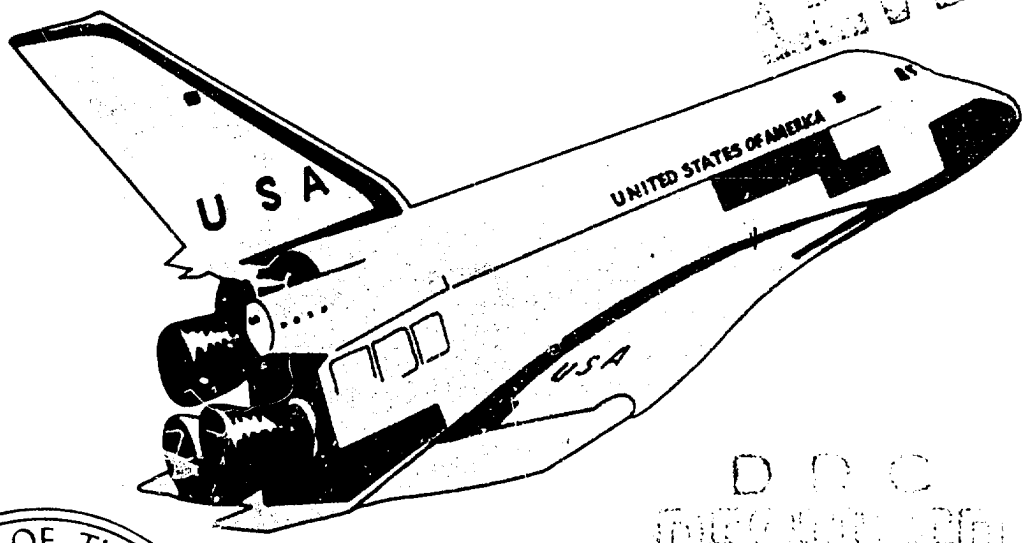
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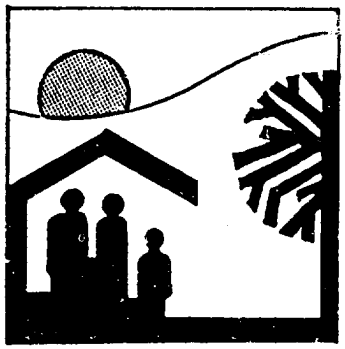
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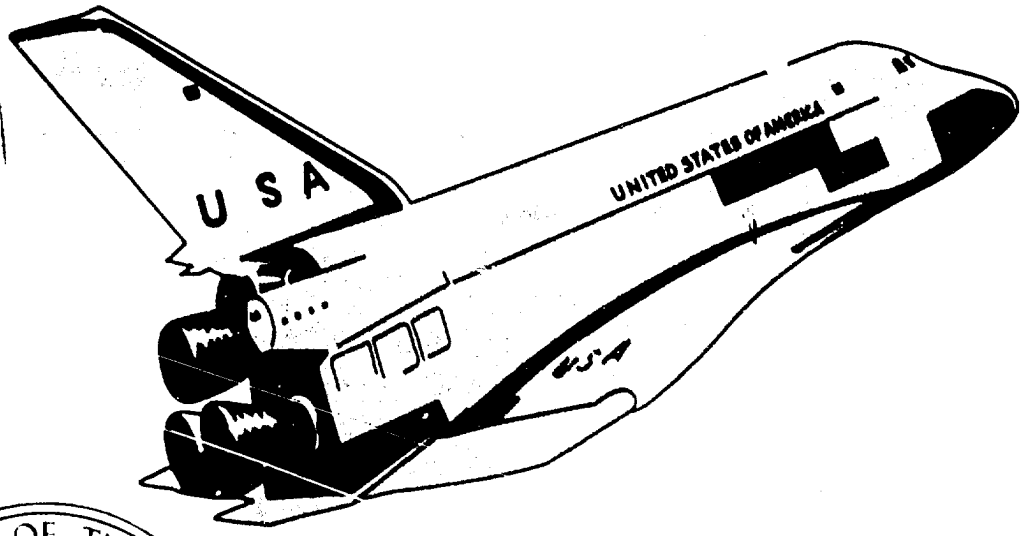
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SUMMARY

1. STATEMENT STATUS

( ) Candidate ( ) Draft (X) Final

2. NAME AND STATUS OF ACTION

Space Shuttle Program at VAFB, California

(X) Administrative ( ) Legislative

3. DESCRIPTION OF PROPOSED ACTION

The proposed action comprises construction, activation, and operation of Space Shuttle facilities at Vandenberg Air Force Base (VAFB) and Port Hueneme harbor, California. There are seven elements in the proposed action, namely:

- Landing strip extension and other modifications at Vandenberg airfield to accommodate Orbiter landings.
- New Orbiter processing facilities adjacent to Vandenberg airfield.
- New facilities at Port Hueneme harbor to receive, wash, and disassemble recovered spent Solid Rocket Boosters (SRBs) delivered by sea.
- New Marine Facility on the VAFB coast for receipt of Shuttle External Tanks (ETs).
- A tow route and tow road, partially using existing roads, for transporting, respectively, (1) the Orbiter from the processing facility at the airfield and (2) the External Tanks from the Marine Receiving Facility and Tank Storage and Checkout Facility to the launch pad at Space Launch Complex No. 6 (SLC-6).
- Modified, expanded support facilities at and near SLC-6 for handling of cryogenic propellants, and ET and SRB storage and processing; and at Coast and Mesa Roads near SLC-4 for receiving, inspection and storage of Titan III Solid Rocket Motors.

- Modified, expanded launch pad facilities at SLC-6 to accommodate Space Shuttle buildup, countdown, and launch.

4. ENVIRONMENTAL IMPACTS

The environment may experience impacts of insignificant to substantial magnitude by one or more of the following aspects of the proposed action:

Appropriations expenditures
Personnel
Demolition
Blasting
Dredging
Utilities realignment
Clearing, grading, excavation
Drainage system development
Paving, grooving
Heavy equipment operation
Pile driving
Riprap emplacement
Concrete preparation
Structures erection
Equipment installation
Fencing
Revegetation/landscaping
Waste disposal
Commuting traffic
Existence of facilities
Maintenance
Supporting traffic
Orbiter ferrying, mating, demating
Orbiter servicing
Subsystems servicing
Dockside activities
Marine facility preparation
Marine, rail, air, truck transport
Barge docking, disembarking
Solid Rocket Booster servicing, storage
External Tank servicing, storage
Component integration
Payload preparation, handling
Propellant handling
Auxiliary power unit operation
Deluge water use
Rocket engine operation
Shuttle launch, ascent
Shuttle abort
Orbiter descent, approach, landing
Pad refurbishment
Parachute refurbishment
Hazardous area clearance
Wastewater handling, disposal
Spectator activity
Accidental spills, fires, explosions

The environmental factors to be impacted by the above include:

Shoreline stability
Topography
Soils
Hydrology
Water quality
Air quality
Microclimate
Noise
Terrestrial flora
Terrestrial fauna
Aquatic flora
Aquatic fauna
Rare, endangered, threatened species
Archaeology
Economy
Employment
Industry
Population
Housing
Land use
Urban services
Transportation
Recreation
Aesthetics, serenity, well being

5. PROBABLE ADVERSE ENVIRONMENTAL EFFECTS

Presently identifiable adverse impacts that could occur as a result of the proposed action and potential accidental occurrences associated with it include:

- Minor alteration of shoreline stability and topography in relatively small areas for marine facilities construction.

- Mechanical removal of soil in relatively small areas for facilities construction.

- Possible chemical changes in soils in limited areas as a result of minor spillage associated with construction activities and operational accidents.

- Minor changes in drainage/runoff patterns in relatively small areas.

- Transient and perhaps recurrent minor degradation of water quality in limited areas resulting from construction site runoff and operational accidents.

- Transient, recurrent elevation of noise levels in Lompoc and environs (northwestern Santa Barbara County).

- Occurrence of sporadic to periodic sonic booms in various areas of the region.

- Permanent removal of common and special interest vegetation/flora in relatively small areas for facilities construction.

- Transient and possibly recurrent exposure of agricultural crops, common native and exotic vegetation, and special interest vegetation/flora in limited areas to small concentrations of toxic rocket exhaust products.

- Permanent removal of faunal habitats for facilities construction in relatively small areas, and associated increases in human disturbance to fauna in adjacent areas. However, none of these areas are designated as critical habitats.

- Transient recurrent exposure of fauna in limited areas to sonic booms and high intensity rocket noise.

- Transient and possibly recurrent exposure of fauna in limited areas to small concentrations of toxic rocket exhaust products.

- Possible wildfires.

- Disturbance of archaeological resources in some construction areas.

- Temporary, recurrent curtailments of recreational uses of beach areas (Ocean Beach, Jalama Beach) during launches.

- Short term, incremental contributions to the decrease in serenity in northwestern Santa Barbara County.

- Land use changes (small amounts of agricultural land converted to residential and other urban uses).

- Minor increase in demand for urban services in adjacent communities.

6. ALTERNATIVES

Various alternatives to the proposed action were defined and investigated. The major classes of alternatives are listed below:

- No action
- Delayed action
- Alternative to the VAFB launch site
- Alternatives to the proposed launch complex
- Alternatives to the proposed landing complex
- Alternatives to the proposed ET delivery
- Alternatives to the proposed intrabase transport of Space Shuttle components at VAFB
- Alternatives to the proposed SRB processing

7. AGENCIES FROM WHICH COMMENTS HAVE BEEN RECEIVED

Copies of the Draft Environmental Statement (DES) were provided for review and comment to Federal Agencies, State and local government, and the general public. Written comments were received from the following:

FEDERAL AGENCIES

Department of the Army
Los Angeles District,
Corps of Engineers
P.O. Box 2711
Los Angeles, CA 90053
FROM: Hugh G. Robinson, Colonel, CE
District Engineer

U.S. Department of Commerce
National Oceanic and Atmospheric
Administration
National Marine Fisheries Service
Southwest Region
300 South Ferry Street
Terminal Island, CA 90731
FROM: Gerald V. Howard
Regional Director

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Marine Mammal Division
7600 Sand Point Way, NE
Seattle, WA 98115
FROM: George Y. Harry, Jr.
Director, Marine Mammal Division

U.S. Department of Commerce
The Assistant Secretary for Science and Technology
Washington, D.C. 20230
FROM: Sidney R. Galler
Deputy Assistant Secretary for Environmental Affairs

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Ocean Survey
Rockville, MD 20852
FROM: Gordon Lill
Deputy Director
National Ocean Survey

Department of Health, Education, and Welfare
Office of the Secretary
Washington, D.C. 20201
FROM: Charles Custard
Director, Office of Environmental Affairs

U.S. Department of the Interior
Office of the Secretary
Washington, D.C. 20240
FROM: Larry E. Meierotto
Deputy Assistant Secretary

National Aeronautics and Space Administration
Washington, D.C. 20546
FROM: Nathaniel B. Cohen, Director
Office of Policy Analysis

Department of the Navy
Office of the Assistant Secretary
(Manpower, Reserve Affairs and Logistics)
Washington, D.C. 20360
FROM: Everett Pyatt
Principal Deputy
Assistant Secretary of the Navy
(Logistics)

Department of Transportation
Federal Aviation Administration
Western Region
P.O. Box 92007
Worldway Postal Center
Los Angeles, CA 90009
FROM: W. Bruce Chambers
Regional Planning Officer

Department of Transportation
United States Coast Guard
Eleventh Coast Guard District
Union Bank Building
400 Oceangate
Long Beach, CA 90822
FROM: R.C. Hertica
Captain, U.S. Coast Guard
Chief, Marine Safety Division
By direction of the District Commander

Advisory Council on Historic Preservation
1522 K Street, NW
Washington, D.C. 20005
FROM: Louis S. Wall
Assistant Director, Office of Review and Compliance

Marine Mammal Commission
1625 Eye Street, NW
Washington, D.C. 20006
FROM: Robert J. Hofman
Acting Executive Director

STATE GOVERNMENT AND AGENCIES

California Coastal Commission
1540 Market Street
San Francisco, CA 94102
FROM: William R. Ahern
Ports and Energy Coordinator

California Coastal Commission
South Central Coast Regional Commission
1224 Coast Village Circle
Suite 36
Santa Barbara, CA 93108
FROM: Philip G. Berry
Staff Planner

University of California, Irvine
Department of Ecology and Evolutionary Biology
School of Biological Sciences
Irvine, CA 92717
FROM: R.L. Pitman
M. Naughton
P. Kelly
A. Martin
B. Burgeson

The Resources Agency of California
Office of the Secretary
Resources Building
1416 Ninth Street
Sacramento, CA 95814
FROM: L. Frank Goodson
Assistant Secretary for Resources

LOCAL GOVERNMENT, CIVILIAN AGENCIES AND GENERAL PUBLIC

County of Santa Barbara
Office of Environmental Quality
105 East Anapamu Street
Santa Barbara, CA 93101
FROM: Albert F. Reynolds
Environmental Quality Coordinator

County of Santa Barbara
Board of Supervisors
105 East Anapamu Street
Santa Barbara, CA 93101
FROM: Harrell Fletcher, Chairman

County of Santa Barbara
Health Care Services
Air Pollution Control District
4440 Calle Real
Santa Barbara, CA 93110
FROM: John B. English
Director, Air Pollution Control

County of Santa Barbara
Department of Transportation
Court House
Santa Barbara, CA 93101
FROM: Leland R. Steward
Director of Transportation

County of Santa Barbara
Health Care Services
4440 Calle Real
Santa Barbara, CA 93110
FROM: Lawrence Hart, M.D., M.P.H.
Director

County of Santa Barbara
Office of Environmental Quality
105 East Anapamu Street
Santa Barbara, CA 93101
FROM: Cecilia Ann Terry

LOCAL GOVERNMENT, CIVILIAN AGENCIES AND GENERAL PUBLIC (Cont'd.)

County of Santa Barbara
Department of Planning
Engineering Building
123 East Anapamu Street
Santa Barbara, CA 93101
FROM: Kim Skinnarland
Project Manager
Local Coastal Program

Santa Barbara County-Cities
Area Planning Council
1306 Santa Barbara Street
Santa Barbara, CA 93101
FROM: Clifford Petrie
Executive Secretary

The American Cetacean Society
National Headquarters
P.O. Box 4416
San Pedro, CA 90731
FROM: Millie Payne
Executive Secretary

California Wildlife Trust
3435 Hermosa Avenue
Hermosa Beach, CA 90254
FROM: Edward S. Loosli
Director

Lompoc Valley Economic Development
Association
205 North H Street
Lompoc, California 93436
FROM: C.C. Carmichael
Director

Mr. John E. Eastin
1100 La Salle Canyon Road
Lompoc, CA 93436

8. DOCUMENT AVAILABILITY

Copies of the FES and background Environmental Baseline Studies have provided for the convenience of the general public at the locations listed below.

USAF INFORMATION OFFICES

Information Office
Vandenberg AFB, CA 93437

Information Office
HQ Space and Missile Systems Organization
P.O. Box 92960, Worldway Postal Center
Los Angeles, CA 90009

LIBRARIES

Lompoc Public Library
601 East North Avenue
Lompoc, CA 93436

San Francisco Public Library
Civil Center
San Francisco, CA 94102

LIBRARIES (Cont'd.)

Santa Maria Public Library
420 South Broadway
Santa Maria, CA 93454

University of California at Santa Santa Barbara
Library
Goleta, CA 93017

Santa Barbara Public Library
4040 East Anapamu Street, Box 1019
Santa Barbara, CA 93102

Los Angeles Public Library
630 West 5th Street
Los Angeles, CA 90017

University of California at Los Angeles
Library
405 Hillguard
Los Angeles, CA 90024

U.C. Berkeley Library
2090 Kitterage Street
Berkeley, CA 94704

U.C. Riverside Library
7th and Orange/Box 468
Riverside, CA 92502

Oxnard Public Library
241 A "C" Street
Oxnard, CA 93030

Ventura Public Library
651 East Main Street, Box 771
Ventura, CA 93001

Santa Barbara City College Library
712 Cliff Drive
Santa Barbara, CA 93109

San Luis Obispo Public Library
San Luis Obispo, CA 93401

9. DOCUMENT FILING

The DES and FES were filed with the President's Council on Environmental Quality in August 1977 and January 1978, respectively.

TABLE OF CONTENTS

	Page
List of Data Briefs	xvi
List of Figures	xvii
List of Matrices	xix
List of Tables	xx
1.0 Introduction to the Proposed Action	1-1
1.1 The Proposed Action	1-1
1.2 Purpose	1-1
1.2.1 Space Shuttle System at Vandenberg Air Force Base	1-1
1.2.2 Environmental Statement	1-3
1.3 Overview	1-4
1.3.1 National Goal	1-4
1.3.2 National Space Transportation System Program	1-5
1.3.3 Space Shuttle Vehicle	1-6
1.3.4 Space Shuttle Operations	1-8
1.3.4.1 Flight Operations	1-9
1.3.4.2 Ground Operations	1-9
1.3.5 Site and Surrounding Region of the Proposed Action	1-10
2.0 Description of the Proposed Action	2-1
2.1 Orbiter Sequence	2-5
2.2 Solid Rocket Booster Sequence	2-18
2.3 External Tank Sequence	2-27
2.4 Launch Pad Operations Sequence	2-31
2.5 Implementation of the Proposed Project	2-45
2.5.1 Construction/Activation	2-45
2.5.1.1 Construction/Activation Implementation Schedule	2-49
2.5.1.2 Summary of Direct Costs for Construction/Activation	2-49
2.5.1.3 Manpower Summary for Construction/Activation	2-52
2.5.2 Operations	2-54
2.5.2.1 Operations Implementation Schedule	2-54
2.5.2.2 Summary of Direct Costs for Operations	2-55
2.5.2.3 Manpower Summary of Operations	2-57
3.0 Description of the Existing Environment	3-1
3.1 Physical, Chemical, Biological, and Archaeological Environment	3-2
3.1.1 Topography and Geomorphology	3-2
3.1.1.1 Topography	3-2
3.1.1.2 Geomorphology	3-7B
3.1.2 Geology	3-9
3.1.2.1 Surface Geology	3-9
3.1.2.2 Subsurface Geology	3-10
3.1.2.3 Soils	3-13
3.1.2.4 Geologic Hazards	3-16
3.1.3 Water Resources/Quality	3-18
3.1.3.1 Surface Water	3-18
3.1.3.2 Groundwater	3-21
3.1.3.3 Water Quality	3-26

TABLE OF CONTENTS (Continued)

		Page
3.1.4	Oceanography	3-30
	3.1.4.1 Currents and Circulation	3-30
	3.1.4.2 Tides	3-31
	3.1.4.3 Seas and Swells	3-31A
	3.1.4.4 Tsunamis	3-33
3.1.5	Sedimentology	3-33
	3.1.5.1 Erosion and Transport	3-33
	3.1.5.2 Sediment Budget	3-35
3.1.6	Meteorology	3-36
	3.1.6.1 Regional Climatology	3-36
	3.1.6.2 Site Climatology	3-37
3.1.7	Air Quality	3-40
3.1.8	Noise	3-42
	3.1.8.1 Noise in the Rural Environment	3-47
	3.1.8.2 Noise in the Urban Environment	3-47
	3.1.8.3 Other Noise in Rural and Urban Environments	3-49
3.1.9	Biology	3-53
	3.1.9.1 Terrestrial Biota	3-53
	3.1.9.2 Freshwater Biota	3-68
	3.1.9.3 Marine Biota	3-70
3.1.10	Archaeology	3-75
	3.1.10.1 General Archaeological Setting	3-75
	3.1.10.2 Vandenberg Archaeological Sites	3-75
	3.1.10.3 Port Hueneme Archaeological Sites	3-77
	3.1.10.4 Channel Islands Archaeological Sites	3-77
3.2	Socioeconomic Environment	3-77A
3.2.1	The Effects Region	3-77A
	3.2.1.1 Immediate Effects Area	3-77A
	3.2.1.2 Intermediate Effects Area	3-78
	3.2.1.3 Regional Effects Area	3-80
3.2.2	Social Characteristics	3-80
	3.2.2.1 Demographic Profile	3-81
	3.2.2.2 Labor Force Size and Availability	3-86
3.2.3	Existing Land Use Patterns	3-87
	3.2.3.1 Land Use in the Immediate Effects Area	3-87
	3.2.3.2 Future Development	3-88
	3.2.3.3 Land Use in the Port Hueneme Area	3-92
3.2.4	Housing Market	3-92
3.2.5	Economic Profile	3-95
	3.2.5.1 Regional and Intermediate Effects Areas	3-95
	3.2.5.2 Santa Barbara County	3-95
3.2.6	Public Services	3-99
	3.2.6.1 Education	3-99
	3.2.6.2 Medical Services	3-101
	3.2.6.3 Police Protection	3-101
	3.2.6.4 Fire Protection	3-102
	3.2.6.5 Electrical Utilities	3-102

TABLE OF CONTENTS (Continued)

	Page
3.2.6.6 Water Supply and Distribution	3-102
3.2.6.7 Wastewater Distribution and Treatment	3-102
3.2.6.8 Solid Waste Disposal	3-103A
3.2.6.9 Natural Gas Supply	3-103B
3.2.6.10 Telephone Communications	3-103B
3.2.6.11 Highways	3-103B
3.2.6.12 Rail Transportation	3-105
3.2.6.13 Marine Transportation	3-106
3.2.6.14 Air Transportation	3-107
3.2.7 Cultural Amenities	3-109
3.2.7.1 Public Recreation	3-109
3.2.7.2 Vandenberg Air Force Base Recreation	3-111
3.2.7.3 Marine Sportfishing	3-111
3.2.7.4 Historical Setting	3-111
3.2.7.5 The Channel Islands	3-112
3.2.7.6 Aesthetics	3-113
4.0 Relationship of Proposed Action to Land Use Plans, Policies, and Controls	4-1
4.1 Relationships Onbase	4-1
4.2 Relationships Offbase	4-3A
5.0 Environmental Impact of the Proposed Project	5-1
5.1 Physical, Chemical, Biological, and Archaeological Impacts	5-10
5.1.1 Construction Impacts	5-10
5.1.1.1 Impact on Air Quality	5-10
5.1.1.2 Impact on Shoreline Stability	5-11
5.1.1.3 Impact on Topography and Soils	5-11
5.1.1.4 Impact on Hydrology and Water Quality	5-14
5.1.1.5 Impact on Noise	5-17
5.1.1.6 Impact on Biology	5-18
5.1.1.7 Impact on Archaeological Resources	5-20
5.1.2 Operations Impacts	5-21
5.1.2.1 Impact on Air Quality	5-21
5.1.2.2 Impact on Microclimate	5-30
5.1.2.3 Impact on Shoreline Stability	5-32
5.1.2.4 Impact on Topography, Geology, and Soils	5-32
5.1.2.5 Impact on Hydrology and Water Quality	5-34
5.1.2.6 Impact on Noise	5-35
5.1.2.7 Impact on Biology	5-46
5.1.2.8 Impact on Archaeological Resources	5-48I
5.1.2.9 Inadvertent Weather Modification	5-48A
5.2 Socioeconomic Impacts	5-49
5.2.1 Construction/Activation Phase	5-49
5.2.1.1 Indirect Economic Impact	5-49
5.2.1.2 Indirect Employment Impact	5-52
5.2.1.3 Impact on the Industrial Sector	5-52
5.2.1.4 Impact on Population Growth	5-54
5.2.1.5 Impact on the Housing Market	5-57
5.2.1.6 Impact on Current Land Use	5-57
5.2.1.7 Impact on Public Services	5-57
5.2.1.8 Impact on Cultural Amenities	5-61

TABLE OF CONTENTS (Continued)

Page

5.2.2 Operations Phase 5-62
5.2.2.1 Indirect Economic Impact 5-63
5.2.2.2 Indirect Employment Impact 5-65
5.2.2.3 Impact on the Industrial Sector 5-66
5.2.2.4 Impact on Population Growth 5-67
5.2.2.5 Impact on the Housing Market 5-71
5.2.2.6 Impact on Current Land Use 5-71
5.2.2.7 Impact on Public Services 5-71
5.2.2.8 Impact on Cultural Amenities 5-77
6.0 Alternatives 6-1
6.1 Program Planning 6-1
6.1.1 No Action 6-1
6.1.2 Delayed Action 6-2
6.1.3 Alternative Launch Site 6-2
6.2 Facilities and Operations Planning 6-4
6.2.1 Launch Complex Alternatives 6-4
6.2.1.1 Separate Buildup and Launch Facilities 6-4
6.2.1.2 Two Launch Pads 6-4
6.2.1.3 All-New Launch Complex 6-5
6.2.2 Landing Complex Alternatives 6-5
6.2.2.1 South Vandenberg Landing Complex 6-6
6.2.2.2 Alternative Modifications of Landing Complex 6-6
6.2.2.3 Offbase Landing Complex 6-7
6.2.3 External Tank Delivery Alternatives 6-9
6.2.3.1 Different Delivery Vehicles and Onsite Fabrication 6-9
6.2.3.2 Direct Delivery to Vandenberg by Deep Draft Barge 6-9
6.2.3.3 Direct Delivery to Vandenberg by Transoceanic Air Cushion Barge..... 6-10A
6.2.3.4 Delivery to Port Hueneme/Transshipment to Vandenberg by Hovercraft.... 6-10B
6.2.3.5 Delivery to Alternate Port/Overland Transport to Vandenberg 6-11
6.2.3.6 Delivery to Port Hueneme/Transshipment of Single Tanks to Harbor at Vandenberg by Shallow Draft Barge 6-12
6.2.3.7 Delivery to Offshore Docking Facility/Airborne Transfer to Vandenberg 6-13
6.2.4 Alternatives for Transport of Components on Vandenberg 6-13A
6.2.4.1 Alternate Tow Routes 6-15
6.2.4.2 Alternate Transport Vehicles 6-16
6.2.5 Alternate Spent Solid Rocket Booster Processing 6-17
6.2.5.1 Direct Delivery of Recovered Boosters to Vandenberg 6-17
6.2.5.2 Booster Disassembly at Port Hueneme 6-17
6.2.5.3 Offsite Refurbishment of All Booster Sections 6-18
6.2.5.4 Offsite Parachute Processing 6-18
7.0 Probable Adverse Environmental Effects Which Cannot be Avoided Should the Proposal be Implemented 7-1
7.1 Unavoidable Adverse Impacts 7-1
7.2 Suggested Mitigation Measures for Avoidable Adverse Impacts 7-3
8.0 Relationship Between Local Short Term Use of Man's Existing Environment and the Maintenance of Long Term Productivity 8-1
9.0 Irreversible and Irretrievable Commitments of Resources 9-1
10.0 Considerations That Offset the Adverse Environmental Effects 10-1

TABLE OF CONTENTS (Continued)

		Page
11.0	Energy Conservation	11-1
11.1	Energy Conservation Requirements	11-1
11.2	Energy Supply and Demand	11-1
11.2.1	Electrical Energy	11-1
11.2.2	Natural Gas	11-3
11.2.3	Petroleum Products	11-4
11.3	Potential Mitigation Measures to Reduce Energy Consumption	11-5
11.3.1	Construction	11-5
11.3.1.1	Architectural and Civil Engineering Design	11-5
11.3.1.2	Plumbing, Heating, Ventilation, and Air Conditioning Design	11-6
11.3.1.3	Electrical Design	11-7
11.3.2	Operations	11-7
11.3.3	Maintenance	11-8
11.3.4	Other Energy Conservation Measures	11-8
12.0	Details of Unresolved Issues	12-1
13.0	Consultation and Coordination with Others	13-1
14.0	Bibliographic References	14-1
15.0	Glossary of Selected Terms	15-1
16.0	List of Acronyms and Abbreviations	16-1

Appendices A thru Y Comments and Responses

LIST OF DATA BRIEFS

Data Brief Number	Title	Page
2.1-1	Orbiter	2-9
2.1-2	Orbiter Ferry	2-9
2.1-3	Mate/Demate Facility and Operations	2-10
2.1-4	Orbiter Descent Operations	2-11
2.1-5	Orbiter Approach Operations	2-11
2.1-6	Airfield Landing Facility	2-12
2.1-7	Orbiter Landing Operations	2-13
2.1-8	Orbiter Safing/Deservicing Facility and Operations	2-14
2.1-9	Orbiter Maintenance/Checkout Facility and Operations	2-15
2.1-10	Orbiter Hypergolic Servicing Facility and Operations	2-16
2.1-11	Space Transportation System Tow Route	2-17
2.2-1	Solid Rocket Booster	2-21
2.2-2	Port Hueneme Harbor--Solid Rocket Booster Recovery	2-22
2.2-3	Solid Rocket Booster Wash Facility and Operations at Port Hueneme	2-23
2.2-4	Solid Rocket Booster Disassembly Facility and Operations	2-24
2.2-5	Parachute Refurbishment Facility and Operations	2-25
2.2-6	Solid Rocket Booster Receiving, Refurbishment, and Subassembly Facility and Operations	2-26
2.2-7	Titan IIID Receiving Inspection and Storage Facility	2-26A
2.3-1	External Tank	2-28
2.3-2	External Tank Storage and Checkout Facility/Operations at Vandenberg	2-28
2.3-3	Shallow Draft Barge Delivery Facility/Operations	2-29
2.4-1	Launch Pad Facility	2-30
2.4-2	Mobile Service Tower Facility	2-31
2.4-3	Solid Rocket Booster Buildup Operations	2-32
2.4-4	External Tank Mating Operation	2-38
2.4-5	Orbiter Mating Operation	2-38
2.4-6	Payload Preparation and Changeout Facilities	2-39
2.4-7	Payload Insertion Operations	2-39
2.4-8	Launch Pad Propellant System	2-40
2.4-9	Launch Pad Fueling Operations	2-40
2.4-10	Launch Control Center Facility	2-41
2.4-11	Support Equipment Building and Air Conditioning Shelter	2-41
2.4-12	Space Shuttle Vehicle Launch	2-42
2.4-13	Space Shuttle Vehicle Ascent	2-43
2.4-14	Abort During Ascent	2-44
2.4-15	Launch Pad Refurbishment Operations	2-44

LIST OF FIGURES

Figure Number	Title	Page
1.1-A	Location of Vandenberg Air Force Base	1-2
1.2-A	Over-Water Launch Azimuths	1-2
1.3-A	Configuration and Relative Sizes of the Space Shuttle Vehicle and Orbiter	1-7
1.3-B	Vicinity Map Showing Vandenberg Air Force Base and Surrounding Communities	1-11
2.0-A	Shuttle Ground Operations Activities	2-2
2.0-B	Location of Proposed Space Shuttle Facilities at Vandenberg Air Force Base	2-3
2.0-C	Shuttle Launch-to-Launch Turnaround Timetable	2-4
2.1-A	Artist's Conception of the Orbiter in Ferry	2-6
2.1-B	Artist's Conception of the Orbiter on its Approach to VAFB Following Completion of a Mission	2-6
2.1-C	Location of Orbiter Processing Facilities	2-8
2.2-A	Location of Solid Rocket Booster Processing Facilities	2-19
2.3-A	Location of External Tank Handling Facilities	2-27A
2.4-A	Artist's Conception of the Shuttle Launch Complex	2-32
2.4-B	Location of Facilities Situated at the Shuttle Launch Complex	2-33
2.4-C	Launch Pad Processing Timeline	2-35
2.5-A	Key Space Transportation System Milestones	2-45
2.5-B	Space Shuttle Program Master Development Schedule	2-50
2.5-C	Annual Direct Labor Required for Construction and Activation Categories for Shuttle Project	2-53
2.5-D	Annual Direct Labor Required for Shuttle Operations	2-58
3.1.1-A	Topography of the Immediate Vandenberg Area	3-3
3.1.1-Aa	Aerial Photograph of the Point Arguello Terrace and Existing Boathouse Facilities and Embayment	3-6A
3.1.1-B	Bathymetry of the Southern California Borderland	3-7
3.1.1-C	Major Geomorphic Provinces of Southern California	3-8
3.1.2-A	Geology of the Vandenberg Region	3-11
3.1.2-B	Distribution of Soil Associations Near Vandenberg Air Force Base	3-15
3.1.2-Ba	Soil Series on and Adjacent to the Point Arguello Terrace	3-15A
3.1.2-C	Tectonic Map of Southwestern Santa Barbara County	3-17
3.1.3-A	Locations of Streams in the Immediate Vandenberg Area	3-19
3.1.3-B	100-Year Flood Plain of the Santa Ynez River Near VAFB	3-23
3.1.3-C	Coastal Water Quality Data Locations	3-29
3.1.4-A	Surface Circulation in the Southern California Bight	3-30
3.1.8-A	CNEL Values for Typical Outdoor Locations	3-44
3.1.8-B	Projected CNEL Contours for Lompoc Valley	3-45
3.1.8-C	Predicted Maximum Noise Level Contours for Minuteman Missiles from a Coastal Launch Site	3-50
3.1.8-D	Locations of Acoustic Measuring Stations and Approximate Titan IIIC, D, E OASPL Contours from SLC-4	3-51
3.1.8-E	Predicted OASPL from Titan IIIC, D, E Launch Versus Ground Distance from Launch Site	3-52
3.1.9-A	Distribution of Generalized Vegetation Types on Vandenberg Air Force Base	3-55
3.1.9-B	Distribution of Generalized Vegetation Types in the Santa Barbara Region	3-57
3.2.1-A	Immediate Effects Area of Lompoc Valley, Santa Maria Valley, and Vandenberg Air Force Base	3-78
3.2.1-B	Intermediate and Regional Effects Areas	3-79
3.2.2-A	Population Growth Analysis Areas	3-81
3.2.3-A	Incorporated and Unincorporated Communities in the Immediate Effects Area	3-88
3.2.3-B	Current Land Use for Vandenberg Air Force Base and Surrounding Area	3-89

LIST OF FIGURES (Continued)

Figure Number	Title	Page
3.2.3-C	Suitability of Land for Urban Development in the Lompoc Urban Study Area	3-90
3.2.3-D	Suitability of Land for Urban Development in the Santa Maria-Orcutt Urban Study Area	3-91
3.2.6-A	Major Highways and Average Daily Traffic Volumes in the Vicinity of Vandenberg Air Force Base	3-104
3.2.6-B	Air Transportation Corridors and Vandenberg Air Force Base Launch Azimuths	3-108
4.1-A	Current Zoning for Vandenberg Air Force Base and Surrounding Area	4-2
5.1.2-A	Maximum 10-Minute Exposure to and Instantaneous Concentration of HCl Gas at Ground Level	5-27
5.1.2-B	Rain Acidity Predicted from Washout of HCl Gas from a Hypothetical Shuttle Ground Cloud	5-31
5.1.2-C	HCl Deposition Predicted from Washout of HCl Gas from a Hypothetical Shuttle Ground Cloud	5-31
5.1.2-D	Predicted Sea Level Footprint of Sonic Boom Overpressures Resulting from VAFB Shuttle Launches from SLC-6 into an Orbit of 70° Inclination	5-39
5.1.2-E	Predicted Sea Level Footprint of Sonic Boom Overpressures Resulting from VAFB Shuttle Launches from SLC-6 into an Orbit of 90° Inclination	5-40
5.1.2-F	Predicted Sea Level Footprint of Sonic Boom Overpressures Resulting from VAFB Shuttle Launches from SLC-6 into an Orbit of 98° Inclination	5-41
5.1.2-G	Predicted Footprint of Sonic Boom Overpressures Resulting from Normal End-of-Mission Return of Orbiter to Vandenberg Air Force Base	5-42
5.1.2-H	Predicted Footprint of Sonic Boom Overpressures Resulting from Non-Orbital Return of the Orbiter to Vandenberg Air Force Base Subsequent to an Abort Following a Launch	5-43
5.1.2-I	Predicted Footprint of Sonic Boom Overpressures Resulting from a Once-Around Return of Orbiter to Vandenberg Air Force Base Subsequent to an Abort Following a Launch	5-44
5.2.1-A	Total North County Employment Resulting from Space Shuttle Construction and Activation Activities at Vandenberg Air Force Base	5-53
5.2.1-B	Shuttle and Non-Shuttle Related Commuter Traffic Projections for the Construction/ Activation Phase in 1981	5-60
5.2.2-A	Total North County Employment Resulting from Space Shuttle Operations Activities at Vandenberg Air Force Base	5-67
5.2.2-B	Shuttle and Non-Shuttle Related Traffic Projections and Resultant Peak-Hour Levels of Service in Average Operations Phase Year	5-75
6.2-A	Proposed and Alternate Tow Routes	6-14

LIST OF MATRICES

Matrix Number	Title	Page
5.0-A	Impact Summary for Proposed Modification/Expansion of Landing and Taxiing Facilities/Activities at VAFB Airfield	5-3
5.0-B	Impact Summary for Proposed Orbiter Processing Facilities/Activities at VAFB Airfield	5-4
5.0-C	Impact Summary for Proposed Support Facilities/Activities at Port Hueneme	5-5
5.0-D	Impact Summary for Proposed Shallow Draft Barge Landing Facility/Activity at VAFB	5-6
5.0-E	Impact Summary for Proposed Modification/Expansion of Tow Route Road/Corridor/ Activity Between Shuttle Support Facilities and SLC-6	5-7
5.0-F	Impact Summary for Proposed Modification/Expansion of SLC-6 Support Facilities/ Activities and Titan III SRM Facility at VAFB	5-8
5.0-G	Impact Summary for Proposed Modification/Expansion of SLC-6 Launch Pad Facility/ Activity at VAFB	5-9

LIST OF TABLES

Table Number	Title	Page
2.5.1-1	Summary Investment Cost Estimates for Vandenberg Shuttle Construction/Activation Phase	2-51
2.5.1-2	Projected Regional Distribution Expenditures Resulting from the Construction/ Activation Phase of the Space Shuttle Program at Vandenberg	2-52
2.5.2-1	Planned Space Shuttle Launch Schedule at Vandenberg Air Force Base	2-55
2.5.2-2	Summary Investment Cost Estimates for VAFB Shuttle Operations	2-56
2.5.2-3	Projected Regional Distribution of Expenditures Resulting from the Operations Phase of the Space Shuttle Program at Vandenberg	2-57
2.5.2-4	Estimated Breakdown of Personnel for Shuttle Operations During Fiscal Year 1981	2-59
3.1.3-1	Water Quality of the San Antonio Creek at Various Locations	3-27
3.1.3-2	Water Quality of the Santa Ynez River at Various Locations	3-27
3.1.3-3	Quality of Groundwater Supply at VAFB from Lompoc Area, January 1975	3-28
3.1.3-4	Quality of Domestic Water Supply at VAFB from San Antonio Basin Groundwater	3-28
3.1.3-5	Coastal Water Quality in the Project Region	3-29
3.1.4-1	Tidal Elevation Data, Los Angeles, 1923 to 1975	3-32
3.1.8-1	Comparison of Various Noise Sources, Noise Levels, and Loudness	3-43
3.1.9-1	Dominant Species of the Vegetation in the Project Area	3-58
3.1.9-2	Selected Floral Taxa of Special Interest	3-62
3.1.9-3	Selected Faunal Species Prominent on Vandenberg Air Force Base	3-64
3.1.9-4	Selected Avian Species Prominent on Vandenberg Air Force Base	3-65
3.1.9-5	Rare, Endangered, and Threatened Species of Terrestrial Vertebrates in the Project Region	3-67
3.1.9-5A	Observations of Breeding Pairs of Seabirds of the Channel Islands in 1976*	3-72C
3.1.9-6	Rare, Endangered, and Threatened Species of Marine Vertebrates in the Project Region	3-74
3.2.2-1	Population Change in Santa Barbara County, 1960 to 1970	3-80
3.2.2-2	Population Growth in the Immediate Effects Area and Santa Barbara County, 1960 to 1973	3-82
3.2.2-3	Preliminary Growth Figures for Santa Barbara County and Cities, 1975	3-82
3.2.2-4	Demographic Profile of the Regional Effects Area, 1970	3-83
3.2.2-5	Demographic Profile of Principal Cities of Santa Barbara County, 1970	3-83
3.2.2-6	Household Income Distribution in Santa Barbara and Ventura Counties, 1974	3-84
3.2.2-7	Occupational Distribution of Workers by Area, 1970	3-85
3.2.2-8	Regional Labor Force, 1976	3-86
3.2.3-1	Land Use Changes for Port Hueneme-Oxnard Area, 1959 to 1973	3-91
3.2.4-1	Summary of Housing Units and Vacancy Rates in the Immediate Effects Area, 1975	3-94
3.2.4-2	Housing Stock and Vacancy Rates in Port Hueneme, Oxnard, and Ventura, 1975	3-94
3.2.5-1	Personal Income, by Industry, in Five-County Region in 1972	3-96
3.2.5-2	Employment, by Industry, in Five-County Region for August 1975	3-96
3.2.5-3	Employment in Santa Barbara County, 1970 to 1975	3-97
3.2.5-4	Past and Projected Earnings, by Industry Type, in Santa Barbara County for Selected Years	3-98
3.2.5-5	Santa Barbara County Employment Distribution, 1971	3-98
3.2.6-1	Morning Traffic Volume into Vandenberg Air Force Base	3-105
3.2.6-2	Annual Aircraft Operations in the Intermediate Effects Area	3-109
3.2.7-1	Recreation Facilities in the Immediate Effects Area	3-110
4.2-1	General Plan Status for Santa Barbara County, Lompoc, and Santa Maria	4-4
4.2-2	Comparison of Existing and Planned Land Use in Santa Barbara County by Category	4-5
4.2-3	North County Offbase Land Requirements for Projected Development to 1990	4-6
5.1.1-1	Special Interest Plants to be Impacted by Space Shuttle Construction Activities at VAFB	5-18A

LIST OF TABLES (Continued)

Table Number	Title	Page
5.1.2-1	**Expected Main Engine Exhaust Constituents**	5-24
5.1.2-2	**Expected SRB Exhaust Constituents**	5-24A
5.1.2-3	Recommended Limits on Public Exposure to Hydrogen Chloride (HCl) and Chlorine (Cl_2)	5-26
5.1.2-4	Shuttle Ground Cloud Data Predicted for 48 Selected Meteorological Cases at Vandenberg During 1974	5-28
5.1.2-5	Guidelines for Unprotected Exposure of Humans to Low Frequency Noise	5-37
5.2.1-1	Projected Regional Output (Sales) Resulting from Annual Expenditures Associated with the Construction/Activation Phase of the Space Shuttle Program at Vandenberg	5-51
5.2.1-2	Projected Regional Earnings (Employment Income) Resulting from Annual Expenditures Associated with the Construction/Activation Phase of the Space Shuttle Program at Vandenberg	5-51
5.2.1-3	Projected Indirect Employment Resulting from Annual Expenditures Associated with the Construction/Activation Phase of the Space Shuttle Program at Vandenberg	5-52
5.2.1-4	North County Employment Growth by Industrial Sector Resulting from Shuttle Program Construction/Activation through 1981	5-54
5.2.1-5	Effect of the Shuttle Program Construction/Activation Phase on Local Growth through 1981	5-56
5.2.2-1	Projected Regional Output (Sales) Resulting from Annual Expenditures Associated with the Operations Phase of the Space Shuttle Program at Vandenberg	5-64
5.2.2-2	Projected Regional Earnings Resulting from Annual Expenditures Associated with the Operations Phase of the Space Shuttle Program at Vandenberg	5-65
5.2.2-3	Projected Indirect Employment Resulting from Annual Expenditures Associated with the Operations Phase of the Space Shuttle Program at Vandenberg	5-66
5.2.2-4	North County Employment Growth by Industrial Sector Resulting from VAFB Shuttle Program Operations to 1990	5-68
5.2.2-5	Shuttle Related Employment and Net Employment Growth in Santa Barbara County Resulting from Annual Expenditures for the Space Shuttle Program at Vandenberg	5-69
5.2.2-6	Effects of the Shuttle Program Operations Phase on Local Growth through 1990	5-70
11.2-1	Electrical Energy Supply and Demand for the Space Shuttle Program	11-3

1.0 INTRODUCTION TO THE PROPOSED ACTION

1.1 THE PROPOSED ACTION

The proposed action is the development and operation of a Space Shuttle Program (herein referred to as the Space Shuttle or Shuttle) at Vandenberg Air Force Base, California (see Figure 1.1-A). The U.S. Air Force Systems Command (AFSC), representing the Department of Defense (DOD), is the proponent of this action. This Environmental Statement has been prepared by the AFSC Space and Missile Systems Organization (SAMSO), which is the lead DOD agency for Space Transportation System (STS) planning.

1.2 PURPOSE

1.2.1 SPACE SHUTTLE SYSTEM AT VANDENBERG AIR FORCE BASE

A new generation of manned space flight will begin in 1979. The first manned orbital flights of the Space Shuttle will be launched from Kennedy Space Center, Florida and will be conducted by the National Aeronautics and Space Administration (NASA). Restrictions on overflight of land during ascent limit launch azimuths at Kennedy Space Center to between 35 and 120 degrees. The resulting orbits will be of low-to-mid inclination; that is, they are generally restricted to the equatorial plane.

The purpose of the Space Shuttle at Vandenberg is to provide a substantially different range of launch azimuths. The location of Vandenberg--140 miles north of Los Angeles, California, on the Pacific Ocean coast (see Figure 1.2-A)--permits Shuttle launch azimuths of 158 to 201 degrees, which will allow high orbital inclinations that will be required for specific missions. These high inclination missions will include pole to pole orbits that provide perpendicular coverage of the entire planet, which is required for defense, weather or earth resources surveillance, communications relay, navigational systems, and other scientific purposes. Another important class of high inclination missions is the sun-synchronous mission in which the orbit maintains its initial orientation relative to the sun.

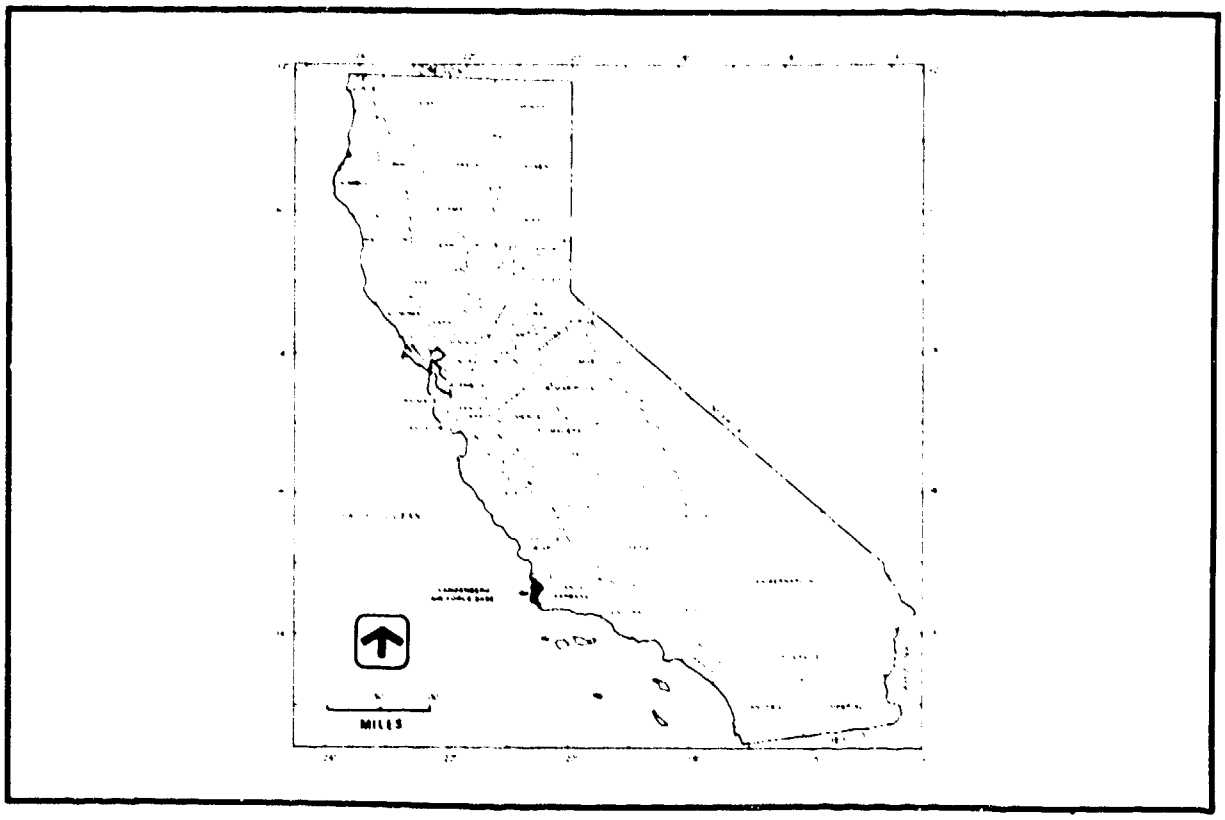


FIGURE 1.1-A. Location of Vandenberg Air Force Base.

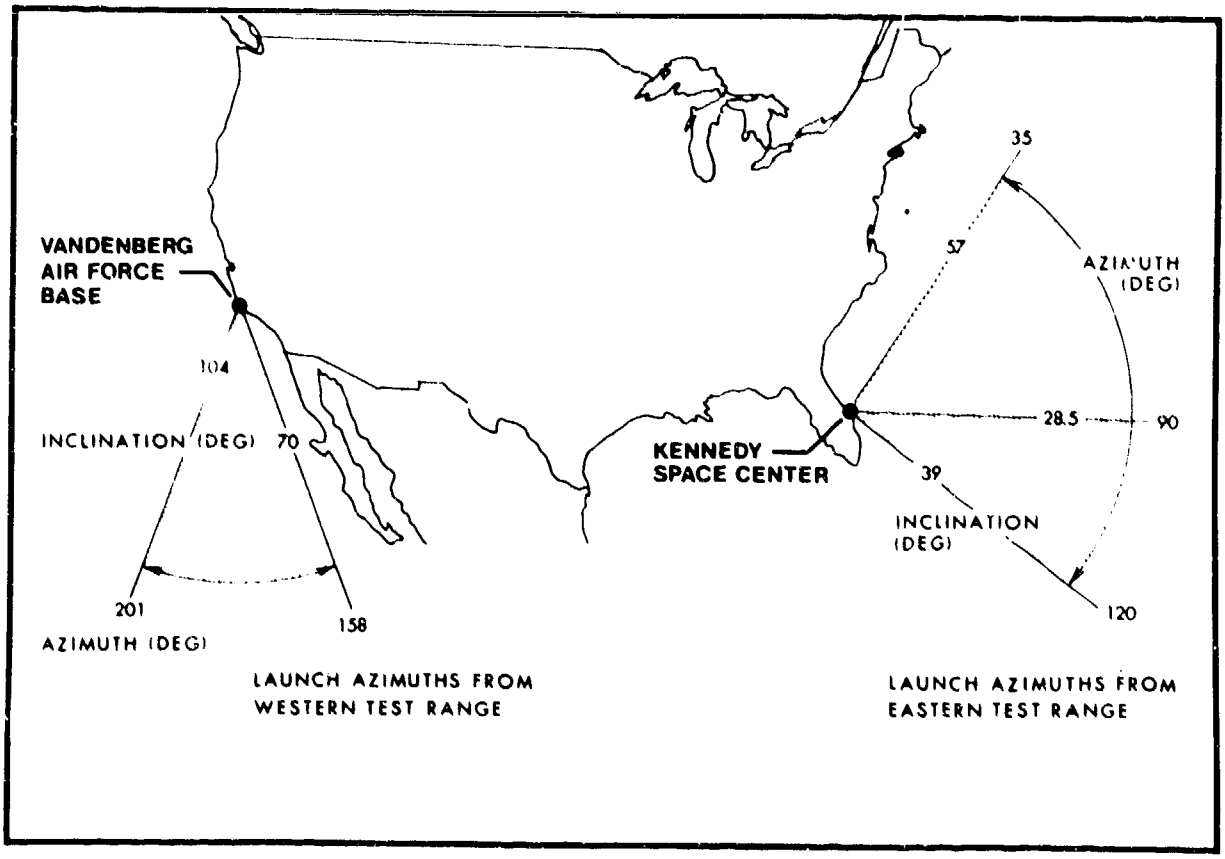


FIGURE 1.2-A. Over-water launch azimuths.

Development of the Shuttle at Vandenberg entails a 4-year development program of construction, support equipment installation, and facility activation. Construction will begin in 1979 and will be completed by the end of 1982. During this period, the existing runway will be rebuilt and lengthened, new facilities will be constructed, existing roads will be modified for use as a tow route, a hovercraft facility will be constructed, and existing facilities will be modified. Construction materials will be delivered by rail, truck, and possibly aircraft.

1.2.2 ENVIRONMENTAL STATEMENT

The purpose of this Environmental Statement is (1) to continue environmental planning for the Shuttle at Vandenberg and supporting actions at Port Hueneme, California, and (2) to formally document the anticipated environmental effects of the proposed project.

The Air Force, which is the Department of Defense executive agency for the Shuttle program, will have responsibility for all Space Shuttle Vehicle launches from Vandenberg. This Environmental Statement reflects the goals presented in Air Force Regulation (AFR) 19-1, "Protection and Enhancement of Environmental Quality," and complies with AFR 19-2, "Environmental Assessments and Statements," as amended, and AFR 19-7, "Environmental Monitoring." These regulations constitute U.S. Air Force directives for compliance with the National Environmental Policy Act of 1969. Provisions of the California Environmental Quality Act of 1970 are also addressed in this Statement.

The subject of this Environmental Statement is the development and operation of the Shuttle at Vandenberg and supporting actions at Port Hueneme, California. Similar actions planned for the John F. Kennedy Space Center (KSC) in Florida have been addressed in Amendment No. 1 (dated August 1973) to the basic KSC Institutional Environmental Impact Statement (originally issued in August 1971). Moreover, the environmental effects associated with global aspects of the Shuttle (including rocket exhaust in the upper atmosphere, reentry of Space Shuttle Vehicle components, and ocean impact/recovery) subsequent to proposed launches from either Vandenberg or KSC are documented in the July

1977 Draft Environmental Statement for the Space Shuttle Program, prepared by NASA. Finally, anticipated effects associated with the development and operation of an Interim Upper Stage (IUS)--a vehicle which can be integrated with the Space Shuttle to effect the placement of payloads into high energy orbits or on interplanetary flight trajectories--are addressed in an October 1977 Candidate Environmental Statement prepared by SAMSO.

In light of the above, it is necessary to realize that the Space Shuttle System is an advanced state-of-the-art program that will utilize new materials, innovative processes, and high technology support equipment and subsystems. Extensive planning and testing of the launch vehicle and subsystems have been underway since 1969, leading to the current proposed program at Vandenberg. Further studies and planning are continuing as necessary to finalize facility and subsystems details prior to actual design and manufacture.

Baseline data for facilities and systems used in this report reflect the latest planning status as of November 1, 1977, and adjustments to this data will naturally occur as design details are finalized. However, new materials usage, operations, and possible future changes thereof are not expected to significantly alter the environmental setting reported herein. Supplements to this Statement will be issued should this situation change.

1.3 OVERVIEW

1.3.1 NATIONAL GOAL

On January 5, 1972, the President announced that the United States should proceed with the development of an entirely new type of space transportation system, one designed to place an emphasis on the utilization of space for more directly beneficial endeavors rather than on the pioneering explorations that have characterized this country's manned space flight programs to date.

The Department of Defense has determined that the Space Shuttle will be a cost-effective means of transporting defense-related payloads to and from space and will provide an improved operational capability to make more effective use of space. Accordingly, following development flight testing by NASA, the Space Shuttle will be operated by both NASA and the Air Force to accomplish those missions required by each agency.

1.3.2 NATIONAL SPACE TRANSPORTATION SYSTEM PROGRAM

NASA and the U.S. Air Force have jointly established program objectives, priorities and the overall allocation of resources for the STS. Development, operations, and logistic requirements will be shared by these two agencies. The Air Force is responsible for developing the Interim Upper Stage (IUS), which will be carried in the payload bay and used to boost spacecraft from the low earth orbit of the Orbiter to higher orbits, and the ground support systems at Vandenberg. The Air Force will be the launch agent (organization responsible for Shuttle operations at a Launch/Landing Site) at Vandenberg. In the near term, all Space Shuttle flights will be controlled from the Johnson Space Center in Houston, Texas. For the far term, a separate Department of Defense Mission Control Center will be developed.

Currently, projected missions can be grouped into five basic categories: (1) the placement and recovery of satellites in low earth orbit, (2) Orbiter delivery or retrieval of a propulsive upper stage (which may be the Interim Upper Stage) and a satellite in low earth orbit, (3) the use of Orbiter itself as an orbiting satellite, hosting observation sensors and other mission equipment, (4) use of Orbiter as a space lab and test bed, and (5) use of the Space Shuttle for the inspection, servicing, and repair of satellites in low earth orbit.

The first orbital Shuttle flight will be conducted from Kennedy Space Center in March 1979. The initial operational capability of Vandenberg for the Shuttle program is scheduled for June 1983.

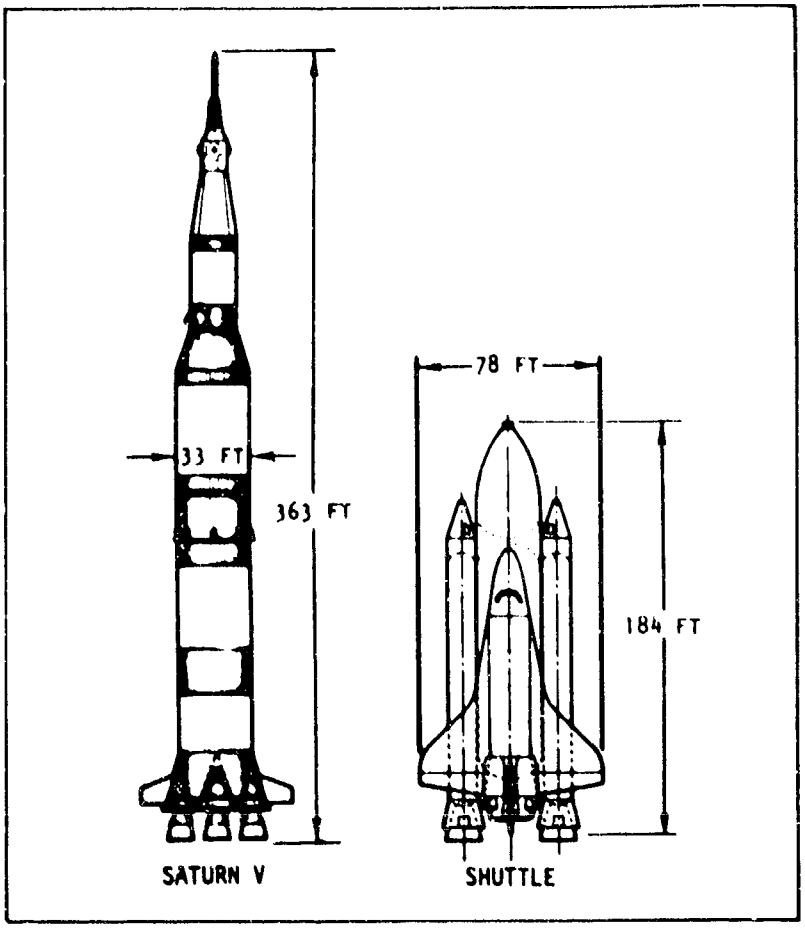
1.3.3 SPACE SHUTTLE VEHICLE

The Space Shuttle Vehicle or Space Shuttle, will consist of the manned reusable Orbiter, an expendable liquid hydrogen/liquid oxygen External Tank, and two reusable Solid Rocket Boosters. At launch the Orbiter and Boosters will be clustered about the External Tank, as illustrated in Figure 1.3-A. The Space Shuttle is 184 feet high and has an overall width of 78 feet, as compared to the Saturn V's 363-foot height and 33-foot diameter. The Space Shuttle will weigh 4.4 million pounds at lift-off and will develop 6.4 million pounds of thrust at sea level.

From Vandenberg, the Space Shuttle can carry up to 32,000 pounds of cargo, including 7 persons, aboard the Orbiter into a low earth orbit approximately 100 nautical miles above earth. It is designed to support its crew in space for up to 30 days.

At launch, the two Solid Rocket Boosters and the Orbiter's three Space Shuttle main engines (drawing liquid propellants from the External Tank) will operate together. The solid rocket propellants will burn out and the Solid Rocket Booster casings will separate from the Space Shuttle Vehicle at an altitude of about 150,000 feet approximately 124 seconds after lift-off (exact flight profiles are specific to each mission) for a parachuted descent, ocean recovery, and reuse. The Space Shuttle Vehicle main engines will continue propelling the Orbiter and the External Tank to between approximately 300,000 and 500,000 feet, which would be reached between 500 and 550 seconds following lift-off. The External Tank will be jettisoned 30 seconds after Main Engine Cutoff for a planned impact into the ocean. Two Orbital Maneuvering Subsystem engines will provide the additional thrust necessary to place the Orbiter into a low earth orbit. It will remain in orbit until its mission is completed and then will reenter the atmosphere, landing on a runway at its recovery site.

The descending Orbiter will be in radio blackout until it reaches an altitude of about 160,000 feet, approximately 280 nautical miles from the landing site. After blackout, the Orbiter will receive guidance signals from the Microwave Scanning Beam Landing System (MSBLS) and the Tactical Air Navigation (TACAN) system located at Vandenberg.



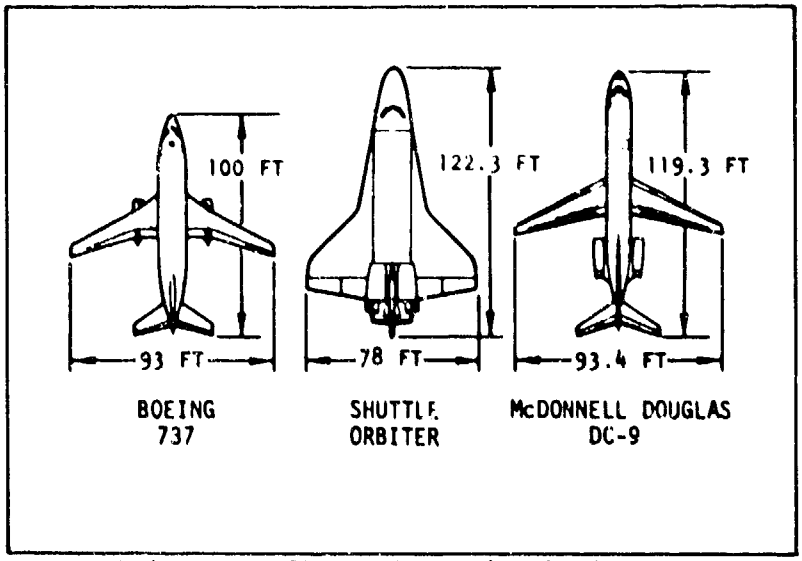


FIGURE 1.3-A. Configuration and relative sizes of the Space Shuttle Vehicle and Orbiter.

The Orbiter will begin to use the MSBLS, an automatic landing (autoland) system, at an altitude of 12,000 feet when it is 5 to 6 nautical miles from the runway. The Orbiter will descend on a 24-degree glide slope (that is, the acute angle between flight path and extended runway centerline) from the beginning of the autoland sequence until it reaches an altitude of about 2,000 feet, where it will transition to a 3-degree glide slope. This will occur about 7,500 feet from the runway and 30 seconds prior to touchdown. A final flare maneuver will be made prior to touchdown, about 3,100 feet down the runway. Flight operations are considered to end when the Orbiter comes to a stop on the runway.

The major components of the Space Shuttle Vehicle are:

(1) Orbiter--Orbiter is 107.5 feet long (122.3 feet long with tail empennage used during ferrying), 78 feet across from wing tip to wing tip, and 56.6 feet high at the tail. Figure 1.3-A illustrates the size of the Orbiter in comparison to commercial airliners.

(2) External Tank--the tank is roughly cylindrical, 27.6 feet in diameter, and 153.8 feet long. Within the outer skin are two cryogenic fuel tanks, one for liquid hydrogen and the other for liquid oxygen, which are the fuel and oxidizer, respectively, for the three Space Shuttle main engines carried onboard the Orbiter. The External Tank is the only major component of the Space Shuttle that is not recovered for reuse.

(3) Solid Rocket Booster--two 12.2-foot diameter and 149.2-foot long Solid Propellant motors will be part of each Space Shuttle

1.3.4 SPACE SHUTTLE OPERATIONS

The scope of activity associated with operation of the Shuttle is separated into Flight and Ground Operations. These are interrelated actions but are

fundamentally different. Flight Operations will encompass all activities related to flight for a particular mission, from the moment of rocket engine ignition on the launch pad until the returning Orbiter rolls to a stop on the runway. Ground Operations will include all actions from the time the Orbiter comes to rest on the runway until the next Space Shuttle is launched.

1.3.4.1 Flight Operations

Typical Flight Operations at Vandenberg will commence with the ignition of the three Space Shuttle main engines and the two Solid Rocket Boosters. Flight Operations are described in Section 1.3.3.

1.3.4.2 Ground Operations

Activities required to support Space Shuttle Flight Operations are termed Ground Operations. At Vandenberg these will encompass all actions necessary to receive, refurbish, store, subassemble, and check out major Space Shuttle components, including the Orbiter, External Tank, and Solid Rocket Booster. Ground Operations will also include the buildup of the Space Shuttle Vehicle from major components on the launch pad, as well as required support and logistic services.

Ground Operations have four distinctive cycles or sequences of activity. The Orbiter, External Tank, and Solid Rocket Booster all have their own activity cycles. These cycles merge as each component is delivered to the launch pad. The fourth activity cycle encompasses launch pad operations. The four cycles are completely described in Section 2.0.

For each launch, Ground Operations related to a specific flight terminate at lift-off and recommence when the Orbiter lands. However, during the flight period, Ground Operations will continue with many concurrent activities in preparation for other flights.

1.3.5 SITE AND SURROUNDING REGION OF THE PROPOSED ACTION

The proposed project site is at Vandenberg Air Force Base in northern Santa Barbara County, within an area commonly referred to as California's Central Coast region. Support for Solid Rocket Booster recovery will be provided at Port Hueneme, in Ventura County. The locations of Vandenberg and Port Hueneme are shown on Figure 1.3-B.

San Luis Obispo, Santa Barbara, and Ventura Counties comprise most of the south Central Coast and the northern portions of the Southern California region and are often called the Tri-County area. These three counties are grouped together because they have many similarities and ties. Most of the activity generated by the proposed project probably will occur within the Tri-County area. The description of the existing environment presented in Section 3.0 focuses on this region.

The geographical location of Vandenberg is unique to its mission. Vandenberg has special importance because it is located on a promontory along the California coast where missiles can be launched westerly and southerly over the Pacific Ocean. The ability to launch over water is considered critical to the maintenance of a positively controlled missile flight safety program. The Base provides the only location on the West Coast where hazards from overflight by large boosters containing explosives and toxic fuels can be reduced to acceptable levels. In general, the Vandenberg launch azimuths are complementary to the over-water launch azimuths available at the Eastern Test Range in Florida.

Vandenberg AFB is assigned to the Strategic Air Command (SAC). The principal tenant is the Space and Missile Test Center (SAMTEC), an element of SAMSO, Air Force Systems Command (AFSC), which operates the Western Test Range. As host command, the 1st Strategic Aerospace Division is responsible for providing management, operational analysis, and material support for all SAC and over 40 Federal and Civilian tenant agencies located at Vandenberg as well as for controlling and conducting SAC's Intercontinental Ballistic Missile (ICBM) operational flight tests into the Western Test Range.

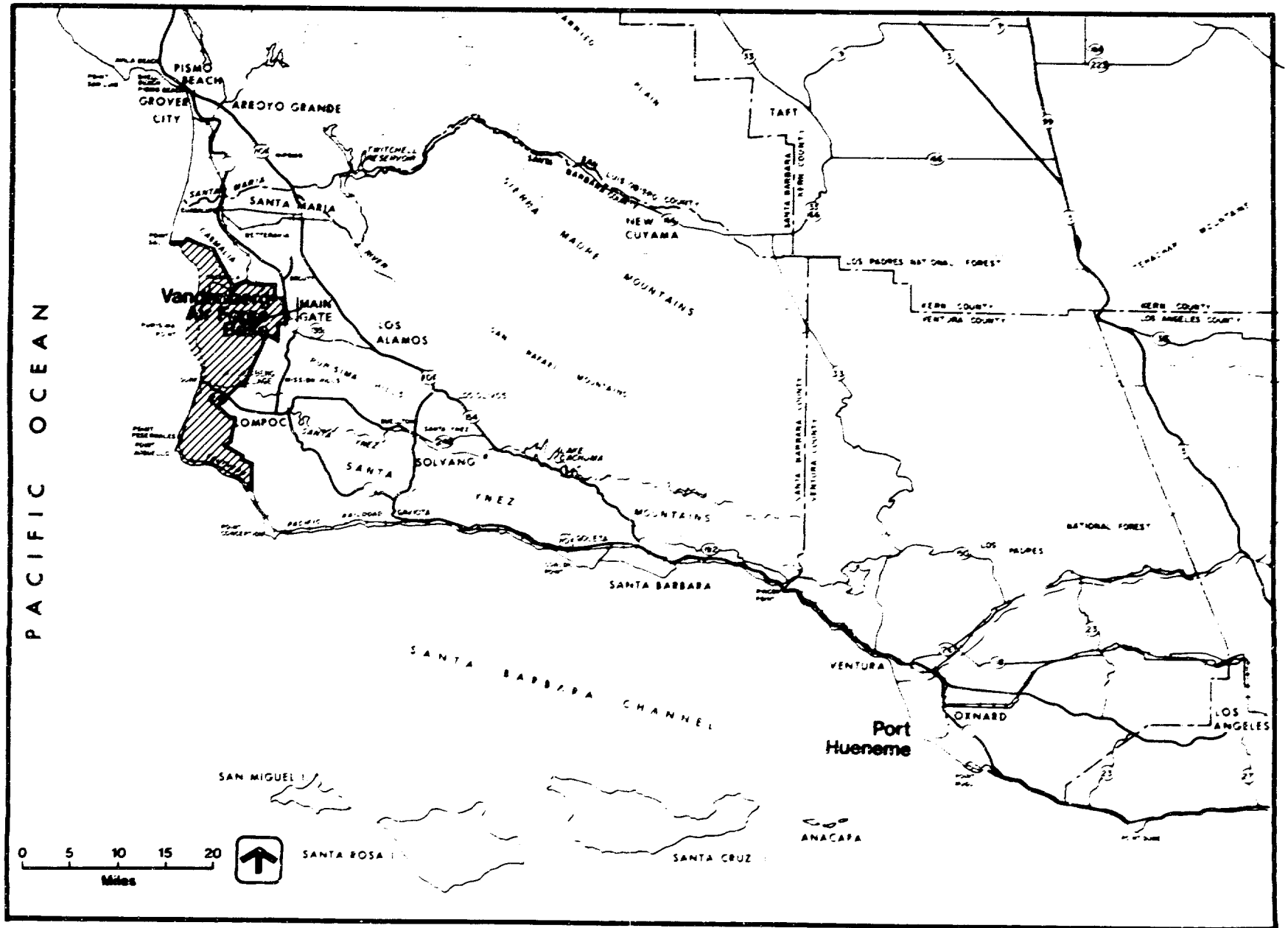


FIGURE 1.3-B. Vicinity map showing Vandenberg Air Force Base and surrounding communities.

A variety of space and missile systems operate from this Base. To provide for this level of launch activity, extensive launch and technical support facilities exist at Vandenberg AFB.

Presently air traffic volume at Vandenberg is considered to be low, with annual takeoffs and landings at about 6,750 operations. However, total operations of all types, including touch and go radar approaches, approximate 27,000 per year. Vandenberg has no assigned fixed-wing aircraft and has three attached H-1 helicopters. The existing airfield runway at Vandenberg is approximately 8,000 feet long and is considered adequate to handle large transport-type aircraft.

2.0 DESCRIPTION OF THE PROPOSED ACTION

The proposed action involves the development of Space Transportation System (STS) facilities and operation of the Space Shuttle Vehicle from Vandenberg Air Force Base. Details on the facilities and activities required to operate the Space Shuttle are presented in this section. Most of the data presented are taken from STS planning information of October 1, 1976. Overall construction requirements and the STS implementation schedule also are discussed.

The proposed action has been divided into four basically independent sequences of activities required for Orbiter, Solid Rocket Booster, and External Tank preparation, and Launch Pad operations (see Figure 2.0-A). A brief narrative at the beginning of each sequence orders and relates the activities of the sequence. The location of facilities associated with the particular sequence is presented on Figure 2.0-B. Also shown is the proposed location for a new Receiving, Inspection and Storage (RIS) Facility necessary for processing Solid Rocket Motors (SRMs) in support of the present Titan III program; this processing activity is currently carried out at SLC-6 but must be relocated to make way for Shuttle processing requirements.

It is planned that all four sequences of all activities from one launch to another can be completed in as few as 208 hours (8.7 days). In other words, two successive launch operations could be scheduled within 208 hours of each other. Figure 2.0-C illustrates a composite time schedule of events described later in this report.

Certain fuels, propellants, and processing fluids and gases, which are toxic, explosive, or caustic, will be involved in the four sequences of activity. These are listed by name on the summary sheets; quantities are listed, if known.

This report utilizes a systematic methodology to explain and summarize data required for analysis of impact and explanation of the proposed action. A standardized data form is used; these forms are referred to as data briefs. These sheets detail program activities and facilities, and summarize data that is considered pertinent to evaluation and analysis with regard to the environmental impact of the proposed action.

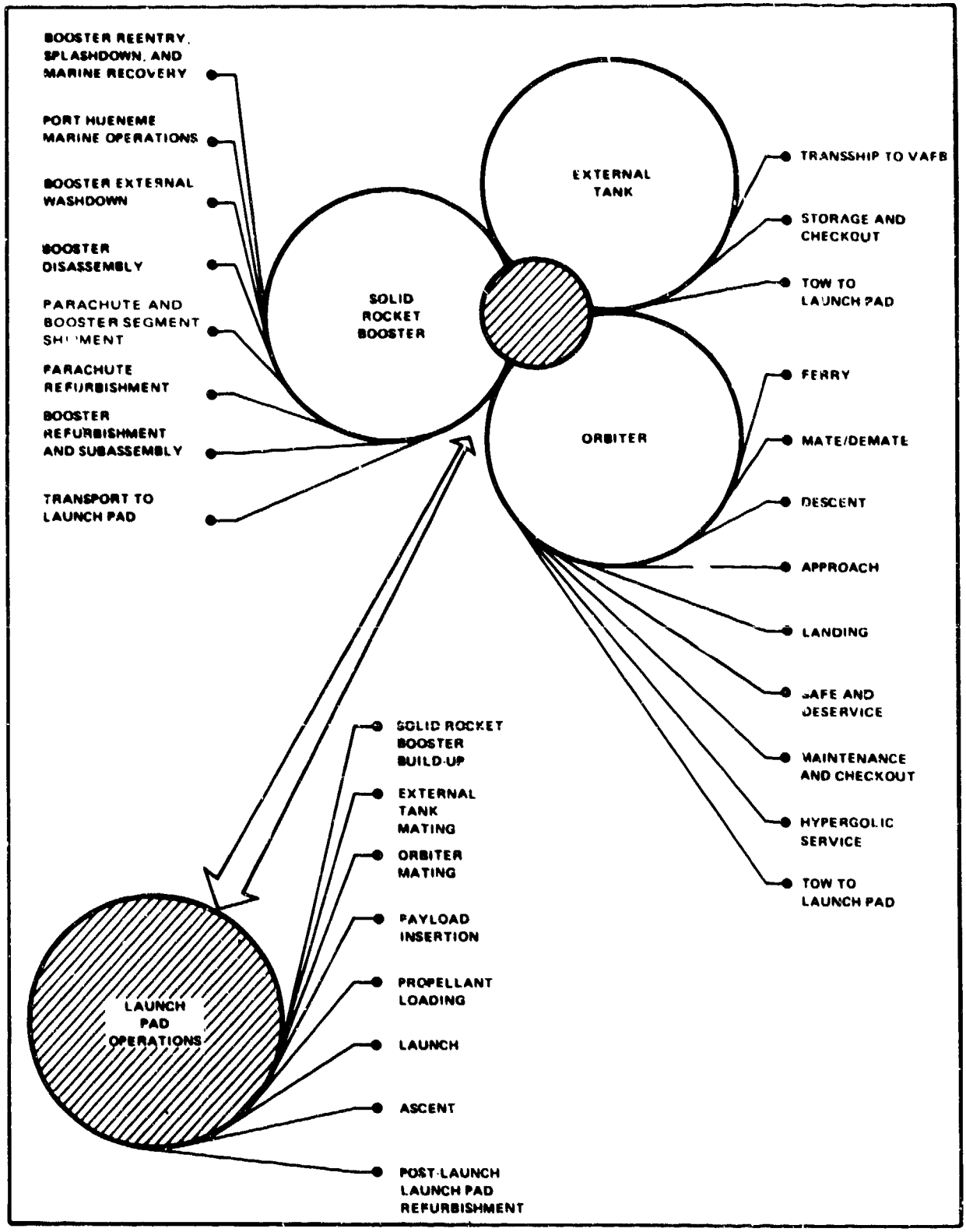


FIGURE 2.0-A. Shuttle Ground Operations activities

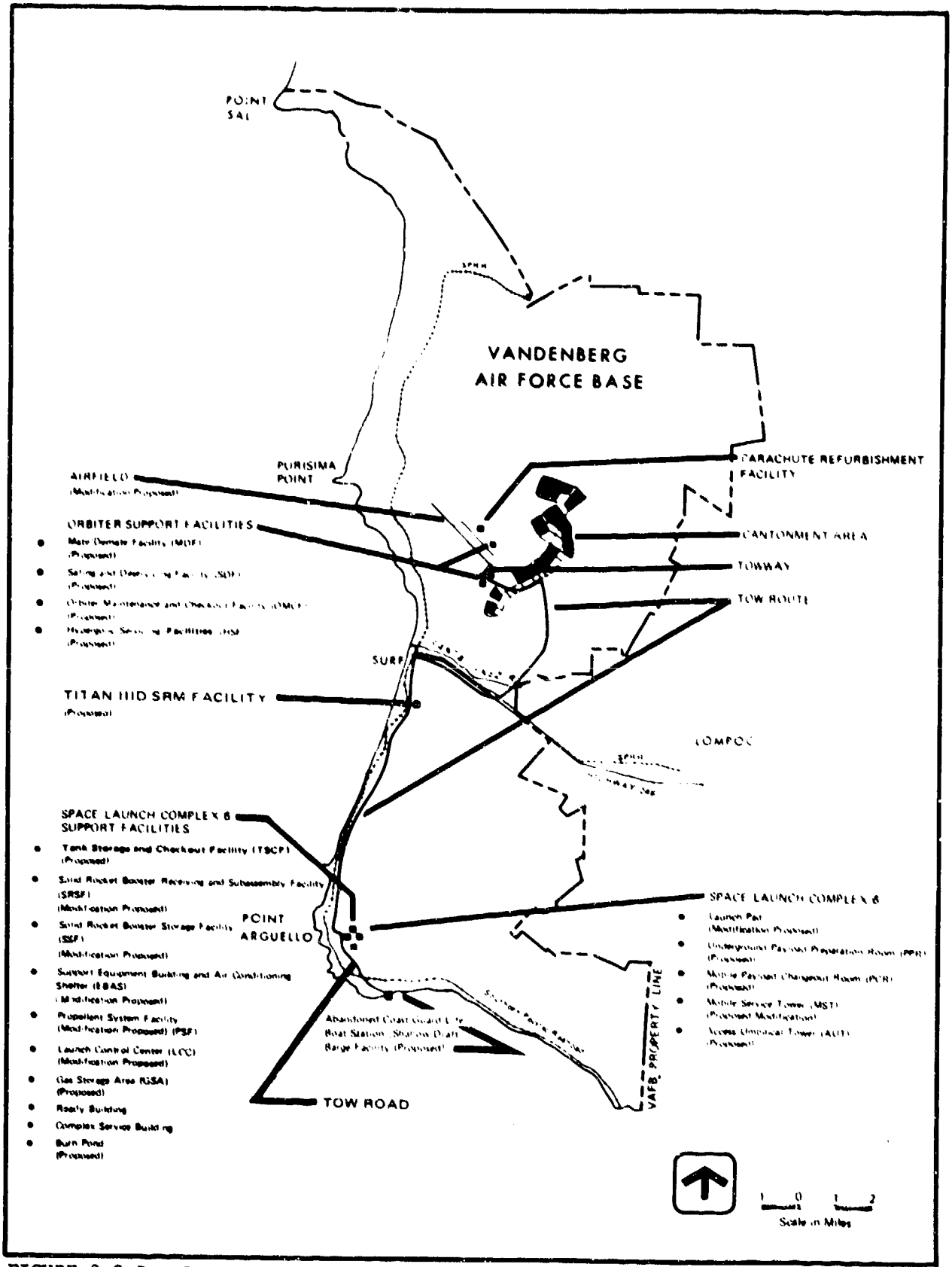


FIGURE 2.0-B. Location of proposed Space Shuttle facilities at Vandenberg Air Force Base.

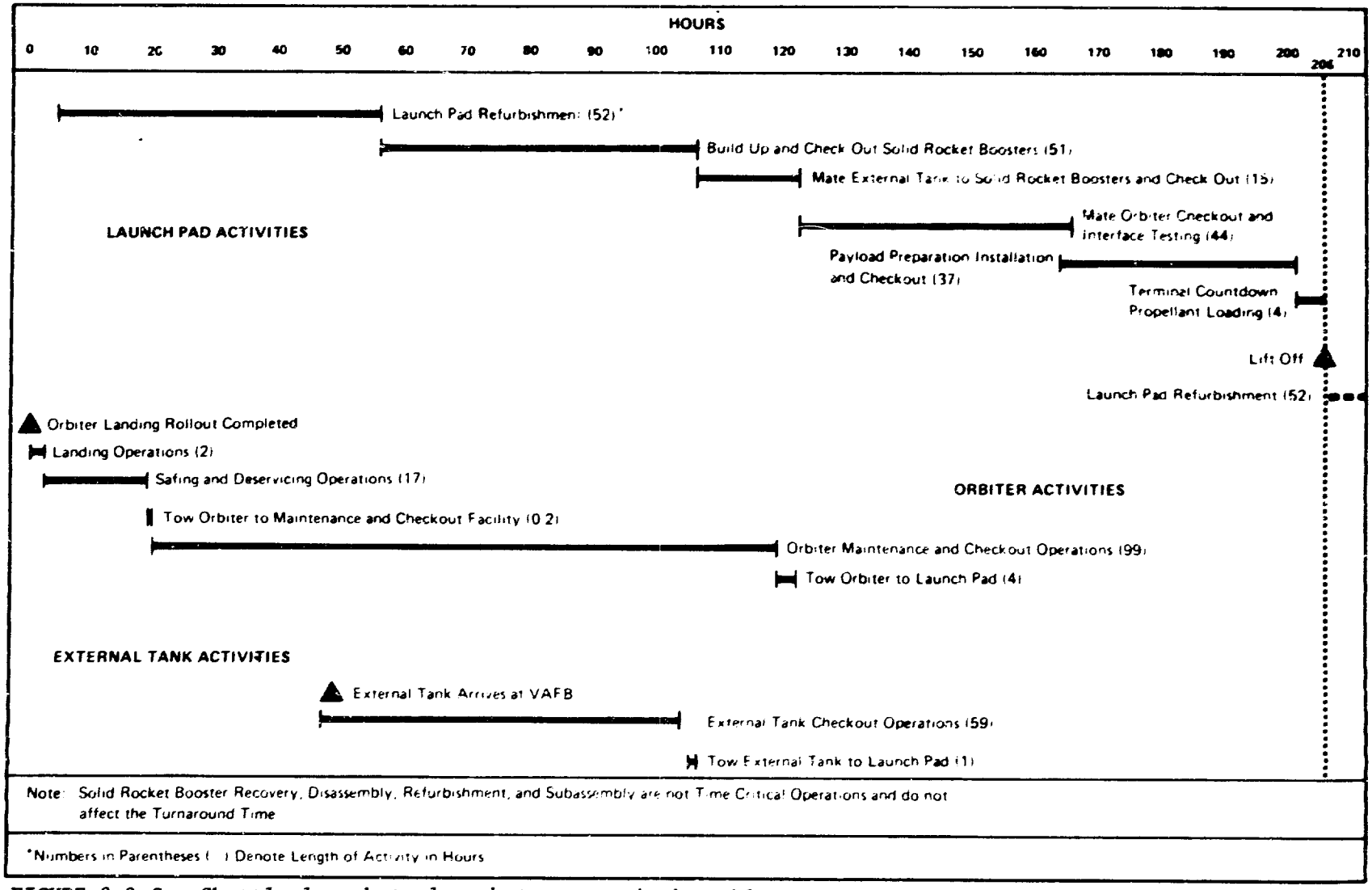


FIGURE 2.0-C. Shuttle launch-to-launch turnaround timetable.

The following information is contained on each summary sheet: graphic representation of the activity or facility being described; brief description of the activity or facility; summary of actions that will be associated with the activity or performed at the facility; solids/liquids/gases that will be involved with the action or stored in the facility; noise sources; construction information; construction and operational manpower levels; identification of natural features that may be altered; emissions from construction and operation, including nonoperational emissions which could occur as a result of accidental events; and general comments, where special items are noted. The order in which the summary sheets appear is consistent with STS planning and is intended to aid understanding of the proposed action. Additionally, these sheets may be referred to for details of specific activities, equipment, or facilities during consideration of the following sections of this report. A brief narrative introduces each of the four sequences.

2.1 ORBITER SEQUENCE

The sequence of activities necessary to prepare the Orbiter for launch pad operations will begin with one of two possible activities. The first is receipt of the Orbiter by ferry atop a specially configured 747 carrier aircraft. The second and more usual activity is the Orbiter's return from space and runway landing. Both activities will take place at the Vandenberg airfield.

Figure 2.0-A illustrates the sequence of the Orbiter-related activities. All activities will be interdependent except hypergolic servicing. The hypergolic servicing activity will not be performed on the Orbiter itself (that is, hypergolic modules will be detached from the Orbiter for servicing); servicing will be performed on a continual basis.

The first activity of the Orbiter sequence will be receipt of the Orbiter by ferry mode (an artist's conception of the Orbiter in ferry on the carrier aircraft is shown in Figure 2.1-A). This could occur in three cases: (1) shipment to or receipt from Edwards Air Force Base, the Orbiter test site;

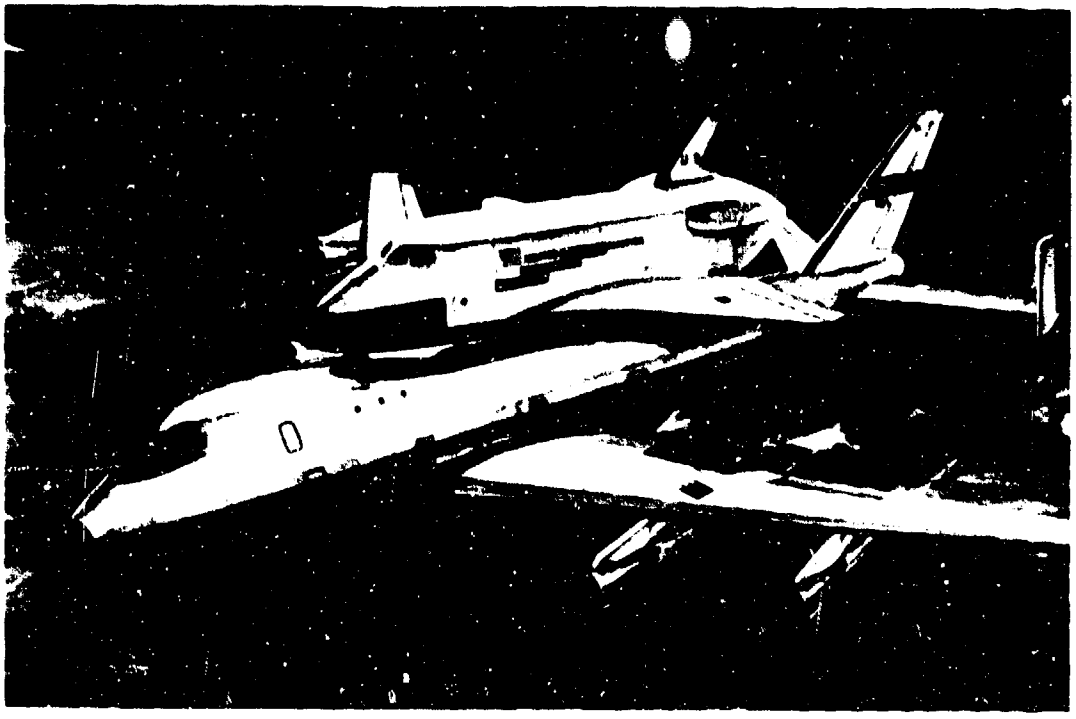


FIGURE 2.1-A. Artist's conception of Orbiter in ferry.

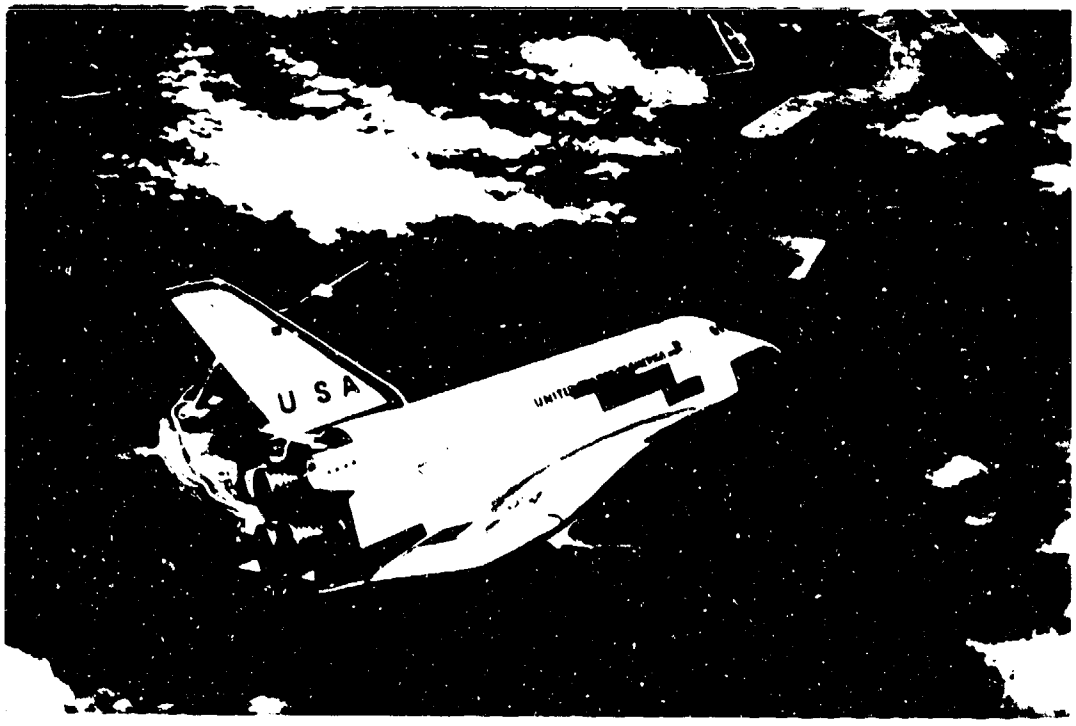


FIGURE 2.1-B. Artist's conception of the Orbiter on its approach to VAFB following completion of a mission.

(2) transferral from an alternate airfield (at Hawaii or Guam) where it landed in an emergency or because of adverse weather conditions at Vandenberg; (3) transferral of Orbiters from Kennedy Space Center. The only facility associated with this infrequent activity will be the Mate/Demate Facility used at the airfield to connect or disconnect the Orbiter and 747 ferry aircraft.

The more usual initial Orbiter sequence activity will be reentry of the Orbiter from a space mission and its descent to the landing site. For purposes of this report, descent is used to describe activities between 85,000 feet and 12,000 feet altitude. Airfield approach activity will follow descent and is defined to begin at an altitude of 12,000 feet and terminate as the Orbiter's landing gear touches the runway. Runway landing operations activities will include Orbiter roll to stop, all ground servicing on the runway, and towing of the Orbiter to the next activity--safing and deservicing. Figure 2.1-B is an artist's conception of the Orbiter on its approach to Vandenberg Air Force Base.

At the Safing and Deservicing Facility, residual cryogenic and hypergolic fuels will be removed, and protective works will be installed. The Orbiter's interior will be cooled and vented. Data stored electronically will also be immediately removed.

Next, the Orbiter will be towed to the Orbiter Maintenance and Checkout Facility to remove a payload, if required, and to complete various tests, inspections, and maintenance activities in preparation for the next mission. An ongoing function directly related to this will be the servicing of hypergolic propellant components. The hypergolic components of the Orbiter are: (1) propulsion units utilizing propellants that combust spontaneously upon mixing and (2) hydraulic system power units that utilize the catalytic decomposition of hydrazine. Subsystem components will be removed from the Orbiter and trucked to the Hypergolic Servicing Facility where they will be maintained and repaired. They will then be returned to the Maintenance and Checkout Facility for reinstallation on the Orbiter.

Finally, the Orbiter will be towed from the Maintenance and Checkout Facility to the launch pad area. The tow route will, for the most part, consist of

existing Base and public roads that will necessarily require some modification. Construction of a new connecting road (between the airfield area and an existing Base road) will also be required. Large side and overhead clearances will be needed because of the envelope created by the Orbiter's wing span and tail height and will involve modifications such as pavement widening, tree removal, overhead powerline modification, and clearance widening.

Figure 2.1-C shows the proposed location of facilities that will be associated with the Orbiter processing sequence: airfield, Safing and Deservicing Facility (SDF), Orbiter Maintenance and Checkout Facility (OMCF), Hypergolic Service Facilities (HSF), and the towway and tow route.

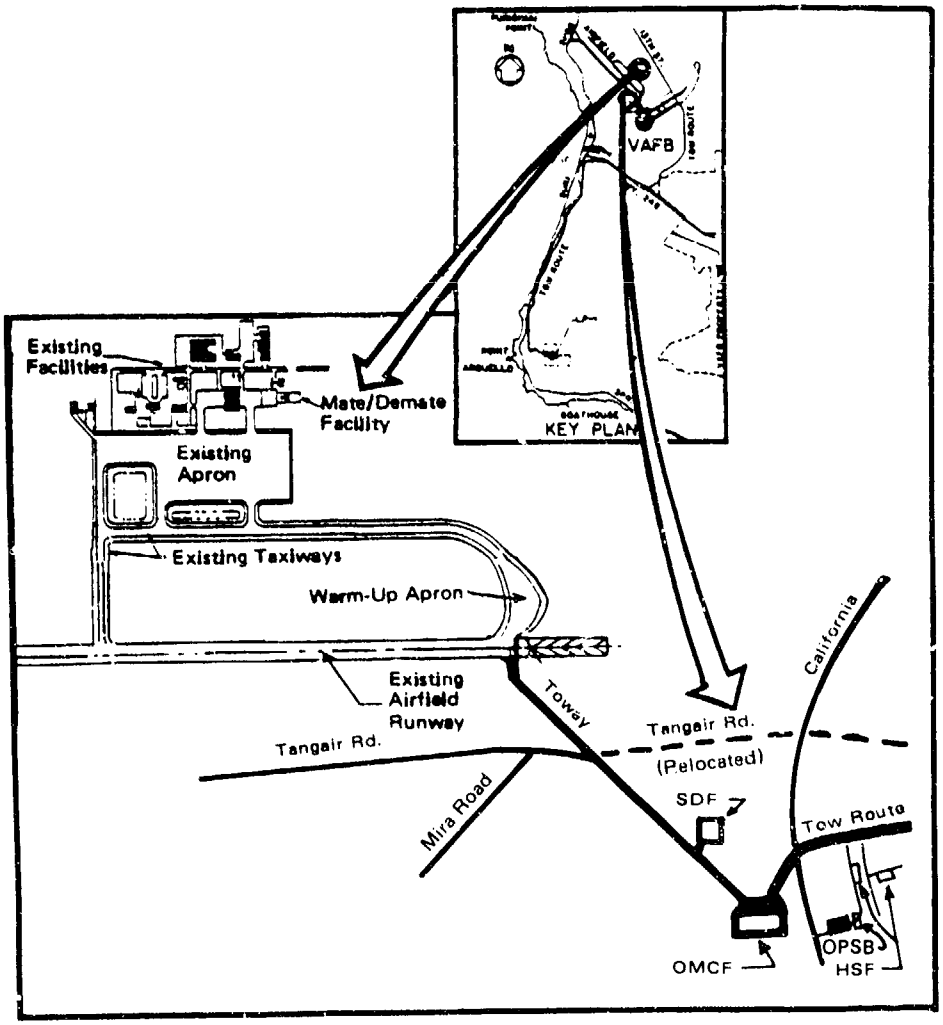
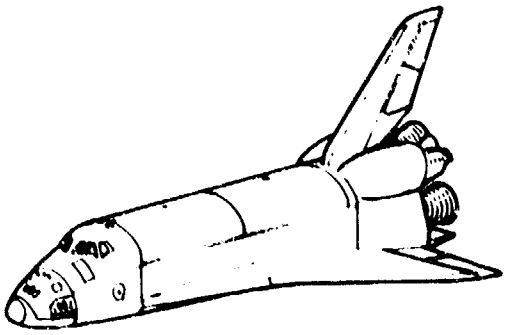


FIGURE 2.1-C. Location of Orbiter processing facilities

Data Brief 2.1-1. ORBITER



DESCRIPTION:

Length:	122 ft
Wing span	78 ft
Dry weight:	150,000 lb
Payload capacity	65,000 lb (32,000 lb from VAFB)
Payload compartment	60 ft x 15 ft diameter

ACTIVITY

Not applicable

SOLIDS/LIQUIDS/GASES

SUMMARY OF PROPELLANTS/LIQUIDS/GASES

Propellant systems	Chemical name		Maximum quantity (lb)	Abort residual (lb)	Normal residual (lb)
Main propulsion	Liquid oxygen	(LO_2)	1,401	1,521	Negligible
	Liquid hydrogen	(LH_2)	257	257	Negligible
Orbital maneuvering	Nitrogen tetroxide	(N_2O_4)	15,585	365	1,558
	Monomethylhydrazine	(MMH)	9,517	199	952
Reaction control (forward and aft)	Nitrogen tetroxide	(N_2O_4)	4,550	1,300	2,370
	Monomethylhydrazine	(MMH)	2,341	2,200	1,580
Payload bay kits (3 max.)	Nitrogen tetroxide	(N_2O_4)	21,300	21,300	2,130
	Monomethylhydrazine	(MMH)	14,160	14,160	1,416
Auxiliary power units (3 units)	Hydrazine	(N_2H_4)	874	874	437

Vent system

18 vents (2- forward reaction control system, 2 - forward fuselage, 3 - mid fuselage, 2 - wings, 2 - orbital maneuvering system pods, and 2 - aft fuselage) with total area of 12 sq in.

Hydraulic system

Hydraulic fluid: 475 lb

Electrical power subsystem

Oxygen: 1,562 lb

Hydrogen: 184 lb

Water produced from fuel cell reaction

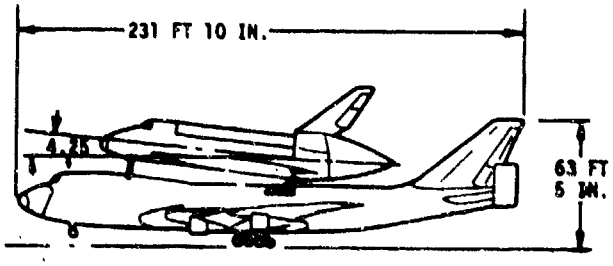
Pyrotechnic device locations

Nose gear uplock release, external tank attach points, liquid oxygen/liquid hydrogen umbilical, fire extinguishing system.

OTHER:

Crew: 4-person flight crew and up to 3 passengers. Length of space mission: one orbit to 30 days.

Data Brief 2.1-2. ORBITER FERRY



DESCRIPTION

Orbiter is attached to 747-100 carrier aircraft on top of the fuselage. Mate/Demate facility is required for Orbiter placement or removal from carrier aircraft.

ACTIVITY:

Ferry of Orbiter between VAFB and Edwards AFB, California; Kennedy Space Center, Florida; or auxiliary landing site

SOLIDS/LIQUIDS/GASES:

All Orbiter systems are deactivated and inert.

NOISE:

No Orbiter operation; normal 747-100 operational noise.

CONSTRUCTION, MANPOWER, NATURAL FEATURES TO BE ALTERED:

Not applicable.

EMISSIONS:

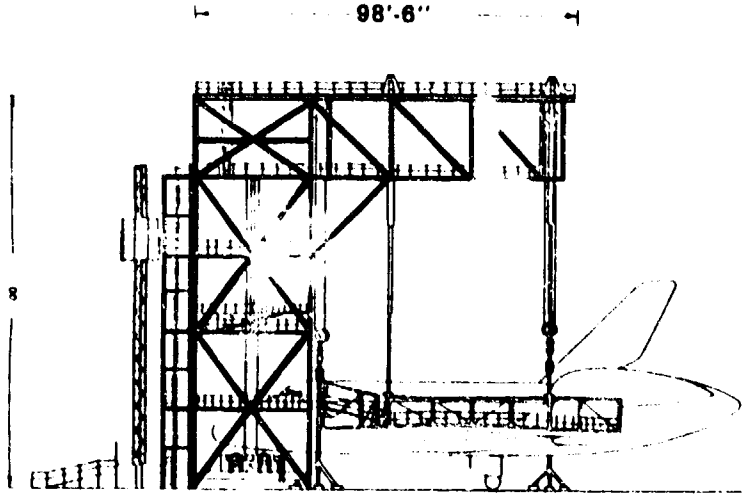
Operational: None other than normal 747-100 exhaust.
Nonoperational: Accidental crash of 747/Orbiter.

OTHER:

First ferry flight to VAFB, March 1982.

Data Brief 2.1-3. MATE/DEMATE FACILITY AND OPERATIONS

FACILITY



DESCRIPTION

80 ft wide by 99 ft long by 100 ft high open steel structure.

ACTIVITY

Mate and demate Orbiter with 747 aircraft.

SOLIDS/LIQUIDS/GASES

Construction materials required for steel erection and concrete foundation. Hydraulic fluid required for lift mechanism.

NOISE

Construction: Pile driving and typical construction equipment for steel erection and concrete work.
Operation: Hoisting.

MANPOWER

Construction Average: 12. Operation: 20 (est.).

EMISSIONS

Operational: None.
Nonoperational: Accidental fire.

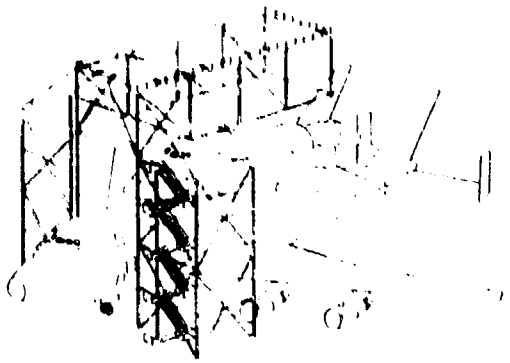
CONSTRUCTION

Pile foundation to 50 ft depth. Steel erection and mechanical/electrical installation.

NATURAL FEATURES TO BE ALTERED

None.

OPERATION



DESCRIPTION

Orbiter, 747-100 Ferry Aircraft, Mate/Demate device.

ACTIVITY

Inbound: 747 with Orbiter towed to Mate/Demate facility; carrier crew egress/ingress; carrier aircraft nose stabilization, and placement of wheel chocks; position lift sling on Orbiter, lift Orbiter, tow ferry aircraft to parking apron, lower Orbiter onto stabilizing jacks, deploy landing gear, tow to Orbiter Maintenance and Checkout facility by tow tractor at speeds less than 5 miles per hour.
Outbound: Mate/Demate activities are similar in nature to inbound activities but the sequence of operations is reversed.

NOISE

Crane mechanical noise; tow tractor engine noise.

EMISSIONS

Operational: Tow tug engine exhaust.
Nonoperational: Accidental fire.

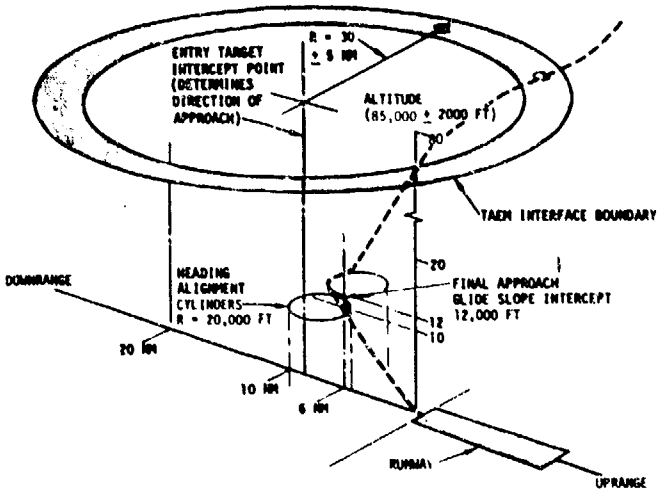
SOLIDS/LIQUIDS/GASES

None.

CONSTRUCTION, MANPOWER, NATURAL FEATURES TO BE ALTERED

Not applicable.

Data Brief 2.1-4. ORBITER DESCENT OPERATIONS



DESCRIPTION:

Descent from 85,000 to 12,000 ft elevation.*
Terminal area energy management maneuvering.

ACTIVITY:

Orbiter descent from 85,000 ft elevation on atmospheric reentry following mission completion to landing site final approach altitude of 12,000 ft. Descent to final approach initiated 6 to 7 nautical miles from end of VAFB runway.

Payload residuals
Orbiter residuals (see Orbiter Landing Summary Sheet).

NOISE:

Sonic boom - Approximately 2.0 lb/sq ft, main engines and orbital maneuvering engines are unpowered; auxiliary power unit.

CONSTRUCTION, MANPOWER, NATURAL FEATURES TO BE ALTERED:

Not applicable.

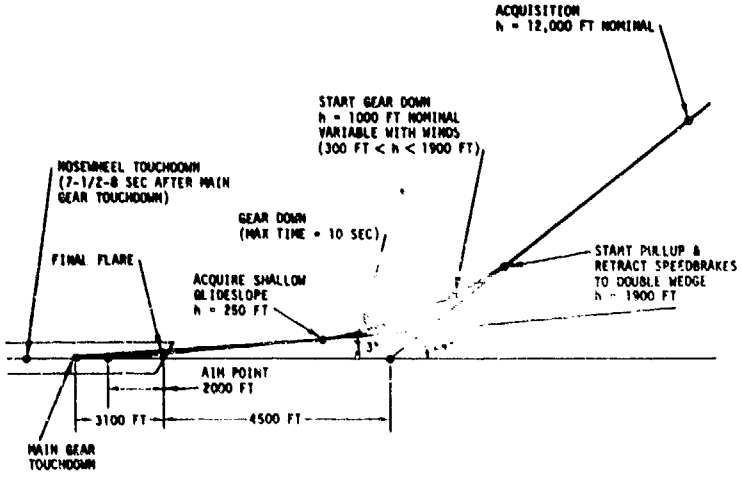
EMISSIONS:

Operational: Auxiliary power unit exhaust; out-gasing of hot thermal protection system; aerodynamic control surfaces are only means of Orbiter flight control.

Nonoperational: Accidental mid-air collision with other aircraft.

*Purpose of Terminal Area Management is to perform flight maneuvers to adjust flight speed, altitude, and direction to match final approach requirements.

Data Brief 2.1-5. ORBITER APPROACH OPERATIONS



DESCRIPTION:

Descent from 12,000 ft elevation to runway.

ACTIVITY:

Terminal approach and touchdown on runway. Orbiter is unpowered.

SOLIDS/LIQUIDS/GASES:

Residual propellants (see Orbiter Runway Landing Operations Summary Sheet).

NOISE:

Engines are nonoperative; velocity at 12,000 ft elevation is 290 knots; auxiliary power unit operation; wind noise possibly perceived at ground level.

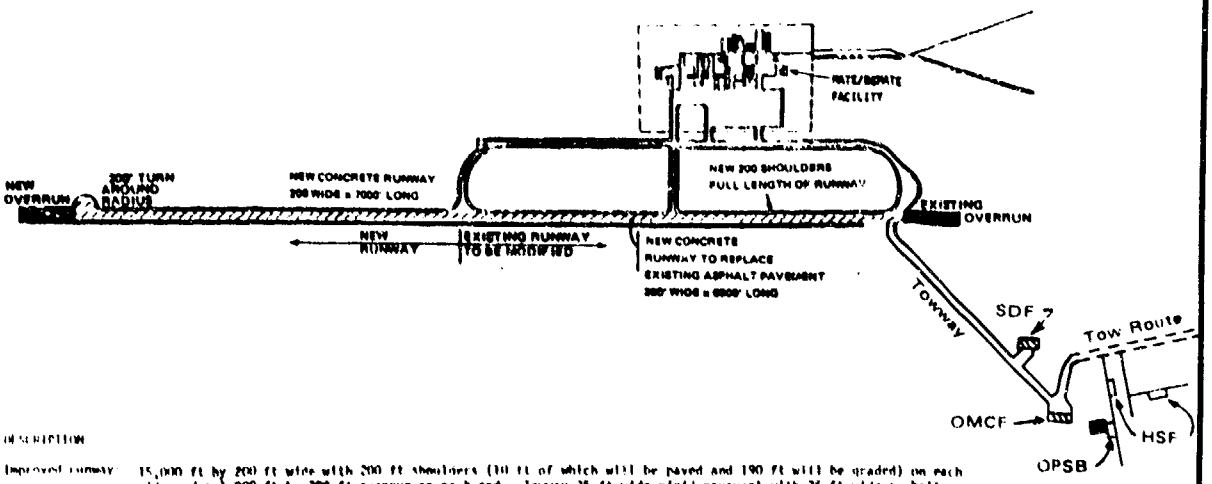
CONSTRUCTION, MANPOWER, NATURAL FEATURES TO BE ALTERED:

Not applicable.

EMISSIONS:

Operational: Auxiliary power unit exhaust; out-gasing of hot thermal protection system.
Nonoperational: Accidental crash, fire, explosion; accidental release of residual fuels.

Data Brief 2.1-6. AIRFIELD LANDING FACILITY



DESCRIPTION

Improved runway: 15,000 ft by 200 ft wide with 200 ft shoulders (10 ft of which will be paved and 190 ft will be graded) on each side and a 1,000 ft by 200 ft overrun on each end. Taxiway 35 ft wide rigid pavement with 25 ft wide asphalt shoulders. Relocate 1,200 ft long segment of Tanjair Road.

ACTIVITY

Facility Modification Construction

SOLIDS/LIQUIDS/GASES

Disposal of excess concrete, asphalt, lime, sand, and other construction materials

NOISE

Noise Sources: pavement breaker, ripper, loaders, trucks, other mobile construction equipment, pavement grooving machines, and concrete batch plants.

CONSTRUCTION

[illegible] underlying material, steel concrete batch plant, [illegible] utilities, compact base [illegible] grooves in the runway, install electrical equipment.

MANPOWER

Construction Average: 164 Operation: 25

NATURAL FEATURES TO BE ALTERED

Gully at northwest end of runway partially filled in with disposal material, increased runoff water, 16-million sq ft area cleared; borrow and spoil disposal areas required.

EMISSIONS:

Operational: Dust from concrete batch plant and cleared land areas, dust raised by equipment on graded roads, silt from pavement grooving; solid wastes; gaseous emissions from asphalt and construction equipment.

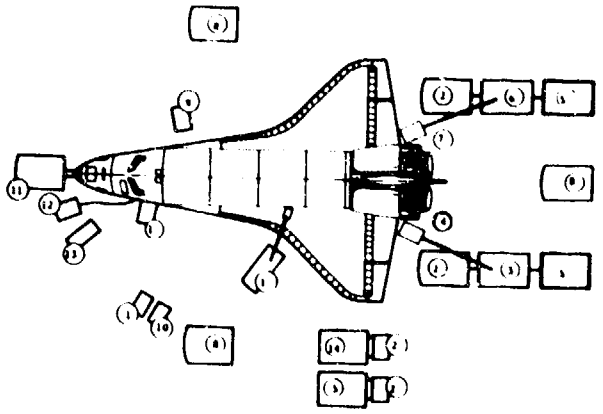
Nonoperational: Gasoline and diesel fuel spills, accidental fire, explosion.

OTHER

Construction Schedule: April 1979 - September 1980

Possible disruption to aviation activity.

Data Brief 2.1-7. ORBITER LANDING OPERATIONS



DESCRIPTION:

Orbiter Access Platform (1)*, Tractor (2), Ground Coolant Unit (3), Electrical/Coolant/Fuel Umbilical Boom (4), Ground Power Unit (5), Purge Unit (6), Purge/Oxidizer Umbilical Boom (7), Crash Truck (8), Pneumatic Pressurization Unit (9), Mobile Fan (10), Tow Tractor (11), Air Conditioning Unit (12), Crew Bus (13), Oxidizer Waste Tank (14), Fuel Waste Tank (15)

ACTIVITY:

After touchdown, Orbiter rolls to stop at end of runway; crash/fire/reserve units follow Orbiter down runway. Auxiliary power units shut down within one minute after stop. Ground service units connect to Orbiter. Crew egress. Preliminary safety inspection for propellant leaks (see "Other," 2) Towed to Safing and Deservicing Facility with ground equipment at speeds below 5 miles per hour.

SOLIDS/LIQUIDS/GASES:

See Orbiter Data Summary Sheet for typical and abort residuals.

NOISE:

Ground service equipment engines and compressors. Orbiter auxiliary power unit turbines (shutdowns within one minute following Orbiter stop).

CONSTRUCTION, MANPOWER, NATURAL FEATURES TO BE ALTERED:

Not applicable.

EMISSIONS:

Operational: Tire scrubbing at touchdown; out-gasing of hot thermal protection system, venting from cooling operation; auxiliary power unit exhaust, Ground Support equipment exhaust

Nonoperational: Fire, explosion, or accidental release of residual fuels.

OTHER:

1. During landing operation, Microwave Scanning Beam Landing System is operational.
2. If propellant leakage is discovered during inspection following landing and it is determined to be hazardous, propellant systems are immediately off-loaded into standby mobile tanks.
3. Possible accidental deer strikes.

*Number in parentheses corresponds to equipment number shown in Graphic.

Data Brief 2.1-8. ORBITER SAFING/DESERVICING FACILITY AND OPERATIONS

FACILITY



DESCRIPTION:

Steel frame building consisting of two areas: a 146 by 192 ft by 70 ft high hangar and a 60 by 192 ft by 18 ft high office and shop area.

ACTIVITY

Orbiter ordnance safing and fluids gases deservicing following touchdown. Cool Orbiter interior with blowers, drain residual fuels purge tanks and systems.

SOLIDS/LIQUIDS/GASES

Gaseous nitrogen (GN_2) storage: 600 cubic ft @ 6,000 psi and pad for tanker
Gaseous helium (GHe) storage: 800 cubic ft @ 6,000 psi and pad for tanker
Pad for waste tanker
Gaseous hydrogen (GH_2) tanker
Oxydizer pad for waste tanker
Gaseous oxygen (GO_2) pad for tanker

NOISE:

2 - 15-ton bridge cranes, blowers, and air compressors.

CONSTRUCTION

Typical

MANPOWER

Construction Average: 80. Operation: 91 per shift (2 shifts)

NATURAL FEATURES TO BE ALTERED

Facility constructed on level area with low vegetation adjacent to existing airfield facilities.

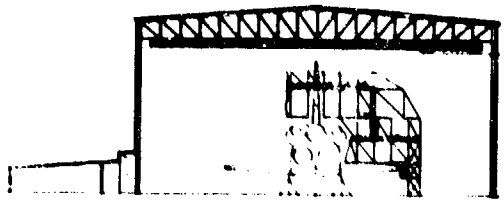
EMISSIONS

Operational: See Orbiter Safing and Deservicing Summary Sheet.
Nonoperational: Hypergolic and toxic fluid spills, toxic gas emissions.

OTHER

7 ft security fence surrounds facility area. Approximately 160 by 220 ft. Parking to accommodate 180 personnel. Construction Schedule January - December 1981.

OPERATION



DESCRIPTION

Orbiter in Safing and Deservicing facility.

ACTIVITY

Safing and Deservicing after initial cooling on runway, purge fuel cells, tow Orbiter to Maintenance and Checkout facility following deservicing.

SOLIDS/LIQUIDS/GASES:

Hydrazine (N_2H_4)
Liquid oxygen (LO_2)
Liquid hydrogen (LH_2) — Residual quantities as listed on Orbiter Data Summary Sheet
Gaseous helium (GHe)
Gaseous nitrogen (GN_2)

NOISE:

Liquid transfer only.

CONSTRUCTION, MANPOWER, NATURAL FEATURES TO BE ALTERED:

Not applicable.

EMISSIONS:

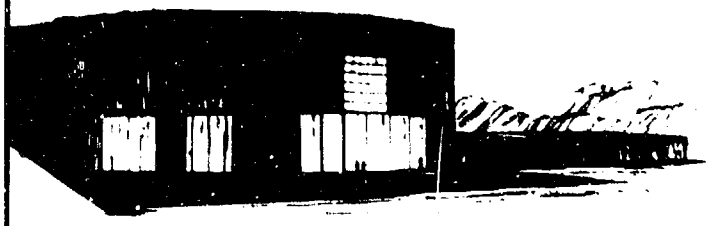
Operational: Vent air from building. Drained liquids and gases in mobile tanks.
Nonoperational: Accidental release of residual quantities of liquids and gases. Accidental fire or explosion.

OTHER:

If damage or leakage is detected, gases and liquids will be off-loaded to mobile tankers. Interior pressure of Safing and Deservicing facility will be maintained above ambient during Orbiter servicing. Vapor scrubbers and liquid containment systems installed for gas or fuel releases. Water deluge system for fire or propellant spill.

Data Brief 2.1-9. ORBITER MAINTENANCE/CHECKOUT FACILITY AND OPERATIONS

FACILITY



DESCRIPTION:

Steel frame building consisting of two areas: a 203 by 340 by 101 ft high hangar and a 204 by 100 by 10 ft high shop and technical area; 52 ft high concrete blast wall separates hangar and shop/office area. Payload deservicing area is also completely blast protected by heavy concrete wall and ceiling.

ACTIVITY:

Handling operations equipment and personnel are located in the OMCF. Removal of the payload, Orbiter maintenance and system checkout, installation of hypergolic modules, removal/installation of Space Shuttle Main Engines and payloads, launch processing control/monitor of landing, mate/demate, Orbiter and hypergolic systems checkout.

SOLIDS/LIQUIDS/GASES:

Gaseous hydrogen (GH_2) pad for tanker
Gaseous helium (GHe) pad for tanker
Gaseous oxygen (GO_2) pad for tube trailer
Gaseous hydrogen (GH_2) pad for tube trailer
Hypergol pad for waste tanker

NOISE:

Light industrial

CONSTRUCTION:

Typical.

MANPOWER:

Construction Average: 50 Operation: 240 per shift (2 shifts)

NATURAL FEATURES TO BE ALTERED:

Facility constructed on level area with low vegetation adjacent to existing airfield facilities.

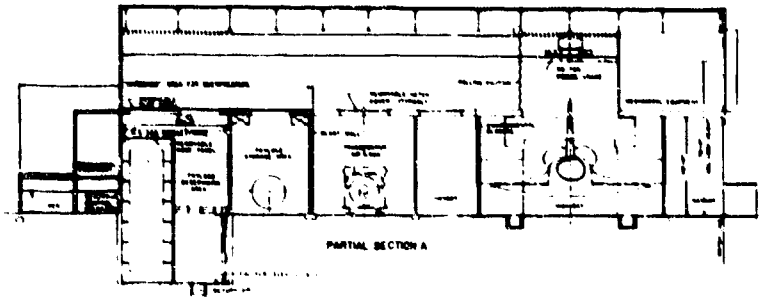
EMISSIONS:

Nonoperational: Accidental leakage or spill of gases or liquids.

OTHER:

Security fence surrounds facility area of approximately 550 by 400 ft. Parking to accommodate 600 personnel. Construction Schedule: April 1980 - July 1981

OPERATION



DESCRIPTION:

Orbiter in Maintenance and Checkout Facility.

ACTIVITY:

Position Orbiter and attach supporting power/electrical connections; inspect Thermal Protection System (TPS) by solvent wipe-down and non-destructive testing; as necessary, repair/replace Thermal Protection System tiles, perform detailed inspection of subsystems; payload removal/installation; test fuel cells; Service Active Thermal Control System, Atmospheric Revitalization System and other systems; replenish consumables, pressurize gas bottles; connect ordnance; perform integrated preflight test. Orbiter towed from Maintenance and Checkout Facility to SLC-6 launch pad on wheeled transporter by diesel tractor.

SOLIDS/LIQUIDS/GASES:

Monomethylhydrazine (MMH)
Nitrogen tetroxide (N_2O_4)
Hydrazine (N_2H_4)
Isopropyl alcohol
Freon TF
Freon 21
Gaseous nitrogen (GN_2)
Gaseous helium (GHe)
Gaseous hydrogen (GH_2)
Gaseous oxygen (GO_2)
Compressed air
Hydraulic fluid
Ammonia (NH_3)
Carbon dioxide (CO_2)
TPS bonding material
TPS inter-tile insulation material
Lube oil
Liquid hydrogen (LH_2)
Liquid oxygen (LO_2)
FC-40 coolant
Potable water

NOISE:

Light industrial

CONSTRUCTION, MANPOWER, NATURAL FEATURES TO BE ALTERED:

Not applicable.

EMISSIONS:

Operational: Solvent vapors; drained liquids and gases in mobile tanks.
Nonoperational: Accidental release of gases and liquids listed above; accidental fire/explosion; contaminated waste water from spill cleanup.

OTHER:

If damage or leakage is detected, residual gases and liquids will be offloaded to mobile tanks. If required, the following operations will be performed: remove hypergolic modules, change main engine, remove/replace Orbiter components, install/remove air ferry kit. Vapor scrubbers and hypergolic water flush system will be installed for gas or propellant leaks.

Data Brief 2.1-10. ORBITER HYPERGOLIC SERVICING FACILITY AND OPERATIONS

FACILITY



DESCRIPTION:

One 100 ft x 86 ft support building for technical and office space. Two 71 ft by 71 ft by 47 ft high steel and concrete buildings containing shop, technical and module storage areas, test cells and adjacent deservicing pads.

ACTIVITY:

Tear down, inspect, clean, reassemble and test the Orbiter payload bay kit, forward reaction control subsystem, aft propulsion subsystem, auxiliary power unit subsystems and hypergolic propulsion and attitude control subsystems aboard upper stages.

CONSTRUCTION:

Typical.

SOLIDS/LIQUIDS/GASES:

Hydrazine (N_2H_4) waste tanker pad
Helium (He) tanker
Gaseous nitrogen (GN_2) tanker pad
Freon and alcohol supplied by tanker

NOISE:

4 - 25-ton bridge cranes.
Compressed air lamp
Heating, ventilating, and air conditioning equipment

MANPOWER:

Construction Average: 21 Operation: 36 per shift (2 shifts)

NATURAL FEATURES TO BE ALTERED:

Facility constructed on level area with low vegetation adjacent to existing airfield facilities.

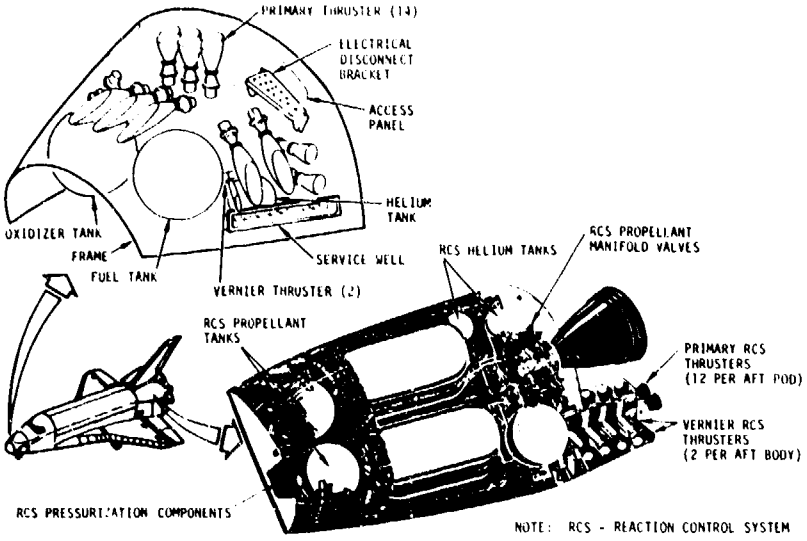
EMISSIONS:

Nonoperational: Leakage or spill of gases or liquids.

OTHER:

Parking to accommodate 32 cars. Construction Schedule: July 1980 - July 1981.

OPERATION



NOTE: RCS - REACTION CONTROL SYSTEM

DESCRIPTION:

Orbiter hypergolic propellant module and component servicing.

ACTIVITY:

Servicing of Orbiter detachable hypergolic modules such as: Payload Bay kits, aft propulsion subsystem, forward reaction control subsystem, and auxiliary power unit components. Maintenance and Checkout of these subsystems is not related to sequence of Orbiter. Components hauled by truck from and to Orbiter Maintenance and Checkout Facility or Safing and Deservicing Facility.

SOLIDS/LIQUIDS/GASES:

Gaseous helium	(GHe)	Isopropyl alcohol
Monomethylhydrazine	(MMH)	Freon TF
Nitrogen tetroxide	(N_2O_4)	
Hydrazine	(N_2H_4)	
Gaseous nitrogen	(GN_2)	

NOISE:

Shop noise.

CONSTRUCTION, MANPOWER, NATURAL FEATURES TO BE ALTERED:

Not applicable.

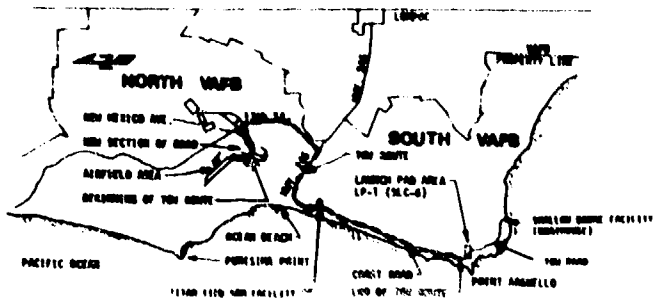
EMISSIONS:

Operational: Solvent vapors--drained liquids and gases in tanks.
Nonoperational: Accidental release of gases and liquids; release of contaminated waste waters from spill washdown; fire, explosion.

OTHER:

Test cells will be maintained at less than ambient pressure. Other areas will be maintained at greater than ambient pressure. Fuel vapor detection units and oxidizer vapor detection units will be installed. Fuel vapor scrubbers, water deluge, and washdown will be utilized for spills, leaks, or fire.

Data Brief 2.1-11. SPACE TRANSPORTATION SYSTEM TOW ROUTE



DESCRIPTION:

Develop tow route for transporting Orbiter from airfield processing area and tow road for transporting External Tanks from Shallow Draft Barge docking facility. Tow route is approximately 16 miles in length and utilizes existing roadways. Tow road is approximately 7 miles in length and partially utilizes existing roadway corridors and partially utilizes undeveloped grazing areas.

ACTIVITY:

Roadway construction/modification and utilities relocation. Tow operations.

SOLIDS/LIQUIDS/GASES:

Construction: Typical road construction materials

Operation: Orbiter and spent Solid Rocket Booster casings contain residual propellants and ordnance.

NOISE:

Construction: Typical heavy construction noise

Operation: Heavy to light diesel and gasoline powered vehicles

CONSTRUCTION:

Roadbed and road surface (asphaltic concrete overlays) improvements; road realignment and widening - minimum paved width 24 ft; strengthen underground culverts/conduits; remove/relocate roadside features penetrating Orbiter clearance envelope; clear and grub land 5 ft from edge of cuts/fills; no modification of 13th Street bridge; possibly modify Highway 246 bridge; relocate underground interfering overhead electrical lines.

MANPOWER

Construction Average: 17 Operation: 20 per tow operation

NATURAL FEATURES TO BE ALTERED

Excavation along roadways and adjacent terrain. Possible disruption to natural features adjacent to roads including archaeological sites. Drainage patterns and road grades will be substantially unaltered

EMISSIONS:

Operational: Construction - Typical road construction emissions; Operation - Vehicle exhaust

Nonoperational: Accidental release of residual propellants and gases, accidental fire, explosion

OTHER:

Construction Schedule: April 1979 - April 1980.

2.2 SOLID ROCKET BOOSTER SEQUENCE

Two Solid Rocket Boosters will be used for launch assist on the Space Shuttle Vehicle. These will be jettisoned during ascent, will parachute into the ocean, be recovered at sea, and then be refurbished for reuse. The Solid Rocket Booster will be composed of several segments that will be assembled on-site prior to launch. Recovered boosters will be towed to Port Hueneme and disassembled after recovery. The solid propellant sections will be shipped by rail to the manufacturing facility. Following casement examination and propellant replenishment, the segments will be returned by rail to Vandenberg. Nonpropellant components will be transported to and refurbished at the Base.

The Solid Rocket Booster activity sequence is depicted in Figure 2.0-A. For purposes of this report, this sequence will begin with marine operation following recovery of the casings about 150 miles offshore. The sequence will be completed when the Solid Rocket Booster segments are ready for launch pad operations (this will include buildup into a complete booster on the launch mount). Figure 2.2-A indicates the location of facilities associated with the Solid Rocket Booster activities.

This report does not consider the rail shipment of the rocket booster segments between Port Hueneme and the manufacturer nor between the manufacturer and Vandenberg. Solid Rocket Booster splashdown, ocean recovery, and tow to the Port Hueneme entrance channel are also excluded. These aspects of the STS operation are a portion of the Space Shuttle Program and are included in the National Aeronautics and Space Administration (NASA) Space Shuttle Program Environmental Impact Statement.

The first activity of the Solid Rocket Booster sequence will take place just outside Port Hueneme Harbor. Here the recovery vessels, each towing one floating spent booster, will be met by workboats to maneuver the booster casings for harbor entry and subsequent lift-out onto a dock. Ship berthing and maintenance will be required for the recovery vessels. An existing wharf facility will be modified to accommodate these activites.

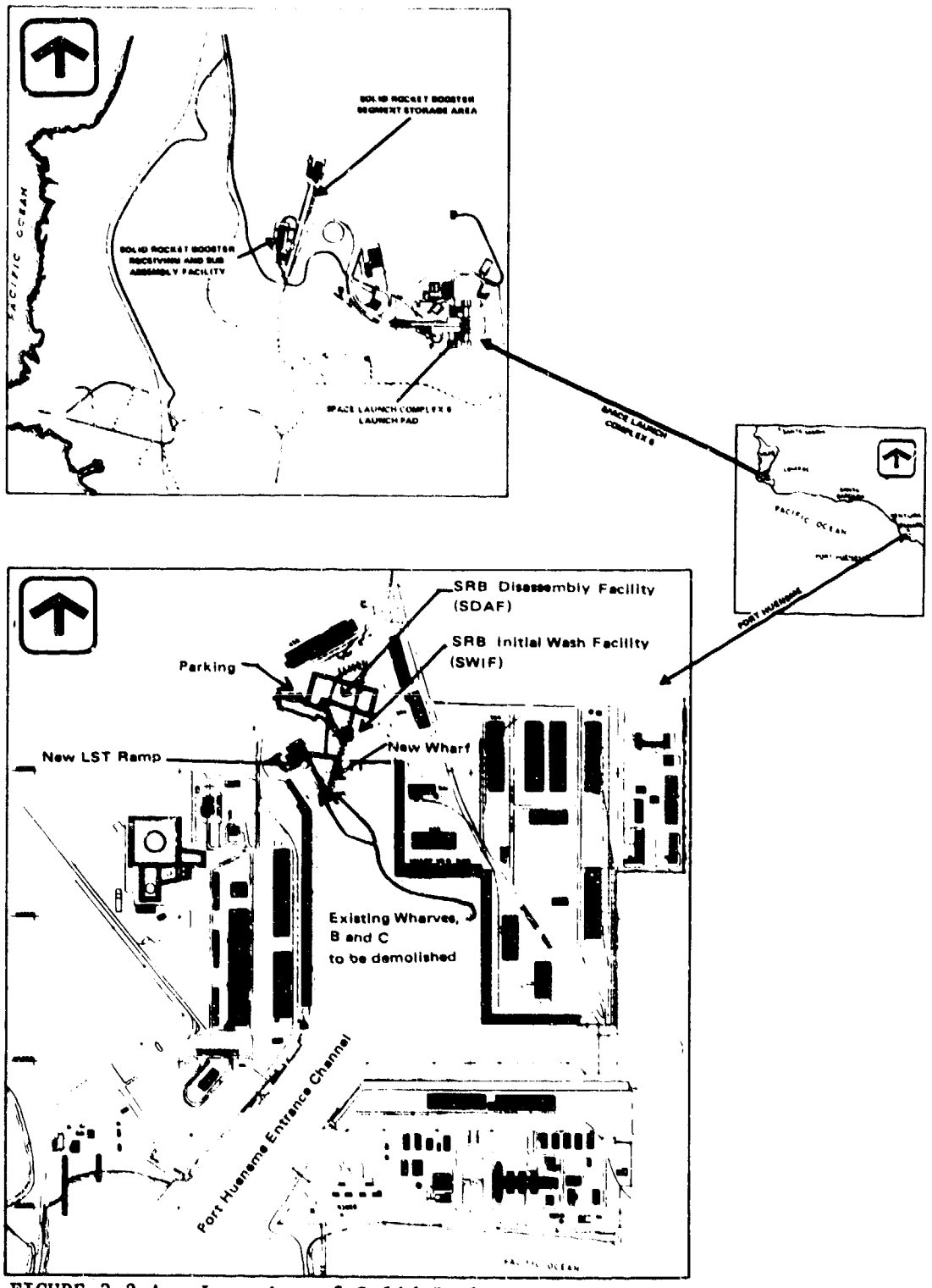


FIGURE 2.2-A. Location of Solid Rocket Booster processing facilities.

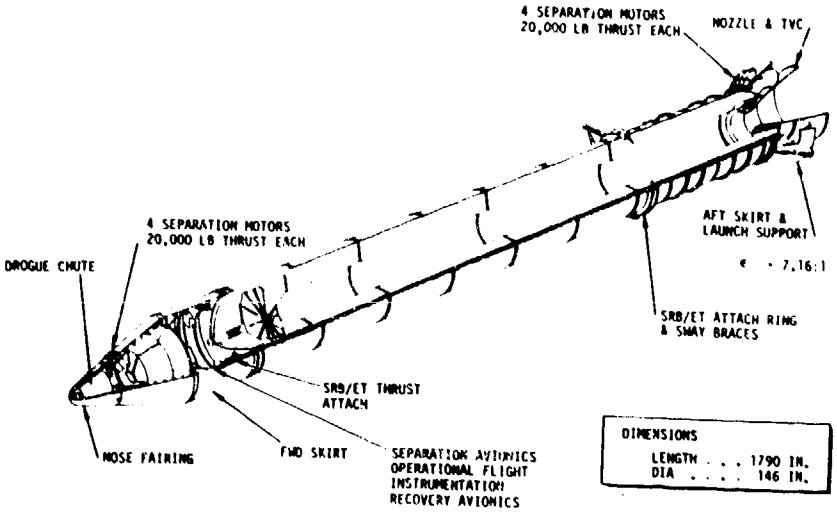
Next, the boosters will he hoisted from the water at the recovery wharf. At the same time, the parachutes that were rolled onto reels at sea during recovery will be transferred from the recovery vessel to the dock. Parachutes will be washed at Vandenberg in a separate activity. After each booster is hoisted onto a transporter on the dock, the ordnance system will be disconnected and the outside casing rinsed. It will then be towed to the Disassembly Facility where exposed surfaces of the booster will be subjected to high pressure washdown. The spent boosters will be disassembled into segments, final washed, dried, and prepared for shipment. The propellant sections, which will be essentially 12-foot-diameter steel tube sections, will be shipped to the Solid Rocket Booster manufacturing facility by rail. The remaining inert components of the booster, such as the forward skirt, nose cone, and aft skirt, will be trucked or railed from the Disassembly Facility to the Solid Rocket Booster Refurbishment and Subassembly Facility, located at the launch pad area on Vandenberg.

The activity related to the washing and refurbishment of recovered parachutes probably will include the transport of these parachutes by truck or railroad to Vandenberg. Once at Vandenberg, they will be trucked to existing Building Number 1728. This building will be modified to accomodate the washing, rinsing, drying, and repacking of the parachutes for the next mission.

Titan III Solid Rocket Motors (SRMs) will no longer be processed at the launch complex intended for Shuttle use. Instead, a new Titan III facility will be built to accommodate the receiving, inspection and storage of the SRMs. It is currently proposed to locate this facility about 5 miles north of the Shuttle launch area, near the junction of Coast and Mesa Roads. Titan III SRM segments would continue to be delivered by rail from the manufacturer. Upon arrival at this facility, each will be uprighted and inspected. Components will be subassembled and integrated, if required. The segments will then be stored until needed at the Titan launch pad.

The next activity will be the receipt of replenished booster sections received by railcar from the manufacturer and subassembly of refurbished components in preparation for Solid Rocket Booster reassembly. All sections will be stored, ready to be transported to the launch pad for assembly into complete Solid Rocket Boosters. Propellant sections will be stored both within the Solid Rocket Booster Refurbishment and Subassembly Facility and on railroad cars outside the facility. The smaller nonpropellant sections will be stored within the existing Solid Rocket Booster Storage Facility. Assembly of the Solid Rocket Booster on the launch mount is considered to be a launch pad operations activity.

Data Brief 2.2-1. SOLID ROCKET BOOSTER



DESCRIPTION:

Each booster is 149 ft long and 12 ft 2 in. in diameter. Two boosters mounted on External Tank. Gross weight (each): 1,251,177 lb; Solid propellant (each): 1,108,348 lb.

ACTIVITY:

Not applicable.

SOLIDS/LIQUIDS/GASES:

1,109,348 lb of ammonium perchlorate Al with PBAN binder solid propellant per booster. Eight 20,000 lb thrust separation motors per booster. Each booster contains a hydrazine auxiliary power unit.

NOISE, CONSTRUCTION, NATURAL FEATURES TO BE ALTERED, EMISSIONS:

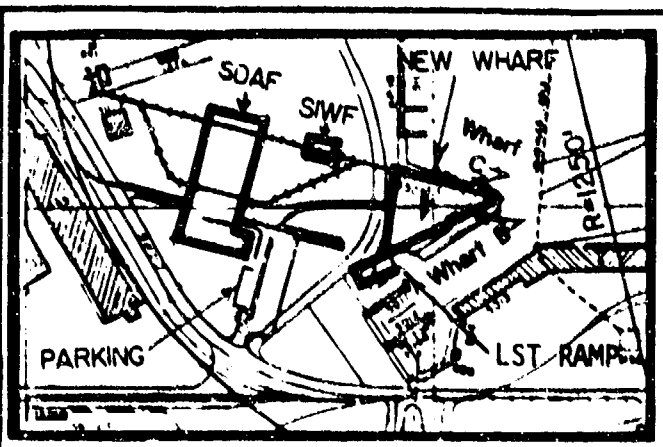
Not applicable.

OTHER:

Under normal or abort operations, boosters separate from External Tank at 149,562 ft elevation, and fall back to earth with the aid of three 122 ft diameter parachutes (per booster) for recovery and reuse; 10-40 mission design life depending on subsystem; pilot chute and nozzle extension are not recovered.

Data Brief 2.2-2. PORT HUENEME HARBOR--SOLID ROCKET BOOSTER RECOVERY

FACILITY



DESCRIPTION:

An approximate 300 ft. by 250 ft. by 200 ft. triangular shaped wharf area equipped with utilities, water, and a connecting dockside railline leading to Initial Wash Facility and Booster Disassembly Facility.

ACTIVITY:

Facility Modification/Construction

CONSTRUCTION:

Remove existing condemned wharves B and C, each approximately 250 to 300 ft. in length, and part of existing Landing Ship Tank (LST), Dredge to 18 ft. below Mean Lower Low Water (MLLW) at face of existing wharves. Excavate for new 50 ft. wide by 100 ft. long LST ramp. Compact, embank, and grade approximately one acre. Install storm drainage, utilities. Construct new concrete wharf and LST ramp. Install interfacility connecting rail line.

SOLIDS/LIQUIDS/GASES:

Disposal of demolished wharf debris, concrete, asphalt, and dredge materials. Disruption of bottom sediments. Generation of floating debris.

NOISE:

Noise sources: Bulldozers, backhoes, shiploaders, compactors, dredgers, trucks.

NATURAL FEATURES TO BE ALTERED:

Bottom topography near existing wharves B and C and LST ramp

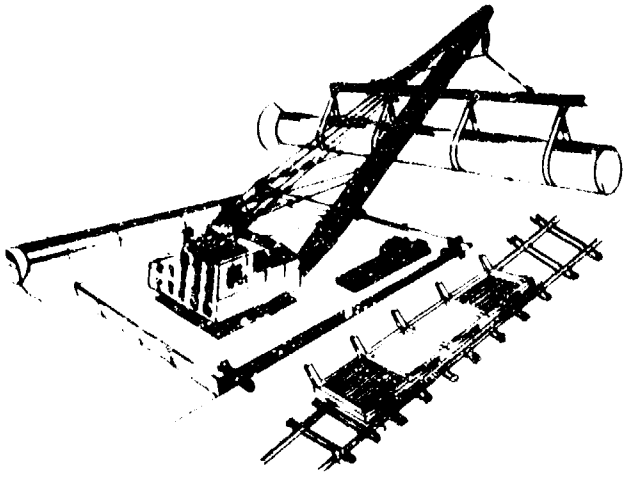
EMISSIONS:

Vehicle emissions, fugitive dust, dredge material odors.

OTHER:

Localized increased turbidity and water quality degradation; localized biota and habitat damage.

OPERATION



DESCRIPTION:

Two recovery vessels, each with one floating spent Solid Rocket Booster under tow; two workboats.

100 ton Navy barge crane; 10 ton mobile crane on dock; and 1 transporter.

ACTIVITY:

Workboats rendezvous with Solid Rocket Booster recovery vessel; position booster casing alongside recovery vessel, move into port, and position booster at dockside. Ship berthing and maintenance.

Hoisting of front cone assembly and parachutes from recovery vessel to dock. Hoisting of floating Solid Rocket Booster from water and positioning on transporter; ordnance safing; preliminary external rinse; Solid Rocket Booster towed to wash facility.

SOLIDS/LIQUIDS/GASES:

Residual contaminated ocean water sealed inside Solid Rocket Booster spent casing. Also residual hydrazine and four spent separation motor solid propellants.

NOISE:

Ship engine noise from manpowering operations.
Valve hatters. Crane motor noise.

CONSTRUCTION, MODIFIED, NATURAL FEATURES TO BE ALTERED:

Not applicable

EMISSIONS

Operational: Exhausts from ship, boat, and crane barge engines. Preliminary external booster casing rinse water.

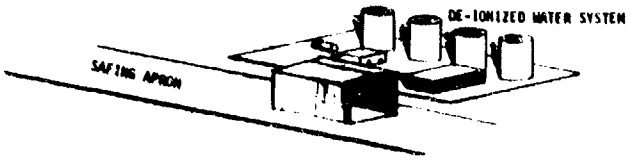
Nonoperational: Potential contaminated ocean water leakage from plugged booster casings. Accidental diesel fuel spills. Accidental explosion of ordnance during safing operations.

OTHER

Maintenance and berthing of recovery vessels, workboats, and associated recovery equipment will be provided at Port Hueneme. Vessel configurations have not been developed to date.

Contaminated ocean water inside casing may have to be released to ocean to debalast for hoisting. Navy barge crane is existing at Port Hueneme.

Data Brief 2.2-3. SOLID ROCKET BOOSTER WASH FACILITY AND OPERATIONS AT PORT HUENEME



DESCRIPTION:

50 by 50 by 30 ft high initial wash building with associated water storage tanks and wastewater treatment system. Solid Rocket Booster on Transporter.

ACTIVITY:

Construction: Typical with installation of water storage tanks - 40,000 gallon maximum capacity per tank.
Operation: Automated wash of external surfaces of recovered spent Solid Rocket Booster casings. External wash of booster casing with heated deionized water while booster is on transporter. Complete ordnance and hypergolic systems safing. Nozzle plug removed and interior of booster casing drained. Nozzle plug shipped to recovery vessel berth. Water displacing preservative applied to scratched or bare metal surfaces.

SOLIDS/LIQUIDS/GASES:

Potable water
Deionized water
Surfactants (detergents)
Wastewater contaminated with solid propellant and solid propellant combustion products.
Hydrazine (N_2H_4), gaseous nitrogen (GN_2) purge, residual contaminated ocean water.

NOISE:

Construction: Typical building construction noise levels.
Operation: High noise levels from high pressure pumps and water spray. Air compressors.

CONSTRUCTION:

Typical steel frame construction.
Facility site is currently graded and level

MANPOWER:

Construction Average: 30 (est.)*
Operation: 15 (est.)

NATURAL FEATURES TO BE ALTERED:

Facility will be constructed on existing graded area at the U.S. Navy Construction Battalion Center, Port Hueneme.

EMISSIONS:

Operational: Treated wastewater discharged to port wastewater system. Periodic disposal of accumulated solid residue.
Nonoperational: Accidental release of hydraulic fluid, hydrazine.
Release of contaminated water. Accidental explosion from ordnance safing. Spillage of metal preservative chemicals.

OTHER:

Construction Schedule: October 1980 - September 1981.

Solid Rocket Booster is safed by bleeding and flushing residual hypergolic fuel from Thrust Vector Control System and removal of destruct ordnance. Booster Thermal Protection System insulation removed by high pressure water sprays. Casing is rinsed with potable and then deionized water.

*Construction will be concurrent with construction of the External Tank Storage Facility and will utilize a common workforce.

Data Brief 2.2-4 SOLID ROCKET BOOSTER DISASSEMBLY FACILITY AND OPERATIONS

FACILITY



DESCRIPTION:

A 160 ft by 288 ft by 56 ft high bay structure having an attached 60 ft by 225 ft by 27 ft low Bay storage module and an attached 60 ft by 200 ft by 18 ft administrative facility.

ACTIVITY:

Receipt of washed spent Solid Rocket Booster casing, disassembly of booster sections, final wash, shipping preparation, loading of segments on rail/truck transporters.

SOLIDS/LIQUIDS/GASES:

Potable water
Deionized water
Surfactants (detergents)
Wastewater contaminated with solid propellant and solid propellant combustion products.

NOISE:

Mechanical noise from disassembly operations and segment handling.

CONSTRUCTION:

Typical steel frame building construction with installation of exterior bridge crane supports.

MANPOWER

Construction Average: [illegible] (est.) shifts

NATURAL FEATURES TO BE ALTERED

Facility will be constructed on existing graded area at the U.S. Construction Battalion Center, Port Hueneme.

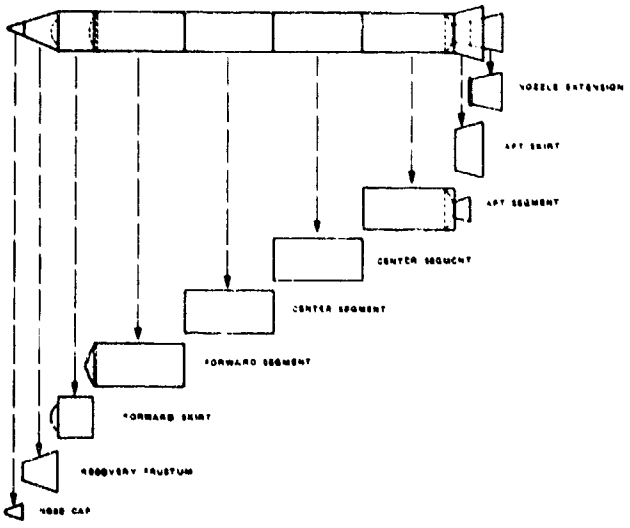
EMISSIONS:

Operational: Wastewater.
Nonoperational: Hydraulic fluid

OTHER:

Construction Schedule: October 1980 - September 1981

OPERATION



DESCRIPTION:

Operation at Port Hueneme

ACTIVITY:

Disassembly of spent booster casing, final wash, dry and application of preservative to metal surfaces, transport of propellant and nonpropellant components. Casing towed to facility from Initial Wash Facility. Propellant segments shipped out by rail. Non-propellant components transported by rail or truck to Solid Rocket Booster service and refurbishment facility at Vandenberg.

SOLIDS/LIQUIDS/GASES:

Booster Thermal Protection System insulation, spent or residual Solid Rocket propellant, surfactant, deionized water, metal preservatives

NOISE

Light industrial noise. High pressure wash water system, forced air blowers.

CONSTRUCTION, MANPOWER, NATURAL FEATURES TO BE ALTERED:

Not applicable.

EMISSIONS:

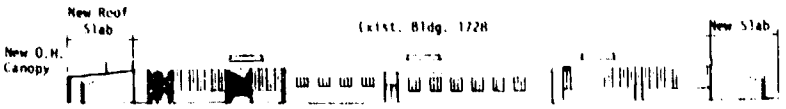
Operational: Diesel engine exhaust from tractor and locomotive used to transport Solid Rocket Booster casing and components. Wash and rinse water. Exhaust air from hot forced-air dryers.
Nonoperational: Accidental release of contaminated wash/rinse water. Spillage of metal preservative chemicals.

OTHER:

Solid Rocket Boosters are disassembled by jacking apart major booster segments and final disassembly of components. Nozzle, propellant sections, and various smaller subassemblies shipped to booster manufacturer by railroad on dedicated railcars. Aft and forward skirt, frustum, and various small subassemblies transported to SLC-6 booster refurbishment facility. Various other subassemblies scrapped.

Data Brief 2.2-5. PARACHUTE REFURBISHMENT FACILITY AND OPERATIONS

FACILITY



DESCRIPTION:

Construction: Modify interior of VAFB existing Building 1728. Add washer and dryer units, demineralized water storage tanks.

Operation: Rinse/wash, dry, defoul, repair, repack parachutes.

ACTIVITY:

Construction: Equipment installation/erection.
Operation: Receive reeled parachutes, unreel, defoul, rinse/wash and dry on monorail system, repair as necessary, repack.

SOLIDS/LIQUIDS/GASES:

Demineralized water, cleaners, wastewater.

NOISE:

Construction: Typical fabrication noise. Operation: Dryer blowers, trucks.

CONSTRUCTION:

Assembly of equipment for monorail transporter, modification of utilities, erection of tanks, installation of washer and dryer units. Possible demolition reconfiguration of building interior.

MANPOWER:

Construction Average: 25 (est.)

Operation: 10 (est.).

NATURAL FEATURES TO BE ALTERED:

None.

EMISSIONS:

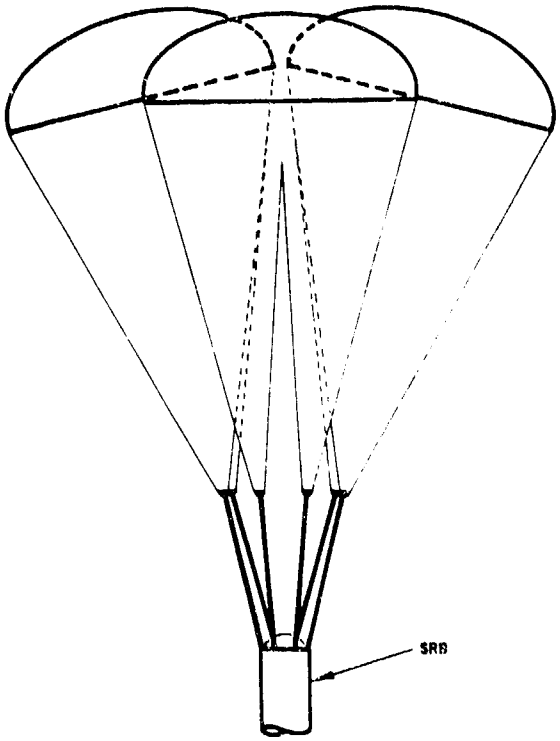
Operational: Dryer exhaust air. Wastewater containing salt, oil, sand, and marine residue.

Nonoperational: Wastewater containing salt, oil, sand, and marine residue.

OTHER:

Each Solid Rocket Booster has three parachutes which are 122 ft in diameter; have 122 suspension lines, 143 ft in length. Dry weight, 1,056 lb, wet weight, 1,821 lb.

OPERATION



DESCRIPTION:

Three parachutes per booster are received on reels. Each parachute is 122 ft in diameter with 143 ft suspension lines.

ACTIVITY:

Receive wet reeled parachutes from solid rocket recovery vessel at Port Hueneme, transship to VAFB parachute refurbishing facility to be: defouled, rinsed, dried, repaired, and repacked. Refurbish recovery float and ship recovery components to Solid Rocket Booster Receiving and Subassembly Facility.

SOLIDS/LIQUIDS/GASES:

Potentially solid rocket propellant contaminated ocean water.

NOISE:

Engine noises from shipping vehicle. Forced air fans and wash water pumps.

CONSTRUCTION, MANPOWER, NATURAL FEATURES TO BE ALTERED:

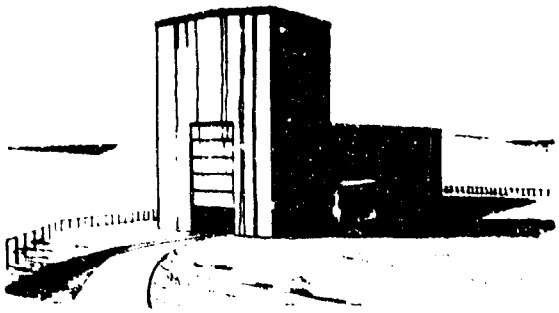
Not applicable.

EMISSIONS:

Operational: Contaminated wastewater. Evaporation from forced air dryer.

Data Brief 2.2-6 SOLID ROCKET BOOSTER RECEIVING, REFURBISHMENT, AND SUBASSEMBLY FACILITY AND OPERATIONS

FACILITY



DESCRIPTION:

Modified existing facility - steel-framed structure consisting of two main areas: an 84.5 by 205 by 55 ft high Low Bay; and an 84.5 by 66 by 120 ft high High Bay.

ACTIVITY:

All onsite Solid Rocket Booster segment operations excluding spent booster disassembly and buildup of the booster are accomplished within this facility.

NOISE

Construction: Steel erection and typical construction noise levels.

Operation: Industrial shop noise levels.

SOLIDS/LIQUIDS/GASES:

Potable water	Gaseous helium (GHe)	Metal preservatives
Deionized water	Gaseous hydrogen (GH_2)	Hydraulic fluid
Compressed air	Paint	

CONSTRUCTION:

Expand existing building with 205 ft extension of existing 55 ft high facility and add 66 ft High Bay with 120 ft height. Install new cranes and support equipment. Existing parking area adjacent to the building on the east side of Road C will be enlarged.

MANPOWER:

Construction Average: 22 Operation: 116 (2 shifts).

NATURAL FEATURES TO BE ALTERED:

Existing facility located at SLC-6.

EMISSIONS:

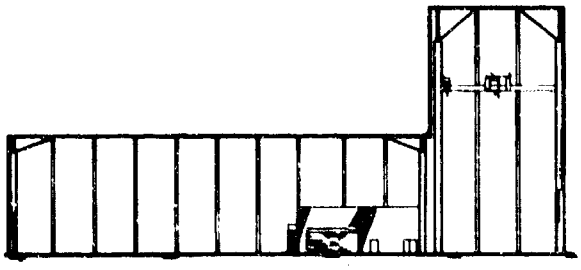
Operational: Facility exhaust air. Paint and grinder booth exhaust.
Nonoperational: Accidental ignition and burning of solid rocket propellant.*

OTHER:

Construction Schedule: April 1980 - March 1981.

*Storage of 4 forward and 8 center segments will be provided outside the facility and 4 aft segments within the facility. Total storage capacity is equivalent to 4.3 million pounds of solid propellant.

OPERATION



DESCRIPTION:

Aft and forward Solid Rocket Booster skirts in Solid Rocket Booster receiving and subassembly facility.

ACTIVITY:

Receive from booster disassembly facility and refurbish aft and forward skirt subassemblies, and various subassemblies. Receive Solid Rocket Booster propellant segments (horizontal on railroad cars) and subassemblies from manufacturer, prepare for vertical storage on special railroad cars stored at SLC-6 storage facility, and inspect. Subassemble total aft and forward skirts in preparation of Solid Rocket Booster assembly on launch pad.

NOISE:

Light industrial noise

SOLIDS/LIQUIDS/GASES:

Gaseous nitrogen (GN_2)	Deionized water
Gaseous helium (GHe)	Paint
Compressed air	Metal preservatives
Hydraulic fluids	Pyrotechnics
Potable water	Ammonium perchlorate Al with PBAN binder Solid Rocket Booster propellant.

CONSTRUCTION, MANPOWER, NATURAL FEATURES TO BE ALTERED:

Not applicable.

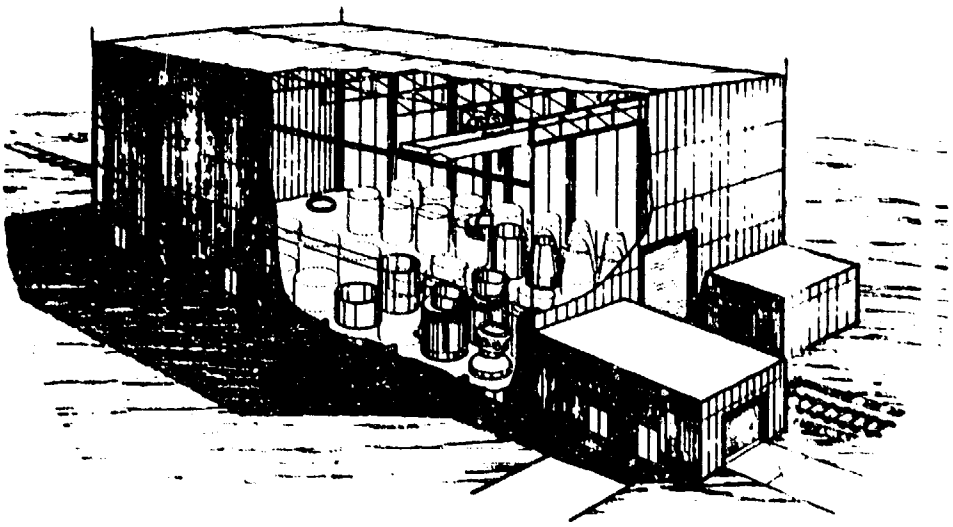
EMISSIONS:

Operational: Exhaust from paint booths and grinders.
Nonoperational: Accidental ignition and burning of solid propellant. Spillage of metal preservative chemicals, hydraulic fluid.

OTHER:

Refurbishment of Solid Rocket Booster subassemblies at SLC-6 facility includes: inspection, electrical checkout, replacement of defective elements, minor damage repair, touch-up painting, and packaging.

Data Brief 2.2-7 TITAN IIID RECEIVING INSPECTION AND STORAGE FACILITY



DESCRIPTION:

New structural frame/metal siding structure with 143 ft by 85 ft by 55 ft high bay assembly/storage area and 22 ft by 31 ft and 42 ft by 32 ft by 20 ft high low-bay support/storage area.

CONSTRUCTION ACTIVITY:

Construct new building; provide access roads, paved parking area, fencing, railroad spur, utilities, fire protection system, and 50-ton monorail crane.

OPERATION ACTIVITY:

Receive, inspect and storage Titan IIID Solid Rocket Motor segments. Transport segments to Space Launch Complex No. 4 on as needed basis.

MANPOWER:

Construction: 22 (est.) Operations: No change from current levels.

NATURAL FEATURES TO BE ALTERED:

Upward sloping natural terrain requires excavation and grading.

SOLIDS/LIQUIDS/GASES:

Disposal of excavated dirt. Chemical spillages, solid propellant, fuel/oil leaks.

NOISE:

Typical construction noise during building erection. Light industrial, vehicle, rail and crane noise during operations.

EMISSIONS:

Dust materials during construction. Vehicle exhaust emissions during construction and operations.

2.3 EXTERNAL TANK SEQUENCE

The External Tank will be a large integrated assembly consisting of two separate tanks--one for liquid oxygen and one for liquid hydrogen. It will be mated to the Orbiter and will supply propellant to the three main engines through an umbilical connection. The External Tank will be jettisoned at approximately 500,000 feet altitude with a tumbling motion to impact into a remote targeted ocean site; it will not be recovered.

External Tank activities leading to the integration of each tank with the Space Shuttle Vehicle are identified in Figure 2.0-A. Also, the proposed locations of facilities associated with these External Tank activities are shown on Figure 2.3-A.

The tanks will be manufactured in Louisiana and transported by sea through the Panama Canal to Vandenberg on a ballasted, tug-towed barge. The tanks will be shipped under moderate inert gas pressure. Four tanks will be delivered per barge shipment. Upon arrival at Vandenberg, in the nearshore vicinity of the Boathouse, the barge will deballast. Accompanying tug boats will then maneuver it into the embayment.

Once dockside, the barge will reballast until it rests firmly on the submarine bottom. The ETs, on their wheeled transporters, then will be towed from the barge to the External Tank Storage and Checkout Facility near SLC-6.

When the SDB is ready to depart it will be deballasted to its shallow draft configuration. Harbor tugs will maneuver the SDB while the ocean tug tows it out of the embayment for its return trip to the External Tank manufacture site. At the planned maximum launch rate of 20 launches per year, the SDB will make 5 round trips to VAFB annually.

Storage and Checkout activity for the tanks will include inspection, pressure and humidity tests, and cleaning. The tanks will then be stored, ready for transport to the launch pad. When required, an External Tank will be towed to the launch pad for buildup of a Space Shuttle Vehicle. Activities that will follow transport to the pad are part of the launch pad operation sequence.

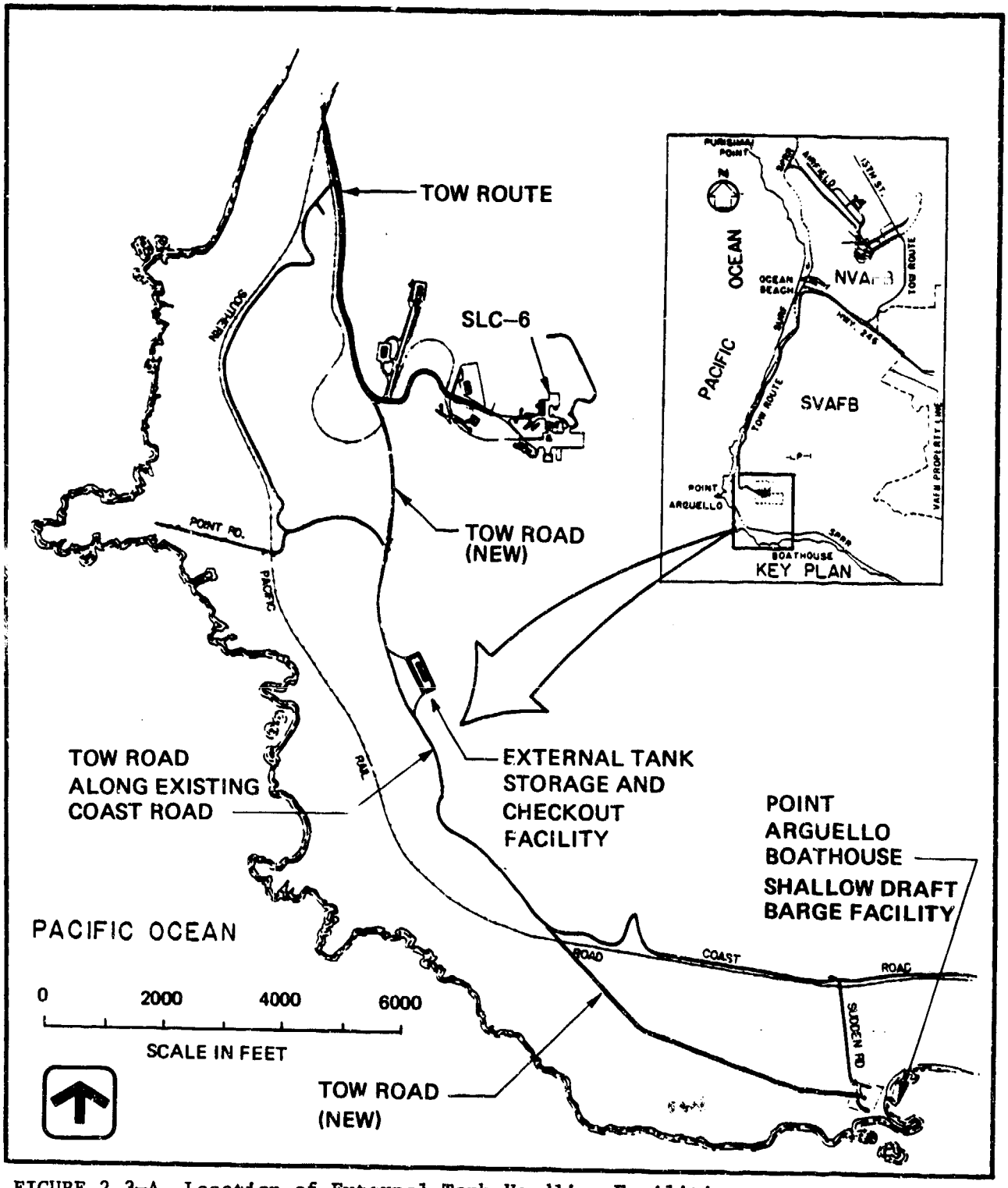
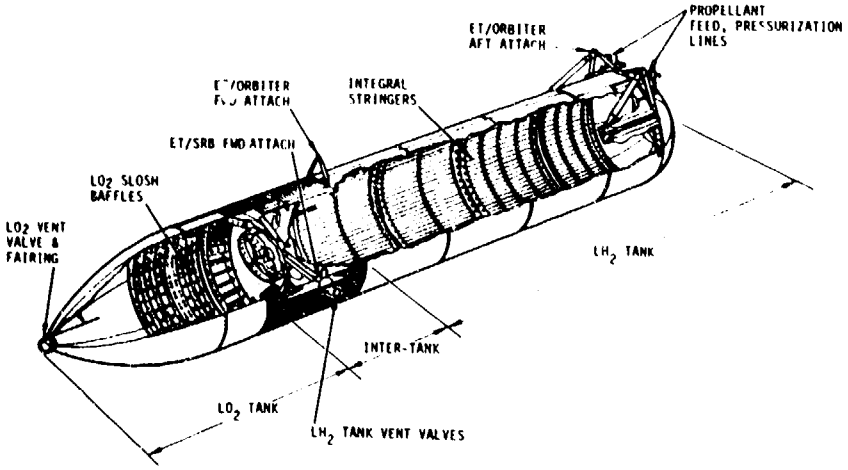


FIGURE 2.3-A. Location of External Tank Handling Facilities.

Data Brief 2.3-1. EXTERNAL TANK



DESCRIPTION:

Length: 153 ft 10 in.
Diameter: 27 ft 7 in.(without external insulation)

Empty weight: 76,365 lb
Loaded weight: 1,626,365 lb

ACTIVITY:

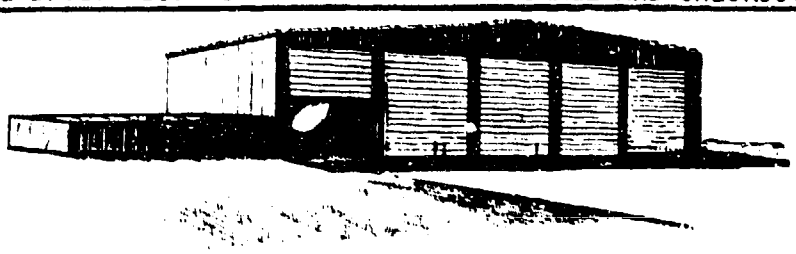
Notapplicable.

SOLIDS/LIQUIDS/GASES:	Capacity
Liquid hydrogen (LH_2)	223,000 lb
Liquid oxygen (LO_2)	1,427,000 lb

NOISE, CONSTRUCTION, MANPOWER, NATURAL FEATURES TO BE ALTERED, EMISSIONS:

Not applicable.

Data Brief 2.3-2. EXTERNAL TANK STORAGE AND CHECKOUT FACILITY/OPERATIONS AT VANDENBERG



DESCRIPTION:

Steel frame building 180 ft by 260 ft by 50 ft high with attached 180 ft by 80 ft by 20 ft high office facility; 40,000 sq ft asphalt maneuvering apron; 6,000 sq ft asphalt storage apron; and 20,000 sq ft asphalt parking area.

ACTIVITY:

Visual inspection and initial storage of External Tanks immediately following receipt at Vandenberg from manufacturer. Electrical and instrumentation test. Leak test of liquid oxygen and hydrogen tanks. Tank pressure and humidity tests. Tanks stored until needed. Tanks individually towed on wheeled transporter to launch pad by diesel tractor on as-needed basis.

CONSTRUCTION:

Typical construction techniques for steel frame industrial building.

NATURAL FEATURES TO BE ALTERED:

Facility to be constructed on existing gently sloping terrain near SLC-6.

MANPOWER:

Construction Average: 30 (est.)
Operation Average: 7 (est.)

SOLIDS/LIQUIDS/GASES:

Gaseous nitrogen at 6 $\pm$ 0.5 psig for liquid oxygen tank leakage tests.
Pressure is reduced to 3.7 $\pm$ 1.3 psig for storage.
Freon gas tracer for leak test. Helium used for hydrogen tank test and storage at above pressure.

NOISE:

Typical construction noise from steel erection. Five motor driven roll-up doors; heating, ventilating, air conditioning unit operation.

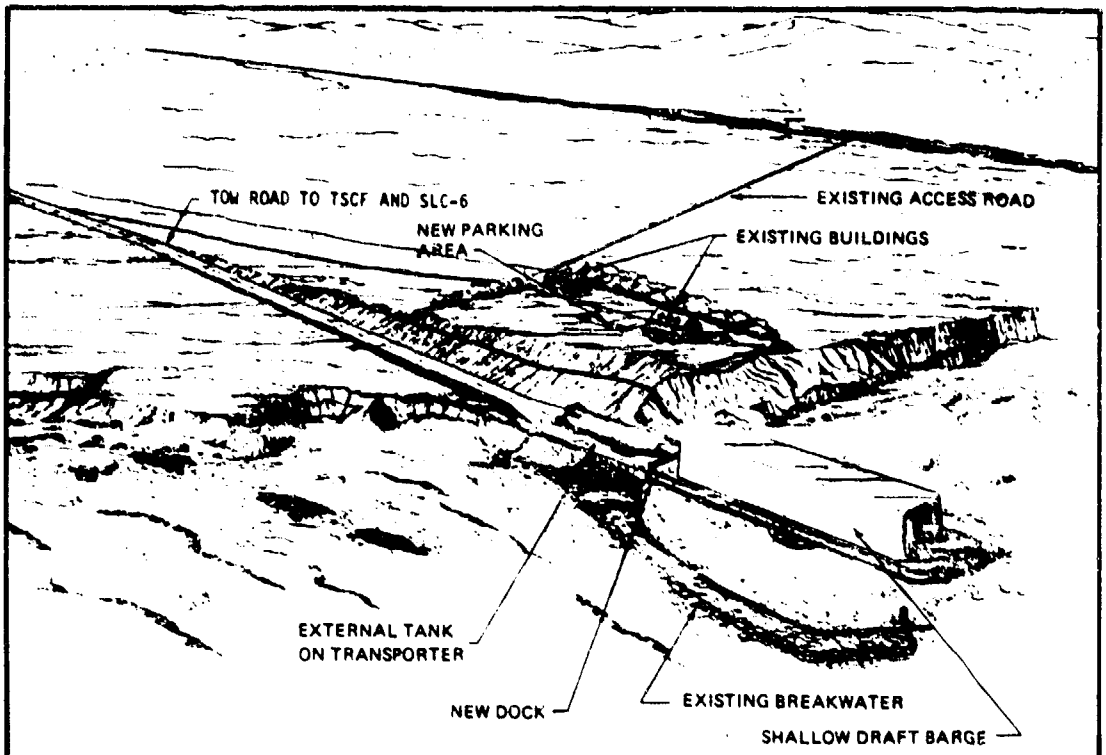
EMISSIONS:

Operational: Dust materials during construction.
Nonoperational: Purged gaseous nitrogen from test pressure to storage level with traces of freon. Purged helium from pressure tests. Accidental releases of gaseous nitrogen, helium, and freon.

OTHER:

Construction Schedule: October 1980 - September 1981.

Data Brief 2.3-3. SHALLOW DRAFT BARGE DELIVERY FACILITY/OPERATIONS



DESCRIPTION:

Receiving dock, 100 ft wide by 200 ft long. tow road, 24 ft wide with 4 ft shoulders. Navigational aids. Ballastable transhipment barge, 86 ft wide by 428 ft long.

CONSTRUCTION ACTIVITY:

Remove existing embayment pier and attached boathouse. Dredge approximately 10,000 cu yds of material from about 5 acres of subtidal bottom. Excavate 78,000 cu yds of material from 110,000 sq ft of coastal terrace for tow road cut. Erect dock consisting of sheetpiling, earth fill, and asphaltic cover. Pave tow road with asphalt.

OPERATIONS ACTIVITY:

Deballast transhipment barge outside harbor. Maneuver barge to dock using shallow draft tug vessels. Unload ETs and tow to TSCF. Reload empty ET transporters. Deballast barge and maneuver seaward for link-up with ocean-going tug vessel.

NATURAL FEATURES TO BE ALTERED:

Embayment submarine topography; 1,000 ft long cut through shoreline bluff into coastal terrace.

SOLIDS/LIQUIDS/GASES:

Floating demolition debris. Resuspended sediments. Diesel fuel and oil leakages.

NOISE:

Noise from blasting and dredging. Diesel engine noise from excavation and road way equipment, tugs and tow tractor.

EMISSIONS:

Vehicle emissions, fugitive dust, dredge material odors.

OTHER:

Localized increased turbidity and water quality degradation, localized biota and habitat damage.

2.4 LAUNCH PAD OPERATIONS SEQUENCE

The Space Shuttle will be composed of four specialized elements that will be mated to form the vehicle. These are the Orbiter, which will contain personnel and payloads, two Solid Rocket Boosters for initial boost, and the External Tank, which will supply propellant to the Orbiter main engines.

All four major elements of the Shuttle Vehicle will be brought together in sequence on the launch pad at the existing Space Launch Complex No. 6, which will be modified for use in the STS program. Figure 2.4-A shows the launch pad as it will appear when the proposed modifications have been completed and with a Space Shuttle Vehicle on the launch pad. Figure 2.0-A illustrates the launch pad sequence of activities. The mating of all four elements directly at the launch pad is termed the Integrated-On-Pad activity. This concept differs from the Integrate-Transfer-Launch system (that is, offpad integration in a remote building with subsequent transfer to the launch pad on a mobile launcher) used by NASA at the Kennedy Space Center.

The major modifications to Space Launch Complex No. 6 will be conversion of the existing concrete underground rocket flame diverter to accommodate the configuration of the Solid Rocket Boosters and Orbiter main engines, excavation to accommodate an extension of the trackage to retract the Mobile Service Tower to a clear launch-ready position, addition of an underground payload preparation facility and a mobile Payload Changeout Room, and construction of cryogenic propellant storage tanks. Figure 2.4-B shows the proposed location of facilities at the launch complex.

The Shuttle launch pad will be a concrete hardstand with a launch mount and underground flame diverters, a fixed access/umbilical tower with swingaway arm, separate trackage for the Mobile Service Tower, which will roll back to the east of the pad, and the Payload Changeout Room, which will roll back to the west.

Launch pad operations will commence with the Mobile Service Tower at the launch mount. The west side of the Mobile Service Tower will have doors that can be opened to accommodate the Space Shuttle and closed to protect inside activity

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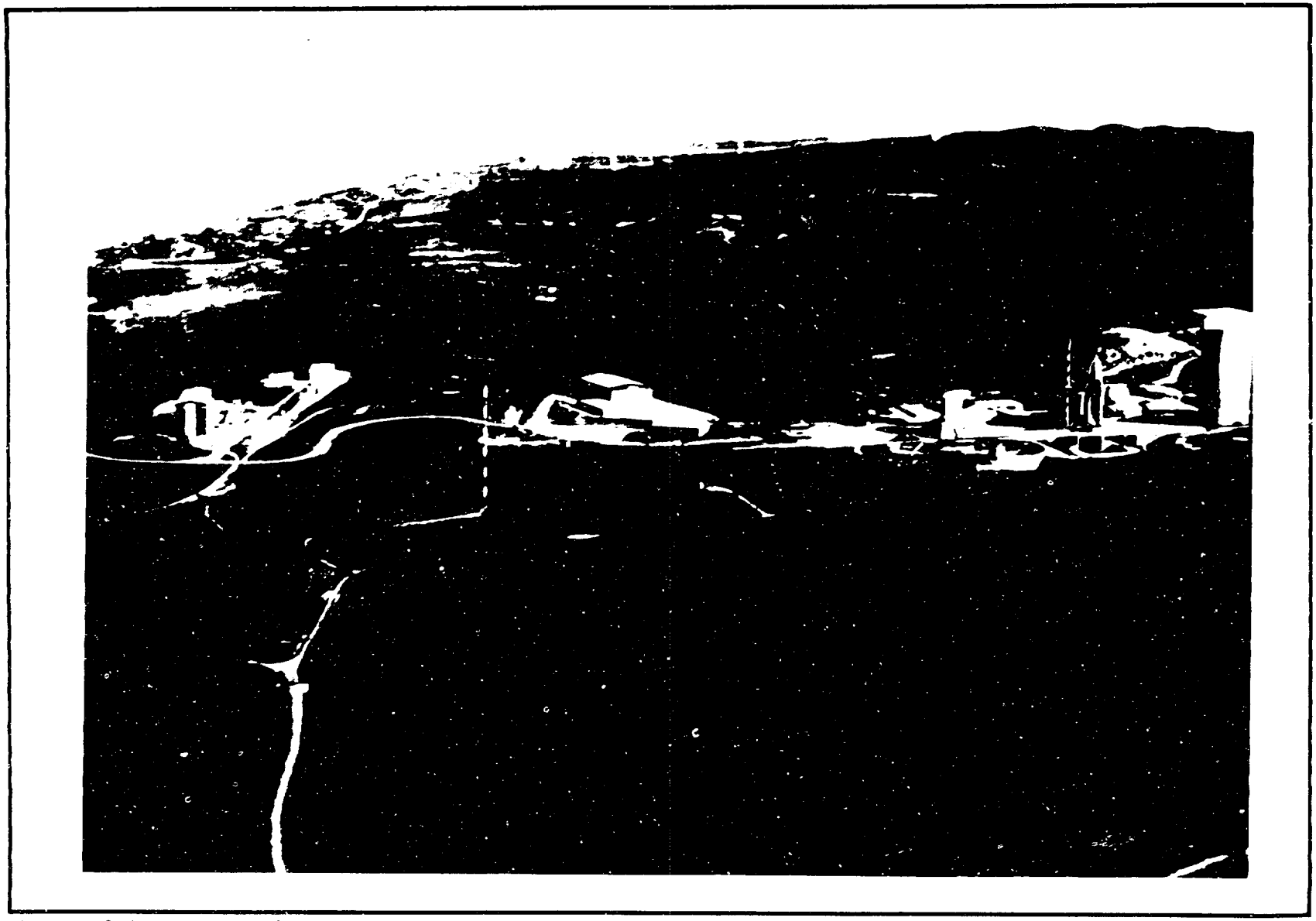


FIGURE 2.4-A. Artist's conception of the Shuttle launch complex.

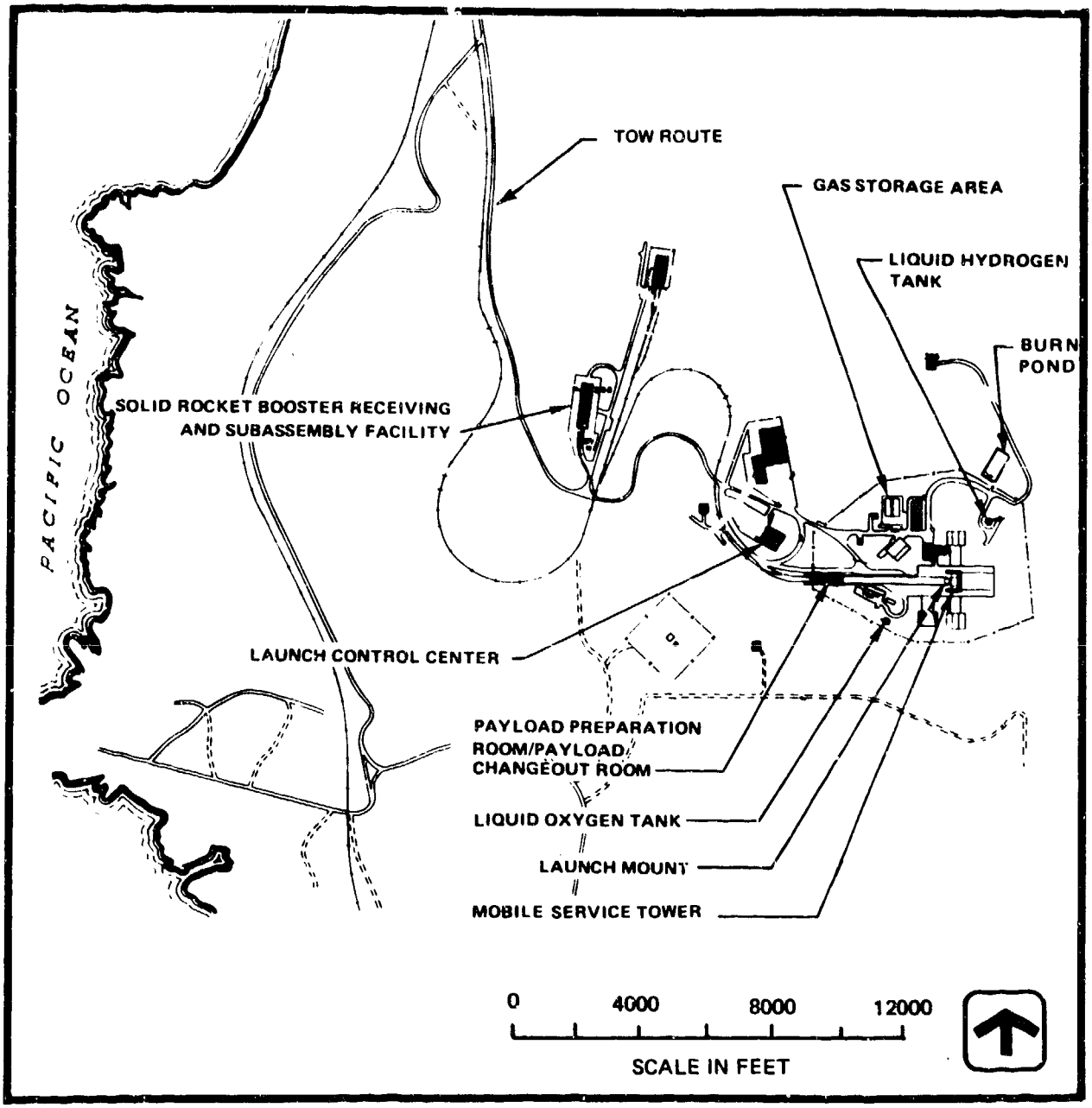


FIGURE 2.4-B. Location of facilities situated at the Shuttle launch complex.

from strong winds and windborne debris. Bridge cranes will lift the booster segments, External Tank, and Orbiter.

The first activities of the launch pad operations sequence will be receipt of Solid Rocket Booster segments from the storage facility and simultaneous build-up of two Solid Rocket Boosters in place on the launch mount. Next, the External Tank will be received from its storage and checkout facility. The tank will be hoisted to a vertical position from its wheeled transporter by an erection strongback hoist on the mobile Payload Changeout Room. It will then be positioned and mated to the two Solid Rocket Boosters housed within the Mobile Service Tower. The mating activity will continue when the Orbiter is received from the Maintenance and Checkout Facility. The activity sequence for Orbiter mating will be the same as described above for the External Tank.

Finally, the payload will be received at an underground Payload Preparation Room, transferred to the aboveground mobile Payload Changeout Room, transported to the Orbiter inside the Payload Changeout Room, and inserted into the Orbiter under clean room conditions.

Hazardous servicing will be suspended until the Payload Changeout Room is retracted about 5 hours before launch. Countdown will begin 4 hours before launch (T-4 hours) and will include main propellant loading, crew and passenger loading, payload cryogenic loading (if required), and the terminal countdown. If, after fueling but prior to launch, a mission abort were to take place, the propellants would be offloaded and recycled for later use.

The launch activity will be predominantly computer controlled and monitored. Space Shuttle main engines will start at T-4 seconds and reach 90 percent power at T-0.13 seconds. The Solid Rocket Boosters will be ignited and the holddown hardware released pyrotechnically at T-0 seconds. The launch activity

is defined, for the purposes of this report, to terminate when the tail of the Space Shuttle Vehicle has reached a height equal to the top of the access tower.

The next activity--ascent--will include the 66-second sequence wherein the Space Shuttle will accelerate from 70 miles per hour at 280 feet elevation above the pad to 1,180 miles per hour at 50,000 feet elevation approximately 4 miles downrange.

Prior to and during the launch, high pressure water will be sprayed on the access tower and onto launch pad concrete surfaces, including the flame trench, at a rate of 650,000 gpm for less than one minute, to minimize damage, fire, and launch induced noise. The water is stored in the 1.2 million-gallon tank situated on a hill near the launch pad. The tank is supplied from the Base water supply and possibly from return water collected in the flame trench. Plans are for the latter to be treated and subsequently recycled or disposed.

The final activity of this sequence will involve all operations required to refurbish the launch pad area in preparation for the next launch. Figure 2.4-C summarizes the time sequences of all launch operations activities.

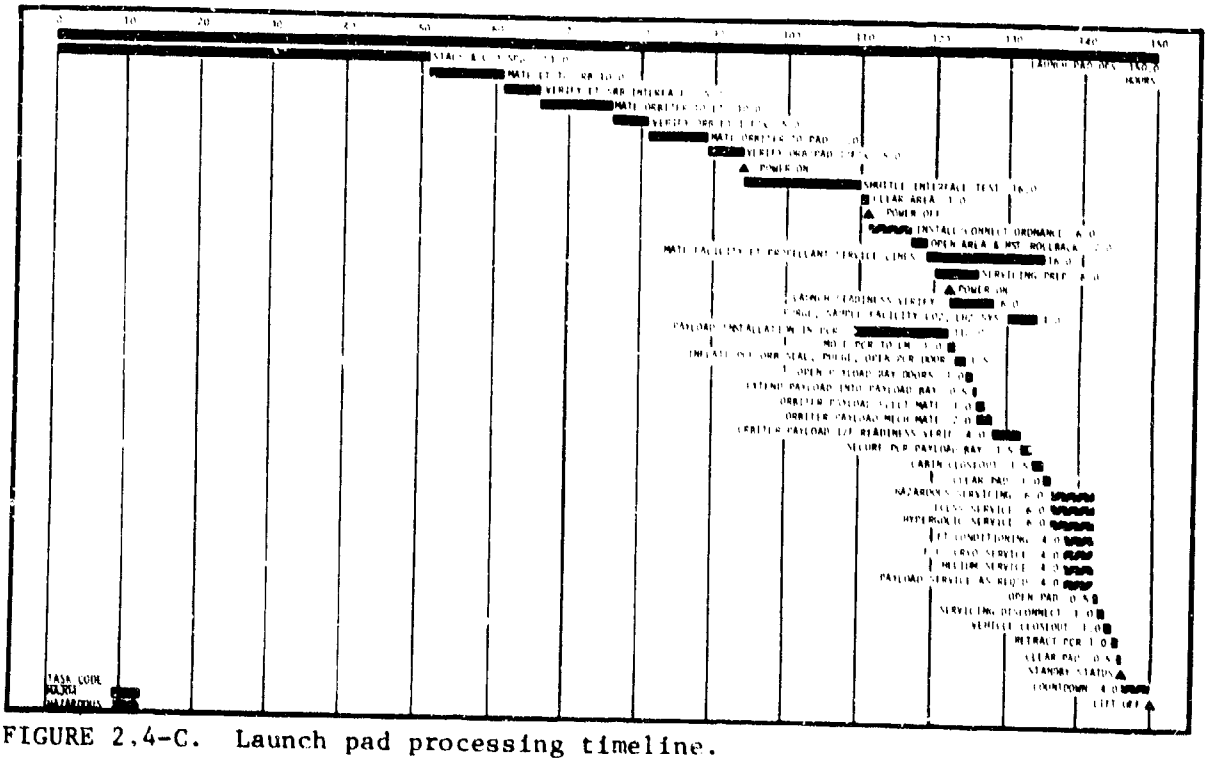
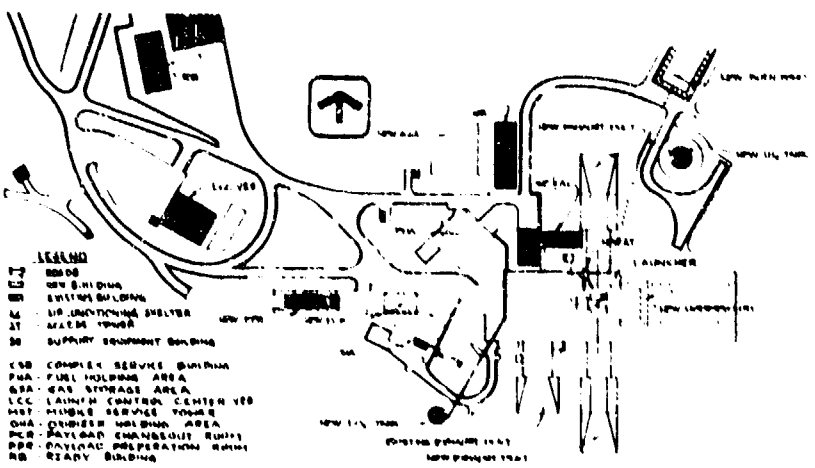


FIGURE 2.4-C. Launch pad processing timeline.

Data Brief 2.4-1. LAUNCH PAD FACILITY



DESCRIPTION

Space Launch Complex No. 6, an existing launch pad facility developed for the cancelled Manned Orbital Laboratory program, will be modified to serve as the Space Shuttle Vehicle launch pad

ACTIVITY

Construction - Extensive modification of existing complex including refurbishment of existing facilities, construction of new facilities, roads, and utility systems and extensive earth work

Operation - Servicing and buildup of Space Shuttle Vehicle, preflight and launch activities

SOLID/LIQUID ASES

Liquid oxygen	(LO_2)	Hydrazine (N_2H_4)	Ac Ic coolant	Halon 1301
Liquid hydrogen	(LH_2)	Hydraulic fluid	Freon 21	Diesel fuel
Monomethylhydrazine (MMH)		Potable water	Ammonia (NH_3)	Mixed oxides of nitrogen (MON_3)
Nitrogen tetroxide	(N_2O_4)	Deionized water	Freon 114	
Liquid [illegible]	(LN_2)	Deluge water	Isopropyl alcohol	

NOISE

Construction - Heavy construction noise
Operational - Launch preparation - Light industrial noise
Launch - rocket engine noise (see Launch Operations)

CONSTRUCTION

Construction of new facilities and modification (some extensively) of existing facilities - Modification of existing elevation contours, and road and utility systems - Development of new launch mount and rocket exhaust ducts - See Sec 6 facility summary sheets for details

MANPOWER

Construction - Total SLC-6 - 1965 (average) - Launch Pad only - 560 (average)
Operation - 175, 2 shifts (total SLC-6 area)

NATURAL FEATURES TO BE ALTERED

Landform altered by cuts and fills - Drainage pattern alteration - Increased noise levels - Existing visual environment altered by increased height of Mobile Service Tower and new tall structures

EMISSIONS

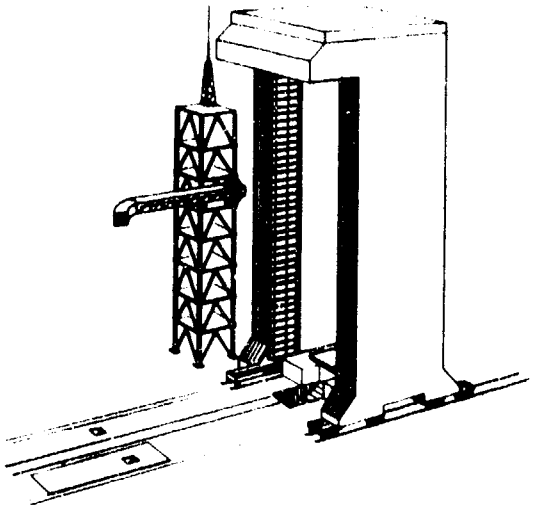
Operational - See launch area facility and operation summary sheets

Nonoperational - See launch area facility and operation summary sheets

OTHER

Construction Schedule - Total SLC-6 area - April 1979 - September 1981
Launch Pad only - April 1979 - September 1980

Data Brief 2.4-2. MOBILE SERVICE TOWER FACILITY



DESCRIPTION:

Existing 87.5 by 135.5 by 315 ft high steel frame enclosed structure capable of movement over rails.

ACTIVITY:

Construction: Modify interior of tower to provide access platforms compatible with Space Shuttle Vehicle, increase height 21 ft to accommodate new cranes, extend tower railway to the east, provide increased structural strength, replace existing space vehicle doors.

Operation: Mobile Service Tower encloses launch mount to facilitate Space Shuttle Vehicle buildup and checkout. Rolls east to parking position for launch.

SOLIDS/LIQUIDS/GASES:

See launch pad facility.

NOISE:

Construction: Heavy construction noise.

Operation: Light industrial noise.

CONSTRUCTION:

Extensive structural modification of existing Manned Orbital Laboratory program Mobile Service Tower, provide new tie-down anchor points, extend rails approximately 130 ft east, excavate hillside located immediately east of the launch pad to extend existing 430 ft elevation at east edge of pad to a point coinciding with existing 480 ft elevation. Provide drainage control above new cut.

MANPOWER:

Construction Average: 36. Operation: Requirements included in total launch pad requirements.

NATURAL FEATURES TO BE ALTERED:

Extensive excavation and recontouring of hillside located east of the launch pad. Alteration of existing drainage patterns.

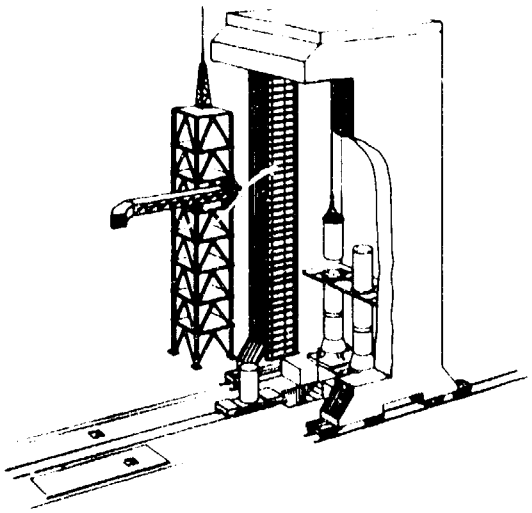
EMISSIONS:

Operational/Nonoperational: None from Mobile Service Tower. See launch pad operations for Space Shuttle Vehicle buildup and checkout missions.

OTHER:

Construction Schedule: April 1980 - September 1981.

Data Brief 2.4-3. SOLID ROCKET BOOSTER BUILDUP OPERATIONS



DESCRIPTION:

Mobile Service Tower in position over vacant launch mount.

ACTIVITY:

Individual Solid Rocket Booster segments arrive at pad on rail cars to be stacked/mated. Both boosters built up simultaneously. Thrust vector control serviced, batteries installed, electrical connection to monitors, ordnance installed. Verification and checkout of subsystems.

SOLIDS/LIQUIDS/GASES:

1,108,148 lb ammonium Al perchlorate with PBAN binder-solid propellant per booster. Hydraulic fluid. Gaseous nitrogen.

NOISE:

Crane mechanical noise. Switch engine/rail noise.

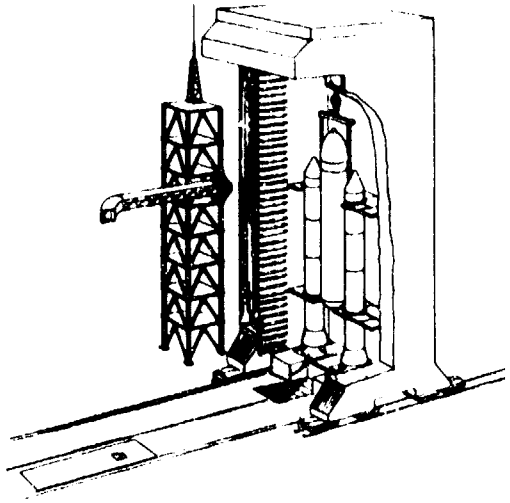
CONSTRUCTION, MANPOWER, NATURAL FEATURES TO BE ALTERED:

Not applicable.

EMISSIONS:

Operational: Switch engine exhaust.
Nonoperational: Combustion products from accidental solid propellant ignition and burning. Hydraulic fluid spill.

Data Brief 2.4-4. EXTERNAL TANK MATING OPERATION



DESCRIPTION:

Two Solid Rocket Boosters stacked on launch mount within Mobile Service Tower.

ACTIVITY:

Receive and position External Tank. Hoist tank to vertical position against mobile Payload Changeout Room. Mate tank with boosters at launch pad. Retract Changeout Room and close Mobile Service Tower Doors. Attach electric cables.

SOLIDS/LIQUIDS/GASES:

3.7 ± 1.3 psig of helium in liquid hydrogen tank. 3.7 ± 1.3 psig of nitrogen in liquid oxygen tank. See Solid Rocket Booster summary sheet for solid propellants.

NOISE:

Crane mechanical noise. Tow vehicle engine noise.

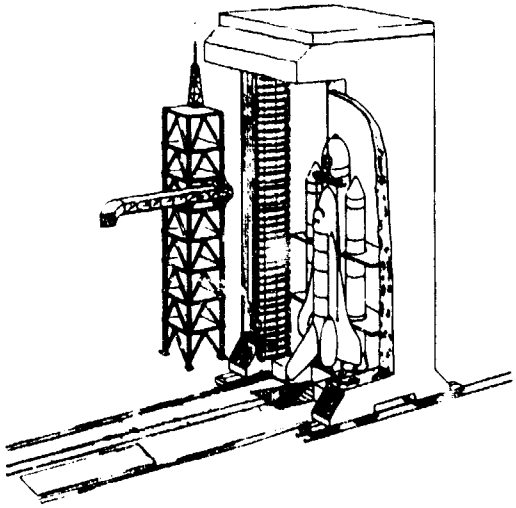
CONSTRUCTION, MANPOWER, NATURAL FEATURES TO BE ALTERED:

Not applicable.

EMISSIONS:

Nonoperational: Leakage of helium/nitrogen. See Solid Rocket Booster launch pad operations summary sheet for additional nonoperational emissions.

Data Brief 2.4-5. ORBITER MATING OPERATION



DESCRIPTION:

Two Solid Rocket Boosters and mated External Tank on launch mount within Mobile Service Tower.

ACTIVITY:

Receive and position Orbiter. Hoist vehicle to vertical position against mobile Payload Changeout Room. Mate Orbiter with External Tank at launch pad. Retract Changeout Room and close Mobile Service Tower Doors. Position access equipment. Connect Orbiter electrical cables, propellant umbilical hoses. Install final Thermal Protection System material. Perform shuttle interface testing. Install ordnance. Roll back Mobile Service Tower from launch mount to launch position.

SOLIDS/LIQUIDS/GASES:

Monomethylhydrazine (MMH) Hydrazine (N_2H_4) Ammonia (NH_3) Gaseous oxygen (GO_2) Lube oil
Nitrogen tetroxide (N_2O_4) Freon Gaseous hydrogen (GH_2) Hydraulic fluid

See Solid Rocket Booster and External Tank summary sheets for propellants/pressurants.

NOISE:

Crane mechanical noise. Tow vehicle engine noise.

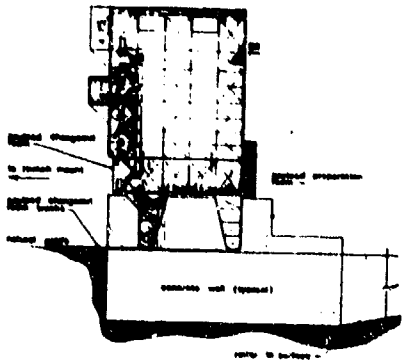
CONSTRUCTION, MANPOWER, NATURAL FEATURES TO BE ALTERED:

Not applicable.

EMISSIONS:

Nonoperational: Accidental leakage of gases/liquids listed above. See Solid Rocket Booster and External Tank launch pad operation summary sheets for additional nonoperational emissions.

Data Brief 2.4-6. PAYLOAD PREPARATION AND CHANGEOUT FACILITIES



DESCRIPTION:

Mobile 95 ft by 85 ft by 184 ft high Payload Changeout Room and 105 ft by 330 ft by 116 ft high partially buried Payload Preparation Room.

ACTIVITY:

Construction: Construct Preparation Room, associated access ramp, and mobile Changeout Room structure.

OPERATION: Payloads delivered by truck down ramp, through airlock into Payload Preparation Room to be serviced and hoisted into mobile Payload Changeout Room. Room rolls on rails to launch mount. Seals to Orbiter, inserts payload into cargo bay, and returns to position over Preparation Room. Changeout Room also used to hoist and mate External Tank and Orbiter at launch pad.

SOLIDS/LIQUIDS/GASES:

Gaseous oxygen (GO_2)
Gaseous nitrogen (GN_2)
Gaseous hydrogen (GH_2)
Gaseous helium (GHe)
Liquid hydrogen (LH_2)
Ammonia (NH_3)
Hydrazine(N_2H_4)
Monomethylhydrazine (MMH)
Liquid oxygen (LO_2)
Compressed air
Conditioned air

NOISE:

Construction: Heavy construction noise Operation: Light industrial noise.

CONSTRUCTION:

Clear area, excavate to about 60 ft, construct reinforced concrete Preparation Room and associated 310 ft long by 40 ft wide ramp leading from surface to floor at depth of 52 ft. Construct steel frame mobile Changeout Room tower, install tracks from Preparation Room to launch mount, provide new access road to ramp.

MANPOWER:

Construction Average: Payload Preparation Room - 45 Operation: Requirement is included in total launch pad requirements.
Payload Changeout Room - 50

NATURAL FEATURES TO BE ALTERED:

Facility will be constructed at existing developed SLC-6 area. Payload Changeout Room will be 184 ft high.

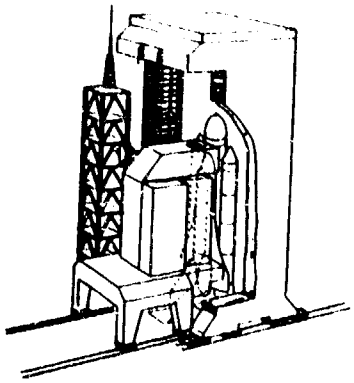
EMISSIONS:

Operational: Exhaust conditioned air.
Nonoperational: Accidental leakage of liquids/gases noted above. Accidental fire, explosion of upper propulsive stage.

OTHER:

Payload Preparation Room Construction Schedule: April 1980 - May 1981.
Payload Changeout Room Construction Schedule: October 1980 - December 1981

Data Brief 2.4-7. PAYLOAD INSERTION OPERATIONS



DESCRIPTION:

Mating and buildup of Space Shuttle Vehicle has been completed.

ACTIVITY:

Payload delivered by truck to Payload Preparation Room at launch pad. Payload positioned for hoisting in Payload Changeout Room where checking and inspection is completed. Mobile room is rolled to launch mount and Changeout Room seals to Orbiter followed by insertion and mounting of payload in Orbiter cargo bay.

SOLIDS/LIQUIDS/GASES:

Not applicable.

NOISE:

Payload Changeout Room rolling on steel rail. Crane mechanical noise.

CONSTRUCTION, MANPOWER, NATURAL FEATURES TO BE ALTERED:

Not applicable.

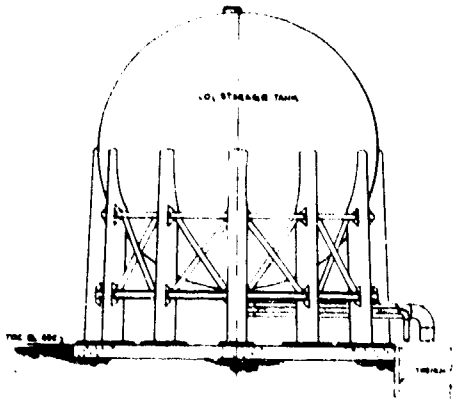
EMISSIONS:

None.

OTHER:

Payload materials and characteristics other than propellants are not included herein.

Data Brief 2.4-8. LAUNCH PAD PROPELLANT SYSTEM



DESCRIPTION:

Liquid hydrogen storage tank(s) of 850,000 gallon capacity. Liquid oxygen storage tank(s) of 400,000 gallon capacity, pumps, and distribution system.

ACTIVITY

Construction: Erection of tanks and installation of distribution system.
Operation: Fill tanks from tanker trucks, store propellants, and supply propellants to Space Shuttle Vehicle at the launch pad.

SOLIDS/LIQUIDS/GASES

Liquid hydrogen (LH_2)
Liquid oxygen (LO_2)
Gaseous hydrogen (GH_2)
Gaseous oxygen (GO_2)

NOISE:

Construction: Typical construction with heavy steel erection.
Operation: Propellant pumps, vapor boil-off.

CONSTRUCTION

Earthwork (cut, fill, grading, trenching), assemble and erect tanks, install pumps, manifolds, distribution piping, utilities, instrumentation, and access roads.

MANPOWER

Construction: See launch pad construction. Operation: Controlled from launch control center.

NATURAL FEATURES TO BE ALTERED:

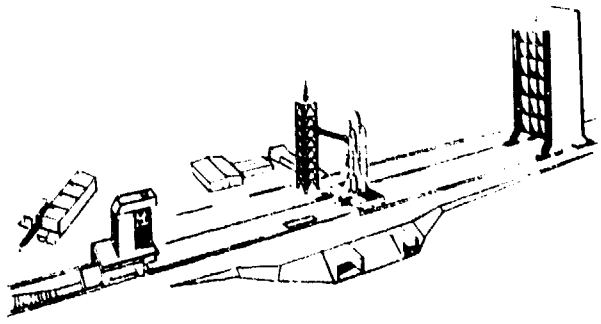
LH_2 tank area to be cut from existing hillside northeast of launch pad.
LO_2 tank area to be filled on existing slope southwest of launch pad.
Blast retaining wall to be constructed between liquid hydrogen tank and launch pad.

EMISSIONS:

Operational: Flared gaseous hydrogen (GH_2) Vented gaseous oxygen (GO_2)

Nonoperational: Gaseous hydrogen (GH_2) --- gaseous oxygen (GO_2) -- Explosion

Data Brief 2.4-9. LAUNCH PAD FUELING OPERATIONS



DESCRIPTION:

Mobile Service Tower has been retracted to launch position. Payload has been inserted and Payload Changeout Room is at pad.

ACTIVITY

Load fuel cell liquid oxygen and hydrogen, load monomethylhydrazine, load oxygen, nitrogen, helium gases, retract Payload Changeout Room, initiate launch countdown, purge liquid oxygen and liquid hydrogen fueling systems with gaseous nitrogen and gaseous helium, respectively, load crew.

SOLIDS/LIQUIDS/GASES:

Space Shuttle Vehicle is launch ready and contains solid/liquid gas as described on general description summary sheets for Orbiter, external tank, and Solid Rocket Booster (?).

NOISE:

Noise from propellant loading pumps, lines, and vents. Noise from movement of Payload Changeout Room to launch position.

CONSTRUCTION, MANPOWER, NATURAL FEATURES TO BE ALTERED:

Not applicable.

EMISSIONS:

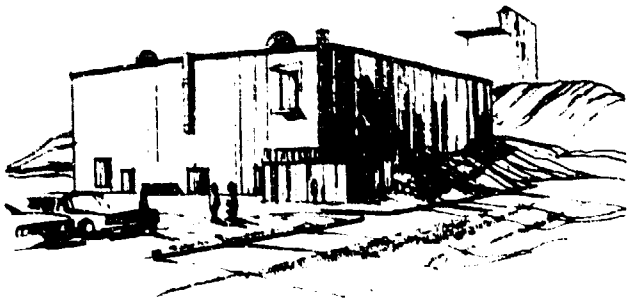
Operational: Vented gaseous nitrogen, helium, and oxygen. Vented gaseous hydrogen routed to burn pond for disposal by combustion. Burn pond also used to unload propellants if launch is aborted prior to ignition.

Nonoperational: Burn pond used for disposing of liquid hydrogen (LH_2) emergency spills or excess. Dump pit used for disposal of liquid oxygen (LO_2) emergency spill or excess. Accidental release of any of above listed materials. Accidental fire, explosion.

OTHER:

Vapor scrubber unit and vacuum used to control hypergolic propellant vapors and spilled liquid. Maximum fueling rate for liquid oxygen and liquid hydrogen is 5,000 gallons per minute and 12,000 gallons per minute, respectively.

Data Brief 2.4-10. LAUNCH CONTROL CENTER FACILITY



DESCRIPTION:

Existing 110 by 140 by 40 ft high partially buried reinforced concrete wall building

ACTIVITY

Construction: Reconfigure interior, erect earthen blast barricade, install support equipment.

Operation: Monitor component and launch vehicle testing, control countdown and launch.

SOLIDS/LIQUIDS/GASES:

Solid wastes from interior modifications.

NOISE:

Construction: Earthmoving equipment noise for earthen blast barricade construction, equipment delivery, and installation activity noise.

Operation: Ventilation system, hazard warnings, paging system.

CONSTRUCTION:

Erection of blast barricade between building and launch pad. Removal and reinstallation of interior walls and floors, installation of mechanical systems, installation of electrical equipment.

MANPOWER:

Construction Average: 10 (est.) Operation: 114 per shift (two shifts).

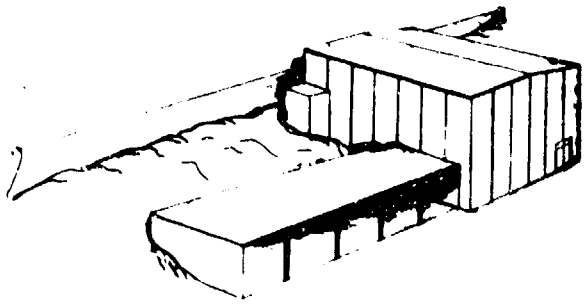
NATURAL FEATURES TO BE ALTERED, EMISSIONS:

Earthen blast barricade will be a new topographical feature.

OTHER:

Construction Schedule: April - December 1979.

Data Brief 2.4-11. SUPPORT EQUIPMENT BUILDING AND AIR CONDITIONING SHELTER



DESCRIPTION:

Existing two-story concrete Manned Orbital Laboratory program "AGE Building" and adjacent steel frame structure approximately 46 by 130 ft.

ACTIVITY:

Support equipment building and air conditioning shelter are existing buildings located at SLC-6 adjacent to the existing launch platform. Minor modifications will be made to interior layout and facility services.

NOISE:

Light construction noise, equipment delivery.

SOLIDS/LIQUIDS/GASES:

Not applicable.

CONSTRUCTION:

Minor alteration of interiors.

MANPOWER:

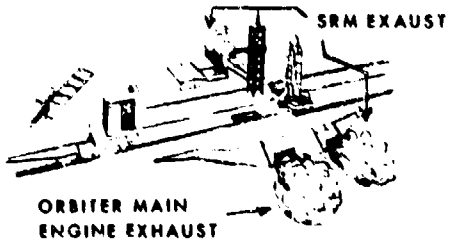
Construction: Construction activities will be integral with launch pad modifications.

Operation: None.

NATURAL FEATURES TO BE ALTERED, EMISSIONS:

Not applicable.

Data Brief 2.4-12 SPACE SHUTTLE VEHICLE LAUNCH



DESCRIPTION:

Ten minutes prior to lift-off (T-10 min) through tower clearance on Space Shuttle Vehicle ascent

ACTIVITY:

Orbiter auxiliary power units initiate operation at T-5 min. Solid Rocket Booster auxiliary power units initiate operation at T-20 sec. Solid Rocket Booster ignitors armed at T-5 sec. Pad deluge water system discharge initiated at slow rate at T-10 sec, increased to full rate at T-4 sec. Space Shuttle main engines start-up initiated at T-4 sec, reach 90 percent power at T-6.6 sec. Solid Rocket Booster ignition and hold-down release at T-0. Space Shuttle Vehicle pitches over from vertical ascent to flight path angle after clearing access/umbilical tower.

SOLIDS/LIQUIDS/GASES:

See general description summary sheets for Orbiter, External Tank, and Solid Rocket Booster (2).

NOISE:

Starting with ignition and continuing 2 to 4 seconds, noise field is strongly affected by flame deflections, as shuttle climbs away from pad transition to free stream jet, noise source occurs.

CONSTRUCTION, MANPOWER, NATURAL FEATURES TO BE ALTERED:

Not applicable

EMISSIONS:

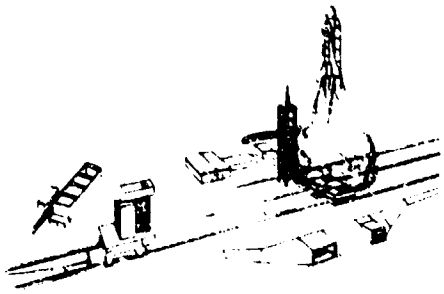
Operational: Space Shuttle main engine and Solid Rocket Motor exhaust. Vapor from burning paints, cables, etc. on launch pad. Contaminated deluge water contained in flame detector trench.

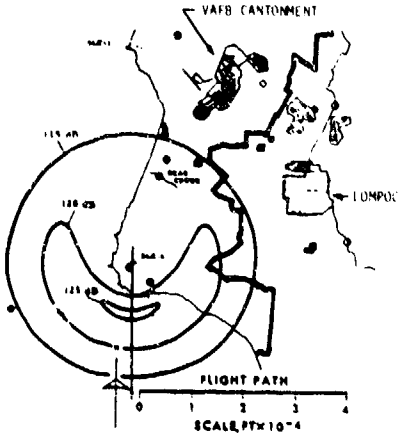
Nonoperational: If launch is terminated, cryogenic fuels will be unloaded and recycled for later use. Explosion or crash will release all Space Shuttle Vehicle materials.

OTHER:

Water deluge system utilizes 1.25 million gallon water tank with head pressure at launch pad of 250 psig. Filtered closed circuit television used to detect hydrogen fires and other nonvisible combustion; water, foam, dry powder remotely controlled fire extinguisher systems at [illegible]

Data Brief 2.4-13 SPACE SHUTTLE VEHICLE ASCENT





NOMINAL SHUTTLE OASPL CONTOURS, T-40 SEC. ALTITUDE 15,811 FT, SLC-6 AREA CANDIDATE SITE

DESCRIPTION:

280 ft above pad (Tower clearance) to 50,000 ft elevation.

ACTIVITY:

Ascent commences with vehicle clearing access tower, which occurs 6 seconds after lift-off at a velocity of 70 miles per hour. Ascent to 50,000 ft altitude occurs 72 seconds after lift-off at a velocity of 1,180 miles per hour and 4 miles downrange.

SOLIDS/LIQUIDS/GASES:

See general description summary sheets for the Orbiter, External Tank, Solid Rocket Booster (2).

NOISE:

See map inset for noise contours for Space Shuttle Vehicle at 15,811 ft elevation.

CONSTRUCTION, MANPOWER, NATURAL FEATURES TO BE ALTERED:

Not applicable.

EMISSIONS:

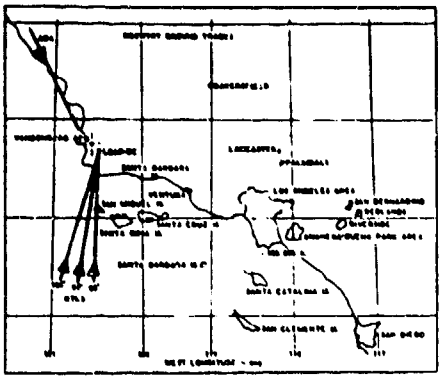
Operational: Space Shuttle main engine and Solid Rocket Booster exhaust.

Nonoperational: Explosion or crash would release all Space Shuttle Vehicle materials.

OTHER:

At 149,000 ft altitude, Solid Rocket Boosters separate from vehicle and return to Pacific Ocean, 120 miles downrange, for recovery. At approximately 500,000 ft altitude, External Tank separates from Orbiter and tumbles to a remote ocean site.

Data Brief 2.4-14. ABORT DURING ASCENT



DESCRIPTION

Return to Launch Site (RTLS) abort, Abort Once Around (AOA).

ACTIVITY:

If one of the three Space Shuttle's main engines (liquid propellant engine) fails on lift-off, an RTLS abort will occur. This involves utilization of the Orbital Maneuvering System engines (hypergolic propellant engine) to provide required thrust, jettison of Solid Boosters, in-plane turn with remaining main engines firing, release of External Tank when empty, and landing of Orbiter at VAFB airfield. If propulsion failure occurs later during ascent, the Orbiter will continue to fly around the earth on a sub-orbital trajectory and land at the VAFB airfield after one revolution of earth.

SOLIDS/LIQUIDS/GASES:

Volume of materials onboard the Space Shuttle Vehicle during abort will vary from near pre-launch quantities to Orbiter residual quantities.

NOISE

Noise level field will be altered by an abort situation at launch due to operation of different rocket engines.

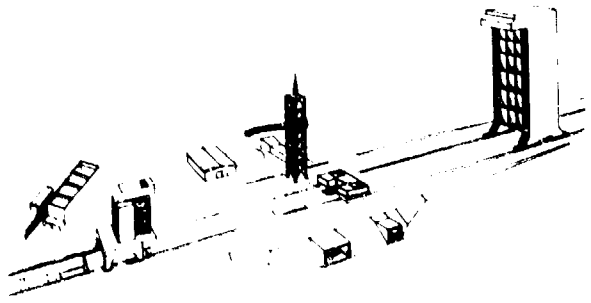
CONSTRUCTION, MANPOWER, NATURAL FEATURES TO BE ALTERED:

Not applicable.

EMISSIONS:

Operational: RTLS abort reduces emissions from one oxygen/hydrogen burning engine and adds emissions from hypergolic hydrazine/nitrogen tetroxide burning engines. AOA abort is similar but would occur at higher altitudes.
Nonoperational: Aborts are emergency situations with increased risk of explosion and/or crash.

Data Brief 2.4-15. LAUNCH PAD REFURBISHMENT OPERATIONS



DESCRIPTION:

Pad in launch configuration following launch of Space Shuttle Vehicle.

ACTIVITY:

Verification of extinguishment of all fires; drain and purge propellant lines and refurbish as required; power down electrical/electronic equipment; turn off all hand actuated valves; refurbish umbilical tower; maintenance of Mobile Service Tower, doors and electrical equipment and reposition launch mount; refurbish launch mount and flame trench; refill water reservoir.

SOLIDS/LIQUIDS/GASES:

Liquid oxygen (LO_2)	Gaseous nitrogen (GN_2)	Nitrogen tetroxide (N_2O_4)
Liquid hydrogen (LH_2)	Gaseous helium (GHe)	Fire retardants - foam, dry powder
Gaseous hydrogen (GH_2)	Monomethylhydrazine (MMH)	Contaminated water from blast

NOISE

General maintenance and light construction repair.

CONSTRUCTION, MANPOWER, NATURAL FEATURES TO BE ALTERED:

Not applicable.

EMISSIONS:

Operational: Small quantities of gaseous nitrogen and helium from maintenance operations. Dust from construction activities.
Nonoperational: Propellant releases from maintenance activities.

OTHERS:

Water reservoir is supplied from both VAFB supply and recycled water from flame trench. Replenish propellants by tanker truck.

2.5 IMPLEMENTATION OF THE PROPOSED PROJECT

Implementation of the proposed project includes ongoing studies and future design, construction, activation, and operation. A study of the STS was initiated in 1972 and is currently continuing with a Ground Support System Study. Key milestones including both Vandenberg and NASA Space Shuttle activities are shown on Figure 2.5-A. The initial operating capability (IOC) for launch of the Space Shuttle from Vandenberg will occur in June 1983. The launch rate will increase through 1984 and reach an operational limit of 20 launches per year.

2.5.1 CONSTRUCTION/ACTIVATION

During the 1979 to 1982 construction and activation period, facilities at Vandenberg will be established, modified, or expanded. Construction of new facilities will typically involve the following activities: clearing and removal of vegetation from the construction site; rough-grading of the exposed soil; excavation for below-grade rooms, foundations, and underground utility lines; grading and finishing surface drainage systems; preparation and pouring of concrete; erection and completion of the structure; installation

SPACE TRANSPORTATION SYSTEM AT VANDENBERG AFB	DATE	NASA SPACE SHUTTLE DEVELOPMENT AND KENNEDY SPACE CENTER OPERATIONS
9 SSVs LAUNCHED FROM VAFB	1984	27 SSVs LAUNCHED FROM KSC
4 SSVs LAUNCHED FROM VAFB	1983	21 SSVs LAUNCHED FROM KSC
IOC FOR VAFB	JUNE 1983	
FIRST EXTERNAL TANK AT VAFB	JUNE 1982	
FIRST SOLID ROCKET BOOSTERS AT VAFB	MAY 1982	
	APRIL 1982	(19 SSVs LAUNCHED DURING 1981-1982)
FIRST ORBITER AT VAFB	MARCH 1982	
	1981	
	APRIL 1980	IOC: 5 SSVs LAUNCHED IN 1980
BEGIN STS CONSTRUCTION	APRIL 1979	FIRST SSV MANNED ORBITAL FLIGHT
	JUL 1977	FIRST APPROACH AND LANDING TEST
	FEB 1977	FIRST CAPTIVE TEST FLIGHT
	OCT 1976	COMPLETE CONSTRUCTION OF FIRST ORBITER
BEGIN GROUND SUPPORT SYSTEMS STUDY	JULY 1976	

IOC IS INITIAL OPERATIONAL CAPABILITY
SSV IS SPACE SHUTTLE VEHICLE

FIGURE 2.5-A. Key Space Transportation System milestones.

of pavement; landscaping of the area; and cleanup and disposal of construction debris. Construction of specific facilities may also require pile driving, blastwall or barrier erection, heavy steelwork, and fence equipment.

Modification of existing structures will range from rearrangement of interior partitions to significant facility expansions. Modification activities may involve any or all of the activities required for construction on new facilities plus demolition actions. Facilities activation will encompass equipment installation, equipment interconnection and checkout, testing of interfacility networks, and maintenance of the facilities from the completion of construction until the initiation of Space Shuttle operations. Unusual or specific facility construction and activation activities are identified on the data brief sheets. The overall scope of construction is reflected on the individual data brief sheets and is briefly described in the following paragraphs.

Of the existing 8,000-foot-long by 200-foot-wide runway located on the north portion of the Base, 6,000 feet will be removed and replaced, and a 7,000-foot extension will be added. A new towway will be constructed to connect the runway with the nearby Orbiter processing facilities. The Mate/Demate Facility will be essentially a 100-foot-high open steel structure supporting a winch assembly. It will be supported on 40-foot-deep piles and will be used to offload or onload the Orbiter atop a modified Boeing 747 ferry aircraft.

The Safing and Deservicing Facility is to be a 76-foot-high steel frame hangar-type building with a technical services area. The Orbiter Maintenance and Checkout Facility will be used for payload removal and inspection, maintenance, and repair of the Orbiter in preparation for the next launch. The Hypergolic Service Facilities are to be steel and concrete wall buildings in which the Orbiter's hypergolic propulsion and power units will be serviced. These three facilities are classified as hazardous (because toxic and explosive materials will be present) and will be designed accordingly. The Safing and Deservicing Facility, the Orbiter Maintenance and Checkout Facility, and the Hypergolic Service Facilities will be secured by controlled access such as fencing and closed-circuit television. Parking areas will be provided at each facility.

The tow route from the Orbiter processing facilities to the launch pad area at Space Launch Complex No. 6 will, for the most part, utilize existing roads. These roads will be modified to provide a minimum width of 24 feet, reinforced as necessary with an additional thickness of asphalt. Intersections will be modified to accommodate the turning radius of the transporter. Utility lines will be relocated. Roadside obstructions, including vegetation, will be removed, and narrow roadway cuts will be enlarged to provide required clearance for Orbiter transport.

Construction proposed for South Vandenberg will consist of the development of a Shallow Draft Barge Facility at the existing Point Arguello Boathouse facility, installation of an External Tank Storage and Checkout Facility immediately south of Space Launch Complex No. 6, development of a tow road connecting Space Launch Complex No. 6 with these two facilities, and extensive renovation and expansion of facilities at the launch complex itself. The Shallow Draft Barge Facility will consist of a 100 ft wide dock for receiving of the barge and unloading of newly manufactured External Tanks. The existing semi-protected embayment will be dredged as is necessary to accommodate ingress and egress of the barge and associated maneuvering tugs. Topographic cuts and fills will be accomplished for the connecting tow road. The External Tank Storage and Checkout Facility will be a 5-bay steel frame structure scheduled for location on the Point Arguello terrace.

Construction at Space Launch Complex No. 6 will encompass both supporting facilities and the launch pad itself. The existing Solid Rocket Booster Facility will be enlarged through the addition of a 55-foot-high steel frame bay. A new steel frame Solid Rocket Booster Disassembly Facility will be constructed near the existing booster facility. An existing building located in the Base cantonment will be modified to receive and refurbish the Solid Rocker Booster recovery parachutes. The existing Launch Control Center and Support Equipment Building will be modified internally. An earthen blast barrier will be placed southeast of the Launch Control Center to provide added protection in case of an explosion at the launch pad. A new cryogenic propellant system will be installed. A portion of this system will include a liquid hydrogen storage tank located northeast of the launch pad. The existing hillside will be excavated for this tank. A smaller liquid oxygen storage tank will be located on fill material

southwest of the launch pad. A hardstand for pressurized gas storage will be located northwest of the launch pad.

The existing Space Launch Complex No. 6 launch pad, originally constructed for the cancelled Manned Orbital Laboratory program, was designed for the Titan IIIM space launch vehicle. It will be extensively modified to accommodate the Space Shuttle Vehicle. The launch mount will be relocated approximately 150 feet east of the existing mount. New exhaust ducts will be constructed to conduct the exhaust of each Solid Rocket Booster. The single existing exhaust duct will be modified to extend beneath the new launch mount and will conduct the exhaust from the Orbiter's three cryogenically fueled main engines. A new access umbilical tower about 165 feet high will be constructed adjacent to the launch mount to provide access to the Orbiter crew cabin. The existing Mobile Service Tower will be modified through the addition of new overhead cranes and reconfiguration of work platforms to permit buildup of the Space Shuttle on the launch mount. Additionally, the trackway on which the Mobile Service Tower travels will be extended to provide a pull-back position about 400 feet east of its present position. This extension will require significant excavation. A new payload preparation and handling facility will be constructed west of the launch mount. The Payload Preparation Room will be partially below grade, with a truck ramp leading from an access road to its receiving area 55 feet below the surface. A mobile Payload Changeout Room and associated trackway running from the payload preparation facility to the launch mount will be constructed. Infrastructure requirements such as new roads, utilities, and drainage control systems will be installed within the launch complex area.

Two new facilities will be constructed at Port Hueneme on property owned and used by the U.S. Navy. A steel frame structure will be established for initial external washing of spent Solid Rocket Boosters recovered at sea. Another steel frame structure will be constructed for the disassembly and final washing of booster segments. Existing port facilities will be modified to support the booster recovery vessels and booster liftout operation. A rail spur system will be installed to facilitate intrafacility movement of the recovered boosters.

Additional facilities may also be constructed (other existing buildings may also be modified) at Vandenberg to support Shuttle operations. These will include facilities for the flight crew and for components storage. Moreover, use of

the existing Titan IIID Solid Rocket Booster preparation facility for the Shuttle will require that a new facility be constructed near Space Launch Complex No. 4 to support the ongoing Titan IIID program.

2.5.1.1 Construction/Activation Implementation Schedule

Design for Space Shuttle facilities at Vandenberg began January 1977. Construction activity for the runway, Mate/Demate Facility, tow route, launch complex facilities, and utilities is scheduled to begin April 1979. Construction of the remaining Shuttle facilities should be initiated in 1980. Figure 2.5-B is a detailed master development schedule denoting periods of design criteria planning, facilities design, construction, support equipment installation, and system testing for each facility.

2.5.1.2 Summary of Direct Costs for Construction/Activation

Table 2.5.1-1 summarizes annual cost estimates by categories. As noted, an investment of about $658 million (1975 dollars) will be required for construction of facilities, purchase and installation of support equipment, other procurement, and activation (including the initial launch) of Shuttle capability at Vandenberg. The projected funding buildup starts from Fiscal Year 1976. The peak years, with regard to dollars invested, will be Fiscal Years 1980 and 1981. It is in these years that most construction and procurement funding will be concentrated. Activation appropriations will be more broadly distributed temporally.

In terms of program year dollars, the aforementioned investment costs will total approximately $1,046 million. Moreover, portions of the expenditures will necessarily take place in various locations. Estimates of expenditure portions for the regionalized impact area (Santa Barbara County, the Tri-County region, and the Five-County region) are summarized on an annual basis in Table 2.5.1-2. The remainder, $248 million, would be spent outside the Five-County area.

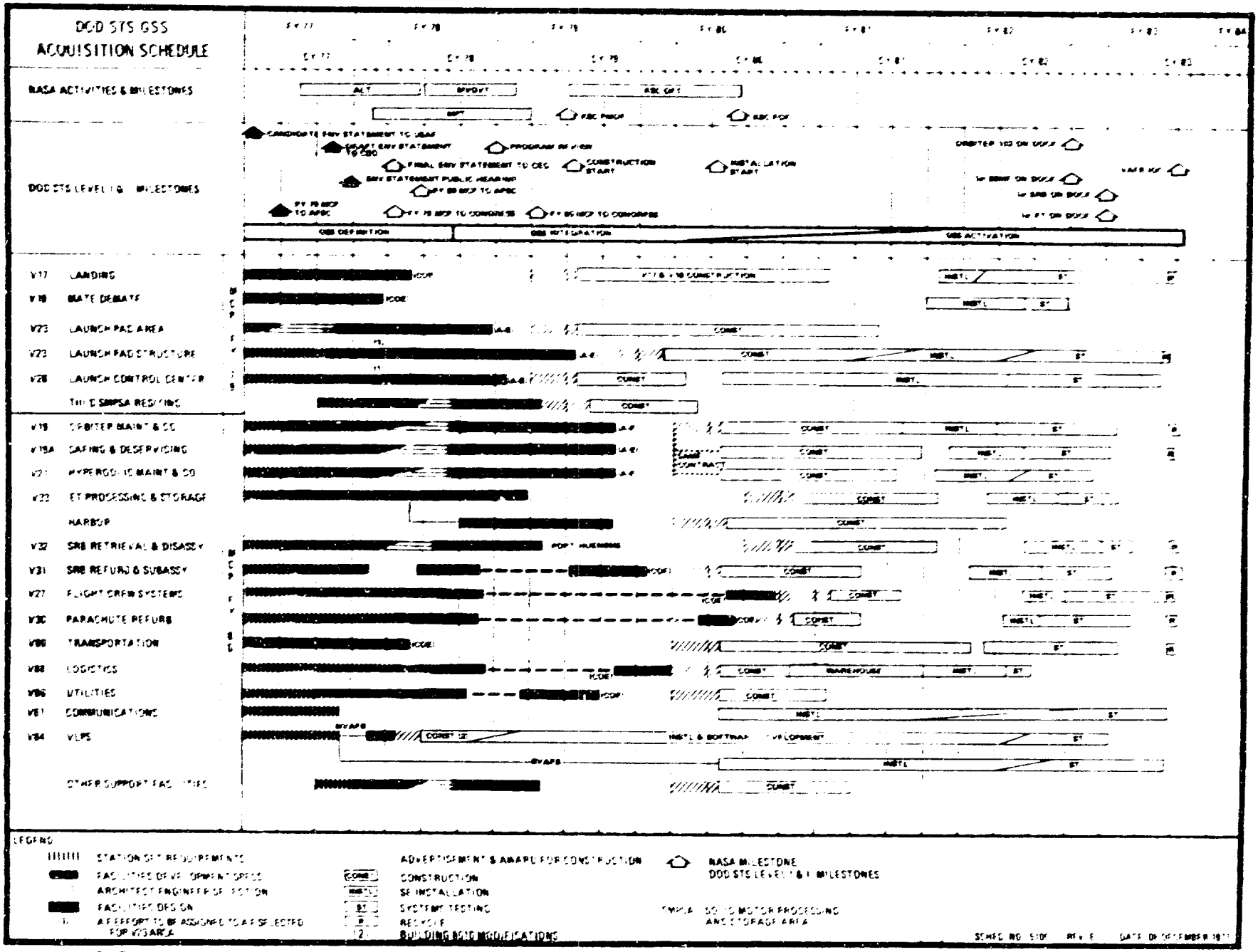


FIGURE 2.5-3. Space Shuttle Program master development schedule.

Table 2.5.1-1. SUMMARY INVESTMENT COST ESTIMATES (in thousands of 1975 dollars) FOR VANDENBERG SHUTTLE CONSTRUCTION/ACTIVATION PHASE

Appropriation code	Fiscal Year							
	Prior years	1978	1979	1980	1981	1982	1983	Total
P-3020		12,600	42,900	62,800	63,600	18,800	100	200,800
P-3080		5,900	10,600	32,600	10,100	3,800	—	63,000
P-3600	27,000	19,700	27,000	31,600	43,400	43,000	20,100	211,800
P-3300 V[a]	2,600	8,300	15,700	81,400	58,700	9,200	—	175,900
P-3300 P[b]	—	—	—	6,100	—	—	—	6,100
Total	29,600	46,500	96,200	214,500	175,800	74,800	20,200	657,600

[a]Vandenberg AFB.

[b]Port Hueneme.

Table 2.5.1-2. PROJECTED REGIONAL DISTRIBUTION EXPENDITURES (in thousands of 1975 dollars) RESULTING FROM THE CONSTRUCTION/ACTIVATION PHASE OF THE SPACE SHUTTLE PROGRAM AT VANDENBERG

Fiscal Year	Impact region		
	Santa Barbara County	Tri-County region	Five-County region
Prior years	28,434	28,632	29,600
1978	25,794	26,597	29,475
1979	38,312	39,527	45,350
1980	84,758	94,896	127,350
1981	78,310	82,853	104,625
1982	44,026	49,738	53,150
1983	20,100	20,100	20,100
Total	319,734	342,143	409,650

For Fiscal Years 1976 through 1978 and in Fiscal Year 1983, projected expenditures will be low relative to the 1979 through 1982 Fiscal Year period.

2.5.1.3 Manpower Summary for Construction/Activation

Direct employment for the Construction/Activation phase of the Shuttle Program proposed for Vandenberg will arise from expenditures of funds from two appropriations categories, namely, the construction portion of the construction and design category and the entire activation category. Figure 2.5-C summarizes this expected employment distribution on a Fiscal Year basis.

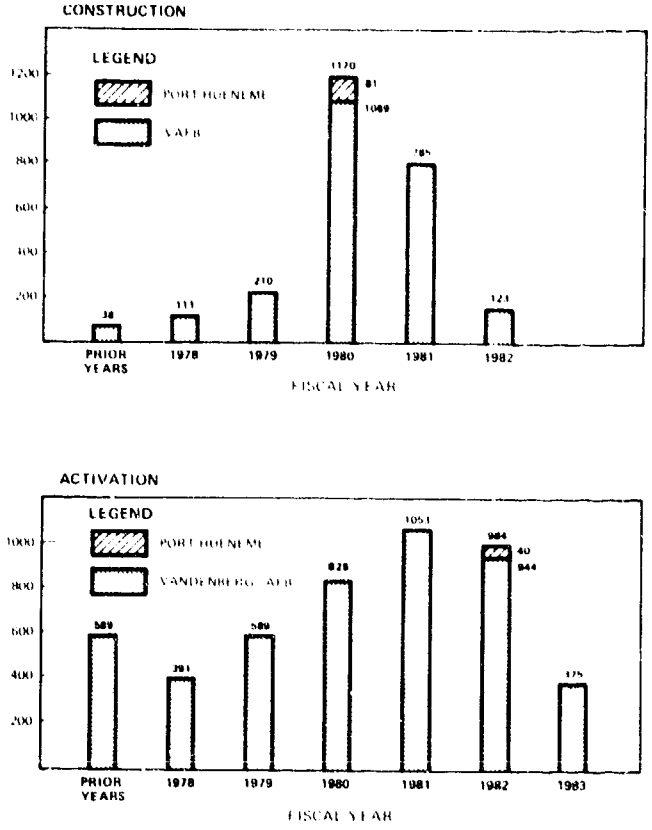


FIGURE 2.5-C. Annual direct labor required for construction and planning and activation categories for Shuttle project.

Construction employment will consist of about 57 percent craft labor and 43 percent supervision, inspection, and overhead (SIOH), and the peak labor force will be required in Fiscal Year 1980. Activation labor will be required from Fiscal Years 1976 through 1983 and will include contractor personnel involved in ground support system planning.

The total direct labor requirements of this phase for Vandenberg and/or Port Hueneme for any particular year can be determined from Figure 2.5-C by summing the appropriate combination of construction and planning/activation bar-graphed data. Thus, in Fiscal Year 1980 (the peak program year), the direct labor requirement will total 1,995 manyears. Ninety percent of the employment

opportunity for that year will occur at Vandenberg, in the north potion of Santa Barbara County (referred to as the North County). North County employment will reach a peak in 1981. Peak employment at Port Hueneme will occur in Fiscal Year 1980.

2.5.2 OPERATIONS

The operation of the STS at Vandenberg will reduce, and eventually eliminate, activities associated with the Titan III unmanned nonrecoverable space launch program. Preliminary plans have been developed to phase out expendable launch vehicle programs. The Shuttle may be used exclusively as operational maturity is gained and actual capabilities of the STS are demonstrated.

2.5.2.1 Operations Implementation Schedule

Full operation of the Space Shuttle from Vandenberg is projected to begin in Fiscal Year 1983. Operations will continue as long as the STS is technologically and economically viable, with the annual launch rate depending on the economies of operation at any particular time.

The schedule of launches currently planned for the Shuttle at Vandenberg is summarized in Table 2.5.2-1 along with the winding down of the expendable launch program. The first Shuttle launch, schedule for 1983, is categorized as part of the activation portion of the Construction/Activation phase discussed in Section 2.5.1. The remaining launches are to be part of the Operations phase discussed herein.

Table 2.5.2-1. PLANNED SPACE SHUTTLE LAUNCH SCHEDULE AT VANDENBERG AIR FORCE BASE

Fiscal Year	Shuttle launch rate	Expendable vehicle launch rates
1980	—	7
1981	—	11
1982	—	8
1983	4+IOC[a]	6
1984	9	2
1985	13	2
1986	15	—
1987	18	—
1988	18	—
1989	15	—
1990	16	—
1991	17	—

[a]Initial activation launch (not part of Operations phase).

Four launches are scheduled for Fiscal Year 1983, and nine are planned for Fiscal Year 1984. From Fiscal Years 1985 through 1991, the average annual launch rate is to be 16 missions per year. Excluding the Initial Operational Capability (IOC) first launch scheduled for 1983, a total of 128 launches are initially planned as part of the Operations phase of the proposed action. The transition from expendable vehicles to Shuttle Operations between 1983 and 1985 permits a shifting of personnel levels from one program to the other.

2.5.2.2 Summary of Direct Costs for Operations

Estimates of the direct costs of operations are detailed in Table 2.5.2-2. As noted, about $710 million (1975 dollars) in expenditures will be required to support the 128 operational launches scheduled to occur at Vandenberg. The projected funding buildup will begin from Fiscal Year 1983. Peak expenditures of about $90 million will occur in Fiscal Years 1987 and 1988. On a cost per launch basis, the higher values in the earlier years will be due primarily to an anticipated need for more personnel to make the new system run smoothly. In terms of 1983 program-year dollars, total operations expenditures will equal almost $1.2 billion.

Table 2.5.2-2. SUMMARY INVESTMENT COST ESTIMATES (in thousands of 1975 dollars) FOR VAFB SHUTTLE OPERATIONS

Item \ Operations schedule	1983	1984	1985	1986	1987	1988	1989	1990	1991	Total
	4 launches 12 months	9 launches 12 months	13 launches 12 months	15 launches 12 months	18 launches 12 months	18 launches 12 months	15 launches 12 months	16 launches 12 months	17 launches 12 months	125 launches 99 months
Manpower Cost	18,400	37,400	59,200	59,000	58,700	58,700	58,700	58,700	56,800	465,600
Consumables	3,000	7,000	10,000	11,500	13,900	13,900	11,500	12,300	12,000	95,100
S. E. Spare Parts	2,000	2,400	2,300	2,300	2,300	2,300	2,400	2,400	2,400	20,800
Other	12,100	15,000	15,000	15,000	15,000	15,000	15,000	15,000	14,400	131,500
Total (1975 Dollars)	35,500	61,800	86,500	87,800	39,900	89,900	87,600	88,400	85,600	713,000
Total (1983 Dollars)[a]	59,285	103,206	144,455	145,626	150,133	150,133	146,292	147,628	142,952	1,190,210

[a]Escalated by 1.67 over 1975 values.

Table 2.5.2-3 summarizes the anticipated annual distribution of operations expenditures within the regionalized impact area (Santa Barbara County, the Tri-County region, and the Five-County region). Inasmuch as all expenditures are anticipated within the Five-County region, the annual totals for this region equal the expected total annual expenditures shown in Table 2.5.2-2 for project operations. Approximately 72 percent of the total expenditures are expected to occur in Santa Barbara County. Differences between expenditures in Santa Barbara County and the Tri-Counties are small ($35 million total). The only expenditures projected outside of Santa Barbara County are for consumables and the Port Hueneme facilities; collectively, these expected costs amount to about 28 percent of the total projected cost.

Table 2.5.2-3. PROJECTED REGIONAL DISTRIBUTION OF EXPENDITURES (in thousands of 1975 dollars) RESULTING FROM THE OPERATIONS PHASE OF THE SPACE SHUTTLE PROGRAM AT VANDENBERG

Fiscal Year	Impact region		
	Santa Barbara County	Tri-County region	Five-County region
1983	28,578	29,820	35,500
1984	48,328	50,367	61,800
1985	65,048	67,989	86,500
1986	64,796	67,869	87,800
1987	63,020	68,234	89,900
1988	63,110	68,324	89,900
1989	63,100	68,300	87,600
1990	62,057	67,184	88,400
1991	60,091	65,056	85,600
Total	518,128	553,143	713,000

2.5.2.3 Manpower Summary of Operations

Figure 2.5-D summarizes the expected employment distribution at Vandenberg and Port Hueneme on a Fiscal Year basis. A constant number of 98 jobs is projected for Port Hueneme beginning in 1985, with 31 manyears in Fiscal Year 1983,

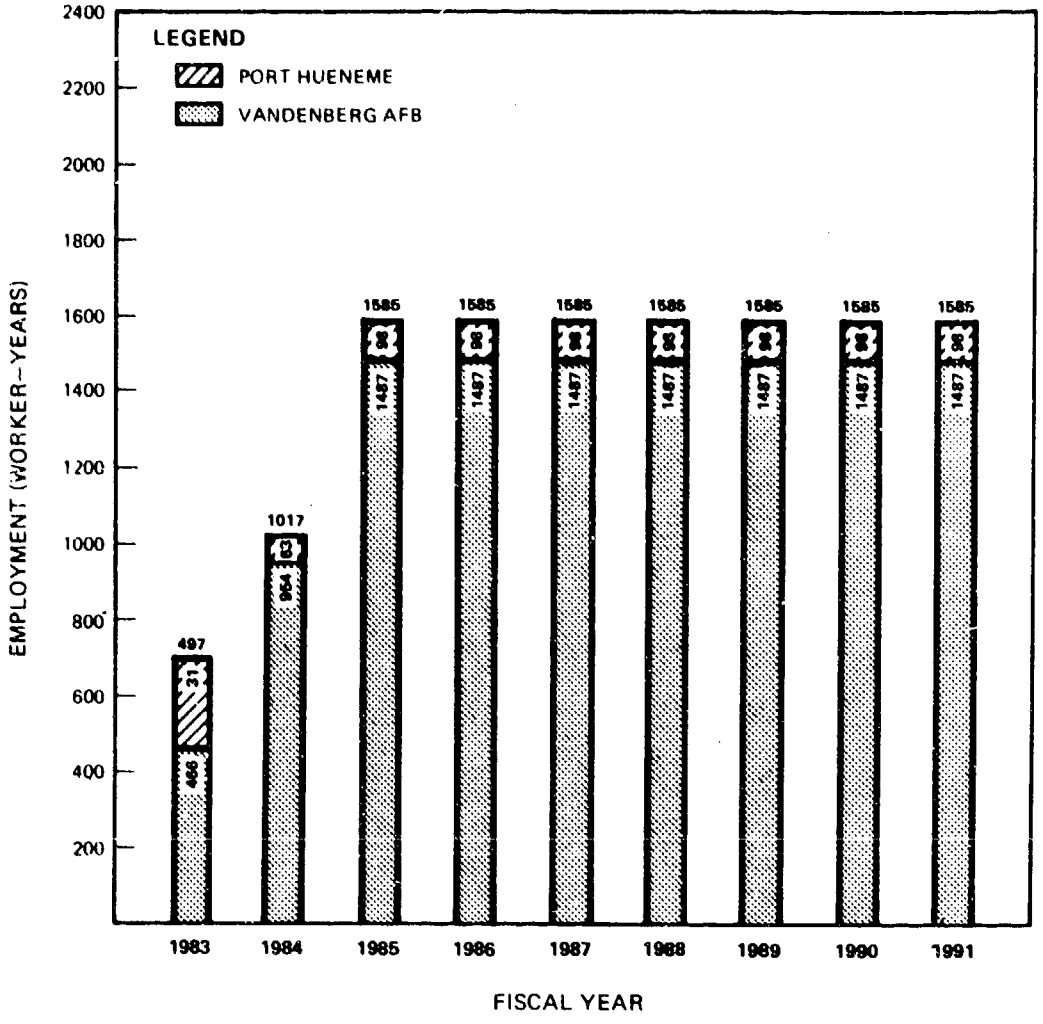


FIGURE 2.5-D. Annual direct labor required for Shuttle operations.

and 63 manyears for Fiscal Year 1984. At Vandenberg, however, job numbers are expected to reach 1,585 in Fiscal Year 1985.

The personnel that will be involved in operations and maintenance during the operating period will be split into two shifts. The makeup of the 1,585 man force estimated for Fiscal Year 1985 is shown in Table 2.5.2-4. Direct labor constitutes 88 percent of the total with management and administrative support making up the remaining 12 percent.

Table 2.5.2-4. ESTIMATED BREAKDOWN OF PERSONNEL FOR SHUTTLE OPERATION DURING FISCAL YEAR 1985

Direct Labor	1,388	Indirect Labor	197
Test Operations and Support		Management	20
Launch Operations	306	Finance and Contracts	47
Orbiter Maintenance	153	Administration	63
Launch Proc. System Operations	90	Other	67
Other Operations	142		
Quality	106		
Safety	38		
SE and Facility Maintenance	88	Total Personnel Requirement	1,585
Supervision	80		
Program Management	120		
Engineering	119		
Logistics	127		
Data	19		

Reference: Document UCR 77-076, 6 May 1977, System/Design Trade Study Report—Launch Rate Optimization.

3.0 DESCRIPTION OF THE EXISTING ENVIRONMENT

The following section presents a description of the existing environment. Information presented herein provides the foundation for the analysis of environmental impacts presented in Section 5.

This section divides the environment into two general categories. The physical, chemical, biological, and archaeological characteristics of the existing environment are described in Section 3.1, and the socioeconomic characteristics are described in Section 3.2. It should be recognized that these two sections are not independent of each other. For example, archaeological material that exists on Vandenberg constitutes a physical resource and is discussed in Section 3.1; however, the actual importance of this resource is related to its cultural value. Many aspects of the social and economic environment either are or have been shaped by the physical character of the region, and vice versa.

The information presented in the following sections can be considered an inventory of various characteristics of the existing environment. However, it is also an analysis of the important interrelationships that are acting in the existing environment. Such an analysis is necessary to understand how the proposed action might affect these relationships.

3.1 PHYSICAL, CHEMICAL, BIOLOGICAL, AND ARCHAEOLOGICAL ENVIRONMENT

Most of the impacts discussed in Section 5 will affect only the Tri-County region. Many of these impacts will focus on areas smaller than the total region because the extent of an area described in relation to one impact may vary slightly from another affected area and because different impacts affect different ranges of study areas. Most of the following discussion, therefore, centers on the Vandenberg and Port Hueneme areas, including the Lompoc Valley, Burton Mesa, lower Santa Maria Valley, and the Oxnard coastal plain areas.

3.1.1 TOPOGRAPHY AND GEOMORPHOLOGY

3.1.1.1 Topography

Mainland. The project region lies in parts of the southern Coast Range and Transverse Range, 2 of 11 major geomorphic provinces in California.

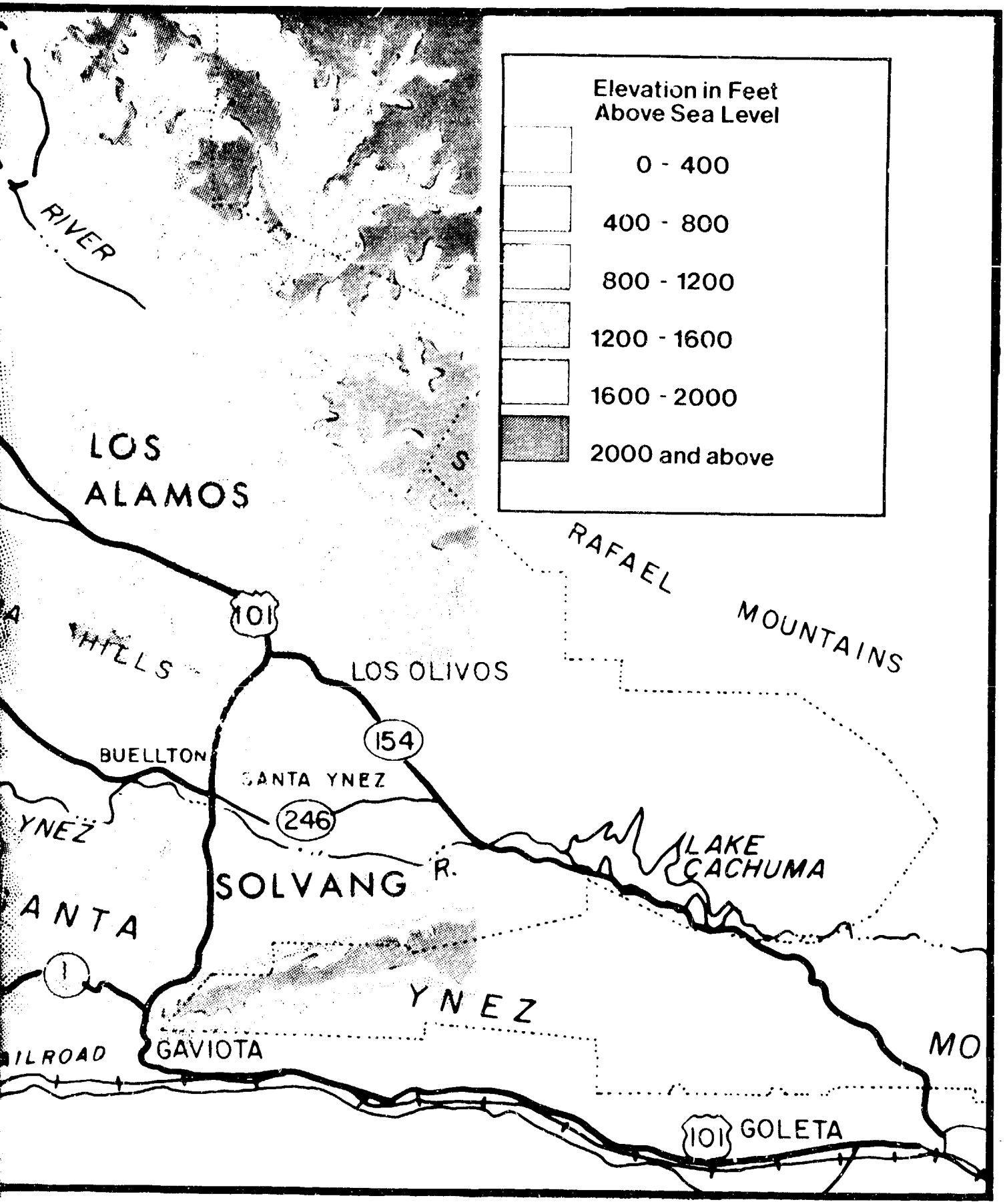
The rugged Coast Ranges extend from sea level to maximum elevations of 6,000 to 7,000 feet, averaging about 2,000 to 4,000 feet, and are separated by short, narrow valleys. Near Santa Barbara and Ventura Counties, the north-northwest trending Coast Ranges abut the east-west trending Transverse Ranges. A topographic map of the Vandenberg area is presented as Figure 3.1.1-A.

Two main flood-plain valleys, the Santa Maria and Lompoc-Santa Ynez, lie between the two provinces and are separated by Burton Mesa, the Purisima Hills, and the Casmalia Hills. The Santa Maria Valley flood plain ranges from an elevation of 300 feet on its eastern end to sea level at the coast. The elevation of the Lompoc-Santa Ynez Valley near Lompoc (about 10 miles from the coast) is approximately 100 feet.

Vandenberg Air Force Base is located on Burton Mesa, which is about 400 feet in elevation. South of the Base, the east-west trending Santa Ynez Mountains (the western edge of the Transverse Ranges) form a narrow, continuous range parallel to the coast. Mount Tranquillon, the highest point on the Base



FIGURE 3.1.1-A. Topography of the immediate Vandenberg area.


Elevation in Feet
Above Sea Level
0 - 400
400 - 800
800 - 1200
1200 - 1600
1600 - 2000
2000 and above
RIVER
LOS
ALAMOS
RAFAEL
MOUNTAINS
101
LOS OLIVOS
154
BUELLTON
SANTA YNEZ
246
SOLVANG
R.
LAKE
CACHUMA
1
YNEZ
GAVIOTA
GOLETA
101

(elevation 2,150 feet), is part of the Santa Ynez range. At the north end of the Base are the Casmalia Hills, with an elevation of approximately 1,600 feet. The Purisima Hills, east of the Base, rise to approximately 1,500 feet in elevation.

Port Hueneme lies south of the Santa Ynez Mountains on the flood plain of the Ventura and Santa Clara Rivers.

Coastal. Coastal terraces, rocky promontories, high sea cliffs, extensive sand dunes, and wide beaches are all found in the coastal area from Port San Luis to Point Mugu. North of Vandenberg, the coastline from Monterey Bay to Point Sal is generally rocky with high cliffs and numerous rocky promontories. South of Vandenberg, a coastal terrace generally lies between the Santa Ynez Mountains and the shoreline from Point Conception to Rincon Point. From here to the city of Ventura the terrace disappears, and the flat, low-lying depositional flood plain of the Ventura and Santa Clara Rivers spreads from Ventura to Point Mugu.

The following is a brief outline of the prominent features along the Vandenberg coastal region, from Point Sal in the north to the Sudden Ranch in the south, covering approximately 35 miles of coastline:

(1) Point Sal to Purisima Point--the rocky headland to Point Sal is over 1 mile long and rises to elevation 1,625 feet about 3 miles inland; the long, shallow cuspate beach with sand dunes extending inland is fully open to prevailing swells. About 4 miles south of Point Sal is Lions Head, a rocky reef extending 0.3 mile offshore.

(2) Purisima Point to Point Pedernales--Purisima Point is low and rocky, with reefs extending southeast for 0.3 mile; its north side has extensive inland dunes. The long, shallow cuspate beach stretches to Bear Creek. Ocean Beach is about 4 miles south of Purisima Point and extends to Point Pedernales. The Santa Ynez River mouth at the north end of Ocean Beach is usually blocked by a natural sand bar that acts as a barrier forming a small inland lagoon; the barrier remains intact except during heavy stream flow. Intertidal and offshore rocks lie at Honda Canyon just north of Point Pedernales.

(3) Point Pedernales to Point Arguello--this area has rockbound, coastal cliffs that extend south for 2.5 miles. Point Arguello is narrow, rocky, overhangs the water's edge, and

is divided by gullies on the north and south sides; there is a large tidepool area with scattered rocks and boulders at the headland; irregular ridges, shallow offshore reefs, and exposed rocks modify the surf.

(4) Point Arguello Boathouse (south of Point Arguello) to Point Conception--beaches and exposed bedrock lie along the base of rocky cliffs.

Topographic features in the immediate vicinity of the proposed shallow draft harbor site include narrow beaches; a small jetty which extends a few hundred yards offshore; rocky coastal cliffs; a small, gently sloping terrace; and the nearby foothills of the Santa Ynez Mountains. A photograph of the area depicting these features is presented in Figure 3.1.1-Aa.

This site is on a terrace adjacent to the existing buildings of the (abandoned) Coast Guard life boat station and extends onto the rocky beach and shallow semiprotected area on the lee side of the existing jetty. The terrace in this area slopes north-south from the foothills to the sea cliff at a rate of about 6 feet in elevation per 100 feet horizontally. The cliff itself is about 40 to 60 feet in height. Large talus cones are present in many areas along its base. Below the cliff are rocky intertidal zones separated by an occasional narrow beach. The embayment area behind the existing jetty is shallow (less than about 12 feet in depth) with occasional outcrops of bedrock and boulders protruding through sand covered bottom. A narrow, steep, and unpaved road cut extends from the terrace adjacent to existing structures to the Boathouse behind the jetty.

Submarine. The bathymetry or submarine topography of the offshore area from Port San Luis to Point Mugu is shown in Figure 3.1.1-B. From Pismo Beach south to Point Conception, the continental shelf between the 600-foot depth contour and the shoreline is approximately 10 to 15 miles wide. A series of submarine canyons occurs on the continental slope about 5 miles west of Point Arguello, where the continental shelf narrows and turns into the Santa Barbara Channel.



FIGURE 3.1.1-Aa. Aerial photograph of the Point Arguello terrace and existing Boathouse facilities and embayment.

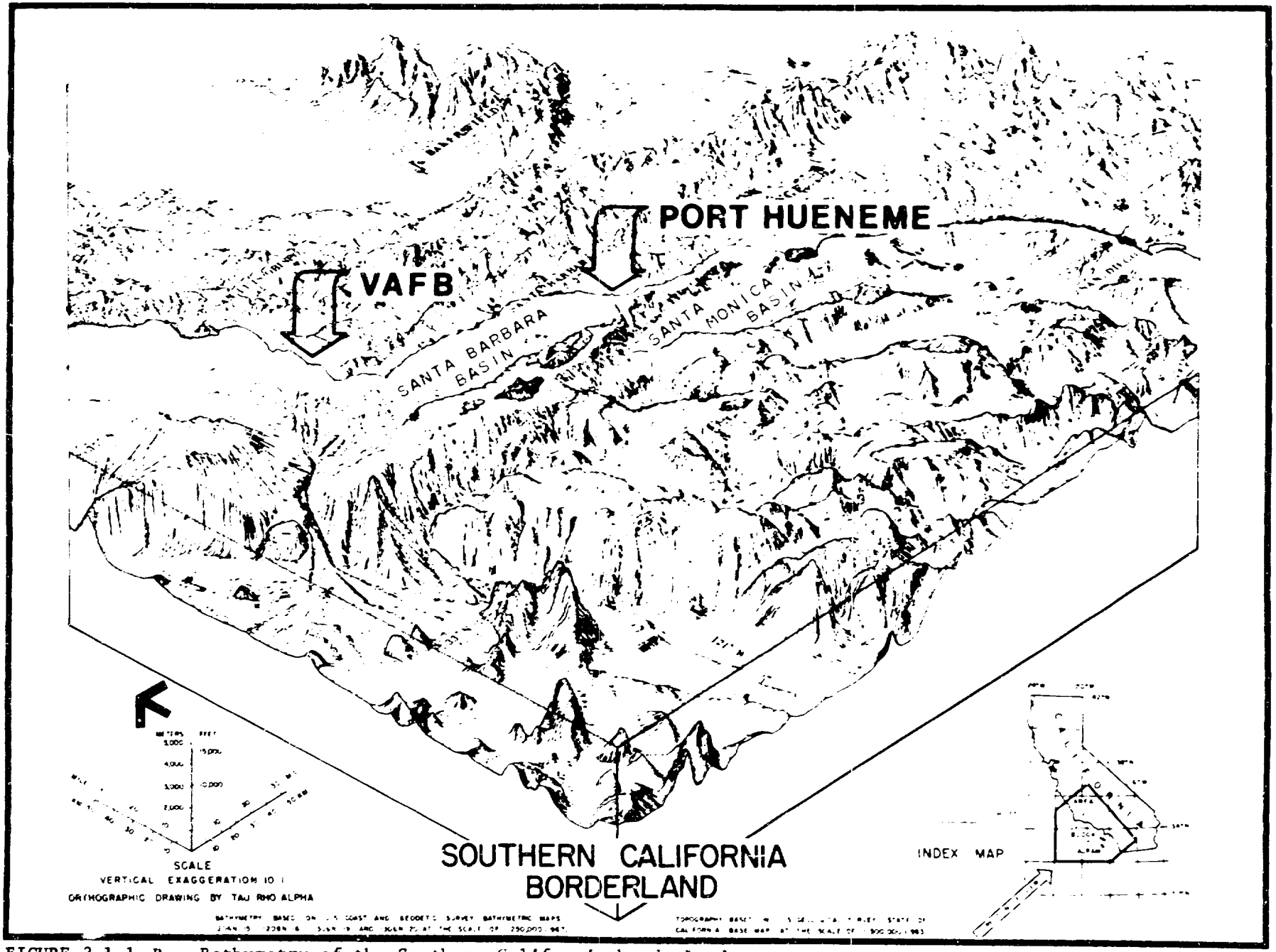


FIGURE 3.1.1-B. Bathymetry of the Southern California borderland.

The Santa Barbara-Oxnard Shelf trends northwest-southeast and is about 25 miles long, with a maximum width of about 16 miles. The total area from Point Conception past Port Hueneme that is shallower than 325 feet is approximately 300 square miles.

Offshore Islands. The Channel Islands lie on an east-west axis 19 to 27 miles from the mainland. The major islands adjacent to the Santa Barbara coast consist of San Miguel, Santa Rosa, and Santa Cruz. To the east of Santa Cruz Island on this east-west axial line lie the Anacapa Islands. The Anacapa Islands, along with Santa Barbara Island, form the major part of the Channel Islands National Monument.

San Miguel, the westernmost island, has an area of 14 square miles. It is the smallest and flattest island of the three and is approximately 4 miles wide and 10 miles long, attaining a maximum height of 831 feet. Prominent rocky headlands dominate the eastern half of this windswept island. High, rocky cliffs occur in the western part of the island.

Santa Rosa Island lies about 4 miles to the southeast of San Miguel Island and attains a maximum height of 1,040 feet. It is approximately 17 miles long, 10 miles wide, and has an area of 84 square miles. Santa Rosa Island is the most rugged island of the three and has well-developed beaches on its eastern shore and steep canyons on its northern and southern shores.

Approximately 8 miles to the east of Santa Rosa Island lies Santa Cruz Island. It is the largest of the islands, with an area of 96 square miles, and is approximately 24 miles long and 8 miles wide. The shore is composed mainly of bold, rocky cliffs, some rising 500 feet from the sea. Generally, beaches are small and limited to those found at the mouths of canyons, but some larger stretches of sandy beach do occur along the western edge of the island. In the west-central part of Santa Cruz Island is a central valley that runs from the mountainous central part of the island almost due westward to the coast.

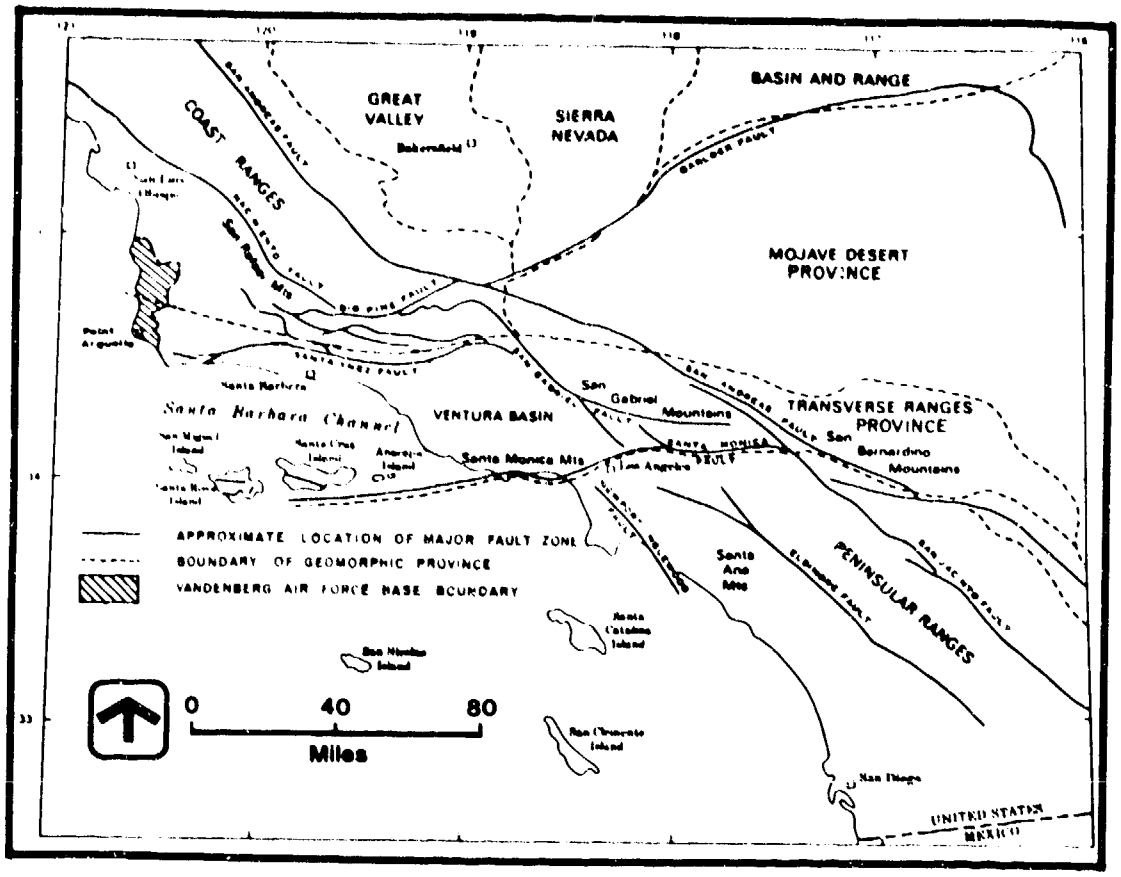
Santa Barbara Island, with an area of about 1 square mile, and tiny Sutil Island nearby, are about 100 miles southeast of Point Conception. Both are composed of basaltic lava flows that have been cut into steep cliffs as high as 500 feet. There are no beaches on either island.

3.1.1.2 Geomorphology

The Transverse Ranges and the Coast Ranges provinces (see Figure 3.1.1-C) in Santa Barbara County have complex geomorphic histories. Mountain building processes are still occurring in the region. Expressions of extensive folding and faulting are common.

Many landforms follow the underlying geologic structure, indicating that erosion in some areas has not yet altered the topographic expression of the underlying geologic formations. In the San Rafael Mountains, however, where folding may be much older than in other areas near Vandenberg, topography does not conform closely to the underlying structure (for example, Cachuma Mountain is synclinal).

Much of the area is in an early mature state of erosion, exhibiting sharp ridges, mountains, and V-shaped canyons. The hilly areas, such as the lower



Reference: Vedder, Wagner, and Schoellhamer, 1969.[159]

FIGURE 3.1.1-C. Major geomorphic provinces of Southern California.

Santa Ynez Mountains, Purisima Hills, and foothills of the San Rafael Mountains are in a middle-to-late mature stage of erosion, characterized by rounded crests and valleys with small flood plains.

In the Port Hueneme area, the dominant landform is a wide, delta-shaped, depositional coastal plain.

The geomorphology of the nearshore and offshore areas of the region is not clearly understood. The coastline may be in a mature stage of erosion based on the fact that the coastline both north and east of Point Conception is relatively straight.[24] Offshore, the submarine topography generally follows the character of the two geomorphic provinces.

3.1.2 GEOLOGY

The following discussion of regional geology is intended to provide an overview of the Tri-County area, with emphasis on Vandenberg Air Force Base and immediately adjacent area.

3.1.2.1 Surface Geology

The surface geology around Vandenberg reflects the existence of two geomorphic provinces, the southern Coast Ranges and the Transverse Ranges, and two major stratigraphic provinces, the Santa Ynez Mountains and the Santa Maria Basin (see Figure 3.1.2-A). Extensive folding and faulting throughout the area formed four general structural provinces:

(1) Santa Ynez Mountain uplift--rock units uplifted along the Santa Ynez fault and subsequently folded.

(2) Lompoc Lowland--an area of low relief, comprising Burton Mesa and Lompoc Valley.

(3) Los Alamos syncline--a deep syncline traversing Los Alamos and Upper Santa Ynez Valleys.

(4) San Rafael Mountain uplift--mountains uplifted by faulting.

The Channel Island are geologically the westward extension of the Santa Monica Mountains and have been separated from the mainland for at least 100,000 years or longer. During this period these northern Channel Islands were probably interconnected and did not finally separate until the most recent interglacial period, about 18,000 years ago.

The surface geology of the three major islands exhibits more evidence of volcanic activity than appears on the mainland. The small islands of Santa Barbara and Sutil are composed entirely of basaltic lava flows that have been cut into steep cliffs along the coastline. Santa Cruz Island possesses a wider variety of rock types than most of the Santa Barbara County mainland.

Much of the coast of Santa Cruz Island consists of volcanic rock, although extensive stretches of coastal cliffs are formed from the Monterey Formation. The coastal cliffs on Santa Rosa Island are also cut from the Monterey Formation, but this island has a more varied lithography than the mainland coast or Santa Cruz Island. San Miguel Island has prominent rocky headlands on the eastern half of the island that are formed chiefly from volcanic rock. In the western part of the island, the rocky cliffs are cut mostly from relatively durable Cretaceous and early Tertiary sedimentary rock which is generally more resistant and firmly cemented than that of the Monterey Formation.(72)

3.1.2.2 Subsurface Geology

The Santa Ynez Mountains and the Santa Maria Basin, stratigraphic provinces south and north, respectively, of Vandenberg, are roughly divided by the Casmalia and Solomon Hills and presumably overlie the Franciscan Formation basement rock. The formations that make up the Santa Ynez Mountains were deposited in the Santa Barbara embayment during Cretaceous to Pliocene time. The Santa Maria Basin was formed during the Miocene and was heavily sedimented throughout the Pliocene and Pleistocene.

The subsurface geology of the Channel Islands is similar in some respects to that of the mainland, despite the fact that these inslands are assumed to be a geological extension of the Santa Monica Mountains located south of the study area. The Monterey Formation appears on the islands of Santa Cruz and Santa Rosa. On Santa Rose Island most of the coastal cliffs are cut from the Monterey Formation, which has a more varied lithography here than on the mainland coast or on Santa Cruz Island. In addition to the typical siliceous and diatomaceous shales usually present in this rock unit, it includes a coarser-grained sandstone, breccia, and conglomerate, plus a considerable thickness of tuffaceous rock indicating a more voluminous contribution from volcanic sources than is characteristic of the mainland Monterey rocks.(72)

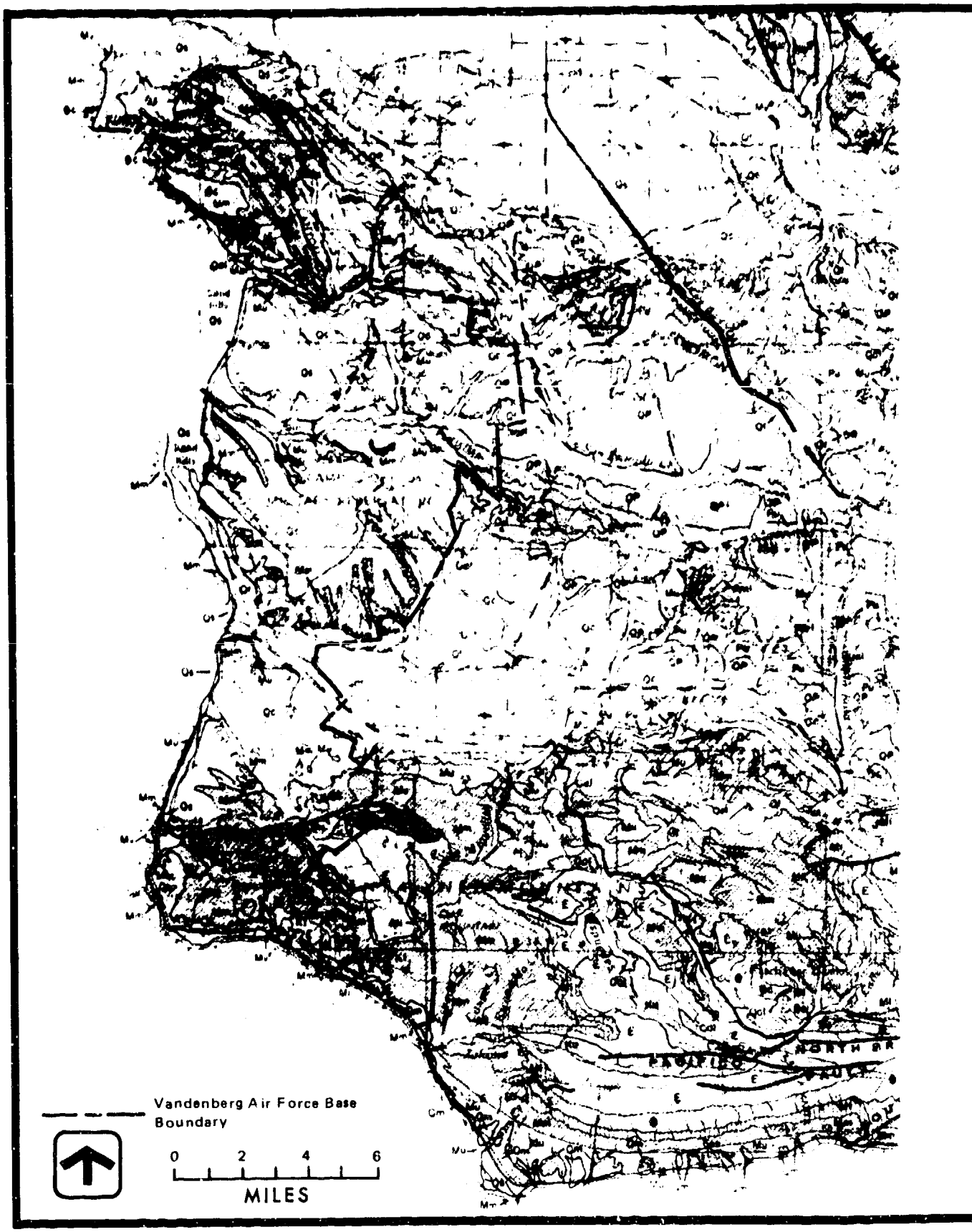
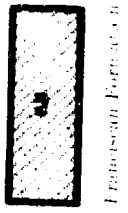


FIGURE 3.1.2-A. Geology of the Vandenberg region.

LEGEND

SEDIMENTARY AND METASEDIMENTARY ROCKS

- Dune sand
- Alluvium
- Quaternary nonmarine terrace deposits
- Pleistocene marine and marine terrace deposits
- Pleistocene nonmarine
- Plio-Pleistocene nonmarine
- Upper Pliocene marine
- Middle and/or lower Pliocene marine



Franciscan Formation

IGNEOUS AND META-IGNEOUS ROCKS

- Upper Miocene marine
- Middle Miocene marine
- Lower Miocene marine
- Oligocene nonmarine
- Oligocene marine
- Eocene marine
- Upper Cretaceous marine
- Lower Cretaceous marine
- Knoxville Formation
- Miocene volcanic: rhyolite; andesite; basalt; pyroclastic rocks
- Franciscan volcanic and metavolcanic rocks
- Mesozoic ultrabasic intrusive rocks

Reference: California Division of Mines and Geology, miscellaneous dates. (14)

2

3.1.2.3 Soils

Soil composition and thickness in the project region vary widely because of differences in slope gradients and underlying rock types. The primary constituent of soils on the Base is Pleistocene terrace deposits of sand and alluvium. Extensive soil borings have proven these to be predominantly silty sand. A generalized soil map for the immediate Vandenberg area is shown on Figure 3.1.2-B.

The composition of the alluvial soils on the Base ranges from very young active dune sands and soils found along stream channels and flood plains, to older, strongly developed claypan soil. The loose surface soils on the Base range from 2 to 4 feet in depth and are overly cemented materials that prevent adequate drainage and cause stands of water during heavy rainfall (especially on Burton Mesa, near the Vandenberg runway).

The major soils of the northern and central Vandenberg areas are the well-drained shaley clay loam and silty clays on the uplands; the somewhat poorly drained to moderately well-drained sands and loamy sands on terraces, coastal dunes and sandy beaches; and the well-drained to somewhat poorly drained sandy loams to silty clay loams and excessively drained sands normally found on mesas and dunes.

Soils in the South Vandenberg area generally include deep, permeable, and agriculturally productive soils of alluvial fans; poorly drained, dark-colored soils found in basin areas; compact, slowly permeable, highly erodable soils of old terrace deposits; coastal beaches; dune sand; excavated land; fill; and tidal marshes.

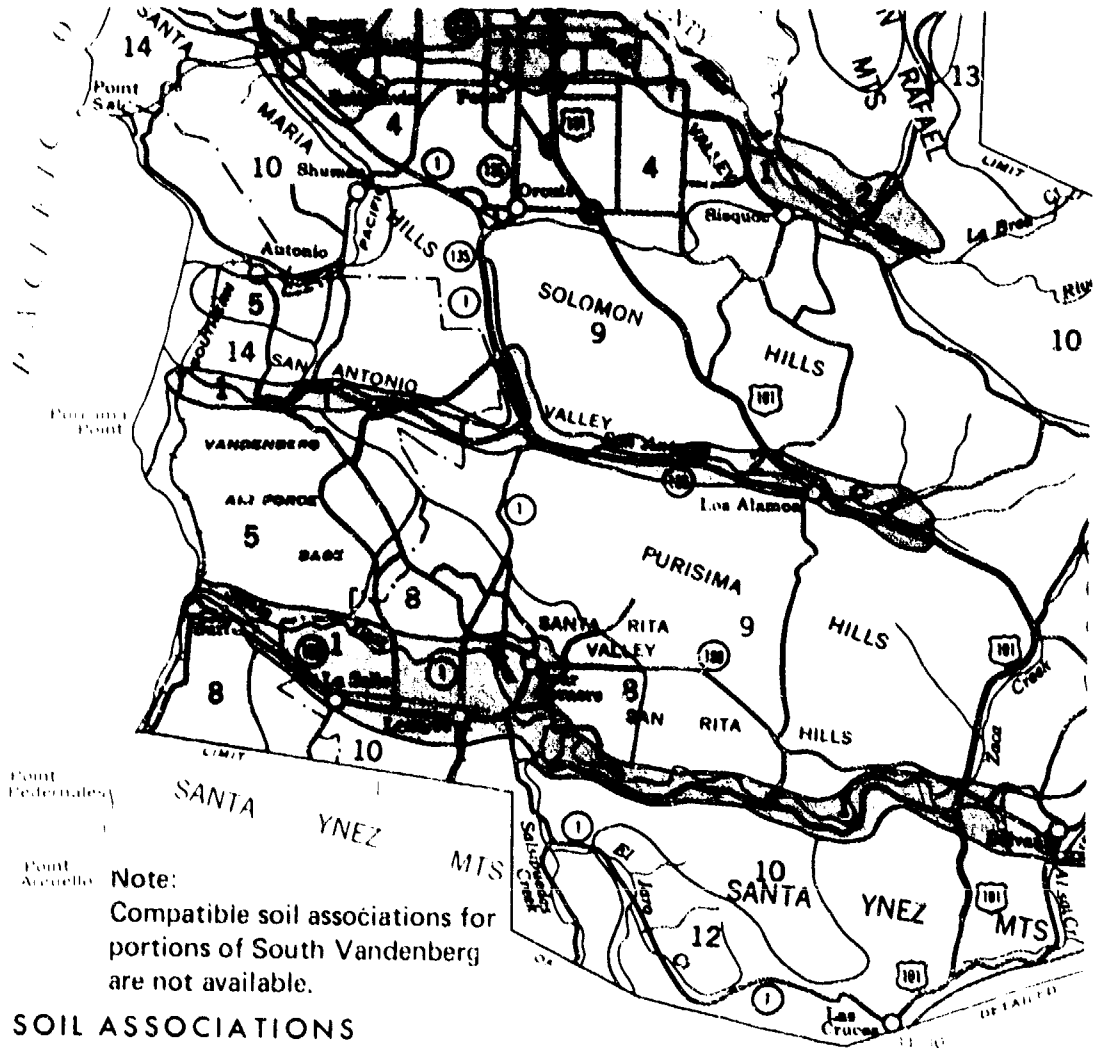
Two significant soil associations occur in the immediate area of Port Hueneme--the Camarillo-Hueneme-Pacheco and the Riverwash-Sandy alluvial land-Coastal beaches group. Both are found on level to moderately sloping lands such as alluvial fans, in basin areas, and on plains.

A map of the various soils series present on and adjacent to the Point Arguello terrace is presented in Figure 3.1.2-Ba. The predominant soils on this terrace are members of the Arguello series. These soils formed on old alluvial fans and stream terraces from materials washed from Santa Lucia soils. In accordance with Figure 3.1.2-B, they would be classified as members of the Shedd-Santa Lucia-Diablo association. Other soils in the immediate area of the site include members of the Elder, Baywood, Sorrento, Montezuma, Jalama, Watsonville, and Tangair series. Some areas consist of rough, broken lands where no true soil cover exists.

The soils on the Arguello terrace vary in their capacity to support vegetation (typically annual grasses, herbs, shrubs, and a few trees). Although some of these soils have limited value for agricultural production, those of the Arguello and Elder series (the predominant soils of the site area) are suitable for a wide range of crops, provided that irrigation is employed.

The soil associations of the Channel Islands are similar to those of the mainland. Beach and dune sands predominate on the coasts, especially on the north shore of San Miguel Island, the east and west shores of Santa Rosa Island, and the north shores of Santa Cruz Island, and the Anacapa Group. Terrace soils appear on San Miguel Island and along the north and south shores of Santa Cruz Island. Soils derived from volcanic rock appear on all three main islands, particularly on Santa Cruz and San Miguel. The central valley of western Santa Cruz Island contains alluvial soils. Rough, broken, and stony land predominantly occurs on rugged Santa Rosa Island.

Parts of San Miguel Island are landscaped with deposits of calcium carbonate, called "caliche," which have formed in the shape of tree trunks. These deposits, formed thousands of years ago, are very fragile, despite their mineralized compositon.



Note:
Compatible soil associations for portions of South Vandenberg are not available.

SOIL ASSOCIATIONS

SOMEWHAT EXCESSIVELY DRAINED TO SOMEWHAT POORLY DRAINED, NEARLY LEVEL TO MODERATELY STEEP SOILS OF THE ALLUVIAL FANS, FLOOD PLAINS, VALLEYS, AND TERRACES

1 Sorrento-Mocho-Camarillo association. Nearly level to moderately sloping, well drained to somewhat poorly drained sandy loams to silty clay loams on flood plains and alluvial fans.

2 Pleasanton-Botella-Elder association. Nearly level to moderately steep, well drained and moderately well-drained sandy loams to clay loams on terraces and alluvial fans and in valleys.

SOMEWHAT EXCESSIVELY DRAINED TO SOMEWHAT POORLY DRAINED, NEARLY LEVEL TO VERY STEEP SOILS OF THE TERRACES AND ADJACENT UPLANDS

4 Betteravia-Garey association. Nearly level to moderately steep, moderately well drained and well drained loamy sands to sandy loams on terraces.

5 Tangair-Narlon association. Nearly level to strongly sloping, somewhat poorly drained and moderately well drained sands and loamy sands on terraces.

6 Positas-Ballard-Santa Ynez association. Nearly level to moderately steep, well drained and moderately well drained fine sandy loams to clay loams on terraces.

8 Marina-Oceano association. Nearly level to moderately steep, somewhat excessively drained and excessively drained sands on mesas and dunes.

WELL DRAINED AND SOMEWHAT EXCESSIVELY DRAINED, GENTLY SLOPING TO VERY STEEP SOILS OF THE UPLANDS AND HIGH TERRACES

9 Chamise-Arnold-Chow-Rock association. Gently sloping to very steep, well drained and somewhat excessively drained sands to clay loams on high terraces and uplands.

10 Sheidd-Santa Lucia-Diablo association. Strongly sloping to very steep, well drained shaly clay loams and silty clays on uplands.

12 Los Osos-Gaviota association. Moderately sloping to very steep, well drained and somewhat excessively drained clay loams to sandy loams on uplands.

MISCELLANEOUS LAND TYPES

13 Sedimentary rock land-Rough broken land association. Steep to extremely steep, excessively drained lands on uplands.

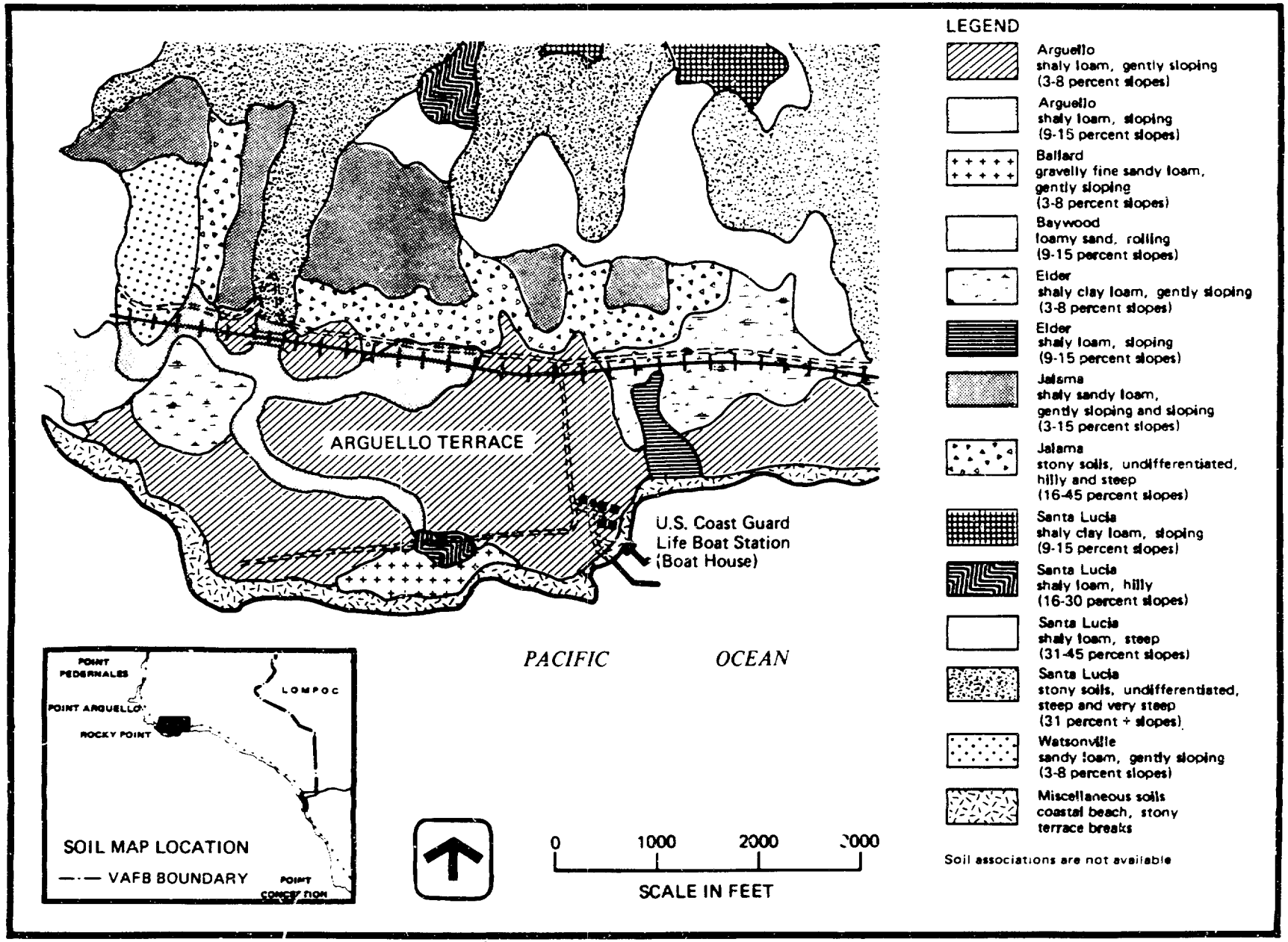
14 Dune land association. Coastal sand dunes and sandy beaches.

*Textures in name of associations refer to surface texture of the soils.

0 2 4 6
MILES

Reference: U.S. Department of the Interior, Soil Conservation Service, 1972. (146)

FIGURE 3.1.2-B. Distribution of soil associations near Vandenberg Air Force Base.



Reference: Soils Conservation Service.(177)

FIGURE 3.1.2-Ba. Soil series on and adjacent to the Point Arguello terrace.

All three of the nearby Channel Islands have been faulted to some degree. Faulting on San Miguel Island has been minor, but major faults cross Santa Rosa Island and Santa Cruz Island.

Preliminary studies by the California Division of Mines and Geology indicate that in the inland portion of Vandenberg, the probable maximum intensity of

3.1.2.4 Geologic Hazards

Significant geologic hazards can occur in the immediate project area. These include earthquakes, soil liquefaction, landslides and soil creep, expansive soils (all discussed in this section), tsunamis (see Section 3.1.4.4), and flooding (see Section 3.1.3.1).

Seismic Hazards. Major earthquakes in the Santa Barbara County area were recorded as early as 1769. Since that time a major earthquake has occurred in this area about every 15 to 20 years. Although Vandenberg is located in a historically earthquake-susceptible area, no damage has been recorded at the Base.(138)

Near the project area, strong shaking and major damage from earthquakes have occurred several times since the quake of 1769, which is the earliest definitely dated earthquake in California.

The major east-west fault in the Vandenberg area, the Santa Ynez, extends from the upper Santa Ynez River, westward along the north slope of the Santa Ynez range near Gibraltar Reservoir, to Gaviota Pass. Here the fault branches, with the south branch extending out to sea approximately two miles west of Gaviota Beach. The north branch continues westward and joins the Pacifico fault (see Figure 3.1.2-C).

The Honda fault is important because of its proximity to SLC-6 (about 1.5 miles away). However, this fault, which roughly parallels Honda Creek from the coast east for about 7 miles, is classified as inactive.

Nine faults in the Santa Barbara County are considered active (movement in the last 11,000 years): Big Pine extension, Graveyard-Turkey Trap, Mesa, More Ranch, Nacimiento, Pacifico, Santa Cruz Island, Santa Rosa Island, and Santa Ynez.(72) With the possible exception of the Big Pine extension, none of these faults extend on Vandenberg.

All three of the nearby Channel Islands have been faulted to some degree. Faulting on San Miguel Island has been minor, but major faults cross Santa Rosa Island and Santa Cruz Island.

Preliminary studies by the California Division of Mines and Geology indicate that in the inland portion of Vandenberg, the probable maximum intensity of

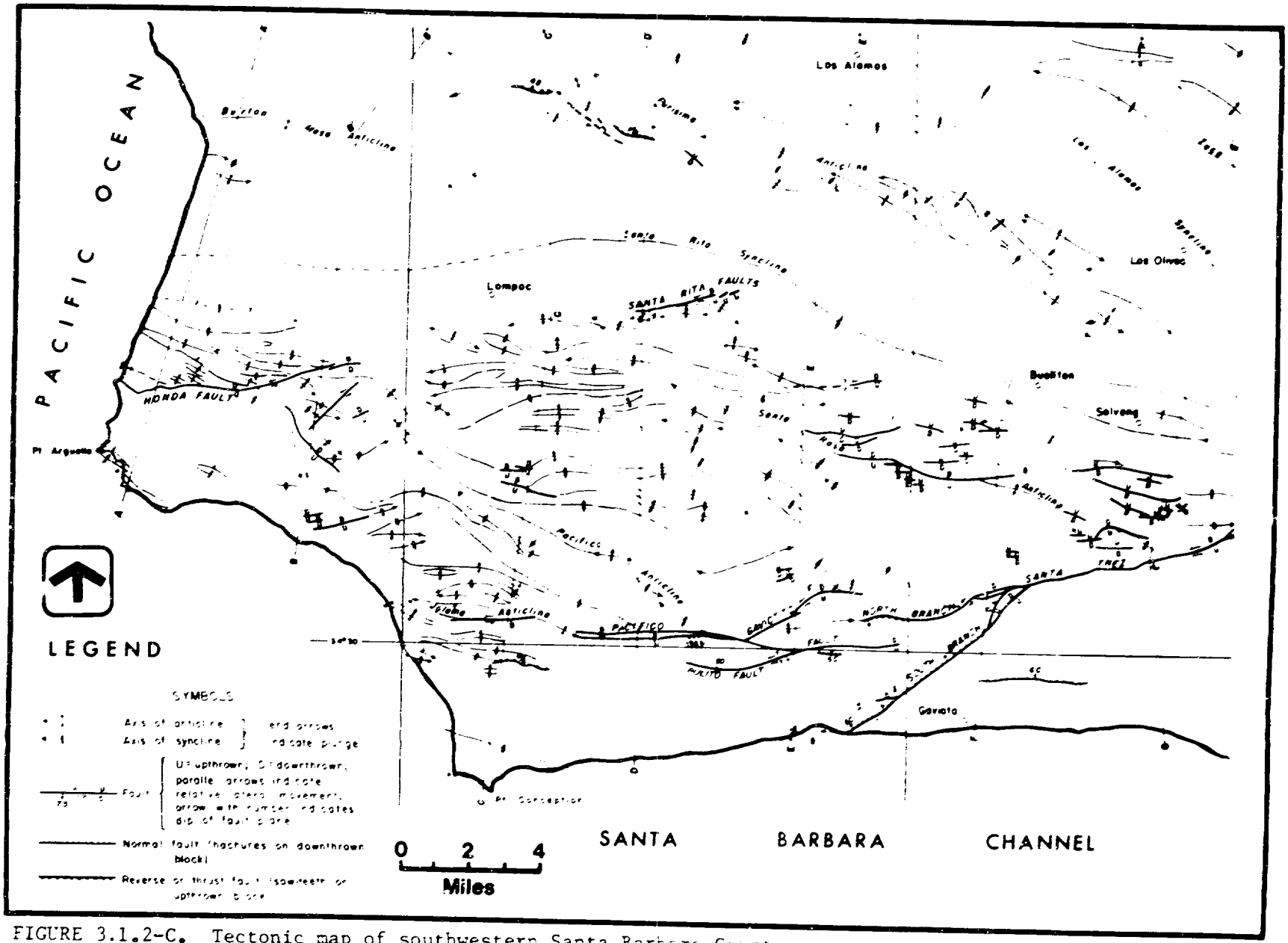


FIGURE 3.1.2-C. Tectonic map of southwestern Santa Barbara County.

earthquakes would be VII to VIII on the Modified Mercalli scale. Earthquakes of this intensity would be felt by all persons in the area and damage would be expected to range from moderate to considerable in ordinary well-built structures. However, much of the coastal zone (including SLC-6 and Port Hueneme) and the Channel Islands could expect earthquakes with higher probable maximum intensities of IX or X. Earthquakes of this intensity would destroy most masonry and frame structures.

Other Hazards. Soil liquefaction and landslides and soil creep may cause significant hazards on Vandenberg. Soil liquefaction occurs when the soil looses its shear resistance and flows like a viscous fluid as a result of the loss of intergranular pressure. It occurs in saturated granular soils and can be induced by earth tremors. Soils typically prone to liquefaction are found along beaches, river mouths, estuaries, and below the water table within the project region. The complete loss of a soil's integrity during liquefaction can result in dramatic failure of structures constructed on these soils. Although no data were available concerning damages caused by soil creep or landsliding on Vandenberg, landslides and mass earth movements have damaged structures and caused significant problems in Santa Barbara County.[72] The potential for damage does exist on Vandenberg and immediately adjacent areas; however, areas where evidence of landsliding and soil creep can be found are generally steep and undeveloped, and will not be affected by planned Shuttle activities.

3.1.3 WATER RESOURCES/QUALITY

3.1.3.1 Surface Water

Surface water supplies in the Vandenberg area are limited by seasonal stream flow, and Vandenberg presently does not use surface water for domestic purposes. However, in Santa Barbara County, water is stored in the upper Santa Ynez Valley in Jameson Lake, Gibraltar Reservoir, and Cachuma Reservoir and exported primarily to the Goleta, Summerland, Montecito, and Carpinteria areas.

Fresh water occurs in small permanent lakes, streams, and ponds in the Vandenberg area. The five lakes in the area have a combined volume of slightly over 200

acre-feet; they are Punchbowl Lake (covering 13.6 acres), Mod III Lake (covering 9.6 acres), and Upper, Middle, and Lower Canyon Lakes (covering a combined area of 27.3 acres).[16]

Three major streams, San Antonio Creek, the Santa Ynez River, and the Santa Maria River, plus numerous small creeks drain surface runoff in the area (see Figure 3.1.3-A). The flow in all the streams is seasonal; high discharge flooding may occur from November through May, and little or no discharge occurs in most streams during dry months.

San Antonio Creek, the smallest of the three major streams, is about 28 miles long, drains about 154 square miles, and terminates in a small freshwater lagoon on the coast. Small tributaries carry stormwater runoff to the creek from Burton Mesa and the eastern part of Vandenberg Air Force Base.

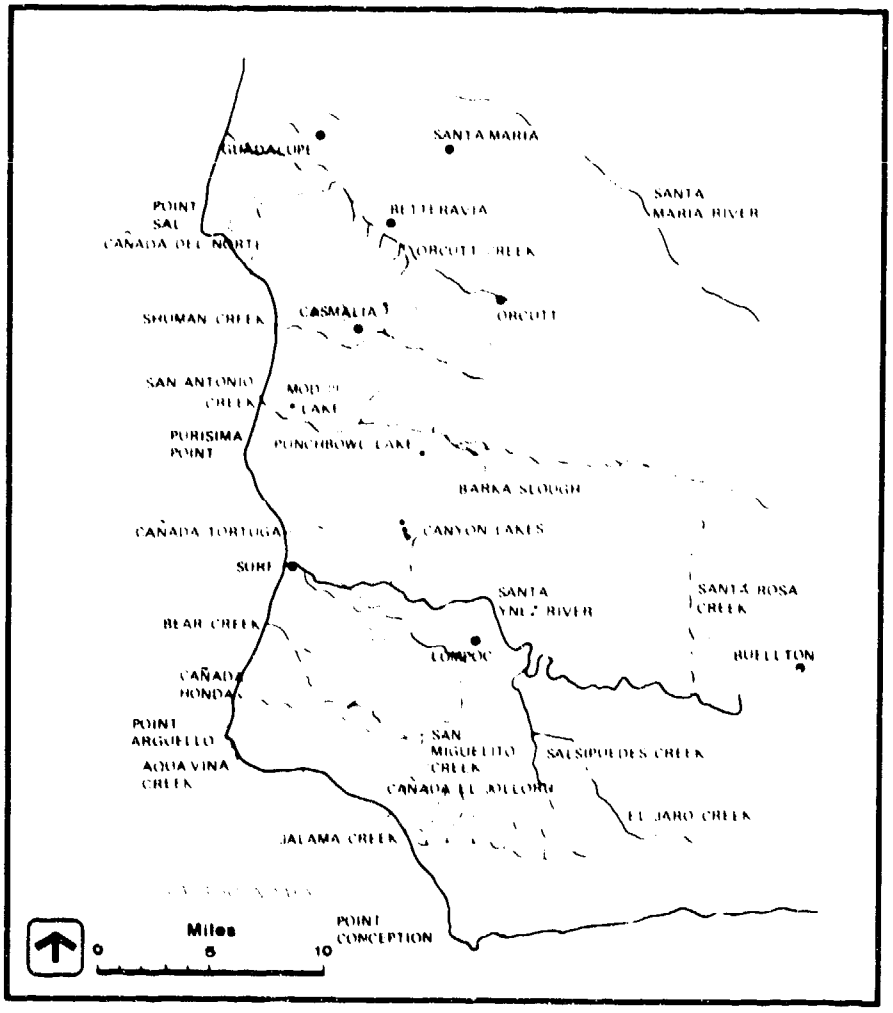


FIGURE 3.1.3-A. Locations of streams in the immediate Vandenberg area.

The watershed of the Santa Ynez River is about 70 miles long and between 8 and 20 miles wide, draining an area of about 900 square miles. The average flow rate of the river is about 51.5 cfs. The basin can be separated into the following five distinct subareas based on hydrologic and topographic characteristics:

(1) The headwater subarea contains the storage reservoirs--Jameson Lake, Gilbraltar Reservoir, and Cachuma Reservoir. About two-thirds of the precipitation in the total valley occurs in this subarea.

(2) The Santa Ynez, Buellton, and Santa Rita subareas lie between Lompoc and Cachuma Reservoir. Data from a gauging station on Salsipuedes Creek, one of the tributaries of the Santa Ynez, range from a frequent minimum discharge of 0 to the maximum recorded flow of 11,400 cubic feet per second (cfs) that occurred in March 1962. The river itself shows a similar pattern, ranging from no surface flow during the dry months to a maximum of 100,000 cfs that occurred during the January 1969 flood.

(3) The Lompoc subarea extends from State Highway 1 to the Pacific Ocean. Much of the South Vandenberg area drains to the Santa Ynez River through small tributaries, such as Santa Lucia Creek, in this subarea.

The Santa Maria River located north of the Base, has a drainage area of about 1,740 square miles. Its average annual flow is about 33.4 cfs. The Santa Maria River bisects the Santa Maria Valley and meets the coast near Point Sal.

The smaller streams of importance include:

(1) Shuman Creek--9 miles long; drains about 21 square miles; no water quality data available.

(2) Cañada Tortuga--intermittent creek about 2 miles long, drains south and west side of Vandenberg airfield; no data available on precise drainage area, discharge, or water quality.

(3) Bear Creek--drains only a few square miles; no data on discharge available.

(4) Cañada Honda Creek--over 8 miles long; discharge data available from 8.47 of 12 square miles drained; flow has ranged from 0 in dry months to peak of 2,120 cfs in February 1962; summer flow comes from seeps and springs along canyon walls.

(5) Jalama Creek--about 10 miles long; drains about 24 square miles; water flow data not available; has a small lagoon at its mouth.

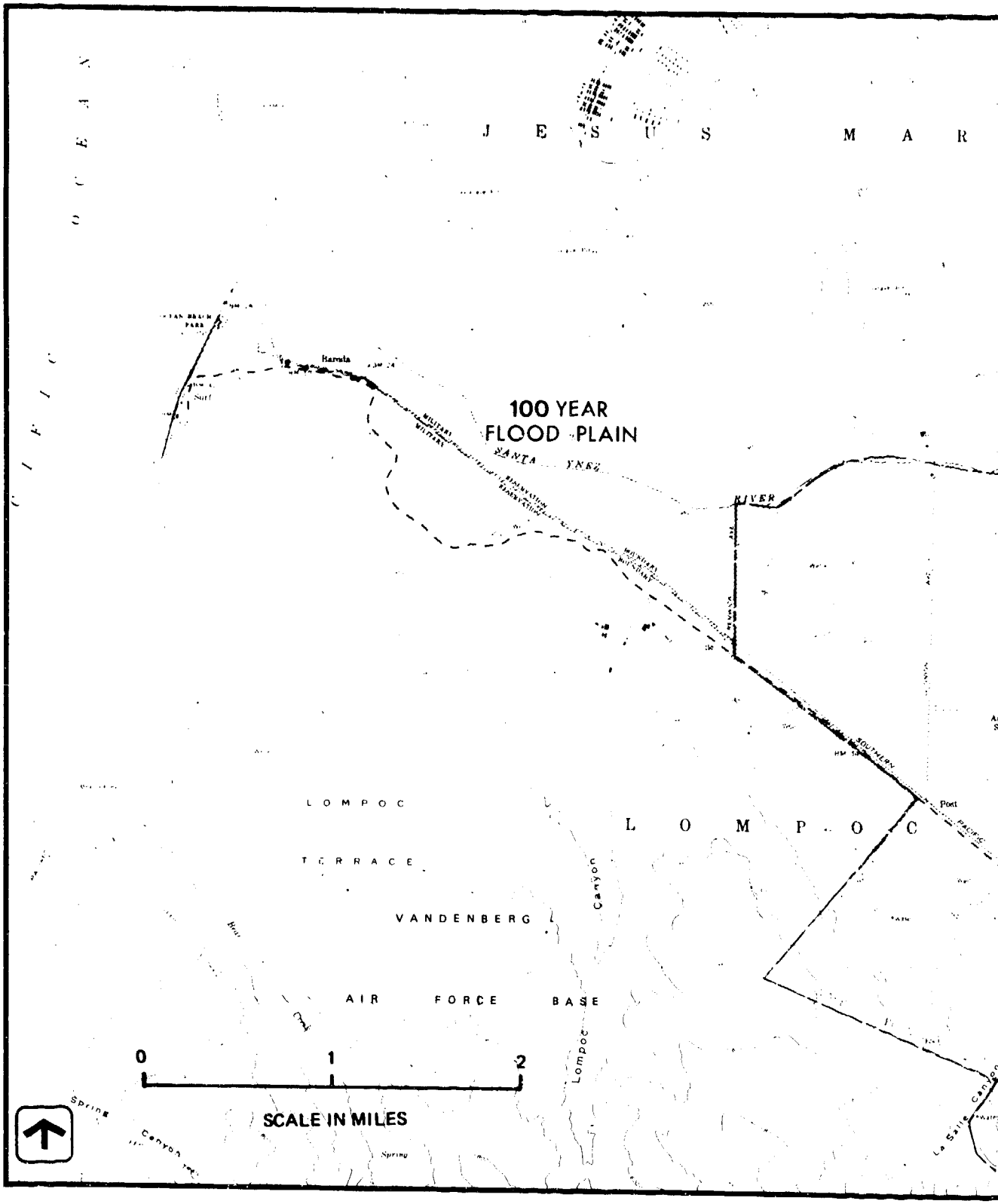
(6) Numerous small ephemeral creeks--southern slopes of Santa Ynez Mountains; typically drain about 1 square mile; typical slopes about 0.01 ft/ft, all confined within steep canyon walls.

Streams in the area can flood during heavy precipitation, and the general slope of creek drainages contributes to rapid runoff and peak discharge to the ocean. However, little data are available on floods outside developed areas. Recently, the Santa Ynez River flood of January 26, 1969 had a peak discharge of 100,000 cfs. A smaller subsequent flood on February 25, 1969 had a peak flow of 70,000 cfs.[144] Both of these floods caused damage, but floods of these magnitudes are rare. Figure 3.1.3-B shows the approximate 100-year flood-plain boundary for the Santa Ynez River below Lompoc. Water velocities averaging as high as 11 feet per second (fps) in the channel were computed for such a flood.

3.1.3.2 Groundwater

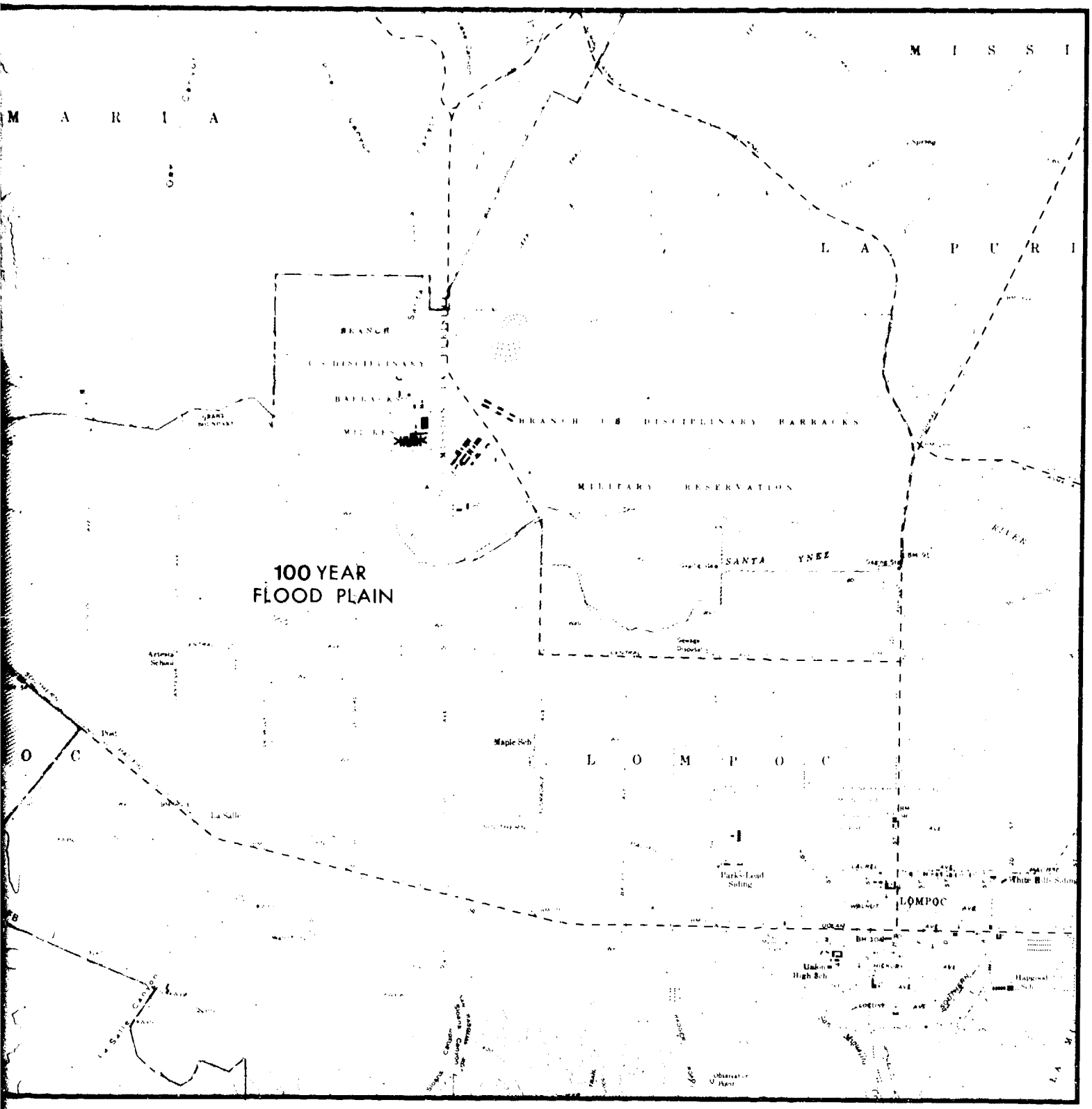
Occurrence. Several rock formations in the region provide groundwater for local wells. In the Santa Ynez upland area, the Paso Robles Formation yields water to numerous moderate capacity wells, and, in the Lompoc area, it supplies water to a few wells with fair yields. A few wells penetrate to the Orcutt sand in the Lompoc valley and terrace areas. Terrace deposits in the Santa Ynez upland yield moderate supplies to wells. Young alluvium of the valley floors (occurring downstream from the San Lucas Bridge) are the principal water source in the Lompoc valley and plain. Finally, the loose, unconsolidated river channel deposits supply a few wells in and upstream from the Buellton area.

Activities at Vandenberg are concentrated in the Lompoc subarea and the western portion of the San Antonio basin. Here groundwater is supplied by a combination of rainfall, excess irrigation water, connate water, and subsurface inflow from adjacent areas.



Reference: U.S. Army Corps of Engineers, 1970.(144)

FIGURE 3.1.3-B. 100-year flood plain of Santa Ynez River near VAFB.


100 YEAR
FLOOD PLAIN
MARIA
MISSI
LA PURI
BRANCH
MILITARY RESERVATION
SANTA YNEZ
LOMPOC
Maple Sch
La Salle
Parks Land Siting
LOMPOC
Union High Sch
Hapgood Sch
White Hills Subdiv

2

Precipitation varies from a mean annual value of about 14 inches near the coast to about 40 inches in the headwaters of the Santa Ynez River basin. For the Lompoc plain area, less than 8 percent of the precipitation is potential recharge to groundwater, and the rest is lost by evapotranspiration.(26)

Most water pumped from the Lompoc subarea is used for irrigation. These waters percolate back into local aquifers and form a major source of recharge. The amount of pumped water used for irrigation has decreased from over 90 percent in 1957 to less than 60 percent in 1965, which could indicate greater storage depletion in the future.(26) However, the total amount of water pumped for all purposes has increased.

Most of the annual recharge in the Lompoc terrace (south of the Santa Ynez River from La Salle Canyon to the ocean) is supplied by a limited amount of precipitation falling directly on the surface.(27) Although the aquifer in this area is in hydraulic continuity with groundwater in the Santa Ynez Valley, water levels are much higher than in the Santa Ynez Valley. The water generally moves away from the terrace to the north and west, occasionally discharging into Bear Creek Canyon and Lompoc Canyon.

Use. Currently, Santa Barbara County's water resources are derived from about 80 percent groundwater and 20 percent surface sources.(56) An overdraft is occurring in the Lompoc plain area, however, both the valley and plain are sources of supply for Vandenberg. Groundwater use in the San Antonio Valley is 10,000 acre-feet per year compared with the supply of 14,500 acre-feet per year.(135) On the Lompoc plain, about 16,000 acre-feet per year are used and 15,400 acre-feet per year are supplies.

All Vandenberg water is supplied from aquifers underlying the Base and vicinity. In the Santa Ynez River area, four wells were operated in 1975, yielding a total 4,430 acre-feet per year.(138) This amounts to almost 30 percent of the current use of the Lompoc plain supply.

South Vandenberg's water comes from aquifers in the Lompoc terrace. Average 1975 yield was 230 acre-feet per year from two wells. Recharge to the aquifer

is unknown; however, the usable groundwater in storage is an estimated 60,000 acre-feet.[27] Assuming the groundwater basin extends over an area of 4,800 acres and the average specific yield is 12 percent, the water table decline would be about 0.40 foot per year.[27] This value is close to the rate of 0.375 foot per year reported by Vandenberg.[138]

The Base also receives water from wells along San Antonio Creek. In 1975 two wells produced a total yield of 2,580 acre-feet per year. Based on the total annual use of 10,000 acre-feet per year, Vandenberg is withdrawing over one-fourth of this amount.

3.1.3.3 Water Quality

All streams in the Vandenberg region generally show highly mineralized water as a result of groundwater inflow and irrigation return flows. Table 3.1.3-1 and Table 3.1.3-2 present water quality data for the San Antonio and Santa Ynez Rivers, respectively. These tables reflect typical water properties in the site area. High dissolved solids (usually over 500 ppm) and high hardness are common. Smaller streams in the Point Arguello area have somewhat higher water quality than the major streams. In these smaller streams, TDS, salinity, and chloride concentrations range from 25 to 650 parts per million (ppm), from 240 to 1,270 ppm, and from 46 to 188 ppm, respectively.[27] In addition, water originating at high elevations in the area generally has lower mineral concentrations. It is to be noted that surface waters of San Antonio Creek and the Santa Ynez River below Cachuma Lake are not used for domestic purposes.

Generalized groundwater quality data in the San Antonio Creek and Lompoc areas are shown on Table 3.1.3-3 and Table 3.1.3-4. Groundwater in the Vandenberg area is high in dissolved solids, chloride, sulfates, and hardness. For drinking water purposes, maximum levels of 500, 250, and 250 mg/l are recommended for TDS, chloride, and sulfate, respectively.

Water quality data for the area offshore of Vandenberg is shown on Table 3.1.3-5. The locations of sample stations are presented on Figure 3.1.3-C. (Stations 5 and 6 are located immediately offshore of Ocean Beach.) The

Table 3.1.3-1. WATER QUALITY OF THE SAN ANTONIO CREEK AT VARIOUS LOCATIONS

Parameter[a]	Sample location[b]			
	November 18, 1972		August 4, 1975	
	1	2	3	4
pH (pH units)	7.0	7.2	8.4	8.3
Phenols	<0.001	<0.001		
Total organic carbon	18	20		
Chemical oxygen demand	150	68		
Chloride	176	312		
Nitrate	7.0	4.0		
Nitrite	<0.02	<0.02		
Phosphate	3.2	6.0		
Mercury	0.005	0.005		
Arsenic	0.01	0.01		
Cadmium	0.01	0.01		
Chromium	0.05	0.05		
Copper	0.01	0.01		
Lead	0.05	0.05		
Nickel	0.05	0.05		
Silver	0.05	0.05		
Zinc	0.05	0.05		
Total hardness (ppm)			325	581
Salinity (ppm)			1,100	2,700
Turbidity (JU)			39	26

[a] Mg/l, except where noted.

[b] 1 Sample taken in a partially dammed area a few miles upstream from the mouth of San Antonio Creek.
2 Sample collected at the partially impounded mouth of San Antonio Creek.
3 Sample taken at Highway 135 above Harris Canyon.
4 Sample taken near San Antonio Road.

Reference: Williams and Clegern, 1973;[164] Wells and Diana, 1976.[163]

Table 3.1.3-2. WATER QUALITY OF THE SANTA YNEZ RIVER AT VARIOUS LOCATIONS

Parameter[a]	Sample location[b]					
	November 18, 1972	July 15, 1975				
	1	2	3	4	5	6
pH (pH units)	7.7					
Phenols	<0.005					
Total organic carbon	6					
Chemical oxygen demand	36					
Chloride	6,400					
Nitrate	<1.0					
Nitrite	<0.02					
Phosphate	2.7					
Mercury	0.005					
Arsenic	0.02					
Cadmium	<0.01					
Chromium	<0.05					
Copper	0.02					
Lead	0.15					
Nickel	<0.05					
Silver	<0.05					
Zinc	<0.05					
Total hardness (ppm)		520	596	686	530	513
Salinity (ppm)		0	1,660	1,090	1,660	2,200
Turbidity (JU)		12	12	32	8	28

[a] Mg/l, except where noted.

[b] 1 Sample taken at river mouth
2 Sample #1 taken above Lake Cachuma
3 Sample #2 taken above Lake Cachuma
4 Sample taken at river above Salsipuedes Creek
5 Sample taken at El Jaro Creek
6 Sample taken at Salsipuedes Creek

Reference: Williams and Clegern, 1973;[164] Wells and Diana, 1976.[163]

Table 3.1.3-3. QUALITY OF GROUNDWATER SUPPLY AT VAFB FROM LOMPOC AREA, JANUARY 1975

Constituent[a]	Source	
	Lompoc plain	Lompoc terrace
Calcium	170	55
Magnesium	40	28
Sodium	140	90
Sulfate	230	96
Chloride	260	130
Fluoride	0.1	0.3
Iron	0.49	0.6
Manganese	0.50	0.03
Dissolved solids	1,110	533
Total hardness	590	250
Alkalinity	286	167
pH	7.2	7.1

[a]Mg/l, except pH.

Reference: U.S. Air Force, Vandenberg Air Force Base, 1975.(140)

Table 3.1.3-4. QUALITY OF DOMESTIC WATER SUPPLY AT VAFB FROM SAN ANTONIO BASIN GROUNDWATER

Constituent[a]	Concentration
Calcium	70
Magnesium	14
Sodium	60
Sulfate	71
Chloride	72
Fluoride	0.2
Iron	0.20
Manganese	0.05
Dissolved solids	452
Total hardness	230
Alkalinity	187
pH	7.3

[a]Mg/l, except pH.

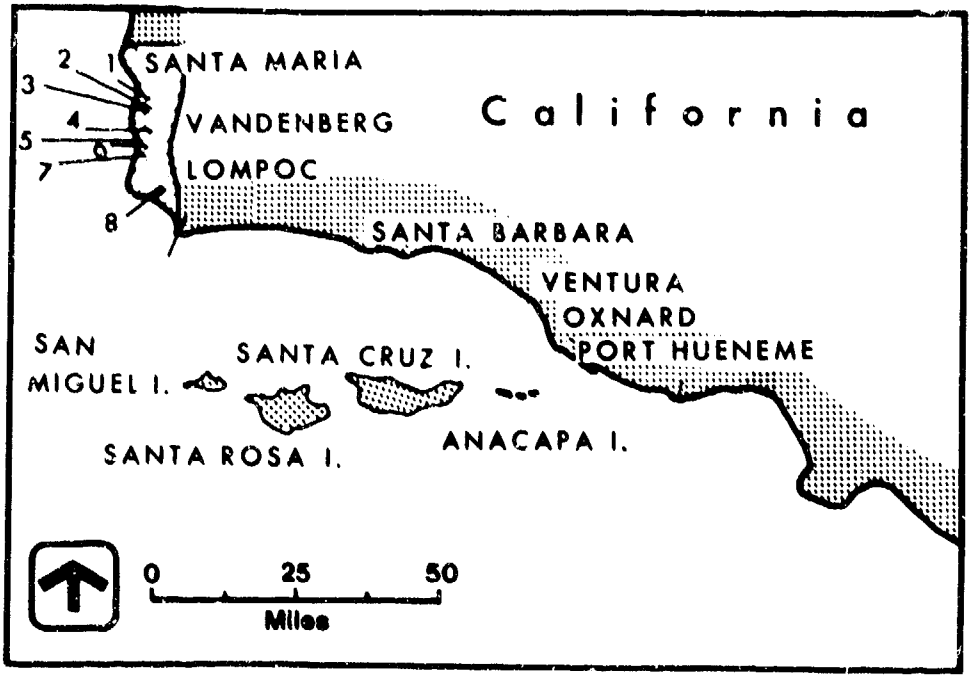
Reference: U.S. Air Force, Vandenberg Air Force Base, 1975.(140)

TABLE 3.1.3-5. COASTAL WATER QUALITY IN THE PROJECT REGION

Parameter	Units	Sample location* and date										
		1	2	3	4	5	6		7	8		
		11/73	11/73	11/73	11/73	11/73	11/74	3/75	11/73	11/74	3/75	4/75
pH	pH units	7.8	7.9	7.9	7.8	7.8	7.7	7.8	7.8	7.8	7.7	8.1
Total suspended solids	mg/l						6	9		5	6	4
Total dissolved solids	mg/l	43,562	42,176	42,965	43,004	43,000			42,217			-
Salinity	ppt											-
Oil and grease	mg/l						<1.0	<1.0		<1.0	<1.0	<1.0
Phenols	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.002	<0.001	0.001	<0.001	<0.001
Surfactants	(LAS as MBAS)	0.20	0.20	0.20	0.20	0.20			0.12			-
Biochemical oxygen demand	mg/l	22.0	18.0	18.0	16.0	30.0	<1.0	<1.0	15.0	1.0	<1.0	1.0
Chemical oxygen demand	mg/l	<5.0	<5.0	<5.0	<5.0	<5.0			5.0			-
Total organic carbon	mg/l	<1.0	<1.0	<1.0	<1.0	<1.0			<1.0			-
Turbidity	Jackson						5	8		6	6	4
Ammonia nitrogen	mg/l						<0.1	<0.1		0.1	<0.1	<0.1
Kjeldhal nitrogen	mg/l						1.1	1.2		0.8	0.6	0.2
Organic nitrogen	mg/l						1.0	1.1		0.7	0.7	0.1
Nitrate nitrogen	mg/l	<1.0	<1.0	<1.0	<1.0	<1.0	0.1	<0.1	<1.0	<0.1	0.1	0.12
Chloride	mg/l	18,800	17,600	18,500	18,000	18,600			18,600			-
Phosphate (total)	mg/l						0.07	0.06		0.12	0.10	0.12
Orthophosphate	mg/l						0.06	0.01		0.01	0.01	0.10
Aluminum	mg/l						0.20	0.21		0.18	0.20	0.18
Arsenic	ug/l	<10.0	<10.0	<10.0	<10.0	<10.0	3.8	3.1	<10.0	3.7	4.0	<1.0
Cadmium	ug/l	50.0	40.0	50.0	40.0	40.0	0.04	0.03	40.0	0.04	0.04	0.02
Chromium	ug/l	<50.0	<50.0	<50.0	<5C	<50.0			<50.0			-
Copper	ug/l	30.0	15.0	30.0	20	20.0	3.0	4.0	30.0	4.5	3.0	4.0
Lead	ug/l	<50.0	<50.0	<50.0	<50.0	<50.0	1.1	1.5	<50.0	1.4	1.5	1.2
Mercury	ug/l						<0.2	<0.2		0.2	<0.2	<0.2
Nickel	ug/l	19.0	19.0	20.0	20.0	20.0	0.2	0.2	20.0	0.2	0.2	0.2
Silver	ug/l	<50.0	<50.0	<50.0	<50.0	<50.0			<50.0			-
Zinc	ug/l	<50.0	<50.0	<50.0	<50.0	<50.0	0.9	1.6	<50.0	2.0	1.8	2.0

*Locations are shown in Figure 3.1.3-C

References: Williams and Clegern, 1973.(164)
Rodrigue, et al, 1974 and 1976.(95)(96)



References: Williams and Clegern, 1973.(164)
Rodrigue, et al, 1974 and 1976.(95)(96)
Southern California Coastal Water Research Project, 1973.(112)

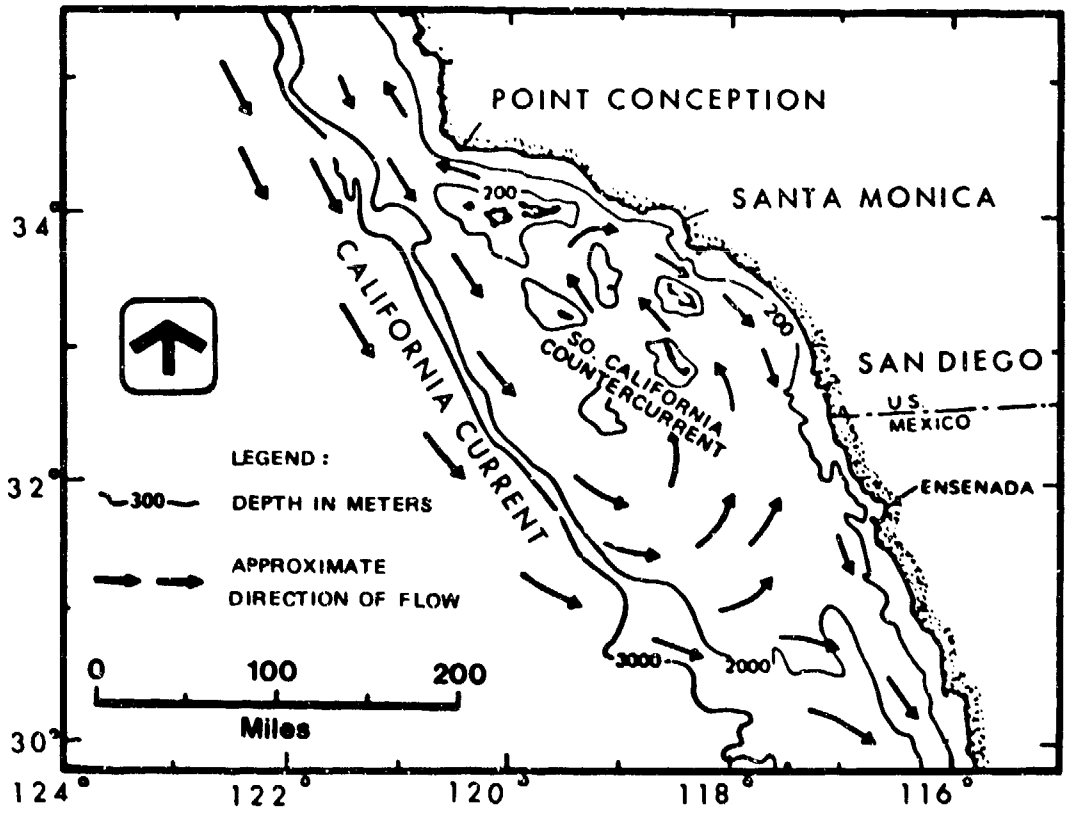
FIGURE 3.1.3-C. Coastal water quality data locations.

marine environment in the vicinity of Point Arguello is essentially pristine, and sources of man-induced pollutants are insignificant. The embayment water quality, as indicated in Table 3.1.2-5, Station 8, does not reflect contamination. No beneficial uses of coastal water are impaired. Under natural conditions, nutrients, oxygen depletion, and turbidity may be locally increased by periodic surface runoff and sea conditions.

3.1.4 OCEANOGRAPHY

3.1.4.1 Currents and Circulation

Two principal currents affect the Vandenberg coastal area: the offshore California current (resulting in part from the general clockwise [anticyclonic] winds), with an average velocity of 0.25 to 0.5 knot, and the counterclockwise Southern California countercurrent that prevails in the Santa Barbara Channel southeast of Point Conception and north of the Channel Islands (see Figure 3.1.4-A).



Reference: Jones, 1971.[43]

FIGURE 3.1.4-A. Surface circulation in the Southern California Bight. (0 to 100 m)

The surface current over the Santa Barbara-Port Hueneme shelf area is generally part of the Southern California countercurrent. Studies in this area indicate that the currents are complex (with mid-depth and bottom current speeds often exceeding surface speeds). Currents over the inner shelf are predominantly parallel to shore, and current speeds are higher in the winter than in summer. Currents near Port Hueneme are strongly influenced by a submarine canyon extending from the harbor entrance. Currents inside the harbor are believed to be dominated by wind generated local circulations.

The Boathouse area is protected by Point Arguello to the west and Point Conception to the southeast. Hence, wave access is limited to headings between West and Southeast. High swells occur in the area as a result of severe storms approaching from the south. Observations made on an offshore drilling platform off Gaviota during the year of 1970 showed that the maximum wave height was 14 feet with wave period of 10 to 12 seconds for a severe storm from the south.(178)

3.1.4.2 Tides

Sea level variations are primarily caused by tides. Significant meteorologically induced tidal fluctuations along the Vandenberg coastline are rare and thus relatively unimportant. Astronomical tides, however, do affect the area, and they result from the passage of two harmonic tidal components, one with a period of 12.5 hours and the other of 25 hours. This tidal fluctuation usually consists of two highs and lows daily.

Tide-level statistics from Los Angeles to Avila (north of Vandenberg) show little variation. However, because the Los Angeles tide station has the longest period of record (53 years), the tidal elevations at this station are considered most reliable and are believed to correlate well with levels along Vandenberg. Tide-level statistics for Los Angeles are shown in Table 3.1.4-1. Tides are semi-diurnal at Point Arguello and other locations on the California Coast. Tide elevation data presented in Table 3.1.4-1 for Los Angeles, California should

be multiplied by a correction factor of 0.96 for application to the Point Arguello area.

3.1.4.3 Seas and Swells

According to reported data, 52 percent of the waves off the California shore are from the northwest, 17 percent from the north, and 17 percent from the west. Wave heights are less than 4 feet for 50 percent of the time and less than 7 feet for 85 percent of the time.(151)

Refraction analyses were conducted for Ocean Beach and the Point Arguello Boathouse area. At Ocean Beach, the nearshore wave energy comes largely from the west and northwest, but Purisima Point shelters the area, thus reducing the wave

Table 3.1.4-1. TIDAL ELEVATION DATA, LOS ANGELES, 1923 to 1975[a]

Tide	Elevation (in feet)	Date
Extreme high water	+7.8	1/8/74
Mean higher high water	+5.4	N/A
Mean sea level	+2.8	N/A
Mean lower low water	0	N/A
Extreme low water	-2.6	12/26/32 and 12/17/33
Mean diurnal range	5.4	N/A

[a]Period of records: 1923 through 1975.

Reference: Summary of data from U.S. Department of Commerce, 1975.(152)

energy from both directions. At the Boathouse, the wave access is between the west and southeast, but Point Arguello shelters the site from predominantly northwesterly waves.

The limited data available on the Santa Barbara-Port Hueneme area indicate that half of the time the wave heights in the area are less than 2 feet.(85) Because the submarine canyon at the entrance to Port Hueneme disperses the incoming wave energy, wave conditions there are expected to be much less severe than at other locations along this stretch of coastline.

No records of surf observations are available for the Vandenberg coastline; however, at Pismo Beach, due north of Vandenberg, the mean surf height was 2.67 feet. Other points in the Santa Barbara Channel area show that mean surf heights vary between 1.9 and 3.5 feet.(143) The Vandenberg coastline between Point Sal and Point Arguello is more exposed to northwesterly waves. Thus, it is expected to experience higher surf than areas east of Point Conception that show mean surf heights between 1.9 and 3.5 feet.

3.1.4.4 Tsunamis

Tsunamis (sea waves associated with offshore earthquakes) along the Central and Southern California coasts have not been well recorded and documented until recently. Since 1946 only five significant tsunamis have been recorded and each was associated with distant earthquake epicenters. Tsunami flooding of the Vandenberg coastline can occur in low-lying areas such as the mouth of the Santa Ynez River. However, the recurrence intervals for tsunamis have not been predicted for the VAFB coastline.

3.1.5 SEDIMENTOLOGY

3.1.5.1 Erosion and Transport

Inland Runoff. Erosion on Vandenberg and surrounding areas is a significant problem because most local soils are highly susceptible to erosion. Several types of erosion are common in the region; however, erosion caused by surface runoff is the most important. Within the study area, the most important factors influencing surface runoff are soil or rock characteristics, slope gradients, and vegetative cover.

Rapid sheet flow on moderately sloping land has led to severe gullying on some portions of Vandenberg. Recently, the use of off-road vehicles has been restricted and a requirement for digging permits has been implemented to reduce potential damage to soil and ground cover on Vandenberg.

Shoreline Bluff Erosion and Weathering. The erosion of sea cliffs is usually caused by undercutting from ocean waves, slope failures, weathering, and seismic actions. Estimates made by Bowen and Inman in 1966 of shoreline bluff erosion around the Point Sal and Point Arguello promontories indicate an average retreat of 1 foot per year, or less. Estimates for cliff erosion from Point Conception east to Rincon Point are about 1/2 foot per year.[11]

River Transport. Two major rivers are the prime sources of sediment supply for the Vandenberg coastline: the Santa Maria and the Santa Ynez Rivers. Most sediment is brought down to the beaches during major floods, and much of this material is distributed along the adjacent beaches by waves.

Quantitative estimates of the sediment load in rivers are difficult to develop, and investigators often obtain divergent results. Based on the U.S. Geological Survey's stream gauging and sediment sampling data from October 1968 to September 1971, a 1976 study estimated that the Santa Maria River carries 250,000 cu yd/yr of sand to the beaches and that the Santa Ynez has a similar sediment yield.(131)

Wind Transport. The well-developed sand dunes around Point Sal, Purisima Point, and the lower Santa Ynez River suggest that onshore winds cause considerable inland sand movement. Estimates of wind transport at Ocean Beach indicate a net inland transport of about 3 cu yd/yr for each foot of beach front. This estimate generally applies to beaches between Point Sal and Point Arguello. From Point Arguello to Point Conception, transport becomes negligible because, with the change in shoreline orientation, the predominant winds blow offshore.

Littoral Transport. The longshore sand transport, commonly called littoral drift, is caused by waves striking the shoreline at an angle and thereby generating a longshore component of wave energy. Along the Ocean Beach area, the net southerly littoral transport was an estimated 180,000 cu yd/yr.(131) At the Boathouse area, the net transport was an estimated 152,000 cu yd/yr. These figures, however, can fluctuate significantly from year to year.

Although the littoral drift for other parts of the Vandenberg coastline has not been investigated in detail, it has been established that drift increases eastward from Point Conception as the supply of littoral materials becomes more available from local streams.(131) Dredging records at Santa Barbara Harbor show that as much as 300,000 cu yd/yr of sand pass through the area.

Offshore and Onshore Transport. On the California coast, the summer swells tend to produce onshore transport and sand buildup on beaches, and the winter storm waves tend to generate offshore transport of beach material, resulting in more eroded, steep beaches. Beach profile changes were surveyed north of the Santa Ynez River between November 1974 and June 1975.[131] The results show significant accretion from November to December and from January to February and significant erosion from December to January. Profile changes from February to June were relatively minor. Monthly beach elevation changes reached a maximum of 2 meters, while relative shoreline positions moved about 30 meters. Although the survey did not include the summer months, the data indicate a typical seasonal cycle of change.

3.1.5.2 Sediment Budget

The net sediment balance will determine if a certain section of shoreline will accrete, remain stable, or erode. A sediment budget is a bookkeeping technique that quantitatively describes the supply and demand of sediment material for a specified reach of coastline.

The sediment budget at the Ocean Beach area is complex and is not clearly understood. The supply of littoral material from upcoast is an estimated 70,000 cu yd/yr.[131] The Santa Ynez River contributes an average of about 250,000 cu yd/yr of material. Because much of this sediment is transported to the coast under flood conditions, an estimated 120,000 cu yd/yr would overshoot the shallow beach area and would be lost (at least temporarily) in deeper water. The onshore wind transport for the Ocean Beach area is an estimated 20,000 cu yd/yr. Littoral transport is estimated at about 180,000 cu yd/yr. Thus, it is believed that this area is stable or nearly stable.

The sediment budget at the Boathouse also appears to be in balance. It is essentially governed by littoral transport alone because there is no influx of sediments from streams, and wind transport and cliff erosion are negligible. Littoral supply is an estimated 151,000 cu yd/yr; littoral drift is an estimated 152,000 cu yd/yr.[41]

3.1.6 METEOROLOGY/CLIMATOLOGY

3.1.6.1 Regional Climatology

The climate from Monterey south to the Mexican border is categorized as a dry subtropical (Mediterranean) climate. Vandenberg and Port Hueneme both lie in semiarid zones bordered by a subhumid zone. Based on a rainfall classification, the dry subhumid zone has an annual rainfall of 20 to 30 inches, while the semiarid zone has 10 to 20 inches. The subhumid zones are the result of orographic lifting of moist air over the coastal hills.

The most characteristic climatic feature of the Southern California coastal area is the persistent night and morning low cloudiness and fog, followed by sunny afternoons. These conditions occur most often during spring and summer. As a result of the moderating effect of the ocean, coastal temperature remains comfortable all year, with occasional temperatures above 85°F or below 45°F. Daytime winds are generally from the west, while nighttime winds are often from the east and north. Severe storms, thunderstorms, and tornadoes are rare in this area of California. During the fall and early winter (and occasionally during late spring and early summer), strong, dry northeasterly winds (known as Santa Ana) occur.

The Southern California coast is affected by the stable eastern end of the subtropical Pacific High, a high pressure center located at about latitude 30° to 40° N. During summer, Southern California is influenced by dry, stable tropical air and during winter, by less stable moist marine air. Air circulation in the area is influenced by the Pacific High, the cold California current, and inland topography.

Temperature Inversion. The air circulation at the southeastern quadrant of the Pacific High has a descending motion that causes a subsidence inversion along the coastal area of Central California. This inversion, with a base averaging 1,000 ft above the ground, is very persistent during the summer, but is frequently absent during other seasons. During the autumn, winter, and spring surface inversions frequently form in the early morning as a result of radiational cooling under clear skies.

Seasonal Climate. Seasonal variations in the local Southern California climate are not as sharply defined as those of continental climates. The wet season (winter), from November through April, consists of generally fair weather interspersed with short periods of cloudiness and rainshowers. The dry season (summer), from June through September, is characterized by low cloudiness and fog during the night, with sunny afternoons and little rainfall. The months of April and October are considered transition periods.

Thunderstorms are relatively rare; an average of two to three occur each year. The periods of most likely occurrence are: (1) during winter, when storms are associated with active cold fronts, and (2) in September, with the movement of tropical moisture into the region from the southeast or south. However, these storms are not as severe as those of most other regions, and hail occurrence is rare.(19)

Tropical storms and hurricanes formed off the west coast of Central America have never been recorded as far north as Point Conception, and, of the tropical storms recorded within 300 miles of the Southern California coast, all were in the final, extratropical stages of dissipation and were rapidly losing energy.(19)

3.1.6.2 Site Climatology

Vandenberg Air Force Base. Vandenberg's proximity to the coast results in strong tempering influences on both temperature and moisture content of the air, and produces little range between extremes.

The average annual temperature is 55°F. Mean monthly minimum temperatures range from 43°F in January to 53°F in August and September. Average maximum temperatures range from 59°F in March to 68°F in October. The lowest temperature recorded from 1958 to 1970 was 26°F; the highest was 100°F. Temperatures are seldom low enough for a long enough time to cause substantial crop damage. The annual growing season in the coastal areas of Santa Barbara County varies between 300 and 350 days.

The total average annual precipitation for the Vandenberg region is 12.7 inches. Rainfall maxima coincide with extratropical storms that move inland from the southwest in winter. February is generally the wettest month, with 2.60 inches of precipitation; July is usually the driest month, with 0.01 inch of precipitation as the monthly mean value.

The annual mean surface wind speed is 6.1 knots from a predominantly northwest direction. Maximum mean gusts of wind up to 41 knots have been experienced during January, February, and March.

Wind speeds and directions over the Base vary greatly as a result of the widely varying terrain. In general, wind speeds are stronger on the higher ground, along the beaches, and on Sudden Ranch. It is of particular interest that the average maximum diurnal wind speed (about 15 knots at 3 p.m.) at southern Vandenberg is greater than that at the northern part of Vandenberg (about 5 to 7 knots at 4 p.m.).[110]

The mean annual relative humidity recorded at the Vandenberg airfield is 77 percent.[69] Monthly variations are small as a result of the stabilizing influence of the offshore California current. Occassionally low relative humidity (less than 10 percent) occurs during Santa Ana winds.

Advection and radiation coastal fog accounts for a large percentage of the reduced visibility in the Vandenberg region. Occurrences of fog at Vandenberg's airfield are greatest during July, August, and September. November through March is relatively clear, with fog occurring about 12 percent.[69] Ground fog is usually confined to late evening and morning hours, but frequently persists in the nearshore area throughout the day.

Low visibility at Point Arguello usually occurs between July and October, particularly during the early morning hours when visibilities of 0.25 mile or lower occur approximately 5 percent of the time. In July and August the visibility improves considerably in the afternoons. Low visibility at the Boathouse is more pronounced in winter months than in other seasons.[41]

The cumulative average annual cloud cover is 48 percent.[158] Although this average value is not representative of sky cover at any given time, it does indicate that clouds are common in the Vandenberg area. (The total cloud cover is greater at northern Vandenberg than at southern Vandenberg, especially during su mer.)[41][131] The annual average ceiling height is approximately 000 feet, depending on the base height of the inversion. In general, cloudiness decreases inland.

Port Hueneme. Like those at Vandenberg, meteorological conditions at Port Hueneme are relatively consistent, with little range to the extremes due to the tempering influence of the Pacific Ocean. Point Mugu meteorological data are used to summarize conditions at Port Hueneme as follows:[48]

(1) The average annual surface temperature is 59°F. Mean monthly minimum temperatures range from 44°F in January to 57°F in June, July, and August. Average maximum monthly temperatures range from 62°F in January and March to 72°F in September.

(2) The total annual precipitation for the Point Mugu region averages 10.55 inches. January is usually the wettest month, with 2.57 inches of precipitation; July and August are the driest months, with mean precipitation values of 0.01 inch.

(3) On an annual basis, surface wind direction ranging from westerly through northerly predominates, with surface wind speeds ranging from 4 to 10 knots. The mean speed of winds at Point Mugu is 8 knots.

(4) The annual mean relative humidity recorded at Point Mugu is 75 percent. Humidity at Point Mugu, like that at Vandenberg, is influenced by the cold California Current and the hot Santa Ana winds.

(5) Cloud coverage is at a maximum in summer and at a minimum in winter. Frequently fog or haze occurs beneath the stratus clouds, making it difficult to determine the actual cloud base. The dominant features are the diurnal variation in stratus clouds during the summer and the lack of clouds during the winter. At Point Mugu, the greatest frequency of overcast skies occurs around 6:00 a.m.

3.1.7 AIR QUALITY

Vandenberg Air Force Base is located in the California South Central Coast Air Basin where the predominant surface air movement is from the ocean onto the land (see Section 3.1.6.2). Air quality measurements in the South Central Coast Air Basin are relatively sparse. The area has a relatively low population and limited heavy industry. Prior to June 1976, the Basin comprised San Luis Obispo County and Santa Barbara County north of the crest of the Santa Ynez Mountains, including Vandenberg north of Cojo Bay and Oak Mountain summit. It now includes San Luis Obispo, Santa Barbara, and Ventura Counties. Vandenberg currently maintains an extensive air pollution and dust control program and contributes only a small fraction (about 1 percent) of the air pollutants in the basin.[99][138]

The Santa Ynez Valley is generally a relatively clean area. During a 1974-75 field measurement program, only ozone, hydrocarbons, and suspended particulates exceeded the national or California ambient air quality standards. Ozone exceedances were frequent; suspended particulate exceedances were rare; and hydrocarbon exceedances were frequent. Hydrocarbons throughout California ordinarily exceed the standards (hydrocarbon standards are not directly related to health effects, but were established to control ozone levels). The area sampled was approximately 25 miles east and 5 miles south of the Vandenberg main gate, and the sampling was concentrated primarily in and around the communities of Buellton, Solvang, and Santa Ynez.[4]

Hourly ozone concentrations measured at the Solvang APCD Station exceeded the national hourly standard (0.08 ppm) during 3 percent of the 7,530 hours observed and during 18 percent of the 309 days observed. During May through September, the standard was exceeded during 36 percent of the days observed (monthly range, 27 to 45 percent); maximum hourly concentrations were between 0.12 and 0.17 ppm. The standard was exceeded during at least 1 day each month except during December and January. The highest concentrations were observed during the April-September period.[4]

Standard ozone calibration procedures were changed in June 1975. The new procedure produces measurements that are 0.8 times those determined by the 1974 method. Consequently, in relation to the air quality standard, the values discussed are probably conservative overestimates of the ozone concentrations.

State of California ambient air quality standards for carbon monoxide (CO) and nitrogen dioxide (NO_2) (40 ppm CO and 0.25 ppm NO_2, respectively) were not exceeded at the Solvang APCD Station during any observed hour of the year. On an annual basis maximum hourly average CO concentrations was 1 ppm, and the maximum hourly average NO_2 concentration was 0.07 ppm, well below the standards.[4]

Suspended particulate matter 24-hour averages were measured at the Solvang APCD Station during 5 days each month except February (1 day), July (3 days), and October (4 days). The California standard (100 µg/cu m per 24 hour period) was exceeded on 2 days in July (maximum 116.7 µg/cu m) and on 1 day in August (111.2 µg/cu m), and was nearly reached on 1 day in September (99.6 µg/cu m).[4]

Three-hour average (6 to 9 a.m.) nonmethane hydrocarbon concentration measurements at the Solvang APCD Station frequently exceeded the national standard (0.24 ppm) by factors of approximately 4 to 16. On approximately 65 percent of the 203 days observed, the standard was exceeded. The highest concentrations were observed during the August to January period. The standard was exceeded on all 112 days observed during September through January.[4]

In addition to the aforementioned air quality data for the region surrounding Vandenberg, a preliminary air quality sampling program was initiated at four stations on the Base to supplement the available data. This initial program consisted of air quality sampling one day per month during May, June, and July 1976. Results of the air quality sampling program for the area are as follows:[3][115]

(1) Ozone 1-hour average concentrations during June and July were less than 0.01 ppm, far below the national standards (0.08 ppm). (Ozone measurements were not accomplished during May.)

(2) Carbon monoxide concentrations (instantaneous) were measured between a low of 2.2 and a high of 21.7 ppm (June). All were below the one-hour California standard (40 ppm).

(3) Nitrogen oxide concentrations (instantaneous) were measured between a low of 0.0020 and a high of 0.0180 ppm (June). All were well below the California hourly standard (0.25 ppm).

(4) Suspended particulate matter 24-hour average concentrations were lowest in June when they averaged between 20 and 32 µg/cu m, well below the standard. In May, measurements ranged from 64 µg/cu m to 99 µg/cu m approximating the 24-hour California standard (100 µg/cu m). In July, the measured concentrations exceeded the California standard by factors of 10.1, 8.1, and 5.9. Such exceedances commonly occur in coastal agricultural regions and are typically associated with wind-blown dust or sea salt aerosol during windy periods.

3.1.8 NOISE

The following discussion of the ambient noise environment of Vandenberg and surrounding areas is based on limited existing data; therefore, various assumptions have been made concerning probable noise produced by natural and man-made sources. For this report, the term noise is used to represent any unpleasant, distracting, or unwanted sound.

Sound pressures heard by the human ear vary over a wide range. To make this range easier to study, sound pressures are converted into units called decibels (dB). However, because the human ear does not react to sounds at low frequencies in the same way as it does to sounds at high frequencies, the character of the sound must also be evaluated. A special electronic network is used in sound level meters to reproduce the filtering effect of the human ear. This network is referred to as the A scale or the A-weighted network. The resulting sound measurements are expressed in units of dBA. These levels are used to evaluate the effect of noise on humans. The dBA units range from 0, the threshold of hearing, to beyond 140 dBA, the threshold of pain. An example of typical A-weighted sound levels is given in Table 3.1.8-1.

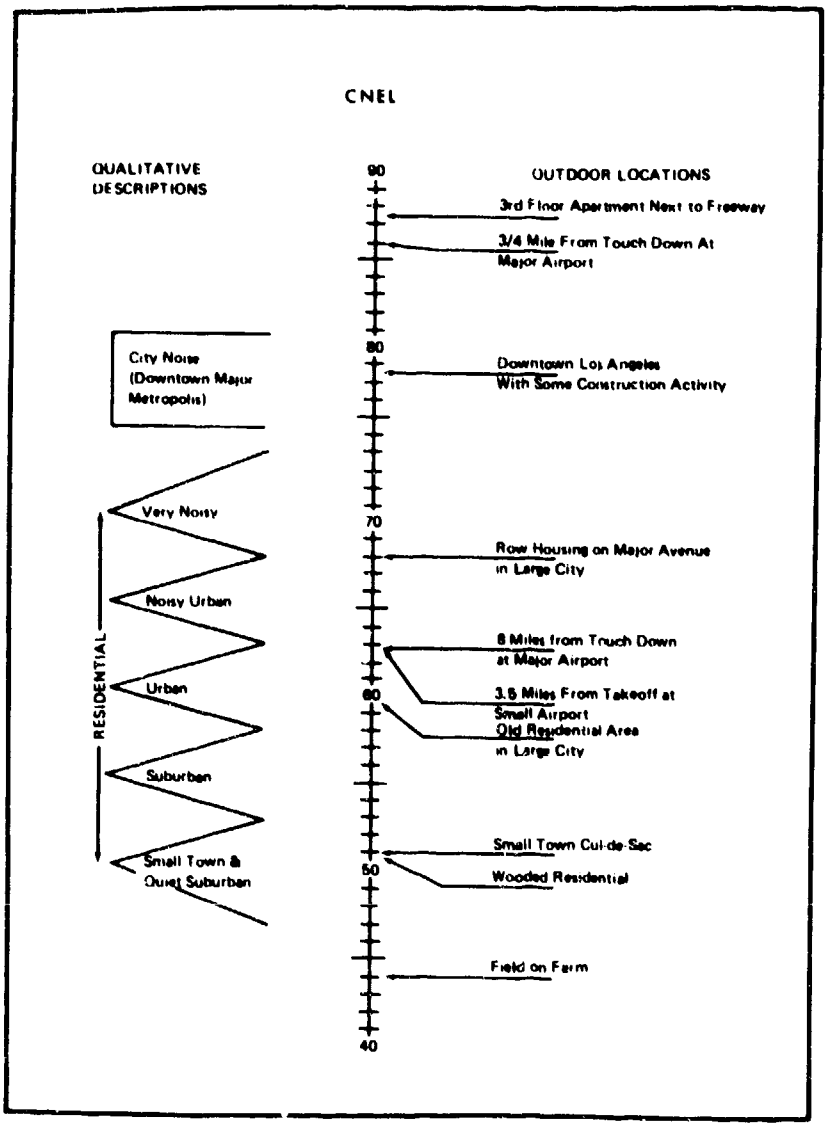
The tolerance an individual will have to noise may vary according to the duration of exposure. There are many commonly used measures of noise exposure that consider not only the A-weighted decibel variation of sound, but also the duration of that sound. The California State Department of Aeronautics has adopted the Community Noise Equivalent Level (CNEL). This is an average noise level which weights noise occurring during evening hours (7:00 p.m. to 10:00 p.m.) by 5 dB and noise occurring during late evening and early morning hours (10:00 p.m. to 7:00 a.m.) by 10 dB, relative to daytime noise levels. Thus,

Table 3.1.8-1. COMPARISON OF VARIOUS NOISE SOURCES, NOISE LEVELS, AND LOUDNESS

Decibel ratings dBA	Overall	Outdoor noise sources	Loudness
130		Jet aircraft take-off with after-burner	
120	Uncomfortable		32 times as loud
		Turbo-prop aircraft at take-off	
			16 times as loud
		Jet fly-over @ 1,000 ft	
100	Very loud		8 times as loud
		Power mower Diesel truck at 40 mph @ 25 ft	
90		Motorcycle @ 25 ft	4 times as loud
		Gasoline powered trucks @ 25 ft Car wash @ 20 ft	
80		Propeller plane fly-over @ 1,000 ft	2 times as loud
	Moderately loud	Automobile at 65 mph @ 25 ft High urban ambient sound	Reference noise
		Air conditioning unit @ 100 ft	1/2 as loud
60			
	Quiet	Large transformers @ 100 ft	1/4 as loud
50			
		Bird calls, lower limit	
40			1/8 as loud
	Just audible		
10			
	Threshold of hearing		
0			

the CNEL is an average (weighted) daytime-nighttime noise level. The United States Environmental Protection Agency (EPA) frequently uses a similar noise measurement, the Day-Night Average Noise Level (L_{dn}). This measurement differs from the CNEL only by the elimination of the 5 dB weighting factor applied to noise that occurs during the evening hours (7:00 p.m. to 10:00 p.m.). For sources of noise in the areas that immediately surround Vandenberg, the two measures, CNEL and L_{dn}, are about equal.(40)

CNEL data is used in this discussion to document the baseline character of noise in the areas immediately surrounding Vandenberg (Lompoc Valley and the Santa Maria-Orcutt area). Figure 3.1.8-A shows CNEL values for typical outdoor locations. Outdoor CNEL values that fall below the 65 dBA contour are normally considered acceptable for residential land use.(40)



Reference: J.J. Van Houten, 1974.[40]

FIGURE 3.1.8-A. CNEL values for typical outdoor locations (dBA).

No measurements were made for the purposes of this study. Data presented in this section were extracted from the existing literature Figure 3.1.8-B shows projected CNEL contours for the Lompoc Valley. This map was constructed from an analysis of noise produced by traffic on primary and secondary arterials, train movements, and aircraft operations.[40] Although no similar map is currently available for VAFB or the Santa Maria Valley area, it is expected that CNEL contours would be much like those shown for the Lompoc Valley. (Generally, the relative magnitude and orientation of contours associated with rail rights-of-way, arterials, and aircraft flight paths would be similar.)

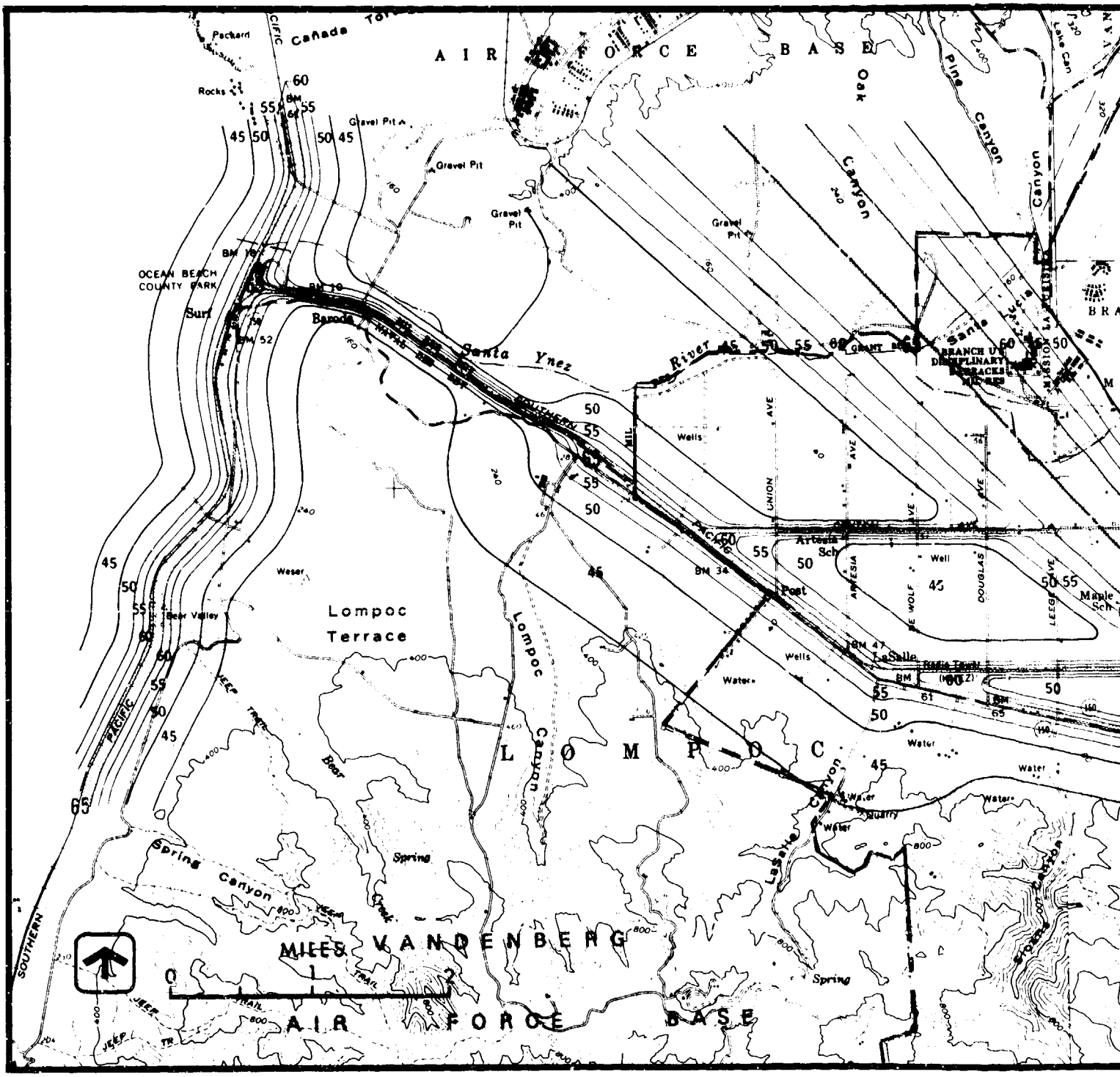
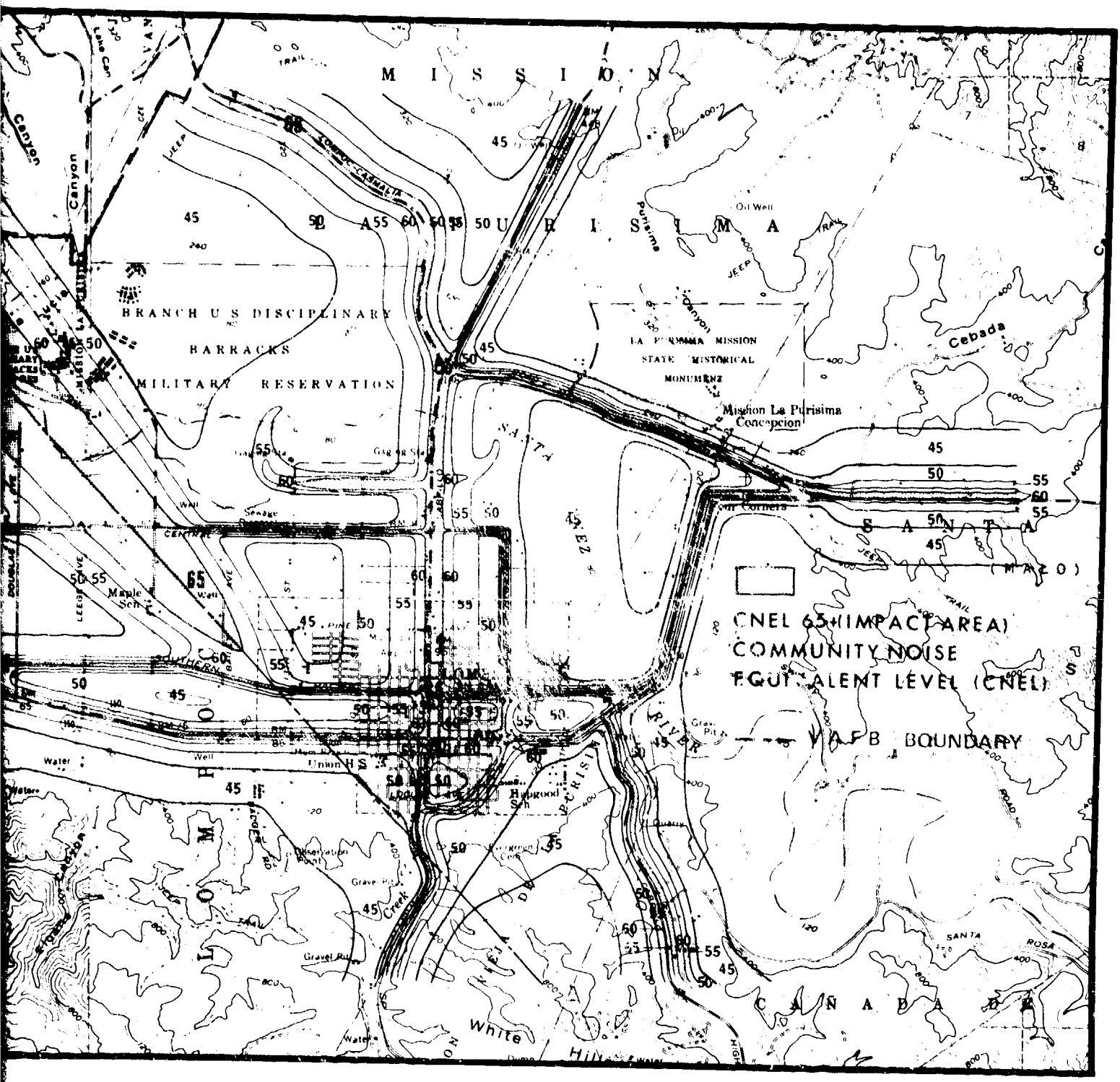


FIGURE 3.1.8-B. Projected CNEL contours for Lompoc Valley.


MISSION
LA PURISIMA
BRANCH U S DISCIPLINARY BARRACKS
MILITARY RESERVATION
LA PURISIMA MISSION STATE HISTORICAL MONUMENT
Mission La Purisima Concepcion
SANTA INEZ RIVER
SANTA MARIA
CANADA
CNEL 65+(IMPACT AREA)
COMMUNITY NOISE
EQUIVALENT LEVEL (CNEL)
VAFB BOUNDARY

3.1.8.1 Noise in the Rural Environment

The CNEL contour map shows that noises in the rural portions of the Lompoc Valley, which are removed by a mile or more from major transportation corridors, are less than 45 dBA. It is expected that there would be significant daily variation in noise levels (to as high as 70 dBA) for all isolated rural areas as a result of such things as winds and storms.

3.1.8.2 Noise in the Urban Environment

Automobiles, trucks, trains, and aircraft are the most important sources of noise in the project area. The lowest CNEL contours in Lompoc occur at maximum distances from the major transportation corridors. Typically, these levels are shown to be about 45 to 55 dBA on Figure 3.1.8-B. CNEL contours above 65 dBA are generally located within 100 feet of an arterial centerline. It is expected that the major contributor to noise on Vandenberg and in the Santa Maria-Orcutt area would also be vehicle traffic.

Although traffic on arterials is responsible for most noise in the project area, increase in average daily traffic (ADT) over the next 10 years would not be expected to appreciably change CNEL contours shown on Figure 3.1.8-B. A study prepared for Lompoc indicates that if traffic on primary and secondary arterials increased by a factor of over 1.3, the corresponding change in CNEL contours would be less than 1.5 dBA.

Noise from stationary sources such as industrial facilities was not considered in the preparation of Figure 3.1.8-B. Such sources do contribute to the existing noise environment of the Lompoc area (and on VAFB and the Santa Maria-Orcutt area). However, the contribution of noise from commercial, industrial, and agricultural sources in the Lompoc Valley is not considered excessive.[40] Any impact on noise sensitive land uses that is now occurring in the study area from stationary sources is likely to be localized and, thus, relatively unimportant.

Rail service in the Vandenberg-Lompoc area is provided by the Southern Pacific Railway. The main line generally follows the coastline from Ventura to

Casmalia. In the Vandenberg-Lompoc area, three branch lines connect to the Southern Pacific main line. These include a line 10 miles long beginning at Surf and extending eastward to Lompoc (a spurline 3 miles long connects the Lompoc branch line to the Johns-Manville diatomaceous earth mining plant), a short branch line connecting the Base with the main line, and a branch line connecting Santa Maria with the main line.(35)

Noise generated by trains is intense and can propagate for considerable distances. In the Vandenberg-Lompoc-Santa Maria area transient train noise is part of the existing environment. However, this area does not now experience any significant exposure to noise produced by thru traffic because the urban areas are well removed from the coast main line. Activity on Vandenberg and in Lompoc and Santa Maria consists of spurline traffic, which is generally less noisy than faster moving traffic on the main line.

However, within Lompoc and Santa Maria spurline traffic does cause noise impact.(40)(103) Rail rights-of-way pass through both cities and several train movements per day occur on each of these lines. Some residential areas adjacent to these spurlines experience noise levels in excess of 80 dBA. In Lompoc, a study prepared for the noise element of the General Plan suggests that, "adding cars on existing trains will not substantially increase the exposure levels now being experienced." However, it explains that, "additional train movements are undesirable and will probably cause some citizen concern."(40)

Three airports exist in the immediate Vandenberg area at Lompoc, Santa Maria, and Vandenberg. The Lompoc airport is a small uncontrolled field with no scheduled commercial service. The Santa Maria airport is controlled and provides both private and scheduled commercial operations. The airfield at Vandenberg is also controlled, but serves only military traffic.

Annual traffic volume at the Lompoc airport (take-offs and landings) was estimated at about 15,300 operations in 1975.(35) Annual traffic volume at the Santa Maria airport was estimated at about 58,000 operations.(35) Operations at both airports do not cause significant noise impact for their respective communities. At this time, further growth expected in operations in the 1975

to 1990 time frame should not create additional noise impact if noise sensitive land uses are not allowed to develop adjacent to these facilities.(40)(103)

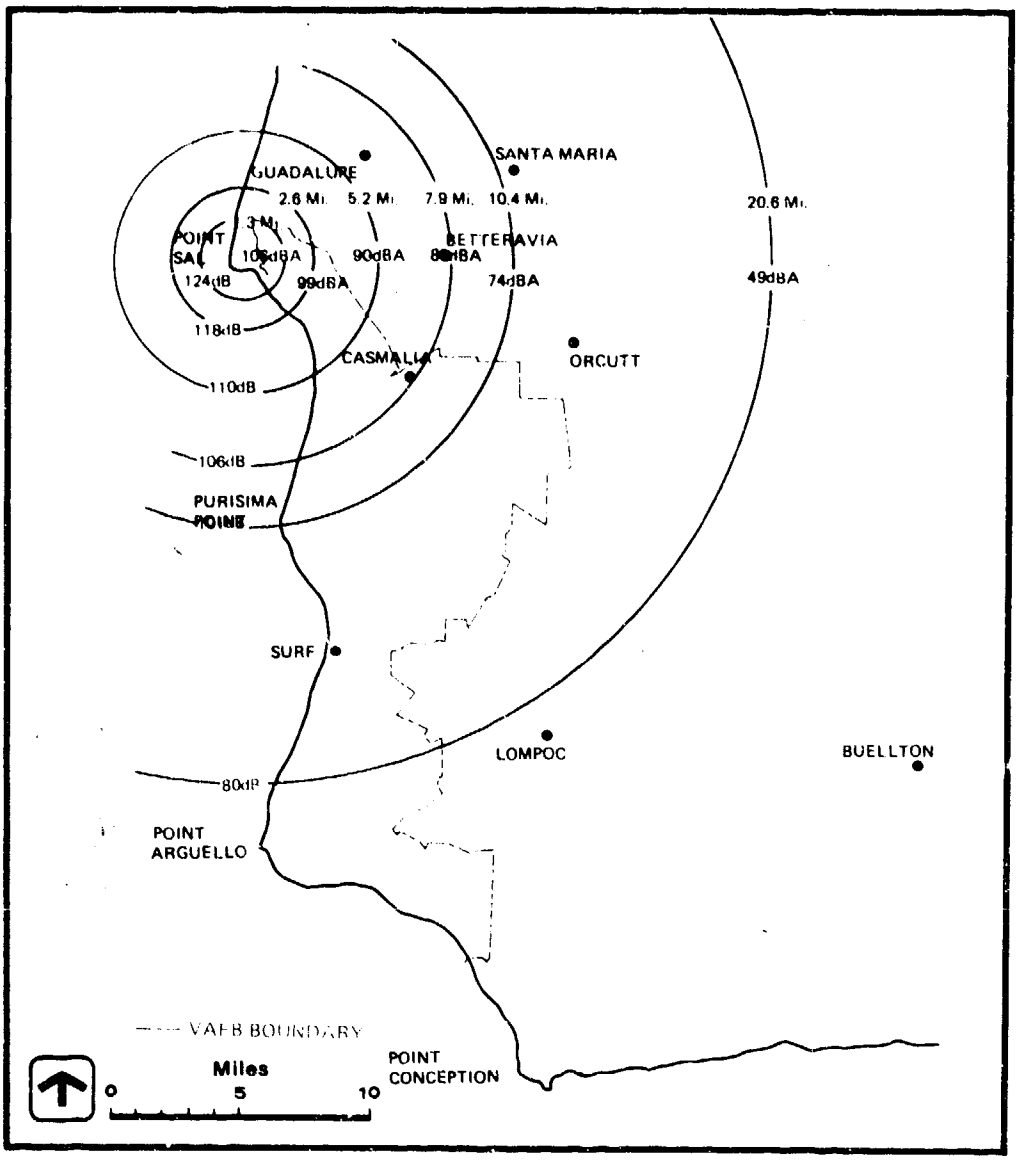
Noise near Vandenberg is confined to the southwestern part of Lompoc and the immediate airfield area on the Base. (CNEL contours for the Lompoc Valley are shown in Figure 3.1.8-B.) CNEL contour patterns for the Lompoc Valley are influenced by aircraft approaching Runway 30 from the southeast. This approach path brings aircraft over the southwestern portion of Lompoc at minimum altitudes of 3,000 feet above sea level. Traffic using this approach includes mostly jet and large transport type aircraft. No fixed-wing military aircraft are currently based at Vandenberg, and air traffic is considered light. Annual traffic volume is about 6,500 operations per year.

3.1.8.3 Other Noise in Rural and Urban Environments

Another noise source affecting both the rural and urban environments is missile launchings at Vandenberg. Noise produced by current missile launches at Vandenberg does not appreciably affect the CNEL contours for the Lompoc Valley. This is due to the relatively infrequent launch occurrences (less than 50 launches in 1975) and the short temporal existence of corresponding emitted noise. Although a variety of missiles is launched from Vandenberg, the predominant vehicles are Minuteman and Titan III.

Minuteman launch facilities are located adjacent to Point Sal Road in the northernmost part of Vandenberg. During a launch, a missile's ascent is assumed to be essentially straight up during maximum noise production of the engines. Thus, typical noise level contours of equal intensity are approximately circular and centered on the launch site (see Figure 3.1.8-C). It should be noted, however, that the contours presented in this figure do not consider the influences of terrain.

The only active Titan III site is in the western portion of southern Vandenberg and is designated SLC-4.

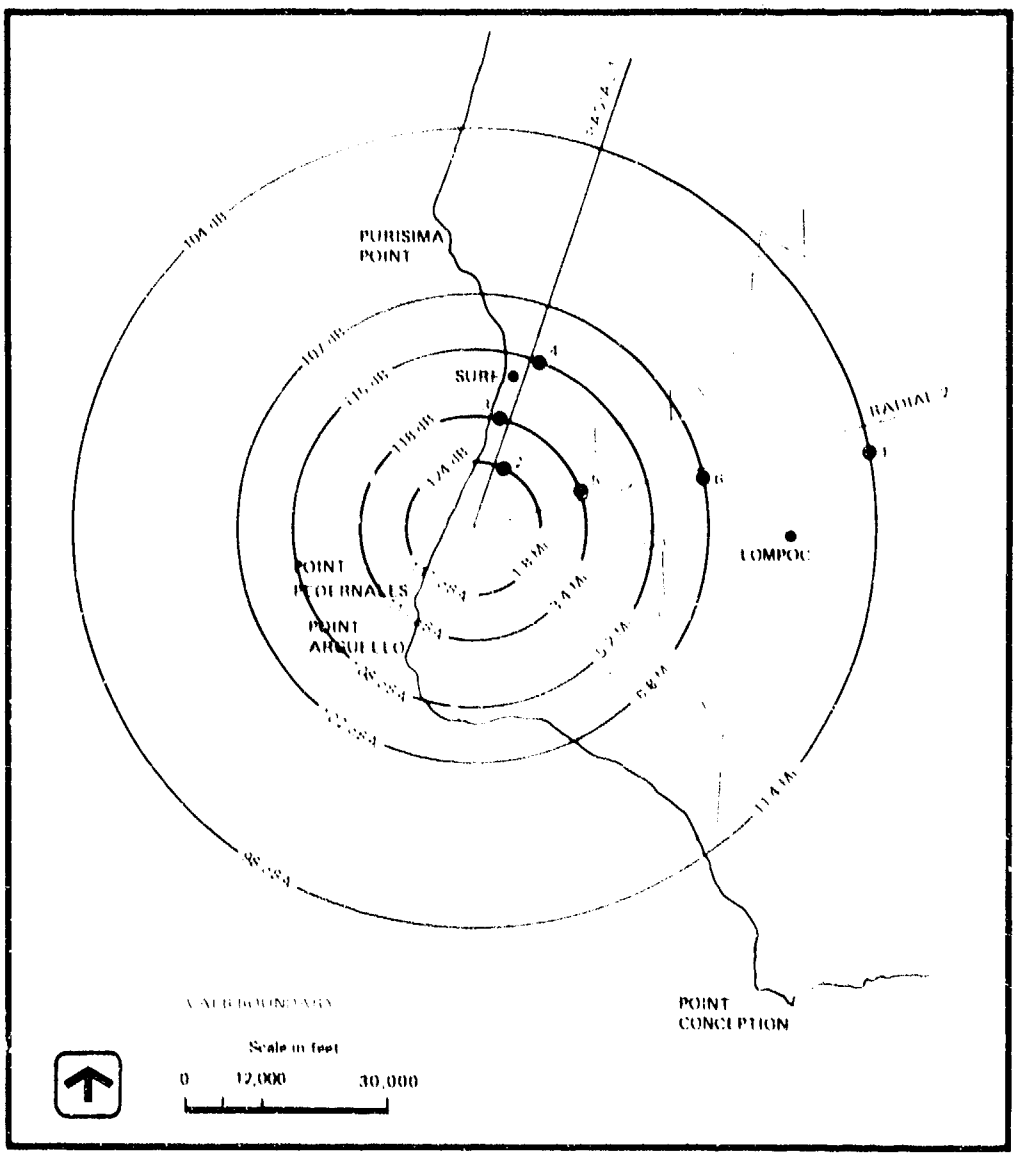


Reference: Smith, 1975.[109]

FIGURE 3.1.8-C. Predicted maximum noise level contours for Minuteman missiles from a coastal launch site.

Acoustic measurement stations were set up at six locations to monitor Titan III levels during ignition and liftoff (see Figure 3.1.8-D).[12]

Station 1	La Purisima Hills
Station 2	Building #934 (Radial 1)
Station 3	Far Fallback (Radial 1)
Station 4	Tracking Site 45 (Radial 1)
Station 5	Building #657 (Radial 2)
Station 6	Central Avenue-Lompoc (Radial 2)

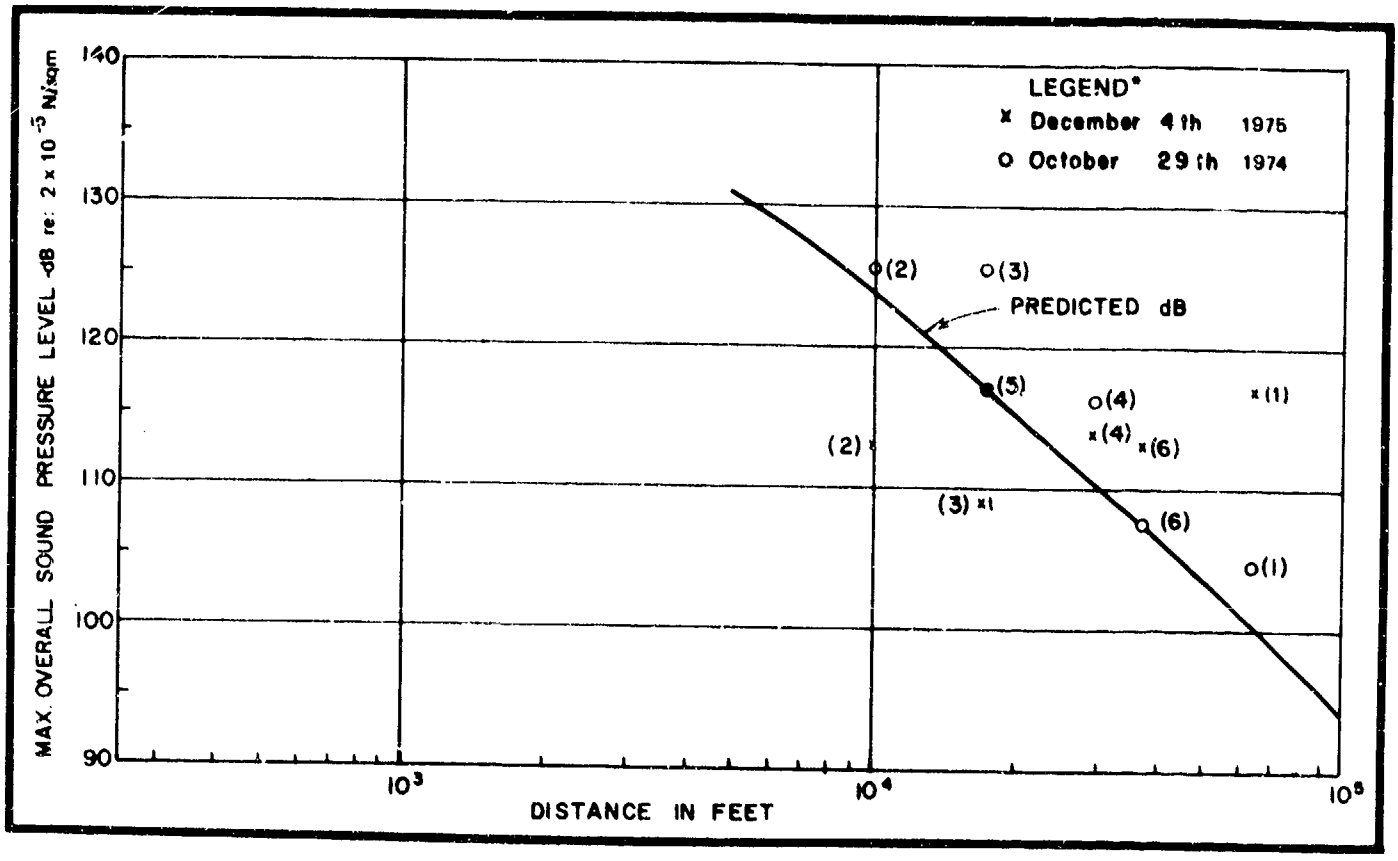


Reference: U.S. Air Force, 1976.(175)

FIGURE 3.1.8-D. Locations of acoustic measuring stations and approximate Titan III OASPL contours from SLC-4.

Figure 3.1.8-E shows the predicted overall sound pressure (OASP) levels (dB and dBA) expected from Titan IIIC, IIID, IIIE launch vehicles at different distances from one launch site. The OASP includes contributions from all octave bands. The individual octave band levels are, therefore, lower than the overall level. Superimposed on Figure 3.1.8-E are measurement data for two dates obtained at the stations shown in Figure 3.1.8-D.

The figure is basically valid for all ground locations, although it assumes that the frequency attenuation is constant at all frequencies whatever the distance to the ground station.



*See Figure 3.1.8-D for location of measurement stations shown in parentheses.

Reference: Harker, 1974[169]

FIGURE 3.1.8-E. Predicted OASPL from Titan IIIC, D, E launch versus ground distance from launch site.

3.1.9 BIOLOGY

The biota of the project region interact with many aspects of the physical environment and various man-related disturbances. On land, climatic influences and the diversity of geologic substrates, historical factors, and human activities create an environment dominated by various vegetation types that support characteristic assemblages of animals. In the sea, the orientation of the coastline, diversity of geologic substrates, offshore islands, and nearshore and offshore currents give rise to a similar diversity in the marine biota. Meteorological and biological investigators commonly characterize the project area as a borderland, a biogeographic boundary area between coastal Southern California and the Central California coast.

Wherever the discussion pertains to the biota, the term "project area" generally connotes that portion of Santa Barbara County west of Highway 101 and south of the Santa Maria Valley, while the term "project region" connotes coastal southern San Luis Obispo County, Santa Barbara County, the northern Channel Islands, and coastal Ventura County (see Figure 1.3-13).

3.1.9.1 Terrestrial Biota

Disturbance History. The project region has been subjected to extensive and intensive man-induced disturbances for over a century. These disturbances have had significant effects on the vegetation, fauna, and landforms in many locales and are at least partly responsible for the current distribution of vegetation types and fauna. Exotic species have been introduced either accidentally or for a variety of purposes such as erosion control, timber production, dune stabilization, and agricultural production. In the major valleys (Lompoc, Santa Rosa, Santa Rita, Santa Ynez, Los Alamos, and Santa Maria Valleys) and their tributaries, extensive areas have been modified by the destruction of the local biota in preparation for agricultural and urban development.(16)(107)(132)(133)

Outside these developed areas, fire, and grazing activities (mostly by cattle) are the major disturbance processes affecting the biota. They have resulted in large-scale modification of the vegetation and, hence, the fauna. The biota has been additionally modified by pollution, hunting, domestic/feral animals, and human activities.

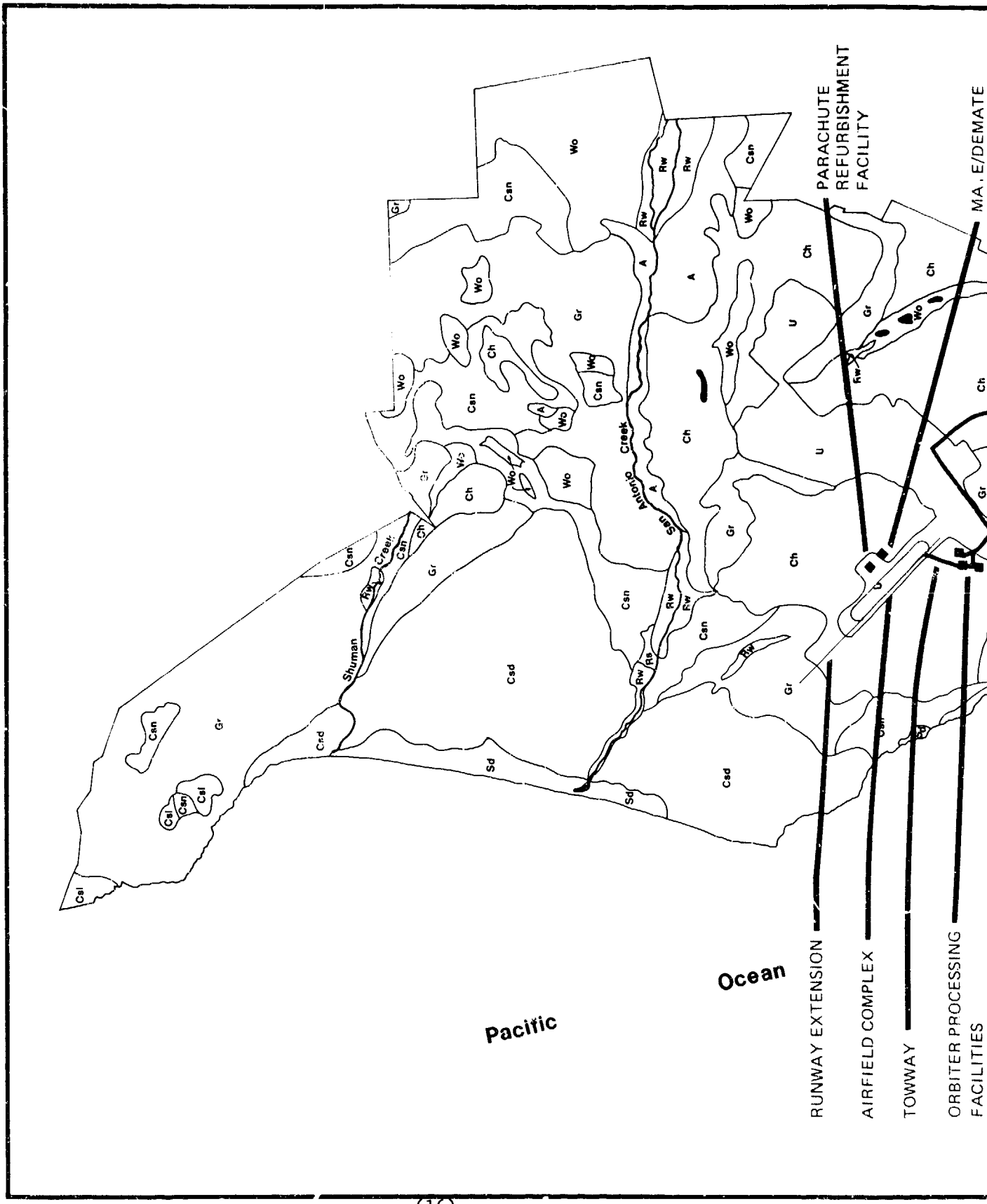
Vegetation and Flora. Each vegetation type represents a generalization based on recurrent physiognomic and floristic plant assemblages. These assemblages were identified through interpretation of aerial imagery, onsite field studies (including quantitative vegetation analysis), and secondary source research.(16)(17)

The distribution of these vegetation types on Vandenberg and in the Santa Barbara region is presented in Figures 3.1.9-A and -B. The dominant species in the vegetation of the project area are listed in Table 3.1.9-1.

Introduced Plants. Introduced plants significantly affect portions of the project region. Some of these plants have become naturalized members of the native vegetation. An excellent example is ice plant, which has become a codominant on stabilized dunes. The best example of complete naturalization is the grassland, where the dominant grasses and forbs are introduced species from Eurasia. Most of the plants of ruderal habitats such as dumps, graded roadsides, spoil banks, and similarly disturbed sites are introduced species.

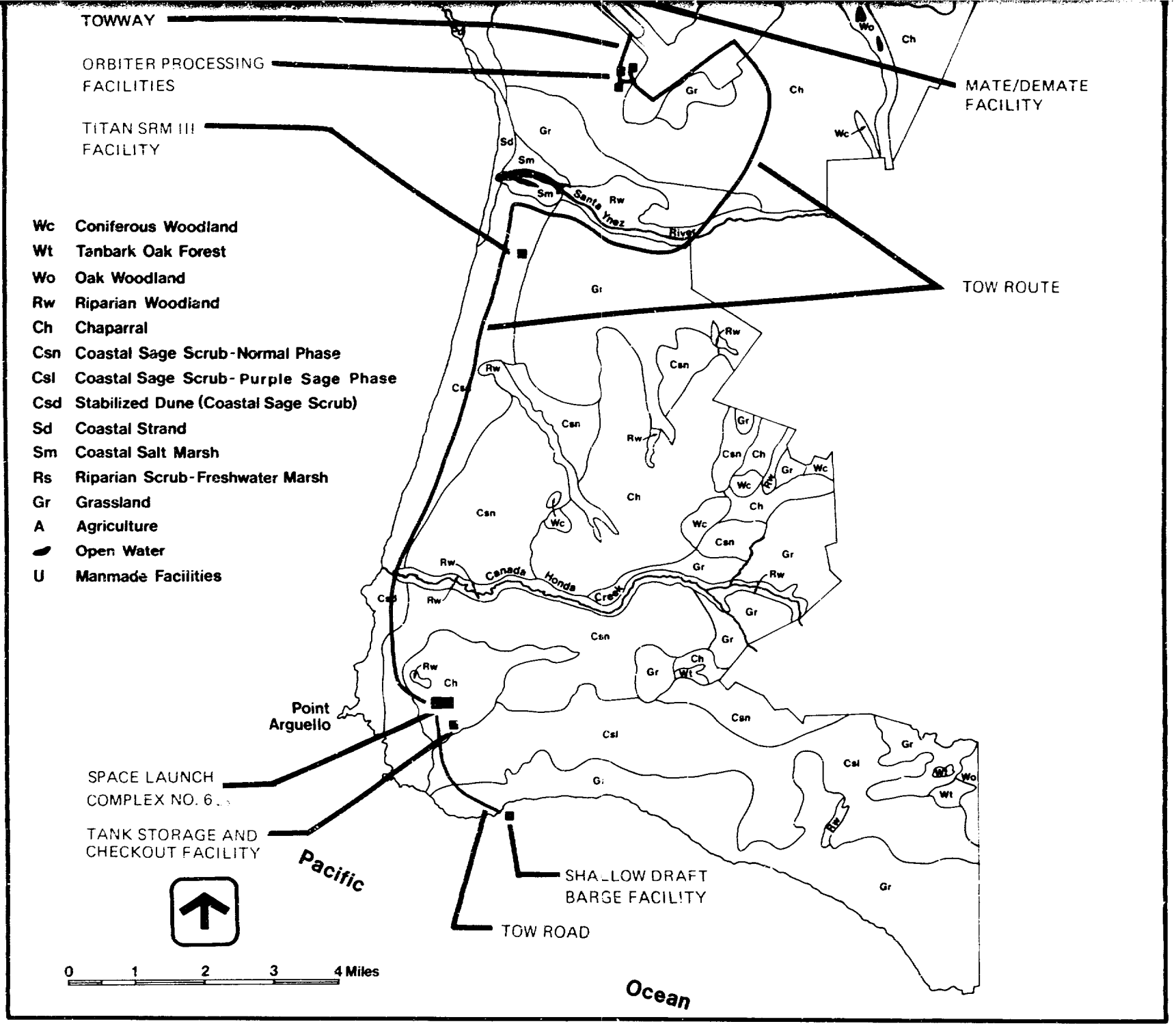
Commercially Important Species. Agricultural crops represent a significant proportion of the total biological and economic production in the project area. Intensive agriculture such as that of irrigated truck, field, ornamental flower seed, orchard, and vineyard crops is prevalent in areas where soils are good and where irrigation water is readily available. Extensive irrigated pasture/forage and dry-farmed grain and beans occupy areas where soils are less capable or where irrigation water is not readily available.(132)

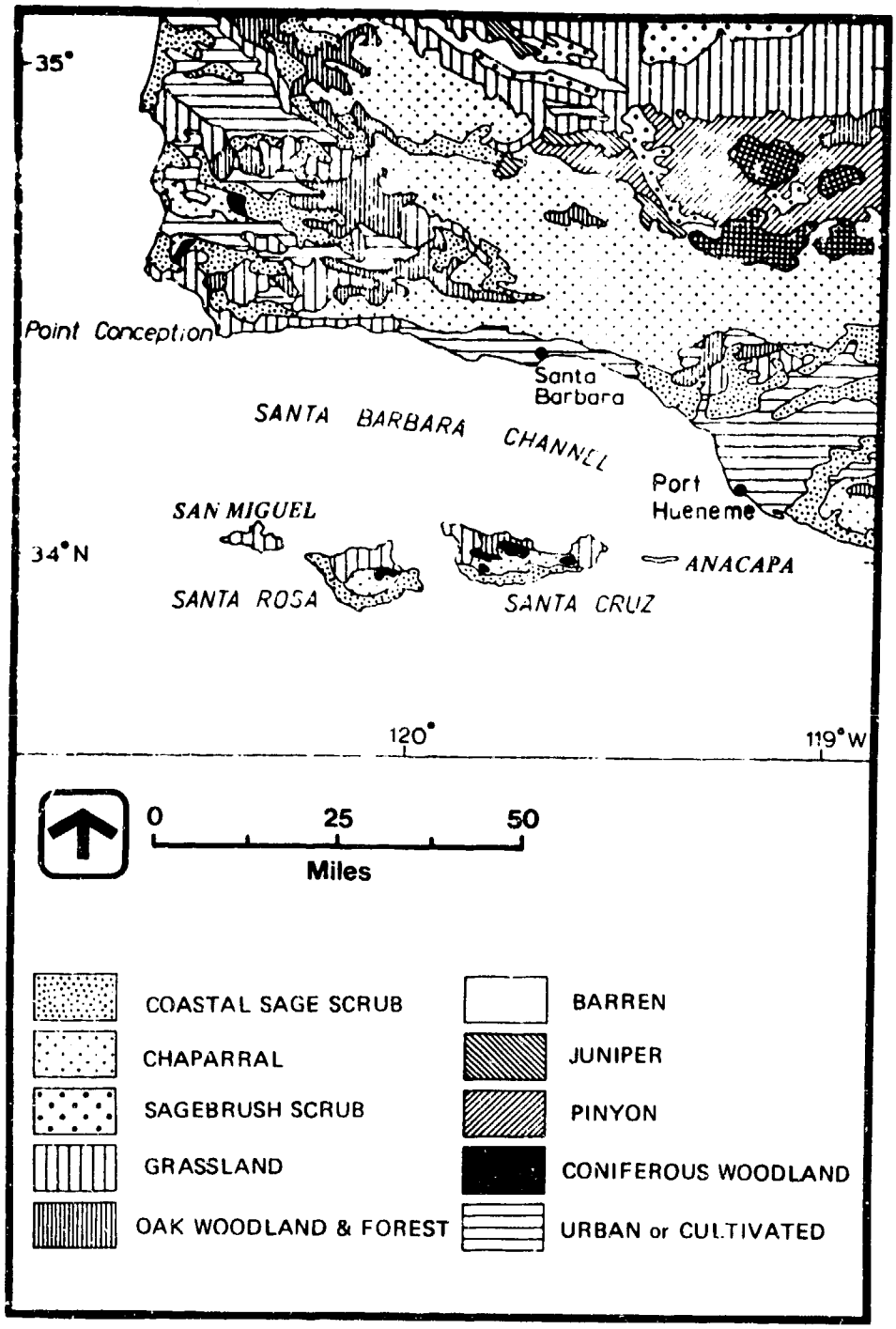
Another group of commercially important species is the introduced annual grasses and forbs (grassland) of the region's grazing lands. Some of these,



Reference: Coulombe and Cooper, 1976[16]

FIGURE 3.1.9-A. Distribution of generalized vegetation types on Vandenberg Air Force Bas


TOWWAY
ORBITER PROCESSING FACILITIES
TITAN SRM III FACILITY
MATE/DEMATE FACILITY
TOW ROUTE
Wc Coniferous Woodland
Wt Tanbark Oak Forest
Wo Oak Woodland
Rw Riparian Woodland
Ch Chaparral
Csn Coastal Sage Scrub-Normal Phase
Csl Coastal Sage Scrub-Purple Sage Phase
Csd Stabilized Dune (Coastal Sage Scrub)
Sd Coastal Strand
Sm Coastal Salt Marsh
Rs Riparian Scrub-Freshwater Marsh
Gr Grassland
A Agriculture
Open Water
U Manmade Facilities
Santa Ynez River
Canada Honda Creek
Point Arguello
SPACE LAUNCH COMPLEX NO. 6
TANK STORAGE AND CHECKOUT FACILITY
SHALLOW DRAFT BARGE FACILITY
TOW ROAD
Pacific Ocean
0 1 2 3 4 Miles



Reference: Orme, Bowden, and Minnich, 1971.[111]

FIGURE 3.1.9-B. Distribution of generalized vegetation types in the Santa Barbara region.

Table 3.1.9-1. DOMINANT SPECIES OF THE VEGETATION IN THE PROJECT AREA

Coastal Strand		
Abronia latifolia	Yellow sand verbena	Subjected to nearly continual salt spray and physical disturbance caused by movement of sand by wind and storm waves.
A. maritima	Beach sand verbena	
A. umbellata	Dune sand verbena	
Cakile maritima	Sea rocket	
Convolvulus soldanella	Beach morning glory	
Franseria chamissonis including ssp. *bipinnatasecta*	Beach bur	
Stabilized Dune (coastal sage scrub)		
Haplopappus ericoides	Heather-leaved goldenbush	Transitional gradient of vegetation between coastal strand and coastal sage scrub.
Lupinus chamissonis	Beach bush lupine	
Carpobrotus edulis	Ice Plant	
Coastal Sage Scrub (normal phase)		
Artemisia californica	Coastal sagebrush	Widespread throughout the region; dominates the sides of many canyons and various lower elevational areas.
Baccharis pilularis ssp. *consanguinea*	Coyote brush	
Mimulus aurantiacus ssp. *lompocensis*	Lompoc monkeyflower	
Toxicodendron diversilobum	Poison oak	
Coastal Sage Scrub (purple sage phase)		
Salvia leucophylla	Purple sage	Found on many south-facing slopes, ridges near Point Sal, and the lower slopes of the Tranquillon ridge.
Artmesia californica	Coastal sagebrush	
Encelia californica	Bush sunflower	
Grassland		
Avena barbata	Slender wild oats	A result of man-induced disturbances such as the removal of native vegetation; dominated by introduced annual species.
A. fatua	Wild oats	
Bromus mollis	Soft chess	
B. rigidus	Ripgut	
B. rubens	Red brome	
Erodium cicutarium	Redstem filaree	

Continued next page

Table 3.1.9-1 (Cont'd.). DOMINANT SPECIES OF THE VEGETATION IN THE PROJECT AREA

Grassland (Cont'd)		
Hordeum spp.	Foxtail	
Lolium multiflorum	Italian ryegrass	
Medicago hispida	Bur clover	
Chaparral		
Adenostoma fasciculatum	Chamise	
Arctostaphylos pechoensis var. *viridissima*	Lompoc manzanita	Thick-leaved, deep-rooted, mostly evergreen, native shrubs; grades into coniferous or oak woodland or tanbark oak forest.
A. rudis	Shagbark manzanita	
Ceanothus ramulosus var. *fascicularis*	Buckbrush	
Quercus wislizenii var. *frutescens*	Scrub oak	
Oak Woodland		
Quercus agrifolia	Coast live oak	Common in valleys and on moister slopes; grades into chaparral, coastal sage scrub, grassland, or tanbark oak forest.
Q. lobata	Valley oak	
Toxicodendron diversilobum	Poison oak	
Coniferous Woodland		
Pinus muricata	Bishop pine	
P. remorata	Santa Cruz Island pine	
Arctostaphylos pechoensis var. *viridissima*	Lompoc manzanita	Coniferous phase of relictual north coastal flora; in the Purisima Hills and on the Lompoc terrace.
A. rudis	Shagbark manzanita	
Ceanothus papillosus var. *roweanus*	Tranquillon ceanothus	
Vaccinium ovatum	Huckleberry	
Tanbark Oak Forest		
Lithocarpus densiflora	Tanbark oak	Found on north-trending slopes of Tranquillon Mountain, Sudden Peak, Oak Mountain, Jualachichi Summit, and Palo Alto Hill; dominated by relictual north coastal flora; frequent exposure to fog and drizzle supports large populations of mosses, lichens, and fungi upon and around the trees and shrubs.
Vaccinium ovatum	Huckleberry	
Gaultheria shallon	Salal	
Polystichum munitum	Sword fern	

Continued next page

Table 3.1.9-1 (Cont'd.). DOMINANT SPECIES OF THE VEGETATION IN THE PROJECT AREA

Riparian Woodland		
Acer negundo ssp. *californicum*	California boxelder	Includes dense understory of herbaceous and shrub species along river courses, streambeds, and in areas where the water table lies close to the surface.
Alnus rhombifolia	White alder	
Juglans californica	Southern California walnut	
Populus trichocarpa	Black cottonwood	
Salix lasiandra	Willow	
Toxicodendron diversilobum	Poison oak	
Riparian Scrub/Freshwater Marsh		
Salix lasiandra	Willow	Mostly perennial herbs and shrubs; grades into riparian woodland.
S. lasiolepis	Arroyo willow	
Nasturtium officinale	Watercress	
Scirpus californicus	California bulrush	
S. robustus	Pacific coast bulrush	
Typha angustifolia	Narrowleaf cattail	
T. latifolia	Broadleaf cattail	
Salt Marsh		
Distichlis spicata	Saltgrass	At mouth of Santa Ynez River; low growing perennial herbs.
Frankenia grandifolia	Alkali heath	
Jaumea carnosa	Jaumea	
Salicornia virginica	Pickleweed	

as well as other introduced and native species, have commercial significance as weeds in croplands and pastures and as alternate or intermediate hosts for pests and diseases of the agricultural vegetation.

Selected Floral Taxa of Special Interest in the Project Region. The species listed in Table 3.1.9-2 constitute much of the unique flora of the mainland project region. No law currently designates any mainland plant species rare, endangered, or threatened in California; Powell (1974) is considered the definitive listing of special interest species in California.(23)(93).

Purisima Hills Coniferous Woodland and Dwarf Chaparral. In the Purisima Hills, an extensive stand of bishop pine contains a unique relictual group of Douglas fir trees that constitutes the southernmost outpost of this latter species in California. Santa Cruz Island pine, another relictual species, and *Eriodictyon capitatum* are endemic to this habitat. In some areas, this coniferous woodland intergrades with special interest coastal chaparral. Such chaparral occurs mostly on sandy substrates (ancient dunes) and dominates parts of Purisima Hills, Burton Mesa, and the Lompoc terrace. It is dominated by several species listed in Table 3.1.9-2 that are restricted to similar scattered coastal locales in Santa Barbara and San Luis Obispo Counties.(56)

Relictual North Coastal Flora. The relictual north coastal flora comprises species that less than 10,000 years ago (during a cooler, moister climatic period) were widespread throughout Southern California. Conspicuous species in the flora include tanbark oak, sword fern, salal, and huckleberry. Bishop pine and Santa Cruz Island pine, as well as other species including madrone and Douglas fir, may be considered members of this relictual flora.(108)

These species occu marily in chaparral, oak and coniferous woodlands, and tanbark oak forest. Some occur in coastal sage scrub. These areas of occurrence have been designated "ecological communities of greatest interest" and "areas of particular ecological interest" in the Conservation Element, Santa Barbara County Comprehensive Plan (1974).(56) These locations are characteristically moist canyons, and north slopes and ridges that have a high incidence of summer fog.

Table 3.1.9-2. SELECTED FLORAL TAXA OF SPECIAL INTEREST

SCIENTIFIC NAME[b]	VERNACULAR NAME	MAINLAND OCCURRENCE BY VEGETATIONAL ASSOCIATION[c]											
		Wc	Wt	Wo	Rw	Ch	Csn	Csp	Csd	St	Sm	Rs	Gr
Agrostis hooveri[R]	Hoover's bentgrass					*							
Amsinckia spectabilis var. *microcarpa*[L]	Lompoc fiddleneck					*			*				
Arctostaphylos pechoensis var. *viridissima*[R]	Lompoc manzanita					*							
Arctostaphylos refugioensis[E]	Refugio manzanita					*							
Arctostaphylos rudis[R]	Shagbark manzanita					*							
Castilleja mollis[E]	Soft-leaved Indian paintbrush								*	*			
Ceanothus impressus including var. *nipomensis*[L]	Nipomo ceanothus					*							
Chorizanthe angustifolia[L]	Narrow-leaved spine-flower					*			*				
Chorizanthe breweri[E]	Brewer's spine-flower												*
Cicuta bolanderi[E]	Bolander water hemlock				*							*	
Cirsium loncholepis[E]	Gracious thistle				*							*	
Cirsium rhothophilum[E]	Surf thistle								*	*			
Cordylanthus maritimus[E]	Salt marsh bird's beak										*		
Corethrogyne leucophylla[R]	Branching beachaster	*							*				
Dicentra ochroleuca[E]	Cream dicentra					*		*					
Dichondra donnelliana[E]	California dichondra						*	*	*				
Erigeron foliosus var. *blochmanae*[E]	Blochman's leafy daisy								*	*			
Eriodictyon capitatum[E]	Lompoc yerba santa	*				*							
Eriogonum nidularioforme[L]	Crisped buckwheat			*		*							
Erysimum insulare[E]	Island wallflower								*				
Erysimum suffrutescens var. *lompocense*[R]	Lompoc wallflower						*		*				
Malacothrix incana var. *suculenta*[E]	Surf malacothrix								*	*			
Monardella crispa[3]	Dune mint									*			
Monardella undulata var. *frutescens*[E]	San Luis monardella					*			*				
Monardella undulata var. *undulata*[R]	Purisima monardella					*			*				
Pinus remorata[R]	Santa Cruz Island pine	*											
Scrophularia atrata[E]	Black-flowered figwort			*	*	*			*				
Senecio blochmanae[R]	Blochman's butterweed								*				
Thermopsis macrophylla var. *agnina*[E]	Santa Ynez false-lupine		*										

[a] Based on information in Coulombe and Cooper (1976), Munz and Keck (1965), Munz (1974), Hoover (1970), Powell (1974), and Smith (1976). (16)(38)(74)(75)(93)(107)

[b] E = Taxa on "Very Rare and Rare and Endangered Plants" list.(93)
R = Taxa on "Rare and Not Endangered Plants (Including Some of Uncertain Status)" list.(93)
L = Taxa on "Plants Not Rare but Mostly of Limited Distribution" list.(93)

[c] Vegetation symbols: Wc - Coniferous woodland; Wt - Tanbark oak forest; Wo - Live oak woodland; Rw - Riparian woodland; Ch - Chaparral; Csn - Coastal sage scrub (normal phase); Csp - Coastal sage scrub (purple sage phase); Csd - Coastal sage scrub (stabilized dune); St - Coastal strand; Sm - Coastal salt marsh; Rs - Riparian scrub/freshwater marsh; Gr - Grassland.

Fauna. The vegetation/habitats of the project region support a broad variety of fauna. The prominent faunal species of commercial importance are introduced domestic cattle (beef and dairy), horses, dogs, cats, and, to a lesser extent, poultry, goats, sheep, and rabbits. Honeybees are agriculturally important as pollinators and honey producers. Other introduced and native species have commercial importance as pests to crops, grazing lands, and domestic life. These species include nematodes, insects, a few other invertebrates, certain birds such as starlings and crows, rabbits, and some rodents. Recreationally important species include mule deer, feral pig (wild boar), quail, doves, rabbits, fox, badger, raccoon, and water fowl. Some of these and other species that are prominent on VAFB are listed in Tables 3.1.9-3 and -4.

Biota of the Channel Islands. The biota of the Channel Islands is generally similar to that of the nearby western Santa Barbara and San Luis Obispo coast. However, notable and significant biological differences do occur. Historically, the influence of introduced pigs and grazing animals, primarily sheep but including cattle, has had a devastating impact on portions of the islands, especially in areas that have burned. They have been responsible for the destruction of much of the native vegetation and for the associated success of many introduced herbs (weeds and grasses). Recovery of the native vegetation is occurring where the feral sheep have been removed.(111)(92)

On the islands, relictual populations of species and divergent forms (subspecies, races) persist in isolation from the current centers of their distribution. Some species are relicts of formerly widespread populations that are now extinct or nearly extinct throughout the rest of their former ranges. Other forms represent variants of mainland forms preserved or developed on the islands. These islands represent a unique biological resource; their greatest values may be derived from their scientific study.(92)

Vegetation and Flora. The vegetation types on the islands are generally comparable to those on the mainland (see Figure 3.1.9-B). They include coastal strand (dunes), coastal sage scrub, chaparral, oak woodland, coniferous woodland (closed-cone and Torrey pines), riparian woodland, riparian scrub/freshwater marsh, grassland, and planted trees and ornamentals.

Table 3.1.9-3. SELECTED FAUNAL SPECIES PROMINENT ON VANDENBERG AIR FORCE BASE

SCIENTIFIC NAME[a]	COMMON NAME	Rw	Wo	Wt	Wc	Ch	Cs	Sd	Sm	Rs	Gr	CI
AMPHIBIANS												
Ensatina eschscholtzii	Ensatina	*	*	*	*	*	*	*			*	
Batrachoseps attenuatus	California slender salamander	*	◆	*	◆	◆	◆	◆			◆	
Aneides lugubris	Arboreal salamander	◆	*	◆	*	*	*	*				
Bufo boreas	Western toad	*	◆		*	◆	◆	◆		◆	*	
Hyla regilla	Pacific treefrog	*	◆	◆	*	*	*			*	◆	●
Rana aurora	Red-legged frog	*								*		
R. catesbeiana	Bullfrog	◆								*		
REPTILES												
Clemmys marmorata	Western pond turtle	◆								*		
Sceloporus occidentalis	Western fence lizard	*	*	*	*	*	*	*	*		*	●
Eumeces skiltonianus	Western skink	*	*	*	◆	*	*				*	
Gerrhonotus multicarinatus	Southern alligator lizard	*	*	*	◆	*	*	*			*	●
Diadophis punctatus	Ringneck snake	◆	*	*	◆	*	◆					
Coluber constrictor	Racer	*	◆		◆	*	*	*		*	*	
Pituophis melanoleucus	Gopher snake	*	◆	*	*	*	*	*	◆	◆	*	●
Thamnophis sirtalis	Common garter snake	*				*	*	◆		*	*	
T. elegans	Western terrestrial garter snake	*	*	*	*	*	*	*		◆	*	
MAMMALS												
Didelphis marsupialis	Common opossum	*	*	◆	◆	*				*	*	
Sorex ornatus	Ornate shrew	*	*	*		*	*	*	◆	◆		●
S. trowbridgii	Trowbridge's shrew	*	*	*	*	*	*	*	*		*	
Scapanus latimanus	Broad-footed mole	◆	◆	◆	◆	◆	*					
Sylvilagus audubonii	Desert cottontail	*	*		*	*	*	*	*	*	*	
S. bachmani	Brush rabbit	*		*	◆	*	*	*				
Lepus californicus	Black-tailed jackrabbit		*		*	*	*	*	*		*	
Spermophilus beecheyi	California ground squirrel	*	*	*	*	*	*	*	*	*	*	
Sciurus griseus	Western gray squirrel		◆	◆	*							
Thomomys umbrinus	Southern pocket gopher	*	*	*	◆	*	*				*	
Perognathus californicus	California pocket mouse	*	*	*	*	*	*	*		*	*	
Dipodomys agilis	Agile kangaroo rat	*	*		*	*	*	*		*	*	
Reithrodontomys megalotis	Western harvest mouse	*	*		*	*	*	*	*	◆	*	●
Peromyscus californicus	California mouse	*	*	*	*	*	*	*		*		●
P. maniculatus	Deer mouse	*	*	*	*	*	*	*	*	*	*	●
P. boylii	Brush mouse		◆	*	◆	◆						
P. truei	Pinon mouse		*	◆	*	◆						
Neotoma fuscipes	Dusky-footed woodrat	*	*	*	*	*	*			*		
Microtus californicus	California vole	*	*	*	*	*	*	*	*	*	*	●
Castor canadensis	Beaver	*								*		
Canis latrans	Coyote	*	*	◆	*	*	*	*	*	*	*	
Urocyon cinereoargenteus	Gray fox	◆	◆	◆	◆	*	◆	◆	◆	◆	◆	●
Procyon lotor	Raccoon	*	◆	*	*				*	*		
Mustela frenata	Long-tailed weasel	*	◆	◆	◆	*	*	*	◆	◆	*	
Taxidea taxus	Badger		◆			*	◆	*			◆	
Mephitis mephitis	Striped skunk	*	◆		◆	*	◆	◆			*	
Lynx rufus	Bobcat	*	◆	◆	◆	*	*	*	◆	◆	◆	
Sus scrofa	Feral pig	*						*		*		●
Dama hemionus	Mule deer	*	*	*	*	*	*	*	*	*	*	●

[a] Rw=Riparian woodland; Wo=Oak woodland; Wt=Tanbark oak forest; Wc=Coniferous woodland; Ch=Chaparral; Cs=Coastal sage scrub (all phases); Sd=Coastal strand and dunes; Sm=Coastal salt marsh; Rs=Riparian scrub/freshwater marsh, lakes, and ponds; Gr=Grassland; CI=Channel Islands.

● = Species known to occur;[92] ◆ = Species expected;[16] * = Species observed.[16]

References: Coulombe and Cooper, 1976;[16] Coulombe and Mahrdt, 1975;[17] Philbrick, 1967;[92] Hall and Kelson, 1959;[32] Stebbins, 1954.[126]

Table 3.1.9-4. SELECTED AVIAN SPECIES PROMINENT ON VANDENBERG AIR FORCE BASE

SCIENTIFIC NAME	COMMON NAME	OCCURRENCE BY HABITAT[a]											
		Rw	Wo	Wt	Wc	Ch	Cs	Sd	Sm	Lg	Rs	Gr	CI
BIRDS													
Podiceps nigricollis	Eared grebe									*	*		●
Podilymbus podiceps	Pied-billed grebe							◆		*	*		●
Puffinus griseus	Sooty shearwater							*					●
Pelecanus occidentalis	Brown pelican							*		*			●
Phalacrocorax penicillatus	Brandt's cormorant							*					●
Ardea herodias	Great blue heron									*			●
Egretta thula	Snowy egret									*			
Anas platyrhynchos	Mallard									*	*		●
A. cyanoptera	Cinnamon teal									*	*		
Melanitta perspicillata	Surf scoter							*		*			●
Oxyura jamaicensis	Ruddy duck									*	*		
Buteo jamaicensis	Red tailed hawk	*	*		*	*	*		◆			*	●
Fulica americana	American coot									*	*		
Haematopus bachmani	Black oystercatcher							*					●
Charadrius vociferus	Killdeer	*						*			◆	◆	●
Arenaria melanocephala	Black turnstone							*		*			●
Numenius phaeopus	Whimbrel							*		*			●
Catoptrophorus semipalmatus	Willett							*		*			●
Calidris alba	Sanderling							*		*			●
C. mauri	Western sandpiper									*	*		
C. minutilla	Least sandpiper							*		*	*		●
Lobipes lobatus	Northern phalarope									*	*		●
Larus heermanni	Heermann's gull							*		*			●
L. delawarensis	Ring-billed gull									*			
L. occidentalis	Western gull							*		*			●
Sterna albifrons	Least tern									*			
Lophortyx californicus	California quail	*	*		*	*	*					*	●
Zenaida macroura	Mourning dove			*	◆	*						*	●
Megaceryle alcyon	Belted kingfisher	◆					◆			◆	*		●
Colaptes auratus	Common flicker	◆	*	*	*	*	◆					*	●
Dendrocopos pubescens	Downy woodpecker	*	*										
Petrochelidon pyrrhonota	Cliff swallow	*					*		◆		*		
Aphelocoma coerulescens	California scrub jay		*	*	*	*	*					◆	●
Corvus brachyrhynchos	Common crow	*					*					*	
Parus inornatus	Plain titmouse		*	*		◆							
Psaltriparus minimus	Common bushtit	*	*	*	*	*	*						●
Chamaea fasciata	Wrentit	*	*	*	*	*	*					*	
Thryomanes bewickii	Bewick's wren	*	*	*	*	*	*					*	●
Telmatodytes palustris	Long-billed marsh wren								*	*	*		●
Toxostoma redivivum	California thrasher	◆	*		*	*	*					*	●
Lanius ludovicianus	Loggerhead shrike	◆				*	*					*	●
Sturnus vulgaris	Starling					*						*	●
Sturnella neglecta	Western meadowlark						◆					*	●
Agelaius phoeniceus	Red-winged blackbird										*	*	●
Carpodacus mexicanus	House finch	*	*		*		*		*			*	●
Pipilo erythrophthalamus	Rufous-sided towhee	*	*	*	*	*	*					◆	●
P. fuscus	Brown towhee	*	*	*		*	*						●
Passerculus sandwichensis	Savannah sparrow								*				●
Junco hyemalis	Slate-colored junco	*	*	*	*	*							
Zonotrichia leucophrys	White-crowned sparrow		*	*	*	*	*		*			*	●
Melospiza melodia	Song sparrow	*	*			*			*	*	*		●

[a] Rw=Riparian woodland; Wo=Oak woodland; Wt=Tanbark oak forest; Wc=Coniferous woodland; Ch=Chaparral; Cs=Coastal sage scrub (all phases); Sd=Coastal strand and dunes; Sm=Coastal salt marsh; Lg=Coastal lagoons; Rs=Riparian scrub/freshwater marsh, lakes, and ponds; Gr=Grassland; CI Channel Islands.

◆ = one sighted in habitat;[17] * = 2 or more sighted in habitat;[17] ●=known to occur.[68]

References: American Ornithologists Union, 1957, 1973;[2] Coulombe and Cooper, 1976;[16] Coulombe and Mahrdt, 1975;[17] Metcalf, 1972. (68)

Chaparral and woodland vegetation types are essentially absent from San Miguel and Anacapa Islands. Several endemic species occur only on the islands.

Fauna. The faunal communities of the Channel Islands resemble those of similar habitats on the mainland. Fewer species commonly occur in the island habitats than occur in similar mainland habitats. Consequently, individual species often utilize habitats on the islands that they seldom utilize on the mainland.(168)

The terrestrial avifauna of the islands generally resembles that of similar habitats on the mainland; however, the Santa Cruz Island jay (a subspecies of the common scrub jay) and several other avian taxa are recognized as subspecies of mainland forms.(2)(168) Oceanic and shorebirds are relatively common on the islands. California's only nesting colony of brown pelicans (endangered species) occurs on West Anacapa Island, and in recent years on an islet adjacent to Santa Cruz Island.(13)(68)

Twelve introduced species of terrestrial mammals have been reported from one or more of these islands in recent times. The islands are known to support 10 native species of terrestrial mammals. These taxa represent subspecies or races of nearby mainland forms that are endemic to the islands. Their natural history and ecologic relations, as far as is known, closely resemble those of their mainland counterparts.(92)

Endemic races of the Channel Islands fox, a rare species, occur in stable populations at the carrying capacity of their habitats on San Miguel Island Santa Rosa Island, and Santa Cruz Island.(13) The islands include some of the most important California breeding grounds (rookeries) for (pinniped) marine mammals.(22)(92)

Rare, Endangered, and Threatened Terrestrial Vertebrate Species. Nine terrestrial vertebrate species (7 bird species, 2 mammal species, and 1 reptile species) that occur in the project region are designated rare (R) or endangered (E) by the California Department of Fish and Game, or

endangered (En) or threatened (T) by the U.S. Fish and Wildlife Service and are listed in Table 3.1.9-5.[13][154][155][221] No terrestrial invertebrates or amphibians that occur in the project area are known to be similarly designated.

Table 3.1.9-5. RARE, ENDANGERED, AND THREATENED SPECIES OF TERRESTRIAL VERTEBRATES IN THE PROJECT REGION.

CATEGORY	SCIENTIFIC NAME	COMMON NAME	STATUS
BIRDS	*Gymnogyps californianus*	California condor	En, E,T
	Haliaeetus leucocephalus leucocephalus	Southern bald eagle	En, E,T
	Falco peregrinus anatum	American peregrine falcon	En, E,T
	Falco mexicanus	Prairie falcon	T
	Coccyzus americanus occidentalus	Yellow-billed cuckoo	R
TERRESTRIAL MAMMALS	*Lanius ludovicianus mearnsi*	San Clemente loggerhead shrike	En
	Amphispiza belli clemente	San Clemente sage sparrow	T
	Urocyon littoralis	Island fox	R
	Cervus nannodes	Tule elk	R
REPTILES	*Klauberina riversiania*	Island night lizard	T

Endangered, Threatened, and Special Interest Invertebrates. Populations of two gastropod mollusks, *Haplotrema minimum* (snail) and *Hesperarion hemphilli* (slug), are located in the tanbark oak forest on Tranquillon Mountain, many miles south of other nearest known populations (northern San Luis Obispo County). Another snail species, *Haplotrema duranti*, occurs in riparian habitats along Santa Ynez River (and probably other streams on VAFB); the nearest known populations are in northern San Luis Obispo County. *Helminthoglypta fieldi* (snail) has 75 percent of its known range on VAFB at Surf and near the mouth of Santa Ynez River. A species proposed for federal endangered status, *Helminthoglypta walkeriana* (Morro Bay banded dune snail), may occur in the dunes on VAFB.[171]

Several butterfly species that have been proposed for federal threatened or endangered status may occur in the project area and are discussed below:[170]

1. *Plebejus (Icaricia) icarioides moroensis* (Morro Bay blue) is known only along the coast of San Luis Obispo and Santa Barbara Counties where the larval host plant is thought to be *Lupinus chamissonis*, a stabilized dune dominant.

2. *Panoquina panoquinoides errans* (salt marsh skipper) occurs from Santa Barbara County into Mexico; its larval host plant is *Distichlis spicata*, a (Santa Ynez) salt marsh dominant.

3. *Euphydryas editha wrighti* (Wright's checkerspot) and *E. e. monoensis* (mono checkerspot) may occur on VAFB and in the Santa Maria area where *E. editha* specimens (not identified to subspecies) have been collected. The larval host plants were *Plantago* spp. (plantains) in marshy habitats.

Endangered and Threatened Plants. The U.S. Fish and Wildlife Service has recently designated four plants as endangered species. These are the San Clemente broom (*Lotus scoparius* ssp. *traskiae*), the San Clemente Island bushmallow (*Malacothamnus clementinus*), the San Clemente Island larkspur (*Delphinium kinkiense*), and the San Clemente Island indian paintbrush (*Castilleja grisea*). These four species have the distinction of being the first plants to be added to the U.S. List of Endangered and Threatened Wildlife and Plants.(221)

3.1.9.2 Freshwater Biota

General. The freshwater biota of the project region comprises the organisms of lakes and ponds, streams, freshwater marshes, and riparian scrub and woodland. (Coastal lagoons are discussed in Section 3.1.9.3.) The extent and composition of these aquatic assemblages are strongly influenced by water management, agricultural development, cattle grazing, effluent discharge, and the introduction and eradication of species.

Six streams (Cañada del Norte, San Antonio Creek, Santa Ynez River, Cañada Honda Creek, Cañada del Jolloru, and Jalama Creek), their tributaries, and five lakes (Mod III, Punchbowl, and Upper, Middle, and Lower Canyon Lakes) constitute the major freshwater habitats of the Vandenberg area. The biota occurring in these habitats are discussed below.[16][17][163]

The non-vascular aquatic vegetation is dominated by diatoms and green algae. The vascular aquatic vegetation is dominated by floating ferns and duck weed, baccharis, poison hemlock, rushes, watercress, beardgrass, pondweeds, docks, willows, bulrushes/tules, bur reed, cattails, and nettle. (See also 3.1.9.1, riparian vegetation.)

The aquatic insect fauna is dominated by water beetles, fly and mosquito larvae, and various water bugs, mayflies, stoneflies, caddisflies, dragonflies, and damselflies. A large variety of other invertebrate taxa also are widespread; prominent among them are crayfish, freshwater scud, water fleas, snails, and worms.

The fish fauna includes steelhead trout, carp, flathead minnow, channel catfish, mosquito fish, arroyo chub, threespine sticklebacks, bluegill, red-ear sunfish, largemouth and smallmouth bass, black crappie, and tidewater goby. Other prominent vertebrate species are listed in Tables 3.1.9-3 and -4.

Rare, Endangered, and Threatened Freshwater Vertebrate Species. Recent studies have demonstrated that *Gasterosteus aculeatus williamsoni*, unarmored threespine stickleback, occurs in San Antonio Creek and El Rancho Pond, waters in which a subspecies *G. a. microcephalus* is currently absent.[16] Previously, this subspecies was known only in the Los Angeles, Mojave, San Gabriel, Santa Ana, Santa Maria, and Santa Clara Rivers where it hybridized with subspecies *G. a. microcephalus*. It is designated endangered (E) by the California Department of Fish and Game, and threatened (T) by the U.S. Fish and Wildlife Service.[13][154][155] These inconspicuous, nongame fish represent the only rare, endangered, or threatened species of fish expected to occur in the project region.[16] However, certain rare, endangered, or threatened avian species discussed under Terrestrial Biota and Marine Biota occasionally occur in freshwater habitats.

3.1.9.3 Marine Biota

Point Sal to Cojo Bay. The intertidal zone from Point Sal to Cojo Bay comprises a complex of habitat types, including rocky shores, sandy beaches, and lagoons. North of Point Arguello the biota is generally typical of that which occurs elsewhere along the Central California coast.(96)

During an intertidal survey at the Point Arguello Boathouse 69 species were recorded in the semiprotected rocky intertidal zone. Thirty-two species were animals representing 6 phyla, and the remaining 37 species were plants representing 4 divisions. Red algae, gastropod mollusks, crustaceans, and polychaete worms comprised the majority of species; nearly 50 percent of the animal species were gastropod mollusks.(95)

In the intertidal zone of the sandy beach at Ocean Beach, 14 species of animals, representing 3 phyla, were recorded.(95) Six species were annelids, 7 species were arthropods, and 1 species was nemertean (proboscis worm). The number of species and the number of individuals per species recorded at any particular time were highly variable throughout the year. The greatest animal densities occurred at the high-tide level. Crustaceans, especially sand crabs, were the predominant organisms. The microscopic interstitial biota of sandy beaches is poorly known, but diatoms, protozoans (especially ciliates), nematode worms, and copepod crustaceans constitute the more common taxa that occur. The nearly total absence of all organisms at all intertidal levels in March was probably due to the effects of storms that occurred during late February and early March. Recovery of certain dominant species took place within a month.

The lagoons in the project region vary in size as well as in species composition. Lagoons characteristically are estuarine, euryhaline, or hyposaline habitats. Therefore, they commonly exhibit gradients in water quality and biota that range from marine at the ocean to progressively fresher water farther inland.

The subtidal region between Point Sal and Cojo Bay varies greatly in habitat types and biotic composition. At Ocean Beach, inshore dominant species of fish include shiner perch and spotfin surfperch. Spotfin surfperch, curlfin turbot, plainfin midshipman, and dark-blotched rockfish are dominant offshore.

Planktonic organisms characteristically exhibit patchy distributions, primarily because of variations in ocean currents, food supply, nutrient supply, and predation. The structure of planktonic communities may undergo marked seasonal, daily, and diurnal variations.

At least 297 species of marine fish occur in the Point Arguello region.[70] The most diverse groups are the surfperches, rockfishes, sculpins, clinids, and flatfishes. Fishes of commercial and recreational importance are discussed later in this section.

Three species of sea turtles are the only marine reptile species that are expected to occur in the project region. Vagrant loggerhead turtles, leatherback turtles (*Dermochelys coricea;* endangered species), and green turtles (*Chelonia mydas;* threatened species) may occasionally occur as far north as the project region.[126]

A large variety of marine birds occurs in the project region. These species include truly oceanic birds, shorebirds, and a variety of species that frequent coastal lagoons. Forty-three species were observed in coastal lagoons around VAFB. Shorebirds and gulls were most abundant. These and other prominent marine species are listed in Table 3.1.9-4.[17]

California least terns, an endangered species, have recently established new nesting colonies at the mouth of the Santa Ynez and, possibly, San Antonio Lagoons. Also, about 25 pairs have been found nesting on the south side of the Santa Maria River mouth. Another endangered avian species commonly observed in the Vandenberg region is the California brown pelican. The savannah sparrow (*Passerculus sandwichensis bryanti*) is reported to occur in the project area. It is not known whether the endangered subspecies *P. s. beldingi* occurs there also.[16][17] However, *P. s. beldingi* does occur in the project region.

A variety of marine mammals occurs in the project region. California sea lions haul out on the beaches at Vandenberg. Harbor seals are reported to breed on Vandenberg in rocky areas. Steller sea lions, California sea lions, and northern elephant seals have breeding populations at San Miguel Island. Northern fur seals, which breed on San Miguel Island, may sporadically occur on the mainland. The project region is within the former breeding range of (threatened) southern sea otters and (rare and threatened) Guadalupe fur seals, and the (rare) tule elk.

Neither species is known to breed in the region at this time, but suitable habitat is present and the species may sporadically occur.[13][16][17][22]

Cetaceans (whales, dolphins, porpoises) also occur in the region. Gray whales are probably the most conspicuous species. During the spring and fall, migrating individuals and small groups are frequently seen in the project region.

Biota of the Channel Islands. Seabird populations of the Channel Islands have been examined in a recent study funded by the Bureau of Land Management. That investigation has shown that although the four Northern Channel Islands provide essential feeding, nesting, and breeding areas for both resident and imigrating seabirds in the Southern California Bight, San Miguel supports the largest colony in both numbers and in numbers of species. The list below shows which species breed on each particular Island.[187]

Island	Breeding Species
San Miguel (Prince Island, Castle Rock, Richardson Rock)	Ashy storm petrel, double-crested cormorant, Brandt's cormorant, pelagic cormorant, western gull, pigeon guillemot, Xantu's murrelet, Cassin's auklet, black oyster catcher, snowy plover, Leache's storm petrel.
Santa Rosa	Brandt's cormorant, pigeon guillemot, pelagic cormorant, black oyster catcher, snowy plover.
Santa Cruz (Gull Island, Scorpion Rock)	Ashy storm petrel, brown pelican, pelagic cormorant, western gull, pigeon guillemot, Cassin's auklet, black oyster catcher, Brandt's cormorant, double-crested cormorant, Xantu's murrelet, snowy plover.
Anacapa	Brown pelican, double-crested cormorant, western gull, black oyster catcher, pelagic cormorant.
Santa Barbara (Sutil Islet and Shag Rock)	Ashy storm petrel, double-crested cormorant, Brandt's cormorant, western gull, pigeon guillemot, Xantu's murrelet, black oyster catcher, double-crested cormorant, Cassin's auklet, black storm petrel.
San Nicholas (Begg Rock)	Brandt's cormorant, western gull, snowy plover.

Santa Catalina (Bird Rock)	Western gull, double-crested cormorant, Brandt's cormorant, black oyster catcher.
San Clemente (Castle Rock and N.W. Harbor Islet)	Western gull, pelagic cormorant, Brandt's cormorant, black oyster catcher.

Numerous other sea and shore-associated avian species use the islands and surrounding waters as feeding and resting sites. These include loons and grebes, shearwaters, herons, ducks and geese, rails, plovers, sandpipers, phaleropes, jaegers, auks, and many species of gulls and terns. A discussion of the seven most significant breeding species occurring in the San Miguel area is provided below.(208)

Leach's Storm-Petrel (*Oceanodroma leacorhoa*). Leach's storm-petrels were found to breed in the Channel Islands for the first time in 1976. This species breeds abundantly north and south of the Southern California Bight, but the tiny polulation at San Miguel Island is probably the only one in the Channel Islands.

Ashy Storm-Petrel (*O. homochroa*). The entire world range of the Ashy storm-petrel is contained off the coast from central California to northern Baja California. The largest breeding colony is on the Farallon Islands, and the second largest colony is at San Miguel Island. Though not endangered, the entire world population of Ashy storm-petrels may only number 10,000 - 20,000 individuals.

Double-Crested Cormorant (*Phalacrocorax auritus*). The 60 pairs that breed at Prince Island--a rock off of San Miguel Island--comprise what is probably the largest colony in southern California and one of the largest in the state. Numbers and breeding success of this beleaguered species have been steadily declining in recent years, and double-crested cormorants may become one of California's next Endangered Species.

Brandt's Cormorant (*Phalacrocorax penicillatus*). Nearly 77 percent of the Brandt's cormorants that breed in the Channel Islands occur in the San Miguel Island area and along the north side of nearby Santa Rosa Island.

Pelagic Cormorant (*Phalacrocorax pelagicus*). Two-thirds of the Channel Islands population of this species breeds at the San Miguel complex.

Pigeon Guillemot (*Cepphus columba*). This species has its southernmost range in western America in the Channel Islands; the bulk of the population is found in San Miguel.

Cassin's Auklet (*Ptycheamphus aleuticus*). 11,000+ pairs breed on two offshore rocks at San Miguel Island. This constitutes over 98 percent of the breeding auklets in the Channel Islands.

Table 3.1.9-5A indicates the specific seabird pairs breeding on particular islands in 1976.

Table 3.1.9-5A. OBSERVATIONS OF BREEDING PAIRS OF SEABIRDS ON THE CHANNEL ISLANDS IN 1976 (208)

Location \ Birds	PTLA	PTAS	PTBL	PELB	COD	COB	COP	GUW	GP	MLX	AKC
San Miguel Island	?	+?	0	0	0	62	78*	10	200*	+?	?
Castle Rock	?	+?	0	0	0	363*	34*	50	100*	+?	1,000+*
Prince Island	2+*	200+*	0	0	60*	590*	10	500	150*	75	=10,000*
Santa Rosa Island	?	?	-?	0	0	366*	24+	15	125+*	?	?
Santa Cruz Island	?	+	-?	0	0	45	25	100	200+*	?	+
Gull Island	0	0	0	0	0	55	0	50	0	1	70
Scorpion Rock	0	+	0	0	0	0	0	125	+?	+?	50
West Anacapa Island	-?	-?	-?	417*	7	0	0			?	-?
Middle Anacapa Island	-?	-?	-?	0	0	0	0	2,500	5	?	-?
East Ancapa Island	-?	-?	-?	0	0	0	0			1	-?
San Nicolas Island	-?	-?	-?	0	0	165	0	935	0	+	-?
Santa Barbara Island	?	+?	?*	0	10	73	0	1,125	45	1,000-* 5,000	?
Sutil Island	-?	25	25*	0	30	70	0	75	15	75	35
Shag Rock	?	?	?*	0	0	0	0	9	?	15	0
Santa Catalina Island	-?	-?	-?	0	0	0	0	4	0	0	0
Bird Rock	0	0	0	0	0	0	0	26	0	0	0
San Clemente Island	-?	-?	-?	0	0	15	0	32	0	0	0
Bird Rock	0	0	0	0	0	0	0	28	0	0	0

*These constitute the most important colonies. Both the Brandt's cormorants and pigeon guillemots nest on the north site of Santa Rosa Island.

KEY TO CODES: 1+ present 1+? probably present -? probably not present 0 not present

PTLA - Leach's storm-petrel
PTAS - Ashy storm-petrel
PTBL - Black storm-petrel
PELB - Brown pelican
COD - Double-crested cormorant
COB - Brandt's cormorant
COP - Pelagic cormorant
GUW - Western gull
GP - Pigeon guillemot
MLX - Xantus' murrelet
AKC - Cassin's auklet

At Santa Barbara Island, there exists the only known breeding colony of black storm-petrels in the United States. Also the Xantus' murrelet colony located on Santa Barbara Island is the largest in the United States and possibly the world. During 1976 it was found that these murrelets consistantly foraged in waters off the northwest side of the island, towards San Miguel.

In addition, myriad seabirds use the Bight annually as feeding grounds during the non-breeding season; many northern breaders winter in the Bight and southern hemisphere breeders summer there. For at least two species--black brant (*Branta bernicula*) and pink-footed shearwater (*Puffinus creatopus*)--it is possible that at certain times of the year the majority of the world population may be traveling offshore of that area.

The Channel Islands and surrounding waters support one of the world's most diverse assemblages of marine mammals. Historically, seal and sea lion populations in the Southern California Bight were much larger. Pinnipeds once bred in great numbers along the southern California mainland coast and still do in areas north of Point Conception where little or no human activity is present. Human activity in southern California has disturbed these marine mammals to such an extent that they no longer breed at their previously established coastal rookeries. Today, seals and sea lions breed and pup almost exclusively on the Channel Islands.(187)

The most thorough study to date of the marine mammals inhabiting the southern California waters and offshore islands is being conducted under the auspices of the Bureau of Land Management baseline studies program, by contract with scientists at the University of California, Santa Cruz, and Irvine. The six-month progress report characterized the pinniped population as follows:

> "Many thousand seals and sea lions are found in the Southern California Bight either as year-round residents or as seasonal transients. Major populations of the northern elephant seal, *Mirounga augustirostris*, the California sea lion, *Zalophus Californianus*, and the harbor seal, *Phoca vitulina*, pup and breed

each year on the rocks and beaches of the Channel Islands. In addition, the northern fur seal, *Callarhinus ursinus*, and the Steller sea lion, *Eumetopias jubata*, have the southernmost extension of their breeding range in these islands. With the presence of rare Guadalupe fur seals, *Arctocephalus townsendi*, an endangered species, the Southern California Bight possesses the largest and most diverse pinniped community in temperature waters."

From census data contained in the above report, major breeding and haul-out areas have been mapped. Highest densities of animals are found on San Miguel Island, where a survey at the peak of the sea lion breeding season found 15,337 pinnipeds, primarily clustered on the west end. San Miguel Island and its associated rocks form the most important pinniped habitat in southern California. Six species of seals and sea lions inhabit the island, the five breed there. According to the U.S. Fish and Wildlife Service, San Miguel Island has an ideal environment for pinnipeds because of its climate and the configuration of its low, sandy beaches. Because it is located where warm and cold currents meet, the island demarcates the southern range of norther species of pinnipeds and the northern range of southern species.

Pupping and breeding for sea lions and fur seals occur from May 20 to August 20 whereas northern elephant seals range from December 20 to February 20. These periods are particularly critical because disturbances at these times may cause the animals to stampede and increase the chances of mortality to the young.

Biota of the Point Arguello Boathouse Embayment. Subtidal habitats in the Boathouse Embayment consist of a rocky boulderfield which covers the shoreward half of the bay and a sandy bottom habitat over the outermost portion. A third prominant habitat is located under the existing pier and includes caissons, pilings and miscellaneous riprap.

The organization of the exposed open-coast rocky areas are characterized by their staying power and resistance to shock wave. A characteristic assemblage of animals in the exposed intertidal area is the (*Mytilus-Pollicipes-Pisaster*) association, composed of the California mussel, the Pacific goose barnacle, and the common, purple, or ocher seastar. This is fairly well restricted to the lower two-thirds of the intertidal zone. Many other organisms, including red, brown, and green algae, surf grass, and abalone, may be found to occur with this association. Dense algal growth covers much of the rocky substrate habitat within the embayment. These primarily consist of red algae (Rhodophyta). Several brown algae species are presented, including *Macrocystis pyrifera*, *Egregia menziesii*, and *Cystoseira osmundacea* which provide the greatest standing crops and protective cover for kelp fish. A flowering plant, *Phyllospadix torreyi*, is also common. Only 2 species of green algae (Chlorophyta) have been observed.

The greatest biological diversity within the embayment is in the boulderfield habitat. Total algal cover there is nearly 100 percent. Most of the benthic invertebrate species within the embayment inhabit this area. A snail, *Mitrella carinata*, and a seastar, *Patiria miniata* are the most abundant species. A total of 12 benthic invertebrate species have been documented within the pier habitat; of these, *P. miniata* was most abundant.

The subtidal sandy bottom surfaces within the embayment contain numerous species of benthic invertebrates as well as many infaunal invertebrate species beneath the surface. Average infaunal density (to a depth of 17 cm) is about 315 invertebrates per square meter of sediment. Two polychaete worms (*Axiothella rubrocincta* and *Lumbrineris zonata*), a burrowing shrimp (*Callianassa californiensis*), and a clam (*Tellina modesta*) are most abundant.

Many species of fish pass through the mouth of the embayment. The majority consist of inshore schooling species dominated by the walleye surfperch (*Hyperprosopon argenteum*), topsmelt (*Atherinops affinis*), and pile surfperch (*Damalichthys vacca*). Resident harbor seals (*Phoca vitulina*) have been observed within and around the embayment on occasion.

Areas outside the embayment embayment appear to have greater subtidal species richness and diversity. A brief examination of an outer rocky reef showed 45 species of benthic invertebrates present with a sea anemone (*Corynactis californica*), two species of polychate worms (*Eulistylia polymorpha* and *Spirorbis sp.*), a bryozoan (*Bugula neritina*), and two species of seastars (*Leptasterias hexactis* and *Patiria miniata*) the most abundant. Fish are numerous and variant around this habitat.

Port Hueneme. Port Hueneme is located in the warm temperature marine zoogeographical region of the northern hemisphere. The shoreline in the Port Hueneme area includes sandy beaches and two rock jetties through which ships pass into the mud-bottomed Port Hueneme Harbor. The harbor sediments and waters are polluted by shipping and other activities, yet little information is available concerning water quality and the marine biota.[20][46][145] No rare or endangered marine algae, invertebrates, or fish are reported to occur in this area.

The rocky jetty at the entrance to Port Hueneme Harbor supports marine organisms typical of exposed rock substrata on the Southern California coast. The diversity of organisms is relatively low because these protected waters are away from the ocean and are strongly influenced by shipping activities and pollutants.

Approximately 176 species of fish from 65 families may occur near Port Hueneme.[70] The most important inshore fishes are surfperch, drums, sanddabs, and anchovies. Dominant fishes that occur farther offshore include flounders, midshipmen, and rockfish.

Phytoplankton that predominate in waters off Port Hueneme include diatoms, euglenoids, and dinoflagellates. The most abundant zooplankton just southwest of Port Hueneme are copepods, cladocerans, and larvaceans.

Port Hueneme handles substantial local fish hauls as well as larger fish hauls from surrounding regions. Annual fish catches landed at Port Hueneme in 1970 ranged from 347,137 pounds (local catch) to 372,942 pounds (northern waters

catch) and 1,943,460 pounds (southeastern waters catch). The dominant commercial species, in descending order of abundance, include rockfishes, rock seabass, and barred sand bass.[12]

Approximately 53 species of marine birds occur in the Port Hueneme region. The marine avifauna is similar to that in the Vandenberg region. California brown pelicans and California least terns are endangered species that are expected to feed and rest in the Port Hueneme area. Harbor seals are the only marine mammals that are common near the harbor. They may occasionally enter harbor waters.

Commercial and Recreational Aspects of the Marine Environment. The project region contains extensive marine resources. It also serves as a recreational area. Among the major resources of potential use to man are beds of giant kelp that have served as an alginate source for many industries. The following discussion is derived largely from Best and Oliphant (1965).[12]

Some species of mollusks such as abalones, clams, and squid are harvested commercially. Octopus is sometimes taken for food. The crustacean harvest in the Point Arguello region is minor in comparison with the fish and mollusk catches. Several species of crabs are taken, as are limited numbers of spiny lobsters and shrimp.

Among the most important commercial fishes are flatfishes, rockfishes, and several other inshore and offshore species. The most valuable flatfish is the California halibut. Other economically important flatfishes include a variety of soles, flounders, and sanddabs.

Flounders, kelp bass, lingcod, and rockfishes represent 64 percent of all party-boat catches. Between Port San Luis and Point Sal, angler effort is high. South of Point Sal, this activity diminishes somewhat until Point Conception is reached, where party-boat fishing increases again.

Anadromous steelhead trout are occasionally taken offshore in the San Luis Obispo area and near Jalama Beach. Surfperches constitute most of the fishes caught by shore anglers between Avila and Point Conception.

Numerous species of shore and ocean birds and marine mammals have aesthetic and recreational importance. Of particular interest are sea otters, sea lions, harbor seals, and gray whales. An estimated 2,900 to 4,500 gray whales pass Point Arguello each migratory season; at that time many sport-boat operators conduct excursions during which these animals can be observed.

Rare, Endangered, and Threatened Marine Vertebrate Species. Sixteen marine vertebrate species that occur in the project area are designated by the California Department of Fish and Game as rare (R) or endangered (E), or by the U.S. Fish and Wildlife Service as endangered (En) or threatened (T).[13][154][155] These special status species are listed in Table 3.1.9-6.

Table 3.1.9-6. RARE, ENDANGERED, AND THREATENED SPECIES OF MARINE VERTEBRATES IN THE PROJECT REGION.

CATEGORY	SCIENTIFIC NAME	COMMON NAME	STATUS
REPTILES	*Chelonia mydas*	Green turtle	T
	Dermochelys coricea	Leatherback turtle	En
BIRDS	*Pelicanus occidentalis californicus*	California brown pelican	En, ET
	Rallus longirostris levipes	Light-footed clapper rail	En, ET
	Laterallus jamaicensis	Black rail	RT
	Sterna albifrons browni	California least tern	En, ET
	Passerculus sandwichensis beldingi	Belding's savannah sparrow	E
MARINE MAMMALS	*Physeter catodon*	Sperm whale	En, T
	Megaptera novaeangliae	Humpback whale	En, T
	Balaenoptera borealis	Sei whale	En, T
	Balaenoptera musculus	Blue whale	En, T
	Balaenoptera physalus	Finback whale	En, T
	Eubalaena sieboldii	Right whale	En, T
	Eschrichtius robustus	Gray whale	En, T
	Arctocephalus phillipi townsendi	Guadalupe fur seal	En, RT
	Enhydra lutris nereis	Southern sea otter	T
	Mirounga angustirostris	Northern elephant seal	ER

3.1.10 ARCHAEOLOGY

3.1.10.1 General Archaeological Setting

The project area comprises a portion of the land occupied during late prehistoric and historic times by the Chumash Indians. "Chumash" is a linguistic term that is applied to the people who inhabited the Southern California coast from Malibu to Estero Bay, including the Santa Barbara Channel Islands. They lived in large permanent villages and, in the late Chumash period, produced ornamental artifacts of shell, bone, and stone.

Although sporadic contact between the Spanish and these Indians occurred from the mid-1500s on, the first historical accounts date from Portola's expedition of 1669. The first mission in the area was established in 1787, but the major effects of the later mission program were disruption of the Indians' traditional way of life and reduction of their population through disease. Organized Chumash culture no longer existed by 1840.

The locations of Chumash villages have been established from accounts of expeditions along the Vandenberg coastline in the 1770s and from Spanish mission records. Seven known Chumash village locations are found inside or within 1 mile of the boundaries of Vandenberg Air Force Base. These villages had a combined estimated population in 1760 of between 415 and 720 persons.[29] Some archaeological sites in the Vandenberg area have been identified as the remains of specific villages. Thus far, 1,000 to 1,200 archaeological sites have been located in Santa Barbara County, and, of these, 460 are within the Vandenberg boundaries.

Sites within the project area are representative of all three periods recognized in the prehistory of Santa Barbara County: Late Horizon (Canaliño or Chumash), 1000-1850 A.D.; Middle Horizon (Hunting or Intermediate), 3000 B.C. to 1000 A.D.; and Early Horizon (Oak Grove or Millingstone), 6000-3000 B.C.

A previous study formulated a tentative reconstruction of settlement-subsistence patterns in the Vandenberg-Lompoc area, and data gathered during 1974 were used to refine this model.[114] It related settlement patterns in the Vandenberg area to the location of four resource zones that differ in the availability of various flora, fauna, and mineral resources.[29] Archaeological sites in these resource zones include villages, characterized by sedentary or semisedentary

occupation, and secondary sites, which were occupied temporarily or seasonally and represent a range of functional types.

Population centers were generally located several miles inland from exposed westerly facing coasts. These villages were situated in valleys with major perennial streams where food resources were continuously available and abundant. The inland climate is also more suitable for year-round living than is the rocky foreshore. Small temporary-use sites, characterized by the presence of shellfish remains, occur in linear patterns connecting the rocky coastal zones and the interior population centers. These probably represent established routes of travel.

Where coastal areas are southerly facing, with protected sandy and rocky foreshores, villages were located on the coastal plain near the mouths of small perennial streams. These villages were more sedentary than those in the interior. Here, abundant marine resources were found, and terrestrial resources were available a short distance from the coast.

3.1.10.2 Vandenberg Archaeological Sites

Some 80 archaeological sites are known to exist within or near the boundaries of proposed project sites.(29) Each of these archaeological sites is considered an individual, unique resource with the potential for contributing information leading to better understanding of the archaeological system in the region. Nine of these sites are of particular significance because of their location near proposed facilities. These are SBa 534, 539, 654, 670, 678, 680, 682, 931, and 1128. Five additional sites, which are not located adjacent to proposed facilities, are of particular significance because of their importance within the total cultural and ecological system which constitutes the archaeological setting. These are SBa 210, 551, 552, 662, and 1040. (SBa is the official California designation for archaeological sites in Santa Barbara County.) The California State Historic Preservation Office and the National Park Service indicate that these sites do meet National Register Criteria. In accord with National Historic Preservation Act of 1966 and guidelines on 36 CFR 800 procedures, nomination forms have been submitted to the California State Historic Preservation Office for their opinion. These forms will subsequently be submitted by the Air Force to the National Advisory Council on Historic Preservation.

Twenty-five archaeological sites are known to exist on the Point Arguello terrace in or near the proposed project boundaries. These are SBa 211, 551, 555, 635,

636, 637, 638, 639, 643, 648, 651, 653, 712, 1105, 1106, 1107, 1108, 1109, 1110, 1111, 1114, 1116, 1117, 1118, and 1148. Included are village sites, which are located on the coastal plain along the southerly-facing portions of the coast, as well as limited activity and temporary sites of various types. All are considered part of the larger settlement-subsistence pattern of the Vandenberg-Lompoc area.(136) In addition to these known sites, unknown archaeological resources, including buried sites along the shore and underwater sites, may exist in this area.

The existing environment also includes an abandoned Coast Guard station, boathouse, and associated pier, which were constructed in 1934. This facility is not an historical place and does not appear to meet the criteria for such designation as established in the National Historical Preservation Act of 1966.

3.1.10.3 Port Hueneme Archaeological Sites

According to available records, site maps, and manuscripts on file at the archival facility of the UCLA Archaeological Survey, no archaeological resources are known to exist in the area to be modified or utilized by the project. This area has not been subjected to a systematic on-foot field survey; however, a number of Late Chumash village sites are found at nearby Point Mugu, particularly in the area south of the lagoon.

3.1.10.4 Channel Islands Archaeological Sites

Like Vandenberg, a large number of archaeological sites are known to exist on the Channel Islands. Only the Santa Barbara Group (San Miguel, Santa Rosa, Santa Cruz, and Anacapa) are considered close enough to be within the project area. Sites found on the islands include villages, characterized by sedentary or semisedentary occupations and secondary sites, which were occupied temporarily or seasonally (representing a range of functional types). The three larger Islands (Santa Cruz, Santa Rosa, and San Miguel) apparently supported hundreds of Canalinos prior to the Spanish period. San Miguel which is the most westerly island and is closest to Vandenberg contains roughly 580 archaeological sites.

3.2 SOCIOECONOMIC ENVIRONMENT

The following description of the existing socioeconomic environment presents a discussion of the effects region for potential Shuttle impacts. Although the Shuttle project at Vandenberg could be expected to induce national and even international social and economic effects, discussions presented in this report focus on the area near Vandenberg where effects are most likely to be measurable.

3.2.1 THE EFFECTS REGION

The Space Shuttle project will have measurable social and economic effects in an immediate area, an intermediate area, and a regional area relative to the location of Vandenberg. The following section provides a description of the social characteristics, land use, housing market, economic profile, public services, and cultural amenities of these three effects regions.

3.2.1.1 Immediate Effects Area

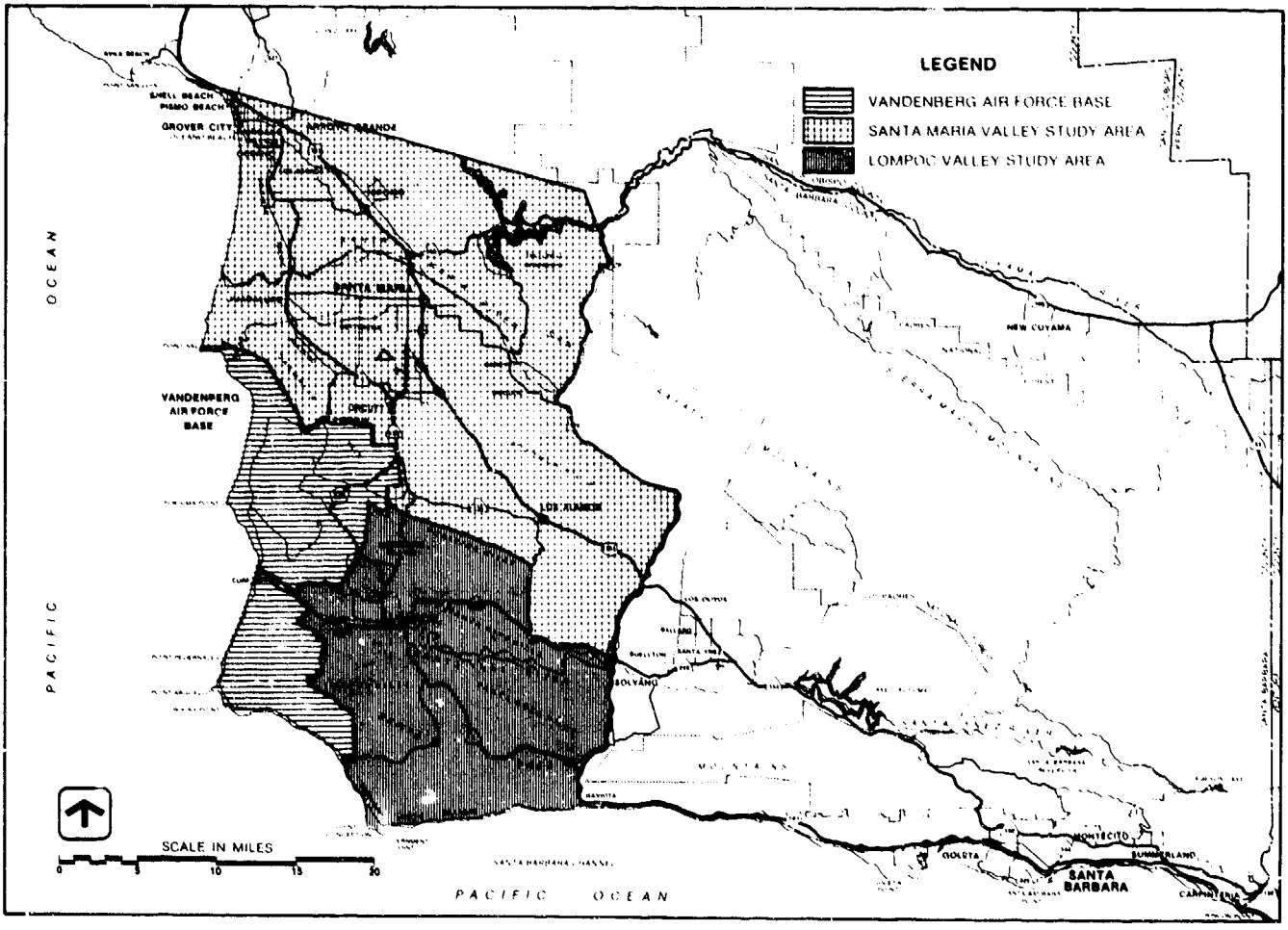
Most of the Shuttle project's social and economic effects will be concentrated within the immediate effects area. As shown on Figure 3.2.1-A, this area lies adjacent to Vandenberg Air Force Base on the north and east. Major subareas of the immediate effects area are the Lompoc and Santa Maria Valleys.

Lompoc Valley

A survey in 1974 indicated that 60 percent of the Base working population living offbase resided in the Lompoc Valley, primarily in the community of Lompoc and in the unincorporated communities of Vandenberg Village and Mission Hills.[137] Three main roads connect Vandenberg with the Lompoc Valley--the Lompoc/Casmalia Road, the Santa Lucia Canyon Road/Pine Canyon Road, and State Highway 246, also known as Ocean Avenue. The Lompoc area, with an estimated 1973 population of 36,900, provides a full range of economic services and includes a major shopping area.

Santa Maria Valley

The 1974 survey also indicated that over 35 percent of Base employees living offbase resided in the Santa Maria Valley, and almost all of these resided in either Orcutt or Santa Maria. The primary roads into VAFB are Highways 1 and 135 and the Lompoc-Casmalia Road. The Santa Maria area, with an estimated 1973 population of 53,100, provides a full range of economic services, and Santa Maria-Orcutt comprises a major shopping area.



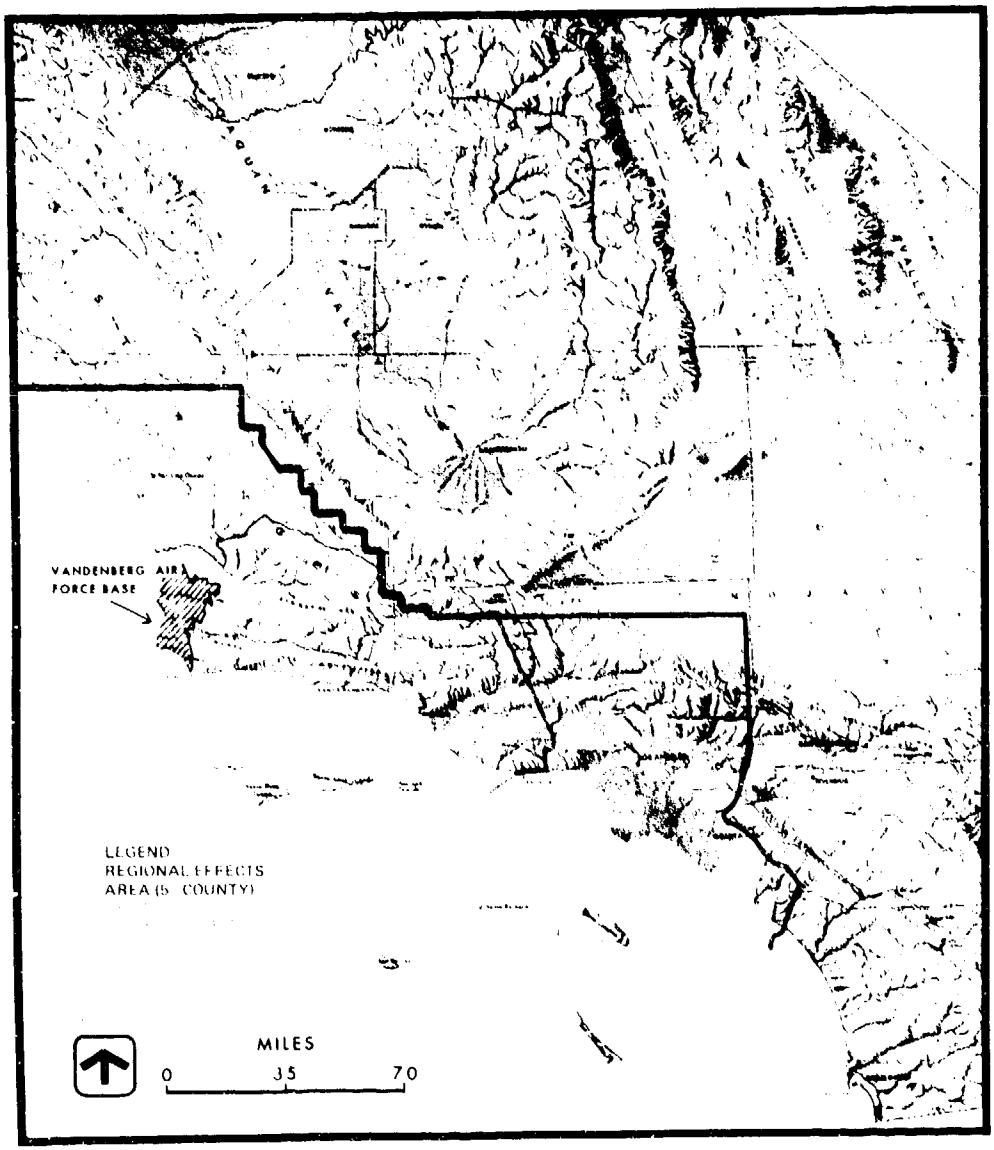
Reference: Henningson, Durham & Richardson, 1976.(35)

FIGURE 3.2.1-A. Immediate effects area of Lompoc Valley, Santa Maria Valley and Vandenberg Air Force Base.

3.2.1.2 Intermediate Effects Area

The intermediate effects area includes San Luis Obispo County, Santa Barbara County, and Ventura County, collectively termed the Tri-County area (see

Figure 3.2.1-B). Although these counties are divided by political and physical boundaries, they are economically and socially very similar. They are united by U.S. Highway 101, State Highway 1, and the Southern Pacific Railroad, and all are coastal counties with important economic activity in agriculture and services, particularly tourism. The Shuttle project will be located in Santa Barbara County, but certain aspects of this project will involve Port Hueneme in Ventura County; also, the Santa Maria Valley (which is in the immediate effects area) extends from Santa Barbara County into San Luis Obispo County. Social and economic effects of the project are therefore likely to be measurable within this region.



Reference: Henningson, Durham & Richardson, 1976.(35)

FIGURE 3.2.1-B. Intermediate and regional effects areas.

3.2.1.3 Regional Effects Area

A five-county regional area is formed by the Tri-County area and Los Angeles and Orange Counties. All five counties are linked by U.S. Highway 101 and the Southern Pacific Railroad (see Figure 3.2.1-B). Los Angeles and Orange counties are the major source of goods and services, particularly manufacturing and transportation, for the entire Southern California region including Vandenberg Air Force Base. In fact, over two-thirds of the known Space Shuttle contractors in California are located in this area.

3.2.2 SOCIAL CHARACTERISTICS

For the past 30 years, the dominant social characteristic of the effects region has been rapid population growth, stimulated by climate and economic opportunities, particularly in the aerospace industry. In the early 1970's however, growth eased somewhat, reflecting national trends.

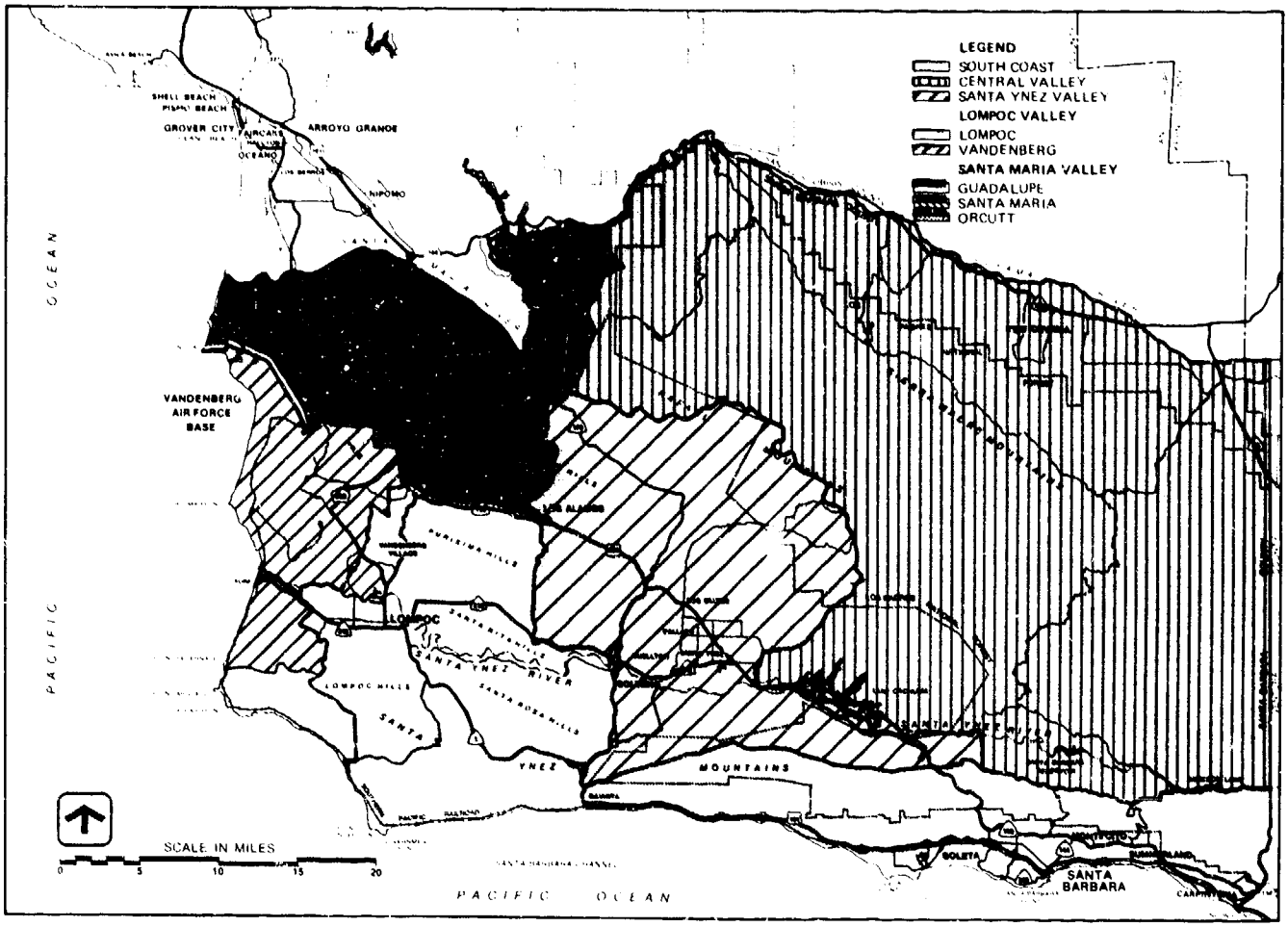
Within the Five-County region, the areas likely to experience project related population shifts are in northern Santa Barbara County and specifically in the Lompoc and Santa Maria Valleys where growth has traditionally been in close accord with activities at Vandenberg (see Figure 3.2.2-A). Consequently, the following discussion focuses on these areas.

The 1960 to 1970 percentage change in population for the areas shown on Figure 3.2.2-A is presented in Table 3.2.2-1.

Table 3.2.2-1. POPULATION CHANGE IN SANTA BARBARA COUNTY, 1960 TO 1970

Region	1960	1970	Percent change
North County	75,707	113,899	50
Lompoc Valley	(28,234)	(47,729,	(69)
Lompoc	(17,194)	(31,163)	(81)
Vandenberg	(11,040)	(16,566)	(50)
Santa Maria Valley	(39,667)	(56,630)	(43)
Santa Maria	(23,938)	(33,295)	(39)
Orcutt	(11,539)	(19,477)	(69)
Guadalupe	(4,190)	(3,858)	(-8)
Santa Ynez Valley	(6,462)	(8,328)	(29)
Central Valley	(1,344)	(1,212)	(-10)
South Coast Area	93,255	150,425	61
County total	168,962	264,324	56

Reference: Wallace and others, 1975.[162]



Reference: Wallace and others, 1975.(162)

FIGURE 3.2.2-A. Population growth analysis areas.

A tabulation of the annual growth in the North County and in both valleys between 1960 and 1973 is provided in Table 3.2.2-2. As shown in Table 3.2.2-3, recent county growth has failed to meet projections; a primary factor is a reduction in the birthrate and average household size.

3.2.2.1 Demographic Profile

Demographic information in the Five-County region is summarized in Table 3.2.2-4. Data for the principal cities of Santa Barbara County are shown in Table 3.2.2-5. The rapid growth that has characterized the region can yield a very dynamic demographic profile, but in recent years much of this growth has leveled so that 1970 census data are believed to be representative of current patterns. This is substantiated by data from the 1975 special census.(91)

Table 3.2.2-2. POPULATION GROWTH IN THE IMMEDIATE EFFECTS AREA AND SANTA BARBARA COUNTY, 1960 TO 1973[a]

Year	Vandenberg[b]	Lompoc	Santa Maria	North County[c]	Santa Barbara County
1960	12,519	14,415	20,027	75,707	169,961
1961	15,879	18,000	23,250	95,264	182,812
1962	20,485	21,000	25,625	96,945	209,231
1963	20,554	23,250	29,156	104,178	216,541
1964	20,406	24,000	30,281	107,776	227,812
1965	17,292	24,375	31,031	109,688	236,344
1966	18,517	24,625	31,469	110,872	243,562
1967	19,132	24,812	31,844	111,792	249,812
1968	17,689	24,969	32,156	112,583	255,750
1969	16,039	25,094	32,406	113,241	260,312
1970	13,568	25,284	32,749	113,899	264,324
1971	12,035	25,469	33,250	114,875	268,719
1972	12,442	25,625	33,625	115,781	272,781
1973	11,564	25,750	33,781	116,656	276,531

[a]Most data are estimates.

[b]Average working population not including onbase dependents.

[c]Includes Lompoc, Santa Maria, Santa Ynez, and Central Valleys.

References: Santa Barbara County Board of Supervisors, 1974.(98)
U.S. Air Force, 1974.(141)

Table 3.2.2-3. PRELIMINARY GROWTH FIGURES FOR SANTA BARBARA COUNTY AND CITIES, 1975

Area	4/1/70 Census	County population projections 4/1/75	10/1/75 Cities-county census	Percentage projected change	Percentage actual change
Vandenberg	16,566	12,312	10,048	-25.7	-26.0
Lompoc	25,284	26,000	24,237	+2.8	-4.2
Santa Maria	32,749	34,000	33,645	+3.8	+2.7
Guadalupe	3,145	3,281	3,062	+4.3	-2.8
Santa Barbara	70,215	73,875	72,238	+5.2	+2.4
Santa Barbara County	264,324	283,156	280,605	+7.1	+5.9

Reference: C. Pauley, 1975.(91)

Table 3.2.2-4. DEMOGRAPHIC PROFILE OF THE REGIONAL EFFECTS AREA, 1970

Criteria	Santa Barbara	San Luis Obispo	Ventura	Los Angeles	Orange
Total Population	264,324	105,690	376,430	7,003,066	1,420,386
Percent Female	50.7	47.4	50.3	41.6	50.9
Percent Non-White	4.4	4.8	3.8	14.3	2.5
Percent Married (14 and over)	59.8	58.2	65.2	59.2	65.8
Number of Families	63,721	25,630	91,366	1,7 9,331	361,062
Average Number of Persons per Housing Unit	3.1	3.1	3.5	2.8	3.2
Age Profile					
Percent 0 - 5	7.9	6.5	9.6	8.3	8.9
Percent 5 - 18	25.0	21.7	29.8	24.0	28.0
Percent 18 - 64	58.0	59.5	54.0	58.4	56.2
Percent 65+	9.1	12.3	6.6	9.3	6.9
Median Age	26.2	28.9	25.1	29.6	26.2

Reference: U.S. Department of Commerce, 1973[147] and 1971[148].

Table 3.2.2-5. DEMOGRAPHIC PROFILE OF PRINCIPAL CITIES OF SANTA BARBARA COUNTY, 1970

Criteria	Lompoc	Santa Maria	Santa Barbara
Total Population	25,284	32,749	70,215
Percent Female	48.5	51.1	54.2
Percent Non-White	6.4	5.3	4.6
Percent Married (14 and over)	64.9	64.9	53.8
Number of Families	6,340	8,241	18,053
Average Number of Persons per Housing Unit	3.4	3.2	2.5
Age Profile			
Percent 0 - 5	10.2	5.9	8.6
Percent 5 - 18	26.7	18.6	26.5
Percent 18 - 64	58.9	55.1	59.4
Percent 65+	4.2	20.4	5.5
Median Age	23.6	34.9	25.3

Reference: U.S. Department of Commerce, 1973[147] and 1971[148].

Income Levels

Income and its distribution are among the descriptors used in measuring community welfare. Because people in different income groups have different spending patterns, income distribution is also related to economic development.

Both Santa Barbara and Ventura Counties had special censuses in 1975. Some of the preliminary results of these censuses are displayed in Table 3.2.2-6.

Table 3.2.2-6. HOUSEHOLD INCOME DISTRIBUTION IN SANTA BARBARA AND VENTURA COUNTIES, 1974

Area	Under $4,000 (%)	$4,000 to $10,000 (%)	$10,000 to $15,000 (%)	$15,000 to $25,000 (%)	Over $25,000 (%)	Sample size	Median household income
Carpinteria Valley	10.8	31.2	25.2	23.4	8.6	659	$11,627
Montecito	3.7	15.4	15.2	26.6	39.1	407	$21,071
Santa Barbara[a]	20.3	36.1	20.0	13.8	7.7	4,934	$ 8,854
Goleta Area	13.9	25.1	20.4	28.9	11.4	2,872	$12,682
Santa Ynez Valley	13.3	29.5	23.4	31.6	12.1	653	$11,536
Lompoc Area	10.8	30.2	27.3	24.0	7.6	1,807	$11,643
Vandenberg[b]	1.1	11.6	30.5	50.5	6.3	95	$16,167
Santa Maria Area	12.4	32.8	29.1	22.0	3.7	1,330	$10,814
Orcutt Area	5.4	12.1	26.9	37.7	12.9	613	$15,145
Guadalupe Area	19.5	50.9	20.3	9.3	0	118	$ 7,676
Cuyama Valley	15.2	36.9	23.4	15.2	8.6	46	$ 9,571
Total County	14.8	30.6	22.6	22.5	9.5	13,534	$11,017
Ventura County[c]	10.5	26.3	26.3	27.7	9.1	90,423	NA

[a]Includes Mission Canyon.

[b]Does not include persons living onbase.

[c]In Ventura County, family income rather than household income was estimated.

References: Santa Barbara County Planning Department, 1976.(102)
Ventura County Planning Department, 1975.(161)

Relative to national trends, per capita income in Santa Barbara County, as well as in California as a whole, has fallen since 1950. Income in Santa Barbara County has declined relative to statewide averages. A recent publication of the Bureau of Economic Analysis shows that, taking the United States average per capita income (in constant 1967 dollars) as 1.00, the record and projections for California and Santa Barbara County are as follows:(149)

Year	California	Santa Barbara
1950	1.24	1.34
1969	1.14	0.95
1971	1.12	0.94
1980	1.11	0.96
1990	1.09	0.96

Occupation by Category

In occupational distribution, the immediate and intermediate effects areas are similar (see Table 3.2.2-7). The Lompoc Valley had larger fractions in the professional, technical, sales, clerical, and craftsmen categories than Santa Maria Valley had in 1970, while the latter led in operatives of all kinds, laborers, and service workers.

Table 3.2.2-7. OCCUPATIONAL DISTRIBUTION OF WORKERS (16 and older) BY AREA, 1970

Occupational category	Lompoc Valley[a] (percent)	Santa Maria Valley[b] (percent)	Santa Barbara County (percent)	San Luis Obispo County (percent)	Ventura County (percent)
Professional, Technical, and Kindred	24.3	18.1	20.8	15.7	18.8
Managers, Administrators, including Farm	10.0	9.9	10.5	11.9	10.1
Sales and Clerical Workers	28.5	21.8	24.6	22.2	23.4
Craftsmen, Foremen, and Kindred	14.7	12.7	11.4	11.9	13.8
Operatives, including Transportation	11.0	15.3	10.4	10.2	13.6
Laborers, including Farm	5.5	9.7	7.6	9.2	8.4
Service Workers, including Household	6.0	12.5	14.7	19.0	12.0
Total[c]	100.0	100.0	100.0	100.1	100.1
Total number of workers	9,728	18,948	94,980	35,687	131,901

[a]Includes the City of Lompoc, Vandenberg (U), Lompoc N (U), and Lompoc NW (U).

[b]Includes the cities of Santa Maria and Guadalupe, Orcutt (U), and Santa Maria S (U).

[c]May not sum to 100.0 percent due to rounding error.

Reference: U.S. Department of Commerce, 1971.(148)

3.2.2.2 Labor Force Size and Availability

The Five-County regional labor force in February 1976, including employed and unemployed, is summarized in Table 3.2.2-8. The Tri-County intermediate effects area made up 7.6 percent of the regional labor force, 7.6 percent of the region's employed, and 7.7 percent of the region's unemployed.

In the immediate effects area, General Research Corporation in 1971 estimated the economic split between the North County and the South Coast in Santa Barbara County. Of those employed in contract construction, about 38 percent were estimated to work in the North County.(25) Assuming that relationship still held in February 1976, about 1,140 would be so engaged (by place of work) in the North County.

In December 1975, a survey of local construction labor unions indicated that current and future construction projects in the area are not fully utilizing the available supply of skilled craftsmen.(35) Several unions indicated that numerous craftsmen (including plumbers, electrical workers, plaster and cement masons, laborers, operating engineers, carpenters, and painters) are locally available for any job, but other categories of craftsmen would have to be drawn from beyond the Tri-County and even the Five-County regional effects area. These workers may include ironworkers, millwrights, boilermakers, and asbestos workers.

Table 3.2.2-8. REGIONAL LABOR FORCE, 1976 (in thousands)

County	Civilian labor force	Employment	Unemployment		Nonagricultural wage and salaried employees	Contract construction
			Number	Rate (unadjusted)		
Los Angeles	3,245.8	2,920.3	325.5	10.0	3,055.7	89.9
Orange	797.0	736.6	60.4	7.6	586.3	21.2
Ventura	171.2	153.4	17.8	10.4	111.4	3.4
Santa Barbara	116.2	105.4	10.8	9.3	94.5	3.0
San Luis Obispo	46.5	43.1	3.4	7.3	35.1	2.6
Total	4,376.7	3,958.8	417.9	9.5%	3,883.0	120.1

References: State of California, 1976.(116)(117)(118)(119)(120)

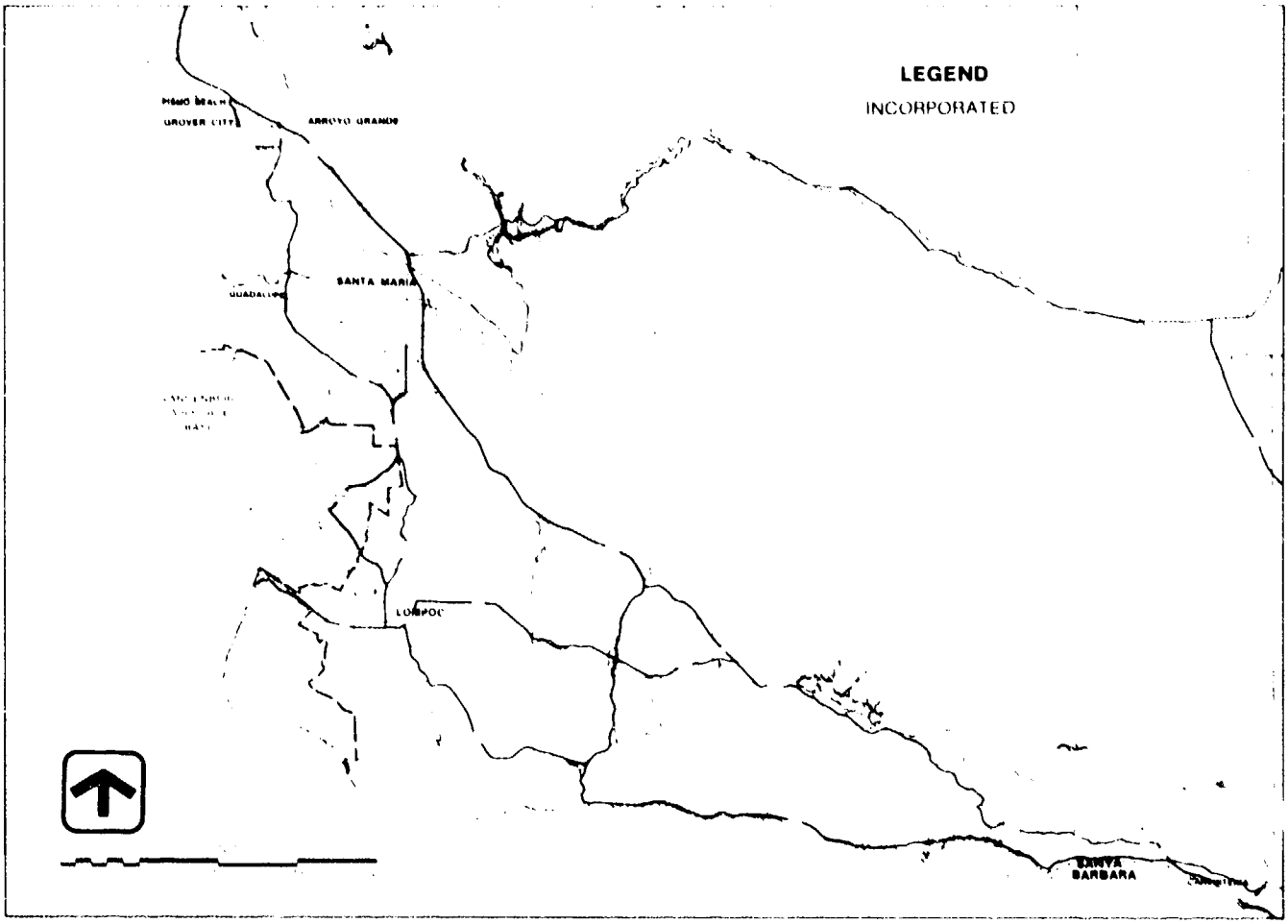
3.2.3 EXISTING LAND USE PATTERNS

Vandenberg Air Force Base is located in the northern part of Santa Barbara County and comprises 5.6 percent of the 1,753,370 acres in the county. Land use in the remainder of the county is devoted primarily to the Los Padres National Forest (44 percent), to agricultural grazing and cultivation (40 percent), and to urban development (about 2 to 3 percent). Urban development in the county is concentrated primarily in the Santa Maria, Cuyama, Lompoc, and Santa Ynez Valleys, and the southeast coastal plain.

3.2.3.1 Land Use in the Immediate Effects Area

The land along the northern and eastern boundary of the Base is primarily open space and grazing land. The nearest urban areas in the Santa Maria Valley are Casmalia, adjacent to the northern boundary of the Base; Guadalupe, 4.5 miles north of the Base; and Santa Maria-Orcutt, 2.5 miles northeast of the Base (see Figure 3.2.3-A). The Vandenberg Village-Mission Hills area, which is about 1 mile east of the Base, and the City of Lompoc, which is 5 miles southeast, form the major urban areas in the Lompoc Valley. One additional population center adjacent to the Base is the Federal Correctional Institution, which occupies 3,500 acres of land between the Base's eastern boundary and Vandenberg Village. Large agricultural areas common throughout the region form a buffer between these urban centers and Vandenberg.

Current land use patterns on and near Vandenberg are presented in Figure 3.2.3-B. Onbase, a central area--called the cantonment area--is dedicated to Base support and includes Air Force facilities, contractor areas, and housing and living support. An airfield is located a short distance northwest of the cantonment, while the remaining southwest and northwest Base areas are dedicated to missile launch facilities. A large portion of the Base is open space. A coastal corridor through the Base is allocated to the Southern Pacific Railroad.(137)

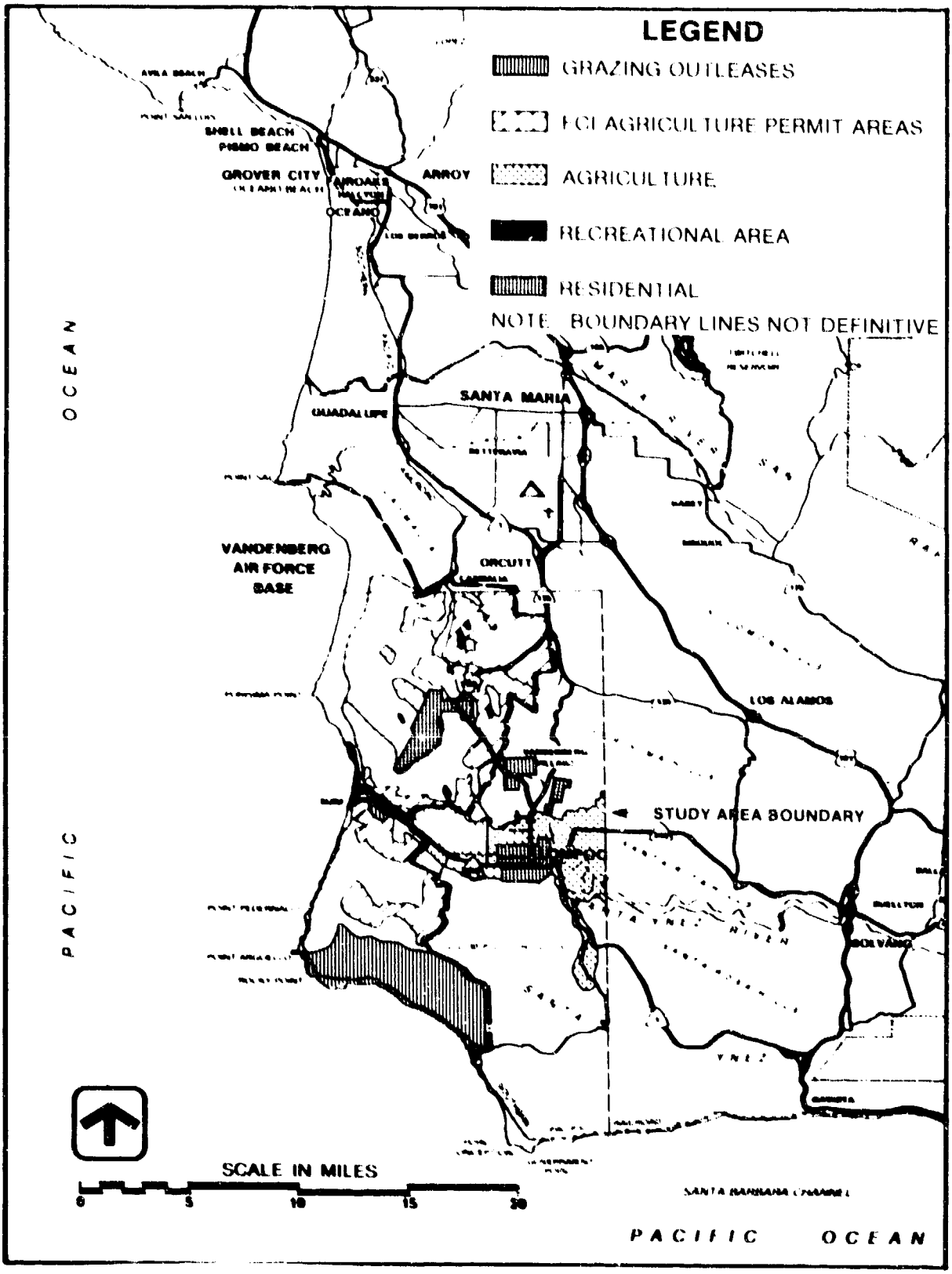


Reference: Hennings on, Durham, and Richardson, 1976.[35]

FIGURE 3.2.3-A. Incorporated and unincorporated communities in the immediate effects area.

3.2.3.2 Future Development

The key variable in determining future development patterns in the county as a whole is the future stability of agricultural uses in the vicinity of urban areas. This, in turn, will depend upon: (1) the development policies of Santa Barbara County and the five incorporated cities, (2) the possible limitations of future urban growth in the South Coast region by continuing restrictions on land, water, and existing public services, and (3) the economic viability of continued agricultural uses in selected areas.

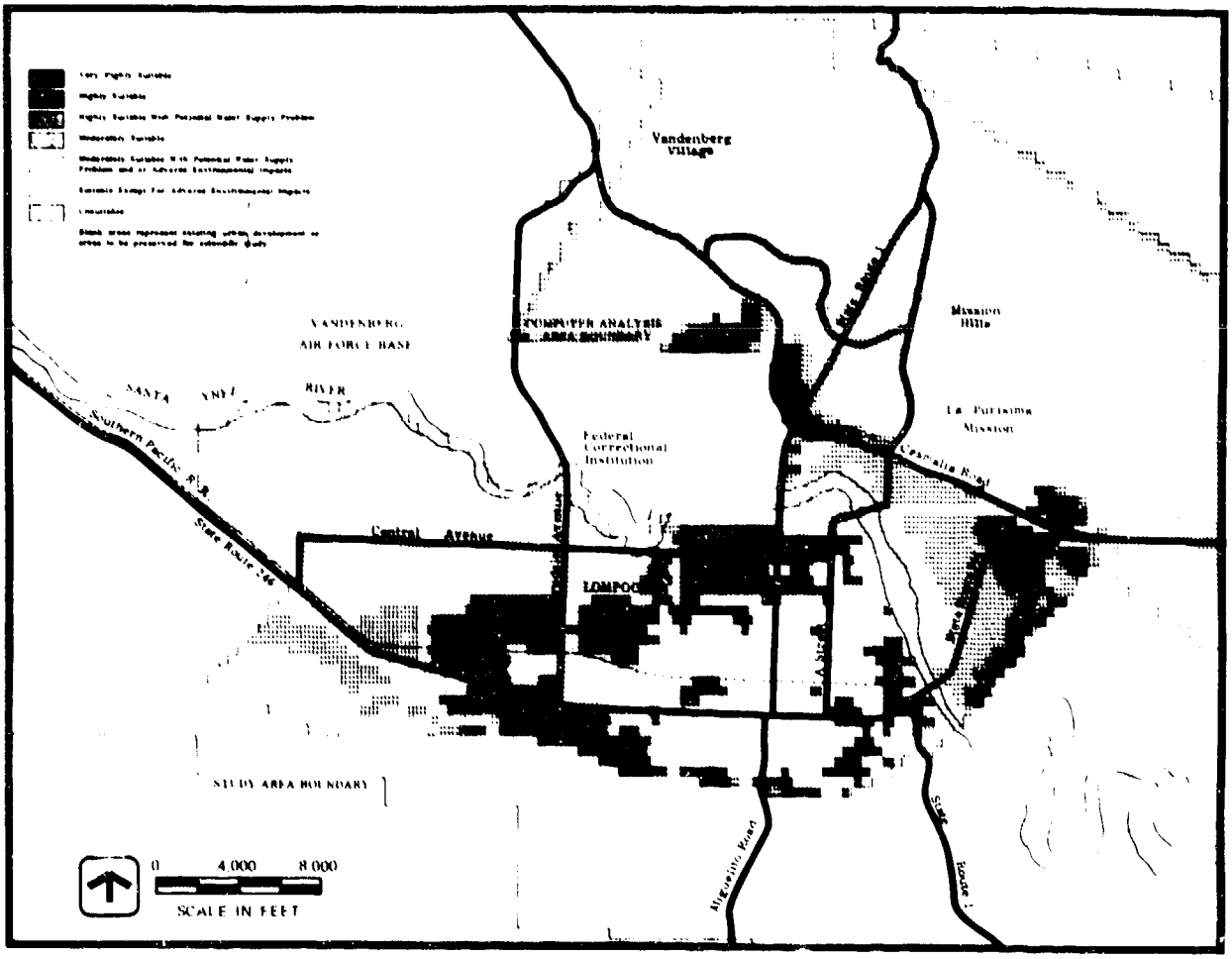


Reference: U.S. Air Force, 1975.[139]

FIGURE 3.2.3-8. Current land use for Vandenberg Air Force Base and surrounding area

The recent history of land use changes in the Lompoc and Santa Maria-Orcutt area indicates that agriculturally zoned land has gradually been developed for urban use. From the late 1950s to the early 1960s, significant urban expansion occurred simultaneously with the activation of Vandenberg Air Force Base. Lompoc's most significant expansion in the last 15 years occurred in the early 1960s.

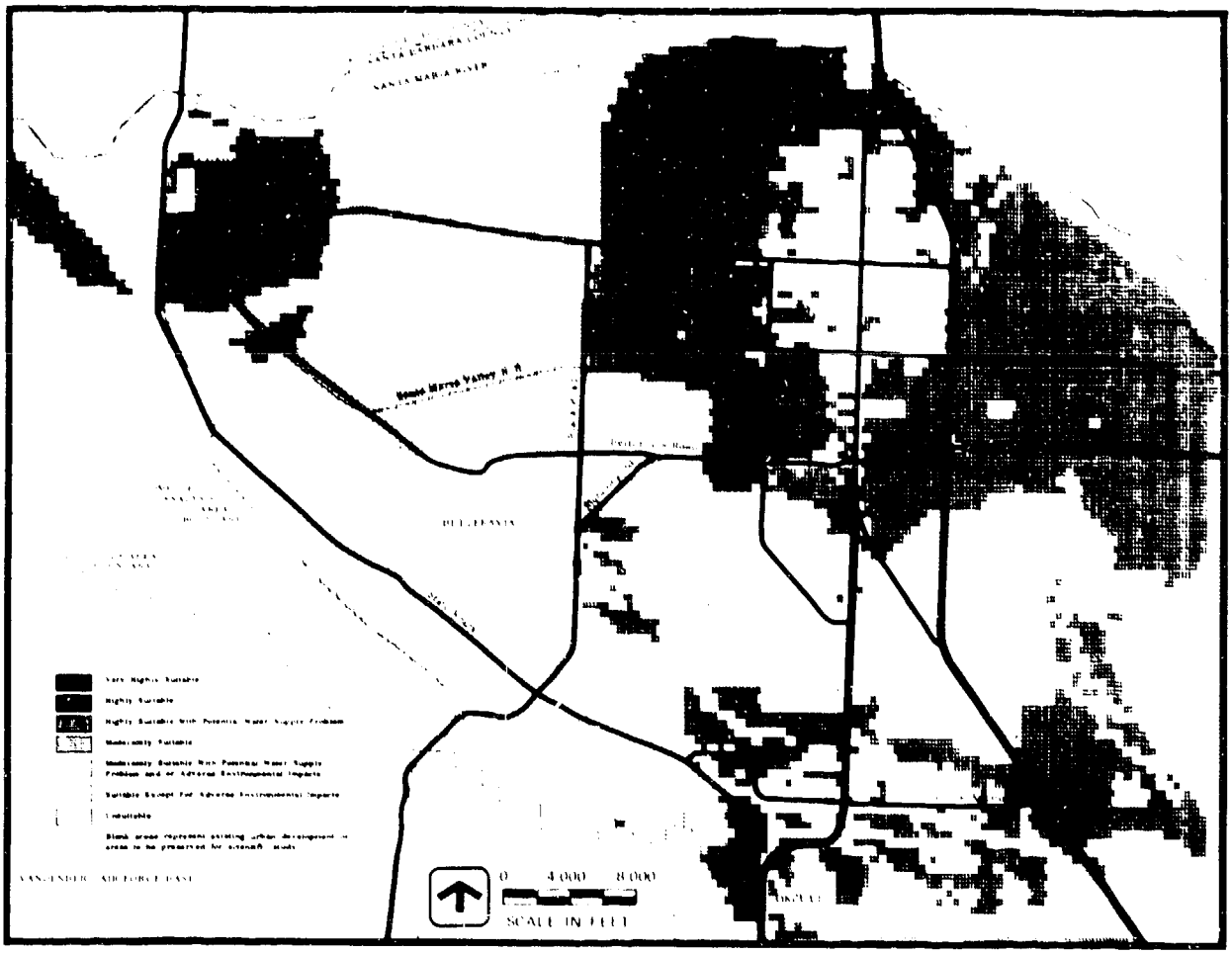
The map of the Lompoc urban study area (see Figure 3.2.3-C) shows that 790 acres are ranked as very highly suitable for urban development; of these, almost one-half are used for irrigated truck and ornamental crop production.



Reference: Henningson, Durham, and Richardson, 1976[35]

FIGURE 3.2.3-C. Suitability of land for urban development in the Lompoc urban study area.

The Open Space Element states that the greatest opportunities for urban expansion in the county exist in the Santa Maria-Orcutt study area. Over 3,500 acres are ranked as very highly suitable for urban expansion (see Figure 3.2.3-D). Urban development of the lands around Orcutt and the airport would not involve conversion of irrigated agriculture, but approximately half of the very highly suitable land northeast of Santa Maria is irrigated farmland. Overall, about 60 percent of the very highly suitable lands are not in agricultural use.



Reference: Henningson, Durham, and Richardson, 1975.[35]

FIGURE 3.2.3-D. Suitability of land for urban development in the Santa Maria-Orcutt urban study area.

Several development proposals have been made for areas east and south of Vandenberg. These include on- and offshore oil drilling, recreational facilities (including a marina), a nuclear power plant, and a liquefied natural gas (LNG) terminal. The power plant, marina and most other recreational facilities, and onshore oil exploration are not currently in active planning states. Offshore, some oil wells are already producing, and exploration for new fields is continuing. Further discussion of proposed development is provided in Section 4.0.

3.2.3.3 Land Use in the Port Hueneme Area

Port Hueneme harbor is the site of the U.S. Navy Construction Battalion Base. The City of Port Hueneme provides housing and services to the naval personnel associated with the Base.

As shown in Table 3.2.3-1, land uses in the surrounding area are predominantly agricultural open space, although recent years have seen a shift toward more residential and service/government uses. These changes represent a gradual change from a rural setting to a low density suburban pattern, and these trends are expected to continue.(20)

In the Port Hueneme harbor area, the potential for expanded industrial land use is moderate to high. The redevelopment plan for the city (adopted in 1972) calls for the demolition or rehabilitation of approximately 270 acres of land adjacent to or near the harbor. Forty acres of the land adjacent to the harbor were designated for industrial uses related to the harbor itself. The harbor has a moderate to high potential for storage and staging of marine related activities and facilities.

3.2.4 HOUSING

Table 3.2.4.1 shows a summary of the number of housing units by dwelling type with associated vacancy rates for the communities in the immediate Vandenberg area. Data presented in this table do not include military and rent-free housing. As of October 1975, there were 2,085 family housing units (about

1,800 were single family dwellings), 200 units of mobile home space, 1,429 permanent barracks spaces, 83 bachelor officers' quarters, and various transient and student housing facilities located on Vandenberg.

Transient housing is provided in the immediate area by apartments, motels, trailer space in mobile home parks, and campgrounds. Total numbers of apartment units in the communities surrounding Vandenberg are shown on Table 3.2.4-1. Santa Maria supplies the largest number of motel rooms in the immediate area with a total of 1,101 rooms; the Lompoc area provides 309 rooms; and the Buellton area supplies 218 rooms.[104][58][36] Some mobile home parks in the Vandenberg area do provide space for transient trailers and other recreational vehicles. Although no data for the Lompoc and Buellton areas were available, Santa Maria provides only about 10 to 15 spaces from the total of 14 mobile home parks in the area. In addition, there are only three campsites within 25 miles of the maingate at Vandenberg that provide spaces for trailers. These include Colson Canyon campground (10 spaces) located about 10 miles northeast of Sisquoc, Gaviota Beach State Park (59 spaces) at Gaviota, and Jalama Beach County Park (100 spaces) located about 15 miles south of Lompoc.

Table 3.2.3-1. LAND USE CHANGES FOR PORT HUENEME-OXNARD AREA, 1959 TO 1973

Category	Area (in square miles)		
	1959	1971	1973
Undeveloped Open Space	3.81	2.03	2.03
Pasture	11.53	7.01	7.01
Cultivated Land	100.90	89.23	88.21
Residential	7.42	21.13	22.10
Service/Government	10.67	16.72	16.72
Commercial	1.65	2.20	2.25
Extractive Mining	0.26	0.33	0.33
Industrial	1.79	1.37	1.37
Total	140.02	140.02	140.02

Reference: Dames & Moore, 1974.[20]

Table 3.2.4-1. SUMMARY OF HOUSING UNITS AND VACANCY RATES IN THE IMMEDIATE EFFECTS AREA, 1975

Dwelling type	Lompoc	Vandenberg Village	Mission Hills	Santa Maria	Orcutt
Single Family					
Number	5,007	1,034	760	8,291	3,160
Percent of total	59.2	79.8	99.9	67.6	89.9
Vacant	146	25	26	363	142
Vacancy rate (%)	2.9	2.4	3.7	3.2	2.6
Multi-Family					
Number	3,069	260	0	3,070	99
Percent of total	33.9	20.1	0.0	25.0	1.6
Vacant	280	2	0	168	32
Vacancy rate (%)	6.9	10.0	0.0	5.5	3.2
Mobilehomes/Trailers					
Number	382	2	1	765	309
Percent of total	6.9	0.1	0.1	6.2	8.5
Vacant	37	0	0	46	16
Vacancy rate (%)	6.3	0.0	0.0	6.0	3.1
Total Units					
Number	8,458	1,296	761	12,266	6,019
Percent of total	100.0	100.0	100.0	100.0	100.0
Vacant	383	51	28	539	193
Vacancy rate (%)	4.5	3.8	3.7	4.4	3.2

Reference: Security Pacific Bank, 1975. (105)

An overall picture of the current distribution of dwelling units in Oxnard, Ventura, Port Hueneme, and Ventura County as a whole, including trailers and group quarters, is provided in Table 3.2.4-2. These figures are based on first-count summary data of the 1975 special census for Ventura County. (160)

Table 3.2.4-2. HOUSING STOCK AND VACANCY RATES IN PORT HUENEME, OXNARD, AND VENTURA, 1975

Type of dwelling unit	Community		
	Port Hueneme	Oxnard	Ventura
Single Family			
Number	3,185	16,031	15,578
Percent of total	53.3	56.1	62.5
Vacant	121	769	714
Vacancy rate (%)	3.8	4.8	4.6
Multi-Family			
Number	2,727	10,325	7,820
Percent of total	45.6	36.1	31.4
Vacant	754	1,799	869
Vacancy rate (%)	27.6	16.8	11.1
Mobilehomes/Trailers			
Number	65	2,245	1,530
Percent of total	1.1	7.8	6.1
Vacant	11	105	42
Vacancy rate (%)	16.9	4.7	2.8
Total Units			
Number	5,977	28,601	24,928
Percent of total	100.0	100.0	100.0
Vacant	886	2,613	1,625
Vacancy rate (%)	14.8	9.1	6.5

Reference: Ventura County Environmental Resources Agency, 1975. (160)

3.2.5 ECONOMIC PROFILE

3.2.5.1 Regional and Intermediate Effects Area

A breakdown of personal income and labor earnings by industrial sectors (per the Standard Industrial Classification) of the Five-County region in 1972 is provided in Table 3.2.5-1. Another major dimension, employment, is displayed in Table 3.2.5-2. A primary reason for including Los Angeles and Orange Counties in the regional effects area was their large manufacturing capacities and special and highly developed aerospace products. Much of the ground support equipment procurement, in scale and kind, would be beyond the capabilities of the manufacturing firms in the Tri-County area.

3.2.5.2 Santa Barbara County

Since January 1974, labor force statistics for Santa Barbara County (and for all other California counties) have been compiled by the State of California Employment Development Department. As in employment data reported each month for the United States, employment includes: (1) those who worked as paid employees, or in their own business, profession, or on their own farm, or who worked 15 hours or more as unpaid workers in a family enterprise, and (2) those who were not working but who had jobs or businesses from which they were temporarily absent because of illness, bad weather, vacation, labor management dispute, or personal reasons, whether or not they were paid for the time off.

Unemployed persons comprise all those who did not work during the survey week, those who made specific efforts to find jobs within the prior 4 weeks, and those who were available for work during the survey week. The unemployed are counted by place of residence.

Table 3.2.5-1. PERSONAL INCOME, BY INDUSTRY, IN FIVE-COUNTY REGION IN 1972 (in millions of 1972 dollars)

Standard Industrial Classification	Santa Barbara		San Luis Obispo		Ventura		Los Angeles		Orange	
	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent
Agriculture	37.9	4.3	1.5	0.6	80.2	7.7	63.2	0.2	5.6	0.1
Mining	9.6	1.1	1.1	0.5	19.8	1.9	138.6	0.4	35.6	0.7
Construction	46.6	5.3	33.7	13.0	65.6	6.3	1,497.2	4.7	369.9	7.7
Manufacturing	107.6	12.3	13.1	5.0	146.4	14.0	8,877.3	28.2	1,480.4	30.8
Transportation, Communication, and Utilities	36.1	4.1	25.5	9.8	46.7	4.5	2,297.9	7.3	181.2	3.8
Trade	137.9	15.8	45.8	17.6	163.0	15.6	5,690.9	18.1	804.1	16.8
Finance, Insurance, and Real Estate	(a)		8.4	3.2	33.7	3.2	2,063.3	6.5	273.3	5.7
Services	215.1	24.6	40.9	15.7	128.4	12.3	6,138.4	19.5	811.2	16.9
Other	(a)		2.3	0.9	10.2	1.0	55.3	0.2	19.6	0.4
Federal Government-Civilian	44.9	5.1	5.8	2.2	138.8	13.3	823.9	2.6	90.2	1.9
Federal Government-Military	59.3	6.8	5.4	2.1	53.3	5.1	357.1	1.1	127.6	2.7
State and Local Government	137.0	15.7	76.4	29.4	156.6	15.0	3,525.0	11.2	601.4	12.5
Total by place of work	874.8	100.0	260.2	100.0	1,042.6	100.0	31,528.1	100.0	4,800.5	100.0
Total by place of residence[b]	1,247.0	-	409.7		1,545.9	-	38,044.7	-	7,061.8	-

[a]Not available due to Bureau of the Census Disclosure Provisions.

[b]Includes residence adjustment plus property income and transfer payments.

Reference: U.S. Department of Commerce, 1974.(150)

Table 3.2.5-2. EMPLOYMENT, BY INDUSTRY, IN FIVE-COUNTY REGION FOR AUGUST 1975 (in thousands)

Standard Industrial Classification	Santa Barbara		San Luis Obispo		Ventura		Los Angeles		Orange	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Agriculture	6.5	6.6	3.4	9.4	16.7	13.0	9.4	0.3	9.3	1.6
Mining	0.7	0.7	0.1	0.3	1.7	1.3	11.1	0.4	2.2	0.4
Construction	3.4	3.5	1.2	3.3	4.2	3.3	97.9	3.2	23.8	4.1
Manufacturing	12.0	12.2	1.7	4.7	15.9	12.4	768.0	25.3	152.1	26.1
Durables	(9.0)	(9.2)	(0.8)	(2.2)	(10.0)	(7.9)	(516.3)	(16.9)	(115.9)	(19.8)
Nondurables	(3.0)	(3.1)	(0.9)	(2.5)	(5.9)	(4.6)	(253.7)	(8.3)	(36.4)	(6.2)
Transportation, Communication, and Utilities	3.0	3.1	2.4	6.6	4.4	3.4	175.4	5.8	17.7	3.0
Wholesale Trade	3.8	3.9	1.2	3.3	5.4	4.2	218.7	7.2	25.2	4.3
Retail Trade	17.0	17.3	7.9	21.8	20.5	16.0	470.4	15.5	119.4	20.4
Finance, Insurance, and Real Estate	4.1	4.2	1.0	2.1	4.2	3.3	185.8	6.1	31.8	5.5
Services	24.3	24.8	6.7	18.6	21.0	16.4	636.9	20.9	114.4	19.6
Government	21.3	21.8	10.8	29.7	34.1	26.6	465.8	15.3	87.3	14.9
Federal	(3.8)	(3.9)	(0.6)	(1.6)	(10.7)	(8.4)	(NA)	-	(8.8)	(1.5)
State and Local	(19.5)	(19.9)	(10.2)	(28.1)	(23.4)	(18.3)	(NA)	-	(78.5)	(13.4)
Total	98.1	100.1[a]	36.3	100.2[a]	128.1	99.9[a]	3,039.4	100.0	584.4	100.0

[a]May not sum to 100.0 percent due to rounding error.

References: State of California, 1975. (121)(122)(123)(124)(125)

The revised procedures have been applied back to 1970 for Santa Barbara County, and the results are shown in Table 3.2.5-3, in which the first four categories are listed by place of residence and the balance by place of work. The past earnings by industrial division (in 1967 dollars) for selected years and projections ahead to 1990 are presented in Table 3.2.5-4. The earnings data, by industrial division, are listed by place of work.

Economic data usually are provided at the countywide level of aggregation and, to a lesser extent, for selected cities. Table 3.2.5-5 contains an estimate of the division of economic activity between North County and South Coast in Santa Barbara.

Table 3.2.5-3. EMPLOYMENT IN SANTA BARBARA COUNTY, 1970-1975
(in thousands)

Category	1970	1971	1972	1973	1974	1975
Civilian labor force[a]	98.8	103.9	106.1	107.2	112.7	113.5
Employment[a]	93.6	97.4	100.2	100.9	106.0	105.1
Unemployment[a]	5.2	6.5	5.9	6.3	6.7	8.4
Unemployment percent[a]	5.3	6.3	5.6	5.9	5.9	7.4
Nonagricultural[b]						
Wage and Salary	81.3	81.6	84.6	90.1	91.9	93.0
Mining	1.0	1.0	0.8	0.7	0.7	0.7
Construction	3.6	3.4	3.3	3.6	3.4	3.2
Manufacturing	10.4	9.6	10.6	12.2	13.3	12.3
Transportation, Communication, and Utilities	3.4	3.4	3.3	3.2	3.1	3.0
Trade	18.3	18.8	19.7	21.1	20.9	21.0
Financial, Insurance, and Real Estate	3.2	3.3	3.7	4.1	4.2	4.1
Services	20.0	20.5	21.3	23.0	23.7	24.1
Federal Government	4.2	4.0	3.9	3.9	3.7	3.8
State and Local Government	17.2	17.6	18.0	18.3	18.9	20.8
Agriculture[b]	5.6	5.6	5.5	5.6	5.7	5.7

[a]By place of residence.

[b]By place of work.

References: Security Pacific Bank, 1975.(105)
State of California, 1975.(123)(124)

Table 3.2.5-4. PAST AND PROJECTED EARNINGS, BY INDUSTRY TYPE, IN SANTA BARBARA COUNTY FOR SELECTED YEARS (in thousands of 1975 dollars)

Category	1950	1969	1971	1980	1990
Agriculture	48,432	30,375	36,122	26,500	23,500
Mining	1,978	10,575	8,626	7,400	7,300
Contract Construction	11,794	45,713	38,141	61,600	87,900
Manufacturing	30,543	94,943	83,793	111,100	138,700
Transportation, Communication, and Public Utilities	9,719	27,765	28,649	46,400	68,500
Wholesale and Retail Trade	46,439	106,137	111,694	165,000	216,800
Financial, Insurance, and Real Estate	7,778	25,423	27,864	49,000	77,800
Services	18,936	168,167	175,151	318,400	497,000
Federal Government	5,016	35,444	36,804	54,800	82,500
State and Local Government	15,510	91,447	105,498	183,400	288,200
Federal Military	6,940	45,216	41,009	64,400	94,400
Total earnings	223,085	684,224	689,356	1,088,400	1,582,800
Total personal income	273,632	853,373	888,646	1,406,900	2,062,500

Reference: U.S. Department of Commerce, undated.(149)

Table 3.2.5-5. SANTA BARBARA COUNTY EMPLOYMENT DISTRIBUTION, 1971

Industry	South Coast	North County	Total	North County percent of total
Agriculture	2,652	3,749	6,401	58.6
Mining	332	591	923	64.0
Construction	2,379	1,460	3,839	38.0
Manufacturing	4,738	4,841	9,579	50.5
Transportation, Communication, and Public Utilities	1,907	1,234	3,141	39.3
Wholesale Trade	2,065	1,160	3,225	36.0
Retail Trade	8,801	6,169	14,970	41.2
Finance, Insurance, and Real Estate	2,285	728	3,013	24.2
Services	15,051	6,109	21,160	28.9
Other	8,300	4,000	12,300	32.5
Government				
Federal - Defense	-	1,800	1,800	100.0
Federal - Nondefense	1,349	851	2,200	38.7
State	400	200	600	33.3
Special District	300	200	500	40.0
County	2,465	435	2,900	15.0
City	730	870	1,600	54.4
Public Education	6,773	2,427	9,200	26.4
Total	60,527	36,824	97,351	37.8

Reference: E.N. Dodson and others, 1972.(25)

3.2.6 PUBLIC SERVICES

Public services such as education, safety, transportation, and communication are provided by both governmental agencies and private industry. Changes in the cost of services related to the Shuttle project are unlikely to be noticeable beyond the immediate effects area of the Lompoc and Santa Maria Valleys. Consequently, the focus of this section is on those areas, although some comments on possible overflow areas are also included.

3.2.6.1 Education

In October 1975, the county of Santa Barbara had a public school enrollment of 57,088 students, contained in 80 elementary and 35 unified and secondary schools. The county is serviced also by 17 parochial and 32 private or special schools, with total Fall 1974 enrollments of 3,207 and 5,442, respectively.

The Lompoc Unified School District has 3 senior high schools, 2 junior high schools, and 13 elementary schools,with a total Fall 1975 enrollment of 10,976, including 5,307 elementary and 5,669 secondary students. The elementary and secondary schools have a current capacity for 8,800 and 6,560 pupils, respectively.

Schooling for onbase personnel is provided by the Lompoc Unified School District. There are three elementary schools and one junior high school on the Base. Los Padres Elementary School, which is combined with the Martha Negus Orthopedically Handicapped Center, had a Fall 1975 enrollment of 365, with a maximum capacity of 570. Data on the other two elementary schools were not available. Vandenberg Junior High School had a Fall 1975 enrollment of 700. Base high school students commute to Cabrillo Senior High School in Vandenberg Village. Two parochial schools are also located in Lompoc. Maximum capacities for these schools are unavailable.

Twenty-five schools in six elementary districts serve the Santa Maria area. All of these districts together form the Santa Maria Secondary School District for grades 9 through 12. This district has four high schools, with a total 1975 enrollment of 4,775. At this time, both the elementary and secondary schools in Santa Maria are filled almost to capacity and, in a recent election, a bond issue to finance new construction failed.

The Santa Barbara School District supported 4,901 students in 15 elementary schools and 13,047 students in 8 secondary schools in Fall 1975. The elementary and secondary schools have a current capacity for 5,925 and 13,414 pupils, respectively. The Goleta Union School District had 6,243 pupils in 12 elementary schools in Fall 1975, with an enrollment capacity of 7,170.

The Solvang School District had 3,681 students enrolled in its elementary-junior high school in Fall 1975. The school probably could increase its enrollment by 40 to 50 pupils.

Several institutions provide higher education in Santa Barbara County. The largest of these is the University of California at Santa Barbara, with a total Fall enrollment of 14,384. The city of Santa Barbara also has a city college with a total Fall enrollment of 9,079. Santa Maria maintained a total Fall 1975 enrollment of 9,076 at Allan Hancock Junior College.

More than 2,000 students attend college-level programs at the education center onbase. The seven colleges providing these programs are Allan Hancock, Chapman, Golden Gate University, La Verne, University of California at Santa Barbara, University of Southern California, and United States International University. Courses are designed primarily for the needs of the military personnel and their dependents, but are also open to civilians in the surrounding communities. Associate, Bachelors, and Masters degrees can be earned in residence. Courses are also offered toward a Ph.D. in some selected fields.

3.2.6.2 Medical Services

In Santa Barbara County there are 10 acute care hospitals and 18 nursing care facilities currently in operation, as well as many ambulatory care facilities. The Health Manpower Education Consortium for the Channel Counties concluded that there were approximately 194 dentists and 562 physicians and surgeons practicing in Santa Barbara County in 1975. This would allow for about 2 physicians or surgeons per 1,000 people.

Lompoc has one hospital with 129 beds that provides acute, skilled, and intermediate care. The Vandenberg Air Force Base 50-bed hospital serves both active and retired military personnel and their families. The hospital has the capacity to expand to 125 beds in present facilities.

Santa Maria has three acute care hospitals and four nursing care facilities. Marian Hospital, with 125 beds, usually has full occupancy. Santa Maria Hospital has 56 beds and is currently operating at about 75 percent capacity. Valley Community Hospital has 48 beds available and operates at about 50 percent occupancy. By the criteria of the California Health Planning Standard, the facilities in Santa Maria are adequate.

Arroyo Grande Community Hospital is also in the Santa Maria Valley (in San Luis Obispo County) and has a capacity of 49 beds.[137]

3.2.6.3 Police Protection

The County Sheriff's office served the residents of Santa Barbara County with a staff of 242 officers in 1975. This allows for 1 officer for 1,157 county residents, or 0.9 officer for each 1,000 persons.

Santa Maria had 46 police officers to protect its 1975 population of 33,645. This average of 1 policeman per 731 persons provides a ratio of 1.4 officers for 1,000 persons. The smaller City of Lompoc supported a police force of 30 officers for its 1975 population of 24,200. This provides 1 policeman for every 806 persons, or 1.2 officers for 1,000 persons.

3.2.6.4 Fire Protection

Santa Barbara County has 175 firemen providing fire and rescue service for some 1,322 square miles. As of Fall 1975, there was a ratio of 0.6 firefighter to 1,000 persons. Santa Maria has 14 fulltime firemen and Lompoc has 19, for firemen per capita ratios of 0.4 and 0.8 per 1,000, respectively. Reserve personnel are available in all areas to provide added protection.

3.2.6.5 Electrical Utilities

Two companies provide electrical service to the immediate effects area. The Pacific Gas and Electric Company serves San Luis Obispo County and north Santa Barbara County, including Lompoc, Santa Maria, and Vandenberg. Southern California Edison serves the southern half of Santa Barbara County and all of Ventura County. Neither company reports any problems in providing electricity to current or projected customers at this time.

3.2.6.6 Water Supply and Distribution

Information on water supplies in Santa Barbara County is discussed in Section 3.1.3.

3.2.6.7 Wastewater Distribution and Treatment

Wastewater treatment facilities in the immediate effects area currently include city-owned plants at Lompoc and Santa Maria, government-owned plants at Vandenberg and the Federal Correctional Institution, and the Laguna Sanitation District plant serving rural Santa Maria Valley. The Naval Center at Port Hueneme is served by the City of Port Hueneme's sewage treatment plant. The South Coast area of Santa Barbara County is served by a variety of local public works departments and local sanitary districts.

Sewage from the cantonment area of North Vandenberg is transported by gravity and four lift stations to the main treatment plant. Built in 1942, with a capacity of 3 mgd, the plant still is adequate for the average base flow of 1.3 mgd, and maximum flows of 1.6 mgd. During periods of excessive rain, infiltration amounts to 0.3 mgd. Discharge from the plant currently is via an 18-inch ocean outfall, which will be replaced by a land disposal system that is currently under design. When the system is completed, the ocean outfall will be abandoned and land disposal adopted.(137) Operating at normal efficiency, the plant will adequately serve a Base population of 30,000. Thus, excess capacity is available to accommodate expected growth.

The South Vandenberg industrial area collection system is connected into a main interceptor sewer which discharges into a series of two raw sewage lagoons. The larger lagoon consists of approximately 3.2 acres and the smaller unit is approximately half that size. Raw sewage flowing into the lagoons receives treatment by sedimentation and by biological action of aerobic bacteria. There normally is no discharge from the lagoons except during extremely wet weather. Additional ponds are planned to eliminate this problem by providing expanded storage space. It is estimated that the South Vandenberg industrial area treatment system could serve an equivalent population of approximately 1,900 people.(137)

A new regional wastewater treatment facility was completed in 1977 in Lompoc. The facility provides excellent secondary treatment and nitrification increases the city's capacity from 1.7 mgd to 5 mgd. Vandenberg Village has been connected to the Lompoc system, adding an additional 0.5 mgd. Vandenberg Air Force Base has negotiated for connection to the Lompoc system. Originally the facility was designed to include service for the Federal Correctional Institution (FCI) at Lompoc; however, the FCI developed plans for a separate system. The new secondary treatment facility at FCI has a 0.3 mgd design capacity to serve a maximum of 2,350 people; no future expansion is anticipated. Average daily flow is expected to be 0.25 mgd.

The Laguna County Sanitation District near Santa Maria has just completed an addition to its sewage treatment facility. The facility presently accommodates a dry weather flow of 1.37 mgd with a design dry weather flow capacity of 1.6 mgd. The district presently serves an unincorporated population of about 19,000.(216)

A city-owned facility serves the incorporated areas of Santa Maria (approximately 35,000 people). Average daily flow in 1975 was 4.5 mgd with a peak flow of 7 mgd. Capacity for secondary treatment is 6.5 mgd. Santa Maria is studying proposals for expansion, but no decisions have been made.(195)

The Port Hueneme Wastewater Treatment Plant a secondary treatment facility serves a population of approximately 21,000; its service area includes the city of Port Hueneme, the Silver Strand and Hollywood-by-the-Sea beaches, the Channel Islands harbor area, and the Naval Construction Battalion Center at Port Hueneme. The Naval Center abandoned its treatment plant and diverted its sewage to the Port Hueneme treatment facility in 1971. At present, there are proposals pending to reroute some wastewater from the Port Hueneme plant to the nearby Oxnard plant for treatment.

The Department of Public Works of the City of Santa Barbara is presently expanding and updating its system. A new plant under construction will accommodate a population of 86,000 persons and provide secondary treatment. The Goleta Sanitary District provides sewage facilities (primary treatment) for the approximately 65,000 residents of Goleta Valley. Studies are being completed for updating the system.(188) Other local districts include the Carpinteria, Summerland, and Montecito Sanitary Districts. Each provides service to small, unincorporated communities.

3.2.6.8 Solid Waste Disposal

There are 10 solid waste transfer and disposal sites in Santa Barbara County. Each of these sites has a remaining life of at least 10 years, and with expansion of several sites and future resource recovery programs. These existing

sites would adequately serve the residents of the county for a considerable length of time. It sould be noted that both Santa Barbara County and Vandenberg Air Force Base have active recycling programs. Both programs are designed to play increasingly important roles in the handling of local solid waste.

3.2.6.9 Natural Gas Supply

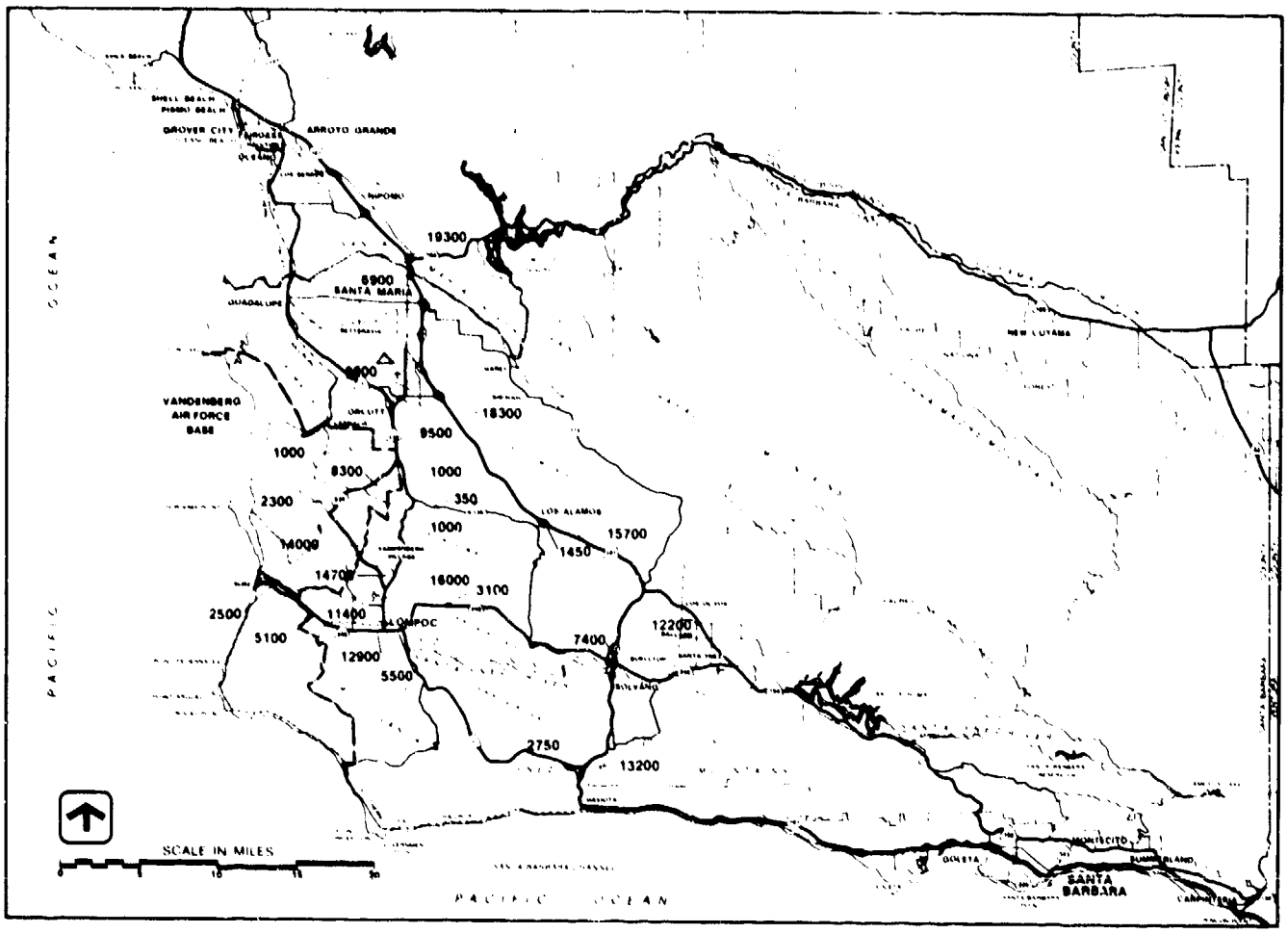
The natural gas supplier in the immediate effects area and in all of Santa Barbara County is the Southern California Gas Company. At this time Southern California Gas provides service to existing customers in the area and will provide hookup for new commercial or residential users.

3.2.6.10 Telephone Communications

Telephone communications are provided to the Lompoc-Santa Maria area, including Vandenberg Base housing, by General Telephone Company of California. Service to nonresidential Base facilities is provided by the Air Force.

3.2.6.11 Highways

The major highway in the Los Angeles to San Francisco coastal transportation corridor is U.S. 101 (see Figure 3.2.6-A). The highway is either freeway or expressway through the entire regional effects area, with the exception of 6 blocks in the City of Santa Barbara. In addition, state highways such as 1, 135, 154, and 246 fill out a network that adequately serves the area.



Reference: Henningson, Durham & Richardson, 1976.[35]

FIGURE 3.2.6-A. Major highways and average daily traffic (ADT) volumes in the vicinity of Vandenberg Air Force Base.

Average daily traffic (ADT) counts in the vicinity of Vandenberg also are shown in Figure 3.2.6-A, while Table 3.2.6-1 shows the numbers of vehicles entering various gates on the Base. To minimize congestion, work starting times are staggered at 15-minute intervals, with the peak traffic load occurring at 7:30 a.m. Those living onbase and those using car pools or public transportation to reach work (approximately 25 percent of the work force) were not counted in the survey and are not included in the table.

The limiting structures on highways near Vandenberg (for vehicles approaching from the south) are the Gaviota tunnel and the connector bridge from U.S. 101

to State 1 near Las Cruces. The tunnel is two lanes wide, with vertical clearances of 16'3" on the left edge of the pavement, 22'3" at the center line, and 14'2" at the right edge of the pavement. The connector bridge is 19 feet wide. Missile parts up to 19 feet (at legal height and weight) have been permitted to travel on U.S. 101, State 1, and State 246 to the Base.

Table 3.2.6-1. MORNING TRAFFIC VOLUME INTO VANDENBERG AIR FORCE BASE

Gate	Time of day					
	0700	0715	0730	0745	0800	Total
Pine Canyon Gate	160	484	728	618	460	2,450
Main Gate	244	582	1,130	600	900	3,456
Utah Gate	0	8	22	2	6	38
Titan Gate	6	20	196	2	146	370
13th Street Gate	38	158	142	184	130	652
South Gate	20	38	244	160	154	616
Total	468	1,290	2,462	1,566	1,796	7,582

Reference: U.S. Air Force, 1975.[137]

3.2.6-12 Rail Transportation

Three railroads provide service in the vicinity of Vandenberg: the Southern Pacific, the Santa Maria Valley, and the Ventura County Railroads. The Southern Pacific Transportation Company lines serve as the backbone of the Los Angeles-to-San Francisco coastal rail transportation corridor. Freight service is provided to most of the cities along the coast. AMTRAK passenger service is available in Oxnard, Santa Barbara, and San Luis Obispo.

Three branch lines at Vandenberg connect to the Southern Pacific main line. The Ventura County Railroad connects the Southern Pacific main line in Oxnard with the harbor facilities at Port Hueneme. The Santa Maria Valley Railroad connects the Southern Pacific main line to the Santa Maria Valley.

On the Base, Southern Pacific tracks pass directly between the launch facilities and the ocean and are therefore overflown on all launches. To minimize the potential risk to people and property, trains are not subjected to overflights. This is accomplished through close communications between the trainmaster at Surf and launch personnel at Vandenberg. An electronic surveillance system, posted schedules, and radio communication between the stationmaster and the trains or the Base are utilized to minimize overflight possibilities.

3.2.6-13 Marine Transportation

The major harbor in the Tri-County region is Port Hueneme, which is the fourth largest harbor in Southern California (by traffic volume). Annual traffic operations at Port Hueneme totaled about 1,200 inbound and outbound vessels in 1974.(142) Port Hueneme is considered capable of handling all projected traffic increases in the near future without expansion of existing facilities.(6)

In the near future, Southern California marine transportation may be affected by three major proposed projects: (1) shipment of Alaskan oil to Southern California, (2) development of oil and gas resources in the Southern California Outer Continental Shelf, and (3) importation of liquefied natural gas (LNG) to Southern California. Development of the Prudhoe Bay oil field on Alaska's North Slope will result in an estimated average increase of 0.85 oil tankers per day in Southern California waters.(153) Future petroleum production on the Southern California Outer Continental Shelf will involve survey and workboat traffic crossing shipping lanes, platform construction, well drilling, and construction of pipeline or transshipping facilities.

If any of the LNG terminal proposals is approved by the FPC, several very large LNG carriers per day will be arriving in Southern California. Accurate estimates of the number of arrivals per day are not available; however, if the largest LNG carriers being considered are used exclusively, there could be 425 arrivals per year at the proposed Point Conception port alone, resulting in a daily increase in traffic of 2.3 carriers (considering both arrivals and departures.(19)

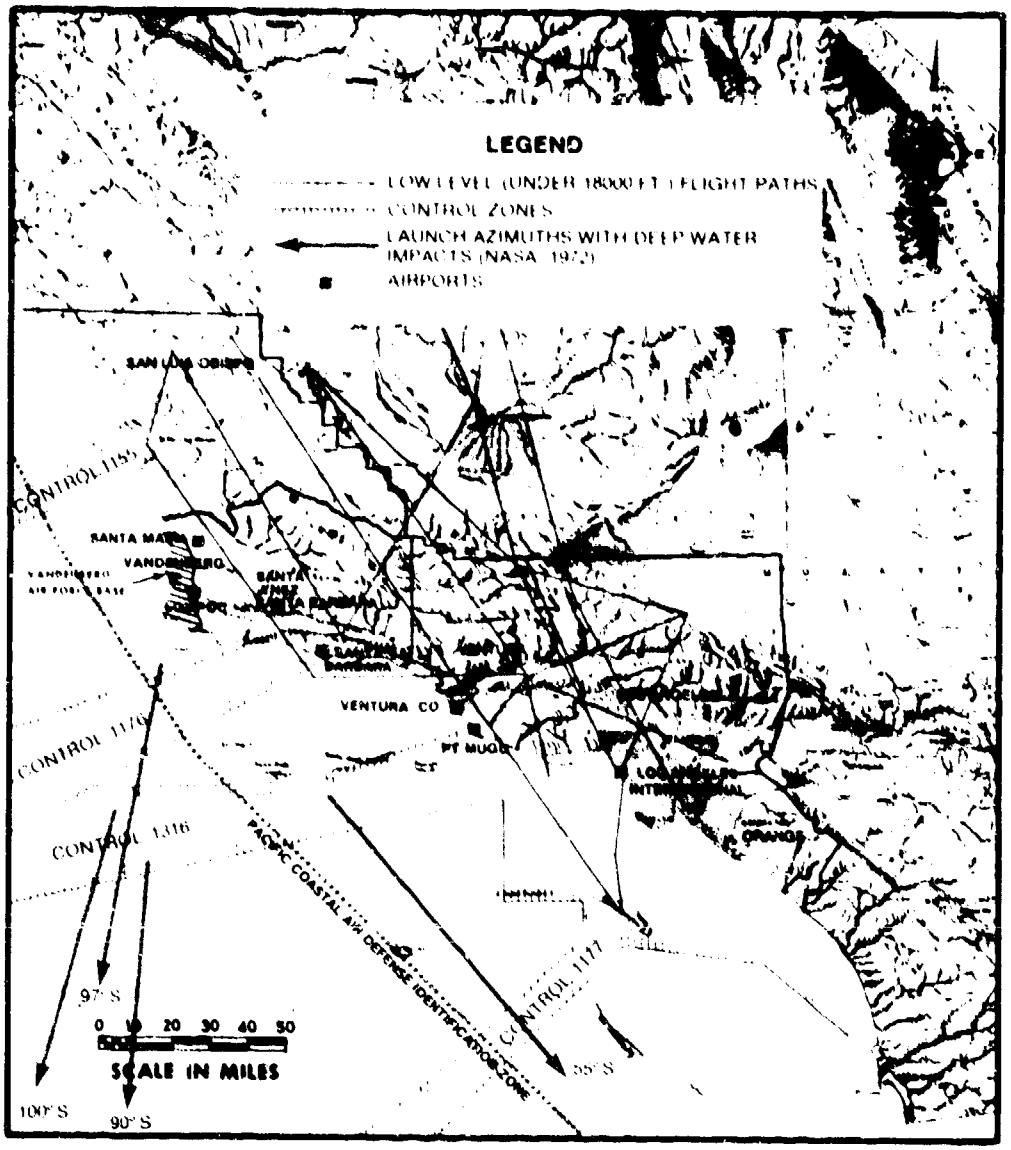
The impending development of the Elk Hills Naval Petroleum Reserve may involve Port Hueneme as the transshipment point for loading of oil tankers. If loading occurs in the port, development of Elk Hills will require up to 3 small tankers (35,000 deadweight tons) a day (6 tanker movements).

The weather along Southern California's coast is dominated by stiff northwesterly winds and waves most of the year. North of Point Conception, this weather tends to drive vessels leeward toward a rugged rocky coastline. Southeast of Point Conception, some shelter from the weather is provided by the intervening land mass. The nearest leeward hazards are the Channel Islands. The area is also noted for its frequent dense marine fogs, requiring radar for safe navigation. Offshore islands, rocks, and oil platforms present additional hazards to navigation. Use of designated shipping lanes in the Santa Barbara Channel reduce the chance of collision.

Current space and missile operations at VAFB require the designation of danger zones. Marine traffic is advised by radio broadcasts, announcements in the *Notice to Mariners*, current status announcements at local harbors, and sea and air patrols to avoid these danger zones. Launches are programmed to confine potentially dangerous debris to these danger zones, although some debris may fall outside the designated areas. There are no known instances of missile debris from Vandenberg impacting or threatening marine traffic.

3.2.6-14 Air Transportation

There are seven active airports in the vicinity of Vandenberg Air Force Base (see Figure 3.2.6-B): Santa Barbara Municipal, Santa Ynez, Lompoc, Santa Maria Public, Ventura County at Oxnard, Point Mugu Naval Air Station, and Vandenberg. Flight operations include jet air carriers, air taxis, and military aircraft, but the vast majority of operations are general aviation. It is to be noted that the Lompoc and Santa Ynez airports do not provide scheduled commercial service and Point Mugu Naval Air Station is used only by military traffic. Operations are summarized in Table 3.2.6-2.



Reference: Southern California Association of Governments, 1973.[111]

FIGURE 3.2.6-B. Air transportation corridors and Vandenberg Air Force Base launch azimuths.

There are four offshore aircraft control zones between San Luis Obispo County and Orange County (see Figure 3.2.6-B), designated Control 1155, 1176, 1316, and 1177, from north to south, respectively. All except Control 1155 are overflown by missiles on southerly launch azimuths. Because of the potential danger to aircraft, these three control zones are closed during launches. Control 1155 is available for aircraft during launches and is sufficient to handle traffic for the short time period required. Airspace directly over the Base is restricted at all times.

Table 3.2.6-2. ANNUAL AIRCRAFT OPERATIONS IN THE INTERMEDIATE EFFECTS AREA

Airfield Location	Based aircraft	Annual operations[a]
Vandenberg	11	6,754
Lompoc	40	15,300
Santa Maria	91	58,000
Santa Ynez	30	13,000
Santa Barbara Municipal	213	105,000
Ventura County	200	105,000
Point Mugu	NA[b]	35,000[c]

[a]Does not include touch-and-go operations.

[b]Not available.

[c]Includes military and civilian.

Reference: U.S. Department of Transportation, 1973.(156)

3.2.7 CULTURAL AMENITIES

3.2.7.1 Public Recreation

Community parks, public beaches, golf courses, and wilderness areas are all found within the immediate Vandenberg-Lompoc-Santa Maria vicinity. Recreational activities at these facilities include swimming, boating, surfing, fishing, hiking, biking, camping, barbecuing, field sports, golfing, picnics, and riding. Activities, facilities, and acreages for parks within the immediate effects area are summarized in Table 3.2.7-1. Although camping areas are usually filled during the summer season, other facilities are generally uncrowded.

For public safety, it is sometimes necessary to close one or more of the three nearby parks when missile launches from Vandenberg are scheduled. The type of missile and direction of the launch determine which parks, if any, need to be closed.

Table 3.2.7-1. RECREATION FACILITIES IN THE IMMEDIATE EFFECTS AREA

Name	Location	Ownership	Area (acres)	Boating	Camping	Events/Exhibits	Field Sports	Fishing	Hiking	Historic	Picnicking	Playground	Riding	Skin Diving	Swimming	Tennis	Undeveloped
Santa Barbara County																	
1. El Capitan State Park	South Coast	State	111		X			X			X				X		
2. Gaviota Beach State Park	South Coast	State	2,796	X	X			X			X				X		
3. Guadalupe Dunes Park	Guadalupe	County	26					X									
4. Jalama Beach Park	Point Conception	County	28		X			X			X						
5. Kenneth L. Adam Park	Lompoc	Federal	61								X	X					
6. La Purisima Mission State Historic Park	Lompoc	State	903			X				X	X						
7. Le Roy Park	Guadalupe	County	4								X	X					
8. Miguelito Park	Lompoc	County	4								X	X					
9. Nojoqui Falls Park	South of Solvang	County	83		X		X				X		X			X	
10. Ocean Park (Surf)	Lompoc	County	40	X				X			X						
11. Point Sal State Park	Guadalupe	State	49					X			X			X	X		
12. Refugio Beach State Park	South Coast	State	39	X	X			X			X				X		
13. Santa Maria Fairgrounds	Santa Maria	State	36			X											
14. Santa Rosa Park	Buellton	County	21								X	X					
15. Suey Park	Santa Maria	County	19										X				
16. Vandenberg Village Park (North)	Lompoc	County	20														X
17. Waller Park	Santa Maria	County	154				X				X	X					
San Luis Obispo County																	
18. Avila Beach Park	Avila Beach	County	3.5	X	X						X	X			X		
19. Grove City Park	Grover City	County	3								X	X					
20. Oceano Memorial Park	Oceano	County	7		X			X			X						
21. Pismo Beach State Park	Pismo Beach	State	959	X	X			X	X		X	X			X		

Reference: O. Wyatt, 1975.(167)

3.2.7.2 Vandenberg Air Force Base Recreation

Vandenberg has its own recreation facilities that are, with some exceptions, open to Base personnel and their guests only. These include a campground, four major picnic grounds, extensive equestrian and nature trails, designated off-road vehicle areas, and an 18-hole golf course. In addition, hunting and fishing are permitted at Vandenberg.

3.2.7.3 Marine Sportfishing

Although there is no marina development at Vandenberg, some private fishing boats from San Luis Obispo and Santa Barbara visit the area.

Any pleasure craft or fishing vessels in the Vandenberg area present a potential safety hazard during launches. Notice of a possible launch is posted in various ports and in the *Notice to Mariners*, but occasionally vessels are noted in the danger zone for a particular launch. If this occurs, the Base will send helicopters to notify the boat by loudspeakers and will attempt to notify by ship-to-shore communications or citizen band radios. If a vessel refuses to move or is slow to move, the Base normally will notify the California Game and Parks Commission or other enforcement agencies. There have been missions considered so important that launches have been made directly over the craft that have refused to leave the restricted area. The probability of damage to these vessels is considered to be very small, but the Air Force attempts to reduce even this small risk by not having vessels in the area.

3.2.7.4 Historical Setting

The earliest known permanent settlers in the area were the Chumash Indians, who used the varied food resources of the land and ocean. La Purisima Mission was founded near a Chumash village in 1787. A small town grew up

near the mission. Later, American settlers gave the town the name of Lompoc after the Indian village. Santa Maria also can trace its beginning back to the Chumash Indians.

La Purisima Mission State Historical Park, located just northeast of Lompoc (Table 3.2.7-1) is the only nationally recognized historical site in the Vandenberg region. It is registered as California State Historic Landmark No. 340 and is included in the *National Register of Historic Places*. La Purisima is the only completely restored California mission.

Other sites of historic interest in the immediate effects area include Artesia School, a Santa Barbara County landmark relocated to downtown Lompoc (formerly on the outskirts); Jesus Maria Rancho Adobe, located near Casmalia Road on the eastern edge of Vandenberg Air Force Base; Point Arguello, a historic shipping point; the Elizalde Adobe in Betteravia; the original site of La Purisima Mission located just south of the present day City of Lompoc; the Santa Maria Adobe located near the town of Garey; Sisquoc Church, a county landmark in the Sisquoc area; Manzana School also near Sisquoc; the Wickenden and Foxen Adobes in Fox Canyon; and the San Julian Ranch 10 miles south of Lompoc.(56)

The currently unused Coast Guard Station (and Boathouse) located approximately 3 miles southeast of Point Arguello on Vandenberg was constructed in 1934 and used as a base for Coast Guard personnel who tended and operated the support facilities used for safety and rescue operations.

3.2.7.5 The Channel Islands

The Channel Islands, except Anacapa, have little public access. Anacapa Island and tiny Santa Barbara Island (which is part of the Catalina Group) have been designated as a national monument. Public access to Anacapa Island is provided by commercial boat from the Channel Islands Harbor in the Ventura-Port Hueneme area. Yachtsmen and fishermen utilize the surrounding waters of all the Channel Islands for commercial and recreational fishing. However, lack of public access to most of the Islands precludes their general use. The fact that the larger islands have

remained relatively undisturbed does enhance their potential value as a regional or national cultural resource. The islands do possess unique physical, biological, and cultural (historic and archaeologic) resources and several proposals are pending to establish one or more of the islands as State or National Parks.

3.2.7.6 Aesthetics

The boundaries of Vandenberg Air Force Base enclose a wide variety of terrain. Rocky ocean points, sandy beaches, mesas, rolling hills, and flood plains can all be found within Vandenberg's 98,400 acres. The variation in terrain is matched by that of the flora. Chaparral, coastal sage, oak woodland, and grassland are represented. The facilities at Vandenberg occupy a relatively small portion of the total land area. The cantonment near the airfield on North Vandenberg represents the only area of extensive development. The terrain, flora, and comparative openness contribute to the interesting and occasionally spectacular visual appearance of Vandenberg.

Launches usually are visible from some distance. The effect is short term and intermittent, but occasional launches just after sunset have created unusual, multicolored displays. Sightings from Los Angeles, San Francisco, and even Las Vegas have been reported. Day or night launches are of very short visual duration.

While the visual effect of missile launches is generally viewed as aesthetically positive, noise effects are largely negative. The largest and noisiest missile launched to date from Vandenberg has been the Titan III. Sound levels near the launch can be very high, but the large open space onbase serves as a sound buffer zone for the nearest communities.

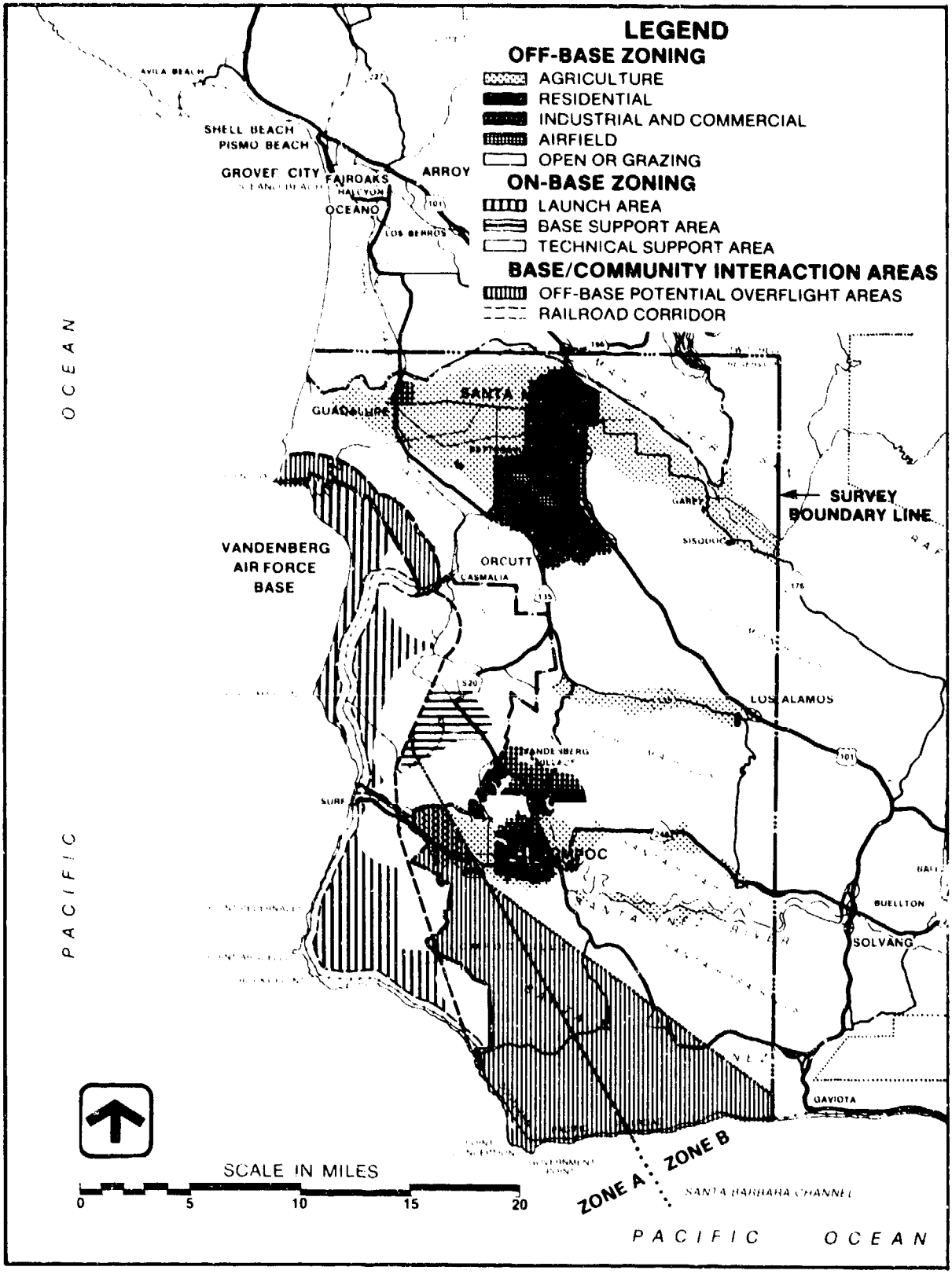
4.0 RELATIONSHIP OF PROPOSED ACTION TO LAND USE PLANS, POLICIES, AND CONTROLS

The following Section presents a discussion of local land use plans, policies, and controls as they relate to the proposed project. Further, this Section describes the compatibility of the construction and operation of the proposed project with these plans, policies, and controls. Additional detailed discussion is provided in the Reference Document for this Statement. Discussion of existing land use patterns in the project region is presented in Section 3.2.

The proposed Space Shuttle project will be developed entirely within Vandenberg and Port Hueneme harbor. Construction of new facilities or the modification of existing facilities at Vandenberg will not result in any significant or incompatible land use changes onbase. Land use change offbase is expected to occur as an indirect consequence of the proposed project, but this change will be small in extent and effect.

4.1 RELATIONSHIPS ONBASE

Construction and operation of Shuttle facilities at Vandenberg will not alter the relationships of the three general land use areas that have been designated in the VAFB Master Plan (the principal document guiding onbase land use).(139) These three areas are the Launch Area, the Base Support Area, and the Technical Support Area (see Figure 4.1-A). All three categories incorporate developed and undeveloped lands. Launch Areas are located along most of the Vandenberg coastline. Lands designated as Base Support are located in and adjacent to the cantonment area and Base housing areas. The Technical Support Areas occupy lands that buffer Launch Areas from the Base Support Areas. In addition, lands devoted to Technical Support also buffer the railroad mainline from the Launch Area and occupy areas not suitable for extensive development because of their topography or geology. Thus, these land use areas constitute the zoning for VAFB, which is based on the need to segregate launch facilities from those common facilities necessary to operate and maintain a military base.(139)



Reference: Henningson, Durham & Richardson, 1976.[35]

FIGURE 4.1-A. Current zoning for Vandenberg Air Force Base and surrounding area.

Facilities planned for the Shuttle project have been sited according to these existing land use zones. Consequently, development of Shuttle facilities at Vandenberg will not be in conflict with onbase zoning criteria.

Local and county land use plans, policies, and controls do not apply to federal lands. Consequently, there will be no direct conflict with any state or local land use regulations. It should be noted that county and state agencies cannot make legally binding land-use policy for Vandenberg.

Nevertheless, the California Coastal Zone Conservation Commission has proposed to support onbase efforts to achieve various objectives that include the preservation of coastal dunes and strand, coastal salt marsh, the intertidal zone, and such relatively undisturbed natural upland areas as the coastal terraces of South Vandenberg. These proposals may conflict with the present or future mission of VAFB. It is to be recognized that the implementation of this action may be contrary to the objectives proposed by the State Coastal Commission because the Shallow Draft Barge harbor site at Point Arguello extends across the intertidal zone and occupies part of an undeveloped coastal terrace. Also, it is possible that the development of Shuttle support facilities in this area would attract further development on the terrace. The proposed harbor facilities are planned to have a single function (which is to serve as an ET unloading point for the barge). In the future, however, it is likely that the improved harbor facility could have some additional utility for other project or non-project related activities at Vandenberg. Thus, the existence of the facility could provide an incentive for further development of the area which could be inconsistent with the objectives of the State Coastal Management Program. Construction of additional facilities on the terrace would increase the extent of land-use change and the probability that the objectives of the State Coastal Commission would be disregarded.

One special consideration that may influence use of offshore Vandenberg relates to the ownership of subtidal areas. Development of the proposed harbor in the Boathouse embayment may be subject to controversy because the State Lands Commission has jurisdiction over areas offshore of Vandenberg within 3 miles of the coast.

This ownership includes the tidelands that exist within 300 yards of the coast.(176) The State has suggested that any development within that area would require a permit from the State Lands Commission. As such, an additional review step at the State level will be necessary prior to modification of the Point Arguello Boathouse harbor.

4.2 RELATIONSHIPS OFFBASE

Offbase, the two basic tools which local governments have to guide land use are the General Plan and zoning. In recent years, the statutes of the State of California have been amended in ways that require General Plans and zoning to be consistent. As a result of this and the need to periodically update planning documents, elements of the General Plans for Santa Barbara County, Santa Maria, and Lompoc are currently in the process of revision. The status of these three General Plans is shown in Table 4.2-1. The plans for Santa Barbara County and Santa Maria are generally out-of-date and will soon be superseded by major revisions being prepared but currently unavailable. However, officials do indicate that zoning will probably be used as the primary tool for a moderate growth policy in Santa Barbara County.

Because both the Santa Barbara County and the Santa Maria General Plans are currently being revised, a detailed discussion of existing zoning and planned land use patterns in the immediate effects area would be misleading. However, it is possible to state that the proposed Land Use Element of the County's General Plan suggests that significantly less urban land than is projected in the current General Plan will be required to satisfy growth. Table 4.2-2 provides a comparison between the lands required to accommodate projected urban development under the new proposed Land Use Element and the existing General Plan.

The proposed Land Use Element points out that much of the land that the present plan proposes for development lacks water supply facilities and could not be supplied from minimal extensions of existing facilities. This fact, in conjunction with lower growth projections, has influenced the extent and location of projected urban development. As described in Section 3.2.3, the Lompoc and Santa Maria-Orcutt areas have large acreages of lands considered

Table 4.2-1. GENERAL PLAN STATUS FOR SANTA BARBARA COUNTY, LOMPOC AND SANTA MARIA

Mandated elements	County of Santa Barbara			City of Santa Maria			City of Lompoc		
	Adopted by Board of Supervisors	Plan development or revision in process	Estimated target	Adopted by City Council	Plan development or revision in process	Estimated target	Adopted by City Council	Plan development or revision in process	Estimated target
Land Use	1965 plus revisions to date	Revisions	1976	1965	Revisions	1976	1974	Revisions	Continuous
Circulation	1965 plus revisions to date	Revisions	1976	1965	Revisions	1976	1967	Revisions	Not estimated
Housing	1969 (initial)	Revisions	1977	No	Development	1976	1975	Revisions	Continuous
Open Space	1973 (interim)	Revisions	1976	1973	Revisions	1976	1974	-	-
Conservation	No	Development	1976	No	Development	1976	1974	-	-
Seismic Safety	No	Development	1976	No	Development	1976	1974	-	-
Scenic Highways	1975	No	-	No	Development	1976	1974	-	-
Noise	No	Development	1976	No	Development	1976	1974	-	-
Safety	No	Development	1976	No	Development	1976	1975	-	-
Permissive elements									
Public Buildings	1965	No	-	1967	No	-	-	-	-
Public Facilities	1965	No	-	1968	Revisions	1976	1965	-	-
Parks and Recreation	1965	Revisions	1976	1972	No	-	-	-	-
Equestrian and Hiking Trails	1969	Revisions	1976	-	-	-	1965	-	-
Bikeways	1975 (partial)	Development	Not estimated	-	-	-	1974	Revisions	1976 (long-range plan)
Water and Sewer	-	-	-	-	-	-	1972	-	-

References: **Kammer**, 1975.[44]
Kaufman, 1975.[45]
Lucien, 1975.[59]
Livingston and Blayney, 19..[55,56]

Table 4.2-2. COMPARISON OF EXISTING AND PLANNED (1990) LAND USE IN SANTA BARBARA COUNTY BY CATEGORY (in acres)

Land use	South Coast	Santa Ynez Valley	Lompoc	Santa Maria Orcutt	Balance of County
Residential[a]					
Existing Land Use[b]	22,760	1,680	3,700	5,550	3,400[c]
Proposed General Plan	27,630	2,790	4,850	7,690	3,720[c]
Existing General Plan	40,220	4,000	10,290	13,220	4,460[c]
Commercial and Office[d]					
Existing Land Use[b]	1,420	230	210	550	40
Proposed General Plan	1,450	280	440	670	60
Existing General Plan	1,490	490	600	1,140	150
Industrial[e]					
Existing Land Use[b]	2,120	170	330	5,150	700
Proposed General Plan	2,600	220	670	5,330	930
Existing General Plan	2,930	390	1,100	7,110	960
Total					
Existing Land Use[b]	26,300	2,080	4,240	11,250	4,140
Proposed General Plan	31,680	3,290	5,960	13,690	4,710
Existing General Plan	44,640	4,880	11,990	21,470	5,570

[a] Includes streets, schools, parks, and other community facilities.

[b] Estimated acreages derived from tabulation of the number of grid cells in each land use category; total includes streets.

[c] Includes residential on Vandenberg Air Force Base.

[d] Includes hotels, motels, and resorts.

[e] Includes public utilities and transportation facilities.

Reference: Livingston and Blayney, 1975.(54)

highly suitable for urban development. In fact, the greatest opportunity for urban expansion in Santa Barbara County exists in the area between Orcutt and Santa Maria.(54)

In Lompoc, the recently adopted (1974) land use policies and standards are generally indicative of how the community will develop in the next several years. The objectives for land development in the city enumerated in Lompoc's Land Use Plan Element provide for a linear trade district for the Lompoc Valley, prevention of incompatible land uses, and the preservation of agriculture as one of the basic land uses of the planning area.(57) Further, new commercial and residential development will be planned to in-fill existing undeveloped urban areas, rather than displace agricultural lands adjacent to the city. The standards which the City of Lompoc adopted to realize these general objectives include a projected population of 58,000 in the planning area by 1980 and 71,000 by 1990. Control of land use is to be achieved through the provisions of the zoning ordinance. Growth of the city will be

generally northward, with significant amounts of land restricted for industrial use; prime farmland east and west of the city will be protected from development. Population will be concentrated in three areas of the Lompoc Valley much as it is today. In addition, Vandenberg Village and Missions Hills are planned to be incorporated into the City of Lompoc before 1990. (57)

As an indirect consequence of construction and operation of the proposed project, some additional urban land will be required in northern Santa Barbara County. This land requirement will result from growth pressures induced by the Shuttle project at Vandenberg. Expected Shuttle-related urban land requirements have been measured against the projected urban land requirements for the North County presented under the moderate growth scenario of the Santa Barbara County Proposed Comprehensive Plan. A comparison of projected Shuttle-related land requirements with those projected in the County Proposed Comprehensive Plan is presented in Table 4.2-3. Data presented in this table are for the 1990 time frame. However, it is expected that all of the urban land development required as a consequence of the proposed project will be realized by 1983 (the beginning of the operations phase).

Table 4.2-3. NORTH COUNTY OFFBASE LAND REQUIREMENTS FOR PROJECTED DEVELOPMENT TO 1990

Land use category	Additional land required (acres)		
	Without Shuttle	For Shuttle	With Shuttle
Residential	1,961	67	2,028
Industrial	64	11	75
Retail Trade	77	2	79
Commercial	31	0	31
Office	13	1	14

Reference: Henningson, Durham & Richardson, 1976. (35)

As discussed in Section 3.2.3, ample developable land exists in both the Lompoc and Santa Maria-Orcutt areas to accommodate Shuttle and non-Shuttle related growth without significant encroachment upon existing agricultural lands. In the Lompoc area it is expected that future residential development will be concentrated near Vandenberg Village and Mission Hills because of their proximity to Vandenberg and the many recent residential construction starts in these two areas. Industrial development is more likely to occur closer to the city in the area near the airport. Office development probably will occur as in-fill in the downtown area along Ocean and H Streets where necessary zoning exists. In the Santa Maria-Orcutt area, Shuttle related development is likely to occur around Orcutt, which is closer to the Base than Santa Maria and which has recently experienced residential and commercial-industrial development.

Shuttle related land use change is expected to constitute a relatively small percentage (less than 10 percent) of the total new urban land requirements in the 1975 to 1990 time frame.(35) Consequently, the indirect impact of the proposed project on offbase land use is considered small. Assuming that agriculture continues as a viable land use (both the Santa Barbara County Proposed Comprehensive Plan and the Lompoc General Plan support the preservation of agricultural lands), little conversion of agricultural land to urban uses would be expected. In addition, it is to be noted that North County areas, particularly the Lompoc area (which is likely to experience the greatest Shuttle related impact) are interested in attracting additional development beyond that projected in the County Proposed Comprehensive Plan.(35) One objection to this plan has been an insufficient allocation for development in the Lompoc area. Thus, the proposed project will add somewhat to the projected urban development of the area and would help to bring Lompoc's growth more in line with local preferences.(35)

An additional consequence of the proposed project relates specifically to the Operations phase. The region due south and southeast of the Base is regarded as an area that could be subjected to hazardous overflights by missiles. This area is designated in the Master Plan for VAFB as a region

where nondevelopment leases should be secured or retained (see Figure 4.1-A).[139] Although this area is a sparsely populated, unincorporated portion of Santa Barbara County, future development there could increase the safety hazards associated with existing or proposed launch programs at Vandenberg. Pressure for development of this area is considered low, and as long as this situation continues, land use (currently agricultural and open space) will remain compatible with VAFB operations. It is to be noted that the parks located at Ocean Beach and Jalama are closed for some launches. It is expected that proposed project operations will also require occasional closure of these public recreational areas. Consequently, there will be an impact of minor importance to the recreational utility of lands in these two areas.

In addition, an LNG ship terminal and processing facility has been proposed at Point Conception. The Air Force has evaluated this proposal and considers it compatible with existing and planned operations at Vandenberg. Offshore oil development south and west of the Base has also been evaluated and is not considered objectionable from the standpoint of public safety. However, lease sales in certain offshore areas near Vandenberg have included stipulations that require evacuation of platforms prior to a launch.[222]

At Port Hueneme and in the surrounding communities, the construction and operation of harbor support facilities is not expected to result in any land use change. The area where the Disassembly Facility and the Solid Rocket Booster Wash Facility will be constructed is already in an industrial land use. Further, the construction and operations labor forces are small and any induced land use change outside the harbor area (that is, project related increases in residential land) are expected to be unmeasurable.

In summary, the proposed action will result in land use change in the immediate effects area. However, the potential effects of the project are considered generally compatible with existing plans, policies, and controls. Projected Shuttle related development both on and offbase should not be extensive and is not expected to cause significant impacts.

5.0 ENVIRONMENTAL IMPACT OF THE PROPOSED PROJECT

The evaluation of the proposed project's impact on the environment covers both construction and operation of the Space Shuttle ground support facilities at Vandenberg Air Force Base. Impacts associated with launch and ascent of the Space Shuttle Vehicle and descent of the Orbiter are included only to the extent of their occurrence in the lower atmosphere. Other system related impacts (those that might occur in the upper atmosphere and in space, and those that may result from atmospheric reentry and ocean impact of the External Tank and Solid Rocket Boosters and recovery of the latter) have been addressed in the National Aeronautics and Space Administration's (NASA's) Draft Environmental Statement of July 1977.

For this Statement, evaluation of the environmental impact of the proposed action is accomplished with the aid of seven matrices (Matrices 5.0-A through -G), each representing a particular element of the project. These project elements are listed as follows:

(1) Modification and expansion of landing and taxiing facilities and activities at the VAFB airfield.

(2) Orbiter processing facilities and activities at the VAFB airfield.

(3) Space Shuttle ground support facilities and activities at Port Hueneme, California.

(4) Shallow Draft Barge landing facilities and activities at VAFB.

(5) Modification and expansion of existing tow route, tow road, and corridor between Shuttle support facilities and Space Launch Complex No. 6 (SLC-6) and expansion of its use.

(6) Modification and expansion of SLC-6 support facilities and activities and Titan III SRM Facility at VAFB.

(7) Modification and expansion of the existing launch pad facility and activities at SLC-6.

Each matrix was constructed in a manner enabling the impacts of specific aspects of each project element to be identified. As noted in Matrices 5.0-A through -G, both the construction and operational components of each project element are separately represented. Impacting situations are denoted by the physical presence of one or two symbols within individual matrix boxes.

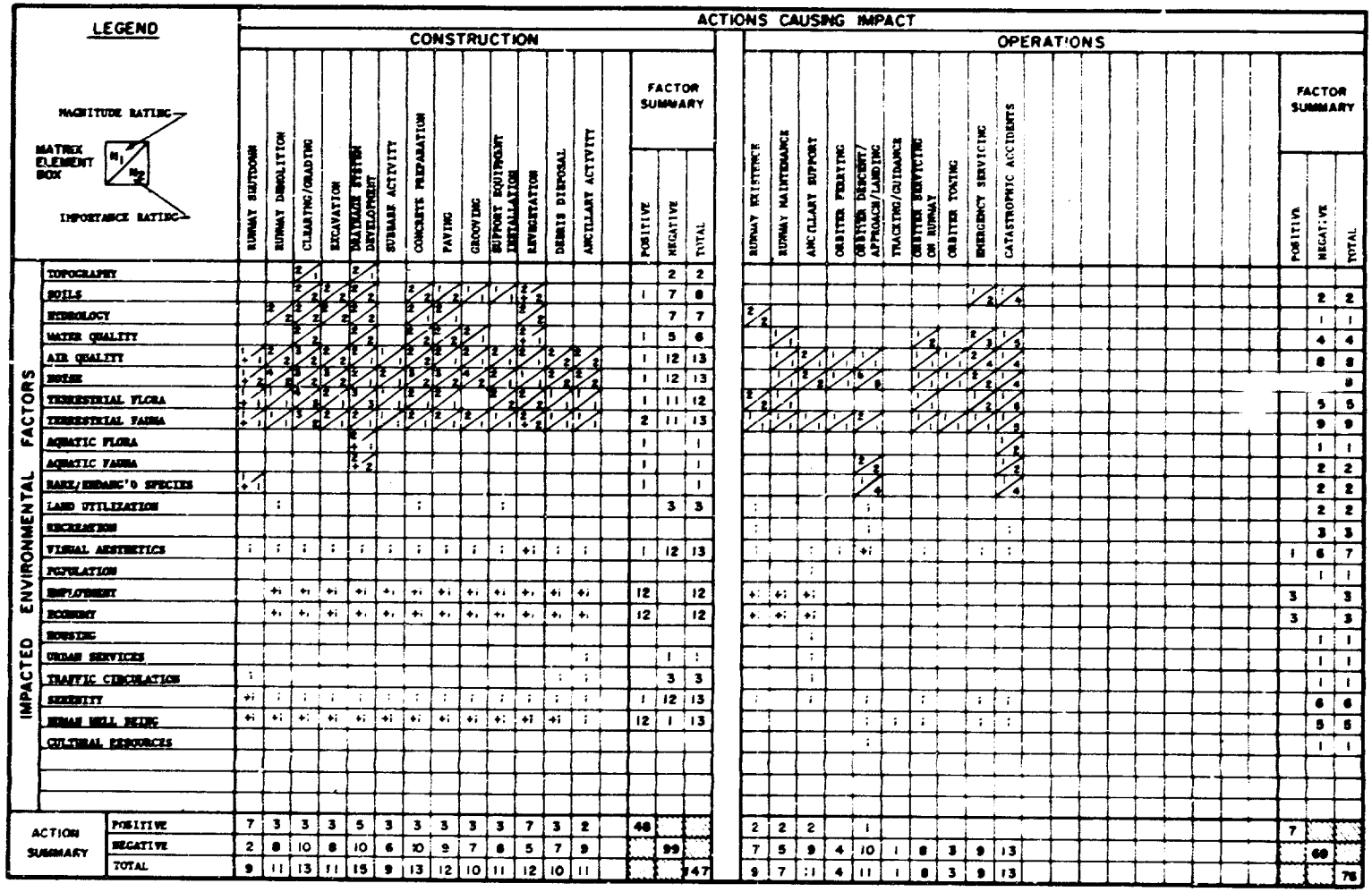
Although all impacting situations, regardless of type, were identified on the impact matrices, only those of a physical/chemical/biological/archaeological nature were amenable to evaluation and, hence, rating on an individual basis; those of a socioeconomic nature were not because they were the indirect result of groups of individual actions. Accordingly, the former are identified by matrix boxes containing two numbers (ratings) separated by a diagonal line, whereas the latter are identified by matrix boxes containing the letter "i". The numerical ratings represent "word weights" on a scale of 1 to 10 as follows:

Rating Numbers	Word Weight
1	Insignificant
2	Minimal
3	Minor
4	Discernible
5	Moderate
6	Significant
7	Substantial
8	Great
9	Major
10	Extreme

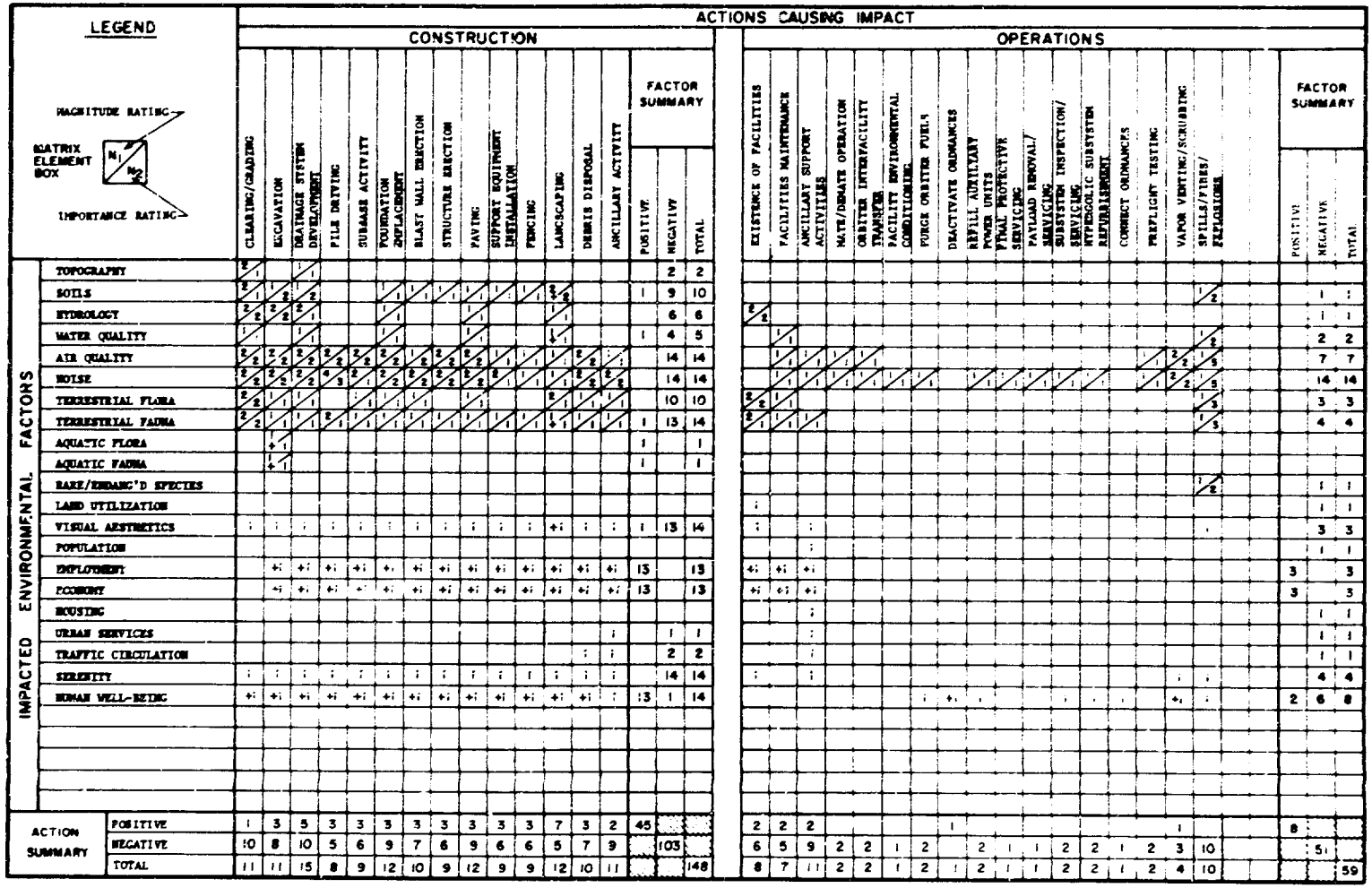
The upper left-hand number relates to the magnitude (degree, extensiveness, scale, probability of occurrence) of the impact on a particular environmental factor. The lower right-hand number weights the importance (significance) of the impact as it relates to the existing environment as a whole. For cases where a particular impact comprises both positive and negative attributes, a rating within a particular matrix box represents a summary of the net effect. All impacting situations are negative unless otherwise indicated as positive (+).

The positive, negative, and total results of each matrix are summarized at the bottom (as the number of impacts per specific action), to the right (as

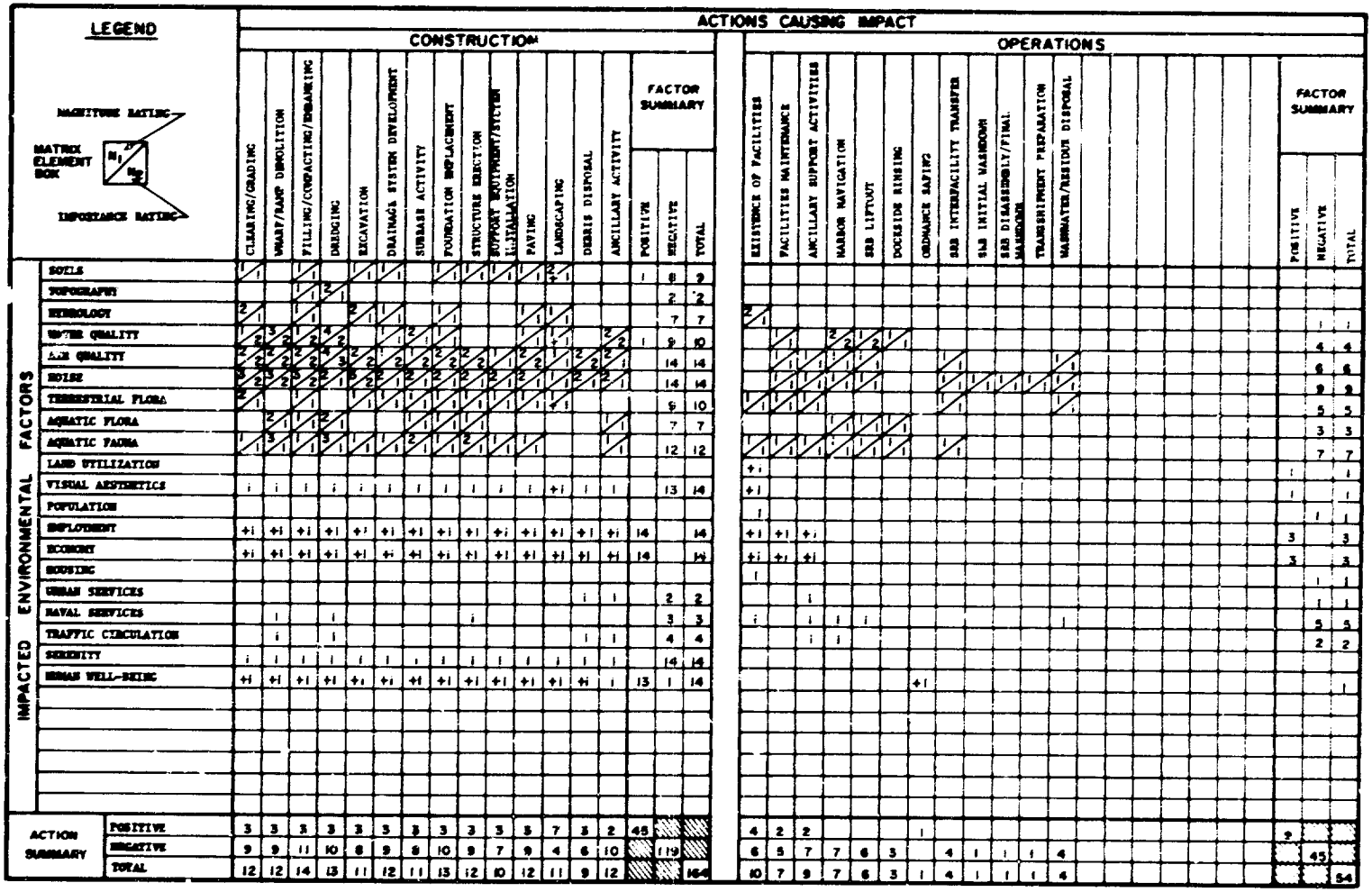
Matrix 5.0-A. IMPACT SUMMARY FOR PROPOSED MODIFICATION/EXPANSION OF LANDING AND TAXIING FACILITIES/ACTIVITIES AT VAFB AIRFIELD



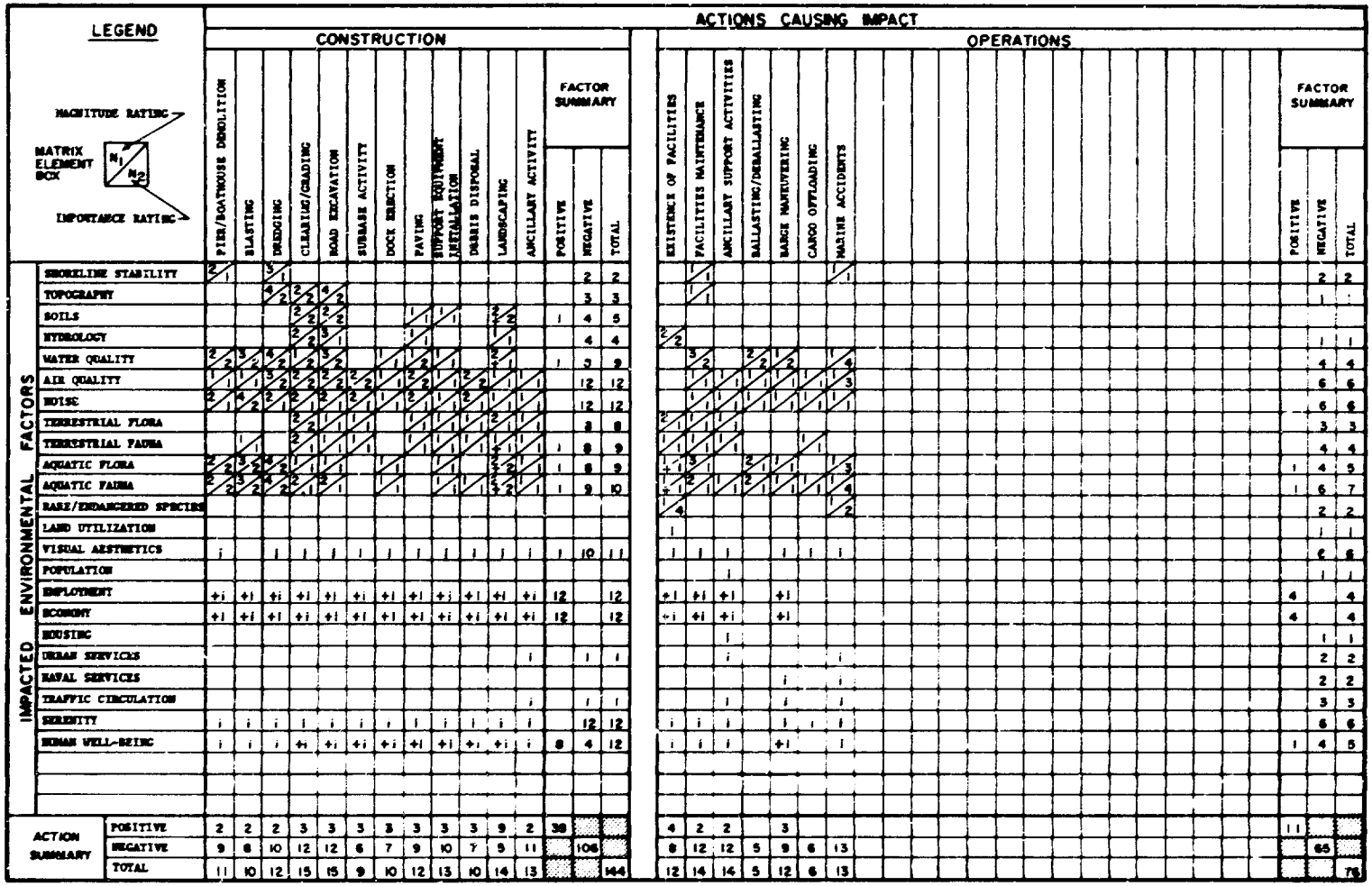
Matrix 5.0-B. IMPACT SUMMARY FOR PROPOSED ORBITER PROCESSING FACILITIES/ACTIVITIES AT VAFB AIRFIELD



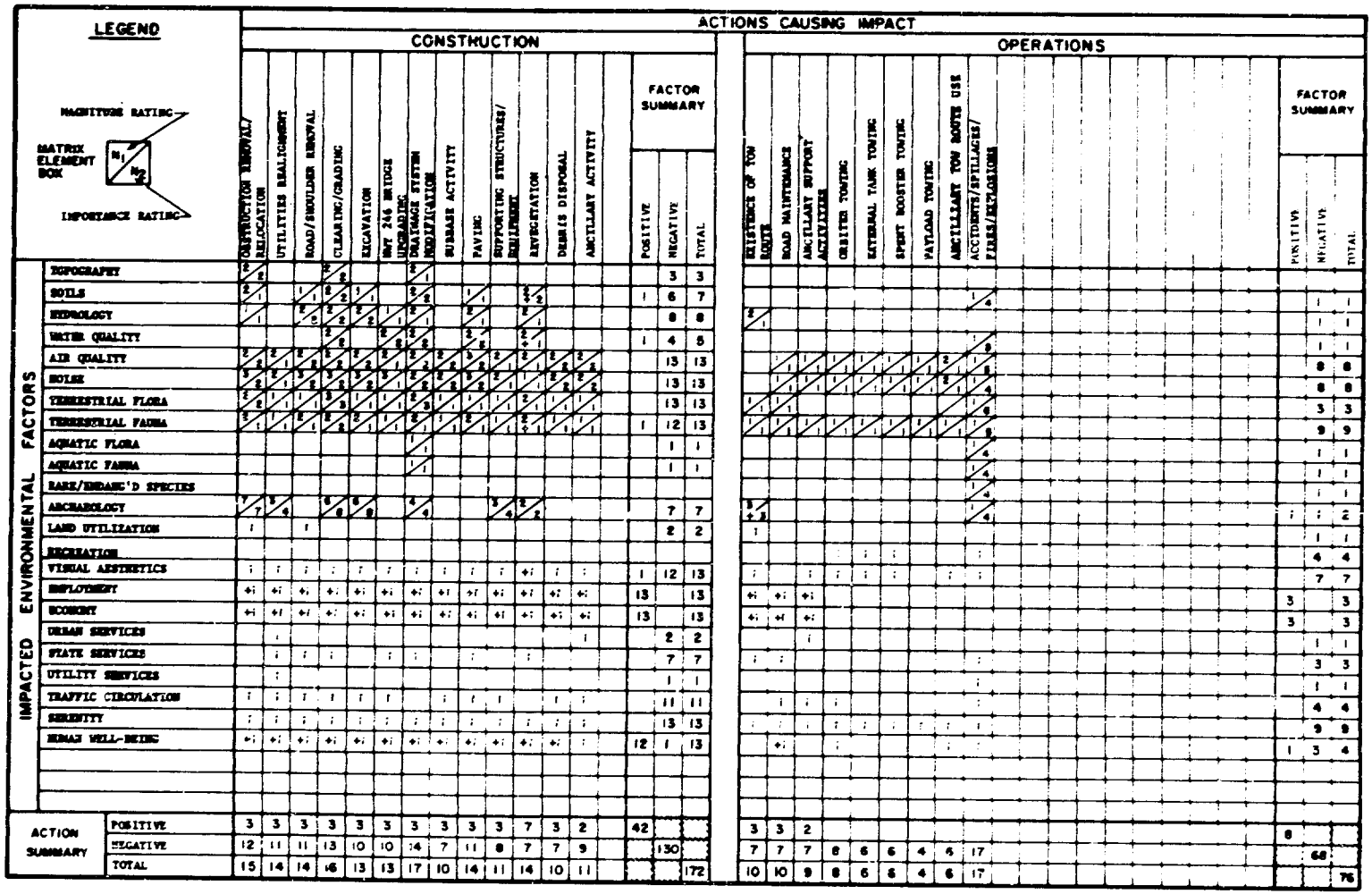
Matrix 5.0-C. IMPACT SUMMARY FOR PROPOSED SUPPORT FACILITIES/ACTIVITIES AT PORT HUENEME



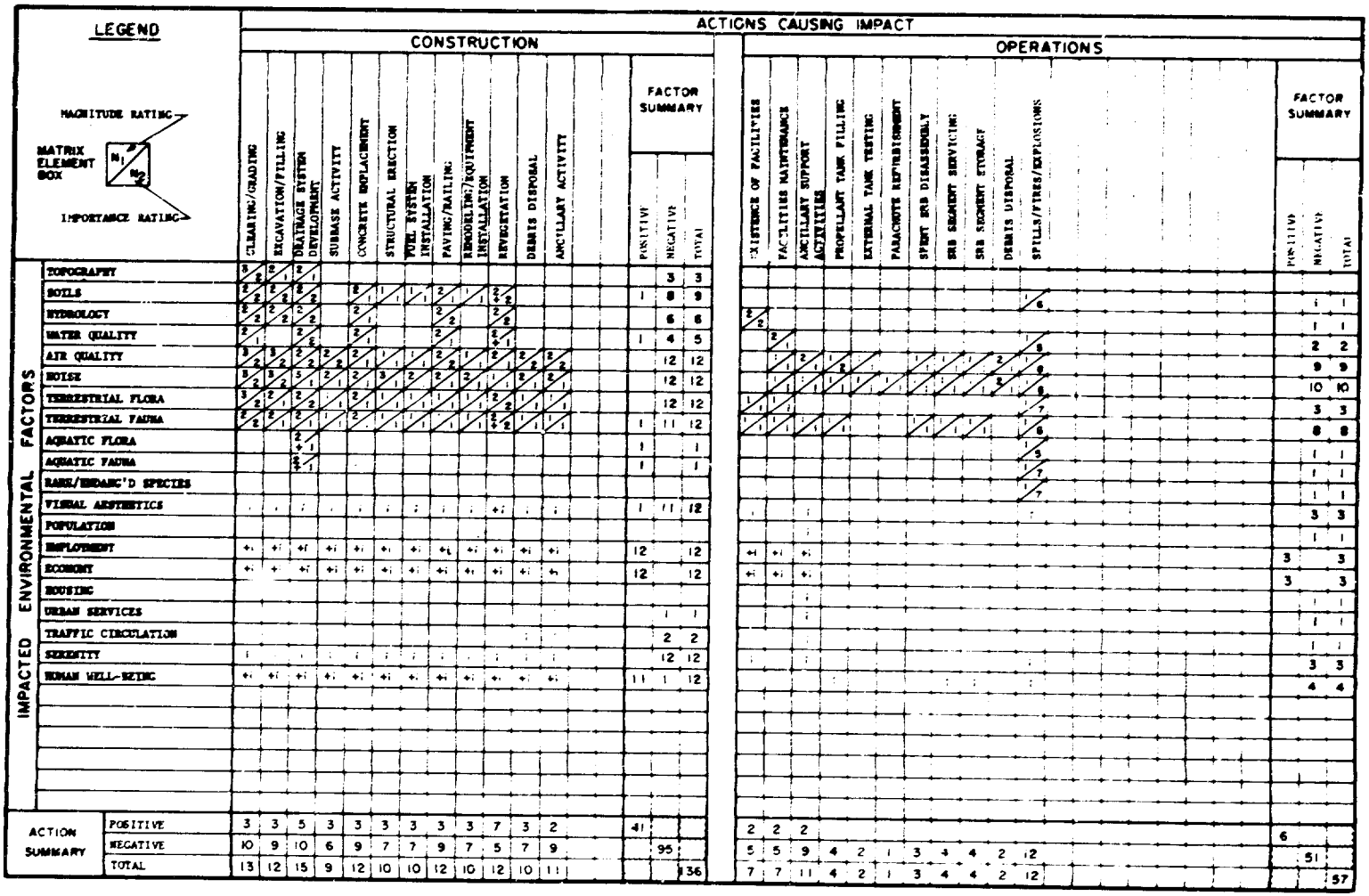
Matrix 5.0-D. IMPACT SUMMARY FOR PROPOSED SHALLOW DRAFT BARGE LANDING FACILITY/ACTIVITY AT VAFB



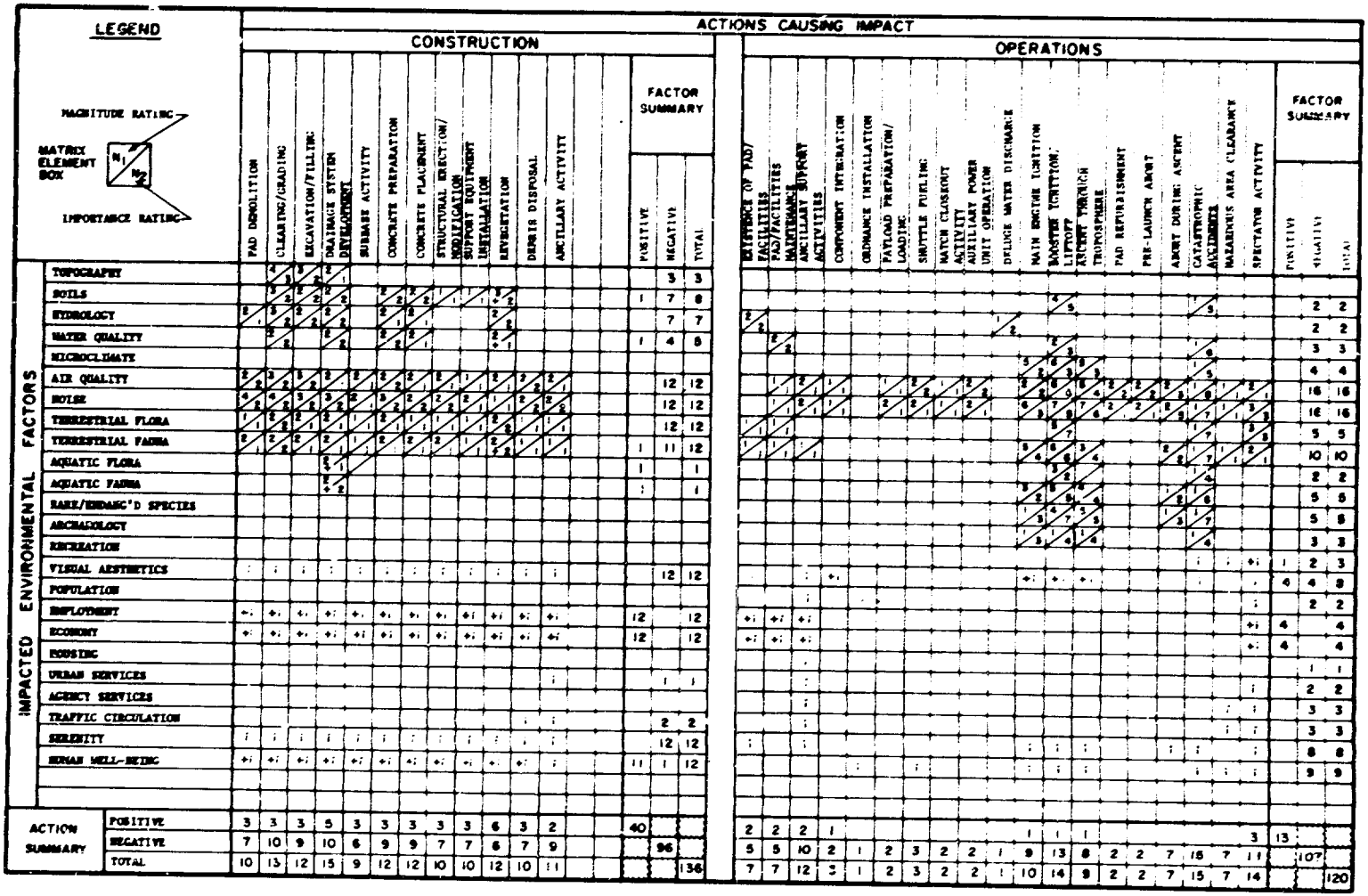
Matrix 5.0-E. IMPACT SUMMARY FOR PROPOSED MODIFICATION/EXPANSION OF TOW ROUTE ROAD/CORRIDOR/ ACTIVITY BETWEEN SHUTTLE SUPPORT FACILITIES AND SLC-6



Matrix 5.0-F. IMPACT SUMMARY FOR PROPOSED MODIFICATION/EXPANSION OF SLC-6 SUPPORT FACILITIES/ ACTIVITIES AND TITAN III SRM FACILITY AT VAFB



Matrix 5.0-G. IMPACT SUMMARY FOR PROPOSED MODIFICATION/EXPANSION OF SLC-6 LAUNCH PAD FACILITY/ACTIVITY AT VAFB



the number of impacts per specific environmental factor), and at the lower right-hand corner (as the total number of impacting situations).

A discussion of the rated impacts (the physical, chemical, biological, and archaeological impacts) is presented below in Section 5.1. In the interest of maintaining continuity with the matrices, words corresponding to the numerical ratings are used as impact descriptors within the narrative. Socio-economic impacts are discussed in Section 5.2.

5.1 PHYSICAL, CHEMICAL, BIOLOGICAL, AND ARCHAEOLOGICAL IMPACTS

The physical, chemical, biological, and archaeological impacts resulting from the proposed Space Shuttle program at Vandenberg Air Force Base include those on topography, soils, shoreline stability, geology, hydrology, water quality, microclimate, air quality, noise, terrestrial and aquatic fauna and flora, rare and endangered species, and archaeological sites. Impacts on all of these will occur in one form or another by one or more actions of the proposed project. For the most part, their individual occurrences will vary temporally and/or spatially with respect to one another. Details associated with these impacts are contained in the Reference Document for this Statement.[136] Results are summarized below, first for the Construction phase and finally for the Operations phase.

5.1.1 CONSTRUCTION IMPACTS

5.1.1.1 Impact on Air Quality

During construction, air quality will be affected in two primary ways: (1) by unavoidable exhaust emissions from vehicles and heavy construction equipment, and (2) by dust caused by operation of this equipment and other machinery. Air quality will also be affected to a minimal extent by asphalt paving operations associated with all project elements. Estimates are that the temporal contribution of air pollutants from the Shuttle Construction phase could equal the current Base contribution, the latter constituting about 1

percent of the air pollutants in the entire South Central Air Basin. However, dust control measures (repetitive site waterings and equipment speed controls) will be stringently practiced at all construction sites and should greatly minimize the particulate contribution that would otherwise occur. Most generated dust is expected to settle out within the confines of the Base with little carry-over into offbase populated areas. Final revegetation of scarified areas should effectively inhibit further related dust generation.

5.1.1.2 Impact on Shoreline Stability

The only construction activity that is expected to affect shoreline stability is the preparation of the SDB harbor area and the associated cut through the sea cliff adjacent to the Boathouse. Expected impact would be insignificant in magnitude and importance. Dredging in the harbor could cause some slight interruption of normal littoral transport around the jetty. The result of this could be a small and temporary deprivation of sand to the beach immediately downshore of the harbor. This would occur during the time required to re-establish normal transport around the jetty and across the mouth of the harbor (where dredging is proposed). During this time (estimated at a few months) some additional erosion of the beach and the sea cliff immediately downshore of the harbor could occur.

5.1.1.3 Impact on Topography and Soils

Impacts on topography and soils will occur in those areas where clearing, grading, and recontouring are required. These areas will include the proposed runway extension, the sites for the airfield support facilities, the tow route, the facility sites at SLC-6, and in the Boathouse area.

Impacts on topography will include the direct change associated with alteration of natural contours and indirect change related to the modification of existing drainage patterns. In the airfield area, which is located on the fairly level terrain of Burton Mesa, all earthwork will be of a balanced cut and fill nature.

Maximum cuts and fills are expected to be less than 12 feet in elevation. This includes the partial filling of a small ravine located near the extreme northern end of the runway extension. Drainage system development around the runway and support facilities will not alter the general drainage pattern on the mesa. It is expected that the recontouring required in the airfield area would not be particularly apparent to the casual observer after revegetation of the construction areas.

Along the proposed tow route, topographic effects will generally be limited to minor roadbed widening and the removal of additional material primarily along two existing road cuts to provide additional clearance for the Orbiter. One primary cut is located on 13th Street about 0.5 mile north of the Santa Ynez River; the other is located on Highway 246 about 2 miles west of the 13th Street and Highway 246 intersection. The quantities of earth that will be removed from these two cuts are not yet known, but net change is not expected to be especially prominent because both cuts already exist.

Topographic change in the immediate area of SLC-6 should not be prominent. The launch complex is situated on a gently sloping coastal terrace. Consequently, development of facility sites will only require minor recontouring. Most of the extensive earthwork will be associated with excavation for launch pad facilities (subgrade payload preparation room and flame trenches), construction of a large earthen blast wall, and the enlargement of an existing hillside cut immediately east of the launch complex. Although quantitative estimates for the proposed earthwork are currently unknown, excavation for the launch pad facilities will be considerable. Ultimately, however, the excavation will be concealed by the facilities themselves. The earthen blast wall will be constructed with spoil from nearby excavations and, when completed, will appear as a small hill between the launch pad and the Launch Control Center. The significance of its presence, however, will be minimal. The most discernible topographic impact will be that associated with the hillside cut east of the complex.

Actions causing impacts relative to the Shallow Draft Barge and ET facilities will be associated with the clearing and grading of new sections of Coast Road, placement of fill in small ravines along this roadway, clearing and grading the

Tank Storage and Checkout Facility site, and constructing the roadcut through the sea cliff to the proposed harbor site.

Impacts to topography will, at most, be discernible in magnitude. The largest amount of fill required will be placed across a small ravine (about 40 feet deep and 50 feet across) located immediately south of SLC-6. Placement of fill in this location will not interrupt the natural drainage because culverts of adequate size to handle flood flows will be constructed. Other earthwork along the improved Coast Road will be insignificant. Just south of the location where the proposed tow road joins with Coast Road another small ravine (Oil Well Canyon) will require filling. The amount of earthwork necessary at this location is somewhat less than that required to cross the ravine south of SLC-6. Appropriately sized culverts will ensure that the natural drainage is not interrupted. The new section of tow road that will cross the Arguello terrace (see Figure 2.3-A) will be constructed approximately at grade with the terrace. This will minimize the total earthwork required to prepare the roadway. Similarly, the site of the Tank Storage and Checkout Facility will not require significant grading. Construction of the road and the ET handling facility could cause minimal alteration of the natural drainage patterns on the terrace, but this would be insignificant in importance.

A large cut through the sea cliff (about 1,000 feet long and from 50 to 200 feet wide) will be constructed to provide access to the shallow draft harbor. The sea cliff at the location of the proposed cut is about 40 to 50 feet high. The topographic character of the sea cliff and the terrace will be permanently altered during construction. However, with the exception of a change in the visual quality of the site, the cut will have insignificant importance. It is possible that it would cause a minimal alteration of drainage patterns in the immediate vicinity of the boathouse. However, little or no impact would be associated with this change.

In general, no impacts on topography will occur that will significantly change the character of the existing landscape. Further, any alteration of drainage that might occur from construction activities will be localized and of little or no consequence. Impacts are expected to be no greater than discernible in magnitude and minimal in importance. No topographic impacts are expected at Port Hueneme because the proposed construction sites are currently near-level.

Soil impacts are expected in and adjacent to the construction sites described above (including Port Hueneme). It is estimated that the total construction program will affect about 500 acres (less than 0.3 percent) of the land at Vandenberg and 2-4 acres of land at Port Hueneme. Changes in soil structure and removal of vegetative cover during scarification and regrading will expose soil to increased erosion. In addition, soils will suffer some contamination from incidental spills of concrete, fuels and lubricants from construction equipment, and asphalt. However, such soil contamination is likely to be very localized, and all areas of bare soil will be reseeded following construction. None of the construction sites are in agricultural use and any reduction in soil productivity as a result of contruction will be relatively insignificant. Thus, soil impacts at Vandenberg are considered to range from insignificant to minor in magnitude and from insignificant to minimal in importance. Impacts at Port Hueneme are expected to be insignificant or minimal because all construction sites are either graded or are covered by existing structures.

5.1.1.4 Impact on Hydrology and Water Quality

The physical alteration of existing topographic features (addressed in Section 5.1.1.3) as is necessary for construction will, in turn, result in the minor localized alteration of existing drainage paths. Moreover, new pavement and structures scheduled for presently unoccupied land areas at VAFB and Port Hueneme will serve as percolation barriers and/or rainfall interceptors that would accelerate runoff locally and reduce percolation. Estimates are that about 200 acres of currently available infiltration area (99 percent at VAFB and 1 percent at Port Hueneme) will be covered over with concrete, asphalt, and the like. Overall new coverage, however, will represent only a fractional

percentage of the total infiltration area available (tens of thousands of acres at VAFB and several hundred acres at Port Hueneme).

Although construction water needs have not yet been quantified, it is unlikely that demands would exceed 0.5 million gallons per day (mgd). Water would typically be required for such activities as dust control, subbase moisture control, concrete preparation, and runway grooving. Thus, a portion of this water will interact with prevailing hydrologic conditions at the various construction sites. Although small quantities of water which become contaminated with use (such as in preparing concrete or in serving as a coolant during runway grooving operations) will enter the soil matrix or be carried away as surface runoff, perceptible changes in the quality of natural water systems are not expected.

Activities such as clearing and grading will result in the temporary exposure of land from which sediments may be eroded during heavy rainfall periods. Accidental spills of fuels and lubricants may also contribute to runoff contamination. Most rivers and creeks on VAFB are sufficiently remote from the various construction sites that attendant water quality impacts are not expected. Santa Ynez River and Honda Creek, however, are exceptions in that they are proximate to existing roads of the proposed tow route. Hence, contaminated runoff waters from nearby roadway construction sites would, upon entering these streams, impact their water quality to some minimal short term extent. Final revegetation of scarified zones will eliminate recurrences.

Construction impacts associated with the shallow draft barge facilities will be most significant in the harbor area. Demolition of the existing pier will generate waterborne pollutants such as dust, small wood fragments, or concrete which may escape to the ocean. Minor spillage of diesel fuel, oil, and grease from equipment used in the demolition process could create localized degradation of marine waters. Small quantities of debris may escape the harbor area, but the impact on water quality outside the harbor will be negligible because a barrier will be placed to contain the debris inside the harbor.

In addition, dredging the submarine bottom of the boathouse harbor and excavating earth and rock for the dock will temporarily degrade nearby coastal water through increased turbidity. Materials placed in suspension will eventually settle, depositing a silt layer on the marine surface below. Fuel, oil, and grease spills from construction equipment also will contaminate local water.

Construction activities at Port Hueneme will result in temporary water quality degradation during pier alterations, dredging, and facility erection operations. Dredge spoils may be unaesthetic and emit an undesirable odor. Construction accidents may cause fuels, lubricants, or debris to spill into the harbor. These can degrade waters near the site, but should not cause long term water quality problems. Temporary increases in turbidity will diminish as suspended material settles and disperses.

Runoff from construction at the Solid Rocket Booster Disassembly Facility (SDAF) and the Solid Rocket Booster Initial Wash Facility (SIWF) sites may carry increased silt into the harbor if heavy rain should fall when open soils are exposed. Eroded soil as well as common construction residuals could be flushed.

Paving and construction of buildings will generate minor wastes and spills that may be carried in local runoff and flushed to the ocean. The amounts of contamination will be minor, and because the materials are not expected to be toxic or hazardous, the magnitude and importance of the impact will be minimal.

5.1.1.5 Impact on Noise

Almost all construction activities will cause some temporary increase in local noise levels adjacent to construction sites. These increases will be caused by such activities as heavy equipment operation, pile driving, blasting, and the use of miscellaneous power tools. However, most proposed construction sites are well removed from heavily populated areas, and typical construction noise would be expected to attenuate to unobjectionable levels before reaching such areas. For example, a particularly noisy activity associated with construction of the Mate/Demate Facility at the airfield will be pile driving. It is expected that impulsive sound of about 110 dBA would be produced onsite. At the closest margin of the cantonment area, however, this sound would attentuate to approximately 62 to 65 dBA. It is estimated that this level would be 6 to 8 dBA above ambient. Although such sounds could be intrusive to people working outdoors, it is unlikely that they would disturb people situated in nearby homes or offices.

It is to be noted that portions of the tow route requiring modification do transect the cantonment area. Operation of heavy equipment and pneumatic tools along this portion of the route could cause short term noise intrusion for people who work in nearby offices or other facilities. Land use in this area, however, could be categorized as industrial. As such, the area occasionally experiences above normal ambient noise levels. Tow route construction noises will therefore constitute a minor additional impact only.

On South Vandenberg, construction noise will discernibly alter the existing noise environment in the immediate area of the construction sites. Heavy equipment will be used to improve Coast Road, to construct the new sections of tow road, and to excavate the cut through the terrace and sea cliff for access between the harbor and ET storage facility. Some blasting also will be required to facilitate excavation of the Shallow Draft Barge harbor bottom and the tow road cut.

Blasting noise produced during construction of the harbor will occur only infrequently over a fairly limited time period (estimated at 3 to 4 months). The overpressures produced by blasting cannot be determined accurately because data concerning charge sizes and other important factors are not available at

this time. However, considering the remote location of the project site, it is unlikely that these impulsive sounds would disturb either the visitors to Jalama Beach or the permanent population of the Lompoc Valley.

The importance of the impacts caused by construction noise on South Vandenberg would be insignificant or minimal because only the construction personnel themselves would be exposed to noise levels that would be significantly above ambient. Further, access to the site will be strictly controlled and all workers operating in particularly noisy environments will be required to wear hearing protectors.

5.1.1.6 Impact on Biology

Consequential construction impacts on terrestrial flora will occur only from vegetation removal on VAFB at the proposed construction sites. Less than 1 percent of the special interest coastal chaparral on Burton Mesa and other native vegetation on VAFB is expected to be removed as a result of the proposed expansion of the tow route, construction of additional airfield support facilities, and facilities located on South Vandenberg. Further, a few individuals of the special interest species listed in Table 3.1.9-2 (except those that occur only in coniferous or live oak woodlands, tanbark oak forest, or coastal salt marsh) will be removed where they are present on land that will be cleared and graded. Results of a recent inventory carried out to document the expected extent of this removal are summarized in Table 5.1.1-1. Although the impact is of some discernible importance, Shuttle construction activities will not jeopardize the continued existence of any of these special interest plant species on Vandenberg.[224]

Habitat removal (described above) and the accompanying effects on some resident animals in zones of construction will constitute the primary impacts to terrestrial fauna. Also, human presence, equipment movement, noise, and dust are expected to disturb fauna in nearby areas. As stated above, the amount of native habitat that will be affected is small. Moreover, some of the proposed construction area has been substantially disturbed by past events. Consequently, faunal impacts as a whole are expected to be no more than minor in magnitude and minimal in importance at VAFB. Related impacts at Port Hueneme

Table 5.1.1-1. SPECIAL INTEREST PLANTS TO BE IMPACTED BY SPACE SHUTTLE CONSTRUCTION ACTIVITIES AT VANDENBERG

Shuttle Facility Construction Item / Scientific Name[a]	*Arctostaphylos viridissima*	*Arctostaphylos rudis*	*Castilleja mollis*	*Ceanothus impressus*	*Cirsium rhothophilum*	*Erigeron foliosus* var. *blochmanae*	*Erysimum suffrutescens* var. *lompocense*	*Malacothrix incana*	*Monardella crispa*	*Scrophularia atrata*	*Senecio blochmanae*
Airfield Extension	X	X	X	X			X			X	
Orbiter Processing Facilities	X	X		X							
Tow Route	30+	5+	5	10+	?	?	28	23	35		22
SLC-6	X	X	X	X						X	
Tow Road									50		
Tank Storage and Checkout Facility									X		

[a]Refer to Table 3.1.9-2 for common name of special interest plant.

Note:

(1) Numerical quantities refer to actual number of plants expected to be removed.
(2) A plus (+) sign indicates that actual number of plants to be removed is not precisely known but can be expected to exceed the indicated value by a small additional amount.
(3) The "?" indicates that expected removal of individuals of the indicated species is questionable but would constitute no more than a few.
(4) The "X" indicates removal of a small percentage (less than one percent) of a very large number of plant individuals.

Data Source: Wooten, et al, 1977.(224)

are considered insignificant because the proposed sites of construction activity are nearly devoid of biota.

In the Boathouse area there are some planted trees within 100 feet of the construction zone. These trees are important because groups of monarch butterflies congregate in them during winter. However, no adverse effect on the butterflies is expected if construction occurs during other seasons.

Water quality changes in Santa Ynez River and Honda Creek waters caused by tow route construction activities constitute a potential impact to the resident aquatic biota. Yet, as was discussed in Section 5.1.1.3, such changes would be (at most) minimal and of short term extent. Associated impacts on aquatic biota are therefore expected to be insignificant.

Blasting and dredging of approximately 4 acres of (semiprotected) intertidal and subtidal habitat in the SDB harbor area would destroy or displace all biota within that affected area, but would be expected to only minimally affect the biota of the nearby coastline. A debris screen will be used to contain resuspended sediments within the dredged area.

The potentially affected marine area represents a minimal proportion of similar (although not as well protected) habitats along the coast between Point Arguello and Point Conception. Nevertheless, recolonization of this small area is expected to be rapid, and no rare, endangered, or threatened species are expected to be appreciably affected. It should be noted that the destruction of this subtidal and intertidal biota in this area is contrary to the intent of the California Coastal Act of 1976, which is directed towards protecting such undisturbed marine habitats. Connell and others also emphasize the special character of this area even though it has not been included in the South Coast Intertidal Preserve east of Point Conception. "The area provides a mainland study area analogous (and complementary) to the Channel Islands Scientific and Educational Preserve."[88] Therefore, the importance of this impact may be as high as discernible.

Construction of docks and loading/unloading facilities in Port Hueneme will disrupt some habitat and destroy organisms found within the northeastern wharf

area of the harbor. This area is presently out of service and not vulnerable to further degradation. Less than a half acre of muddy bottom and inactive pilings will be removed and replaced, making any biological impact insignificant in magnitude and importance.

Least terns and brown pelicans are the only rare, endangered, or threatened fauna known or expected to appreciably use areas that will be affected by construction. On coastal Vandenberg none of the construction activities and attendant disturbances, however, are expected to pose a threat to the feeding and survival habits or reproductive success of these birds. Consequently, the impact of the Construction phase on these animals will be minimal.

5.1.1.7 Impact on Archaeological Resources

Archaeological surveys conducted thus far at VAFB indicate that there will be no impact on known resources resulting from construction activities on North Vandenberg. Recent surveys in planned construction areas on North Vandenberg yielded no discovered sites.[191] Assuming no additional sites are located, archaeological impacts, therefore, will be restricted to South Vandenberg.

No archaeological sites are known to exist in the project area at Port Hueneme. Impact at Port Hueneme is, therefore, not expected to occur.

Although extensive efforts have been employed to avoid disturbance to archaeological resources, current plans for construction along the proposed tow route indicate that three sites will be affected by the proposed improvements along Coast Road. These sites include SBa 539, 670, and 931. Of these sites, SBa 931 and 670 are especially important because they may contain key information concerning the archaeological system of Vandenberg. Damage to these resources is a result of road widening and realignment activities could be of substantial magnitude and great importance.

Twenty-five archaeological sites are known to exist on the Point Arguello terrace in or near the proposed project boundaries. These are SBa-211, 551, 555, 635, 636, 637, 638, 639, 643, 648, 651, 653, 712, 1105, 1106, 1107, 1108,

1109, 1110, 1111, 1114, 1116, 1117, 1118, and 1148. Included are village sites, which are located on the coastal plain along the southerly-facing portions of the coast, as well as limited activity and temporary sites of various types. All are considered part of the larger settlement-subsistence patterns of the Vandenberg-Lompoc area, and none will be impacted by the proposed project. In addition to these known sites, unknown archaeological resources, including buried sites along the shore and underwater sites, may exist in this area.

The existing environment also includes an abandoned Coast Guard station, boathouse, and associated pier, which were constructed in 1934. This facility is not currently an historical place but may meet the criteria for such designation as established in the National Historical Preservation Act of 1966. A study concerning this matter is currently underway.

Mitigation measures including systematic removal of samples from site areas to be impacted will be employed to reduce impacts. A mitigation and data recovery program currently is being developed in compliance with the National Historic Preservation Act of 1966 and in coordination with the California Historic Preservation Office, the National Park Service, and Native American Indian groups.

5.1.2 OPERATIONS IMPACTS

5.1.2.1 Impact on Air Quality

As noted in Matrices 5.0-A through -G, many operational aspects of the proposed action will impact air quality. With few exceptions, however, the magnitude and importance of most of these individual impacts will be minimal or insignificant. Generally, impacts will be the result of emissions from project related automobile, truck, aircraft, rail, and marine traffic. Discharges of gaseous oxygen, hydrogen, nitrogen, helium, and refrigerants are also expected from normal servicing operations. The receipt and handling of hypergolic fuels (nitrogen tetroxide, hydrazine, and monomethylhydrazine) will

occur only under controlled conditions and in accordance with established safety procedures. Because hydrazines (like many industrial chemicals) are toxic and suspected carcinogens, accidental spillages will be contained and neutralized, thus minimizing the release of deleterious vapors into the atmosphere. It is to be noted that all facilities associated with the handling of hydrazines either have been or will be sited to ensure that, in the event of spills, populated areas will not be affected. On the whole, the average contribution of air pollutants from the Operations phase will be no more than 5 percent of the current Base contribution, the latter constituting about 1 percent of the air pollutants in the South Central Coast Air Basin. Short term contributions from rocket exhaust at launch, however, are considered of potential concern in small localized areas.

Five minutes before a typical Shuttle launch, the hydrazine fueled auxiliary power units in the Orbiter and Solid Rocket Boosters (SRBs) will be activated, resulting in the discharge of insignificant quantities of ammonia and nitrogen to the atmosphere. At four seconds before liftoff, the three Orbiter main engines (fueled with liquid oxygen and hydrogen) will be ignited. This will result in the discharge of those constituents (mostly water vapor) listed in Table 5.1.2-1. Liftoff will occur almost simultaneously with the ignition of the SRB motors (solid propellant fueled units producing those exhaust constituents listed in Table 5.1.2-2). The proposed use of an ammonium perchlorate/aluminum/PBAN propellant for the SRBs will result in the emission of three major byproducts of combustion: carbon monoxide gas (CO), mostly converted to CO_2 during afterburning; aluminum oxide particles (Al_2O_3); and hydrogen chloride gas (HCl). Additionally, a great deal of heat will be released with the Orbiter and SRB exhaust.

During the entire ignition and liftoff sequence, emitted rocket engine exhausts will be ducted under the launch pad and discharged to the side, whereupon the plumes will rise and merge into what is called a ground cloud. The mechanism causing this rise, and thus inducing the strong convective currents that will lift and transport dust and debris with the cloud, will be the thermal buoyancy of the hot (initially about 2,888°K or 4,729°F) exhaust.[8] It is to be noted that this is a highly localized and short term event. Substantial quantities of ambient air will be entrained during the turbulent rise of the cloud to its stabilization altitude (~1 km). Accompanying this will be a reduction in temperature and concentration of exhaust constituents. Beyond that time, further expansion and

Table 5.1.2-2. EXPECTED SRB EXHAUST CONSTITUENTS (percent by weight of nozzle exit plane flow[a])

Constituent	Location	
	Nozzle exit plane	Plane 1 km downstream[b]
Hydrogen chloride (HCl)	21.41	14.18
Chlorine (Cl_2)	0.008	1.60
Atomic chlorine (Cl)	0.246	0.013
Nitric oxide (NO)	0.001	0.989
Nitrogen peroxide (NO_2)	-0-	0.02
Carbon monoxide (CO)	24.36	0.052
Carbon dioxide (CO_2)	3.33	30.85
Hydrogen (H_2)	2.09	-0-
Hydroxyl (OH) and atomic hydrogen (H)	0.02	-0-
Nitrogen (N_2)	8.78	8.26
Water (H_2O)	9.39	28.59
Aluminum oxide (Al_2O_3)	30.32	22.56
Aluminum chloride ($Al Cl_3$)	0.02	0.02
Iron chloride	0.97	0.97
Total	100.0	108.1[c]

[a]Total mass flow (2 SRB engines) ≈ 9400 kg/sec.

[b]Afterburning complete.

[c]Total is greater than 100 percent because of chemical addition of air to form water, nitric oxide, and carbon dioxide.

Reference: Stephens and Stewart, 1977.(220)

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5-23 - 5-24

Aluminum oxide, in the form of particles, is commonly regarded as an inert nuisance dust. A substantial proportion of the nearly 62 tons of Al_2O_3 particles contained in the ground cloud will be approximately 10 microns in diameter, and many such particles will settle out of the cloud within 5 to 10 km of the launch pad.(82)(83) However, some of the Al_2O_3 will remain suspended in the cloud as tiny particles with diameters of approximately 1 micron and smaller that, if inhaled, would penetrate alveolar spaces in the lungs.(83)(86)(128) Much of this small sized dust will be coated with adsorbed HCl, forming acid particles (which may contain aluminum chlorides and oxychlorides).(82)(83) Little is known about the behavior and effects of such acid coated particles, and no air quality standards or recommended exposure limits exist for them; studies in this regard are continuing.(83)

Atmospheric diffusion studies conducted by NASA predict maximum exposure levels and concentrations of Al_2O_3, NO_2, and CO near sea level and downwind from a normal Space Shuttle launch that are far below levels allowed by California and national ambient air quality standards.(79)(82)(115) No ambient air quality standards for HCl or Cl_2 have been established.(76) Table 5.1.2-3 summarizes limits on exposure of the public to HCl and Cl_2 gases as recommended by the National Academy of Sciences, National Research Council, Committee on Toxicology. Indications are that, for a typical Shuttle launch, the maximum expected 10-minute mean concentrations of these gases at or below 500 feet (152 m) above sea level will be less than half these limits.(79)(80)(82)(83)

Figure 5.1.2-A displays the maximum instantaneous concentrations of HCl gas predicted[1] at ground level downrange from hypothetical Shuttle launches

[1]The National Aeronautics and Space Administration/George C. Marshall Space Center (NASA/MSFC) multilayer diffusion model was used to develop these predictions. This model is currently favored for simulation and prediction of rocket exhaust concentrations associated with Titan III and hypothetical Shuttle launches. It has been shown (for Titan III launches) to yield conservative, but realistic, predictions over flat terrain. This model has not considered changes induced by topographic variations such as those existing at VAFB.

Table 5.1.2-3. RECOMMENDED LIMITS ON PUBLIC EXPOSURE TO HYDROGEN CHLORIDE (HCl) AND CHLORINE (Cl_2)

Species	Type of Limit	Duration	Time weighted average concentration	Comments
Hydrogen Chloride (HCl)	Short Term Public Limit (STPL)	10 minutes	4.0 ppmv	Excursions above these levels are likely to produce objectionable odors and/or irritation
		30 minutes	2.0 ppmv	
		60 minutes	2.0 ppmv	
		1 hour daily	2.0 ppmv	
		5 hours/day, 3-4 days/month	0.7 ppmv	
	Public Emergency Limit (PEL)	10 minutes	7.0 ppmv	Possible temporary discomfort at these levels, but effect is reversible
		30 minutes	3.0 ppmv	
		60 minutes	3.0 ppmv	
Chlorine (Cl_2)	Short Term Public Limit (STPL)	10 minutes	1.0 ppmv	3.0 ppmv[a]
		30 minutes	0.5 ppmv	1.0 ppmv[a]
		60 minutes	0.5 ppmv	1.0 ppmv[a]
	Public Emergency Limit (PEL)	10 minutes	3.0 ppm	Levels are ceiling limits and should not be exceeded
		30 minutes	2.0 ppm	
		60 minutes	2.0 ppm	

[a]Recommended maximum allowable instantaneous excursions. Any excursion above the STPL should be compensated for by an equivalent reduced exposure during the applicable time period.

Reference: National Academy of Sciences-National Research Council, 1971,[77] 1973.[78]

simulated for six common generic meteorological conditions at Vandenberg. Comparison of Table 5.1.2-3 and Figure 5.1.2-A shows that the predicted maximum instantaneous HCl concentrations (for all meteorological conditions) result in values that are less than the 4 ppmv STPL recommended when integrated over a 10-minute period. Moreover, the expected maximum Cl_2 concentrations are also less than the STPLs (predicted Cl_2 values will be 11.3 percent of HCl values, as previously stated). The predicted NO_2 values (0.1 percent of HCl values) are anticipated to be less than one-tenth the recommended STPLs.[115][127] Predicted CO levels are miniscule.

To provide further estimates of gaseous constituent contributions occurring from periodic launches throughout the year, meteorological data from Vandenberg (taken at 0400 PST, when the atmosphere is generally most stable) on 48 days in 1974 were used in the NASA/MSFC diffusion model.[80] The results of these computations for HCl are displayed in Table 5.1.2-4. In every case the maximum ground level concentration and exposure are predicted to occur within

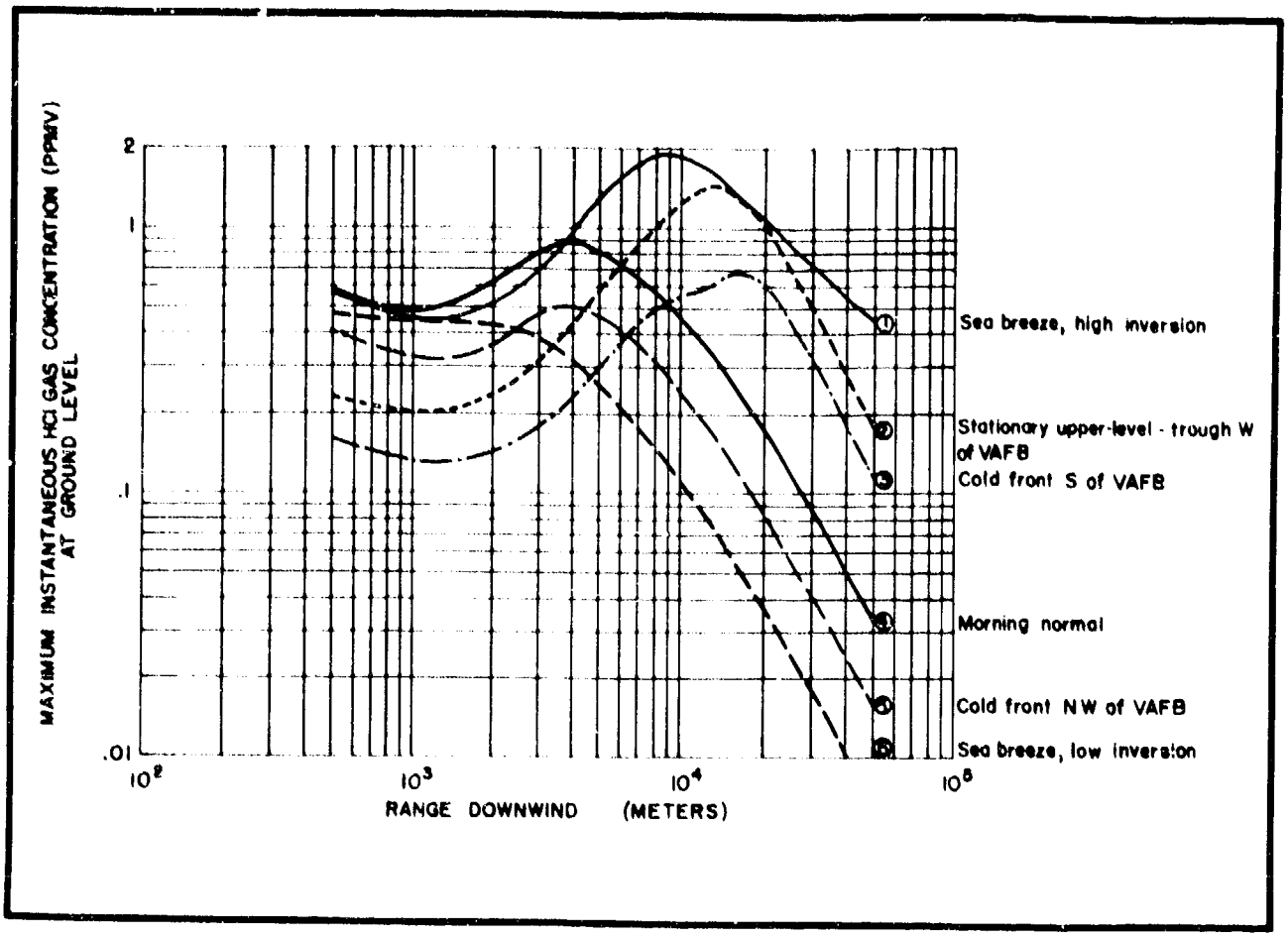


FIGURE 5.1.2-A. Predicted maximum instantaneous HCl gas concentration at ground level for six generic meteorological conditions at VAFB.

about 10 km of the launch pad, either onbase or over the ocean. Moreover, the predicted 10-minute time-mean HCl concentrations are, in all cases, less than one-half the STPL. Based on aforementioned percentage approximations, other exhaust constituents are predicted to represent even smaller fractions of their standards.

The predicted maximum ground level 10-minute time-mean Al_2O_3 concentration approximates 800 µg/cu m and is much less than allowable exposures[1] for occupational workers. Because of the transient nature of the ground cloud,

[1]The allowable daily 8-hour average concentration for nuisance dusts such as Al_2O_3 in occupational work atmospheres is 10,000 µg/cu m.

Table 5.1.2-4. SHUTTLE GROUND CLOUD DATA PREDICTED FOR FORTY-EIGHT SELECTED METEOROLOGICAL CASES AT VANDENBERG DURING 1974[a]

Date (1974)	Ground cloud behavior predictions					Ground level HCl predictions	
	Mean transport direction (degrees)	Cloud stabilization height (meters)	Horizontal distance to cloud stabilization (meters)	Horizontal distance to maximum ground level concentration (meters)	Approximate horizontal distance to maximum ground level exposure (kilometers)	Maximum instantaneous ground level HCl concentration (ppmv)	Approximate 10-minute time-mean ground level HCl concentration (ppmv)
Wed - 9 Jan	131	1,014	211	3,750	6	.22	.26
Tues - 15 Jan	354	824	378	3,505	5	1.05	.41
Mon - 21 Jan	172	1,094	587	5,500	7	1.27	.28
Mon - 28 Jan	170	1,024	1,498	4,250	6	.15	.03
Mon - 4 Feb	155	784	13	4,728	4	1.05	.93
Sun - 10 Feb	31	1,094	177	6,000	6	.39	.35
Sat - 16 Feb	140	854	246	2,943	5	.41	.27
Sat - 23 Feb	213	894	1,192	4,960	5	.38	.05
Sat - 2 Mar	75	1,214	2,056	5,000	7	.43	.10
Sat - 9 Mar	185	1,139	498	4,750	6	.14	.05
Fri - 15 Mar	190	964	364	5,500	5	.68	.37
Tues - 26 Mar	41	1,084	512	5,250	6	.52	.22
Mon - 1 Apr	142	974	855	3,750	5	.24	.07
Sun - 7 Apr	190	994	1,985	6,500	7	2.69	.28
Sat - 13 Apr	198	1,040	771	4,283	6	.18	.07
Fri - 19 Apr	159	1,305	2,711	6,500	9	.79	.18
Fri - 26 Apr	135	1,043	1,607	4,879	7	.96	.17
Thur - 2 May	152	944	619	4,860	6	1.01	.37
Wed - 8 May	155	854	257	4,156	5	1.39	.86
Tues - 14 May	159	879	864	5,322	6	2.54	.53
Wed - 22 May	199	859	385	5,132	5	.67	.27
Wed - 29 May	162	979	680	5,527	6	1.65	.57
Tues - 4 Jun	177	819	215	3,393	5	.35	.10
Tues - 11 Jun	186	829	339	4,846	6	3.08	1.22
Mon - 17 Jun	93	1,204	506	4,633	7	.19	.13
Wed - 26 Jun	202	729	592	3,062	4	.66	.11
Wed - 3 Jul	283	919	631	5,000	5	.63	.19
Wed - 10 Jul	113	1,216	694	5,668	7	.44	.38
Wed - 17 Jul	162	734	49	3,204	4	.86	.50
Wed - 24 Jul	256	764	98	3,087	4	.46	50
Wed - 31 Jul	289	834	87	2,792	5	.24	.24
Tues - 6 Aug	173	814	360	4,799	5	2.04	.33
Tues - 13 Aug	174	1,054	220	4,266	6	.17	.19
Mon - 19 Aug	165	804	837	4,178	5	2.81	.51
Sun - 25 Aug	303	969	218	5,498	6	.86	.67
Sat - 31 Aug	101	854	322	4,646	5	.93	.50
Sun - 8 Sep	195	794	502	4,343	4	.46	.10
Mon - 16 Sep	208	864	307	4,775	5	.52	.15
Tues - 24 Sep	157	973	285	4,499	5	.36	.23
Fri - 4 Oct	164	1,074	404	5,411	7	1.04	.50
Sun - 13 Oct	238	774	205	4,392	5	2.62	1.97
Mon - 21 Oct	175	939	299	4,264	5	.32	.19
Fri - 1 Nov	140	1,484	1,511	6,004	10	.46	.25
Sat - 9 Nov	187	1,009	1,820	7,028	7	2.26	.27
Sat - 16 Nov	183	899	425	5,799	5	.31	.11
Sat - 23 Nov	207	939	1,236	7,521	7	3.38	.41
Sat - 30 Nov	325	964	1,168	4,964	6	.99	.18
Sun - 8 Dec	66	824	641	3,869	5	.59	.12

[a] Cases pertain to meteorologic conditions at 0400 Pacific Standard Time on the tabulated date. Prediction data were developed using the NASA/MSFC multilayer diffusion model.

Reference: NASA/MFSC[80]

this corresponds to a 24-hour average of 6 μg/cu m--a 6 percent contribution with respect to the ambient air quality standard[1] for the State of California. Relative to ambient conditions at Vandenberg (see Section 3.1.7) and considering that the entire Base contribution to the total particulates in the South Central Coast Air Basin is small (about 1 percent), launch induced particulate contributions will be very slight.

Researchers are currently divided on the question of synergism resulting from the mixture of aforementioned constituents. On the one hand, it is felt that the presence of minute (less than 1 micron in diameter) HCl coated Al_2O_3 particles (which may also contain aluminum chlorides and oxychlorides), NO_2, and Cl_2 in solid propellant exhaust may impart slightly greater toxic effects in comparison with simulated exhaust containing like quantities of commercial Al_2O_3 particles and HCl gas.(86)(128) On the other hand, it is felt that individual constituent effects may, at worst, be additive, but only if toxicity threshold levels for one of the constituents prevail.(50)(166) Although studies in both areas are continuing, the importance of either potential effect on offbase populated areas (or cantonment populations) is expected to be insignificant. The basis for this assessment primarily rests on the fact that none of the ground level exposure predictions discussed above approaches a toxic situation.

For the first several minutes following a normal Space Shuttle launch (and perhaps much longer when the relative humidity is above 85 percent), much of the HCl in the ground cloud will be in combination with suspended aerosol droplets.(82)(83) Moreover, it has been postulated that the presence of Al_2O_3 in the cloud may act as nucleating centers and be capable of enhancing aerosol growth during this initial period. Under especially high humidity conditions these aerosol droplets may enlarge and precipitate from the cloud (rainout) as an acid rain. Alternatively, if an independent rain were to fall through the ground cloud, the raindrops would absorb exhaust constituents (washout) and become an acid rain. Studies of these processes are continuing. Figures

[1]The California ambient air quality standard for suspended particulate matter is a 24-hour time-weighted average concentration of 100 μg/cu m.

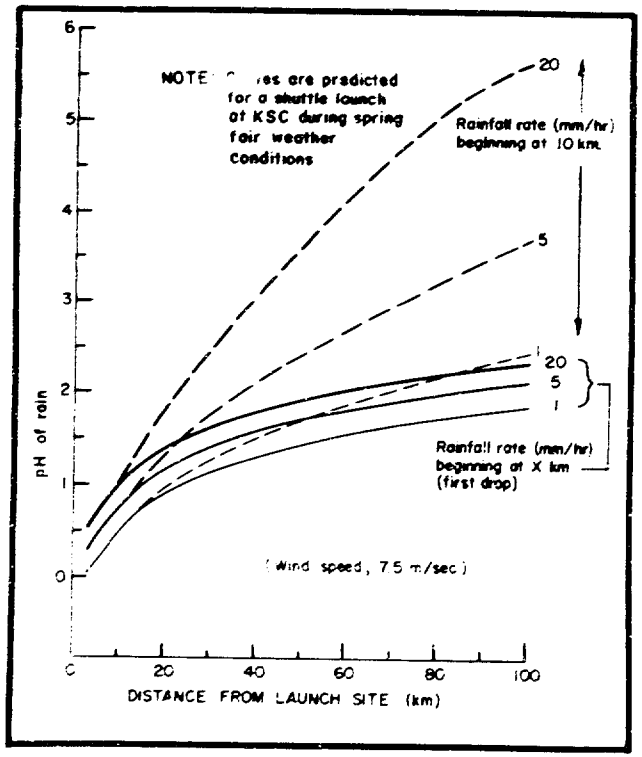
5.1.2-B and -C show rain acidity and HCl deposition (given three differential rainfall rates) predicted for a hypothetical Shuttle ground cloud washout under spring fair weather conditions at KSC. Some of these prediction curves are for the first droplets only, while others indicate how subsequent droplets become progressively less acidic. It is to be noted that imminent washout conditions will most likely represent constraints for flight related reasons; consequently, launches during these conditions are not likely to occur.

In summary, it is felt that booster ignition and liftoff may have localized transient impact of significant magnitude. The importance of this impact would be discernible at most. Air quality in communities adjacent to the Base usually will not be appreciably affected; long term and regional impacts to air quality will be insignificant.

Local onbase air quality could be substantially altered for a short time following a major hypergolic fuel spill or uncontrolled burn of solid rocket propellant. Such occurrences are considered improbable (and so are rated insignificant in magnitude). Estimates are that if the worst-case event (a slow continuous burn on the pad) were to occur, a maximum instantaneous ground level concentration of 6.66 ppmv HCl could be attained, but would occur within 5 kilometers of the launch pad.[31] This concentration when time integrated is below the recommended 10-minute PEL for this constituent (see Table 5.1.2-3). Indications are that these impacts will not pose substantial hazards to nearby uncontrolled population centers. The unlikely event becomes an impact of great importance considering the harm that could be imparted unexpectedly to nearby unprotected operations personnel and the potential damage that could occur to property and special interest vegetation in the event of a concurrent, continuous rainout or washout.

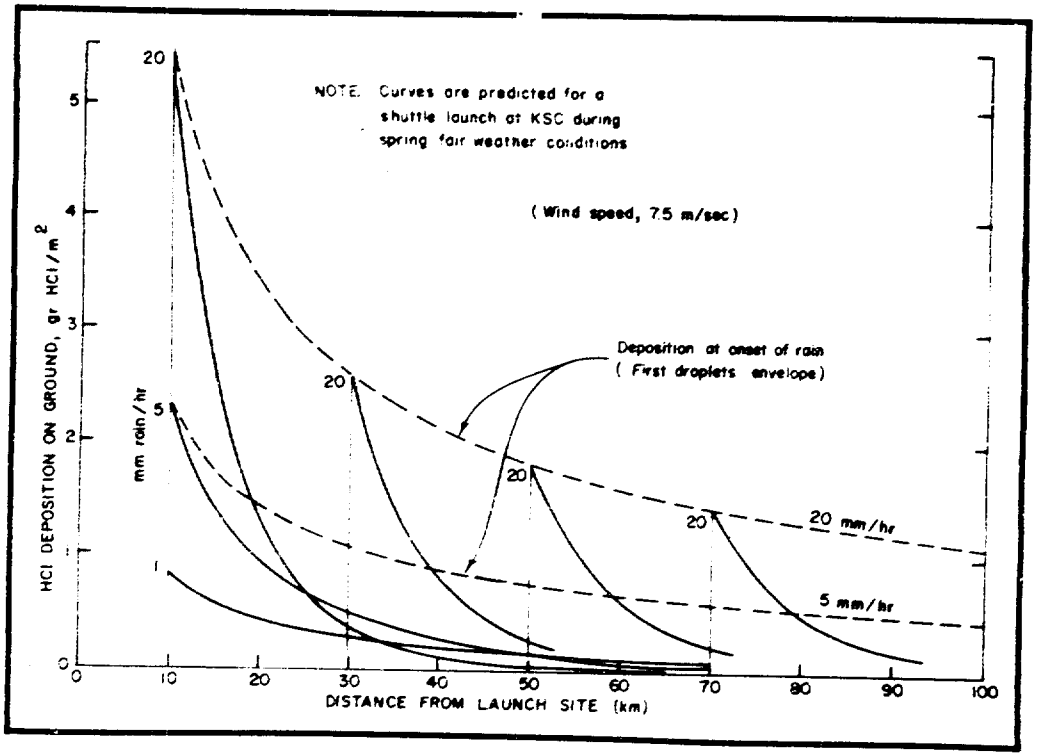
5.1.2.2 Impact on Microclimate

Launches will generate transient and dramatic micrometeorologic changes in the immediate vicinity of the launch pad. The rocket blast with its large induced over-pressures (in the near field), extreme temperatures, turbulence, and humidity variations will cause a local change of significant magnitude. Such changes, however, will not be appreciable outside the SLC-6 area,



Reference: NASA/JSC, 1976.[82]

FIGURE 5.1.2-B. Rain acidity predicted from washout of HCl gas from a hypothetical Shuttle ground cloud.



Reference: NASA/JSC, 1976.[82]

FIGURE 5.1.2-C. HCl deposition predicted from washout of HCl gas from a hypothetical Shuttle ground cloud.

except in the immediate vicinity of the ascending Shuttle Vehicle. Changes at or very near the pad undoubtedly would be so severe that they would be fatal to man or animals. Temperatures of over 4,500°F are estimated to occur in a launch exhaust gas cloud. Because all personnel in the area during a launch will be adequately protected, the importance of the temporary changes is considered minor. However, microclimatic changes would also occur in the unlikely event of a catastrophic accident. Because there would be some potential for impact to unprotected personnel, the importance of such an impact is considered moderate.

5.1.2.3 Impact on Shoreline Stability

The only impacts to shoreline stability will result from the existence and maintenance of the Shallow Draft Barge facility. Onshore-offshore transport of sediments by summer swells would be affected to some extent because sediments would be trapped in the dredged basin, thus reducing the supply of sand to beaches on the north side. Careful replenishment of north beaches by the use of sediments periodically dredged from the basin would alleviate any possible minor erosion problems.

5.1.2.4 Impact on Topography, Geology, and Soils

For the most part, proposed project operations will have little potential for affecting either topography or geology. Operation of the Shallow Draft Barge facilities would generate insignificant impacts to onshore or submarine topography. Occasional maintenance dredging may be required in the harbor to clear accumulated sediments generated by cliff and shore erosion, and from littoral drift.

At most, minimal impact to soils would occur and be limited to the vicinity of the facilities. Impacts could result from contaminated runoff and accidental spills. Contaminants may include refined petroleum products, substances washed off parking lots, and metal preservatives used in the Tank Storage and Checkout Facility.

The only changes to soil that might be expected to occur during project operations would result from contamination by launch ground clouds and from accidental spills or project related wildfires.

Acid rainout or washout from a ground cloud conceivably could have some effects on soil chemistry over a large downwind area (perhaps from 5 to 25 square miles), although no data are presently available to substantia e this. The exact extent, the likelihood, and the severity of resultant soil damage are presently unknown. It should be noted that most soils, including those found in the Vandenberg area, do have a considerable buffering capacity. Consequently, it is assumed that they could absorb some low pH rain or mist from one or more ground clouds without exhibiting any measurable change. The potential for long term buildup of contaminants in soils affected by a series of launches is considered low because most local soils would be rapidly flushed by any subsequent rainfall. The probability of any permanent change to soil characteristics, such as fertility, is considered to be extremely low. It is conservatively estimated that impact, if it occurred, would be no greater than discernible in magnitude and moderate in importance, based on the relatively large areas that could be affected.

Impact to local soils as a result of accidental spills or a project related wildfire could be more important than contamination from normal launches. Further, the possible consequences of toxic chemical or fuel spills is considered of less potential importance than impacts associated with wildfires. It is expected that even large spills of toxic chemicals would only affect limited areas and that such areas could be expected to recover from any resultant loss in fertility within several years. Although it is difficult to estimate the scale of impact from a wildfire, it is probable that it would be much greater than impacts associated with the largest conceivable spills or other accidents.

Generally, a fire could make very large areas more susceptible to erosion and could cause extensive loss of fertility from humus destruction. Because such project related events would be rare, the magnitude of this impact is considered insignificant. However, a large wildfire could have a significant importance.

5.1.2.5 Impact on Hydrology and Water Quality

Operation of the proposed facilities will have, at most, a minimal impact on the hydrology of the Vandenberg and Port Hueneme areas. The existence of the various Shuttle facilities will cause some effect on local runoff characteristics as a result of a very small increase in the total amount of paved land (which precludes infiltration and accelerates runoff). Less than 200 acres of land will be required for the entire project at both Vandenberg and Port Hueneme. Loss of such a small amount of infiltration area is not expected to cause a measurable change in groundwater levels, and provision of drainage systems at each facility will eliminate any local increases in erosion. In addition, domestic and industrial water requirements (including deluge water which will be treated and reused for each Shuttle launch) are small and would not appreciably impact available groundwater resources.

Occasionally, water quality in streams and lakes might be affected by normal Shuttle operations. These effects would include incidental contamination from minor spills of fuels and lubricants and from fertilizers used for maintaining landscaping. Small quantities of fuels and lubricants also might be spilled during activities at Port Hueneme or the SDB facility at VAFB. The consequences of such contamination would be minimal and short lived. Another possible effect on water quality in the harbor at Port Hueneme would occur if one of the nozzle plugs were to fall out of a spent SRB during haulout operations. A worst-case event could involve the spillage of about 175 pounds of residual propellant in partial solution with entrapped sea water into the harbor. Because the harbor is subject to flushing by tidal action, such contamination would be expected to dissipate rapidly and cause only minimal impacts (see Section 5.1.2.7). The SRB washwater will be discharged to a treatment plant. Treated effluent will be discharged into the Naval Base's sewerage system.

The arrival, maneuvering, and unloading of External Tanks at the large dock will entail tug and vessel operations as well as land transport. Maneuvering operations are expected to generate turbidity and increase concentrations of suspended solids within the harbor. Although the bulk of particles may be redeposited in the immediate dock vicinity, some will migrate outside the harbor and spread to other areas. Other operational wastes such as diesel fuel,

oil, and grease, if accidentally spilled, will enter and possibly degrade harbor water. The amount of materials emitted will be small, and natural flushing will dilute them to low concentrations. Ballast water will be of a marine water composition and will not introduce significant contaminants. No other water quality impacts are anticipated.

Acid rainout or washout from the launch ground cloud may also contaminate surface waters. Although it is difficult to evaluate the consequences of such an effect, it is conceivable that small shallow water bodies could experience some pH or chloride ion change. This is considered unlikely, but even if such changes were to occur, the local surface waters are not used for domestic purposes. Any contamination from rocket exhaust would be expected to attenuate rapidly as a result of natural flushing and dilution. Thus, the importance of contamination from the exhaust cloud is considered to be minor.

Emissions resulting from operations accidents have a somewhat greater potential for causing impacts to water quality. Although severe accidents are considered very unlikely, the occurrence of such an event might cause an impact of moderate importance. For example, the crash of a tank truck could dump a large quantity of toxic hypergolic fuel into a major watercourse like the Santa Ynez River. Because hypergolic fuels are water soluble, they would be expected to dilute rapidly. It is possible that such an event could cause temporary contamination of an area perhaps as large as the Santa Ynez Lagoon. Further discussion of the consequences of this type of accident is presented in Section 5.1.2.7.

Other catastrophic events that could cause water quality impacts would include a large wildfire or an accidental ignition of one or more SRB segments. Effects of a wildfire are discussed in Section 5.1.1.4. The consequences of an accidental booster ignition would be expected to be similar to those produced during a normal launch, but concentrations of contaminants could be somewhat higher. It is conservatively assumed that the small watercourses (and some coastal waters) in the SLC-6 area could experience a temporary, but significant, degradation in water quality.

5.1.2.6 Impact on Noise

Impacts of normal operations primarily will be a result of rocket launch noise, sonic booms and sound focusing produced during ascent of the Shuttle Vehicle, and sonic booms produced during reentry of the Orbiter. Other noise effects are expected to be minor compared to these three impacts of Shuttle Vehicle flight.

The Shuttle vehicle will be considerably larger than any other missiles currently launched from Vandenberg; therefore, the associated impacts resulting from rocket engine noise are expected to be greater than those occurring from current launch operations. However, in recent years there have been no complaints concerning noise produced during any launches. This can be attributed to the fact that the low frequency noises typically produced by rocket engines are not particularly annoying. It is also believed that many people residing in the Lompoc and Santa Maria areas closely identify with activities

at Vandenberg and, as a result, are not annoyed by missile noise. Also, rocket noise is a rather short-term phenomena, lasting at most only a few minutes and only occurs infrequently.

During a typical launch, main engine ignition will occur at T minus 4 seconds and will reach 90 percent power by T minus 0.13 seconds. During this very brief interval, sound levels on the launch pad are expected to reach an absolute level of about 160 dB.[a] This sound will contain mostly low frequencies (<50 Hz), and will be perceived in the Lompoc Valley as a distinct low rumble. In Lompoc and in the Base cantonment area the sound pressure is expected to be as high as 105 to 110 dB.

Liftoff will occur almost simultaneously with booster ignition, at which time on-site noise levels will rise to about 170 dB.(223) Estimates for Lompoc and the cantonment indicate that these sound pressure levels will have attenuated to as low as the 130 level, as a result of distance alone. Coupled with the further attenuating effects of turbulent mixing and topographic shielding, levels in these two areas are expected to be about 115 dB. In terms of the absolute increase in transient noise, this will represent an impact of substantial magnitude.

Noise levels from Space Shuttle launches will be 8 to 10 dB higher than Titan III noise levels. This will be due solely to the greater thrust involved in a typical Shuttle launch (6.4 million pounds versus 2.5 million pounds for the Titan IIID). Peak sound pressure levels are expected to persist for approximately 10 seconds. Most of the energy will be in the near infrasonic range (less than 100 Hz), peaking at 20 to 30 Hz. Well-defined guidelines established by the USAF Aerospace Medical Research Laboratory (see Table 5.1.2-5) and indications by the U.S. Environmental Protection Agency that infrasound exposures below 130 dB present no serious health problems support the expectation that the maximum perceived noise levels of 115 to 120 dB in Lompoc during Shuttle launches will create no deleterious physiological effects. From an annoyance standpoint,

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[a] Frequency content of sound produced by Space Shuttle Vehicle engines is unavailable at this time. Consequently, exact conversion of dB to dB(A) is not possible but approximate conversions can be made by subtracting 20 from a given dB value.

however, there will likely be some people in the area who find this noise objectionable--a factor of moderate importance.
of moderate importance.

Table 5.1.2-5. GUIDELINES FOR UNPROTECTED EXPOSURE OF HUMANS TO LOW FREQUENCY NOISE

Noise frequency range (hertz)	Sound pressure level[a] (re: 20 N/sq m) (dB)	Exposure limits
1 - 7	150	4 min/day with 24 hours rest
8 - 11	145	4 min/day with 24 hours rest
12 - 20	140	4 min/day with 24 hours rest
20 - 80	135	20 min/day with 24 hours rest

[a]Sound pressure levels apply to discrete single frequencies or to band bands of noise including the stated frequencies.

Reference: U.S. Air Force, 1974.(134)

After clearing the access tower, the Shuttle Vehicle will gradually pitch over and begin its ascent. As the Shuttle Vehicle climbs through the troposphere in the 66 seconds following liftoff, perceived noise levels in the Lompoc Valley and in other surrounding areas will steadily diminish. At T plus 24 seconds the Shuttle Vehicle will have ascended to 5,340 feet and will cause noise in Lompoc and the cantonment at an estimated 110 dB. By T plus 40 seconds noise produced by the vehicle will have decreased to about 105 dB in both areas.

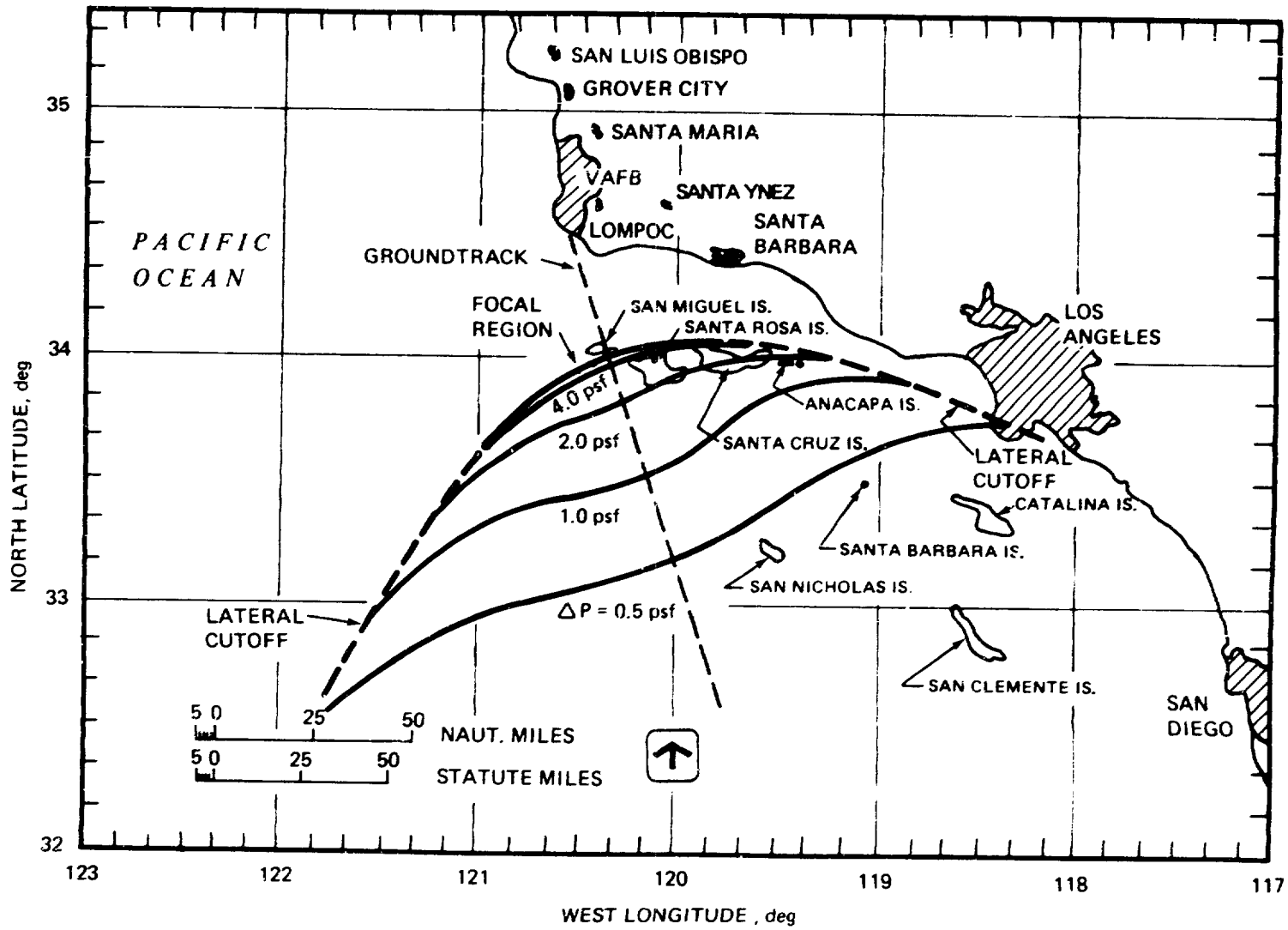
Sonic booms are expected to occur during ascent, and substantial overpressures are expected to occur along the vehicle's ground track. Because the Shuttle Vehicle will only use over-water launch azimuths, these booms are not expected to affect populated areas. However, these booms may impinge on one or more of the Channel Islands depending on the launch azimuths.

Substantial overpressures are expected for two reasons: first, sound focusing will result from longitudinal acceleration and pitchover maneuvers; second, the rocket exhaust plume will increase the effective vehicle size (tests indicate that a rocket plume may double sonic boom overpressures that would be experienced from the vehicle alone).

Sea level footprints of sonic boom overpressures resulting from VAFB Shuttle launches from SLC-6 are shown in Figures 5.1.2-D, -E, and -F for three launch inclinations (70°, 90°, and 98°, respectively). Typical overpressures expected without focusing effects could be as high as 6 pounds per square foot (psf) about 40 miles downrange, diminishing to less than 1 psf about 60 miles downrange. However, focusing is expected to occur within a zone that could be about 1,000 feet wide and extend 40 miles on either side of the ground track. The frequency and severity of any focusing effect will depend on meteorological conditions at the time of launch and on the exact ground track of the missile. The focusing factor may be as high as 5 at the zone's center, but probably will be about 2 at the lateral limits of the zone. Overpressures in the center of the focus zone (typically located about 40 miles downrange) could be as high as 30 psf, diminishing to about 10 psf at the lateral edges of the zone.(81) It is a remote possibility that a ship at sea could suffer some minor damage if it were at or near the center of the focus effect. Prelaunch safety measures, however, call for clearing of craft from downrange hazardous zones.

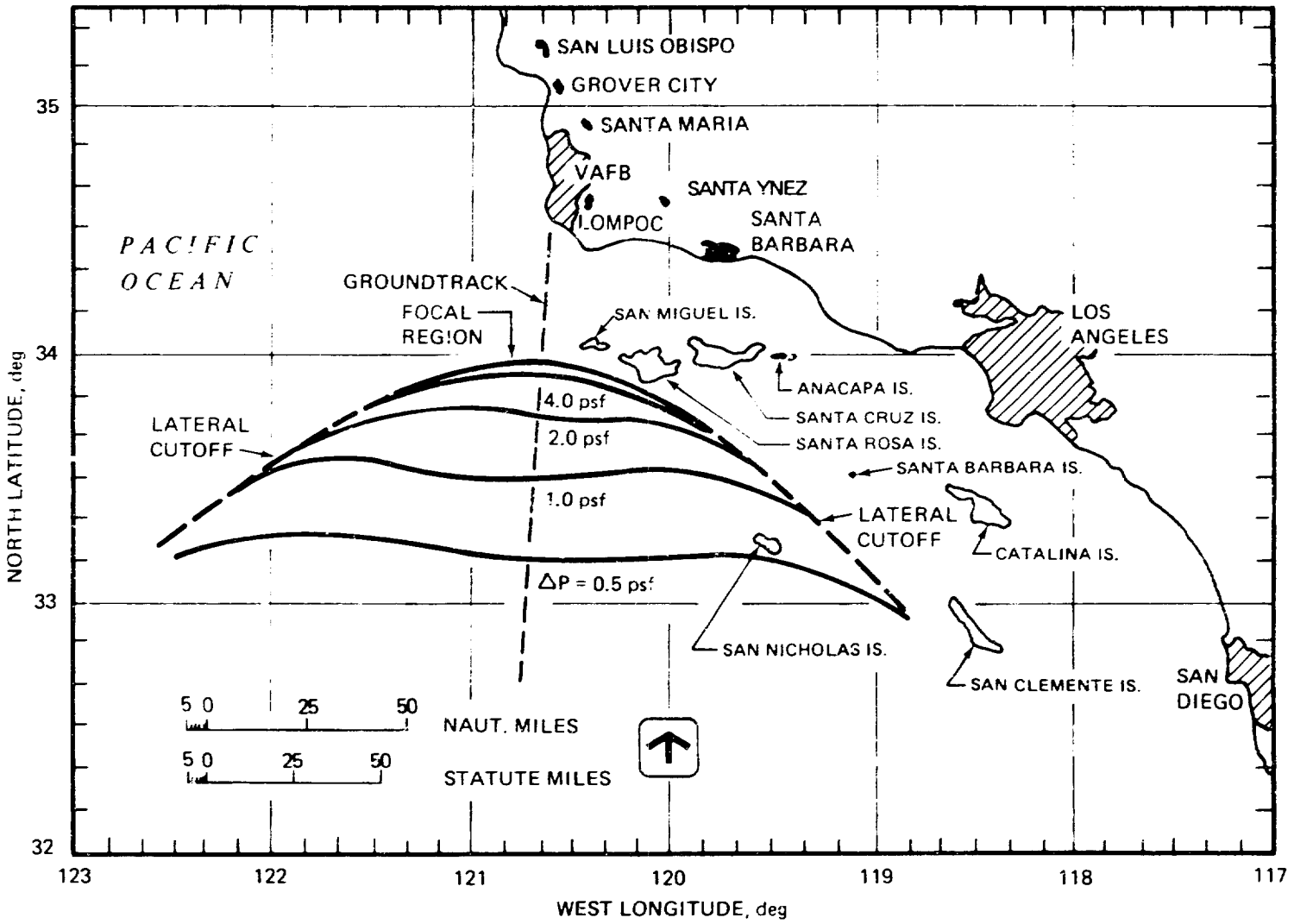
In addition, the boundaries of the focus zone are expected to include the Channel Islands. Potentially, some animals on these islands would be affected by overpressures in the focus zone. The impact of sonic booms produced during vehicle ascent is described as significant because it is considered that this represents an upper bound on the importance that such events could have. It is to be noted that studies concerning sonic booms and sound focusing produced during Shuttle ascent are currently underway. These studies will further define the extent of any effects associated with these phenomena.

The Orbiter, as it descends through the troposphere will propagate sonic booms. Plots depicting areas and magnitudes of sonic boom overpressures from Orbiter returns to VAFB are shown in Figures 5.1.2-G, -H, and -I for normal end-of-mission scenarios and for Abort-Once-Around (AOA) and Return-To-Launch-Site (RTLs) abort situations, respectively. Normal reentries will cause booms of up to 1.5 psf to impinge in the area of Lompoc.(33) Overpressures of this magnitude might cause some minor damage to plaster and vibrations of large glassed areas with some associated glass breakage. However, sonic booms of this magnitude would be more appropriately regarded as a nuisance than a threat to property.(81) Further, sonic boom footprints having overpressures greater than 2.0 psf are only expected over ocean areas.



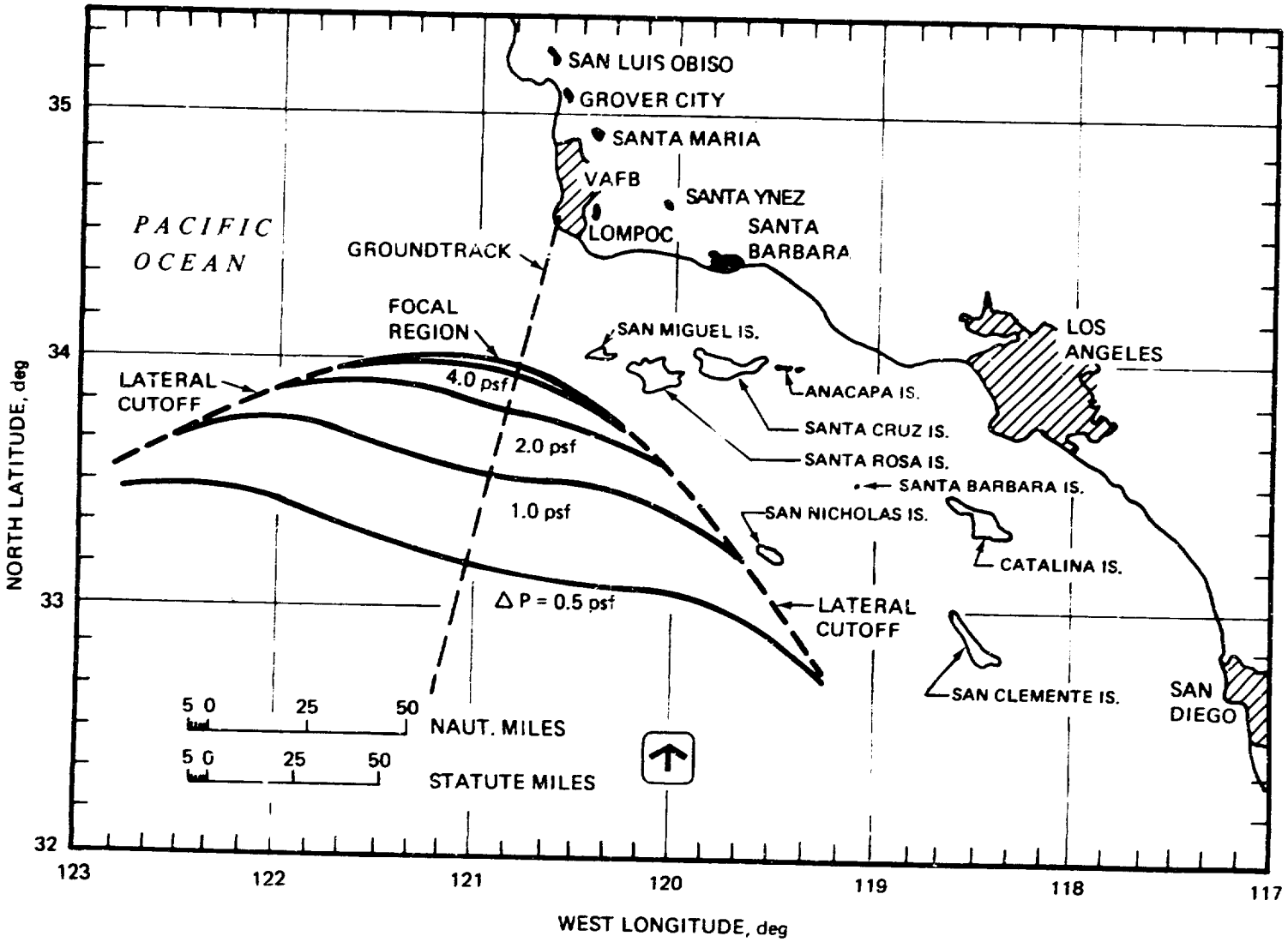
Reference: McDonnell Douglas Technical Services. (184)

FIGURE 5.1.2-D. Predicted sea level footprint of sonic boom overpressures resulting from VAFB Shuttle launches from SLC-6 into an orbit of 70° inclination.



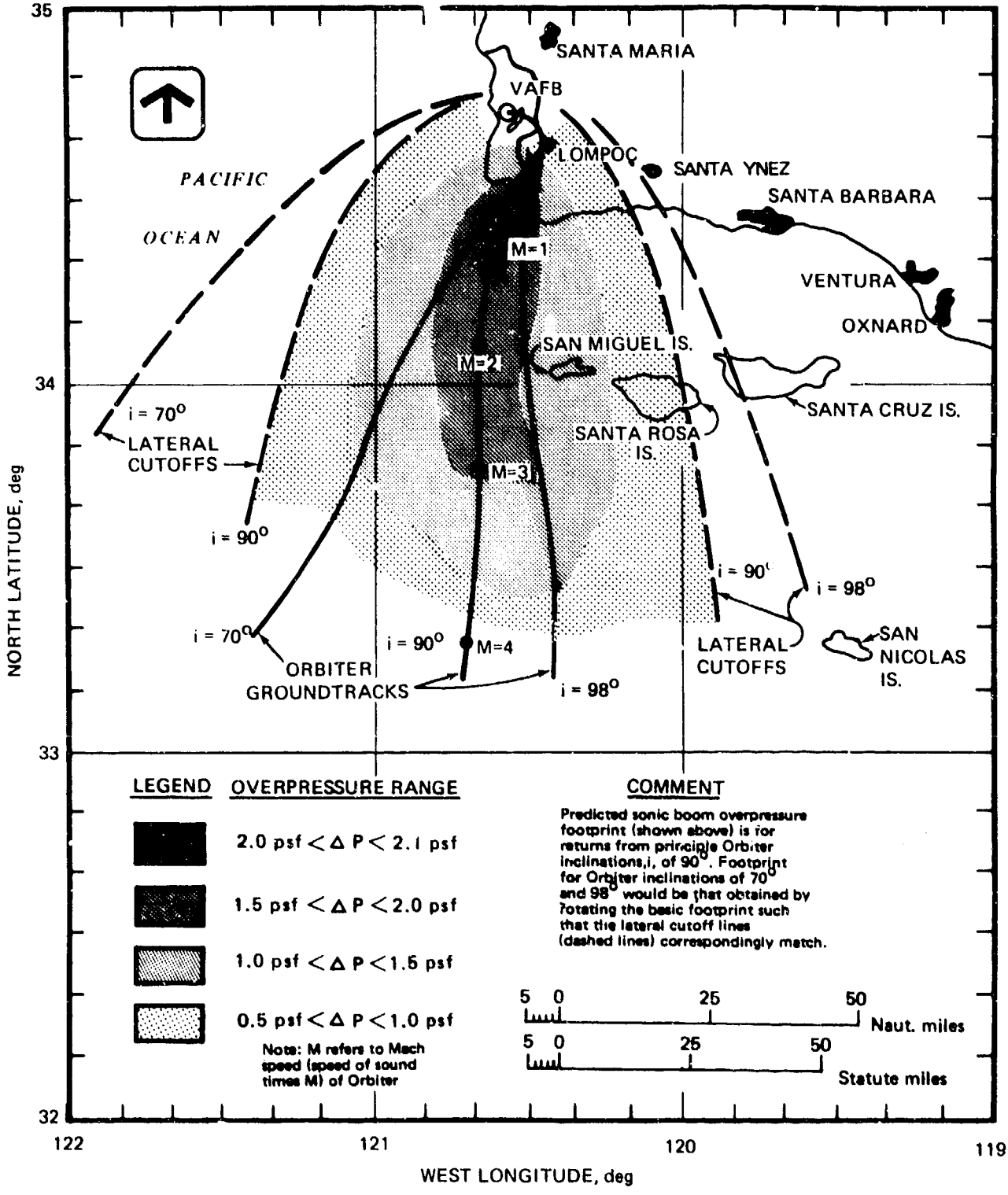
Reference: McDonnell Douglas Technical Services.(184)

FIGURE 5.1.2-E. Predicted sea level footprint of sonic boom overpressures resulting from VAFB Shuttle launches from SLC-6 into an orbit of 90° inclination.



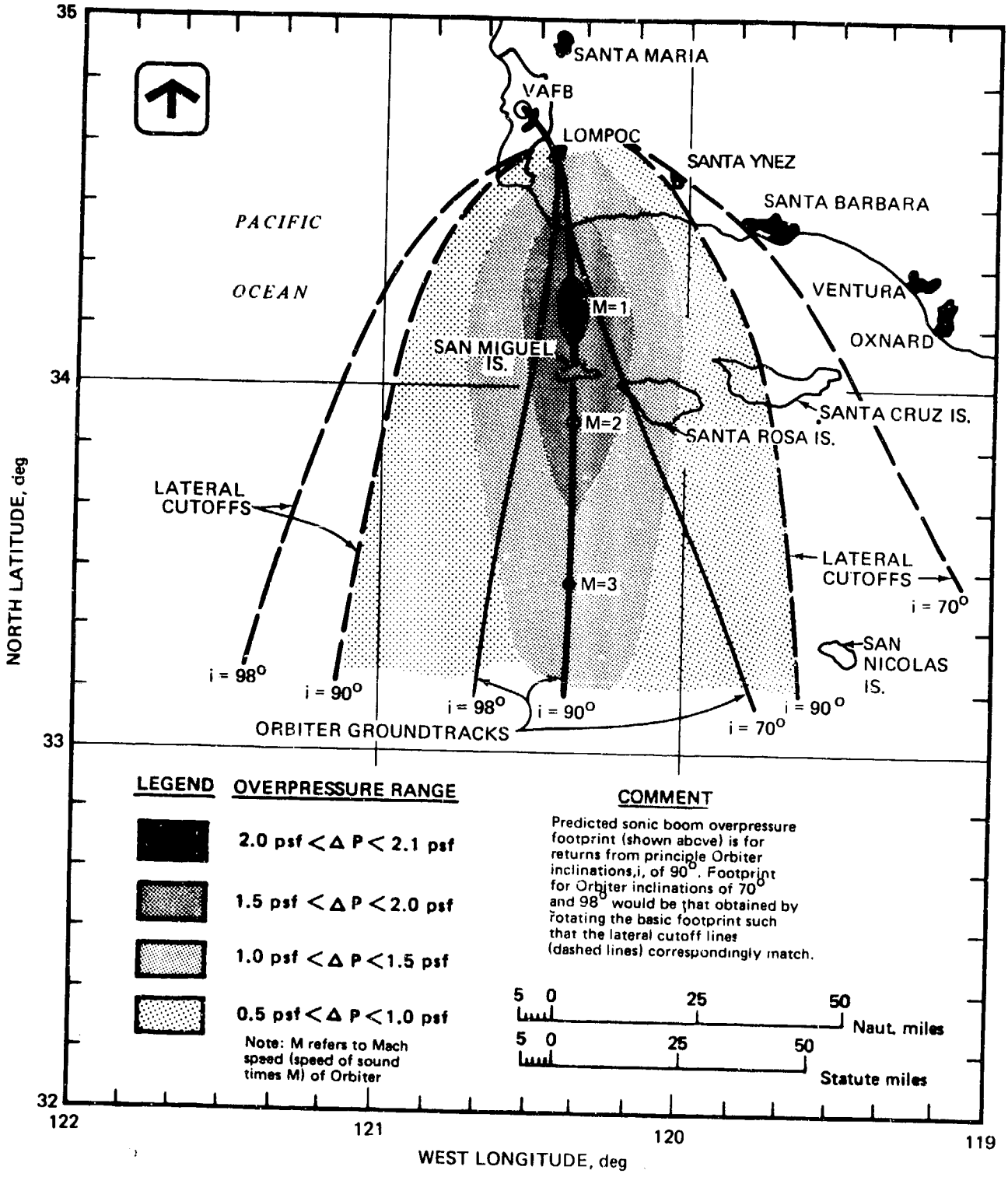
Reference: McDonnell Douglas Technical Services.(184)

FIGURE 5.1.2-F. Predicted sea level footprint of sonic boom overpressures resulting from VAFB Shuttle launches from SLC-6 into an orbit of 98° inclination.



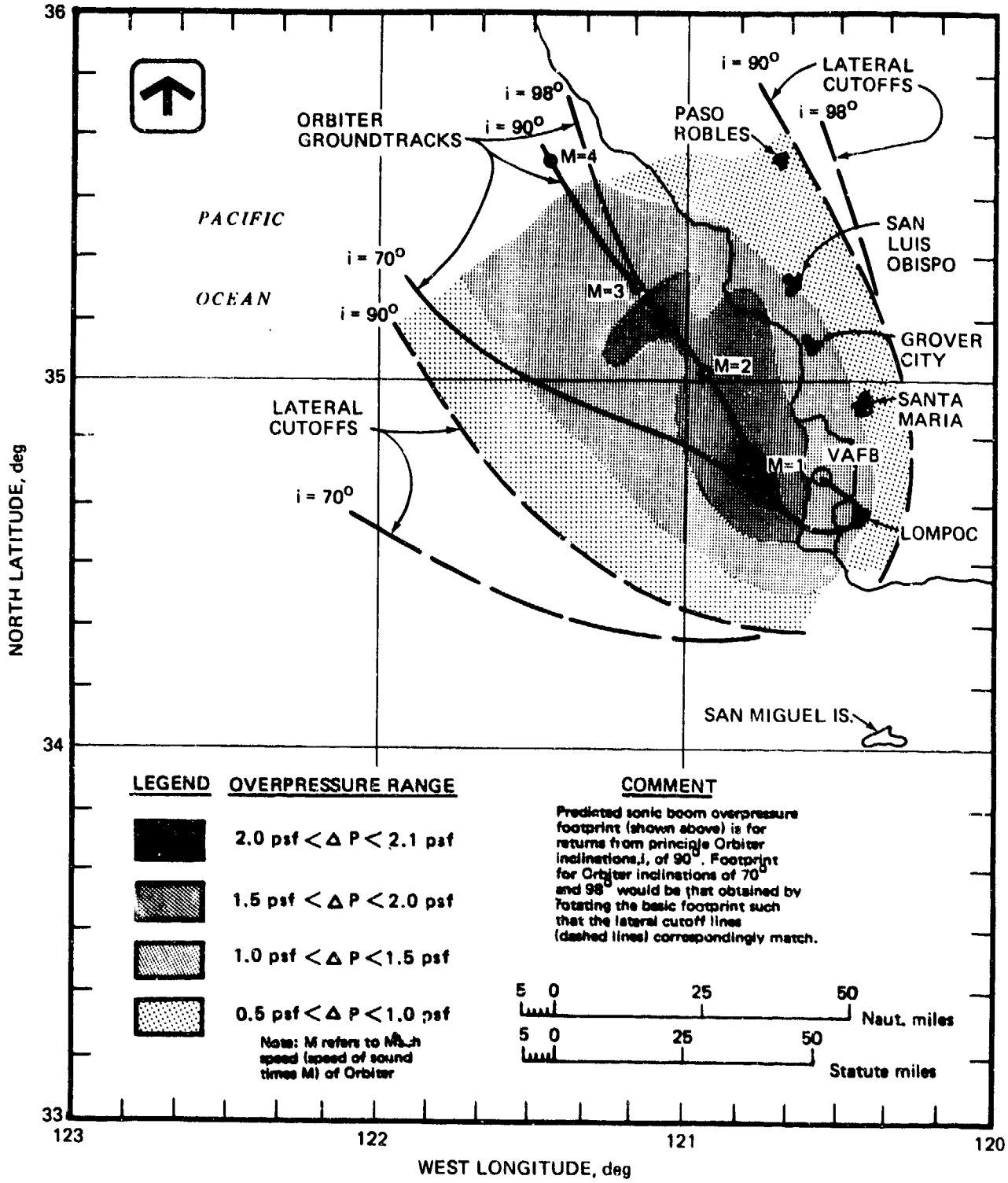
Reference: McDonnell Douglas Technical Services[174]

FIGURE 5.1.2-G. Predicted footprint of sonic boom overpressures resulting from normal end-of-mission return of Orbiter to Vandenberg Air Force Base.



Reference: McDonnell Douglas Technical Services[174]

FIGURE 5.1.2-H. Predicted footprint of sonic boom overpressures resulting from non-orbital return of the Orbiter to Vandenberg Air Force Base subsequent to an abort following a launch.



Reference: McDonnell Douglas Technical Services[174]

FIGURE 5.1.2-I. Predicted footprint of sonic boom overpressures resulting from a one-around return of Orbiter to Vandenberg Air Force Base subsequent to an abort following a launch.

These booms represent a significant instantaneous change over ambient conditions. Because the consequences would be limited, the importance of sonic booms is judged as only moderate.

Other noise impacts are expected as shown in Matrices 5.0-A through 5.0-G. Briefly, the more noteworthy include:

(1) Insignificant noise increases in the Lompoc-Vandenberg area caused by incidental additional air traffic at VAFB in support of the Shuttle Operations phases.

(2) Insignificant noise increases due to the additional traffic load imposed by the community operations work force and other operation related traffic.

(3) Minimal noise near the ocean beach area produced by infrequent hovercraft operations (30 per year).

(4) Insignificant to minimal noise produced by operations of various kinds of equipment in the airfield and SLC-6 areas. Such equipment would typically include pumps, compressors, cranes, air compressors, and vehicles.

(5) Insignificant to minimal noise produced by operations at Port Hueneme. Such operations would include the use of various types of industrial equipment in a setting that already is industrial.

(6) Possible temporary, minimal to minor increases in local community noise levels due to increased tourism and spectator activity.

(7) Insignificant noise produced during harbor operations at the SDB facility at the Point Arguello Boathouse and the ET facility on the Arguello terrace.

None of these impacts have the potential for affecting large numbers of people, and none are considered particularly objectionable.

One final category of noise impacts that could occur at Vandenberg would involve the noise resulting from a highly unlikely catastrophic accident.

One of the worst scenarios concerning operational impacts would be the explosion of a Space Shuttle Vehicle on the pad. The fully fueled vehicle has an explosive equivalency of about 300,000 pounds of TNT.[1] If such an explosion were to occur, it would result in a blast wave of about 300 lb/sq in. at about 100 feet from the explosion. At 800 feet from the source, the overpressure would drop to about 5 lb/sq in. (masonry structures could be destroyed at this distance). At 2,200 feet from the source, the overpressure would be about 1 lb/sq in. (a pressure that properly designed concrete structures can withstand, but under which other structures with light curtain walls might fail). The noise equivalency at 100 feet, 800 feet, and 2,200 feet would be 220 dB, 184 dB, and 169 dB, respectively. Blast noise would be of short duration and impulsive, and could cause loss of life among unprotected workers in the immediate SLC-6 area. In Lompoc, blast noise from this event (estimated at about 149 dB) could break windows, crack plaster, and produce a startle effect. The magnitude of the impact of this event is considered insignificant because its probability is remote. However, if it were to occur, there would be substantial consequences in the nearsite area.

5.1.2.7 Impact on Biology

The continued existence of newly constructed facilities and facility addition in support of the Shuttle Operations phase will preclude recolonization by existing bi ta. On VAFB, this would constitute a long term loss of about 200 acres of native habitat, which is a small fraction of the several tens of thousands of such acres on the Base; at Port Hueneme, 2 acres of potentially reconstitutable land (that now is essentially barren) will be used.

Routine maintenance and/or ancillary support of ground operations, facilities, and equipment are expected to generate slight transient impacts on terrestrial and aquatic biota through disturbances from vehicle movements, noise emanations, dust emissions, weed control activities, occasional animal-vehicle collisions, and the increased presence of personnel. Overall estimates are

that these Shuttle induced biotic disturbances will increase no more than 10 percent (a minor magnitude) over current disturbance levels. On a distributional basis, the magnitude and significance of this increase are expected to be even smaller.

As noted in Matrices 5.0-A through -G, most of the other biota-impacting situations caused by normal operations are considered low level. In general, these situations will evolve from sporadically generated dust, noise, or water quality disturbances caused by such activities as Orbiter ferry operations, Orbiter mating to and demating from the Boeing 747 carrier; Orbiter servicing on the runway and in related airfield processing facilities; dockside handling of ETs and SRBs at Port Hueneme; harbor navigation and berthing of required operations craft in Port Hueneme; interfacility transport (either on land or water) of Shuttle components; receiving and handling of Shuttle components at SLC-6; onpad integration of Shuttle components; receiving and pumping of propellants at SLC-6; clearance of hazardous areas; activation (5 minutes before launch) and continued operation of onboard Auxiliary Power Units; refurbishment of the launch pad subsequent to a launch; and handling and servicing of an onpad abort. In accordance with related air, water, and noise impact discussions (Sections 5.1.2.1, 5.1.2.5, and 5.1.2.6, respectively), Shuttle induced changes in these environmental factors will be slight and infrequent. Noise changes might occasionally startle nearby terrestrial and aquatic fauna. Airborne dust changes would, at most, represent potentially small increases to amounts that normally are deposited on plant foliage. Water quality changes induced by accidental release (into Port Hueneme waters) of water propellant mixtures from recovered SRBs, and unavoidable leaks of gas and oil from marine vessels in Port Hueneme are expected to be very small. In the SDB harbor area it is expected that minor emissions of such substances as diesel fuel, lubricating oil, and antifouling and corrosion inhibiting compounds commonly would occur during operations. These substances may depress the occurrence and abundance of particularly pollution-sensitive species (perhaps including nudibranchs and many kinds of planktonic larvae) inside the harbor. Periodic tugboat operations are expected to suppress the development of kelp forests and populations of associated organisms. Periodic disturbance of local sea birds, shorebirds, and marine mammals is expected during normal operations. No rare, endangered, or threatened species are expected to be consequentially affected in the SDB harbor area. Impacts would, at most, impart a highly localized and transient effect

to aquatic biota. The overall collective impact of the aforementioned disturbances to biota is expected to be minimal. Minor impacts of a similar type are expected to result from low level noise and air quality changes induced by Shuttle related spectator activity in areas off the Base.

During a normal launch, transient changes in microclimate (discussed in Section 5.1.2.2) will occur within and near the ground area and air space occupied by hot, turbulent exhaust. Biota would be appreciably impacted by this change only if they were present in severely affected spaces; unfortunately situated organisms would perish. It is expected that a few smaller animals, including insects, reptiles, small mammals and, perhaps, an occasional bird would unavoidably perish during each launch. Observations by Base personnel indicate that larger mammals avoid launch areas, especially during launch operations.

Besides changes in microclimate, the generation of a ground cloud during Shuttle launch will impart short term changes to ambient air quality conditions. Corresponding impacts to the biology of the area will be a function of meteorological conditions during and after the launch, the temporal behavior of the cloud, and the spatial location of biota relative to the moving, diffusing cloud mass. Constituents within the cloud (see Section 5.1.2.1) will include hydrogen chloride (HCl), acid-coated aluminum oxide (Al_2O_3) particles, chlorine (Cl_2), and nitrogen oxides (NO_X). Biological contact (through diffusion, aerosol impingment, rainout, or washout) with these constituents will constitute an impacting situation. Direct impact would occur through uptake by inhalation or absorption. Indirect impact could result through cloud induced changes in water quality, soil chemistry, and habitat suitability. Inasmuch as launch induced changes in water quality and soil chemistry will be transient and, at most, minor (see Section 5.1.2.4 and 5.1.2.5), biological impacts generated by these changes will be insignificant.

Researchers are currently involved in studies dealing with the potential effects associated with the exposure of plants and animals to constituents from rocket exhausts. These investigations have focused on determining constituent concentration and exposure thresholds necessary to cause biological damage or death. For the variety of vegetation studied in this regard, tolerance indicators such as leaf tip burn, leaf damage, defoliation, twig death, and plant death have been used.[30][50][51][53][88][89] Tolerance indicators used in related animal studies have included respiratory irritation, respiratory damage, skin damage, sight interference, blood pH

change, and death.[21][76][86][166] Results from some of the experiments are summarized below:

(1) From vegetation studies:

(a) Cosmos--a crop displaying the greatest sensitivity to HCl tests conducted so far--exhibited traces of leaf discoloration and tip burning following a 20-minute exposure to 2 ppmv of HCl vapor in air.[50][51][52]

(b) Aster, calendula, marigold, zinnia, and nasturtium displayed leaf damage following a 20-minute exposure to 2 - 6 ppmv of HCl vapor in air.[50][51][52][53]

(c) Centaurea displayed leaf discoloration following a 20-minute exposure to 7 - 14 ppmv of HCl vapor in air.[50][51]

(d) Nasturtium and marigold displayed no visible injury upon exposure to HCl and high concentrations (75 mg/cu m) of Al_2O_3, but only when the concentration of HCl was below the threshold level required to initiate damage symptoms.[50]

(2) From animal studies:

(a) Bobwhite quail and domestic chicken eggs displayed a 50 percent mortality rate upon a single 15-minute exposure to HCl gas in concentrations ranging from 168 to 260 ppmv.[128]

(b) Domestic pigeons exposed to 100 ppmv HCl for 6 hours per day for 50 days displayed slight unrest, irritation of the eyes and nose, and slightly reduced hemoglobin concentrations.[76][166]

(c) Concentrations of HCl gas which produced 50 percent mortality in laboratory mice were found to be 14,000 ppmv at 5 minutes exposure and 2,600 ppmv at 30 minutes exposure; for HCl aerosols, 50 percent mortality was achieved at 11,000 ppmv at 5 minutes exposure and 2,100 ppmv at 30 minutes exposure. Higher concentrations were required to achieve the same results in rats[21]

(d) For the cotton mouse *Peromyscus gossypinus*, respiratory distress was displayed upon 10-minute exposure to HCl and Al_2O_3 of 29 and 80 ppmv, respectively, per gram of body weight; mortalities of 10 percent were achieved when respective concentrations were increased to 39 and 111 ppmv per gram of body weight.[86]

It is to be noted that cosmos (and other sensitive test species cited above) is presently grown in Lompoc Valley, 9-10 kilometers from the launch pad. In accordance with VAFB Shuttle ground cloud predictions shown in Figure 5.1.2-A (in Section 5.1.2.1), a peak instantaneous ground level concentration of nearly 2 ppmv HCl could occur at this location. Computations on a 10-minute time-weighted average basis indicate that the exposure would be 1 ppmv.[79] On a 20-minute basis, the exposure would be even less, and substantially below the 2 ppmv necessary to achieve leaf tip burn. It is to be recognized that the sensitivities of several Lompoc-grown crops whose appearance is critical to their marketability (celery, lettuce, cauliflower, broccoli, and spinach) have not yet been determined. However, respective sensitivity values are not expected to differ (at least on the downside) significantly from those for cosmos. Hence, the highest ground level HCl exposures predicted to occur in valleys of the project region will be less than known or expected thresholds required to initiate damage symptoms in plants. Based on aforementioned studies, additive damage effects resulting from the presence of suspended Al_2O_3 will not be induced. It may be noted that meteorological conditions that would cause a ground cloud to move toward the Lompoc Valley are expected to occur less than 5 percent of the time (based on meteorological records).[80]

Stands of relictual north coastal flora and other special interest plant species occur in the nearby mountains east of SLC-6, less than 10 kilometers distant. As such, HCl predictions applied to the previous discussion also pertain herein, although with some qualification. At the higher elevations of these stands, vertical distances between the ground cloud stabilization level and ground level will decrease. As such, instantaneous ground level concentrations and corresponding time-mean weighted average concentrations will increase above those predicted by the NASA/MSFC diffusion model (which assumes flat terrain). Lacking the tools to make predictions of the expected ground level HCl concentrations, the impact associated with this discussion is uncertain. The Air Force, however, is currently conducting limited reconnaissance at VAFB in an attempt to detect exhaust induced effects from periodic Titan launches at SLC-4 (about 4 miles north of SLC-6). Thus far, no biotic effects associated with the launches have been reported.

Relictual north coastal flora and other special interest plant species also occur on the Channel Islands at elevations between 300 and 640 meters. Considering their distance from the launch pad area (50-70 kilometers), however, peak instantaneous ground level concentrations of HCl gas at these locations probably would be no greater than 1 ppmv (see Figure 5.1.2-A and Table 5.1.2-4). Vegetation damage, therefore, is not expected to result from gaseous contact.

Rainout or washout of HCl from a Shuttle generated ground cloud and the attendant effects resulting from impingement of acid droplets on vegetation are currently the subject of much study. According to the predictions depicted in Figure 5.1.2-B of Section 5.1.2.1, the pH of the initial droplets during a washout will vary from ≤ 0.5 (for an occurrence initiated at or very near the launch site) to $2.0 \leq pH \leq 2.5$ (for an occurrence initiated 100 km from the pad). The pH of subsequent droplets, however, will progressively increase to more neutral levels as washout continues. Impingement of the initial droplets on vegetation would therefore cause the larger impact relative to that of subsequent droplets. The cumulative impact for any single washout event, however, would be a function of rainfall rate and corresponding rate of dilution. In parts of the project area, natural vegetation damage--caused by deposition of chloride from wind blown sea salt aerosol--periodically occurs.[88][89] Hence, rainout/washout events might be expected to cause somewhat similar damage. Such damage could cover several tens of square kilometers and would be either additive to that which already occurs or introductory. In the latter case, a moderate impact would be expected. The significance of this impact may be substantial in that special interest flora could be affected.

As with vegetation, faunal populations will occasionally be exposed to ground level concentrations of HCl and Al_2O_3 from a Shuttle generated ground cloud. However, the expected levels of exposure will be substantially less than the aforementioned threshold levels required to induce discomfort or death. Even in the event of a rainout or washout, direct impacts on most fauna would be unlikely. Exceptions might occur in instances of direct impingement of acid droplets on such organisms as slugs, snails, amphibians, or on bird eggs; under conditions of low rainfall rate, the progressive dilution of the more acidic earlier droplets may be insufficient to prevent absorption of toxic

quantities or dissolution of eggshell material. Such events would be of importance inasmuch as isolated populations or endangered species (such as nesting least terns at VAFB or brown pelicans on the Channel Islands) could be affected. Another potential ground cloud induced faunal impact would be that indirectly occurring as a result of exhaust constituent induced degradation of vegetative habitat.

Common biota and rare, endangered, and threatened species are expected to experience impacts from rocket noise and sonic booms generated during a Shuttle launch. The extent of the effect will be generally confined to the land area surrounding SLC-6 and the downrange area to and including the Channel Islands (see Section 5.1.2-6). Unprotected fauna situated within approximately 1,900 acres of land surrounding SLC-6 will be exposed to low frequency transient noise levels between 145 and 190 dB, depending on distance from the launch pad. Effects associated with exposure of wildlife and domestic animals to these low frequency noise levels are indefinite; there is an apparent lack of documented information in this regard. However, no noise induced biotic effects have been reported from the Air Force's current reconnaissance program of Titan launches at SLC-4. Nevertheless, because of the element of uncertainty associated with the effects of higher levels of Shuttle induced noise, a conservative allowance for a moderate impact is assigned. The basis for this assignation includes possible decreases in reproductive success with an accompanying reduction in fauna populations in the immediate vicinity of SLC-6.

Sonic booms generated by shuttle craft during launch and landing may impact the living resources in the immediate vicinity of VAFB. All launches and landings are planned to be over water for general safety purposes and to avoid possible effects of sonic booms in high population density areas. However, as indicated in Section 5.1.2.6 of this Statement, projected sonic booms <u>will</u> have impact on several of the Channel Islands.

For both launch and landing, the trajectory inclination will range from 70 to 98°. Inclinations at and near 70° are of primary concern, since above this figure the predicted sonic boom footprint is over water. Figure 5.1.2-D demonstrates that the "focusing" area is restricted to a band some 1,000 ft wide

(relative to the path of the vehicle) at a distance of about 40 mi from the launch site. In the focusing area, ground-level overpressures are estimated to be, maximally, 30 psf. Potentially only San Miguel Island will be affected by such overpressures. Beyond the area of focusing, overpressures diminish rapidly from 4.0 to 0.5 psf at a distance of 60 miles from launch site. Laterally, overpressures will diminish from about 4.0 psf (on or adjacent to Santa Rosa Island) to slightly less than 2.0 psf (on Anacapa Island) over a distance of 50 miles.

The proposed program calls for 129 launches to occur between 1983 and 1991. Of these, six may be on the 70° inclination flight path. Assuming that these will be evenly dispersed over the eight year period, less than one per year will be at or near the 70° inclination which would result in the generation of a sonic boom of significant overpressure at San Miguel Island. Sonic booms associated with normal re-entry will occur more often over this island; however, in no case will resulting overpressures be greater than 2 psf. Re-entry sonic boom overpressures over the other Channel Islands (Santa Rosa and Santa Cruz Islands only) will be no greater than 1.0 psf.

The potential effects of sonic booms on the biota of the Channel Islands are of two broad types and are of concern with respect to three groups of animals. Overpressures may cause direct physical or physiological damage and may startle the animals, cause aberrant behavior and thus impact the population indirectly. Animals of concern include pinnipeds and seabirds breeding on the islands as well as cetaceans in the adjacent waters.

Direct physical and/or physiological damage is not anticipated at the expected maximum of 30 psf overpressure. The ear is the body structure most sensitive to, and most easily injured by, overpressure. Yet, dozens of humans have been exposed to sonic boom overpressures of up to 144 psf with only momentary discomfort and a temporary ringing and fullness in the ear.[205] Marine mammals are expected to have the same reponse.

Because of the impedance mismatch between air and water, 99.8% of the impinging acoustic energy of a sonic boom will be reflected back into the air. Both theory and some experimental evidence support the conclusion that the pressure wave when entering water is rapidly smoothed and attenuated with depth, being only 1/10th its surface amplitude at a depth of 20 to 30 feet.[15]

Submerged pinnipeds and whales are not expected to suffer direct effects. Laboratory studies on the effect of overpressure on sea otters were conducted using explosive charges of various sizes. Results of tests on 12 animals indicated that the highest overpressure permitting survival was 275 psig (36,000 psf). One sea otter survived 365 psig (52,560 psf) without ruptured ear drums. Post-mortem examinations indicated that trauma to the lungs was responsible for death in most cases.(219) It was also reported that at 1 m from a seismic "sparker" the peak sound pressure was 2,100 psf. At that distance, sensitive fish species were not stunned and experiments with several invertebrates showed them to be less vulnerable than fish to the overpressures.

The most serious effects of sonic booms are expected to be exhibited through the behavioral "startle" reaction that is anticipated to affect both breeding pinnipeds and seabirds. In nesting seabirds the most serious scenario involves startling brooding adults, causing them to leave their nests. Unattended eggs and young would then be exposed to predators and possibly suffer mortality. Actual documentation of this sequence, however, is lacking.

Observations on domestic fowl exposed to sonic booms with overpressures of approximately 3 psf indicated that these birds generally respond more than larger animals such as cows and horses. Their response ranged from flight, running, crowding and cowering to what was described as pandemonium--wild scattering, flying and running--though no injuries or deaths were reported.(189)

Wild birds exposed to similar sonic boom overpressures were observed to react more strongly if in flocks than singly. When exposed, birds usually broke off whatever activity they were engaged in. Passerine birds on the ground usually took flight, while gulls in flight jerked to the side with extra wing-strokes, but quickly resumed their previous direction of travel.(210)

One field study included a test area subject to sonic booms created by aircraft from a nearby AFB, and a control site not so affected. Approximately 35 booms of greater than 1 psf impacted the test area during the four month study; one may have occurred in the control area. Clutch size and hatching rates for the bird species studied did not suffer between the two areas.(211)

A laboratory study of bobwhite quail addressed the hypotheses that exposure of eggs to above normal atmospheric pressure would decrease hatching success, reduce growth rates and increase mortality. Test batches of eggs were submitted to simulated sonic booms of 2.0, 4.0, and 5.5 psf, all at frequencies of 1, 2, and 3 per day for 18 days. Although significant differences were noted in some experiments with respect to dose or frequency, the results showed no trends with increasing dose or frequency. The authors concluded that the pressures applied had no effects on growth, reproduction and mortality of bobwhite quail.(211)

In another planned study (as opposed to casual observation) chicken eggs were exposed to about 30 sonic booms per day during incubation; median intra-incubation pressures were 0.75-1.25 psf when pressures outside the building housing the incubators were 5 psf. For about the last half of the incubation period outside pressures were raised to 17-19 psf. It was concluded that the overpressures involved do not lower or affect hatchability.(192)(193)

In 1969, a mass hatching failure (99 percent) in the Sooty tern population of the Dry tortugas was reported to be attributed to aircraft sonic booms. Historical records showed normal annual productions of 25,000-30,000 fledglings. The failure was attributed (circumstantially) to low-level, supersonic flights which might have produced overpressures of 100 psf or more.(209)

An indirect, behavorial effect may also be projected for pinnipeds using San Miguel Island as a rookery. In this scenario, the worst-case would be a general "startle" reaction followed by a stampede to the water. In the process young pups would be crushed to death immediately or separated from their mothers to die later. Documented evidence concerning the effects of sonic booms on pinniped behavior during breeding, pupping, and nursing are limited.

National Marine Fisheries Service (NMFS) biologists stationed on San Miguel Island had the opportunity to observe the startle reaction and subsequent behavior of pinnipeds to sonic booms. Two sonic booms occurred on May 22, 1975 and it was estimated that 75 percent of all California sea lions in the rookeries were alarmed and stampeded to the water. Though the sea lions were pupping at the time, no deaths or injuries to pups were reported in the stampede. On another occasion, NMFS personnel also observed that up to 100 percent of 10,000 sea lions and fur seals stampeded following a sonic boom. Pups were reported to be crushed and separated from their mothers, though exact numbers are not indicated.

Finally, sonic booms, generated during the return of the Orbiter from space (or from an ascent abort), will impact coastal habitats on the mainland (see Figures 5.1.2-D, -E, and -F). Impacts, however, are expected to be minimal and would consist only of short-lived startle reactions. Generally, birds will demonstrate the greatest response to these events. Of discernible importance in this regard are the least terns and brown pelicans that will be impacted. Project related sonic booms generated during Orbiter return will not impact the nesting areas of the endangered and threatened California condor.

Fires, explosions, and major fuel spills (all highly improbable events) constitute potential biota-impacting accidents that could occur during the Operations phase. Specific effects primarily would depend upon the location and extent of the accident and the resultant primary effects (changes in noise, air quality, water quality, and thermal surrounding).

Wildfires could begin at the airfield, on the tow route, or within SLC-6. If not controlled, burnoff of large acreages of special interest habitat would occur on Burton Mesa, adjacent to the Santa Ynez River, contiguous to the Coast Road, or near SLC-6. Subsequent natural regrowth would occur but could take several (5 to more than 25) years. Fire control measures would reduce the extent of fire damage, but the control measures themselves would have their own attendant impacts. For example, construction of firebreaks would destroy all plant life within the cleared areas. Given either fire or firebreak, some associated fauna would be destroyed.

A major spill of hydrazines could occur on the tow route or at the airfield, SLC-6, or Port Hueneme. Unless immediately contained, such a spill would result in the release of deleterious vapors that are suspected of being carcinogenic. Nearby fauna exposed to these materials would be impacted. Impacts on marine organisms would occur in the event of a major fuel spill during hovercraft operations. The extent of the effect, however, would be highly localized. Recolonization to pre-spill levels would likely be rapid.

Explosions of cryogenic fuels could occur on the tow route, at the airfield, or at SLC-6. The largest potential explosive source will be the integrated, fully fueled Shuttle Vehicle on the launch pad. Most above-ground animals within a few hundred feet of the blast would perish. Others nearby would suffer serious harm. Startle effects would occur within several thousand feet.

Maximum peak ground level concentrations (6.66 ppmv HCl) resulting from a solid propellant burn on the pad would occur within 5 km of the launch site. With slight deviation, these concentrations would persist for the duration of the burn. Relative to aforementioned thresholds, highly sensitive plant species would suffer leaf or other tissue damage, and nearby fauna might experience slight irritation. If a rainout or washout event were to occur along with this burn (an extremely improbable dual event), biological impact could be substantial. The basis for this assessment is that a slow burn event would tend to prolong the duration of acid droplet fallout.

5.1.2.8 Impact on Archaeological Resources

Based on criteria provided by the National Historical Preservation Act, potential impacts on archaeological resources during operations are not considered especially important. The existence of the tow route is considered a potential beneficial impact of a minor nature because it would cover a portion of several sites. Paving over portions of these sites will reduce access by vandals and will provide some protection from erosion.

In the area of SLC-6, ground vibration caused by rocket motor operation will not result in subsurface displacement of archaeological material. It is estimated that rocket motors will produce ground motion vibrational velocities approximating 0.02 inches/sec and accelerations approximating 0.002g within the nearest sites. Considering the area's earthquake history, this represents much weaker vibration than has recently occurred, and that is likely to occur, during natural seismic events. The magnitude of the expected vibrational impacts is therefore considered minimal, although the importance of the impacts, were they to occur, could be minor.

It is remotely possible that sonic booms produced during operations could cause damage to archaeological or historical resources in the project area. However, the likelihood of an impact occurring of more than discernible importance is very low. Energy transmitted to the ground from a sonic boom would be very low and would attenuate at a rapid rate. It is possible that an artifact eroding out of a hillside could be jarred loose or perhaps a fragile article lying on the surface of the ground could be damaged by a boom. However,

such occurrences (if they actually did occur) certainly would not constitute important impacts to the archaeological system of an area.

Although it is considered unlikely, an acid rainout or washout could also affect certain archaeological material like shell and bone in middens. It is

believed that this type of effect would not extend more than a few centimeters below the surface. At most, the importance of such impact might be discernible. Finally, if operations were to result in a wildfire, the construction of firebreaks might impact an archaeological site. Although it is difficult to evaluate the nature of such an impact, it also could have discernible importance. Preplanned location of firebreaks to avoid known sites would reduce the potential for this impact.

5.1.2.9 Inadvertent Weather Modification

A recent study undertaken by NASA considered the potential for local weather modification resulting from the Al_2O_3 particles found in solid rocket motor exhaust clouds. The study concluded that for Kennedy Space Center launches, a potential for weather modification might exist over the peninsula near KSC if the Al_2O_3 particles in the Shuttle ground cloud could act as effective ice forming nuclei. There is no scientific evidence to date that the Al_2O_3 particles in the ground cloud will act as such. The nucleating activity of the Al_2O_3 particles must be accurately determined in order to adequately assess the potential for inadvertent weather modification.

Weather modification can be achieved by changing either the cloud condensation nuclei and/or the ice forming nuclei populations (the addition of such nuclei into a cloud is commonly referred to as cloud seeding). An assessment of the potential for weather modification from solid rocket motor nucleating agents (Al_2O_3) suggests that weather modification could also occur at Vandenberg AFB. Such modification could be in the form of either enhanced or suppressed precipitation.

Experience in planned weather modification experiments has shown that ice nuclei which function at temperatures warmer than -8°C are desirable for precipitation enhancement experiments; however, ice nuclei that function best at temperatures colder than -15°C tend to suppress precipitation. It has therefore been suggested that in clouds with cold cloud-top temperatures the addition of artificial nuclei only increases the competition for the available water vapor and fewer ice crystals can grow to the size of precipitation elements.[182] Aluminum oxide aerosols nucleate best at low temperatures; therefore, a decrease in precipitation might reasonably be expected from the function of great amounts of nuclei in cold cumulus clouds.

California relies heavily upon winter storms and their attendant precipitation for agricultural water and water for human consumption. Tropical air masses in summer also furnish water supplies for California. Space Shuttle launches from VAFB could conceivably produce weather modification in both summer and winter. The form of this modification could be either rainfall increases or decreases, depending on the nucleating agent activity. To initiate such changes the Shuttle launch times would have to coincide with the passage of coastal range convective cloud bands accompanying winter storms or summer tropical air mass movements over the coastal areas. The area that could be affected lies from 60 to 240 km downwind from the launch site.[183][186]

Laboratory tests of the burning of solid rocket fuel have been conducted; however, it is impossible to extrapolate ice nuclei activity or the number of available nuclei for a large motor burn from such tests.[185] In addition, the laboratory investigation did not test Al_2O_3-H_2O-HCL interactions for possible deactivation of the aerosol as a source of ice nuclei.

The activity of the exhaust particles for ice nucleation and subsequent weather modification remains a major unknown factor. An additional unknown factor is the length of time that the exhaust particles preserve their activity (that is, do they preserve their activity long enough to modify the weather?).

NASA is continuing to study the problem of number density, size distribution, and ice nucleating activity of Al_2O_3 exhaust particles. In conjunction with the National Oceanic and Atmospheric Administration (NOAA) Weather Modification Program Office in Boulder, Colorado, NASA plans to sample Titan exhaust clouds at KSC and VAFB using NOAA aircraft equipped for an earlier weather modification project. The aircraft will fly repeatedly through the exhaust cloud gathering samples of nucleating agents.

Post analysis of the data should reveal the nucleating particle size distribution, number density, and activity in the exhaust cloud. These data should reveal the actual potential for inadvertent weather modification from Space Shuttle launches at VAFB under various meteorological conditions. If the potential for adverse weather modification is significantly high under any of these conditions, inadvertent weather modification will become a Space Shuttle launch constraint.

5.2 SOCIOECONOMIC IMPACTS

The socioeconomic impacts resulting from the construction/activation and operation of the proposed Shuttle program at Vandenberg Air Force Base (VAFB) will generally be beneficial. Project funds will be expended by the Air Force for employment and purchases. These effects will, in turn, have indirect impacts on business activity, public revenues, population growth, land use, public services, transportation, and cultural amenities. Details associated with these impacts are contained in the Reference Document for this Statement.(136) Results are summarized below, first for the Construction/Activation phase and second for the Operations phase.

5.2.1 CONSTRUCTION/ACTIVATION PHASE

Direct investment costs for the Construction/Activation phase of the Space Shuttle program at VAFB are presented in Table 2.5.1-1 of Section 2. The expected distribution of these funds amongst Santa Barbara County, the Tri-County region, and the Five-County region are summarized in Table 2.5.1-2. Approximately $o58 million, in 1975 dollars ($1,046 million in program year dollars), will be required to build facilities, purchase support equipment, and provide for activation of facilities (including an initial launch). Of these expenditures, about $320 million, $342 million, and $410 million (in 1975 dollars) are anticipated to be distributed within Santa Barbara County, the Tri-County region, and the Five-County region, respectively. The remainder would be distributed outside the Five-County region. Direct labor requirements for the Construction/Activation phase are shown in Figure 2.5-C in Section 2.

5.2.1.1 Indirect Economic Impact

The indirect economic impact of the Construction/Activation phase of the proposed Space Shuttle program at VAFB was determined (for Santa Barbara County, the Tri-County region, and the Five-County region) using the Regional Industrial Multiplier System (RIMS). In essence, this indirect economic impact represents an estimate of the total increase in regional output stimulated by project direct expenditures.

The expected annual increases in regional output resulting from the distributed direct annual expenditures of the Shuttle project are summarized in Table 5.2.1-1. As noted, the estimated increases in output are large for each region, with more than $863 million projected for Santa Barbara County alone and over $1.6 billion for the Five-County region. Annual output will peak in Fiscal Year 1980—the year when annual expenditures will peak.

For the 1979 through 1982 Fiscal Year period, the average increased output in the Santa Barbara County economy due to Construction/Activation expenditures will be almost $170 million per year; the Tri-County and Five-County regions will have annual averages of about $184 million and $331 million, respectively.

The annual and total increases in earnings (income) that are expected to result from direct expenditures for the Construction/Activation phase are summarized in Table 5.2.1-2. Averages of the expected increases in the 4-year interval of Fiscal Years 1979 through 1982 are estimated to be about $62 million, $66 million, and $98 million for Santa Barbara County, the Tri-County region, and the Five-County region, respectively. By way of comparison, the 1972 earnings component of personal income was $600 million for Santa Barbara County, $1,500 million for the Tri-County region, and $30,000 million for the Five-County region. Hence, during peak years, the Construction/Activation phase of the proposed Shuttle program at VAFB would account for the equivalent of about 10 percent of the total 1972 earnings in Santa Barbara County, 4 percent in the Tri-County region, and 0.3 percent in the Five-County region.

Previous studies of total economic activity in Santa Barbara County indicate a 40:60 division between the North County area (above the Santa Ynez Mountains) and the South Coast. Assuming that the 40:60 division will apply to the indirect portion of Santa Barbara County earnings, and that the entire direct portion will accrue to the North County area because of proximity, estimates are that, during peak years, the Construction/Activation phase will add about $44 million annually to the earnings of the North County area. This amounts to over 18 percent of the $240 million (40 percent of $600 million) earned in that area in 1972.

Table 5.2.1-1. PROJECTED REGIONAL OUTPUT (sales) RESULTING FROM ANNUAL EXPENDITURES ASSOCIATED WITH THE CONSTRUCTION/ACTIVATION PHASE OF THE SPACE SHUTTLE PROGRAM AT VANDENBERG (in thousands of 1975 dollars)

Fiscal Year	Impact region		
	Santa Barbara County	Tri-County region	Five-County region
Prior years	69,701	71,562	118,962
1978	66,335	68,826	117,923
1979	100,489	104,598	181,297
1980	247,524	274,049	508,853
1981	219,765	230,720	419,569
1982	110,712	126,589	213,264
1983	48,280	49,406	80,782
Total	862,806	925,750	1,640,650

Reference: Henningson, Durham & Richardson, 1976.[35]

Table 5.2.1-2. PROJECTED REGIONAL EARNINGS (employment income) RESULTING FROM ANNUAL EXPENDITURES ASSOCIATED WITH THE CONSTRUCTION/ACTIVATION PHASE OF THE SPACE SHUTTLE PROGRAM AT VANDENBERG (in thousands of 1975 dollars)

Fiscal Year	Impact Region		
	Santa Barbara County	Tri-County region	Five-County region
Prior years	23,034	23,499	35,093
1978	22,875	23,401	34,847
1979	35,180	36,004	53,589
1980	93,988	101,154	150,440
1981	81,287	83,120	123,874
1982	37,369	42,213	62,951
1983	15,643	15,958	23,831
Total	309,376	325,349	484,625

Reference: Henningson, Durham & Richardson, 1976.[35]

5.2.1.2 Indirect Employment Impact

The indirect labor requirements in the North County, Santa Barbara County, the Tri-County region, and the Five-County region are summarized in Table 5.2.1-3. Based on the 1975 total employment base for each impact region, the projected increases reflect changes of approximately 2.9 percent for Santa Barbara County (and its North County portion), 1.2 percent for the Tri-County region, and 0.14 percent for the Five-County region.

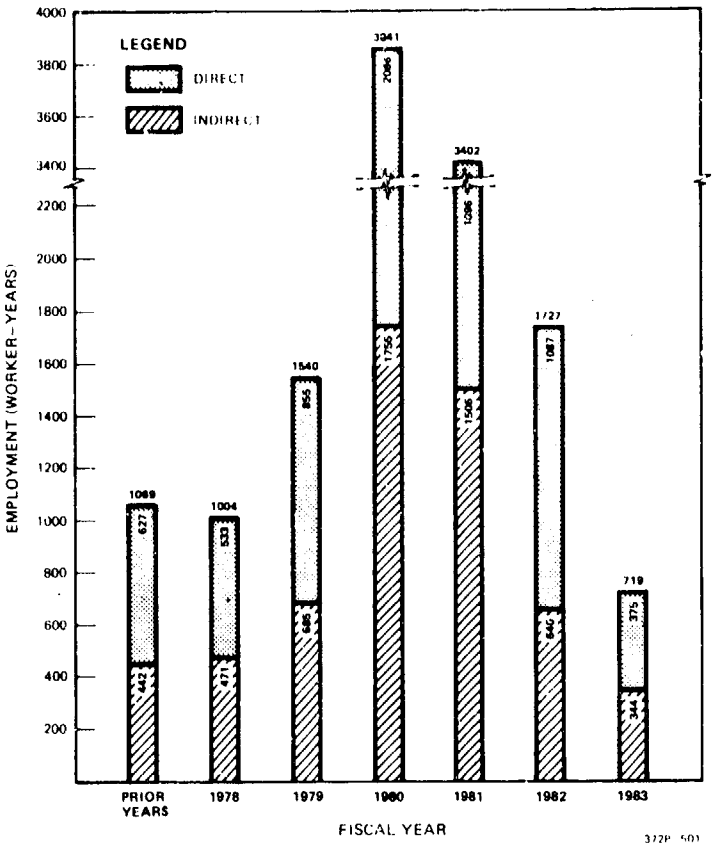
5.2.1.3 Impact on the Industrial Sector

The annual averages of the North County direct and indirect labor requirements are presented in Figure 5.2.1-A. For the peak years (Fiscal Years 1979 through 1982), there should be an annual average of 2,628 worker-years of employment in North County. Of these, 1,481 will be directly required for Shuttle project construction and activation activities at Vandenberg Air Force Base. The remaining 1,147 will be indirect.

Table 5.2.1-3. PROJECTED INDIRECT EMPLOYMENT RESULTING FROM ANNUAL EXPENDITURES ASSOCIATED WITH THE CONSTRUCTION/ACTIVATION PHASE OF THE SPACE SHUTTLE PROGRAM AT VANDENBERG (in worker-years)

Fiscal Year	Impact region			
	North County	Santa Barbara County	Tri-County region	Five-County region
Prior years	442	1,105	1,162	1,989
1978	471	1,178	1,243	2,021
1979	685	1,713	1,812	3,009
1980	1,755	4,388	4,910	8,125
1981	1,506	3,766	3,989	6,692
1982	640	1,600	2,021	3,486
1983	344	860	900	1,454
Total	5,843	14,610	16,037	26,776

Reference: Henningson, Durham & Richardson, 1976.[35]



Reference: Henningson, Durham & Richardson, 1976.[35]

FIGURE 5.2.1-A. Total North County employment resulting from Space Shuttle construction and activation activities at Vandenberg Air Force Base. Includes direct and indirect employment resulting from local procurement of P-3080 equipment.

The likely industrial breakdown of the average North County labor requirements is summarized in Table 5.2.1-4. For comparative purposes, the projected employment growth (to 1981) without the proposed Shuttle project is provided. Fiscal Year 1981 was used as the projection basis for this table (and others presented in subsequent pages) because it is one of the four scheduled years during which construction will be at its peak (see Figure 2.5-3 in Section 2) and best reflects the expected construction industry shift resulting from Vandenberg construction activities. Because the Construction/Activation phase of the program is primarily a manufacturing activity (installation and check-out of support equipment), construction and manufacturing industries will experience the largest growth over this time period.

Table 5.2.1-4. NORTH COUNTY EMPLOYMENT GROWTH BY INDUSTRIAL SECTOR RESULTING FROM SHUTTLE PROGRAM CONSTRUCTION/ACTIVATION THROUGH 1981[a]

Industry	Employment (worker-years)				Percent change	
	1971 baseline	Projected without STS	For STS	Projected with STS	Without STS	With STS
Agriculture	3,749	4,143	0	4,143	10.5	10.5
Mining	591	535	31	566	- 9.5	- 5.2
Construction	1,460	1,818	875	2,693	24.5	84.5
Manufacturing	4,841	4,891	1,457	6,348	1.0	31.1
Transportation, Communications, and Utility	1,234	1,464	75	1,539	18.6	24.7
Wholesale Trade	1,160	1,458	75	1,539	25.7	32.2
Retail Trade	6,169	7,352	422	7,774	19.2	26.0
Finance, Insurance, and Real Estate	728	838	45	883	15.1	21.3
Services	6,109	6,745	422	7,167	10.4	17.3

[a]Fiscal Year 1981 is one of the years during which employment will be at its peak (see Figure 2.5-C in Section 2).

Reference: Henningson, Durham & Richardson, 1976.(35)

5.2.1.4 Impact on Population Growth

New jobs in an area can generate population growth if the number of jobs is large or if locally unavailable specialized skills are required. Analysis of the duration of project-related employment indicates that the growth aspects of crafts and Supervision, Inspection, and Overhead (SIOH) jobs be separated from those of activation and indirect employment. The former will have a short-term impact while the latter will have long-term impacts.

Most transient construction workers can be expected to locate according to availability of accommodations and proximity to the construction sites. Therefore, 48 percent of the imported craftsmen are expected to locate in the Lompoc Valley, 32 percent in Santa Maria-Orcutt, and 20 percent in Buellton. Craftsmen imported from Los Angeles are not expected to relocate their families because Los Angeles is proximal enough for weekend trips home.

About 304 (90 percent) of the SIOH employees will be local hires and 34 (10 percent) will be imported.(47) Based on Los Angeles labor pool data, these 34 workers and their families will total 84 people. Assuming residential

preferences would be the same as for current non-military base employees, 50 people (60 percent of the 84 will locate in Lompoc, 25 people (30 percent) in Santa Maria-Orcutt, and 9 people (10 percent) in other local communities.

All of the activation positions are expected to be filled by current base employees reassigned to the Shuttle project. In a worst-case analysis, however, 20 percent of the activation positions could be filled by people newly moved into the area. In 1981, the peak year, up to 212 imported employees can be expected. With families, a total of 524 people could be anticipated: 210 in Lompoc, 157 onbase, 105 in Santa Maria-Orcutt, and 52 distributed to all other local communities. The 1979 to 1982 average level of 854 activation employees would involve 171 new workers and, with families, a population increase of 422 people, 253 would reside in Lompoc, 127 in Santa Maria-Orcutt, and 42 in other North County areas.

As stated previously, total annual average indirect employment for North County for the 1979 through 1982 period will be 1,147 jobs. A large proportion (about 70 percent) of these jobs will go to current local residents. The remainder, of 344 jobs, will attract new residents. Including families, about 850 additional people can be expected as a result of indirect economic growth stimulated by the Shuttle program. Since this indirect growth will not include military families, the residential choices should resemble those of SIOH employees. Lompoc can anticipate 510 new people through indirect growth, Santa Maria-Orcutt, 255 people; and other local areas, 85 people. A total North County growth of 1,356 people is projected as a result of the Shuttle construction and activation program at Vandenberg.

Population projections for Santa Barbara County and its cities are useful for evaluating future incremental population changes resulting from the proposed project. Santa Barbara County's *Proposed Comprehensive Plan* developed by Livingston and Associates, describes three alternative growth scenarios, each with its own set of assumptions.(54) In the High Growth Scenario, there would be a 2.4 percent average annual increase in employment and a 1.8 percent average annual increase in population. In the Moderate Growth Scenario, the average annual growth rate in employment would be 1.14 percent, and in population would be 0.90 percent. In the Restricted Growth Scenario, the average annual increase in jobs would be 0.88 percent, and the average annual increase in

population would be 0.46 percent.[54] Of these three alternative growth scenarios, the Moderate Growth Scenario was selected as the basis for population distribution analysis.

The choice of the Moderate Growth Scenario was based on county resident preferences, consistency with environmental constraints, and preservation of the County's present character.[54] Only in Lompoc does the Moderate Growth Scenario forecast lower employment and population levels than those recommended by General Plan Advisory Committees appointed by the County Board of Supervisors. Projected growth to 1981 (one of the peak employment years) was interpolated from this Scenario for the various localities listed in Table 5.2.1-5 and is compared with expected Shuttle induced growth. As noted, the largest increased growth rate over the 6 years from the 1975 baseline to 1981 is only 2.4 percent in Lompoc. In most other areas, the increase in growth rate from the Shuttle program will be about 1 percent.

In summary, population growth resulting from the Construction/Activation phase will have only minor incremental effects on locally projected growth rates. Changes are so small that they probably fall within the confidence interval that brackets the projections. Still, this incremental growth could have impacts on other aspects of the community infrastructure. These possible impacts are discussed in the remaining subsections of this narrative.

Table 5.2.1-5. EFFECT OF THE SHUTTLE PROGRAM CONSTRUCTION/ACTIVATION PHASE ON LOCAL GROWTH THROUGH 1981

Community	Population				Percent change	
	Current (1975)	Projected without Shuttle program	For Shuttle program	Projected with Shuttle program (1981)	Without Shuttle program	With Shuttle program
Lompoc	30,271	32,191	726	32,917	6.3	8.7
Vandenberg	13,616	14,342	126	14,468	5.3	6.3
Santa Maria/Orcutt	54,210	56,196	363	56,559	3.7	4.3
North County	114,295	119,589	1,356	120,945	4.6	5.8
Santa Barbara	75,608	78,929	574	79,503	4.4	5.2
Goleta	69,644	74,906	701	75,607	7.5	8.6
South Coast	166,290	178,094	1,275	179,369	7.1	7.9
Santa Barbara County	280,585	297,683	2,631	300,314	6.1	7.0
Port Hueneme/Oxnard	116,457[a]	126,995	85	127,080	9.0	9.1

[a]Baseline 1974 data adjusted to 1975.

Reference: Henningson, Durham & Richardson, 1976.[35]

5.2.1.5 Impact on the Housing Market

Shuttle induced growth during the Construction/Activation phase will impose a countywide requirement for 1,065 more housing units than are currently projected in the aforementioned Moderate Growth Scenario. Compared with projected housing requirements (from a 1973 baseline) without the Shuttle program, this amounts to an additional change of about 1 percent. The largest project induced demand (294 housing units) is projected for the community of Lompoc. The remaining demand of 771 units will be distributed among Vandenberg (51 units), Santa Maria-Orcutt (147 units), Santa Barbara (232 units), Goleta (284 units), and elsewhere in North County (57 units). Additionally, 34 units will be required in support of the 21 months of Construction/Activation scheduled for Port Hueneme.

5.2.1.6 Impact on Current Land Use

Land use impacts associated with the Construction Activation phase of the proposed action are summarized in Section 4.0 of this Statement.

5.2.1.7 Impact on Public Services

Shuttle induced growth resulting from the Construction/Activation phase will result in 482 school enrollments over and above that projected through 1981 without the project. This represents 40 students per grade level, assuming even distribution across 12 grade levels. Proportionately, the largest project induced change will occur in Lompoc-Vandenberg (134 enrollments) and in Santa Barbara-Goleta (280 enrollments). Both areas will have sufficient enrollment capacity to accommodate the change. However, 8 additional teachers in the former area and 17 additional teachers in the latter area would be required to maintain acceptable student-teacher ratios. Current projections without the Shuttle program indicate that the Santa Maria-Orcutt area will have no excess enrollment capacity. Yet, an additional 56 enrollment will be imposed on the area as a result of the proposed action which, in turn, will induce a need for 3 or 4 teachers to maintain acceptable student-teacher ratios. Only 21 students are expected in the Port Hueneme-Oxnard area as a

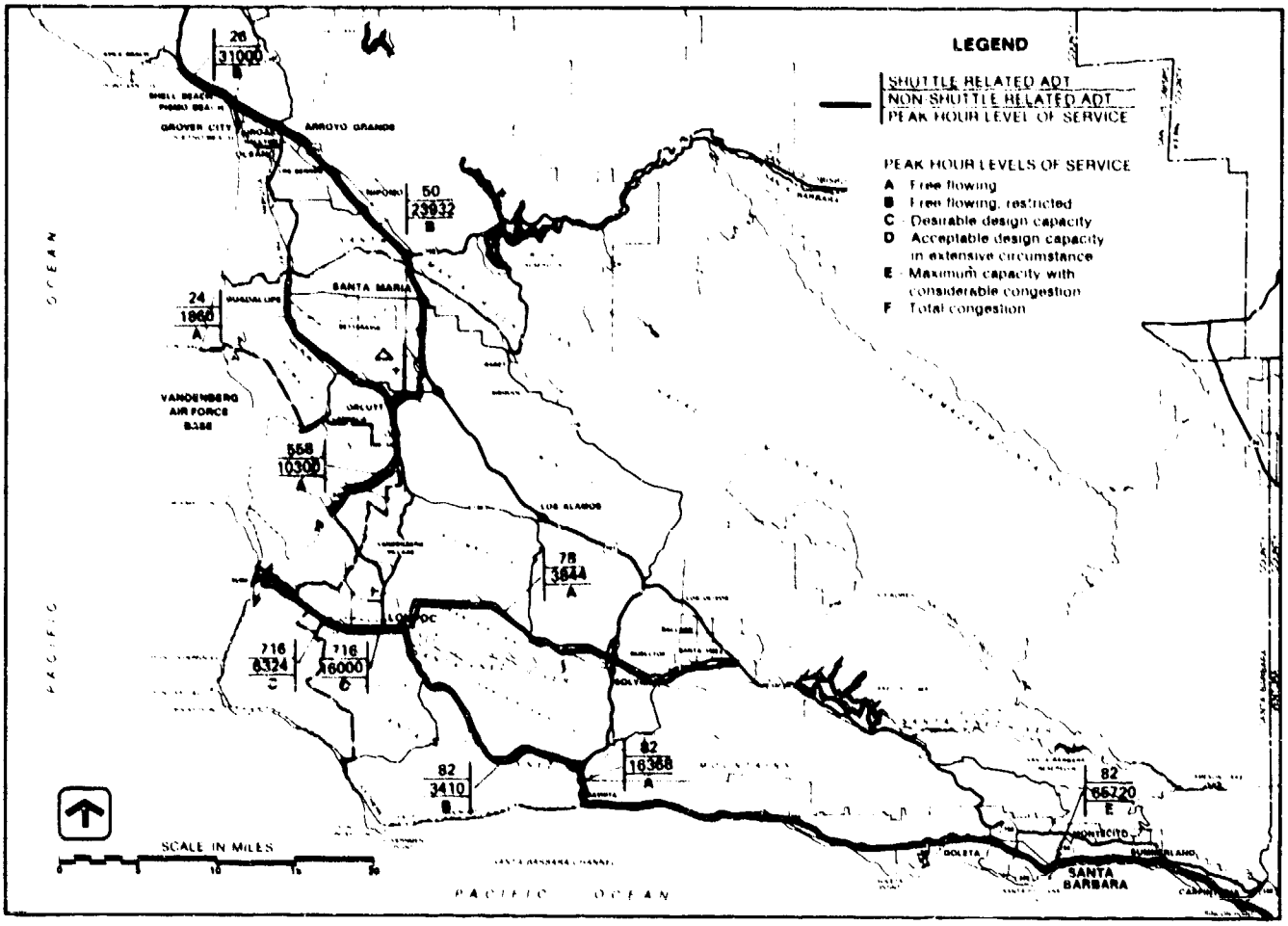
result of the Construction/Activation phase and their presence will be of no consequence to student-teacher ratios.

Hospital bed requirements from the Shuttle induced growth projections shown in Table 5.2.1-6 were determined using the California Health Planning Standard of 2.4 beds per 1,000 residents. Accordingly, about 6 hospital beds will be required to accommodate the expected countywide growth. This demand would likely be evenly divided between the North County and the South Coast. Sufficient beds are now available in the communities of each region to meet the requirements under total population projections with the Shuttle program.

In Lompoc, projected growth unrelated to the Shuttle program will necessitate the expansion of the Lompoc Police Department by 3 police officers. This staff buildup will be sufficient to accommodate the city's projected Shuttle induced growth. Expected Shuttle related growth in all other areas will not impose a requirement for additional police officers. Additional fire protection personnel will not be required to accommodate any local Shuttle induced growth.

Housing growth (summarized in Section 5.2.1.5) will, in turn, place demands on gas and electricity supplies and telephone service. Southern California Gas Company would be able to provide gas service to the anticipated new households, with or without the Shuttle program. Southern California Edison and the Pacific Gas and Electric Companies anticipate no difficulty in providing electricity to current or projected households throughout the Construction/Activation period. The General Telephone Company anticipates no problem in providing communications service for future projected demands evolving from the Construction/Activation phase.

On a countywide basis without the Shuttle program, additional growth from population increase alone will require about 1,915 acre-feet of water per year (based on a per capita water consumption of 100 gallons per day). Shuttle induced growth will add 295 acre-feet per year to the domestic water demand,



Reference: Henningson, Durham & Richardson, 1976.[35]

FIGURE 5.2.1-B. Shuttle and non-Shuttle related commuter traffic projections for the Construction/Activation phase in 1981.

All materials and supplies for the Construction/Activation phase are expected to be delivered by truck or rail transportation (the former is not reflected in Figure 5.2.1-B). Average truck delivery rates in the North County area are expected to be low (5 to 10 deliveries per week). Rail deliveries would be made over Southern Pacific Railroad trackage to existing spurs located within VAFB. The expected average rail delivery rate would be 2 to 3 train loads per week during peak years of construction. Most truck deliveries will probably occur during the off-peak hours of roadway traffic. Also, rail deliveries would be coordinated so as not to interfere with normal rail traffic (2 passenger and 10 freight trains per day). Resulting impacts are therefore anticipated to be minimal.

Because Southern Pacific has right-of-way priority over its trackage, Shuttle related roadway construction activities must be coordinated with railroad scheduling. Other than inconvenience to construction and railroad personnel, no impact is expected.

Impacts on marine transportation in the Santa Barbara Channel and along the Vandenberg coastline will be small and due solely to the movement of vessels supporting nearshore construction activities at the barge landing facility. Marine transportation in Port Hueneme may be impacted as a result of activities associated with modifying an existing wharf to facilitate the onloading/offloading of solid rocket booster components. During construction, there may be some interference with contiguous dockside activities or neighboring vessel traffic. Such interference is expected to be minimal, however, because construction activities will be of short duration and both the construction schedules and the use of specialized equipment will be coordinated with Port authorities.(146)

5.2.1.8 Impact on Cultural Amenities

A slight, though short term, increase in the use of existing recreational facilities is expected to result from Shuttle induced increases in North County population. Construction workers may choose to use campgrounds for housing purposes. Except for holiday weekends, however, this usage is not expected to create added stress or inconvenience to these or other areas of recreational interest. No effects are anticipated in the Port Hueneme area.

Many aspects of the Construction/Activation phase will, in one form or another, impact the aesthetic and serene qualities of certain areas. For example, the physical presence of workers, construction equipment, material stockpiles,

denuded terrain, and structure in various stages of completion will detract from the existing visual aesthetics of those areas where construction is to take place. Construction materials delivery, equipment operation, and associated exhaust and dust plumes produced by construction activities will further add to this visual detraction. Aural serenity will be primarily impacted by noises generated during construction, with demolition activities, heavy equipment operation, and pile driving activities constituting the bulk of this disturbance. Most of these impacts will occur in restricted areas (such as the VAFB airfield, SLC-6, and Port Hueneme) where public presence is sporadic and low. Moreover, the pleasant atmosphere of the beach area would incur some qualitative degradation resulting from nearshore construction activities at the barge landing site. The boathouse landing site is restricted for general use due to its location. Hence the magnitude and importance of the impact is expected to be minimal.

The aforementioned aesthetic and serenity impacts may, in themselves, constitute an impact to the well-being of certain individuals. To others, however, they may not. Further, all planned construction and activation activities will necessarily involve expenditures for labor, materials, and equipment which, in turn, will generate an indirect need for supportive services. Both direct and indirect expenditures will therefore contribute to the economic stability of involved communities. Certain individuals will benefit from the jobs that become available while others will benefit from related increases in business sales. The overall economic gains will contribute positively to human well-being.

5.2.2 OPERATIONS PHASE

The Operations Phase begins in Fiscal Year 1983 and, except for the initial launch scheduled for June of 1983, includes all Vandenberg Shuttle launches of 1991 (see Table 2.5.2-1 of Section 2). Estimates of the direct cost of operations are detailed in Table 2.5.2-2. As noted, about $710 million (1975 dollars) in expenditures will be required to support the 125 operational

launches. Peak expenditures of nearly $90 million will occur in Fiscal Years 1987 through 1991. On a cost-per-launch basis, the higher values in the earlier years will be due primarily to an anticipated need for more personnel to make the new system run smoothly. In terms of 1983 dollars, total operations expenditures will equal almost $1.2 billion; in project year dollars, the cost is $1.3 billion. Direct labor requirements for the Operations phase are shown in Figure 2.5-D of Section 2.

5.2.2.1 Indirect Economic Impact

The indirect economic impact of the Operations phase of the proposed project was determined using the Regional Industrial Multiplier System (RIMS), the methodology for which is detailed in the Reference Document.[136] As such, it represents an estimate of the total increase in regional output (sales) stimulated by direct expenditures for project operations.

The expected annual increases in regional output (sales) that can be attributed to direct annual expenditures for the Operations phase are summarized in Table 5.2.2-1. In general, the annual increases anticipated for the Five-County region are smaller than those expected during peak years of the Construction/Activation phase. Yet, over the 108-month period of operations, almost 2.4 billion dollars of output will be generated in this region. Nearly half (49 percent) of this total increase will occur in the Tri-County region, and most of this will accrue to Santa Barbara County.

The average annual output in Santa Barbara County that can be attributed to Operations expenditures will be about $118 million. This represents a $52 million (30 percent) decline from the average annual output expected during the peak years (Fiscal Years 1979 through 1982) of the Construction/Activation phase. In the Tri-County region, the average annual output during operations will be about $129 million, a 30 percent decline from that of the Construction/Activation phase. Thus, the economic expansion projected for these two regions in the earlier Construction/Activation phase will contract somewhat as the Space Shuttle program moves into the Operations Phase. In the Five-County region, the earlier $331 million average annual output will decline to about $262 million, a drop of almost 21 percent.

Table 5.2.2-1. PROJECTED REGIONAL OUTPUT (sales) RESULTING FROM ANNUAL EXPENDITURES ASSOCIATED WITH THE OPERATIONS PHASE OF THE SPACE SHUTTLE PROGRAM AT VANDENBERG (in thousands of 1975 dollars)

Fiscal Year	Impact region		
	Santa Barbara County	Tri-County region	Five-County region
1983	58,613	62,652	117,505
1984	99,121	105,821	204,558
1985	133,413	142,845	286,315
1986	132,897	142,593	290,618
1987	129,254	143,360	297,569
1988	129,439	143,549	297,569
1989	129,418	143,498	289,956
1990	127,279	141,154	292,604
1991	123,247	136,683	283,336
Total	1,062,618	1,162,155	2,360,030

Reference: Henningson, Durham & Richardson, 1976.[35]

The expected annual and total increases in earnings (employment income) resulting from the regional output (sales) of Table 5.2.2-1 are summarized in Table 5.2.2-2. The average annual earnings from Vandenberg Shuttle operations will be about $36 million in Santa Barbara County, $40 million in the Tri-County region, and $80 million in the Five-County region, all in 1975 dollars. For each of these areas, this represents about 6, 3, and 0.3 percent, respectively, of the total earnings realized in 1972.

Earnings (employee income), outputs (sales), and expenditures projected for Santa Barbara County probably will be somewhat concentrated in the North County area, primarily because of proximity. The basis for this expectation is the likelihood that the entire direct portion of Santa Barbara County earnings will accrue to North County, and that the indirect portion of countywide earnings will distribute on a 40:60 division between North County and the South Coast.

Hence, North County earnings will decrease from the annual average of $44 million attributable to the peak years of construction/activation to $23 million during operations.

5.2.2.2 Indirect Employment Impact

The indirect employment requirements expected from the Operations phase are summarized in Table 5.2.2-3 and will consist mostly of personnel working in supplier industries. The average annual indirect employment from Operations expenditures will be 496 jobs in North County, 1,239 in Santa Barbara County, 1,432 in the Tri-County region, and 4,680 in the Five-County region. Based on the 1975 total employment base for each impact region, Operations-related indirect employment for Santa Barbara County (and its North County area), the Tri-County region, and the Five-County region will be about 1.2 percent, 0.5 percent, and 0.12 percent, respectively.

Table 5.2.2-2. PROJECTED REGIONAL EARNINGS RESULTING FROM ANNUAL EXPENDITURES ASSOCIATED WITH THE OPERATIONS PHASE OF THE SPACE SHUTTLE PROGRAM AT VANDENBERG (in thousands of 1975 dollars)

Fiscal Year	Impact region		
	Santa Barbara County	Tri-County region	Five-County region
1983	18,111	19,347	35,945
1984	30,628	32,678	62,574
1985	41,225	44,111	87,584
1986	41,065	44,033	88,900
1987	39,939	44,270	91,026
1988	39,997	44,328	91,026
1989	39,990	44,312	88,698
1990	39,329	43,588	89,508
1991	38,083	42,208	86,672
Total	328,367	358,875	721,933

Reference: Henningson, Durham & Richardson, 1976.

Table 5.2.2-3. PROJECTED INDIRECT EMPLOYMENT RESULTING FROM ANNUAL EXPENDITURES ASSOCIATED WITH THE OPERATIONS PHASE OF THE SPACE SHUTTLE PROGRAM AT VANDENBERG (in man-years)

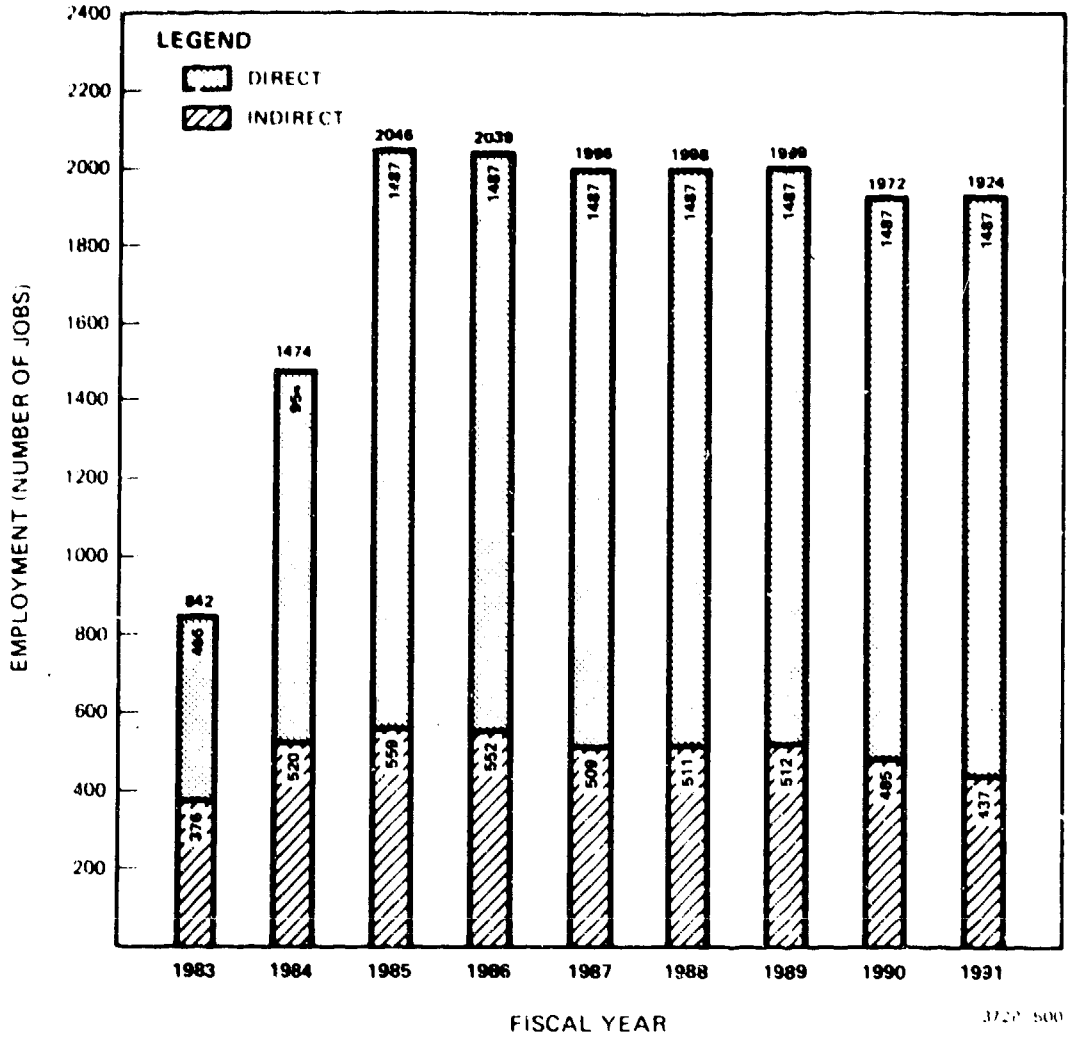
Fiscal Year	Impact region			
	North County	Santa Barbara County	Tri-County region	Five-County region
1983	376	939	1,016	2,298
1984	520	1,300	1,404	3,767
1985	559	1,397	1,522	5,025
1986	552	1,381	1,515	5,137
1987	509	1,273	1,538	5,318
1988	511	1,278	1,543	5,318
1989	512	1,279	1,542	5,120
1990	485	1,214	1,471	5,189
1991	437	1,093	1,336	4,948

Reference: Henningson, Durham & Richardson, 1976.[35]

5.2.2.3 Impact on the Industrial Sector

Direct and indirect North County industrial manpower requirements generated by the Operations phase at Vandenberg are presented in Figure 5.2.2-A. Based on 108 months of operations and assuming no phasing down of other ongoing launch operations at Vandenberg, an annual average of 1,810 jobs should result in North County. Of these, 1,314 will be directly required for Shuttle operations at Vandenberg. The remaining 496 will be of an indirect nature. Only a small portion of the direct positions are expected to provide new jobs.

Even if all of the above direct and indirect positions were to provide new jobs, the net change in the projected growth rate in industrial sectors would be small. This is evidenced by comparing the growth rate columns in Table 5.2.2-4 which presents the likely distribution of these 1,810 jobs. By and large, the moderate shift of 21 percent in the



Reference: Henningson, Durham & Richardson, 1976.[35]

FIGURE 5.2.2-A. Total North County employment resulting from Space Shuttle operations activities at Vandenberg Air Force Base.

manufacturing sector is reflective of all direct employment being considered as new jobs. Otherwise, the induced growth would be less than 6 percent.

5.2.2.4 Impact on Population Growth

The preceding analysis is indicative of requirements that would be necessary if current operations underwent no change. However, the Air Force anticipates that certain ongoing operations at VAFB will phase down during the first few years of Shuttle operations and that no long term change in Base population will occur (refer to Table 2.5.2-1). This

Table 5.2.2-4. NORTH COUNTY EMPLOYMENT GROWTH BY INDUSTRIAL SECTOR RESULTING FROM VAFB SHUTTLE PROGRAM OPERATIONS TO 1990[a]

Industry	Employment				Percent change	
	Baseline (1971)	Projected without Shuttle	For Shuttle	Projected with Shuttle	Without Shuttle	With Shuttle
Agriculture	3,749	4,536	0	4,536	21.0	21.0
Mining	591	479	20	499	- 19.0	- 15.6
Construction	1,460	2,176	63	2,239	49.0	53.4
Manufacturing	4,841	4,941	1,017	5,958	2.0	23.1
Transportation, Communications, and Utilities	1,234	1,693	52	1,745	37.2	41.4
Wholesale Trade	1,160	1,756	52	1,808	51.4	55.9
Retail Trade	6,169	8,534	288	8,822	38.4	43.0
Finance, Insurance, and Real Estate	728	948	31	979	30.2	34.5
Services	6,109	7,381	288	7,669	20.8	25.5

[a]Growth assumes no phasing down of other ongoing launch operations at VAFB. Also, growth caused by Construction/Activation (see Table 5.2.1-4) is not reflected in this table.

Reference: Henningson, Durham & Richardson, 1976.

would mean that little or no change in net expenditures and, correspondingly, indirect growth would result. Inasmuch as this is still uncertain, the analysis presented below and throughout the remainder of this section assumes (as a worst case) that 20 percent of the direct and 30 percent of the indirect requirements will constitute new jobs.

Table 5.2.2-5 summarizes the expected new growth in Santa Barbara under the above described worst case condition for Shuttle operations. Employment projections peak in 1985 with a total of 2,884 direct and indirect jobs resulting from Vandenberg expenditures. Applying the aforementioned direct and indirect new employment factors results in a peak of 716 jobs in Santa Barbara County. Over the 108 months of operations, employment will average 637 new jobs in the county.

Based on trends in the residential preferences of Base employees over the past several years (1961 through 1974), the areas of Lompoc, VAFB, and Santa Maria-Orcutt will likely be preferred by 40 percent, 30 percent,

Table 5.2.2-5. SHUTTLE RELATED EMPLOYMENT AND NET EMPLOYMENT GROWTH IN SANTA BARBARA COUNTY RESULTING FROM ANNUAL EXPENDITURES FOR THE SPACE SHUTTLE PROGRAM AT VANDENBERG.

Fiscal Year	Total direct employment	Total indirect employment	New direct employment (worst case)	New indirect employment (worst case)	Total new employment (worst case)
1983	466	939	113	232	395
1984	954	1,300	191	390	581
1985	1,487	1,397	297	419	716
1986	1,487	1,381	297	414	711
1987	1,487	1,273	297	382	679
1988	1,487	1,278	297	383	680
1989	1,487	1,279	297	384	681
1990	1,487	1,214	297	364	661
1991	1,487	1,093	297	328	625

Reference: Hennings on, Durham & Richardson, 1976.

and 20 percent, respectively, of the direct operations work force that will be newly required; the remaining 10 percent will distribute to other unidentifiable local areas. No distribution of the required direct work force at Port Hueneme was considered.

Indirect employees allocated to North County (40 percent of the total) are expected to distribute themselves to local areas in the same proportions as direct employees except that the option for onbase housing will not exist. Because these jobs are the indirect result of expenditures, and because of the predominating trend toward the Lompoc and Santa Maria-Orcutt areas, 60 percent of the indirect employees in North County were distributed to Lompoc, 30 percent to Santa Maria-Orcutt, and the remaining 10 percent to other local areas. Indirect employee allocations to the South Coast (60 percent of the total) are expected to be 45 percent to Santa Barbara and 55 percent to Goleta, in accordance with the *County Plan's* Moderate Growth Scenario.[54]

Based on the above analysis and applying Los Angeles work force statistics (74 percent of the work force is married and 45 percent of those married have 2.21 children), community population growth projections induced by Shuttle

operations at Vandenberg and Port Hueneme were derived to 1990. These are presented in Table 5.2.2-6 and are compared with Moderate Growth Scenario projections without the Shuttle. Accordingly, the Operations phase induces the largest increase percentage changes in Lompoc (2.5 percent) and at Vandenberg (1.5 percent). In all other communities, Operations induced growth would represent a change of only 1 percent (or less) of that anticipated without the Shuttle program. Considering the Shuttle induced community population projections shown in Table 5.2.1-5, projected growth from the Operations phase will be sufficient to stabilize the pre-Operations growth which took place in Lompoc and Santa Maria, but will not sufficiently compensate for that which took place in Goleta and Santa Barbara. Any actual decline, however, would take place in construction related industries wherein all projects and employment are relatively short term.

Table 5.2.2-6. EFFECTS OF THE SHUTTLE PROGRAM OPERATIONS PHASE ON LOCAL POPULATION GROWTH THROUGH 1990[a]

Community	Current (1975)	Projected without Shuttle Program (1990)	For Shuttle Program	Projected with Shuttle (1990)	Without Shuttle	With Shuttle
Lompoc	30,271	35,070	662	35,732	15.8	18.0
Vandenberg	13,616	15,430	174	15,604	13.3	14.6
Santa Maria/Orcutt	54,210	59,175	214	59,389	9.2	9.6
North County	114,295	127,530	1,167	128,697	11.6	12.6
Santa Barbara	74,608	85,410	149	85,559	14.5	14.7
Goleta	69,644	82,800	182	82,982	18.9	19.1
South Coast	166,290	195,800	331	196,131	17.7	17.9
Santa Barbara County	280,585	323,330	1,568	324,898	15.2	15.8
Port Hueneme/Oxnard	116,457[b]	148,071	106	148,177	27.1	27.2

[a]Growth projections for the Construction/Activation phase (see Table 5.2.1-5) are not reflected in this table.

[b]Baseline 1974 data adjusted to 1975.

Reference: Henningson, Durham & Richardson, 1976.[35]

5.2.2.5 Impact on the Housing Market

It is anticipated that activation personnel from the Construction/Activation phase will continue on as operations personnel in the Operations phase. Therefore, much of the total operations-induced housing demand within each community will be offset by that which will have occurred during the Construction/Activation phase (refer to Section 5.2.1.5). Accordingly, 430 fewer housing units will be required in Santa Barbara County than the earlier phase. That is, the Space Shuttle operations phase at VAFB will create a total countywide demand for 635 units—60 percent of the level required for the construction and activation phase, and 0.7 percent above the projected housing requirements (from a 1973 baseline) without the Shuttle program. The exception to this reduced demand is Vandenberg, where 19 additional housing units will be required. In the Port Hueneme-Oxnard area, the Operations phase will impose a demand for about 9 additional housing units above the 34 required for the Construction/Activation phase.

5.2.2.6 Impact on Current Land Use

Land use impacts associated with the Operations phase of the proposed action are summarized in Section 4.0 of this Statement.

5.2.2.7 Impact on Public Services

Operations-induced growth will result in 344 countywide school enrollments above those projected to 1990 without the proposed project. Proportionately, the largest induced change will occur in Lompoc-Vandenberg (205 enrollments) and in Santa Barbara-Goleta (73 enrollments). An additional 53 enrollments will be imposed on the Santa Maria-Orcutt area. Actually, the expected 73 Santa Barbara-Goleta enrollments represent a decline from the 280 enrollments anticipated from the Construction/Activation phase (see Section 5.2.1.7). This decline, corresponding to an

expected decline in required indirect employment, will be offset by the moderate increase (71 enrollments over the earlier phase) expected for the Lompoc-Vandenberg area. That increase would exert a demand for 4 additional teachers. In Santa Maria-Orcutt, a very slight increase (3 enrollments) will occur over the earlier phase and will not exert a demand for additional teachers. Overall, the expected 344 countywide school enrollments induced by the Operations phase will represent a decline from the 482 enrollments anticipated in the Construction/Activation phase. In Port Hueneme, only 23 new students (2 more than that induced by construction/activation) are expected from Shuttle related operations.

By itself, population growth from the Operations phase would impose a countywide need for 4 hospital beds (3 in North County and 1 in South Coast). Inasmuch as this demand is essentially identical to that expected to be induced by the Construction/Activation phase (see Section 5.2.1.7), no cumulative impact will occur. An adequate number of hospital beds are now available in the communities of each region to meet the needs of 1990 projected growth, with or without the Space Shuttle program. Hospital facilities in the Port Hueneme-Oxnard area will not be impacted by the Operations phase.

North County growth evolving from the Operations phase (see Table 5.2.2-6) would exert a need for 1 additional police officer and 1 additional fireman. The anticipated community distribution of this induced growth indicates that this need would likely occur in the city of Lompoc. Additional police officers and firemen (over and above that which would be required for non-Shuttle related growth) will not be required in the South Coast and Port Hueneme-Oxnard areas as a result of the Operations phase.

It is uncertain whether or not the local suppliers of the Southern California Gas Company will be able to provide uninterrupted gas service to the anticipated new households (projected to 1990), with or without the Shuttle program. However, Southern California Edison and the Pacific Gas and Electric Companies foresee no difficulty in supplying electricity to meet the projected total 1990 housing demand (including Shuttle induced demand). General Telephone Company is aware of the potential Shuttle induced growth that is expected; providing communication services for this growth is not anticipated to be a problem.

Assuming a per capita domestic water consumption of 100 gallons per day (gpd), North County growth projected (to 1990) without the Shuttle program will induce an additional need for 1,482 acre-feet per year of water for domestic use. With the Shuttle program, the domestic demand will increase 131 acre-feet per year (21 acre-feet per year less than that induced by the Construction/ Activation phase). The apportionment of this Shuttle induced domestic demand is projected as follows:

(1) Lompoc, 76 acre-feet per year (same as that induced by the earlier Construction/Activation phase);

(2) Santa Maria, 24 acre-feet per year (one more than that induced by the earlier phase);

(3) Vandenberg, 20 acre-feet per year (19 more than that induced by the earlier phase);

(4) Elsewhere in North County, 11 acre-feet per year (same as that induced by the earlier phase).

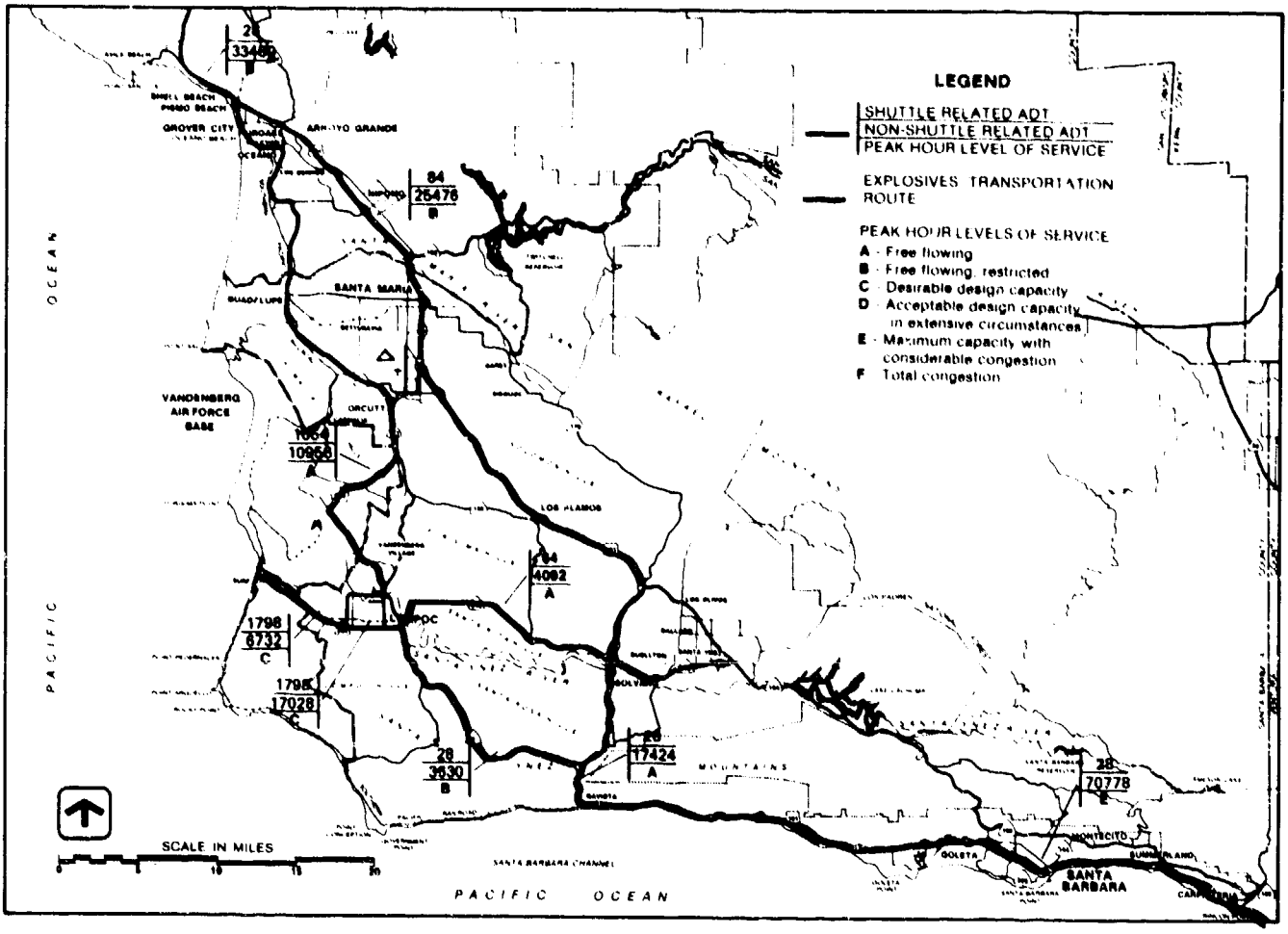
On the South Coast, Santa Barbara and Goleta can anticipate 17 and 20 acre-feet per year, respectively, of domestic water demand from growth related to the operations phase. Both are reductions of 48 and 58 acre-feet per year, respectively, in the growth induced domestic demands attributable to the Construction/Activation phase. Overall, the water demand induced through Shuttle related domestic growth can be accommodated, along with that projected without the Shuttle, through full exploitation of available local resources. It is not expected that these Shuttle induced domestic water uses will impose more than a minor incremental effect on wastewater treatment capacity currently planned for the near future.

While the growth projections of local landfill demands do not specifically provide for the Shuttle program, they do anticipate projects of similar size. Thus, the Shuttle Operations phase and its attendant projected growth will have an insignificant effect on the project life of existing solid waste disposal facilities in the area.

Demands placed on segments of the public roadway system by the Construction/ Activation phase (discussed in Section 5.2.1.7) will be replaced by those of vehicular traffic from Shuttle operations personnel and truck deliveries of consumables such as rocket fuels. Figure 5.2.2-B shows the most probable routes to be used (routes established by the California Highway Patrol for the transportation of explosives, such as fuels, are shown in red). Included are data quantifying Shuttle and non-Shuttle related average daily hour traffic conditions (categorically denoted with letters of the alphabet) indicate that the desirable design capacity of the roadway system will only be exceeded in Santa Barbara (where periodic short term congestion already exists). Exceptions to this will likely occur during the first few months of the Operations phase as a result of spectator traffic evolving from public desire to view a Shuttle launch. Estimates for cartage of hypergolic and cryogenic fuels through Santa Barbara indicate a required flow of 53 tankers per week from Los Angeles suppliers. All supplemental utilization of the countywide roadway system for Shuttle program purposes will impact roadway maintenance requirements and costs to some unknown minimal extent. Periodic short term closure of the tow route, including the Highway 246 portion, will be necessary during time of Shuttle launch and Orbiter transport between the VAFB airfield and SLC-6.

As part of the Operations phase, Port Hueneme is annually scheduled to accommodate (at a maximum) marine traffic associated with the receipt of an average of 28 spent Solid Rocket Boosters (SRBs) from recovery points at sea (14 dual ship recoveries), and the eventual transshipment by rail or truck of components thereof to Vandenberg and the manufacturer. Although Shuttle induced vessel traffic will add to future non-Shuttle related traffic densities within the harbor, the Port Hueneme Services Office has indicated that, as long as regular schedules are established for these operations, the port can be scheduled to accommodate the proposed usage. (6) (34) Plans are such that individual Shuttle induced marine traffic events will be temporarily intermittent throughout any operations year. Hence, the impact on marine traffic in Port Hueneme or the Santa Barbara Channel is expected to be minimal. Impacts on marine transportation along the Vandenberg coastline will be small and due solely to delivery of external tanks.

External tank movement will be coordinated with train schedules so that towage of the ET'S across Southern Pacific Railroad trackage near the boathouse does not hamper the passage of trains.



Reference: Henningson, Durham & Richardson, 1976.[35]

FIGURE 5.2.2-B. Shuttle and non-Shuttle related traffic projections and resultant peak-hour levels of service in average Operations phase year.

Transshipment of spent SRB propellant segments to the propellant manufacturer and the return of replenished segments to VAFB, will be accomplished by rail. Spur lines located within VAFB would be used for Base entry or egress. In accordance with anticipated launch schedules (see Table 2.5.2-1), the maximum recurrence rate will be 18 SRB transshipment cycles per year. Considering the light rail traffic on Southern Pacific Railroad trackage

through VAFB (2 passenger tains and 10 freight trains per day), the additional SRB transshipment activities will constitute an impact of minimal magnitude.

As with the Construction/Activation phase there would likely be some use of existing local air transportation facilities by operations personnel and visiting officials. On the basis of population growth projections for the Operations phase (see Table 5.2.2-6), this usage is not expected to impart a need for additional airport facilities. Air traffic movements into and out of Vandenberg are expected to double (from the current 6,754) in support of the Operations phase. No effects on air transportation in the Port-Hueneme-Oxnard area are anticipated.

During final Shuttle launch countdown periods, the following transportation-impacting safety procedures would be implemented:

(1) A portion of Highway 246 (from the coastline to some inland point near Lompoc) and the Jalama Beach road (from the coastline to an inland point) will be closed to uncontrolled population.

(2) Upon notification of a scheduled launch, local airports would be requested to alter their flight activities as necessary to avoid hazards at the time of launch.

(3) Because Shuttle launch trajectories (see launch envelope in Figure 1.2-A) cross aircraft control zones 1176, 1177, and 1316 (see Figure 3.2.6-B), air traffic controllers at Los Angeles International Airport would, upon notification (by the Air Force) of a scheduled launch, be requested to coordinate the diversion of associated commercial air traffic to control zone 1155.

(4) Appropriate maritime personnel would, upon notification (by the Air Force) of a scheduled launch and its associated debris fallout zones, inform jeopardized marine traffic to relocate to nonhazardous ocean areas.

(5) The stationmaster at Surf would, through established radio communication links with train engineers, monitor the location of all nearby trains so that, at the time of liftoff, none are within the launch hazard zone.

It is to be noted that the above procedures represent a continuation of past and present policy practices with respect to VAFB launches. The impacts associated with their implementation include the inconvenience of delays and the slight additional costs for coordinating manpower efforts and diversionary travel.

5.2.2.8 Impact on Cultural Amenities

Existing recreational facilities (along with additional development already planned) should be adequate to absorb the long term growth (see Table 5.2.2-6) associated with the Shuttle Operations phase. During scheduled launches, it will be necessary to close Jalama and Ocean Beach Parks, an established practice for some of the existing Titan launch programs at VAFB. It is anticipated that each closure would be for no more than one (1) day.

It is not anticipated that any known historic site in the area will be intentionally impacted by any aspect of the proposed action. Unintentional impacts could occur, however, depending on the circumstances surrounding the unavoidable cause. Even then, imparted effects would likely be minor. For example, the supersonic maneuvers of the Orbiter during its descent from space will unavoidably cause sonic boom overpressures. Should these become focused in areas containing relics or structures of historic nature, damage to the more fragile portions (for example, windows or light fixtures) could occur. As previously mentioned in Section 5.1.1, normal sonic boom overpressures (generated during Orbiter descent) are not expected to exceed 2.1 psf. La Purisima Mission, a National Historic Place, conceivably could be exposed to these overpressures. Therefore, windows of the mission would be most vulnerable to damage. All artifacts located within the facility are housed in tempered glass cases and would therefore be less vulnerable. Although most openings in the mission are covered by wood shutters, those of the Chapel and administrative area are glassed. All windows were installed during a 1930s restoration and consist of panes that are relatively small in size (6 x 8 inches for the chapel and 16 x 24 inches for the administrative area). Engineering calculations indicate that panes of this size should adequately withstand the expected overpressures without damage. This potential adverse impact has been coordinated with the State Historic Preservation Office. If required, a mitigation program will be developed for approval by the Advisory Council on Historic Preservation in compliance with 36 CFR 800.

Noise generated during a typical launch and/or sound overpressures generated during Space Shuttle ascent or Orbiter descent may prove to be disturbing to some individuals residing or working offbase, particularly during nighttime hours. A typical event such as crashes, fires, and/or explosions may also impart similar disturbances to serenity. Inasmuch as neighboring populations have been and currently are periodically exposed to rocket noise from Titan and Minuteman launches, the likelihood of general acceptance of Shuttle launch noise is high. Unavoidable overpressures generated during a Shuttle ascent or as a result of an accidental onbase explosion will likely be accepted for similar reasons. Alternatively, descent overpressures will be audible in areas located farther north of the Base. Inasmuch as current populations in these areas are not normally subjected to sonic booms, some displeasure over their disruption of serenity is expected.

When viewed from a safe distance, a Space Shuttle launch with its rocket engine noise, ground cloud, and trailing exhaust plume will (for most people) be an aesthetically pleasing and exhilarating event. As such, crowds of spectators are expected to gather in the area for at least the first few of these events. These crowds may, in many respects, be particularly annoying to local residents. With them will come increased traffic congestion, attendant noise, littering, and perhaps some unintentional property damage—all likely to be irritating to some degree. This will likely impose some financial burden on those public service departments which would be responsible for implementing control, cleanup, and restorative measures in accordance with the need. Alternatively, spectator presence will provide some short-term economic stimulation through expenditures for food, shelter, entertainment, and the like. Specific impacts will therefore be variable, but the overall net effect on human well-being is expected to be minor.

6.0 ALTERNATIVES

This Section is divided into alternatives that deal with (1) Program Planning, encompassing the overall program alternatives of no project, delayed project, and alternate project sites, and (2) Facilities and Operations Planning, presenting alternative procedures for implementing the program under Vandenberg's authority.

6.1 PROGRAM PLANNING

6.1.1 NO ACTION

If the Space Shuttle program were not developed at Vandenberg, any adverse environmental impacts that could result from the project would be precluded; however, this alternative would conflict with the conditions that led to the selection of Vandenberg as one of the two sites for Space Shuttle launches.

After carefully screening about 150 different sites throughout the U.S., a joint National Aeronautics and Space Administration/Department of Defense Shuttle Launch and Recovery Board chose Vandenberg as a Space Shuttle launch and landing facility. The Base was selected for several reasons, including the following: (1) its coastal location makes available a large area for recovery of the Solid Rocket Boosters and possible emergency jettisoning of the External Tank; (2) of all the West Coast areas studied, it had the least terrain limitations and the existing development around VAFB does not impede necessary land requirements; (3) it has an existing landing field and an existing launch facility that could be modified for shuttle missions; (4) it could provide complementary western and southern launch azimuths to balance the Kennedy Space Center's eastern launch azimuth capability; and (5) potential effects on population centers near Vandenberg would be small under normal operating conditions because they are well removed from launch sites.

In addition, Vandenberg has an established space vehicle launch program with more than 18 years of operational history. Because of its existing space

vehicle programs, Vandenberg has qualified personnel that would be available for the proposed Space Shuttle program.

Finally, halting development of the Space Shuttle at Vandenberg would require an increase in launchings of unmanned military Titan III space missions to accommodate some DOD missions planned for the Shuttle. While the environmental effects on the troposphere would be less than those projected for Shuttle, some increase over existing effects would result from the required increase in missions. Continuing and increasing the Titan III program would result in increased cost of the unmanned military space program and would preclude the economics possible through the Shuttle because of reusability of Shuttle vehicle components as well as many payloads.

6.1.2 DELAYED ACTION

The current proposed program scheduled for Vandenberg allows for an initial testing and operation period for the Space Shuttle at Kennedy Space Center prior to initiating operation at Vandenberg. Approximately 50 Space Shuttle launches will be conducted at KSC before the first Vandenberg launch, scheduled for June 1983. Facilities planning and construction at the Base also will be delayed to allow maximum use of data and design criteria developed from the Kennedy Space Center program.

While further delay in the Vandenberg program could possibly yield additional data from the Kennedy Space Center program, delays also would increase the cost of construction and operation because of inflation. Additionally, the expendable launch vehicle program (Titan) would have to be continued and probably increased during such a period of delay.

6.1.3 ALTERNATIVE LAUNCH SITE

During the study conducted by the joint National Aeronautics and Space Administration/Department of Defense Shuttle Launch and Recovery Board on proposed sites for the Space Shuttle program, an area was found near Matagorda, Texas, that had the potential to accommodate much of the total program. The site apparently had clear areas for booster impact and recovery and was sufficiently

free of existing development to warrant further investiga ion. After detailed study, the Board found no operational, economic, or environmental advantage in establishing a new single launch site.

The environmental impact of establishing the Space Shuttle program on a single new site, such as the Texas location, probably would be greater than developing the program at the two existing coastal sites (Kennedy and Vandenberg). In addition, a single site would have more frequent launch scheduling than either of the existing sites, hence a greater potential for focusing operational impacts on one area.

Further, extensive construction and an influx of personnel to the local area would be needed to develop a new site, thus increasing both the economic and social cost of the program. An analysis prepared by the Board showed that a new site would cost over $300 million (1972 dollars) more than the cost of establishing the same capability at the two existing launch sites. The analysis also demonstrated that the cost saving in operating a single site did not overcome the significantly increased initial investment. Major facilities needed for the Space Shuttle program are currently available at the two existing sites and would require only modification and/or expansion to accommodate the program. The construction labor force needed at a single new site probably would be greater than the combined personnel requirements at Vandenberg and Kennedy. These personnel could put a greater burden on local communities surrounding the alternate site, and additional federal funds might be needed to provide or improve community services.

Finally, a new site could preclude or reduce Vandenberg's role as a base for military space missions. If Department of Defense plans for use of the Space Shuttle in later military missions were switched to an alternate site, existing operations might be gradually phased out. Undoubtedly, this would result in significant economic decline in the communities surrounding Vandenberg.

6.2 FACILITIES AND OPERATIONS PLANNING

6.2.1 LAUNCH COMPLEX ALTERNATIVES

The launch complex for the proposed project will be an Integrate-on-Pad (direct buildup of the launch vehicle on the launch mount) concept, using the existing Space Launch Complex No. 6 with extensive modifications.

6.2.1.1 Separate Buildup and Launch Facilities

One alternative to the proposed plan is an Integrate-Transfer-Launch concept, where the Space Shuttle is erected on a mobile launch platform in the Vehicle Assembly Building and then moved on the platform to the launch pad. The major differences between this alternative and the proposed concept are (1) the existing unused Space Launch Complex No. 6 was designed as an Integrate-on-Pad launch complex and would require more extensive modification than is planned, and (2) the alternative would require an approximately 100-foot wide by 8,000-foot long transporterway, which would make extensive clearing and grading necessary.

The main advantage of the Integrate-Transfer-Launch is that it reduces the risk of losing launch capability if an accident occurs during buildup. However, developing this alternative would significantly increase the impacts on biotic resources in the Point Arguello area and probably increase impacts on archaeological sites during clearing and grading for the transporterway. The Integrate-Transfer-Launch concept also would increase costs by about $20 million (1975 dollars) more than the proposed concept because of more extensive modifications required for the SLC-6 facilities.

6.2.1.2 Two Launch Pads

The second alternative is development of two launch pads, with the pads separated by a minimum of 3,440 feet. After studying pad operations, investigators concluded that a single launch pad could accommodate the

projected schedule of 20 Space Shuttle launches per year. In addition, the possibility of a major on-pad accident that could severely damage the single pad was considered small. Having two pads would not reduce the risk of delaying launches because, if a major accident occurred, all Space Shuttle operations would probably be curtailed until a thorough investigation was completed and any necessary corrections made. Developing two pads also would produce additional construction impacts and costs not necessary under the current program schedule.

On the basis of these considerations, the single launch pad appears to be preferable to the two-pad alternative. However, future development may require an additional launch pad; should the launch rate exceed the planned schedule and require a second pad, an environmental statement amendment will be developed.

6.2.1.3 All-New Launch Complex

The third alternative is an all-new launch complex either near the existing, unused Space Launch Complex No. 6 or at one of three other possible sites on North Vandenberg, Bear Creek, or Sudden Ranch. Development at an alternate site probably would produce greater construction and operation impacts; it would increase the development cost of the Space Shuttle program at Vandenberg; and it would leave the existing Space Launch Complex No. 6 unused, with no apparent potential for use by other programs.

In addition, operations from the sites on North Vandenberg and Bear Creek would have significantly greater potential for noise and air quality impacts in the Lompoc Valley. Construction on the Sudden Ranch site could pose significant impacts because of its proximity to a particularly valuable archaeological site.

6.2.2 LANDING COMPLEX ALTERNATIVES

The landing complex for the proposed Space Shuttle program at Vandenberg will be at the existing airfield on North Vandenberg. The proposed modifications to the complex will involve the existing 8,000-foot runway, 7,000 feet of which is asphalt concrete. A new portland cement concrete surface will be added as well as a 7,000-foot northwest extension. A new towway will be constructed to provide access to the Safing and Deservicing Facility, Maintenance and Checkout Facility, and the Hypergolic Service Facility, all of which are to be located on the southwest side of the runway.

6.2.2.1 South Vandenberg Landing Complex

One alternative to this plan is locating a new landing complex along the coast north of Point Arguello near the Space Launch Complex No. 6 site on South Vandenberg. This alternative would (1) eliminate need for a transportation route across the Santa Ynez River and for much of the currently proposed tow route, (2) improve program security because the Orbiter would not be towed over public roads, (3) allow more efficient use of manpower because personnel could commute quickly from one facility to another, and (4) reduce noise in the nearby city of Lompoc because the glide path approach to a landing area on South Vandenberg would avoid populated areas.

These advantages, however, are not considered sufficient to justify a new site because of (1) the increased environmental impacts on archaeologic and biologic resources caused by the increased construction required on South Vandenberg, (2) the increased risk of landing accidents as a result of adjacent steep terrain and increased incidence of fog on South Vandenberg, and (3) an increased $12.6 million (1974 dollars) more than the cost to modify the existing North Vandenberg airfield.(49)

6.2.2.2 Alternative Modifications of Landing Complex

The second alternative considered involves five different modifications of the existing airfield complex.

(1) Studies were conducted to determine if the existing runway could be used as part of the Orbiter landing runway. One study showed that residual quantities of liquid oxygen onboard the Orbiter during landing would be hazardous in the event of a spill.(66) Under certain conditions, liquid oxygen saturated asphalt could react violently to produce a spontaneous fire or explosion. The existing runway, although structurally adequate, is also exhibiting signs of deterioration and advance aging (a brittle condition exists throughout the depth of the asphaltic portion); although the runway could handle a few Orbiter landings, major rehabilitation would eventually be required during the Shuttle program and would necessarily impose mission delays at a sizable cost.(173) Further, a high potential for Orbiter tire blowout and resultant gear failure from "digging in" on an asphaltic concrete pavement places a high risk on Orbiter survivability. All of the aforementioned suggested that the existing runway would require some form of immediate rehabilitation (using portland cement concrete) prior to Shuttle use.

(2) Because the Orbiter is designed to land on a 10,000-foot long runway, consideration was given to limiting the runway length

to 12,000 feet. This proposal was deemed insufficiently conservative because of the lack of knowledge of the actual landing characteristics of the Orbiter in an unpowered mode and the possibility that arresting gear would be required to capture the Orbiter should it overrun the runway. Such equipment could severely damage the Orbiter.

(3) Extending the runway to the southeast as well as to the northwest would require a shorter northwest extension and avoid a small topographic depression farther northwest. However, large cuts would be required in the southeast extension, thereby significantly increasing the cost by 3.0 to 5.4 million dollars. A southeast extension would bring the landing threshold closer to the Base cantonment, thus bringing the Orbiter over the cantonment at a lower altitude. In addition, both the Orbiter and possibly other aircraft using the new runway probably would overfly Lompoc about 350 feet lower than current proposed altitudes and could bring aircraft landing noise closer to the civilian population. The added effect, however, would have only a minimal impact.

(4) Also considered was combining the Orbiter processing operation into a single facility rather than having the separate Safing/Deservicing and Maintenance/Checkout Facilities. Such a single processing facility will be used at Kennedy Space Center. The two-facility concept will provide a relatively higher safety margin by separating the hazardous initial deservicing and safing operations from the more routine Orbiter servicing operations. Potential environmental impacts during operation will be the same as those for a single facility.

(5) The alternative of siting all the Orbiter processing facilities on the east side of the runway adjacent to the existing airfield control and service structures was considered. This concept would allow for the clustering of airfield facilities and Orbiter support facilities in a single locale. However, it was determined that Public Emergency Limits for hypergolic propellants could be exceeded in nearby downwind populated areas in the event of a spill. Consequently, siting of the OMCF, SDF, and HSF on the eastern side of the runway (closer to the more populated Base areas) did not provide the safety margin for exposure to spills that the proposed siting scheme provides.

6.2.2.3 Offbase Landing Complex

The third alternative is assigning the Orbiter landing to a site off Vandenberg Air Force Base. Both Edwards Air Force Base, California, and Kennedy Space Center were considered for alternate landing sites, and both have existing Orbiter landing capabilities. Landing at one of these sites would eliminate the need to modify the existing runway and construct a new Safing and Deservicing Facility at Vandenberg. However, landing the Orbiter at either site would require air ferry of the Orbiter to Vandenberg by the 747 ferry aircraft for future launchings. Returning the Orbiter to Vandenberg would result in additional expense and fuel consumption, and the added cost in lieu

of direct return to Base probably would overcome any savings in facility construction. In addition, a landing capability would still have to be provided at Vandenberg in case of a Return-to-Launch-Site abort. The Orbiter could land at Edwards Air Force Base following possible aborts, but it would overfly the greater Los Angeles area. The potential impacts of this alternative are considered substantially greater than those that might occur at Vandenberg. While overflight of populated areas by the Orbiter in normal flight during descent will occur at the end of most missions, such overflight during emergency situations is considered hazardous. Also, if the Orbiter experienced propulsion failure before orbital insertion but after it was too late to return to the launch site, it would need an abort-once-around trajectory. Because of the earth's rotation, the Vandenberg site would have moved 1,100 miles east during the suborbital swing around the world. The Orbiter would have sufficient cross-range capability to travel the 1,100 miles to Vandenberg, but Edwards Air Force Base (about 150 miles east of Vandenberg) would be more than 1,200 miles off track. To enable the Orbiter to travel the additional range to Edwards, the Orbiter's thermal protection system would have to be modified to meet more stringent requirements, adding 800 pounds to the weight and about $19.4 million more in development and operational costs.[28]

6.2.3 EXTERNAL TANK DELIVERY ALTERNATIVES

6.2.3.1 Different Delivery Vehicles and Onsite Fabrication

Two alternatives discussed briefly were the possibility of delivering the External Tanks to the West Coast via some means other than ship, and the possibiblity of providing onsite fabrication of the tanks at Vandenberg to avoid transport from the manufacturer.

The 154-foot long by 28-foot diameter cylindrical tanks can only be delivered to the West Coast by ship because the size of the tank precludes shipment by truck, train, or special cargo aircraft. Delivery atop the 747 ferry aircraft was investigated; however, the cost to modify the 747 was prohibitive. The effort to duplicate an extensive manufacturer's installation to provide onsite fabrication capability was not considered a viable alternative.

6.2.3.2 Direct Delivery to Vandenberg by Deep Draft Barge

Two sites at Vandenberg were considered for development and operation of a new harbor--Ocean Beach (about 0.5 mile north of the mouth of the Santa Ynez River), and near Point Arguello Boathouse (the abandoned Coast Guard Lifeboat Station) about 4 miles southeast of Point Arguello.(94) Developing a harbor at these sites could involve blasting and dredging activities that would result in substantial adverse environmental impacts to the marine ecosystems, particularly at the Boathouse where especially rich intertidal and subtidal marine species are established.

At Ocean Beach, changes in sand transport patterns and shoreline stability could significantly alter the coastal sand dunes and Santa Ynez Lagoon. Such an impact, along with increased human disturbance and construction of access roads, could interfere with use of the area by least terns (endangered species). Least terns are known to nest at the mouth of the Santa Ynez River. Adverse impacts on the Santa Ynez River salt marsh and the diverse dune flora could also occur.

At the Boathouse, existing facilities would have to be at least partially removed. Additional impacts caused by construction of the access roads would also occur, much like those described for the proposed action.

The weather conditions at both sites also would affect use of either harbor. Operations will have to be suspended if offshore wave heights exceed 6 1/2 feet, wind speed exceeds 20 knots, or visibility is less than 0.25 nautical miles.

Use of the Ocean Beach harbor, based on these restrictions, could only be about 70 percent of the time, with monthly use varying from 62.3 percent in May to 82.9 percent in January. Use of the Boathouse harbor would be for more than 70 percent of the time for 10 months a year, at least 75 percent for 9 months, and at least 80 percent for 7 months. Neither site would be open 90 percent of the time, as NASA requires. Delayed use of a harbor would impose operational risks to the Space Shuttle program and potential launch delays at both Vandenberg and Kennedy. Acquisition of a second External Tank delivery barge to help alleviate this delay would increase the program costs.

Development and operation of either harbor also would increase program costs. The life-cycle cost at Ocean Beach is an estimated $41.3 million (1975 dollars). This is $24.5 million greater than the cost of the proposed External Tank delivery method, based on a partial life-cycle cost analysis that excluded maintenance and support manpower costs.(65)

The cost at the Boathouse is an estimated $24.3 million (1975 dollars). This is about $7.5 million greater than the cost of the proposed External Tank delivery method on a partial life-cycle cost basis. On an expanded life-cycle cost basis (including consideration of maintenance and support manpower costs), this alternative would amount to $28.6 million (1975 dollars), or $4.6 million greater than the $18.9 million cost of the proposed concept.(65)

6.2.3.3 Direct Delivery to Vandenberg by Transoceanic Air Cushion Barge

An additional alternative involving the direct delivery of ETs to Vandenberg Air Force Base by transoceanic Air Cushion Barge (ACB) was evaluated. Under this concept, a large specially constructed barge-like craft would be used to transport ETs from the manufacturer to Vandenberg Air Force Base. The ACBs would carry four ETs at a time from the manufacturer to offshore Vandenberg in the same way as a conventional tug-towed barge. However, upon arrival in the nearshore vicinity of Surf a skirt system around the ACB would be deployed and an air cushion system would be activated. The levitated craft then would be winched ashore through the surf zone.

This concept would require the construction of a small offshore mooring structure, a launching ramp and pad in the dunes near Surf, a short access road to the Tow Route, minor improvements to the Tow Route, and a relocation of the External Tank Storage and Checkout Facility to a site immediately south of SLC-6.

The ACB alternative would eliminate the need for a large new harbor at Vandenberg. It would also enjoy an advantage over other alternatives involving transhipment of ETs from Port Hueneme, because no new tank handling and storage would be required at that location.

Because this alternative involves the use of a dedicated ACB vehicle for transport to and from Vandenberg, delays in ET delivery schedules for reasons such as poor weather would not impact overall STS program schedules (see Section 6.2.3.2). The capability of delivering four ETs at a time would also minimize the possibility of launch delays at Vandenberg, because an adequate stockpile of ETs (for contingency purposes) would be available between successive visits of the ACB. Implementation of this alternative would impact archaeological sites that are in the immediate area of the ACB landing ramp and pad at Surf. In addition, construction/operations at Surf might necessitate the closure of portions of the Surf beach area to the public. Some interuption of normal dune migration would be expected because portions of the landing ramp and pad would

be developed directly through the Surf dunes. This alternative would also result in an aesthetic impact to the Surf dunes - an area that is used for recreation by the public. Relocation of the External Tank Storage and Check Out Facility from its proposed location near the Boathouse to a location closer to SLC-6 would not result in any significant impacts relative to the proposed action.

The construction/activation costs of the ACB alternative would be approximately $0.6 million (1975 dollars) less than the proposed action. This does not include the cost of the ACB vehicle itself. Vehicle development and procurement costs would be the responsibility of NASA.

6.2.3.4 Delivery to Port Hueneme/Transhipment to Vandenberg by Hovercraft

This alternative involves the shipment of tanks from the manufacturer (four at a time) via an ocean going barge to Port Hueneme. Following arrival at Port Hueneme the tanks would be transferred to a storage facility near the dock and held for transshipment to Vandenberg AFB. One at a time, the ETs would be towed from the storage facility onto a hovercraft barge. This hovercraft would be considerably smaller than the transoceanic vehicle described in the previously discussed alternative, and would be capable of carrying only two tanks at a time. The hovercraft would be towed to offshore Vandenberg like a conventional barge. However, upon arrival in the nearshore area of Surf, hovercraft fans would be activated and the craft would be winched across the surf zone and up a ramp to a landing pad. The ETs would then be offloaded and towed to a tank storage facility in the immediate area of SLC-6. The hovercraft landing facility would be generally similar to that described for the ACB alternative except that the ramp and landing pad would be somewhat smaller. Little, if any, additional modification to the tow route would be required if this concept was implemented.

This particular alternative also eliminates the need for a new or modified harbor at Vandenberg and would eliminate the potential for program delays

that are associated with the direct delivery of tanks by deep draft barges. Because this alternative requires additional tank handling and storage at Port Hueneme, there is an increased potential for damage to the ETs.

Construction and operation of additional facilities at Port Hueneme would not result in significant environmental impacts. The impacts associated with this alternative at Vandenberg would be essentially the same as those described for the ACB option. The location of the landing ramp and pad in the Surf dunes potentially would impact nearby archaeological sites. Also, the landing facility could act as a barrier to normal dune migration. Implementation of this alternative would result in an aesthetic impact to this area and it is possible that construction/operations could require the periodic closure of portions of the recreational beach.

The cost of this alternative would be approximately $3.1 million (1975 dollars) greater than the proposed action. This is mainly attributable to the increased construction/operations requirements at Port Hueneme.

6.2.3.5 · Delivery to Alternate Site/Overland Transport to Vandenberg

Two alternate sites outside Vandenberg were considered for delivery of the External Tanks: Port San Luis (about 25 miles north of Vandenberg) and Cojo Bay (6 miles south of the Base, just east of Government Point).[117] Either site would involve harbor construction and operations that would result in adverse marine impacts.

Furthermore, the transportation route for either site would require modifications. From Port San Luis to Vandenberg, the route is by public road which would require extensive modifications (such as utilities realignment, embankment cuts, route realignment) to accommodate the ET clearance envelope. From Cojo Bay to Vandenberg, the route is by rail, primarily requiring obstruction removal. The modifications from Port San Luis would produce appreciable impacts on terrestrial ecosystems, whereas the Cojo Bay to Vandenberg

modifications would involve limited terrestrial impacts. In addition, construction and operation along the public road from Port San Luis would produce periodic traffic congestion and other interferences with civilian populations. Transport over either route would increase the risk of accidental damage or vandalism to the tanks. In the proposed delivery concept, the tanks would be maintained in restricted areas.

Use of the Cojo Bay site also might conflict with other planned uses, because projects such as a major LNG ship terminal have been proposed in that area; however, the compatibility of the Vandenberg project with such proposed actions currently cannot be assessed. Acquisition of development rights for privately owned land inland of Cojo Bay would be required. The procedural details for acquiring such rights have not been investigated, but it is believed that land acquisition could cause delay in meeting project schedules.

The cost of the Port San Luis alternative is an estimated $28.9 million (1975 dollars). This is $12.8 million greater than the cost of the proposed External Tank delivery method, on a partial life-cycle cost basis.(65) The cost of the Cojo Bay alternative is an estimated $24.1 million (1975 dollars), which is $7.3 million greater on a partial life-cycle cost basis.(65)

6.2.3.6 Delivery to Port Hueneme/Transshipment of Single Tanks to Harbor at Vandenberg by Shallow Draft Barge

Because of the potential risks, environmental impacts, and expenses of developing a large harbor at Ocean Beach, Point Arguello Boathouse, Port San Luis, or Cojo Bay, the established all-weather port at Port Hueneme was considered for use as a transshipment point. Use of this harbor would allow the transoceanic delivery barge to meet its schedule and would help avoid delays in planned launches.

Transshipment of the External Tanks from Port Hueneme to Vandenberg by small shallow-draft barge would require new harbor facilities at Vandenberg; again, Ocean Beach and the Point Arguello Boathouse were considered as candidate sites.

Existing environmental conditions at Ocean Beach dictate the need for a fairly extensive harbor facility to accommodate all barges, regardless of size. This is not true of the Boathouse area, however. The reduced size and draft of the barge intended for use in this alternative would enable the existing Boathouse embayment to be used. Therefore impacts on the marine environment would be less than those for the direct delivery alternative discussed in Section 6.2.3.2. However, transshipment deliveries and the attendant operational impacts associated with vessel movement and ballasting and deballasting within the embayment would occur four times as often as those of the proposed action.

The partial life-cycle cost of a small harbor at Ocean Beach is an estimated $29.5 million (1975 dollars). This is $12.1 million greater than the cost of the proposed External Tank delivery method. On the basis of an expanded life-cycle cost, the additional cost of this alternative is $14.1 million.(65)

The partial life-cycle cost of the Boathouse harbor is an estimated $15.8 million (1975 dollars). This is $1.0 million less than the cost of the proposed delivery method. On the basis of an expanded life-cycle cost, this alternative would cost about $2.4 million less than the proposed concept.(65)

6.2.3.7 Delivery to Offshore Docking Facility/Airborne Transfer to Vandenberg

A final alternative considered was delivery of the tanks by barge from Louisiana to a mooring facility offshore at Vandenberg, then airborne delivery of the tanks (one at a time) to an onshore location. Various airborne vehicles were considered, including an Aerocrane, a Heli-Stat, and a Heavy-lift Helicopter--all conceptual.

All three vehicle concepts are unproven and require an unknown amount of development. The Aerocrane concept is a hybrid vehicle combining a buoyant (helium) airship and rotary wings (four wings on the circumference of the sphere, with the entire spheroid/wing assembly rotating). The Heli-Stat is a hybrid buoyant airship and helicopter vehicle based on the use of existing helicopter parts. The Heavy-lift Helicopter, with a maximum payload of 35 tons, would

require that the External Tank be filled with helium to achieve the necessary lift margin. The U.S. Army, which developed the Heavy-lift Helicopter concept, cancelled the program in August 1975.

Pursuing any of these concepts would present a high risk to the initial delivery schedule, and to the ability to provide the system at an acceptable cost. The Aerocrane concept, which appears to be least costly, would have a partial life-cycle cost of an estimated $25.3 million (1975 dollars). This is an $8.5 million increase over the proposed hovercraft delivery method.(65)

It is inferred that only minimal environmental impact would result from the offshore docking/airborne transfer option. It is expected that the mooring facility could be designed and located so that no appreciable impacts would accompany its construction or operation.

6.2.4 ALTERNATIVES FOR TRANSPORT OF COMPONENTS ON VANDENBERG

The Space Shuttle program at Vandenberg requires that the components be transported between facilities that are located as much as 17 miles apart. Major components will be carried on a strongback frame with multiple commercial wheel dollies; it will be towed by a heavy-duty semitractor (altogether an 80-wheeled transporter) over a tow route consisting primarily of existing roads (most of the route is shown on Figure 6.2-A). The following alternatives were considered during project planning.(61)(64)

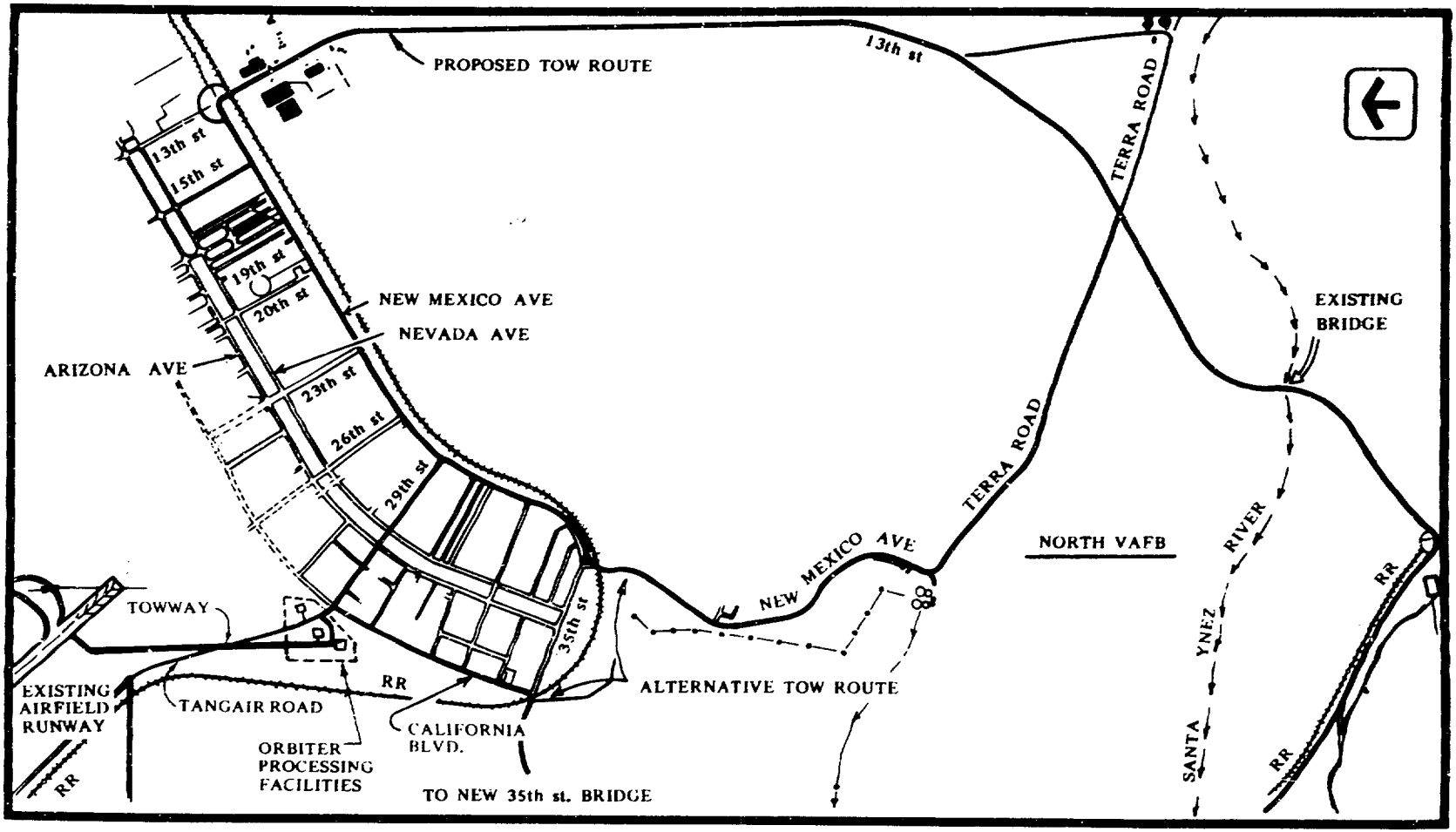


FIGURE 6.2-A. Proposed and alternate tow routes.

6.2.4.1 Alternate Tow Routes

Two alternate tow routes starting at Tangair Road were considered: (1) New Mexico Road/Terra Road (see Figure 6.2-A) to 13th Street then following the remainder of the proposed route, and (2) California Boulevard to 35th Street, across the Santa Ynez River by a new bridge, and then following the remainder of the proposed route.

To prevent any grades from exceeding 6 percent and to allow for adequate support of the Orbiter and transporter wheel loads, a minimum of 12,000 feet of roadway along the Terra Road route (between 35th Street and 13th Street) would require relocating and/or rebuilding. For the 35th Street bridge route, about 5,000 feet of roadway would require relocating along part of 35th Street. This route also would require less traffic control than either the proposed route or the New Mexico/Terra road alternative because it would not intersect with as many streets.

The relocation required for both alternate routes would affect large areas of unusual coastal chaparral. The 35th Street bridge route would affect appreciable areas of *Eriodictyon capitatum* (Lompoc yerba santa), a special interest shrub species. New bridge construction also would affect riparian and aquatic communities, whereas the proposed tow route would have more limited impact on these environmental factors.

Although none of the tow routes have been surveyed to identify archaeological sites along their routes, archaeological resources probably will not be affected by any of the three routes. However, survey verification would be required as an impact determining measure.

Costs for the Terra Road route would be an estimated $0.5 million (1975 dollars) more than the proposed route, and the 35th Street bridge route would be an estimated $1.3 million (1975 dollars) more.

6.2.4.2 Alternate Transport Vehicles

Four different modes of transporting Shuttle components were considered. One involved transporting the Orbiter on its own landing gear, but that possibility was rejected in the design phase because:

(1) Towing requirements would limit the grades to 6 percent; the actual grade along the 13th Street portion of the tow-way is about 8 percent. This requirement would result in more adverse environmental impacts during grading than the proposed route.

(2) Orbiter landing gear width is 27 feet, but most of the proposed route is 24 feet wide. Again, impacts would be greater as a result of required widening of the roadway.

(3) The Orbiter exceeds the maximum wheel and axle loading capacity for the existing roadway.

(4) Towing the Orbiter over about 17 miles would risk damage to its gear and tires.

The second mode of component transportation considered would be the use of air cushion transporters to carry ETs (from Port Hueneme) and fully assembled spent SRB casings directly to SLC-6. However, this option also was rejected in the design phase because it was determined that wheeled transport after component transfer from a hovercraft landing facility will also afford the required flexibility.(61)

The third type of vehicle considered for component transport was a modified version of the existing surplus missile transporters used for the Saturn II and Saturn IC. This alternative was rejected in the design phase because of high wheel loading, high maintenance costs, and the extensive modification required. Modification would cost between an estimated $0.3 million and $0.5 million (1975 dollars) per transporter.(61)

The last mode considered was by rail over existing railroad tracks on the Base. However, moving the massive Orbiter and External Tanks over this route would involve obstacle clearance problems and possible railcar upsets because of oversized loads on the narrow support system afforded by the standard rail line.(67)

6.2.5 ALTERNATE SPENT SOLID ROCKET BOOSTER PROCESSING

The proposed action includes delivery to Port Hueneme of the spent Solid Rocket Boosters recovered at sea following a launch. The boosters will be lifted onto a dock, ordnance will be disconnected, and the exterior of the booster will be washed at a new Solid Rocket Booster wash facility. The spent boosters will be transshipped to Vandenberg by hovercraft barge and towed from the hovercraft dock to the launch area. Each spent booster will be disassembled at a Solid Rocket Booster Disassembly Facility. The spent propellant sections will be shipped by rail to the booster manufacturer in Utah for refurbishing and refilling with propellant. The nonpropellant sections are to be moved to the Solid Rocket Booster Receiving and Servicing Facility where they will be refurbished and stored for reuse. The large Solid Rocket Booster recovery parachutes will be washed and refurbished at a modified facility in the Vandenberg cantonment area. The following alternatives for spent Solid Rocket Booster processing were considered during project planning.

6.2.5.1 Direct Delivery of Recovered Boosters to Vandenberg

Delivering the recovered boosters directly to Vandenberg would require a protected area for docking and lift-out operations; hence, construction of a harbor at Vandenberg would be a prerequisite. The impacts and costs for such construction are discussed in Section 6.2.3.2.

6.2.5.2 Booster Disassembly at Port Hueneme

If the booster casing were disassembled at Port Hueneme instead of at Vandenberg, the empty propellant sections would be shipped by rail directly to Utah and the nonpropellant sections shipped by rail to Vandenberg or an offsite refurbishment facility. Although several ground and marine operations required in the proposed action would be eliminated, no appreciable environmental change, versus the proposed action, would occur, and some cost saving could result. Any cost saving due to a reduced requirement for booster

handling at Vandenberg would be balanced out by the fact that if booster disassembly were done at Vandenberg, personnel could be shared with nearby facilities.

6.2.5.3 Offsite Refurbishment of All Booster Sections

Instead of refurbishing nonpropellant sections at Vandenberg, these sections could be refurbished at Utah with the propellant sections, or sent to Kennedy Space Center. Offsite refurbishment of nonpropellant sections would present no appreciable change in environmental impacts or significant risks over the proposed option. Cost probably would increase by about $250,000 over a 20-year life cycle.(62)

6.2.5.4 Offsite Parachute Processing

Parachute refurbishment could be done at an existing offsite facility at Point Mugu or the Space Shuttle parachute facility at Kennedy. Both alternatives may require expansion to accommodate the Vandenberg program requirements. No appreciable environmental impacts versus the proposed action are expected. Modifying the existing facility at the Pacific Missile Test Center, Point Mugu, California, would increase the cost by an estimated $0.4 million (1976 dollars) over the proposed option. Modification at Kennedy would cost an estimated $1.2 million (1976 dollars) more than the proposed life-cycle cost.(63)

7.0 PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED

7.1 UNAVOIDABLE ADVERSE IMPACTS

The following probable adverse environmental impacts are unavoidably associated with the proposed action. These impacts are grouped according to their general importance. Impacts which are considered unavoidable, but are of a minor or lower importance have not been discussed in this Section. However, they are treated in Sections 5.1 and 5.2.

The five impacts listed below are considered to be discernible to moderate in importance.

(1) Noise resulting from the operation of heavy construction equipment will cause some annoyance to Base personnel who work near construction sites. Support vehicle traffic will also cause localized impacts adjacent to site access routes. These impacts will be of a short duration, lasting only through the construction period.

(2) The destruction of vegetation/flora, faunal habitat, and fauna on about 400 acres will result from the implementation of the proposed action. This is a very small amount of the total habitat now existing on Vandenberg.

(3) An increased demand on the overburdened Santa Maria school system resulting from increased enrollments will occur. The incremental increases due to influx of the children of project personnel involved in construction and operation will be small. The estimated maximum number of students that the Santa Maria-Orcutt area will have to accommodate is only 61.

(4) Periodic Shuttle launches will require the evacuation of the public from Jalama Beach park. Closure of this recreational area will be infrequent (coinciding with scheduled launches) and of short duration.

(5) Prior to Shuttle launches, marine and air traffic will be requested to divert around hazardous downrange areas. This will result in a temporary disturbance of normal traffic movements.

The following six impacts are considered significant to substantial in importance.

(1) Small portions of several known archaeological sites (and possibly unidentified sites) will be destroyed during construction. The most important impacts that will accrue will be a result of widening the tow route corridor near the confluence of State Highway 246 and Coast Road. Even with the successful completion of salvage operations planned according to 36 CFR 800, some site information will be irretrievably lost.

(2) Rocket engine noise will cause a disturbance to the local population and to animals. Rocket noise is part of the existing environment on South Vandenberg and in the Lompoc Valley. The noise produced by the Shuttle vehicle will be considerably greater and will occur more frequently than the noise produced by current launches of the Titan III (the largest vehicle now launched from Vandenberg).

(3) Impacts to biological resources may be caused by rocket exhaust emissions. Under certain circumstances (such as rainout or washout events), the potential does exist for damage to the unique floral resources of the area. The expected rarity of such occurrences, however, suggests that serious and/or permanent damage is unlikely.

(4) Deleterious environmental effects may be caused by accidents involving major spills of toxic fuels, fires, explosions, or other catastrophic events. A worst case event could result in loss of life. However, the possibility of such an occurrence is considered exceedingly remote.

(5) Animals, including special interest marine mammal species (pinnipeds) and endangered and threatened brown pelicans on the Channel Islands, will be exposed to sonic booms and occasionally, sound focusing overpressures of up to 30 psf generated during the Shuttle ascent. These overpressures could cause damage to fragile eggs and disruption of breeding activities to some minr extent.

(6) Sonic booms from the Orbiter will impinge on the Channel Islands and populated areas during some normal and abort landings. The maximum expected magnitude of these booms (2.0 to 2.1 psf), although great enough to cause minor damage, will occur over ocean areas. Overpressures over the Channel Islands will be less than 2.0 psf. Pressure levels over populated areas are expected to be no greater than 1.5 psf. These latter events could cause minor glass or plaster damage. However, such occurrences would be very infrequent.

7.2 SUGGESTED MITIGATION MEASURES FOR AVOIDABLE ADVERSE IMPACTS

The following mitigation measures would reduce the severity of the adverse impacts listed below. These and many other measures are included for consideration in the Space Shuttle Environmental Protection Plans (EPPs) which are being employed to implement mitigative measures that are required by current Air Force Regulations (AFR 19-1 and 19-7). The EPPs are currently being developed, and mitigative measures are being incorporated into facility design criteria. A qualified environmental engineer responsible for the implementation and success of the EPPs as well as the enforcement of all applicable regulations will be present onsite during both Construction and Operation phases of the Space Shuttle Program. Additionally, a professional archaeologist will be available on an on-call basis.

(1) Adverse Impact: Disturbance of areas containing important resources such as native biotic communities and archaeological features adjoining construction sites.

Mitigation Measure: Restrict all construction equipment, materials, and personnel to designated construction areas and transportation routes. If additional land must be used temporarily, such use should be restricted to barren areas, ruderal vegetation, annual grassland, or other disturbed areas rather than areas of native vegetation. Such temporary uses should be established only on land that, on the basis of previous investigation, is not expected to contain archaeological or special interest floral resources. Wherever such features adjoin construction areas, these restrictions should be rigidly enforced. Revegetation on or near areas of archaeological significance should not employ discing or plowing; broadcast seeding and hydromulching should be used to avoid subsurface disturbance.

(2) Adverse Impact: Loss of archaeological resources impacted by construction.

Mitigation Measure: Recover archaeological material according to guidelines established by the Advisory Council on Historical Preservation (36 CFR 800) before initiating construction. This includes the development of a Data Recovery Program for review and approval by the Council and the removal of the required material.

One of the specific duties of the archaeologist will be the regular inspection of all construction sites for any indication of unearthed archaeological materials. Construction supervision will include the directive to

workers to immediately report the discovery of buried bones, shell, other fossil materials, or human artifacts. When a find occurs, work at the site will be halted until examination and appropriate mitigation of possible impacts can be accomplished by qualified personnel.

(3) Adverse Impact: Loss of special interest flora in areas impacted by construction.

Mitigation Measure: For those areas where impacts to special interest plants are unavoidable, the topsoil for all stationary construction sites will be removed and stockpiled prior to initiation of construction and put back in place after the construction activity is terminated. Areas adjacent to construction sites will be protected by designating and clearly marking allowable construction zone limits and erecting light fences around known locations of special interest plants. Disturbed areas will be reseeded with non-competitive native plant species.

(4) Adverse Impact: Possible damage to La Purisima Mission in the form of window breakage from sonic boom overpressure.

Mitigation Measure: Develop protective measures for all mission windows in coordination with the State Historic Preservation Office and the Advisory Council on Historic Preservation.

(5) Adverse Impact: Behavioral disturbance to biota of San Miguel Island resulting from exposure to sonic boom focusing overpressures.

Mitigation Measure: Restrict launches at or near the 70° inclination to times of the year when breeding and rearing activities are at a minimum.

Mitigation Measure: Vary or alter the trajectory for those launches scheduled at or near the 70° inclination so as to move the sound focusing region seaward of the Island.

(6) Adverse Impact: Demolition or relocation of the Boathouse pier and supported lifeboat structure, thereby altering the natural features of these facilities which may be eligible for historical registration.

Mitigation Measure: Develop protective measures for these facility components in coordination with the State Historic Preservation Office and the Advisory Council on Historic Preservation.

8.0 RELATIONSHIP BETWEEN LOCAL SHORT TERM USE OF MAN'S EXISTING ENVIRONMENT AND THE MAINTENANCE OF LONG TERM PRODUCTIVITY

Current plans call for the Space Shuttle to replace at least a portion of the current fleet of expendable launch vehicles in the 1980s. The proposed modification and expansion of existing facilities (as well as the construction of new facilities) at VAFB and Port Hueneme, California, and the operation of these facilities in support of the Space Shuttle program are compatible with these long term plans. In general, the short term impacts resulting from developing Shuttle launch capability at Vandenberg will be of minimal consequence compared with the gains to be realized over the longer term.

In the preceding sections of this Statement, it has been demonstrated that the undesirable short term effects resulting from construction of Space Transportation System (STS) ground support systems at VAFB and Port Hueneme are insignificant to minor, sometimes infrequent, and generally transient and nonpersistent. Long term construction effects of a relatively minor consequence include the small amount of essentially permanent development that would occur in neighboring communities as a result of an influx of construction personnel and their families, and the irretrievable loss of fuels used in this development as well as in the construction of STS ground support facilities. Removal of the pier and lifeboat facility at the Point Arguello Boathouse can be construed as imparting a long term adverse effect in that the potential for nomination of this 1934 facility component--one of few remaining on the California coastline--for historic registration in the distant future would be precluded. Relocation of this structure to a location somewhat east of its present position may obviate this effect. The only other long term adverse environmental effect that could occur would be the irrevocable destruction of small portions of known archaeological sites along the tow route. Mitigative measures such as archaeological data recovery and close construction monitoring by a qualified archaeologist will greatly minimize the adversity of this impact.

Pursuant to the actions of construction will be the use of man's environment as is necessary to carry out ground operations and attendant launches. For the most part, short term effects will be insignificant to minor, transient, and generally nonpersistent. Exceptions to this would be the moderate to significant

short term changes in ambient noise and air quality conditions resulting from either Shuttle rocket engine activation or ascent/descent maneuvering, or both. Additionally, low probability short term events such as spills, fires, or explosions could, if not controlled, impart impacts of consequential importance. These events and the aforementioned launch and/or descent noise and/or air quality changes are of concern in view of the potential for longer term effects to the special interest flora and endangered fauna. All other long term effects (such as land commitments and irrevocable energy and material use) are considered compatible with current plans for prosperity.

One desirable long term effect of the Space Shuttle program is that it will facilitate the maintenance of current employment and economic support levels in Santa Barbara County and, to a lesser extent, other contiguous county areas. Another is that the program will greatly reduce the cost of space exploration and, at the same time, help expand the use of space for the protection and betterment of mankind. Typical users of the Space Shuttle will likely include federal and state agencies, county and city planners, public utilities, communications networks, observatories, research foundations, universities, resource planners, and manufacturing and transportation industries. Launch payloads will provide practical data that will beneficially impact the daily lives and long term future of mankind.

9.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The major commitments during construction include the use of material and other resources such as wood, cement, aggregate, plastics, steel, aluminum, other metals, petroleum products, electric energy, natural gas, and human resources. The resources, except for recyclable items, will be irretrievably lost. The land that will be occupied by the Space Shuttle facilities at Vandenberg and Port Hueneme could be returned to open space uses if buildings, roads, launch pad facilities, and other structures were removed and the land revegetated. Alternatively, the facilities could be modified for use in other programs subsequent to Space Shuttle program termination. Hence, it cannot be said that the commitment of land to the Space Shuttle project is absolutely irreversible. Some irretrievable loss of archaeological materials will also occur from construction. Even if salvage operations are undertaken, some percentage of each impacted site will be irreversibly and irretrievably lost.

The major commitments of resources during operations include nonrecyclable materials in Shuttle components (such as ETs), petroleum based fuels and paints, solid and liquid rocket propellant, and human resources. Certain exotic, unique, or particularly valuable materials or other resources (such as gold, platinum, and special ceramics and cements) will be expended and irretrievably lost during the fabrication of special application components of the Shuttle Vehicle or expended during launch operations. However, one goal of the program is to reduce the loss of these resources through their reuse wherever possible.

Most of the materials and resources that would be committed for the Space Shuttle are not in short supply. Construction materials such as wood, cement, asphalt, aggregate, paint, fuel, and structural steel are readily available from suppliers in the region; their use for the project would not limit other unrelated construction activities in the region. Rocket propellants are manufactured from abundant chemicals.

The use of human resources for construction and operation of the Space Shuttle project is considered an irretrievable loss only in the sense that

it will preclude the personnel from engaging in other work activities. This is discussed in detail in Section 5.2.

Construction of the facilities will remove vegetation/habitat and associated fauna in the construction zones. The area that will be affected amounts to less than 1 percent of the land area of VAFB, and although it could be restored to its native condition following the useful life of the project, this would be highly unlikely.

Operations may cause the localized removal of certain flora or fauna. However, the permanency of this effect cannot be determined at this time. An environmental monitoring program required under Air Force Regulation 19-7 will be implemented, as planned. This program will identify the beginnings of any significant and potentially irreversible losses of environmental resources in the study area, should any occur during construction or operations. Such timely warning will permit the implementation of corrective/mitigative actions. In effect, this program will provide an additional check on irreversible loss or damage to environmental resources.

Some growth of local communities with related conversion of agricultural land to urban uses will result from the project, although this extent of change cannot be accurately determined from planning efforts to date. Such changes will be irreversible for all practical purposes. Even under the worst case growth analysis presented in this report, the expected growth attributable to the proposed action is but a fraction of the growth expected without the project.

10.0 CONSIDERATIONS THAT OFFSET THE ADVERSE ENVIRONMENTAL EFFECTS

The potential benefits of the Space Shuttle program development at Vandenberg are local, regional, and national in scope. At the local level, communities surrounding Vandenberg will experience economic stimulation from increased demands on goods and services and from increases in the tax base. Employment and population growth are expressed goals of the Lompoc area, and the proposed project will induce such growth. Further, implementation of the proposed project would arrest and reverse adverse consequences to local economies that a gradually declining work force at Vandenberg might cause. Without the project, direct and indirect employment from operations at Vandenberg can be expected to remain constant or possibly decline unless expanded or additional programs replace those currently in effect.

Economic benefits and increased employment will also benefit the regional areas as discussed in Section 5.2. Although such effects will not be as visible as similar local benefits, they will still constitute considerations that significantly offset adverse impacts.

National and international benefits of the STS program are discussed in the July 1977 NASA Draft Environmental Statement for the Space Shuttle program. Briefly, these benefits are: (1) the improved management of the earth's environment and natural resources; (2) ability to launch and recover environmental and resource monitoring satellites expected to be operational during the 1980s for various users such as the National Oceanic and Atmospheric Administration and the Departments of Interior and Agriculture; (3) continuing research and development of improved systems by DOD, NASA, and the user agencies to provide a greater understanding of the processes that govern the weather, improved prediction of weather and especially weather hazards, monitoring and control of pollution, and an improved capability for inventory and management of the earth's resources on a national and even a global scale; and (4) increased productivity of the space systems themselves afforded by the Shuttle in recovering, maintaining, and reusing them.

Finally, STS activities at Vandenberg are critical to the satisfaction of overall program goals. Because the types of missions that can be flown from the Vandenberg AFB are different and complementary to those planned for STS operations at the Kennedy Space Center, operations from both facilities will be required to satisfy these goals. National and international benefits that will be derived from the program will necessarily be a result of activities at Vandenberg.

11.0 ENERGY CONSERVATION

11.1 ENERGY CONSERVATION REQUIREMENTS

An amendment to the California Environmental Quality Act (CEQA) requires a discussion of energy conservation measures in all California Environmental Impact Reports. The California State Energy Resources Conservation and Development Commission has developed energy conservation standards for design and construction of nonresidential buildings (such as the Space Shuttle ground facilities). The Energy Commission also is developing guidelines for EIRs that apparently emphasize energy conservation measures for the project rather than energy impacts on the environment.

Although the Space Shuttle program is a federally funded project on federal lands and, therefore, exempt from these California environmental requirements, the Department of Defense policy is to comply to the utmost with state and local environmental regulations. Air Force policy requires that every consideration be given to energy conservation in design and operation of Air Force facilities. Therefore, the energy systems and programs used throughout the project will be based on the most feasible, economic conservation measures, using onbase facilities to balance public utility systems. This section is limited to a discussion of energy consumption and conservation at Vandenberg, in keeping with the Energy Commission's guidelines for EIRs.

11.2 ENERGY SUPPLY AND DEMAND

11.2.1 ELECTRICAL ENERGY

Pacific Gas and Electric Company (PG&E) currently provides electrical service to Vandenberg through two 69-KV transmission lines from the Orcutt Divide substation, which has an estimated peak load of 95,000 KW (July 1976). Its capacity is 160,000 KW. Power to the substation is provided mainly by PG&E's Morro Bay power plant, a fuel-burning facility with a 990-MW capacity. In addition, transmission lines connect the Divide substation with other sub-

stations supplied by other area power plants, and this interlocking system ensures that outages at the Morro Bay facility should have little or no effect on Vandenberg's electrical supply.

Of the six power plants on Vandenberg used to supply electrical service to the Base, two probably will be used to support the proposed Space Shuttle program. Power Plant No. 1, on North Base, is a 4.16-KV plant consisting of six 1,000-KW diesel generators. The planned installation of two additional 1,000-KW diesel generators and a new transformer will provide electrical service to the airfield facilities. The new transformer will be connected to a new switching station (12.47 KV) at the airfield, and transmission lines will be connected from the commercially supplied substation nearby. The diesel power would be supplied in parallel with the commercial power and would be the primary power source during critical operations. Commercial power would be used as a backup source.

The second facility, Power Plant No. 6, supplying power to the Space Launch Complex No. 6 area, is a 2.4-KV plant consisting of four 1,000-KW diesel-driven generators. This power plant will be used as backup to the commercial power substation in the area. In addition, a redundant power source will be provided by connecting the second set of PG&E's 69-KV transmission lines to the substation.

Southern California Edison Company will supply power for the Solid Rocket Booster support facilities at Port Hueneme using existing 4.16 KV transmission lines on the U.S. Naval Construction Battalion Base.

Although the electrical energy demand required during construction is not known, operational demand of the proposed Space Shuttle facilities is summarized in Table 11.2-1. The total demand of 5,950 KW at Vandenberg represents 9 percent of the unused, available commercial power from the Orcutt Divide substation. Use of Power Plants No. 1 and 6 could lessen the actual power demand.

Table 11.2-1. ELECTRICAL ENERGY SUPPLY AND DEMAND FOR THE SPACE SHUTTLE PROGRAM

Electrical energy supply			
Commercial electrical power available at Orcutt Divide substation			160,000 KW
Current peak load at Orcutt Divide substation			95,000 KW
Excess capacity at Orcutt Divide substation			65,000 KW
Electrical energy demand - Vandenberg Air Force Base			
Mate/Demate Facility		200 KW	
Orbiter Maintenance and Checkout Facility		500 KW	
Safing and Deservicing Facility		350 KW	
Hypergolic Service Facility		350 KW	
Launch Pad No. 1		2,500 KW	
Launch Control Center		500 KW	
SRB Receiving and Subassembly Building and Storage Facility		300 KW	
Tank Checkout and Storage Facility		250 KW	
Parachute Refurbishment Facility*		250 KW	
Titan III SRM Receiving, Inspection and Storage Facility	Subtotal	250 KW 5,450	
Electrical energy demand - Fort Hueneme			
SRB Wash Facility		250 KW	
SRB Disassembly Facility		250 KW	
	Total	5,950 KW	

*Existing Facility, Adequate Power Currently Available (60)
Reference: McDonnell Douglas Astronautics Company, 1976.

11.2.2 NATURAL GAS

Southern California Gas Company's supplies of natural gas to Vandenberg and the Naval Construction Battalion at Port Hueneme are limited as a result of natural gas shortages at all levels. Future natural gas supplies are unpredictable and will depend on proposals that include liquefied natural gas delivery from Indonesian or Alaskan reserves and gas production by coal conversion methods. The Federal Power Commission largely controls natural gas availability through its allocation to Southern California's suppliers.

The gas company supplies all firm users and some small interruptible users. Currently, curtailments for interruptible users are less than 1 week per year; however, curtailments may increase significantly in subsequent heating seasons. Representatives of the gas company estimate that limited curtailment of firm users is possible by 1978 unless additional natural gas supplies become available.

Southern California Gas supplies natural gas to North Vandenberg airfield through a 3-inch supply line. If available, gas could be used for general heating at the Orbiter Maintenance and Checkout Facility, the Hypergolic Service Facility, and the Safing and Deservicing Facility. Special gas requirements at the Maintenance and Checkout Facility include the thermal protection system repair area and air conditioning for special equipment.

The Space Launch Complex No. 6 area is remote from the North Vandenberg gas distribution system and, thus, relies on a self-contained low-pressure gas system. Two liquid propane gas (LPG) tanks (5,500 gallons and 1,000 gallons) currently service the site. Tank capacity will be increased if necessary to support the Solid Rocket Booster Receiving and Subassembly and the Disassembly Facilities areas. Diesel fuel, the only propellant allowed in this area, will be delivered by tank truck.

At Port Hueneme, the Southern California Gas Company will provide gas used for heating water at the Solid Rocket Booster Wash Facility through distribution lines servicing the Base.

Gas volume required to support ground facilities has not been determined; however, the possibility of using Total Energy (power generation supplied at the site) or Selective Energy Systems (power generation supplied both at the site and from a public utility system) to reduce or eliminate the need for natural gas is being studied.

11.2.3 PETROLEUM PRODUCTS

Gasoline and diesel fuel volumes required for facilities construction and operation have not been studied. However, the Air Force intends to use diesel fuel as the primary petroleum product for Space Shuttle ground operations at Vandenberg, and it will be the only fuel allowed in the area of Space Launch Complex No. 6.

11.3 POTENTIAL MITIGATION MEASURES TO REDUCE ENERGY CONSUMPTION

The Space Shuttle program will require significant amounts of energy during facilities construction and operation. The Space and Missile Systems Organization plans to promote an active program of energy conservation through careful attention to design, specifications, and operations.

11.3.1 CONSTRUCTION

Based on the requirements in the Air Force Design Manual for Facility Design and Construction (AF Manual 88-15), the following concepts will be explored.

11.3.1.1 Architectural and Civil Engineering Design

(1) Use topography and geologic features to optimize cuts and fills and minimize earth transport and rock removal requirements.

(2) Use prefabrication and modular construction.

(3) Use materials and methods of construction to provide walls, roofs, and floor slabs with "U" factors that meet Air Force standards for Vandenberg and, as much as possible, California nonresidential building standards.

(4) Preplan material movement to minimize power use.

(5) Select materials based on energy conservation considerations, functional requirements, fire safety, and construction and maintenance costs.

(6) Plan window use and orientation carefully.

(7) Use double-pane insulating glass for windows and entryways in air conditioned buildings.

(8) Fully weatherstrip doors and operable windows.

(9) Install reflective and double draperies for all public spaces.

11.3.1.2 Plumbing, Heating, Ventilation, and Air Conditioning Design

(1) Use comfort and ventilation systems designed to minimize space conditions and conserve energy.

(2) Provide automatic setback of heating during off-hour and unoccupied periods whenever enconomical.

(3) Use insulation on ducts, piping, and equipment to reduce energy exchange with ambient air.

(4) Design systems with equipment (such as charcoal and other filter units) that minimizes fresh air use and optimizes air recirculation--considering energy conservation, economic feasibility, and acceptable ventilation rates.

(5) Establish periods and capabilities of up to 100-percent recirculation and low heat output during off-hour periods.

(6) Reclaim heat using waste-water heat collectors.

(7) Size ducts and grilles to provide economic energy use.

(8) Use radiant heaters, including portable units, for task area heating.

(9) Use heat generated by lighting.

(10) Control hot water use and temperature to save energy while providing reasonable comfort levels and meeting health standards.

(11) Provide automatic combustion control of heaters and boilers.

(12) Emphasize selecting energy-efficient, durable equipment.

(13) Use automatic exhaust fans where feasible.

(14) Use humidity or enthalpy control to conserve energy.

(15) Maintain domestic water temperatures and flow rates at optimum levels commensurate with health requirements.

(16) Design low-water-use type plumbing fixtures.

(17) Provide for future installation of readily available improved energy conserving systems and devices.

11.3.1.3 Electrical Design

(1) Use efficient lighting fixtures and sources.

(2) Adjust design lighting levels to the task, avoiding over-illumination.

(3) Use automatic lighting control in appropriate areas.

(4) Use low lighting fixtures in high ceiling areas.

(5) Use minimum cosmetic lighting.

(6) Use minimum, safe, outdoor lighting levels.

(7) Use the most efficient electric motors.

11.3.2 OPERATIONS

The following elements will be used or considered in the energy conservation plan:

(1) Onsite fire protection, including fire line, hydrants, hoses and extinguishers, alarm systems, and fire equipment and personnel.

(2) Onsite first aid facilities.

(3) Personnel work periods scheduled to reduce traffic congestion.

(4) Encouraged bus and car pool travel.

(5) The most energy-efficient modes of transport (rail and marine) for boosters, fuel tanks, and other expendable material.

(6) A continued energy conservation program promoted through:

a. Reducing heating levels when buildings are not in use.

b. Using outside air whenever temperatures permit.

c. Heating water during off-peak periods.

d. Charging batteries during off-peak periods.

e. Purchasing new or replacement equipment based on energy efficiency, operational economy, and pollution constraints.

f. Turning off lights and equipment when not in use.

g. Monitoring and controlling lighting, heating, and humidity consistent with comfort and energy conservation.

h. Recycling waste as fuel whenever feasible.

i. Installing automatic closers on exterior doors.

11.3.3 MAINTENANCE

The following will be used on a maintenance program to reduce energy consumption:

(1) Maintain and lubricate motor driven equipment properly.

(2) Frequently clean and replace air filters.

(3) Maintain heating, air conditioning, mechanical, and automotive equipment properly.

(4) Frequently clean heat transfer surfaces and fluorescent light fixtures.

(5) Frequently clean refrigerant condensers, coils, etc.

(6) Check for heat leaks.

(7) Periodically survey and balance plant loads.

11.3.4 OTHER ENERGY CONSERVATION MEASURES

Major energy saving during construction will be stressed to contractors, construction workers, and supervisors. The Air Force is committed to energy conservation but recognizes that strong leadership will be required to bring about voluntary acceptance of such measures. A program to accomplish this would include the following aspects:

(1) Encourage car pooling, small cars, and adherence to speed limits for personal transportation, delivery trucks, and other vehicles.

(2) Promote good energy practices onsite, including shutting down equipment not in use, turning off lights, and accepting lower light and heat levels in offices and winter work areas.

(3) Coordinate delivery schedules to minimize energy consumption.

(4) Use rail and marine transport for delivering major construction materials.

(5) Schedule personnel work periods to minimize traffic congestion.

(6) Implement efficient, economic systems and equipment.

(7) Organize construction activities to minimize onsite movement of materials, supplies, equipment, and personnel.

(8) Provide materials storage to minimize rehandling and transportation.

12.0 DETAILS OF UNRESOLVED ISSUES

One currently significant unresolved issue relates to General Accounting Office's (GAO) suggestion that Congress consider delaying funding authority; (1) until the benefits of the STS program can be more fully substantiated, (2) as a potential cost saving measure to eliminate concurrent development and production, and (3) to provide an increased opportunity to better define space transportation requirements during the 1980s.

A full discussion of the advantages and disadvantages of delayed funding is beyond the scope of this report. However, delayed funding could influence the scheduled timing of construction and operation of the proposed project. This could alter associated impacts. For example, rescheduled construction might require an increase in the peak labor force. Duration of certain impacts probably would be reduced, but the intensity of effects could increase. It is not possible at this time to actually assess the potential changes to impacts described in this report that might result from program delays.

There are other issues not precisely resolved at this time that are related to implementation of the project. The Space Shuttle project is an advanced state-of-the-art program which will utilize new materials, innovative processes, and sophisticated support equipment. Extensive planning studies and testing have led to the current well-defined project description for STS ground support facilities and activities at Vandenberg. However, further studies and planning are continuing as necessary to finalize facility and subsystem details prior to actual design and manufacture. Additional information will be generated during these ongoing efforts, although it is unlikely that such information would significantly alter the conclusions presented in this report.

As a state-of-the-art project, the Space Shuttle program is necessarily unique and will have unique environmental issues associated with it, such as the effects of the rocket exhaust ground cloud and the effects of sonic boom overpressures produced during Orbiter ascent and reentry into the atmosphere. By and large, an assessment of these impacts has been determined using analytical

tools and up-to-date information of a relative or comparative nature. In some instances, worst-case assumptions were used to describe and evaluate environmental consequences. At worst, this leads to a conservative overstatement of impacts, particularly with respect to those of questionable occurrence or definition.

For example, the potential for meteorological alterations associated with nucleating agents (Al_2O_3 particles) entrained within solid rocket motor exhaust clouds remains largely unknown. Weather modification may or may not occur at Vandenberg AFB in the form of either enhanced or suppressed precipitation. Studies conducted by the National Oceanographic and Atmospheric Administration (NOAA) and NASA are expected to help reveal the potential for inadvertent weather modification from launches at VAFB under various meteorological conditions. At present, however, this still remains an unresolved issue.

Sonic boom impacts associated with sound focusing events--the specifics of which are presently imprecisely defined, is another open issue. Nevertheless, studies are currently underway to examine the possibility of altering either the launch inclination and/or azimuth angles which create sonic boom overpressures on the Channel Islands. Because each launch will have unique payload and trajectory requirements, it is not possible to precisely define all such parameters at the present time. Specific details incorporating alterations to proposed launch trajectories which would affect sound focusing and the sonic boom footprint over the Channel Islands must await final flight plan preparations.

Additional information from ongoing studies and from actual launches of Shuttle vehicles at the Kennedy Space Center, scheduled to commence in 1979, may provide a basis for further analysis of impacts at Vandenberg. Any information that would significantly affect conclusions in this report would be presented and analyzed in supplements to this document.

13.0 CONSULTATION AND COORDINATION WITH OTHERS

The data upon which the foregoing report is based were gathered from many sources. A large proportion of the data was gathered directly or indirectly through contacts with persons who are familiar with specific aspects of the proposed project, the project region, or the potential interactions between project elements and environmental attributes. Some key personal communications are referenced along with the printed data sources in Section 14, Bibliographic References. The informative contacts that were made with many persons in various federal, state, local, public, and private agencies were too numerous to reference, therefore, only a listing of the agencies is presented below.

FEDERAL PUBLIC AGENCIES

Advisory Council on Historic Preservation

Federal Correctional Institution at Lompoc

National Aeronautics and Space Administration

- Lyndon B. Johnson Space Center, Texas
- John F. Kennedy Space Center, Florida
- Langley Research Center, Hampton, Virginia
- George C. Marshall Space Flight Center, Alabama

U.S. Air Force, Space and Missile Systems Organization

U.S. Air Force, Vandenberg Air Force Base Real Estate Office

U.S. Army Corps of Engineers, Los Angeles District, California

U.S. Army Corps of Engineers, Coastal Engineering Research Center, Washington, D.C.

U.S. Department of Agriculture

- Soil Conservation Service, Davis, California
- Soil Conservation Service, Santa Barbara, California

U.S. Department of Commerce, National Oceanic and Atmospheric Administration

- National Ocean Survey, Washington, D.C.
- National Marine Fisheries Service, Southwest Region, Terminal Island, California

U.S. Department of the Interior

- Bureau of Reclamation, Planning Division, Sacramento, California
- Geological Survey, Laguna Niguel, California
- National Park Service, Western Region, Interagency Archaeological Services
- U.S. Fish and Wildlife Service, Region I

U.S. Department of Transportation, Federal Aviation Administration, Santa Barbara Airport

U.S. Environmental Protection Agency, Western Region

U.S. Navy, Port Hueneme Naval Base, California

STATE PUBLIC AGENCIES

California Coastal Commission

California Department of Fish and Game

California Department of Fish and Game, Long Beach, California

California Department of Fish and Game, Wildlife Conservation Board, Sacramento, California

California Department of Parks & Recreation, State Historic Preservation Office

State Office of Planning and Research, State Resources Agency.

California Polytechnic State University, Department of Anthropology, San Luis Obispo, California

University of California, Institute of Archaeology, Los Angeles, California

San Diego State University, Center for Regional Environmental Studies

State of California, Water Quality Control Board, Los Angeles Region

University of California Cooperative Agricultural Extension Service, Santa Barbara, California

University of California, Department of Anthropology, Riverside, California

University of California, Santa Barbara

Department of Anthropology Geography Remote Sensing Unit

State Lands Commission, Sacramento, California

LOCAL PUBLIC AGENCIES

Alan Hancock Junior College

Goleta Sanitary District

Goleta Union School District

Lompoc Community Development Department

Lompoc Department of Public Works

Lompoc Fire Department

Lompoc Hospital District

Lompoc Police Department

Lompoc Unified School District

Oxnard Planning Department

Port Hueneme Planning Department

Santa Barbara City College Department of Anthropology

Santa Barbara City Police Department

Santa Barbara County Assessor's Office

Santa Barbara County-Cities Area Planning Council

Santa Barbara County Department of Public Works

Santa Barbara County Department of Transportation

Santa Barbara County Local Agency Formation Commission

Santa Barbara County Office of Environmental Quality

Santa Barbara County Parks Department

Santa Barbara County Planning Department

Santa Barbara County School District

Santa Barbara County Sheriff's Office

Santa Barbara County Water Agency

Santa Maria Airport Manager's Office

Santa Maria Community Development Department

Santa Maria Department of Public Works

Santa Maria Fire Department

Santa Maria Hospital

Santa Maria Joint Union School District

Santa Maria Planning Department

Santa Maria Police Department

Solvang School District

PRIVATE AGENCIES

Aerospace Corporation, El Segundo, California

Archdiocese of California (Roman Catholic Church)

Association of Heat and Frost Installers and Asbestos Workers, Local 5

Bookman-Edmonston, Glendale, California

Brown & Caldwell, Pasadena, California

Cottage Hospital, Santa Barbara, California

General Telephone Company of California, Santa Maria-Lompoc, California

Goleta Valley Community Hospital, Goleta, California

International Association of Bridge, Structural, and Ornamental Ironworkers, Local 433

International Brotherhood of Boilermakers Local, Lodge 93

International Brotherhood of Electrical Workers, Local 413

International Brotherhood of Painters and Allied Trades, Local 715

International Union of Operating Engineers, Local 12

Laborers International of North America, Local 1222

Loudenclos Mobile Homes, Santa Maria-Orcutt, California

McDonnel Douglas Astronautics Company

Marian Hospital, Santa Maria, California

Millwrights and Machine Erectors, Local 1607

Operative Plaster and Cement Masons, Local 341

Pacific Gas and Electric Company, Santa Maria-Lompoc, California

Pinecrest Hospital, Santa Barbara, California

Ruth, Clarence, local expert on Indian historical resources (deceased)

Saint Francis Hospital, Santa Barbara, California

Santa Barbara Botanic Garden

Santa Barbara Museum of Natural History

Smithsonian Institution, Washington, D.C.

Southern California Edison Company, Santa Maria-Lompoc, California

Southern California Gas Company, Santa Maria-Lompoc, California

Southern Pacific Transportation Company

Spanne, L.W., local archaeologist, Lompoc, California

Stearns-Roger, Inc., Los Angeles, California

United Brotherhood of Carpenters and Joiners of America, Local 1062

Valley Community Hospital, Santa Maria, California

Candelaria American Indian Council, Oxnard, California

Quabajai Chumash Association, Santa Barbara, California

Santa Ynez Reservation, Santa Ynez, California

Central Coast Indian Council, Paso Robles, California

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15.0 GLOSSARY OF SELECTED TERMS

abort - the premature termination of an action, procedure, or mission relating to a spacecraft or rocket.

abort-once-around - an abort in which, shortly after launch, the Orbiter fails to achieve required trajectory or velocity and, without attaining orbit, jettisons SRBs and ET, completes one circumnavigation of the earth, and lands at the launch point associated airfield.

accretion - the gradual buildup of land over a long period of time by the action of the forces of nature, such as by deposition of water or airborne material on a beach, or by reason of an act of man, such as the accretion formed by a breakwater or beach fill deposited by mechanical means.

adaptation - a human being's or a social group's ability to exist or coexist in a given environment (physical and social); an organism's adjustment to a given set of environmental conditions.

agglomerate - rock containing a predominance of rounded or subangular fragments greater than 32 mm in diameter.

alluvial deposit - sediment (sand, silt, or detrital material) deposited in place by the action of streams.

alveolar - pertaining to alveoli, the small sac-like chambers in the lungs in which the majority of gas exchange takes place.

ambient - surrounding on all sides; an encompassing atmosphere; environment.

anticline - a convex upward fold in the earth's crust.

anticlinorium - a series of anticlines and synclines so arranged structurally that together they form a general arch or anticline.

anticyclone - an atmospheric anticyclonic circulation. A closed circulation (clockwise in the Northern Hemisphere). With respect to the direction of its rotation, it is the opposite of a cyclone. Because anticyclonic circulation and relative high atmospheric pressure usually coexist, the terms anticyclone and high are used interchangeably in common practice.

aquifer - that stratum or zone below the surface which will yield water.

artifact - an archaeological find which exhibits any physical attributes that can be assumed to be the result of human activity.

assemblage - in archaeology, all of the industries present at one site.

attitude - the position of an aircraft or spacecraft determined by the relationship between its axes and a reference datum (as the horizon or a particular star).

authigenic - generated on the spot. A term applied to growth in place of occurrence.

azimuth - horizontal direction expressed as the angular distance between the direction of a fixed point and the direction of the object; an arc of the horizon measured between a fixed point and the vertical circle passing through the center of an object, usually in astronomy and navigation clockwise from the north point through 360 degrees.

backshore - that zone of the shore or beach that lies landward of the foreshore, and that is usually dry and only affected by wave action generated by severe storms.

basin - an area having certain common features throughout, particularly a tract where the strata dip from all sides toward the center.

bathymetry - the measurement of ocean depths and seafloor topography.

benthos - the group of organisms that constitute the aquatic bottom community.

bight - a bend, especially in a river or mountain chain; a bend in a coast forming an open bay; a bay formed by such a bend.

biota - animal and plant life of an ecosystem.

blank - in archaeology, a preform of stone or shell that will later be manufacured into a specific artifact type.

BOD - an abbreviation for biochemical oxygen demand which is the quantity of oxygen consumed in the biochemical oxidation of organic matter in a specific time, at at specified temperature, and under specified conditions.

cantonment - the quarters assigned to military personnel.

catchment - drainage basin.

climatology - the scientific study of climate; in addition to the presentation of climatic data it includes the analysis of the causes of differences of climate (Physical Climatology) and the application of climatic data to the solution of specific design or operational problems (Applied Climatology). Climatology may be further subdivided according to purpose or point of view: Microclimatology, Synoptic Climatology, and others.

COD - an abbreviation for chemical oxygen demand. This term is a measure of oxygen consuming capacity of organic and inorganic matter present in water or wastewater.

cohort - a group of individuals having a statistical factor (as age or class membership) in common in a demographic study.

coliform - a group of bacteria which includes all aerobic and faculative anaerobic gram-negative bacilli that ferment lactose with the production of gas.

connate water - water entrapped in the interstices of a sedimentary rock at the time the rock was deposited.

contour - a line connecting points of equal value, such as equal elevations on a topographic map or equal sound pressure levels on a sound intensity map.

conventional pollutants - phenols, phosphorous, nitrogen, iron, oil and grease, solids, and heavy metals other than mercury.

cryogenic - relating to very low temperatures.

cuspate - crescent shaped.

demography - the statistical study of human populations especially with reference to size and density, distribution, and vital statistics.

deployment - that time and function required for opening of the Orbiter doors, removing a payload from the bay, placing it in the near vicinity of the Orbiter, and detaching the payload from the Orbiter. In this definition, deployment is not completed until the Orbiter and payload are at a safe distance apart such that the payload is assured stable orbital conditions not to be further perturbed by Orbiter operations.

dissolved solids - theoretically, the anhydrous residues of the dissolved constituents in a water medium. Measured values generally include errors associated with the presence of nonfilterable residue (that is, suspended material that cannot be filtered from the water medium) and some retained water of crystallization and occlusion, the amount of which is dependent on the drying temperature.

drift - (1) the speed at which a current runs; (2) also, floating material deposited on a beach (driftwood); (3) sometimes used as an abbreviation of littoral drift.

ecosystem - an organic community and its physical environment.

embayment - an indentation in a shoreline forming an open bay; term describing a continental border area that has sagged concurrently with deposition so that an unusually thick section of sediment results.

eolian (aeolian) - pertaining to transport or deposit by the action of wind.

ephemeral stream - a stream or portion of a stream that flows only in direct response to precipitation. Its channel is at all times above the water table.

evapotranspiration - the combined processed by which water is transferred from the earth's surface to the atmosphere; evaporation of liquid or solid water plus transpiration from plants.

fecal coliform - the portion of the coliform bacterial group present in the feces of warmblooded animals that produces gas from lactose at 44.5°C.

flake - in archaeology, a stone chip produced when a stone or core is hit at the edge and the stone fractures along the edge of the ripple.

fluvial - of, or pertaining to rivers.

foreshore - that zone of the shore or beach lying landward of the shoreline which is usually wet and directly affected by all wave action.

formation - the primary unit in stratigraphy consisting of a succession of strata useful for mapping or description.

geomorphology - a branch of both physiography and geology that deals with the form of the earth, the general configuration of its surface, and the changes that take place in the evolution of land forms.

ground cloud - the rocket exhaust emitted during ignition/liftoff that coalesces into a cloud in the lower atmosphere (usually below 2 km).

habituate - to accustom or familarize; to frequent.

hammerstone - a rock used in battering or hammering.

hardiness (of water) - a physical-chemical characteristic attributable to the presence of alkaline earths (principally calcium and magnesium), expressed as equivalent calcium carbonate ($CaCO_3$).

haul out - the term used to refer to seals or sea lions leaving the ocean and ascending the shore.

headwater - uppermost area of a drainage basin; water here originates from springs, rainfall, and melting snow.

hertz (Hz) - frequency measured in cycles per second; 1 hertz = 1 cycle per second.

homocline - a group of inclined beds of the same dip; a structural condition in which the beds dip uniformly in one direction.

horizon - in archaeology, a cultural class which displays an extensive distribution in space and a restricted distribution in time.

hydrogeologic - pertaining to groundwater, with particular emphasis on its chemistry, mode of migration, and relation to the geologic environment.

hypergolic - igniting upon contact of components without external aid (as a spark); of, relating to, or using hypergolic fuel.

isopleth - a line on a map connecting points at which a given variable has a constant value; a line denoting equal quantity.

leeward - being in or facing the direction toward which the wind is blowing; also, being the side opposite the windward.

littoral drift - the bottom materials moved in the littoral zone under the influence of waves and current. Direction of movement or transport of littoral materials depends upon wind and wave direction.

living terrace - an occupation level of an archaeological site.

low water datum - an approximation to the plane of mean low water that has been adopted as a standard reference plane.

mano - in archaeology, a hand held grinding stone used in conjunction with a metate.

metate - a stone grinding slab.

meteorology - the study dealing with the phenomena of the atmosphere. This includes not only the physics, chemistry, and dynamics of the atmosphere, but is extended to include many of the direct effects of the atmosphere upon the earth's surface, the oceans, and life in general.

midden - in archaeology, a deposit of occupational debris, rubbish, or other byproducts of human activity.

milligrams per liter (mg/l) - a unit expressing the concentration of chemical constituents in solution. Milligrams of solute per liter of water equivalent to ppm in water quality.

morphology - the form and structure of an organism or any of its parts.

mortar - in archaeology, a bowl shaped grinding implement used for processing acorns and seed materials.

mudstone - a general classification pertaining to a deposit consisting of an indefinite proportion of clay, silt, and sand particles.

nodal zone - an area at which the predominant direction of the littoral transport changes.

ophiolite - a basic igneous rock associated with geosynclinal sediments, generally altered to rocks rich in serpentine, chlorite, epidote, and albite.

overpressure - pressure above what is usual or normal.

perennial - lasting throughout the whole year; persisting for several years.

permeability - the capacity of a material for transmitting a fluid; related to the porosity, particle size, and hydraulic conductivity of the material.

pestle - a hand-held grinding implement used with a mortar.

physiography - the study of the genesis and evolution of land forms.

piezometric surface - the pressure surface used in descriptions of confined aquifers.

plankton - drifting plants (phytoplankton) and animals (zooplankton), usually microscopic, floating or weakly swimming in the surface layers of a body of water.

ppm - parts per million, milligrams of constituent per kilogram of liquid medium.

rainout - the micrometeorological process by which aerosol droplets/particulates within a cloud enlarge and precipitate out of the cloud; also, the droplets/particulates that have fallen out of the cloud.

recharge - the process by which water is absorbed and is added to the zone of saturation, either directly into a formation, or indirectly by way of another formation.

rhyolite - the aphanitic equivalent of granite. (Aphanitic - pertaining to a texture of rocks in which the crystalline constituents are too small to be distinguished with the unaided eye.)

riparian - relating to the bank or edge of a watercourse or body of water.

ruderal - where the natural vegetation has been disturbed by man; weedy.

serpentine - metamorphic rockes of greenish, blackish, or grayish color formed by the alteration of earlier volcanic rocks.

settlement pattern - in archaeology, the distribution of sites within a region with respect to natural topography and resources.

sorbent - a substance that takes up and holds by either adsorption or absorption.

specific conductance - a measure of the ability of water to conduct an electrical current, expressed in micromhos per centimeter at 25°C, related to the number and specific chemical types of ions in solution, and used for approximating the dissolved-solids content in the water.

spoil - earth and rock excavated or dredged.

Standard Industrial Classification - a U.S. government code whereby an establishment may be classified by type of ownership and type of primary activity.

stemmed point - in archaeology, an arrowhead with a basal stem.

stratigraphy - the arrangement of strata; that branch of geology that deals with the origin, composition, distribution, and succession of strata.

stratosphere - an upper portion of the atmosphere that is above approximately 7 miles (depending on latitude, season, and weather) where the temperature changes little with changing altitude and clouds of water are rare.

structural province - a geographic area consisting of a characteristic or similar geologic structure.

substrate - any substance used as nutrient by a microorganism; the substances used by organisms in liquid suspension; the liquor in which activated sludge or other matter is kept in suspension.

syncline - a fold in rocks in which the strata dip inward from both sides toward the axis.

synergism - a word describing a situation when two or more compounds administered together produce an effect greater than the sum of the effects of each compound administered alone.

synoptic - affording a general view of a whole; relating to or displaying atmospheric or weather conditions as they exist simultaneously over a broad area.

system - in archaeology, a set of objections and their relationships between the objects and between their attributes.

tarring pebble - in archaeology, a small pebble used to coat the insides of baskets with tar so that the baskets will hold water.

taxon - a named group of organisms, that is, a species, genus, family, etc; plural: taxa.

troposphere - the portion of the atmosphere that is below the stratosphere in which generally temperature decreases rapidly with altitude, clouds form, and convection is active.

tsunami - an ocean wave produced by a submarine earthquake, landslide, or volcanic action; popularly called a tidal wave when it overflows the land.

washout - the micrometeorological process by which atmospheric gases/aerosols/particulates are absorbed and carried to the ground by an independent overriding rain; also, the atmospheric materials so removed.

watershed - the area contained within a drainage basin above a specified point on a stream.

16.0 LIST OF ACRONYMS AND ABBREVIATIONS

ACB	Air Cushioned Barge
ADCOM	Aerospace Defense Command
ADS	Aerospace Defense Squadron
ADT	Average Daily Traffic
AFAA	Air Force Audit Agency
AFCMD	Air Force Contract Management Division
AFCS	Air Force Communications Service
AFLC	Air Force Logistics Command
AFR	Air Force Regulations
AFSC	Air Force Systems Command
AICUZ	Air Installation Compatibility Use Zone
AOA	Abort Once Around
APC	Santa Barbara County-Cities Area Planning Council
APCD	Air Pollution Control District
ATC	Air Training Command
AUT	Access/Umbilical Tower
BEA	Bureau of Economic Analysis
BOD	Biochemical Oxygen Demand
CBD	Central Business District
CEQA	California Environmental Quality Act of 1970
CES	Candidate Environmental Statement
CNEL	Community Noise Equivalent Level
COD	Chemical Oxygen Demand
DE	Directorate of Civil Engineering
DES	Draft Environmental Statement
DIS	Defense Investigative Services
DMA	Defense Mapping Agency
DO	Dissolved Oxygen
DOD	Department of Defense
EBAS	Support Equipment Building and Air Conditioning Shelter
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EPP	Environmental Protection Plan
ERME	Environmental Resources Management Element
ET	External Tank
ETR	Eastern Test Range
EWO	Emergency War Order
1STRAD	First Strategic Aerospace Division
FES	Final Environmental Statement
FPC	Federal Power Commission
GAO	General Accounting Office
GATR	Ground Air Transmitter Receiver (Station)
GSA	Gas Storage Area
HSF	Hypergolic Servicing Facility
ICBM	Intercontinental Ballistic Missile
ILS	Instrument Landing System
IMF	Integration and Mating Facility
IOP	Integrate-on-Pad
IRBM	Intermediate Range Ballistic Missile
ITL	Integrate-Transfer-Launch
I-O	Input-Output
IUS	Interim Upper Stage
JSC	Lyndon B. Johnson Space Center
KSC	John F. Kennedy Space Center
LAFCO	Local Agency Formation Commission
LCC	Launch Control Center
L_{d-n}	Day-Night Average Noise Level
LEO	Littoral Environmental Observation
LNG	Liquefied Natural Gas
LP	Launch Pad
LPG	Liquid Propane Gas
LST	Landing Ship Tank
MAC	Military Airlift Command
MDF	Mate/Demate Facility
MLRA	Mobile Launch Refurbishment Area
MPT	Missile Procedures Trainer (environment)
MRAPCON	Mobile Radar Approach Control
MSBLS	Microwave Scanning Beam Landing System
MSFC	George C. Marshall Space Flight Center
MST	Mobile Service Tower
NAHB	National Association of Home Builders
NASA	National Aeronautics and Space Administration
NAVAIDS	Navigational Aids

NEPA	National Environmental Policy Act of 1969
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Survey
OASPL	Overall Sound Pressure Level
OMCF	Orbiter Maintenance and Checkout Facility
OPSB	Orbiter Processing Supply Building
PCR	Payload Changeout Room
PPR	Underground Payload Preparation Room
PRF	Parachute Refurbishment Facility
PSF	Propellant System Facility
PST	Pacific Standard Time
PTA	Potential Toxic Area
R&D	Research and Development
RMS	Root Mean Square
RPIE	Real Property Installed Equipment
RIMS	Regional Industrial Multiplier System
RTLS	Return to Launch Site
SAALC	San Antonio Air Logistics Center
SAC	Strategic Air Command
SACMET	SAC Management Engineering Squadron
SAMSO	Space and Missile Systems Organization
SAMTEC	Space and Missile Test Center
SDAF	Solid Rocket Booster Disassembly Facility
SDB	Shallow Draft Barge
SDF	Safing and Deservicing Facility
SIC	Standard Industrial Classification
SIOH	Supervisory, Inspection, and Overhead
SIWF	Solid Rocket Booster Initial Wash Facility
SLC	Space Launch Complex
SPL	Sound Pressure Level
SRB	Solid Rocket Booster
SRM	Solid Rocket Motor
SRSF	Solid Rocket Booster Refurbishment and Subassembly Facility
SSF	Solid Rocket Booster Storage Facility
SSMO	Summary of Synoptic Meteorological Observations
SSV	Space Shuttle Vehicle
STC	Satellite Test Center
STPL	Short Term Public Limits
STS	Space Transportation System
TACAN	Tactical Air Navigation
TDS	Total Dissolved Solids
TDY	Temporary Duty
TMCF	Tank Maintenance and Checkout Facility
TNT	Trinitrotoluene
TPS	Thermal Protection System
TSCF	Tank Storage and Checkout Facility
TTI	Tetra Tech, Inc.
TVC	Thrust Vector Control
TVOR	Terminal VHF Omnidirectional Range
UHF	Ultra High Frequency
USNMC	U.S. Naval Missile Center
USPS	U.S. Postal Service
VAFB	Vandenberg Air Force Base
VHF	Very High Frequency
WTR	Western Test Range

COMMENTS AND RESPONSES

The following are public comments which resulted from issuance of the Draft EIS. The public hearing for the Draft EIS was held on 28 September 1977. Text of the public hearing is included. Written comments were sent to Headquarters USAF or Space and Missile Systems Organization/DEV in letter form. Component comments in the hearing transcript and in each letter have been identified with a reference number to the left of the paragraph in which the comment appears. Air Force's responses to the comments follow each item and are identified by the reference number.

Comments Received Relative to the Draft EIS

APPENDIX		PAGE
A	Transcript of Public Hearing on Space Shuttle Program at Vandenberg Air Force Base held at Lompoc, California, 28 September 1977	A-1 through A-63
B	Comments from Department of the Army, Los Angeles District Corps of Engineers (in letter dated 6 October 1977)	B-1 through B-2
C	Comments from Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Serivce, Terminal Island, California (in letter dated 23 September 1977)	C-1 through C-9
D	Comments from Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Marine Mammal Division (in letter dated 4 October 1977)	D-1 through D-3
E	Comments from Department of Commerce, The Assistant Secretary for Science and Technology (in letter dated 21 October 1977) and National Oceanic and Atmospheric Administraiton, National Ocean Survey (in letter dated 13 October 1977)	E-1 through E-4
F	Comments from Department of Health, Education and Welfare, Office of the Secretary (in letter dated 7 October 1977)	F-1 through F-3

APPENDIX		PAGE
G	Comments from Department of the Interior, Office of the Secretary (in letters dated 13 September 1977 and 8 November 1977)	G-1 through G-13
H	Comments from Department of the Navy, Office of the Assistant Secretary (Manpower, Reserve Affairs and Logistics) (in letter dated 12 October 1977)	H-1 through H-2
I	Comments from Department of Transportation, Federal Aviation Administration (in letter dated 6 October 1977)	I-1 through I-2
J	Comments from Department of Transportation, United States Coast Guard (in letter dated 7 November 1977)	J-1 through J-7
K	Comments from Environmental Protection Agency	K-1
L	Comments from Marine Mammal Commission (in letter dated 6 October 1977)	L-1 through L-4
M	Comments from National Aeronautics and Space Administration, Office of Policy Analysis (in letter dated 1 November 1977)	M-1 through M-4
N	Comments from California Coastal Commission (in letter dated 2 November 1977)	N-1 through N-5
O	Comments from California Coastal Commission, South Central Coast Regional Commission (in letters dated 11 October 1977 and 1 November 1977)	O-1 through O-6
P	Comments from University of California, Irvine, Department of Ecology and Evolutionary Biology, School of Biological Sciences (in letter dated 3 October 1977)	P-1 through P-6
Q	Comments from County of Santa Barbara, Office of Environmental Quality (in letter dated 23 September 1977) and Board of Supervisors (in letter dated 20 October 1977)	Q-1 through Q-30
R	Comments from County of Santa Barbara, Department of Planning (in letter dated 30 September 1977)	R-1 through R-4

APPENDIX		PAGE
S	Comments from Santa Barbara County-Cities Area Planning Council (in letter dated 7 October 1977)	S-1 through S-4
T	Comments from Advisory Council on Historic Preservation (in letter dated 14 September 1977)	T-1 through T-2
U	Comments from The American Cetacean Society, National Headquarters (in letter dated 30 September 1977)	U-1 through U-2
V	Comments from California Wildlife Trust (in letter dated 5 October 1977)	V-1 through V-2
W	Comments from Lompoc Valley Economic Development Association (in letters dated 30 September 1977 and 7 October 1977)	W-1 through W-4
X	Comments from Mr. John E. Eastin (in letter dated 29 September 1977)	X-1 through X-3
Y	Comments from The Resources Agency of California (in letter dated 5 December 1977)	Y-1 through Y-9

APPENDIX A

TRANSCRIPT OF PUBLIC HEARING

- Draft Environmental Impact Statement -

-- Space Shuttle Program, Vandenberg Air Force Base, California --

PUBLIC HEARING

DRAFT ENVIRONMENTAL IMPACT STATEMENT

SPACE SHUTTLE PROGRAM

VANDENBERG AIR FORCE BASE, CALIFORNIA

DATE:	28 September 1977
TIME:	1900 HOURS (7:00 P.M.)
PLACE:	Lompoc Civic Auditorium 217 South L Street Lompoc, California

PRESIDING OFFICER

Colonel Allen C. Smith
Chief Circuit Judge
5th Judiciary Circuit
USAF Trial Judge
Travis AFB, CA

PROJECT OFFICER

Lt Colonel Earl H. Jones, Jr.
STS Environmental Project Manager
Department of the Air Force
Space and Missile Systems Organization (AFSC/DE)
Los Angeles, CA

TRANSCRIPT OF PUBLIC HEARING* ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE PROPOSED SPACE SHUTTLE PROGRAM AT VANDENBERG AIR FORCE BASE, CALIFORNIA

COLONEL ALLEN C. SMITH--Presiding Officer

First, I'd like to welcome you to this hearing. I'm Colonel Allen C. Smith, a military judge assigned to the 5th USAF Judicial District. I'm located at Travis Air Force Base, California. I've been assigned the duty of conducting this hearing here tonight on the draft environmental impact statement on the proposed Space Shuttle System at Vandenberg Air Force Base, California.

Now, the proposed action comprises construction, activation, and operation of Space Shuttle facilities at Vandenberg Air Force Base and Port Hueneme, California.

My role in connection with this hearing is simply to conduct the hearing. I have no knowledge whatever concerning the nature of the project or any of its details. We do, however, have people here tonight who have such knowledge. I have not participated in the development of the project nor given legal advice concerning it, and I will not be making any recommendations or decisions on the project. So I am simply here to conduct the hearing.

Now, the purposes of this hearing are twofold. The first is to provide you with the opportunity to present your views to the Secretary of the Air Force on the environmental impact the proposed project would have on your community. The second is to provide the Air Force with an opportunity to present information on the project to you and to try and answer any questions you may have regarding the project.

This hearing is being recorded verbatim by Mrs. Patricia Gonzalez, a qualified court reporter, and the verbatim transcript of the hearing will be forwarded to the Office of the Secretary of the Air Force for use in the decision making process. Additionally, we have a tape recorder taking down everything that is said, as a backup system.

At this time, I'd like to introduce or point out to you Lt. Colonel Earl Jones, who is the Environmental Project Officer for the Space Shuttle Program. Colonel Jones is right over here to my left. Colonel Jones will coordinate the presentations to be made by several officers connected with the project and those presentations will take approximately one hour. He will introduce the other members of the team that make the presentation to you as they step up to the podium.

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*The hearing convened at 1900 hours (7:00 P.M.) on 28 September 1977 and adjourned later that evening at 2158 hours (9:58 P.M.).

Our agenda or plan of action this evening is as follows. First we will have the presentation by Colonel Jones and the other members of his team. Second we will have statements and comments from any individual or representative of a group that desires to make such a statement. Third, we will open the floor for questions. Colonel Jones, the members of his team, and other experts that they have here will attempt to answer any and all questions that you have.

As far as the ground rules regarding the statements, at the time you entered out there, there was a gentleman passing out cards to those of you that desired them. Anyone who desires to make an oral statement should take one of those cards, write their name, address, group affiliation or any other information that is significant on the card, present it to the people picking up or passing out the cards, who also will pick them up out there, and they will present them to me. I will call the names of persons desiring to make a statement in the order that I receive the cards. At the present time I have the name of only one person that desires to make a statement, so apparently there aren't too many who have signed up so far. But in the event that you do desire to make such a statement, please fill out one of the cards, give it back to the person that gave it to you, and it will get to me. As far as time limitations, for representatives of groups we will allow ten minutes; for individuals not representing a particular group or organization we will allow five minutes. With respect to written materials, if you desire to make a statement or present information or data to be included in the hearing transcript and you have it present this evening, present it to me and I will have it marked as an exhibit. It will be attached to the transcript of the proceedings. In the event that you desire to make a statement or present information or data concerning the environmental impact of the proposed project on your community and you do not have it prepared tonight, there are two courses of action open to you. The first is that you may send it to the following address, SAMSO/DEV, Post Office Box 90009, Los Angeles, California. The zip code is 92960.* Any statements sent to that address should be received by next Monday, 3 October 1977. Additionally, you have until 10 October 1977 to submit any written materials to that address to be considered in connection with the transcript of the hearing.

As to questions (the third part of the program this evening) from the floor, we have people who will be carrying portable microphones or handcarried microphones throughout the audience. At that time we will have Colonel Jones and the members of his team present on the stage here and people will be walking through. If you could simply stand, identify yourself, name, address, group affiliation, or any other information that you feel is significant and understanding the nature of your question, etc., and then give us your question through the microphone, and Colonel Jones and his people will answer any and all questions.

I have no other introductory or beginning remarks here. At this time, I'd like to turn the hearing over to Colonel Jones. We will start off with

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*This address is incorrect. Note corrections on page A-23.

presentations from the members of the Air Force team. Once again, we welcome you. Colonel Jones, your floor.

LT COLONEL EARL H. JONES, JR--Project Officer

Our formal presentation today will be in two parts. The first part will cover the basic general and specific aspects of the program plan for Vandenberg Air Force Base, and the second aspect of the presentation will cover environmental impacts related to that program.

The first part of the presentation will be in two basic parts. The first part will be the general aspects of the program, which will be presented by Colonel Tom Sumner, who is the Program Director for the Space Shuttle Program and representing the DOD responsibilities for that particular program. The second part of the program briefing, the specific aspects of the program at Vandenberg, will be presented by Lt Colonel Aubrey Sloan, and I will present the environmental aspects of the presentation.

At this time I'd like to present Colonel Sumner.

COLONEL THOMAS SUMNER--Program Director

Thank you, Colonel Jones. As Colonel Jones mentioned, I'm Colonel Tom Sumner. I represent the Department of Defense's interest in the Space Transportation System. It's become commonly known as the Space Shuttle Program.

As you will see, the Space Shuttle vehicle is but one element of the Space Transportation System. I'll attempt to give you a brief overview of what that system is. I have a brief film that I'd like to start with and then go to some briefing slides. The film is short, only about seven minutes, but it highlights some of the features of the system. Could I have the film now, please.

[THE FILM WAS SHOWN]

Could I have the first view graph, please.

[SLIDE #1 IS SHOWN]

Well, you have been introduced to the program. That's the upper stage they talked about [referring to Slide #1] and this is to give you an indication of the trend we have had in rocketry and going into space in both the Department of Defense and in the NASA. Heretofore, we've been relying upon vehicles that have been known as expendable launch vehicles. That's a Titan III, that's an Atlas [referring to Slide #1]. We've built a whole family of these vehicles and they have served us well in DOD as well as NASA for the past number of years, but we are now moving into a new era, the reusable vehicle known as the Space Shuttle. Next slide please.

[SLIDE #2 IS SHOWN]

Let's talk about the major elements of the Space Transportation System, reminding you again that this is a joint program between ourselves and the NASA. The thing that's attracting the most attention in this program, of course, the major element, is the Shuttle vehicle itself. The development of the Shuttle vehicle is the responsibility of the NASA. The Department of Defense inputs their requirements to the NASA so that the vehicle is being built to the specifications of both the NASA as well as the DOD. Now, NASA is going to be responsible for constructing a launch and landing site on the East Coast at Kennedy Space Center. NASA will also be responsible for developing a mission control center at the Johnson Spacecraft Center right outside of Houston in Clear Lake, Texas. This is the facility that NASA used to control the Apollo and the Gemini and the Skylab projects. That facility will be modified to exercise the necessary control of the Shuttle vehicle. So the elements that you see in black [referring to Slide #2] are the responsibility of the Department of Defense or the Air Force to develop. Those elements are a launch and landing site here at Vandenberg Air Force Base, the upper stage that was mentioned briefly in the movie to take our payloads and NASA's payloads into higher energy orbits, and then, of course, to continue to develop payloads as we have done in the past in our different programs such as that communications satellite or navigation satellite that was mentioned. We also have an organization known as the Air Force Satellite Control Facility. It has its center of operations up at Sunnyvale, California, and it will continue to work as it has done in the past; and we will have to make some modification of that facility so that it can talk to the Johnson Spacecraft Center in coordinating payload deployment activities from the Shuttle. Now, what you don't see on the chart, and it was not left off intentionally, is the fact that NASA is also building a whole series of payloads such as the Space Lab and I should have these depicted up on there. Bear in mind then that the payloads will be military, commercial, and scientific in nature. We, the Air Force, will launch our payloads from both Kennedy as well as Vandenberg Air Force Base, and NASA will employ Vandenberg Air Force Base as well as Kennedy. Next slide please.

[SLIDE #3 IS SHOWN]

Let me expand a little more on what the movie said about the Space Shuttle vehicle. It's a very exciting vehicle. It uses some new technology. On the other hand, it also uses a lot of airplane technology; and it's built somewhat like an airplane, but it is half airplane and half spacecraft. It's fairly large, about the length of a DC-9 aircraft. It has a fuselage about the size of a DC-10 aircraft. It has a cargo compartment known as a payload bay, and clam shell doors. The cargo bay is fifteen feet in diameter and sixty feet long. The vehicle can place about 65,000 pounds into due east orbit out of Vandenberg Air Force Base. It's being built by Rockwell Company. It uses three large engines back here [referring to Slide #3] to help boost it into orbit. Those engines burn hydrogen and oxygen. The hydrogen and the oxygen are carried in this large external tank, which is being built by the Martin Marietta Company in Michoud, Louisiana. The two solid rocket boosters are being developed by the Thiokol Company in Utah. When you add up the total thrust that these engines develop, plus these two solid rocket boosters, it comes to about 6 and 1/2 million pounds of thrust. The vehicle itself weighs about 4 and 1/2 million pounds, so you've got considerable thrust to weight ratio. That's why it comes off the ground and goes into orbit. All of the engines are ignited on the pad (the three shuttle main engines that burn the hydrogen and the oxygen, plus the two solid rocket boosters). The solids burn for about two minutes; and when their propellant is expended, they are jettisoned away from the Shuttle vehicle and then parachutes deploy to bring the solids down in a soft descent into the ocean. That'll be about 120 miles downrange. The solids are recovered, they're refurbished, they're refueled, and then they are reused again. Now, the only part of the Shuttle vehicle that is not reusable is the external tank. The tank continues to furnish fuel to the Shuttle main engines, taking it into orbit up to near orbital velocity. And when the tank is depleted of fuel, it comes off of the Shuttle vehicle and it is deliberately re-entered into a broad ocean area down in the southern part of the world in an uninhabited area. After the vehicle gets into orbit, the payload doors are opened. The mission is then performed. Either the deployment of a satellite or some captive mission such as a Space Lab vehicle, which will be contained inside, stay inside the cargo compartment of the Shuttle. The Shuttle can stay in orbit up to thirty days. Most missions will probably be in the neighborhood of about seven days. Then the payload bay doors are closed up. The Shuttle also contains a couple of other engines called orbit manuevering systems engines that are on the vehicle. They burn fuel that's internal to the Shuttle vehicle, not the hydrogen and oxygen in the tank. Those engines are used to get it the final velocity it needs to make orbit and they are also used to deboost the Shuttle vehicle so that it comes out of orbit and returns to the atmosphere. Then the Shuttle will glide to a landing either at Kennedy or here at Vandenberg. In the early days of the testing of the vehicle, Edwards Air Force Base will be used to recover the Shuttle vehicle. Then the vehicle is processed through a facility or a series of facilities and it is prepared for another launch. So, the vehicle is used over and over again.

One of the major differences between the way the system is being built at Kennedy and the way we are building things here at Vandenberg is the fact that the NASA, in the construction of their facilities at Kennedy, took advantage of the existence of the Apollo facilities that were down there from the Apollo days.

We are taking advantage of the facilities that were built for the Air Force's manned orbiting laboratory. So, we have a slight difference in the way we approach the problem. They integrate all their vehicle inside a large building known as a verticle assembly building and transfer to a pad and launch it. We will process the vehicle in different facilities here at Vandenberg and integrate everything on the pad. Next chart please.

[SLIDE #4 IS SHOWN]

This is a look at the differences between Kennedy and Vandenberg as far as launch azimuths are concerned. Kennedy is intended primarily for equatorial type orbits--ones that stay near the plane of the equator. The orbits that we fly out of Vandenberg are intended to be more highly inclined, that is, inclined to the plant of the equator (more nearly like polar orbits). So we might launch anywhere from 158 degrees to a 208 degree azimuth, whereas at Kennedy it can run anywhere from 120 degrees in launch heading up to 35 degrees getting these types of inclinations. The main point I'd like to make is Kennedy is due primarily for equatorial and Vandenberg primarily for polar type operations.

[SLIDE #5 IS SHOWN]

The overall schedule of the Space Shuttle vehicle itself is shown here [referring to Slide #5]. As you can see, going back to 1972 was when the design and the program got started and there was an awful lot of activity. The event that has received the most publicity just recently was the approach and landing test which took place at Edwards Air Force Base just this summer. There have been three of them conducted and NASA has planned two more of those tests. The first orbital flight is planned to take place in the middle of 1979 down at Kennedy and then they intend to have about six or seven, you might say, development flights and the system will be declared operational at Kennedy in middle 1980. That's the target date. For Vandenberg, our operational date is planned for the latter part of 1982 or the early part of 1983.* Next Vu-graph.

[SLIDE #6 IS SHOWN]

This is what the Space Shuttle vehicle, or I should say the Orbiter portion of of the Space Shuttle vehicle, looked like when it was on top of its Shuttle carrier aircraft, the 747, when it was conducting its approach and landing test at Edwards, and I think I've got another Vu-graph. Give me the next one please.

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*The current target date for initial operational capability at Vandenberg is June 1983.

[SLIDE #7 IS SHOWN]

It shows what it looked like right after it separated from the 747. The purpose of these tests was to determine the handling qualities and the stability characteristics of the Orbiter vehicle. And that's why they are doing them at Edwards, because they've got the big long dry lake bed over there. It gives them lots of tolerance to land the Orbiter vehicle in.

The next one, please, I believe shows the Orbiter vehicle with the gear down.

[SLIDE #8 IS SHOWN]

Here is a chase airplane back in the background [referring to Slide #8]. And it's just before it makes a landing, just a few feet above the ground. Those tests have been going very well. Next one please.

[SLIDE #9 IS SHOWN]

Now, I'm going to introduce Colonel Sloan in just a few minutes and he's going to explain the details of what we are going to be doing here at Vandenberg. But, I put this up to give you some appreciation for the logistics that are involved in the program. It is a fairly large program with a launch and landing site at Kennedy. The tank, the big large external tank, is going to be manufactured in New Orleans and it will be taken by inland waterways on a barge to Kennedy for those launches. For Vandenberg those tanks will come by barge through the Panama Canal directly into Vandenberg Air Force Base at the harbor that we have located here. Port Hueneme will be involved inasmuch as when the solid rocket boosters are recovered at sea, they will be brought to Port Hueneme where we will do the refurbishment of the solid rocket boosters. The large solid rocket motors will be transported by rail, or it's planned by rail. It could turn out to be truck. Most likely they will be transported by rail from the manufacturers to both sites. So the purpose of this, as I mentioned, is to give you some appreciation for the fact that it's a national program, that it involves an awful lot of our geography in the United States.

Well, I'd like to turn it over now to Colonel Sloan, who will tell you about what we are going to be doing here at Vandenberg, and then I'll come back on the stage and answer questions you may have.

LT COLONEL AUBREY SLOAN

Colonel Sumner has just finished telling you about the glamour part of the program. Quite obviously, watching that Orbiter land is something to behold; but there is a lot of spade work that must be done before we ever reach that stage. To set the ground work for what we are doing at Vandenberg, I'd like to discuss with you very briefly our overall implementation philosophy for the facilities and activities here at Vandenberg.

In general, we have three guidelines that we have been following. The general requirement we have is to support up to two Orbiters here at Vandenberg and, within that capability, to support up to twenty launches a year through 1990. Now, that is to be based, in turn, upon a five day work week, two shifts per day. The primary driving goal behind implementing those kinds of requirements is a need to minimize the total cost for what we are doing here at Vandenberg and we have done that through two methods. The first is to use as much of existing Vandenberg facilities and real estate as we possibly can. Quite obviously, anything that's existing that we can use would minimize the cost and minimize any kind of environmental impact as compared to constructing something new. Second, our guidance has been to make as much use as possible of existing NASA techniques, facilities, equipment as we can in the development of Vandenberg. As a matter of fact, the ground support equipment that we intend to use here at Vandenberg to support our activities is about seventy-five to eighty percent in common with what NASA is using at Kennedy. Finally, and of more pertinence to this meeting tonight is the consideration of environmental activities.

Back in 1972, we started our first studies for what we wanted to do here at Vandenberg. An inherent part of those studies was the consideration of the environmental impact of them. In 1973 we started a series of data gathering activities that were multidisciplinary. They involved non-DOD government agencies, academia, as well as industry people to gather data to form a base line of environmental data for Vandenberg Air Force Base against which we could measure our activity that we planned. That information and the resulting analyses are reflected in the draft environmental statement.

[SLIDE #10 IS SHOWN]

This map [referring to Slide #10] will give you an indication in overview of the facilities we are planning to build at Vandenberg and their general locations. It's color coded. Those in green represent new facilities that we must build because there is nothing here on Vandenberg that will satisfy those unique requirements. These other items represented in clear blocks are items that we are modifying, we can use with some modification. Now, in general, all the facilities grouped here in north Vandenberg around the runway area are associated with processing the Orbiter prior to launch. When that Orbiter is ready, it will be towed over the existing road network, across the 13th Street bridge, down Highway 246, and down the coast road here to the Space Launch Complex. As I am sure you are well aware, this was built for the Titan IIIM

in the MOL Program. All the facilities then grouped down here around SLC-6 are those associated with processing the booster for launch. Not shown on here are those facilities at Port Hueneme that will be used for recovery of the solid rocket boosters, and I'll address that a little bit later. I'll be coming back to this map as I go through each facility here so you'll be able to see what we are talking about and its relative location.

[SLIDE #11 IS SHOWN]

This [referring to Slide #11] is a map of the runway area at Vandenberg as it exists today. You are looking toward the northwest on this map. Toward the northwest are the existing tower sitting up here and the existing runway facilities. This road coming down here is Tangair Road. Now, what we've done is ask our artist to take that photograph and doctor it up as to what it would look like.

[SLIDE #12 IS SHOWN]

Here is the same photo now where we've doctored in the proposed facilities around the runway area [referring to Slide #12]. As you can see, we've added a little tow route here and four major facilities. In addition, there will be a 7,000 foot extension to the runway, giving Vandenberg then a capability of a 15,000 foot runway. At end of mission, the Orbiter will land on the runway from either direction. At the end of roll out, ground power will be connected to the Orbiter, the Orbiter will be shut down, the crew will be taken out of the Orbiter, and the Orbiter will be towed off the runway, down the little tow route here, into this first facility, which is called the Safing and Deservicing Facility. After being processed here, it will go over into this other large facility, an Orbiter Maintenance and Checkout Facility. Some systems will be removed in these two facilities and brought over to this third facility, a Hypergolic Maintenenace Facility.

[SLIDE #13 IS SHOWN]

This is an artist's concept of the first facility, the Safing and Deservicing Facility [referring to Slide #13]. We are talking down here in the lower lefthand corner. After the Orbiter comes off the runway, it will be towed into this facility. At this point, there are various pyrotechnic systems aboard the Orbiter that will have to be safed. What are the pyrotechnics we are talking about? There are various explosive devices aboard the Orbiter that are used to insure separation of various systems in the event that normal hydraulic or manual systems do not function. For instance, when the Orbiter

lands, obviously the landing gear has to come down. If for some reason that did not work, the astronaut pilot has the option of firing a small pyrotechnic device that explodes and releases the landing gear and locks it in place. Likewise there are various things that stick out all over the Orbiter that normally would fold back in for a landing. If for some reason that did not happen, he could fire another explosive device that would literally separate that system from the Orbiter while it's still in orbit. All these systems, then, must be made secure after the Orbiter lands. In addition, in this facility, any residual propellants left on board the Orbiter would be drained and purged. Those fuels then would be stored in trailers and then removed and suitably disposed of. Following safing and deservicing of propellant systems, the Orbiter will next be towed to the Orbiter Maintenance and Checkout Facility, the other green block. It's at the top of the chart, about in the center.

This is a new large facility. Once towed into this facility, the Orbiter will undergo both scheduled and unscheduled maintenance. Periodically, certain things must be maintained, just like your automobile. In addition, just like an automobile, certain things happen you didn't plan on and these must be repaired prior to the next flight. If the particular mission the Orbiter was on called for bringing back a payload, that payload would be extracted here and taken to another facility for subsequent processing. The reverse case is also done in here. Certain payloads, NASA payloads, will be installed in this facility, and I'm talking primarily about the Space Lab. That is a large payload. It will fill the Orbiter bay. It will be brought in here, inserted into the Orbiter prior to transporting it down to the launch pad.

[SLIDE #14 IS SHOWN]

This is a photograph of the Orbiter when it was being towed from Palmdale to Edwards [referring to Slide #14]. What I wanted to depict here was not the Orbiter but the transporter. In the Orbiter Maintenance Checkout Facility--after the Orbiter has been prepared, closed out, and ready to move to the launch pad--it will be jacked up and placed on this transporter; and a caravan similar to this, then, would move the sixteen miles from the runway down to the launch pad. And, again, this is merely to illustrate the type of transporter that will be used to cover that sixteen miles.

[SLIDE #15 IS SHOWN]

This is a photograph of the launch complex as it exists today [referring to Slide #15], and I'm sure you can all recognize the mobile service tower that's out there now. But I do want to point out a few of the other major facilities on the launch pad that we do intend to modify and use for the Shuttle. This is the existing flame duct that was built for the Titan IIIM. Here is the Launch Control Center, and on the far left hand are some buildings that were built to handle the Titan solid rocket segments. This same photo was doctored up to illustrate what it would look like for the Shuttle.

[SLIDE #16 IS SHOWN]

Here you see the Shuttle vehicle standing on the launch pad ready for launch. The modified mobile service tower is in a retracted position. This is a new structure, payload changeout room, which I'll address shortly. Here is the existing flame duct, which will be used for the main engines of the Shuttle. And we will construct two new ducts, one here and one on the other side [referring to Slide #16] to handle the exhaust of the solid rocket boosters. You still see the launch control center in use, a new facility here for handling external tanks, and a modification to the solid rocket facility down here now to handle Shuttle.

[SLIDE #17 IS SHOWN]

Taking a closer look at that launch pad, this is an artist's conception of what that launch pad will look like [referring to Slide #17]. Again, the mobile service tower is pulled back, the Orbiter is sitting on a new launch mount, and a new access platform. This is the crew access arm through which the astronauts will ingress into the vehicle. This large structure is called a payload changeout room and is going to serve several functions. While the Orbiter, the Space Shuttle vehicle, is being assembled on the launch pad, the payload that goes into it is being brought into a new facility here called a payload preparation room. The payloads will come in here in a shipping container. Once inside the payload preparation room, that container will be washed down. We will establish a clean room atmosphere around it, open up the container, remove the payload, and place it into a cell in one of these buildings for subsequent checkout prior to launch. At that point in the countdown when the Orbiter is ready to receive the payload, the payload changeout room, a mobile structure, will roll back over the payload preparation room. A crane will reach down through this hole and extract that payload, attach it to a payload handling mechanism inside the payload changeout room. Next, this whole structure will translate forward, enclose itself around the Orbiter. The Orbiter payload bay doors will open. The payload handling mechanism will insert the payload into the Orbiter bay. The doors will close. The payload changeout room will move back, and the vehicle then will stand ready on the launch pad for launch.

Now, quite obviously, the mobile service tower is a high visibility structure. You've seen it around for a number of years. I'd like to talk just a moment here on how that structure is going to be used. We have a dual use for it. One of the things, in addition to handling payloads, is erection of the vehicle itself on the launch pad. Initially the solid rocket segments will be brought out to the launch pad and through use of an overhead crane in the mobile service tower we will lift them up and place them on the launch mount. Next, the external tank will be brought to the launch pad and a strong back that will be on the front side of that payload changeout room will pick the tank up, move it over to the launch mount, and attach it to the solid rocket boosters. Finally, the Orbiter will be brought to the launch pad from north Vandenberg

on that rubber tired transporter and in the same vein that strong back will come down and attach itself to the Orbiter. It will rotate the Orbiter up. The system then translates forward again and mates the Orbiter then to the external tank. The final step then in the process as I described earlier is to bring the payload in.

[SLIDE #18 IS SHOWN]

This is a photograph of the Boathouse area on South Vandenberg as it exists today [referring to Slide #18]. We plan to use this area, this natural little harbor in here, by modifying that marine facility to handle the external tanks. Again, we've got an artist's concept of what that would like in a similar view.

[SLIDE #19 IS SHOWN]

This [referring to Slide #19] is a large NASA barge that will bring the external tanks, four at a time, from Michoud, Louisiana, through the Panama Canal, up the west coast of California, directly into the Boathouse area here at Vandenberg. To appreciate the size of this barge, that's a little over 400 hundred feet and it's about 80 feet wide and about 35 feet tall. Here's a little tug that will assist it in docking here and, as you can see in comparing it to the photo as it exists now, a road will be needed from this little docking lift to be put here to tie it back in to the launch pad at SLC-6.

[SLIDE #20 IS SHOWN]

This is a photograph of Port Hueneme [referring to Slide #20]. And just to briefly mention our activities down there, the project area we are describing is within this black line. Why we are using Port Hueneme? We are using it because it is there. Again, maximum use of existing facilities. We have a harbor to bring back the recovered Solid Rocket Boosters. They will be brought into an area that's located roughly back in here. The facility we are building down there is called a Solid Rocket Booster Disassembly Facility and the sequence here is, after the Solid has been towed into the harbor area, it's brought up beside the dock. A large crane will lift it out of the water, put it on little mobile dollies. It will be brought into this facility and washed down, and the Solid Rocket Booster disassembled into its major segments. Now, this is a segment that was originally filled with propellant and was originally transported into Vandenberg by rail. After recovery these segments are now empty so after disassembly here, they will be put back aboard a rail car, shipped back to the manufacturer for subsequent refilling and then that will be again brought back to Vandenberg and used for another launch. Some components

of the Solid Rocket Booster that have been recovered and disassembled here then will be shipped by rail or by truck to Vandenberg for refurbishment and again subsequent reuse.

[SLIDE #21 IS SHOWN]

I'd like to conclude with an overall schedule of our activities here at Vandenberg. We've divided our activities into three growth periods, if you will, a definition period that we are still in, an integration period that we are about to enter, and finally an activation period. And, as you can see, there is some overlap on these activities [referring to Slide #21]. This shows our current activities in that we are still defining our requirements. And what the environmental statement reflects is the best requirements we had at the time the document was prepared. At the same time, based upon these requirements, we are preparing detailed specifications and design criteria for both facilities and the support equipment that goes into those facilities. We are in a design phase now of those facilities and that will continue into 1979. At the completion of this activity, about mid-1979, we will start construction on the first facilities. And the first facility to be constructed or modified right now, we plan to do the airfield, the lengthening of the airfield. During this same time period, we will start the design of our support equipment. We hope to get underway with this activity next month. That will extend all during this period and will overlap with the actual building of the support equipment. As I mentioned earlier, about 75 percent of that support equipment, however, NASA has already designed and built. So we don't have to repeat the design phase for those items. It's the other 25 percent that we will have the responsibility for design of. During this period of time, during construction and support equipment procurement, we have started our initial development of the computerized launch system that will be used for the Shuttle here at Vandenberg. And the acronym here stands for Vandenberg Launch Processing System. NASA at Kennedy is using a launch processing system, so we are using major portions of that system. And to differentiate between the two we put a V in front of it. We are going to start the development of the software portion of that in the very near future, like next month. We are also starting procurement of the actual computer itself from NASA next month. That computer hardware then will come in late 1978. It will be installed here at Vandenberg while the bulk of our support equipment will start coming in here in 1980 as the facility construction completes. This is why you see an overlap between those two periods, because activation backs up into the first completion of facilities. This activity will go on, then, and we go through some general systems tests of individual facilities as well as integrated systems tests to make sure that all the facilities play together as a unit. When this is complete, we will have achieved our first launch in late 1982 or early 1983.

That completes my presentation. Colonel Jones now will discuss the environmental impact associated with what we have planned here then.

LT COLONEL EARL H. JONES, JR--Project Officer

As Colonel Sloan indicated, our current project description, which is presented in the Environmental Statement, which he just described to you, was developed over a period of four or more years of intensive evaluations of numerous alternatives for providing ground support facilities at Vandenberg Air Force Base. Those studies have been supported concurrently by environmental studies as well as environmental impact analyses. For our current project description, we submitted an environmental impact statement, a draft environmental statement, to the Council on Environmental Quality on the 18th of August for public review and comment. At this time, I would like to review our identification as well as our assessment of the environmental impacts associated with the Space Shuttle ground support facilities and system operation at Vandenberg.

[SLIDE #22 IS SHOWN]

This will be the general format of my presentation. I intend to discuss those environmental impacts associated with each major aspect of the program at Vandenberg. There are seven of those activities identified here [referring to Slide #22]. I will end up the presentation with a review of some rather specific socioeconomic impacts. For each activity I will also discuss both construction as well as operation impacts. When I get to the launch pad activity, I will have separate discussions on both the construction as well as the operations of the launch pad area.

[SLIDE #23 IS SHOWN]

This indicates the airfield activities [referring to Slide #23]. As far as the airfield is concerned, our assessment of impacts there, as far as construction is concerned, we indicate only two primary impacts. The first impact concerns the removal of certain special interest plants. I would like to say here that our identification of special interest plants on Vandenberg, which has been the emphasis of the floral aspect of our analysis, was based upon a list that was published by the California Native Plant Society as well as lists published by the Smithsonian Institute. Now, certain species on those lists have been published on proposed lists of endangered plants by the Fish and Wildlife Service. We do anticipate that extension of the runway will remove certain of these special interest plants in that particular area. However, our assessment is that these plants grow in some abundance throughout Vandenberg Air Force Base and also the plants are not on the endangered list. I would also like to say here that these assessments have been accomplished in coordination with various private and university agencies as well as the Fish and Wildlife Service.

The normal construction noise and spills will be impacts associated with just about every construction activity. In each case, we find that these impacts will be very localized and very short term in nature. Nothing unusual that would not be associated with any construction activity that you might be aware of.

As far as the operations impacts, the impacts in this area are primarily that of sonic booms in the local area. Now, at the current time, we do experience sonic booms from our current operation of the Titan program. However, these sonic booms are not normally heard in the local area. However, the return of the Orbiter at subsonic* speeds as it approaches Vandenberg Air Force Base will create sonic booms of very small intensities in the area. Those intensities are such that we do not anticipate any structural or physical damage. We anticipate that those impacts will be of a startle nature only, and those startle impacts can be lessened. We do feel that they will be lessened because we do intend to announce the events sometime prior to their occurrence.

In the Orbiter processing area, we also anticipate some removal of certain special interest plants. Again, none of these plants are on the endangered list and, again, the plants grow in abundance throughout the base. So we do not anticipate that we will endanger the continued existence of these plants. And, again, normal construction noise and spills. And for this particular activity we do not anticipate any operational impacts.

[SLIDE #24 IS SHOWN]

As far as the tow route modifications are concerned, as Colonel Sloan indicated, we don't intend to build any new roads. We intend to use existing base road networks. However, the wing span on the Orbiter, as you can see here [referring to Slide #24], is of such a nature that many of the existing road cuts are simply not wide enough in certain cases. The road will have to be widened in a few instances. Because of this, we've had to comply with the National Historic Preservation Act of 1966. We have done archaeological surveys throughout the base and, as far as the program is concerned, we've concentrated these surveys within the project area. We've identified eighty such sites located within a very broadly defined project area on Vandenberg and, if you read the impact statement, it indicates that there was a potential of impacting or disturbing some eight of those sites. Now, we have coordinated these impacts with the National Parks Service. We've coordinated them with professional archaeologists as well as local native American Indian groups. Now, I say local native American Indian groups because the sites represent and provide values associated with historic and prehistoric Chumash civilizations. So we have coordinated very closely with various native American Indian groups in the local area here. As a result of that coordination and working with the

*The word "subsonic" is incorrect. The speaker intended to use the word "supersonic".

facility planners, we have reduced those impacts from some eight sites to three sites. And those three sites which will be impacted, we have managed also to minimize the impacts to those sites. So through the intensive or aggressive implementation of a mitigation program, we have lessened the impacts and we do intend to continue compliance with the law by developing a data recovery program; and that program also will be developed in close coordination and consultation with native American groups. Now, again, the tow route modifications and road extensions will also impact a few special interest plants. Again, none of these plants are on the endangered list and they also grow in abundance throughout the base. We have also, in coordination with these various agencies, realigned the road in such a way that we have also mitigated those impacts by reducing the disturbance to a minimum.

[SLIDE #25 IS SHOWN]

At Port Hueneme, the work we will do there concerns itself not only with the construction of the disassembly facility for the Solid Rocket Boosters, but it also involves the modification of some existing wharfs at Port Hueneme. The only construction impacts associated with our activities at Port Hueneme involve a modification of those wharfs. We do anticipate we will temporarily disrupt some biology, however, we feel historically that biology will rapidly rehabitate the area in time. So, our assessment of that impact will be very minimal. We do not anticipate any operational impacts at Port Hueneme.

[SLIDE #26 IS SHOWN]

Before I get into the impacts associated with our marine facility, I'd like to again acquaint you with the existing facility as it is and as Colonel Sloan showed you. However, on this particular photograph here [referring to Slide #26] I have shown, marked out in tape here, the particular specific area which we will impact. As far as our selection of the Boathouse area for this, we not only considered the operational and economic considerations as far as mission accomplishment is concerned, but we also wanted to insure from an environmental point of view that we were consistent as much as possible with the California Coastal Zone Plan. Now, although Vandenberg Air Force Base is not part of the California Coastal Plan, we feel that in cooperation with the State, we wanted to preserve those aspects of the Vandenberg coastline which were consistent with that plan. So, we've looked at this existing facility and we feel that, since there is an existing embayment facility there, it would be less of an impact to modify that facility than to develop a brand new facility somewhere else along the Vandenberg coastline. So we intend to cut in this area. We are concentrating alignment of that cut with an existing road here. And, again, I'll show you what the facility looks like as an artist's conception.

[SLIDE #27 IS SHOWN]

Okay, let's get to our assessment of the impacts at that facility. Our construction impacts would involve the disruption of some marine biology. In our assessment, we feel that biology will rapidly restore itself in time. Historically it does that, and also the biology in the embayment is very small in there in comparison to more abundant biology of the same type along other parts of the Vandenberg coast. We are also concerned with the scenic impacts. A large cut through a bluff could have some pretty drastic visual impacts. Although we feel that Vandenberg is really visually inaccessible to the general public because it is a closed base, we were concerned. But we feel that, as far as the visual impacts are concerned, that degradation will be very small. What I'd like to do at this time is take you through a series of before and after slides. I will show you scenes taken from the water about 2,000 feet out, from different views. You will first see a view taken from this side looking askew into the facility [referring to Slide #27]. You will see another view looking directly into the cut, and I'll show you another after view looking at the facility from this side [referring to Slide #27]. We have had a very good artist to touch up a photograph for us and it gives you a good idea why we feel the visual degradation will be very small.

[SLIDES #28 AND #29 ARE SHOWN]

Again, on your left is the scene of that facility before the cut [referring to Slide #28] again, and with the Boathouse in place. On your right is the area with the cut in it and with the Boathouse removed [referring to Slide #29]. Okay. Let's look at that from another view.

[SLIDES #30 AND #31 ARE SHOWN]

This is looking directly into the area which will be cut on your left [referring to Slide #30]. Again, looking at that cut with the Boathouse removed on your right [referring to Slide #31]. Although I don't have a before on the next slide, I would like to show you, by looking from this side [referring to Slide #30], what that cut looks like from another direction.

[SLIDE #32 IS SHOWN]

As you can see here [referring to Slide #32], this is really the cut. But, you can see an indentation in the bluff here that currently exists and there

is very little demarcation between the two. So that's basically why we have assessed the visual impacts as being very small, minimal. Again, from an operational point of view, because of the need to continually redress the bottom, periodically we will continue to disrupt that submarine biology. But, again, we feel that that disruption will be very small in proportion to the total biology available. And we have found through surveys in the area that there is no subtidal biology of any significance in that embayment area.

[SLIDE #33 IS SHOWN]

Now, this next slide covers only the construction of the launch pad area. No operations. As far as the construction of the launch pad area and other than normal construction noise and spills which will again be local and short term, we will also remove certain special interest plants. Again, those plants are abundant throughout the base. The base is very unique in this aspect. And also, none of these are on the endangered list.

[SLIDE #34 IS SHOWN]

Now, let's look at operational impacts. During operations at Vandenberg, again, we will be using larger boosters than we currently use on the Titan Program; and the use of those larger boosters will result in increased noise levels in the general area. We have assessed those noise levels in terms of estimating the specific levels concerned and we find that those levels are far below the standards established by the Environmental Protection Agency. Sonic booms will be another impact not normally associated with launches here at Vandenberg, at least not normally associated with those launches as far as discernible by the local public. However, because of the large vehicle, because of the supersonic speeds also associated with this vehicle, we have estimated that sonic booms will impact the general area. However, these sonic booms will not impact inhabited areas. Our concern with the sonic booms is that they will impact the Channel Islands.

We are not now sure what those impacts to the various forms of biology on the Channel Islands will be. We are currently undergoing studies, initiating studies to determine what those impacts might be. The primary concern there are some very special interest forms of biology, special interest wildlife. In particular, we have the Brown Pelican, California Brown Pelican. We have the Peregrine Falcon, and we have many other species of birds and mammals on the Islands. Now, these species I have just mentioned are currently listed on the endangered or threatened Federal list. Because they are, we are coordinating with the Fish and Wildlife Service and we are also working with various Federal, various university, and private agencies to help us in assessing what those impacts might be. At the same time, we are also studying ways in which we can completely avoid the Channel Islands in terms of sonic boom impacts. Our current assessment, however, is that the inclinations where

these impacts will occur, and based on our mission models, those impacts will be very infrequent. However, as I said, again, we are also looking at ways in which we can avoid those impacts concurrent with studying the specific nature of the impacts.

Degradation of air quality. As you can see on the slide on your left here, associated with the shuttle launches will be this ground cloud; and a ground cloud will contain exhaust constituents, just like the exhaust out of an automobile. Now, the constituents here are quite different. There will be many many elements and many chemicals associated with that ground cloud which have pollutant potentials. Now, only two are of concern to us in our impact analysis. These are hydrogen chloride and particulates in the form of aluminum oxide. Now, for hydrogen chloride there are standards--national standards--for hydrogen chloride as far as impact on humans. Those national standards are that a human can be exposed without any appreciable effect to an instantaneous level of some seven parts per million or on a time weighted basis can be exposed to levels of four parts per million over a period of ten minutes. Now, we have used a mathematical model developed by the NASA Marshall Space Flight Center, and that mathematical model, which has been proven to be very conservative, indicates that the maximum or peak levels anticipated in the general Vandenberg-Lompoc area will not exceed two parts per million. Also on a time weighted basis, no biology, including humans, in that area would be exposed to levels more than one part per million over a ten minute period. So we feel that as far as human impacts, there will be none because they are far below those national standards. However, we have over the past several years been looking at the sensitivity of various plants and animals to hydrogen chloride. The results of our studies so far indicate that plants, and we have been also looking at plants specific to the Vandenberg area as well as animals exhibit no effects to the kinds of levels that we anticipate to be associated with the Shuttle program here. However, if that ground cloud were to encounter rain, we have a phenomenon called HCl Washout. In this particular case, the raindrops falling through the cloud will become slightly acidic. Now, we have calculated the levels of acidity also using mathematical models, and the levels of acidity that we have found or anticipate we feel will be very low. And we don't anticipate any effects on biology in this area. Again, NASA as well as DOD is studying the effects of various plants on being exposed to certain acidity levels. However, based on the meteorology in this area, we feel that there will be very rare events when that cloud will pass over inhabited areas. In fact, those events should not happen more than five percent of the time.

There is also a potential for modification of the weather. Now, the aluminum oxide particles in that cloud also have a potential for being a source of cloud seeding. I'm sure all of you have heard of cloud seeding. We are not sure whether they do have this potential. We are doing some studies in conjunction with NASA and the National Oceanographic and Atmospheric Administration to determine whether these particles do have that capacity. However, if the capacity were there, there would be a potential of maybe suppressing rainfall as well as increasing rainfall. However, that event would be very localized, limited to the area of the cloud itself.

The next unit of slides is socioeconomic in nature. What I tried to do here is provide you a comparison of anticipated socioeconomic impacts during both the construction as well as operational phases.

[SLIDE #35 IS SHOWN]

You see a few pluses over here [referring to Slide #35] because the program is continually being refined and revised. And our current estimates are that our total direct expenditures for construction and activation of the program will be some 800 million dollars. During the operations, there will be a total--over the life of the operation period up to 1990--of some 1.1 billion dollars. And we also indicate up here how we anticipate those expenditures will be distributed in the general area. Whenever you input a dollar directly into an area, it also results in some multiplier effects, as I am sure many of you are aware of. Those multiplier effects are indicated by the increased regional output. In any case, they will be approximately almost a three to one ratio.

[SLIDE #36 IS SHOWN]

Again, over here on your right [referring to Slide #36], we show increases in income associated with the Shuttle program. The basic distribution of that income on a total basis for the total period is indicated here, as well as on an annual basis; and the figures I show here are averages throughout the program. These figures will fluctuate slightly from year to year. However, the figures I show here are averages, annual averages; and the distribution shown here is based upon the general distribution of those kinds of expenditures today.

[SLIDE #37 IS SHOWN]

Okay, on the left [referring to Slide #37], increased employment associated with the program. During construction, an average of 910 people will be employed. Here's the distribution of those people. And we also showed not only direct employment but also indirect employment--those people that will be generated throughout the community to support the construction as well as the operational personnel. Now, the figure shown here for the operational personnel indicates an additive figure. In other words, we show an employment of some 350 people over and above the current levels at Vandenberg Air Force Base. We feel that the employment levels at Vandenberg Air Force Base will all be necessary to support the program. And, in addition, the program requirements will generate an additional 350 jobs. And, of course, the distribution of those jobs is indicated up here also. You may find some differences in the Port Hueneme figures than you read the environmental impact statement. Those differences of the Port Hueneme statement reflect only the fact that we have chosen to move our external tanks directly into Vandenberg rather than moving those tanks by way of Port Hueneme. Again, whenever you add a body on a payroll, he is going to bring in families and all kinds of other people. And there will be some population growth as well. I show here generally what that distribution of population growth will be. Those people have to live in houses.

[SLIDE #38 IS SHOWN]

An increase in housing demand I show in Operations here, and the additional houses required over and above the homes generated during the construction period. And also we show, we feel, that most of the socioeconomic impacts will be beneficial to the area. We feel the demand as far as population growth, demand on public services, demand on housing, will be insignificant impacts based upon the capacity of the area to support this demand.

In summary, our impact analysis for the Space Shuttle Program at Vandenberg again indicates a minor removal of special interest plants (and, again, none of these plants are endangered; they are very abundant), some minimal disturbance to archaeological sites, and we are working very diligently to minimize those impacts as they affect native American religious and heritage concerns. We anticipate some increase in noise as well as introduction of sonic booms to the area, some short term but localized degradation of air quality, and, as I indicated before, economic stimulation.

That ends my presentation.

COLONEL ALLEN C. SMITH--Presiding Officer

Thank you very much, gentlemen. We appreciate the presentation. I now would like to recognize several local personages who are present. First we would like to recognize the mayor of Lompoc, California, the Honorable Charlotte Benton. Would she stand please?

[MAYOR CHARLOTTE BENTON STANDS]

We appreciate your coming.

We would also like to recognize the presence of Santa Barbara County Supervisor, Mr. Robert Hedlund. If he is present, would he stand please?

[MR. ROBERT HEDLUND STANDS]

Sir, we appreciate your presence very much, and we thank you for your interest in the program.

We are going to take a brief recess here of about ten minutes so we can set the stage up for the questions and presentations by other persons. I would like to, during the recess, call your attention to the pictures--the artist's conceptions of the various facilities that will be involved--that are down here in the orchestra pit. And, I would also like to correct a mistake that I made in connection with the address at the SAMSO office. In the event that you desire to submit written statements to be incorporated in the transcript of this hearing, they should arrive at SAMSO at the following address: SAMSO/DEV, Post Office Box 92960, Los Angeles, California, Zip Code 90009. I had the Post Office Box and the Zip Code reversed earlier. They should arrive there not later than 3 October 1977.

Let's recess ten minutes. At the end of the recess we will be ready to proceed with presentations from other persons and take questions from the floor immediately thereafter.

[A RECESS* IS HELD]

COLONEL ALLEN C. SMITH--Presiding Officer

We are now ready to begin the second aspect of the agenda for the evening--the presentation of statements by individuals or representatives of groups. I have several names here already, and we will get to them in just a moment.

Once again, if you desire to make a statement or a comment, please fill out one of these small cards that the people at the entranceway have available, give it back to the person that you obtained if from or one of the other personnel going up and down the aisles; they will see that they get to me. Your name will be called. And if you could step up to the podium on the opposite side of the stage from where I am and make your presentation, we would appreciate it.

Once again, if you are representing a group or organization, we would appreciate it if you would limit your presentation to ten minutes. If you are speaking as an individual, we would appreciate it if you would limit your presentation to five minutes.

I think we are ready to go. Is there a Professor James Pittman present? He was the first name that I had. The University of California at Irvine faculty, Professor Pittman. Professor, we would like to have you come up to the podium. Professor Pittman is, as I understand it, a member of the faculty of the Ecology

*The hearing recessed at 2018 hours, 28 September 1977, and reconvened at 2031 hours, 28 September 1977.

and Evolutionary Biology Department at the University of California at Irvine. Is that correct, sir?

[MR. PAUL KELLY (in place of Professor Pittman)
Dept. of Ecology and Evolutionary Biology
University of California at Irvine
Irvine, California]

MR. PAUL KELLY

No, sir. That is not correct. Actually, there must have been some misinformation passed along. My name is Paul Kelly. I think the reservation for a presentation was made by Mr. Robert Pittman who is on the staff at the University of California at Irvine.

COLONEL ALLEN C. SMITH--Presiding Officer

Welcome.

MR. PAUL KELLY

So as Paul Kelly I am representing myself and a few biologists on the staff of the Department of Ecology & Evolutionary Biology at UC Irvine, and we are associated with other research staffs at the University of California at Santa Cruz and other institutions that are currently involved in an investigation of marine resources of Southern California. The study has been funded by the Bureau for Land Management; and they have spent several million dollars over the past three years to fund these studies. These studies have been funded because of extreme public interest and also interest by State and Federal agencies in the marine resources of Southern California, especially the potential impact on these resources by oil drilling.

As experts on avifauna, marine birds on the Channel Islands, we were recently invited to a meeting hosted by the Air Force and the environmental consultants working for The Ralph M. Parsons Company that assisted in the formation of the EIS.* We attended this meeting in El Segundo because we had an interest in the brown pelican, which was being addressed at this meeting, and the potential

*The Ralph M. Parsons Company is responsible for development of Environmental Protection Plans for Shuttle ground support facilities.

impact of the Space Shuttle, in particular the sonic booms, on the brown pelican. At the meeting we were particularly distressed to find out that San Miguel Island was merely the focal point of some of the sonic booms that are anticipated to occur over the Channel Islands. And these booms, we discovered, will be significantly, actually extremely, stronger than normal sonic booms that we occasionally experience on the mainland. We were particularly distressed to find out that San Miguel was in this path because we have found, over the past few years, that San Miguel is the home of the largest sea bird colony in the Channel Islands. Actually the largest colony in numbers and the greatest number of species occur at San Miguel Island. These species are particularly vulnerable to any disturbance and, in fact, this colony, although it is the largest colony in Southern California, represents only a remnant of former vast populations that inhabited the Channel Islands. These populations have been decimated by human disturbance and particularly, in recent years, by introduction of pollutants such as DDT in marine environment, other pesticides and oil spills, as you are well aware here. In addition, many of the Channel Islands have been grazed. They have been severely overgrazed by cattle, cats, rats, and many other feral animals that have been introduced. So, marine birds are at an extremely low population level and any disturbance could be particularly devastating.

We were also disturbed to find that in the initial draft EIS, particularly the avifauna, the birds of the Channel Islands, had only been given a cursory mention. In fact, they were mentioned in one sentence that stated the birds were fairly common on the Channel Islands. So, we are hoping to provide through our input to the brown pelican meeting, this meeting this evening, and a letter that we have addressed to the Air Force, some information on the sea birds of the Channel Islands so that they can at least be given consideration in the environmental impact statement, and perhaps measures can be taken to mitigate any damage to these populations.

As an example of the type of destruction that can occur on these islands, we have been present on the colonies when sonic booms have taken place. And the result can be extremely destructive in that birds nesting on the surface tend to fly from their nests, and nearby predatory species such as Western gulls will then come in and devour the eggs of such species as the brown pelican and other surface nesting birds.

In addition, the substrate island on which these birds are nesting are extremely fragile, and landslides and rocks are easily dislodged. And we suspect that sonic booms of this intensity may actually affect the geology of the island. Some of the birds depend on the fragile topsoils and burrow in these topsoils; and they might actually have the topsoil dislodged or destroyed by the sonic booms.

In addition, a couple comments about these species, which number about eleven or twelve at San Miguel Island in particular, and a few other species that are scattered about in the Channel Islands. A number of these species have extremely limited ranges, partly because of the environmental disruption that has already taken place, as I mentioned. And some of these species are potentially endangered. They have very limited ranges. Some occur only in the Channel Islands and along very small portions of the California coast. They are certainly potentially endangered and information is lacking at this time to really classify them. Certainly the Brown Pelican, which formerly nested at San Miguel Island,

I think as Lt Colonel Earl Jones mentioned, will be potentially impacted by the sonic booms, although it is on the outer fringes of the areas that will experience sonic booms and so hopefully it will not experience such severe disruptions as the animals at San Miguel Island.

We are certainly looking forward to the success of the Space Shuttle. But we hope that, at least in the environmental impact statement, the flora and fauna of San Miguel Island particularly, which is to be acquired by the National Parks Service as part of the Channel Islands National Monument, will be given complete consideration and that any damage to marine birds will hopefully be mitigated. Thank you.

COLONEL ALLEN C. SMITH--Presiding Officer

Thank you very much, Mr. Kelly. Our next speaker is a Mr. Robert B. Sech, representing the I.B.E.W. I might add that even though Mr. Kelly indicated that he was speaking as an individual, I made an administrative determination that he was representing a group, namely the group that conducted the research that he was reporting. So, we allowed him beyond the five minute time for individuals.

Mr. Sech, welcome.

[MR. ROBERT B. SECH
711 North Second Street
Lompoc, California]

MR. ROBERT SECH

Thank you, sir. I am on the executive board for the National Brotherhood of Electrical Workers and we are interested in the preservation of all these plants and fish and everything else. But we are also more so interested in our young people. We need jobs and we need jobs badly. I guess the big word for that is socioeconomic.

Now, this town really needs that. And the other adjoining towns. Now, it is sad to have our young people have to leave the area and go somewhere else looking for jobs. So what I want to tell you is that we do need jobs here. Now, we realize that we don't want our young people going away and we don't know what environment they are getting into. Now, if they are closer to home, if we had any of them that got real rough, we could send them up in orbit and then we could see how they are behaving from the ground up.

COLONEL ALLEN C. SMITH--Presiding Officer

Thank you very much, Mr. Sech. We appreciate your comments.

The next speaker that I have listed here is a Mr. John C. Hartman of the Sierra Club, Scenic Shoreland President, as I have it listed here. Mr. Hartman, we welcome you to the hearing.

[MR. JOHN C. HARTMAN, Scenic Shoreland President
Sierra Club
4097 Solar Way]

MR. JOHN C. HARTMAN

Mr. Chairman, this report was prepared by Mr. Fred Eisler of Santa Barbara, California, who is president of the Scenic Shoreline Preservation Conference and also Conservation Coordinator for the Sierra Club in this area, which is known as the Los Padres Chapter. He mailed this to me and, since he couldn't be here, requested that I present this at this time.

The impact on the wildlife onshore and in the marine environment in the vicinity of Vandenberg Air Force Base as well as the Channel Islands and surrounding waters has not been adequately considered in the draft EIS.

The draft, Part 5, Page 33, notes that "sonic booms are expected to occur during ascent and substantial overpressures are expected to occur along the vehicle's ground track. These booms may impinge on one or more of the Channel Islands depending on the launch azimuths." The overpressures are estimated to become as high as 30 pounds per square foot and we are concerned that such pressures can be substantial to the point of being disastrous to birds and marine mammals and other species along the firing range.

Chemical concentrations from the Shuttle generated ground cloud can reach levels of exposure resulting--according to the EIS, Part 5, Page 45--in the direct impingement of acid droplets on such organisms as slugs, snails, amphibians and birds' eggs. Such events would be of importance inasmuch as isolated populations of endangered species such as nesting least terns at Vandenberg Air Force Base or brown pelicans on the Channel Islands could be affected. Another potential ground cloud induced faunal impact would be that indirectly occurring as a result of exhaust constituent induced degradation of vegetative habitat.

The EIS refers in passing to the danger to wildlife of a major spill of hydrazines on the tow route or at the airfield or at Port Hueneme. Impacts on marine organisms would occur in the event of a major fuel spill during hovercraft operations.

The EIS recognizes that the Channel Islands are the most important sea lion and elephant seal rookeries in California waters and the only California nesting colony of brown pelicans occur on these islands. The islands are probably the most significant marine biological area, we might add, available in the nation for a national park. A bill now before Congress, H.R. 7264, would provide park dedication of the islands. The Channel Islands National Monument includes both Anacapa and Santa Barbara Islands and surrounding waters. Navy-held San Miguel Island is the subject of a Memorandum of Understanding between the Navy and Department of Interior to assure protection of the unique quality of this area evidently to be heavily impacted by the proposed project.

The EIS, we believe, presents only the most general indication of the impacts caused by the Shuttle program. We request that more specific research studies be conducted upon the impact upon specific sites, species, and habitats to appraise in the detail required by law such ecological effects as sonic booms and other noise conditions, overpressures, Shuttle generated ground clouds, fuel spills and explosions, and weather modification. These studies should include evaluation of damage to eggs; description of breeding activities; physiological damage to pinnipeds, birds, and other wildlife; impairment of endangered species and critical habitats; degradation of recreation and wilderness values of existing and potential national monument and park areas; and the many other factors neglected in the draft EIS. The overpressure is estimated to be so high as to have a potential impact on certain geological formations in the islands, including those sites penetrated by auklet burrows that might collapse from the impact.

The marine environment and coastal wetland are increasingly being degraded by urban developments. The people of California and the Nation have strongly endorsed effective coastal protective measures. The Carter Administration has reaffirmed this national policy in the President's Environmental Message and in recent Executive Orders on wetland and coastal protection. The Solicitor of the Department of Interior asserts in his opinion of August 1977 that Section 7 of the Endangered Species Act of 1973 unequivocally states that all federal agencies and departments shall insure that activities authorized, funded, or carried out by them do not result in the destruction or adverse modification of critical habitat. The impact upon the habitat of the endangered brown pelican at the rookeries on Anacapa Island, Scorpian Rock, Santa Cruz, and their flight and feeding areas elsewhere in the region should be specifically evaluated and reviewed under the procedures of Interior Department regulations. The endangered least tern and the ecosystem upon which it depends should be similarly researched. Other endangered species along this critical section of the Pacific Flyway and in the transitional zone between northern and southern waters of the Pacific Ocean in the vicinity of Vandenberg Air Force Base and the Channel Islands are undoubtedly also affected by the project as more intensive research would probably reveal. In the vicinity of Port Hueneme, especially at Mugu Lagoon, are critical habitats that could be impaired by spills and other hazards associated with the Shuttle project.

We would further like to request that the Coast Guard review-procedures under the 4(f) provisions of the Department of Transportation Act be employed to supplement other effective procedures as a means of guaranteeing the most thorough possible evaluation of the Shuttle project.

I thank you.

COLONEL ALLEN C. SMITH--Presiding Officer

Thank you very much, Mr. Hartman. We appreciate your comments.

Our next speaker is Mr. Tu Blu Jays, I believe the name is, a representative of the Traditional Chumash Indian Tribe, in Santa Ynez, California.

I might remind everybody, while our next speaker is approaching the podium, that if you would like to present a written statement....Mr. Hartman had a letter he was reading from--sir, if you could step around over to the podium if you can make your way across the front up there, that will be alright--....that if you will present the statement to me....apparently you are reading from a letter.... I will be happy to mark it as an exhibit and attach it to the transcript that will be forwarded to the Office of the Secretary of the Air Force for consideration in the decision-making process.

Welcome, sir.

[MR. TU BLU JAYS
P.O. Box 65
Santa Ynez, California]

MR. TU BLU JAYS

I will try to read this in five minutes.

The following is for a matter of public record. It is a policy statement regarding religious attitudes of Traditional Chumash People toward proposed construction at Vandenberg Air Force Base. It was presented to the United States Air Force officials, civilian contractors, and interested people in the Vandenberg Air Force Base area, prepared by Traditional Chumash People.

Preface. Traditional Native People accept the responsibility for the future and past of their people. Their activities are guided by the future of the old ones, the children here today, the children yet unborn, as well as native people passed on.

Without the use of alcohol or drugs, the traditional people carry on their daily life with the hope that the future of the children and old ones be made secure by having a safe place to live and learn the teachings of the old ones, so as to have a better understanding of the meaning of their own existence.

Introduction. This is a policy statement by traditional Chumash people, regarding their religious attitudes toward the proposed alteration of the religious and culturally significant tribal land known as Vandenberg Air Force Base.

In attempting to commit traditional religious beliefs to paper, we encounter the danger of those beliefs being misinterpreted or labelled political views, since the values of traditional native people differ from those of most Americans. This is demonstrated by archaeologists, anthropologists, U.S. Air Force officials--as well as civilian contractors directly or indirectly involved with the projects taking place at Vandenberg--who focus their attention on interests which do not correspond with the basic values of traditional native religion.

In traditional Indian thought, all things of the earth are sacred and have a balancing function in the universe. Trees, plants, herbs, animals of land and air, nature's elements, the effects of the sun, wind, and water are all regarded with equal respect. To abuse any of the Great Spirit's expressions would result in the immediate activation of the law of cause and effect. The balance and respect maintained through the practice of traditional ceremonies has not changed and is an integral part of the traditional way of life that has existed for centuries.

The traditional Chumash people who have already passed into another dimension are still affected by the alteration of their religious and cultural tribal land. So it is the responsibility of present traditional Chumash people, as it is of every race of people, to protect the religion of their ancestors as well as their own, right here and now.

For these reasons, various interested traditional Chumash people, including elder religious leaders, joined to discuss their concerns about the archaeological areas at Vandenberg. During these discussions the traditional people voiced complete disapproval of all excavations, because the Chumash religion strictly forbids all unearthing of Indian materials and remains. A violation of this teaching carries a strong premonition of great harm to those persons responsible when the unearthing occurs.

Unlike the prevailing non-Indian culture, traditional native people are not concerned with the study of ancient cultures and peoples. Quite the contrary, the excavating, examining, and preserving of ancient tools and bones is totally alien to our thinking and is looked upon as barbaric.

The archaeological community is supposedly concerned with the retrieval of artifacts and remains of human beings for the purpose of understanding the religion and culture of native people--an endeavor which traditional people view as amusing. An understanding of religion and culture through its artifacts is still pure guesswork of an unexact science. Only by experiencing the culture directly or through attending traditional ceremonies, without the participation of any foreign religion, can an individual hope to grasp some understanding or meaning of the spiritual teachings and values.

Therefore, the salvage and dating of retrieved artifacts, as stated previously, violates one of the most sacred teachings of traditional native religion. So it would be impossible to sanction the use of archaeologists to excavate and study the various artifacts and burials present in the earth throughout Vandenberg.

The Chumash traditional people fully realize that the archaeological community as well as others connected with the Space Shuttle project will not support these recommendations; however, since the position taken herein is based completely on religious beliefs, the Chumash traditional people can form no other attitude or conclusion.

The areas of proposed impact contain the remains of traditional Chumash people who have been placed in the womb of Mother Earth by other traditional Chumash people in a religious and sacred manner without the use of man-made laws or equipment. Since our religion teaches us multi-dimensional concepts, we know that the dead are not powerless and that the bones and flesh of our ancestors fertilize Mother Earth and should in no way be made to suffer exposure at the hands of people now living. Therefore, we traditional Chumash people refuse to have any part in breaking the seal on any burial or village site. We do not wish to violate our teachings and religious values or bring harm to any people through such action.

As far as the animals are going, the herbs and all that stuff, that includes the pelican and the peregrine falcons, who have an important role in our religion, the feathers and beads and stuff used for headdresses and everything like that, they are also associated with us. The northern fur seals, stuff like that, is also of concern. That's all.

COLONEL ALLEN C. SMITH--Presiding Officer

We thank you very much, sir. Once again, if you would like to submit a written statement, I can mark it as an exhibit and attach it to the transcript.

Our next speaker this evening is a Mr. Charles Carmichael, representing the Lompoc Valley Economic Development Association. Mr. Carmichael, welcome.

[MR. CHARLES C. CARMICHAEL
205 South H Street
Lompoc, California]

MR. CHARLES C. CARMICHAEL

Thank you, sir.

I think to properly view the Space Shuttle program as it affects Lompoc, we've got to project our thinking back to approximately 1957 when Lompoc had a population of approximately 5,500, and it had three basic industries at that time--the diatomaceous mines, agriculture, and the military disciplinary barracks.

Shortly after Sputnik and the Department of Defense moved into Vandenberg, the population exploded until about 1965, when we experienced a total valley population of approximately 42,000.

Now, taking away Vandenberg Air Force Base, we have those three original basic industries left to support the area. And I say, now, that we are dependent economically on Vandenberg Air Force Base by well over 60 percent of the dollar income coming into this community. Our unemployment figure is excessively high. We graduate approximately 800 students a year out of our two high schools and a large majority of those students have got to leave this valley to seek meaningful employment or higher education.

I think it would behoove all of us to support this program in every way possible and particularly when you think that many of the existing programs at Vandenberg are due to phase out at some time in the future. If we don't look towards the future and support a program such as the Space Shuttle program, then I believe that we are missing a bet. I believe the Space Shuttle program as it was depicted here today is really an extension of a very exciting future for the city of Lompoc. As you know, we carry the missile as part of our insignia. And over the years I feel that Lompoc has joined hands with the Air Force at Vandenberg and supported their programs out there. The community is pretty well rounded out now, with the exception of some industrial facilities in support of the programs at Vandenberg.

Frequently, I believe, when these environmental impact studies come out, that we are all prone to read them and say, "Yes, we agree with them." Or in these specific instances of the individuals who have preceded me here, a few of them have some specific objections; and certainly they should be listened to and try to understand their objections on the matter on which they put forth. And I think that in every case the objections can be mitigated. They should be, and I believe that the Air Force will do so. However, I again urge everybody who has a copy of the environmental impact study to take a close look at it; and don't just ignore it and say, "Yes, we support it." Write a letter to the address that was given to you previously and support it in writing as well.

I think that in the future, as this program develops and unfolds, we are going to realize many benefits here in Lompoc as a result of it. And again, I ask all of you to support it if you can in full consciousness. Thank you.

COLONEL ALLEN C. SMITH--Presiding Officer

Thank you very much, Mr. Carmichael. You had marked on the card here that you are going to submit a written statement. Is that correct, sir?

MR. CHARLES C. CARMICHAEL

I will submit a written statement. Not tonight, though.

COLONEL ALLEN C. SMITH--Presiding Officer

Alright. We thank you very much. Our next speaker is Mr. Robert L. Hedlund, Santa Barbara County.

Welcome, sir. We are happy to have you.

[MR. ROBERT L. HEDLUND
1301 West Guava
Lompoc, California]

MR. ROBERT L. HEDLUND--Santa Barbara County Supervisor

Good evening, gentlemen. Thank you. I think my comments will be directed really to questions; and I am hoping that I can get some type of response either in writing or verbally.

First of all, I would like to say that I have had some experience with people having problems with sonic booms--that is, windows cracked, plaster broken--and I'm hoping that there is some kind of a reimbursement fund that will be available to pay for these damages.

In regard to the tow route modification, I am hoping that there will be an archaeologist during the construction phase to catalog and identify any of the artifacts that may be unearthed.

In regard to the marine facility access road, from the diagrams and the slides it appeared that the cut was quite large. And I'm wondering, since this area and the soils there are subject to considerable erosion, if you were planning ground cover for that to mitigate that particular problem.

In regard to the total facility, I'm wondering what are your water requirements. This area is one that lacks water. So we are hoping that if you are using considerable amounts, that you would use reclamation methods so that we would have an adequate percolation back into the ground water system.

In regard to the ground cloud. When you were discussing the launch pad you did mention that a human could be within that cloud for a period of ten minutes,

I believe, and there was up to a maximum of seven parts per million of hydrogen chloride. However, you also stated that there was aluminum oxide but you did not relate that to the health. And I'm wondering if there is a health factor there.

In relation to the socioeconomic impacts, you again on the chart, you stated that there was 387 million dollars involved during the construction process and 1.1 billion during the operations process. And I'm assuming that the operations figure includes the Shuttle itself. And I'm wondering if that is a legitimate dollar amount to show for actually pumping into the economy of this particular area rather than to where that Shuttle was constructed.

Also, you stated that there was, during the construction phase, 910 people involved, at the 387 million. That would decrease during the operations period to 350 people directly involved. Yet, again, it was a 1.1 billion increase. So I'm wondering what the situation there is to cause that.

I think probably the most important thing I'm concerned about is that, as Mr. Carmichael mentioned previously, the Lompoc Valley has experienced a gigantic increase or a boom. And then we also experienced a decrease and it was an economic and social disaster. I am hoping fervently that this particular project will not allow or will not provide this particular community to experience that situation again.

Lastly, in regard to your draft environmental impact study. In relation to what the county is doing environmentally and planningwise, has your environmental impact study been coordinated with the LNG project on Point Conception? Has it been involved in the comprehensive plan for Santa Barbara County? Have your officers been involved with the Citizens' Advisory Group to the comprehensive plan to inform them and assist them in understanding exactly what you are doing, and also to hopefully bring it into conformance with what the county is planning?

Gentlemen, that's the only questions that I have. And I'm hoping very much that you will work your hardest to bring the Shuttle project to fruition and provide this community with a very good military project and it can also be a very good technical project, and there will be, I'm hoping, a lot of spinoffs on that. Thank you very much.

COLONEL ALLEN C. SMITH--Presiding Officer

Thank you very much, Supervisor Hedlund. We appreciate your comments and your questions. I'm going to ask that the members of the panel up here hold off on answering for just a few moments. I only have one or two more speakers on the list here. We would like to take them first.

The next speaker that I have is a Marjorie Cushman and I have here a written statement only. Mrs. Cushman, did you desire to make an oral statement? [pause] Apparently there was a response. I didn't hear it.

[MRS. MARJORIE CUSHMAN
300 North Los Angeles Street
Los Angeles, California 90053]

MRS. MARJORIE CUSHMAN

I said no.

COLONEL ALLEN C. SMITH—Presiding Officer

Alright. If you could get your written statement to me at any time, I'll mark it as an exhibit and it will be attached to the transcript of the proceedings.

The final speaker that I have a card on at the present time is a Mr. Bruce Beebe of 283 Regulus Avenue, Lompoc, California. We welcome you, sir.

[MR. BRUCE BEEBE
283 Regulus Avenue
Lompoc, California]

MR. BRUCE BEEBE

I have at least one question. As a member of our community for the past few years, I have been harassed from time to time with regards to low flying military aircraft practicing at Vandenberg Air Force Base runway. And my question this evening is what will be the anticipated nature of aircraft activity during the Space Shuttle operations? Is it possible to get an answer now?

COLONEL ALLEN C. SMITH--Presiding Officer

Well, once again, I would like to hold off on answers. We will be just a few moments more.

MR. BRUCE BEEBE

Okay. I'll ask another question then. With regards to the disposal of fuel from the Space Orbiter, could you please specifically tell me how the fuel will be discarded. Do you have a site in mind? How will it be discarded? That is my second and last question.

COLONEL ALLEN C. SMITH--Presiding Officer

Alright. Thank you very much sir, for the questions. I have no other cards filled out indicating that people desire to give statements or make comments at this time for the record. In the event that you do, I'll call again for statements or comments later on in the evening, assuming that the questions don't take up all of the remaining time period that we have. If you desire to make a statement or a comment, please raise your hand and someone will be there shortly to give you one of the cards. Please fill it out. It will be presented to me and we will call you to the podium to make your comment.

Now, the third part of the program this evening is questions from the audience. And the team of Colonel Jones and other personnel here at Vandenberg Air Force Base will give answers to those questions. We are now ready to begin with that. Colonel Jones, you have a series of questions from the last two speakers. Would you like to start off answering those before we start taking other questions?

LT COLONEL EARL H. JONES, JR --Project Officer

I would like to say that on the stage here we have representatives of the various Air Force organizations involved with the Shuttle program who will field your questions. We have, next to me, Mr. William Fick, who is representing 4392nd Aerospace Support Group. We have Colonel Edward D. Bailey who is the Deputy Commander, 1st Strategic Division....Chief of Staff, I'm sorry. Of course, then, we have Colonel Joseph Mirth, who is the Deputy Commander of SAMTEC. You have met Colonel Sloan and you have met Colonel Sumner. And we have with us and supporting us right here in our audience several people who have the capability to answer, hopefully, your most detailed questions.

So starting with my conception of Mr. Hedlund's questions, he asked what procedures do we have for processing sonic boom claims. I'm paraphrasing it and if I'm incorrect, please correct me. What procedures do we have for processing sonic boom claims. I would first like to say that the intensities we expect, maximum intensities of sonic booms in the Lompoc area, should not exceed one and a half pounds per square foot. Those low intensities should not cause any structural damage in the area. However, there may be a case where you have

buildings already previously weakened by other reasons--wear and tear. You may get a little plaster cracking or something like that. We do have an existing claims procedure and I think that Major Cline can elaborate further on that.

MAJOR CLINE [seated with the audience]

Yes, sir. There is a procedure within the Air Force that individuals who have claims against the government for sonic boom damage to be investigated through our own local legal office at the base. It's a matter of filling out a form advising our office that you do have a potential claim that you would like to report to them. They send out an investigator and you fill out the proper forms and the claim is processed from that point. So the funds do exist and the system is in existence now.

LT COLONEL EARL H. JONES, JR.--Project Officer

Thank you. The next question by Mr. Hedlund was related to a cut proposed in the Boathouse area. He expressed concern about the size of the cut, the visual impact of that, and asked whether we intend to mitigate that by plantings and seedings. We do absolutely plan to do just that. The photos I showed do not indicate that. The photos I showed up here indicated the cut without that mitigation. The visual impacts, then, we anticipate will be very small after the mitigation program. We do intend to use native plantings, native seeds for that area. We anticipate the impacts will be smaller visually.

The next questions relates to water requirements. And I would like to address this question to Dr. Vomacka. We did address water requirements in the socio-economic report and I think you will find in there that the water requirement is very small. I don't have the specific figures just at my fingertips now. Dr. Vomacka?

DR. DAVID VOMACKA [seated with the audience]

I don't have the numbers at my fingertips either. Was the question related to water requirements for construction needs or water requirements for additional people who might be moving into the community, or probably a combination of both of those?

MR. ROBERT C. HEDLUND--Santa Barbara County Supervisor

I would say a combination.

MR. DAVID VOMACKA

As far as water requirments for the construction project itself is concerned, we do not have appropriate numbers for those. They simply have not been developed yet that I am aware of. The largest single number will probably go into the preparation of concrete for the extension of the runway, unless that is asphalt. Is that now asphalt? I'm sorry. I don't know the current baseline enough. It's been both at one time or another.

LT COLONEL EARL H. JONES, JR --Project Officer

In our report we did make a stab at it. We made a stab at estimating the water requirements. During construction, we estimated the population increase without the Shuttle will require approximately 1900 acre feet of water per year. As far as Shuttle induced growth we estimate here, we say Shuttle induced growth will add 221 acre feet per year to the domestic water demand, of which about 117 acre feet per year will accrue to the North County area, which is basically the Lompoc-Santa Maria area. During the operations phase, the per capita domestic water consumption, based on 100 gallons per day in the North County--you know, without the Shuttle program--the North County will need some 1482 acre feet. And we only estimate some additional 18 acre feet more than the construction requirements, or an increased demand of some 135 acre feet during the operations phase per year. The 1900 acre feet was without Shuttle and we indicated 117 acre feet was additional Shuttle demand during construction.

The next question, if I recall it, related to hydrogen chloride and aluminum oxide. I would like to correct Mr. Hedlund in that I think we said that the standards indicate that a one time peak exposure public emergency limit of seven parts per million of hydrogen chloride. Our estimates are, based upon mathematical approximations of that, that [the] peak level would not exceed two parts per million. So, far below the public emergency limit requirements. As far as the time exposure short term limit of ten minutes, this is the standard of ten minutes, which is allowed. Four parts per million is allowed. That means that you won't smell it and you won't, you know, get any other after-effects from it. And as far as that time exposure, we don't anticipate levels to exceed one part per million. That's compared to the four parts per million that is standard. We have performed considerable studies on plants and wildlife. And other than a few species of flowers that may have some little tip burn, most of the plants are very hardy and require very high levels of high concentrations

of hydrogen chloride before any damages are shown. So we are far below that. And animals would be the same.

On aluminum oxide, I would like to refer the question on aluminum oxide to Dr. Rodrigue, Tetra Tech Corporation.

DR. RAYMOND RODRIGUE [seated with the audience]

My recollection on the expected peak concentrations of aluminum oxide particles in the air as the result of Shuttle generated ground cloud is about 800 micrograms per cubic meter; and this is a peak expected exposure over a ten minute period. Eight hundred! Now, this is to be compared with occupational limits of 10,000 micrograms per cubic meter over an eight hour period. It is also to be compared with the California Air Quality Standard of about 100 micrograms per cubic meter continuously for a twenty-four hour period. So the 800 generated over a ten minute period is much lower than allowable standards for both occupational workers as well as the general public.

COLONEL ALLEN C. SMITH--Presiding Officer

Doctor, excuse me. Are you saying, in effect then, that there is no appreciable hazard or danger from the aluminum oxide that will be generated by blast in effect?

DR. RAYMOND RODRIGUE

In essence, the aluminum oxide can be considered really as nuisance dust and, if up at high levels, as a nuisance to humans and animals. But the levels expected are much lower than those allowed.

LT COLONEL EARL H. JONES, JR--Project Officer

The other question related to the operational cost--comparing the 910 million dollars planned for during the construction and activation period, which extends

from 1979 to 1982, to [the] 1.1 billion during the operational phase, 1982 through 1990--and whether that was a realistic figure if it included the Orbiters. That figure only includes the operational costs of the system at Vandenberg Air Force Base. It does not include other system costs which would include the Orbiter. It does not include those items which will fall under NASA, the NASA responsibilities. Only those operational costs associated with the program operations at Vandenberg Air Force Base.

Also he had a question on employment. Employment indicated the [pause]....the other figure was 800 million for construction [referring to the discussion of preceding paragraph]....employment going from 910 people during the construction and activation period and down to 350. That slide did not indicate that we would drop down to 350 people from construction to operation. It indicated that we would have 350 people added to the existing employment levels at Vandenberg Air Force Base right now. Those employment levels, the total requirement, was also shown on that slide; and the total requirement should [on an] average over the 83 months of operation during that planning period, should be be approximately 1766 people, which represents a 350 increase in employment level at Vandenberg.

Have we looked at the LNG? We have not worked directly with the people planning the LNG. However, we have considered the siting of the LNG and we do consider that site to be compatible with the Shuttle operations. We have accomplished safety analyses. And, based on trajectories we do intend to use, we do not see any inconsistency with the LNG siting and the Shuttle program.

Involvement with comprehensive planning and the Citizens' Advisory Committee. Throughout this program over the last couple of years, we have briefed various community groups, including county and local planning groups. I personally, myself as well as Colonel Sloan, have briefed these groups; have briefed the Environmental Quality Office, County Environmental Quality Office. We have provided information to them. Additionally, we have requested their comments on the environmental statement; and we would hope that those comments on the environmental statement would reflect those consistencies or inconsistencies of the program with the community plans.

I think that sums up all of Mr. Hedlund's questions. If I haven't covered them all, please let me know.

COLONEL ALLEN C. SMITH--Presiding Officer

He asked a question about archaeologists.

LT COLONEL EARL H. JONES, JR--Project Officer

I don't recall. Would somebody repeat that question?

COLONEL ALLEN C. SMITH--Presiding Officer

The question was whether or not the Air Force was making arrangements to employ or utilize archaeological skills in the course of preparing the expansion of the tow route facility and any other facilities where archaeological areas or areas that have archaeological interest may be disturbed.

LT COLONEL EARL H. JONES, JR--Project Officer

We have used professional archaeologists throughout the environmental planning for this program. As a matter of fact, not only have we, in the Shuttle Program, used professional archaeologists, but also Vandenberg Air Force Base has accomplished archaeological surveys as far back as 1971 on this base in coordination with the National Parks Service; and we employed a professional archaeologist from the University of California at Santa Barbara--and he is currently under contract with us in performing archaeological surveys and insuring that we comply with the law and--to complete those requirements required by the law. And that effort is currently underway. We will continue to employ professional archaeologists throughout this program, including construction, especially during the construction period.

Any more? Okay.

I understand the gentleman asked a question concerning the level of aircraft activity generated by the Shuttle program, and I don't have an answer. Does anyone else have an answer?

COLONEL THOMAS SUMNER--Program Director

I'd like to answer that one.

LT COLONEL EARL H. JONES, JR--Project Officer

Okay, Colonel Sumner.

COLONEL THOMAS SUMNER--Program Director

At the present time, the only planned aircraft activity that would be directly connected with the Shuttle project itself would be 747 Shuttle Carrier Aircraft. When we first bring the Orbiter to Vandenberg, it will be necessary to deliver the Orbiter vehicle on top of the 747. If it should become necessary to exchange an Orbiter vehicle with another vehicle at Kennedy or move an Orbiter to Kennedy--we intend to have that flexibility, we will use the 747 aircraft. That will be the only aircraft operations that would be directly involved in the Shuttle flights themselves. Other aircraft operations at Vandenberg, I presume, would go on as usual.

LT COLONEL EARL H. JONES, JR--Project Officer

I think Colonel Bailey has some additional information.

COLONEL EDWARD D. BAILEY

I believe that, as Colonel Sumner said, he mentioned the direct flights in direct support of the Shuttle. We anticipate that there will probably be a slight increase from approximately 160 aircraft landings per month, which we now have, upwards to about 200 a month. That would take into consideration all of the support requirements attendant to contractors and the SAMTEC operations as well as our own support operations. We presently have, and this is outlined in the study, additional operations at the base which take into consideration aircraft making touch and go landings and radar approaches. We don't anticipate any increase in that type of aircraft activity. As a matter of fact, there will be a period of time during the construction phase when that will amost disappear entirely; and the present level of 160 aircraft landing and the operation and then takeoff per month will decrease as the construction actually takes place.

LT COLONEL EARL H. JONES, JR--Project Officer

I would like to refer the question on disposal of fuel to Mr. Fick.

MR. WILLIAM FICK

The last gentlemen asked how we would dispose of fuel taken off of the Orbiter. I presume he meant, when it returned. We have a fuel disposal program now; and exotic fuels are either reprocessed if that's possible--if the conditions are so they can be--or they are sold if there is someone who will buy it. We will sell anything we can dispose of. If no one will buy it, then we pay to have someone take it and dispose of it; and then the criteria [by] which they dispose of it is to dispose of it in a Class A designated facility, wherever that might be.

LT COLONEL EARL H. JONES, JR--Project Officer

If I'm correct, that satisfies all the questions that were raised during the presentations.

COLONEL ALLEN C. SMITH--Presiding Officer

Alright, Colonel Jones. I have one more that was presented to me in writing and it is as follows:

> "My name is Joseph Toomey. I live at 952 La Salle Canyon Road, which is directly adjacent to Vandenberg Air Force Base. I have historically used the water from La Salle Canyon Creek on my small farm. Will there be any adverse effect on my usage of this water?

MR. WILLIAM FICK

There is nothing in the environmental impact statement that would indicate an adverse effect in the sense of contamination at La Salle Canyon.

COLONEL ALLEN C. SMITH--Presiding Officer

How about in the sense of the diminution of the water available, in other words, use of the water in connection with the project itself?

MR. WILLIAM FICK

The Shuttle will not. The water required on South Vandenberg to support the Shuttle will come from the present well fields that exist on South Vandenberg, just as it would have come for the MOL program had it proceeded [and just] as it comes down to the Titan program and all other facilities on South Vandenberg.

As to Mr. Toomey's use of La Salle Canyon water being affected by the Shuttle, I can't see that there would be any; but I don't know what water he is talking about, [that is] if he is talking about water in La Salle Canyon off the base or on the base.

COLONEL ALLEN C. SMITH--Presiding Officer

Apparently, from your answer, it wouldn't matter. There would be no effect on it whatever.

That completes, as far as I know, the questions that have [been] presented by speakers and have been given to me. If we have people in the audience that have additional questions, I think we now have people that are ready to carry microphones for questions. Do we have any additional questions from the audience? If you could raise your hand. [Pause] Apparently we have a question down here, and another one over there.

If you could state your name please and any other information of significance--either address, group affiliation, whatever--it might lend guidance on the question.

MR. LEROY SCOLARI [seated with the audience]

Thank you. I am LeRoy Scolari, 423 North "G" Street, Lompoc, and I am a neighborhood rancher to Vandenberg Air Force Base. There are several items of concern which I raise questions over.

One is the weather modification liability. Suppose we have a launch right at this time of the year when many crops are out and they sustain damage from rain which may have occurred from weather modification, or on the other hand, lose rain because of this?

The second question. Is there any planning for resident evacuations in Overflight Zone A and B as shown in Figure 4.1-A, Page 42, and if so, consideration of just compensation? We had this type of agreement with NASA during earlier programs, and I was just wondering if this is being included in this.

And also, according to the Page 3-51 chart in regards to noise levels, what are the expected hazards in regards to the 108 decibel area?

Thank you.

LT COLONEL EARL H. JONES, JR--Project Officer

Okay. I think as far as the weather modification is concerned, I really can't answer your question as to whether your ranch will experience any modification of weather or not. As I indicated before, whether there will be a weather modification phenomenon is determined by the kind of activity of the particles--aluminum oxide particles--[and] the nature of the effective ice nuclei activity of those particles. We don't know what kind of particles we have or will experience with the Shuttle. We are currently, when I say "we" I mean NASA and the DOD along with the National Oceanographic Atmospheric Administration, we are monitoring some current clouds of Titan launches. As a matter of fact, we just monitored clouds for those launches and we are trying to gather some data to determine the type of particles that make up the aluminum oxide. Whether these particles are active or not and will cause either suppression or whether they will cause increased precipitation in any given area will be basically indicated by whether they will support these activities at certain temperatures. Now, if they do support it and we do find that there will be a weather modification potential that will actually happen as I indicated before, that modification will be very localized. But I can't give you an exact answer now because it will be quite some time before we will have definite answers on it. But if it does occur, we don't anticipate that it will be either prolonged in duration or that it will be very extensive an area of coverage.

COLONEL ALLEN C. SMITH--Presiding Officer

Colonel Jones, I think perhaps what Mr. Scolari is interested in is, let's assume you have a launch on a day that it is not raining but the generation of small particles similar to the silver iodide particles that are used commercially in weather propagation programs and so forth creates a storm or a rain storm on his adjacent ranch land. Perhaps a more cogent question: Is there any program or plan, claims program, whatever it might be, that would compensate him for hay that he has cut that might mold, etc., on the ground? That type of question. Perhaps Major Cline would be the best to answer that.

LT COLONEL EARL H. JONES, JR--Project Officer

Well, since this is a very new phenomenon, if it does occur, obviously we have no claims procedure today. But in anything that can be directly associated with an activity on the base, obviously there would be a claims procedure established in order to handle that. And I think your question on claims procedure also related to evacuation of areas in Zones A and B on the map, which you indicated. Is that correct? On Zones A and B I'd like to refer that to the current SAMTEC safety people. I'm not sure what we do right now, but it would be similar to what's going on right now. I would like to refer that to Mr. Don Benn, who is head of our Safety Office.

MR. DONALD BENN [seated with the audience]

We have a current procedure for developing risk contours for every program and we will do the same thing with the Shuttle program. Section A and B were used before we had this procedure. We mathematically calculate a risk area in which people must be evacuated and we do have an arrangement, the same arrangement we had in the past, for evacuating and compensating people that have to be removed from the area. Because this contour is calculated now and is much smaller than it has been in the past, we haven't found it necessary for a few years to do this. I presume the location of your ranch, the Scolari Ranch, is still in a very safe area. And considering the launch azimuths we are talking about for this vehicle, I don't think we will be causing you to evacuate. However, this is evaluated on every launch, using the current predicted winds and the performance of the vehicle that we are going to work with. At this time I presume you won't be evacuated; but there is an arrangement to compensate if you are evacuated.

LT COLONEL EARL H. JONES, JR--Project Officer

In regard to noise. I did indicate during my presentation that the noise levels expected would be well below the EPA standards. Those EPA standards say that no physiological effects should occur to human beings at noise levels at these frequencies. And we are talking about frequencies in the infrasonic range, which is below 100 cycles per second. Now, at these frequency ranges, any levels below 130 decibels should cause no physiological effects. And the levels we expect from the Shuttle in Lompoc should not exceed 115 decibels, which is below the standard and represents an approximately 10 to 15 decibel increase over the current noise levels associated with the Titan program.

COLONEL ALLEN C. SMITH--Presiding Officer

Alright. I have the address here of Mr. Scolari on a card so that, Mr. Scolari, I think we can say that we will get a written response to you with respect to possible compensation in the event that, as a result of a launch, weather damages crops. So we have the address and there will be a written response in that regard.

There was a question from somebody in this area.

MR. ROBERT PITTMAN [seated with the audience]

Yes. My name is Bob Pittman. I'm a research biologist at UCI and I have been working at Channel Islands for two years now; and I have a couple of questions.

At San Miguel Island right now, the largest pinniped rookery in the world is out there. There are at least six species of pinnipeds that occur there. The largest sea bird colony in Southern California is at San Miguel Island. And in the environmental impact statement it is indicated that San Miguel Island is at least potentially an area of high impact. The potential destruction of wildlife at Vandenberg Air Force Base is probably negligible to the potential for destruction at San Miguel Island. But there is nothing in the environmental impact statement about San Miguel Island at all.

Also, at least two species of birds. It's probable that the entire world population of these two species of birds at one time or another during the year pass the Point Conception area. These are migrating species and they migrate off the point there. At least one of these species of birds, the pink footed sheerwater, migrates in huge flocks; and there is a potential for disaster there. Can we look forward to seeing this situation remedied in a future EIS?

LT COLONEL EARL H. JONES, JR--Project Officer

I would like to say that we have considered the pinnipeds in the EIS. If you reread it again, it is there. We have referred the possible impacts to the pinnipeds to the Marine Mammal Commission which is established in the Marine Mammal Protection Act of 1972 and we have asked for their consultation and assistance in defining the nature of the impacts to the pinnipeds on San Miguel Island. We have not received that consultation yet, but it has been promised to us. We are also, as you know, we are studying the impacts or initiating studies to determine the exact impacts to the avifauna as well as other wildlife on the Channel Islands as well as sonic booms that might impact those islands. We don't know what the impacts are; and I'm sure that nobody else here can tell us what the impacts are. We can speculate a lot, but until we complete these studies to determine the effects of these sonic boom intensities on them, we won't be able to make an exact impact analysis. But when we look at our mission model, we don't feel that the inclinations that indicate those maximum impacts will ever be used in the program. It's very unlikely that those inclinations will be used; so if those inclinations are not used, the impacts will not occur to the islands. Now, if in any case those inclinations are used though, we are also looking at ways in which we can alter the trajectory and other manuevers that may move the sonic boom footprints away from those islands. And we are seriously looking at that, but that also takes study and some time to determine. We are dedicated to trying to figure out any feasible way, short of just cancelling the program altogether, to avoid those islands. And we are going to try to do that. But, at the same time, we are going to see, try to determine, in conjunction with you as well as other people in the scientific community, just what those impacts might exactly be.

MR. ROBERT PITTMAN

Okay. I just have one more question. It is concerning these studies on sea birds concerning the effects of the boom. You have mentioned that there are studies or that perhaps there will be studies. Could you outline these for me, please?

LT COLONEL EARL H. JONES, JR--Project Officer

No, I can't. Other than the outline which we provided last week, we haven't had time to initiate the program yet. The meeting we had last week which you participated in and which Mr. Kelly participated in, that meeting was designed to solicit your assistance in helping us outline such a program. We have those inputs and we are using those inputs to develop a program right now. And we will provide you a copy of the program we outlined and our plans for implementing them.

COLONEL ALLEN C. SMITH--Presiding Officer

Next question.

MR. DON GRIFFITH [seated with the audience]

Since the question of weather modification came up, I thought maybe I could make a couple comments. I'm Don Griffith. I work at North American Weather Consultants in Santa Barbara, California, and we are involved there in cloud seeding programs as well as air quality studies. It is my understanding that the releases from an individual launch of a Space Shuttle would be on the order of 160 to 170 tons of aluminum oxide and you are planning on twenty to forty launches per year. If these particles do turn out to be effectivized nuclei, then they do certainly have a potential of modifying the rainfall. Based on the weather modification experience of the firm I'm working with, I would certainly not necessarily agree that the potential effects of these particles released into the atmosphere would be localized. Based on a research program that we performed in Santa Barbara County in previous years, it looks like the effects of releasing silver iodide particles extended downwind to maybe 100 to 150 miles. Therefore, I might suggest you consider mitigation measures, perhaps consisting of considering launching your launches or timing your launches where they would not coincide with the passage of frontal systems through the area in the wintertime. I suspect you would find no problem in the summertime since there is an absence of natural rainfall in the area. That's more in line of a comment than a question, I guess.

COLONEL ALLEN C. SMITH--Presiding Officer

We appreciate the comment and Colonel Sumner has a comment in that regard.

COLONEL THOMAS SUMNER--Project Director

The launch rate is predicted to be a maximum of twenty a year, not twenty to forty. A maximum of twenty a year. In all probability, I doubt if we will ever be launching into a frontal system because that would pose a problem to the Shuttle vehicle itself. So the effects of going into dense moisture would probably be minimized just based upon the fact that we would be desirous of flying into safe weather conditions with the Shuttle. But I want to correct the

misimpression you might have had about the launch. It's a maximum of twenty a year.

LT COLONEL EARL H. JONES, JR--Project Officer

I'd like to also add that the total tonnage of aluminum oxide you indicated is actually the total emission tonnage we are talking about. Many of those would be particles of a size that would diffuse out very rapidly, and it's a question of how much will actually remain aloft as part of the cloud. Of course, as you know, that's a function of the effects in terms of what kind of effects it will have. We still have a lot of unanswered questions and we are currently attempting to answer those questions.

COLONEL ALLEN C. SMITH--Presiding Officer

Do we have any more questions from the audience? We have a question down here in the center.

MS. AUDREY MARTIN [seated with the audience]

In the environmental impact statement, it says that sonic booms can go up to maximum overpressures of 30 pounds per square foot and I know that normal sonic booms are on the order of one to three pounds per square foot. I would like to know when you start getting structural damage, when you get hearing damage, and what does 30 pounds per square foot mean?

COLONEL ALLEN C. SMITH--Presiding Officer

Could you state your name please?

MS. AUDREY MARTIN

I'm sorry. I'm Audrey Martin. I'm a research biologist from the University of California at Irvine.

COLONEL ALLEN C. SMITH--Presiding Officer

Colonel Jones?

LT COLONEL EARL H. JONES, JR--Project Officer

I'd like to start out, before I turn it over to my colleagues. I'd like to start out by saying and emphasizing that these sonic booms that you mentioned will not impact any populated areas. They will only impact the Channel Islands and, of course, we have already heard the concerns there. There will be no structures and no people other than the few people, of course, who manage the islands. And as far as the physical effects, is there anybody here who can talk as to the expected physical effects of thirty pounds per square foot? [Pause] We can't, so we'll have to provide you a written reply on that.

MS. AUDREY MARTIN

Okay.

COLONEL ALLEN C. SMITH--Presiding Officer

We have a question in the back there apparently, behind you.

MR. JOHN EDWARDS [seated with the audience]

This is just a statement about the effects of sonic booms. There was a test done by the Air Force or NASA and in conjunction with the Air Force; and they used overpressures of 144 psf over people that were in houses; and it blew the windows out, but it didn't really have any effect on the people--the people who were inside of the houses. There were cattle outside. The cattle were not affected. They didn't do any followup studies, so I couldn't really say if they had hearing impairment or anything like that. People became more shell-shocked; and they would anticipate the sonic booms as they came over. But there didn't seem to be any bad physiological damage from it. That was 144 psf with rise times similar to the rise times expected for the Shuttle sonic booms.

COLONEL ALLEN C. SMITH--Presiding Officer

We appreciate the comments, sir. Could you please identify yourself?

MR. JOHN EDWARDS

Yes. I'm John Edwards from Los Angeles, California.

COLONEL ALLEN C. SMITH--Presiding Officer

Thank you, sir. Do we have any other questions? In the very back.

MR. GLEN SEVY [seated with the audience]

I'm Glen Sevy, just a student at Alan Hancock. Can you assure me that sonic booms will not have any more effect than the rockets that are presently sent up that shatter our windows, rattle our doors, etc?

LT COLONEL EARL H. JONES, JR--Project Officer

We don't create any sonic booms in the local area with our current launch programs. The sonic booms that do occur, occur far out in the ocean and at very high altitudes. You may hear occasional sonic booms from maybe a jet aircraft in the area, but nothing occurring at Vandenberg Air Force Base.

COLONEL ALLEN C. SMITH--Presiding Officer

Any additional questions? I don't see any hands up right now. I do have one more card from a gentleman who desires to make an oral statement. A Mr. Paul Wack, who is Assistant Planning Director of the Santa Barbara County Planning Department.

MR. PAUL WACK [seated with the audience]

Sir, can I speak from here?

COLONEL ALLEN C. SMITH--Presiding Officer

Of course.

MR. PAUL WACK

From previous testimony I think there is a little bit of confusion in the organization of county government here. So I'll just clarify the point that the Office of Environmental Quality is responsible for full disclosure documents in the environmental area; and the County Planning Department is the lead agency for all county planning. Related to that specifically, the data contained in your document related to the comprehensive plan has undergone significant modification, both in terms of the participants in the planning process and in terms of the data generated. So we would request that our department be added to your list of contacting agencies so we can get that problem taken care of.

And also of more immediate concern in terms of growth inducement is that there is a rezone study presently pending involving the Lompoc Valley, 134,000 acres, in which the County Planning Department is in the process of hearing bids from consultants to prepare an EIR. And that should have some kind of relationship, you know, to the growth inducement factors of your Shuttle program. It's also rather interesting that, just to show we never leave a stone unturned, is that we have a zone change pending to rezone Vandenberg Air Force Base, for what it's worth, and that's from the U-Zone. Mr. Fick is aware of this and the only purpose of that is that we are in the process of removing all the U-zoning in the area. So I doubt if that will have any kind of impact on your program. Thank you.

COLONEL ALLEN C. SMITH--Presiding Officer

Thank you, sir.

Any other questions or any other comments that people desire to make concerning the program? We can take comments from where you are seated in the audience if you would like, rather than coming to the podium. Apparently no additional questions; no additional comments.

I have a couple of matters to remind you of. First, Colonel Jones and the people present will be around and available to answer informal questions for a few minutes for a short while after the adjournment of the formal hearing.

Next, I remind you that, with respect to written materials, if you desire to have any item attached to the transcript of these hearings, if you could present it to me and I will be available for a few minutes after adjournment as well. For a short time after adjournment. I will mark it as an exhibit and give it to the court reporter; and it will be included in the transcript of the hearing.

Now additionally! If you desire to present a statement, information, or data at a later date and you don't have it available tonight, two alternatives are open. First, if you can get it to the address that I gave you earlier by 3 October 1977--and that address is SAMSO/DEV, Post Office Box 92960, Los Angeles, California 90009. So, statements may be sent to that address. If they arrive by 3 October 1977 they will be attached to the transcript of this hearing. Additionally, you have the alternative of sending statements directly to the Office of the Secretary of the Air Force. The address there would be SAF/MIQ, Washington, D.C. 20330; And you have until the 10th of October 1977 to submit statements to be considered in this matter.

Reference has been made by numerous speakers here tonight and by, I am happy to note, many people in the audience to the environmental impact study. And you have seen people around with the large blue book. Colonel Sloan has one here. Copies of this document are available in your libraries and other academic institutions in the Lompoc general area here. It is a rather lengthy document and it is very very detailed. In the event that you have specific questions, you might find that they are answered by referring to copies of this document.

Once again, any additional questions; any additional comments or statements that anybody would like to make? Have I overlooked anybody that turned in a card and I haven't called?

LT COLONEL EARL H. JONES, JR--Project Officer

May I make a comment? In addition to the environmental impact statement, you will notice, if you read the statement [that] it refers to a reference document. For those of you who feel that there are certain areas in the document that are not adequately covered! For the sake of brevity and being concise, we have tried to eliminate much of the superfluous data that we normally generate to support a statement like this. However, we have included that data in a separate document, which we refer to as a Reference Document to the statement; and if you wish, you can contact the same SAMSO/DEV address for a copy of that document.

COLONEL ALLEN C. SMITH--Presiding Officer

Once again. Any comments, questions before we adjourn the hearing? I don't see any hands up anywhere in the auditorium.

On behalf of the Air Force, I wish to express my thanks and appreciation for all of us to those of you that made comments, presented questions and statements here this evening; and we certainly appreciate your interest in the proposed Space Shuttle project here at Vandenberg Air Force Base. We thank you very much for your participation, and this hearing is adjourned.

[THE PUBLIC HEARING IS ADJOURNED*]

*The hearing adjourned at 2158 hours, 28 September 1977.

RESPONSE TO THE PUBLIC HEARING ON THE
DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE
PROPOSED SPACE SHUTTLE PROGRAM AT VANDENBERG AIR FORCE BASE, CALIFORNIA

GENERAL RESPONSE TO CONCERNS EXPRESSED DURING THE PUBLIC HEARING

Inasmuch as the proposed Space Shuttle program at Vandenberg is part of an advanced state-of-the-art Space Transportation System proposed for this Nation, subjects of apprehension and concern, such as those brought forth in the public hearing, will necessarily evolve as the project moves from initial conceptualization through the planning phase. Extensive planning for this program has been underway since 1969, and throughout the course of this activity, numerous problems of varying concern have arisen. However, it has been an established program policy not only to pursue and define these problems but to develop and incorporate program measures aimed at alleviating the associated concerns.

The Shuttle exhaust ground cloud, for example, became a subject of concern very early in the planning phase. As a result, a number of studies were initiated to gain insight into the problem. Thermochemical studies were carried out, first, to determine the product makeup of the rocket engines' exhausts at the exit planes and, second, to define each product's concentration. Followup studies were similarly undertaken to incorporate afterburning effects in conjunction with the presence of variable amounts of added deluge water. Concommitant with this effort were several development and refinement studies aimed at producing a reliable numerical model exhaust ground cloud subsequent to its discharge and attainment of stabilization height. Studies were also initiated to define biological tolerances to the various rocket exhaust constituents so as to gain insight into the impacts that would likely occur. Supporting this effort have been numerous field reconnaissance studies to seek out evidence of ground cloud biological damage resulting from ongoing missile launching programs. Although information resulting from all of the aforementioned studies has been utilized in arriving at the conclusions presented in the Environmental Statement, further model refinement and biological studies are continuing in an effort to bring final resolution to the issue. To date, it appears as though the concerns related to the direct ground level effects of the cloud's gaseous constituents were somewhat overrated.

The acid rain phenomenon and, most recently, the potential weather modification phenomenon have evolved during the course of prior ground cloud study programs. Studies related to the former have only recently resulted in the spacial definition of the occurrence, were it to occur. Perturbation boundaries associated with the triggering and prolongation of an acid rain occurrence, however, are currently under investigation. The potential for weather modification is also currently under investigation. Supplements to this Environmental Statement will be prepared to inform interested parties of the latest findings in both regards.

Shuttle generated sonic booms are another environmental impact that evolved early in the planning phase. Initial study efforts were confined to defining the required launch inclination and return flight path schedules desired for the Operations phase of the Shuttle program. Subsequent studies were carried out to define abort return flight path scenarios. Meanwhile, investigators were tasked with numerically simulating the various launch and return scenarios so as to define the spacial distribution and boundaries of expected ground level sonic boom overpressures. The results, as displayed in Figure 5.1.2-D through -I, represent the most recent (June 1973) evaluation of this effort. Based on this information, launches to or near the 70° orbital inclination currently represent a project aspect of concern, primarily from the standpoint of sound focusing. However, many of the researchers involved in these Shuttle sonic boom studies feel that the maximum expected sound focusing overpressures of 30 lb/sq ft is an overprediction. Investigations are continuing in an effort to resolve this question. Meanwhile, a study has been initiated to determine the feasibility of varying or altering the launch azimuths of those launches currently scheduled to or near the 70° orbital inclination* so as to move the sound focusing zone to low impact ocean areas. Moreover, studies are planned first to determine if and to what extent faunal behavioral effects will occur on the Channel Islands as a result of exposure to sonic booms, and second to define the consequences of such occurrences. Supplements to this Statement will be prepared to inform interested parties of the latest impact findings. Section 5.1.2.7 of this FEIS has been updated to include an up-to-date analysis of biological impacts expected to

*Of the 129 Shuttle launches currently scheduled for the Operations phase at Vandenberg, only 6 are scheduled to occur at or near the 70° inclination.

occur from Shuttle generated sonic booms in the event that the program and defined overpressures remain unchanged.

GENERAL RESPONSE TO TU BLU JAYS' POLICY STATEMENT*, Page A-29 through A-31

The Space and Missile Systems Organization (SAMSO), United States Air Force at Los Angeles, California, is responsible for development of Ground Support Facilities at Vandenberg AFB, California, in support of the Department of Defense (DOD) Space Shuttle Program. Space Shuttle operations are scheduled to begin at Vandenberg in June 1983.

As part of the environmental planning and impact analysis required by the National Environmental Policy Act (NEPA) of 1969 and the National Historical Preservation Act of 1966 , a comprehensive archaeological survey was accomplished for the Shuttle Project areas. The survey identified some 80 archaeological sites which provide information on prehistoric and historic Chumash settlements along the Vandenberg coastline. This effort was accomplished through the Interagency Archaeological Services, National Park Service in San Francisco and was closely coordinated with the California State Historical Preservation Office.

Initial planning indicated that seven to eight of the sites identified would be unavoidably impacted by proposed construction activities. Efforts to develop a Data Recovery and Mitigation Program required by the Historic Preservation Act were initiated by the Air Force based on guidelines issued by the Advisory Council on Historic Preservation.

The Air Force's commitment to develop alternatives to avoid or reduce impacts has already reduced these impacts from eight to three sites. Disturbance to these also will be limited to areas of least significance.

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*This response pertains to those concerns expressed during the public hearing of which were not specifically addressed in the text of the Final Environmental Statement (FES).

In order to insure that Native Americans are involved in the Data Recovery and Mitigation as well as the impact analysis as early as possible, the Air Force initiated efforts to coordinate with and solicit the input of groups in the Vandenberg region during May 1977. The first such meeting was held on 11 May 1977 and subsequent meetings were held on 10 June 1977, 12 July 1977, and 12 September 1977. These meetings have been designed to orient Native American Groups to the Shuttle Program and archaeological findings to develop alternative plans and mitigations to avoid and reduce impacts to sites, to obtain cultural and religious comments, and to identify a representative cadre of Native Americans who can represent and speak for all the groups concerned.

To date, representatives of the following organizations and councils have participated in these meetings:

Central Coast Indian Council
White Oak Foundation, Santa Ynez Reservation
Quabajai Chumash Association
Candelaria American Indian Association
Santa Barbara County School
Chumash Owl Clan, Santa Ynez Reservation
Red Wind Foundation

The Air Force policy on Space Shuttle archaeological impacts and mitigations at Vandenberg are as follows:

(1) To fully comply with the letter and intent of NEPA and the National Historical Preservation Act.

(2) To fully comply with Executive Order 11593.

(3) To fully comply with guidelines established by the Advisory Council on Historical Preservation.

(4) To comply with State laws to the maximum extent practicable.

(5) To avoid disturbing any site where practicable.

(6) To insure that Native Americans participate in all archaeological surveys, data recovery and mitigation planning, data recovery activities, and coordination meetings.

(7) To insure Native American representation on site during all construction earthmoving activities.

(8) To rebury all artifacts and human remains recovered and to designate an inviolate site on Vandenberg for that purpose.

(9) To allow Native Americans on Vandenberg to perform religious ceremonies at selected sites within the constraints of safety and security requirements.

(10) To delay actual data recovery operations until the U.S. Congress takes final action of FY 79 Military Construction Program.

The Air Force will continue to explore all avenues for mitigating the impact of construction activities on archaeological sites and respecting the religious beliefs of the Native American people with regard to these sites.

RESPONSES TO SPECIFIC QUESTIONS ADDRESSED DURING THE PUBLIC HEARING

A.1 MR. LEROY SCOLARI, pg A-45

As was stated by Major Cline at the public hearing (see page A-37 of Public Hearing Transcript), there is an Air Force established procedure through which individuals can file claims against the government for damages associated with Air Force activities. Such claims, of course, are subject to investigation to ascertain probable as well as responsible cause. Under probable cause, a damaging event not only must be one that doubtless could occur under given conditions existing at the time of the event, but must be ascertained as having occurred and having caused the stated damage. Moreover, the damaging event must be one that did either directly or indirectly occur as a result of an Air Force activity.

Presently, the scientific community has neither proven nor disproven that weather modification could occur subsequent to and as a direct result of a Space Shuttle launch from Vandenberg Air Force Base. Studies are currently underway to resolve this question as it relates to the gamut of possible environmental conditions that might occur at times acceptable for a Shuttle

launch. It is anticipated that, before the first planned launch at Vandenberg, sufficient facts will be available to define an "occurrence window" (should one exist) of a potential Shuttle induced weather modification event. Such information should prove useful in establishing a valid basis for what only can be categorized, presently, as potential future governmental damage claims.

A.2 MS. AUDREY MARTIN, pg A-50

Structural response to sonic boom overpressure is highly dependent (1) upon the structure's location and orientation relative to a propagating boom; (2) upon the structure's size, shape, makeup, manner of assembly, integrity, state of repair, and age; (3) on the form of the overpressure signature and its variation over the structure; and (4) on the frequency response characteristic of the structure or any of its components to the impulse of the overpressure or to induced energy transmitted seismically. Hence, the initiation of structural damage will depend upon the susceptibility of a particular structure to the characteristics of a given sonic boom.

With respect to man-made structures, buildings appear to be most susceptible, with damage apparently being confined to the more brittle secondary structures such as glass and plaster.(A5) McKinley found little evidence to indicate that sonic boom generated overpressures between 1-5 lb/sq ft caused any damage to modern residential buildings other than to plaster or window glass components.(A3) Controlled tests by Parrott in 1962 had demonstrated that window glass can be shattered by sonic booms, but only when the overpressures exceeded 20 lb/sq ft. (A7) Wiggins has produced regression curves showing the probability of glass damage as a function of overpressure; these curves indicate that for an overpressure of 30 lb/sq ft, probable glass damage would be about 0.05 broken panes per pane per sonic boom (that is, one broken pane out of every 20 panes).(A9) The Biomedical Laboratory of the Aerospace Medical Division carried out a series of tests dealing with sonic boom generated overpressures of up to 144 lb/sq ft; they reported that damage to structures was principally confined to glass breakage, plaster cracking, light bulb breakage, and furnishings falling from shelves.(A6) It should be noted that, on an average, glass windows are currently installed to withstand wind pressures of 70-80 lb/sq ft.(A5)

The susceptibility of natural structures to sonic boom induced damage is quite dependent on the degree of vibrational instability or particular structural status of the feature. A general result of terrain tests summarized by the IACO Sonic Boom Panel was that induced particle velocities of about 0.002 to 0.02 in./sec were associated with nominal peak overpressures of 0.5 to 5.0 lb/sq ft.[A2] A logarithmically linear extrapolation of these data would indicate that peak overpressures of 30 lb/sq ft would induce particle velocities of about 0.12 in./sec in any impacted terrain. Considering the area's earthquake history, this represents a much weaker vibration than has recently occurred, or that is likely to occur, during natural seismic events. Crowley et al. state that particle velocity criteria for minor damage to weak residential structures is about 1.0 in./sec.[A1] This is almost an order of magnitude higher than that expected from Shuttle generated sonic booms.

Humans and animals appear to be quite tolerant, physiologically, to sonic boom overpressures. During the aforementioned tests carried out by the Biomedical Laboratory of the Aerospace Medical Division, bioacoustics personnel were exposed (without ear protection) to sonic booms ranging in peak positive pressure from 50 to 144 lb/sq ft. Results showed that some momentary discomfort, fullness, and ringing of the ears were experienced with the more intense booms. In that same study, cinematographically recorded exposures of several nearby groups of cattle and a corraled horse to these events showed that responses were either unrecognizable or consisted of an apparent alerting response accompanied by trotting off a short way.[A6] The National Academy of Sciences states that: "Dozens of individuals have been exposed to sonic boom overpressures from 35 to 120 lb/sq ft with no worse effect than momentary discomfort and slight temporary ringing and a sense of 'fullness' in the ears. The margin of safety is very wide indeed."[A4][A5] White's criteria for effects on young adults applicable to fast-rising, short- and long-duration overpressures in ambient air indicate that the threshold for eardrum rupture is 720 lb/sq ft—almost 25 times the focal overpressure expected from Shuttle launches.[A8] Similar criteria for effects on fauna are unavailable; it is reasonable to expect, however, that hearing damage is not likely to occur as a result of Shuttle generated sonic boom overpressures.

RESPONSE REFERENCES

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A2. ICAO Sonic Boom Panel Report DOC 6694, SBP/II, 12 October 1970; reprinted in Noise Control 1971, Hearings Before the Subcommittee on Public Health and Environment, House of Representatives, 92nd U.S. Congress, June 16-24, 1971. Serial No. 92-30. U.S. Government Printing Office.

A3. McKinley, R.W., "Response of Glass Windows to Sonic Booms," Materials Research and Standards, 4:594-600, 1964.

A4. National Academy of Sciences, Status Report: Committee on SST Sonic Boom, 2 volumes, January 27 and July 21, 1965.

A5. National Bureau of Standards, The Effects of Sonic Boom and Similar Impulsive Noise and Structures, NTIS PB-206 725, NTID 300.12 Environmental Protection Agency, December 31, 1971.

A6. Nixon, C.W., H.K. Hille, H.C. Sommer, and E. Guild, Sonic Booms Resulting from Extremely Low-Altitude Supersonic Flight: Measurements and Observations on Houses, Livestock, and People, AMRL-TR-68-52, Wright-Patterson AFB, October 1968.

A7. Parrott, T.L., "Experimental Studies of Glass Breakage Due to Sonic Booms," Sound, 1:18-21, 1962.

A8. White, C.S., "The Scope of Blast and Shock Biology and Problem Areas in Relating Physical and Biological Parameters," Annals, New York Academy of Science, pp 89-101.

A9. Wiggins, J.H., Jr., "Effects of Sonic Boom" J.H. Wiggins Company, Palos Verdes Estates, California, 1969.

APPENDIX B

COMMENTS FROM

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT CORPS OF ENGINEERS
(Letter dated October 6, 1977)

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
P. O. BOX 2711
LOS ANGELES, CALIFORNIA 90053

SPLED-E

6 October 1977

Honorable John C. Stetson
Secretary of the Air Force (SAF/MIQ)
Washington, D. C. 20330

Dear Mr. Secretary:

This is in response to a letter from your office dated 12 August 1977 which requested review and comments on the draft environmental impact statement for the Space Shuttle Program, Vandenberg Air Force Base, California.

The proposed plan does not conflict with existing or authorized plans of the Los Angeles District, Corps of Engineers. We have no comments concerning the environmental impacts of the proposed plan.

B.1 Any filling in wetlands or waters of the United States and any work in navigable waters will require a permit from the U.S. Army Corps of Engineers as required by Section 404 of the Federal Water Pollution Control Act Amendments of 1972 (FWPCA) and Section 10 of the River and Harbor Act of 1899. Under provisions of Section 404 of FWPCA, any filling of wetlands must be avoided if possible. We suggest that Mr. Charles M. Holt, Chief, Navigation Branch, be contacted at (213) 688-4933, regarding requirements for filing permit applications.

Thank you for the opportunity to review and comment on these reports.

Sincerely yours,

HUGH G. ROBINSON
Colonel, CE
District Engineer

RESPONSE TO COMMENTS FROM
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
-LOS ANGELES DISTRICT-

B.1 No activities currently associated with Space Shuttle deployment at Vandenberg AFB, California, require any filling of wetlands. For any activity that might have impact on navigable waters, permits will be obtained in compliance with the appropriate statute.

APPENDIX C

COMMENTS FROM

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE
SOUTHWEST REGION
(Letters dated September 23, 1977 and June 3, 1975)

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Region
300 South Ferry Street
Terminal Island, California 90731

September 23, 1977

FSW33/RSH

Mr. James F. Boatright
Office of the Secretary of the
Air Force (SAF/MIQ)
Washington, D.C. 20330

Dear Mr. Boatright:

Thank you for sending us a copy of your Draft EIS for the Space Shuttle Program. If you have not already done so, please also send copies and a request for comments to the Office of the Deputy Assistant Secretary for Environmental Affairs, U.S. Department of Commerce, Washington, D.C. 20230. Doing this will ensure that your Draft EIS will receive full and timely consideration by all appropriate components of the Department.

In order to provide as timely a response to your request as possible, we are submitting our comments to you directly, in parallel with their transmittal to the Department of Commerce for incorporation in the Departmental response.

General Comments

C.1 Potential adverse impacts of the Space Shuttle Program on marine mammals should be examined in more detail. The cumulative effects of low level concentrations of HCl, Cl_2, Al_2O_3, and NO_x on pinniped physiology have not been considered. Similarly, visual and olfactory senses may be impaired by the exhaust products even at low concentrations.

C.2 A reevaluation of the adverse impacts of sonic booms and sound overpressures generated during the shuttle ascent should also be considered. The effects of these disturbances on marine mammal populations inhabiting the Channel Islands (especially San Miguel Island) have not been discussed in sufficient detail. These disturbances may cause a change in normal behavioral patterns resulting in massive stampeding towards the water. Substantial numbers of pups could be crushed in any large scale movement of animals. Therefore, the assignment of only "moderate" impact from shuttle induced

1626-77

sonic booms may not truly reflect the potential impact the noise disturbances could have on existing marine mammal populations.

Specific Comments

2.0 Description of the Proposed Action

2.2 Solid Rocket Booster Sequence

C.3 Page 2-18, paragraph 4. Ship berthing facilities necessary for recovery vessels should be described in this section, particularly if new facilities requiring construction are planned.

2.5 Implementation of the Proposed Project

2.5.1 Construction Activitation

C.4 Page 2-47, paragraph 2. Further description of the proposed hovercraft facility and associated offshore structures should be included in this section. Specifically, the dimensions of the concrete loading platform and the type of offshore structures planned for construction should be described in further detail.

3.0 Description of the Existing Environment

3.1 Physical, Chemical, Biological, and Archaeological Environment

3.1.9 Biology

3.1.9.3 Marine Biology

C.5 Page 3-74, Table 3.1.9-6. The California Department of Fish and Game lists the northern elephant seal as rare and endangered and, therefore, should be included in this table.

5.0 Environmental Impact of the Proposed Project

5.1 Physical, Chemical, Biological, and Archaeological Impacts

5.1.1 Construction Impacts

5.1.1.6 Impact on Biology

C.6 Page 5-16, paragraph 3. The size of the area to be impacted as well as the time period necessary for the construction of

the hovercraft landing facility should be included in this section. Without this information any evaluation as to the effects of construction on the existing marine biota is of questionable value.

5.1.2 Operations Impacts

5.1.2.7 Impact on Biology

Page 5-39, paragraph 12. Designating the construction of the offshore mooring structure at the hovercraft landing facility as a beneficial impact is strictly a subjective determination.
C.7 It is true that the placement of riprap material will serve as a new rocky habitat for colonization, however, displacement and burying of the existing sandy beach fauna will also occur.

Page 5-40, paragraph 1. The statement that "biotic disturbances will increase no more than 10 percent (a minor magnitude) over
C.8 current disturbance levels" should be substantiated, especially since operation impacts on marine mammals have not been discussed in detail.

6.0 Alternatives

6.1 Program Planning

6.1.3 Alternative Launch Site

Page 6-3. An alternative utilizing a launch trajectory to the
C.9 west, thus avoiding impacts to the Channel Islands which are important marine mammal habitats, should be investigated.

7.0 Probable Adverse Environmental Effects Which Cannot be Avoided Should the Proposal be Implemented

Page 7-1, paragraph 5. The sonic booms and overpressures associated with the shuttle ascent may have greater than "discernible" or "moderate" impacts on marine mammal species which occur on the Channel Islands. High sound pressure levels may induce a stampede and escape response to the water.
C.10 Should this occur, pups may be crushed by the large scale movement of animals. Similarly, females could conceivably lose track of their pups during these conditions (see attached letter, dated June 3, 1975). The intensity of the sonic booms described in the DEIS may also be potentially deafening to these acoustically oriented animals.

7.2 Suggested Mitigation Measures for Avoidable Adverse Impacts

Page 7-4. The adverse impacts of sonic boom overpressures on
C.11 marine mammal populations could be mitigated by a change in trajectory to a more western direction. This would result in

a reduction in noise level which would occur otherwise over the Channel Islands (particularly San Miguel Island).

Thank you for allowing our agency the opportunity to review this draft EIS. We would appreciate receiving a copy of the Final EIS upon it's issuance.

Sincerely,

FOR/

Gerald V. Howard
Regional Director

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC & ATMOSPHERIC ADM.
NATIONAL MARINE FISHERIES SERVICE

June 3, 1975

Commanding Officer
Pacific Missile Range
Pt. Mugu, California 93042

Dear Sir:

We have received a report from Bud Antonelis and Edward Jameyson, of the Northwest Fisheries Center, Marine Mammal Division, San Miguel Island research station, that at 1453 and again at 1457 hours on May 22, 1975, a sonic boom of high intensity occurred over the western portion of San Miguel Island. These booms were observed to have caused a pronounced distrmbance to the California sea lions on Pt. Bennett rookeries. It was estimated that 75% of all animals on the rookery beaches were alarmed by the booms and subsequently stampeded to the water. California sea lions are pupping on San Miguel Island at this time and disturbances of this type can be expected to increase mortality of the young. Disturbance of this magnitude can be considered a violation of the Marine Mammal Protection Act of 1972 (public law 92-522; section 102), and the regulations promulgated thereunder (section 216.11) copies of which are enclosed. We bring this to your attention not as a threat of legal action but to show cause for our concern. In addition the northern fur seals at San Miguel Island are protected by the Convention for Conservation of the North Pacific Fur Seal, andinternational convention signed by Canada, Japan, the USSR and the United States. The small fur seal colony at San Miguel Island has become recently established and is being intensively protected.

Large concentrations of seals and sea lions in California are found only on those Channel Islands under control of the Navy. This has resulted from the protection fromhuman disturbance afforded by Naval administration. We hope that the Navy will continue to afford protection by reducing or eliminating the sonic booms in the vicinity of seal rookeries in the Channel Islands.

If this should not be possible, operations involving the creation of sonic booms might be scheduled to concide with periods when seals are not pupping or breeding. For San Miguel and San Nicolas Islands pupping and breeding activity occur from 20 May to 20 August for sea lions and fur seals, and from about 20 December to 20 February for northern elephant seals. Thus these 5 months of the year are the most critical, with disturbance having greatest deleterious effects on seal populations. Disturbances outside the pupping and breeding seasons are expected to be of lesser significance. Thus, if operations that create sonic booms could be restricted to the periods 20 August to 20 December and 20 February to 20 May the deleterious effects to seal populations would be minimized.

We thank you for your cooperation in the past and hope that this request will be favorably considered.

Sincerely,

Gerald V. Howard
Regional Director

Enclosures: (Note: copy of Marine Mammal Protection Act with appropriate sections marked.)

cc:
Dr. George Y. Harry, Jr., Director, Marine Mammal Div., NWFC
Cdr. Robert O. Baker, Code 3250-1, PMR

bc: GCx3
C. Fiscus
F35
ADMIN

DWB:mpr

RESPONSE TO COMMENTS FROM
U.S. DEPARTMENT OF COMMERCE
NATIONAL MARINE FISHERIES SERVICE
-SOUTHWEST REGION-

C.1 To our knowledge, data dealing specifically with HCl, Cl_2, Al_2O_3 and NO_x effects on pinniped physiology and visual and olfactory senses do not exist. Yet, with respect to the Shuttle program at Vandenberg, it is doubtful that any problematic impact will occur. As stated in Section 5.1.2.1, expected peak concentrations of HCl, Cl_2 and NO_x at ground level (500 ft above sea level) will be well below the short term public limits (STPLs), and predicted ground level concentrations of Al_2O_3 (a nuisance dust) will not be contrary to State or Federal standards. Considering the distances involved to areas where pinniped species congregate, expected sea level concentrations of these constituents will be no greater than about 20 percent of the predicted maximums. This is well below any concentration levels presently known by researchers (who have dealt with related physiological and sensory effects in studies on other fauna) as representing an impact.

C.2 A discussion on the effects of sonic booms on marine mammal populations of the Channel Islands has been incorporated in Section 5.1.2.7 of the Final EIS.

C.3 Facilities for berthing the SRB recovery ships currently exist at Port Hueneme. No new berthing facilities are planned. However, an existing wharf will be modified to accommodate the recovery operation. Information associated with this proposed modification has been added to Data Brief 2.2-2 in Section 2.

C.4 The proposed hovercraft facility at Vandenberg is no longer being planned. A decision has been made to adopt the Shallow Draft Barge SDB) concept (discussed in Appendix B of the Draft EIS) as the favored method of External Tank delivery to the Base. This EIS has been changed to reflect that decision.

C.5 The northern elephant seal has been included in Table 3.1.9-6 of this Final EIS.

C.6 Refer to Response C.4 above.

C.7 Refer to Response C.4 above.

C.8 The statement in question refers to ground support activities and not to actual operations of the Shuttle. The primary impacts on marine mammals will be effects of sonic booms over the Channel Islands, which are discussed in Section 5.1.2.7 of the Final EIS. The maintenance and support of these ground operations should not grossly affect the resident biota. This can be inferred from the fact that Shuttle ground support activities will actually represent much less than a 10 percent increase over current launch support levels.

C.9 In order for the Shuttle to achieve earth orbit with a westerly launch trajectory, it would first have to be accelerated to a speed which overcomes the earth's easterly rotational speed, and further accelerated to a final speed necessary to maintain orbit. The weight of the additional fuel necessary to accomplish the first feat would be such that carriage of the planned payload weights would not be possible. This would defeat the purpose of the Shuttle program.

C.10 The key word in the statement to which you refer is the word "importance." Reference is made to the discussion (on page 5-2 of this document) which delineates the meaning of the word "importance" when used for purposes of defining an impact. Use of this word relates to the <u>significance</u> of the impact as it relates to the environment as a whole. Matrix 5.0-G on page 5-9 of the FEIS portrays the impact of "ascent through the troposphere" as being of "moderate" importance for non-endangered aquatic fauna and of "significant" importance for endangered species. In view of the newly incorporated discussion (presented in Section 5.1.2.7

of the FEIS) on sonic boom impacts on the Channel Islands' biota, it is felt that these ratings are justifiably reasonable. Reference is made to Response A.2 of Appendix A for a discussion pertaining to potential hearing damage.

C.11 Of the 129 planned Shuttle launches, only 6 will potentially occur on the 70 degree inclination. All others will be at higher inclinations, resulting in (1) a more westerly trajectory with respect to the ground track and, therefore, (2) a reduction in expected overpressure levels over the Channel Islands. Studies are currently underway to assess the possibility of either varying the trajectory so as to move the overpressure focal region downrange or adjusting the trajectory slightly upwards so as to move the focal region westerly. Precise definition of these potential mitigating measures will be made once a detailed flight plan has been defined. These studies are presently scheduled to be completed by December 1978.

APPENDIX D

COMMENTS FROM

UNITED STATES DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES DIVISION
MARINE MAMMAL DIVISION
(Letter dated October 4, 1977)

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

NOAA
NATIONAL MARINE FISHERIES SERVICE, NWFC
MARINE MAMMAL DIVISION
7600 SAND POINT WAY, N.E.
SEATTLE, WASHINGTON 98115

October 4, 1977

James F. Boatright
Deputy Assistant Secretary
Department of the Air Force
Washington, D.C. 20330

Dear Secretary Boatright:

We have reviewed the Draft Environmental Impact Statement for The Space Shuttle Program Vandenberg AFB, California, dated August 1977. We are concerned about the disruptive effect of focused sonic boom and engine noise on the breeding populations of seals at San Miguel Island, California. Your report states that the focused overpressure could approach 30 psf. Focusing of sonic boom overpressure at San Miguel Island appears most severe on the space shuttle launch with inclination angle of 70 degrees (page 5-34A). Apparently given these launch conditions the maximum estimated overpressures will be experienced at or very near San Miguel Island.

We have had a biologist on San Miguel Island during the months of May-September each year since 1969. They have recorded the effects of sonic booms from aircraft and missiles on seals. The startle effect of sonic booms on the animals is considerable, with up to 100% of the sea lions and fur seals (approximately 10,000 animals) stampeding to the water; causing at least temporary disruption of the reproductive social structure. It is not possible for us to know what the boom from a larger overpressure will do, but we expect an even more dramatic startle and stampede reaction
D.1 from the California sea lions and Northern fur seals. Pups are sometimes crushed in the stampedes and are often separated from their mothers. Most pups older than one week of age will eventually reunite with the female; however, if newborn pups are separated from the female, abandonment and death of pups can result. The pups of California sea lions are born from 20 May to 20 June and those of northern fur seals from 1 June to 1 August, thus the most sensitive period is 20 May to 1 August for sea lions and fur seals. If there is flexibility in scheduling shuttle launches, we request that launches which would focus large sonic boom overpressures at San Miguel Island would not occur between 20 May and 1 August.

We originally feared the projected maximum sonic boom overpressure might cause physical damage to seals ear structures resulting in hearing
D.2 impairment. Though reading the proceedings of the 1965 Sonic Boom Symposium (Journal Acoustical Society of America, 39:S1-S80), we find that numans have been exposed to sonic boom overpressures exceeding 100 psf without hearing damage. Therefore we would not expect damage to seals hearing from

a single sonic boom of 30 psf, but are concerned about the possible long term effects of repeated exposure to large overpressures.

Sincerely yours,

George Harry

George Y. Harry, Jr.
Director, Marine
Mammal Division

RESPONSE TO COMMENTS FROM
U.S. DEPARTMENT OF COMMERCE
NATIONAL MARINE FISHERIES SERVICE
-MARINE MAMMAL DIVISION-

D.1 A detailed flight plan has not been defined for Shuttle launches at Vandenberg. However, current traffic projections indicate that, of a total traffic projection of 129 launches at Vandenberg, only 6 would potentially occur at or near the 70° inclination. It is on this inclination that Shuttle generated sonic booms could focus on San Miguel Island. Studies are currently underway to assess the possibility of varying the trajectory associated with this inclination so as to move the focal region away from this island. Precise definition of this potential mitigating measure, however, is not possible at this time. Consideration will be given to your request to schedule launches on this trajectory at times other than between 20 May and 1 August. However, chances are that, of the six currently forecasted launches on this inclination, only one or two might occur between these dates. This is based on the assumption of an even distribution of the six launch events over the operation period (1983 to 1991).

D.2 As stated in the above response, large overpressures on the Channel Islands, specifically San Miguel Island, are expected to occur infrequently in view of current traffic projections for launches at or near the 70° inclination. Assuming an even distribution of these six launches over the operations period, it is probable that the impact would occur no more than once every year. At this frequency, it would appear that the "cumulative effects" impact (about which you are concerned) would be negligible. It is to be noted, however, that factual test data (on seals) specifically supporting this allegation is unavailable. However, some insight on the subject might be obtained from the discussion contained in Response A.2 of Appendix A.

APPENDIX E

COMMENTS FROM

UNITED STATES DEPARTMENT OF COMMERCE
THE ASSISTANT SECRETARY FOR SCIENCE AND TECHNOLOGY
(Letter dated October 21, 1977)
AND
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SURVEY
(Letter dated October 13, 1977)

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Science and Technology
Washington, D.C. 20230
(202) 377-~~5111~~ 4335

October 21, 1977

Office of the Secretary
Department of the Air Force (SAF/MIQ)
Washington, D.C. 20330

Gentlemen:

This is in reference to your draft environmental impact statement entitled, "Space Shuttle Program, Vandenberg Air Force Base, California." The enclosed comments from the National Oceanic and Atmospheric Administration are forwarded for your consideration. Even though comments from the Southwest Regional Office of the National Marine Fisheries Service have been previously sent directly to you, their comments are also attached for your ready reference.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. We would appreciate receiving five (5) copies of the final statement.

Sincerely,

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

Enclosures - Memo from National Ocean Survey, October 13, 1977

Memo from National Marine Fisheries Service, September 23, 1977

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SURVEY
Rockville, Md 20852

C52/JLR

OCT 14 1977

OCT 13 1977

TO: William Aron
Director
Office of Ecology and Environmental Conservation

FROM: Gordon Lill
Deputy Director
National Ocean Survey

SUBJECT: DEIS #7709.24 - Space Shuttle Program
Vandenberg AFB, CA

The subject statement has been reviewed within the areas of NOS responsibility and expertise, and in terms of the impact of the proposed action on NOS activities and projects.

The following comment is offered for your consideration.

E.1 Geodetic control survey monuments may be located in the proposed project areas. If there is any planned activity which will disturb or destroy these monuments, NOS requires not less than 90 days' notification in advance of such activity in order to plan for their relocation. NOS recommends that funding for this project includes the cost of any relocation required for NOS monuments.

FOR REFERENCE MEMO FROM THE MARINE FISHERIES SERVICE

PLEASE SEE APPENDIX C

RESPONSE TO COMMENTS FROM
U.S. DEPARTMENT OF COMMERCE
THE ASSISTANT SECRETARY FOR SCIENCE AND TECHNOLOGY
AND
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
-NATIONAL OCEAN SURVEY-

E.1 Geodetic control survey monuments are indicated on site plans for construction areas. The Corps of Engineers has procedures that are followed for timely modification to NOS if these monuments need to be removed.

APPENDIX F

COMMENTS FROM

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OFFICE OF THE SECRETARY
(Letter dated October 7, 1977)

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

OFFICE OF THE SECRETARY

WASHINGTON, D.C. 20201

AF PREV
The Pentagon
Room 5D431
Washington, D.C. 20330

OCT 7 1977

Dear Sir:

Thank you for the opportunity to review the draft Environmental Impact Statement on the Air Force Space Shuttle Program, Vandenberg Air Force Base, California.

The proposed expansion of the Vandenberg Air Force Base for the purpose of launching the Space Shuttle will probably have no significant effect on the Public Health and Safety of the population in the subject area provided that:

F.1 1) Launches are not carried out more frequently than the stated 208-hour intervals;

F.2 2) Technological advancements or changes are not implemented without a new or amended environmental impact statement; and

F.3 3) No accidents occur. Since this cannot be predicted, we would suggest that contingency plans for emergency water supplies in the event of contamination be addressed in the final EIS, including emergency procedures for evacuation in the event of a transportation mishap. These contingency plans should include the duration of contamination in hours or days (rather than the use of the term - "temporary"), the degradation products of the chemicals involved in various probable scenarios and plans for evacuation and/or provision of temporary shelter and subsistence.

We recognize the anticipated noise problem as well as the sonic boom. The health risk seems to have been minimized through location and choice of flight path.

It has been noted that the decision to proceed with this project at this site has been made and that it may be difficult to incorporate changes in the program at this late stage. We would hope that any
F.4 alterations in the program will be discussed sufficiently early to avoid circumvention of the NEPA process so that we are not faced with the review of a "fait accompli."

Sincerely,

Charles Custard

Charles Custard
Director
Office of Environmental Affairs

RESPONSE TO COMMENTS FROM
DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
-OFFICE OF THE SECRETARY-

F.1 208 hours represents the minimum practical turnaround time between launches. In other words, two successive launch operations could be scheduled within 208 hours of each other. The annual launch rate at Vandenberg is not projected to exceed 20 operations per year. Consequently, the average interval between successive launches during peak activity years would be approximately one launch every 18 days (see Table 2.5.2-1 in the FEIS).

F.2 Air Force regulations require the preparation of addendums or supplements to the EIS if the scope of the Shuttle program at Vandenberg changes, and if that change results in a significant increase in expected impacts or impacts that are controversial in nature. Minor changes and refinements in the project can be expected. Such changes would not merit further description. However, the Air Force will prepare and publish supplements to the FEIS when major changes are considered.

F.3 Land use planning (and existing zoning) for Vandenberg is based on the concept of buffering populated areas from those areas where hazardous operations occur. Over 90 percent of Vandenberg is devoted to open space for this reason. The launch site was selected for its remote location, and transportation routes for hazardous substances (such as hypergolic fuels) have been chosen to minimize the exposure of the general public in the event of an accident. Possible accident scenarios have been prepared and evaluated as described in the FEIS. The public would be excluded or evacuated from areas that are considered hazardous during operations. For example, certain downrange areas such as Jalama Beach would be evacuated prior to certain launches. In addition, the Air Force is in the process of developing plans designed to mitigate environmental damage from accidents such as spills or wildfires. Contingency planning to insure public health and safety has been a primary criteria during all phases of the project.

In addition, surface waters on and immediately near Vandenberg are not used for drinking. Considering the current project description, there are no accidents that have a reasonable potential for impacting domestic water supplies.

It should be noted that almost all of the conceivable accidents associated with the project would occur on Base in remote areas, over low populated regions, or over the ocean. Vandenberg Air Force Base does have plans for handling local disaster although the details of these plans go beyond the scope of the FEIS. These plans include the provision of emergency medical service, temporary housing, and subsistence.

F.4 As stated above in Response F.2, the Air Force requires environmental assessments of all significant or controversial impacts that might arise as a result of a change in the proposed project. Air Force environmental regulations have been prepared to comply with the National Environmental Policy Act. These regulations assure that the environmental impact analysis process is not circumvented.

APPENDIX G

COMMENTS FROM

UNITED STATES DEPARTMENT OF THE INTERIOR

OFFICE OF THE SECRETARY

(Letters dated September 13 and November 8, 1977)

V DA supra 2 V

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

-77/865

SEP 13 1977

DCS/P&R
Asst DCS
Executive
Asst Exec
Action
Susp

Mr. James F. Boatright
Deputy for Installations
Management
Department of the Air Force
Washington, D. C. 20330

Dear Mr. Boatright:

This is in response to your request of August 12, 1977, for the Department of the Interior's review and comments on a draft environmental statement to Space Shuttle Program at Vandenberg AFB, California.

This is to advise you that the Department will have comments on the draft statement but will be unable to reply by the date requested since we have just received the documents. Please consider this letter as a request for an extension of time in which to comment. Our comments should be available by the end of October.

It would be appreciated if, in the future, all such requests for review were directed to the Office of Environmental Project Review with all copies of the statement being sent to that office in order to achieve a coordinated Departmental response. Ten copies of such documents are needed.

Sincerely yours,

Bruce Blanchard, Director
Environmental Project Review

11-26-77

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER-77/865

NOV 8 1977

Mr. James F. Boatright
Deputy for Installations
Management
Department of the Air Force
Washington, D. C. 20330

Dear Mr. Boatright:

Thank you for your August 12, 1977, letter requesting our review and comments on a draft environmental statement for the Space Shuttle Program at Vandenberg Air Force Base in California.

2. Description of the Proposed Action

We are concerned with the preservation of cultural resources in the vicinity of the proposal.

The cultural resources sections of the draft statement are inaccurate and need up-dating to reflect potential construction impacts. Final survey and data recovery plans are presently being revised by the Space and Missiles Systems Organization, the Air Force, and the National Park Service's Interagency Archeological Service Office. These groups are working together to resolve any other problems relating to the cultural resources. The final statement should accurately reflect impacts, status or compliance, and mitigation plans.

In addition to the sections of the proposed tow route and runway extension areas discussed in the draft statement, the following areas should be surveyed also:

G.1 1. Project area at Port Hueneme. Page 2-48 discusses two new facilities to be constructed at Port Hueneme that could adversely affect cultural resources, if any are found to be present. Although existing records do not document any previously located resources, an intensive survey should be conducted to confirm the presence or absence of significant cultural remains.

1626-77

2. Nearshore area proposed for construction of mooring structure. As stated on page 5-17, the possibility exists
G.2 that submerged cultural resources may be disturbed during mooring operations. An archeologist, knowledgeable about underwater conditions in the area, should be consulted concerning the necessity for an underwater investigation.

3. Alternate tow route sections. In addition to the unsurveyed two route section, the two alternate tow route
G.3 sections should be surveyed. All other aspects being equal, we recommend the alternative that would have the least impact upon significant cultural resources be selected.

The disposal of water from the flame trench that is not
G.4 recycled (see page 2-35) and that may contain significant concentrations of toxic substances should be discussed.

3. Description of Existing Environment

We believe the possibility for significant impact to the resources of the Channel Islands from sonic boom over-pressures has been understated. The Channel Islands contain extremely fragile outstanding biological resources, including one of the largest pinniped rookeries in the
G.5 world and one of the major sea bird rookeries in the western United States, housing large numbers of different breeding species. At present Anacapa Island and Santa Barbara Island are designated as a National Monument. Additionally, other Channel Islands have been proposed as a national marine park.

More information on the resources of the Channel Islands should be included in Chapter 3. A list of sea birds which breed on the Islands and estimated population sizes
G.6 should be provided. Rookeries which support large numbers of breeding birds or rare species should be described. The sea bird rookery on Prince Island, which is not mentioned in the draft statement, is of particular importance to several species.

While the pinniped rookeries on San Miguel Island are
G.7 mentioned (see pages 3-66 and 3-77), more detail is necessary. In addition to the species noted, northern fur seals and harbor seals also breed on this island.

Castle Rock, immediately to the northwest, is also a very important rookery. An estimate of populations of different species which bear young on the Island, numbers in the tens of thousands, should be provided to give some indication of the importance of this area.

Geological and archeological resources on the Channel Islands should also be discussed. In particular, the
.8 fragile caliche forest and the roughly 580 archeological sites on San Miguel merit attention.

Under Cultural Amenities, the Channel Islands National Monument should be included. It should be noted that there are 12 structures on Anacapa Island. Many of these structures are eligible for listing in the National Register of Historic Places. If there is any possibility
.9 of impact to these structures, both the State Historic Preservation Officer and the Advisory Council on Historic Preservation must be contacted concerning appropriate mitigating measures.

It is stated on page 3-76 of the draft statement that thus far 80 archeological resources are known to exist within or near the boundaries of proposed project sites. Fourteen of these resources have been evaluated for their National Register of Historic Places eligibility and have been determined by the State Historic Preservation Officer to be eligible for inclusion. From the descriptions included in the 1974 archeological report (Reference 114), it
.10 would appear that many of the remaining 66 identified cultural resources possess qualities that meet the criteria for inclusion. Although not directly affected by the proposed project, in order to ensure that the valuable information inherent in these resources is protected and preserved, the resources should be evaluated for their inclusion in the National Register. The appropriateness of a district nomination for the significant cultural resources in the project area should be considered in consultation with the State Historic Preservation Officer.

Page 3-76 also states that 8 of the identified cultural resources are of particular significance due to their proximity to proposed facilities. Adverse impacts,
.11 resulting from construction of the tow route and hovercraft landing facility, will affect 7 of these resources; however, the nature and extent of impacts to SBa 534 and SBa 539 is not identified.

We understand that the Point Arguello boathouse shallow draft barge option is being considered rather than the hovercraft facility which might impact archeological site SBa 684. Should the latter option be reconsidered, however, it will be necessary to develop plans to mitigate
G.12 adverse construction effects at the site. Regarding operational effects, it is not appropriate to deposit sand from hovercraft clean-up operations on site SBa 684. A more practical alternative would be to select another
G.13 location to deposit the sand, or to consider the feasibility of data recovery at the archeological site.

We are unaware of any specific proposals to cover any sites with paving and, for the present, we do not recommend this
G.14 as a viable option.

4. Relationship of Proposed Action to Land-Use Plans, Policies and Controls

This chapter should include a discussion of proposals to designate the Channel Islands as a national marine park or a marine sanctuary. Five of the Channel Islands, including San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Santa Barbara, are included in the Act sent to the Congress under the General Authorities Act (S. 3430) as a site which may have potential for inclusion in the
G.15 National Park System. The National Park Service is studying the Islands at this time. Furthermore, they have recommended that these islands and the area eight miles out to sea from each Island be designated a marine sanctuary. The State of California has issued a more encompassing proposal, including 3 additional islands - San Nicholas, San Clemente, and Santa Catalina - and offshore waters extending 12 miles from each island.

5. Environmental Impact of the Proposed Project

Impacts to the resources discussed in the previous paragraphs should be included in this chapter. We question the judgment that impacts on breeding bird and
G.16 pinniped populations would occur only "to some minor extent" (page 5-45). It should be noted that pinniped populations are extremely sensitive to human disturbance.

G.17 It is possible that a loud sonic boom would startle adult populations and cause trampling of the pups. Disturbance of sea bird colonies during the nesting season causes many sea birds to fly off the nest, allowing gulls to rush in and eat their eggs and chicks. The scientific literature provides other examples of negative impacts of aircraft noise on bird populations. We are also concerned as to the possible impact of acid rain, resulting from hydrogen chloride in the exhaust, on island flora and fauna, particularly bird egg shells, and would like more information about this discussed in the final document.

G.18 The possible impact of sonic booms to cetacean populations concerns us also. Large dolphin populations are found immediately east of San Miguel Island, near the focal point of a sonic boom resulting from Vandenberg Air Force Base shuttle launches on a 70° inclination (Figure 5-1.2-d). It is possible that sonic booms could also impact migrating whale populations. More information should be provided regarding the relationship of whale migration paths to areas which would be affected by large sonic boom overpressures and the possible impacts which might occur.

G.19 Figure 5-1,3-g should be replaced with an accurate detailed figure since it is impossible to determine from the present one to what degree, if any, the Santa Ynez Indian Reservation would be impacted by sonic booms.

G.20 Section 5.1.2.8, Impact on Archeological Resources, should also mention possible impacts to archeological sites on San Miguel. Some of the sites are located on eroding cliffs or steep, unstable inclines and could be disturbed as a result of sonic booms.

G.21 Consideration of potential damage to sand castings of ancient trees in the caliche forest on San Miguel Island and possible impacts to historical structures on Anacapa Island from sonic boom overpressures should be discussed in this chapter also.

7. Unavoidable Adverse Impacts

We feel that, unless more evidence is provided to the contrary, possible impacts to the pinnipeds and sea
G.22 birds which breed on the Channel Islands should be considered "significant and substantial in importance" and not "discernible to moderate in importance" (pages 7-1 and 7-2).

We would hope, however, that mitigating measures can be developed to decrease the intensity of sonic boom overpressures which would occur over the Islands. Preferable possibilities would include using an inclination large enough so that the focal point would be to the southwest of the Channel Islands or in some other way altering the
G.23 ground track so sonic booms resulting from launching will not occur over the Islands. Another possibility would be to schedule any sonic booms over the Islands in the fall, from October to early December, when pinnipeds and sea birds are least active in bearing young. Migrating whale populations and those of other marine mammals, however, might continue to be affected at this time.

We hope these comments will be of use to you in preparing the final environmental statement.

Sincerely,

Larry E. Meierotto

Deputy Assistant SECRETARY

RESPONSE TO COMMENTS FROM
U.S. DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY

G.1 As is stated in Section 7.2 of this statement, Space Shuttle Environmental Protection Plans (EPPs) are being developed, and impact mitigative measures are being incorporated into facility design criteria. Moreover, a qualified environmental engineer will be present onsite to oversee this effort during the construction phase of the program at Vandenberg as well as Port Hueneme. Backing this effort will be a qualified archaeologist who will be available to support this effort on an on-call basis. In the event that cultural resources are located at Port Hueneme during the various phases of the Shuttle program, actions detrimental to the find will be halted until examination and appropriate mitigation of possible impacts can be accomplished by qualified personnel.

G.2 The p oposed hovercraft facility at Vandenberg which included the mooring structure is no longer being planned. A decision has been made to adopt the Shallow Draft Barge (SDB) concept (discussed in Appendix B of the Draft EIS) as part of the proposed action. This FEIS has been changed to reflect that decision. As such, the suggested underwater investigation at Surf will not be necessary. However, an underwater archaeology survey has been scheduled for the boathouse area location in support of the Shallow Draft Barge concept.

G.3 Areas for tow routes were surveyed for archaeological sites by a professional archaeologist walking over the proposed tow routes. No sites were found.

G.4 Design specifications for the launch pad call for provision of a method of sampling water properties prior to returning what remains from the 80,000 gallons of deluge water to storage or disposing over grade. The water will

be neutralized to soil pH before discharge. Examination of the possible constituents of the exhaust (see Table 5.1.2-2) shows that no substances of great hazard would be present in the water. Chloride, alumina particulate, iron chloride, carbonate, and possible nitrate would be the main exhaust products in the water; none of these is of any particular hazard biologically. If neutralization is not possible, contaminated water will be hauled to an acceptable disposal area.

G.5 A discussion of sonic boom impacts on the biological resources of the Channel Islands has been incorporated into Section 5.1.2.7 of this FEIS.

G.6 An expanded discussion of the existing Channel Islands environment has been incorporated into Section 3 of the FEIS and includes a detailed bird listing. Reference is also made to information provided by the California Coastal Commission (see letter in Appendix N) and by the University of California at Irvine (see letter in Appendix P).

G.7 More detailed information concerning Channel Island pinniped populations has been incorporated in Section 3 of this FEIS.

G.8 A discussion of the existing geological and archaeological resources of the Channel Islands has been incorporated in Section 3.1 of the FEIS.

G.9 A discussion of the Channel Islands National Monument has been incorporated into Section 3.2.7 of this FEIS.

Reference is made to the discussion on sonic boom related structural damages presented in Response A.2 of Appendix A. Reference is also made to the discussion on the expected frequency of sonic booms over the Channel Islands during the launch program (see Responses D.1 and D.2 of Appendix D). Both the State Historic Preservation Officer and the Advisory Council on Historic Preservation have been contacted for assistance regarding the minor damage to structures on Anacapa Island that could occur from the infrequently expected 2 lb/sq ft overpressures.

G.10 The Air Force will consult with the State Historic Preservation Officer regarding additional archaeological sites to be nominated to the National Register of Historic Places. Vandenberg AFB has a plan in effect to protect and preserve identified archaeological sites.

G-11. Although Site SBa 534 is proximate to proposed facilities, it will not be impacted by Shuttle related construction or operational activities. Impacts to Site SBa 539, however, are expected as a result of tow route construction activities, and information in that regard has been incorporated into Section 5.1.1.7 of this Final Environmental Statement. Section 5.1.1.7 has also been modified (as a result of recent studies) to reflect the fact that Sites SBa 654, 678, 682, and 1128 will not be impacted by proposed Shuttle activities. For additional information dealing with sites to be impacted at Vandenberg, reference is made to the general response (contained on page A-58 of Appendix) to Mr. Tu Blu Jays' policy statement presented in the DES public hearing.

G.12 See above Response G.2.

G.13 See above Response G.2.

G.14 The Air Force has no present plans that require paving archaeological sites. We have been advised by archaeologists that paving over sites may be desirable under certain conditions. The determination as to whether such action is a viable option must be considered on a case by case basis.

G.15 Recent proposals to designate the Channel Islands as a national marine park or a marine sanctuary are discussed in Section 3.2.7 of the FEIS. It should be noted here that, as of this date, these proposals are still pending.

G.16 A more detailed discussion of the anticipated sonic boom impacts on the Channel Islands' biota is presented in Section 5.1.2.7 of the FEIS.

G.17 Information on the expected effects of sonic booms on the biota of the Channel Islands has been added in Section 5.1.2.7 of this Statement.

Floral and faunal impacts associated with acid rain fallout from a Shuttle ground cloud are addressed in Section 5.1.2.7 of the EIS are based on available published material. Information specifically dealing with studied effects on the biota of the Channel Island, however, is presently unavailable. Related studies are currently underway. As new information becomes known, better definition of the potential impacts will be possible.

G.18 A discussion of sonic boom impacts to cetacean populations has been incorporated into Section 5.1.2.7 of this FEIS.

G.19 Figures 5.1.2-D through -I are amended in the FEIS to show the location of Santa Ynez. The Indian reservation is located adjacent to the community of Santa Ynez and is outside the lateral cutoffs for Shuttle vehicle or Orbiter induced sonic booms in all cases.

Data presented in the above mentioned figures are general, but represent the best available information at this time. It should be noted that the sonic boom footprints and overpressures depicted on these figures are considered conservative estimates of the actual overpressures that would occur during Shuttle operations.

G.20 Reference is made to Response A.2 of Appendix A for a discussion on the potential for sonic boom damage to natural features or structures.

G.21 Refer to above Response G.9.

G.22 Refer to Response C.10 of Appendix C.

G.23 Reference is made to Responses D.1 and D.2 of Appendix D for a discussion of potential mitigation measures currently under study as well as current traffic projections and expected frequency of events. A discussion of sonic boom impacts on the marine mammals of the Channel Islands and migrating whales has been incorporated into Section 5.1.2.7 of the FEIS.

APPENDIX H

COMMENTS FROM

DEPARTMENT OF THE NAVY
OFFICE OF THE ASSISTANT SECRETARY
(MANPOWER, RESERVE AFFAIRS AND LOGISTICS)
(Letter dated October 12, 1977)

DCS/P&R
Asst DCS
Executive
Asst Exec
Division
Supp
Info 12 OCT 1977

DEPARTMENT OF THE NAVY
OFFICE OF THE ASSISTANT SECRETARY
(MANPOWER, RESERVE AFFAIRS AND LOGISTICS)
WASHINGTON, D.C. 20360

(B)

MEMORANDUM FOR THE DEPUTY ASSISTANT SECRETARY OF THE AIR FORCE FOR INSTALLATIONS AND MANAGEMENT

Subj: Draft Environmental Impact Statement on the Space Shuttle Program, Vandenberg, AFB, California

Ref: (a) Deputy Assistant Secretary of the Air Force for Installations and Management ltr of 12 Aug 1977

Reference (a) requested review of the Draft Environmental Impact Statement (EIS) on the proposed Space Shuttle Program, Vandenberg AFB, California.

The construction of facilities and the space shuttle operations at the Naval Construction Battalion Center, as shown in the draft EIS, do not reflect the current planning as proposed by the Air Force Space and Missile Systems organization (AFSC) and concurred in by the Navy.

It is therefore requested that the Environmental Impact Statement be revised to include the latest proposals for construction of facilities and operations at the Naval Construction
H.1 Battalion Center by the AFSC in Los Angeles. These proposals, which have been tentatively approved by the Navy, are set forth below for ready reference.

a. Reconstruct wharves B and C, and a Landing Craft Ramp to support the solid rocket booster (SRB) and parachute recovery operations, homeport berthing for the two SRB recovery vessels, and general support for the Naval Construction Battalion Center's port operations.

b. Construction of an SRB high-pressure wash facility near wharves B and C.

c. Construction of an SRB desafing and disassembly facility near wharves B and C.

d. Construction of a Marine Operations Center.

AF/PRE
Dir:
Dep Dir:
Assoc:
Dep Constr:
Exec:
/Exec:
SPO
SCSP:
ACT: V

Everett Pyatt
Principal Deputy
Assistant Secretary of the Navy
(Logistics)

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RESPONSE TO COMMENTS FROM
DEPARTMENT OF THE NAVY
OFFICE OF THE ASSISTANT SECREATRY
(MANPOWER, RESERVE AFFAIRS AND LOGISTICS)

H.1 The latest AFSC proposals for construction of facilities and operations at the Naval Construction Battalion Center are included in Section 2 of the FEIS.

APPENDIX I

COMMENTS FROM

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
(Letter dated October 4, 1977)

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WESTERN REGION
P O BOX 92007 WORLDWAY POSTAL CENTER
LOS ANGELES CALIFORNIA 90009

October 4, 1977

Office of the Secretary
of the Air Force (SAF/MIQ)
Washington, D. C. 20330

Gentlemen:

As requested in your letter dated 12 August 1977 we have now completed a review of your Draft Environmental Impact Statement (EIS) on the proposed Space Shuttle Program, Vandenberg AFB, CA.

Our findings indicate that this proposed project will not present any problem from an environmental viewpoint to any existing or presently planned FAA facilities.

We appreciate the courtesy extended in bringing this matter to our attention.

Sincerely,

W. BRUCE CHAMBERS
Regional Planning Officer

RESPONSE TO COMMENTS FROM
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

No response required for these comments.

APPENDIX J

COMMENTS FROM

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD
(Letter dated October 12, 1977)

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS
COMMANDER (mep)
ELEVENTH COAST GUARD DISTRICT
UNION BANK BLDG.
400 OCEANGATE
LONG BEACH, CA. 90822
Phone: 213-590-2301

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OCT 12 1977

Office of the Secretary
of the Air Force (SAF/MIQ)
Washington, D. C. 20330

Dear Mr. Boatricht:

As requested in your letter dated 12 August 1977 the Draft Environmental Impact Statement (EIS) on the Proposed Space Shuttle Program at Vandenberg Air Force Base (VAFB), California dated August 1977 has been reviewed and comments follow.

One of the concerns of the Coast Guard with regard to this project is the reentry of the Space Shuttle Vehicle components and ocean impact/recovery operations. Your Draft EIS stated that the environmental effects associated with these reentry and recovery operations are documented in the July 1972 Final EIS for the Space Shuttle Program, prepared by the National Aeronautics and Space Administration (NASA). A copy of that EIS has been requested, however, it has not been received as yet. In an effort to respond within the 45 days requested in your aforementioned letter, comments (if any) on the reentry and recovery operations will follow separately upon receipt and review of the 1972 NASA EIS.

From the limited amount of information in your Draft EIS regarding the ocean impact/recovery operations we can determine that these operations will impact on marine traffic and of course increase the potential for
J.1 oil spills in the operational area. Although these recovery vessels will have to cross the traffic lanes and this area is especially sensitive to pollution, it is anticipated that if normal mitigating measures are taken significant adverse impacts will be avoided. These operating guides and mitigating measures should, however, be addressed specifically in your EIS.

It cannot be emphasized enough that one of our main objectives is to prevent oil spills and when needed, insure that the most expedient, effective cleanup measures are taken. It is also noted that some of the statements in the Draft EIS sound as though there is no concern for spills that dilute or are flushed out to sea by tidal action. The National policy on pollutants expressed in the Federal Water Pollution Control Act is that no
.2 discharge is acceptable and that a conscious effort must be made to clean up all spills. It is suggested when revising this Draft EIS, that when addressing the topic of degradation of water quality, more quantitative information be included on spill potentials, probability and adverse impacts; and less qualitative adjectives such as minimal impacts, minor contamination, moderate importance and insignificant effects. In addition, exception

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OCT 12 1977

is taken with the term "unavoidable" as it is used on page 5-14. In this context it is felt that there is no such thing as an unavoidable spill; accidental, yes, but not unavoidable.

In addition to the reentry and recovery operations, there are other elements of both the construction phase and the operation phase of this proposed program that represent potential sources of pollution including; construction equipment and operations at Port Hueneme, hovercraft, barge operations and construction equipment of hovercraft landing facility. This pollution potential would also exist if either of the two options (Air Cushioned Barge and Shallow Draft Barge) for delivering External
J.3 Tanks and Solid Rocket Boosters from Port Hueneme to VAFB are adopted. As has been done by other agencies in the past a pollution contingency plan might also be advised in this EIS for spills of lube oil, fuel oils and hypergolic fuels. The intentions here are not to site this potential pollution as a problem to the proposed program but rather to urge you to include further data in this Draft EIS to show how this potential will be dealt with.

The unavoidable adverse impacts of diverting or halting marine traffic around hazardous downrange areas prior to 20 Shuttle launches per year is considered significant. Depending on the inclination taken from the Space Launch Complex sonic boom overpressures resulting from both launches
J.4 and reentries cross the Southern California Traffic Separation Scheme in the Santa Barbara Channel. As stated on page 5-34 of the Draft EIS these overpressures could cause damage to vessels at sea. Because the Coast Guard's expertise does not include effects of sonic booms, it would be of interest to us to know more details about the possible severity of damage to vessels or platforms at sea.

Although every effort will be made to clear the hazardous zone of all craft this could not be guaranteed and therefore, realistic details of worst case situations would seem appropriate. From the Coast Guard point of view the sonic boom overpressures resulting from a launch on a 70° in-
J.5 clination as shown on page 5-34A would have the worst effects on the traffic lanes and parts of Los Angeles Harbor including Coast Guard facilities in that area. Page 3-107 addresses some of the specifics of designating "danger zones". It appears that the Air Force plans on operating in the same manner they do during current space and missile operations. The probability and magnitude of adverse impacts associated with the Space Shuttle program seem to be so much greater than those of missile operations that it might be warranted to look at further ways of insuring the clearing of danger zones.

Page 4-8 of this Draft EIS states that the Air Force has determined this
J.6 proposed project to be compatible with the planned Liquefied Natural Gas (LNG) ship terminal at Point Conception. However, the graphs on pages 5-35 through 5-37 showing overpressure footprints resulting from returns of

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OCT 12 1977

Orbiter to Vandenberg show the proposed LNG site in the area affected by the sonic boom. In addition, there are Coast Guard facilities on Point Conception and Point Arguello that appear to be affected.

It looks as though these sonic booms will also affect areas leased and to be leased by the Bureau of Land Management for offshore oil development. Page 4-8 of this Draft EIS states that the Air Force has also determined
J.7 this project is not in conflict with Outer Continental Shelf development, however, lease sales in certain offshore areas near VAFB have included stipulations that require evacuation of platforms prior to a launch.

Another factor that would be significant when determining the impact to marine traffic would be the amount of time this hazardous zone would have to be kept clear with each launch and reentry including circumstances that
J.8 may affect that time such as poor weather or other factors postponing the launch. Also, in the event of an abort following a launch how much time is there before reentry on both the non-orbital and once-around return of Orbiter to VAFB? What would this mean in terms of delaying marine traffic? Would the Shuttle components (SRBs and ET) be jettisoned the same time as a normal launch and therefore impact the ocean in the same areas?

As briefly mentioned on page 3-38 of this Draft EIS the VAFB region is subject to reduced visibility due to fog. It is felt that the occurrence
J.9 of fog and other adverse weather conditions are significant enough in the Shuttle's marine operational areas to warrant a plan of rules and restrictions for marine operations during these adverse conditions.

For purposes of bridge administration, Coast Guard bridge permits will be required for the construction or modification of any bridge or causeway over a navigable waterway of the United States. Specifically, a bridge
J.10 permit may be required for modification and expansion of the bridge over the Santa Ynez River on the Proposed tow route road between VAFB airfield and the Space Launch Complex No.6. A determination of navigability will be made to determine if the waterways along the tow route are navigable waters of the United States.

The opportunity to comment on this Draft EIS is appreciated. Please forward a copy of the Final EIS to this office when completed.

R. C. HERTICA
Captain, U. S. Coast Guard
Chief, Marine Safety Division
By direction of the District Commander

RESPONSE TO COMMENTS FROM
DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

J.1 Effects of STS operations (including effects and mitigation of ocean impact/recovery operations) on marine traffic are addressed in the National Aeronautic and Space Administration's Draft Environmental Impact Statement dealing with the Shuttle program as a whole.

For a launch azimuth of 158° the relatively small (about 23 NM) circular area for SRB impacts is generally south of Warning Area (W-289) in PMTC Warning Areas A and B and more than 35 NM from the nearest land, e.g., San Nicolas Island. A sector of potential launch azimuths between 158° and 201° will be available to the STS Program. The 23 NM hazard circle will be within that planning sector but along the chosen launch azimuth. For the highly improbable, nonnominal case, the SRB jettison would be at approximately 125 seconds; however, the impact area could vary greatly within the zone defined by the Space and Missile Test Center as safe for impacts. In both nominal and nonnominal (abort) cases, it is highly improbable that any interference would occur with ocean traffic. The area is west of the oil exploration operations on the Tanner-Cortez banks. The W-239 area is routinely used for missile launches and flights, bomb drops, gun-firings, and other hazardous operations which cause surface impacts.

J.2 No statement in the Draft EIS should be interpreted to mean the Air Force is not concerned with spills. During both the construction of facilities and operation of the Shuttle program, extreme care and safety precautions will be taken to prevent accidental spills. Under normal operations, no measurable spills should occur. Accidental spills will be cleaned up to minimize their areal extent, volume, and containment concentration. It should be noted that there are no major sources of marine oil spills associated with Shuttle operations. Vessels will carry fuels and lubricants in support of their own operations, but not for supplying Shuttle-associated vehicles.

The paragraph containing the word "unavoidable" has been revised.

J.3 Pollution contingency plans are being developed as part of the overall Shuttle program. Environmental Protection Plans (EPPs) are a part of facility design specifications and were developed to address mitigation measures for spills associated with probable accidents. Detailed descriptions of spill contingency plans are not available at this time. However, it should be noted that large marine oil and fuel spills are not considered probable Shuttle related accidents. Marine transport of hazardous materials and fuels will not occur during the construction or operation of the proposed project. It is possible that land based spills could be washed to the ocean through local drainages, but the quantities of materials that would likely be involved would be small. As stated in the EIS, land based spills (depending on the type of material spilled) could be dealt with in several ways. These would include chemical neutralization, dilution, and removal of contaminated earth to suitable disposal sites. Containment of land based spills will be discussed in the EPP for the Shuttle program.

J.4 Additional research and study into the magnitude and effects of sonic overpressures are currently underway. Some insight into the potential for sonic boom damage can be obtained by referring to the structural response discussion presented in Response A.2 of Appendix A.

J.5 The Code of Federal Regulations (Title 33-CFR 204.202 and 204.202a) established danger zones along the Vandenberg Air Force Base coastline extending seaward about 3 NM. These segmented, 3-mile wide coastal areas were designed primarily for the safety of small boat operators fishing along the coastline. Very seldom does a sizable vessel venture away from the established shipping lanes to within 3 NM of the coastline near Vandenberg Air Force Base. The at-sea areas around the SRB impact points are more appropriately called "hazard areas" and will be designated as temporary hazard/warning areas in public notices to both mariners and aviators.

In addition to the maritime notices (discussed in forthcoming Response J.8), the hazardous area is searched by aircraft (visual and radar) to

ensure ships are clear. The SRB recovery ships themselves will be radar equipped and able to report any shipping within their range of coverage. A Consolidated Area Summary Position Estimate Report (CASPER) is requested from the U.S. Navy Shipping Data Center in Hawaii prior to each missile launch operation. All ships complying with the Automated Mutual Assistance Vessel Rescue (AMVER) reporting system and/or filing sailing and movement reports as well as other ship positioning indicators are included in the CASPER system.

If, despite all of the aforementioned precautions, surface traffic appears to be entering a highly hazarded area just prior to launch, the SAMTEC operations are held until the ship hit risk is again reduced to a reasonable level. These systems and procedures have been in effect for years in avoiding significant adverse effects on traffic and have provided for safe, efficient, incident free "joint-use" of the broad ocean areas.

J.6 Potential effects of sonic boom overpressures on the proposed LNG site and on Coast Guard facilities at Point Conception and Point Arguello can be extrapolated from the discussion contained in Response A.2 of Appendix A. Overpressures of no more than 2 lb/sq ft are expected to impact these facilities. As such, damage occurrence would be limited (if it occurred) to brittle secondary structures such as glass or plaster.

J.7 The evacuation of platforms in certain areas prior to launch is a precautionary measure. As stated, the Air Force has determined that the proposed project is not in conflict with outer continental shelf development. Sonic booms are one hazard associated with existing and proposed launches from Vandenberg. However, other hazards include exposure to toxic exhaust and debris fallout. It should be noted that Shuttle operations will not result in the designation of any new areas where evacuation of platforms would be required. It should also be noted that lease sale permits allow evacuation at the SAMTEC Commander's discretion, but do not require evacuation as a routine precaution.

J.8 Mariners are advised several days in advance of operations that hazard a specific surface area. If a hazard occurs within a coastal "Danger Zone," that zone will be closed to entry by public notices. Notices to Mariners, HYDROPACS, NAVAREA 12 Notices, LONOTES, Pacific Edition - Daily Memorandum from the Hydrographic Center, and broadcast notices on marine frequencies all advise mariners of the area to be avoided. This advance notice coupled with the relatively small hazard area allows all ships to plan courses around the area with negligible interference to the missile or shipping operations. Prior studies by SAMTEC involving interviews with several mariners from freighters, tankers, and ships of the Military Sea Transportation Service indicate a willingness to accommodate these pre-planned minor deviations that do not add appreciably to sailing time.

In the event of an abort following a launch, surveillance of hazardous ocean areas would continue until such time as the emergency situation poses no threat to the passage of marine traffic. Such a situation would cease to exist once the Orbiter has safely landed. At worst, a once-around return would be carried out within a time frame of about two hours following launch. The duration of a non-orbital return would be slightly less. During either situation, SRBs will be jettisoned at burnout within drop zones that are essentially the same as in a normal flight. The External Tank will be jettisoned only when empty in either the preplanned impact area or in ocean areas nearer to the launch site but situated within the launch corridor where clearance advisory warnings have been issued and surveillance is being maintained.

J.9 Marine operations such as docking and maneuvering in nearshore areas could be hazardous during especially adverse weather conditions. Rules and regulations governing operations during such conditions would be developed prior to the implementation of the proposed action.

J.10 Because no determination has yet been made concerning the navigability of the Santa Ynez River, it is still not clear if a Coast Guard Bridge permit will be required. However, if a permit is required, the U.S. Air Force will submit any necessary applications. The current project description does not include a modification to the 13th Street bridge over the Santa Ynez River. The environmental consequences of the proposed bridge modification on State Highway 246 are discussed in the FEIS.

APPENDIX K

COMMENTS FROM

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

RESPONSE TO COMMENTS FROM
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

As of 14 Dec 1977, Official Comments from Environmental Protection Agency (EPA) had not been received. If comments are subsequently transmitted, they will be reviewed and responded to in the future supplement to this Document.

APPENDIX L

COMMENTS FROM

MARINE MAMMAL COMMISSION

(Letter dated October 6, 1977)

MARINE MAMMAL COMMISSION
1625 EYE STREET, N. W.
WASHINGTON, DC 20006

7 October 1977

Lt. Col. Earl H. Jones, Jr.
SAMSO/DEV
Los Angeles Air Force Station
P. O. Box 92960
Los Angeles, California 90009

Re: DEIS on Vandenburg
Space Shuttle Program

Dear Col. Jones:

The Marine Mammal Protection Act of 1972 recognized that certain species and population stocks of marine mammals are, or may be, in danger of extinction or depletion as a result of man's activities, and established a national policy to protect and conserve marine mammals and the ecosystems of which they are a part. Among other things, the Act states that: "In particular, efforts should be made to protect the rookeries, mating grounds, and areas of similar significance for each species of marine mammal from the adverse effect of man's actions" (Section 2 (2)).

The Act established the Marine Mammal Commission (Section 201), and charged the Commission with overseeing all Federal activities which affect the conservation and protection of marine mammals (Section 202(a)). Pursuant to our responsibilities under Section 202(a) of the Marine Mammal Protection Act, the Commission, in consultation with the Committee of Scientific Advisors on Marine Mammals, has reviewed the Draft Environmental Impact Statement (DEIS) for the proposed Space Shuttle Program, Vandenberg AFB, California, and offers the following comments.

Item 3 on page 7-1 of the DEIS states that:

> Animals, including special interest marine mammal species (pinnipeds) and endangered and threatened brown pelicans on the Channel Islands, will be exposed to sonic booms and sound focusing overpressures generated during the Shuttle ascent. These overpressures could cause damage to eggs and disruption of breeding activities to some minor extent [emphasis added].

L.1

We find nothing in the DEIS to substantiate the conclusion that pinnipeds on the Channel Islands will be affected only "to some minor extent."

San Miguel Island, the western-most of the four northern Channel Islands, is used by six species of pinnipeds for breeding and/or hauling-out. The Commission believes that San Miguel is unique in that it is the only island in the world to carry such a wide diversity of pinnipeds. The Island lies near the northern end of the breeding range of three species and near the southern end of the breeding range of the other three species.

The DEIS states (p. 4-45) that: "Sonic booms and sound focusing events (the latter producing maximum overpressures estimated at 30 psf) will likely impact the Channel Islands on occasional launches." and that "Startle effects are expected to occur from both events." "Startle effects" are not defined and the frequency that launch and landing paths would pass
L.2 over San Miguel Island are not projected. Sea lions and harbor seals are known to "stampede" when "startled", and such stampedes could have a significant adverse impact on populations of these species residing on the Channel Islands. Stampeding sea lions will crawl over pups, crushing them, and repeated disturbance may cause one or more of the species to abandon pups or to abandon traditional haul-out and pupping sites.

Since presently available information is inadequate to determine whether the proposed action will adversely affect pinniped populations on San Miguel Island and the other Channel Islands, we request that you provide us with, and include in the final EIS, definitive information on: (1) the
L.3 frequency, by month and year, with which the sonic booms are expected to impinge on the Channel Islands; (2) the exact levels of sonic overpressure that can be expected on the Channel Islands; and (3) how each of the pinniped species that reside on these islands will react to the expected noise levels.

If the information you provide indicates that there is a reasonable expectation that pinnipeds on San Miguel Island will be adversely impacted, and if the launch and recovery azimuths cannot be controlled to avoid adverse impacts, we will formally recommend, pursuant to Section 202(a)(4) of the Act, that the Space Shuttle Program be shifted to an alternative launch site (re: Section 6.1.3 of the DEIS). If data you provide appear to substantiate the conclusion that pinnipeds on the Channel Islands will be impacted only to a minor extent by the proposed action, we will recommend that monitoring studies be carried out during the life of the Shuttle Program to insure that marine mammals and other marine resources are not adversely impacted.

We also advise you that the proposed option described in Section B.2.0 could adversely affect harbor seals. As noted above, repeated disturbance could cause harbor seals to abandon preferred haul-out and pupping sites and we, therefore, recommend that you determine the importance of the Point Arguello Boathouse area as a harbor seal haul-out site before giving this option further consideration. The results of the harbor seal investigation should be included in the final EIS.

L.4

If you have any questions concerning our comments or expressed concerns, please contact me (202-653-6237).

Sincerely,

Robert J. Hofman, Ph.D.
Acting Executive Director
Marine Mammal Commission

RESPONSE TO COMMENTS FROM MARINE MAMMAL COMMISSION

L.1 A discussion of sonic boom impacts on the biota of the Channel Islands has been incorporated into Section 5.1.2.7 of the FEIS.

L.2 See above Response L.1.

L.3 Reference is made to Figures 5.1.2-D, -E, -F, -G, and -H for best estimates on expected levels of sonic boom overpressures on the Channel Islands. A presentation of exact levels, as requested, is not possible using current state-of-the-art predictive tools.

Reference is made to Responses D.1 and D.2 of Appendix D for a discussion on the expected frequency of occurrence of the anticipated worst-case situations. A discussion of expected impacts on the pinnipeds of the Channel Islands is presented in Section 5.1.2.7 of the FEIS.

L.4 The Point Arguello Boathouse facility is visited by Air Force personnel on almost a daily basis. To our knowledge, this site is not one where pupping takes place nor is it a preferred haul-out location. Seals of various type, including the harbor seal, have been observed within and near the embayment's waters. It would seem reasonable to assume that they do haul out on the nearby shore on occasion. Construction activities, therefore, would discourage this nearby activity for a short period of time (3 to 4 months). Disruption of this activity during the Operations phase would occur no more than 5 times per year (one to two days per occurrence).

APPENDIX M

COMMENTS FROM

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
OFFICE OF POLICY ANALYSIS
(Letter dated November 1, 1977)

National Aeronautics and
Space Administration

Washington, D.C.
20546

DCS/P&R
Asst DCS
Executive
Asst Exec
Action
Susp
Info

Reply to Attn of ADA-1

November 1, 1977

Office of the Secretary
of the Air Force
(SAF/MIQ)
Washington, DC 20330

Dear Sir:

NASA personnel have reviewed the Draft Environmental Impact Statement (EIS), Space Shuttle Program, Vandenberg Air Force Base, California. The following paragraphs represent the consolidated comments of the NASA reviewers:

M.1 1. On pages 1-4, 5-1, and 10-1, the reference made to the NASA 1972 Space Shuttle EIS should be deleted and reference made instead to the July 1977 NASA draft EIS for the Space Shuttle Program (copy enclosed). There may be other places in the USAF draft where reference to the 1972 NASA document is made; in each instance the reference should be changed to the 1977 reference.

M.2 2. On page 5-19, paragraph 3, line 10, it should be noted that the cloud concentrations referred to in this sentence are concentrations at the exhaust cloud center and fall off to zero at the edge in a somewhat gaussian manner.

M.3 3. On page 5-20, table 5.1.2-2 should be replaced with the enclosed table, since it contains the latest values for exhaust constituents produced by solid-fueled propellant units. The values used in this table are those used by NASA in its draft EIS for the Space Shuttle Program, July 1977.

4. On page 5-19a, second sentence, the discussion regarding approximating the concentrations of minor constituents in the ground cloud is obviated when table
M.4 5.1.2-2 is replaced with the enclosed table, as suggested in comment #3. It is thus recommended that the whole paragraph on page 5-19a be deleted with the exception of sentence 1, and that sentence 1 be modified by adding "(see table 5.1.2-2)" at the end of the sentence.

5. On page 5-26 paragraph 1, lines 2, 3, & 4 are somewhat misleading; please rewrite to read "predicted for a hypothetical Shuttle ground cloud washout under
M.5 spring weather conditions at KSC. Some of these prediction curves are for the first droplets only, while others indicate how subsequent droplets become progressively less acidic."

We appreciate the continual consultation with us on this matter and the opportunity to comment on this draft EIS.

Sincerely,

Nathaniel B Cohen

Nathaniel B. Cohen, Director
Office of Policy Analysis

Enclosure

5.1.2-2

TABLE ~~4-1~~.-- EXHAUST PRODUCTS FOR NORMAL BURN[a]

(Percent by weight of nozzle exit plane flow)

Product	Nozzle exit plane	Plane 1 km downstream[b]
SRM (total mass flow ~9400 kg sec^{-1} for 2 motors)		
Hydrogen chloride	21.41	14.18
Chlorine (Cl_2)	.008	1.60
Chlorine (Cl)	.246	.013
Nitric oxide	.001	.989
Nitrogen peroxide	0	.02
Carbon monoxide	24.36	.052
Carbon dioxide	3.33	30.85
Hydrogen	2.09	0
Hydroxyl and atomic hydrogen	.02	0
Nitrogen	8.78	8.26
Water	9.39	28.59
Aluminum oxide	30.32	22.56
Aluminum chloride	.02	.02
Iron chloride	.97	.97
Total	100.0	[c]108.1
Orbiter main engines (total mass flow ~1410 kg sec^{-1} for 3 engines)		
Water	95.9	128
Hydrogen	3.5	0
Argon, nitrogen, other	.6	.6
Total	100.0	[c]128.6

[a]From reference C-2.

[b]Afterburning complete.

[c]Total greater than 100% because of chemical addition of air to form water, nitric oxide, and carbon dioxide.

RESPONSE TO COMMENTS FROM
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
-OFFICE OF POLICY ANALYSIS-

M.1 Reference has been changed as indicated.

M.2 Suggested notation is included in this document.

M.3 Table 5.1.2-2 is replaced with table indicated.

M.4 Sentence has been modified as suggested. Balance of paragraph has been revised to reflect new percentages of minor exhaust constituents as a function of the HCl concentration at any point in the ground cloud at any time after stabilization.

M.5 Specified lines have been rewritten as indicated.

APPENDIX N

COMMENTS FROM

CALIFORNIA COASTAL COMMISSION
(Letter dated November 2, 1977)

STATE OF CALIFORNIA EDMUND G. BROWN JR., *Governor*

CALIFORNIA COASTAL COMMISSION
1540 MARKET STREET, 2nd FLOOR
SAN FRANCISCO, CALIFORNIA 94102
PHONE: (415) 557-1001

November 2, 1977

Major R. Wooten
Department of the Air Force
P.O. Box 92960
Worldway Postal Center
Los Angeles, CA 90009

Subject: Draft Environmental Impact Statement, Space Shuttle Program

Dear Major Wooten:

As agreed upon in discussion October 31, we are forwarding the California Coastal Commission Staff comments on the DEIS directly to your office. The opportunity to comment at this late date is greatly appreciated.

Staff is concerned with the alternative that has apparently been selected for delivery of external tanks to Vandenburg AFB, and with the inadequate consideration given to the effects of sonic booms and sound focusing events produced by Space Shuttle fly overs.

Implementation of the Shallow Draft Barge (SDB) concept, as indicated to staff of the CCC in a meeting with you on October 27, will require extensive excavation of a coastal terrace, as well as blasting and dredging of approximately 4 acres of intertidal and subtidal habitat that support biotic communities considered to be unique because of their abundance, diversity and undisturbed quality. (DEIS, B-28) Under Section 30233 of the California Coastal Act of 1976, the diking, filling or dredging of open coastal waters may be permitted only where there is no feasible less environmentally damaging alternative, and where feasible mitigation measures have been provided to minimize adverse environmental effects. The SDB concept, as presented, is the least desirable of three alternatives discussed in the EIS.

The California Coastal Act of 1976 also requires that marine resources be maintained, enhanced, and, where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance and uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes. (Section 30230)

It appears that due to severe sonic effects during ascent of the Shuttle Vehicle, the maintenance of healthy populations of certain marine organisms as required under Section 30230 of the Act would be severely threatened. Both pinnipeds and seabirds breeding on the Channel Islands are known to be extremely sensitive to disturbance of any sort during critical reproductive stages of their life cycles. The predicted sonic boom overpressures resulting from 70 degree launch azimuths could be as high as 30 psf near the center of the focal zone (San Miguel Island) and 2 at the lateral limits of the zone (Anacapa Island). Santa Rosa Island and Santa Cruz Island would suffer sonic effects somewhere between 2 and 30 psf. Since it is known that typical sonic booms range from 1 to 3 psf, and eardrum damage may occur at 7 psf, the threat to the reproductive potential of several important species is very significant.

According to the Marine Mammal Commission, the Channel Islands and surrounding waters support one of the world's most diverse assemblages of marine mammals. Historically, seal and sea lion populations in the Southern California Bight were much larger. Pinnipeds once bred in great numbers along the southern California mainland coast and still do in areas north of Point Conception where little or no human activity is present. Human activity in southern California has disturbed these marine mammals to such an extent that they no longer breed at their previously established coastal rookeries. Today, seals and sea lions breed and pup almost exclusively on the Channel Islands.

The most thorough study to date of the marine mammals inhabiting the southern California waters and offshore islands is being conducted under the auspices of the Bureau of Land Management baseline studies program, by contract with scientists at the University of California, Santa Cruz, and Irvine. The six-month progress report characterized the pinniped population as follows:

> Many thousand seals and sea lions are found in the Southern California Bight either as year-round residents or as seasonal transients. Major populations of the northern elephant seal, Mirounga augustirostris, the California sea lion, Zalophus californianus, and the harbor seal, Phoca vitulina, pup and breed each year on the rocks and beaches of the Channel Islands. In addition, the northern fur seal, Callarhinus ursinus, and the Steller sea lion, Eumetopias jubata, have the southernmost extension of their breeding range in these islands. With the presence of rare Guadalupe fur seals, Arctocephalus townsendi, an endangered species, the Southern California Bight possesses the largest and most diverse pinniped community in temperature waters.

From census data contained in the above report, major breeding and haul-out areas have been mapped. Highest densities of animals are found on San Miguel Island, where a survey at the peak of the sea lion breeding season found 15,337 pinnipeds, primarily clustered on the west end. San Miguel Island and its associated rocks form the most important pinniped habitat in southern California. Six species of seals and sea lions inhabit the island, and five breed there. According to the U.S. Fish and Wildlife Service, San Miguel Island has an ideal environment for pinnipeds because of its climate and the configuration of its low, sandy beaches. Because it is located where warm and cold currents meet, the island demarcates the southern range of northern species of pinnipeds and the northern range of southern species.

Unquestionably, the greatest known danger to pinnipeds is disturbance during critical periods in their life cycles—breeding, pupping, and nursing.

The four Northern Channel Islands and surrounding waters also provide essential feeding, nesting, and breeding areas for resident and migrant seabirds in the Southern California Bight. These pelagic (open ocean) birds comprise such large species as shearwaters, petrels, murrelets, auklets, and gulls. Some of these birds spend most of their lives on or above the open ocean, coming ashore only in selected areas to breed and nest.

The marine ammmal/seabird baseline studies being conducted under the auspices of the Bureau of Land Management has begun to quantify, for the first time, numbers, species, and habitat requirements of these birds, and to demonstrate the importance of the Channel Islands to their survival. Their six-month progress report characterized the state of aquatic bird populations this way:

> Finally, the avifauna is complex; perhaps 150 species occur more or less abundantly in the Southern California Bight...(but) for many nesting seabirds of the Channel Islands, the present populations are remnants of once much larger populations. The health of the present populations in many cases is not good; disturbance, chemical pollution, predators, and perhaps other factors are resulting in reproductive failure. The future of these populations appears to be in jeopardy, and they should be protected from future insult if they are to maintain viable populations in southern California.

As can be seen from the accompanying figure, according to the California Department of Fish and Game, all of the eight offshore islands in Southern California are major seabird rookeries. The list below, compiled from several sources, shows which bird species breed on each of the Channel Islands.

Island	Breeding Species
San Miguel (Prince Island, Castle Rock Richardson Rock)	Ashoy storm petrel, double-crested cormorant, Brandt's cormorant, pelagic cormorant, western gull, pigeon guillemot, Xantu's murrelet, Cassin's auklet, black oyster catch, snowy plover, Leache's storm petrel, Brandt's cormorant
Santa Rosa	Brandt's cormorant, pigeon guillimot, pelagic cormorant, balck oyster catcher, snowy plover
Santa Cruz (Gull Island, Scorpion Rock)	Ashby storm petrel, brown pelican, pelagic cormorant, western gull, pigeon guillimot, Cassin's auklet, black oyster catcher, Brandt's cormorant, double-crested cormorant, Xantu's murrelet, snowy plover
Anacapa	brown pelican, double-crested cormorant, western gull, black oyster catcher, pelagic cormorant
Santa Barbara (Sutil Islet and Shag Rock)	Ashby storm petrel, double-crested cormorant, Brandt's cormorant, western gull, pigeon guillimot, Xantu's murrelet, black oyster catcher, double-crested cormorant, Cassin's auklet, black storm petrel
San Nicholas (Begg Rock)	Brandt's cormorant, western gull, snowy plover
Santa Catalina (Bird Rock)	western gull, double-crested cormorant, Brandt's cormorant, black oyster catcher
San Clemente (Castle Rock and N.W. Harbor Islet)	western gull, pelagic cormorant, Brandt's cormorant, black oyster catcher

Numerous other sea and shore-associated avian species use the islands and surrounding waters as feeding and resting sites. These include loons and grebes, shearwaters, herons, ducks and geese, rails, plovers, sandpipers, phaleropes, jaegers, auks, and many species of gulls and terns.

We hope that the above information about the Channel Islands and the potential effect of this project on the integrity of its breeding populations of seals, sea lions and
N.1 seabirds will prompt the Air Force to reconsider the propriety of using launch azimuths that would have severe sonic impacts on the Channel Islands without much more consideration of both potential effects and adequate mitigation strategies.

Although the Coastal Commission has been enjoined from exercising the consistency provisions of Section 307 under the Coastal Zone Management Act of 1972, the requirement that Federal activities affecting the coastal zone shall be, to the maximum extent practicable, consistent with approved state management programs is one that we realize the Department of the Air Force has tried to comply with from the beginning on this project.

We appreciate your cooperative spirit, and this opportunity to comment at such a late date.

Very truly yours,

William Ahern

WILLIAM R. AHERN
Ports and Energy Coordinator

RESPONSE TO COMMENTS FROM
STATE OF CALIFORNIA
CALIFORNIA COASTAL COMMISSION

N.1 The matter of launch azimuths has been carefully examined. A review of Shuttle traffic projections indicates that of the 129 total launches over the program life, a potential of only six will follow the 70° inclination. Assuming these particular launches are randomly distributed over the 1983 through 1990 program period, they would be expected to occur less than once per year. Depending upon the duration of critical life cycle stages of pinnipeds, the probability of disturbance by sonic booms may be very small.

Launch trajectories may be adjusted somewhat to move the focal region further downrange. The launch inclination may also be increased, thereby moving the entire focal region away from critical areas of the Channel Islands. Because these measures to alleviate sonic boom overpressures over the Channel Islands depend upon specific performance requirements for each launch, formulation of mitigation must await a detailed flight plan definition. Any modification in this regard will be described in an supplemental to the EIS. Consideration will be given to such measures as the scheduling of those launches planned for a 70° orbital inclination to times that would avoid certain critical biological cycles.

APPENDIX O

COMMENTS FROM

CALIFORNIA COASTAL COMMISSION

SOUTH CENTRAL COAST REGIONAL COMMISSION

(Letters dated October 11 and November 1, 1977)

STATE OF CALIFORNIA EDMUND G. BROWN JR., *Governor*

California Coastal Commission
SOUTH CENTRAL COAST REGIONAL COMMISSION
1224 COAST VILLAGE CIRCLE, SUITE 36
SANTA BARBARA, CALIFORNIA 93108
(805) 969-5828

October 11, 1977

Office of the Secretary of the Air Force
SAF/MIQ
Washington, D.C. 20330

Dear Sir:

As you know the California Coastal Commission was mandate by the People of the State of California under Proposition 20 and the California State Legislature in the 1976 Coastal Act to protect and enhance Coastal Resources and provide for and protect public access to the coast. The State and Regional Commissions have accomplished this through a permit review and analysis process. More recently the Coastal Commission has begun the Local Coastal Programs (LCP's). The local jurisdictions working with the Commission will develop Land Use Plans and Implimenting Ordinances in compliance with the 1976 Coastal Act. The County of Santa Barbara is in the process of doing the Land Use Plan portion of their LCP at this time.

Our concerns and comments are two fold: the protection and enhancement of Coastal Resources and Public Access to the Coast; and the County of Santa Barbara's ability to do their LCP without decisions and land use commitments being made which would prejudice that ability. This Program would appear to have some possible impact on both.

Although Vandenberg Air Force Base is exempt from the 1976 Coastal Act and State Review, we trust that the activities at Vandenberg Air Force Base, particularly the Space Shuttle Program, will be sensitive to these concerns.

We have reviewed the Draft E.I.S. and attended a public hearing on it in Lompoc, California. We request that the following questions and concerns be addressed in the final E.I.S. and development plans.

O.1 1. We are concerned about the sanctity of the Channel Islands habitats and the recreational boating activities in their vicinity. The stated magnitude of the sonic booms (30.0 psf) over the Islands

could have an adverse effect on both. Can the launch azimaths be altered to avoid the Channel Islands? If not how many of the Channel Islands will be effected? Is a closure or evacuation from this area expected?

2. With expected increased tanker traffic, including possible LNG tankers, in the Channel, are launches expected to have impacts such
0.2 as delays or closures? If so, for how long? Has an accident probability been calculated? If it has, what are the chances of an accident?

3. On page 4 - 8 there is a very short paragraph relative to the possible LNG site at Point Conception. LNG due to its extremely hazardous nature is of particular concern locally. This short
0.3 statement doesn't fully evaluate the potential relationship between the possible LNG site and the Space Shuttle Program. Since the likeljhood of Point Conception being the selected site a full evaluation should be undertaken.

4. The frequent or periodic closure of public beaches is unexceptable. This adverse impact could be lessened by not scheduling launches on weekends or holidays and by opening more Federal
0.4 land to public use. The latter would also seem appropriate with an increase in population and potential beach users generated by the Program. What will be the frequency and duration of public beach closures?

5. Weather alterations can have very serious impacts on the agriculture, economy and flora and fauna of the South Coast. This potential adverse impact should be fully understood and presented in public forum prior to exceptance of the Final E.I.S. and
0.5 approval of this project. This question seems to have been too lightly dismissed as an unknown at this time.

We hope our review and comments will prove useful in preparing the Final E.I.S. We are looking foreward to assisting and/or working with you in cooridinating planning efforts on this and future coastal projects.

I would like to request the full and complete Draft E.I.S. on the Space Shuttle.

Sincerely,

Philip G. Berry
Staff Planner

PGB/cm
cc: Madge Strong - State Coastal Commission
Kim Skinnerland - LCP Project Manager,
Santa Barbara County.

STATE OF CALIFORNIA
alifornia Coastal Commission
OUTH CENTRAL COAST REGIONAL COMMISSION
224 COAST VILLAGE CIRCLE, SUITE 36
ANTA BARBARA, CALIFORNIA 93108
05) 969-5828

November 1, 1977

Lt. Col. Earl H. Jones, Jr.
SAMSO/DEV
P. O. Box 92960
Los Angeles, CA 90009

Re: Draft EIS for Space Shuttle Program, Vandenberg Air Force Base

Dear Lt. Col. Jones:

Extention of the final date for submission of comments is appreciated and provides the opportunity for one further statement. This comment is in regard to the abondoned Coast Guard boathouse and pier at Pt. Arguello. Although we cannot disagree with the discussion on page B-32, the boathouse is somewhat unique in Santa Barbara County. Physical appearance of the structure is interesting and attractive. Therefore, the following recommendation is being made:

> Relocation of the boathouse and pier to the left or east would provide for its retention, allowing at the same time, the use as proposed for the barge.

0.6 The proposed cut through the bluff with its direct visual impact could be further mitigated by relocation of the boathouse. The boathouse providing an additional point of visual focus attracting the eye away from the proposed bluff cut. Thus, being more in conformance with PRC Section 30251, Scenic and Visual qualities of coastal areas. The effect is apparent from the before and after photographs used to illustrate the bluff cut.

0.7 There is always the possibility, within the distant future that the land maybe opened to the public. The boathouse, because of its interesting architecture and outmoded use, could become a focal point of public recreation and access. This should also be considered in the review.

Thank you again for the extended opportunity to reply. Your consideration of this and the previous comments is appreciated.

Sincerely,

Philip G. Berry
Staff Planner

PGB/cm
cc: Madge Strong
Kim Skinnerland

RESPONSE TO COMMENTS FROM
CALIFORNIA COASTAL COMMISSION
SOUTH CENTRAL COAST REGIONAL COMMISSION

0.1 San Miguel Island is the only one of the Channel Islands that could potentially be impacted by the expected sound focusing overpressures of 30 lb/sq ft. Other islands such as Santa Rosa and Santa Cruz could be impacted by overpressures of up to 4 lb/sq ft. Anacapa Island might experience overpressures of no more than 2 lb/sq ft. Refer to Responses D.1 and D.2 of Appendix D for a discussion of the expected frequency of these events. Closure or evacuation of these islands will not be necessary.

0.2 The U.S. Air Force has examined the proposed construction and operation of an LNG terminal at Point Conception, and has determined that there will not be a conflict with Shuttle operations. At the present time no accident probabilities have been calculated, but it is believed that the possibility of an accident is extremely remote. This is based on the fact that the launch site is well removed from the proposed LNG site and the fact that marine traffic will have advance notice (through the Notice to Mariners System) of hazardous Shuttle operations. The Notice to Mariners will contain a description of the time and area where hazardous operations will take place. However, transit of marine traffic cannot be restricted through such areas. The duration of Shuttle related operations that might pose hazards to marine traffic will be short--estimated at about 30 minutes. If a ship followed the recommendations published in the Notice to Mariners, it is likely that the maximum delay would be less than an hour. Notice will be published well in advance and in most cases marine traffic could be expected to re-schedule transits through hazardous areas in a manner that would eliminate delays.

0.3 LNG facilities of the type contemplated for Point Conception have been in operation at various locations in the United States, Japan, and other overseas locations for several years without record of any major incident.

A full evaluation has been undertaken by numerous agencies at the Federal, State, County, and City levels of government, various segments of industry, and the scientific community. The results are before the Public Utilities Commission at this time and it appears that the risks of an incident are reasonably low (less than one in ten million).

0.4 Current launch programs require the closure of Jalama Beach an average of 2 or 3 times a year. It is anticipated that this frequency will continue. In order to reduce the adverse impact on the public, launches are planned for weekdays.

0.5 The discussion of Inadvertent Weather Modification (IWM) in the Draft Environmental Impact Statement presents the corporate scientific knowledge presently available on the subject. Potential impacts of IWM are currently under intense investigation by scientists at the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), and the Department of Defense (DOD). The potential adverse impacts, if any, will be fully disclosed in a supplement to the Environmental Impact Statement.

0.6 The current Shuttle baseline concept of delivery is the Shallow Draft Barge at the Boathouse. In order to accommodate the barge, it is proposed to remove the existing pier and boat storage structure. This is necessary in order to locate the landing site as far west as possible and thus benefit fully from wave action protection from the existing breakwater. Locating the landing east of the existing pier structure would necessitate dredging of an area of the beach which has been much less disturbed than the area around the existing pier. From past studies, it is known that this area also possesses a much richer and varied benthic life than the area immediately west of it (closest to the pier). Location of the landing, east of the proposed location, would probably require the extension of the breakwater in order to provide the necessary protection. Such an extension would necessitate significantly more dredging and heavy construction than is currently planned and, consequently, greater environmental disturbance of the entire area.

The visual impact of the proposed cut in the bluff has been a major consideration during the planning process of this facility. Computer programs were utilized to provide accurate before and after impressions of the facility as viewed from offshore. These studies indicate minimal visual impact. The effect will be further mitigated by landscaping the sides of the cut to match existing bluff vegetation. It is expected that the cut in its final state will resemble a small canyon opening i the palisades--many of which occur throughout the area.

0.7 Air Force use of the Boathouse is compatible with future land uses. Recognizing that possibly within somewhere in the distant future this area may become public, all efforts will be made to preserve the cultural integrity of the complex. The main building (the Boathouse) will be fully restored, maintained, and used for the project. The relocation in an easterly direction of the dock and the boat storage building is not considered an acceptable alternative at this time because of the great costs involved and attendant impact on the marine biota resulting from additional dredging and heavy construction.

The Air Force has requested the State Historic Preservation Office (SHPO) to evaluate the Boathouse complex for recommendations under the National Historical Preservation Act of 1966. Based on the fact that an identical complex designed and built at the same time frame, 1934-1936, as the Humbolt Bay Boathouse was nominated, the SHPO has recommended that nomination forms be prepared for the Boathouse complex. The Air Force initiated action through the NPS, Archaeological Services Branch, to contract for a professional historian to evaluate this complex. If it is determined that the Boathouse complex does meet the criteria as a national monument, relocation of the Boathouse and pier will be considered as an alternative for its preservation. One professional group (American Society of Civil Engineers) determined from its evaluation that the structure was not unique or of historical significance.

APPENDIX P

COMMENTS FROM

UNIVERSITY OF CALIFORNIA, IRVINE
DEPARTMENT OF ECOLOGY AND EVOLUTIONARY BIOLOGY
SCHOOL OF BIOLOGICAL SCIENCES
(Letter dated October 3, 1977)

UNIVERSITY OF CALIFORNIA, IRVINE

BERKELEY • DAVIS • IRVINE • LOS ANGELES • RIVERSIDE • SAN DIEGO • SAN FRANCISCO

SANTA BARBARA • SANTA CRUZ

DEPARTMENT OF ECOLOGY AND
EVOLUTIONARY BIOLOGY
SCHOOL OF BIOLOGICAL SCIENCES

IRVINE, CALIFORNIA 92717

3 October 1977

APP FRE

James F. Boatright
Deputy for Installations Management
Office of the Assistant Secretary
Department of the Air Force
Washington, D.C. 20330

(58)

Dear Mr. Boatright:

We are writing to you in response to your request for comments on the draft environmental impact statement concerning the proposed Space Shuttle Program at Vandenberg AFB, California. As employees of Dr. George L. Hunt, Jr. at the University of California, Irvine, we have just completed a three year baseline study of the seabirds of the Southern California Channel Islands (Contract # AA550-CT6-26). This study is part of a multi-million dollar effort funded by the Bureau of Land Management to assess biological activity in the Southern California Bight prior to the development of offshore oil resources. Since the Channel Islands are among the areas to be affected by the proposed project, we feel that our information may be of use to you in evaluating your alternatives.

At present, the United States Air Force is considering deploying a Space Shuttle Vehicle from Vandenberg Air Force Base, in northern Santa Barbara County, and one of the proposed flight paths is a course directly over San Miguel Island. According to the Environmental Impact Statement Draft Summary (EISDS), the main effect to the Channel Islands, and San Miguel Island in particular, will be the sonic booms and sound focusing events produced by the fly-overs. These booms may produce maximum overpressures of 30 lb/ft^2 (psf). Since typical sonic booms range from 1-3 psf overpressure and eardrum damage may occur at 7 psf, a boom of this magnitude has great structural and biological destructive potential. However, the present EISDS fails to adequately outline or mitigate the possible detrimental effects
1 of these booms on the breeding seabirds of the area. It summarizes the status of the marine avifauna in this affected region with a single sentence: "Oceanic and shorebirds are relatively common on the [Channel] islands" (p. 3-66). The potential impact on these birds is handled in a single paragraph (p. 5-45) which briefly alludes to startle effects and "minor" disruptions of seabird breeding activities.

In this letter, we hope to communicate the importance and the vulnerability of the seabird populations in the Channel Islands. For brevity, we have concentrated on the San Miguel Is. area, since it is prospectively the most highly impacted and is by far the largest most diverse seabird colony in southern California. To illustrate the latter point we have attached a preliminary report of our findings concerning the distribution and numbers of seabirds breeding on the Channel Islands. In addition, details on the seven most significant breeding species that occur in the San Miguel area are provided below:

1) Leach's Storm-Petrel (Oceanodroma leacorhoa). Leach's Storm-Petrels were found to breed in the Channel Islands for the first time in 1976. This species breeds abundantly north and south of the Southern California Bight, but the tiny population at San Miguel Island is probably the only one in the Channel Islands.

1626-77

2) Ashy Storm-Petrel (O. homochroa). The entire world range of the Ashy Storm-Petrel is contained off the coast from central California to northern Baja California. The largest breeding colony is on the Farallon Islands, and the second largest colony is at San Miguel Island. Though not endangered, the entire world population of Ashy Storm-Petrels may only number 10,000-20,000 individuals.

3) Double-crested Cormorant (Phalacrocorax auritus). The 60 pairs that breed at Prince Island, a rock off of San Miguel Island, comprise what is probably the largest colony in southern California and one of the largest in the state. Numbers and breeding success of this beleaguered species have been steadily declining in recent years, and Double-crested Cormorants may become one of California's next Endangered Species.

4) Brandt's Cormorant (Phalacrocorax penicillatus). Nearly 77 % of the Brandt's Cormorants that breed in the Channel Islands occur in the San Miguel Island area and along the north side of nearby Santa Rosa Island (also potentially heavily impacted).

5) Pelagic Cormorant (Phalacrocorax pelagicus). Two-thirds of the Channel Islands population of this species breeds at the San Miguel complex.

6) Pigeon Guillemot (Cepphus columba). This species has its southernmost range in western America in the Channel Islands; the bulk of the population is found at San Miguel.

7) Cassin's Auklet (Ptycheamphus aleuticus). 11,000+ pairs breed on two offshore rocks at San Miguel Island. This constitutes over 98% of the breeding auklets in the Channel Islands.

Clearly, destruction of this colony would dramactically alter the marine avifauna in southern California and for some species, in the world. Such destruction is possible under the present Space Shuttle program. Outlined below are a number of specfic contingencies which have not been addressed by the EISDS and which we feel are real potential threats to the survival of these birds. This list is by no means complete.

1) By far the overwhelming majority of seabirds that breed on San Miguel Is. occur on two offshore rocks (Prince Is. and Castle Rk.). These islets are extremely sensitive to physical disturbance because of their delicate and precarious structure. These colonies are so fragile that the effects of a single person walking around can cause appreciable damage through displacement of large r cks and landslides. We believe that the proposed 128 flyovers and their concomitant near-seismic booms could reduce these islets to piles of rubble. (The Shuttle landing will also entail a tremendous sonic boom; its re-entry path has not been determined yet, but one of the proposed courses is directly over San Miguel Is.) Destruction of these islets would eliminate the breeding habitat for nearly all the birds in the San Miguel area.

2) Even if the islets remain standing, many species nest in burrows excavated in loose top soil and in rocky crevices. During the course of the non-breeding season, normal weathering often causes collapse of many of the burrows in the honey-combed hillsides. Cassin's Auklets nest in the most fragile habitats, and a sonic boom-induced collapse at a time when thousands of auklets are incubating could mean disaster for this species in the Bight. Other burrow and crevice nesters in the San Miguel area that could also be affected are Leach's and Ashy Storm-Petrels, Xantus' Murrelet and Pigeon Guillemot.

3) Considerable time was spent at the El Segundo meeting discussing the possible effects of the sonic boom on Brown Pelican eggs. Brown Pelicans nest in what would be a low to medium impact area (Anacapa Is.). Probably as important a problem is the effect on the eggs of the huge numbers of other breeding seabirds that occur in the expected high impact area of San Miguel. There is also a possibility that an instantaneous increase in the ambient pressure by 30 psf will stun or even kill any birds (or other animals) in the affected area. Cormorants jarred unconscious over water would quickly succumb to feather wetting and drown; birds on nests would tumble from cliff nest sites.

4) Another potentially serious problem is ear damage to the birds due to the terrific pressure change associated with the sonic boom. Nocturnal nesting seabirds (these include both petrel species and Cassin's Auklets) identify there own species and locate their mates by calling around the colony at night. Most social communication, including much of courtship, is vocal in most species of seabirds. Massive damage to the hearing of these birds has the potential of incapacitating reproduction in many of them.

5) A major problem for surface nesters is the predation of exposed eggs by Western Gulls. Cormorants and Pelicans are particularly susceptable to disturbance, and they flush from the nest readily. We have seen large numbers of cormorants desert a roost because of "normal" sonic booms. Gulls sweep down on unguarded nests, including other gull nests, and devour eggs left unattended. A single well-timed disturbance of this sort can totally forfeit the reproductive efforts of these species for an entire season.

6) At present, launches have been scheduled at Vandenberg AFB at rates up to twenty per year from December 1982 through 1990. Disregarding the disastrous possibilities described above, regular disturbance of breeding seabirds throughout a long period such as this, even at low levels, could sufficiently discourage breeding in some species as to result in their effective disappearance from the San Miguel area.

Other comments not specifically related to San Miguel Is. are also relevant here. At Santa Barbara Is., there exists the only known breeding colony of Black Storm-Petrels in the United States. Also, of more importance, the Xantus' Murrelet colony located on Santa Barbara Is. is the largest in the United States and possibly the world. During our 1976 field season we found that these murrelets consistantly foraged in waters off the northwest side of the island, towards San Miguel. The impact here may only be slight, but these are important populations and should be given consideration.

In addition to the breeding species described, myriad seabirds use the Bight annually as feeding grounds during the non-breeding season; many northern breeders winter in the Bight and southern hemisphere breeders summer there. The potential impact of the Space Shuttle on these populations and on huge flocks of seabirds migrating north or south around the Pt. Concepcion area is potentially catastrophic. In the case of at least two species (Black Brant, Branta bernicula and Pink-footed Shearwater, Puffinus creatopus) it is possible that at certain times of the year the majority of the world population may be traveling offshore of that area.

It is our considered opinion that the draft of the present Environmental Impact Statement is somewhat less than adequate in its assessment of impact for the Space Shuttle Program. We hope that the information and concerns we have presented here will be of assistance in formulating the final EIS and mitigation program. The natural resources of San Miguel Island are manifold, and the colonial seabirds are only a small part. It is our sincere hope that all these resources be given some consideration before they are dismissed. If we can be of any additional help, do not hesitate to contact any of us.

Sincerely,

R.L. Pitman

M. Naughton

P. Kelly

A. Martin

B. Burgeson

cc: Lt. Col. Earl Jones, Environmental Coordinator, USAF
John Edwards, Environmental Engineer, R.M. Parsons Co.
Fred Eissler, Sierra Club, Santa Barbara, CA
Dr. Richard Martyr, Audubon Society, Sacramento, CA
Dr. Dan Anderson, U.C. Davis
Dr. G.L. Hunt, Jr., U.C. Irvine
Dr. Joseph R. Jehl, San Diego, CA
Dr. H. Lee Jones, U.C. Los Angeles
Thomas Dohl, U.C. Santa Cruz
Ken Briggs, U.C. Santa Cruz
William Ehorn, Superintendent, National Park Service, Channel Islands
Bureau of Land Management, Los Angeles Office

Table Number of Seabird Pairs Breeding in the Channel Islands in 1976

Island	PTLH	PTAS	PTBL	PELB	COD	COB	COP	GUW	GP	MLX	AKC
1. San Miguel	?	+?	0	0	0	62	78*	10	200*	+?	?
Castle Rk.	?	+?	0	0	0	363*	34*	50	100*	+?	1000+*
Prince Is.	2+*	200+*	0	0	60*	590*	10	500	150*	75	≈10,000*
2. Santa Rosa	?	?	-?	0	0	366*	24+	15	125+*	?	?
3. Santa Cruz	?	+	-?	0	0	45	25	100	200+*	?	+
Gull Is.	0	0	0	0	0	55	0	50	0	1	70
Scorpion Rk.	0	+	0	0	0	0	0	125	+?	+?	50
4. West Anacapa	-?	-?	-?	417*	7	0	0			?	-?
4. Middle Anacapa	-?	-?	-?	0	0	0	0	2500	5	?	-?
4. East Anacapa	-?	-?	-?	0	0	0	0			1	-?
5. San Nicolas	-?	-?	-?	0	0	165	0	935	0	+	-?
6. Santa Barbara	?	+?	?*	0	10	73	0	1,125	45	1000-* 5000	?
Sutil Is.	-?	25	25*	0	30	70	0	75	15	75	35
Shag Rk.	?	?	?*	0	0	0	0	9	?	15	0
7. Santa Catalina	-?	-?	-?	0	0	0	0	4	0	0	0
Bird Rk.	0	0	0	0	0	0	0	26	0	0	0
8. San Clemente	-?	-?	-?	0	0	15	0	32	0	0	0
Bird Rk.	0	0	0	0	0	0	0	28	0	0	0

* These constitute the most important colonies
Both the Brandt's Cormorants and Pigeon Guillemots nest on the north side of Santa Rosa Is. and would be contained within the heavily impacted area

Key to Codes:

+ present
+? probably present
-? probably not present
0 not present

PTLH- Leach's Storm-Petrel
PTAS- Ashy Storm-Petrel
PTBL- Black Storm-Petrel
PELB- Brown Pelican
COD- Double-crested Cormorant
COB- Brandt's Cormorant
COP- Pelagic Cormorant
GUW- Western Gull
GP- Pigeon Guillemot
MLX- Xantus' Murrelet
AKC- Cassin's Auklet

RESPONSE TO COMMENTS FROM
UNIVERSITY OF CALIFORNIA, IRVINE
DEPARTMENT OF ECOLOGY AND EVOLUTIONARY BIOLOGY
SCHOOL OF BIOLOGICAL SCIENCES

P.1 The impacts associated with potential sonic booms on the biota of the Channel Islands have been incorporated into Section 5.1.2.7 of the FEIS. Reference is made to Responses D.1 and D.2 of Appendix D for a discussion of mitigation measures currently under investigation.

APPENDIX Q

COMMENTS FROM

COUNTY OF SANTA BARBARA
OFFICE OF ENVIRONMENTAL QUALITY
(Letter dated September 23, 1977)
AND
BOARD OF SUPERVISORS
(Letter dated October 29, 1977)

COUNTY OF SANTA BARBARA

ALBERT F. REYNOLDS
Environmental Quality Coordinator

105 E. Anapamu St.
Santa Barbara, Calif. 93101
Telephone 966-1611



OFFICE OF ENVIRONMENTAL QUALITY

September 23, 1977

Office of the Secretary of the Air Force
(SAF/MIQ)
Washington, D.C. 20330

Attention: James F. Boatright

Dear Mr. Boatright:

As Environmental Quality Coordinator for Santa Barbara County, I am assembling this County's comments on the Draft EIS for the Vandenberg Space Shuttle.

There are a number of County departments and decision-makers who need to review the draft. Since we received only two copies of the document, it will be impossible for us to complete our review by the October 10th deadline (even though SAMSO is sending us an additional six copies).

We would greatly appreciate a fifteen-day extension to October 25th to complete our review and transmit our comments.

Thank you,

Albert F. Reynolds
Environmental Quality Coordinator

AFR:lh

HARRELL FLETCHER
Chairman
Fifth District
ROBERT E. KALLMAN
Vice-Chairman
Second District
DAVID YAGER
First District
WILLIAM B. WALLACE
Third District
ROBERT L. HEDLUND
Fourth District



HOWARD C. MENZEL
County Clerk-Recorder
and Ex-Officio
Clerk of the
Board of Supervisors

Telephone (805) 966-161
Ext. 271

COUNTY OF SANTA BARBARA
BOARD OF SUPERVISORS
105 East Anapamu Street
Santa Barbara, California 93101

October 28, 1977

TO: Office of Environmental Protection
Space and Missile Systems Organization
Department of the Air Force

FROM: Harrell Fletcher, Chairman
Board of Supervisors
County of Santa Barbara

RE: Comments Regarding Adequacy of the Draft EIS for the Space Shuttle Program, Vandenberg AFB, California

Enclosed are the comments of the County of Santa Barbara and its various departments concerning the potential environmental impacts which are associated with the proposed Vandenberg Air Force Base Space Shuttle Program. These comments have been compiled for the purposes of fulfilling County requirements as an affected local jurisdiction under the provisions of the U.S. National Environmental Policy Act. It should be noted here that these comments are solely directed at the adequacy of the EIS and do not necessarily reflect the pros and cons of the Vandenberg Air Force Base Space Shuttle Program.

Air Pollution Control District

The County Air Pollution Control District (APCD) offers its comments and concerns with regard to two general categories in which the project will affect air quality: 1) overall ambient air quality in the Lompoc region, and 2) the effect of "hazardous" pollutants upon population in the vicinity of Vandenberg Air Force Base during Space Shuttle Launches. With respect to the first category, particular concern is expressed with regard to the potential for local damage resulting from concentrations of hydrogen chloride and subsequent acid rain. Also, the APCD notes that the Space Shuttle launches will introduce a significant amount of NO_x, a precursor of oxidant, into region where the oxidant air quality standard is currently violated.

The APCD notes that it is very difficult to suggest mitigation measures for these impacts.

Department of Transportation

The County Department of Transportation (DOT) indicates that the Draft EIS "does not contain a sufficiently detailed analysis of the impacts on the local road system from the increased traffic which would result from increased employment". The DOT offers comments in three areas of local road impact which need revised treatment in the EIS: 1) existing roadways and current traffic problems, 2) projections of future traffic (both volumes and their distribution) and its impacts on traffic operation, and 3) possible mitigating measures relative to traffic impacts.

The DOT indicates that, from the local viewpoint, the Draft EIS is currently lacking in important areas of information. Although the DOT memo to the Office of Environmental Quality dated October 13, 1977, specifically pertains to the transportation-related impacts associated with the Space Shuttle Program, it should be pointed out that the DOT comment regarding the need for information to support the assumptions on potential new employment (p.3, paragraph 2) is critical to many other impact areas such as population growth and distribution. Accordingly, this topic requires careful, detailed treatment in the EIS.

Environmental Health Care Division

The County Environmental Health Care Division offers comments on the adequacy of the Draft EIS in regards to noise, water resources and quality, solid waste, and land use. Particular attention is given to the need for verification of the potential impacts of the Space Shuttle program upon ambient noise levels, focusing upon possible public health and welfare issues associated with increased vibrations and utilizing the State Model Noise Ordinance as a reference point. The need for a delineation of project-related impacts upon future increases in air, vehicular and railroad traffic--with a description of their associated effects upon the Community Noise Equivalent Level (CNEL) contours in the Lompoc Valley is crucial to an adequate noise assessment in the EIS.

We strongly recommend that the EIS characterize the projected increases in water demands associated with the Space Shuttle in conjunction with the proposed State Water Project for Santa Barbara County. This should include sufficient detail to adequately contrast State Project Water with local alternatives, such as conjunctive use and water reclamation.

LNG Missile Impact Risk Assessment

Safety considerations associated with the proposed Liquified Natural Gas facility near Point Conception in Santa Barbara County and its interrelationship with the Space Shuttle Program must be adequately explored in the EIS. Documentation of the probability of a missile fragment striking a sensitive area of the LNG facility should be accurately presented in the EIS.

Assessment of Potential Impacts upon Biology, Agriculture and Human Health

Issues regarding the potential effects of the HCL and AL_2O_3 upon biotic communities of biological interest are not adequately explored in the EIS. In addition, there

exists the potential for adverse impacts upon the agricultural industry of the Lompoc Valley due to "acid rain" associated with the ground cloud. The synergistic effects of HCL and AL_2O_3 upon vegetation and animal life needs further study.

Thank you for the opportunity to comment upon the Space Shuttle Draft Environmental Impact Statement. We trust our concerns will be given adequate attention in the Final Statement.

Respectfully Submitted,

Harrell Fletcher, Chairman
Santa Barbara County Board of Supervisors

AFR:lh
Atts.

LETTERS OF COMMENT

Air Pollution Control District

Santa Barbara County Department of Transportation

Santa Barbara County Environmental Health Division

Liquified Natural Gas Facility Risk Assessment

Assessment of Potential Impacts upon Biology, Agriculture and Human Health

COUNTY OF SANTA BARBARA • HEALTH CARE SERVICES
AIR POLLUTION CONTROL DISTRICT
4440 CALLE REAL, SANTA BARBARA, CALIFORNIA 93110 • PHONE (805) 964-8658

LAWRENCE HART, M.D., M.P.H.
DIRECTOR

JOHN B. ENGLISH
DIRECTOR, AIR POLLUTION CONTROL

M E M O R A N D U M

DATE: September 26, 1977

TO: Albert F. Reynolds
Environmental Quality Coordinator
Office of Environmental Quality

FROM: John B. English
Director, Air Pollution Control

SUBJECT: Draft EIS on Vandenberg Space Shuttle

We have reviewed the Draft Environmental Impact Statement on the proposed Space Shuttle Program, Vandenberg AFB, with interest, and have the following comments.

There are two general categories of air pollution which the Space Shuttle Program will impact and about which we are concerned. We do not have mitigating suggestions for these impacts, other than the "No Action" alternative (which we are not seriously suggesting), but we feel that these impacts should be made more clear in the Impact Statement, so that the effects on the environment in Santa Barbara County are more fully covered.

The first category, of those we refer to above, is the overall air quality in the region. The Impact Statement discusses air pollutant concentrations in the shuttle launch ground cloud as percentages of the hydrogen chloride concentration (in the range of 40 ppm) because of the concern about local damage from this pollutant (acid rain). The air quality in the region will be impacted by the large quantity of NO_x in the ground cloud; it appears that this amount of NO_x will be in the range of 5 tons (3 ppm in cloud). To put this number in perspective, our rule covering new sources of air pollution coming into the Lompoc and Santa Maria areas limits the emission of NO_x to 5 or 10 pounds per hour unless the applicant supplies an air quality impact analysis (computer modeling study) showing that the expected NO_x emission will not adversely affect the NAAQS. The air quality standard for oxidant, for which NO_x is a precursor, is currently violated in Santa Maria and the Solvang/Santa Ynez area.

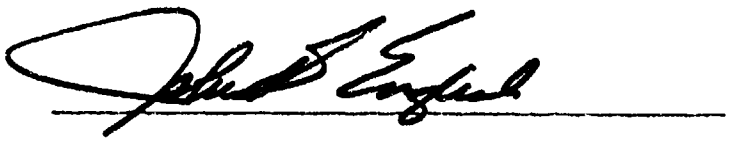
Q.1

The second area of concern is the effect of "hazardous" pollutants

on residents or spectators who may be impacted by the fallout from the ground cloud. As is noted on page 5-21, some of the 60 tons of aluminum oxide in the ground cloud will be 1 micron or smaller in diameter and
Q.2 probably coated with adsorbed hydrogen chloride. If these particles are inhaled, they will penetrate the alveolar spaces in the lungs. In the absence of knowledge about the effects of exposure to such particles, would it not be best to evacuate the public who might be exposed to this ground cloud, in the same manner that the public is evacuated from areas under the flight path?

The discussion of the receipt and handling of the hypergolic fuels (nitrogen tetroxide, hydrazine and monomethylhydrazine) does not really present the whole picture of environmental impacts. Vapors vented from the storage of these fuels (normal operation) must be disposed of
Q.3 in some manner. Scrubbing or incineration are two approaches that minimize the hazardous pollutant, but there is some residual in the scrubber water or the incinerator stack gases; these should be covered in more detail than "minimizing the release of deleterious vapors into the atmosphere".

We appreciate the opportunity to comment on this Draft Environmental Impact Statement.



John B. English
Director, Air Pollution Control

JBE:ce
cc: Dr. Hart, APCO



COUNTY OF SANTA BARBARA
CALIFORNIA

Department of Transportation

COURT HOUSE, SANTA BARBARA, CALIFORNIA 93101
TELEPHONE (805) 966-1611

LELAND R. STEWARD
DIRECTOR OF TRANSPORTATION
ROAD COMMISSIONER

H. R. Callahan
ASSISTANT DIRECTOR OF TRANSPORTATION
ASSISTANT ROAD COMMISSIONER

MEMORANDUM

TO: Mr. Albert F. Reynolds, October 13, 1977
Environmental Quality Coordinator

FROM: Leland R. Steward,
Director of Transportation

SUBJECT: Draft EIS for Vandenberg Space Shuttle

After reviewing the Draft EIS for the Space Shuttle Program at Vandenberg Air Force Base dated August, 1977, we have several comments regarding the adequacy of the document.

In general, the report does not contain a sufficiently detailed analysis of the impacts on the local road system from the increased traffic which would result from increased employment. We have comments in three areas of local road impact which need revised or more detailed treatment:

1. Description of the existing road system, including current traffic problems related to VAFB traffic.

2. Projections of future traffic and its impact on traffic operation.

3. Possible mitigating measures relative to traffic impacts.

1. Description of the Existing Road System

The discussion in Section 3.2.6.11 omits several County Highways which provide primary access to Vandenberg Air Force Base, including Vandenberg Road, Lompoc-Casmalia Road, Floradale Avenue and Central Avenue. The only mention of operational efficiency in this Section is a statement that the area is "adequately served". From the local viewpoint, operational problems already exist on these routes which will be aggravated by the proposed action. Two which immediately come to mind are the intersection of Vandenberg Road and Lompoc-Casmalia Road at the Main Gate,

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Q.4

OPERATIONS ENGINEER
(805) 967-9315

HAROLD L. PURDY
SENIOR DESIGN ENGINEER
(805) 966-1611

JOHN J. MADDOCK
TRANSPORTATION PLANNING ENGINEER
(805) 966-1611

Gordon Gibbs
CONSTRUCTION ENGINEER
(805) 967-9315

where peak hour demand exceeds the capacity of the intersection, causing daily congestion, and the Santa Lucia Canyon and Lompoc-Casmalia intersection, where commuter traffic must turn left across approaching traffic on a high speed expressway type facility. Section 3.2.6.11 should contain a discussion of these routes and operational problems, including their peaking characteristics and the role they play in Vandenberg commuting patterns.

2. Projections of Future Traffic and its Impact on Traffic Operation

Section 5.2.1.7 of the D.E.I.R. contains statements regarding the impacts of Shuttle related traffic, which are somewhat misleading and which, at least, need treatment in greater detail. Some of the statements are repeated in Section 5.2.2.7. First, we take exception to the commuter routes shown in Figure 5.2.1-B. In other Sections, the D.E.I.R. projects the housing impacts in terms of additional housing demand and number of employed persons for various communities. It is debatable where additional housing may actually be built, and the D.E.I.R. supposition that a certain percentage will be located in Lompoc may or may not prove correct. There is no doubt, however, that the major current and planned new housing construction activity in close proximity to the base is in the Vandenberg Village and Mission Hills areas North and West of Lompoc. These areas utilize
Q.5 Lompoc-Casmalia Road and Santa Lucia Canyon Road for access to the Main Gate, the Pine Canyon Gate and South Vandenberg. These routes and their existing operational problems will undoubtedly be impacted by Shuttle commuting traffic, yet they are not shown in Figure 5.2.1-B nor are these impacts discussed. The left turn traffic on Lompoc-Casmalia Road at Santa Lucia Canyon, for instance, is certain to be affected. Assuming that the majority of the new jobs will be at South Vandenberg or in the main cantonment area, it is reasonable to assume that much of the commuter traffic will use this route, as it does now. Similarly, congestion problems at the Main Gate will be aggravated by the increased traffic projected for Vandenberg Road and Lompoc-Casmalia Road.

The statement on Page 5-59 and repeated on Page 5-74 that in no case will Shuttle-related traffic exceed the desirable design capacity of the roadway system needs qualification, as do the levels of service shown on Figures 5.2.1-B and 5.2.2-B. We question the appropriateness of the terminology "desirable design capacity of the roadway" when discussing operational
Q.6 levels of service. The analysis should not have consisted of assuming that a certain percentage of the ADT occurs during the peak hour and comparing the assumed volume to a theoretical capacity of, say, 1800 vehicles per hour per lane, for example. Such an analysis often ignores variations in peak hour percentages such as occur near Vandenberg, where peak hour traffic is as high as twenty percent of daily traffic (forty percent on portions of Santa Lucia Canyon Road) and

variation in the peak hour demand rate, which can vary widely within the peak hour. Level of service is really an instantaneous qualitative description of operation and should be used as such. Additionally, it appears that the level of service computations used to describe future operation were performed for sections of roadway uninhibited by traffic conflicts and intersection controls, which are the most common determinants of capacity in the operational sense, except in isolated roadway sections. It is possible, using isolated roadway sections, to deduce that future operation will be at a high level of service when, in fact, serious operational problems could exist at certain locations which should be considered in the analysis of impacts.

One additional comment regarding traffic-related impacts concerns the transportation routes for explosives shown on Figure 5.2.2-B. An increase in the transport of explosive material to some extent increases the chances of serious accidents. Increased auto traffic increases the chances further, especially at locations such as the intersection of Santa Lucia Canyon and Lompoc-Casmalia Road, where the left turns across a high speed facility constitute a hazard. This potential impact should be mentioned within the D.E.I.R.

Q.7

All of the above impacts are dependent in terms of severity on the extent to which the Shuttle Program actually increases traffic, especially commuter traffic. It appears from the discussion in Section 5.2.1.4 on population growth that certain assumptions were made relative to the percentage of new jobs which will be filled by current residents and base employees. The remaining jobs would be filled by new residents. If the projected shuttle-related traffic is based on these assumptions (i.e. that 70 to 80 percent of the jobs will be filled by existing employees or residents), some indication should be given to support this assumption as to which current programs or jobs will be reduced to provide the labor force for the new jobs with only a relatively small net increase in employed persons. Otherwise, it should be noted that traffic impacts could be greater than those anticipated.

Q.8

One final comment on transportation related impacts involves the Lompoc Airport. To what extent would increased air traffic affect operations at this County facility?

Q.9

3. Mitigating Measures

The traffic-related impacts of the Space Shuttle Program could be mitigated by appropriate modifications to the road system. Modifications, while not anticipated to be numerous, would be determined according to the severity of the problem and the

Albert F. Reynolds Leland R. Steward

cost and effectiveness of alternative solutions.

Thank you for the opportunity to comment on the Space Shuttle Draft Environmental Impact Statement. We trust our concerns will be given adequate attention in the Final Statement.

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COUNTY OF SANTA BARBARA • HEALTH CARE SERVICES

4440 CALLE REAL, SANTA BARBARA, CALIFORNIA 93110 • PHONE (805) 964-8848

LAWRENCE HART, M.D., M.P.H.
DIRECTOR

MEMORANDUM

TO: Albert F. Reynolds
Environmental Quality Coordinator
Office of Environmental Quality

FROM: Lawrence Hart, M.D., M.P.H.
Director

DATE: 17 October 1977

SUBJECT: Draft Environmental Impact Statement
Space Shuttle Program
Vandenberg AFB, California

Environmental Health Services has reviewed the subject environmental impact statement and has the following comments on the impending qualitative changes in the environment in regards to noise, water resources and quality, solid waste, and land use.

NOISE

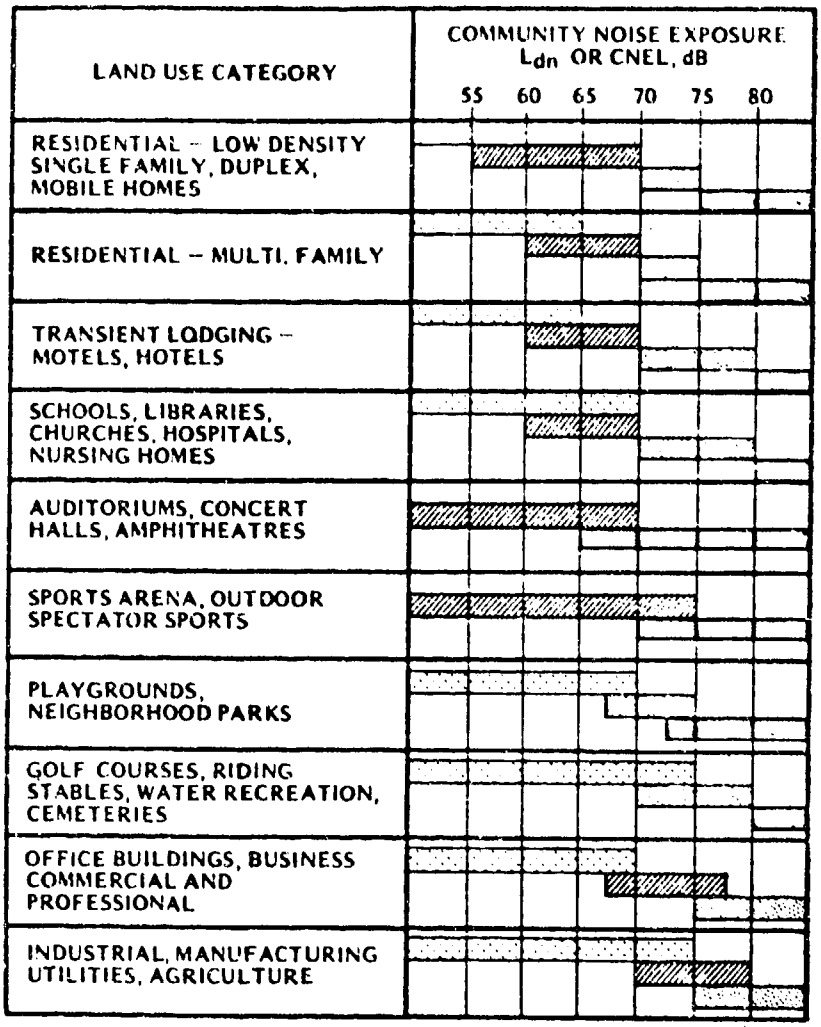
At this time, the County of Santa Barbara has not adopted a noise ordinance. Therefore, Health Care Services has utilized the State Model Noise Ordinance and the Guidelines for the Preparation and Content of Noise Elements of the General Plan (from the Office of Noise Control) as a guideline for its recommendations, the latter in this particular case.

The Office of Noise Control recommends the following sound levels for the specified land use. See Table 1 - Land Use Compatability for Community Noise Environments.

Assessment of the Community Noise Equivalent Level (hereafter referred to as CNEL) contours for the Lompoc Valley (Figure 3.1.8-B) indicate numerous areas which have exceeded or are approaching the recommended levels for compatible land use. However, there have been no provisions
Q.10 made for the projected increase in air, vehicular or railroad traffic as a result of the Space Shuttle Operations. At the same time, the traffic data on which these noise contours are based on are not specified; that is, what are the average daily traffic (ADT) figures and are these noise contours based on 6,750 or 27,000 air operations per year? Therefore, it is strongly recommended that projected CNEL contours for the

TABLE 1

LAND USE COMPATABILITY FOR COMMUNITY NOISE ENVIRONMENTS



INTERPRETATION

NORMALLY ACCEPTABLE

Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.

CONDITIONALLY ACCEPTABLE

New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning will normally suffice.

NORMALLY UNACCEPTABLE

New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design.

CLEARLY UNACCEPTABLE

New construction or development should generally not be undertaken.

CONSIDERATIONS IN DETERMINATION OF NOISE–COMPATIBLE LAND USE

A. NORMALIZED NOISE EXPOSURE INFORMATION DESIRED

Where sufficient data exists, evaluate land use suitability with respect to a "normalized" value of CNEL or L_{dn}. Normalized values are obtained by adding or subtracting the constants described in Table 1 to the measured or calculated value of CNEL or L_{dn}.

B. NOISE SOURCE CHARACTERISTICS

The land use-noise compatibility recommendations should be viewed in relation to the specific source of the noise. For example, aircraft and railroad noise is normally made up of higher single noise events than auto traffic but occurs less frequently. Therefore, different sources yielding the same composite noise exposure do not necessarily create the same noise environment. The State Aeronautics Act uses 65 dB CNEL as the criterion which airports must eventually meet to protect existing residential communities from unacceptable exposure to aircraft noise. In order to facilitate the purposes of the Act, one of which is to encourage land uses compatible with the 65 dB CNEL criterion wherever possible, and in order to facilitate the ability of airports to comply with the Act, residential uses located in Community Noise Exposure Areas greater than 65 dB should be discouraged and considered located within normally unacceptable areas.

C. SUITABLE INTERIOR ENVIRONMENTS

One objective of locating residential units relative to a known noise source is to maintain a suitable interior noise environment at no greater than 45 dE CNEL of L_{dn}. This requirement, coupled with the measured or calculated noise reduction performance of the type of structure under consideration, should govern the minimum acceptable distance to a noise source.

D. ACCEPTABLE OUTDOOR ENVIRONMENTS

Another consideration, which in some communities is an overriding factor, is the desire for an acceptable outdoor noise environment. When this is the case, more restrictive standards for land use compatibility, typically below the maximum considered "normally acceptable" for that land use category, may be appropriate.

Lompoc Valley be submitted along with present and projected CNEL contours for Vandenberg Air Force Base. This will allow evaluation of the effects of noise on the general population as well as to provide data for planning of future land use.

Q.11 Environmental Health Services concurs that the noise impact on the heavily populated areas during the construction phase will probably be minimal. It is expected that the ambient noise levels will be increased intermittantly and cause some annoyance at various times, but this will be temporary in nature and should not be expected to present problems.

The construction phase, however, will significantly affect the workers on site. All precautions must be taken to protect the worker. California OSHA regulations allow an over-all exposure of 90 dBA for an 8-hour day.

Infrasonic frequencies are those which are below 16 Hz. Although the Environmental Protection Agency (hereafter referred to as the EPA) has stated that it does not appear that "exposure to infrasound, at intensities below 130 dB SPL, present a serious health hazard", the fact that comprehensive studies have shown that there is a potential of danger to man's health cannot be ignored. Mohr, et al, has shown that adverse ef-
Q.12 fects on man can result from high intensity infrasonics, ranging from 100 to 160 dB, for short periods (two minutes).[1] The frequency spectrum from a typical launch (during ignition) is, for the most part, expected to be low (less than 50 Hz) and the sound pressure level is expected to range from 105 to 110 dB in the Lompoc and cantonment area. It is also expected that sound pressure levels in these two areas during the liftoff will be between 115 to 120 dB. Mohr has observed respiratory rhythm changes, chest wall vibration, gag sensations, and post-exposure fatigue when exposure levels consisted of frequencies from 0 to 50 Hz and up to 145 dB.

The sonic booms which will be created as the Orbiter ascends and descends warrants further studies. Substantial overpressures will be created, and coupled with atmospheric factors, sonic booms can create serious struc-
Q.13 tural damage, particularly if imperfections in the building have already weakened it. Also, the possibility that repetitive sonic booms could prove detrimental to structures should be evaluated.

One environmental impact aspect which is not addressed is noise induced vibrations. It is conceivable that structural damage could result from vibratory energy transmission through the ground and air. Although this
Q.14 relationship is not clearly defined, it is recommended that studies be conducted to assess the possibility of effect of noise-induced vibrations on materials with respect to concomitant frequencies and sound pressures and distances from the launch site.

1. Mohr, G.C., Cole, J.M., Guild, E.C., and Von Gierke, M.D., "Effects of Low Frequency and Infrasonic Noise on Man", Aerospace Medicine, Volume 36, Pages 817-824, 1965.

There are some noise impact areas which cannot be immediately assessed. These include the annoyance of residents by the increased launches and
Q.15 the noise created by the Air Cushion Barge along with the winching procedures.

WATER RESOURCES AND QUALITY

The advent of the Space Shuttle Program means increased water consumption in various parts of Santa Barbara County due to an increase in population, and whether or not the increased demand will produce significant impact upon available water resources must be carefully scrutinized. The projected increases in acre feet per year for the various areas are as follows: Lompoc--62; Vandenberg--10; Santa Maria--32; Santa Barbara--47; Goleta--57.

According to a U.S. Geological Survey by G.A. Miller (Open File Report 76-183; April, 1976) on the ground water resources in the Lompoc area, the estimated total ground water storage is 720,000 acre-feet (Lompoc plain (main zone) 80,000, the shallow zone, 135,000; Lompoc terrace 100,00 Lompoc upland 400,000). Since 1941, there has been a decrease in ground water storage in all areas. The decrease in the Lompoc plain measures approximately 38,000 acre-feet, 1,000 acre-feet in the Lompoc terrace, and 25,000 acre-feet in the upland. The annual pumpage by the City of Lompoc in 1970-71 was 3,700 acre-feet from the Lompoc plain. Vandenberg Air Force Base also pumps from the Lompoc plain, and in 1971-73, they pumped about 3,800 acre-feet. Also, the construction of the facilities for the Space Shuttle Program will, it has been estimated, be one-half million gallons per day. This is roughly 1.5 acre-feet per day. It is anticipated that the bulk of the projected 62 acre-feet increase in consumption, due to population increase as well as the construction needs, will be incurred in the Lompoc plain.

The ground water storage for the Santa Barbara-Montecito area, according to the 1968 U.S. Geological Survey Water Supply Paper 1859-A, totals 281,000 acre-feet, of which 184,000 acre-feet is in Santa Barbara and 97,000 acre-feet is in Montecito (these figures are from 1959). In Santa Barbara, according to 1964 data, the storage had dropped to 178,000 acre-feet due to below average recharge and continued withdrawal. In the Montecito area, there had been little change in the ground water storage in the period from 1959 to 1964. The term "perrenial-yield" is defined on the basis of long-term dependability of the water supply. In the Santa Barbara-Montecito area, it is the "rate at which water can be pumped from wells year after year without decreasing ground water in storage to the point where the pumping lift would become economically infeasible or where water of poor quality would begin to intrude into the reservoir". According to this same report, it is estimated that the perrenial yield is between 1,700 and 2,000 acre-feet per year in the Santa Barbara area. The data to accurately determine the perrenial yield for the Montecito area is lacking but long-term estimation is approximately 2,500 acre-feet per year. However, in a published report in January, 1973, Geo-Technical Consultants, Inc. of

Ventura determined a practical perrenial yield of 1400 to 1500 acre-feet, 200 to 300 of which is derived from the Toro Canyon subunit. At the present time, the City of Santa Barbara is pumping about 3,000 acre-feet per year while the safe yield is 2,000 acre-feet. However, the City operates on a conjunctive basis, pumping more from surface reservoirs during the wet years. In the Monteciot area, it is estimated that 860 acre-feet per year will ultimately be pumped from the ground in order to meet the maximum demand in addition to the approximate 400 acre-feet pumped from provate sources in recent years.

According to data obtained from the Goleta County Water District, the storage capacity of the entire Goleta basin is about 200,000 acre-feet in the upper 400 feet. However, due to various reasons, which include sea water intrusion, quality degradation, water rights, possibly subsidence and native vegetation disruption, much of the 200,000 acre-feet is unusab Since the drought and the consequent heavy pumpage, it is estimated that there is 15,000 acre-feet of recharge (over and above the amount which is taken out) and 10,000 acre-feet of "de-water" storage. The District is presently pumping about 5,500 acre-feet per year while the safe yield is 4,310 acre-feet (from a study completed in 1976). However, the Goleta County Water District is on a mini-conjunctive use in that an ordinance which was passed in May 1973 restricts the District from over-drafting the ground water basin. From May, 1973, until 1975, there was much more rainfall and most of the water was pumped from surface sources (Cachuma). The amount which was saved during this period is presently being taken out due to the fact that since 1976, Santa Barbara County has been experienci a drought situation.

The increase in consumption of water means a simultaneous increase in the discharge of waste water. This increase in volume of waste water is not expected to present any problems in the Santa Barbara or Goleta areas as the treatment facilities are designed to adequately handle much more than the anticipated increase. However, the Lompoc and Santa Maria facilities are operating almost to capacity and therefore, concurrent construction o additional treatment facilities must be planned for.

The Space Shuttle Operations may also affect the quality of water in Sant Barbara County. Spills of fuels and lubricants (including gas and oil), which can contaminate surface runoff and eventually to into the Santa Yne River and Honda Creek will probably ultimately reach the ocean. One cannot say that their impact on water quality will invariably be "to some mi imal short term extent" because it is not certain that the like will "qui ly dilute". Tidal dissipation can only mean that the area of contaminati will become greater. In addition, the cumulative effect of spills is not accounted for. Also, do spills onto the ground mean a change in ground water quality; that is, the total dissolved solids and mineral contents o the ground water in the Lompoc area is relatively high and will spills increase these values?

Q.16

The quality of ground water in the Lompoc area is definitely affected by

the discharge of sewage effluent. In fact, so much so that it may limit the use of the ground water. The sewage effluent, according to the U.S. Geological Survey 76-183 referred to earlier, is high in total dissolved solids and chloride content, two major constituents of the criteria for water quality in the Lompoc area. It is strongly recommended that further
Q.17 evaluation be given to the effects that such discharge will have on ground water quality in the Lompoc area.

SOLID WASTE DISPOSAL

The increase in population will mean an increase in the volume of solid waste disposal throughout the County. At the present time, evaluation of the available land fills indicate that they will be adequate to handle the anticipated increase in solid waste generation.

similar to those in the Desert Region. For instance, due to the location of a large number of windmills in a small area, formation of eddies near the sea surface can occur, which leads to more sea salt particulate formation offshore. Furthermore, large-scale wind extraction can disturb local sea-land breeze patterns and consequently reduce the onshore dispersion of air pollutants. Since high pollutant concentrations of photochemical oxidants, particulate matter, nitrogen dioxide and sulfur dioxide are experienced by the Coastal Region, wind energy systems can possibly exacerbate air quality conditions.

Since much of the coastal area is presently urbanized, the introduction of a work force to construct a wind energy facility in an offshore area will have negligible effects on the coast. In a large portion of the coast, housing is readily available to house the work force.

Health and safety risks are minimal for offshore windmills. The exceptions are risks to low flying planes, ships, and migrating birds.

Offshore wind energy systems may disrupt the visual quality of the coastal area due to the prominance of large wind tower structures. The extent of this impact will depend upon the number of windmills and their distance from shore. The deterioration of the coast's visual environment may impact the recreation industry which is becoming increasingly important to the region's economy.

2.3 DESERT SCENARIO

2.3.1 Regional Characteristics

The Desert Region is the most sparsely populated area of the State (see Figure 2-1). Most desert residents are located in the rapidly growing southwest portion of the region (see Figure 2-8). The largest population concentration is in the Riverside-San Bernardino metropolitan area (2.28, 2.29, 2.30). The remainder of the desert population resides primarily in either retirement communities such as Anza Borrego, Palm Springs, and Morongo Valley, or on military bases including Twentynine Palms Marine Base and Edwards Air Force Base (2.6).

Although the Desert Region can currently be characterized as relatively unurbanized, by the year 2000 a significant increase in the amount of property devoted to urban land-use will have occurred. Nevertheless, only minor amounts of cropland and vacant acreage will be converted to urban use (see Figure 2-9) (2.28-2.30).

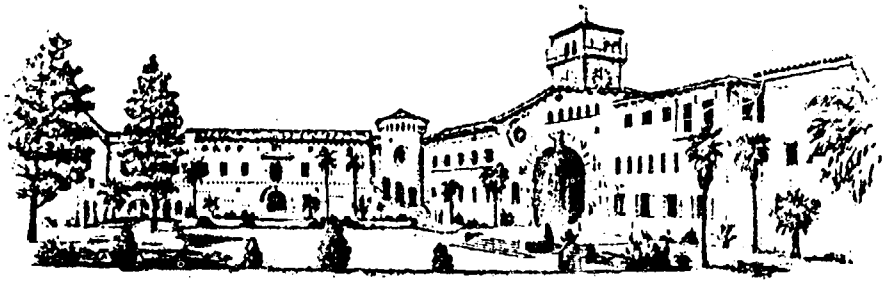
Any of the ten technologies evaluated in Volume II will require long transmission lines which could disturb archaeological artifacts, create soil erosion, and damage the aesthetic quality of the desert. They might also increase the incidence of Valley Fever.

With the exception of several retirement communities, young and middle-aged residents predominate in the Desert Region. The percentage of 18 to 54 year-olds is higher in the northern portion, while in the southern portion, such areas as the Imperial Valley contain a large number of residents under the age of 18.

COUNTY OF SANTA BARBARA

ALBERT F. REYNOLDS
Environmental Quality Coordinator

105 E. Anapamu St.
Santa Barbara, Calif. 93101
Telephone 966-1611



OFFICE OF ENVIRONMENTAL QUALITY

October 28, 1977

TO: Albert F. Reynolds, Environmental Quality Coordinator

FROM: Cecilia Ann Terry

RE: Space Shuttle EIS and Possible Effects upon Human Health, Agriculture, and Natural Vegetation

While issues of environmental impact are generally adequately alluded to in the Draft EIS, some issues are addressed on the basis of often inadequate data and indicates the need for increased documentation. These issues fall into three general categories: 1) Little is said regarding the sensitivities of native plants (especially those of biological interest) to HCL, 2) Little is said regarding the possible additive or synergistic effects of HCL and AL_2O_3 or other fuel constituents on plants or animals, 3) No indication is made in the EIS as to the likelihood of natural floral community composition change in the area as a direct result of increased acidity caused from rainout from the ground cloud.

The EIS states that . . . "the presence of AL_2O_3 in the cloud may act as nucleating centers and be capable of enhancing aerosol growth during this initial period. Under especially high humidity conditions these droplets may enlarge and precipitate from the cloud (rainout) as an acid rain." While this acid rain may not pose much anticipated problem in Lompoc, it should be
Q.19 pointed out that cloud movement towards Lompoc could damage crops in the area that are sensitive. Those crops which are marketable on the basis of their appearance could suffer loss. This could be mitigated by prohibiting launches during those meteorological conditions conducive to cloud movement into Lompoc (expected only about 5% of time according to EIS).

Furthermore, the impact of the ground cloud movement towards Tranquillon Mountain and other nearby mountains was inadequately addressed. This area supports a relictual north coastal flora (a biologically interesting community) on the north-trending slopes. Frequent exposures to fog and drizzle are
Q.20 expected here. This would indicate a high probability of large amounts of acid rainfall. In addition, at the higher elevations, vertical distance between the ground cloud stabilization level and ground level will decrease, making ground level concentrations in the cloud higher than those predicted for

the flat-lands. This could mean an increase in the acidity of the rainfall in addition to the more frequent accurance of rainfall that could be expected here as opposed to the flat-lands. The EIS does not address this issue or what may happen to the communities of natural plants exposed over time to acid rainfall dosages.

Q.21 While losses to agricultural crops in Lompoc area may occur, these would likely be temporary losses since most crops in the area are row crops and subject to seasonal replanting: A damaged crop would thus be replaced. However along the normal ground cloud path, the natural flora would be subject to a more frequent occurance of the acid rainfall condition. Studies should be made to determine the effect of this acid rainfall on the possible long-term community change.

Q.22 There is no indication in the report as to how the HCL and AL_2O3 might affect lichens and mosses, which would be most impacted in those mountain areas east of the launch site. Lichens and mosses would logically be the most easily and readily damaged by a water-based pollutant such as an acid rainout. The mountain areas support large populations of mosses, fungi and lichen upon and around the trees and shrubs.

Q.23 Little information is known as to how HCL and AL_2O_3 will affect animals and humans. The National Academy of Science has published recommendations as tc the exposure limits to the public of HCL and CL_2 gases. While the ground cloud maximum expected 10-minute concentrations below 500 ft. elevation will be less than half these limits, little is known as to the possible additive or synergistic effects of the HCL and the AL_2O_3. The ground cloud will contain tiny suspended particles of AL_2O_3, in the range of 1 micron and smaller. It is known that particles in this range if inhaled will penetrate the alveolar spaces in the lungs, and the draft EIS so states. However, the ground cloud also contains HCL, which will absorb into the AL_2O_3 forming acid particles. Little is known about the behavior and effects of such acid coated particles, especially on live lung tissues. In addition, at higher elevations, the concentrations one would be exposed to could be higher making a greater likelihood of adverse effects. The possible adverse effects of the pollutants at higher elevations, both to plants and people are not covered in this document.

RESPONSE TO COMMENTS FROM
COUNTY OF SANTA BARBARA
OFFICE OF ENVIRONMENTAL QUALITY

Q.1 The amount of nitrogen oxides in a typical ground cloud at stabilization is 2,500 kg (5,500 lb) (reference NASA DEIS, July 77, page 60). At the peak of Space Shuttle activity (subsequent to 1984), the launch rate will be one flight approximately every 18 days. The Santa Barbara APCD rule limiting new sources of air pollution to 10 pounds per hour emission of NO_x would appear reasonable for continuous source emissions. This rule would allow 4,320 lb of NO_x over an 18-day period for each new source. A typical Space Shuttle launch every 18 days and the amount of NO_x produced instantaneously cannot really be compared to a continuous point source. If two or three new sources emitting the allowed 10 pounds of NO_x per hour were located in Lompoc, the "new source rule" would allow them to operate without filing an air quality impact analysis. Together over a span of 18 days, they would contribute a total of 8,640 to 12,960 pounds of NO_x which is considerably more than that released instantaneously by a Shuttle launch once every 18 days.

Q.2 Safe operation of the Shuttle system has been a primary criterion during all aspects of the program. As in the case of past programs, the flight tracks are selected so as not to fly over any populated areas. Land use planning for Vandenberg is based on the concept of buffering populated areas from those areas where hazardous operations occur. Over 90 percent of the Base is devoted to open space for this reason. A major factor in launch site selection is its remote location, and transportation routes for hazardous substances have been chosen to minimize the exposure of the general public in the event of an accident. The public would be excluded or evacuated from areas that are considered hazardous during operations. Observation areas for all unprotected personnel and the public will be located many miles from the pad. Therefore, there is little chance that residents or spectators will be impacted by ground cloud fallout. Research conducted by the Aerospace Medicine Research Laboratory has shown that a

synergistic effect between alumina and HCl is not evident. However, other researchers have indicated that a synergistic effect is possible. This problem is under study.

Q.3 To limit threats of adverse effects of hypergolic fuels to both the public and launch personnel and ecological systems on Vandenberg, extensive research is being conducted in two major areas. The first involves exposure to personnel working at the various facilities where fuels are handled. The USAF School of Aerospace Medicine is conducting research to develop and evaluate personnel monitors and area monitors capable of detecting leaks of these materials at threshold limit values. Development is required because we know of no such direct sensing instruments available at this time. Secondly, the USAF Civil and Environmental Engineering Development Office, Tyndall AFB, Florida, is conducting research to determine the most environmentally acceptable disposal methods. All receipt and handling areas will have scrubbers or incinerators. However, the choice of either method will be based upon technical evaluations of the secondary pollution problem, i.e., toxicity of the resulting stack gases and/or treatment of the scrubber water. A scrubber now under study by NASA looks very promising. Also being studied are proper disposal methods for spills. The SAMSO Propellant Group has been formed to monitor all these research efforts. Results will be included in a supplement to the Shuttle Environmental Statement.

Q.4 Primary access to Vandenberg Air Force Base is provided by the State Highways indicated in the FEIS and by a number of County roads and highways including the Lompoc-Casmalia Road, Vandenberg Road (part of each being County Highway S-20), Floradale Avenue, and Central Avenue. For the most part, these roads do adequately serve the area. However, there is some congestion at the Main Gate and Pine Canyon Gate during morning and evening peak traffic hours. This is indicated by traffic counts reported in Table 3.2.6-1 of the DEIS. In general, the public access roads to the Base could handle some increase in traffic without hampering the flow of traffic. However, at the intersection of the Main Gate and Pine Canyon Gate, any additional traffic would create further congestion, and extend the existing traffic delay [U.S. Air Force, 1974 (137, revised May 1977].

All Base units have been divided into groups with working hours starting at 15 minute intervals between 0700 and 0800. Two peak periods remain (0730 and 0800) and further redistribution of arrival and departure times would reduce existing levels of congestion.

Q.5 The commuter routes described in Section 5.2.1.7 and identified in Figure 5.2.1-B, represent routes associated with the workforce required by the Construction and Activation period. This is a temporary phase of the project and will draw on a labor force from an area which includes the major urban centers of Santa Barbara and neighboring counties. The routes represented in Figure 5.2.1-B are the most likely access routes for these relatively distant workers who are temporarily employed at VAFB. These workers will no doubt create additional congestion at the principal Base gates, a situation which could be substantially mitigated by scheduling arrival and departure times to avoid existing peak periods of arrival and departure. Such a staggering would alleviate congestion at critical intersections of the local highway network as well.

Section 5.2.2.7 refers to traffic patterns associated with the Operations phase of the project. In this case, the bulk of the workforce will be local residents including those living in the Vandenberg Village and Mission Hills areas. As indicated in the comments, these areas will utilize the Lompoc-Casmalia Road and Santa Lucia Canyon Road for access to the principal VAFB gates. These routes, which relate to the Operations phase, should be shown in Figure 5.2.1-B, along with Central Avenue and Floradale Avenue.

There are several projects which would improve highway access and traffic flow. Improvements to Lompoc-Casmalia Road between State Route 1 and Highway 246, are included in the County Program in the near future. Widening of Central Avenue from State Route 1 to Floradale Avenue was completed in 1976. Improvement of S-20 between the Main Gate and Pine Canyon Gate is part of the Santa Barbara County Road Improvement Program for FY79 [U.S. Air Force, 1975 (137), revised May 1977].

Commuted congestion at the principal VAFB gates, an existing problem, can be alleviated through additional redistribution of arrivals and departures times for the workforce. Table 2.7-1 indicates that more than half the present traffic arrives during the 0730 and 0800 quarter-hour periods.

Q.6 Table 3.2.6-1 does suggest that peak period traffic congestion near VAFB does exist. The proposed project, with its slight increases in traffic, will exacerbate this problem unless mitigating measures are taken. Some improvements in the highway network are included in present and future plans. Improvements to the Lompoc-Casmalia Road between State Route 1 and Highway 246, are included in the County Program in the near future. Widening of Central Avenue from State Route 1 to Floradale Avenue was completed in 1976. Improvements of S-20 between the Main Gate and the Pine Canyon Gate of VAFB are part of the Santa Barbara County Road Improvement Program for FY 79 [U.S. Air Force, 1975 (137), revised May 1977].

As the comment suggests, however, congestion can exist at specific points for limited periods due to peak levels of traffic, which may be a sizable proportion of average daily traffic. Under existing circumstances, all Base units have been divided into groups with working hours starting at 15-minute intervals between 0700 and 0800. Even with this practice, however, congestion persists. One can see from Table 3.2.6-1 that the bulk of the traffic arrives during two of the periods—around 0730 and 0800. Additional redistribution of arrival times at these gates will serve to not only reduce congestion at the gates, but at critical intersections throughout the local highway network.

Q.7 To ensure the safe transport of flammable or explosive materials through populated areas, the California Legislature has established regulations on this subject in Division 14 of the Vehicle Code. The regulations provide for:

- Special licensing of drivers.
- Special inspection of transporting vehicles.
- Safe design and construction of liquid cargo-carrying vehicles.

- Establishment of routes and safe stopping points.
- Supplying drivers with maps of approved routes.

Design and construction criteria are established by the State Fire Marshal and all other criteria by the State Highway Patrol. Routes established by the Highway Patrol for the transportation of explosives in Santa Barbara County are shown on Figure 5.2.2-B. Generally, routes follow U.S. Highway 101 and State Highways 1 and 246 with special by-pass provision for the more built-up areas of Lompoc.

Delivery of propellants will depend on the number and types of Orbiter missions and the amount of losses from storage tanks. Present weekly tanker estimates (one tanker carries 6,000 gallons) for hypergolics, liquid oxygen, and liquid hydrogen will require about 75 tankers from Los Angeles suppliers (McDonnell Douglas Astromatics Company, 16 January 1976, Don Barnes, telephone communication, SAMSO-HDRS-MISC-39). Other fuels and gases will be required in lesser quantities.

Such vehicles therefore represent a comparative rarity in regional traffic flows. The low probability of an accident can be further reduced by ensuring that delivery periods do not coincide with peak traffic periods. It is possible, although unknown at this time, that propellant requirements for the Shuttle will be equal to or less than requirements for the existing expendable launch programs, thus resulting in a net decline in transportation of these materials.

Q.8 The assumption that 80 percent of the jobs will be filled by present residents refers to the labor force applied to the Operations phase of the project, with some of these personnel being involved in the Activation phase as well. The "20 percent new residents" was a worst-case assumption, because Air Force sources indicate that all of these personnel may be transferred from existing Base activities. A specific example is the existing expendable launch vehicle program. If that were the case, there would be no influx of new workers and dependents and thus no impact on traffic.

The 70 percent assumption, on the other hand, refers to the indirect jobs generated by the project but filled by existing residents. This rests on

the assumption that the bulk of the direct jobs would be filled by existing residents and thus the increase in local consumption expenditures would be limited to only those direct personnel who are new to the area.

The actual mix of existing and new residents gaining jobs created will depend on the phase of the business cycle generally, and the local labor market situation that prevails at the time the project is undertaken. The heavier unemployment locally at the time, the larger the proportion of jobs which will be filled by existing local residents. Because both in the county and state unemployment rates have been quite high, relative to typical rates of the 1950s and 1960s, and because these rates have not decreased markedly during times of prosperity and move up rapidly in times of stagnation or recession, the 70 percent assumption seems reasonable.

Q.9 Lompoc Airport, with 40 based aircraft and an average of less than 300 operations per week, is the closest general aviation facility to VAFB. It can expect to experience some minor increase in traffic associated with contractor officials during the Construction and Activation phase of the project. During the Operations phase periods of substantial traffic at Lompoc may be experienced at times of launch and Orbiter landing events. These peaks, however, will be of limited duration and attendance can be expected to decline after the first several flights.

Q.10 The CNEL data presented in the FEIS (paragraph 3.1.8, Figure 3.1.8-B) was obtained from existing literature on the subject (FEIS reference #40). No new measurements were taken. The CNEL lines on Vandenberg AFB were developed by comparing base traffic to the average daily traffic information found in the reference. The noise contours resulting from air traffic are based on 27,000 air operations per year. Of those operations, 6,750 involved a touch-and-go fuel stop operation. The remainder were low approaches and departures where the runway was not touched. In general, only minor increases in vehicular traffic are expected. However, Vandenberg AFB is preparing an Air Installation Compatibility Use Zone (AICUZ) document to be released in mid-78 to the public. This document is based on accurate (measured) average daily traffic figures for the Base and reflects the overall noise contours in L_{dn}. The L_{dn} and CNEL

systems are similar except that L_{dn} assesses a penalty for night operations. The results of this study and the projected impact of the proposed Shuttle program will be included in the aforementioned supplement.

Q.11 By Executive Order, the Air Force Occupational Health and Safety Standards must be consistent with those of the Occupation Safety and Health Act. In the case of noise exposure, extensive Air Force research has determined that 84 dBA is the permissible limit for an 8-hour day. This standard is rigorously enforced for all Air Force military and civilian personnel. The Air Force does not have the authority to enforce this criteria and the use of hearing protection on civilian contractor personnel even if they are working on a military installation. However, all contractors must comply with OSHA as a requirement in their contracts.

Q.12 At frequencies below 50 Hz, sound pressure levels are expected to range from 103 to 110 dB in Lompoc and the Base cantonment area. At most, the duration of the noise will extend between the time the main engines are fired at T minus 4 seconds and the completion of ascent to 50,000 feet at T plus 72 seconds; a period of 76 seconds. Within this period, persons in the cantonment area and Lompoc will experience objectionable noise, particularly for the approximate 10 seconds of peak levels.

Q.13 The effect of sonic booms upon structures is addressed in Response A.2 of Appendix A. The degree of vibration induced in a particular structure is governed by the pressure signature distribution over the structure and the physical properties of the structure. The severity of damage depends upon the condition of the structure and cannot be readily generalized. Every structure accumulates damage and weakness as it ages. Repetitive exposure to sonic booms could hasten this process, and shorten the expected lifetime of the structure. According to British studies, a structure or structural element which is near the end of its lifetime could be vulnerable to damage from a sonic boom.(Q1)

Q.14 Vibrational resonance within structures can lead to magnification of overpressures.(Q2) Resonance may be associated with both structural members and enclosed volumes, such as rooms. Overpressure magnification factors

of 2 or more may result from room resonances. Unfortunately, further research is necessary before specific impacts can be quantified.

Q.15 The proposed hovercraft facility at Vandenberg is no longer being planned for. A decision has been made to adopt the Shallow Draft Barge (SDB) concept (discussed in Appendix B of the Draft EIS) as the favored method of External Tank delivery to the Base. This EIS has been changed to reflect that decision. Noise at that facility will be minor relative to launches.

Q.16 Accidental minor spills of fuels and lubricants (gas or oil) will be localized to paved areas or soils exposed during construction. The quantities involved are expected to be too small (measured in terms of a few liters) to create a detectable impact on groundwater quality. These and large spills would be either contained in a local area or cleaned up and removed to a controlled waste disposal site. The relatively low rainfall and lack of infiltration on paved or compacted areas eliminates the risk of contaminants being flushed below the ground surface.

Q.17 In general, many water uses can add dissolved materials, thereby increasing their concentration in the effluent. This is true of municipal water use as well as irrigation use and others. The incremental addition of dissolved solids resulting from increased water use by population associated with the Shuttle program will be quite minor. Comparing the 62 acre-feet per year of additional water used in the Lompoc area with the 14,500 acre-feet per year total use shows that less than a half a percent could be affected. Because return flows are higher in TDS by a fractional portion, the concentration effect is even less, on a percent basis. When this 62 acre-feet is further (hypothetically) compared with the hundreds of thousands of acre-feet of groundwater in the Lompoc area, the potential for degradation is relatively insignificant. Some increase in TDS will occur if water of a higher salinity is returned to the aquifer; however, the specifics of the Lompoc area indicate the effect of the Shuttle will be negligible.

Q.18 The Air Force will review the studies in question to further assess the probability of a missile fragment striking a sensitive area of the LNG facility.

Q.19 Losses incurred from Space Shuttle operations will be investigated through the Air Force's legal office at Vandenberg Air Force Base. As stated in the EIS, intervening topography and the remoteness of the launch site reduce the possible severity of crop and other damages associated with ground cloud movements toward Lompoc. Despite the 5 percent probability of ground cloud movements toward the Lompoc Valley, the likelihood of measurable damage is much lower. The low ecpected likelihood of damage does not, at the present time, merit an alteration of acceptable launch conditions.

Q.20 The discussion of acid rainfall impacts on natural plant communities as found in Section 5.1.2.7 of the EIS, particularly pages 5-41 through 5-44, represents the best available information to date. It should be noted that an acid rainfall event (if it occurs) is not expected to be a frequent occurrence. This is based on the fact that, to date, no such event has occurred from Titan launches at Vandenberg.

Q.21 The Air Force is currently studying this problem to determine exhaust-induced effects from past and present Titan launches at VAFB. To date, no biotic effects from toxic exhaust constituents have been detected on Vandenberg AFB. Moreover, an acid rainfall event has not been observed from Vandenberg Titan launches. Presently, studies by NASA are underway to determine the biological effects of acid rain.

Q.22 The subject you address is one that was considered during the preparation of this Statement. To date, however, studies in this regard have not been carried out. In the event of an acid rainfall, some damage to lichens and mosses is expected; the extent or degree of this possible damage, however, is not known. Regardless, the expected infrequency of such an event and the low probability of repeated events occurring in the same area support a conclusion that such impacts, if they occur, would be very minor.

Q.23 The possible adverse effects of pollutants at higher elevations is discussed in Section 5.1.2.7, specifically on page 5-43.

RESPONSE REFERENCES

Q1 ICAQ Sonic Boom Panel Report DOC 6694, SBP/II, 12 October 1970, reprinted in Noise Control 1971, Hearings Before the Subcommittee on Public Health and Environment, House of Representatives, 92nd U.S. Congress, June 16-24, 1971. Serial No. 92-30 USGPO.

Q2 National Bureau of Standards, The Effects of Sonic Boom and Similar Impulsive Noise on Structures, Environmental Protection Agency, 31 December 1971.

APPENDIX R

COMMENTS FROM

COUNTY OF SANTA BARBARA
DEPARTMENT OF PLANNING
(Letter dated September 30, 1977)



COUNTY OF SANTA BARBARA
CALIFORNIA

DEPARTMENT OF PLANNING

ENGINEERING BUILDING
123 E. Anapamu St.
SANTA BARBARA
CALIFORNIA
93101
Phone: 966-1611 Ext. 230

BRITT A. JOHNSON
Planning Director

PAUL W. WACK
Assistant Planning Director

September 30, 1977

DCS/Plan
Asst DCS
Executive
Asst Exec
Action
Susp
Info

Office of the Secretary of the Air Force
SAF/MIQ
Washington, D. C. 20330

Dear Sir/Madam:

The County of Santa Barbara Planning Department is in the process of developing a land use plan to implement the provisions of the Coastal Act of 1976. Although Vandenberg AFB is exempt from the Coastal Act of 1976, some base activities, particularly the Space Shuttle Program, do affect County lands within the Coastal Zone. We have reviewed portions of the Draft E.I.S.and would request that the following questions/suggestions be addressed in the Final E.I.S.:

.1 1. Will the sonic booms affect only San Miguel Island?

2. What impact will the sonic booms have on recreational boating activities
.2 in the vicinity of the Channel Islands, i.e., do you plan to evacuate boats from the vicinity of the islands at the time of each launch?

3. What will be the frequency and duration of closures of the County Parks at Jalama and Ocean Reach? Northern Santa Barbara County experiences a
.3 shortage of opportunities for beach access and recreation. Closing County Parks, especially if such closures were to occur during weekends, will affect public opportunities for coastal recreation.

.4 4. Will Point Sal State Beach also be closed during launches?

5. Since the Lompoc area will experience some influx of population as a result of construction and operation of the Space Shuttle, northern Santa Barbara County's already limited coastal recreational resources will be
.5 impacted. Has Vandenberg AFB considered opening other areas of its coastline for beach access and recreation to accommodate increased recreational demand?

.6 6. Will Space Shuttle operations have any impact on tanker traffic in the Santa Barbara Channel, including potential LNG tankers?

We hope these comments will be of use to you in preparing the Final E.I.S. We will be happy to offer our assistance in coordinating planning efforts for geographical areas of mutual concern.

Sincerely,

Kim Skinnarland

Kim Skinnarland
Project Manager
Local Coastal Program

KS:dc

cc: -Robert Hedlund, Supervisor, Fourth District
-Phil Berry, Regional Coastal Commission
-Michael Pahos, County Park Department
-Madge Strong, State Coastal Commission

RESPONSE TO COMMENTS FROM
COUNTY OF SANTA BARBARA
DEPARTMENT OF PLANNING

R.1 No. Sonic boom effects and boom footprints are presented in Section 5.1 of the FEIS. See Figure 5.1.2-0 through -1.

R.2 Sonic booms produced by the Space Shuttle should have very little, if any, impact on recreational boating activities in the vicinity of the Channel Islands. Only 6 launches are planned over a ten year period that will produce sonic booms in the vicinity of the islands. At the highest predicted overpressure (30 psf) directly in the focus zone, no physiological damage will occur to people or significant structural damage to their boats. Evacuation of recreational boats from the vicinity of the Channel Islands will not be required by Space Shuttle launches.

R.3 The most frequently used Space Shuttle launch azimuth of 193 degrees will not require closure of Jalama Beach or Ocean Park. The Vandenberg AFB beach area south of Ocean Park and Surf Station will be closed during Space Shuttle launches. For minimum launch azimuth trajectories, Jalama Beach may be closed two or three times a year at the most.

R.4 Point Sal Beach is located on North Vandenberg and will not be subject to closure as a result of Shuttle launches.

R.5 The impact of minor increases in population and occasional closure of Jalama Beach for short periods is not considered a significant impact to the local coastal recreational resources. Increased recreational demand has not been quantified, but would be very low. At this time the Air Force has no plans to open any additional areas of Vandenberg to the public.

R.6 The only impacts that Shuttle operations will have on marine traffic in the Santa Barbara Channel will relate to the very small increases

in traffic resulting from the transit of barges carrying Shuttle vehicle components to Vandenberg and from the launch of the vehicle itself. Increased marine traffic will present a small navigation safety hazard due to the greater opportunity for accidents (ship collisions, etc.). Ship traffic in the channel is not considered especially heavy and the incremental contribution of Shuttle related traffic is very small. Additional information is provided in Section 5 of the FEIS. A tanker in the channel could be exposed to some hazard if it was in transit through certain downrange areas. However, the location of these areas and the times when operations could pose hazards will be published in the Notice to Mariners.

APPENDIX S

COMMENTS FROM

SANTA BARBARA COUNTY-CITIES AREA PLANNING COUNCIL

(Letter dated October 7, 1977)



Santa Barbara County - Cities Area Planning Council

1306 Santa Barbara Street
Santa Barbara, Cal. 93101
(805) 966-1611

October 7, 1977

Mr. James F. Boatright
Deputy for Installations Management
Deputy Assistant Secretary
Department of the Air Force
Washington, D. C. 20330

Dear Mr. Boatright:

In accordance with your letter dated August 12, 1977, we have reviewed the draft Environmental Impact Statement of the proposed Space Shuttle Program, Vandenberg Air Force Base, California. The following comments as we interpret they may relate to the programs of this Area Planning Council are offered below for your consideration.

1. The Area Planning Council is also the Airport Land Use Commission for Santa Barbara County. We are in the formative stages of preparing an Airport Land Use Plan, and S.1 although our preliminary finding do not conflict with yours, it should be noted that such a study is in progress on a cooperative arrangement with the Base Civil Engineer Command.

2. S.2 With reference to the above, to what degree will activities from the space shuttle increase the use of Lompoc Airport? Will noise impacts result from such increased use?

S.3 3. Page vi: "Land use . . . (small amount of agricultural land . . . .)"

What is the estimated acreage and is it prime agricultural land?

S.4 4. Page 2-1: (Paragraph 3.) Suggest you convert and/or reference 208 hours to days.

5. Page 3-103: Solid Waste Disposal section.

S.5 Would be appropriate to discuss recycling of waste materials. Also, reference to the Solid Waste Management Plan for Santa Barbara County.

S.6 6. Page 5-64-65: Is phrase "except South Coast" an assumption? If so, it should be stated as such.

S.7 7. Should not a consideration be made to an AICUZ plan for VAFB?

We are pleased to have had the opportunity to review the Draft Environmental Impact Statement for this program and anticipate further development with enthusiasm.

Sincerely,

Clifford Petrie
Executive Secretary

CP:rm

cc: Colonel S.F. Martino

RESPONSE TO COMMENTS FROM
SANTA BARBARA COUNTY-CITIES AREA PLANNING COUNCIL

S.1 It has been noted that such a study is in progress.

S.2 Construction and operation of the Shuttle program will cause some additional traffic at the Lompoc Airport. This increase would be small based on the limited local population increase expected as a consequence of construction and operations. It is conservatively expected that traffic will increase by no more than 50 operations per week. (Most VIP traffic would utilize the field at Vandenberg.)

The Lompoc Airport does not handle a large traffic volume at present (see Section 3.2 of the EIS) and could accommodate additional Shuttle related operations without difficulty. Increased operations at Lompoc would cause a slight alteration of noise level (CNEL) contours around the airport. However, additional traffic would not significantly displace the current CNEL contours. Land use surrounding the Lompoc Airport is generally agricultural, with limited commercial development near the intersection of Central Avenue and H Street. Existing residential and other noise sensitive land uses are generally well removed from the airport area. Based on these facts, noise impact from increased operations should be insignificant.

S.3 Table 4.2-3 in the FEIS details the amount of additional urban land (by category) required for the Shuttle program through 1990. It is reasonable to assume that almost all new urban land will displace existing agricultural lands.

Most new urban land will be infill along the fringes of existing communities in the North County area. Although much of this land may have the potential for high agricultural productivity, it would not be considered prime farmland. This is because typical parcel sizes would be small and land values (and taxes) would be relatively high. Agricultural operations in such areas are usually marginal from an economic standpoint.

S.4 The FEIS now also describes the 208 hour minimum turnaround time for launch activities as 8 2/3 calendar days.

S.5 The FEIS now includes a brief description of waste material recycling programs as part of Section 3.2.6. Also, this section includes reference to the County Solid Waste Management Plan.

S.6 Reference to pages 5-64 to -65 appears to be incorrect. No response to this question is possible.

S.7 The existing Air Installation Compatibility Use Zone (AICUZ) plan for Vandenberg is out of date and a new plan is currently being prepared. The new plan will be compatible with the Base Master Plan, which is briefly described in Section 4 of the FEIS.

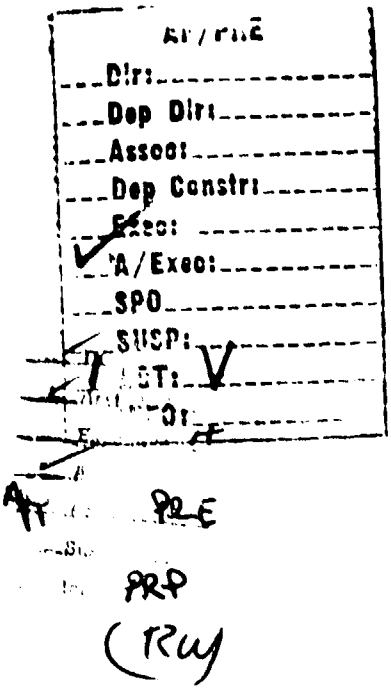
APPENDIX T

COMMENTS FROM

ADVISORY COUNCIL ON HISTORIC PRESERVATION

(Letter dated September 14, 1977)

Advisory Council on
Historic Preservation
1522 K Street N.W.
Washington, D.C. 20005



September 14, 1977

James F. Boatright
Deputy for Installations Management
Deputy Assistant Secretary
Department of the Air Force
Washington, D.C. 20330

Dear Mr. Boatright:

This is in response to your request of August 12, 1977, for comments on the draft environmental statement (DES) for the proposed Space Shuttle Program, Vandenberg AFB, California. We have reviewed the DES and note that the undertaking will affect six archeological sites that may be eligible for inclusion in the National Register of Historic Places.

Pursuant to Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470f, as amended, 90 Stat. 1320) Federal agencies must, prior to the approval of the expenditure of any Federal funds or prior to the granting of any license, permit, or other approval for an undertaking, afford the Council an opportunity to comment on the effect of the undertaking upon properties included in or eligible for inclusion in the National Register of Historic Places. However, we also note that the U.S. Air Force is aware of its responsibility pursuant to Section 106 with respect to the proposed undertaking. Accordingly, we look forward to working with the Air Force in accordance with the "Procedures for the Protection of Historic and Cultural Properties" (36 C.F.R. Part 800) at the appropriate time.

Nevertheless, until the requirements of Section 106 are met, the Council considers the DES incomplete in its treatment of historical, archeological, architectural and cultural resources. To remedy this deficiency, the
T.1 Council will provide, in accordance with its "Procedures," substantive comments on the effect of the undertaking on these properties. Please call Michael H. Bureman at (303) 234-4946 to assist you in completing this process.

Sincerely yours,

Michael H. Bureman

Louis S. Wall
Assistant Director, Office of
Review and Compliance

T-1

1626-77

RESPONSE TO COMMENTS FROM ADVISORY COUNCIL ON HISTORIC PRESERVATION

T.1 The Air Force is fully aware of its responsibilities under Section 106 of the National Historic Preservation Act of 1966. Actions are presently underway for obtaining the Advisory Council's comments. The completed nomination forms have been sent to the State Historic Preservation Officer.

The Air Force will take no action prior to receiving the Advisory Council's comments on these proposed activities at Vandenberg AFB.

APPENDIX U

COMMENTS FROM

THE AMERICAN CETACEAN SOCIETY
NATIONAL HEADQUARTERS
(Letter dated September 30, 1977)

THE AMERICAN CETACEAN SOCIETY

NATIONAL HEADQUARTERS

September 30, 1977

P. O. Box 4416
San Pedro, Ca. 90731
(213) 548-6279

TO: SAMSO-DEV

FROM : Millie Payne, Executive Secretary

RE: Space Shuttle Operation, Vandenberg Air Force Base

The American Cetacean Society is a nonprofit corporation engaged in educational and conservational activities relating to marine mammals and their environment, with emphasis on cetaceans. As such, we are extremely concerned about the effect of powerful sonic booms on the marine mammal populations of the Channel Islands and surrounding waters.

San Miguel Island is the only place on earth where six species of pinnipeds haul and and breed. It is unacceptable that these animals be subjected to booms reaching 40 psf. Physiological effects can only be speculated upon; but hearing loss and spontaneous abortion are serious possibilities. Pinnipeds, when frightened, stampede toward the water, and widespread pup mortality is the result. This has been observed many times.

U.1 Clearly, routing the shuttle away from San Miguel and the other channel islands is indicated.

The waters in question are inhabited throughout the year by several species of cetaceans, many of them on the U.S. Endangered Species List. Blue, finback, humpback, minke and sperm whales are seen commonly around the islands, along with pods of pilot whales, killer whales, common dolphins, white sided dolphins and Dall porpoises. The extremely rare northern right whale also is known to inhabit these waters.

A very high percentage of the entire population of the California gray whale migrates through these waters twice every year, between October and April. The southern migration includes all pregnant females. The Pacific gray whale stock is the only one remaining of this species.

The perception of cetaceans is primarily accoustical. The potential for significant, even disastrous damage to these populations from sonic booms must be recognized and eliminated.

U.2 Until it can be established that powerful sonic booms will not adversely affect cetaceans, they must not be allowed to occur over cetacean habitat.

RESPONSE TO COMMENTS FROM THE AMERICAN CETACEAN SOCIETY NATIONAL HEADQUARTERS

U.1 Consideration of alternative launch directions to avoid the Channel Islands, and San Miguel in particular, has been discussed in Responses C.11 and D.2. Should additional information become available to address this impact, it will be incorporated in an amendment to the EIS.

U.2 Impacts to cetacean habitats have been incorporated into Section 5.1.2.7 of this FEIS. Reference is also made to Comment D-2.

APPENDIX V

COMMENTS FROM

CALIFORNIA WILDLIFE TRUST
(Letter of October 5, 1977)



CALIFORNIA WILDLIFE TRUST

3435 HERMOSA AVENUE • HERMOSA BEACH, CALIFORNIA 90254
TELEPHONE (213) 372-0285

October 5, 1977

EDWARD S. LOOSLI

Office of the Secretary of the Air Force
(SAF/[illegible])
Washington D.C. 20330

re: Draft EIS for Space Shuttle, Vandenberg Air Force Base;

The California Wildlife Trust feels that the discussion of endangered and Threatened Species in this draft EIS is inadequate.

The entire paragraph 5 on page 3-71 needs amplification. The EIR should establish the California least tern activities around San Antonio Lagoon. The last sentence which states that "it is not known whether the endangered subspecies [illegible] beldingi occurs there also," is not sufficient for a Final EIR. It is necessary to establish whether the Beldings Savannah Sparrow is present and the Long Beach Office of the Calif. Department of Fish and Game will assist in identification.

V.1

The California Tule Elk should be added to the last sentence of page 3-71. Along with the southern sea otter and Guadalupe fur seal, the Tule Elk (rare) once ranged over the project area. Vandenberg is within the historic breeding area of the Tule Elk and although these exclusive California mammals do not exist at the present time, suitable habitat is present.

V.2

Sincerely,

Edward S. Loosli

Edward S. Loosli
Director-California Wildlife Trust

RESPONSE TO COMMENTS FROM
CALIFORNIA WILDLIFE TRUST

V.1 Additional information concerning the activities of the California least tern and the occurrence of Belding's savannah sparrow around San Antonio Lagoon are included in Section 3.1.9.3 of the Final Environmental Statement.

V.2 Information relating to the California tule elk is incorporated in the Draft EIS, and is found on page 3-67 in the terrestrial vertebrate discussion.

APPENDIX W

COMMENTS FROM

LOMPOC VALLEY ECONOMIC DEVELOPMENT ASSOCIATION
(Letters of September 30 and October 7, 1977)

ECONOMIC
DEVELOPMENT
ASSOCIATION

205 NORTH H STREET
LOMPOC, CALIFORNIA 93436 (805) 736-3315

September 30, 1977

Department of the Air Force
Headquarters Space & Missile Systems Organization
Los Angeles Air Force Station, P. O. Box 92960
Worldway Postal Center, Los Angeles, Ca. 90009

Attention: Lt. Colonel Earl Jones

Dear Sir:

This letter confirms our Board of Director's views which I stated during your public presentation of the Space Shuttle Environmental Impact Report in Lompoc, Wednesday, September 18th.

The Lompoc Valley Economic Development Association is a non-profit organization supported by local citizens interested in achieving the common goal of reducing our high unemployment rate and to establish some meaningful employment for our 800 or so students who graduate from the local high schools each year.

Since 1957 when Lompoc was primarily an agricultural town of 5,500 we have grown to a population approximating 46,000 and have found ourselves almost totally dependant upon the labor force established at Vandenberg Air Force Base. During the intervening years of 1957 to date, our community has made great strides in expanding residential areas, utility systems, public and safety services of all aspects, all in support of the influx of personnal primarily occasioned by the ballistic missile and space programs conducted by Vandenberg Air Force Base.

Upon the advent of the Space Shuttle Program, we the citizens of Lompoc, feel that we are just as much an integral part of supporting the program as you in the military or the aerospace contractors. We share your views that if the United States is to continue to progress in space exploration we must develop new and sophisticated programs. We, in the Economic Development Association, feel that Lompoc's role in support of the Space Shuttle Program is an exciting follow-on to earlier programs conducted at Vandenberg Air Force Base and are proud to be a part of it.

This organization sees no adverse environmental impacts to our local area.

Sincerely,

C. C. Carmichael
Director

CCC:mb

ECONOMIC
DEVELOPMENT
ASSOCIATION

205 NORTH H STREET
LOMPOC, CALIFORNIA 93436 (805) 736-3315

October 7, 1977

Mr. James F. Boatright, Deputy
Office of the Secretary of the Air Force
(SAF/MIQ)
Washington, D. C. 20330

Dear Mr. Boatright:

Although this office was not listed on the original distribution list, we have secured a copy of your Environmental Impace Analysis for the Air Force Space Shuttle Program and make the following comments in accordance with your letter dated 12 August 1977:

This letter confirms our Board of Director's views which I stated during your public presentation of the Space Shuttle Environmental Impace Report in Lompoc, Wednesday, 18 September.

The Lompoc Valley Economic Development Association is a non-profit organization supported by local citizens interested in achieving the common goal of reducing our high unemployment rate and to establish some meaningful employment for our 800 or so students who graduate from the local high schools each year.

Since 1957 when Lompoc was primarily an agricultural town of 5,500 we have grown to a population approximating 46,000 and have found ourselves almost totally dependant upon the labor force established at Vandenberg Air Force Base. During the intervening years of 1957 to date, our community has made great strides in expanding residential areas, utility systems, public and safety services of all aspects, all in support of the influx of personnel primarily occasioned by the ballistic missile and space programs conducted by Vandenberg Air Force Base.

Upon the advent of the Space Shuttle Program, we, the citizens of Lompoc, feel that we are just as much an integral part of supporting the program as you in the military or the aerospace contractors. We share your views that if the United States is to continue to progress in space exploration we must develop new and sophisticated

programs. We, in the Economic Development Association, feel that Lompoc's role in support of the Space Shuttle Program is an exacting follow-on to earlier programs conducted at Vandenberg Air Force Base and are proud to be a part of it.

This organization foresees no adverse environmental impact to our local area, conversely, the socio/economic advantages to be realized will far outweigh those minor environmental considerations which will be occasioned by the Space Shuttle Program. If the Space Shuttle Program fails to materialize and no new programs are instituted at Vandenberg, the Lompoc Valley will suffer additional economic problems over those experienced during the last few years while Vandenberg phased down many existing programs.

Sincerely,

C. C. Carmichael
Director

CCC:mb

RESPONSE TO COMMENTS FROM
LOMPOC VALLEY ECONOMIC DEVELOPMENT ASSOCIATON

No response to these comments is required.

APPENDIX X

COMMENTS FROM

MR. JOHN E. EASTIN

(Letter dated September 29, 1977)

1100 LaSalle Canyon Road
Lompoc CA 93436
September 29, 1977

SAMSO/DEC
P.O. Box 92960
World Way Postal Center
Los Angeles CA 90009

Gentlemen:

This is a statement for the record concerning the Space Shuttle Program at Vandenberg AFB.

I live in LaSalle Canyon, Santa Barbara County, west of Lompoc, and have a concern as to the security of the LaSalle Canyon watershed when the Space Shuttle Program becomes operational. This concern is based on the fact that approximately 10 families living in the canyon are relying on a water table that is near the surface and is shallow in depth. The water table is approximately 18 feet at the mouth of the canyon proceeding to 50 feet, more or less, on down the canyon. The depth of the water table is 18-30 feet at the mouth and increases as it proceeds down the canyon. Another problem with the water in this area is that the underlying diatomite prevents deeper wells from producing more or better water.

If, during the launch process, a malfunction should occur which would cause the missile in total to crash in the LaSalle Canyon watershed,
X.1 what would the short and long term impact be to the water downstream to the residents? Who would be responsible for the health hazard and who would "fix" the water problem? It is not sufficient to say that a missile
X.2 could not or would not hit the ground in total (not destroyed)--past performance has proven otherwise.

It should also be noted that no consideration was given to the LaSalle
X.3 Canyon Creek in the Environmental Impact Study. This is strange due to the fact that even in the dryest of seasons LaSalle Creek has running water.

Sincerely,

JOHN E. EASTIN

RESPONSE TO COMMENTS FROM
JOHN E. EASTIN

X.1 Launch azimuth ranges from 158 to 201 degrees, or slightly to the east and west of due south, respectively. Figure 1.2-A of the Draft EIS summary, (pg. 1-2) illustrates the launch direction. La Salle Canyon drains northerly along the eastern border of the Point Arguello missile facility and is over 6 miles (10.5 km) northwest of the launch site. The area of concern is thus out of the Space Shuttle Launch corridor and quite distant from areas in which an explosion, catastrophic accident might occur. Should a Space Shuttle main engine fail on lift-off, a Return to Launch Site (RTLS) or Abort Once Around (AOA) procedure would be followed. This is summarized in Section 2.4 of the DEIS summary.

An emergency, such as an explosion, fire or major fuel spill at the SLC-6 launch site, could release large quantities of hydrazines and/or cryogenic fuels. However, little impact would be expected on La Salle Canyon. This is because the launch pad is topographically isolated from La Salle Canyon by a 500 foot (152 m) ridge and the area is not in the trajectory of a launch.

The cryogenic materials would eventually evaporate to the atmosphere and probably not reach groundwater and surface sources. Hydrazine would also evaporate and dissipate with little, if any, effect on La Salle Canyon.

Short term effects would be dominated by the consequences of a fire, if one should occur. HCl, if released, could dissolve in water on the surface and affect pH and chloride concentrations until flushing occurs. These effects would be relatively short term, and limited to water exposed on the surface. Long term effects on groundwater supplies are not likely because none of the materials released would remain to enter the aquifer.

X.2 Funds for claims against the government for damages resulting from Air Force activities are processed through the Base legal office. A form is available for this purpose.

X.3 The DEIS primarily focused upon the major surface and groundwater sources on and near Vandenberg. Flow occurs in numerous springs in Point Arguello and flows not only to the north in areas such as La Salle Canyon, but also to the east and south of Tranquillon Ridge. The intent of the environmental description was to characterize this occurrence of fresh water, and not provide a detailed description of each individual spring. Published data were not available to characterize the hydrology and quality of many small springs.

APPENDIX Y

COMMENTS FROM
THE RESOURCES AGENCY OF CALIFORNIA
OFFICE OF THE SECRETARY
(Letter dated December 5, 1977)

-FICE OF THE SECRETARY
RESOURCES BUILDING
1416 NINTH STREET
95814
(916) 445-5656

partment of Conservation
partment of Fish and Game
partment of Navigation and
Ocean Development
partment of Parks and Recreation
partment of Water Resources
partment of Forestry

EDMUND G. BROWN JR.
GOVERNOR OF
CALIFORNIA

Air Resources Board
Colorado River Board
San Francisco Bay Conservation and
Development Commission
Solid Waste Management Board
State Lands Commission
State Reclamation Board
State Water Resources Control Board
Regional Water Quality Control Boards
Energy Resources Conservation and
Development Commission
California Coastal Commission
California Conservation Corps
State Coastal Conservancy

THE RESOURCES AGENCY OF CALIFORNIA
SACRAMENTO, CALIFORNIA

1977 DEC 5

Department of Air Force
Space and Missile Systems Organization
Los Angeles Air Force Station
P. O. Box 92960
Worldway Postal Center
Los Angeles, CA 90009

Attention: Mr. Roig-DEV

Gentlemen:

The State of California has reviewed the Environmental Impact Analysis Process, Draft Environmental Impact Statement (DEIS), Space Shuttle Program, Vandenberg AFB, California, August 1977, which was submitted to the Office of Planning and Research (State Clearinghouse) within the Governor's Office.

This review, which meets the requirements of Part II of U. S. Office of Management and Budget Circular A-95 and the National Environmental Policy Act of 1969, was coordinated with the Departments of Water Resources, Health, Transportation, Navigation and Ocean Development, Food and Agriculture, Conservation, Fish and Game, and Parks and Recreation; the Energy Resources Conservation and Development Commission; the Solid Waste Management Board; the State Lands Division of the State Lands Commission; the Public Utilities Commission; the State Water Resources Control Board; and the Air Resources Board.

As you are aware, the State of California strongly supports research and development of a variety of space programs. Please contact us if you wish assistance in resolving concerns expressed in the following comments on this document.

Water Quality

Y.1 Because the water used during launching on the pad is proposed for treatment and reuse or disposal, a discussion of the effect

of its disposal and the adverse impacts on hydrology and water quality is required.

We consider that the possibility of stream and ground water contamination will be much greater than stated, due to the
Y.2 long-term effects of the project. The total project should be evaluated rather than considering each individual segment separately.

It is also estimated that contamination of tideland areas can
Y.3 be a very serious problem with much greater long-term effects than stated.

Oil spill and gas leaks at the facility could contaminate
Y.4 the beaches - Ocean and Jalama - resulting in no public recreation use.

Waste Discharge

The DEIS indicates that waste discharges will occur from several of the support operations, including the parachute
Y.5 refurbishment facility and solid rocket booster disassembly facility. Sections of the DEIS that discuss impact on water quality should address these discharges from support operations.

Waste discharges from the facilities which are not discharged to the Vandenberg Air Force Base sewer system are subject to
Y.6 regulation by the State. Any proposed waste discharges should be approved, as required under Section 13260 of the State Water Code.

Preservation of Historic Resources

The subject document has stated that "the supersonic maneuvers of the Orbiter during its descent from space will unavoidably cause sonic boom overpressures. Should these become focused in areas containing relics or structures of historic nature, damage to the more fragile portions...could occur" (page 5-77). As the Mission La Purisima Concepcion is located within the proposed undertaking's area of potential environmental impact, and the DEIS states that the windows of the mission will be vulnerable
Y.7 to damage, the report should indicate what effect (if any) will repeated sonic boom overpressures have on the relatively friable and fragile adobe brick construction of the mission. As the "normal sonic boom overpressure" cited (2.1 psf) is expected to create adverse effects on the 190-year old mission walls, and also because there is a possibility that the 2.1 psf figure may be exceeded, the applicant should submit to the State data addressing these concerns with recommendations for mitigating any adverse effects.

Geology

Y.8 The applicant should use the "Fault Map of California," 1975, DMG, by C. Jennings, to update and include all of the study area, (see Figure 3.1.2-c) as far north as Point Sal. We also suggest that the applicant refer in this section to the USGS report, "Preliminary Map Showing Recency of Faulting in Coastal Southern California", M.F. 585, by Ziony, et al, 1974.

Y.9 The geologic section of the DEIS should mention the offshore faults and their seismic significance.

Y.10 Specific reference should be made to studies projecting the probable maximum intensity or magnitude of future earthquakes at Vandenberg AFB.

Y.11 Because soil liquefaction is stated to be a possible geologic hazard, specific site investigations should be performed prior to construction of facilities.

Wildlife Resources

The DEIS is inadequate with respect to the following:

Section 3. Description of the Existing Environment

Page 66 through 74

The Federal Register recently (August 11, 1977) listed the following endangered and threatened animals and plants which have not been considered. These are:

Animals

San Clemente loggerhead shrike - Endangered
Island night lizard - Threatened
Y.12 San Clemente sage sparrow - Threatened

Plants

San Clemente broom - Endangered
San Clemente bushmallow - Endangered
San Clemente Island larkspur - Endangered
San Clemente Island indian paintbrush - Endangered

Y.13 The tables are erroneous because of misuse of the federal classification, "threatened". The only officially listed

threatened species in California are southern sea otter, Island night lizard and San Clemente sage sparrow. All occur in the project region.

Y.14 Belding's savannah sparrow, (Passerculus sandwichensis beldingi) occurs in the project region but not in the project area. The northernmost nesting area for this subspecies is Goleta Slough, based on 1977 survey data.

Y.15 Status of nesting by California least terns in northern Santa Barbara County and southern San Luis Obispo County is not yet adequately documented. Nesting has probably occurred in this region regularly the past several years, but only two instances of nesting have been verified by the Department of Fish and Game since 1969. In 1971, a colony of at least thre breeding pairs nested on the south side of the Santa Ynez River mouth, west of the railroad tracks. In 1977, approximately 25 pairs were found nesting on the south side of the Santa Maria River mouth. Nesting colonies may have gone undetected by researchers in these areas in other years and in other river mouth areas in the project region.

Y.16 Based on recent reports of peregrine falcons seen by U. S. Fish and Wildlife Service personnel and of suspected nesting on the Channel Islands, a comprehensive survey is necessary to document peregrine falcon use in the area affected by the space shuttle program.

Section 5. Environmental Impacts of the Proposed Project

Page 34

Y.17 An adequate discussion of overpressure effects on breeding activity and egg damage to avifauna is necessary. We are particularly concerned regarding the effects on rare, endangered, and threatened species. The effects of overpressure could be significant, not minor as stated in Section 7, page 1(3).

Page 41

Y.18 Both the short-term and long-term chronic effects of acid ground clouds and acid rainouts on animal and plant physiology and bird eggs within the project area and adjacent areas should be thoroughly discussed.

Y.19 This section does not discuss the program's possible effects on nongame species within the project area and region. The document should address possible impacts on all wildlife species which may result from the proposed project.

Section 7. Unavoidable Adverse Impacts

Page 3

Y.20 Under "Suggested Mitigation Measures..." we recommend that Vandenberg AFB prepare and implement a wildlife management program to provide for the management, enhancement, and protection of wildlife resources. To be effective, this program should be headed by a full time wildlife biologist with an adequate staff. With this staff Vandenberg could recommend management, enhancement, and preservation programs which could mitigate for some of the impacts from the Space Shuttle program.

Y.21 Because the implementation of the Space Shuttle Program will impact endangered and threatened wildlife and plants, the project sponsor must, under Section 7 of the Endangered Species Act, enter into consultation with the U. S. Fish and Wildlife Service.

Y.22 All mitigation measures being developed in the Space Shuttle Environmental Protection Plan should be included in this document. The mitigation measures proposed on pages 3 and 4 are inadequate.

Y,23 In addition, if the program is enlarged or substantially modified, a supplemental or revised DEIS will be required.

Thank you for the opportunity to review and comment.

Sincerely,

L. FRANK GOODSON
Assistant Secretary for Resources

cc: Director of Management Systems
State Clearinghouse
Office of Planning & Research
1400 Tenth Street
Sacramento, CA 95814
(SCH No. 77100329)

U. S. Dept. of the Air Force
Washington, D.C. 20330
Attn: Mr. James Boatwright

RESPONSE TO COMMENTS FROM
THE RESOURCES AGENCY OF CALIFORNIA
OFFICE OF THE SECRETARY

Y.1 Reference is made to Response G.4 of Appendix G for a discussion of the quantity and constituent makeup of deluge water associated with each launch and the steps that will be taken in the event that disposal is required. Land disposal of 80,000 gallons of treated deluge water will occur no more often than the peak average frequency of proposed Shuttle launches at Vandenberg (that is, about once every 20 days). This represents a minimal impact to the existing hydrology of the area. In the event that these disposed waters come into contact with existing subsurface waters, changes in water quality would be slight with respect to nonhazardous constituents only. Direct discharge of treated deluge water into surface waters is not planned.

Y.2 See above Response Y.1. All other wastewaters generated in the Shuttle program will either be discharged to treatment facilities or hauled to an acceptable landfill disposal site. Stream or ground water contamination from highly improbable catastrophic events is a possibility; however, safety and contingency mitigation measures will be part of the Shuttle program and are being designed to keep all potential impacts related to catastrophic events to an acceptable level.

Y.3 The proposed hovercraft facility at Vandenberg is no longer being planned. A decision has been made to adopt the Shallow Draft Barge (SDB) concept (discussed in Appendix B of the Draft Environmental Statement) as part of the proposed action. This Final Environmental Statement has been changed to reflect that decision and pertinent discussions associated with potential tidelands contamination during construction and operation of the SDB facility have been included. No other Shuttle activity is expected to impart impacts to tidelands areas.

Y.4 Ocean and Jalama Beaches are sufficiently removed from any currently proposed Shuttle activity, and no contamination impacts are expected.

Y.5 See above Responses Y.1 and Y.2. Wastewaters from the Parachute Refurbishment Facility will be discharged to the Base treatment plant. Those from the Solid Rocket Booster Disassembly Facility, now planned for location at Port Hueneme, will be treated prior to discharge into the Naval Facility's sewerage system.

Y.6 The Air Force will obtain all necessary approval in this regard prior to the implementation of proposed Shuttle operations. No actions requiring such approvals are planned as being necessary during the Construction phase.

Y.7 La Purisima Mission Concepcion would conceivably be exposed to sonic boom overpressures of 2.1 psf, but only under circumstances involving an emergency return of the Orbiter necessitating a more inland flight path. This would, however, constitute an unintentional infrequent event. Under normal or aborted returns, the Mission would be exposed to sonic boom overpressures of less than 1.0 psf. It is not expected that any impact will occur to the Mission as a result of repeated exposure to these low level overpressures. The State Historic Preservation Office and the Advisory Council on Historic Preservation have been consulted and are aware of the potential impacting situation.

Y.8 Consideration will be given to the use of the suggested fault map as well as other related maps in forthcoming supplements. Time constraints do not permit the evaluation of that material for this FES planning document.

Y.9 Two faults--the Santa Ynez Fault and the Honda Fault--do extend into the marine environment and have been considered in Section 3.1.2.4 of this Statement. Their seismic significance has also been indicated in general terms. Consideration will be given to other offshore faults in forthcoming supplements to this planning document.

Y.10 Reference has been made in Section 3.1.2.4 to studies by the California Division of Mines and Geology concerning probable maximum intensities of future earthquakes in the inland portion of Vandenberg.

Y.11 As stated in Section 3.1.2.4 of this Statement, planned Shuttle activities and soil liquefaction does not represent an impacting situation. This statement is based on engineering site investigations that have been carried out to date.

Y.12 Information pertaining to the recently designated endangered and threatened plants has been incorporated into Section 3.1.9 of this Final Environmental Statement.

Y.13 Information contained in the tables in question was derived from literature that is appropriately referenced in the text preceding the tables.

Y.14 This information has been incorporated into Section 3.1.9.3 of this Final Environmental Statement.

Y.15 Information associated with the occurrence of least terns at the mouth of the Santa Maria River has been incorporated into Section 3.1.9.3 of this Final Environmental Statement.

Y.16 Biological surveys thus far carried out under Air Force authorization have not yielded any documentation of the presence of peregrine falcons at VAFB. Further biological studies are planned with respect to the Shuttle program. Should these raptors be observed, details associated with the observation(s) will be documented.

Y.17 A detailed discussion pertaining to the impacts of Shuttle generated sonic booms on avifauna has been incorporated into Section 5.1.2.7 of this Final Environmental Statement.

Y.18 Reference is made to the initial portion of the "General Response to Concerns Expressed in the Public Hearing" contained in Appendix A of this document inasmuch as it deals with the study history of acid ground cloud impacts. Information contained in Section 5.1.2.7 of this Statement represents the most up-to-date evaluation on the ground cloud/biology impacting situation.

Y.19 Some of the impact assessments presented in Section 5.1.2.7 of this Statement are keyed to habitats and are discussed in general with respect to nongame animals. Furthermore, there are many instances in that Section where impacts on specific nongame species are also discussed.

Y.20 The suggested wildlife management program is one that has been already implemented at VAFB. This program is headed by a full-time natural resources planner.

Y.21 Consultation with the U.S. Fish and Wildlife Service has been formally requested.

Y.22 The referenced Environmental Protection Plan is still under preparation and will be made part of the design specifications and operational requirements for Space Shuttle facilities.

Y.23 Should the Shuttle program at VAFB be enlarged or substantially modified, the Air Force will issue supplements to this Statement. It should be noted that forthcoming supplements are planned primarily to update impacts associated with the proposed action as documented herein.