many issues. With Sept. 4, 1984, the date for withdrawal of service fast approaching, and no replacement air carrier on the horizon, I question many of the proposed improvements' necessity. The Grand Canyon may return to being a turboprop airfield.

**GRAND CANYON AIRLINES**



It is, of course, possible that another carrier may establish jet service to the Grand Canyon, but I question whether such conjecture should be the basis on which a 20 year Plan should be formulated.

Regarding the Environmental Review, I believe that the issue of helicopter noise was sufficiently discussed at the review meeting. Suffice it to say that noise is, if anything, a major consideration among the local populace. I believe the questions regarding the validity of the "ldn" noise contours were sufficiently discussed as well. It would be desirable to compare computer generated models with the reality of the Canyon/Tusayan area before settling the noise issues. The comments of the National Park Service bear further consideration.

I strongly support the relocation of the ATC tower to the east side of the airport. Safety would be greatly enhanced.

Lastly, I appreciate your patience and consideration of our local concerns. As you discovered at the start of the planning process, Tusayan and the Grand Canyon Airport are inextricably entwined. Sentiments run strong about the airport. Your community involvement is greatly appreciated.

Very truly yours,

Ronald L. Warren
General Manager

cc: Mr. Sonny Najera
Mr. Tom Boswell

United States Department of the Interior

NATIONAL PARK SERVICE
GRAND CANYON NATIONAL PARK
P.O. BOX 129
GRAND CANYON, ARIZONA 86023-0129

IN REPLY REFER TO:
L3215 (GRCA)

JUL 16 1984

Messrs. James Webster and Clinton Dodge
Leedshill-Herkenhoff, Inc.
Arizona Title Building
111 West Monroe, Suite 718
Phoenix, Arizona 85003

RECEIVED 7-17-84

Gentlemen:

We appreciate the opportunity to review both the Final Draft Report of the Grand Canyon National Park Airport Master Plan and the accompanying Environmental Review. We have anxiously awaited the Environmental Review, expecting that document would address the concerns which have been raised by the park over the last 9 1/2 months. Unfortunately, that has not been the case. As stated in our letters of comment dated October 23, 1983, December 12, 1983, and June 5, 1984 on previous review drafts, the park is very concerned about direct and indirect impacts to the park resulting from airport expansion. In our June 5 letter, we specifically identified the following issues to be addressed in the Environmental Review document:

1. An analysis of noise impacts to the park. This would include specific analysis of frequency of aircraft noise and noise volume along approach paths and along tour routes over the park. We would also like general information on aviation trends over the park.

2. An analysis of the projected water demand to include analysis of sources for additional water. This appears to be especially critical now that limitations have apparently been placed on capture of runway run-off water.

3. An analysis of visitor arrivals to Grand Canyon National Park to include review of arrival times, transportation modes to the park and demands on concession facilities related to lodging, food, etc.

Only two of these issues are addressed and then only in the most cursory fashion. We do not feel the existing environmental document is adequate, and believe that the environmental compliance process should advance at least to the next level with the preparation of a full environmental analysis. Our specific comments on this Environmental Review are attached.

In summary, we cannot endorse the airport expansion as proposed until park comments are addressed as identified. We continue to offer our assistance in addressing these concerns, but must ask for an appreciation of them on your behalf.

Sincerely,

Richard W. Marks

Richard W. Marks
Superintendent

Enclosure

cc:
Governor Babbitt
Congressman Stump
Regional Director, National Park Service

Specific Comments on the Draft Environmental Review (June 1984)

Page 4, Paragraph 4. This discussion of Grand Canyon visitation is misleading. While visitation has obviously increased since 1920, visitation has been relatively stable over about the last 10 years, reaching a peak in 1976.

Page 9-17 Noise. The issue of noise impact to Grand Canyon National Park is dealt with in a very cursory fashion. As with most aircraft noise studies, the predominant area of concern is the community immediately adjacent to the airport. When addressing the issue of noise over the canyon, the report states "Although the projected noise levels associated with overflights are forecasted to be less than 65 Ldn (day-night average sound level), which is generally considered compatible for all land uses, the impact may be more severe due to the low background noise levels characteristic of the Grand Canyon." While this generalization is probably true, it does little to help clarify what the impacts of increased size and capacity at the airport are in terms of increased aircraft noise levels at the canyon.

It is unclear to us how the Ldn model operates. How is the day/night average developed? What does Ldn 65 mean? How is surface contour taken into consideration in this model? While the EPA may support the use of Ldn's to measure the impact of sound and while engineering standards may exist, it appears a more appropriate metric for this airport and surrounding area would be Noise Exposure Forecast (NEF); a measure of the overall time in a 24 hour period when a certain A-weighted decibel level occurs, for several decibel levels.

The summary of the section on noise states "it appears that existing airport traffic noise is compatible with the Airport's surroundings". While this may be true on the basis of engineering standards appropriate for an urban area, we know that existing use levels are incompatible with the backcountry experience in Grand Canyon at some occasions during the year. The report does go on to say "However, due to low background noise levels or other sensitive elements, local needs and values may require lower noise levels (than Ldn 65)". Despite this fact, after discussing a number of alternatives for the reduction of noise, the report concludes "Many of these strategies are not appropriate for the Grand Canyon National Park Airport. They are oriented towards airports which have more traffic and noise impact than GCN." While a small airport such as GCN would have little impact in an urban area, because of the setting of the airport and its proximity to the canyon, two of these noise mitigation techniques (1) landing fees based on noise and (2) complete or partial curfews are worth further investigation. Both these techniques could reduce the impacts of sound over the canyon without severely limiting aviators. The first mitigation measure provides financial incentive to buy quieter aircraft or to reduce the noise levels through modification. These mitigation measures should be actively considered and encouraged, rather than dismissed in an off-hand manner.

Page 9, Paragraph 1. The use of a noise prediction model which integrates noise events onto a 24-hour schedule for measuring noise impacts at Grand Canyon National Park Airport is highly misleading due to existing (and projected) use patterns. According to the Final Draft Report for the Airport Master Plan (page III-2) 85% of the operations occur between 9 a.m. and 5 p.m. and 100% of the operations occur between 8 a.m. and 6 p.m.

Page 10, Paragraph 8. What is the basis for assuming all existing aircraft conform with existing noise standards (FAR Part 36)? This assumption should be backed up with data.

Page 11, Paragraph 1. Basing the noise prediction model on the 183 "summer days" from April through September again produces misleading results. It would be much more accurate to utilize the peak month of August in these calculations, during which 15.2 percent of the total annual use occurred during the period 1980-1982 (Final Airport Master Plan).

Page 18, Paragraph 5. Just because FAR Part 130 states all land uses are, normally compatible with noise levels Ldn 65 and below doesn't make it true. Data needs to be collected at Grand Canyon National Park to quantify existing background levels and determine the magnitude of increase that would be expected along various flight/ approach paths.

Page 18, Paragraph 7. Does this last sentence mean that airport expansion will add 306 more vehicles to SR 64 during the peak hour? If so, what percent increase is this? What will be the total daily increase as distributed by hours?

Page 20, Paragraph 3. Wildlife will not be able to relocate to other suitable habitat, unless it is unoccupied, which seems unlikely.

Page 22. The report projects water usage at the airport will increase by roughly 1,000% over the next 20 years yet provides no basis for these projections. To meet this demand, it states that it will be necessary to truck in more water than at present, without identifying a source, and indicates that this will increase the economic burden on all importers of water in the area. As mitigation measures, the report suggests that people could conserve water or maximize the precipitation catchments "within water right limits". However, there is no requirement to conserve, no examination of how much additional water could be collected by the second method, and no estimate of how much water might be conserved. With this information, an estimate could be made of how much water would have to be purchased and trucked in. This cost could be so prohibitive that any financial incentive to expand the airport is lost. Further details should be provided in this section.

Page 30, Paragraph 3. A 1983 study of visitors to Grand Canyon indicates foreign visitation may account for as much as 42% of the South Rim summer visitation.

Page 30, Paragraph 4. This summary of P.L 93-620 is misleading by deleting all reference to the need to protect the natural quiet of the park. Some discussion of the pertinent F.A.A. regulations and requests would also be appropriate here, as well as a brief discussion of the park's concern with aerial overflights.

Page 31. Two impacts on the park are mentioned, both of them characterized as indirect. These are, an increase in visitation and an increase in the number of overflights of the canyon. However, there is no attempt to estimate these increases or to discuss the magnitude of the changes created by these increases. Given the safety record of aircraft over the canyon, the potential for increased fatalities as a result of the increases in overflights should be discussed. It should also be possible to predict the increase in flights for certain flight routes.

Noise impact contours should be extended into the park, because even though 65 Ldn may be an appropriate cutoff for many areas, Grand Canyon's unique environment and the desire of backcountry travelers for a primitive back-country experience makes noise at lower levels a concern. At present levels, noise is a concern in the backcountry. With increased traffic, noise will become an even more important issue. To gloss over this subject in such a cursory fashion demonstrates a lack of understanding of the issue of noise at Grand Canyon.

The report states: "Significant numbers of peregrine falcon have been noted in the vicinity of Grand Canyon" (page 19). Despite this mention, the report does nothing to characterize the disturbance of peregrine or any other wildlife by increased numbers of aircraft.

Four possible mitigation measures are discussed. This list, however, is hardly exhaustive and the two noise mitigation measures discussed previously, landing fees based on noise and curfews on aircraft take-offs and landings are two examples. Other restrictions based on time; limiting aircraft to certain days of the week, or certain months in the year, are also not considered. The manner in which such possible restrictions might affect the aviation forecasts developed in previous reports are not considered, but it is hoped that these forecasts will at least take into consideration the possibility that one of these mitigation measures will be carefully considered and possibly implemented.

The report discussed what it refers to as "the most severe" measure, limiting aircraft to an altitude above the rim, and concludes "This elevation would probably be high enough that the attractiveness of the overflight would be lost to the tourist". To seriously maintain that the "attractiveness" of the Grand Canyon is "lost" at any altitude above the rim is suspect. This statement is pure conjecture and has no place in an environmental analysis.

LEEDSHILL-HERKENHOFF, INC.
Arizona Title Building
111 West Monroe, Suite 718
Phoenix, Arizona 85003
(602) 252-0412

James L. Webster, PE

August 15, 1984

Mr. Sonny Najera, Director
Aeronautic Division
Arizona Dept. of Transportation
205 S. 17th Street
Phoenix, Arizona 85007

Attn: Mr. Tom Boswell
Airports Engineer

RE: GRAND CANYON NATIONAL PARK AIRPORT MASTER PLAN
AIRSPACE REVIEW

Dear Mr. Boswell,

As we discussed, both the present Airport Layout Plan and the proposed Airport Layout Plan presented in the Master Plan violate the FAR Part 77 obstruction standards. Parked aircraft on existing ramps and aircraft on the taxiway penetrate the 7:1 transitional surface. The ramp layout in the Master Plan places parked aircraft further from the runway due to the parallel taxilane but parked aircraft will in some instances still penetrate the 7:1 transitional surface. Some penetrations of the 34:1 approach surface at the GA apron are also possible in both the present and ultimate configuration.

These penetrations are economically necessary due to the topography of the site. Penetrations of Part 77 surfaces are acknowledged in AC 5300-11 which states "Buildings and parked aircraft may penetrate the airport imaginary surfaces defined in Subpart C of FAR Part 77 when an FAA aeronautical study has determined that the specific penetration will not result in a hazard to air navigation". The ILS approach to runway 3 is to a decision height of 200 ft., the minimum allowable for Category I. Therefore, we assume that the present aircraft penetrations are not considered hazardous.

However, to our knowledge, the FAA has not performed an airspace study on the proposed Airport Layout Plan.

We have enclosed prints of the revised Airport Layout Plan and Airspace Plan incorporating your comments. We suggest that ADOT submit these to the FAA and request an airspace evaluation, if this has not previously been done.

If there are any questions regarding this data, please do not hesitate to call.

Sincerely,

Clint Dodge

CLINT DODGE

er

BRUCE BABBITT, Governor

Commissioners:
FRANCES W. WERNER, Tucson, Chairman
CURTIS A. JENNINGS, Scottsdale
W. LINN MONTGOMERY, Flagstaff
FRED S. BAKER, Elgin
LARRY D. ADAMS, Bullhead City

Director
BUD BRISTOW

Assistant Director, Services
ROGER J. GRUENEWALD

Assistant Director, Operations
DUANE L. SHROUFE

DEPT. OF TRANSPORTATION

SEP 07 1984

AERONAUTICS DIVISION

Call GA, address Lindskill to me, this by in draft

**ARIZONA GAME & FISH DEPARTMENT**

2222 West Greenway Road Phoenix, Arizona 85023 942-3000

September 4, 1984

Mr. Sonny Najera, Director
Aeronautics Division
Arizona Department of Transportation
1801 West Jefferson
Phoenix, Arizona 85007

RE: Grand Canyon National Park
Airport Environmental
Review and Master Plan;
ADAP Project #6-04-0019-13

Dear Mr. Najera:

The Arizona Game and Fish Department has reviewed the above-referenced airport expansion project and concurs with the need to correct certain safety deficiencies and to meet future demands of flight operations.

However, we feel the action, as proposed, would significantly impact the quality of the environment, particularly for wildlife, both within and adjacent to the project area. The following questions and comments center around the placement and relocation of Rain Tank, and the loss of vegetative cover providing forage, escape cover, and thermal cover for wildlife species.

1. Did the Aeronautics Division consider or apply for a FAA waiver for penetrations of FAR Part 77 surfaces as an alternative to the proposed plan?

2. In reference to Rain Tank, the Master Plan depicts two proposed relocation sites, yet there are no structural descriptions or construction aspects for relocation of this important wildlife water source. Was this overlooked or will details be discussed at a later date?

3. In the proposed plan, it is stated that a tree obstruction removal plan is being initiated. Does this statement mean only those trees that penetrate the FAR Part 77 surfaces will be removed, or will all trees and vegetation be removed, regardless of size or degree of penetration?

As mentioned previously, our Department is not opposed to the airport expansion project; we realize some safety and facility standards cannot be compromised. However, we feel that most of the environmental impacts can be satisfactorily mitigated or entirely avoided through the application of standard environmental protection measures incorporated into the construction specifications.

Further, we are aware that Leedshill-Herkenhoff, Inc. had not intended the scope of the environmental review to reach the depth of an assessment, but we feel this document will be viewed as such and, therefore, must contain certain criteria.

Finally, we are somewhat disappointed at the lack of communication between our agencies involving a project of this magnitude and environmental ramifications. The Department of Transportation has always been very cooperative on other major projects and has considered our Department a cooperating agency when dealing with wildlife and habitat concerns.

We appreciate the opportunity to review the proposed airport expansion plan and hope our comments and suggestions are of use.

Sincerely,

Bud Bristow, Director

Tim Baumgarten

Tim Baumgarten
Wildlife Manager
Flagstaff Regional Office

TB:lea

cc: State Clearinghouse, AZ 84-80-0023

In addition to the above questions, we offer the following suggestions and comments concerning ADAP #6-04-0019-13:

- Section II.C. of the environmental review contains erroneous statements and does not discuss wildlife issues adequately. The statements, ". . . will not significantly reduce wildlife in the area," and " . . . most wildlife will relocate due to loss of their supporting habitat," are inconsistent and contradictory to the basic principle of 'carrying capacities'. Loss of supporting habitat results in a reduction in numbers of each affected population, both immediate and on a long-term basis.

These wildlife values must be considered:

a. Approximately 15-20 resident elk and 15-30 transient elk utilize Rain Tank, forage, and escape cover located within the project.

b. The affected site supports a secondary fawning grounds to the south and 40-60 mule deer utilize Rain Tank, forage, escape cover, and thermal cover -- involving both summer and winter ranges.

c. Merriam's Turkey have been observed feeding within the project area, but no known turkey roost sites will be affected by tree obstruction removal.

d. Due to the relatively young age structure and lack of interconnecting crowns, ponderosa pine losses will only affect food sources and escape cover for the tassel-eared squirrel. No nest trees were observed.

e. Wintering bald eagles have been observed foraging on fish species currently inhabiting Rain Tank.

f. Duck species of the Anatinae family have regularly utilized Rain Tank during migrations.

g. Several species of shorebirds feed and nest in and around Rain Tank. These include (common name) egrets, herons, plovers, curlews, sandpipers and killdeer. These species usually inhabit the project area during spring and summer months.

h. Two species of raptors are known to utilize the area for foraging -- red-tailed hawk and turkey vulture.

i. Numerous species of songbirds indigenous to the area will be impacted through losses of foraging and nesting habitats.

j. Prey species, such as cottontail rabbits, will diminish from losses of escape cover.

- The effects of the planned tree obstruction removal can be minimized by removing only trees intruding airspace surfaces and allowing browse species and forage species to remain, e.g. cliffrose, golden currant, fernbush, big sage. In addition to these species, younger aged (less than 8" DBH) juniper, pinyon and ponderosa pine provide valuable escape and thermal cover for all species of wildlife.

- Positive assurances of the relocation and placement of Rain Tank are needed. This water source provides wildlife within a 3-mile radius a reliable, year round water. We suggest that alternative sites I and II (Figure V-7) be re-evaluated. Both locations bring wildlife within close proximity of proposed runways and may promote animal-aircraft collisions. There would be very little escape cover or limited travel corridors to the water source. We suggest the newly constructed tank be placed further southwest than Rain Tank I. This low lying area could retain sufficient surface acreage of water to resist drought periods and yet provide an adequate watersource for cattle operations and wildlife needs. A second, less economically feasible location would be in Rain Tank Wash. An earthen structure damming this deep canyon would have ample water storage, yet provide disposal of excavated material. Regardless of location, the newly constructed tank must have timely construction to have a source completed before the present tank is obliterated. The new tank should have an equivalent or greater storage capacity and provide an efficient water barrier to avoid soil seepage.

- When reseeding disturbed areas in the vicinity of the runways, we suggest the planting of less palatable grasses and plant species to avoid attracting foraging animals near landing/take-off areas.

- We discourage any deposition of excavated material and grading of Rain Tank Wash, as depicted in Figure V-7 of the Master Plan. This would represent a total destruction of an irreplaceable riparian habitat.

LEEDSHILL-HERKENHOFF, INC.
Arizona Title Building
111 West Monroe, Suite 718
Phoenix, Arizona 85003
(602) 252-0412

James L. Webster, PE

October 11, 1984

Mr. Richard Marks, Superintendent
Grand Canyon National Park
P. O. Box 129
Grand Canyon, Arizona 86023-0129

Re: Grand Canyon National Park Airport
Master Plan
Response to National Park Service Comments (13215(GRCA))

Dear Mr. Marks:

Thank you for your comments on the Draft Environmental Review dated July 16, 1984.

As a general response to your comments, we must reiterate the intended purpose and scope of the Environmental Review as pointed out in the Introduction of the draft report. This study and the resultant report were not intended to be prepared to the level of detail required for an Environmental Assessment. Rather, its purpose is to identify, potential impacts so that ultimate concept design can incorporate mitigation measures; to bring to the forefront for further consideration in the planning process those issues that would render the subsequent projects controversial on environmental grounds. We feel that the draft report, with some further expansion and refinement in a few areas, meets the intended purpose.

We feel we do have an appreciation for the Park's concerns. We also realize that analysis of such concerns or impacts as noise, overflights, Park visitor arrivals, transportation modes to the Park and demands on concession facilities at the Park are not to the level of detail which the Park Service would prefer. That level of detail is beyond the scope of the Master Plan and Environmental Review. However, as I indicated to you in our phone conversation, we will expand the Federal Properties Section of the ER to further convey these concerns (particularly with the impacts of noise and overflights) and your desire for further study at the Environmental Analysis/Impact Statement level.

Relative to the water issues, water demand impacts are addressed in greater detail than normally provided in a master plan, specifically in Chapters I, IV and V of the draft final and in the Environmental Review. As we stated in our letter to you of June 29, 1984, a runoff capture limit has not been established and the water rights issue has not been resolved to our knowledge in the current condemnation proceedings.

Page two.
Grand Canyon National Park Airport
October 11, 1984

The attached sheets include responses to your specific comment as included in your July 16th letter.

We hope this addresses your comments as identified. Please do not hesitate to contact me if you have further questions.

Very truly yours,
LEEDSHILL-HERKENHOFF, INC.

J. L. Webster

James L. Webster, P.E.
President
Arizona Regional Operations

JLW:mb

Encl.

cc: Mr. Gary Adams, Arizona Department of Transportation, Aeronautics Div.

The following are responses to your specific comments on the Environmental Review (ER):

1. Grand Canyon visitation trends (Page 4, Paragraph 4.)

   We concur that this discussion could be misleading and will clarify the visitation historical trends in the final ER Report.

2. Noise issues (Page 9-17)

   a. The Day/Night Level (Ldn) measure.

   A technical appendix which deals with noise basics, the Ldn, land use and community response, and Ldn land planning applications, which will be added to the Report, is attached.

   The following is a summary of that information:

   In airport and aircraft noise study, two different types of noise measures are needed - one to measure the noise of individual noise events, such as the noise signal of an aircraft flyover, and another to describe the noise environment resulting from a complex of noise events, such as the noise exposure due to several operations.

   Basic noise measures (A-weighted sound level (units of dBA) and perceived noise level, PNL (units of PNdB)) can be used to measure the maximum level of aircraft flyby or engine runup; but neither can be used to measure the duration of the noise event. Laboratory tests show clearly that noisiness and annoyance increase with the signal duration as well as its magnitude.

   The noise level (dBA or PNdB) can be integrated with time for the duration of the event thereby obtaining a good measure of the actual aircraft noise and annoyance for a single event. The resulting noise measures are SEL (time integration of dBA) and EPNL (time integration of PNdB). In order to measure the response to a number of noise events (the noise environment) an environmental descriptor is needed.

   The descriptor starts with the annoyance of the single event and adds in factors for the number of events, and the time of day they take place (more annoyance at night). Noise environment descriptors include the composite noise rating (CNR), the noise exposure forecast (NEF) and the day/night level (DNL or Ldn). The CNR has several major shortcomings: it does not account for the duration of the noise (it is based on PNL not EPNL); and adjustments for the number of events and contributions of different aircraft classes is on a "step" basis occasionally leading to unrealistic results.

   The NEF and Ldn noise descriptors are the same except for using different noise measures and different normalization constants. The NEF model is based on EPNL and Ldn is based on the SEL noise measure. Both account for the number of operations and the time of day at which they occur. Use of NEF does not provide more detailed data than Ldn.

"In terms of applications to aircraft situations, Ldn is based on the same consideration as NEF, and indeed, except for changes in noise data base and a few constants, the computer programs used to calculate NEF contours can be utilized to generate Ldn contours." (Community Noise Exposure Resulting from Aircraft Operations: Application Guide for Predictive Procedure, Bolt Beranek & Newman, Inc., Nov. 1974).

In summary, the noise environment descriptor (NEF or Ldn) starts with an individual noise event (PLNL or SEL). To this event the cumulative effect of many operations by deffering types of noise sources is added; a weighting factor is also added to account for the variation in community response to aircraft noise (Night time response vs. day time response). Finally, the NEF or Ldn value must be related to the expected impact of noise on people. Studies provide a basis for a noise index correlating the average annoyance response to a certain Ldn or NEF. Allowable land uses can then be determined.

Another measure of noise is the time above a specified threshold a A-weighted sound (TA). TA indicates the time in minutes that a dBA level is exceeded during a 24-hour period. This type of analysis, through useful, is not a total environment descriptor like NEF or Ldn. It does not account for the nuisance factor of night operations and requires some knowledge on which to base the threshold dBA levels.

However, it can be used to investigate a particularly sensitive localized site such as a building or recreational site as an adjunct to the Ldn descriptor.

b. Validity of the model.

We have identified typical aircraft tracks using existing tracks, information from the Air Traffic Control Tower, and a topographic map of the area. Some of these tracks (shown on Fig. II-1 of the Enviromental Report) are routed over the Canyon and the Park. The model requires the track to be described for at least 50 nautical miles from the point of landing or takeoff at the airport. In both existing and ultimate noise model results, the Ldn 65 contour does not extend very far along approach and take off routes; it does not extend to the Park and Canyon. According to the literature, noise levels below Ldn 65 are generally considered compatible with all land uses. However, we do realize that the levels of noise in the Canyon have been known to cause annoyance to visitors and residents. There are several possible reasons for this impact in addition to the varying noise sensitivity level of individuals. Degree of vegetation, existing land contours, level of background noise, and the position of buildings and walls often affect the impact of noise on human users at a specific site. Due to anyone or a combination of these factors, people may be sensitive to Ldn 60, or 55, or possible even lower.

Given the available data, we feel the noise model serves the purpose intended (i.e. defining the noise environment at Grand Canyon National Park Airport). More detailed analysis or 'time above' and actual noise measurements in the Canyon could be done to more accurately define the noise environment and how it affects the users of the area.

c. Noise Mitigation Techniques; Landing Fees based on Noise, and Complete or Partial Curfews.

It is unreasonable to impose landing fees or curfews on aircraft using Grand Canyon Airport to control noise over the Grand Canyon National Park. Airport users which do not fly over the Canyon would be unfairly penalized. Therefore, it would seem logical for the Park Service to consult with the FAA and commercial flight operators to come with an agreement which affects solely the aircraft which fly over the Canyon. We are still of the opinion that the mitigation measures discussed in the Environmental Report are most appropriate for this situation.

3. <u>Distribution of operations over 24 hour day. (Page 9, Paragraph 1.)</u>

Each operation adds a factor to the noise environment described by the Ldn. At Grand Canyon Airport, the majority of operations occur during the day time hours; the noise factor from these operations is <u>added</u> to the factor from the small number of night operations and <u>both</u> contribute to the noise environment. The fact that the majority of operations are day time operations does not decrease their effect on the noise environment.

4. <u>Federal Aviation Regulation (FAR) Part 36. (Page 10, Paragraph 8)</u>

Under FAR Part 36; Noise Standards, Aircraft type and airworthiness certification is a Federal Aviation Regulation with which all aircraft must comply. Transport category aircraft are routinely inspected for noise standards. The FAA sets time limits on certain retrofitting measures such as quiet nacelles and all transport category aircraft must meet the Part 36 reduced noise limits well before the 2003 planning limit. All non-transport category aircraft must also satisfy Part 36. Their noise level must not exceed the level in their original airworthiness certificate and new aircraft must satisfy current noise standards. The assumption used in the model is therefore a reasonable assumption. All aircraft used must satisfy FAR Part 36. The aircraft in the noise model are typical of those using GCN.

5. <u>Noise prediction model time frame (Page 11, Paragraph 1)</u>

The 6 month period from April through September was used to produce the noise model. The goal of the model was to produce a reasonable representation of the noise experienced in the area. The 6 month time period rather than the whole year was used because the activity at the airport is highly oriented towards the summer months.

August is the month with the most activity at the airport. A noise model based solely on August activity would be valid only as representation of the noise at GCN during the month of August. Again, the model is intended to represent the total noise environment at GCN, not the busiest month's noise. (Note: August operations are 28% higher than those used in the model)

6. Land use compatibility and noise (Page 18, Paragraph 5.)

It is recognized, as is stated on Page 31, paragraph 4 of the ER Report that due to the low background noise levels characteristic areas of the Grand Canyon. The recognized limit of Ldn 65 may not be adequate for GCNP.

However, primary research to quantify existing background levels at the Park and projection of the magnitude of increases that would be expected along flight paths is beyond the intended scope of this particular study.

7. Access requirements (Page 18, Paragraph 7.)

The 306 vehicles per hour (VPH) referenced in this paragraph was taken from Table IV-12, Access and Parking Requirements, located on page IV-34 of the draft master plan report dated June, 1984. The basis of projection is also provided for the Table. The 306 VPH represents an estimation of the number of vehicles (autos, vans and buses) required to handle the 1757 design hour passenger arrivals and departures at the airport in the year 2003. As is seen from the same Table, the 1982 estimated rate is 59 VPH (14% van, 14% bus, and 72% auto).

The most current traffic count (1983) on S.R. 64, from the present airport access road to the Park Headquarters, is estimated by ADOT's Transportation Planning Office at 3,500 vehicles per day. According to the Transportation Planning Office, this is well below capacity for S.R. 64.

An estimation of the total daily increase, distributed by hours, is beyond the scope of study.

8. Wildlife relocation (Page 20, Paragraph 3.)

Since your letter, we have received additional detailed data from the State Game and Fish Department regarding vegetation and wildlife in the area surrounding the airport and outside the 400 acres proposed as being acquired and cleared. The final ER Report will indicate the results.

9. Water Resources (Page 22.)

The projections of water usage were taken directly from Table IV-15, Total Annual Water Supply Requirements, found on page IV-40 of the final draft master plan report dated June 1984. The basis for the projection is also included in that document on page IV-40. The increase in annual water usage from 1982 levels of 1.89 million gallons to 11.2 million gallons projected for 2003 represents an increase of 593% from the present level over the 20 year period.

We concur that the discussion on water to meet the projected demand is perhaps confusing. Due to the fact that present condemnation proceedings have yet to resolve catchment limitations and water rights issues, this section has some unanswered questions and will have until the proceedings are completed. No estimate of how much water legally can be captured and how much water would then be required to be purchased and trucked in can be realistically made until that time.

10. Foreign visitation percentage (Page 30, Paragraph 3.)

The 33 percent referenced was taken from the Mochlis-Wenderoth study of 1982 (cooperative National Park Studies Unit, University of Idaho). Please forward a copy of the referenced study, if available, so that we may update Table II-14.

11. P.L. 93-620 and Park's concerns (Page 30, Paragraph 4.)

We concur that expanding this paragraph to include further discussion of P.L. 93-620. and a brief discussion the Park Services's concern with overflights is appropriate for this section of the Review. We will include this in the final E.R.

12. Federal Properties indirect impacts (Page 31.)

Relative to the comment concerning (1) the lack of an estimate for the projected increases in Park visitation and Park overflights or (2) the land of discussion these increases create, Chapter II of the draft final master plan report indicates (Page II-1) that the availability and completeness of aircraft operations and passenger movement records varies considerably among the various carriers: Data records for the helicopter operations. at Tusayan were, in fact, unavailable as indicated on Page II-6, of the final draft master plan. As a result, it is difficult to arrive at accurate historical base data for passenger and aircraft movements at the Park. Further field research and analysis of visitor and aircraft movements would be required to develop valid estimates of these increases and projected changes. This additional study is beyond the scope of the master plan and environment review but is one element recommended in the master plan conclusions.

Analysis of available air arrival and Park visitation records does not yield any substantial correlation between the two data sources. To arrive at an approximate impact of air arrivals on GCNP visitation would require analysis of transportation modes, visitor profiles and future Park policies regarding visitor limits and Park developments.

Relative to disturbance to wildlife in the Canyon, with available data, the disturbance to the peregrine falcon or other wildlife at the Park by increased aircraft activity can not be definitely characterized with any validity. Further data as to aircraft movements within the Canyon and encroachment on peregrine habitates would be necessary which is beyond the scope of this review and further is not within the control of the airport owner.

Relative to the comment on the mitigation discussed in the review, please refer to our response under 2(c) above.

Relative to the comment on "the most severe" mitigation measure, please be assured that we do not believe that the attractiveness of the Grand Canyon would be lost. The comments relates to the attractiveness of the overflight itself. However, we do agree that the statement is subjective in nature and depends entirely on the altitude that would possible be established. We will, therefore, remove the statement.

# ARIZONA DEPARTMENT OF TRANSPORTATION

AERONAUTICS DIVISION

1801 W. Jefferson Phoenix, Arizona 85007

(602) 255-7691

BRUCE BABBITT
Governor

WILLIAM A. ORDWAY
Director

SONNY NAJERA
Division Director

October 16, 1984

Mr. Tim Baumgarten, Wildlife Manager
Arizona Game & Fish Department
Flagstaff Regional Office
310 Lake Mary Road
Flagstaff, AZ 86001-9342

Re: Grand Canyon National Park Airport Master Plan
Environmental Review
ADAP Project #6-04-0019-13

Dear Mr. Baumgarten:

We appreciate your comments relative to the above referenced Master Plan and associated Environmental Review. The information you provided is the most detailed LEEDSHILL-HERKENHOFF has received relative to vegetation and wildlife. The suggestions and comments provide, relative to wildlife values, impacts and suggested mitigation will be incorporated into the Final Environmental Review and Master Plan.

LEEDSHILL-HERKENHOFF has been in contact on numerous occasions with the U.S. Forest Service relative to vegetation and wildlife management impacts during the development of the Airport Master Plan and Environmental Review. This was due to the fact that the Airport property is surrounded by the Kaibab National Forest and that the proposed projects impact this Federal property. The apparent interaction between the U.S. Forest Service and Arizona Fish and Game was never communicated to them.

The relocation of the Rain Tank will be re-evaluated, with a final decision being held until the outcome of the present condemnation proceedings relative to the Rain Tank. However, specific construction details will be completed at a later date during the design phase. The draft Master Plan does call for the relocated Rain Tank(s) to have at least an equivalent storage capacity to the existing Rain Tank.

Relative to the tree obstruction removal, this project has been initiated as is indicated in the Master Plan and Environmental Review. Those trees penetrating the FAR Part 77 surfaces have been field tagged and will be removed. This is mandatory for FAA certification of the new Instrument Landing System recently installed at the Airport.

Again we appreciate your comments and the detail of information you provided.

Sincerely,

Sonny Najera

SN/dm

cc: Mr. Bud Bristow, Director
Arizona Game & Fish Department

US Department of Transportation
**Federal Aviation Administration**

Western-Pacific Region

P.O. Box 92007
Worldway Postal Center
Los Angeles, CA 90009

DEPT. OF TRANSPORTATION
FEB 2
AERONAUTICS DIVISION

FEB 19 1985

Mr. Thomas L. Boswell
Airports Engineer, Aeronautics Division
Arizona Department of Transportation
1801 W. Jefferson
Phoenix, Arizona 85007

Dear Mr. Boswell:

Grand Canyon National Park Airport, Grand Canyon, AZ;
ADAP 6-04-0019-13; Airspace Case No. 84-AWP-169-NRA
Draft Airport Master Plan

We reviewed the draft Airport Master Plan for Grand Canyon National Park Airport and we have the following comments:

1. The Federal Aviation Administration (FAA) requires studies be conducted for the relocations of the Glide Slope, Medium Approach Light System with Runway Alignment Indicators (MALSR) and Airport Traffic Control Tower before Runway 03 is extended and proposed Runway 03L/21R is constructed. Enclosed for your information is Advisory Circular 150/5300-7B, which outlines the sponsor's responsibility for relocation of FAA facilities.

2. On Page 1V-18, the Bell 206-1 Longranger Helicopter is an older design helicopter with a single powerplant. Recent design helicopters are larger in dimensions and weight. Also, there are helicopters that have dual powerplants for added safety in flight. Using the Bell 206-1 Longranger as the design helicopter for establishing the heliport dimensional requirements would make the heliport obsolete before it is built.

3. The FAA is planning to install a Microwave Landing System (MLS) for Runway 21 along with a MALSR. It is not known at this time whether the MLS will or will not replace the Instrument Landing System.

4. A site should be reserved for future installation of a Type III Automated Weather Observation System (AWOS). Enclosed is a copy of the siting requirements for AWOS.

When the airport master plan is completed, please provide us with the following documents in order for us to close out this ADAP project:

1. Three (3) copies of the Final Airport Master Plan Report.

2. Completed "Outlay Report and Request for Reimbursement for Construction Programs" (FAA Form 5100-61) on the master plan.

3. Completed Financial Status Report (FAA Form 5100-63, enclosed) on the master plan portion only.

4. A copy of the State of Arizona letter indicating the work is 100% complete in accordance with the Sponsor/Consultant contract.

5. Sponsor letter to FAA requesting final payment. A statement should be included on whether or not all work has been completed in accordance with the master plan portion of the Grant Agreement. The location of the financial and project records should be included.

If you have any questions, please give our office a call at (213) 536-6508.

Sincerely,

Ellis A. Ohnstad
Airport Planning Officer

By: Eric Vermeeren
Eric Vermeeren
Airport Planner

Enclosure

ENCLOSURE

AWOS SITE REQUIREMENTS

1. Located at least 400 feet from runway centerline.

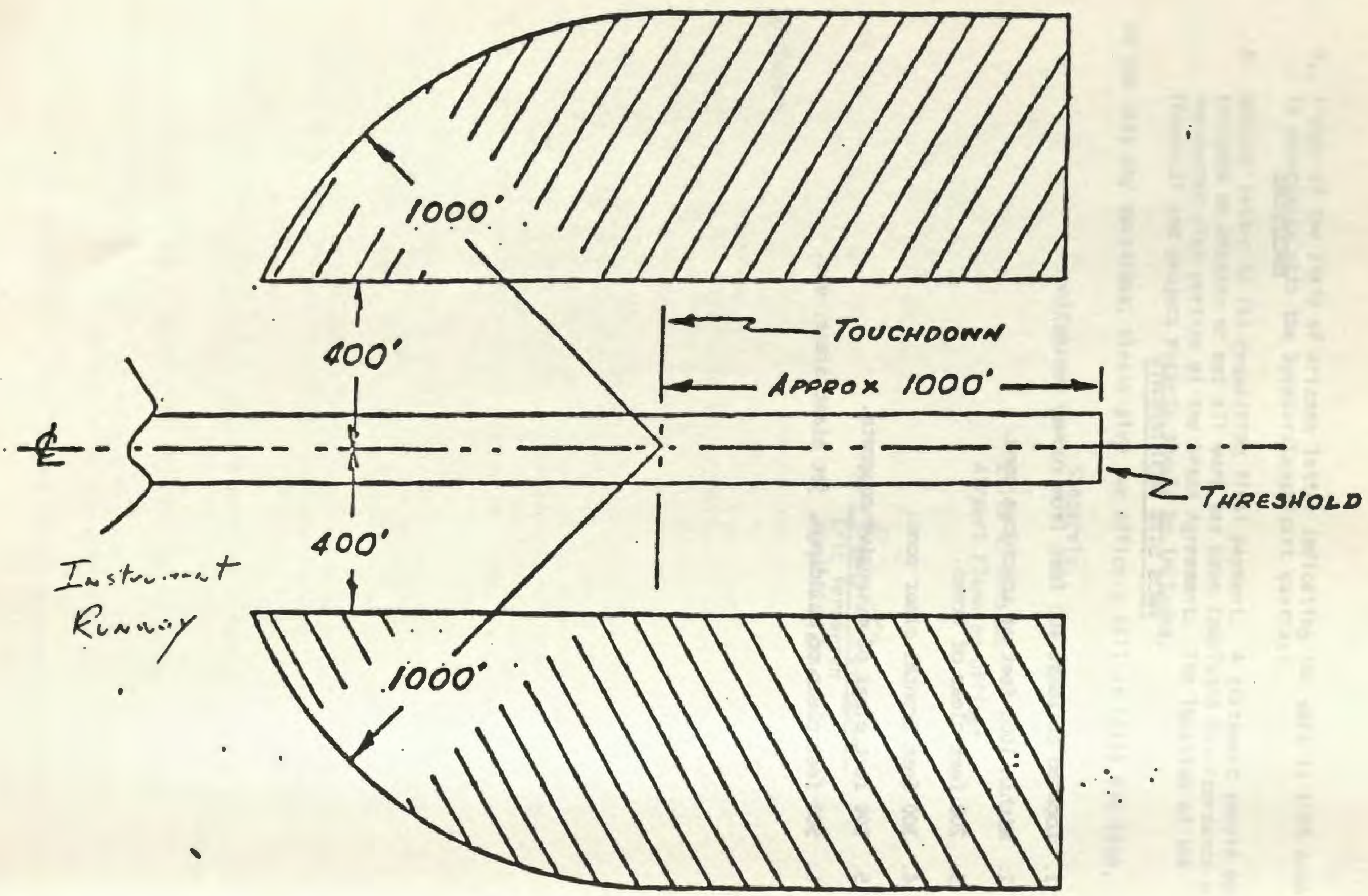
2. Within 1000 feet of touchdown zone.

3. 200 feet clear of trees.

4. 300 feet frontal clear zone.

5. 100 feet clear of extensive concrete.

6. 500 feet clear of buildings, jet blast areas, etc.



1000'
TOUCHDOWN
400'
APPROX 1000'
THRESHOLD
400'
Instrument Runway
1000'

AC NO: 150/5300-7B
DATE: 8 Nov 72

# ADVISORY CIRCULAR

## DEPARTMENT OF TRANSPORTATION
## FEDERAL AVIATION ADMINISTRATION

**SUBJECT:** FAA POLICY ON FACILITY RELOCATIONS OCCASIONED BY AIRPORT IMPROVEMENTS OR CHANGES

1. PURPOSE. To reaffirm to the aviation community the FAA policy governing responsibility for funding relocation, replacement and modification to air traffic control and air navigation facilities that are made necessary by improvements to changes to the airport. The term "airport owner" used herein refers to the political subdivision, military service. or other authority responsible for airport operations and improvements.

2. CANCELLATION: AC No. 150/5300-7A effective 27 Sep 71 is cancelled.

3. CLASSES OF FAA FACILITIES. FAA facilities located on airports and subject to the funding policy of this circular, are classified as follows:

   a. Class I. This class includes the facilities and components that are exclusively used in support of the airport or from which primary benefits are derived by the airport since the facility is located thereon. Examples are:

      Remote Transmitter/Receiver (Tower)
      Airport Traffic Control Tower
      Airport Surveillance Radar
      Airport Surface Detection Equipment
      Precision Approach Radar
      Instrument Landing System and Components
      Approach Lighting Systems and Components
      Visual Landing Aids
      Direction Finding Equipment
      VOR, TVOR and VORTAC used for Instrument Approach
      Weather Observing and Measuring Equipment (owner and operated by FAA)
      Central Standby Power Plant

Initiated by: ABU-10

b. Class II. This class includes the facilities and components that service a wide area and are located on the airport as a matter of convenience. Examples are:

Long Range Radar
Air Route Traffic Control Centers
Peripherals (Remote Control Air-Ground Communication Facility)
VOR and VORTAC (enroute only)
Flight Service Station
Remote Communications Outlet
Limited Remote Communications Outlet

4. RESPONSIBILITY FOR FUNDING.

a. The Airport Owner.

(1) The airport owner is expected to pay (and the agency shall not pay any part of the costs other than might be provided under Airport Development Aid Program funding) for the relocation, replacement or modifications of FAA air traffic control and air navigation facilities or components thereof made necessary by airport improvements or changes, when:

(a) Class I facilities must be relocated, replaced or modified because the airport improvement or change impairs the technical and operational characteristics of the FAA facility.

(b) Class I facilities must be relocated, replaced or modified to permit the extension of runways or construction of new runways and taxiways or other improvements to the existing airport facilities; for example: expansion of parking areas, terminal buildings, and aircraft service areas.

(c) The FAA has a lease, permit, license, or other document covering Class II facilities that gives FAA a legal basis for requesting that the airport owner assume the cost of relocation.

The foregoing are the normal circumstances under which financing responsibility should rest with the airport owner, however circumstances other than the above will be determined on a case-by-case basis.

(2) Where the airport owner grants other parties the right to construct hangars, other buildings, and/or facilities that impair or interrupt the technical and operational characteristics of air traffic control or navigation facilities, the agency expects the airport owner to pay for the relocation, replacement or modification of these facilities or components thereof. Payment to FAA may be made either from recovery of costs from the other parties or from other sources available to the airport owner.

(3) The need for uninterrupted service from some Class I facilities is recognized. This will require special methods for accomplishing the work in order to avoid interruptions of service. In such cases, funding for provision of temporary facilities required to maintain continuity of service is expected to be the airport owner's responsibility. However, it is FAA policy to avoid modernizing or upgrading a facility at the airport owner's expense.

b. The FAA. It is general FAA policy to fund the following:

(1) Relocation into quarters provided by the airport owner when requested by FAA.

(2) Relocation of Class II facilities, located on the airport but the presence is not authorized by a document described in 4.a.(1)(c) above, or the presence on the airport has been assured by unwritten consent of the airport owner.

(3) Relocation of facilities to meet FAA operational requirements or because of technical reasons that are inherent in the site and not caused by airport improvements or changes.

(4) Modernization/expansion costs to meet FAA operational requirements. When a modernization/expansion project is undertaken concurrently with a facility relocation that the airport owner finances, FAA pays only for those costs which would have been expended to meet FAA needs. For example, upgrading an ILS/ALS from CAT. I to CAT. II, adding direct altitude and identification readout to ASR, expanding a tower facility to accommodate ARTS III, etc., concurrent with a relocation of the existing facility that is financed by the airport owner.

(5) Relocation of Class I facilities to a new or another existing airport meeting the necessary physical and operational requirements to qualify for Class I facilities, when the receiving airport will replace the airport from which the facilities are being relocated.

(6) Relocation of Class I facilities, upon recognition by FAA of the necessity for a new or newly designated instrument runway on the same airport, in order to achieve more effective use of these facilities, except in the case of a new runway covered by 4.a. (1)(b).

(7) Flight inspection required for relocation of facilities where the airport owner is one of the military services (Friendship Agreement).

c. Other Funding. In the event that relocations, replacements or modifications of facilities are necessitated due to causes not attributable to either FAA or the airport owner, funding responsibility shall be determined by the FAA on a case-by-case basis.

5. ACCOMPLISHMENT OF WORK.

a. Responsibility. FAA shall have exclusive right to determine how all facets of the relocation of an FAA facility will be accomplished. This includes but is not limited to the engineering, site selection, procurement of equipment, construction, installation, testing, flight inspection and recommissioning of the facility.

b. Reimbursable Agreement. The airport owner and FAA shall negotiate a reimbursable agreement setting forth all essential elements pertinent to the relocation, replacement or modification of an FAA facility. The agreement shall stipulate that in the event actual cost is less than the estimated cost, the sponsor will pay only the actual costs; similarly, if actual cost exceeds FAA estimated cost, the sponsor will pay the actual cost.

J. H. SHAFFER
Administrator

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
Washington, D.C. 20591

Official Business

PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
FEDERAL AVIATION ADMINISTRATION
DOT 515

U.S.MAIL

Copy to Jim ...

DEPT.

SN
GA

# National Parks & Conservation Association

1701 Eighteenth Street, N.W.• Washington, D.C. 20009

RUSSELL D. BUTCHER
*Regional Representative*
SOUTHWEST & CALIFORNIA
Box 67
Cottonwood, AZ 86326
(602) 634-5758

(202) 265-2717

RECEIVED 3-7-85

March 1, 1985

Mr. Sonny Najera
Director, Aeronautics Division
Arizona Department of Transportation
1801 West Jefferson
Phoenix, Arizona 85007

Dear Sonny:

It was a pleasure talking with you yesterday on the phone regarding the Grand Canyon Airport and related matters.

Let me first say that National Parks & Conservation Association, headquartered in Washington, D.C, with its Southwest-&-California regional office in Cottonwood, Arizona, is a private, nonprofit membership organization. We are a citizens' advocacy group that was founded in 1919 and publishes the bi-monthly magazine, National Parks. As I mentioned, one of our major strategies is to promote wherever possible the resolution of environmental questions and conflicts through open dialogue and negotiations.

We appreciate this opportunity to comment on the Grand Canyon National Park Airport Master Plan and Environmental Review documents that were prepared by Leedshill-Herkenhoff, Inc.,oof Phoenix. We recognize that the scope of L-H documents was not to evaluate any of the environmental concerns, such as noise/overflight impacts upon Grand Canyon National Park; visitor-arrivals-by-air impacts upon national park and park concession facilities; and water needs, in detail. We are pleased to note that L-H's documents do mention that these and other environmental impacts may result from airport expansion.

We urge, therefore, that an opportunity to evaluate environmental concerns be provided through an Environmental Assessment or Environmental Impact Statement process. We are particularly interested in the following issues:

(1) Noise impacts--current and projected through the next twenty years--should be researched and analized in greater detail: both the character of aircraft noise and the cumulative impacts. Such carefully gathered and assembled data should then provide a sound basis on which decisions can be made for mitigating demonstrable impacts upon the national park resources and upon the park visitor experience. It seems evident to us that, if anywhere near the suggested several-hundred-percent increase in aircraft flights in the Grand Canyon vicinity should occur over the next twnety years, there will be serious impairment of park values and the public's enjoyment of Grand Canyon.

(2) Visitor arrivals by air should be researched and carefully documented and analized--both current and projected estimates, as they relate to Grand Canyon National Park. Crowding at the South Rim during the peak summer season is already obvious (much of the crowding is, of course, the crunch of too many motor vehicles). There should be some sound basis on which both the National Park Service and the Fred Harvey Company can judge what the future impact is likely to be upon national park and concession facilities as the result of expansion of airport facilities and a projected increase in visitor arrivals by air during the course of the next twenty years. We urge that every effort be made to establish a close cooperative working relationship between the airport operator/owner and the national park which the airport is primarily in business to serve.

(3) Water needs: we realize it is difficult at this time to arrive at reliable projected estimates of future water needs for an expanded airport facility, until questions regarding water rights and catchment limitations are resolved. However, the issue of increased water needs (an increase of nearly 600 percent over the next approximately twenty year period--from 1.89 million gallons in 1982 to over 11 million gallons in 2003) is so basic to the viability of the airport expansion proposal that we urge some interim estimates, based upon several possible outcomes of the water rights and catchment questions, should be made. Included in such estimate discussions should be (1) possible sources of water and (2) cost estimates of water for each of the several possible outcomes.

Because of our Association's particular concern for the welfare of Grand Canyon National Park, we urge that no increased water supplies be obtained, directly or indirectly, from Grand Canyon National Park. (The park's South Rim water is entirely piped up from across Grand Canyon at Roaring Spring. There are mounting ecological concerns about existing levels of water being taken from that critical riparian area. Future increases from this limited source, if permitted, could only increase those concerns.)

3-March 1, 1985

We would also urge that anticipated or possible water sources to meet • projected growth needs at the airport be identified.

National Parks & Conservation Association would welcome any opportunities that ADOT or Avco Services Corporation might wish to offer us, so we could learn more fully on the ground about present and projected future airport operations. And we welcome any opportunities for constructive dialogue in the future.

Again, we appreciate your urging us to write our concerns, at this stage of airport expansion planning, to you.

Sincerely,

Russ Butcher

Russell D. Butcher
Southwest-&-California Representative
Box 67, Cottonwood, AZ 86326

cc: Richard Marks

LEEDSHILL-HERKENHOFF, INC.
Arizona Title Building
111 West Monroe, Suite 718
Phoenix, Arizona 85003
(602) 252-0412

James L. Webster, PE

March 18, 1985

Mr. Russell D. Butcher
Southwest & California Representative
National Parks & Conservation Association
P. O. Box 67
Cottonwood, Arizona 86326

Re: Grand Canyon National Park Airport
Master Plan and Environmental Review

Dear Mr. Butcher:

A copy of your letter of March 1, 1985, submitted to Mr. Sonny Najera, Director of the Aeronautics Division of ADOT, and providing comment on the referenced Airport Master Plan and Environmental Review has been forwarded to our office. We appreciate your time in reviewing the two documents and providing comment.

As you may be aware, the Federal Aviation Administration, under the requirements of The Airport and Airway Development Act of 1970 (P.L. 91-258), "may not authorize a project involving airport location, major runway extension, or runway location found to have an adverse effect unless it finds, in writing, after full and complete review, that 'no feasible and prudent alternative exists and that all possible steps have been taken to minimize such adverse effect'." The Grand Canyon National Park Airport Master Plan proposes, ultimately, both a major runway extension and a new secondary runway should projected growth in aircraft operations actually occur and the projects are actually proposed for construction. At that time, we expect that the FAA, or designated sponsor, will undertake further study in areas of primary impacts and controversies, including noise/overflights.

Also, the Master Plan proposes the acquisition of Forest Service property (publically owned land) adjacent to the existing Airport to provide for the transitional surfaces needed before the main runway extension or for the secondary parallel runway can be constructed. This action will also require that a more detailed study of impacts (direct and indirect) and controversies resulting from the use be completed and reviewed in the decision process.

Please be assured that your concerns and urgings will be documented for review by the Aeronautics Division of ADOT and by the Federal Aviation Administration.

LEEDSHILL-HERKENHOFF, INC.
Arizona Title Building
111 West Monroe, Suite 718
Phoenix, Arizona 85003
(602) 253-0411

rch 18, 1985

Russell D. Butcher
uthwest & California Representative
tional Parks & Conservation Association
O. Box 67
ttonwood, Arizona 86326

Grand Canyon National Park Airport
Master Plan and Environmental Review

ar Mr. Butcher:

copy of your letter of March 1, 1985, submitted to Mr. Sonny Najera, Director
the Aeronautics Division of ADOT, and providing comment on the referenced
rport Master Plan and Environmental Review has been forwarded to our office.
appreciate your time in reviewing the two documents and providing comment.

you may be aware, the Federal Aviation Administration, under the requirements
The Airport and Airway Development Act of 1970 (P.L. 91-258), "may not
thorize a project involving airport location, major runway extension, or run-
location found to have an adverse effect unless it finds, in writing, after
l and complete review, that the feasible and prudent alternative exists and
t all possible steps have been taken to minimize such adverse effect." The
nd Canyon National Park Airport Master Plan proposes, ultimately, both a major
way extension and a new secondary runway should projected growth in aircraft
rations actually occur and the projects are actually proposed for construction.
that time, we expect that the FAA, or designated sponsor, will undertake
ther study in areas of primary impacts and controversies, including noise/
r flights.

o, the Master Plan proposes the acquisition of Forest Service property (public-
y owned land) adjacent to the existing Airport to provide for the transitional
faces needed before the main runway extension or for the secondary parallel
way can be constructed. This action will also require that a more detailed
dy of impacts (direct and indirect) and controversies resulting from the use
completed and reviewed in the decision process.

ase be assured that your concerns and urgings will be documented for review
the Aeronautics Division of ADOT and by the Federal Aviation Administration.

In this regard, your letter will be included in the Comments and Communications Appendix of our final publication of the Airport Master Plan. Additionally, the Association's concerns will be referenced in the text of the Environmental Review (which will also be included in the Airport Master Plan).

Again we appreciate your comments.

Very truly yours,
LEEDSHILL-HERKENHOFF, INC.

Jas. L. Webster

James L. Webster, P.E.
President
Arizona Regional Operations

JLW:mb

cc: Mr. Gary Adams, Arizona Dept. of Transportation, Aeronautics Div.

# APPENDIX H

## ENVIRONMENTAL REVIEW

NOTE: See Appendix G for correspondence relating to Environmental Review.

TABLE OF CONTENTS

## LIST OF FIGURES



## LIST OF TABLES



## LIST OF APPENDICES

## INTRODUCTION

A. PURPOSE:

The Federal Aviation Administration, in accordance with the National Environmental Policy Act of 1969(NEPA), requires that appropriate and careful consideration of environmental effects of contemplated or proposed actions be included in decision-making processes. The environmental impacts of proposed actions shall be considered concurrently with initial planning and development.

The Environmental Review was conducted concurrently with the study and development of the Master Plan for the Grand Canyon National Park Airport (GCN). Its purpose was to provide an environment review to indicate whether the proposed actions could significantly affect the environment with respect to noise, land, air and water quality; is located in historical or archaeological sites; and whether the subsequent development projects would be highly controversial on environmental grounds. It was completed to help identify foreseeable environmental impacts and controversies.

B. SCOPE OF STUDY:

Although not intended to be prepared to the level of detail required in an Environmental Assessment (EA), this review covered major areas found within an EA. Specifically, the Review considered, in accordance with current FAA criteria, on-site and off-site impacts of the proposed development projects.

On-site study was confined to those impacts occuring at the existing Airport and area immediately adjacent to it. Off-site study considered impacts on the environment and operations of the Kaibab National Forest, the Grand Canyon National Park and the community of Tusayan, Arizona, and on public health, welfare and safety resulting from air traffic changes, aircraft type and capacity changes, approach and departure pattern changes, noise and air quality level changes, water demand changes and emergency medical service needs.

## CHAPTER I.

## PROJECT DESCRIPTION

The proposed action contemplates endorcement of a series of construction projects to expand the Grand Canyon National Park Airport (GCN). The Airport is situated on a 859 acre site six miles south of the South Rim of the Grand Canyon National Park and just south of the community of Tusayan, Arizona. See Figure I-1, Vicinity Map and Figure I-2, Location Map. The development projects are needed to correct existing deficiencies and to meet the forecasted demands of increasing flight operations. The development projects are sponsored by the Arizona Department of Transportation, Aeronautics Division.

### A. DESCRIPTION OF PROPOSED ACTION:

This environmental review has been prepared as part of the master planning process and covers all phases of the airport development described in the Master Plan. It is proposed that the Airport development, as shown in Figure I-3, be accomplished in five phases. The activities shown on the Development Summary on the following page are included in the five phases of development.

### B. PURPOSE:

At the present, GCN is the primary air facility serving the Grand Canyon National Park. Other airports in the vicinity include airports with scheduled air carrier service at Flagstaff (81 miles southeast) and Page (137 miles northwest), Arizona; a general aviation airport at Williams, Arizona (50 miles south); and various dirt strips in the general area including one on the North Rim of the Grand Canyon.

The Grand Canyon National Park is visited by approximately 2.7 million tourists each year with more than ten percent of these arriving by plane or taking advantage of the numerous aerial tours available. Consequently, the airport is the third busiest air carrier airport in the State, following Phoenix Sky Harbor and Tucson International.

The primary traffic generator for the Airport is Grand Canyon National Park visitation. Business travel, flight training or air freight are not major sources of demand at GCN. Air taxi, commuter and charter operators carry approximately 90% of the passenger traffic. Presently, no large commercial air carrier is in operation at GCN. Republic Airlines provided service at GCN on a certified air carrier route until January 1985.

Visitation to the Grand Canyon National Park has grown from an estimated 71,601 annual visitors in 1920 and has been relatively stable at an average of 2.7 million visitors over the last 10 years (high of 3,026,235 annual visitors in 1976).

DEVELOPMENT SUMMARY

| Construction Period | Item |
| --- | --- |
| 1984/1985 | Commuter Ramp<br>Tree Obstruction Removal<br>Taxiway Overlay<br>Ramp Expansion<br>Raw Water Storage/System<br>Treated Water Storage<br>Catchment Basin<br>Rehab/Reconfigure |
| 1985/1986 | Heliport & Heliport Terminal<br>Auto Parking - Heliport<br>Access Roadway<br>Auto Parking - Terminal |
| 1987/1988 | Taxiway Improvements<br>Air Carrier Terminal<br>Air Carrier/Commuter Apron<br>G.A. Apron<br>Access Roadway<br>Air Carrier Auto Parking<br>Commuter Terminal Remodel<br>Relocate Fuel Storage Area<br>Relocate ATCT |
| 1988/1993 | Water Treatment Facilities<br>Treated Water Storage<br>Raw Water Storage<br>Commuter Ramp<br>G.A. Ramp<br>Air Carrier Terminal<br>Commuter Terminal<br>Based Commuter Terminal<br>Helicopter Terminal<br>Terminal Parking<br>Helicopter Parking<br>Access Roadway<br>Helicopter Ramp<br>Extend Rwy 3R/21L to 10,700'<br>Stage 1 Rwy 3L/21R - 5,700'<br>Exit Taxiway Improvements |
| 1993/2003 | Air Carrier Ramp<br>Commuter Ramp<br>G.A. Ramp<br>Air Carrier Terminal<br>Commuter Terminal<br>Based Commuter Terminal<br>Helicopter Terminal<br>Terminal Parking<br>Helicopter Parking<br>Access Roadway<br>Helicopter Ramp<br>Stage 2 Rwy 3L/21R - 8,000' |

C. PROJECT SETTING:

The Grand Canyon National Park Airport is located just south of the town of Tusayan and six miles south of the South Rim of the Grand Canyon. It is accessible by automobile from State Highway 64 which connects to Interstate 40 at Williams, 50 miles south.

The Grand Canyon area experiences cool temperatures in the 19 degree (low) to 50 degree (high) range in the winter and 40 degree (low) to 85 degree (high) range in the summer. The sun shines an average of 79 percent of the year with annual precipitation average of 14.46 inches of rainfall and 64 inches of snow.

The elevation of the Airport is approximately 6,600 feet, one mile above the bottom of the Canyon where the closest source of water lies. Although the Airport has a water catch basin, nearby Tusayan Village and Moqui Lodge must truck water in from Williams or Grand Canyon Village.

The town of Tusayan has a year-round population of approximately 260 residents. The area is oriented to tourism and is comprised primarily of motels, eating establishments and other seasonal facilities.

Within the National Park, Grand Canyon Village has several hotels and tourist facilities, ranging from mule trips to the bottom of the Canyon to elegant dining at the lodges. There are hiking trails, a post office, recreational rentals and services, amenities for personal comfort, fuel and a campground.

Applicable laws and ordinances affecting the Airport and its operations include the following:

1. Federal:

   a. Public Law 79-377 Federal Airport Act, May 13, 1956.
   b. Public Law 85-726 Federal Aviation Act, August 23, 1958.
   c. Public Law 91-190 Environmental Policy Act of 1969.
   d. Public Law 91-248 Airport and Airway Development Act of 1970.
   e. Public Law 970248 Airport and Airway Improvement Act of 1982.
   f. Public Law 93-620 Grand Canyon National Park Enlargement Act.

2. State of Arizona:

   a. Arizona Revised Statutes 28-108(17) Operation and Maintenance of the Grand Canyon National Park Airport.
   b. ADOT - Aeronautics Division R17-2-02 Minimum Requirements for fixed base operators.
   c. ADOT - Aeronautics Division R17-2-04 Payment of Landing Fees for Commercial Aircraft landing at Grand Canyon Airport.
   d. ADOT - Aeronautics Division R17-2-06 Establishment of Fees and Charges for Services and Use of Facilities and Equipment at GCN.

3. Local:

   Coconino County Zoning Ordinance adopted June 1974 and amended June 1981. (No local or county laws or ordinances covering general land use, zoning or environmenatal protection relative to airport development or operation have been adopted.)

The existing physical airport facilities are shown on Figure I-4, Airport Facilities and Figure I-5, Airport Site and are summarized in the following Table I-1 along with the ultimate airport facilities which would result from implementation of all of the Master Plan development projects shown in Figure I-3.

Three current projects will have significant impact on the physical and operational aspects of the airport. Numerous trees penetrate the airspace surfaces identified in FAA Regulation Part 77. Recent installation and activiation of the instrument landing system allows lower approaches to the airport in marginal visibility conditions rendering these obstructions much more serious than previously when visuals flight rules were in effect. The obstructions are located in virtually all quadrants of the airspace and in some cases are quite close to the runway. Thus, it is not possible to alter operational procedures to minimize conflicts. ADOT has prepared plans and specifications for removal of the tree obstructions on airport property.

A project to extend the aircraft parking ramp approximately 1500 ft. to the southwest is to be accomplished in the near future. This expansion should relieve present congestion on the parking ramp.

During the summer of 1984, ADOT leased the operations and development of the airport facility to a private enterprise. The lease package includes operations of the existing facilities as well as potential expansion.

TABLE I-1
Airport Facilities

EXISTING

Name: Grand Canyon National Park Airport
Ownership: State of Arizona
Operator: Arizona Department of Transportation - Aeronautics Division
Location: Airport Reference Point: Lat. 35 deg. 57'16"
Long. 112 deg. 08'37"
Airport Elevation: 6611.12' MSL
Mean Max Temp. - Hottest Month: 85.6 Deg. F - July
Magnetic Inclination: 13 Deg. 48 ± E
Total Land Area: 858.66 Acres
Air Traffic Control Tower: FAA - Hours 0800-1800 daily
Runway 3/21 (NE-SW):
- Length: 9,000 ft.
- Width: 150 ft.
- Effective Gradient: 0.844%
- Taxiway: Parallel, 75 ft. wide
- Wind Coverage (15 MPH): - 98.8%
- Pavement: Asphaltic Concrete - 108,000 # Dual
- Lighting: MIRL-MITL
- Prinicpal Subgrade Class: E-7
- Clear Zones: 3-50:1
  21-34:1
- Navigational Aids: VOR-DME, VASI, ILS, GS, LOC, MALSR
- Runway Category: 3 - Precision
  21 - Nonprecision

ULTIMATE

Name: Grand Canyon National Park Airport
Ownership: State of Arizona
Operator: AVCO Management Service Division, AVCO Services Corporation
Location: Airport Reference Point: Lat. 35 deg. 57'08.4"
Long. 112 deg. 08'51.4"
Airport Elevation: 6611.12' MSL
Mean Max Temp. - Hottest Month: 85.6 deg. F - July
Magnetic Inclination: 13 deg. 48 ± E
Total Land Area: 1358 ± Acres
Air Traffic Control Tower: FAA (relocated)
Runway 3R/21L (NE-SW Primary Runway):
- Length: 10,700 ft.
- Width: 150 ft.
- Effective Gradient: 0.844%
- Taxiway: 75 ft. wide
- Wind Coverage: (15 MPH): 98.8%
- Pavement: Asphaltic Concrete - 158,000 # Dual
- Lighting: MIRL-MITL
- Principal Subgrade Class: E-7
- Clear Zones: 3-50:1
  21-34:1
- Navigational Aids: VOR-DME, VASI, ILS, GS, LOC, MALSR
- Runway Category: 3 - Precision
  21 - Nonprecision

TABLE I-1 (Continued)
Airport Facilities

**EXISTING (continued)**

• Helicopter Operations located in Tusayan

General Facilities:

Fencing: Perimeter - Barb Wire
Terminal Area - Chain link
Terminal Building: 9531 SF
General Avaiation Ramp: Area 17,000 SY
Tiedowns 34
Air Carrier Ramp: Area 29,000 SY

Fire and Rescue Building: 2100 SF
Equipment & Shop Buildings: 4512 SF
Residences: 6
Water and Wastewater: Provided
Electrical: APS

**ULTIMATE (continued)**

Runway 3L/21R (NE-SW Secondary Runway)
Length 8,000 ft.
Width: 75 ft.
Effective Gradient: 0.844%
Taxiway: Parallel, 50 ft.
Wind Coverage (15 MPH): 98.8%
Pavement: Asphaltic Concrete - 12,500 # Single
Lighting: None
Principal Subgrade Class: E-7
Clear Zones: 3-20:1
21-20:1
Runway Category: Utility

Heliport:
Takeoff & Landing Area: 65 ft. x 65 ft.
Peripheral Area: 10 ft. wide minimum
Taxiway Width: 20 ft.
Parking Spot: 45 ft. dia.
Clearance: 10 ft. min.
Approach Surface:
Slope: 8:1

General Facilities:

Fencing: Perimeter - Barb Wire
Terminal Area: Chain Link
Terminal Building: 102,000 SY
General Aviation Ramp: 58,760 SY

Air Carrier Ramp: 16,000 SY
Commuter Ramp: 128,760 SY
Fire and Rescue Building: 2100 SY
Equipment and Shop Building: 9000 SF
Residences: None
Water and Wastewater: See Chapter II, Sec. D
Electrical: APS

## CHAPTER II.

## PROBABLE IMPACTS ON THE ENVIRONMENT

### A. NOISE:

#### 1. Introduction:

The purpose of the noise study is to analyze the effects of Airport operation and development on the noise environment in the Airport vicinity. The analysis of Airport noise is accomplished using operations data and the Federal Aviation Administration (FAA) Integrated Noise Model (INM). The model uses the Day/Night Sound Level (Ldn) as a noise environment descriptor. All operations during a 24 hour summer day are integrated by the model to produce a measure of the noise environment they produce. The model result is expressed as noise contours which isolate high noise exposure areas.

#### 2. Noise Environment Descriptor:

The FAA standard metric for determining the cumulative exposure of individuals to noise is the Day-Night Sound Level (Ldn). The Ldn system is also the preferred standard of the Environmental Protection Agency (EPA). Ldn is a method of assessing the amount of exposure to aircraft noise and predicting community response to the various levels of exposure. A detailed discussion of noise basics, the Ldn, land use and community response, and Ldn land planning application can be found in Appendix ER-A . Provision is made to account for noise from all operations, not just the noisiest ones, and account for evening and night operations. The Ldn levels used for planning purposes in this study are 65, 70, and 75. Land use guidelines are based on the compatibility of various land uses with these exposure levels.

Other metrics are in use to describe the noise environment; principally the Noise Exposure Forecast (NEF) and the Community Noise Rating (CNR). For comparison and planning purposes, NEF 30, Ldn 65 and CNR 100 may be considered equivalent, as may NEF 40, Ldn 75 and CNR 115. However, due to technical differences in the three systems, direct comparison or conversion from one system to another can be misleading and is not recommended. Details concerning the Ldn methodology are presented in the Appendix ER-A.

Nearly all studies on residential aircraft noise compatibility recommend no residential uses in noise zones above Day-Night Sound Level (Ldn) 75 or its equivalent in other noise descriptor systems. Usually no restrictions are recommended below Ldn 65. Between Ldn 65 and 75 there is currently no concensus. According to the Department of Housing and Urban Development (HUD), areas between Ldn 65 and 75 may not qualify for FHA mortgage insurance in residential categories. In many cases, HUD approval requires noise attenuation measures, the Regional Administration's concurrence and an Environmental Impact Statement.

Most industrial manufacturing uses are compatible in the airfield environs up to Ldn 85. Above Ldn 70 sound attenuation measures should be incorporated in the design and construction of portions of buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low. Exceptions are uses (such as research or scientific activities) which require lower noise levels.

The transportation, communications and utilities categories have a high noise level compatibility because they generally are not people intensive. When people use land for these purposes, the use is generally very short in duration. Where buildings are required for these uses, additional evaluation is warranted.

The uses of commercial/retail trade, personal and business services categories are compatible without restriction up to about Ldn 70. They are generally incompatible above Ldn 80. Between Ldn 70-80, attenuation should be included in the design and construction of buildings.

The nature of most uses in the public and quasi-public services category requires a quieter environment and attempts should be made to locate these uses below Ldn 65 or else provide adequate attenuation.

Although recreational (golf courses, developed parks, swimming, etc.) use has been recommended as compatible with high noise levels, research has resulted in a more conservative view. Generally, above Ldn 75, noise becomes a factor which limits the ability to enjoy such uses. Where the requirement to hear is a function of the use (e.g. music shell), compatibility is limited. Buildings associated with golf courses and similar uses should be noise atte nuated.

With the exception of forestry activities and livestock farming (normally compatible up to Ldn 75), uses in the resource production, extraction and open space category are compatible almost without restriction.

In short, different noise sensitivities are developed by different land uses.

3. Development of the Noise Model:

Data on traffic and traffic patterns at the Grand Canyon National Park Airport is used with aircraft noise data to model the noise environment for existing conditions and for the ultimate development described in the master plan. Aircraft types are assumed to conform with noise standards called for in the Federal Aviation Regulations, Part 36.

a. Traffic: The daily operations used to model the noise environment at GCN are based on an average summer day. According to the data collected for the Master Plan, approximately 69 percent of annual operations occur during the 6 summer months (April through September, 183 days). The daily traffic used in the model is the average of those 183 summer days. This is expected to reflect the noise environment at GCN when it is most severe. Winter month activity is much lower and the noise environment during that time is not as critical as during the summer months.

(1) Existing (1982): One hundred percent of existing fixed-wing traffic use Runway 3-21; existing helicopter operations use the heliports in Tusayan. The percent and number of operators by aircraft type is shown in Table II-1 developed from data present in Chapter II, III and IV of the Master Plan.

TABLE II-1

Existing Daily Operations

| Aircraft Category | % of Operations | No. of Operations |
|---|---|---|
| Air Carrier | 2.0 | 7.1 |
| Military | 0.4 | 1.2 |
| General Aviation | 12.0 | 41.9 |
| Based Commuter | 22.0 | 78.8 |
| Itinerant Commuter | 41.0 | 147.8 |
| Local | 2.0 | 6.7 |
| Helicopters | 20.0 | 71.6 |
| Slurry Bombers | 0.6 | 2.0 |
| | 100.0 | 355.1 |

Existing fixed wing evening operations are assumed to be about 6% of total daily operations (20 operations). It is further assumed that 5 flights occur during the night by single and twin engine aircraft. Helicopter operations are assumed to be solely during the day.

(2) Ultimate: In 2003, aircraft operations are divided between the primary Runway 3R/21L and the secondary Runway 3L/21R as shown in Table II-2.

Table II-2

Ultimate Runway Utilization

| Runway | % Operations |
|---|---|
| 03R/21L | 52 |
| 03L/21R | 32 |
| 2/20 (Heliport) | 16 |

Runways are located as shown in the Figure I-3. Utilization of Runway 3L/21R is limited to small single and twin engine aircraft when Runway 3R/21L is being fully utilized. Note that the Heliport has been moved from Tusayan to the Airport vicinity (Site 4 shown in Chapter IV of the Master Plan). Operations by aircraft type are as shown in Table II-3.

TABLE II-3
Ultimate Daily Operations

| Aircraft Category | % of Operations | No. of Operations |
|---|---|---|
| Air Carrier | 9 | 71.4 |
| Military | 1 | 5.5 |
| General Aviation | 17 | 136.8 |
| Based Commuters | 8 | 63.0 |
| Itinerant Commuters | 45 | 356.9 |
| Local | 4 | 27.9 |
| Helicopters | 16 | 126.1 |
| Slurry bombers | -- | 2.0 |
| | 100 | 789.6 |

As for existing traffic, ultimate evening operations are assumed to be about 6% of daily operations (40 operations). It is assumed that 10 flights occur during the night. Helicopter operations are assumed to be solely during the day.

b. Tracks and Traffic Pattern: Approach and take-off tracks for the Airport were developed based on existing traffic control procedures using information from the Air Traffic Control Tower and a topographic map of the area. Track lengths of over 50 nautical miles are used in the model. Figure II-1 shows the typical flight tracks used in the model for ultimate traffic (year 2003) according to the Airport Master Plan. Flight tracks used for the existing traffic are similar. Existing helicopter operations use the heliports in Tusayan and are similar in orientation and direction to those shown of Figure II-1.

The preferred traffic direction is on Runway 21; it is assumed that 85% of the time, aircraft will land and take off on Runway 21. Table II-4 and II-5 summarize the tracks used in existing and ultimate conditions. Aircraft types are chosen from those available in the INM data base representative of the existing or anticipated traffic.

4. Noise Impact:

Results of the analysis are shown in Figures II-2 and II-3, Existing and Ultimate Ldn Noise Contours. Three computer runs are presented in Appendix ER-B, which includes existing traffic (1982 statistics), existing helicopter traffic from Tusayan (1982) and ultimate traffic (2003). Figures II-2 and II-3 show Ldn contours for existing and ultimate airport operations. Ldn contours indicate the boundary lines between area of acceptable and unacceptable noise exposures for various land uses. The contours indicate trends in relative noise levels. However, vegetation, land contours and the position of buildings or walls may often affect the noise impact at a specific site.

a. Existing Traffic Ldn Noise Contours: The existing fixed wing Ldn 65 contour is confined to the Airport site. Figure II-2 shows that the .52 square mile 65 Ldn contour occupies about 1/3 of the Airport site (1.3 sq. miles). The 70 Ldn contour occupies .27 square miles and the 75 Ldn contour is

0.13 square miles in area; it includes essentially a narrow strip bordering the runway. The Grand Canyon Squire Inn on the southern end of Tusayan is well outside the 65 Ldn level. The helicopter site in Tusayan has no 70 or 75 Ldn contour. The 65 Ldn contour covers .01 square miles, extending about 1500 feet north of the heliport.

TABLE II-4

Noise Model Traffic Patterns - 1982 (Existing)

| Aircraft* | Runway+ | Approach Direction & Tracks | Take-Off Direction & Tracks |
|---|---|---|---|
| Air Carrier & Group III Charters (DC9), GA Turbojets (Comp. GA Jet), Large Commuters (CV580, F27, DHC-7), Military (Sabre & Hercules), & Slurry Bombers (DC6,7) | 21L/03R | 2/3 from west: 2,3,16<br>1/3 from south: 7,17,18 | 2/3 west: 10,22<br>1/3 south: 8,21 |
| Group II Commuters & Local (SD3-30, DHC6) Comp. GA Twin Engine) | 21L/03R | 80% from west: 75% 4,5,20<br>25% 1,15<br>20% from south: 7,17 | 80% west: 10,22<br>20% south: 8,21 |
| Group I Commuters Local (Comp. GA Single Engine) | 21L/03R | 82% from west: 75% 1,15<br>25% 4,5,20<br>18% from south: 7,17 | 82% west: 10,22<br>18% south: 8,21 |
| Helicopters** | Tusayan Heliports | Tracks 30,31,36,37 | Tracks 32,33,34,35 |

*In all cases 85% of Aircraft use Runway 21L, 21R and 21; 15% use 03R, 03L & 03

**Helicopter tracks: 30 from NE & 31 from NW - landing on 21, 36 from NE and 37 from NW - landing on 03.
32 to the NE & 33 to the NW - take off on 21
34 to the NE & 35 to the NW - take off on 03

+Fixed wing aircraft tracks are shown on Figure II-1.

TABLE II-5
Noise Model Traffic Patterns - 2003

| Aircraft+ | Runway* | Approach Direction & Tracks | Take-off Direction & Tracks |
|---|---|---|---|
| Air Carrier & Group III Charters (DC9), GA Turbojets (Comp. GA Jet), Large Commuters (CV580, F27, DHC-7), Military (Sabre & Hercules), & Slurry Bombers (DC6,7) | 21L/03R | 2/3 from west: 2,3,16,<br>1/3 from south: 7,17,18 | 2/3 west: 10,22<br>1/3 south: 8,21 |
| Group II Commuters & Local (SD3-30, DHC6, Comp. GA Twin Engine) | 60% 21L/03R<br>40% 21R/03L | 80% from west: 75% 4,5,20<br>25% 1,15,16&2<br>20% from south: 6,7,17,19 | 80% west: 10,11,22,23<br>20% south: 8,9,21,24 |
| Group I Commuters & Local (Comp. GA Single Engine) | 35% 21L/03R<br>65% 21R/03L | 82% from west: 75% 1,15,16&2<br>25% 4,5,20<br>18% from south: 6,7,17,19 | 82% west: 10,11,22,23<br>18% south: 8,9,21,24 |
| Helicopter**(Bell 206L, Hughes 500C, Augusta A109) | 20/02 | Tracks 30,31,32,33,34 | Tracks 35,36,37,38,39 |

*In all cases 85% of Aircraft use Runway 21L, 21R, & 20; 15% use 03R, 03L & 02.

**Helicopter tracks are shown on Figure 1 in dashed lines.

+Fixed wing aircraft tracks are shown on Figure 1.

b. Ultimate Traffic: For the case of ultimate Airport traffic 75 and 70 Ldn contours are well contained within proposed future Airport land boundaries. The 75 Ldn area covers .52 square miles and the 70 Ldn area covers 1.05 square miles. Some 65 Ldn area extends outside of Airport property into the Kaibab National Forest and on Tusayan private land. The Grand Canyon Squire Inn is within the Ldn 65 contour but Ldn levels below 70 are generally compatible with hotels and motels.

c. Summary: It appears that existing airport traffic noise is compatible with the Airport's surroundings. All high level noise occurs on the Airport land. However, Low level helicopter noise exposure on private land in Tusayan is incompatible with existing residential use. The Kaibab National Forest and the Grand Canyon National Park are free of any noise above the Ldn 65 level. According to land use compatibility planning (FAR Part 130) all land uses are normally compatible with noise levels below Ldn 65. However, due to low background noise levels on other sensitive elements, local needs and values may require lower noise levels. The ultimate development traffic will produce higher noise levels in small adjoining areas of the Kaibab National Forest. All noise greater than Ldn 70 will be contained on Airport land. Parts of Tusayan and the Kaibab National Forest will be subjected to some noise above Ldn 65 but mostly levels below Ldn 65.

d. Mitigation: There are several strategies used to control noise due to airport activity available to the airport: denial of use, noise abatement takeoff or approach procedures, landing fees based on noise, noise barriers and shielding, acquisition of land and interest therein, and complete or partial curfews. Other strategies are available to the State and local governments: zoning, easements, transfer of development rights (TDR) and purchase. There are also strategies in use for reducing existing non-compatible uses: planning and zoning, public capital improvement projects, purchase assurance programs, soundproofing and acquisition of impacted land. Many of these strategies are not appropriate for the Grand Canyon National Park Airport. They are oriented towards airports which have more traffic and noise impact than GCN.

The State or local government can make use of zoning to ensure land compatibility. Through a zoning ordinance (example is shown in Appendix ER-C local government would be given powers to designate the use permitted for each parcel of land within the ordinance area. Zoning laws should be based on a comprehensive plan taking into account needs and goals of all involved (community, airport, Grand Canyon National Park, National Forest).

The zoning ordinance should include measures for soundproofing future buildings within the Ldn 65 noise level. Retrofitting of old buildings to increase noise level reduction is also possible by among other things installing new soundproofing windows and adding insulation to walls and attic spaces. With a good comprehensive zoning ordinance, potential noise impact problems at the Grand Canyon Airport could be minimized.

At the present time, no retrofit noise attenuation measures are needed. However, to provide for Airport growth, measures should be taken to minimize future noise problems. A comprehensive zoning ordinance is the first step in controlling the noise impact of the airport and is the proposed action. The ordinance should limit future development within the noise contours to compatible land uses and require noise attenuating construction where appropriate. Since Tusayan is unincorporated, the ordinance would have to be enacted and enforced by Coconino County.

The Ldn 75 crosses in the vicinity of the terminal cluster. All future terminal construction should utilize noise attenuating construction. In addition, the present residences on the airport site are within the Ldn 65 and Ldn 70 contours and should be relocated as is proposed in the Master Plan.

B. LAND USE:

1. Existing Conditions:

The Airport property was transferred from the United States Government on February 6, 1967 under Section 16 of the Federal Airport Act of 1946 as amended by the Federal Aviation Act of 1958 to the State of Arizona.

The grantor was the United States Department of Agriculture, Forest Service. The property is surrounded on three sides by the Kaibab National Forest and abutted on the northeast by a privately owned 154 acre parcel. The property ownership in the vicinity of the airport is shown on Figure II-4, Property Ownership Map.

Discussion of existing conditions regarding the Kaibab National Forest and the Grand Canyon National Park are included in Section G: Federal Properties.

The privately owned parcel abutting the northeast boundary of the Airport property comprises the Village of Tusayan. Tusayan has a year-round population of approximately 260 residents. The area is oriented to tourism and is comprised primarily of motels, eating establishments and other seasonal tourism facilities. A general development plan and policy statement was adopted for Tusayan by Coconino County in 1978. The general development plan is shown in Figure II-5. Many of the present land uses were in existance prior to adoption of the plan including several non-conforming uses. As such, these non-conforming uses presently operate under conditional use permits. According to the Coconino County Planning, a more comprehensive development plan and ordinances are needed for Tusayan including noise and tall structures ordinances. The two present helicopter operations located in Tusayan are included among the non-conforming uses operating under Conditional Use Permits.

The Forest Service's District office in Tusayan has received several applications for Use Permits for various residential and commercial uses on Forest Service property adjacent to Tusayan. Due to lack of impact identification, the District has held their approval and the issuing of any use permits.

A development plan for the privately owned 160 acre parcel known as the APEX Siding, west of the Airport property is presently being proposed as a resort facility being served by a private railroad from Williams, Arizona.

Tract X-107 is Mining Claim 12108 and contains the Rain Tank. It is a stock watering tank and has long been a landmark in northern Arizona. Another tank has been added adjacent to the Rain Tank which is essentially an overflow structure. It was created by the 10-X Ranch in conjunction with their Forest Service grazing program. Both are used eight to twelve months a year for livestock watering.

2. Probable Impacts:

The proposed action's impact on land use was determined by evaluating land use conversions, noise, relocation requirements, utility and access road improvements, induced development and the relationship to local development patterns. Probable impacts on the Kaibab National Forest and Grand Canyon National Park are found in Section G: Federal Properties.

Results of the noise analysis in the preceeding Noise Section indicates that aircraft traffic will produce higher noise levels in small adjoining areas. All noise greater than Ldn 70 will be contained on Airport land. As shown in Figure II-3, parts of Tusayan and the Kaibab National Forest will be subjected to some noise above Ldn 65 but mostly below Ldn 65. According to land use compatibility planning (FAR Part 130), all land uses are normally compatible with noise levels Ldn 65 and below.

The proposed expansion of the Airport will require the relocation of seven Airport employee families presently living in mobile homes provided by ADOT on the existing Airport property just south of the existing terminal buildings. The relocation will have a significant impact on the supply of housing in the area, due to the fact that housing is limited.

No existing major or primary improved roads will be closed in conjunction with the Airport expansion. Access to the Airport will be provided from State Route 64 by the relocation of the existing paved two-lane access road, and by a new paved two-lane access road connecting with State Route 64 at the northeast end and the existing Primary Forest Service Road at the southwest end which connects with State Route 64. The access road will impact State Route 64 by adding a projected 306 vehicles during the peak hour make up of approximately 19% buses, 1% trucks and 80% automobiles. The most current traffic count (1983) on State Route 64, from the present Airport access road to the Park Headquarters of Grand Canyon National Park, is estimated by ADOT's Transportation Planning Office at 3,500 vehicles per day. According to the Transportation Planning Office, this count is well below capacity for that segment of State Route 64.

The present Airport operations and expansion of facilities appears to be compatible with development patterns in Tusayan and the surrounding area. The proposed action includes the relocation of existing helicopter operations from Tusayan to the Airport which is seen as having a beneficial land use, noise and safety impact on Tusayan. Few off-site support services are anticipated for the Airport expansion. Areas have been reserved on the Airport property for activities such as fuel storage and other activities normally encountered with this type airport.

Induced development is contemplated to occur due to the proposed action. Demand will be placed on Tusayan for residential housing, and commercial/retail space development. This is seen as significant given the limited amount of land available for development. The type of development would be subject to the approval of Coconino County. The Forest Services' District Offices have expressed interest in supporting planned development adjacent to Tusayan and Airport by providing land under Use Permit once a Comprehensive Land Use Plan for the area has been developed and adopted as a part of the Coconino County General Plan.

Land use measures available to insure compatible development in Tusayan and adjacent areas include development of the Comprehensive Development Plan in conjunction with the Forest Service which includes zoning ordinances which mitigate possible impacts such as noise and tall structures. Once the Comprehensive Plan is developed and adopted, additional Forest Service controlled lands could possibly become available for use to mitigate development impacts.

C. VEGETATION AND WILDLIFE:

1. Existing Conditions:

The native vegetation of this general region is typical of southwestern high country pine forests with open meadows. Ponderosa Pine, Pinon-Juniper and open meadow grasslands reflect the climatic conditions of cool temperatures in the 19 to 50 degree range in the winter and 40 to 85 degree range in the summer. Rainfall averages 14.46 inches per year and snowfall averages 64 inches per year. Browse species and forage species include cliffrose, golden currant, fernbush and big sage. Younger aged (less than 8" DBH) juniper, pinon and ponderosa pine provide valuable escape and thermal cover for all species of wildlife.

According to the Forest Service, characteristic fauna of the general area include deer, elk and ground squirrel. The Bald Eagle has been sighted in the area around Tusayan. However the Forest Service has reported that no nesting in the vicinity of the sighting has been located. Significant numbers of Peregine Falcon have been noted in the vicinity of the Grand Canyon.

The Arizona Game and Fish Department reports that approximately 15 to 20 resident elk and 15 to 30 transient elk utilize Rain Tank (a stock tank located at the southwest end of the existing runway), forage and escape cover located within the project area. The project site supports a secondary fawning grounds to the south of the Airport area and 40 to 60 mule deer utilize Rain Tank, forage, escape and thermal cover. The area provides both summer and winter ranges. Merriam's Turkey have been observed feeding within the project area. Wintering bald eagles have been observed foraging on fish species currently inhabiting Rain Tank. Duck species of the Anatinae family have regularly utilized Rain Tank during migrations. Several species of songbirds and shorebirds feed and nest in and around Rain Tank during the spring and summer months. Shorebirds include egrets, herons, plovers, curlews, sandpipers and killdeer. Two species of raptors are known to forage the area; red-tailed hawks and turkey vulture. The tassel-eared squirrel utilize the ponderosa pine for food sources and escape cover. However, no nest trees for the tassel-eared squirrel have been observed.

2. Probable Impacts:

Although the construction of the new secondary Runway 3L-21R and extension of the primary Runway 3R-21L will be located entirely on existing Airport property, the acquisition of approximately 500 additional acres of Kaibab National Forest will be required to provide for the transitional surface and clear zone. This 500 acres is predominantly high-country pine and represents less than one-half of one percent of the central portion of the total Kaibab National Forest. Of this 500 acres, it is estimated that approximately 400 acres will be required to be cleared during construction to provide for the control surfaces. This will create a short term aesthetic visual impact.

This clearing activity will result in a loses of supporting habitat resulting in a reduction in numbers of each affected population, both immediate and on a long-term basis. According to the Arizona Game and Fish Department, numerous species of songbirds indigenous to the area will be impacted through losses of foraging and nesting habitats. Prey species will diminish from losses of escape cover. Due to the relatively young age structure and lack of interconnecting crowns, ponderosa pine losses will only affect food sources and escape cover for the tassel-eared squirrel.

The existing Rain Tank provides wildlife within a 3-mile radius with a reliable, year round water source. Relocation of the Rain Tank, required for the extension of the primary Runway 3R-21L, must be located so as to minimize the chance of animal-aircraft collisions yet provide for an adequate water source, for the necessary travel corridors and escape cover to the Rain Tank for cattle and wildlife needs. The Master Plan indicates that the relocated Rain Tank will have at least an equivalent storage capacity and provide an efficient water barrier to avoid soil seepage.

Any deposition of excavated material into or the grading of Rain Tank Wash would represent a total destruction of an irreplaceable riparian habitat.

3. Mitigation:

The Arizona Game and Fish Department feels that most of the impacts to vegetation and wildlife can be satisfactorily mitigated or entirely avoided through the application of standard environmental protection measures incorporated into the construction specification.

The effects of tree removal can be minized by removing only those trees intruding airspace surfaces and allowing browse and forage species to remain. Additionally, the reseeding of disturbed areas in the vicinity of the runways with less palatable grasses and plant species will discourage foraging animals near approach/departure areas.

The relocated Rain Tank(s) must have timely construction so as to have a source completed before the present tank is obliterated. However, any deposition of excavated material and grading of the existing Rain Tank Wash (southwest of the Rain Tank) should be avoided.

D. RESOURCES (WATER QUANTITY & QUALITY):

1. Existing Conditions:

Probably the most scarce resource in the regional area in which the Airport is located is water. The community of Tusayan and Moqui Lodge purchase and haul water from Grand Canyon Village or from the City of Williams, Arizona.

The Airport presently relies totally an two sources of supply; storm water runoff and imported (trucked) water. Storm water runoff is captured in a catch basin located between Runway 3-21 and the parallel taxiway, just adjacent to the terminal area, and in a collection system from the roof of the terminal building. The catch basin is capable of containing about 986,000 gallons if water is allowed to accumulate to overflow.

During a storm event, water flows into an intake structure at the lower end of the catchment basin and is pumped to storage. The present capacity of raw water storage at the Airport is approximately 511,000 gallons. The Airport has a dual water system providing water of the appropriate quality for the intended use. Water for consumptive use is treated using a carbon filtration and disinfection system located in the terminal building. Water for non-consumptive uses is not treated. Available information indicates that treated water meets the standards required by the State of Arizona Administrative Rules and Regulation covered under R9-8-221/Maximum Contaminant levels.

When capacity in the raw waterstorage facilities at the Airport is reached, runoff passes over a dike at the south end of the catch basin and flows through drainage swales to the Rain Tank as does all other runoff from the drainage area within which the Airport property is located. (See Hydrology and Flood Hazard Evaluation.)

Because there are months when precipitation is minimal or zero, and the storage capacity and quantities in storage are not great enough to carry over large quantities through the dry periods, water must be imported. The imported water is obtained from the National Park Service facilities at Grand Canyon Village on the South Rim or from the Town of Williams, Arizona, located approximately 50 miles south of the Airport. The water obtained from the Grand Canyon Village is supplied to the South Rim through a piped system transversing the Canyon with the source of supply being Roaring Springs located just below the North Rim. It has been reported that there are mounting ecological concerns about the existing quantities of water being taken from that critical riparian area and that any increases in amounts of water taken above existing levels could only increase the concerns.

This imported water is trucked to the Airport from either location and treated for quality, as described above, depending on intended use. Table II-6 presents historic record of water uses, water purchased and estimates of water (precipitation) catchment at the Airport for the years 1971 through 1982.

TABLE II-6

Water Uses and Sources at GCN

| Year | Airport Use (1000 gal) | Water Purchased (1000 gal) | Water from Catchment (1000 gal) |
|---|---|---|---|
| 1971 | 751 | 162 (22%) | 589 (78%) |
| 1972 | 644 | 205 (32%) | 439 (68%) |
| 1973 | 803 | 149 (19%) | 654 (81%) |
| 1974 | 837 | 162 (19%) | 675 (81%) |
| 1975 | 701 | 140 (20%) | 561 (80%) |
| 1976 | 934 | 300 (32%) | 634 (68%) |
| 1977 | 1,024 | 159 (16%) | 865 (84%) |
| 1978 | 1,607 | 212 (13%) | 1,395 (87%) |
| 1979 | 1,779 | 210 (12%) | 1,569 (88%) |
| 1980 | 2,230 | 684 (31%) | 1,546 (69%) |
| 1981 | 1,375 | 160 (12%) | 1,215 (88%) |
| 1982 | 1,270 | 114 (09%) | 1,156 (91%) |

The Rain Tank, located at the southwest end of Runway 3-21, is an earthen stock tank with a capacity estimated at approximately 4.5 million gallons. During years of average precipitation, the Rain Tank is estimated to fill and refill two to four times a year. Information available on the existing water quality of the Rain Tank indicates that the quality of water meets or exceeds criteria established for Agricultural Protected Uses and identified in Arizona Administrative Rules and Regulation R9-21-209, Table I.

The Rain Tank is situated on a tract of land identified as Mining Claim 12108 which is surrounded by the Airport property. This property has been condemned by the State and title transfer is in process.

2. Probable Impacts:

a. Water Quantity: The proposed development at the Airport will have a significant indirect impact on water quantity. The construction of proposed facilities will enable the Airport to meet the forecasted increased operations and enplanements, which, in turn, require increased quantities of water for consumptive and non-consumptive uses. Table II-7 reproduced from the Master Plan, presents the annual forecasted water requirements.

TABLE II-7

Total Annual Water Supply Requirements

| Year | Annual Water Requirement (1000 gals) |
|---|---|
| 1988 | 3,596 |
| 1993 | 5,404 |
| 2003 | 11,224 |

Under present conditions, this annual water requirement would force the Airport to rely more and more on imported sources and make imported water the primary source over runoff catchment.

Considering the scarcity of water in the region, the amount of the water required would probably place the Airport in the position of competing for available imported sources with Tusayan and other communities and entities in the region which could adversly affect their survival and growth. Additional purchases of water above present levels from the Grand Canyon Village is not seen as viable due to the physical and environmental limitations of their source and supply system. The impact, in part, then becomes economic in nature, as the cost goes up and/or the search for imported water goes further from the Airport (e.g. Williams to Flagstaff to White Mountain communities) and trucking expenses increase.

Should present courses of action being pursued by ADOT that would increase water rights fail, some alternative sources to be investigated might include: regional surface water impoundments; groundater extractions (wells); possible Colorado River water use; or an importation pipeline from communities to the south (e.g. Williams or Flagstaff).

Mitigation measures include:

1. Maximization of precipitation catchments within water right limits.

2. Continued water use conservation.

b. Quality: Surface waters will be affected by both the construction (excavation/grading) and increased operations of the Airport. Subsurface acquifers should not be affected.

The disposal of aircraft generated wastes which might reach the catch basin and/or Rain Tank represents a threat to water quality. Petroleum spills or wastes are a principal concern. These can occur in a number of ways.

Containment by barriers at the source before contaminents can spread or become diluted by storm water runoff provide the most efficient method of treating large petroleum spills. In most instances, quantities are small and removal can be accomplished with absorbent chemicals or through mechanical means. Resulting solid wastes are shoveled and swept into containers for disposal.

New areas used for repairs and maintenance should be constructed to contain wastes from routine aircraft maintenance and cleaning. These wastes contain grease, oils, some heavy metals, strong detergents and sediments. Every effort should be made to retain heavy metals at their source and dispose in solid waste receptacles. Oils, greases and other similar containments collected should be handled and disposed in approved smanner to approved areas, consistent with State regulations.

Another potential contaminant to area surface water is fuel storage tank leaks or ruptures. Underground storage tanks will be constructed of coated metal designed to prevent corrosive type leaks in accordance with State regulations.

A short-term increase in sediment transport and turbidity is expected during construction periods. Temporary erosion and permanent erosion control measures as required by FAA standard construction requirements minimize these sedimentation hazards. The measures include the use of diversion ditches and sediment ponds, seeding, mulching, dust control, etc. After construction and re-establishment of vegetative cover, turbidity levels in surface catchments such as the Rain Tank should return to preconstruction levels.

In summary, the provision of temporary and permanent erosion controls coupled with petroleum waste measures will reduce the projects impacts on surface water quality. As a result, the proposed development projects should not significally alter nor adversly affect water quality.

E. HYDROLOGY AND FLOOD HAZARDS:

1. Existing Conditions:

The existing Airport property is located in the drainage area of Rain Tank Wash which consists of approximately 8,250 acres above the Rain Tank, an earthen stock pond situated at the southwest end of the Airport runway.

The drainage area slopes from its high point at elevation 6,890 feet to the northwest to a meadow which includes the majority of the Airport property. The Airport property topography slopes from elevation 6,600 feet at the northeast end of Runway 3-21 southwest to elevation 6,500 feet at the Rain Tanklocated southwest of Runway 3-21. The Airport property's high point is at the Airport Beacon at elevation 6670 feet, southeast of the existing terminal. Runoff from and entering the Airport property is carried to the Rain Tank via grassy swales located northwest of and parallel to Runway 3-21; between Runway 3-21 and the parallel taxiway; and southeast of and parallel to the taxiway. Culverts allow runoff to pass under turnouts.

Peak flows from the existing site for a 5-year storm event amount to approximately 89.5 cfs at the Rain Tank.

2. Probable Impact:

Grading and surfacing required for the development projects will cause a change in the rate of rainfall runoff in the project area. The net effect of this change will be an increase in the quantity of flow to the existing drainage outfalls. Peak flow from a 5-year storm will increase from 89.5 cfs to 197.3 cfs at the Rain Tank.

Design and construction of the various development projects will include provisions for drainage systems to control increased peak runoff. The existing system of ditches associated with existing runway 3R-21L and new ditches associated with runway 3L-21R construction and terminal area improvements will control and divert runoff from the site to the existing Rain Tank. This ditch systems will also act as diversion ditches for possible sediment flows during construction as well as direct flows after completion.

F. AIR QUALITY:

1. Existing Conditions:

The existing Airport is located in Coconino County and is within the air quality region aligned with the jurisdaction of the Northern Arizona Council of Governments (NACOG). The air quality in the region is considered good. This description is reflected in the State Implementation Plan where the region is classified as a Class I Area indicating ambient pollution levels well within National and State standards.

The region is not classified as an Air Quality Maintenance Area (AQMA) nor does the Airport operate under an Indirect Source Permit.

The Federal Clean Air Act of 1970 (P.L.90140) provided that the EPA issue national standards to protect ambient air quality. The standards apply to pollution from all sources including aircraft. The ambient air standards were published and promulgated in the Federal Register (36(84)), April 30, 1971. The EPA also established Emission Control Standards and Test Procedures for Aircraft-generated Pollutants. These regulations were published in the Federal Register, July 17, 1973. The promulgated emission standards are based on new aircraft classifications adopted by EPA. The fuel venting and smoke number requirements become effective on February 1, 1974, as published by the EPA in the Federal Register, December 28, 1974.

According to the Arizona Department of Health Services, Bureau of Air Quality Control and the EPA, Region 9, ambient conditions monitoring data is available only for total suspended particulates. Over the period from 1971 to 1982, the annual geometric mean for ambient total suspended particulate concentrations, taken at the Grand Canyon monitoring station at Hopi Point, averaged 18 ug/m3 with a high of 40 ug/m3 in 1971. The trend shows consistant, steady concentrations which do not show evidence of increasing. Gaseous polutants have not been monitored.

2. Probable Impacts:

Both operations and short-term construction at the Airport affect ambient air conditions. An investigation of pollutants from projected increased aircraft operations at GCN was made. The analysis was based on the assumption that all proposed improvements were in place to the year 2003 and that the forecasted operations for 2003 are realized.

Pollutants from aircraft operations in the year 2003 have been estimated according to the following procedure:

a. Determine total aircraft engines per Peak Hour Landing/Takeoff Cycle (LTO Cycle).

b. Determine quantity of aircraft emissions, by

c. Determine total aircraft emissions by emission category in lb. per engine per LTO cycle.

d. Determine emission rate of engine per LTO cycle on Normal Peak Hour.

e. Determine aircraft engine emission dispersion concentrations at specified distances from the center of the source area (i.e., approximate center of runways area).

Peak hour 2003 aircraft volumes were taken from Chapter III of the Master Plan and are estimated to be approximately 70 LTO cycles per hour.

The distribution of pollutant emissions was calculated using the following Pasquill-Giffard dispersion estimate formula:

$$X(X,0,0;0) = \frac{Q}{T\,Oy\,Oz\,U}$$

where:

X = concentration of gaseous or particulate pollutant emissions

Oy = standard deviation of the Gaussian plume spread distribution concentration in the horizontal plane

Oz = standard deviation of the Gaussian plume spread distribution concentration in the vertical plane

Q = emission rate of pollutants (grams per second)

U = mean wind speed (assumed neutral turbulance structure, Class D)

T = 3.141592654

and:

| Distance from Center of Service Area (km) | Oy | Oz |
|---|---|---|
| 3.0 | 190 | 65 |
| 6.0 | 350 | 99 |
| 10.0 | 550 | 135 |

This formula was obtained from Workbook of Atmospheric Dispersion Estimates by D. Bruce Turner, U.S. Department of Health Education and Welfare, National Air Pollution Control Administration, Cincinnati, Ohio.

TABLE II-8

Peak Hour Aircraft Engine Emission Concentration, 2003

| Emissions ug/m3 | Dispersion Rate g/Sec. | Distance from Center of the Source Area(KM) 3.0 | 6.0 | 10.0 |
|---|---|---|---|---|
| Carbon Monoxide | 1.41 | 18.170 | 6.48 | 3.022 |
| Hydrocarbons | 0.131 | 1.688 | 0.601 | 0.280 |
| Solid Particulates | 0.012 | 0.154 | 0.055 | 0.025 |
| Nitrogen Oxides | 0.190 | 2.448 | 0.870 | 0.407 |
| Sulfur Oxides | 0.020 | 0.257 | 0.091 | 0.042 |

(1) ug/m3 = microgram per cubic meter

As a result of the calculations, the various pollutants will be dispursed as shown in Table II-8.

The ADHS, Bureau of Air Quality Control has implemented the incremental ambient air quality standards listed in Table II-9. A comparison of these standards with the pollutant concentrations in Table II-8 indicates that the incremental change in ambient pollutant concentrations which would result from aircraft operations would be below the allowable levels. Also, solid particulate pollutants from aircraft operations are well below the ambient levels measured at Hopi Point.

TABLE II-9

Ambient Air Quality Standards - Class I Area

| Emission | Annual Allowable Increment |
|---|---|
| Carbon Monoxide | No Standards Established |
| Hydrocarbons | No Standards Established |
| Solid Particulates | 10 ug/m3 average for any 24-hour period<br>5 ug/m3 annual geometric mean |
| Nitrogen Oxides | No Standards Established |
| Sulfur Oxides | (Sulfur Dioxide) 5 ug/m3 average for any 24-hour period<br>25 ug/m3 average for any 3-hour period<br>2 ug/m3 annual arithmetic mean |

ug/m3 = micrograms per cubic meter

Source: Bureau of Air Quality Control, Arizona Department of Health Services

A somewhat similar analysis for pollutants from ground vehicles at the Airport in 2003 was conducted. Table II-10 shows the results of the analysis with concentrations of pollutant emissions at various distances from the surface of the airport access roadways. These emissions concern only the 306 vehicles projected for the peak hour in the year 2003.

TABLE II-10

Automobile Emission Concentrations, Peak Hour, 2003

| Emission ug/m3 | Distance from Surface of the Access Roadways Within the Source Area, km 0.1 | 0.3 | 0.6 | 1.0 | 3.0 | 6.0 | 10.0 |
|---|---|---|---|---|---|---|---|
| Carbon Monoxide | 36.7 | 14.2 | 9.6 | 5.3 | 2.6 | 0.4 | 0.1 |
| Hydrocarbons | 5.3 | 1.8 | 1.0 | 0.8 | 0.35 | 0.23 | 0.18 |
| Solid Particulates | 0.3 | 0.10 | 0.08 | 0.03 | 0.02 | 0.01 | 0.008 |
| Nitrogen Oxide | 2.3 | 0.8 | 0.48 | 0.33 | 0.15 | 0.10 | 0.08 |
| Sulfur Oxides | 0.1 | 0.03 | 0.02 | 0.01 | 0.005 | 0.0005 | 0.004 |

From the above, it appears that projected concentrations of air pollutants resulting from the forecasted peak hour aircraft and ground vehicles would be below the allowable incremental levels.

## G. FEDERAL PROPERTIES:

### 1. Existing Conditions

The present Airport property is surrounded on three sides by the Kaibab National Forest. National Forest land uses within the vicinity of the Airport include livestock grazing, forest management, mining operations, hunter/recreation and overnight camping. Additionally, preliminary discussions between the State and the Forest Service have been held regarding acquisition by the State of additional land southwest of the Airport.

The Kaibab National Forest's Ten-X campround is located approximately two miles southeast of the Airport property. This campground is situated in the Kaibab National Forest and is open to the public from May 1 to about October 25th each year. It contains seventy family units, each unit designed to accomodate five people. The campground is reportly full each night from Memorial Day weekend thru Labor Day weekend.

The Forest Service maintains a system of primary and secondary roads in the vicinity of the Airport. These roads provide access to the National Forest for administrative and public uses including forest management, water hauling, Airport fence checking, and commercial gravel hauling under Use Permit.

The Forest Service leases a 9.55 acre parcel of land on Airport property adjacent to the runway. This parcel is used as a slurry base for Forest Service aerial fire-fighting operations for northern Arizona and southern Utah.

Vegetation and wildlife situated in the Kaibab National Forest in the vicinity of the Airport property is described in this Chapter under C: Vegetation and Wildlife.

The Grand Canyon National Park's south boundary is located approximately two and a half miles north of the Airport. The Grand Canyon Village is the center of Park activities on the South Rim and is six miles north of the Airport. The village has several hotels and tourist/recreational facilities. The Park is open year around. Visitation has increased since 1920 and has been relatively stable at an average of 2.7 million visitors over about the last 10 years. Visitation reached a peak in 1976 at an estimated 3.03 million visitors. It has been estimated by Park Service studies that foreign visitation accounts for approximately 33 percent of the total, on the average each year.

Park visitation is one of two primary trip generators for the Airport. As the mode of transportation, the Airport accounted for approximately 10 percent of the visitors in 1982. The Park Services' 1977 Development Concept Plan for the South Rim Village established a fixed capacity for overnight lodging units and calls for establishment of a day-use capacity on the South Rim. Presently, day-use limitations have not been implemented.

However, the number of overnight lodging units (including hotels and camping spaces) remains at levels frozen by the 1977 Plan. Currently, all overnight lodging units are full (at capacity) 100 percent of the time during the peak summer season.

The other primary trip generator for the Airport is overflights of the Grand Canyon by fixed wing aircraft. All aircraft overflights of the Canyon, however, are not generated from the Airport. Helicopter overflights also occur with their present base of operations located in the Village of Tusayan, approximately one mile from the Airport. Additionally, aircraft overflights of the Canyon originate from other surrounding municipal airports and private air strips.

The Park Service has been and continues to be very concerned with overflights primarily from the aspects of associated aircraft noise and safety. Section 8 of the Grand Canyon National Park Enlargement Act, P.L. 93620, states that the Secretary of the Interior shall act to protect the health, welfare and safety of the park visitors, and the natural quiet and experience of the Park where it is jeopardized by aircraft or helicopter activity over the Park.

The Park Service has stated that, due to the Canyon's unique environment, existing noise levels from overflights are incompatible with the primitive back country experience in the Canyon on some occassions during the year. As such, noise is of special concern to the Park Service as is witnessed by their noise monitoring research and study being undertaken over the last several years. The Park Service and aircraft sight-seeing tour operators have worked together during recent years to establish routes for overflights in an effort to control and minimize noise and safety impacts on Park visitors.

2. Probable Impacts:

a. Direct Impacts: The project requires the acquisition of approximately 500 acres of land adjacent to the existing Airport and presently within the Kaibab National Forest. Although the construction of the proposed expansion projects would be contained within the existing Airport property, the additional land must be acquired to provide for the transitional surface on the northwest side of the secondary parallel runway and for the clear zone at the southwest end of the primary runway extension. Once acquired, the land would remain as open space. However, any terrain or vegitation (e.g. strands of timber) that protrude through the surface of the 7:1 transitional slope or the clear zone will necessarily need to be removed. Existing forest habitats within these areas, not already disturbed by present aircraft activity, will be lost or forced to relocate.

The development projects proposed will not require the taking of any National Park or existing campground property. An increase in background noise levels will occur during take off and landing operations. This noise impact is documented in the Noise Section of this review. None of the Forest Services primary roads in the area of the Airport will need to be closed due to the proposed action.

b. Indirect Impacts: As described in the Land Use section, it is anticipated that expansion of the Airport will have an induce development impact on the surrounding area. Given the limited amount of developable private land in the area of the Airport, it is anticipated that the Forest Service will see an increase in the number of applications for Use Permits for residential and commercial uses. This is seen as a significant impact. However, the Forest Service has indicated a willingness to support development by issuing Use Permits once a Comprehensive Development Plan is adopted for Tusayan by Coconino County.

The Grand Canyon National Park will see indirect impacts in two primary areas; increases in visitation and increases in overflights of the Grand Canyon. The projected increase in visitation will impact the South Rim Village by increasing the demand of overnight lodging, support services such as restaurants, and basic utilities especially during the summer season assuming present trends continue. Day-use visitation is seen as increasing in proportion to operations at the Airport. This is also seen as a significant impact due to the demand the visitations will place on facilities located at the Park. Quantification of the impact can not be estimated without further study of existing visitor demographics and visitor charcteristics at the Park which was beyond the scope of this environmental review. Also, the Park Service has indicated that it desires to see an analysis of visitor arrivals including arrival times, transportation modes and demands on concession facilities relating to lodging, food and other services.

One mitigating factor is that the majority of day use visitors arriving by air use group transportation either in buses or vans. This tends to minimize the number of vehicles per visitor, thus lessening the impact on the Park roads and parking infrastructure.

Increased overflights of the Grand Canyon will increase proportionally with projected Airport operation to the year 2003. This will have a significant impact on noise, aesthetics and safety. Although the projected noise levels associated with the overflights forecasted to be less than 65 Ldn, which is generally considered compatible for all land uses, the impact may be more severe due to the extremely low background noise levels characteristics of the Grand Canyon. An increase in the number of aircraft overflight of Park facilities and the Grand Canyon will impact visual aesthetics, as well, due to the visual contrast between aircraft and natural background of the Grand Canyon.

Possible mitigation measures to minimize these impacts range from voluntary to manditory control of the Grand Canyon overflights. Four potential control measures, listed from less severe to most severe include:

(1) Voluntary flight tract and altitude restrictions.
(2) Designation of Restricted Air Space.
(3) Designation of Controlled Air Space.
(4) Establishment of an absolute altitude ceiling.

Under the first measure, aircraft tour operations voluntarily observe designated flight track and altitude restriction established jointly by the Park Service and operators. It is noted that this method is a continuation of the method presently being used to limit the impacts of overflights.

Under the second measure, prior permission permits would be required to enter the air space and would have tracks and altitude established. This measure would be conducted similar to the current method of controlling boats and rafts on the Colorado River, where an annual commercial/private use permit is necessary in order to use the river.

The third measure is a similar concept to a Terminal Control Area. The controlling entity such as the FAA control tower has absolute control over entry into the air space. This measure would require the use of radar and would be expensive as well as difficult to implement due to the Grand Canyon terrain.

The last measure is probably the most severe in that a flight altitude is established as an absolute ceiling under which overflights are prohibitive. This altitude would probably be set at an elevation high enough over the rim of the Grand Canyon to minimize noise and visual awareness.

The National Park Services and the National Park and Conservation Association has urged that further, more detailed study be completed to provide an opportunity to evaluate existing and projected levels of noise, overflight and other related impacts on the Park through an Environmental Assessment or Environmental Impact Statement process. The Park Service has requested that the study include a specific analysis of frequency of aircraft noise and noise volume along tour routes over the Park; visitor arrivals by aircraft and related impact on the Park facilities and concession services; and water supply and demand. Copies of correspondence relative to this position are included in Appendix ER-D.

H. CULTURAL RESOURCES:

1. Existing Conditions:

The Forest Service has performed three cultural resource surveys in the immediate vacinity of the Airport. These include one associated with the Tusayan Timber Sale in an area located east of the Grand Canyon Squire Inn; one associated with a Reforestation Program located approximately one-half mile north of the Airport; and the Rain Tank survey in an area southwest of Runway 3-21, just below Rain Tank.

A number of sites were found in the Rain Tank area survey. One site included rock shelters with scatters of pottery indicating habitation. Other sites in the survey included further scatters of pottery and chip stone but no structures.

2. Probable Impacts:

There is a high probability of further cultural resources sites existing in areas adjacent to the Airport. Mr. Tom Cartledge, Forest Service Archaeologist, estimates that a density of 3 to 5 sites per 100 acres are likely to exist in the property needed for the proposed new parallel runway 3L-21R and associated clear zones. These sites may include artifacts of the Archaic Period or Ceramic Period. The artifacts within the Ceramic Period may include those of the Cohnina or Anasazi cultures.

A mitigation program to minimize adverse impact should include the following:

a. Conduct an initial site survey to determine further the probable archaeological significance.

b. Should the initial survey prove positive, coordinate with the Forest Service to conduct a field investigation concentrating on those areas where development and grading would take place.

c. Construction of the development projects could proceed only after areas have been investigated and any diggings undertaken are completed.

d. During construction, representatives of the State Historic Preservation office and/or Forest Service Archaeologist's office be on site should additional artifacts be uncovered. The archaeologist will have the authority to temporarily limit construction operations in order to remove such relics.

The implementation of this program should allow construction to proceed and still allow sufficient opportunity for cultural resource preservation.

I. PUBLIC UTILITIES AND SERVICES:

Police security and fire protection, telephone, electric services, solid and liquid waste disposal and water utilities are provided for operations of the Airport.

Police protection is provided by the Coconino County Sheriff. Airport security is provided by authorized Airport personnel. Fire protection is also provided by Airport personnel for all facilities located at the Airport.

Solid waste from the Airport is deposited in the Coconino County landfill located approximately four miles from the Airport. Wastewater treatment and disposal is provided by the South Grand Canyon Sanitary District at their treatment facilities located just west of the Tusayan. Average daily wastewater flows produced by the Airport will increase from approximately 4,000 gallons per day, presently, to 24,000 gallons per day in the year 2003.

Telephone and electric services will continue to be provided to the Airport by Mountain Bell and Arizona Public Service.

Water utility service was discussed in the Water Resources section.

J. CONSTRUCTION IMPACTS:

This section briefly discusses the short term impacts that will take place during the construction periods. Also presented are the measures to be taken to minimize adverse impacts. The mitigating measures listed will be incorporated in the various project's plans and specification where appropriate.

1. A short term increase in the turbidity of the Rain Tank and storm producing running water will occur. Provisions for temporary erosion controls will limit sediment transport to a minimum.

2. Open burning associated with site clearing operations will result in an increase in air pollution. Burning will only be permitted when meteorological conditions are conductive to dispersion and will conform to State and local requirements. In addition, extreme care will be taken when burning during dry periods.

3. Background acoustic noise levels will increase significantly at the Airport. Heavy equipment used during construction will affect off-site areas as well. The closest off-site sensitive area, the community of Tusayan, will experience peak levels of around 55 dBA from heavy equipment operations. Most

construction operations, however, will be within background conditions at off-site sensitive areas.

4. Existing wildlife in the areas of the proposed heliport, runway extension, parallel runway, and apron and terminal expansions will be forced to relocate or perish. However, numerous habitates adjacent to the Airport property will provide the necessary area to support viable populations.

The No Project Alternative scenario would not, however, limit or eliminate further impacts on noise, air quality, or water resources. Noise levels and emissions may increase over present levels with larger aircraft utilization. The demand for terminal capacity and personal services, including water demand, would approximate those under the Project Alternative. Due to the attraction of aerial sight-seeing, projected impacts by fixed-wing general aviation and helicopter overflights of the Grand Canyon would probably still occur.

For these reasons it was concluded that the No Project Alternative was not a prudent alternative to meet the long range demands.

CHAPTER IV.

## SUMMARY OF COMMUNITY INVOLVEMENT

The Master Plan and Environmental Review were prepared with considerable input by the public. Briefly, the public involvement program consisted of:

1. Establishment of a Community Advisory Group consisting of a representative of interest and/or concerned groups in the airport area.

2. Determination of plans and programs established by local public and private agencies and continued coordination with these entities.

3. Discussions of the Master Plan work products (Chapters) as they were developed at Advisory Group meetings open to the public.

4. Presentation of the plan and this review at a formal advertised public meeting.

The program began in August 1983 with a letter sent to approximately twenty entities having an identifiable interest in the Airport or surrounding communities. The letter announced that a Master Plan for the Airport was being prepared and that an Advisory Group was to be formed to provide input into the planning process. Each entity was requested to nominate one representative to serve as a member of this Advisory Group. Thirteen entities responded initially and included the following representatives:

Mr. Brian Hawley, Coconino County
Mr. Joe Werdman, Northern Arizona Council of Governments
Mr. Ronald L. Warren, Grand Canyon Airlines, Inc.
Mr. James R. Tokarski, Jr., FAA
Mr. Bruce Madison, Madison Aviation
Ms. Nancy Lee, David Babbitt Industries
Mr. John W. Hyatt, Fred Harvey Company
Mr. James Clift, Regina Enterprises, Inc.
Mr. Thomas R. Chacon, U.S.D.A., F.S., Kaibab N.F.
Mr. Stephen Hodapp, Grand Canyon National Park
Mr. Ronald R. Gentry, Republic Airlines
Mr. Gary Maaske, Airport Manager
Mr. Tom Schaffer, Coconino County

As an example, the location of the heliport was selected after the consideration and balancing of several factors such as public access; minimization of noise and exhaust emissions, and increase in safety at the village of Tusayan; enhanced access to adequate fire fighting equipment as well as specialized services such as fueling; access to facilities such as instrument landing systems and obstacle free approaches and departures; reduction in airspace conflict potential between helicopter and fixed wing aircraft; and simplification of control tower operations by having continuous visual contact with all aircraft including helicopters.

C. ALTERNATIVE MODES OF TRANSPORTATION:

The Grand Canyon National Park area is presently served by a system of highways; State Route 64, from the south, interchanges with Interstate 40 at Williams (50 miles south) and, from the east, interchanges with US Highway 89 at Cameron (54 miles east). Except for private dirt strips in the area, all air transportation is limited to GCN. Rail passenger service presently does not exist. However, a private entity is presently investigating rail service between Williams, Arizona and the Grand Canyon National Park, in conjunction with a proposed resort development approximately three miles west of the Airport.

The use of rail or bus travel to satisfy demands for air travel was not considered to be a viable alternative. This conclusion was primarily drawn due to the fact that traffic at the Airport is seen as a "side trip" rather than a "destination". A majority of the tourist using the Airport normally arrive by plane in the morning on a sight-seeing side trip from Las Vegas, Nevada, and then return to Las Vegas in the afternoon. Other tourists take advantage of the numerous local aerial tours available by aircraft or helicopter. Since overnight lodging is limited within the Park, a minimal travel time is, therefore, of prime importance.

Therefore, it was concluded that expansion of the Airport would augment the existing transportation system to the area. People will continue to travel to the Park by bus or automobile and possibly by rail.

D. NO PROJECT ALTERNATIVE:

With the No Project Alternative, as with the Project Alternatives, it must be assumed that the demand estimated by the forecasting model for aviation activity to the year 2003 will materialize, and that tour and mass transportation operators will attempt to satisfy the demand by utilitzing all existing modes of transportation. Under the No Project Alternative scenario, the projected mix of aircraft would continue to utilize the Airport until a point in time where airfield facilities (e.g. runway, ramp, etc.) are operationally at capacity. Since no projects would be proposed to increase the airfield capacity, aircraft activity will begin to shift in aircraft mix to larger aircraft with more passenger capacity. As the shift occurs, the proportion of small aircraft activity at the Airport would most likely decrease. Emplanement activity at the Airport would still approximate those forecasted due to the shift to larger aircraft

Under this No Project Alternative scenario, additional land for expansion would not be required, thereby preserving existing habitats; cultural resources would not be impacted further; increased overflights of the Grand Canyon by fixed wing aircraft from the Airport would probable decrease somewhat due to larger aircraft being utilized.

## CHAPTER III.

## ALTERNATIVES TO THE PROPOSED ACTION

### A. EXPANSION SITE SELECTION:

The Master Plan forecasts that demand by the year 1994 will require additional runway capacity. The existing Airport has physical site constraints which restrict expansion. The Airport is located in a narrow valley meadow. The meadow width is approximately 1200 feet wide at runway elevation, with adjacent terrain rising on each side at a rate of about one vertical foot for each five to ten horzontal feet. The difference in elevation between the existing runway and adjacent hills is typically 70 feet with moderately heavy timber vegetating the slopes.

Due to these physical constraints, four alternatives were considered as possible means of accomodating the projected demand.

> Alternative 1: Abandon the existing airport and relocate the airfield to a location more suitable for future expansion.
>
> Alternative 2: Construct another additional airport.
>
> Alternative 3: Construct a parallel runway near and connecting to the existing airport, but outside the meadow occupied by the present airfield.
>
> Alternative 4: Construct a parallel runway adjacent to the existing runway.

Alternative 1 was evaluated as not being feasible due to the costs associated with abandoning and relocating the Airport. Although there are alternative sites with enough acreage and suitable topographic features for expansion, it was felt that they offer few apparent advantages over the existing location.

Alternative 2 is a feasible means of accomodating projected demand. A conceptual element with this alternative was to situate the additional Airport somewhere on the North Rim. However, since Park visitation demand and facilities are not as concentrated on the North Rim as on the South Rim, and since utilization would depend on future development by the Park Service or other agencies beyond the control of ADOT, this alternative was not pursued. This alternative would also increase development pressures on the North Rim with attendant environmental impacts.

Alternative 3 was conceptualized as an attempt to avoid large amounts of earthwork which would be required for facility expansion in the valley meadow. However, to the north and south of the present site, hilly terrain failed to substantially reduce earthwork required for expansion. Additional factors of consideration in eliminating this alternative include property acquisition requirements, constraints on terminal area expansion, excessive taxiway construction requirements and increased environmental impacts to forested lands.

Alternative 4 presented the most attractive option for the Airport expansion. It was selected primarily due to its proximity to existing facilities, and comparative earthwork and property acquisition requirements and environmental considerations.

Alternative 4 was selected as the site for Airport expansion.

B. MAJOR PROJECTS ALTERNATIVES:

The airfield layout in Figure I-3 was the result of balancing airfield design requirements with the need to minimize adverse impacts. During the development of the Master Plan, alternatives for the placement of the primary runway extention, the secondary parallel runway, heliport and terminals as well as the relocation of the Air Traffic Control Tower were developed and evaluated on the basis of operational, maintenance, environmental, safety and economic factors.

Additionally, during the course of the planning process, others joined as members or participating observers including:

Mr. John Muied, Grand Canyon National Park
Mr. John Bobbitt, Grand Canyon National Park
Ms. Kathy Davis, Grand Canyon National Park
Ms. Sheryl Luckeson, Grand Canyon Squire Inn;
South Grand Canyon Sanitary District;
Tusayan Water Development Association
Mr. Steven Luckeson, Coconino County Sheriff's Dept.
Mr. Bob Donaldson, Grand Canyon Airlines
Mr. Jim Dellen, Grand Canyon National Park Airport

The first meeting of the Advisory Group was held September 14, 1983 in Tusayan, Arizona. A description of the planning process and the role of the Advisory Group were presented and discussed.

During the early stages of the Master Plan and environmental review process, individual meetings were held with each representative to gather information about the Airport and area, and to discuss matters that were of concern to each and to the public in general.

On November 1, 1983, the first working meeting was held in Tusayan, Arizona and was attended by fifteen of the Advisory Group members. Draft Report 1: Inventory, Aviation Forecasts, and Demand/Capacity Analysis was presented and review comments from the Advisory Group were received and discussed.

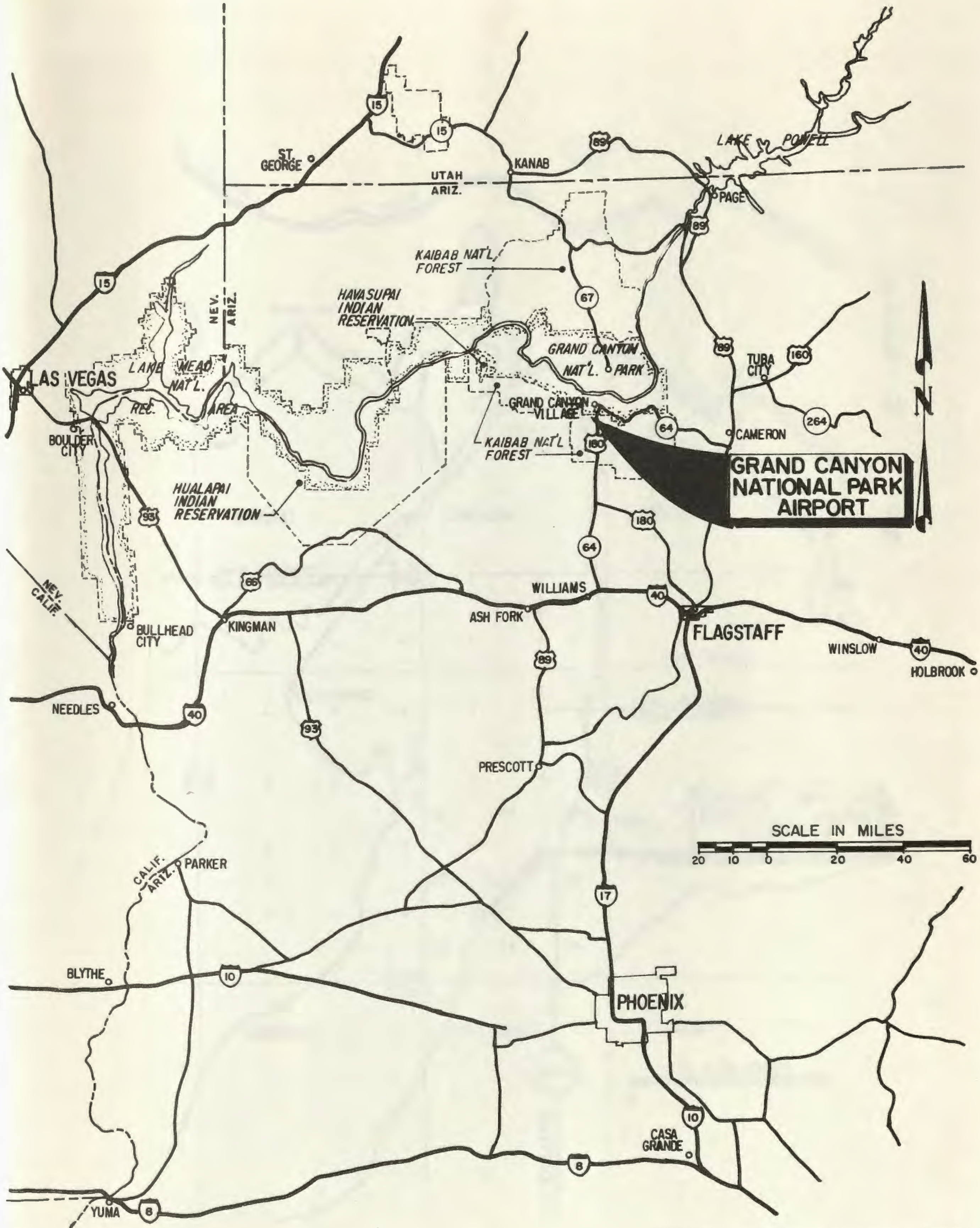
On May 2, 1984, the second working meeting was held in Tusayan, Arizona and was attended by nine of the Advisory Group members. Draft Report 2; Aviation Forecasts (Revised), Demand/Capacity Analysis (Revised), and Airport Requirements was presented and review comments from the Advisory Group were received and discussed.

On June 4, 1984, copies of the Environmental Review were submitted to Arizona State Clearinghouse for distribution through the State's A-95 review procedure.

On July 6, 1984, a formal, advertised public meeting was held in Tusayan, Arizona and was attended by six of the Advisory Group members, a representative of the Arizona Department of Transportation's Aeronautics Division, and four members of the general public. The Preliminary Master Plan¢S and accompanying Environmental Review¢S were presented at the public meeting. Both documents had been distributed for review to each of the Advisory Group Members and available to the general public for review at the Airport; at the Coconino County Planning Department, in Flagstaff, Arizona; and at the offices of the Aeronautics Division in Phoenix, Arizona thirty days prior to the meeting. Comments from those in attendance were received and discussed. Additional opportunity for written comment was invited up to thirty days after the meeting. Letters of comments were received from the Arizona Fish and Game Department, the National Park Service at Grand Canyon National Park, and from the Southwest and California Regional Office of the National Park & Conservation Association. Responses to each letter were prepared and submitted to each of the three entities.

On February 27, 1985, review comments on both the Preliminary Master Plan and Environmental Review were received from the Federal Aviation Administration.

Copies of communications, comments and responses relative to the Environmental Review are included in Appendix G along with other correspondense.

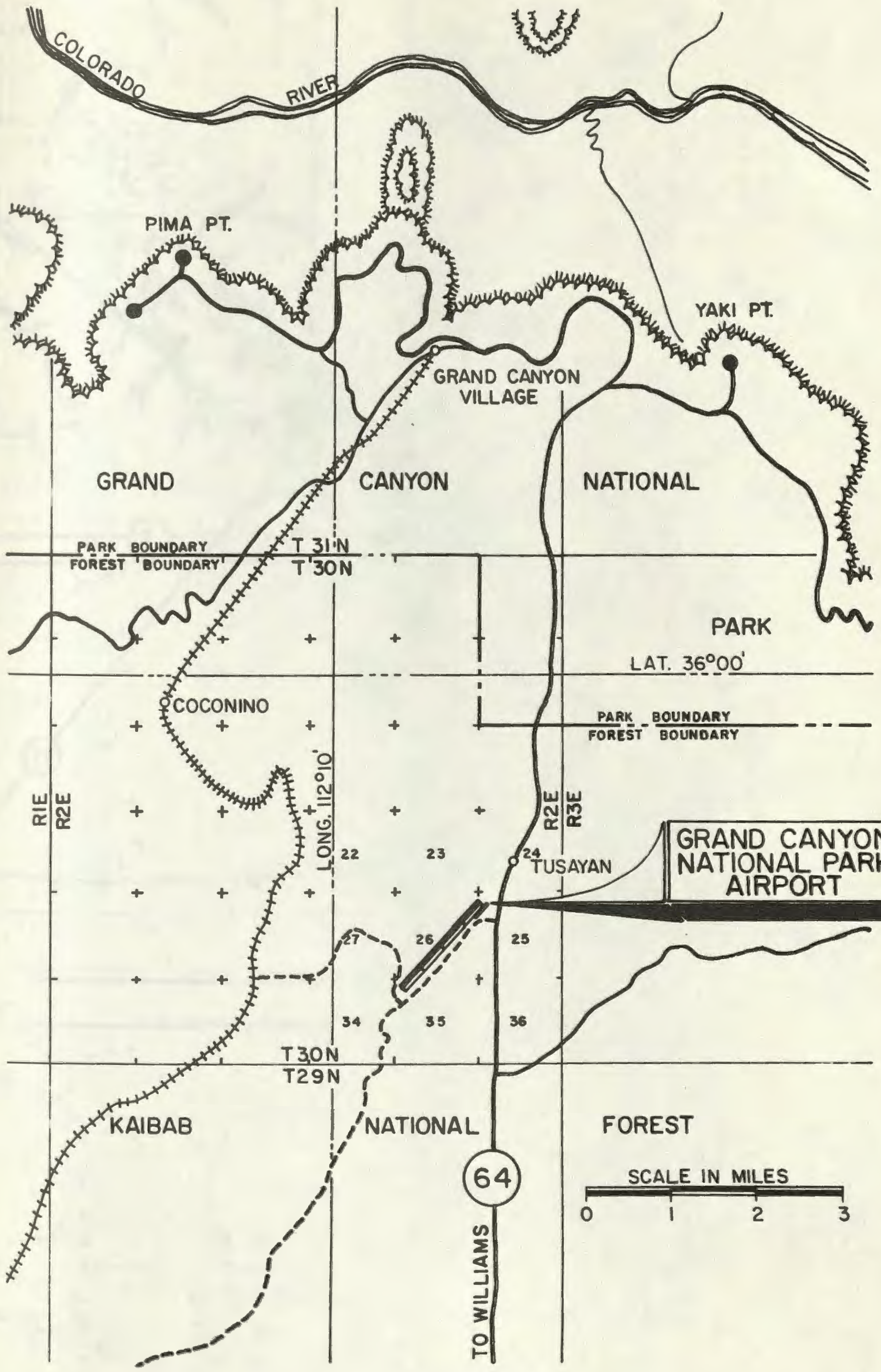



**GRAND CANYON NATIONAL PARK**
**AIRPORT MASTER PLAN**

## VICINITY MAP

LEEDSHILL - HERKENHOFF, INC.

**FIGURE I-1**

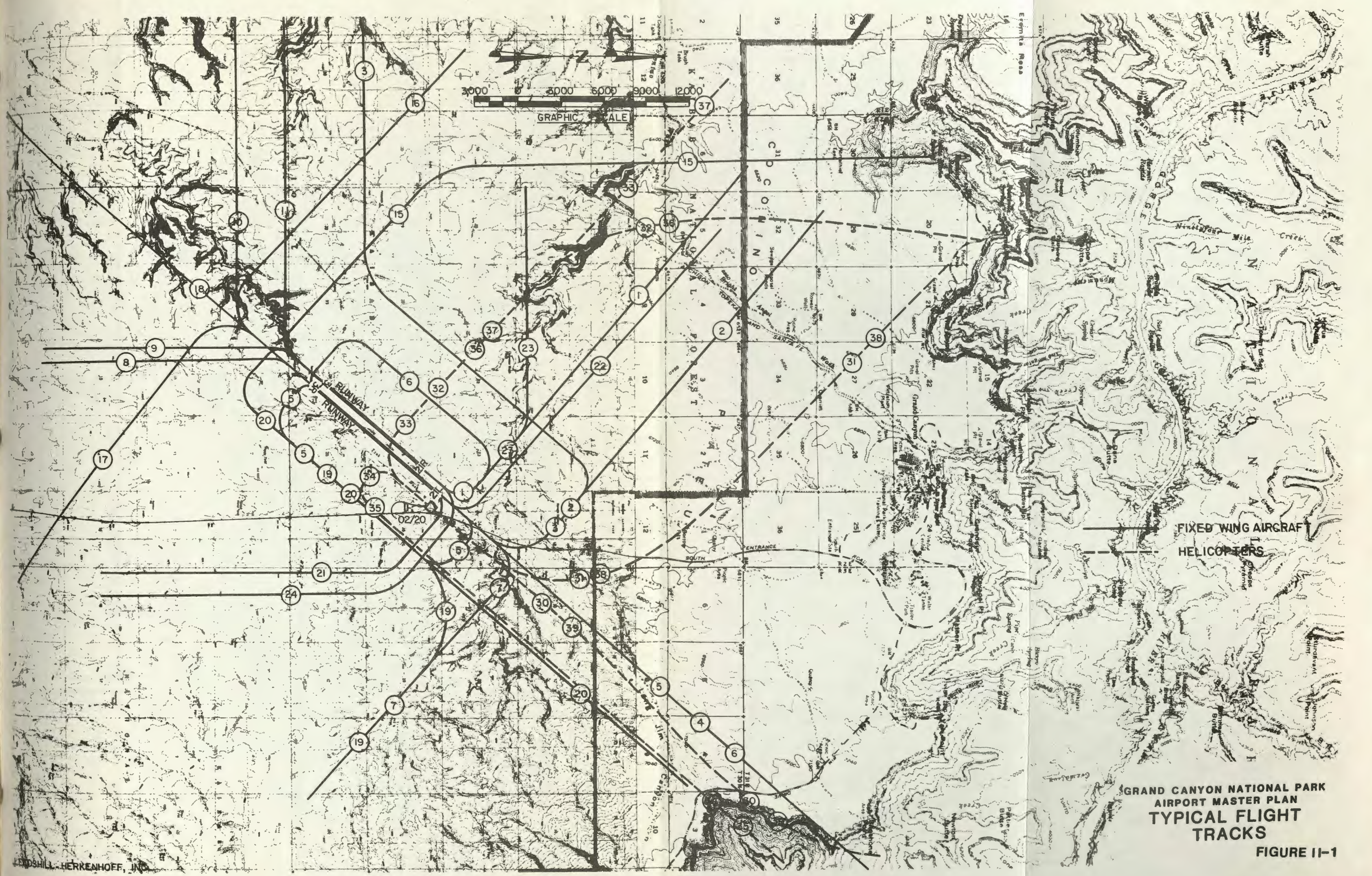



**GRAND CANYON NATIONAL PARK AIRPORT MASTER PLAN**

## LOCATION MAP

LEEDSHILL - HERKENHOFF, INC.

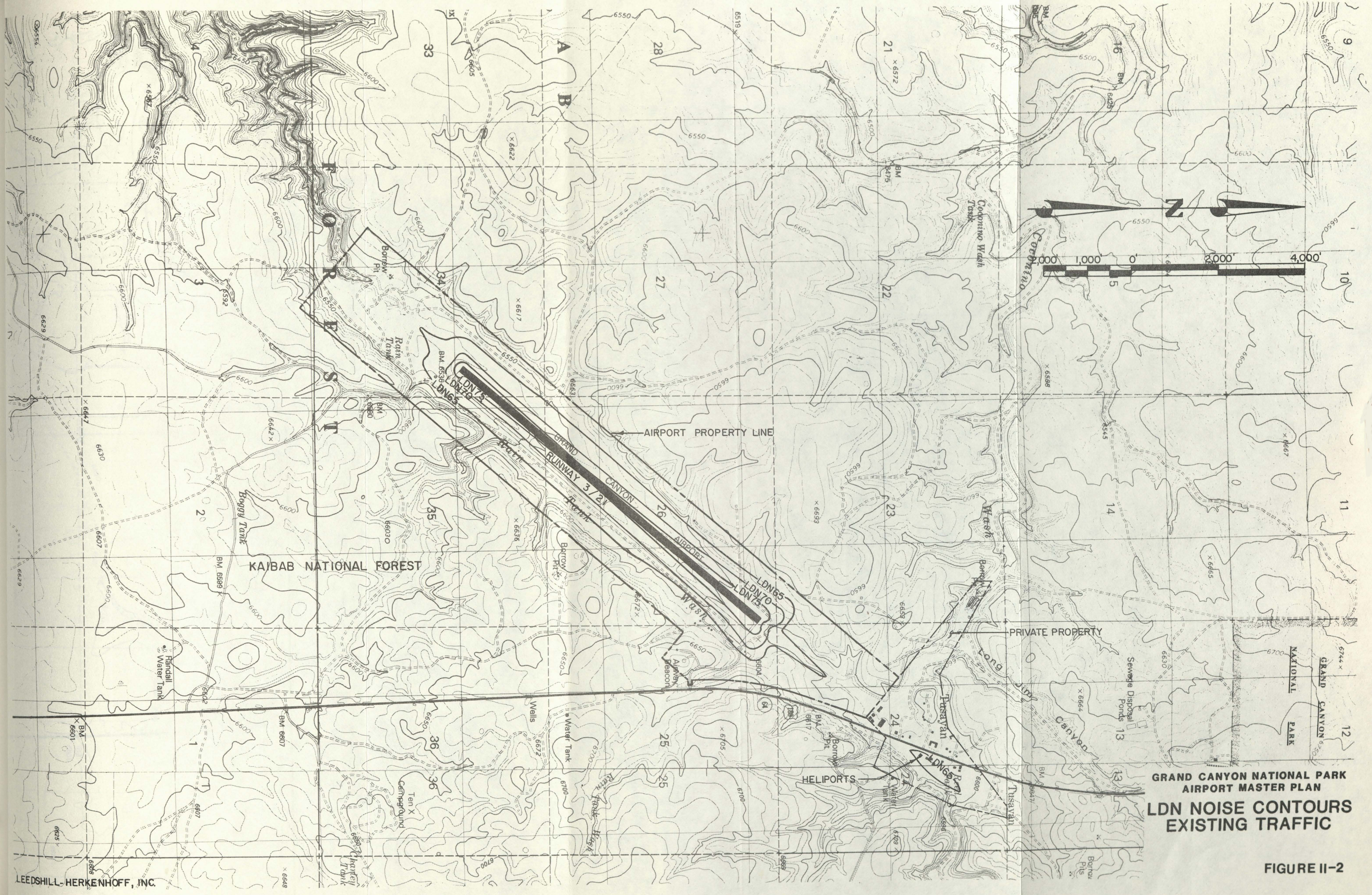
**FIGURE I-2**




GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN

TYPICAL FLIGHT TRACKS

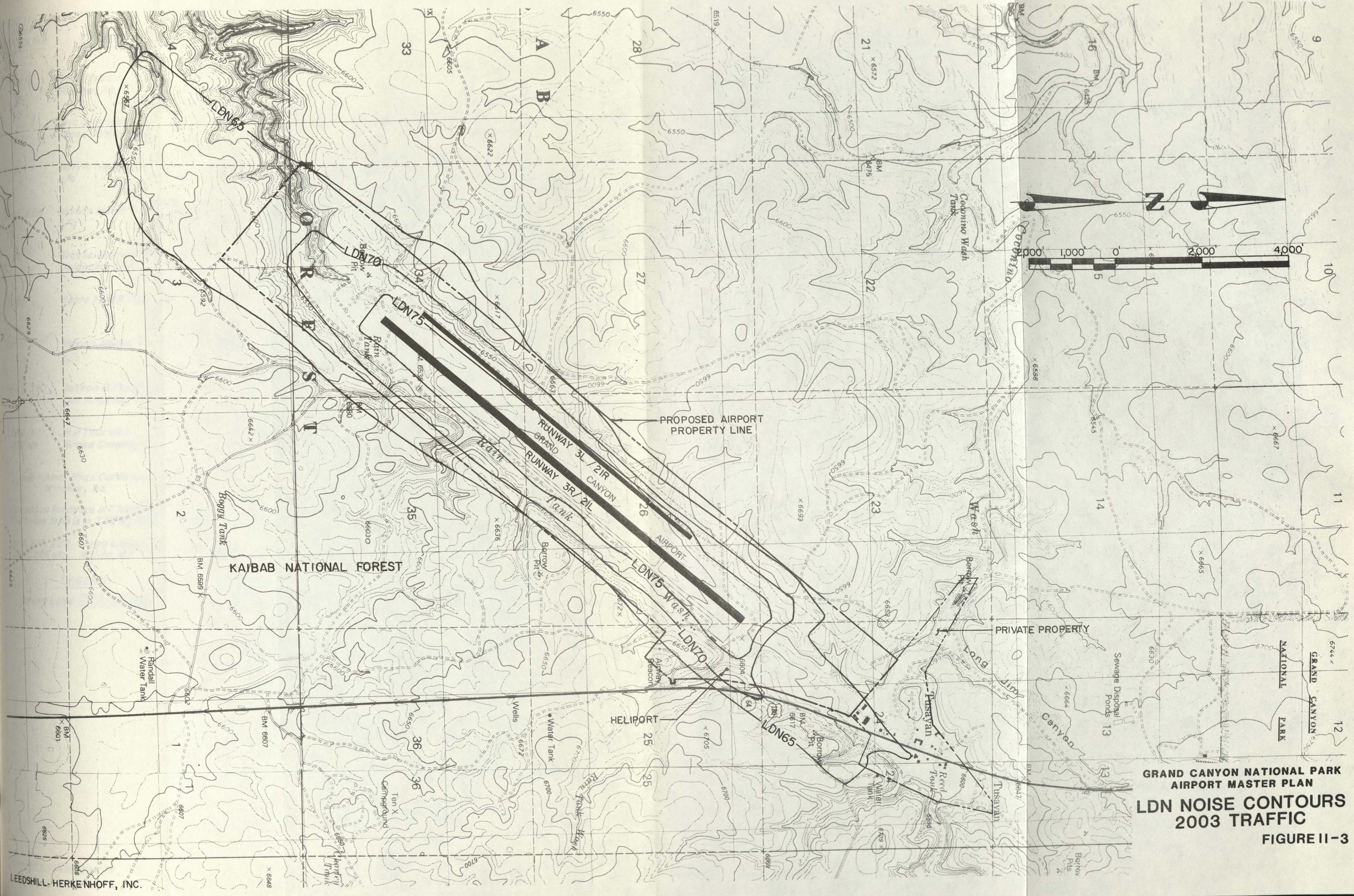
FIGURE II-1




GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN

**LDN NOISE CONTOURS**
**EXISTING TRAFFIC**

FIGURE II-2




GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN

**LDN NOISE CONTOURS 2003 TRAFFIC**

FIGURE II-3

| STATUS NO. | OWNER |
|---|---|
| X5, X15 | Gail Rivas<br>Sedona, Az. |
| | Eric Gueissaz<br>Grand Canyon, Az. |
| X19 | Marvin Hatch<br>c/o |
| X56, X58 | Marvin Hatch<br>c/o |
| X96 | Grover Kennedy Oil Co.<br>Oklahoma City, Ok. |
| X105 | Santa Fe R.R. Co. |
| X107 | Marvin Hatch<br>c/o |
| X40, X67 | Joseph & Theodore Kotzin<br>Los Angeles, Ca. |
| X68, X71, X72 etc. | R.P. Thurston<br>Grand Canyon, Az. |

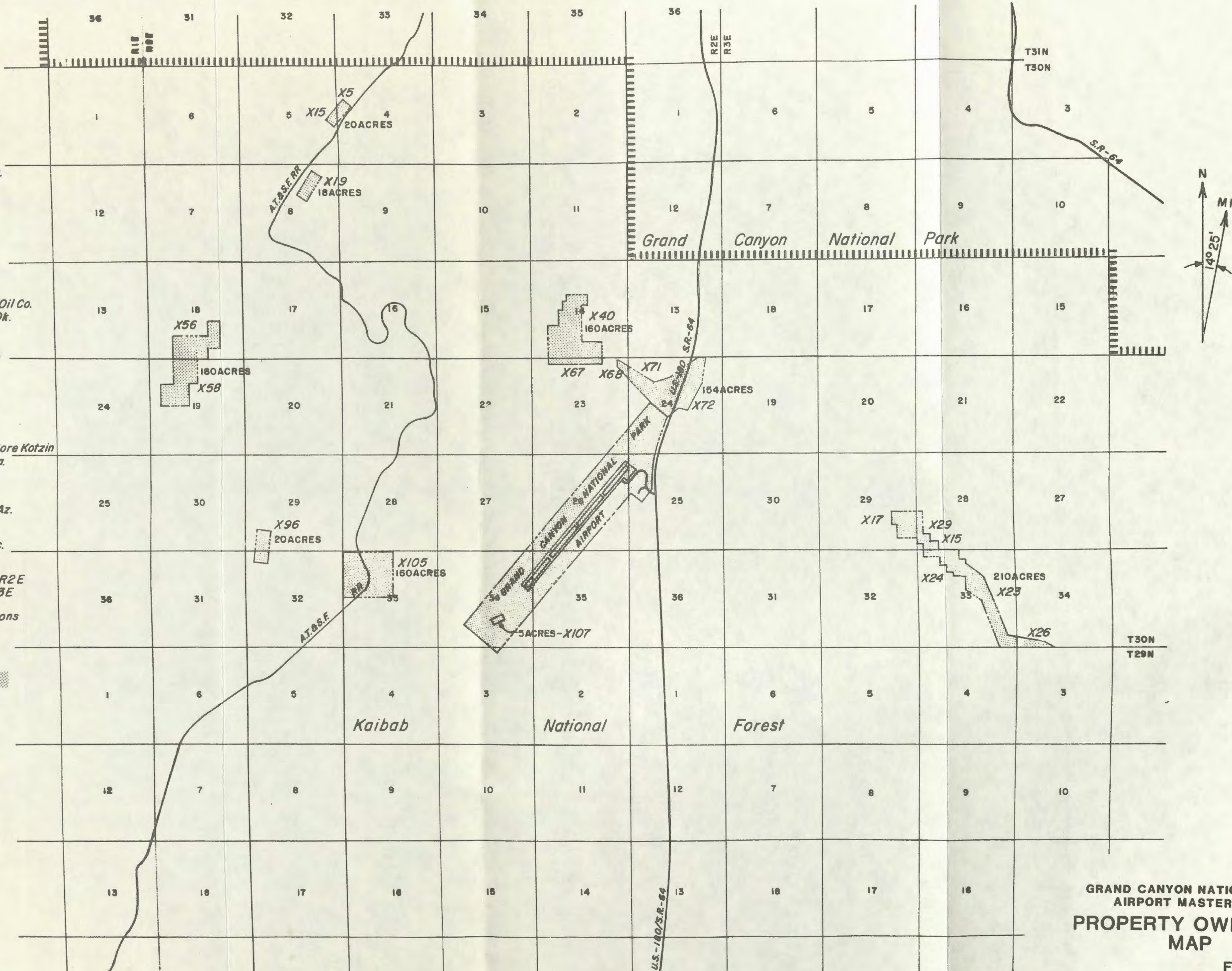
c/o = Ames Bros. Cattle Inc.
Winslow, Az.

The above lands are in T30N, R2E
The below land is in T30N, R3E

| | |
|---|---|
| X15, X17, X23, X24, X26 etc. | Gregg L. Gibbons<br>Rillito, Az. |

LEGEND

Private Land

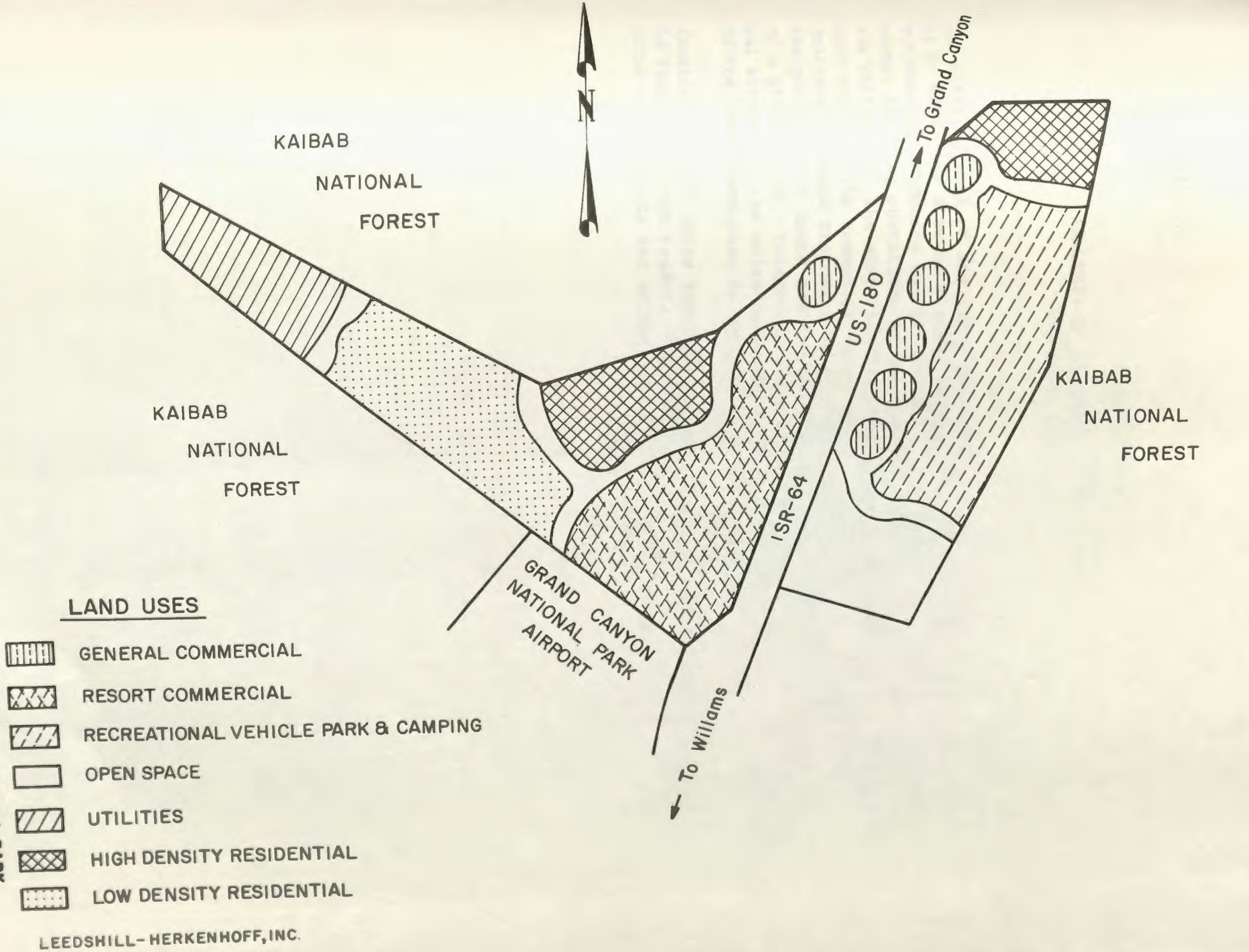



LEEDSHILL-HERKENHOFF, INC.

GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN

PROPERTY OWNERSHIP MAP

FIGURE II-4




GRAND CANYON NATIONAL PARK
AIRPORT MASTER PLAN

TUSAYAN INTERIM LAND USE PLAN
COCONINO COUNTY

FIGURE II-5

APPENDIX "ER-A"

ANALYSIS OF COMMUNITY NOISE EXPOSURE
TECHNICAL APPENDIX

The ultimate goal of analyzing the noise exposure from aircraft operations, is to establish a means whereby compatibility between the airport and the surrounding community can be reached. Compatibility can be achieved by two means; limiting operations at the airport and/or restricting land use in the vicinity of the airport. Both means of achieving compatibility depend upon defining the community responses to the aircraft operational levels. Analysis of these responses depends upon both the measureable quantities, the qualities of sound and the subjective personal perception of noisiness of a given sound. References 1 and 2 contain a detailed review of the analytical aspects of the noise environment, while Reference 3 contains a good summary of the human responses to various noise environments.

Consideration of noise involves special terminology and concepts that may not be familiar to the reader. Thus, the next section provides a brief review of noise fundamentals and an introduction to aircraft noise terminology.

## SECTION I

## I. AIRCRAFT NOISE BASICS

The word noise is in wide use in many fields of technology today, but if we limit our discussion to its use in relation to sound, one may define noise loosely as unwanted sound. For our purposes, an acceptable definition of sound is that it is a physical disturbance of the atmosphere that can be detected by the human ear. A simple source of sound, familiar to all of us, is the tuning fork. When it is struck, it vibrates in a to-and-fro motion, setting the air in motion in the same manner. This resulting disturbance of the air travels outward from the tuning fork and upon entering the ear canal of the listener, produces an auditory sensation, or sound.

We are concerned in defining the impact of aircraft noise on people, on communities and on land uses. Before one can discuss these aspects, it is useful to discuss some properties of sound and develop some of the quantitative scales that are used in the measurement of sound. We will then discuss some of the special properties of sound generated by aircraft operations and give them some insight in the human factors.

### BASIC NOISE MEASURES

There are several attributes that we associate with a sound: it may be loud or faint; it may be high-pitched or low, discordant or pleasing, etc. These various characteristics must be quantified in order to arrive at an engineering description of any given sound and to have a means for comparing two sounds separated in space and time.

### DECIBEL SCALE

The pressure fluctuations in the quiescent atmosphere, which are detected as sound, are generally very small, but nonetheless, there is a large difference in pressure between the faintest audible sound (e.g., rustling leaves) and the loudest sounds (jet engines, rockets). The ratio is on the order of a million billion ($10^{15}$). Although the human ear can distinguish the differences in loudness between these different sources, the differences in loudness are much smaller.

If a given sound source produces a certain subjective sensation of loudness, two identical sources will not be perceived as being twice as loud. Experiments have shown that the human ear, as well as certain other sensory functions, behaves in a non-linear way which is close to the mathematical logarithm function.

Using this mathematical basis, it is possible to construct a scale for measuring the pressure fluctuations (sound pressure) which corresponds fairly well with the properties of the human ear as far as loudness perception is concerned. This scale is called the "decibel scale" and the quantity that it measures is called sound pressure level. The zero on this scale corresponds roughly to the quietest sound an average person can hear. A sound level of about 120 on this scale corresponds to the point where the noise becomes painful.

Figure 1 illustrates the logarithmic nature of the decibel scale; it shows a range of sound pressures ranging from 1 to 10,000 in magnitude translated into scale from 0 to 80 in decibels. Because of the compression inherent in the decibel scale, the addition of two sounds using the decibel scale is very unlike arithmetic addition. One example in Figure 1 shows that the addition of two noises of equal magnitude results in an increase of 3 dB. The second example illustrated in the figure shows that when one sound is appreciably larger than another, the addition of the lesser sound adds very little to the level of the combination. Figure 2 provides a chart and rules for the addition of two noise levels.

## FREQUENCY SPECTRUM

Apart from the loudness of a sound, there is the characteristic of pitch. We have seen that the size of the pressure fluctuations in the air determine the loudness of the sound. The pitch of a sound is related to how often such fluctuations repeat. For audible sounds, this repetition may vary from about 20 times per second to around 16,000 times per second. If a given sound consists of fluctuations which repeat 440 times per second, we say that the sound has a frequency of 440 Hz.

There are various kinds of sounds. The sound produced by the simple tuning fork is known as a pure tone and is usually composed of a single frequency. An example of a more complex sound is a musical note such as Middle C on the piano. This kind of sound has a fundamental frequency (256 Hz) plus several overtones of harmonics. In practice, one encounters sounds that are much more complex, such as speech, music and the wide range of sounds classed as noise. Each of these sounds contains energy, extending over a rather wide frequency range. This includes of course, most aircraft noises, as well as the noise produced by most motor vehicles. One can identify the pure tone with the whine of a jet engine compressor or fan, and the broad band noise with the roar of the exhaust of a turbojet engine.

Figure 3 shows a typical frequency spectrum for a jet exhaust noise. In this instance, noise levels are measured in frequency bands, each an octave in width. The "total" sound level, called the overall sound pressure level, is the sum of the sound levels in each octave band (with addition in accordance with the rules given in Figure 2).

## A-WEIGHTED SOUND LEVEL

To complicate matters, the human ear is more sensitive to sound energy at higher frequencies than at lower frequencies, and further, the ear's sensitivity to sounds of different frequencies changes with the level (magnitude) of the sound. In problems involving people's reaction to noise, one needs a way of accounting for the ear's varying sensitivity to noises which vary in frequency and in level. And, much effort has gone into studies to develop improved methods of relating physical measurements to the subjective response of human listeners.

One early approach for improving the correlation between measured pressures and subjective human response, was the introduction of frequency weighting networks on sound level meters*.

The weighting network that is in widest use today is the A-weighting network. The network discriminates against the lower frequencies to which the ear is less sensitive, according to a relationship approximating a person's subjective reaction in terms of loudness at moderate sound levels. Noise levels with the A-weighting network are identified as the "A-weighted sound pressure level of 77 dB," or more simply as the "A level of 77 dB," or shorter yet, as "77 dBA."

The lower part of Figure 4 shows the electrical frequency response of the A-scale network; the upper part of Figure 4 illustrates the effect of the filter on a typical jet noise spectrum.

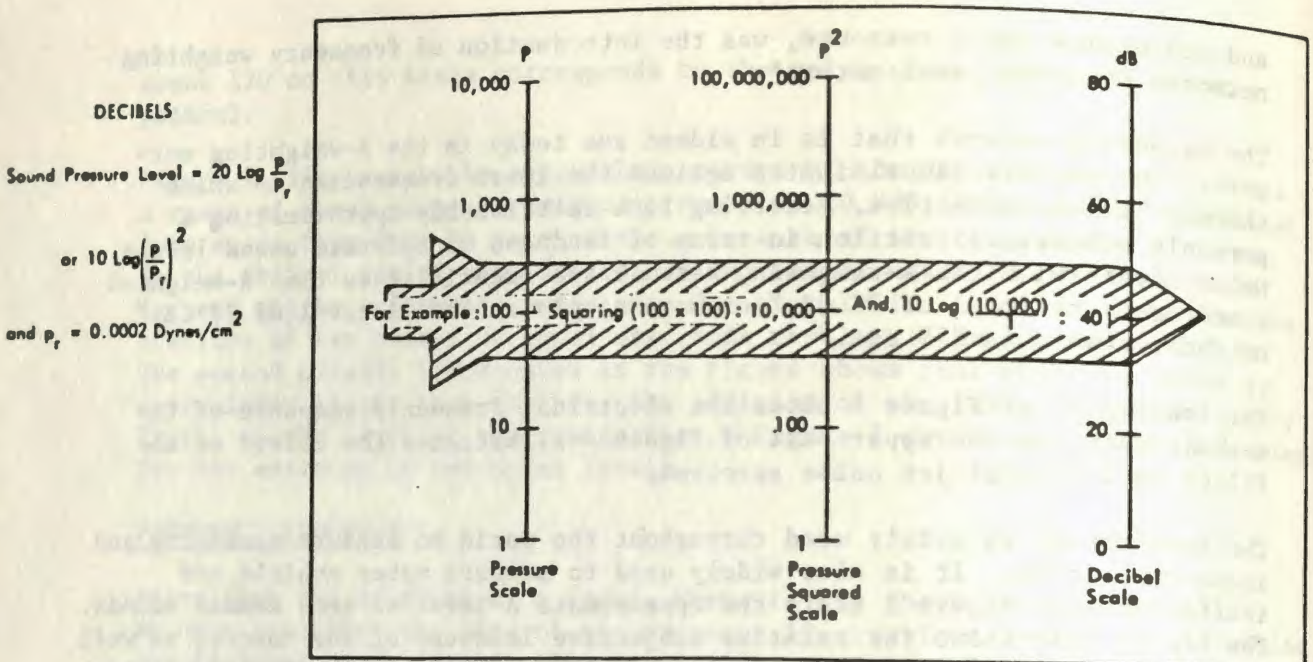
The A-weighting is widely used throughout the world to measure community and industrial noise. It is also widely used to measure motor vehicle and traffic noise. Figure 5 lists the approximate A-level of some common sounds. The figure also shows the relative subjective loudness of the sounds, as well as the relative physical sound energy involved. The relative loudness scale shows that a change of 10 dB in the A-level corresponds to a subjective judgment of a halving or doubling of the loudness of the sound. In other words, a sound judged to be twice as loud as another sound would have a sound level approximately 10 dB greater than the first sound (even though the 10 dB change corresponds to a factor of 10 in actual sound energy). On the other hand, a difference of one or two dB between sounds, although probably detectable if heard within a short time interval, would not be judged to be significantly different in loudness by most observers.

PERCEIVED NOISE LEVEL

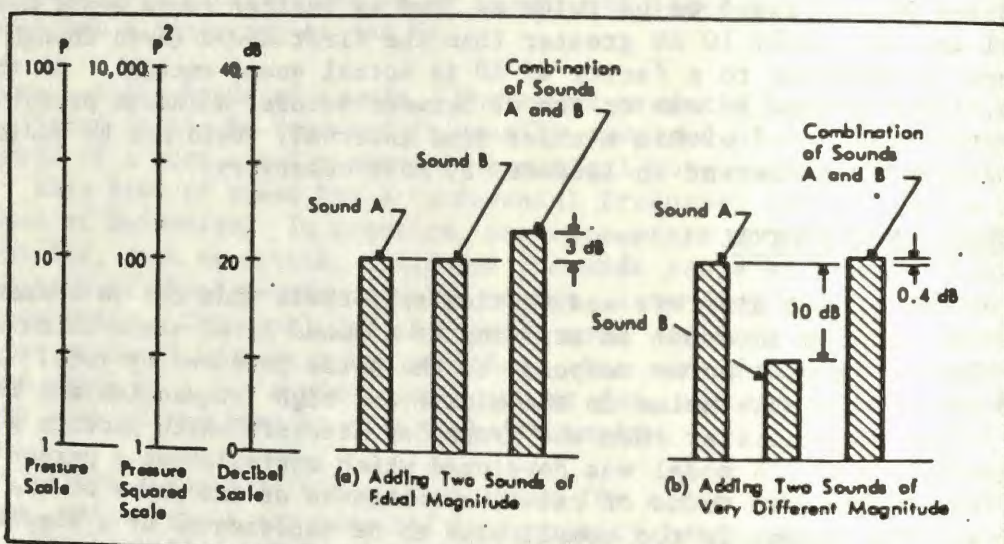
The advent of jet aircraft and particularly their wide use in commercial aviation, renewed interest in arriving at a sound level scale which would correlate well with human response to the noise produced by jets. Jet engines produce considerable noise in the middle and high frequencies and therefore, are judged much noisier than the propeller aircraft which produce a more low frequency noise. A model was developed which approximates a person's subjective response in terms of relative noisiness or annoyance of the aircraft sounds. The scheme is too complicated to be implemented by a simple filter, and requires summing up, in a particular non-linear manner, the noisiness contribution of each frequency band in the noise spectrum. This noise measure is called the perceived noise level (PNL). The unit of measurement is again the decibel, but a caveat is appended to the unit dB. The perceived noise level is therefore expressed in PNdB.

The perceived noise level has come into wide acceptance as a valid measure of

*The sound level meter is a device for measuring sound pressure levels. The small pressure fluctuations are detected by an extremely sensitive sensor called a microphone and are transformed into an electrical signal. By means of electronic circuitry, this electrical signal can be amplified and read out on a meter directly in decibels.




The Logarithmic Nature of the Decibel




Addition of Sound Levels

FIGURE 1. ILLUSTRATING THE LOGARITHMIC NATURE OF THE DECIBEL

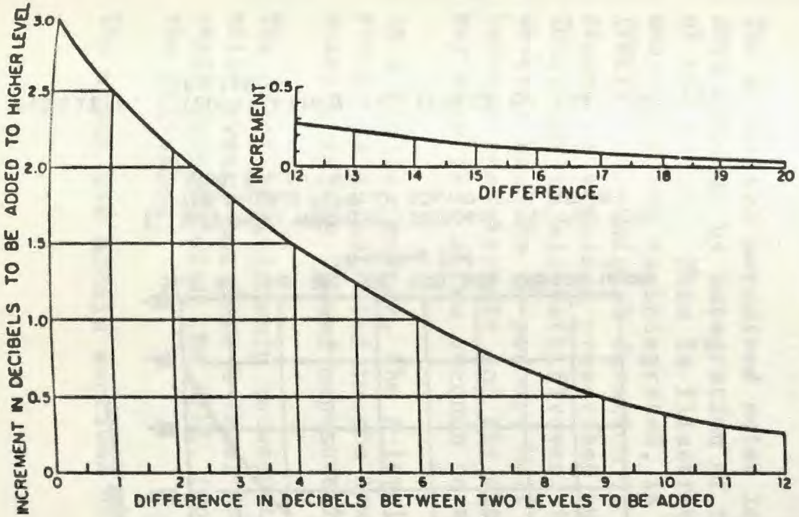



CHART FOR COMBINING SOUND LEVELS BY "DECIBEL ADDITION"

For noise levels known or desired to an accuracy of ± 1 decibel *:

| When two decibel values differ by | Add the following amount to the higher value |
|---|---|
| 0 or 1 dB | 3 dB |
| 2 or 3 dB | 2 dB |
| 4 to 9 dB | 1 dB |
| 10 dB or more | |

* For greater accuracy, use chart above

RULE FOR COMBINING SOUND LEVELS BY " DECIBEL ADDITION"

FIGURE 2. "DECIBEL ADDITION" RULE AND CHART

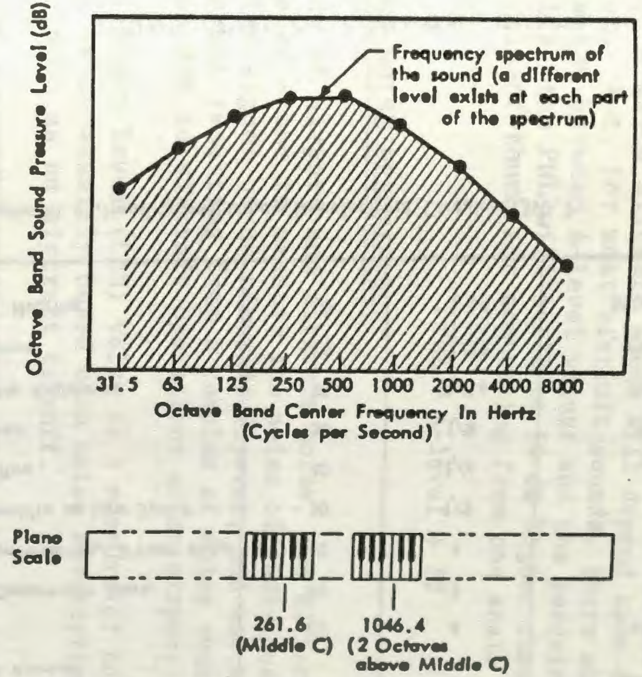
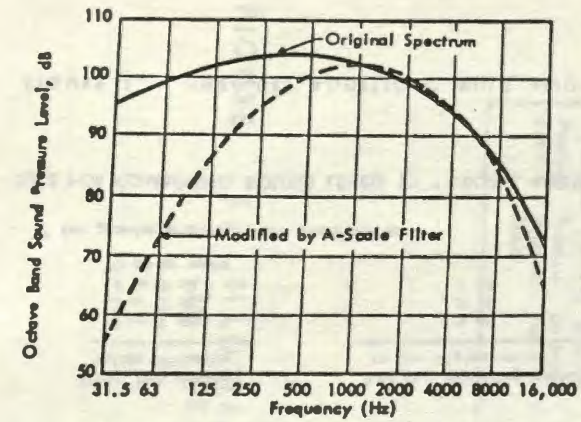
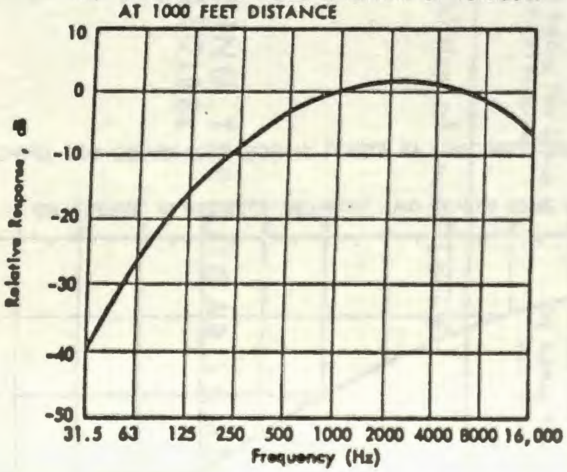



FIGURE 3. TYPICAL FREQUENCY SPECTRUM OF A JET EXHAUST




A. GENERALIZED NOISE SPECTRUM OF TURBOJET AT 1000 FEET DISTANCE




B. ELECTRICAL FREQUENCY RESPONSE SPECIFIED FOR THE A-SCALE FILTER OF SOUND LEVEL METERS (ANSI S 1.4 - 1971)

FIGURE 4. ILLUSTRATING THE EFFECT OF THE A-SCALE FILTER

| Sound | Sound Level [1] dB(A) | Relative Loudness (Approximate) | Relative Sound Energy |
|---|---|---|---|
| Jet Plane, 100 Feet | 130 | 128 | 10,000,000 |
| Rock Music with Amplifier | 120 | 64 | 1,000,000 |
| Thunder, Danger of Permanent Hearing Loss | 110 | 32 | 100,000 |
| Boiler Shop, Power Mower | 100 | 16 | 10,000 |
| Orchestral Crescendo at 25 Feet, Noisy Kitchen | 90 | 8 | 1,000 |
| Busy Street | 80 | 4 | 100 |
| Interior of Department Store | 70 | 2 | 10 |
| Ordinary Conversation, 3 Feet away | 60 | 1 | 1 |
| Quiet Automobile at Low Speed | 50 | 1/2 | .1 |
| Average Office | 40 | 1/4 | .01 |
| City Residence | 30 | 1/8 | .001 |
| Quiet Country Residence | 20 | 1/16 | .0001 |
| Rustle of Leaves | 10 | 1/32 | .00001 |
| Threshold of Hearing | 0 | 1/64 | .000001 |

[1] U.S. Department of Housing and Urban Development Circular 1390.2

FIGURE 5. SOUND LEVEL OF COMMON SOUNDS

aircraft noise although with some further refinements. The presence of identifiable discrete tone makes a noise more objectionable than it would be without these tones. This led to the tone-corrected preceived noise level (PNLT). The exact relationship between the A-level and the PNL or PNLT for a given aircraft sound will depend upon details of the noise spectrum. But, for most aircraft sounds, there will be a rather close correlation between A-level values and the perceived noise levels; typically, the PNL will be 12 to 14 dB higher than the A-levels, thus, a rough rule-of-thumb for converting from one scale to another is:

$$PNL = A\text{-level} + 12$$

AIRCRAFT NOISE DESCRIPTORS

In study of airport and aircraft noise, two different types of noise measures are needed - one to measure the noise of individual noise events, such as the noise signal of an aircraft flyover, and another to describe the noise environment resulting from a complex of noise events, such as the noise exposure due to aircraft operations at an airport.

The Day Night Level (LDN) value is a measure of noise environment. But, it is necessarily based upon noise descriptions of individual noise events, such as an aircraft takeoff.

EFFECTIVE PERCEIVED NOISE LEVEL AND SOUND EXPOSURE LEVEL

Both the A-level and PNL (or PNLT) can be used to measure the maximum level of an aircraft flyby. But neither measure takes into account the duration or the noise event, and laboratory tests show clearly that the noisiness and annoyance increase with the signal duration as well as magnitude. Several measures have been devised to account for both the magnitude and the duration of noise.

The effective perceived noise level (EPNL) takes the duration of the signal into account by integration of the noise level with time for the duration of the event. This is illustrated in the upper part of Figure 6. The noise measure which is integrated, is the tone-corrected perceived noise level (PNLT). The signal duration is defined as the period during which the noise signal is within a prescribed number of decibels of the maximum noise level. Thus, for an aircraft flyover, the signal duration would be on the order of several seconds to perhaps half a minute, depending primarily upon the distance between the aircraft and the observer. For a ground runup, the signal duration may vary from a few seconds to many minutes.

In a similar manner, the A-level can be integrated with time over the noise event, as illustrated in the lower part of Figure 6. The resulting noise measure is the "sound exposure level" (SEL).

The exact relationship between the EPNL and SEL will vary with details of the noise event, but like A-level and PNL, will be well correlated for many aircraft sounds, with the EPNL, typically, 2 to 9 dB greater in magnitude than the SEL value.

The upper and middle sections of Figure 7, summarize two of the noise measures

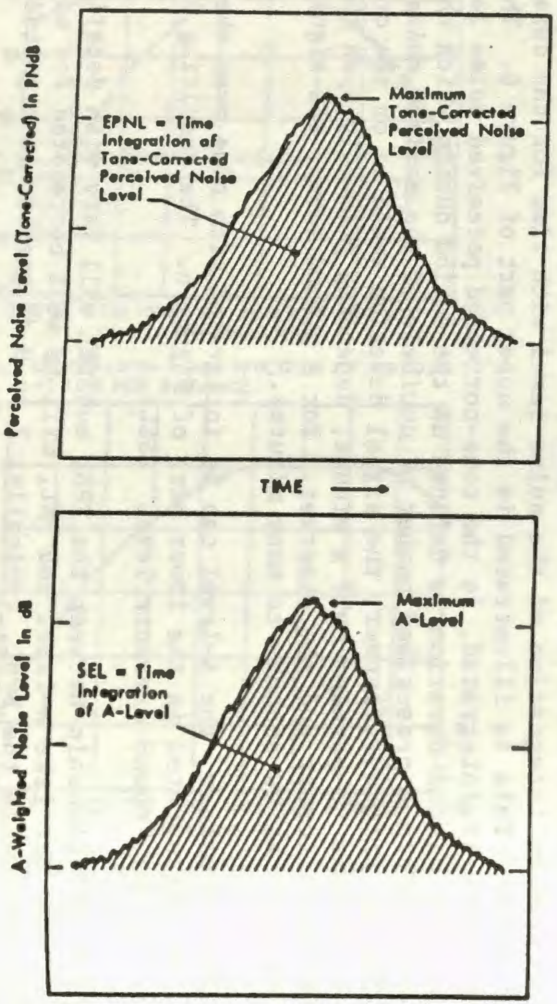
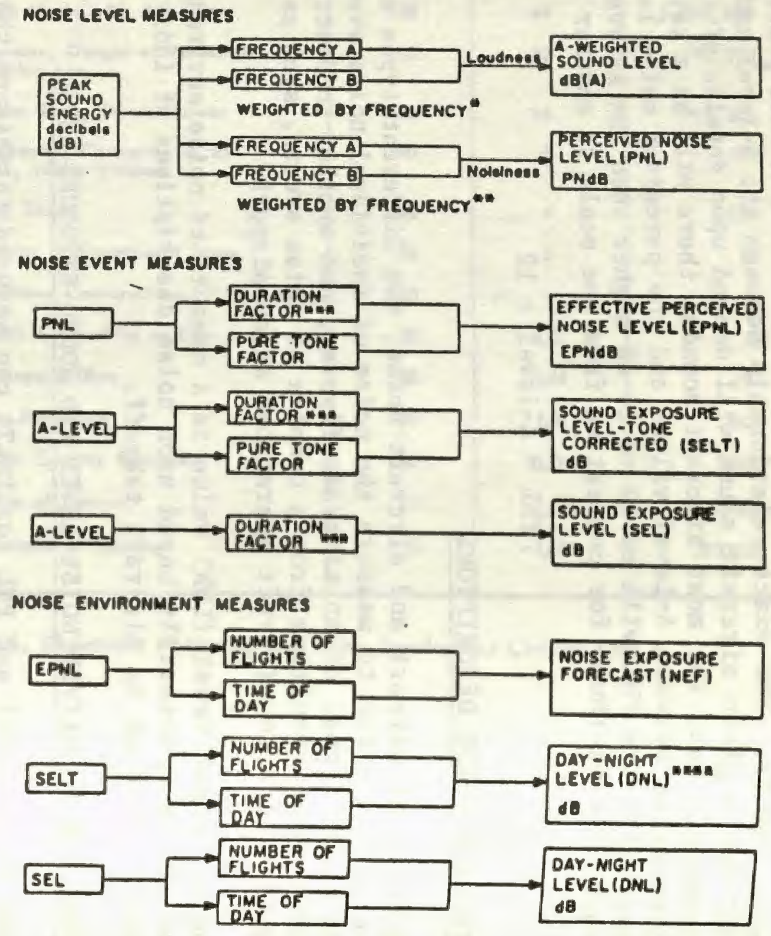



FIGURE 6. COMPARISON OF NOISE MEASURES FOR SINGLE EVENTS




*A simple frequency equalization network
**Analysis in 1/3 or full octave frequency bands
***Time-integration of signal
****Includes Pure Tone Factor

FIGURE 7. COMPARISONS OF AIRCRAFT NOISE MEASURES

for single events discussed so far - the A-level and PNLT, and the EPNL and SEL.

A tone correction, similar to that used with PNLT, the tone-corrected perceived noise level, can be added to the A-level, to obtain tone-corrected A-level, ALT. Integration of the ALT with time, then yields the tone-corrected sound exposure level, SELT.

## NOISE EXPOSURE FORECAST, DAY/NIGHT LEVEL

A description of aircraft noise in terms of the maximum noise levels for individual noise intrusions, is helpful in comparing one aircraft with another or relating the aircraft noise to other sources of noise in the community.

However, we must still construct an environmental descriptor to express the subjective response to a variety of noise intrusions throughout a period of time. It is recognized that such descriptors should make allowance not only for the annoyance of a single event, but also for the number of events and the time of day of these events. Most environmental descriptors of aircraft noise in use in the world today are based on this principle. One starts out with a single event descriptor. A correction factor is applied for the number of aircraft noise events that occur during a given period of the day. Similarly, each of these periods is given a weight depending on the time of day. Since these descriptors are concerned with the environment for residential areas, nighttime events are considered more annoying than daytime events and thus, nighttime noise events count heavier than similar events during the day.

The composite noise rating (CNR), which has been in use, is one of these measures. It was based upon the PNL and contained provision for accounting for the number of aircraft operations and the time of day. The method had several shortcomings: it was based on the PNL, with no correction for duration of flight events or for the presence of "pure tones"; adjustments for the number of events, or for adding together the noise contributions of different classes of aircraft, was on a "step" basis that occasionally led to unrealistic and inaccurate noise exposure estimates.

The noise exposure forecast (NEF) concept and accompanying calculation procedures, remedies many of the shortcomings of the CNR. The NEF is based upon the effective perceived noise level and therefore, contains corrections to account for pure tones and for duration. Also, provision is made to account for noise from all operations and not just the noisiest ones.

The Environmental Protection Agency (EPA) has introduced an environmental measure, called the day/night level (Ldn), based on the SEL noise event measure rather than the EPNL. In terms of application to aircraft situations, it is based on the same consideration as the NEF, and it is anticipated that the EPA will encourage the widespread use of Ldn in describing airport noise environments throughout the country.

In summary, the lower portion of Figure 7 shows the major considerations involved in calculation of the NEF and Ldn measures.

## AIRCRAFT NOISE SOURCES

The aircraft noise sources of major interest are the turbojet and turbofan engines. Although many piston and turboprop aircraft are flying, their contribution to the noise environment is generally small when jet aircraft also operate.

## TURBOJETS AND TURBOFANS

Turbojet and turbofan engines are in general, much larger in terms of power output and produce considerably more noise than turboprop or piston engines. For example, a single military turbojet engine, in afterburner, may generate in excess of 70 kilowatts of acoustic energy, as compared to less than a milliwatt for a human voice. Besides producing higher overall levels, jet engines may produce more noise in the higher frequencies, which cause the noise to be more annoying.

There are two major sources of noise in the jet engine: the roar of the jet exhaust; and the turbomachinery, compressor and fan noise from turbulence produced by rotating blades in the engine. The upper portion of Figure 8 shows the location of sources of noise in a modern turbofan engine.

The exhaust noise is generated by the expansion of the high-velocity exhaust stream into a quiet atmosphere. The shearing forces involved in this process will produce a turbulent eddy system that produces the noise. The scale of the turbulence (the size of the eddies) is small, close to the engine and increases downstream. Since the frequency of the noise is inversely proportional to the eddy size, the high and low contributions to the jet noise are generated in different parts of the exhaust wake behind the engine.

The amount of noise generated by a given air jet is roughly proportional to the eighth power of the jet velocity. Put in different terms, a doubling of the exhaust velocity corresponds to a 256-fold increase in acoustic energy, or, in terms of decibels, an increase of about 25 dB. In-flight noise suppressors, therefore, aim to reduce the average jet velocity in the exhaust stream by inducing air from the surrounding atmosphere into the jet stream.

The turbofan engine produces much less noise for the same engine power for precisely this same reason. The outer portion of the engine, the fan duct, produces a secondary air flow around the primary jet exhaust, reducing the shearing gradients between the jet core and the atmosphere. This principle is carried out to a high degree in the high-bypass ration engines of modern, large transport aircraft. These engines are attractive because they produce more usable power output for a given amount of fuel, in addition to their quiet operation.

The use of afterburners in military aircraft accomplishes, from an acoustic point of view, exactly the opposite as the fan jet. Here, the velocity of of the exhaust jet is increased, thereby increasing the noise output.

For jet exhaust noise, the angle of maximum reduction is of the order of 30 to 50 degrees relative to the exhaust axis. For this reason, the maximum noise level found on the ground will occur well after the aircraft has passed overhead, when the rear "lobe" of the noise pattern reaches the observer. The lower portion of Figure 8 depicts a typical directivity pattern for a turbofan aircraft at takeoff power.

Engine noise sources, other than the exhaust noise, typically, are easily recognizable and even dominant during approach and taxi operations. The characteristic whines of compressors and fans may be extremely annoying.

In the newer versions of the high bypass turbofan engines, major steps are taken to reduce fan noise. Reduction in noise is accomplished by elimination of inlet guide vanes, slowing the fan speed and lining the nacelle ducts with acoustically absorbing material.

## PROPELLER AIRCRAFT

For either the piston or turbine-powered propeller aircraft, the propeller is usually the predominant noise source at takeoff power settings. Although noise is generated over a wide range of frequencies, the main contribution is at the lower frequencies. Most energy is radiated around the propeller blade passing frequency (1/60th of the engine rpm times the number of blades), and multiples of this frequency.

Engine exhaust noise is also an important noise source for the piston-aircraft, hence, at takeoff power, a turboprop aircraft will usually be quieter than a comparable piston-powered plane. At idling or taxiing power, however, the turboprop engine shares with other jet engines, the high-pitched whine of the compressor.

## SOUND PROPAGATION

The propagation of noise from a source to a receiver, depends on several factors, such as their relative distance, atmospheric conditions and intervening acoustic barriers. The influence of distance is a very simple one. As the noise spreads out over a larger and larger area, the amount of energy per unit area becomes less and less. This decrease in intensity is inversely proportional to the square of the distance between source and receiver, or put in terms of decibels, the level will decrease by 6 dB for each doubling of distance.

There are several atmospheric effects that influence the propagation of sound. A very important factor is absorption due to water vapor in the air. The higher the frequency of the sound, the more strongly will it be absorbed in the air. We are all familiar with this phenomenon: thunder propagated over a long distance sounds like a low grumble, whereas, when the lightning strikes close by, there is much high-frequency crackling. Similarly, one can hear the drums of a marching band from a great distance; as they get closer, more and more of the other instruments become audible. The two dashed curves in the upper part of Figure 9 illustrate the increased absorption of high-frequency sound energy: the high-frequency curve decreases with distance much more rapidly than the mid-frequency sound curve.

The lower portion of Figure 9 shows two typical perceived noise level curves. Two cases are shown - one for the takeoff of a turbojet fighter and one for

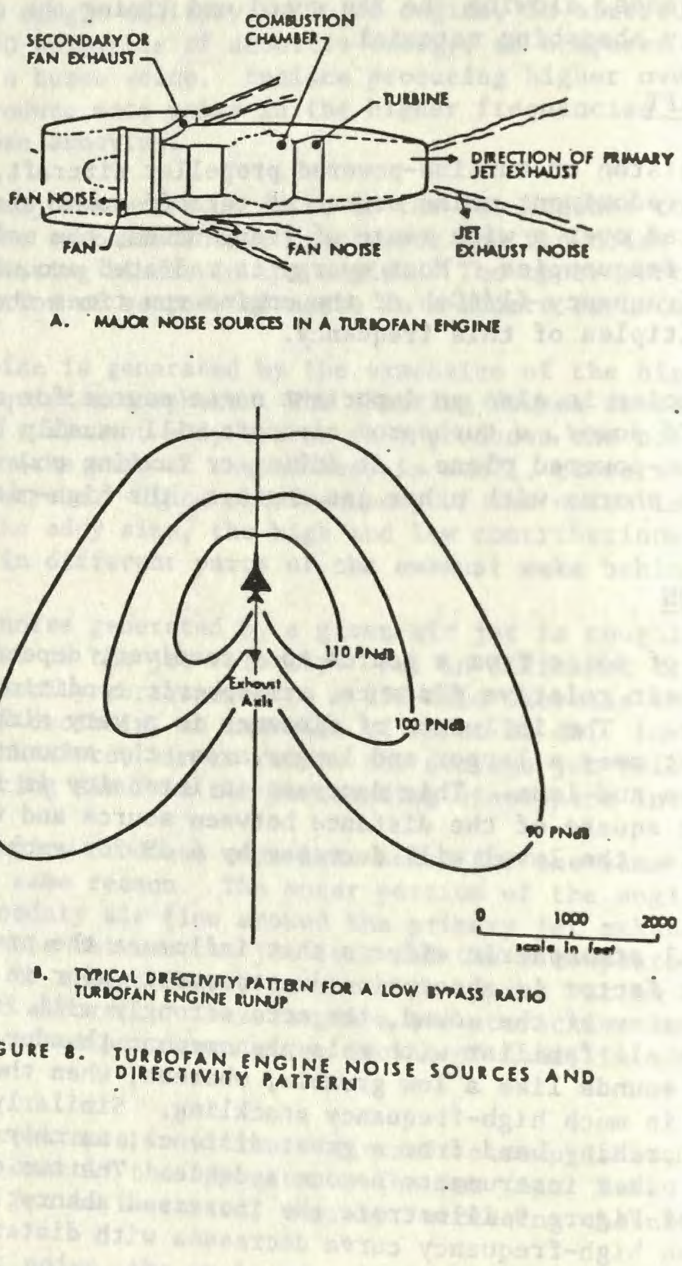



FIGURE 8. TURBOFAN ENGINE NOISE SOURCES AND DIRECTIVITY PATTERN

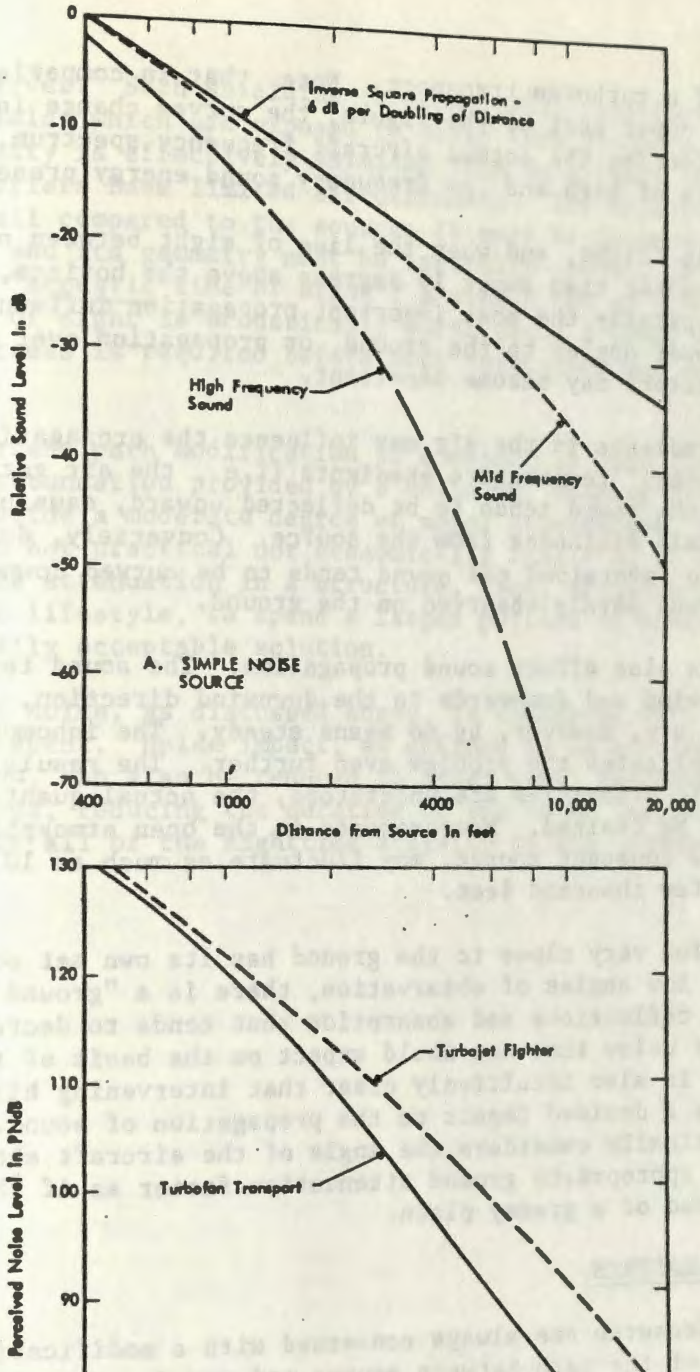



FIGURE 9. TYPICAL SOUND PROPAGATION CURVES

the takeoff of a turbofan transport. Note, that in comparison with the curves in the upper part of the figure, the curves change in shape with distance, reflecting the actual aircraft frequency spectrum, and the varying amounts of high and low frequency sound energy present.

For aircraft in flight, and when the line of sight between observer and aircraft is greater than about 10 degrees above the horizon, air absorption effects are typically the most important propagation influence. For propagation at lower angles to the ground, or propagation over ground, other propagation factors may become important.

Temperature gradients in the air may influence the propagation. During periods of "normal" temperature gradients (i.e., the air gets cooler as one gets higher), the sound tends to be deflected upward, causing "shadow zones" at certain distances from the source. Conversely, during periods of "temperature inversion" the sound tends to be curved downwards tending to increase sound levels observed on the ground.

Wind conditions also affect sound propagation. The sound tends to bend upward into the wind and downwards in the downwind direction. These atmospheric effects are, however, by no means steady. The inhomogeneity of the atmosphere complicates the problem even further. The result is that although the basic principles are understood, the actual quantitative prediction leaves much to be desired. Measurements in the open atmosphere of the sound level, due to a constant source, may fluctuate as much as 10 or 20 dB when the distance is a few thousand feet.

Sound propagation very close to the ground has its own set of additional variables. At low angles of observation, there is a "ground effect" due to ground surface reflections and absorption that tends to decrease the noise levels observed below that one would expect on the basis of free field estimates. It is also intuitively clear that intervening hills, buildings, etc., will have a decided impact on the propagation of sound. The computer program automatically considers the angle of the aircraft above the horizon and chooses an appropriate ground attenuation factor as if the surrounding terrain consisted of a grassy plain.

## NOISE CONTROL MEASURES

Noise control measures are always concerned with a modification of the source, a modification of the path between source and receiver, or a modification of the receiver. Noise control at the source, although the most desirable method, is often not achievable. We have seen earlier, how the use of high bypass turbofans can result in a reduction of the jet noise on takeoff. Certain modifications, such as lining engine nacelles with acoustically absorptive material, will often make a significant reduction in the noise produced at landing power. Compressor whine and other engine related noise can be reduced in this fashion. Research continues in engine design, but the development of quieter engines is a slow and arduous task. Often a great advancement in technology is required before a physical principle can be applied in a safe and reliable production engine.

Modification of the path from source to receiver would involve the use of barriers, natural or artificial, to interrupt the line of sight between aircraft and observer. Such shielding is practically restricted to locations close to airfields which are exposed to noise from ground operations. Sometimes a community is effectively shielded from an airport by hills, but many artificial barriers have limited effectiveness. The shielding barrier must be long and tall compared to the source; it must be located close to the noise source, and its geometry must be carefully chosen. A barrier must interrupt the "acoustic line of sight"; a single row of trees that may interrupt the line of sight is acoustically worthless. A large area of densely planted tall trees is required before such vegetation has any acoustic effect.

The most important path modification to consider in most airport situations, is the noise attenuation provided by a building, housing the observer. Most structures provide a moderate degree of noise attenuation, and it is possible, although often not practical nor economically feasible, to provide a very high degree of noise attenuation in a structure. And, of course, requiring people to alter their lifestyle, to spend a larger portion of their life indoors, may not be a socially acceptable solution.

The control of noise, as discussed above, is concerned with decreasing the noise from a single event. Noise impact, as defined by an environmental descriptor such as the Ldn, can also be reduced in other ways: reducing the number of noise intrusions, reducing the duration of the noise intrusions, or by transferring some or all of the nighttime activity to the daytime hours.

## SECTION II

### II. DESCRIPTION OF LDN PROCEDURES

The day-night level (Ldn) was introduced in Section I as an environmental descriptor of aircraft noise. As such, it takes into account not only the annoyance due to the individual noise event, but the contribution from the multiple noise events occurring during a 24-hour period.

The basic single event descriptor for the Ldn, is the sound exposure level (SEL). As described in Section I, the SEL contains the refinements that are considered necessary in assessing one's subjective reaction to an individual aircraft noise event:

- the noisiness of the signal noise spectrum
- an adjustment for the duration of the event.

To get from this basic SEL information to the Ldn, several steps are necessary. Conceptually, one must provide:

- a means for accounting for the cumulative effect of many operations by differing types of noise sources
- a weighting factor to account for the variation in community response to aircraft noise depending on the time of day.

Then, to have a useful description, one must relate the Ldn values to the expected impact of noise on people, on communities and on land areas.

### BASIC LDN EQUATIONS

In the discussion of Section I, it was mentioned that the human auditory perception behaves more or less logarithmically, resulting in the decibel scale. This same behavior is also applicable to the frequency of occurrence of noise events. Thus, in the Ldn procedure, the same dependence is used as for the decibel scale, namely ten times the logarithm to the base 10 of the number of operations. Thus, a doubling in the number of like noise intrusions results in an increase of 3 dB in the Ldn value.

The twenty-four hour day is broken into day (0701-2200) and night (2201-0700) periods, and a penalty assigned for night operations. The nighttime noise exposure is assessed a penalty by adding 10 dB to nighttime noise levels when combining day and night exposures to obtain a 24-hour value. The resulting expression for noise events of the same magnitude is:

$$\mathrm{DNL} = \mathrm{SEL} + 10 \log_{10} (N_D + 10.0\, N_N) - 49.4 \quad (1)$$

where:

| LAND USE CATEGORY | NSC |
|---|---|
| Residential-Single Family, Duplex, Mobile Homes | 1 |
| Residential-Multiple Family, Dormitories, etc. | 1 |
| Transient Lodging | 2 |
| School Classrooms, Libraries, Churches | 1 |
| Hospitals, Nursing Homes | 1 |
| Auditoriums, Concert Halls, Music Shells | 1 |
| Sports Arenas, Outdoor Spectator Sports | 1 |
| Playgrounds, Neighborhood Parks | 1 |
| Golf Courses, Riding Stables, Water Rec., Cemeteries | 2 |
| Office Buildings, Personal, Business and Professional | 3 |
| Commercial-Retail, Movie Theaters, Restaurants | 3 |
| Commercial-Wholesale, Some Retail, Ind., Mfg., Util. | 4 |
| Manufacturing, Communication (Noise Sensitive) | 2 |
| Livestock Farming, Animal Breeding | 3 |
| Agriculture (except Livestock), Mining, Fishing | 5 |
| Public Right-of-Way | 5 |
| Extensive Natural Recreation Areas | 3 |

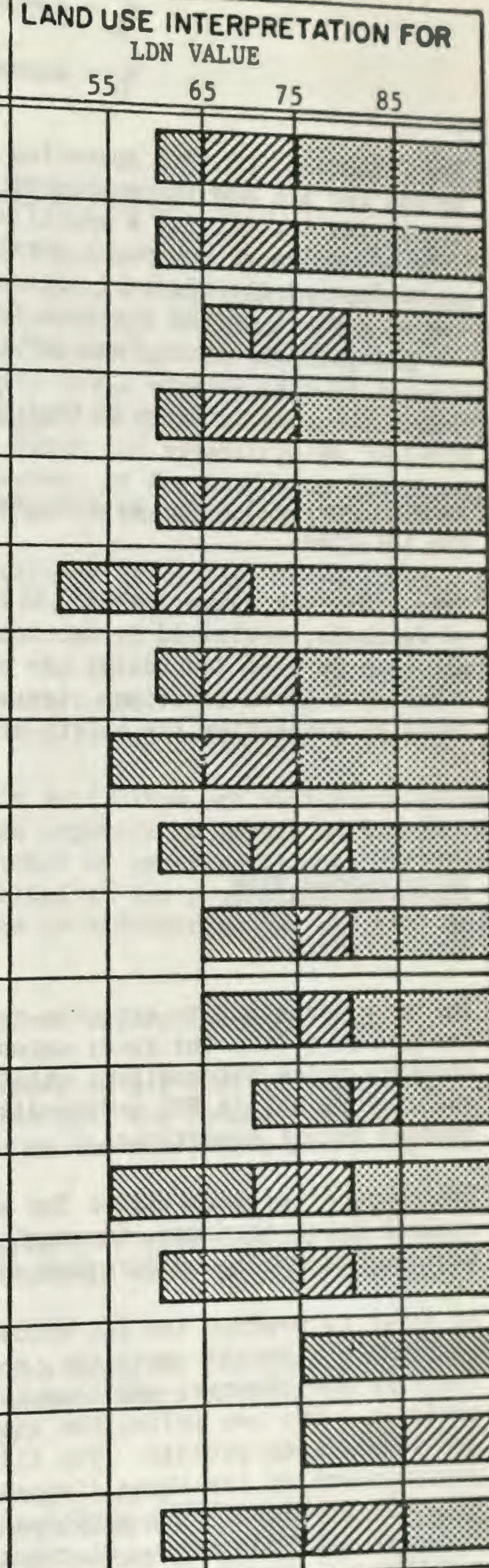



FIGURE 10A LAND USE COMPATIBILITY GUIDELINES FOR AIRCRAFT NOISE ENVIRONMENTS

$N_D$ = number of day events

$N_N$ = number of night events

The "constant" of 49.4 appearing in Equation (1) is simply related to one second for SEL and the number of seconds per 24 hours for DNL. Equation (1) yields the DNL for a specified uniform set of operations - a specific type of engine at one power setting and duration at a given location, flight operations of one class of aircraft along one flight path, etc. The total Ldn at a given ground position is determined by the summation of all the Ldn contributors on an "energy" basis. Formally, then:

$$\text{Ldn} = 10 \log_{10} \sum^{i} \text{antilog} \frac{\text{DNL}_i}{10} \qquad (2)$$

Summing over all noise events that contribute to the noise environment at the location.

Note, that the summation of Ldn values is exactly the same as the addition of decibels, explained in Section I. Hence, the rules given in Figure 2, may also be used for adding Ldn values. The computor computes the Ldn value at a given location. Contours of equal Ldn exposure value are determined by connecting the points of equal Ldn.

## INPUT INFORMATION

### Aircraft Data

The data necessary to estimate noise levels at any ground position must be assumed in a form for ready access in calculation. For flight operations, aircraft noise information, obtained from controlled flight tests, is analyzed to obtain SEL versus distance curves for different takeoff and landing thrust conditions.

The computer program allows for adjustments in the SEL curves for intermediate power settings, for variation in aircraft speed (which would influence duration) and duration adjustments for curved flight paths.

In order to predict the SEL value at a given observer location for a particular aircraft operation, one must determine the relative location of aircraft and observer and compute the distance between the aircraft and observer. One can define the aircraft motion in terms of a flighttrack and an altitude profile. The flighttrack is the projection onto the ground plane of the three dimensional flight path of the aircraft. The altitude profile is the performance characteristics of the aircraft in terms of altitude versus distance from start of takeoff roll or until touchdown. (See Reference 5 for further detail).

## SECTION III

## III. LAND USE AND COMMUNITY RESPONSE INTERPRETATIONS

Much of the usefulness of the Ldn contours lies in their interpretation, in terms of effects on people. In this section, interpretations are given in two contexts. First, Ldn values are interpreted in terms of impact on land uses. These guides are directed towards aiding land planning and development within airports and in community areas outside airport boundaries. Next, an interpretation of Ldn values is given in terms of expected community response. This information is given as a guide for assessing the probable degree of response to noise in community areas, or for assessing the changes in community response resulting from a change in the noise environment.

The input of aircraft noise may be characterized generally, in terms of several areas of interest:

1. Effects on people as individuals.
2. Effects on community actions and attitudes.
3. Impact on human activities (work and recreational) and land uses.

The effects of noise on people and people's activities are varied and often extremely complex. Thus, in relating noise exposure to impact on people, information has been drawn from a large number of experiments and observations. These include controlled laboratory psychological and physiological tests, case history studies of community reactions to aircraft noise, and both small and large scale social surveys.

The effects of noise may be grouped into three interrelated aspects:

1. Physiological effects, both temporary (e.g., startle reactions and temporary hearing threshold shifts), and enduring (for example, permanent hearing damage or the cumulative physiological effects of prolonged sleep loss).

2. Behavioral effects involving interference with ongoing activities such as speech, learning, T.V. watching, sleep or the performance of work tasks.

3. Subjective effects described by such words as "annoyance", "nuisance", "dissatisfaction", "disturbance" which result as a result of behavioral and physiological effects.

Generally, the levels and durations of aircraft noise encountered away from the immediate vicinity of runway and maintenance areas are not severe enough to produce easily measurable long-term physiological effects. For example, the noise levels produced by aircraft flyovers at community positions, even close to the runways, are not intense enough to cause permanent loss of hearing. Thus, the last two categories of noise effects - behavioral and subjective - provide the most usable guides for establishing aircraft noise criteria. Particularly useful information comes from studies of the effects of noise on speech communication and sleep, information gained from case history studies of community response and social surveys in a variety of airport community situations.

There is considerable variability in sensitivity among individuals. There is also considerable variation in the social and economic composition of different communities and in the interests of communities in aviation activities. Thus, the guides given in this section predict "typical responses" or attitudes quite well, but will not necessarily predict accurately, the behavior of any one individual or the response of any given segment of a community.

LAND USE INTERPRETATIONS

Figure 10 provides compatibility interpretations of Ldn values for major land use categories. The figure shows four noise compatibility interpretations for each land use. These four compatibility interpretations are defined in terms of suitability for construction as used in the Department of Housing and Urban Development's "Noise Assessment Guidelines". The four zones range from "clearly acceptable" to "clearly unacceptable".

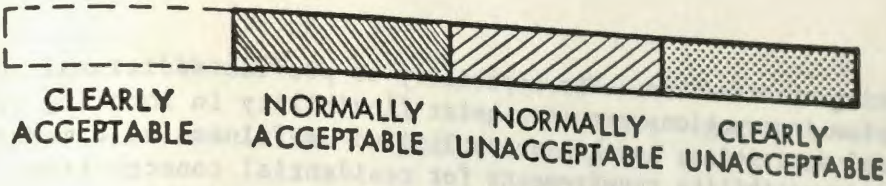
Figure 10 also gives a "noise sensitivity code rating" which provides a gross ranking of the land use in terms of noise sensitivity. The number 1, indicates the land uses most sensitive to noise and 5, the land uses that are least sensitive. The approximate relationship between the noise sensitivity code and the Ldn level, at which new construction or development is not desirable, is given below.

| Noise Sensitivity Code | Approximate Day-Night Level Where New Construction or Development is Not Desirable |
|---|---|
| 1 | 65 |
| 2 | 70 |
| 3 | 75 |
| 4 | 80 |
| 5 | 85 to 90 |

The interpretations given in Figure 10 are based on consideration of many different noise sensitivity factors. These factors include:

1. Speech communication needs.
2. Subjective judgments of noise acceptability and relative noisiness.
3. Need for freedom from noise intrusions.
4. Sleep sensitivity criteria.
5. Case histories of noise complaint experience near civil and military airports.
6. Typical noise insulation provided by common types of building construction.

The land use guides of Figure 10 are based upon the types of building construction that would normally be used where aircraft noise is no concern. Added noise attenuation can be provided in structures, often, as moderate costs in new construction, but, typically, at relatively high costs for modification




**CLEARLY ACCEPTABLE:**

The noise exposure is such that the activities associated with the land use may be carried out with essentially no interference from aircraft noise. (Residential areas: both indoor and outdoor noise environments are pleasant.)

**NORMALLY ACCEPTABLE:**

The noise exposure is great enough to be of some concern, but common building constructions will make the indoor environment acceptable, even for sleeping quarters.
(Residential areas: the outdoor environment will be reasonably pleasant for recreation and play.)

**NORMALLY UNACCEPTABLE:**

The noise exposure is significantly more severe so that unusual and costly building constructions are necessary to ensure adequate performance of activities.
(Residential areas: barriers must be erected between the site and prominent noise sources to make the outdoor environment tolerable.)

**CLEARLY UNACCEPTABLE:**

The noise exposure at the site is so severe that construction costs to make the indoor environment acceptable for performance of activities would be prohibitive.
(Residential areas: the outdoor environment would be intolerable for normal residential use.)

FIGURE 10-B. NOTES FOR LAND USE COMPATIBILITY GUIDELINES FOR AIRCRAFT NOISE ENVIRONMENTS

of existing construction. The capability to provide additional noise attenuation instructions provides great flexibility in locating office and industrial activities, but has quite limited usefulness as a means for relaxing compatibility requirements for residential construction.

COMMUNITY RESPONSE INTERPRETATIONS

The degree, and indeed, the kinds of community response to aircraft noise are influenced by many community factors in addition to the physical noise environment itself. Thus, the guides given in this section to predicting community response are just that, guides, not absolute predictors. Examples can be found of individual community actions that depart in either direction from the guides given in this section.

From recent studies, it is known that a number of nonacoustic influences may effect an individual's response to noise. Some of the influences include:

1. Fear of aircraft crashing in the neighborhood.
2. Susceptibility to noise in general.
3. Extent to which airport and air transportation are seen as important.
4. Belief in misfeasance by those able to do something about the noise problem.
5. Extent to which other things are disliked in the environment and belief about the effect of noise on general health.

Similarly, in terms of communities, the degree of community response will certainly be influenced by such factors as:

1. The degree of economic and social ties between the community and the aviation activity.
2. Feelings within the community as to the necessity of the operations causing the noise intrusion.
3. Past history of results in handling other community/airport problems.

The following chart relates Ldn values to anticipated response in residential communities. Three broad categories of community response are correlated with Ldn values.

CHART FOR ESTIMATING RESPONSE
OF RESIDENTIAL COMMUNITIES

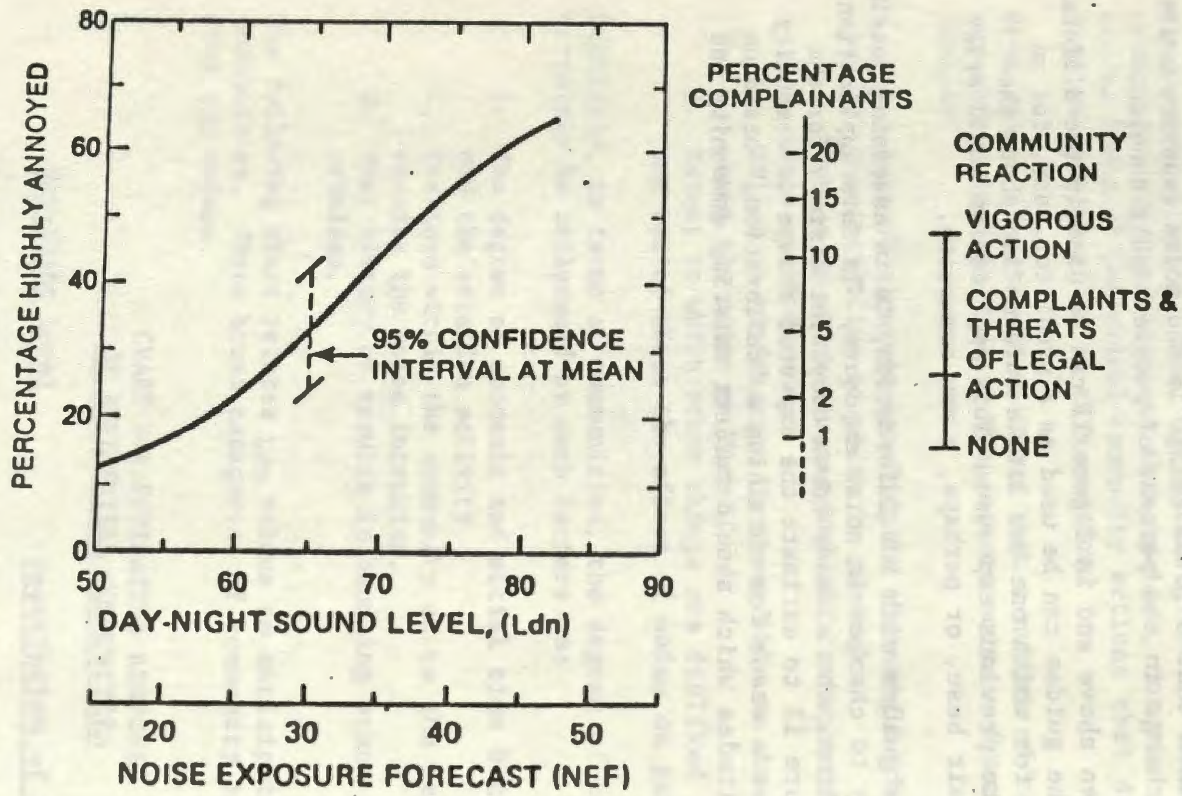
| Day-Night Level | Description of Expected Response |
|---|---|
| Less than 65 | Essentially few complaints would be expected. The noise may, however, interfere occasionally with certain activities of the residents. |
| 65 to 75 | Individuals may complain, perhaps vigorously. Concerted group action is possible. |

| | |
|---|---|
| Greater than 75 | Individual reactions would likely include repeated, vigorous complaints. Concerted group action might be expected. |

An additional guide in predicting the appropriate percent of people likely to be annoyed, or to complain, is given in Figure 11. This shows the percent of highly annoyed as a function of the Ldn value. It is worth noting, that this curve indicates that there would be essentially no annoyance due to aircraft noise exposure for Ldn values of 57 or less. Also, the figure indicates that a 10 dB change in the noise exposure would result in about a 20% change in the percent of people highly annoyed.

The interpretation given above and in Figure 11 can be used in two different ways. First of all, the guides can be used as a predictor, say, for an entirely new situation for which one has little information about the community or response to previous exposure. This application would arise in planning for a new air base, or perhaps, a new community.

A second way to use the guides with Ldn information, is in assessing possible response in a community to changes in noise exposure. In this application, one may use as a base line, the already known complaint history for the community, and use Figure 11 to estimate the expected change in community response. This provides a means for obtaining a "calibration," based on existing community attitudes which should reflect existing community and airport relationships.




**COMPARISON OF VARIOUS MEASURES OF INDIVIDUAL ANNOYANCE AND COMMUNITY REACTION AS A FUNCTION OF THE DAY-NIGHT SOUND LEVEL (Ldn) AND NOISE EXPOSURE FORECAST (NEF)**

FIGURE 11

# SECTION IV

## IV. LDN LAND PLANNING APPLICATIONS

This section outlines some of the direct applications of the Ldn to land use planning. The Ldn procedures provide a tool to define noise impact in a qualitative manner. However, noise is only one of the many environmental factors that must be considered in land planning. In this respect, LDN can be used with quantitative evaluations of other environmental factors in arriving at the complex assessments needed for effective planning.

### LAND USE STRATEGIES

Strategies for achieving land use compatibility as a means of reducing noise conflicts always involve some degree of control or regulation, direct or indirect, of land use. The economic costs, and the legal, political and administrative difficulties in achieving the necessary control of land use is a major limitation in the application of such strategies. Despite these obvious problems, the various strategies available should be explored carefully for applicability to each individual situation. Opportunities for applying effective land use strategies frequently occur, particularly with regard to land not already developed.

The major land use strategies include the following:

1. Land use purchase or lease.
2. Land use easements.
3. Land use zoning and building code restrictions.
4. Land use reconversion or relocation.
5. Encouragement of compatible development.
6. Subdivision regulation.
7. Public service planning (transportation facilities, recreational areas, etc.).

The usefulness of these strategies is greatly dependent upon the degree to which land is already developed. For undeveloped areas, the range of tools will be much wider and less costly to apply, than in already developed areas. From review of the above strategies, it will be apparent that most will require active and close liaison between the local and regional agencies responsible for land planning and development in areas around the airport.

The needs for realistic assessments of the noise environment, and to periodically check the validity of noise environment predictions underlie the growing interest in airport noise monitoring systems. Monitoring systems can be viewed as an aid to planning and operations, with the monitoring information serving as a means of evaluating the combined effect on the noise environment of varied changes in airport operations.

## NOISE ZONING

Zoning, is the placing of legal restrictions on permissible uses of private property with the general intent of preventing conflicts between land uses. Zoning has usually been exclusively a local governmental responsibility with its legal foundation in the power to regulate for the general health, safety and welfare. In zoning, one may set up a scale of uses and densities and allow uses lower on the scale to take place in areas zoned higher on the scale. It is primarily a preventative policy and has little value in already developed areas. Zoning, as traditionally used, can provide three functions:

1. Preserve existing compatible land uses.
2. Prevent changes to compatible land uses.
3. Lead to compatible uses where no dominant use has yet been established.

Zoning, based on consideration of noise exposure, is a relatively new approach to land use compatibility that has yet to be applied on a wide scale. Such zoning, to be effective, must be adopted in near similar form by all the zoning agencies within the noise impact area.

One approach combines noise zoning and building noise insulation requirements to provide the needed flexibility in land use controls. For some uses, land uses are permitted in a zone of greater noise exposure, providing the buildings meet minimum noise insulation requirements, specified in terms of a minimum reduction of outside aircraft noise levels (referred to as "noise level reduction" or NLR).

Building code amendments spell out the structural requirements. These requirements can be achieved by adopting certain specific materials and design features in the contruction, or, to provide more flexibility. Other construction features may be adopted if the plans can be certified by a professional acoustician, that the noise level reduction requirements will be met. A test procedure is provided for use where building officials believe that field verification of NLR values is needed.

This approach illustrates the ties between zoning and the establishment of minimum building noise reduction requirements. Without specifying minimum requirements on building noise insulation, much more rigid, and restrictive land use allocations could be necessary.

## BUILDING NOISE LEVEL REDUCTION REQUIREMENTS

Noise insulation can be a very useful tool for reducing noise impact areas in non-residential areas and for work activities which largely take place indoors. And, as noted before, providing additional noise insulation in areas of high noise exposure, greatly increases the flexibility in land use over that provided by a rigid interpretation of the land use criteria given in Figure 10. The drawbacks of added noise insulation, is that it requires extra planning effort and results in additional construction costs. The degree of noise insulation that can be provided has practical cost limitations; generally, costs are considerably higher for modification of existing construction than for new construction.

While residential construction can be designed to meet high noise insulation requirements, the bulk of existing data indicates that noise insulation should be applied cautiously as a strategy for reducing impacts in residential areas. Three considerations warn against using improved noise insulation as a justification for relaxing aircraft noise - land use compatibility interpretations based on usual residential construction:

1. The unlikelihood that improved noise insulation alone, can significantly reduce the subjective impact of aircraft noise in residential areas.

2. The high cost of modification.

3. Practical difficulties in achieving high values of noise reduction with regular residential construction procedures.

Thus, the major applications of improved noise insulation for improving compatibility with the noise environment should be to non-residential land uses.

Special noise insulation requirements have frequently been incorporated in buildings located near airports. The technical principles, the materials and the design requirements needed to produce buildings of improved noise insulation, are well known.

Noise can be transmitted into a building either:

1. Directly, through openings such as cracks around windows or doors, water pipes, conduits or ventilation ducts or other openings.

2. Indirectly, by the outdoor sound waves setting the building surfaces into vibration with the surfaces, then re-radiating sound waves into the room. These surfaces can include any room surface; windows, doors, walls, roofs, even floors.

To control the noise levels inside the room, <u>both</u> kinds of noise paths - direct opening and radiation of sound from building surfaces - must be controlled. To achieve effective noise insulation, the noise energy contributions from all paths must be reduced significantly. Control of one path and neglect of others will typically result in inadequate noise insulation. One cannot compensate for a major weakness in one path (such as a window) by making other paths (walls and roofs, for example) better. Small exterior areas having poor noise insulation characteristics will drastically reduce the effectiveness of the remaining exterior surfaces.

Since noise insulation effectiveness is generally a function of the weight of the materials, one must often use heavier materials to replace lightweight ones - thicker panes of glass, masonery instead of frame construction, dense concrete versus lightweight block or wood, for example.

The weakest transmission paths are usually the windows and doors, hence, these must be improved as the first step in obtaining improved noise insulation. Typically, windows must be improved by substituting heavier single panes, or even double panes, in frames with efficient gasketing to reduce leakage around the panes. Heavier doors, or even double doors, with efficient weatherstripping, are also needed. With improved windows and doors, heavier walls and roofs may be needed, as well as design attention to such things as the noise transmitted through ventilation ducting or fireplaces, for example.

And, since openings to the exterior must be eliminated, mechanical air ventilation must be provided. For residential construction in most parts of the country, this means that an air conditioning system must be included as one step in improving the noise insulation.

Table I provides approximate noise level reduction values for some typical building construction. Values are shown as ranges. Usually, the higher values would be observed near approach or landing paths of turbojet or turbofan aircraft. The lower values would be observed for propeller aircraft and for turbojet and turbofan takeoffs.

ESTIMATING THE NLR REQUIREMENTS

The Ldn contours, together with the compatibility guides of Figure 10 can be used to estimate the needed improvements in noise insulation for a building when it is to be placed in an adverse, normally noncompatible, noise environment. The detailed development of noise insulation requirements and actual construction needs must be established by more extensive engineering analyses.

The needed improvement in noise insulation can be estimated by taking the difference between the Ldn value at the site, as interpolated from the LDN contours, and the "design" Ldn extracted from Figure 10. The design value typically, should be set by taking a value midway between the limits of the normally acceptabe range. A more conservative "design" value might be chosen by taking the boundary between the clearly acceptable and normally acceptable ranges.

A straight forward noise zoning ordinance recommended by the State Aviation Division is contained in Appendix ___, which incorporates these land use planning guidelines.

TABLE A-1

TYPICAL BUILDING CONSTRUCTION SOUND LEVEL REDUCTION VALUES

| Type of Construction | Noise Level Reduction, dB* |
|---|---|
| Conventional lightweight - windows open | 15 - 20 |
| Conventional lightweight - windows closed | 25 - 30 |
| Conventional lightweight - no windows, or 1/4" glass windows sealed in place | 30 - 35 |
| 1/8" glass windows, sealed in place | 20 - 25 |
| 1/4" glass windows, sealed in place | 25 - 30 |
| Walls and roof - weighing 20 to 40 lbs/sq ft, no windows | 35 - 40 |
| Walls and roof - weighing 40 to 80 lbs/sq ft, no windows | 40 - 45 |
| Heavy walls and roof - weighing over 80 lbs/sq ft, no windows | 45 - 50 |

*In terms of the difference between maximum levels measured outside and inside, expressed as either A-levels or perceived noise levels. The sound level reduction values apply, in general, to noise from aircraft and noise from most surface vehicles (autos, trucks, and motorcycles).

## REFERENCES - APPENDIX "A"


1. Bishop, D.E.; Bolt, Beranek and Newman, Inc., "Community Noise Exposure Resulting from Aircraft Operations: Application Guide for Predictive Procedure". AMRL - TR - 73 - 105 Aerospace Medical Research Laboratory, 1974 (NTIS AD/A-004818).

2. Galloway, W.J.; Bolt, Beranek and Newman, Inc., "Community Noise Exposure Resulting from Aircraft Operations: Technical Review". AMRL - TR - 73 - 106 Aerospace Medical Research Laboratory, 1974 (NTIS AD/A - 004 822).

3. "Impact of Noise on People", Department of Transportation, FAA Office of Environmental Quality, 1977.

4. "Noise Control and Compatibility Planning for Airports", AC No: 150/5020-1, 1983.

5. "User's Guide for the Integrated Noise Model Version 3" FAA report EE-81-17-1982.

## APPENDIX "ER-B"

## COMPUTER OUTPUT FROM THE NOISE ANALYSIS

The noise exposure at Grand Canyon National Park Airport was analyzed using the FAA's Integrated Noise Model (INM), Version 3. This appendix contains 3 computer runs: Existing traffic (1982), Existing Helicopter Traffic (1982), and Ultimate Traffic (2003).

The first part of every run is an "echo report" of all input data. The coordinates for Ldn noise contours follow the "echo report". All computer analyses were developed and run in April 1984.

S E T U P

REPORT 1

| | | | |
|---|---|---|---|
| TITLE | GCN 2 EXISTING TRAFFIC | | |
| AIRPORT | GCN | | |
| ALTITUDE | 6611. FT. | | |
| TEMPERATURE | 539.7 R | 80.0 F | 26.7 C |

NOISE METRICS

EQUIVALENT SOUND LEVEL (LEQ) - THE 24 HOUR AVERAGE OF AN ENERGY SUMMATION OF INTEGRATED A-WEIGHTED LEVELS.

DAY-NIGHT AVERAGE SOUND LEVEL (LDN) - BASED UPON LEQ, WITH NIGHTTIME OPERATIONS WEIGHTED BY A 10 DECIBEL PENALTY.

NOISE EXPOSURE FORECAST (NEF) - THE 24 HOUR AVERAGE OF AN ENERGY SUMMATION OF EFFECTIVE PERCEIVED NOISE LEVELS.

TIME ABOVE A SPECIFIED THRESHOLD OF A-WEIGHTED SOUND (TA) - MINUTES THAT A DBA LEVEL IS EXCEEDED IN 24 HOURS.

R U N W A Y S

| NAME | HEADING | UNITS | STARTING COORDINATES X | STARTING COORDINATES Y | ENDING COORDINATES X | ENDING COORDINATES Y | RUNWAY LENGTH |
|---|---|---|---|---|---|---|---|
| 03R | 27 | FT | 0. | 0. | 5865. | 6826. | 9000. |
| | | M | 0. | 0. | 1788. | 2081. | 2743. |
| | | NMI | 0.000 | 0.000 | .965 | 1.123 | 1.481 |
| 21L | 207 | FT | 5865. | 6826. | 0. | 0. | 9000. |
| | | M | 1788. | 2081. | 0. | 0. | 2743. |
| | | NMI | .965 | 1.123 | 0.000 | 0.000 | 1.481 |

A I R C R A F T

| NAME | CATEGORY | NOISE CURVE NAME | APPROACH PARAMETER NAME | T A K E O F F STAGE1 | P R O F I L E STAGE2 | N A M E S STAGE3 | STAGE4 | STAGE5 | STAGE6 | STAGE7 |
|---|---|---|---|---|---|---|---|---|---|---|
| DC9Q7 | JCOM | 2JT8D9 | AP31 | TOP158 | TOP159 | TOP160 | | | | |
| 4EP | PCOM | R2800 | AP42 | TOP192 | TOP192 | TOP192 | TOP192 | TOP192 | TOP192 | TOP192 |
| GAMTF | JGA | CF700 | AP40 | TOP183 | TOP183 | TOP183 | TOP183 | | | |
| C130 | PMIL | T56A15 | AP43 | TOP186 | TOP186 | TOP186 | TOP186 | TOP186 | TOP186 | TOP186 |
| COMJET | JGA | CGAJ | AP37 | TOP180 | TOP180 | TOP180 | TOP180 | | | |
| DHC7 | PCOM | PT650 | AP44 | TOP187 | TOP187 | TOP187 | | | | |
| CV580 | PCOM | 501D13 | AP45 | TOP188 | TOP188 | TOP188 | TOP188 | | | |
| HTETP | PCOM | PWA7 | AP46 | TOP189 | TOP189 | TOP189 | | | | |
| MTETP | PCOM | PT645 | AP47 | TOP190 | TOP190 | TOP190 | | | | |
| DHC6 | PCOM | PT627 | AP48 | TOP191 | TOP191 | | | | | |
| COMTEP | PGA | CGATEP | AP51 | TOP194 | TOP194 | TOP194 | | | | |
| COMSEP | PGA | CGASEP | AP52 | TOP195 | TOP195 | | | | | |

REPORT 6

## APPROACH PROFILES

| NAME | SEGMENT | DISTANCE FROM RUNWAY END FT | M | NMI | ALTITUDE(FT) | SPEED(KNTS) | THRUST |
|---|---|---|---|---|---|---|---|
| LDN3D | 1 | STOP | | | 0.00 | 32.00 | 3DLND |
| | 2 | -1032.94 | -314.84 | -.17 | 0.00 | FINSP | 3DLND |
| | 3 | 18146.06 | 5500.45 | 2.97 | 1000.00 | FINSP | 3DLND |
| | 4 | 56264.83 | 17149.56 | 9.26 | 1900.00 | FINSP | 3DLND |
| | 5 | 60032.03 | 18297.80 | 9.88 | 1900.00 | FINSP | 3DLND |
| | 6 | 75343.84 | 22964.85 | 12.40 | 1900.00 | FINSP | 3DLND |
| | 7 | 113441.[illegible] | 34570.92 | 18.67 | 1900.00 | FINSP | 0.00 |
| STD3D | 1 | STOP | | | 0.00 | TAXI | REV |
| | 2 | -1002.56 | -305.58 | -.17 | 0.00 | FINSP | 3DLND |
| | 3 | 18476.10 | 5502.71 | 2.97 | 1000.00 | FINSP | 3DAPFS |
| | 4 | 56234.50 | 17140.31 | 9.26 | 3000.00 | FINSP | 3DAPFS |
| | 5 | 60050.30 | 18303.37 | 9.88 | 3200.00 | FINSP | 3DAPFS |
| | 6 | 75313.50 | 22955.60 | 12.40 | 4000.00 | TERMSP | 3DAPTS |
| | 7 | 113471.10 | 34580.03 | 18.67 | 6000.00 | TERMSP | 0.00 |
| GA3D | 1 | STOP | | | 0.00 | 32.00 | 3DLND |
| | 2 | -1002.56 | -305.58 | -.17 | 0.00 | FINSP | 3DLND |
| | 3 | 18076.10 | 5502.70 | 2.97 | 1000.00 | FINSP | 3DLND |
| | 4 | 56234.50 | 17140.31 | 9.26 | 3000.00 | FINSP | 3DLND |
| | 5 | 60050.30 | 18303.37 | 9.88 | 3200.00 | FINSP | 3DLND |
| | 6 | 75313.50 | 22955.00 | 12.40 | 4000.00 | FINSP | 3DLND |
| | 7 | 113471.10 | 34580.03 | 18.67 | 6000.00 | FINSP | 0.00 |
| MIL3D | 1 | STOP | | | 0.00 | 32.00 | 3DLND |
| | 2 | -1002.56 | -305.58 | -.17 | 0.00 | FINSP | 3DLND |
| | 3 | 18076.41 | 5502.70 | 2.97 | 1000.00 | FINSP | 3DLND |
| | 4 | 56231.50 | 17140.31 | 9.26 | 3000.00 | FINSP | 3DLND |
| | 5 | 60050.31 | 18303.37 | 9.88 | 3200.00 | FINSP | 3DLND |
| | 6 | 75313.50 | 22955.00 | 12.40 | 4000.00 | FINSP | 3DLND |
| | 7 | 113471.10 | 34580.03 | 18.67 | 6000.00 | FINSP | 0.00 |

TAKEOFF - TRACKS REPORT 9 - PART A

| TRACK | RUNWAY | INITIAL HEADING | SEGMENT | DIRECTION | LENGTH (NMI) | TURN ANGLE (DEG) | RESULTANT HEADING (DEG) | TURN RADIUS (NMI) |
|---|---|---|---|---|---|---|---|---|
| TR6 | 21L | 207 | 1 | STRAIGHT | 1.90 | | 207 | |
| | | | 2 | LEFT | | 40 | 167 | .40 |
| | | | 3 | STRAIGHT | 50.00 | | 167 | |
| TR10 | 21L | 207 | 1 | STRAIGHT | 2.40 | | 207 | |
| | | | 2 | RIGHT | | 50 | 257 | .40 |
| | | | 3 | STRAIGHT | 50.00 | | 257 | |
| TR21 | 03R | 27 | 1 | STRAIGHT | 1.50 | | 27 | |
| | | | 2 | RIGHT | | 90 | 117 | .30 |
| | | | 3 | STRAIGHT | .60 | | 117 | |
| | | | 4 | RIGHT | | 50 | 167 | .40 |
| | | | 5 | STRAIGHT | 50.00 | | 167 | |
| TR22 | 03R | 27 | 1 | STRAIGHT | 1.80 | | 27 | |
| | | | 2 | LEFT | | 90 | 297 | .30 |
| | | | 3 | STRAIGHT | 50.00 | | 297 | |

## TAKEOFF - OPERATIONS

| TRACK | RUNWAY | AIRCRAFT | CLASS | STAGE | PROFILE | MOD | OPERATIONS DAY | OPERATIONS EVENING | OPERATIONS NIGHT |
|---|---|---|---|---|---|---|---|---|---|
| TR8 | 21L | DC9Q7 | COM | 1 | TUP158 | 0 | 1.00 | .28 | 0.00 |
| | | 4EP | COM | 7 | TUP192 | 0 | .28 | 0.00 | 0.00 |
| | | GAMTF | GA | 1 | TUP183 | 0 | .06 | 0.00 | 0.00 |
| | | C130 | MIL | 1 | TUP186 | 0 | .06 | 0.00 | 0.00 |
| | | COMJET | GA | 1 | TUP180 | 0 | .35 | 0.00 | 0.00 |
| | | DHC7 | COM | 1 | TUP187 | 0 | .62 | 0.00 | 0.00 |
| | | CV580 | COM | 1 | TUP188 | 0 | .31 | 0.00 | 0.00 |
| | | HTETP | COM | 1 | TUP189 | 0 | .31 | 0.00 | 0.00 |
| | | MTETP | COM | 1 | TUP190 | 0 | 2.30 | 0.00 | 0.00 |
| | | DHC6 | COM | 1 | TUP191 | 0 | 7.20 | .51 | 0.00 |
| | | COMTEP | GA | 1 | TUP194 | 0 | 8.10 | .51 | .42 |
| | | COMSEP | GA | 1 | TUP195 | 0 | 3.70 | .38 | .35 |
| TR10 | 21L | DC9Q7 | COM | 1 | TUP158 | 0 | 2.00 | .57 | 0.00 |
| | | 4EP | COM | 7 | TUP192 | 0 | .57 | 0.00 | 0.00 |
| | | GAMTF | GA | 1 | TUP183 | 0 | .11 | 0.00 | 0.00 |
| | | C130 | MIL | 1 | TUP186 | 0 | .11 | 0.00 | 0.00 |
| | | COMJET | GA | 1 | TUP180 | 0 | .71 | 0.00 | 0.00 |
| | | DHC7 | COM | 1 | TUP187 | 0 | 1.25 | 0.00 | 0.00 |
| | | CV580 | COM | 1 | TUP188 | 0 | .62 | 0.00 | 0.00 |
| | | HTETP | COM | 1 | TUP189 | 0 | .62 | 0.00 | 0.00 |
| | | MTETP | COM | 1 | TUP190 | 0 | 9.30 | 0.00 | 0.00 |
| | | DHC6 | COM | 1 | TUP191 | 0 | 28.60 | 2.04 | 0.00 |
| | | COMTEP | GA | 1 | TUP194 | 0 | 32.40 | 2.04 | 1.70 |
| | | COMSEP | GA | 1 | TUP195 | 0 | 20.80 | 2.17 | 1.80 |
| TR21 | 03R | DC9Q7 | COM | 1 | TUP158 | 0 | .18 | .05 | 0.00 |
| | | 4EP | COM | 7 | TUP192 | 0 | .05 | 0.00 | 0.00 |
| | | GAMTF | GA | 1 | TUP183 | 0 | .01 | 0.00 | 0.00 |
| | | C130 | MIL | 1 | TUP186 | 0 | .01 | 0.00 | 0.00 |
| | | COMJET | GA | 1 | TUP180 | 0 | .06 | 0.00 | 0.00 |
| | | DHC7 | COM | 1 | TUP187 | 0 | .11 | 0.00 | 0.00 |
| | | CV580 | COM | 1 | TUP188 | 0 | .06 | 0.00 | 0.00 |
| | | HTETP | COM | 1 | TUP189 | 0 | .06 | 0.00 | 0.00 |
| | | MTETP | COM | 1 | TUP190 | 0 | .40 | 0.00 | 0.00 |
| | | DHC6 | COM | 1 | TUP191 | 0 | 1.30 | .09 | 0.00 |
| | | COMTEP | GA | 1 | TUP194 | 0 | 1.40 | .09 | .08 |
| | | COMSEP | GA | 1 | TUP195 | 0 | .60 | .07 | .06 |
| TR22 | 03R | DC9Q7 | COM | 1 | TUP158 | 0 | .36 | .10 | 0.00 |
| | | 4EP | COM | 7 | TUP192 | 0 | .10 | 0.00 | 0.00 |
| | | GAMTF | GA | 1 | TUP183 | 0 | .02 | 0.00 | 0.00 |
| | | C130 | MIL | 1 | TUP186 | 0 | .02 | 0.00 | 0.00 |
| | | COMJET | GA | 1 | TUP180 | 0 | .13 | 0.00 | 0.00 |
| | | DHC7 | COM | 1 | TUP187 | 0 | .22 | 0.00 | 0.00 |
| | | CV580 | COM | 1 | TUP188 | 0 | .11 | 0.00 | 0.00 |
| | | HTETP | COM | 1 | TUP189 | 0 | .11 | 0.00 | 0.00 |
| | | MTETP | COM | 1 | TUP190 | 0 | 1.60 | 0.00 | 0.00 |

TAKEOFF - OPERATIONS (CONT.)

| TRACK | RUNWAY | AIRCRAFT | CLASS | STAGE | PROFILE | MOD | OPERATIONS DAY | EVENING | NIGHT |
|---|---|---|---|---|---|---|---|---|---|
| | | DHC6 | COM | 1 | TOP191 | 0 | 5.10 | .36 | 0.00 |
| | | COMTEP | GA | 1 | TOP194 | 0 | 5.70 | .36 | .30 |
| | | COMSEP | GA | 1 | TOP195 | 0 | 3.70 | .38 | .32 |

REPORT 9 - PART C

## TAKEOFF - DISTRIBUTION

| | OPERATIONS DAY | EVENING | NIGHT |
|---|---|---|---|
| COMMERCIAL - | 64.7 | 4.0 | 0.0 |
| GENERAL AVIATION - | 77.8 | 6.0 | 5.0 |
| MILITARY - | .2 | 0.0 | 0.0 |

| | | PROPORTIONS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | COMMERCIAL | | | GENERAL AVIATION | | | MILITARY | | |
| TRACK | RUNWAY | DAY | EVENING | NIGHT | DAY | EVENING | NIGHT | DAY | EVENING | NIGHT |
| TR5 | 21L | .19 | .20 | 0.00 | .16 | .15 | .15 | .30 | 0.00 | 0.00 |
| TR10 | 21L | .66 | .65 | 0.00 | .69 | .70 | .70 | .55 | 0.00 | 0.00 |
| TR21 | 03R | .03 | .04 | 0.00 | .03 | .03 | .03 | .05 | 0.00 | 0.00 |
| TR22 | 03R | .12 | .12 | 0.00 | .12 | .12 | .12 | .10 | 0.00 | 0.00 |
| | TOTAL | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 0.00 |

## LANDING - TRACKS

| TRACK | RUNWAY | INITIAL HEADING | SEGMENT | DIRECTION | LENGTH (NMI) | TURN ANGLE (DEG) | RESULTANT HEADING (DEG) | TURN RADIUS (NMI) |
|---|---|---|---|---|---|---|---|---|
| TR1 | 03R | 27 | 1 | STRAIGHT | .40 | | 27 | |
| | | | 2 | LEFT | | 90 | 297 | .20 |
| | | | 3 | STRAIGHT | 50.00 | | 297 | |
| TR2 | 03R | 27 | 1 | STRAIGHT | 1.00 | | 27 | |
| | | | 2 | LEFT | | 90 | 297 | .30 |
| | | | 3 | STRAIGHT | 50.00 | | 297 | |
| TR3 | 03R | 27 | 1 | STRAIGHT | 1.00 | | 27 | |
| | | | 2 | LEFT | | 90 | 297 | .30 |
| | | | 3 | STRAIGHT | .70 | | 297 | |
| | | | 4 | LEFT | | 90 | 207 | .30 |
| | | | 5 | STRAIGHT | 3.00 | | 207 | |
| | | | 6 | RIGHT | | 50 | 257 | .50 |
| | | | 7 | STRAIGHT | 50.00 | | 257 | |
| TR4 | 03R | 27 | 1 | STRAIGHT | 50.00 | | 27 | |
| TR5 | 03R | 27 | 1 | STRAIGHT | .40 | | 27 | |
| | | | 2 | RIGHT | | 90 | 117 | .20 |
| | | | 3 | STRAIGHT | .25 | | 117 | |
| | | | 4 | RIGHT | | 90 | 207 | .20 |
| | | | 5 | STRAIGHT | 1.90 | | 207 | |
| | | | 6 | RIGHT | | 90 | 297 | .20 |
| | | | 7 | STRAIGHT | .25 | | 297 | |
| | | | 8 | RIGHT | | 90 | 27 | .20 |
| | | | 9 | STRAIGHT | 50.00 | | 27 | |
| TR7 | 03R | 27 | 1 | STRAIGHT | 1.00 | | 27 | |
| | | | 2 | RIGHT | | 90 | 117 | .30 |
| | | | 3 | STRAIGHT | 50.00 | | 117 | |
| TR15 | 21L | 207 | 1 | STRAIGHT | .40 | | 207 | |
| | | | 2 | RIGHT | | 90 | 297 | .20 |
| | | | 3 | STRAIGHT | 2.00 | | 297 | |
| | | | 4 | RIGHT | | 46 | 343 | .50 |
| | | | 5 | STRAIGHT | 50.00 | | 343 | |
| TR16 | 21L | 207 | 1 | STRAIGHT | 1.00 | | 207 | |
| | | | 2 | RIGHT | | 90 | 297 | .30 |
| | | | 3 | STRAIGHT | 50.00 | | 297 | |
| TR17 | 21L | 207 | 1 | STRAIGHT | 1.00 | | 207 | |
| | | | 2 | LEFT | | 90 | 117 | .30 |
| | | | 3 | STRAIGHT | 50.00 | | 117 | |
| TR18 | 21L | 207 | 1 | STRAIGHT | 50.00 | | 207 | |
| TR20 | 21L | 207 | 1 | STRAIGHT | .40 | | 207 | |
| | | | 2 | LEFT | | 90 | 117 | .20 |
| | | | 3 | STRAIGHT | .25 | | 117 | |
| | | | 4 | LEFT | | 90 | 27 | .20 |
| | | | 5 | STRAIGHT | 50.00 | | 27 | |

## L A N D I N G - O P E R A T I O N S

| TRACK | RUNWAY | AIRCRAFT | CLASS | PROFILE | OPERATIONS DAY | OPERATIONS EVENING | OPERATIONS NIGHT |
|---|---|---|---|---|---|---|---|
| TR1 | 03R | MTETP | COM | LOW3D | 2.30 | 0.00 | 0.00 |
| | | DHC6 | COM | LOW3D | 7.20 | 0.00 | 0.00 |
| | | COMTEP | GA | LOW3D | 8.10 | 0.00 | 0.00 |
| | | COMSEP | GA | LOW3D | 15.60 | 2.17 | 1.80 |
| TR2 | 03R | DC907 | COM | STD3D | 1.01 | .57 | 0.00 |
| | | 4EP | COM | STD3D | .28 | 0.00 | 0.00 |
| | | GAMTF | GA | MIL3D | .06 | 0.00 | 0.00 |
| | | C130 | MIL | MIL3D | .06 | 0.00 | 0.00 |
| | | COMJET | GA | STD3D | .35 | 0.00 | 0.00 |
| | | DHC7 | COM | STD3D | .62 | 0.00 | 0.00 |
| | | CV580 | COM | STD3D | .31 | 0.00 | 0.00 |
| | | MTETP | COM | STD3D | .31 | 0.00 | 0.00 |
| TR3 | 03R | DC907 | COM | STD3D | 1.01 | 0.00 | 0.00 |
| | | 4EP | COM | STD3D | .28 | 0.00 | 0.00 |
| | | GAMTF | GA | MIL3D | .06 | 0.00 | 0.00 |
| | | C130 | MIL | MIL3D | .06 | 0.00 | 0.00 |
| | | COMJET | GA | STD3D | .35 | 0.00 | 0.00 |
| | | DHC7 | COM | STD3D | .62 | 0.00 | 0.00 |
| | | CV580 | COM | STD3D | .31 | 0.00 | 0.00 |
| | | MTETP | COM | STD3D | .31 | 0.00 | 0.00 |
| TR4 | 03R | MTETP | COM | LOW3D | 3.50 | 0.00 | 0.00 |
| | | DHC6 | COM | LOW3D | 10.70 | 2.04 | 0.00 |
| | | COMTEP | GA | LOW3D | 12.10 | 2.04 | 1.70 |
| | | COMSEP | GA | LOW3D | 2.60 | 0.00 | 0.00 |
| TR5 | 03R | MTETP | COM | LOW3D | 3.50 | 0.00 | 0.00 |
| | | DHC6 | COM | LOW3D | 10.70 | 0.00 | 0.00 |
| | | COMTEP | GA | LOW3D | 12.10 | 0.00 | 0.00 |
| | | COMSEP | GA | LOW3D | 2.60 | 0.00 | 0.00 |
| TR7 | 03R | DC907 | COM | STD3D | 1.00 | .28 | 0.00 |
| | | 4EP | COM | STD3D | .28 | 0.00 | 0.00 |
| | | GAMTF | GA | MIL3D | .06 | 0.00 | 0.00 |
| | | C130 | MIL | MIL3D | .06 | 0.00 | 0.00 |
| | | COMJET | GA | STD3D | .35 | 0.00 | 0.00 |
| | | DHC7 | COM | STD3D | .62 | 0.00 | 0.00 |
| | | CV580 | COM | STD3D | .31 | 0.00 | 0.00 |
| | | MTETP | COM | STD3D | .31 | 0.00 | 0.00 |
| | | MTETP | COM | LOW3D | 2.30 | 0.00 | 0.00 |
| | | DHC6 | COM | LOW3D | 7.20 | .51 | 0.00 |
| | | COMTEP | GA | LOW3D | 8.10 | .51 | .42 |
| | | COMSEP | GA | LOW3D | 3.70 | .38 | .32 |
| TR15 | 21L | MTETP | COM | LOW3D | .40 | 0.00 | 0.00 |
| | | DHC6 | COM | LOW3D | [illegible] | 0.00 | 0.00 |
| | | COMTEP | GA | LOW3D | [illegible] | 0.00 | 0.00 |
| | | COMSEP | GA | LOW3D | [illegible] | .38 | .32 |
| TR16 | 21L | DC907 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

## LANDING - OPERATIONS (CONT.)

| TRACK | RUNWAY | AIRCRAFT | CLASS | PROFILE | OPERATIONS DAY | OPERATIONS EVENING | OPERATIONS NIGHT |
|---|---|---|---|---|---|---|---|
| | | 4EP | COM | STD3D | .10 | 0.00 | 0.00 |
| | | GAMTF | GA | MIL3D | .02 | 0.00 | 0.00 |
| | | C130 | MIL | MIL3D | .02 | 0.00 | 0.00 |
| | | COMJET | GA | STD3D | .13 | 0.00 | 0.00 |
| | | DHC7 | COM | STD3D | .22 | 0.00 | 0.00 |
| | | CV580 | COM | STD3D | .11 | 0.00 | 0.00 |
| | | HTFTP | COM | STD3D | .11 | 0.00 | 0.00 |
| TR17 | 21L | DC9U7 | COM | STD3D | .09 | 0.00 | 0.00 |
| | | 4EP | COM | STD3D | .03 | 0.00 | 0.00 |
| | | GAMTF | GA | MIL3D | .01 | 0.00 | 0.00 |
| | | C130 | MIL | MIL3D | .01 | 0.00 | 0.00 |
| | | COMJET | GA | STD3D | .03 | 0.00 | 0.00 |
| | | DHC7 | COM | STD3D | .06 | 0.00 | 0.00 |
| | | CV580 | COM | STD3D | .03 | 0.00 | 0.00 |
| | | HTETP | COM | STD3D | .03 | 0.00 | 0.00 |
| | | MTETP | COM | LOW3D | .21 | 0.00 | 0.00 |
| | | DHC6 | COM | LOW3D | .63 | 0.00 | 0.00 |
| | | COMTEP | GA | LOW3D | .71 | 0.00 | 0.00 |
| | | COMSEP | GA | LOW3D | .32 | 0.00 | 0.00 |
| TR18 | 21L | DC9U7 | COM | STD3D | .09 | .05 | 0.00 |
| | | 4EP | COM | STD3D | .03 | 0.00 | 0.00 |
| | | GAMTF | GA | MIL3D | .01 | 0.00 | 0.00 |
| | | C130 | MIL | MIL3D | .01 | 0.00 | 0.00 |
| | | COMJET | GA | STD3D | .03 | 0.00 | 0.00 |
| | | DHC7 | COM | STD3D | .06 | 0.00 | 0.00 |
| | | CV580 | COM | STD3D | .03 | 0.00 | 0.00 |
| | | MTETP | COM | STD3D | .03 | 0.00 | 0.00 |
| | | MTETP | COM | LOW3D | .21 | 0.00 | 0.00 |
| | | DHC6 | COM | LOW3D | .63 | .09 | 0.00 |
| | | COMTEP | GA | LOW3D | .71 | .09 | .08 |
| | | COMSEP | GA | LOW3D | .32 | .07 | .06 |
| TR20 | 21L | MTETP | COM | LOW3D | 1.20 | 0.00 | 0.00 |
| | | DHC6 | COM | LOW3D | 3.80 | .36 | 0.00 |
| | | COMTEP | GA | LOW3D | 4.30 | .36 | .30 |
| | | COMSEP | GA | LOW3D | .90 | 0.00 | 0.00 |

## L A N D I N G - D I S T R I B U T I O N

| | | O P E R A T I O N S | |
|---|---|---|---|
| | DAY | EVENING | NIGHT |
| COMMERCIAL - | 64.7 | 4.0 | 0.0 |
| GENERAL AVIATION - | 77.8 | 6.0 | 5.0 |
| MILITARY - | .2 | 0.0 | 0.0 |

| | | P R O P O R T I O N S | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | COMMERCIAL | | | GENERAL AVIATION | | | MILITARY | | |
| TRACK | RUNWAY | DAY | EVENING | NIGHT | DAY | EVENING | NIGHT | DAY | EVENING | NIGHT |
| TR1 | 03R | .15 | 0.00 | 0.00 | .30 | .36 | .36 | 0.00 | 0.00 | 0.00 |
| TR2 | 03R | .04 | .14 | 0.00 | .01 | 0.00 | 0.00 | .27 | 0.00 | 0.00 |
| TR3 | 03R | .04 | 0.00 | 0.00 | .01 | 0.00 | 0.00 | .27 | 0.00 | 0.00 |
| TR4 | 03R | .22 | .51 | 0.00 | .19 | .34 | .34 | 0.00 | 0.00 | 0.00 |
| TR5 | 03R | .22 | 0.00 | 0.00 | .19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TR7 | 03R | .19 | .20 | 0.00 | .16 | .15 | .15 | .27 | 0.00 | 0.00 |
| TR15 | 21L | .03 | 0.00 | 0.00 | .05 | .06 | .06 | 0.00 | 0.00 | 0.00 |
| TR16 | 21L | .01 | .03 | 0.00 | .00 | 0.00 | 0.00 | .09 | 0.00 | 0.00 |
| TR17 | 21L | .02 | 0.00 | 0.00 | .01 | 0.00 | 0.00 | .05 | 0.00 | 0.00 |
| TR18 | 21L | .02 | .04 | 0.00 | .01 | .03 | .03 | .05 | 0.00 | 0.00 |
| TR20 | 21L | .08 | .09 | 0.00 | .07 | .06 | .06 | 0.00 | 0.00 | 0.00 |
| | TOTAL | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 0.00 |

```
P R O C E S S E S
-----------------

VERIFY

EXECUTE

CONTOUR
    LEVELS =  65.00  70.00  75.00
    METRIC LDN
    TOLERANCE = 2.00
    REFINEMENT =  6
    WINDOW =    -5000.  -5000.  15000.  15000.
    SAVED AS GCN2
    REPORT
 VERIFY MODULE ACCESSED.
```

```
--------------------------------------------------------------------------------------------------
NO WARNING MESSAGES WERE PRODUCED BY THE FLIGHT OVERLAY MODULE.
--------------------------------------------------------------------------------------------------
```

NOISE COMPUTATION MODULE SUMMARY

| REFINEMENT LEVEL | NO. OF SQUARES | NO. OF NODES | NO. OF TRIANGLES |
|---|---|---|---|
| 3 | 64 | 280 | |
| 4 | 76 | 256 | |
| 5 | 104 | 350 | |
| 6 | 144 | 494 | |
| | | | 2666 |

RECTANGLE ENVELOPING MAP MOSAIC.
LOW LEFT & UPPER RIGHT CORNERS
XMIN= -.500000E+04YMIN= -.500000E+04
XMAX= .150000E+05YMAX= .150000E+05

0 WARNING MESSAGES WERE PRODUCED BY THE COMPUTATION MODULE

-------------------------------------------------------------
0 WARNING MESSAGES WERE PRODUCED BY THE CONTOUR MODULE
-------------------------------------------------------------

INTEGRATED NOISE MODEL - CONTOUR ANALYSIS REPORT

C O N T O U R - GCN2

GCN 2 EXISTING TRAFFIC
AIRPORT - GCN
LEVEL = 65.0 DB AREA = .52 METRIC = LDN

| ISLAND | PNT | X | Y | PNT | X | Y | PNT | X | Y |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 2500. | 3982. | 2 | 2453. | 3941. | 3 | 2369. | 3881. |
| | 4 | 2290. | 3750. | 5 | 2188. | 3638. | 6 | 2082. | 3543. |
| | 7 | 1939. | 3438. | 8 | 1875. | 3295. | 9 | 1788. | 3212. |
| | 10 | 1722. | 3125. | 11 | 1563. | 2925. | 12 | 1507. | 2868. |
| | 13 | 1405. | 2813. | 14 | 1250. | 2531. | 15 | 1233. | 2517. |
| | 16 | 1222. | 2500. | 17 | 1117. | 2367. | 18 | 854. | 2047. |
| | 19 | 771. | 1948. | 20 | 731. | 1991. | 21 | 704. | 1875. |
| | 22 | 683. | 1860. | 23 | 666. | 1855. | 24 | 657. | 1851. |
| | 25 | 677. | 1823. | 26 | 614. | 1839. | 27 | 648. | 1829. |
| | 28 | 642. | 1807. | 29 | 625. | 1774. | 30 | 585. | 1714. |
| | 31 | 470. | 1565. | 32 | 210. | 1250. | 33 | 156. | 1176. |
| | 34 | 117. | 1133. | 35 | 88. | 1094. | 36 | 0. | 986. |
| | 37 | -42. | 938. | 38 | -133. | 848. | 39 | -191. | 816. |
| | 40 | -220. | 752. | 41 | -309. | 625. | 42 | -311. | 623. |
| | 43 | -313. | 621. | 44 | -454. | 469. | 45 | -462. | 462. |
| | 46 | -409. | 449. | 47 | -565. | 313. | 48 | -595. | 283. |
| | 49 | -625. | 231. | 50 | -671. | 179. | 51 | -713. | 88. |
| | 52 | -750. | 0. | 53 | -762. | -137. | 54 | -704. | -196. |
| | 55 | -625. | -272. | 56 | -617. | -304. | 57 | -610. | -313. |
| | 58 | -615. | -323. | 59 | -625. | -348. | 60 | -671. | -446. |
| | 61 | -721. | -529. | 62 | -760. | -625. | 63 | -903. | -903. |
| | 64 | -625. | -932. | 65 | -501. | -749. | 66 | -395. | -773. |
| | 67 | -313. | -719. | 68 | -171. | -655. | 69 | -176. | -801. |
| | 70 | 0. | -777. | 71 | 104. | -729. | 72 | 194. | -700. |
| | 73 | 275. | -625. | 74 | 209. | -612. | 75 | 313. | -596. |
| | 76 | 440. | -469. | 77 | 456. | -456. | 78 | 469. | -440. |
| | 79 | 560. | -313. | 80 | 605. | -293. | 81 | 625. | -262. |
| | 82 | 690. | -172. | 83 | 765. | -140. | 84 | 807. | -51. |
| | 85 | 845. | 0. | 86 | 891. | 46. | 87 | 938. | 107. |
| | 88 | 982. | 156. | 89 | 1038. | 212. | 90 | 1094. | 281. |
| | 91 | 1162. | 313. | 92 | 1187. | 376. | 93 | 1250. | 457. |
| | 94 | 1258. | 405. | 95 | 1340. | 535. | 96 | 1411. | 625. |
| | 97 | 1563. | 733. | 98 | 1637. | 863. | 99 | 1695. | 938. |
| | 100 | 1875. | 1135. | 101 | 1933. | 1192. | 102 | 1979. | 1250. |
| | 103 | 2138. | 1375. | 104 | 2231. | 1519. | 105 | 2206. | 1563. |
| | 106 | 2519. | 1812. | 107 | 2532. | 1843. | 108 | 2556. | 1875. |
| | 109 | 2813. | 2161. | 110 | 2825. | 2175. | 111 | 2835. | 2188. |
| | 112 | 2938. | 2313. | 113 | 3096. | 2500. | 114 | 3110. | 2515. |

C O N T O U R - GCN2 (CONT.)

GCN 2 EXISTING TRAFFIC
AIRPORT - GCN
LEVEL = 65.0 DB AREA = .52 METRIC = LDN

| ISLAND | PNT | X | Y | PNT | X | Y | PNT | X | Y |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 115 | 3125. | 2536. | 116 | 3285. | 2736. | 117 | 3349. | 2813. |
| | 118 | 3377. | 2843. | 119 | 3394. | 2856. | 120 | 3438. | 2921. |
| | 121 | 3614. | 3125. | 122 | 3639. | 3186. | 123 | 3750. | 3270. |
| | 124 | 3889. | 3438. | 125 | 3978. | 3522. | 126 | 4000. | 3562. |
| | 127 | 4103. | 3656. | 128 | 4129. | 3750. | 129 | 4219. | 3872. |
| | 130 | 4234. | 3891. | 131 | 4243. | 3906. | 132 | 4299. | 3987. |
| | 133 | 4354. | 4063. | 134 | 4364. | 4074. | 135 | 4375. | 4092. |
| | 136 | 4448. | 4182. | 137 | 4510. | 4240. | 138 | 4553. | 4332. |
| | 139 | 4579. | 4375. | 140 | 4629. | 4433. | 141 | 4688. | 4511. |
| | 142 | 4706. | 4531. | 143 | 4774. | 4601. | 144 | 4839. | 4688. |
| | 145 | 4844. | 4673. | 146 | 4919. | 4768. | 147 | 4979. | 4844. |
| | 148 | 5000. | 4866. | 149 | 5079. | 4921. | 150 | 5129. | 5000. |
| | 151 | 5156. | 5027. | 152 | 5225. | 5067. | 153 | 5286. | 5156. |
| | 154 | 5313. | 5193. | 155 | 5381. | 5244. | 156 | 5440. | 5313. |
| | 157 | 5469. | 5341. | 158 | 5538. | 5399. | 159 | 5604. | 5469. |
| | 160 | 5625. | 5488. | 161 | 5711. | 5539. | 162 | 5772. | 5625. |
| | 163 | 5781. | 5634. | 164 | 5860. | 5703. | 165 | 5930. | 5781. |
| | 166 | 5938. | 5788. | 167 | 6018. | 5857. | 168 | 6091. | 5938. |
| | 169 | 6094. | 5940. | 170 | 6178. | 6010. | 171 | 6250. | 6087. |
| | 172 | 6256. | 6091. | 173 | 6353. | 6147. | 174 | 6455. | 6250. |
| | 175 | 6563. | 6380. | 176 | 6644. | 6481. | 177 | 6690. | 6563. |
| | 178 | 6729. | 6729. | 179 | 6771. | 6875. | 180 | 6719. | 6936. |
| | 181 | 6679. | 6992. | 182 | 6575. | 7031. | 183 | 6563. | 7037. |
| | 184 | 6457. | 7082. | 185 | 6406. | 7163. | 186 | 6394. | 7188. |
| | 187 | 6406. | 7206. | 188 | 6468. | 7282. | 189 | 6499. | 7344. |
| | 190 | 6563. | 7430. | 191 | 6594. | 7468. | 192 | 6615. | 7500. |
| | 193 | 6719. | 7634. | 194 | 6729. | 7646. | 195 | 6736. | 7656. |
| | 196 | 6803. | 7740. | 197 | 6850. | 7813. | 198 | 6875. | 7847. |
| | 199 | 6922. | 7915. | 200 | 6884. | 8116. | 201 | 7043. | 8101. |
| | 202 | 7068. | 8125. | 203 | 7177. | 8271. | 204 | 7149. | 8361. |
| | 205 | 7031. | 8186. | 206 | 7016. | 8155. | 207 | 7003. | 8154. |
| | 208 | 6875. | 8136. | 209 | 6870. | 8130. | 210 | 6865. | 8125. |
| | 211 | 6719. | 7935. | 212 | 6682. | 7886. | 213 | 6661. | 7871. |
| | 214 | 6563. | 7823. | 215 | 6559. | 7816. | 216 | 6556. | 7813. |
| | 217 | 6406. | 7657. | 218 | 6406. | 7657. | 219 | 6405. | 7656. |
| | 220 | 6375. | 7625. | 221 | 6254. | 7500. | 222 | 6255. | 7495. |
| | 223 | 6250. | 7496. | 224 | 6226. | 7476. | 225 | 6094. | 7367. |
| | 226 | [illegible] | 7530. | 227 | 5938. | 7616. | 228 | 5875. | 7688. |

C O N T O U R - GCN2 (CONT.)

GCN 2 EXISTING TRAFFIC
AIRPORT - GCN
LEVEL = 65.0 DB AREA = .52 METRIC = LDN

| ISLAND | PNT | X | Y | PNT | X | Y | PNT | X | Y |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 229 | 5791. | 7656. | 230 | 5025. | 7693. | 231 | 5496. | 7629. |
| | 232 | 5439. | 7560. | 233 | 5392. | 7500. | 234 | 5353. | 7460. |
| | 235 | 5313. | 7422. | 236 | 5234. | 7344. | 237 | 5197. | 7303. |
| | 238 | 5156. | 7222. | 239 | 5136. | 7188. | 240 | 5078. | 7110. |
| | 241 | 5132. | 7031. | 242 | 5000. | 6985. | 243 | 4947. | 6928. |
| | 244 | 4922. | 6875. | 245 | 4844. | 6764. | 246 | 4824. | 6739. |
| | 247 | 4811. | 6719. | 248 | 4730. | 6605. | 249 | 4698. | 6563. |
| | 250 | 4673. | 6557. | 251 | 4688. | 6547. | 252 | 4589. | 6406. |
| | 253 | 4554. | 6373. | 254 | 4531. | 6318. | 255 | 4483. | 6250. |
| | 256 | 4435. | 6190. | 257 | 4375. | 6100. | 258 | 4367. | 6090. |
| | 259 | 4244. | 5938. | 260 | 4186. | 5876. | 261 | 4152. | 5848. |
| | 262 | 4132. | 5794. | 263 | 4063. | 5686. | 264 | 4016. | 5625. |
| | 265 | 3906. | 5491. | 266 | 3895. | 5480. | 267 | 3887. | 5469. |
| | 268 | 3773. | 5336. | 269 | 3753. | 5313. | 270 | 3751. | 5311. |
| | 271 | 3750. | 5309. | 272 | 3642. | 5210. | 273 | 3579. | 5171. |
| | 274 | 3542. | 5104. | 275 | 3450. | 5000. | 276 | 3443. | 4994. |
| | 277 | 3438. | 4968. | 278 | 3285. | 4844. | 279 | 3283. | 4842. |
| | 280 | 3281. | 4839. | 281 | 3127. | 4688. | 282 | 3126. | 4686. |
| | 283 | 3125. | 4685. | 284 | 3013. | 4587. | 285 | 2957. | 4543. |
| | 286 | 2916. | 4481. | 287 | 2827. | 4375. | 288 | 2820. | 4367. |
| | 289 | 2813. | 4358. | 290 | 2691. | 4219. | 291 | 2675. | 4200. |
| | 292 | 2656. | 4176. | 293 | 2562. | 4063. | 294 | 2533. | 4029. |
| | 295 | 2500. | 3932. | | | | | | |

C O N T O U R - GCN2

GCN 2 EXISTING TRAFFIC
AIRPORT - GCN
LEVEL = 70.0 DB AREA = .27 METRIC = LDN

| ISLAND | PNT | X | Y | PNT | X | Y | PNT | X | Y |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1250. | 1903. | 2 | 1222. | 1875. | 3 | 1066. | 1765. |
| | 4 | 933. | 1721. | 5 | 865. | 1695. | 6 | 1016. | 1484. |
| | 7 | 771. | 1681. | 8 | 798. | 1529. | 9 | 753. | 1362. |
| | 10 | 695. | 1250. | 11 | 653. | 1222. | 12 | 625. | 1177. |
| | 13 | 548. | 1091. | 14 | 505. | 1057. | 15 | 469. | 997. |
| | 16 | 418. | 938. | 17 | 358. | 892. | 18 | 313. | 819. |
| | 19 | 278. | 781. | 20 | 206. | 731. | 21 | 156. | 658. |
| | 22 | 125. | 625. | 23 | 50. | 575. | 24 | 0. | 502. |
| | 25 | -32. | 469. | 26 | -107. | 419. | 27 | -156. | 337. |
| | 28 | -178. | 313. | 29 | -250. | 250. | 30 | -294. | 156. |
| | 31 | -313. | 123. | 32 | -370. | 58. | 33 | -387. | 0. |
| | 34 | -359. | -47. | 35 | -313. | -51. | 36 | -253. | -59. |
| | 37 | -156. | -113. | 38 | -143. | -143. | 39 | -113. | -156. |
| | 40 | -57. | -256. | 41 | -46. | -313. | 42 | -41. | -353. |
| | 43 | 0. | -384. | 44 | 60. | -373. | 45 | 156. | -317. |
| | 46 | 161. | -313. | 47 | 242. | -242. | 48 | 308. | -156. |
| | 49 | 313. | -152. | 50 | 397. | -84. | 51 | 442. | 0. |
| | 52 | 469. | 39. | 53 | 528. | 97. | 54 | 561. | 156. |
| | 55 | 625. | 251. | 56 | 656. | 282. | 57 | 674. | 313. |
| | 58 | 781. | 464. | 59 | 784. | 466. | 60 | 786. | 469. |
| | 61 | 811. | 498. | 62 | 923. | 625. | 63 | 931. | 631. |
| | 64 | 938. | 641. | 65 | 1059. | 781. | 66 | 1076. | 799. |
| | 67 | 1034. | 830. | 68 | 1185. | 938. | 69 | 1219. | 969. |
| | 70 | 1250. | 1022. | 71 | 1306. | 1066. | 72 | 1394. | 1106. |
| | 73 | 1425. | 1213. | 74 | 1450. | 1250. | 75 | 1511. | 1301. |
| | 76 | 1563. | 1380. | 77 | 1587. | 1406. | 78 | 1660. | 1465. |
| | 79 | 1719. | 1552. | 80 | 1729. | 1563. | 81 | 1810. | 1627. |
| | 82 | 1875. | 1717. | 83 | 1876. | 1718. | 84 | 1977. | 1773. |
| | 85 | 2034. | 1859. | 86 | 2038. | 1975. | 87 | 2120. | 1942. |
| | 88 | 2108. | 2028. | 89 | 2191. | 2031. | 90 | 2273. | 2102. |
| | 91 | 2344. | 2185. | 92 | 2347. | 2188. | 93 | 2427. | 2260. |
| | 94 | 2498. | 2344. | 95 | 2500. | 2346. | 96 | 2590. | 2410. |
| | 97 | 2646. | 2500. | 98 | 2656. | 2511. | 99 | 2731. | 2582. |
| | 100 | 2788. | 2656. | 101 | 2813. | 2683. | 102 | 2877. | 2748. |
| | 103 | 2923. | 2813. | 104 | 2969. | 2868. | 105 | 3018. | 2920. |
| | 106 | 3051. | 2969. | 107 | 3125. | 3065. | 108 | 3158. | 3092. |
| | 109 | 3130. | 3125. | 110 | 3438. | 3397. | 111 | 3460. | 3415. |
| | 112 | 3476. | 3438. | 113 | 3750. | 3726. | 114 | 3763. | 3737. |

C O N T O U R - GCN2 (CONT.)

GCN 2 EXISTING TRAFFIC
AIRPORT - GCN
LEVEL = 70.0 DB AREA = .27 METRIC = LDN

| ISLAND | PNT | X | Y | PNT | X | Y | PNT | X | Y |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 115 | 3769. | 3750. | 116 | 3860. | 3866. | 117 | 3900. | 3906. |
| | 118 | 3903. | 3909. | 119 | 3906. | 3913. | 120 | 4031. | 4063. |
| | 121 | 4047. | 4078. | 122 | 4063. | 4100. | 123 | 4158. | 4219. |
| | 124 | 4189. | 4249. | 125 | 4219. | 4295. | 126 | 4280. | 4375. |
| | 127 | 4330. | 4420. | 128 | 4375. | 4491. | 129 | 4407. | 4531. |
| | 130 | 4465. | 4598. | 131 | 4529. | 4688. | 132 | 4531. | 4691. |
| | 133 | 4609. | 4766. | 134 | 4665. | 4844. | 135 | 4688. | 4868. |
| | 136 | 4757. | 4931. | 137 | 4811. | 5000. | 138 | 4844. | 5035. |
| | 139 | 4908. | 5092. | 140 | 4960. | 5156. | 141 | 5000. | 5198. |
| | 142 | 5062. | 5251. | 143 | 5113. | 5313. | 144 | 5156. | 5357. |
| | 145 | 5216. | 5409. | 146 | 5267. | 5469. | 147 | 5313. | 5511. |
| | 148 | 5370. | 5561. | 149 | 5435. | 5625. | 150 | 5469. | 5658. |
| | 151 | 5536. | 5714. | 152 | 5591. | 5781. | 153 | 5625. | 5818. |
| | 154 | 5689. | 5874. | 155 | 5743. | 5938. | 156 | 5781. | 5975. |
| | 157 | 5847. | 6028. | 158 | 5905. | 6094. | 159 | 5938. | 6124. |
| | 160 | 6008. | 6179. | 161 | 6071. | 6250. | 162 | 6094. | 6272. |
| | 163 | 6168. | 6332. | 164 | 6235. | 6406. | 165 | 6250. | 6426. |
| | 166 | 6362. | 6563. | 167 | 6435. | 6626. | 168 | 6446. | 6679. |
| | 169 | 6457. | 6773. | 170 | 6485. | 6875. | 171 | 6406. | 6921. |
| | 172 | 6342. | 6967. | 173 | 6250. | 6977. | 174 | 6116. | 7009. |
| | 175 | 6194. | 7017. | 176 | 6068. | 7006. | 177 | 6047. | 7031. |
| | 178 | 6023. | 7102. | 179 | 5990. | 7188. | 180 | 5968. | 7218. |
| | 181 | 5938. | 7203. | 182 | 5881. | 7344. | 183 | 5840. | 7402. |
| | 184 | 5781. | 7443. | 185 | 5705. | 7420. | 186 | 5625. | 7371. |
| | 187 | 5597. | 7344. | 188 | 5532. | 7281. | 189 | 5469. | 7212. |
| | 190 | 5445. | 7188. | 191 | 5380. | 7120. | 192 | 5327. | 7031. |
| | 193 | 5313. | 7011. | 194 | 5251. | 6936. | 195 | 5216. | 6875. |
| | 196 | 5156. | 6785. | 197 | 5126. | 6749. | 198 | 5108. | 6719. |
| | 199 | 5004. | 6567. | 200 | 5001. | 6563. | 201 | 5001. | 6562. |
| | 202 | 5000. | 6561. | 203 | 4881. | 6406. | 204 | 4863. | 6387. |
| | 205 | 4844. | 6359. | 206 | 4763. | 6250. | 207 | 4728. | 6209. |
| | 208 | 4688. | 6140. | 209 | 4655. | 6094. | 210 | 4601. | 6024. |
| | 211 | 4515. | 5938. | 212 | 4531. | 5919. | 213 | 4467. | 5846. |
| | 214 | 4426. | 5781. | 215 | 4375. | 5712. | 216 | 4327. | 5673. |
| | 217 | 4338. | 5625. | 218 | 4219. | 5507. | 219 | 4200. | 5488. |
| | 220 | 4188. | 5469. | 221 | 4076. | 5326. | 222 | 4065. | 5313. |
| | 223 | 4159. | 5311. | 224 | 4063. | 5309. | 225 | 3927. | 5156. |
| | 226 | 3916. | 5147. | 227 | 3906. | 5133. | 228 | 3779. | 5000. |

C O N T O U R - GCN2 (CONT.)

GCN 2 EXISTING TRAFFIC
AIRPORT - GCN
LEVEL = 70.0 DB AREA = .27 METRIC = LDN

| ISLAND | PNT | X | Y | PNT | X | Y | PNT | X | Y |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 229 | 3763. | 4937. | 230 | 3750. | 4968. | 231 | 3634. | 4844. |
| | 232 | 3613. | 4825. | 233 | 3594. | 4798. | 234 | 3489. | 4688. |
| | 235 | 3403. | 4662. | 236 | 3438. | 4628. | 237 | 3349. | 4531. |
| | 238 | 3315. | 4498. | 239 | 3281. | 4453. | 240 | 3211. | 4375. |
| | 241 | 3168. | 4332. | 242 | 3125. | 4274. | 243 | 3076. | 4219. |
| | 244 | 3023.. | 4164. | 245 | 2969. | 4079. | 246 | 2955. | 4063. |
| | 247 | 2870. | 3985. | 248 | 2840. | 3906. | 249 | 2813. | 3866. |
| | 250 | 2760. | 3802. | 251 | 2727. | 3750. | 252 | 2656. | 3660. |
| | 253 | 2623. | 3627. | 254 | 2598. | 3594. | 255 | 2500. | 3488. |
| | 256 | 2449. | 3438. | 257 | 2351. | 3356. | 258 | 2303. | 3322. |
| | 259 | 2275. | 3262. | 260 | 2188. | 3134. | 261 | 2180. | 3125. |
| | 262 | 2152. | 3070. | 263 | 2053. | 2969. | 264 | 2043. | 2957. |
| | 265 | 2031. | 2939. | 266 | 1931. | 2813. | 267 | 1904. | 2783. |
| | 268 | 1875. | 2737. | 269 | 1824. | 2682. | 270 | 1755. | 2620. |
| | 271 | 1709. | 2519. | 272 | 1697. | 2500. | 273 | 1633. | 2429. |
| | 274 | 1579. | 2344. | 275 | 1563. | 2320. | 276 | 1501. | 2249. |
| | 277 | 1463. | 2188. | 278 | 1406. | 2106. | 279 | 1371. | 2067. |
| | 280 | 1349. | 2031. | 281 | 1250. | 1903. | | | |

C O N T O U R - GCN2

GCN 2 EXISTING TRAFFIC
AIRPORT - GCN
LEVEL = 75.0 DB AREA = .13 METRIC = LDN

| ISLAND | PNT | X | Y | PNT | X | Y | PNT | X | Y |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1250. | 1603. | 2 | 1201. | 1587. | 3 | 1073. | 1539. |
| | 4 | 1250. | 1292. | 5 | 1355. | 1406. | 6 | 1298. | 1515. |
| | 7 | 1406. | 1430. | 8 | 1482. | 1563. | 9 | 1473. | 1652. |
| | 10 | 1503. | 1672. | 11 | 1606. | 1719. | 12 | 1646. | 1791. |
| | 13 | 1719. | 1805. | 14 | 1728. | 1875. | 15 | 1819. | 1931. |
| | 16 | 1868. | 2031. | 17 | 1875. | 2035. | 18 | 1999. | 2064. |
| | 19 | 2023. | 2138. | 20 | 2031. | 2201. | 21 | 2135. | 2240. |
| | 22 | 2171. | 2344. | 23 | 2188. | 2371. | 24 | 2270. | 2418. |
| | 25 | 2317. | 2500. | 26 | 2344. | 2532. | 27 | 2417. | 2583. |
| | 28 | 2471. | 2656. | 29 | 2500. | 2688. | 30 | 2567. | 2745. |
| | 31 | 2624. | 2813. | 32 | 2656. | 2848. | 33 | 2716. | 2909. |
| | 34 | 2766. | 2969. | 35 | 2813. | 3018. | 36 | 2865. | 3072. |
| | 37 | 2904. | 3125. | 38 | 2969. | 3200. | 39 | 3009. | 3241. |
| | 40 | 3035. | 3281. | 41 | 3125. | 3391. | 42 | 3175. | 3438. |
| | 43 | 3317. | 3438. | 44 | 3272. | 3603. | 45 | 3371. | 3570. |
| | 46 | 3438. | 3683. | 47 | 3497. | 3750. | 48 | 3594. | 3857. |
| | 49 | 3620. | 3880. | 50 | 3638. | 3906. | 51 | 3750. | 4034. |
| | 52 | 3765. | 4048. | 53 | 3775. | 4063. | 54 | 3906. | 4213. |
| | 55 | 3909. | 4216. | 56 | 3911. | 4219. | 57 | 3946. | 4259. |
| | 58 | 4049. | 4375. | 59 | 4063. | 4389. | 60 | 4193. | 4531. |
| | 61 | 4209. | 4531. | 62 | 4219. | 4564. | 63 | 4310. | 4688. |
| | 64 | 4348. | 4714. | 65 | 4375. | 4762. | 66 | 4448. | 4844. |
| | 67 | 4495. | 4880. | 68 | 4531. | 4934. | 69 | 4593. | 5000. |
| | 70 | 4634. | 5043. | 71 | 4688. | 5101. | 72 | 4740. | 5156. |
| | 73 | 4779. | 5205. | 74 | 4844. | 5268. | 75 | 4887. | 5313. |
| | 76 | 4945. | 5367. | 77 | 5000. | 5435. | 78 | 5033. | 5469. |
| | 79 | 5198. | 5527. | 80 | 5156. | 5589. | 81 | 5194. | 5625. |
| | 82 | 5257. | 5681. | 83 | 5313. | 5746. | 84 | 5348. | 5781. |
| | 85 | 5410. | 5840. | 86 | 5469. | 5920. | 87 | 5485. | 5938. |
| | 88 | 5505. | 5998. | 89 | 5625. | 6074. | 90 | 5645. | 6094. |
| | 91 | 5724. | 6151. | 92 | 5781. | 6221. | 93 | 5812. | 6250. |
| | 94 | 5824. | 6303. | 95 | 5938. | 6368. | 96 | 5976. | 6406. |
| | 97 | 6041. | 6459. | 98 | 6094. | 6535. | 99 | 6117. | 6563. |
| | 100 | 6170. | 6602. | 101 | 6243. | 6719. | 102 | 6250. | 6760. |
| | 103 | 6270. | 6755. | 104 | 6273. | 6875. | 105 | 6260. | 6885. |
| | 106 | 6250. | 6886. | 107 | 6236. | 6889. | 108 | 6094. | 6942. |
| | 109 | 5916. | 6875. | 110 | 5938. | 6871. | 111 | 5934. | 6871. |
| | 112 | 5930. | 6875. | 113 | 5904. | 6998. | 114 | 5896. | 7104. |

C O N T O U R - GCN2 (CONT.)

GCN 2 EXISTING TRAFFIC
AIRPORT - GCN
LEVEL = 75.0 DB AREA = .13 METRIC = LDN

| ISLAND | PNT | X | Y | PNT | X | Y | PNT | X | Y |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 115 | 5816. | 7168. | 116 | 5781. | 7231. | 117 | 5723. | 7188. |
| | 118 | 5649. | 7140. | 119 | 5625. | 7097. | 120 | 5563. | 7031. |
| | 121 | 5511. | 6939. | 122 | 5469. | 6920. | 123 | 5435. | 6875. |
| | 124 | 5377. | 6811. | 125 | 5325. | 6719. | 126 | 5313. | 6700. |
| | 127 | 5250. | 6625. | 128 | 5215. | 6563. | 129 | 5156. | 6475. |
| | 130 | 5124. | 6438. | 131 | 5105. | 6406. | 132 | 5000. | 6262. |
| | 133 | 4994. | 6256. | 134 | 4991. | 6250. | 135 | 4957. | 6207. |
| | 136 | 4864. | 6094. | 137 | 4853. | 6084. | 138 | 4844. | 6069. |
| | 139 | 4747. | 5938. | 140 | 4722. | 5903. | 141 | 4688. | 5851. |
| | 142 | 4632. | 5781. | 143 | 4585. | 5728. | 144 | 4531. | 5646. |
| | 145 | 4514. | 5625. | 146 | 4447. | 5553. | 147 | 4393. | 5469. |
| | 148 | 4375. | 5445. | 149 | 4310. | 5377. | 150 | 4268. | 5313. |
| | 151 | 4219. | 5250. | 152 | 4172. | 5203. | 153 | 4142. | 5156. |
| | 154 | 4063. | 5057. | 155 | 4033. | 5030. | 156 | 4011. | 5000. |
| | 157 | 3906. | 4906. | 158 | 3877. | 4873. | 159 | 3858. | 4844. |
| | 160 | 3750. | 4706. | 161 | 3740. | 4697. | 162 | 3734. | 4688. |
| | 163 | 3606. | 4633. | 164 | 3606. | 4531. | 165 | 3597. | 4528. |
| | 166 | 3594. | 4515. | 167 | 3476. | 4375. | 168 | 3451. | 4361. |
| | 169 | 3438. | 4338. | 170 | 3344. | 4219. | 171 | 3306. | 4194. |
| | 172 | 3281. | 4144. | 173 | 3212. | 4063. | 174 | 3125. | 3941. |
| | 175 | 3099. | 3906. | 176 | 3034. | 3841. | 177 | 2984. | 3750. |
| | 178 | 2969. | 3725. | 179 | 2908. | 3655. | 180 | 2870. | 3594. |
| | 181 | 2813. | 3525. | 182 | 2767. | 3483. | 183 | 2733. | 3438. |
| | 184 | 2656. | 3343. | 185 | 2625. | 3312. | 186 | 2602. | 3281. |
| | 187 | 2500. | 3154. | 188 | 2483. | 3142. | 189 | 2475. | 3125. |
| | 190 | 2376. | 3001. | 191 | 2348. | 2969. | 192 | 2351. | 2961. |
| | 193 | 2344. | 2962. | 194 | 2231. | 2813. | 195 | 2229. | 2771. |
| | 196 | 2188. | 2747. | 197 | 2120. | 2656. | 198 | 2084. | 2603. |
| | 199 | 2051. | 2528. | 200 | 2010. | 2500. | 201 | 1920. | 2455. |
| | 202 | 1883. | 2344. | 203 | 1875. | 2339. | 204 | 1753. | 2310. |
| | 205 | 1730. | 2168. | 206 | 1719. | 2166. | 207 | 1627. | 2123. |
| | 208 | 1609. | 2031. | 209 | 1563. | 1977. | 210 | 1496. | 1941. |
| | 211 | 1470. | 1875. | 212 | 1406. | 1791. | 213 | 1303. | 1762. |
| | 214 | 1342. | 1719. | 215 | 1250. | 1603. | | | |
| 2 | 1 | 0. | 282. | 2 | -106. | 156. | 3 | -145. | 145. |
| | 4 | -156. | 77. | 5 | -210. | 0. | 6 | -156. | -30. |
| | 7 | -118. | -114. | 8 | -28. | -156. | 9 | 0. | -206. |

C O N T O U R - GCN2 (CONT.)

GCN 2 EXISTING TRAFFIC
AIRPORT = GCN
LEVEL = 75.0 DB AREA = .13 METRIC = LDN

| ISLAND | PNT | X | Y | PNT | X | Y | PNT | X | Y |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 10 | 68. | -156. | 11 | 143. | -143. | 12 | 156. | -88. |
| | 13 | 245. | 0. | 14 | 289. | 23. | 15 | 313. | 97. |
| | 16 | 357. | 156. | 17 | 423. | 202. | 18 | 465. | 313. |
| | 19 | 469. | 319. | 20 | 553. | 384. | 21 | 591. | 469. |
| | 22 | 625. | 520. | 23 | 682. | 568. | 24 | 711. | 625. |
| | 25 | 781. | 727. | 26 | 811. | 751. | 27 | 830. | 781. |
| | 28 | 938. | 927. | 29 | 943. | 932. | 30 | 946. | 938. |
| | 31 | 968. | 968. | 32 | 1087. | 1094. | 33 | 938. | 1247. |
| | 34 | 784. | 1000. | 35 | 880. | 995. | 36 | 781. | 1087. |
| | 37 | 643. | 938. | 38 | 694. | 868. | 39 | 625. | 914. |
| | 40 | 497. | 781. | 41 | 515. | 735. | 42 | 469. | 747. |
| | 43 | 347. | 625. | 44 | 344. | 594. | 45 | 313. | 587. |
| | 46 | 190. | 469. | 47 | 175. | 450. | 48 | 156. | 434. |
| | 49 | 30. | 313. | 50 | 11. | 302. | 51 | 0. | 282. |
| 3 | 1 | 897. | 1512. | 2 | 944. | 1250. | 3 | 1094. | 1109. |
| | 4 | 1224. | 1250. | 5 | 897. | 1512. | | | |

```
17.32.16.INM3,CM250000,P30,STCX3,T1000,IO500.
17.32.17.USER(C1828,)
17.32.17.*
17.32.17.* GCN2 IS INPUT DATA FILE ON CX1
17.32.17.CFT,ST=CX1.
17.32.17.CFT,GET,SYSIN=GCN2.
17.32.17.$BEGIN,MFLPRC,ZZZZMFL.
17.32.18.$MFLINK,ST=CX1,I=ZZZZINP.
17.32.20.  PTFS  - USER,C1828,.
17.32.21.$MFLINK,SYSIN,I=ZZZZINP.
17.32.21.  PTFS  - GET,GCN2.
17.32.23.  PTFS  - PF REQUEST COMPLETE.
17.32.25. PTF - TERMINATING CONNECTION.
17.32.25.$RETURN,ZZZZINP,ZZZZMFL.
17.32.25.$REVERT.CFT.
17.32.25.SYSCALL,INM7PGM=NOEL.
17.32.26.*INM
17.32.26.*****************************************  *COMPUTER
17.32.26.*INM            31 MAY 85
17.32.26. SCIENCES
17.32.26.*INTEGRATED NOISE MODEL - VERSION 3
17.32.26.* USE NOTES OPTION FOR LISTING OF PROC  * NOTES
17.32.26.$IF(NUM(O))$GOTO(IC)
17.32.26.GOTO(IC)
17.32.26.IC,*
        .NOEXIT.
        .$IF(LF.GT.8)$GOTO(LEF)
        .$IF(FILE(SYSIN,AS))GOTO(ICN)
        .GOTO(ICN)
```

INTEGRATED NOISE MODEL - ECHO REPORT

PAGE 1

S E T U P

REPORT 1

| | | | |
|---|---|---|---|
| TITLE | GCN 3 EXISTING HELICOPTER TRAFFIC | | |
| AIRPORT | GCN | | |
| ALTITUDE | 6590. FT. | | |
| TEMPERATURE | 539.7 R | 80.0 F | 26.7 C |

NOISE METRICS

EQUIVALENT SOUND LEVEL (LEQ) - THE 24 HOUR AVERAGE OF AN ENERGY SUMMATION OF INTEGRATED A-WEIGHTED LEVELS.
DAY-NIGHT AVERAGE SOUND LEVEL (LDN) - BASED UPON LEQ, WITH NIGHTTIME OPERATIONS WEIGHTED BY A 10 DECIBEL PENALTY.
NOISE EXPOSURE FORECAST (NEF) - THE 24 HOUR AVERAGE OF AN ENERGY SUMMATION OF EFFECTIVE PERCEIVED NOISE LEVELS.
TIME ABOVE A SPECIFIED THRESHOLD OF A-WEIGHTED SOUND (TA) - MINUTES THAT A DBA LEVEL IS EXCEEDED IN 24 HOURS.

R U N W A Y S

| NAME | HEADING | UNITS | STARTING COORDINATES X | STARTING COORDINATES Y | ENDING COORDINATES X | ENDING COORDINATES Y | RUNWAY LENGTH |
|---|---|---|---|---|---|---|---|
| 03 | 27 | FT | 8993. | 10467. | 9030. | 10516. | 65. |
| | | M | 2741. | 3190. | 2754. | 3205. | 20. |
| | | NMI | 1.480 | 1.723 | 1.487 | 1.731 | .011 |
| 21 | 207 | FT | 9030. | 10516. | 8993. | 10467. | 65. |
| | | M | 2754. | 3205. | 2741. | 3190. | 20. |
| | | NMI | 1.487 | 1.731 | 1.480 | 1.723 | .011 |

INTEGRATED NOISE MODEL - LOCAL REPORT

PAGE 3

REPORT 3

A I R C R A F T

| NAME | CATEGORY | NOISE CURVE NAME | APPROACH PARAMETER NAME | TAKE OFF PROFILE NAMES STAGE1 | STAGE2 | STAGE3 | STAGE4 | STAGE5 | STAGE6 | STAGE7 |
|---|---|---|---|---|---|---|---|---|---|---|
| H-500 | PGA | H500 | HELIH | HUGHTO | | | | | | |

N O I S E   C U R V E - H507

| | DISTANCE (FT) | | THRUST SETTINGS 1.00 | 2.00 |
|---|---|---|---|---|
| E P N L | 200. | - | 87.30 | 93.20 |
| | 400. | - | 83.20 | 89.10 |
| | 600. | - | 80.70 | 86.50 |
| | 1000. | - | 77.40 | 83.20 |
| | 2000. | - | 72.50 | 78.20 |
| | 4000. | - | 67.80 | 72.40 |
| | 6000. | - | 63.70 | 68.30 |
| | 10000. | - | 58.40 | 62.40 |

| | DISTANCE (FT) | | THRUST SETTINGS 1.00 | 2.00 |
|---|---|---|---|---|
| S E L | 200. | - | 87.30 | 93.20 |
| | 400. | - | 83.20 | 89.10 |
| | 600. | - | 80.70 | 86.50 |
| | 1000. | - | 77.40 | 83.20 |
| | 2000. | - | 72.50 | 78.20 |
| | 4000. | - | 67.80 | 72.40 |
| | 6000. | - | 63.70 | 68.30 |
| | 10000. | - | 58.40 | 62.40 |

INTEGRATED NOISE MODEL - ECHO REPORT



## A P P R O A C H   P A R A M E T E R S

REPORT 5

| NAME | WEIGHT | ENGINES | STOPPING DISTANCE FT | M | NMI | SPEEDS TAXI | FINAL | TERMINAL | THRUST SETTINGS NO. | NAME | VALUE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HLLIH | 2550. | 1.0 | -1. | -0. | -.000 | 50.00 | 50.00 | 50.00 | 1 | LFVAPP | 2.0 |
| | | | | | | | | | 2 | 3DLND | 2.0 |

## TAKEOFF PROFILES

REPORT 7

| NAME | ENGINES | WEIGHT | SEGMENT | DISTANCE FROM RUNWAY END FT | M | NMI | ALTITUDE(FT) | SPEED(KTS) | THRUST |
|---|---|---|---|---|---|---|---|---|---|
| HUGHTO | 1 | 2550. | 1 | 0.00 | 0.00 | 0.00000 | 0.00 | 50.00 | 1.00 |
| | | | 2 | 65.00 | 19.81 | .01070 | 0.00 | 50.00 | 1.00 |
| | | | 3 | 405.00 | 123.44 | .06665 | 100.00 | 50.00 | 1.00 |
| | | | 4 | 745.00 | 227.08 | .12261 | 200.00 | 50.00 | 1.00 |
| | | | 5 | 1085.00 | 330.71 | .17857 | 300.00 | 50.00 | 1.00 |
| | | | 6 | 10000.00 | 3048.01 | 1.64579 | 300.00 | 50.00 | 0.00 |

## T A K E O F F - T R A C K S

| TRACK | RUNWAY | INITIAL HEADING | SEGMENT | DIRECTION | LENGTH (NMI) | TURN ANGLE (DEG) | RESULTANT HEADING (DEG) | TURN RADIUS (NMI) |
|---|---|---|---|---|---|---|---|---|
| TR32 | 21 | 207 | 1 | STRAIGHT | .10 | | 207 | |
| | | | 2 | LEFT | | 90 | 117 | .10 |
| | | | 3 | STRAIGHT | .10 | | 117 | |
| | | | 4 | LEFT | | 90 | 27 | .10 |
| | | | 5 | STRAIGHT | 50.00 | | 27 | |
| TR33 | 21 | 207 | 1 | STRAIGHT | .10 | | 207 | |
| | | | 2 | RIGHT | | 90 | 297 | .10 |
| | | | 3 | STRAIGHT | 50.00 | | 297 | |
| TR34 | 03 | 27 | 1 | STRAIGHT | 50.00 | | 27 | |
| TR35 | 03 | 27 | 1 | STRAIGHT | .30 | | 27 | |
| | | | 2 | LEFT | | 90 | 297 | .20 |
| | | | 3 | STRAIGHT | 50.00 | | 297 | |

TAKEOFF - OPERATIONS REPORT 9 - PART B

| TRACK | RUNWAY | AIRCRAFT | CLASS | STAGE | PROFILE | MOD | OPERATIONS DAY | OPERATIONS EVENING | OPERATIONS NIGHT |
|---|---|---|---|---|---|---|---|---|---|
| TR32 | 21 | H-500 | GA | 1 | HUGHTO | 0 | 15.30 | 0.00 | 0.00 |
| TR33 | 21 | H-500 | GA | 1 | HUGHTO | 0 | 15.30 | 0.00 | 0.00 |
| TR34 | 03 | H-500 | GA | 1 | HUGHTO | 0 | 2.70 | 0.00 | 0.00 |
| TR35 | 03 | H-500 | GA | 1 | HUGHTO | 0 | 2.70 | 0.00 | 0.00 |

REPORT 9 - PART C

T A K E O F F - D I S T R I B U T I O N

| | | OPERATIONS DAY | EVENING | NIGHT |
|---|---|---|---|---|
| COMMERCIAL | - | 0.0 | 0.0 | 0.0 |
| GENERAL AVIATION | - | 36.0 | 0.0 | 0.0 |
| MILITARY | - | 0.0 | 0.0 | 0.0 |

P R O P O R T I O N S

| TRACK | RUNWAY | COMMERCIAL DAY | COMMERCIAL EVENING | COMMERCIAL NIGHT | GENERAL AVIATION DAY | GENERAL AVIATION EVENING | GENERAL AVIATION NIGHT | MILITARY DAY | MILITARY EVENING | MILITARY NIGHT |
|---|---|---|---|---|---|---|---|---|---|---|
| TR32 | 21 | 0.00 | 0.00 | 0.00 | .43 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TR33 | 21 | 0.00 | 0.00 | 0.00 | .43 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TR34 | 03 | 0.00 | 0.00 | 0.00 | .08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TR35 | 03 | 0.00 | 0.00 | 0.00 | .08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | TOTAL | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## LANDING - TRACKS

| TRACK | RUNWAY | INITIAL HEADING | SEGMENT | DIRECTION | LENGTH (NMI) | TURN ANGLE (DEG) | RESULTANT HEADING (DEG) | TURN RADIUS (NMI) |
|---|---|---|---|---|---|---|---|---|
| TR30 | 03 | 27 | 1 | STRAIGHT | 50.00 | | 27 | |
| TR31 | 03 | 27 | 1 | STRAIGHT | .30 | | 27 | |
| | | | 2 | LEFT | | 90 | 297 | .20 |
| | | | 3 | STRAIGHT | 50.00 | | 297 | |
| TR36 | 21 | 207 | 1 | STRAIGHT | .10 | | 207 | |
| | | | 2 | LEFT | | 90 | 117 | .10 |
| | | | 3 | STRAIGHT | .10 | | 117 | |
| | | | 4 | LEFT | | 90 | 27 | .10 |
| | | | 5 | STRAIGHT | 50.00 | | 27 | |
| TR37 | 21 | 207 | 1 | STRAIGHT | .10 | | 207 | |
| | | | 2 | RIGHT | | 90 | 297 | .10 |
| | | | 3 | STRAIGHT | 50.00 | | 297 | |

L A N D I N G - O P E R A T I O N S

| TRACK | RUNWAY | AIRCRAFT | CLASS | PROFILE | OPERATIONS DAY | OPERATIONS EVENING | OPERATIONS NIGHT |
|---|---|---|---|---|---|---|---|
| TR30 | 03 | H-500 | GA | CUPTR2 | 15.30 | 0.00 | 0.00 |
| TR31 | 03 | H-500 | GA | CUPTR2 | 15.30 | 0.00 | 0.00 |
| TR36 | 21 | H-500 | GA | CUPTR2 | 2.70 | 0.00 | 0.00 |
| TR37 | 21 | H-500 | GA | CUPTR2 | 2.70 | 0.00 | 0.00 |

## L A N D I N G - D I S T R I B U T I O N

REPORT 10 - PART C

| | | O P E R A T I O N S DAY | EVENING | NIGHT |
|---|---|---|---|---|
| COMMERCIAL | - | 0.0 | 0.0 | 0.0 |
| GENERAL AVIATION | - | 36.0 | 0.0 | 0.0 |
| MILITARY | - | 0.0 | 0.0 | 0.0 |

| | | P R O P O R T I O N S | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | COMMERCIAL | | | GENERAL AVIATION | | | MILITARY | | |
| TRACK | RUNWAY | DAY | EVENING | NIGHT | DAY | EVENING | NIGHT | DAY | EVENING | NIGHT |
| TR30 | 03 | 0.00 | 0.00 | 0.00 | .43 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TR31 | 03 | 0.00 | 0.00 | 0.00 | .43 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TR36 | 21 | 0.00 | 0.00 | 0.00 | .08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TR37 | 21 | 0.00 | 0.00 | 0.00 | .08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | TOTAL | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

```
P R O C E S S E S
-----------------

VERIFY

EXECUTE

CONTOUR
    LEVELS =   65.00   70.00
    METRIC LDN
    TOLERANCE = 2.00
    REFINEMENT =  6
    WINDOW =       0.      0.  20000.  20000.
    SAVED AS GCN3
    REPORT
VERIFY MODULE ACCESSED.
```

--------------------------------------------------------------------------------
NO WARNING MESSAGES WERE PRODUCED BY THE FLIGHT OVERLAY MODULE.
--------------------------------------------------------------------------------

NOISE COMPUTATION MODULE SUMMARY

| REFINEMENT LEVEL | NO.OF SQUARES | NO.OF NODES | NO.OF TRIANGLES |
|---|---|---|---|
| 3 | 64 | 289 | |
| 4 | 64 | 220 | |
| 5 | 28 | 98 | |
| 6 | 32 | 112 | |
| | | | 1304 |

RECTANGLE ENVELOPING MAP MOSAIC.
LOW LEFT & UPPER RIGHT CORNERS

```
XMIN=    0.             YMIN=     0.
XMAX=    .200000E+05YMAX=     .200000E+05
```

0 WARNING MESSAGES WERE PRODUCED BY THE COMPUTATION MODULE

```
CN3 *WARNING: LDN  70.00 CONTOUR DOES NOT EXIST

--------------------------------------------------------------------
  1 WARNING MESSAGES WERE PRODUCED BY THE CONTOUR MODULE
--------------------------------------------------------------------
```

C O N T O U R - GCN3

GCN 3 EXISTING HELICOPTER TRAFFIC
AIRPORT - GCN
LEVEL = 65.0 DB AREA = .01 METRIC = LDN

| ISLAND | PNT | X | Y | PNT | X | Y | PNT | X | Y |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 9638. | 11347. | 2 | 9633. | 11305. | 3 | 9539. | 11250. |
| | 4 | 9531. | 11245. | 5 | 9461. | 11164. | 6 | 9385. | 11094. |
| | 7 | 9375. | 11167. | 8 | 9296. | 11016. | 9 | 9237. | 10938. |
| | 10 | 9202. | 10993. | 11 | 9062. | 10742. | 12 | 9002. | 10686. |
| | 13 | 8985. | 10025. | 14 | 8927. | 10489. | 15 | 8952. | 10469. |
| | 16 | 9062. | 10432. | 17 | 9116. | 10469. | 18 | 9155. | 10532. |
| | 19 | 9217. | 10543. | 20 | 9312. | 10625. | 21 | 9375. | 10707. |
| | 22 | 9447. | 10781. | 23 | 9473. | 10839. | 24 | 9531. | 10893. |
| | 25 | 9570. | 10738. | 26 | 9608. | 11017. | 27 | 9688. | 11092. |
| | 28 | 9689. | 11094. | 29 | 9739. | 11199. | 30 | 9793. | 11250. |
| | 31 | 9844. | 11337. | 32 | 9805. | 11385. | 33 | 9890. | 11406. |
| | 34 | 9960. | 11523. | 35 | 9844. | 11495. | 36 | 9816. | 11434. |
| | 37 | 9729. | 11406. | 38 | 9668. | 11387. | | | |
| 2 | 1 | 8930. | 10313. | 2 | 8906. | 10404. | 3 | 8862. | 10313. |
| | 4 | 8906. | 10287. | 5 | 8930. | 10313. | | | |

INTEGRATED NOISE MODEL - CONTOUR ANALYSIS REPORT

C O N T O U R - GCN3
------------- ------

```
GCN 3  EXISTING HELICOPTER TRAFFIC
AIRPORT - GCN
LEVEL =  70.1 DB          AREA =  0.06          METRIC = LDN

12.11.17.INM3,CM250000,P30,STCX3.T1000,IO500.
12.11.17.USER(C1A28,)
12.11.17.*
12.11.17.* GCN3 IS INPUT DATA FILE ON CX1
12.11.17.CFT.ST=CX1.
12.11.17.CFT.GET,SYSIN=GCN3.
12.11.17.$BEGIN,MFLPRC,ZZZZMFL.
12.11.17.$MFLINK,ST=CX1,I=ZZZZINP.
12.11.19.  PTFS  - USER,C1A28,.
12.11.19.$MFLINK,SYSIN,I=ZZZZINP.
12.11.20.  PTFS  - GET,GCN3.
12.11.22.  PTFS  - PF REQUEST COMPLETE.
12.11.24. PTF - TERMINATING CONNECTION.
12.11.24.$RETURN,ZZZZINP,ZZZZMFL.
12.11.24.$REVERT.CFT.
12.11.24.SYSCALL,INM/PGM=MODEL.
12.11.24.*INM
12.11.24.******************************************   *COMPUTER
12.11.24.*INM                31 MAY 83
12.11.24. SCIENCES
12.11.24.*INTEGRATED NOISE MODEL - VERSION 3
12.11.24.* USE NOTES OPTION FOR LISTING OF PROC   * NOTES
12.11.24.$IF(NUM(0))$GOTO(1C)
12.11.26.GOTO(1C)
12.11.26.1C,*
12.11.26.$ONEXIT.
12.11.26.$IF(EF.GT.8)$GOTO(1EF)
12.11.26.$IF(FILE(SYSIN,AS))$GOTO(1CH)
12.11.26.GOTO(1CH)
12.11.26.1CH,*
12.11.26.$IFE,$MODELS.NE.$MODELS,LFE1.
12.11.26.$ENDIF,LFE1.
12.11.26.$REWIND(SYSIN)
12.11.26.$GOTO(IMODEL)
12.11.26.IMODEL,*
12.11.26.*
12.11.26.*        INM(I) - MODEL PROGRAM SPECIFIED
12.11.26.*                 FOR EXECUTION
12.11.27.$FUT DES,SYSIN
12.11.28. NO CTMF(S) SELECTED...
12.11.28. UPDATED WORK FILE  SYSIN.
12.11.28.$REWIND,SYSIN.
12.11.28.(COPYNF,SYSIN,TAPE2.
12.11.28. EOI ENCOUNTERED.
12.11.28.$REWIND,TAPE2.
          ATTACH,INM=INM3B2AM/UN=CELIF,M=R.
          ACCESS,EI=...
          STACK PURGING BIT DESELECTABLE.
          (LI=0... ..)
          INITIATE FEL PROCESSING.
```

S E T U P REPORT 1

| | |
|---|---|
| TITLE | GCN 1 2003 ULTIMATE TRAFFIC |
| AIRPORT | GCN |
| ALTITUDE | 6611. FT. |
| TEMPERATURE | 539.7 R 80.0 F 26.7 C |

NOISE METRICS

EQUIVALENT SOUND LEVEL (LEQ) - THE 24 HOUR AVERAGE OF AN ENERGY SUMMATION OF INTEGRATED A-WEIGHTED LEVELS.
DAY-NIGHT AVERAGE SOUND LEVEL (LDN) - BASED UPON LEQ, WITH NIGHTTIME OPERATIONS WEIGHTED BY A 10 DECIBEL PENALTY.
NOISE EXPOSURE FORECAST (NEF) - THE 24 HOUR AVERAGE OF AN ENERGY SUMMATION OF EFFECTIVE PERCEIVED NOISE LEVELS.
TIME ABOVE A SPECIFIED THRESHOLD OF A-WEIGHTED SOUND (TA) - MINUTES THAT A DBA LEVEL IS EXCEEDED IN 24 HOURS.

## R U N W A Y S

| NAME | HEADING | UNITS | STARTING COORDINATES X | STARTING COORDINATES Y | ENDING COORDINATES X | ENDING COORDINATES Y | RUNWAY LENGTH |
|---|---|---|---|---|---|---|---|
| 03R | 27 | FT | 0. | 0. | 6973. | 8116. | 10700. |
| | | M | 0. | 0. | 2125. | 2474. | 3261. |
| | | NMI | 0.000 | 0.000 | 1.148 | 1.336 | 1.761 |
| 21L | 207 | FT | 6973. | 8116. | 0. | 0. | 10700. |
| | | M | 2125. | 2474. | 0. | 0. | 3261. |
| | | NMI | 1.148 | 1.336 | 0.000 | 0.000 | 1.761 |
| 03L | 27 | FT | -140. | 911. | 5074. | 6979. | 8000. |
| | | M | -43. | 278. | 1547. | 2127. | 2438. |
| | | NMI | -.023 | .150 | .835 | 1.149 | 1.317 |
| 21R | 207 | FT | 5074. | 6979. | -140. | 911. | 8000. |
| | | M | 1547. | 2127. | -43. | 278. | 2438. |
| | | NMI | .835 | 1.149 | -.023 | .150 | 1.317 |
| 02 | 27 | FT | 8026. | 7653. | 8068. | 7702. | 65. |
| | | M | 2446. | 2333. | 2459. | 2348. | 20. |
| | | NMI | 1.321 | 1.260 | 1.328 | 1.268 | .011 |
| 20 | 207 | FT | 8068. | 7702. | 8026. | 7653. | 65. |
| | | M | 2459. | 2348. | 2446. | 2333. | 20. |
| | | NMI | 1.328 | 1.268 | 1.321 | 1.260 | .011 |

A I R C R A F T

| NAME | CATEGORY | NOISE CURVE NAME | APPROACH PARAMETER NAME | TAKEOFF PROFILE NAMES STAGE1 | STAGE2 | STAGE3 | STAGE4 | STAGE5 | STAGE6 | STAGE7 |
|---|---|---|---|---|---|---|---|---|---|---|
| 727Q15 | JCOM | 3JT6D9 | AP22 | TOP125 | TOP126 | TOP127 | TOP128 | TOP129 | | |
| F28 | JCOM | 8P555 | AP29 | TOP153 | TOP154 | | | | | |
| DC909 | JCOM | 2JT8D9 | AP30 | TOP155 | TOP156 | TOP157 | | | | |
| DC960 | JCOM | 2JT6U2 | AP35 | TOP172 | TOP173 | TOP174 | TOP175 | | | |
| COMJET | JGA | CGAJ | AP37 | TOP180 | TOP180 | TOP180 | TOP180 | | | |
| GAMIF | JGA | LF709 | AP40 | TOP183 | TOP183 | TOP183 | TOP183 | | | |
| DHC7 | PCOM | PT650 | AP44 | TOP187 | TOP187 | TOP187 | | | | |
| CV580 | PCOM | 501D13 | AP45 | TOP188 | TOP188 | TOP188 | TOP188 | | | |
| HTETP | PCOM | RDA7 | AP46 | TOP189 | TOP189 | TOP189 | | | | |
| MTETP | PCOM | PT615 | AP47 | TOP190 | TOP190 | TOP190 | | | | |
| DHC6 | PCOM | PT627 | AP48 | TOP191 | TOP191 | | | | | |
| COMTEP | PGA | CGATEP | AP51 | TOP194 | TOP194 | TOP194 | | | | |
| COMSEP | PGA | CGASEP | AP52 | TOP195 | TOP195 | | | | | |
| C130 | PMIL | T56A15 | AP43 | TOP186 | TOP186 | TOP186 | TOP186 | TOP186 | TOP186 | TOP186 |
| 4EP | PCOM | R2800 | AP49 | TOP192 | TOP192 | TOP192 | TOP192 | TOP192 | TOP192 | TOP192 |
| B-206 | PGA | H206 | HELIB | BELLTO | | | | | | |
| H-500 | PGA | H500 | HELIH | HUGHTO | | | | | | |
| A-109 | PGA | H109 | HELIA | AUGTO | | | | | | |

**N O I S E   C U R V E - N200**  REPORT 4

EPNL

| DISTANCE (FT) | - | THRUST SETTINGS 1.00 | 2.00 |
|---|---|---|---|
| 200. | - | 89.20 | 89.30 |
| 400. | - | 84.90 | 85.20 |
| 600. | - | 82.30 | 82.70 |
| 1000. | - | 78.70 | 79.40 |
| 2000. | - | 73.40 | 74.70 |
| 4000. | - | 67.90 | 69.40 |
| 6000. | - | 63.90 | 65.70 |
| 10000. | - | 58.30 | 60.40 |

SEL

| DISTANCE (FT) | - | THRUST SETTINGS 1.00 | 2.00 |
|---|---|---|---|
| 200. | - | 89.20 | 89.30 |
| 400. | - | 84.90 | 85.20 |
| 600. | - | 82.30 | 82.70 |
| 1000. | - | 78.70 | 79.40 |
| 2000. | - | 73.40 | 74.70 |
| 4000. | - | 67.90 | 69.40 |
| 6000. | - | 63.90 | 65.70 |
| 10000. | - | 58.30 | 60.40 |

N O I S E   C U R V E - H50

REPORT 4

| | DISTANCE (FT) | - | THRUST SETTINGS 1.00 | 2.00 |
|---|---|---|---|---|
| E P N L | 200. | - | 87.30 | 93.20 |
| | 400. | - | 83.20 | 89.10 |
| | 600. | - | 80.70 | 86.50 |
| | 1000. | - | 77.40 | 83.20 |
| | 2000. | - | 72.50 | 78.20 |
| | 4000. | - | 67.60 | 72.40 |
| | 6000. | - | 63.70 | 68.30 |
| | 10000. | - | 58.00 | 62.40 |

| | DISTANCE (FT) | - | THRUST SETTINGS 1.00 | 2.00 |
|---|---|---|---|---|
| S E L | 200. | - | 87.30 | 93.20 |
| | 400. | - | 83.20 | 89.10 |
| | 600. | - | 80.70 | 86.50 |
| | 1000. | - | 77.40 | 83.20 |
| | 2000. | - | 72.50 | 78.20 |
| | 4000. | - | 67.60 | 72.40 |
| | 6000. | - | 63.70 | 68.30 |
| | 10000. | - | 58.00 | 62.40 |

## N O I S E   C U R V E - H102

REPORT 4

| | DISTANCE (FT) | - | THRUST SETTINGS 1.00 | 2.00 |
|---|---|---|---|---|
| E P N L | 200. | - | 93.00 | 99.80 |
| | 400. | - | 88.60 | 95.60 |
| | 600. | - | 85.90 | 93.10 |
| | 1000. | - | 82.30 | 89.70 |
| | 2000. | - | 76.80 | 84.70 |
| | 4000. | - | 70.50 | 78.80 |
| | 6000. | - | 66.30 | 74.70 |
| | 10000. | - | 60.30 | 68.40 |

| | DISTANCE (FT) | - | THRUST SETTINGS 1.00 | 2.00 |
|---|---|---|---|---|
| S E L | 200. | - | 93.00 | 99.80 |
| | 400. | - | 88.60 | 95.60 |
| | 600. | - | 85.90 | 93.10 |
| | 1000. | - | 82.30 | 89.70 |
| | 2000. | - | 76.80 | 84.70 |
| | 4000. | - | 70.50 | 78.80 |
| | 6000. | - | 66.30 | 74.70 |
| | 10000. | - | 60.30 | 68.40 |

## APPROACH PARAMETERS

| NAME | WEIGHT | ENGINES | STOPPING DISTANCE FT | STOPPING DISTANCE M | STOPPING DISTANCE NMI | SPEEDS TAXI | SPEEDS FINAL | SPEEDS TERMINAL | THRUST SETTINGS NO. | THRUST SETTINGS NAME | THRUST SETTINGS VALUE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HELIB | [illegible] | 1.0 | -1. | -0. | -.000 | 52.00 | 52.00 | 52.00 | 1 | LEVAPP | 2.0 |
| | | | | | | | | | 2 | 3DLND | 2.0 |
| HELIH | 2550. | 1.0 | -1. | -0. | -.000 | 50.00 | 50.00 | 50.00 | 1 | LEVAPP | 2.0 |
| | | | | | | | | | 2 | 3DLND | 2.0 |
| HELIA | 5730. | 2.0 | -1. | -0. | -.000 | 60.00 | 60.00 | 60.00 | 1 | LEVAPP | 2.0 |
| | | | | | | | | | 2 | 3DLND | 2.0 |

A P P R O A C H   P R O F I L E S

| NAME | SEGMENT | DISTANCE FROM RUNWAY END FT | M | NMI | ALTITUDE(FT) | SPEED(KNTS) | THRUST |
|---|---|---|---|---|---|---|---|
| CUPTR1 | 1 | 0.00 | 0.00 | 0.00 | 0.00 | TAXI | 3DLND |
| | 2 | 0.00 | 0.00 | 0.00 | 0.00 | FINSP | 3DLND |
| | 3 | 750.00 | 228.60 | .12 | 100.00 | FINSP | 3DLND |
| | 4 | 1900.00 | 579.12 | .31 | 200.00 | FINSP | 3DLND |
| | 5 | 2850.00 | 868.68 | .47 | 300.00 | FINSP | 3DLND |
| | 6 | 3800.00 | 1158.24 | .63 | 400.00 | FINSP | 3DLND |
| | 7 | 4750.00 | 1447.80 | .78 | 500.00 | FINSP | 3DLND |
| | 8 | 10000.00 | 3048.01 | 1.65 | 500.00 | FINSP | 0.00 |
| CUPTR2 | 1 | 0.00 | 0.00 | 0.00 | 0.00 | TAXI | 3DLND |
| | 2 | 0.00 | 0.00 | 0.00 | 0.00 | FINSP | 3DLND |
| | 3 | 950.00 | 289.56 | .16 | 100.00 | FINSP | 3DLND |
| | 4 | 1900.00 | 579.12 | .31 | 200.00 | FINSP | 3DLND |
| | 5 | 2850.00 | 868.68 | .47 | 300.00 | FINSP | 3DLND |
| | 6 | 10000.00 | 3048.01 | 1.65 | 300.00 | FINSP | 0.00 |
| LOW3D | 1 | STUP | | | 0.00 | 32.00 | 3DLND |
| | 2 | -1033.00 | -314.86 | -.17 | 0.00 | FINSP | 3DLND |
| | 3 | 18046.00 | 5500.43 | 2.97 | 1000.00 | FINSP | 3DLND |
| | 4 | 56269.00 | 17149.30 | 9.26 | 1900.00 | FINSP | 3DLND |
| | 5 | 61731.00 | 18827.49 | 9.88 | 1900.00 | FINSP | 3DLND |
| | 6 | 75342.00 | 22964.20 | 12.40 | 1900.00 | FINSP | 3DLND |
| | 7 | 113437.00 | 34576.28 | 18.67 | 1900.00 | FINSP | 0.00 |
| STD3D | 1 | STUP | | | 0.00 | TAXI | REV |
| | 2 | -1002.56 | -305.58 | -.17 | 0.00 | FINSP | 3DLND |
| | 3 | 18076.40 | 5509.70 | 2.97 | 1000.00 | FINSP | 3DAPFS |
| | 4 | 56234.50 | 17140.31 | 9.26 | 3000.00 | FINSP | 3DAPFS |
| | 5 | 60053.30 | 18303.37 | 9.88 | 3200.00 | FINSP | 3DAPFS |
| | 6 | 75313.50 | 22955.60 | 12.40 | 4000.00 | TERMSP | 3DAPTS |
| | 7 | 113471.00 | 34586.03 | 18.67 | 6000.00 | TERMSP | 0.00 |
| GA3D | 1 | STUP | | | 0.00 | 32.00 | 3DLND |
| | 2 | -1002.56 | -305.58 | -.17 | 0.00 | FINSP | 3DLND |
| | 3 | 18075.40 | 5509.70 | 2.97 | 1000.00 | FINSP | 3DLND |
| | 4 | 56234.50 | 17140.31 | 9.26 | 3000.00 | FINSP | 3DLND |
| | 5 | 60053.30 | 18303.37 | 9.88 | 3200.00 | FINSP | 3DLND |
| | 6 | 75313.50 | 22955.60 | 12.40 | 4000.00 | FINSP | 3DLND |
| | 7 | 113471.00 | 34586.03 | 18.67 | 6000.00 | FINSP | 0.00 |

## APPROACH PROFILE (CONT.)

| NAME | SEGMENT | DISTANCE FROM RUNWAY END FT | M | NMI | ALTITUDE(FT) | SPEED(KNTS) | THRUST |
|---|---|---|---|---|---|---|---|
| MIL30 | 1 | STOP | | | 0.00 | 32.00 | 3DLND |
| | 2 | -1002.56 | -305.58 | -.17 | 0.00 | FINSP | 3DLND |
| | 3 | 18070.40 | 5507.79 | 2.97 | 1000.00 | FINSP | 3DLND |
| | 4 | 56239.50 | 17140.31 | 9.26 | 3000.00 | FINSP | 3DLND |
| | 5 | 60050.30 | 18303.37 | 9.88 | 3200.00 | FINSP | 3DLND |
| | 6 | 75313.50 | 22955.60 | 12.40 | 4000.00 | FINSP | 3DLND |
| | 7 | 113471.00 | 34586.03 | 18.67 | 6000.00 | FINSP | 0.00 |

## TAKEOFF PROFILES

| NAME | ENGINES | WEIGHT | SEGMENT | DISTANCE FROM RUNWAY END FT | M | NMI | ALTITUDE(FT) | SPEED(KTS) | THRUST |
|---|---|---|---|---|---|---|---|---|---|
| BELLTO | 1 | 4030. | 1 | 0.00 | 0.00 | 0.00000 | 0.00 | 52.00 | 1.00 |
| | | | 2 | 65.00 | 19.81 | .01070 | 0.00 | 52.00 | 1.00 |
| | | | 3 | 435.00 | 132.59 | .07159 | 100.00 | 52.00 | 1.00 |
| | | | 4 | 805.00 | 245.36 | .13249 | 200.00 | 52.00 | 1.00 |
| | | | 5 | 1175.00 | 358.14 | .19338 | 300.00 | 52.00 | 1.00 |
| | | | 6 | 1545.00 | 470.92 | .25427 | 400.00 | 52.00 | 1.00 |
| | | | 7 | 1915.00 | 583.69 | .31517 | 500.00 | 52.00 | 1.00 |
| | | | 8 | 10000.00 | 3048.01 | 1.64579 | 500.00 | 52.00 | 0.00 |
| HUGHTO | 1 | 2550. | 1 | 0.00 | 0.00 | 0.00000 | 0.00 | 50.00 | 1.00 |
| | | | 2 | 65.00 | 19.81 | .01070 | 0.00 | 50.00 | 1.00 |
| | | | 3 | 405.00 | 123.44 | .06665 | 100.00 | 50.00 | 1.00 |
| | | | 4 | 745.00 | 227.08 | .12261 | 200.00 | 50.00 | 1.00 |
| | | | 5 | 1020.00 | 310.90 | .16787 | 300.00 | 50.00 | 1.00 |
| | | | 6 | 10000.00 | 3048.01 | 1.64579 | 300.00 | 50.00 | 0.00 |
| AUGTO | 2 | 5730. | 1 | 0.00 | 0.00 | 0.00000 | 0.00 | 60.00 | 1.00 |
| | | | 2 | 65.00 | 19.81 | .01070 | 0.00 | 60.00 | 1.00 |
| | | | 3 | 475.00 | 144.78 | .07817 | 100.00 | 60.00 | 1.00 |
| | | | 4 | 885.00 | 269.75 | .14565 | 200.00 | 60.00 | 1.00 |
| | | | 5 | 1295.00 | 394.72 | .21313 | 300.00 | 60.00 | 1.00 |
| | | | 6 | 1705.00 | 519.69 | .28061 | 400.00 | 60.00 | 1.00 |
| | | | 7 | 2115.00 | 644.65 | .34808 | 500.00 | 60.00 | 1.00 |
| | | | 8 | 10000.00 | 3048.01 | 1.64579 | 500.00 | 60.00 | 0.00 |

## T A K E O F F - T R A C K S

| TRACK | RUNWAY | INITIAL HEADING | SEGMENT | DIRECTION | LENGTH (NMI) | TURN ANGLE (DEG) | RESULTANT HEADING (DEG) | TURN RADIUS (NMI) |
|---|---|---|---|---|---|---|---|---|
| TR8 | 21L | 207 | 1 | STRAIGHT | 2.10 | | 207 | |
| | | | 2 | LEFT | | 40 | 167 | .30 |
| | | | 3 | STRAIGHT | 50.00 | | 167 | |
| TR9 | 21R | 207 | 1 | STRAIGHT | 2.00 | | 207 | |
| | | | 2 | LEFT | | 40 | 167 | .30 |
| | | | 3 | STRAIGHT | 50.00 | | 167 | |
| TR10 | 21L | 207 | 1 | STRAIGHT | 2.80 | | 207 | |
| | | | 2 | RIGHT | | 50 | 257 | .40 |
| | | | 3 | STRAIGHT | 50.00 | | 257 | |
| TR11 | 21R | 207 | 1 | STRAIGHT | 2.00 | | 207 | |
| | | | 2 | RIGHT | | 40 | 247 | .30 |
| | | | 3 | STRAIGHT | 50.00 | | 247 | |
| TR21 | 03R | 27 | 1 | STRAIGHT | 1.80 | | 27 | |
| | | | 2 | RIGHT | | 90 | 117 | .30 |
| | | | 3 | STRAIGHT | .60 | | 117 | |
| | | | 4 | RIGHT | | 50 | 167 | .40 |
| | | | 5 | STRAIGHT | 50.00 | | 167 | |
| TR22 | 03R | 27 | 1 | STRAIGHT | 2.10 | | 27 | |
| | | | 2 | LEFT | | 90 | 297 | .30 |
| | | | 3 | STRAIGHT | 50.00 | | 297 | |
| TR23 | 03L | 27 | 1 | STRAIGHT | 1.90 | | 27 | |
| | | | 2 | LEFT | | 90 | 297 | .30 |
| | | | 3 | STRAIGHT | .80 | | 297 | |
| | | | 4 | LEFT | | 41 | 256 | .30 |
| | | | 5 | STRAIGHT | 50.00 | | 256 | |
| TR24 | 03L | 27 | 1 | STRAIGHT | 1.80 | | 27 | |
| | | | 2 | RIGHT | | 90 | 117 | .30 |
| | | | 3 | STRAIGHT | .70 | | 117 | |
| | | | 4 | RIGHT | | 50 | 167 | .40 |
| | | | 5 | STRAIGHT | 50.00 | | 167 | |
| TR39 | 02 | 27 | 1 | STRAIGHT | 5.90 | | 27 | |
| | | | 2 | LEFT | | 130 | 257 | 2.00 |
| | | | 3 | STRAIGHT | 50.00 | | 257 | |
| TR38 | 02 | 27 | 1 | STRAIGHT | 1.00 | | 27 | |
| | | | 2 | LEFT | | 86 | 301 | 2.00 |
| | | | 3 | STRAIGHT | 50.00 | | 301 | |
| TR36 | 20 | 207 | 1 | STRAIGHT | .60 | | 207 | |
| | | | 2 | RIGHT | | 92 | 299 | .40 |
| | | | 3 | STRAIGHT | 2.50 | | 299 | |
| | | | 4 | RIGHT | | 53 | 352 | 2.70 |
| | | | 5 | STRAIGHT | 50.00 | | 352 | |
| TR37 | 20 | 207 | 1 | STRAIGHT | .60 | | 207 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 3 | STRAIGHT | 50.00 | | 299 | |
| TR35 | 20 | 207 | 1 | STRAIGHT | .60 | | 207 | |
| | | | 2 | LEFT | | 90 | 117 | .16 |
| | | | 3 | STRAIGHT | .16 | | 117 | |
| | | | 4 | LEFT | | 90 | 27 | .16 |
| | | | 5 | STRAIGHT | 0.50 | | 27 | |
| | | | 6 | LEFT | | 130 | 257 | 2.00 |
| | | | 7 | STRAIGHT | 50.00 | | 257 | |

TAKEOFF - OPERATIONS

REPORT 9 - PART B

| TRACK | RUNWAY | AIRCRAFT | CLASS | STAGE | PROFILE | MOD | OPERATIONS DAY | OPERATIONS EVENING | OPERATIONS NIGHT |
|---|---|---|---|---|---|---|---|---|---|
| TR8 | 21L | 727Q15 | COM | 1 | TOP125 | 0 | 1.00 | 0.00 | 0.00 |
| | | F28 | COM | 1 | TOP153 | 0 | 1.30 | 0.00 | 0.00 |
| | | DC9Q9 | COM | 1 | TOP155 | 0 | 6.80 | .28 | 0.00 |
| | | DC980 | COM | 1 | TOP172 | 0 | 1.00 | 0.00 | 0.00 |
| | | COMJET | GA | 1 | TOP180 | 0 | 1.30 | 0.00 | 0.00 |
| | | GAMTF | GA | 1 | TOP183 | 0 | .30 | 0.00 | 0.00 |
| | | C130 | MIL | 1 | TOP186 | 0 | .30 | 0.00 | 0.00 |
| | | DHC7 | COM | 1 | TOP187 | 0 | 2.70 | 0.00 | 0.00 |
| | | CV580 | COM | 1 | TOP188 | 0 | 1.80 | 0.00 | 0.00 |
| | | MTETP | COM | 1 | TOP189 | 0 | 1.80 | 0.00 | 0.00 |
| | | MTETP | COM | 1 | TOP190 | 0 | 6.90 | 0.00 | 0.00 |
| | | DHC6 | COM | 1 | TOP191 | 0 | 9.00 | 1.00 | 0.00 |
| | | COMTEP | GA | 1 | TOP194 | 0 | 3.30 | 1.10 | .85 |
| | | COMSEP | GA | 1 | TOP195 | 0 | 3.50 | .80 | .65 |
| | | 4EP | COM | 7 | TOP192 | 0 | .30 | 0.00 | 0.00 |
| TR9 | 21R | MTETP | COM | 1 | TOP190 | 0 | 3.00 | 0.00 | 0.00 |
| | | DHC6 | COM | 1 | TOP191 | 0 | 3.90 | 0.00 | 0.00 |
| | | COMTEP | GA | 1 | TOP194 | 0 | 6.00 | 0.00 | 0.00 |
| | | COMSEP | GA | 1 | TOP195 | 0 | 8.60 | 0.00 | 0.00 |
| TR10 | 21L | 727Q15 | COM | 1 | TOP125 | 0 | 2.10 | 0.00 | 0.00 |
| | | F28 | COM | 1 | TOP153 | 0 | 2.60 | 0.00 | 0.00 |
| | | DC9Q9 | COM | 1 | TOP155 | 0 | 13.50 | .57 | 0.00 |
| | | DC980 | COM | 1 | TOP172 | 0 | 2.10 | 0.00 | 0.00 |
| | | COMJET | GA | 1 | TOP180 | 0 | 2.60 | 0.00 | 0.00 |
| | | GAMTF | GA | 1 | TOP183 | 0 | .50 | 0.00 | 0.00 |
| | | C130 | MIL | 1 | TOP186 | 0 | .50 | 0.00 | 0.00 |
| | | DHC7 | COM | 1 | TOP187 | 0 | 5.40 | 0.00 | 0.00 |
| | | CV580 | COM | 1 | TOP188 | 0 | 3.60 | 0.00 | 0.00 |
| | | MTETP | COM | 1 | TOP189 | 0 | 3.60 | 0.00 | 0.00 |
| | | 4EP | COM | 7 | TOP192 | 0 | .55 | 0.00 | 0.00 |
| | | MTETP | COM | 1 | TOP190 | 0 | 27.70 | 0.00 | 0.00 |
| | | DHC6 | COM | 1 | TOP191 | 0 | 36.00 | 4.00 | 0.00 |
| | | COMTEP | GA | 1 | TOP194 | 0 | 13.10 | 4.40 | 3.40 |
| | | COMSEP | GA | 1 | TOP195 | 0 | 19.60 | 4.70 | 3.60 |
| TR11 | 21R | MTETP | COM | 1 | TOP190 | 0 | 11.90 | 0.00 | 0.00 |
| | | DHC6 | COM | 1 | TOP191 | 0 | 15.40 | 0.00 | 0.00 |
| | | COMTEP | GA | 1 | TOP194 | 0 | 24.20 | 0.00 | 0.00 |
| | | COMSEP | GA | 1 | TOP195 | 0 | 34.30 | 0.00 | 0.00 |
| TR21 | 03R | 727Q15 | COM | 1 | TOP125 | 0 | .20 | 0.00 | 0.00 |
| | | F28 | COM | 1 | TOP153 | 0 | .20 | 0.00 | 0.00 |
| | | DC9Q9 | COM | 1 | TOP155 | 0 | 1.20 | .05 | 0.00 |
| | | DC980 | COM | 1 | TOP172 | 0 | .20 | 0.00 | 0.00 |
| | | COMJET | GA | 1 | TOP180 | 0 | .20 | 0.00 | 0.00 |
| | | GAMTF | GA | 1 | TOP183 | 0 | .05 | 0.00 | 0.00 |
| | | C130 | MIL | 1 | TOP186 | 0 | .05 | 0.00 | 0.00 |

T A K E O F F - O P E R A T I O N S (CONT.)

| TRACK | RUNWAY | AIRCRAFT | CLASS | STAGE | PROFILE | MOD | OPERATIONS DAY | EVENING | NIGHT |
|---|---|---|---|---|---|---|---|---|---|
| | | DHC7 | COM | 1 | TOP187 | 0 | .50 | 0.00 | 0.00 |
| | | CV580 | COM | 1 | TOP188 | 0 | .30 | 0.00 | 0.00 |
| | | HTETP | COM | 1 | TOP189 | 0 | .30 | 0.00 | 0.00 |
| | | MTETP | COM | 1 | TOP190 | 0 | 1.20 | 0.00 | 0.00 |
| | | DHC6 | COM | 1 | TOP191 | 0 | 1.60 | .20 | 0.00 |
| | | 4EP | COM | 7 | TOP192 | 0 | .05 | 0.00 | 0.00 |
| | | COMTEP | GA | 1 | TOP194 | 0 | .60 | .20 | .15 |
| | | COMSEP | GA | 1 | TOP195 | 0 | .60 | .20 | .10 |
| TR22 | 03R | 727Q15 | COM | 1 | TOP125 | 0 | .40 | 0.00 | 0.00 |
| | | F28 | COM | 1 | TOP153 | 0 | .50 | 0.00 | 0.00 |
| | | DC9Q9 | COM | 1 | TOP155 | 0 | 2.40 | .10 | 0.00 |
| | | DC980 | COM | 1 | TOP172 | 0 | .40 | 0.00 | 0.00 |
| | | COMJET | GA | 1 | TOP180 | 0 | .50 | 0.00 | 0.00 |
| | | GAMTF | GA | 1 | TOP185 | 0 | .10 | 0.00 | 0.00 |
| | | C130 | MIL | 1 | TOP186 | 0 | .10 | 0.00 | 0.00 |
| | | DHC7 | COM | 1 | TOP187 | 0 | 1.00 | 0.00 | 0.00 |
| | | CV580 | COM | 1 | TOP188 | 0 | .60 | 0.00 | 0.00 |
| | | HTETP | COM | 1 | TOP189 | 0 | .60 | 0.00 | 0.00 |
| | | MTETP | COM | 1 | TOP190 | 0 | 4.90 | 0.00 | 0.00 |
| | | DHC6 | COM | 1 | TOP191 | 0 | 6.40 | .80 | 0.00 |
| | | COMTEP | GA | 1 | TOP194 | 0 | 2.30 | .80 | .60 |
| | | COMSEP | GA | 1 | TOP195 | 0 | 3.50 | .80 | .65 |
| | | 4EP | COM | 7 | TOP192 | 0 | .10 | 0.00 | 0.00 |
| TR23 | 03L | MTETP | COM | 1 | TOP190 | 0 | 2.10 | 0.00 | 0.00 |
| | | DHC6 | COM | 1 | TOP191 | 0 | 2.70 | 0.00 | 0.00 |
| | | COMTEP | GA | 1 | TOP194 | 0 | 4.30 | 0.00 | 0.00 |
| | | COMSEP | GA | 1 | TOP195 | 0 | 6.00 | 0.00 | 0.00 |
| TR24 | 03L | MTETP | COM | 1 | TOP190 | 0 | .50 | 0.00 | 0.00 |
| | | DHC6 | COM | 1 | TOP191 | 0 | .70 | 0.00 | 0.00 |
| | | COMTEP | GA | 1 | TOP194 | 0 | 1.10 | 0.00 | 0.00 |
| | | COMSEP | GA | 1 | TOP195 | 0 | 1.50 | 0.00 | 0.00 |
| TR39 | 02 | B-206 | GA | 1 | BELLTO | 0 | 2.40 | 0.00 | 0.00 |
| | | H-500 | GA | 1 | HUGHTO | 0 | 1.20 | 0.00 | 0.00 |
| | | A-109 | GA | 1 | AUGTO | 0 | 1.20 | 0.00 | 0.00 |
| TR38 | 02 | B-206 | GA | 1 | BELLTO | 0 | 2.40 | 0.00 | 0.00 |
| | | H-500 | GA | 1 | HUGHTO | 0 | 1.20 | 0.00 | 0.00 |
| | | A-109 | GA | 1 | AUGTO | 0 | 1.20 | 0.00 | 0.00 |
| TR36 | 20 | B-206 | GA | 1 | BELLTO | 0 | 6.70 | 0.00 | 0.00 |
| | | H-500 | GA | 1 | HUGHTO | 0 | 3.30 | 0.00 | 0.00 |
| | | A-109 | GA | 1 | AUGTO | 0 | 3.30 | 0.00 | 0.00 |
| TR37 | 20 | B-206 | GA | 1 | BELLTO | 0 | 6.70 | 0.00 | 0.00 |
| | | H-500 | GA | 1 | HUGHTO | 0 | 3.30 | 0.00 | 0.00 |
| | | A-109 | GA | 1 | AUGTO | 0 | 3.30 | 0.00 | 0.00 |
| TR35 | 20 | B-206 | GA | 1 | BELLTO | 0 | 13.40 | 0.00 | 0.00 |
| | | H-500 | GA | 1 | HUGHTO | 0 | 6.70 | 0.00 | 0.00 |

INTEGRATED NOISE MODEL - ECHO REPORT



TAKEOFF - OPERATIONS (CONT.)

| TRACK | RUNWAY | AIRCRAFT | CLASS | STAGE | PROFILE | MOD | OPERATIONS DAY | OPERATIONS EVENING | OPERATIONS NIGHT |
|---|---|---|---|---|---|---|---|---|---|
| | | A-109 | GA | 1 | AUGTO | 0 | 6.70 | 0.00 | 0.00 |

## TAKEOFF - DISTRIBUTION

| | | OPERATIONS DAY | EVENING | NIGHT |
|---|---|---|---|---|
| COMMERCIAL | - | 193.0 | 7.0 | 0.0 |
| GENERAL AVIATION | - | 201.1 | 13.0 | 10.0 |
| MILITARY | - | 1.0 | 0.0 | 0.0 |

PROPORTIONS

| TRACK | RUNWAY | COMMERCIAL DAY | COMMERCIAL EVENING | COMMERCIAL NIGHT | GENERAL AVIATION DAY | GENERAL AVIATION EVENING | GENERAL AVIATION NIGHT | MILITARY DAY | MILITARY EVENING | MILITARY NIGHT |
|---|---|---|---|---|---|---|---|---|---|---|
| TR8 | 21L | .17 | .18 | 0.00 | .04 | .15 | .15 | .32 | 0.00 | 0.00 |
| TR9 | 21R | .04 | 0.00 | 0.00 | .07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TR10 | 21L | .50 | .65 | 0.00 | .18 | .70 | .70 | .53 | 0.00 | 0.00 |
| TR11 | 21R | .14 | 0.00 | 0.00 | .29 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TR21 | 03R | .03 | .04 | 0.00 | .01 | .03 | .03 | .05 | 0.00 | 0.00 |
| TR22 | 03R | .09 | .13 | 0.00 | .03 | .12 | .13 | .11 | 0.00 | 0.00 |
| TR23 | 03L | .02 | 0.00 | 0.00 | .05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TR24 | 03L | .01 | 0.00 | 0.00 | .01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TR39 | 02 | 0.00 | 0.00 | 0.00 | .02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TR38 | 02 | 0.00 | 0.00 | 0.00 | .02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TR36 | 20 | 0.00 | 0.00 | 0.00 | .07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TR37 | 20 | 0.00 | 0.00 | 0.00 | .07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TR35 | 20 | 0.00 | 0.00 | 0.00 | .13 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | TOTAL | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 0.00 |

## L A N D I N G - T R A C K S

| TRACK | RUNWAY | INITIAL HEADING | SEGMENT | DIRECTION | LENGTH (NMI) | TURN ANGLE (DEG) | RESULTANT HEADING (DEG) | TURN RADIUS (NMI) |
|---|---|---|---|---|---|---|---|---|
| TR1 | 03L | 27 | 1 | STRAIGHT | .40 | | 27 | |
| | | | 2 | LEFT | | 90 | 297 | .20 |
| | | | 3 | STRAIGHT | 50.00 | | 297 | |
| TR6 | 03L | 27 | 1 | STRAIGHT | .40 | | 27 | |
| | | | 2 | LEFT | | 90 | 297 | .20 |
| | | | 3 | STRAIGHT | .35 | | 297 | |
| | | | 4 | LEFT | | 90 | 207 | .20 |
| | | | 5 | STRAIGHT | 1.80 | | 207 | |
| | | | 6 | LEFT | | 90 | 117 | .20 |
| | | | 7 | STRAIGHT | .35 | | 117 | |
| | | | 8 | LEFT | | 90 | 27 | .20 |
| | | | 9 | STRAIGHT | 50.00 | | 27 | |
| TR15 | 21R | 207 | 1 | STRAIGHT | .40 | | 207 | |
| | | | 2 | RIGHT | | 90 | 297 | .20 |
| | | | 3 | STRAIGHT | 2.00 | | 297 | |
| | | | 4 | RIGHT | | 46 | 343 | .50 |
| | | | 5 | STRAIGHT | 50.00 | | 343 | |
| TR19 | 21R | 207 | 1 | STRAIGHT | .40 | | 207 | |
| | | | 2 | LEFT | | 90 | 117 | .20 |
| | | | 3 | STRAIGHT | .35 | | 117 | |
| | | | 4 | LEFT | | 90 | 27 | .20 |
| | | | 5 | STRAIGHT | 2.80 | | 27 | |
| | | | 6 | RIGHT | | 90 | 117 | .70 |
| | | | 7 | STRAIGHT | 50.00 | | 117 | |
| TR2 | 03R | 27 | 1 | STRAIGHT | 1.00 | | 27 | |
| | | | 2 | LEFT | | 90 | 297 | .30 |
| | | | 3 | STRAIGHT | 50.00 | | 297 | |
| TR3 | 03R | 27 | 1 | STRAIGHT | 1.00 | | 27 | |
| | | | 2 | LEFT | | 90 | 297 | .30 |
| | | | 3 | STRAIGHT | .70 | | 297 | |
| | | | 4 | LEFT | | 90 | 207 | .30 |
| | | | 5 | STRAIGHT | 3.00 | | 207 | |
| | | | 6 | RIGHT | | 50 | 257 | .50 |
| | | | 7 | STRAIGHT | 50.00 | | 257 | |
| TR4 | 03R | 27 | 1 | STRAIGHT | 50.00 | | 27 | |
| TR5 | 03R | 27 | 1 | STRAIGHT | .40 | | 27 | |
| | | | 2 | RIGHT | | 90 | 117 | .20 |
| | | | 3 | STRAIGHT | .25 | | 117 | |
| | | | 4 | RIGHT | | 90 | 207 | .20 |
| | | | 5 | STRAIGHT | 2.40 | | 207 | |
| | | | 6 | RIGHT | | 90 | 297 | .20 |
| | | | 7 | STRAIGHT | .25 | | 297 | |
| | | | 8 | RIGHT | | 90 | 27 | .20 |
| | | | 9 | STRAIGHT | 50.00 | | 27 | |
| TR7 | 03R | 27 | 1 | STRAIGHT | .40 | | 27 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 3 | STRAIGHT | 50.00 | | 117 | | |
| TR16 | 21L | 207 | 1 | STRAIGHT | 1.00 | | 207 | | |
| | | | 2 | RIGHT | | 93 | 300 | .30 | |
| | | | 3 | STRAIGHT | 50.00 | | 300 | | |
| TR17 | 21L | 207 | 1 | STRAIGHT | 1.00 | | 207 | | |
| | | | 2 | LEFT | | 93 | 114 | .30 | |
| | | | 3 | STRAIGHT | 50.00 | | 114 | | |
| TR18 | 21L | 207 | 1 | STRAIGHT | 50.00 | | 207 | | |
| TR20 | 21L | 207 | 1 | STRAIGHT | .40 | | 207 | | |
| | | | 2 | LEFT | | 90 | 117 | .20 | |
| | | | 3 | STRAIGHT | .25 | | 117 | | |
| | | | 4 | LEFT | | 90 | 27 | .20 | |
| | | | 5 | STRAIGHT | 50.00 | | 27 | | |
| TR30 | 02 | 27 | 1 | STRAIGHT | 5.90 | | 27 | | |
| | | | 2 | LEFT | | 130 | 257 | 2.00 | |
| | | | 3 | STRAIGHT | 50.00 | | 257 | | |
| TR32 | 20 | 207 | 1 | STRAIGHT | .60 | | 207 | | |
| | | | 2 | RIGHT | | 92 | 299 | .40 | |
| | | | 3 | STRAIGHT | 2.50 | | 299 | | |
| | | | 4 | RIGHT | | 53 | 352 | 2.70 | |
| | | | 5 | STRAIGHT | 50.00 | | 352 | | |
| TR33 | 20 | 207 | 1 | STRAIGHT | .60 | | 207 | | |
| | | | 2 | RIGHT | | 92 | 299 | .40 | |
| | | | 3 | STRAIGHT | 50.00 | | 299 | | |
| TR31 | 02 | 27 | 1 | STRAIGHT | 1.00 | | 27 | | |
| | | | 2 | LEFT | | 86 | 301 | 2.00 | |
| | | | 3 | STRAIGHT | 50.00 | | 301 | | |
| TR34 | 20 | 207 | 1 | STRAIGHT | .60 | | 207 | | |
| | | | 2 | LEFT | | 90 | 117 | .16 | |
| | | | 3 | STRAIGHT | .16 | | 117 | | |
| | | | 4 | LEFT | | 90 | 27 | .16 | |
| | | | 5 | STRAIGHT | 6.50 | | 27 | | |
| | | | 6 | LEFT | | 130 | 257 | 2.00 | |
| | | | 7 | STRAIGHT | 50.00 | | 257 | | |

L A N D I N G - O P E R A T I O N S

| TRACK | RUNWAY | AIRCRAFT | CLASS | PROFILE | OPERATIONS DAY | OPERATIONS EVENING | OPERATIONS NIGHT |
|---|---|---|---|---|---|---|---|
| TR1 | 03L | MTETP | COM | LOW3D | 11.90 | 0.00 | 0.00 |
| | | DHC6 | COM | LOW3D | 15.40 | 0.00 | 0.00 |
| | | COMTEP | GA | LOW3D | 24.20 | 0.00 | 0.00 |
| | | COMSEP | GA | LOW3D | 34.30 | 0.00 | 0.00 |
| TR6 | 03L | MTETP | COM | LOW3D | 3.00 | 0.00 | 0.00 |
| | | DHC6 | COM | LOW3D | 3.90 | 0.00 | 0.00 |
| | | COMTEP | GA | LOW3D | 6.00 | 0.00 | 0.00 |
| | | COMSEP | GA | LOW3D | 8.60 | 0.00 | 0.00 |
| TR15 | 21R | MTETP | COM | LOW3D | 2.10 | 0.00 | 0.00 |
| | | DHC6 | COM | LOW3D | 2.70 | 0.00 | 0.00 |
| | | COMTEP | GA | LOW3D | 4.30 | 0.00 | 0.00 |
| | | COMSEP | GA | LOW3D | 6.00 | 0.00 | 0.00 |
| TR19 | 21R | MTETP | COM | LOW3D | .50 | 0.00 | 0.00 |
| | | DHC6 | COM | LOW3D | .70 | 0.00 | 0.00 |
| | | COMTEP | GA | LOW3D | 1.10 | 0.00 | 0.00 |
| | | COMSEP | GA | LOW3D | 1.50 | 0.00 | 0.00 |
| TR2 | 03R | 727015 | COM | STD3D | 1.00 | 0.00 | 0.00 |
| | | F28 | COM | STD3D | 1.30 | 0.00 | 0.00 |
| | | DC909 | COM | STD3D | 6.70 | .28 | 0.00 |
| | | DC980 | COM | STD3D | 1.10 | 0.00 | 0.00 |
| | | COMJET | GA | STD3D | 1.40 | 0.00 | 0.00 |
| | | GAMTF | GA | MIL3D | .30 | 0.00 | 0.00 |
| | | C130 | MIL | MIL3D | .20 | 0.00 | 0.00 |
| | | DHC7 | COM | STD3D | 2.70 | 0.00 | 0.00 |
| | | CV580 | COM | STD3D | 1.80 | 0.00 | 0.00 |
| | | MTETP | COM | STD3D | 1.80 | 0.00 | 0.00 |
| | | MTETP | COM | LOW3D | 6.90 | 0.00 | 0.00 |
| | | DHC6 | COM | LOW3D | 9.90 | 1.00 | 0.00 |
| | | COMTEP | GA | LOW3D | 3.30 | 1.10 | 0.00 |
| | | COMSEP | GA | LOW3D | 14.70 | 3.50 | 3.60 |
| | | 4EP | COM | STD3D | .28 | 0.00 | 0.00 |
| TR3 | 03R | 727015 | COM | STD3D | 1.00 | 0.00 | 0.00 |
| | | F28 | COM | STD3D | 1.30 | 0.00 | 0.00 |
| | | DC909 | COM | STD3D | 6.70 | .28 | 0.00 |
| | | DC980 | COM | STD3D | 1.10 | 0.00 | 0.00 |
| | | COMJET | GA | STD3D | 1.40 | 0.00 | 0.00 |
| | | GAMTF | GA | MIL3D | .20 | 0.00 | 0.00 |
| | | C130 | MIL | MIL3D | .30 | 0.00 | 0.00 |
| | | DHC7 | COM | STD3D | 2.70 | 0.00 | 0.00 |
| | | CV580 | COM | STD3D | 1.80 | 0.00 | 0.00 |
| | | MTETP | COM | STD3D | 1.80 | 0.00 | 0.00 |
| | | 4EP | COM | STD3D | .28 | 0.00 | 0.00 |
| TR4 | 03R | MTETP | COM | LOW3D | 10.40 | 0.00 | 0.00 |
| | | DHC6 | COM | LOW3D | 13.50 | 1.50 | 0.00 |
| | | COMTEP | GA | LOW3D | 4.90 | 1.70 | 3.40 |

L A N D I N G - O P E R A T I O N S (CONT.)

| TRACK | RUNWAY | AIRCRAFT | CLASS | PROFILE | DAY | OPERATIONS EVENING | NIGHT |
|---|---|---|---|---|---|---|---|
| | | COMSEP | GA | LOW3D | 2.50 | .65 | 0.00 |
| TR5 | 03R | MTETP | COM | LOW3D | 10.40 | 0.00 | 0.00 |
| | | DHC6 | COM | LOW3D | 13.50 | 1.50 | 0.00 |
| | | COMTEP | GA | LOW3D | 4.90 | 1.70 | 0.00 |
| | | COMSEP | GA | LOW3D | 2.50 | .60 | 0.00 |
| TR7 | 03R | 727Q15 | COM | STD3D | 1.00 | 0.00 | 0.00 |
| | | F2A | COM | STD3D | 1.30 | 0.00 | 0.00 |
| | | DC909 | COM | STD3D | 6.70 | .28 | 0.00 |
| | | DC980 | COM | STD3D | 1.10 | 0.00 | 0.00 |
| | | COMJET | GA | STD3D | 1.40 | 0.00 | 0.00 |
| | | GAMTF | GA | MIL3D | .20 | 0.00 | 0.00 |
| | | C130 | MIL | MIL3D | .30 | 0.00 | 0.00 |
| | | DHC7 | COM | STD3D | 2.70 | 0.00 | 0.00 |
| | | CV580 | COM | STD3D | 1.80 | 0.00 | 0.00 |
| | | MTETP | COM | STD3D | 1.80 | 0.00 | 0.00 |
| | | MTETP | COM | LOW3D | 6.90 | 0.00 | 0.00 |
| | | DHC6 | COM | LOW3D | 9.00 | 1.00 | 0.00 |
| | | COMTEP | GA | LOW3D | 3.30 | 1.10 | .80 |
| | | COMSEP | GA | LOW3D | 3.50 | .80 | .65 |
| | | 4EP | COM | STD3D | .28 | 0.00 | 0.00 |
| TR16 | 21L | 727Q15 | COM | STD3D | .20 | 0.00 | 0.00 |
| | | F2A | COM | STD3D | .20 | 0.00 | 0.00 |
| | | DC909 | COM | STD3D | 1.20 | .05 | 0.00 |
| | | DC980 | COM | STD3D | .20 | 0.00 | 0.00 |
| | | COMJET | GA | STD3D | .20 | 0.00 | 0.00 |
| | | GAMTF | GA | MIL3D | .05 | 0.00 | 0.00 |
| | | C130 | MIL | MIL3D | .05 | 0.00 | 0.00 |
| | | DHC7 | COM | STD3D | .50 | 0.00 | 0.00 |
| | | CV580 | COM | STD3D | .30 | 0.00 | 0.00 |
| | | MTETP | COM | STD3D | .30 | 0.00 | 0.00 |
| | | MTETP | COM | LOW3D | 1.20 | 0.00 | 0.00 |
| | | DHC6 | COM | LOW3D | 1.60 | .20 | 0.00 |
| | | COMTEP | GA | LOW3D | .60 | .20 | 0.00 |
| | | COMSEP | GA | LOW3D | 2.60 | .60 | .65 |
| | | 4EP | COM | STD3D | .05 | 0.00 | 0.00 |
| TR17 | 21L | 727Q15 | COM | STD3D | .10 | 0.00 | 0.00 |
| | | F2A | COM | STD3D | .10 | 0.00 | 0.00 |
| | | DC909 | COM | STD3D | .64 | .03 | 0.00 |
| | | DC980 | COM | STD3D | .10 | 0.00 | 0.00 |
| | | COMJET | GA | STD3D | .10 | 0.00 | 0.00 |
| | | DHC7 | COM | STD3D | .24 | 0.00 | 0.00 |
| | | CV580 | COM | STD3D | .16 | 0.00 | 0.00 |
| | | MTETP | COM | STD3D | .16 | 0.00 | 0.00 |
| | | MTETP | COM | LOW3D | 1.20 | 0.00 | 0.00 |
| | | DHC6 | COM | LOW3D | 1.00 | .20 | 0.00 |

L A N D I N G - O P E R A T I O N S (CONT.)

| TRACK | RUNWAY | AIRCRAFT | CLASS | PROFILE | OPERATIONS DAY | EVENING | NIGHT |
|---|---|---|---|---|---|---|---|
| | | COMTEP | GA | LOW3D | .60 | .20 | .20 |
| | | COMSEP | GA | LOW3D | .60 | .15 | .10 |
| | | 4EP | COM | STD3D | .03 | 0.00 | 0.00 |
| TR18 | 21L | 727D15 | COM | STD3D | .30 | 0.00 | 0.00 |
| | | F28 | COM | STD3D | .30 | 0.00 | 0.00 |
| | | DC9 | COM | STD3D | 1.80 | .08 | 0.00 |
| | | DC980 | COM | STD3D | .30 | 0.00 | 0.00 |
| | | COMJET | GA | STD3D | .30 | 0.00 | 0.00 |
| | | GAMTF | GA | MIL3D | .10 | 0.00 | 0.00 |
| | | C130 | MIL | MIL3D | .10 | 0.00 | 0.00 |
| | | DHC7 | COM | STD3D | .70 | 0.00 | 0.00 |
| | | CV580 | COM | STD3D | .50 | 0.00 | 0.00 |
| | | HTETP | COM | STD3D | .50 | 0.00 | 0.00 |
| | | 4EP | COM | STD3D | .09 | 0.00 | 0.00 |
| TR20 | 21L | MTETP | COM | LOW3D | 3.70 | 0.00 | 0.00 |
| | | DHC6 | COM | LOW3D | 4.80 | .50 | 0.00 |
| | | COMTEP | GA | LOW3D | 1.70 | .60 | .60 |
| | | COMSEP | GA | LOW3D | .90 | .20 | 0.00 |
| TR30 | 02 | B-206 | GA | CUPTR1 | 13.40 | 0.00 | 0.00 |
| | | H-500 | GA | CUPTR2 | 6.70 | 0.00 | 0.00 |
| | | A-109 | GA | CUPTR1 | 6.70 | 0.00 | 0.00 |
| TR32 | 20 | B-206 | GA | CUPTR1 | 1.20 | 0.00 | 0.00 |
| | | H-500 | GA | CUPTR2 | .60 | 0.00 | 0.00 |
| | | A-109 | GA | CUPTR1 | .60 | 0.00 | 0.00 |
| TR33 | 20 | B-206 | GA | CUPTR1 | 1.20 | 0.00 | 0.00 |
| | | H-500 | GA | CUPTR2 | .60 | 0.00 | 0.00 |
| | | A-109 | GA | CUPTR1 | .60 | 0.00 | 0.00 |
| TR31 | 02 | B-206 | GA | CUPTR1 | 13.40 | 0.00 | 0.00 |
| | | H-500 | GA | CUPTR2 | 6.60 | 0.00 | 0.00 |
| | | A-109 | GA | CUPTR1 | 6.60 | 0.00 | 0.00 |
| TR34 | 20 | B-206 | GA | CUPTR1 | 2.40 | 0.00 | 0.00 |
| | | H-500 | GA | CUPTR2 | 1.20 | 0.00 | 0.00 |
| | | A-109 | GA | CUPTR1 | 1.20 | 0.00 | 0.00 |

L A N D I N G - D I S T R I B U T I O N

| | | O P E R A T I O N S | |
|---|---|---|---|
| | DAY | EVENING | NIGHT |
| COMMERCIAL - | 192.9 | 6.9 | 0.0 |
| GENERAL AVIATION - | 201.3 | 13.1 | 10.0 |
| MILITARY - | 1.0 | 0.0 | 0.0 |

P R O P O R T I O N S

| | | COMMERCIAL | | | GENERAL AVIATION | | | MILITARY | | |
|---|---|---|---|---|---|---|---|---|---|---|
| TRACK | RUNWAY | DAY | EVENING | NIGHT | DAY | EVENING | NIGHT | DAY | EVENING | NIGHT |
| TR1 | 03L | .14 | 0.00 | 0.00 | .29 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TR6 | 03L | .04 | 0.00 | 0.00 | .07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TR15 | 21R | .02 | 0.00 | 0.00 | .05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TR19 | 21R | .01 | 0.00 | 0.00 | .01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TR2 | 03R | .17 | .19 | 0.00 | .10 | .35 | .36 | .21 | 0.00 | 0.00 |
| TR3 | 03R | .09 | .04 | 0.00 | .01 | 0.00 | 0.00 | .32 | 0.00 | 0.00 |
| TR4 | 03R | .12 | .22 | 0.00 | .04 | .18 | .34 | 0.00 | 0.00 | 0.00 |
| TR5 | 03R | .12 | .22 | 0.00 | .04 | .18 | 0.00 | 0.00 | 0.00 | 0.00 |
| TR7 | 03R | .17 | .19 | 0.00 | .03 | .15 | .15 | .32 | 0.00 | 0.00 |
| TR16 | 21L | .03 | .04 | 0.00 | .02 | .06 | .07 | .05 | 0.00 | 0.00 |
| TR17 | 21L | .02 | .03 | 0.00 | .01 | .03 | .03 | 0.00 | 0.00 | 0.00 |
| TR18 | 21L | .02 | .01 | 0.00 | .00 | 0.00 | 0.00 | .11 | 0.00 | 0.00 |
| TR20 | 21L | .03 | .07 | 0.00 | .01 | .06 | .06 | 0.00 | 0.00 | 0.00 |
| TR30 | 02 | 0.00 | 0.00 | 0.00 | .13 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TR32 | 20 | 0.00 | 0.00 | 0.00 | .01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TR33 | 20 | 0.00 | 0.00 | 0.00 | .01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TR31 | 02 | 0.00 | 0.00 | 0.00 | .13 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TR34 | 20 | 0.00 | 0.00 | 0.00 | .02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | TOTAL | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 0.00 |

P R O C E S S E S
-----------------

VERIFY

EXECUTE

```
CONTOUR
   LEVELS =   65.00   70.00   75.00
   METRIC LDN
   TOLERANCE = 2.00
   REFINEMENT =   6
   WINDOW =   -10000.  -10000.   20000.   20000.
   SAVED AS GCN1
   REPORT
VERIFY MODULE ACCESSED.
```

NO WARNING MESSAGES WERE PRODUCED BY THE FLIGHT OVERLAY MODULE.

```
          NOISE COMPUTATION MODULE SUMMARY
          --------------------------------
        REFINEMENT        NO.OF        NO.OF       NO.OF
          LEVEL          SQUARES       NODES     TRIANGLES
            3              64           289
            4             156           510
            5             172           568
            6             180           612
         ------------------------------------------------
    RECTANGLE ENVELOPING MAP MOSAIC.                3722
    LOW LEFT & UPPER RIGHT CORNERS
XMIN=      -.100000E+05YMIN=     -.100000E+05
XMAX=       .200000E+05YMAX=      .200000E+05


---------------------------------------------------------------------
   0 WARNING MESSAGES WERE PRODUCED BY THE COMPUTATION MODULE
---------------------------------------------------------------------
```

0 WARNING MESSAGES WERE PRODUCED BY THE CONTOUR MODULE

C O N T O U R - GCN1

GCN 1 2003 ULTIMATE TRAFFIC
AIRPORT - GCN
LEVEL = 65.0 DB AREA = 2.46 METRIC = LDN

| ISLAND | PNT | X | Y | PNT | X | Y | PNT | X | Y |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | -2500. | -244. | 2 | -2809. | -625. | 3 | -3066. | -952. |
| | 4 | -3230. | -1197. | 5 | -3316. | -1419. | 6 | -3356. | -1644. |
| | 7 | -3502. | -1789. | 8 | -3673. | -2029. | 9 | -3924. | -2430. |
| | 10 | -3969. | -2500. | 11 | -4114. | -2761. | 12 | -4260. | -2969. |
| | 13 | -4375. | -3169. | 14 | -4574. | -3438. | 15 | -4738. | -3725. |
| | 16 | -4810. | -3940. | 17 | -5313. | -4339. | 18 | -5364. | -4375. |
| | 19 | -6250. | -5284. | 20 | -6293. | -5313. | 21 | -6250. | -5364. |
| | 22 | -5695. | -5695. | 23 | -5189. | -6003. | 24 | -5173. | -6111. |
| | 25 | -4375. | -5990. | 26 | -4038. | -5913. | 27 | -3438. | -5738. |
| | 28 | -2959. | -5791. | 29 | -2500. | -5635. | 30 | -2234. | -5579. |
| | 31 | -1896. | -5533. | 32 | -1727. | -5148. | 33 | -1591. | -4829. |
| | 34 | -1253. | -4684. | 35 | -1085. | -4375. | 36 | -875. | -4125. |
| | 37 | -625. | -3719. | 38 | -493. | -3438. | 39 | -151. | -2974. |
| | 40 | -10. | -2793. | 41 | 203. | -2500. | 42 | 254. | -2442. |
| | 43 | 313. | -2385. | 44 | 642. | -2031. | 45 | 713. | -1963. |
| | 46 | 781. | -1894. | 47 | 1091. | -1563. | 48 | 1171. | -1483. |
| | 49 | 1250. | -1400. | 50 | 1458. | -1198. | 51 | 1639. | -1014. |
| | 52 | 1775. | -777. | 53 | 1896. | -625. | 54 | 2030. | -467. |
| | 55 | 2168. | -261. | 56 | 2268. | -156. | 57 | 2443. | 57. |
| | 58 | 2630. | 313. | 59 | 2656. | 345. | 60 | 2847. | 591. |
| | 61 | 2977. | 781. | 62 | 3125. | 981. | 63 | 3252. | 1123. |
| | 64 | 3309. | 1250. | 65 | 3594. | 1673. | 66 | 3612. | 1700. |
| | 67 | 3622. | 1719. | 68 | 3664. | 1789. | 69 | 3924. | 2188. |
| | 70 | 3987. | 2263. | 71 | 4063. | 2404. | 72 | 4215. | 2656. |
| | 73 | 4354. | 2834. | 74 | 4395. | 2929. | 75 | 4494. | 3125. |
| | 76 | 4510. | 3146. | 77 | 4531. | 3183. | 78 | 4648. | 3359. |
| | 79 | 4698. | 3427. | 80 | 4766. | 3540. | 81 | 4804. | 3594. |
| | 82 | 4892. | 3702. | 83 | 4976. | 3828. | 84 | 5000. | 3861. |
| | 85 | 5120. | 3942. | 86 | 5217. | 4063. | 87 | 5469. | 4320. |
| | 88 | 5582. | 4418. | 89 | 5667. | 4531. | 90 | 5938. | 4802. |
| | 91 | 6041. | 4897. | 92 | 6126. | 5000. | 93 | 6406. | 5282. |
| | 94 | 6507. | 5368. | 95 | 6594. | 5469. | 96 | 6875. | 5745. |
| | 97 | 6950. | 5832. | 98 | 7063. | 5938. | 99 | 7344. | 6215. |
| | 100 | 7450. | 6319. | 101 | 7539. | 6406. | 102 | 7813. | 6660. |
| | 103 | 7939. | 6718. | 104 | 8034. | 6875. | 105 | 8047. | 6886. |
| | 106 | 8135. | 6971. | 107 | 8281. | 7103. | 108 | 8286. | 7109. |
| | 109 | 8333. | 7212. | 110 | 8454. | 7344. | 111 | 8516. | 7410. |
| | 112 | 8618. | 7486. | 113 | 8677. | 7578. | 114 | 8750. | 7665. |

C O N T O U R - GCN1 (CONT.)

GCN 1 2003 ULTIMATE TRAFFIC
AIRPORT - GCN
LEVEL = 65.0 DB AREA = 2.46 METRIC = LDN

| ISLAND | PNT | X | Y | PNT | X | Y | PNT | X | Y |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 115 | 8837. | 7725. | 116 | 8872. | 7813. | 117 | 8984. | 7980. |
| | 118 | 9015. | 8016. | 119 | 9030. | 8047. | 120 | 9093. | 8156. |
| | 121 | 9177. | 8241. | 122 | 9197. | 8303. | 123 | 9219. | 8352. |
| | 124 | 9329. | 8516. | 125 | 9387. | 8582. | 126 | 9451. | 8750. |
| | 127 | 9453. | 8753. | 128 | 9563. | 8874. | 129 | 9611. | 8984. |
| | 130 | 9688. | 9109. | 131 | 9770. | 9219. | 132 | 9868. | 9363. |
| | 133 | 9805. | 9510. | 134 | 9987. | 9556. | 135 | 10087. | 9688. |
| | 136 | 10097. | 9747. | 137 | 10156. | 9776. | 138 | 10303. | 9922. |
| | 139 | 10332. | 9961. | 140 | 10391. | 10006. | 141 | 10591. | 10156. |
| | 142 | 10583. | 10177. | 143 | 10625. | 10193. | 144 | 10770. | 10391. |
| | 145 | 10732. | 10498. | 146 | 10747. | 10625. | 147 | 10744. | 10744. |
| | 148 | 10625. | 10793. | 149 | 10580. | 10815. | 150 | 10494. | 10832. |
| | 151 | 10406. | 10851. | 152 | 10460. | 10903. | 153 | 10288. | 10888. |
| | 154 | 10138. | 10913. | 155 | 10055. | 10992. | 156 | 10045. | 11273. |
| | 157 | 10036. | 11326. | 158 | 10158. | 11563. | 159 | 10161. | 11568. |
| | 160 | 10243. | 11797. | 161 | 10156. | 11898. | 162 | 10001. | 11797. |
| | 163 | 10140. | 11578. | 164 | 9922. | 11757. | 165 | 9778. | 11653. |
| | 166 | 9688. | 11576. | 167 | 9677. | 11573. | 168 | 9669. | 11563. |
| | 169 | 9219. | 11190. | 170 | 9143. | 11169. | 171 | 9093. | 11094. |
| | 172 | 8750. | 10810. | 173 | 8617. | 10758. | 174 | 8567. | 10625. |
| | 175 | 8516. | 10581. | 176 | 8397. | 10509. | 177 | 8302. | 10391. |
| | 178 | 8281. | 10372. | 179 | 8153. | 10285. | 180 | 8062. | 10156. |
| | 181 | 8047. | 10140. | 182 | 7920. | 10049. | 183 | 7831. | 9922. |
| | 184 | 7813. | 9903. | 185 | 7682. | 9818. | 186 | 7580. | 9688. |
| | 187 | 7578. | 9685. | 188 | 7376. | 9636. | 189 | 7344. | 9599. |
| | 190 | 7308. | 9651. | 191 | 7270. | 9688. | 192 | 7109. | 9847. |
| | 193 | 7007. | 9860. | 194 | 6995. | 9922. | 195 | 6875. | 9998. |
| | 196 | 6795. | 9962. | 197 | 6654. | 9909. | 198 | 6406. | 9740. |
| | 199 | 6352. | 9688. | 200 | 6101. | 9524. | 201 | 5938. | 9319. |
| | 202 | 5845. | 9219. | 203 | 5654. | 9034. | 204 | 5616. | 8923. |
| | 205 | 5533. | 8750. | 206 | 5506. | 8713. | 207 | 5469. | 8650. |
| | 208 | 5378. | 8516. | 209 | 5315. | 6435. | 210 | 5234. | 8300. |
| | 211 | 5721. | 8241. | 212 | 5123. | 8158. | 213 | 5042. | 8087. |
| | 214 | 5000. | 7796. | 215 | 4903. | 7909. | 216 | 4846. | 7813. |
| | 217 | 4706. | 7719. | 218 | 4698. | 7646. | 219 | 4653. | 7578. |
| | 220 | 4531. | 7414. | 221 | 4499. | 7376. | 222 | 4480. | 7344. |
| | 223 | 4374. | 7130. | 224 | 4320. | 7109. | 225 | 4309. | 7097. |
| | 226 | 4207. | 7070. | 227 | 4140. | 6875. | 226 | 4106. | 6831. |

C O N T O U R - GCN1 (CONT.)

GCN 1 2003 ULTIMATE TRAFFIC
AIRPORT - GCN
LEVEL = 65.0 DB AREA = 2.46 METRIC = LDN

| ISLAND | PNT | X | Y | PNT | X | Y | PNT | X | Y |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 229 | 4063. | 6758. | 230 | 3974. | 6641. | 231 | 3904. | 6564. |
| | 232 | 3828. | 6446. | 233 | 3797. | 6406. | 234 | 3698. | 6302. |
| | 235 | 3612. | 6172. | 236 | 3594. | 6149. | 237 | 3492. | 6040. |
| | 238 | 3421. | 5938. | 239 | 3359. | 5866. | 240 | 3275. | 5787. |
| | 241 | 3206. | 5703. | 242 | 3125. | 5620. | 243 | 2949. | 5469. |
| | 244 | 2829. | 5382. | 245 | 2773. | 5352. | 246 | 2656. | 5210. |
| | 247 | 2366. | 5000. | 248 | 2255. | 4933. | 249 | 2188. | 4850. |
| | 250 | 1836. | 4531. | 251 | 1770. | 4480. | 252 | 1719. | 4417. |
| | 253 | 1338. | 4063. | 254 | 1290. | 4023. | 255 | 1250. | 3976. |
| | 256 | 832. | 3594. | 257 | 805. | 3570. | 258 | 781. | 3541. |
| | 259 | 348. | 3125. | 260 | 313. | 3088. | 261 | 5. | 2802. |
| | 262 | -169. | 2669. | 263 | -567. | 2188. | 264 | -625. | 2119. |
| | 265 | -1070. | 1695. | 266 | -1215. | 1492. | 267 | -1412. | 1250. |
| | 268 | -1482. | 1170. | 269 | -1563. | 1060. | 270 | -1780. | 781. |
| | 271 | -1467. | 637. | 272 | -2031. | 432. | 273 | -2121. | 313. |
| | 274 | -2275. | 87. | 275 | -2441. | -156. | 276 | -2500. | -244. |

C O N T O U R - GCN1

GCN 1 2003 ULTIMATE TRAFFIC
IRPORT - GCN
EVEL = 70.0 DB AREA = 1.05 METRIC = LDN

| ISLAND | PNT | X | Y | PNT | X | Y | PNT | X | Y |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1211. | 3125. | 2 | 967. | 2842. | 3 | 541. | 2359. |
| | 4 | 448. | 2255. | 5 | 414. | 2213. | 6 | 395. | 2188. |
| | 7 | 378. | 2171. | 8 | 361. | 2163. | 9 | 338. | 2168. |
| | 10 | 356. | 2144. | 11 | 335. | 2157. | 12 | 339. | 2135. |
| | 13 | 332. | 2111. | 14 | 313. | 2085. | 15 | 283. | 2069. |
| | 16 | 164. | 1930. | 17 | -386. | 1250. | 18 | -391. | 1244. |
| | 19 | -502. | 1127. | 20 | -594. | 1016. | 21 | -625. | 959. |
| | 22 | -772. | 781. | 23 | -875. | 672. | 24 | -925. | 613. |
| | 25 | -1094. | 316. | 26 | -1097. | 313. | 27 | -1259. | 9. |
| | 28 | -1354. | -156. | 29 | -1563. | -619. | 30 | -1565. | -623. |
| | 31 | -1566. | -625. | 32 | -1572. | -635. | 33 | -1815. | -1094. |
| | 34 | -1870. | -1255. | 35 | -2031. | -1489. | 36 | -2069. | -1563. |
| | 37 | -2163. | -1834. | 38 | -2172. | -1867. | 39 | -2316. | -2316. |
| | 40 | -2316. | -2500. | 41 | -1929. | -2705. | 42 | -1563. | -2601. |
| | 43 | -1444. | -2500. | 44 | -1094. | -2235. | 45 | -1006. | -2119. |
| | 46 | -898. | -2031. | 47 | -625. | -1804. | 48 | -510. | -1677. |
| | 49 | -352. | -1563. | 50 | -156. | -1428. | 51 | 28. | -1278. |
| | 52 | 313. | -1140. | 53 | 361. | -1094. | 54 | 612. | -925. |
| | 55 | 659. | -850. | 56 | 741. | -720. | 57 | 866. | -625. |
| | 58 | 1016. | -447. | 59 | 1043. | -418. | 60 | 1064. | -391. |
| | 61 | 1250. | -178. | 62 | 1269. | -156. | 63 | 1418. | -6. |
| | 64 | 1498. | 64. | 65 | 1561. | 160. | 66 | 1680. | 313. |
| | 67 | 1599. | 332. | 68 | 1719. | 355. | 69 | 1888. | 547. |
| | 70 | 1920. | 580. | 71 | 1953. | 620. | 72 | 2094. | 781. |
| | 73 | 2140. | 820. | 74 | 2168. | 886. | 75 | 2270. | 974. |
| | 76 | 2370. | 1068. | 77 | 2502. | 1250. | 78 | 2656. | 1425. |
| | 79 | 2799. | 1576. | 80 | 2895. | 1719. | 81 | 3125. | 1995. |
| | 82 | 3215. | 2097. | 83 | 3270. | 2188. | 84 | 3594. | 2611. |
| | 85 | 3614. | 2656. | 86 | 3625. | 2656. | 87 | 3697. | 2759. |
| | 88 | 3966. | 3125. | 89 | 4010. | 3178. | 90 | 4063. | 3260. |
| | 91 | 4131. | 3350. | 92 | 4234. | 3452. | 93 | 4295. | 3594. |
| | 94 | 4297. | 3596. | 95 | 4399. | 3726. | 96 | 4462. | 3828. |
| | 97 | 4531. | [illegible] | 98 | 4590. | 4004. | 99 | 4627. | 4063. |
| | 100 | 4706. | 4263. | 101 | 4781. | 4282. | 102 | 4792. | 4297. |
| | 103 | 4879. | [illegible] | 104 | 4970. | 4531. | 105 | 4988. | 4544. |
| | 106 | 5030. | 4561. | 107 | 5158. | 4687. | 108 | 5258. | 4742. |
| | 109 | [illegible] | 4855. | 110 | 5411. | 5000. | 111 | 5414. | 5020. |
| | 112 | 5409. | 5058. | 113 | 5634. | 5234. | 114 | 5674. | 5264. |

C O N T O U R - GCN1 (CONT.)

GCN 1 2003 ULTIMATE TRAFFIC
AIRPORT - GCN
LEVEL = 70.0 DB AREA = 1.05 METRIC = LDN

| ISLAND | PNT | X | Y | PNT | X | Y | PNT | X | Y |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 115 | 5703. | 5305. | 116 | 5860. | 5469. | 117 | 5903. | 5503. |
| | 118 | 5938. | 5552. | 119 | 6052. | 5646. | 120 | 6172. | 5703. |
| | 121 | 6230. | 5821. | 122 | 6331. | 5938. | 123 | 6373. | 5970. |
| | 124 | 6406. | 6014. | 125 | 6569. | 6172. | 126 | 6610. | 6202. |
| | 127 | 6641. | 6241. | 128 | 6824. | 6406. | 129 | 6855. | 6427. |
| | 130 | 6875. | 6454. | 131 | 7003. | 6576. | 132 | 7116. | 6634. |
| | 133 | 7182. | 6729. | 134 | 7344. | 6837. | 135 | 7387. | 6875. |
| | 136 | 7578. | 7018. | 137 | 7628. | 7060. | 138 | 7681. | 7109. |
| | 139 | 7813. | 7198. | 140 | 7903. | 7254. | 141 | 7952. | 7344. |
| | 142 | 8047. | 7441. | 143 | 8125. | 7500. | 144 | 8170. | 7578. |
| | 145 | 8281. | 7675. | 146 | 8372. | 7722. | 147 | 8418. | 7813. |
| | 148 | 8516. | 7960. | 149 | 8563. | 8000. | 150 | 8585. | 8047. |
| | 151 | 8704. | 8236. | 152 | 8725. | 8281. | 153 | 8516. | 8446. |
| | 154 | 8377. | 8377. | 155 | 8281. | 8335. | 156 | 8225. | 8337. |
| | 157 | 8047. | 8386. | 158 | 7965. | 8434. | 159 | 7813. | 8458. |
| | 160 | 7653. | 8516. | 161 | 7693. | 8630. | 162 | 7770. | 8750. |
| | 163 | 7731. | 8622. | 164 | 7813. | 8809. | 165 | 7948. | 8984. |
| | 166 | 7932. | 9099. | 167 | 8047. | 9116. | 168 | 8128. | 9219. |
| | 169 | 8251. | 9418. | 170 | 8310. | 9453. | 171 | 8345. | 9624. |
| | 172 | 8441. | 9688. | 173 | 8510. | 9802. | 174 | 8725. | 10131. |
| | 175 | 8375. | 9875. | 176 | 8281. | 9787. | 177 | 8234. | 9735. |
| | 178 | 8186. | 9688. | 179 | 7932. | 9458. | 180 | 7813. | 9333. |
| | 181 | 7718. | 9283. | 182 | 7703. | 9219. | 183 | 7578. | 9095. |
| | 184 | 7506. | 9057. | 185 | 7458. | 8994. | 186 | 7344. | 8874. |
| | 187 | 7263. | 8984. | 188 | 7161. | 9036. | 189 | 7109. | 9087. |
| | 190 | 6998. | 9219. | 191 | 6947. | 9291. | 192 | 6875. | 9339. |
| | 193 | 6652. | 9219. | 194 | 6505. | 9169. | 195 | 6463. | 9162. |
| | 196 | 6443. | 9146. | 197 | 6406. | 9097. | 198 | 6288. | 8982. |
| | 199 | 6071. | 8750. | 200 | 6017. | 8671. | 201 | 5938. | 8531. |
| | 202 | 5927. | 8516. | 203 | 5827. | 8392. | 204 | 5758. | 8281. |
| | 205 | 5703. | 8204. | 206 | 5632. | 8118. | 207 | 5590. | 8047. |
| | 208 | 5469. | 7865. | 209 | 5445. | 7836. | 210 | 5430. | 7813. |
| | 211 | 5325. | 7670. | 212 | 5256. | 7578. | 213 | 5246. | 7566. |
| | 214 | 5234. | 7548. | 215 | 5106. | 7450. | 216 | 5000. | 7365. |
| | 217 | 4959. | 7355. | 218 | 4981. | 7344. | 219 | 4871. | 7215. |
| | 220 | 4776. | 7109. | 221 | 4768. | 7107. | 222 | 4766. | 7097. |
| | 223 | 4543. | 6875. | 224 | 4531. | 6793. | 225 | 4419. | 6641. |
| | 226 | 4314. | 6593. | 227 | 4297. | 6468. | 228 | 4248. | 6406. |

C O N T O U R - GCN1 (CONT.)

GCN 1 2003 ULTIMATE TRAFFIC
AIRPORT - GCN
LEVEL = 70.0 DB AREA = 1.05 METRIC = LDN

| ISLAND | PNT | X | Y | PNT | X | Y | PNT | X | Y |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 229 | 4142. | 6327. | 230 | 4069. | 6172. | 231 | 4063. | 6162. |
| | 232 | 3936. | 6064. | 233 | 3866. | 5938. | 234 | 3828. | 5888. |
| | 235 | 3731. | 5800. | 236 | 3674. | 5703. | 237 | 3594. | 5604. |
| | 238 | 3520. | 5542. | 239 | 3468. | 5469. | 240 | 3359. | 5347. |
| | 241 | 3297. | 5297. | 242 | 3247. | 5234. | 243 | 3125. | 5101. |
| | 244 | 3060. | 5065. | 245 | 3006. | 5000. | 246 | 2656. | 4646. |
| | 247 | 2585. | 4602. | 248 | 2527. | 4531. | 249 | 2188. | 4173. |
| | 250 | 2125. | 4125. | 251 | 2075. | 4063. | 252 | 1719. | 3677. |
| | 253 | 1673. | 3639. | 254 | 1634. | 3594. | 255 | 1250. | 3165. |
| | 256 | 1229. | 3146. | 257 | 1211. | 3125. | | | |
| 2 | 1 | 8831. | 8516. | 2 | 8750. | 8598. | 3 | 8642. | 8516. |
| | 4 | 8750. | 8339. | 5 | 8831. | 8516. | | | |

C O N T O U R - GCN1

GCN 1 2003 ULTIMATE TRAFFIC
AIRPORT - GCN
LEVEL = 75.0 DB AREA = .52 METRIC = LDN

| ISLAND | PNT | X | Y | PNT | X | Y | PNT | X | Y |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1250. | 2378. | 2 | 1110. | 2188. | 3 | 946. | 2029. |
| | 4 | 781. | 1953. | 5 | 562. | 2001. | 6 | 731. | 1769. |
| | 7 | 553. | 1873. | 8 | 565. | 1683. | 9 | 496. | 1455. |
| | 10 | 347. | 1250. | 11 | 325. | 1237. | 12 | 313. | 1210. |
| | 13 | 115. | 1016. | 14 | 91. | 1002. | 15 | 78. | 972. |
| | 16 | -55. | 781. | 17 | -118. | 743. | 18 | -156. | 670. |
| | 19 | -253. | 547. | 20 | -333. | 490. | 21 | -391. | 367. |
| | 22 | -433. | 313. | 23 | -540. | 270. | 24 | -596. | 78. |
| | 25 | -500. | -124. | 26 | -376. | -141. | 27 | -156. | -148. |
| | 28 | -148. | -148. | 29 | -148. | -156. | 30 | -125. | -359. |
| | 31 | -112. | -536. | 32 | 79. | -600. | 33 | 275. | -550. |
| | 34 | 313. | -422. | 35 | 345. | -391. | 36 | 472. | -316. |
| | 37 | 547. | -153. | 38 | 570. | -156. | 39 | 685. | -60. |
| | 40 | 760. | 78. | 41 | 781. | 109. | 42 | 889. | 205. |
| | 43 | 958. | 313. | 44 | 1016. | 384. | 45 | 1102. | 461. |
| | 46 | 1159. | 547. | 47 | 1250. | 660. | 48 | 1313. | 719. |
| | 49 | 1359. | 781. | 50 | 1484. | 934. | 51 | 1526. | 974. |
| | 52 | 1560. | 1016. | 53 | 1719. | 1188. | 54 | 1750. | 1219. |
| | 55 | 1777. | 1251. | 56 | 1953. | 1433. | 57 | 1979. | 1458. |
| | 58 | 2001. | 1484. | 59 | 2188. | 1682. | 60 | 2222. | 1719. |
| | 61 | 2376. | 1859. | 62 | 2462. | 1913. | 63 | 2516. | 2000. |
| | 64 | 2656. | 2180. | 65 | 2663. | 2188. | 66 | 2728. | 2260. |
| | 67 | 2877. | 2422. | 68 | 2894. | 2428. | 69 | 2891. | 2436. |
| | 70 | 3068. | 2656. | 71 | 3107. | 2674. | 72 | 3125. | 2695. |
| | 73 | 3256. | 2825. | 74 | 3353. | 2897. | 75 | 3419. | 3006. |
| | 76 | 3500. | 3125. | 77 | 3547. | 3171. | 78 | 3594. | 3234. |
| | 79 | 3694. | 3359. | 80 | 3700. | 3427. | 81 | 3828. | 3526. |
| | 82 | 3860. | 3594. | 83 | 3968. | 3689. | 84 | 4063. | 3827. |
| | 85 | 4063. | 3828. | 86 | 4174. | 3951. | 87 | 4244. | 4063. |
| | 88 | 4297. | 4132. | 89 | 4373. | 4220. | 90 | 4418. | 4297. |
| | 91 | 4531. | 4455. | 92 | 4567. | 4495. | 93 | 4589. | 4531. |
| | 94 | 4760. | 4760. | 95 | 4765. | 4766. | 96 | 4765. | 4766. |
| | 97 | 4766. | 4767. | 98 | 4978. | 5009. | 99 | 4990. | 5010. |
| | 100 | 5000. | 5024. | 101 | 5200. | 5234. | 102 | 5220. | 5249. |
| | 103 | 5234. | 5272. | 104 | 5416. | 5469. | 105 | 5444. | 5493. |
| | 106 | 5469. | 5522. | 107 | 5630. | 5703. | 108 | 5670. | 5736. |
| | 109 | 5703. | 5771. | 110 | 5855. | 5938. | 111 | 5900. | 5975. |
| | 112 | 5938. | 6029. | 113 | 6073. | 6172. | 114 | 6127. | 6217. |

INTEGRATED NOISE MODEL - CONTOUR ANALYSIS REPORT

C O N T O U R - GCN1 (CONT.)

GCN 1 2003 ULTIMATE TRAFFIC
AIRPORT - GCN
LEVEL = 75.0 DB AREA = .52 METRIC = LDN

| ISLAND | PNT | X | Y | PNT | X | Y | PNT | X | Y |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 115 | 6172. | 6278. | 116 | 6297. | 6406. | 117 | 6360. | 6452. |
| | 118 | 6406. | 6509. | 119 | 6545. | 6641. | 120 | 6599. | 6682. |
| | 121 | 6641. | 6732. | 122 | 6793. | 6875. | 123 | 6839. | 6911. |
| | 124 | 6875. | 6957. | 125 | 7029. | 7109. | 126 | 7074. | 7145. |
| | 127 | 7109. | 7189. | 128 | 7270. | 7344. | 129 | 7312. | 7375. |
| | 130 | 7344. | 7416. | 131 | 7522. | 7578. | 132 | 7553. | 7603. |
| | 133 | 7578. | 7654. | 134 | 7688. | 7813. | 135 | 7746. | 7846. |
| | 136 | 7802. | 8047. | 137 | 7759. | 8254. | 138 | 7670. | 8281. |
| | 139 | 7576. | 8317. | 140 | 7406. | 8344. | 141 | 7344. | 8429. |
| | 142 | 7124. | 8501. | 143 | 7109. | 8506. | 144 | 7108. | 8514. |
| | 145 | 7107. | 8516. | 146 | 7102. | 8523. | 147 | 7023. | 8750. |
| | 148 | 6980. | 8855. | 149 | 6875. | 8944. | 150 | 6710. | 8915. |
| | 151 | 6601. | 8820. | 152 | 6543. | 8750. | 153 | 6472. | 8684. |
| | 154 | 6406. | 8611. | 155 | 6321. | 8516. | 156 | 6252. | 8436. |
| | 157 | 6172. | 8309. | 158 | 6158. | 8281. | 159 | 6057. | 8162. |
| | 160 | 5984. | 8047. | 161 | 5938. | 7982. | 162 | 5861. | 7889. |
| | 163 | 5811. | 7813. | 164 | 5703. | 7654. | 165 | 5671. | 7610. |
| | 166 | 5649. | 7578. | 167 | 5526. | 7401. | 168 | 5483. | 7344. |
| | 169 | 5476. | 7337. | 170 | 5469. | 7322. | 171 | 5303. | 7109. |
| | 172 | 5207. | 7077. | 173 | 5234. | 7034. | 174 | 5214. | 7089. |
| | 175 | 5006. | 7086. | 176 | 4846. | 7029. | 177 | 4804. | 6875. |
| | 178 | 4649. | 6709. | 179 | 4531. | 6500. | 180 | 4474. | 6464. |
| | 181 | 4452. | 6406. | 182 | 4310. | 6185. | 183 | 4353. | 6172. |
| | 184 | 4309. | 6159. | 185 | 4297. | 6085. | 186 | 4267. | 5938. |
| | 187 | 4150. | 5820. | 188 | 4063. | 5737. | 189 | 4041. | 5703. |
| | 190 | 4001. | 5530. | 191 | 3828. | 5528. | 192 | 3779. | 5469. |
| | 193 | 3787. | 5275. | 194 | 3579. | 5337. | 195 | 3497. | 5234. |
| | 196 | 3554. | 5040. | 197 | 3359. | 5083. | 198 | 3280. | 5000. |
| | 199 | 3321. | [illegible] | 200 | 3203. | 4706. | 201 | 3125. | 4685. |
| | 202 | 3052. | 4531. | 203 | 2916. | 4401. | 204 | 2837. | 4350. |
| | 205 | 2793. | 4258. | 206 | 2656. | 4119. | 207 | 2602. | 4063. |
| | 208 | 2422. | 3848. | 209 | 2413. | 3837. | 210 | 2405. | 3828. |
| | 211 | 2168. | 3602. | 212 | 2180. | 3594. | 213 | 2080. | 3413. |
| | 214 | 1991. | 3321. | 215 | 1914. | 3202. | 216 | 1830. | 3125. |
| | 217 | 1774. | 3070. | 218 | 1719. | 2977. | 219 | 1654. | 2891. |
| | 220 | 1572. | 2803. | 221 | 1484. | 2673. | 222 | 1472. | 2656. |
| | 223 | 1371. | 2535. | 224 | 1281. | 2422. | 225 | 1250. | 2378. |

```
15.22.49.INM3,CM250000,P30,STCX3,T1000,I0500.
15.22.49.USER(C1A2A,)
15.22.49.*
15.22.49.* GCN1 IS INPUT DATA FILE ON CX1
15.22.49.CFT,ST=CX1.
15.22.50.CFT,GET,SYSIN=GCN1.
15.22.50.$BEGIN,AFLPRC,ZZZZ*FL.
   ..AFLINK,ST=CX1,I=ZZZZIUP.
   .. PTFS  - USER,C1A2A.
   ..AFLINK,SYSTM,I=ZZZZIUP.
      PTFS  - GET,GCN1.
```

APPENDIX "ER-C"

Model Zoning Ordinance

Ordinance No.__________

AIRPORT LAND USE ZONING REGULATIONS

--------------------- AIRPORT

----------------------, ARIZONA

SECTION I. Purpose: The purpose and intent of the regulations adopted pursuant to this ordinance shall be to encourage land use patterns for housing and other local needs that will separate uncontrollable noise sources from residential and other noise sensitive areas and to facilitate the orderly development of areas around airports by establsihing regulations that must be met before such development will be permitted.

SECTION II. Authority: This regulation is adopted pursuant to Sections ------INSERT STATE STATUTES------------

SECTION III. Definitions: "Airport" means an area used or intended to be used for the landing and takeoff of aircraft.

"Ldn Level" means Day-Night Average Sound Level as computed pursuant to Federal Avaition Administration and Environmental Protection Agency standards and procedures and arranged in contours on a map of airport area of influence.

"Designated Area" is that area round an airport for which land use controls are needed to prevent development that would be sensitive to aircraft noise.

"Ldn Zone 2" is a designated area over which the noise level is between 65 and 75 Ldn.

"Ldn Zone 3" is a designated area over which the noise level exceeds Ldn 75.

"Compatible Use" means a use which is presumed to be compatible for the zone in which it is proposed and may be permitted pursuant to these regulations. A compatible use shall not be regarded as a use by right. "Incompatible Use" means a use which shall not be permitted in the Ldn zone where it is proposed.

SECTION IV. Scope: These regulations shall apply to development within the airport Ldn zones 2 and 3 as defined above.

SECTION V: Nonconforming Uses: The provisions of these regulations shall not apply to any nonconforming use existing on the effective date of the regulations, providing that when the nonconforming use is discontinued for a period of six months or the nonconforming structure is destroyed or damaged to the extent of over 50% of the assessed valuation of the nonconforming structure, any reuse, reconstruction or replacement shall be deemed a new use and shall be subject to the applicable provisions of these regulations.

SECTION VI. Establishment of Airport Zones:

1. In order to carry out the provisions of these regulations, the designated area around __________ Airport shall hereby be divided into the following zones:

a. Ldn Zone 2
b. Ldn Zone 3

2. The boundaries of the above zones are hereby established as shown in the map entitled "Airport Land Use Regulation Map for ________________ Airport" which map and all proposed amendments thereto are hereby incorporated by reference and made a part of this regulation.

3. In determining the boundaries of the above zones, the projected growth and the projected class of the airport as designated in the current approved Airport Master Plan or the Arizona Airport System Plan shall be considered.

SECTION VII. Land Use Schedule:

Except when permitted by a variance issued by the zoning authority:

1. development upon land within the designated airport area shall be regulated in accordance with the following schedule of land uses for various airport zones.

2. any development which is proposed that is in more than one zone shall be limited to the more restrictive use.

3. no designation of compatible use contained in this schedule shall be constued to abrogate or controvene the provisions of any local zoning ordinance or other local, state or federal regulation.

4. the following are designated compatible uses in Ldn Zone 3:

A. Open space.
B. Mining, fishing and agriculture except milk, dairy and poultry production.

C. When operated on land owned or leased by the airport authority: golf courses, tennis courts, riding and hiking trails.

All other uses are designated as incompatible uses in Ldn Zone 3.

5. The following are designated as compatible uses in Ldn Zone 2:

A. All uses designated as compatible in Ldn Zone 3.
B. Playgrounds and parks, including amusement parks.
C. Golf courses, riding stables and cemeteries.
D. Retail commercial establishments.
E. Commercial establishments including wholesale manufacturing, transportation, communications and utilities, but excluding outdoor theaters and stadiums.
F. Other agriculture.
G. Hotels and motels, provided that construction techniques provide ten decibles extra noise reduction over the industry average for similar structures and that such reduction is certified to by a qualified architect, structural engineer or acoustical engineer registered in the State of Arizona; and further provided that airport hazard insurance is available to said establishments. All other uses are designated incompatible uses in Ldn Zone 2.

SECTION VIII. Administration: It shall be the duty of the ________________ to administer and enforce the regulations prescribed herein. Applications for variances shall be made to said ______________________ upon forms furnished by it. Applications required by these regulations, to be submitted to said _________________shall be promptly considered and granted or denied by it. Appeals, judicial review, enforcement and remedies shall be provided pursuant to Sections -------INSERT STATE STATUTES-------.

SECTION IX. Zoning Commission: (This section should set out whether, ------INSERT STATE STATUTES-------, the zoning authority will act as the zoning commission, designate the planning commission to act as zoning commission, or appoint a zoning commission.

SECTION X. Where there exists a conflict between any of the regulations and limitations prescribed herein and any other regulations applicable to the same area, the more stringent limitation or requirement shall govern and prevail.

SECTION XI. Severability: If any of the provisions of these regulations or the application thereof to any person or circumstances is held invalid, such invalidity shall not affect other provisions or applications of these regulations which can be given effect without the invalid provision or application, and to this end the provisions of these regulations are declared to be severable.

SECTION XII. Effective Date: These regulations shall be in full force and effect from and after their passage by the

------------------------------------------------------------------------

------------------.

Passed, adopted and approved ----------------------------------

---------------------------, the _______day of ---------------, 1984.

----------------------------------------