DEPARTMENT OF THE ARMY
HEADQUARTERS, TRIPLER ARMY MEDICAL CENTER

FINAL
ENVIRONMENTAL
IMPACT STATEMENT

HOSPITAL ADDITION / ALTERATION PROJECT
TRIPLER ARMY MEDICAL CENTER
OAHU, HAWAII

AUGUST 1980
Prepared by Department of the Army based on studies
by Belt, Collins & Associates, Ltd./Lyon Associates, Inc./
Welton Becket Associates under Contract DACA84-77-C-0025.
DEPARTMENT OF THE ARMY
HEADQUARTERS, TRIPLER ARMY MEDICAL CENTER
TRIPLER AMC, HAWAII 96859

FINAL ENVIRONMENTAL IMPACT STATEMENT
FOR
HOSPITAL ADDITION/ALTERATION PROJECT
TRIPLER ARMY MEDICAL CENTER
8 AUGUST 1980

Submitted by:
EDWARD J. HUYCKE
Brigadier General, MC
Commanding, Tripler Army Center
Tripler AMC, Hawaii

Approved by:
ADOLPH A. HIGHT
Colonel, EN
Chairman, USASCH Environmental Committee
Fort Shafter, Hawaii

APPROVED BY:

OSA
## CONTENTS

### CHAPTERS

<table>
<thead>
<tr>
<th>I</th>
<th>SUMMARY</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>PROJECT DESCRIPTION</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>PURPOSE OF THE PROPOSED ACTIONS</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>DESCRIPTION OF THE PROPOSED PROJECT</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>ENVIRONMENTAL SETTING</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>LOCATION</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>EXISTING LAND USE</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>PHYSIOGRAPHY AND GEOLOGY</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>SOIL</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>CLIMATE</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>AIR QUALITY</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>SURFACE WATER HYDROLOGY</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>GROUND WATER HYDROLOGY</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>NOISE</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>VEGETATION</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>WILDLIFE</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>VISUAL ENVIRONMENT</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td>ARCHAEOLOGICAL AND HISTORICAL RESOURCES</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>CIRCULATION AND PARKING</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>BUILDING AND UTILITY SYSTEMS</td>
<td>63</td>
</tr>
<tr>
<td>III</td>
<td>LAND-USE RELATIONSHIPS</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>OVERVIEW</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>FEDERAL</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>CONSISTENCY WITH FEDERAL POLLUTION CONTROLS</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>STATE</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>STATE LAND USE DISTRICTS (ACT 187, SLH 1961)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>HAWAII STATE PLAN</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>CITY AND COUNTY OF HONOLULU</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>GENERAL PLAN (RESOLUTION 238)</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>DEVELOPMENT PLANS (PROPOSED)</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>DETAILED LAND USE MAPS</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>ZONING</td>
<td>8</td>
</tr>
<tr>
<td>IV</td>
<td>PROBABLE IMPACTS OF THE PROPOSED ACTION</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>ON THE ENVIRONMENT</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>HYDROLOGIC IMPACTS</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>AIR QUALITY IMPACTS</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>INTRODUCTION</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>CONSTRUCTION AND RENOVATION</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>POST-CONSTRUCTION PERIOD</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>MITIGATIVE MEASURES</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>NOISE IMPACTS</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>INTRODUCTION</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>NOISE IMPACTS ON THE INTERIOR ENVIRONMENT</td>
<td>18</td>
</tr>
</tbody>
</table>
ALTERNATIVES TO THE PROPOSED ACTION
ALTERNATIVE ONE: DO NOTHING
ALTERNATIVE TWO: CONSTRUCTION OF A NEW HOSPITAL
ALTERNATIVE THREE: RENOVATION AND ADDITION
RELATIVE ENVIRONMENTAL IMPACTS OF THE ALTERNATIVES CONSIDERED
PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED
MITIGATION OF ADVERSE IMPACTS
RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY
IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES
OTHER INTERESTS AND CONSIDERATIONS OF FEDERAL POLICY THAT OFFSET THE ADVERSE ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION
COUNTervailing benefits of the Proposed Action
COUNTervailing benefits of alternatives
REFERENCES
APPENDICES
Appendix A. VENTILATION DESIGN CRITERIA FOR ARMY MEDICAL FACILITIES
Appendix B. NOISE SOURCES AND SPECIFIC CONSTRUCTION OPERATIONS
Appendix C. ACOUSTIC DESIGN CRITERIA FOR ARMY MEDICAL FACILITIES
Appendix D. SPECIES OBSERVED OR CAUGHT AT MOANALUA COLLECTING SITES
Appendix E. COORDINATION
<table>
<thead>
<tr>
<th>FIGURES</th>
<th>CHAPTER II</th>
</tr>
</thead>
<tbody>
<tr>
<td>II-1</td>
<td>EXISTING TAMC SITE PLAN</td>
</tr>
<tr>
<td>II-2</td>
<td>EXISTING DEPARTMENTAL BLOCK PLAN</td>
</tr>
<tr>
<td>II-3</td>
<td>PROPOSED DEPARTMENTAL BLOCK PLAN</td>
</tr>
<tr>
<td>II-4</td>
<td>PROPOSED TAMC SITE PLAN</td>
</tr>
<tr>
<td>II-5</td>
<td>CONSTRUCTION PHASING</td>
</tr>
<tr>
<td>II-6</td>
<td>SITE LOCATION AND REGIONAL CONTEXT</td>
</tr>
<tr>
<td>II-7</td>
<td>SURROUNDING LAND USE</td>
</tr>
<tr>
<td>II-8</td>
<td>BASIC GEOLOGIC STRUCTURE OF OAHU</td>
</tr>
<tr>
<td>II-9</td>
<td>OBLIQUE AERIAL PHOTO OF TAMC AND SURROUNDINGS</td>
</tr>
<tr>
<td>II-10</td>
<td>SOILS</td>
</tr>
<tr>
<td>II-11</td>
<td>WIND SPEED AND DIRECTION BY SEASON</td>
</tr>
<tr>
<td>II-12</td>
<td>CARBON MONOXIDE LEVELS VS. WIND DIRECTION: ALIAMANU CRATER, 13 JAN. - 2 MAR. '75</td>
</tr>
<tr>
<td>II-13</td>
<td>AVERAGE CO CONCENTRATION VS. HOUR OF THE DAY: ALIAMANU CRATER, 13 JAN. - 2 MAR. '75</td>
</tr>
<tr>
<td>II-14</td>
<td>HOURLY HYDROCARBON AVERAGES FOR ALL SAMPLING SITES: ALIAMANU CRATER</td>
</tr>
<tr>
<td>II-15</td>
<td>HOURLY CARBON MONOXIDE AVERAGES FOR SAMPLING SITE 2: ALIAMANU CRATER</td>
</tr>
<tr>
<td>II-16</td>
<td>MOANALUA STREAM BASIN</td>
</tr>
<tr>
<td>II-17</td>
<td>EXISTING DRAINAGE: TAMC RESERVATION</td>
</tr>
<tr>
<td>II-18</td>
<td>MAJOR GEOHYDROLOGIC FEATURES OF OAHU</td>
</tr>
<tr>
<td>II-19</td>
<td>EXISTING VEGETATION</td>
</tr>
<tr>
<td>II-20</td>
<td>VIEW OF TAMC FROM DOWNTOWN HONOLULU</td>
</tr>
<tr>
<td>II-21</td>
<td>VIEW OF TAMC FROM PUULOA ROAD</td>
</tr>
<tr>
<td>II-22</td>
<td>VIEW OF TAMC FROM RED HILL OVERPASS</td>
</tr>
<tr>
<td>II-23</td>
<td>VIEW OF HOSPITAL FROM THE TAMC ENTRANCE GATE</td>
</tr>
<tr>
<td>II-24</td>
<td>VIEW OF HOSPITAL FROM LOWER KUKOKI ROAD</td>
</tr>
<tr>
<td>II-25</td>
<td>VIEW OF EXISTING MAIN ENTRY FROM OUT-PATIENT/VISITOR PARKING AREA</td>
</tr>
<tr>
<td>II-26</td>
<td>VIEW OF DOWNTOWN HONOLULU FROM WING C</td>
</tr>
<tr>
<td>II-27</td>
<td>VIEW OF SALT LAKE CRATER AND HONOLULU INTERNATIONAL AIRPORT FROM WING B</td>
</tr>
<tr>
<td>II-28</td>
<td>VIEW OF ALIAMANU CRATER, RED HILL, AND THE WAIANAE MOUNTAIN RANGE FROM WING B</td>
</tr>
</tbody>
</table>
### TABLES

#### CHAPTER II

<table>
<thead>
<tr>
<th>Table</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>II-1</td>
<td>POPULATION SERVED BY TAMC</td>
<td>6</td>
</tr>
<tr>
<td>II-2</td>
<td>AVERAGE DAILY WORKLOAD: FY 1976</td>
<td>7</td>
</tr>
<tr>
<td>II-3</td>
<td>SUMMARY OF STATE OF HAWAII AND FEDERAL AMBIENT AIR QUALITY STANDARDS</td>
<td>27</td>
</tr>
<tr>
<td>II-4</td>
<td>EXISTING SOURCES OF AIR POLLUTION AT TRIPLER ARMY MEDICAL CENTER</td>
<td>29</td>
</tr>
<tr>
<td>II-5</td>
<td>ALIAMANU CRATER AIR QUALITY MONITORING RESULTS: CARBON MONOXIDE LEVELS</td>
<td>32</td>
</tr>
<tr>
<td>II-6</td>
<td>EXISTING AIR-CONDITIONED SPACES</td>
<td>35</td>
</tr>
<tr>
<td>II-7</td>
<td>ESTIMATED PEAK DISCHARGES AT SELECTED LOCATIONS ON MOANALUA STREAM, OAHU</td>
<td>40</td>
</tr>
<tr>
<td>II-8</td>
<td>EXISTING dB(A) SOUND LEVELS AND RELEVANT dB(A) SOUND LEVEL STANDARDS FOR TRIPLER ARMY HOSPITAL</td>
<td>45</td>
</tr>
<tr>
<td>II-9</td>
<td>SPECIES LIST - TRIPLER ARMY MEDICAL CENTER</td>
<td>48</td>
</tr>
<tr>
<td>II-10</td>
<td>PEAK MORNING AND AFTERNOON TRAFFIC VOLUME ON JARRETT WHITE ROAD AT THE TAMC ENTRANCE: JUNE 6 TO 10, 1977</td>
<td>63</td>
</tr>
</tbody>
</table>

#### CHAPTER IV

<table>
<thead>
<tr>
<th>Table</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV-1</td>
<td>COMPARISON OF EXISTING AND PROJECTED RUNOFF</td>
<td>5</td>
</tr>
<tr>
<td>IV-2</td>
<td>TEMPORARY SOURCES OF AIR POLLUTION PRESENT DURING THE CONSTRUCTION PHASE</td>
<td>7</td>
</tr>
<tr>
<td>IV-3</td>
<td>ESTIMATES OF TOTAL SUSPENDED PARTICULATES (TSP) RESULTING FROM CONSTRUCTION OF THE PROPOSED NEW WING</td>
<td>8</td>
</tr>
<tr>
<td>IV-5</td>
<td>EXAMPLES OF PROJECTED NOISE LEVELS INSIDE TRIPLER ARMY HOSPITAL DURING CONSTRUCTION</td>
<td>22</td>
</tr>
<tr>
<td>IV-6</td>
<td>LOCATION AND TYPE OF PROPOSED PARKING FACILITIES</td>
<td>33</td>
</tr>
<tr>
<td>IV-7</td>
<td>AVERAGE ENERGY USE</td>
<td>38</td>
</tr>
</tbody>
</table>
TABLES

CHAPTER V

V-1 ALTERNATE SITE ANALYSIS RANKINGS . . . . . . . 9
V-2 SUMMARY OF SCORES RECEIVED BY THREE
      HIGHEST-RATED SCHEMES . . . . . . . . . . . . . . 12

CHAPTER VI

VI-1 SUMMARY OF MEASURES THAT WOULD BE USED
      TO MITIGATE POTENTIAL ADVERSE IMPACTS . . . . 5
SUMMARY
I SUMMARY

Final Environmental Impact Statement
Hospital Addition/Alteration Project
Tripler Army Medical Center
Honolulu, Oahu, Hawaii

Responsible Office: Commander, Tripler Army Medical Center

1. Name of Action: (x) Administrative  ( ) Legislative

2. Description of the Action: The proposed projects would involve the construction of a new 438,000-square foot hospital addition housing major outpatient clinics, diagnostic and treatment facilities, and supply departments; the construction of a new 24,000-square foot central plant housing chillers, emergency generators, and other mechanical equipment; construction and realignment of roadways, parking areas, utility lines, and other support facilities, as needed, to serve the new construction or eliminate existing deficiencies; and the renovation and structural upgrading of Wings A, B, C, and D of the existing hospital, a total of 576,000 square feet;

The purpose of the proposed additions and alterations is to improve the quality of medical care that can be provided. The electrical, plumbing, mechanical, and transportation systems in the existing structure would be brought up to modern standards, and the interior reconfigured to accommodate new uses, and to improve functional relationships both within and among the hospital's various departments and services.

3. Summary of Impacts

a. Beneficial Impacts: The proposed additions and alterations would result in better medical care for the approximately 158,000 persons who rely on Tripler Army Medical Center (TAMC) for their hospital health care services. They would also make the hospital more efficient and economical, extend its useful life, improve vehicular circulation and parking, and enhance its appearance while still retaining the basic form that has made it a major Honolulu landmark. Expenditures for construction would generate about $345 million in sales and $114 million in income in the State's economy.

b. Adverse Environmental Impacts: The most significant adverse effects of the proposed project would occur during construction. During this phase, strict controls would be required to insure that noise and dust from construction activities do not seriously degrade the quality of the internal hospital environment. The project would
also increase the potential for erosion for a short period during construction. Stormwater runoff would be permanently increased, as would energy consumption. However, projected changes in runoff would not significantly increase the flood hazard of downstream areas.

4. Alternatives: Among other possibilities being examined are:

- continued use of the present facility without major changes;
- replacement of the existing hospital with an entirely new one on another site; and
- a variety of schemes calling for a combination of renovation and new construction.

5. List of all agencies from which comments have been requested:

**State**
- Office of Environmental Quality Control
- Department of Agriculture
- Department of Land and Natural Resources
- Department of Health
- Department of Planning and Economic Development
- Department of Defense
- Department of Accounting and General Services
- Department of Social Services and Housing
- Department of Transportation
- Department of Education
- State Historic Preservation Officer
- Department of Hawaiian Home Lands

**University of Hawaii**
- Environmental Center
- Water Resources Research Center
- School of Medicine

**Federal**
- Environmental Protection Agency
- U.S. Fish and Wildlife Service
- Soil Conservation Service
- Department of the Air Force, 15th Air Base Wing
- Department of the Navy, Naval Base Pearl Harbor
- U.S. Coast Guard
- U.S. Geological Survey

**City and County of Honolulu**
- Department of General Planning
- Department of Land Utilization
- Department of Transportation Services
Department of Parks and Recreation
Department of Public Works
Honolulu Board of Water Supply
Department of Housing and Community Development
Building Department

Other Organizations
Hospital Association of Hawaii
Moanalua Gardens Community Association

6. Comments were received on the Draft EIS from:

State
Office of Environmental Quality Control
Department of Agriculture
Department of Land and Natural Resources
Department of Health
Department of Defense
Department of Accounting and General Services
Department of Transportation
Department of Education

University of Hawaii
Environmental Center
Water Resources Research Center

Federal
Environmental Protection Agency
U.S. Fish and Wildlife Service
Soil Conservation Service
Department of the Air Force, 15th Air Base Wing
Department of the Navy, Naval Base Pearl Harbor

City and County of Honolulu
Department of General Planning
Department of Land Utilization
Department of Transportation Services
Department of Parks and Recreation
Department of Public Works
Honolulu Board of Water Supply
Department of Housing and Community Development

PROJECT DESCRIPTION

PURPOSE OF THE PROPOSED ACTIONS
DESCRIPTION OF THE PROPOSED PROJECT
ENVIRONMENTAL SETTING
  LOCATION
  EXISTING LAND USE
  PHYSIOGRAPHY AND GEOLOGY
  SOIL
  CLIMATE
  AIR QUALITY
  SURFACE WATER HYDROLOGY
  GROUND WATER HYDROLOGY
  NOISE
  VEGETATION
  WILDLIFE
  VISUAL ENVIRONMENT
  ARCHAEOLOGICAL AND HISTORICAL RESOURCES
  CIRCULATION AND PARKING
  BUILDING AND UTILITY SYSTEMS
II PROJECT DESCRIPTION

PURPOSE OF THE PROPOSED ACTIONS

Background
Planning and design of the existing Tripler Army Medical Center (TAMC) were carried out against the backdrop of World War II, and many of the complex's features reflect the hospital's wartime mission as well as the then-current state of medical technology, health care philosophy, and architectural and engineering practices (see Figures 11-1 and 11-2). Among its more noteworthy features are the inclusion of sufficient housing and community facilities to make the reservation a completely self-contained unit; the hospital's use of a stepped configuration and long, narrow wings to take advantage of the site's magnificent views and natural tradewind ventilation; the use of generous lanais, irregular clusters of buildings, and varied building plans to create an informal and restful atmosphere for patients; and the use of 44-bed nursing units containing one large open ward with four eight-bed Copenhagen bays and six to eight private and semiprivate rooms.

From a functional viewpoint, TAMC's original design must be considered a good (and in some ways, inspired) one. The fact remains, however, that the hospital is now 35 years old and that there have been such revolutionary changes in both the hospital's mission and the state of the art of health care that it is becoming increasingly difficult for the facility to provide care that is up to modern standards. A brief review of some of these changes may help to illustrate this point.

First, in 1944, when construction of the present hospital began, there were 442,000 servicemen stationed in Hawaii; at least as many more were in frontline bases supported from here. Few dependents were allowed in the islands, and, as a result, TAMC's client population consisted overwhelmingly of relatively young adult males--many of them suffering from combat wounds. In contrast, today, the nation is at peace and the total "military" population has dropped to 158,000. Of these, only 37 percent (58,000) are active duty personnel (see Table 11-1). As a consequence of this change, the makeup of the hospital's current caseload is radically different than the one for which it was designed.

Most of the diagnostic and life-support equipment now in common use (to say nothing of that which will become available within the foreseeable future) was unknown 30 years ago, and all of it has had to be forced into space which was not originally designed to accommodate it. A research and development service, a plastic surgery service, an allergy service, a hemodialysis unit, medical and surgical divisions of intensive care, cardiac care, and radiotherapy are just some of the areas where the rapid growth in the number and complexity of machines used for patient care has created a pressing need for new or differently configured space.
Figure II-1  EXISTING TAMC SITE PLAN
Figure II-2 EXISTING DEPARTMENTAL BLOCK PLAN
Table II-1 POPULATION SERVED BY TAMC

<table>
<thead>
<tr>
<th>Primary Organizations and Groups Served</th>
<th>Military</th>
<th>Dependents</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Army</td>
<td>18,792</td>
<td>19,260</td>
<td>38,052</td>
</tr>
<tr>
<td>Navy</td>
<td>18,509</td>
<td>32,416</td>
<td>50,925*</td>
</tr>
<tr>
<td>Marine Corps</td>
<td>8,809</td>
<td>7,455</td>
<td>16,264</td>
</tr>
<tr>
<td>Air Force</td>
<td>10,544</td>
<td>20,014</td>
<td>30,558</td>
</tr>
<tr>
<td>Coast Guard</td>
<td>1,276</td>
<td>1,139</td>
<td>2,415</td>
</tr>
<tr>
<td>Sub-Total</td>
<td>57,930</td>
<td>80,284</td>
<td>138,214</td>
</tr>
<tr>
<td>Retirees</td>
<td>7,205</td>
<td>12,960</td>
<td>20,165</td>
</tr>
<tr>
<td>TOTAL</td>
<td>65,135</td>
<td>93,244</td>
<td>158,379</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Secondary Organizations, Areas, and Groups Served</th>
<th>Eligible Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Samoa</td>
<td>31,000</td>
</tr>
<tr>
<td>Trust Territory of the Pacific</td>
<td>92,000</td>
</tr>
<tr>
<td>Merchant Seamen (U.S.P.H.S.)</td>
<td>1,000</td>
</tr>
<tr>
<td>Veterans Administration</td>
<td>93,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>217,000</td>
</tr>
</tbody>
</table>

*Excludes 24,205 afloat.


Finally, whereas the hospital was designed primarily as an inpatient facility, today a large part of its duties involve outpatient care (see Table II-2). This shift in emphasis is reflected in a decrease in the number of beds from the 1,500 originally planned to its 1976 level of 566 and by a tremendous increase in the number and type of outpatient clinics. Even within the inpatient areas, there have been major changes in the types of cases that are seen, e.g., a decrease in orthopedic surgery and an increase in OB/GYN and pediatrics. Piecemeal adjustments made in response to this shift in emphasis have resulted in a confused internal circulation pattern.

Chapter II 6
Table II-2  TAMC AVERAGE DAILY WORKLOAD: FY1976

<table>
<thead>
<tr>
<th></th>
<th>FY1976</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beds Occupied</td>
<td>471.0</td>
</tr>
<tr>
<td>Admissions</td>
<td>57.6</td>
</tr>
<tr>
<td>Births</td>
<td>9.8</td>
</tr>
<tr>
<td>Clinic Visits</td>
<td>2,361.0</td>
</tr>
<tr>
<td>Medical Care</td>
<td>1,854.0</td>
</tr>
<tr>
<td>Health Care</td>
<td>1,988.0</td>
</tr>
<tr>
<td>Dental Procedures</td>
<td>958.0</td>
</tr>
<tr>
<td>Composite Unit</td>
<td></td>
</tr>
</tbody>
</table>


Summary of Deficiencies
Previous studies, reports, and inspections (see, for example, Caudill, Rowlett, Scott, 1975; Department of Defense Area Survey of Health Care Facilities in Hawaii, 1974; Joint Commission on Accreditation of Hospitals, 1977) have indicated that the hospital building itself is structurally sound, but that its physical organization, support and distribution capability, circulation systems, and mechanical, electrical, and life safety systems are inadequate in terms of current medical facility standards.

In terms of spatial characteristics and orientation, there are seldom available the large blocks of space recommended by current Office of the Surgeon General (OTSG) standards for modern, "modular" diagnostic and treatment clinics. Most spaces are functionally deficient in terms of being narrow, low, and inefficiently laid-out. The organization of the spaces has been compromised over the years to the point where the functional grouping of various uses is minimal, and, hence, highly inefficient. The orientation of these spaces to the outpatient service population is not clear, and this creates difficulties for the users. In terms of support and distribution capability, there are aspects of material movement that are presently inadequate, while food service is spread over too much area to function efficiently and needs reorganization.

Vehicular, pedestrian, and supply circulation systems, both exterior and interior, require segregation of traffic types, parking, and service areas in order to minimize circulation conflicts. This could involve selective upgrading of circulation service areas, identification and enhancement of horizontal circulation paths, separation of various categories of traffic, and minimizing use of vertical circulation in high-traffic corridors as well as dedication of vertical circulation to different categories of traffic.
The technology of mechanical, electrical, and life safety systems had developed so rapidly that a completely new central mechanical plant is needed to consolidate the various mechanical systems. The multiple electrical lines, panelboards, communication and alarm systems need to be completely redesigned and replaced. Also, code-conforming plumbing fixtures suited for use by the handicapped, as well as an efficient distribution and collection system for water and wastes, need to be provided.

The proposed additions and alterations would eliminate the many problems noted above. They would significantly improve the facility's ability to provide high quality health care and would insure that TAMC can continue to perform its assigned mission for many years to come.

DESCRIPTION OF THE PROPOSED PROJECT (see Figures II-3 and II-4)

The additions and alterations to the Tripler Army Medical Center (TAMC) are programmed as two separate undertakings. These involve:

Additions

1. Construction of 438,000 square feet of new space for a diagnostic and treatment/outpatient clinic wing plus a new mechanical plant.
2. Construction and realignment of roadways, parking areas, utility lines, and other support facilities, as needed, to serve the new construction or to improve the level of service.

Alterations

1. Renovation of all internal spaces in Wings A, B, C, and part of D of the existing hospital, a total of 576,000 square feet.
2. Installation of entirely new internal mechanical, plumbing, and electrical systems; upgrading existing structures to meet seismic zone 2 requirements.

The remainder of this section describes the main characteristics of each of these components and provides additional information regarding the cost and phasing of the proposed project.

New Construction

While many of the deficiencies noted previously in this discussion can be corrected within the constraints of the shell of the existing building, many others cannot. The most important of these is the fact that, because of its linear shape, limited floor-to-ceiling height, and structural constraints, it is impossible for the existing building to accommodate all of the medical equipment needed for some of the hospital's diagnostic and treatment activities or to allow efficient operation of high-volume clinics. All of these problems would be overcome through the limited new construction that is being proposed.
Figure II-4 PROPOSED TAMC SITE PLAN
The new addition would be built on a 500- by 240-foot area immediately uphill of the existing Wings A, B, and C, and would contain approximately 438,000 square feet of space on four levels. The site is now occupied by the formal entry and porte cochere, portions of Patterson Road, and parts of outpatient/visitor parking lots A, B, and C. Because of the sloping terrain, a deep excavation would be required on the uphill side, and the main entry to the building from the primary outpatient parking area would be on the third level. Direct access to the emergency room would be provided via an entrance at Level 1 on the south side of the wing.

The new addition would have floor-to-floor heights of over nineteen feet, slightly more than six feet greater than most floors in the existing hospital, and this would make it possible to provide a level of service from the mechanical systems (especially air-conditioning) that would be extremely difficult to achieve within the constraints of the existing building. The squarer shape of the new construction also allows much more efficient use of space and internal functioning than is possible in the long, narrow spaces typical of the existing building. Because of these and other factors, the new construction is particularly well suited for hospital activities and departments that use bulky equipment, need high volume air-conditioning or other mechanical services, or handle a large number of patients and require large blocks of well-organized space. Pathology, diagnostic radiology, physical medicine, the pediatric and OB/GYN clinics, and the delivery suite, surgery suite, and various critical care units are examples of activities that meet one or more of these criteria, and have been assigned to the new construction.

As can be seen from the plans, the new addition would be a large structure. To reduce its apparent mass, to create a more informal and less sterile setting, to provide adequate fire protection, and to allow for possible uneven foundation settlement, the building has been broken up into three structurally independent blocks or zones that are separated by vertical light courts. The waiting rooms for the various clinics and services are located around these courts. The spans connecting the zones would house mechanical lines, elevators, maintenance storage, and the like.

The new construction would, of course, contain all new mechanical systems that meet all current and projected needs. Renovated spaces would be similarly equipped within the constraints imposed by the characteristics of the existing structure. A brief description of the various systems is presented below.

**Central Plant** The existing boiler plant would be retained and used to produce steam for the hospital. In addition, a new 24,000-square foot central plant would be built about 250 feet west of Wing D. This new structure would house three electric motor-driven centrifugal chillers, an absorption-type chiller, pumps, cooling towers, condenser water heat-recovery heat exchangers, preheat systems for hot water, emergency power generators, switch gear, and transformers. Solar panels will be located on the roof.
Heating, Ventilation, and Air Conditioning  The main HVAC equipment would be concentrated in three locations. The equipment room on Level 1 would receive steam, chilled water, reheat hot water, domestic hot water, and emergency power from the boiler plant and central plant for distribution within the new wing; the mechanical rooms on the roof would house all of its air handling systems. Finally, vacuum pumps and air compressors for the centralized medical gases system, and additional steam condensate pumps would be located on Level B2. Wings A, B, and C would be supplied with chilled water, reheat water, and domestic water via lines running from the new addition to the existing building on Level B2, and then up to the mechanical spaces on Level 8 via exterior service shafts. The entire system would be monitored and controlled from a central station to insure maximum efficiency.

Plumbing  Almost all of the plumbing system within the existing building would be replaced. All regular sanitary drainage would move by gravity flow to outside sewer lines; acid wastes would also be directed into this system, but only after passing through a neutralizing basin. Liquefied petroleum gas, compressed air, steam, and medical gases would be piped to all areas where needed.

Electrical System  Electrical power for TAMC would continue to be purchased from the Hawaiian Electric Company (HECO), the most economical source. Normal service to the new and renovated buildings would be provided by two new 11.5-Kv underground lines linking the hospital with a new switch station adjacent to the existing switch station located in the vicinity of the deactivated incinerator. In the hospital itself, three new transformer stations would replace two existing stations. In the event that the normal power supply from the utility company is disrupted, essential electrical service would be provided by two new 4.16-Kv underground cables running from the emergency generators in the central plant to Level B1 of the new addition. Automatic transfer switches would reconnect essential system loads to emergency generators in a pre-set sequence.

Sitework  Most of the sitework required is the result of the need to replace roads, parking areas, and utility lines displaced by the new addition or to provide transportation and utility services for it. At the same time, however, the project does provide an opportunity to correct present deficiencies. Therefore, improvements would also be made to Jarrett White Road, staff parking facilities, helipad access and control, and other roads.

Renovated Spaces  The undertaking of alterations would involve the sequential renovation of the entire interiors of Wings A, B, and C of the existing hospital. Portable equipment would be removed and all non-structural partitions demolished. The building's antiquated mechanical systems would be completely replaced (see description later in this section), and the interior would be reconstructed to modern standards using all new materials. Wing D would be partially renovated to provide for a dental clinic and to upgrade the fire protection features in the chapel. Wing E would remain
as-is for use as a mobilization reserve and as temporary quarters for certain hospital functions during the construction period.

In general, the renovated spaces (as contrasted with the new construction) would be used to house administrative activities, support services, nursing units, and clinics that have a relatively light patient load. More specifically, the proposed departmental block plan shown in Figure II-3 has the following space assignments:

Wing A Levels B3 to B1 would house a variety of administrative and support activities, including patient and administrative records, anatomical pathology, the command suite, a portion of food services, and patient administration. The middle levels (B1 to 2) would contain numerous clinics and medical services, e.g., radiation therapy; the cardiology, neurology, dermatology, and pulmonary clinics; and the social work service. Finally, Levels 3 through 9 would be devoted primarily to nursing and nursing support units.

Wing B Each of the three lowest levels in Wing B would be devoted to a single use: biomedical equipment testing and calibration (B3), food service (B2), and the mental health clinic (B1). The remaining four floors would hold nursing units.

Wing C The PX retail and snack bar areas would be housed on Level B2. The eye clinic, ENT clinic, and allergy immunization clinic would occupy the next three floors above, and the two uppermost floors (Levels 3 and 4) would house nursing units.

Wing D At its closest, Wing D is 200 feet away from the main hospital building. Internal travel distances from the extremities of the wing to even the near-end of Wing C approach 900 feet. This is too far for effective integration with the rest of the structure; hence, activities proposed for Wing D are mostly those which can function relatively independently of the remainder of the hospital, e.g., blood donation, the base chapel, the dental clinic, and the hospital shops.

Cost and Phasing
Proper phasing of the proposed project is essential if TAMC is to perform its medical mission throughout the construction period, and if excessive temporary relocation costs are to be avoided. Since it is such a large and long-term project, Federal funding will be incremental, which also affects the phasing. In describing the proposed project, the term "Construction Phase" has been used as a means of emphasizing the fact that the groupings are of items that could be covered by a single construction contract which could be combined with other phases having generally common time frames. The numbering of the phases does not necessarily reflect the order in which they would be completed (see Figure II-5).

The early prep work for the project would involve the following steps:
Figure II-5 CONSTRUCTION PHASING

LEGEND
Early Prep Work
Construction Phase I
Construction Phase II
Construction Phase III
Construction Phase IV
Construction Phase V

Chapter II
A temporary boiler plant would be built to serve the existing building as the present steam main will be displaced by construction.

The existing cafeteria would be moved to temporary quarters within the hospital.

The PX retail outlet would be relocated into a temporary building.

A large temporary parking area would be built to replace the parking that is within the construction area.

The purpose of the early prep work is basically to clear space so that construction can proceed, and its duration is expected to be six months.

Construction Phase I would include establishment of the contractor's work area, much of the major sitework, and the new Command Entry. In addition, work would encompass some permanent renovation on Level 82, adjacent to the new entry that would create space for the hospital headquarters as well as related administrative spaces. The phase would extend over approximately 32 weeks.

Construction Phase II would center on the proposed new addition on the uphill side of the hospital. The phase would have a duration of almost two years and would consist of closing the existing main entry on the uphill side of the hospital, and constructing the new roads and parking, the central paint, and the new hospital addition. Included would be the tunnel structure connecting the new and existing buildings that would house material movement hardware.

Construction Phase III mainly involves the installation of equipment in the new building, the construction of the outpatient entrance to the new building and a connecting corridor between the old and new building at Level 4. During the three months of this phase the separate ambulance entrance to the emergency room would be blocked by the construction of a service road and service court. The walk-in and ambulance patients would use the same entrance for three months; then the emergency room would be moved to the new building where these two types of patients would again have separate entries.

During Construction Phase IV, many functions would be moving from the old building to the new. The then-vacated space on Level 5 in Wings A and B would be renovated for the nursery and OB/GYN ward. The temporary parking and boiler plant would also be removed during this phase. This phase is expected to last nine months.

Alterations to the remainder of the existing building would be budgeted for a new fiscal year. If this Phase V is undertaken, it is estimated to require three years. Work is expected to begin in Wing C; all uses there would be relocated and work would proceed from top to bottom. Then the levels of Wing B which have not already been renovated would be worked
on. Relocations would occur as necessary to clear all floors of the wing being altered.

ENVIRONMENTAL SETTING

The descriptive material contained in this section has two purposes. The first is to provide readers who are not already familiar with Tripler Army Medical Center with a brief overview of the project site. The second is to supply baseline information regarding the physio-chemical, biological, and socio-economic systems affected by the proposed project and, thereby, to set the stage for the discussion of impacts found later in this report. In general, in-depth descriptive information is provided only where it is necessary for an understanding of project-related impacts.

LOCATION

Tripler Army Medical Center occupies a 367-acre site atop the lower portion of Moanalua Ridge, one of the many ridgelines that extend in a southwest direction from the crestline of the Ko'olau Mountain Range (see Figure II-6). It is approximately four miles northwest of downtown Honolulu and three miles due east of Pearl Harbor. Interstate Highway H-1, the Moanalua Freeway (State Highway 72), and Puuloa Road link Tripler to central and eastern Honolulu, Pearl Harbor and West Oahu, and the Honolulu International Airport/Hickam Air Force Base complex, respectively.

EXISTING LAND USE

Tripler Army Medical Center is situated near the middle of the broad band of urbanization that lines Oahu's southern shore and makes up metropolitan Honolulu. This band stretches from Koko Head on the southeast to Pearl Harbor/Waipahu on the west and northwest; this area contains well over 60 percent of the island's population. Because of the steepness of the Ko'olau range, development is limited primarily to the flat coastal plain, the bottoms of many of the larger stream valleys, and the lower portions of relatively narrow ridges similar to the one on which TAMC is built.

The land bordering the Tripler reservation is used for residential and watershed purposes (see Figure II-7). A number of single-family subdivisions are adjacent to the north, south, and west boundaries of the site. State Conservation District land lies northeast and east. Slightly farther away are Fort Shafter Military Reservation to the south, Red Hill Naval Reservation to the north, Aliamanu Military Housing Project and Aliamanu/Salt Lake to the southwest, and the Mapunapuna industrial area and Moanalua Gardens to the south.

There are a variety of different land uses on the Tripler Reservation including industrial (laundry, power plant, warehouse, and motor pool), residential (family housing, bachelor officers' quarters, and enlisted quarters), recreational (tennis courts, theater, gymnasium, playground, and athletic fields), and hospital-related facilities (the hospital, personnel
Chapter 11

SITE LOCATION AND REGIONAL CONTEXT

FIGURE II-6

LEGEND
- MILITARY BASES
- TOWNS
- HIGHWAYS

TRIPLER ARMY MEDICAL CENTER

HONOLULU

CENTRAL BUSINESS DISTRICT

PACIFIC OCEAN

ISLAND OF OAHU

KEY

- Naval Base
- Pearl Harbor Naval Station
- Mountain Range
- City
- Army Base
- Air Force Base
- Naval Air Station
- Railroad
- Major Road

MILES

0 2.5 5

NORTH
Figure II-7  SURROUNDING LAND USE

LEGEND
APT.  APARTMENT
COM.  COMMERCIAL
SCH.  SCHOOL
G.C.  GOLF COURSE
MIL.  MILITARY
RES.  RESIDENTIAL
L. IND.  LIGHT INDUSTRIAL
PARK  PARK

* PROPOSED 923 UNIT APARTMENT COMPLEX
offices, management information center, and clinical investigation and administration offices). The location of each of these land uses is shown in Figure 11-1, and the land area in each of the categories is summarized as follows:

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Percent of Total</th>
<th>Area (in Acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital Facilities</td>
<td>7.7</td>
<td>28.32</td>
</tr>
<tr>
<td>Housing</td>
<td>12.0</td>
<td>44.07</td>
</tr>
<tr>
<td>Recreation</td>
<td>1.4</td>
<td>5.11</td>
</tr>
<tr>
<td>Support Facilities</td>
<td>5.3</td>
<td>19.38</td>
</tr>
<tr>
<td>Open Spaces</td>
<td>66.0</td>
<td>242.29</td>
</tr>
<tr>
<td>Roads</td>
<td>7.6</td>
<td>28.00</td>
</tr>
<tr>
<td><strong>SITE TOTAL</strong></td>
<td><strong>100.0</strong></td>
<td><strong>367.17</strong></td>
</tr>
</tbody>
</table>


TAMC's physical plant consists of 93 permanent buildings and one temporary structure with a total gross floor area of about 1.5 million square feet. Of this, about 808,000 (54%) is in the main hospital building.

PHYSIOGRAPHY AND GEOLOGY

The island of Oahu is a volcanic doublet made up of the Waianae Range on the west and the Ko'olau Range on the east. Each is the remnant of a large shield volcano, but the term "range" conveys the fact that they have lost most of their original shield shape and now appear as long narrow ridges shaped primarily by erosion. Lavas from the Ko'olau Volcano, the younger of the two, bank against the flank of the Waianae Volcano to form the gently sloping surface of the Schofield Plateau (see Figure 11-8).

As previously indicated, the TAMC reservation is situated on the lower portions of Moanalua Ridge. The ridge itself is one of many that extend perpendicular to the northwest-trending crest of the Ko'olau Range. The top of the ridge represents the slightly eroded surface of the original shield of the Ko'olau Volcano. Moanalua Stream on the north and Manalaki Stream on the south have cut deep valleys in the shield, as can be seen in the aerial photograph shown in Figure 11-9. Oval in shape, the reservation dips from northwest to southeast. The highest site elevation is approximately 720 feet and the lowest about 100 feet. The top of the ridge has a fairly regular slope of 8 to 12 percent, but slopes of as much as 150 percent are present on the sides of small gulches that drain the site.

The existing hospital building is centered atop the ridge and stepped down it, so that a minimum of cut and fill was required in its construction. Based on borings made by the United States Army Corps of Engineers
Figure II-8  BASIC GEOLOGIC STRUCTURE OF OAHU

Koolau
Ridgeline

Waianae
Ridgeline

SOURCE: STERNS 1939, 1946

SHADOED RELIEF MAP, OAHU

SEDIMENTARY ROCKS

RECENT
Beach and dune sand

PLEISTOCENE
Alluvium
Limestone (Reefs and dunes)

VOLCANIC ROCKS

KOOLAU RANGE

Quaternary

Lava flows
Pyroclastics
Honolulu volcanic series

WAIANAE RANGE

Nappe volcanics

EROSIONAL UNCONFORMITY
TERTIARY

Koolau volcanic series

Chapter II

20
Figure II-9  OBLIQUE AERIAL PHOTO OF JAMC AND SURROUNDINGS
(1944), the original foundation design for the hospital assumed a bearing capacity of 15 tons per square foot. After site excavation had started, however, the bearing material was found to be extremely variable. Much of the basalt was heavily fractured, rather than solid as had been thought, and in many areas it was underlain with more compressible layers of weathered tuff, red and brown clay soil, ash, and cinders.

A preliminary report on borings made for the present project (U.S. Army Corps of Engineers, June 1977) provides additional information on the material underlying the site of the proposed diagnostic and treatment/outpatient clinic addition. The borings confirm the presence of interbedded layers of tuff, basalt, red and brown clay soil, and breccia identified in the earlier borings. They also give bearing strengths for the upper portions of the borings that are comparable to those obtained previously. Most significantly, however, they indicate that solid, unfractured basalt is more pervasive than was previously thought.

SOIL

Soils at TAMC are of two different types. The first is the Manana series and covers about 70 percent of the site (see Figure 11-10). The Manana series is formed from weathered volcanic material and, in profile, consists of an 8-inch layer of dark, reddish-brown silty clay loam over a 42-inch subsoil layer of silty clay. Permeability is 0.63-2.0 inches per hour. At a depth of 15 to 50 inches is a non-porous, pan-like sheet 1/8 to 1/4-inch thick, with a permeability of less than .06" per hour. The soil is high in acidity, has a medium runoff potential, and a moderate erosion potential. The available water capacity of this soil is 1.2 inches per foot at the surface layer, and 1.3 inches per foot in the subsoil. The average root penetration for vegetation is between 15 and 30 inches, except where cracks in the sheet allow for four-foot penetration. The bearing characteristics are fair-to-good for low buildings, and it is a good source of fill for roads.

The remaining 30 percent of the Reservation is classified by the U.S. Soil Conservation Service as "rock land." It is a land type rather than a soil series, and is characterized by the fact that exposed basalt and andesite covers 25 to 90 percent of the surface. The areas between the rock outcrops have a very shallow soil mantle that is very sticky and plastic. What soil there is has a high shrink-swell potential. As a result, buildings constructed on this material are susceptible to sliding, and foundations and retaining walls built on it may crack.

CLIMATE

Year after year, the east-to-west tradewind flow remains the most prominent feature of the atmospheric circulation across the tropical Pacific. It represents the outflow of air from the Pacific Anticyclone, a huge region of relatively high pressure whose usual location is well north and east of Hawaii, and which accounts for the northeast tradewinds for which the State is famous. The "Pacific High" moves north and south with the sun
and carries the tradewind zone with it. As a result, Hawaii is in the heart of the tradewind belt only between May and September. From October through April, it is north of the most intense tradewind activity and they prevail only 50-75 percent of the time rather than 80-95 percent.

The dominance of the trades and the influence of terrain give special character to the climate of the islands. Orographic precipitation occurs over the Ko'olau Mountains as the moist tradewinds rise to pass over them. As a result, completely cloudless skies are rare. Showers frequently drift off the mountains and sprinkle light, misty rain over the leeward shores. The tradewinds, which average 12-15 knots during the summer, provide a system of natural ventilation that strongly influenced the design of the existing Tripler Army Hospital. They bring to Tripler the mildly warm temperatures and humidity that are characteristic of air masses that have traveled great distances across the water.

As indicated previously, the tradewinds blow with reduced speed and regularity during the winter. When they fail, they are most often replaced by southerly "Kona" winds, sometimes violent but often gentle, that accompany the passage of storm or frontal systems through the island chain. These typically bring heavy rain.

Tripler, like most areas in the islands, has a small annual temperature range. Based on data collected at nearby Honolulu International Airport, it is estimated that average monthly temperatures in February, the coldest month (71.1 degrees F/21.7 degrees C), and August, the hottest (79.5 degrees F/26.4 degrees C), differ by only 8.4 degrees F (4.7 degrees C). Extreme temperatures in 57 years of record at the airport are 90 degrees F (32.2 degrees C) and 56 degrees F (13.3 degrees C).

There is no rain-gauging station on the TAMC Reservation, but data is available from Station No. 766 that is reasonably representative of conditions at Tripler. Median annual rainfall during the 53 years for which data is available was 39.5 inches. The driest year saw only 15.5 inches of rain while the wettest had 67.1 inches. The rainfall in the three wettest months, November, December, and January, is more than 2.7 times as great as that in June, July, and August, the three driest ones. Nevertheless, even during the summer, early morning and nighttime showers provide a reasonable amount of natural irrigation and help control dust on the site. The one-hour rainfall with a recurrence interval of ten years is about 2.75 inches, a number matched in the continental U.S. only along the Gulf Coast, but one that is quite typical of urban areas in Hawaii.

The recording wind gauge closest to TAMC is situated at the Honolulu International Airport. Extrapolation from that site to the Tripler Reservation is an uncertain undertaking, but, given the moderate slopes and the fact that the ridgeline parallels the direction of the prevailing winds, the airport data is believed to be fairly representative of Tripler and is represented in Figure II-11.
Figure II-11  WIND SPEED AND DIRECTION BY SEASON

LEGEND
SEASONAL

SOURCE:  Atlas of Hawaii

HONOLULU INTERNATIONAL AIRPORT

LEGEND
SEASONAL
--- January
--- July

SOURCE:  Atlas of Hawaii

Calm 7.6% 2.7%
Average Wind 8.5
Speed (MPH) 12.8

Chapter II
Atmospheric Dispersion Characteristics and Pollution Stagnation Potential

The persistent, strong, northeast tradewinds usually provide good quality ventilation and air pollutant dispersion. However, the tradewinds typically diminish during January and February bringing southerly winds and, frequently, higher humidities. This period is called "Kona." During Kona conditions, lighter winds and higher humidities can lead to poor ventilating conditions. Stable atmospheric conditions (Pasquill E and F stabilities) can be expected to occur approximately 28 percent of the time on an annual basis in central Oahu, while during Kona conditions (January) E and F Pasquill stabilities occur approximately 36 percent of the time. The frequency with which each stability category is reported to occur at Hickam Airfield, about two miles away, is as follows (U.S. Army Environmental Hygiene Agency, April 1977):

<table>
<thead>
<tr>
<th>Pasquill Stability Class</th>
<th>Percent of Time</th>
<th>Annual</th>
<th>January (Kona)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.2</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>B</td>
<td>3.8</td>
<td>4.7</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>12.2</td>
<td>8.9</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>56.0</td>
<td>50.8</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>17.0</td>
<td>19.9</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>10.8</td>
<td>15.7</td>
<td></td>
</tr>
</tbody>
</table>

It should be noted that the algorithms employed by the NOAA and the USAF ETAC to approximate the stability frequencies are nearly identical. These algorithms, however, have been criticized since they tend to bias the stability frequencies toward neutral (Pasquill D) conditions and may not accurately define the stability frequencies for a given region. Used in this light and with other data, these data may provide a qualitative measure for the atmosphere's dispersive capabilities.

It is clear from the above that the average ventilating capabilities of the atmosphere are diminished during Kona conditions. Associated with the increase in the occurrence of stable conditions during Kona are lower mixing heights that inhibit vertical mixing and dilution.

AIR QUALITY

Air Quality Standards

Ambient Air Quality Both the State of Hawaii and the Federal Government have established air quality standards. A summary of present National Ambient Air Quality Standards (NAAQS) is presented in Table II-3. The NAAQS are divided into primary (health-related) and secondary (welfare-related) standards. In the case of the three major pollutants emitted as a result of fuel combustion, there are only primary standards. For sulfur oxides and particulate matter, there are both primary and secondary standards. It should be noted that for hydrocarbons, the standard has been set in order to prevent photochemical oxidant (Ox) formation. In other words, the standard is based on the precursor role of
## Table II-3 SUMMARY OF STATE OF HAWAII AND FEDERAL AMBIENT AIR QUALITY STANDARDS

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Sampling Period</th>
<th>Federal Standards</th>
<th>State Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Primary&lt;sup&gt;2&lt;/sup&gt; Secondary&lt;sup&gt;3&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>1. Suspended Particulate Matter</td>
<td>Annual Geometric Mean</td>
<td>75</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Annual Arithmetic Mean</td>
<td></td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>Maximum Average in Any 24 Hours</td>
<td>260</td>
<td>150</td>
</tr>
<tr>
<td>2. Sulfur Dioxide</td>
<td>Annual Arithmetic Mean</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Maximum Average in Any 24 Hours</td>
<td>365</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>Maximum Average in Any 3 Hours</td>
<td>1300</td>
<td>400</td>
</tr>
<tr>
<td>3. Carbon Monoxide</td>
<td>Maximum Average in Any 8 Hours</td>
<td>10</td>
<td>5 (9 ppm)</td>
</tr>
<tr>
<td></td>
<td>Maximum Average in Any 1 Hour</td>
<td>40</td>
<td>10 (35 ppm)</td>
</tr>
<tr>
<td>4. Hydrocarbons: Nonmethane</td>
<td>Maximum Average in Any 3 hours</td>
<td>160</td>
<td>100 (0.24 ppm)</td>
</tr>
<tr>
<td>5. Photochemical Oxidants</td>
<td>Maximum Average in Any 1 Hour</td>
<td>160</td>
<td>100</td>
</tr>
<tr>
<td>6. Nitrogen Dioxide</td>
<td>Annual Arithmetic Mean</td>
<td>100</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>Maximum Average in Any 24 Hours</td>
<td></td>
<td>150</td>
</tr>
</tbody>
</table>

<sup>1</sup> Standards for all pollutants given in micrograms per cubic meter, except carbon monoxide is given in milligrams per cubic meter.

<sup>2</sup> Designed to prevent adverse effects on public health.

<sup>3</sup> Designed to prevent adverse effects on public welfare including effects on comfort, visibility, vegetation, animals, aesthetic values, and soiling and deterioration of materials.
hydrocarbons in Ox formation and not on their adverse human health effects. Generally speaking, at normally encountered ambient levels, hydrocarbons are not considered particularly hazardous. Of course, this does not apply to exceptions such as certain aromatic hydrocarbons, e.g., benzopyrene, or to organo-lead compounds, both of which are known carcinogens.

Hawaii’s State Air Quality Standards are substantially more stringent than those established by the Federal Government. As a result, they provide a greater margin of safety with regard to adverse human health and welfare effects. This being the case, most of the comparisons made in the forthcoming discussion will refer to the State’s Air Quality Standards. It should also be noted that the State of Hawaii has a regulation pertaining to fugitive dust arising from construction sites. Downwind total suspended particulate (TSP) concentrations are permitted to be no more than 150 mg/m³ above the upwind concentration as a 12-hour average (Hawaii, State of, Department of Health, 1972a).

**Emission Standards**

Section 112 of the Clean Air Act requires the U.S. Environmental Protection Agency Administrator to establish emission standards for hazardous air pollutants for which there are no ambient air quality standards. Pursuant to this act, a national emission standard for asbestos was promulgated on April 6, 1973 and is contained in the Code of Federal Regulations, Title 40, Subchapter C - Air Programs, Part 61 - National Emission Standards for Hazardous Air Pollutants. Since that date, two additional sets of amendments have been promulgated. The current regulations are applicable to demolition and renovation of structures involving removal or stripping of friable asbestos insulation from pipes, boilers, etc., and to the disposal of asbestos wastes.

**Occupational Health Standards**

Regulations established pursuant to the State’s Occupational Safety and Health Act (OSHA) would apply to the project. Since renovation activities would involve exposure to asbestos dust, it is essential that contractors be familiar with the requirements of Section 304.5-3 of the OSHA regulations to insure compliance.

**Interior Hospital Air Quality Standards**

No specific interior ambient air quality standards exist at either the State or Federal level that are aimed specifically at protecting the particularly susceptible individuals present in hospitals. However, the hospital's internal air quality is indirectly affected by the Department of the Army's Office of the Chief of Engineers' (1973) stringent filtration requirements for critical hospital areas shown in Appendix A. Unfortunately, the filtration systems required would not be effective in removing gaseous pollutants such as carbon monoxide nor, strictly speaking, would they guarantee any particular level of internal air quality.

**Existing Sources of Air Pollution**

Sources and major pollutants associated with the operation of the existing hospital facility are listed in Table II-4. Infectious waste is transported to
Table 11-4  EXISTING SOURCES OF AIR POLLUTION AT TRIPLER ARMY MEDICAL CENTER

<table>
<thead>
<tr>
<th>Source</th>
<th>Pollutants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor Vehicles:</td>
<td>CO, HC, NO\textsubscript{x}, SO\textsubscript{x}, Particulates</td>
</tr>
<tr>
<td>Passenger cars</td>
<td>CO, HC, NO\textsubscript{x}, SO\textsubscript{x}, Particulates</td>
</tr>
<tr>
<td>Light duty trucks</td>
<td>CO, HC, NO\textsubscript{x}, SO\textsubscript{x}, Particulates</td>
</tr>
<tr>
<td>Motorcycles</td>
<td>CO, HC, NO\textsubscript{x}, SO\textsubscript{x}, Particulates</td>
</tr>
<tr>
<td>Heavy-duty vehicles - gasoline</td>
<td>CO, HC, NO\textsubscript{x}, SO\textsubscript{x}, Particulates</td>
</tr>
<tr>
<td>Heavy-duty vehicles - diesel</td>
<td>CO, HC, NO\textsubscript{x}, SO\textsubscript{x}, Particulates</td>
</tr>
<tr>
<td>Steam Generating Plant (oil-fired)</td>
<td>CO, HC, NO\textsubscript{x}, SO\textsubscript{x}, Particulates</td>
</tr>
<tr>
<td>Aircraft:</td>
<td>CO, HC, NO\textsubscript{x}, SO\textsubscript{x}, Particulates</td>
</tr>
<tr>
<td>Helicopters (UH1-series)</td>
<td>CO, HC, NO\textsubscript{x}, SO\textsubscript{x}, Particulates</td>
</tr>
<tr>
<td>Operating Rooms</td>
<td>Anesthetic gases</td>
</tr>
<tr>
<td>Morgue and Laboratories</td>
<td>Organic vapors</td>
</tr>
<tr>
<td>Pathological Incinerator</td>
<td>None (not in use)</td>
</tr>
<tr>
<td>Waste Storage Areas and Containers</td>
<td>Odors and organic vapors</td>
</tr>
</tbody>
</table>

Key:  

- CO - carbon monoxide  
- HC - hydrocarbons  
- NO\textsubscript{x} - nitrogen oxides  
- SO\textsubscript{x} - sulfur oxides  

Chapter 11  29
the Schofield Barracks Landfill for disposal. [After October 1, 1980 all wastes, except tissue wastes which are cremated, will be disposed of either at the Waiphau Incinerator or at the Puu Palailai Landfill.] The operating rooms, morgue, and laboratories are not considered major sources of ambient air pollution because of their relatively small emission rate of organic vapors and gases.

The only stationary source of air pollutants at TAMC which could be of any significance is the steam generating plant. The plant has three identical boilers which alternate in operations so that only one is in use at any given time. Estimates of pollutants issuing from one boiler were made in a U.S. Army Support Command, Hawaii, "Air Pollutant Emissions Report (OMB Form 158-R75)" as follows:

<table>
<thead>
<tr>
<th>Pollutants</th>
<th>Tons/Year</th>
<th>Lbs./Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particulates</td>
<td>2.20</td>
<td>1.5</td>
</tr>
<tr>
<td>SO₂</td>
<td>0.58</td>
<td>4.5</td>
</tr>
<tr>
<td>CO</td>
<td>0.44</td>
<td>0.4</td>
</tr>
<tr>
<td>HC</td>
<td>11.70</td>
<td>8.0</td>
</tr>
</tbody>
</table>

An "Ambient Air Quality Assessment" (No. 21-0316-77) was conducted at TAMC in 1976 by the U.S. Army Environmental Hygiene Agency. In it, EPA modeling techniques were used to estimate air pollutant emissions on the base by civilian vehicles (the vast majority of all vehicles present) with the following results:

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Tons/Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td>140.7</td>
</tr>
<tr>
<td>HC</td>
<td>2.3</td>
</tr>
<tr>
<td>NOₓ</td>
<td>0.3</td>
</tr>
<tr>
<td>SO₂</td>
<td>1.2</td>
</tr>
<tr>
<td>Particulates</td>
<td>1.4</td>
</tr>
</tbody>
</table>

In addition, CO concentrations along Jarrett White Road were estimated using EPA's HIWAY line-source model. Results indicated that the CO concentrations were elevated, but probably would not exceed the State's one-hour standard.

TAMC air pollution emissions comprise a miniscule fraction of the State of Hawaii emissions. This is shown in the table below where the sum of TAMC's vehicular and boiler emissions is compared to the State of Hawaii 1978 emissions inventory:
<table>
<thead>
<tr>
<th>Pollutant</th>
<th>State Emissions (1973)</th>
<th>Tons/Year</th>
<th>% of State Emissions Due to TAMC</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td>268,000</td>
<td>141.28</td>
<td>0.053</td>
</tr>
<tr>
<td>HC</td>
<td>72,000</td>
<td>2.74</td>
<td>0.004</td>
</tr>
<tr>
<td>NO\textsubscript{X}</td>
<td>63,000</td>
<td>12.90</td>
<td>0.021</td>
</tr>
<tr>
<td>SO\textsubscript{X}</td>
<td>126,000</td>
<td>6.80</td>
<td>0.005</td>
</tr>
<tr>
<td>Particulates</td>
<td>35,000</td>
<td>3.60</td>
<td>0.010</td>
</tr>
</tbody>
</table>

**Existing External Air Quality**

There are no permanent air monitoring stations on or in close proximity to TAMC. The nearest monitoring site operated by the State Department of Health is at Kalihi Kai, an area containing light industrial, commercial, and some residential units about 2.5 miles SSE of TAMC. Unfortunately, data from that site is probably not representative of the TAMC area because the hospital is situated at a much higher elevation, is nearer the Koolau Mountains, is farther from the shoreline, and is in a much less developed area. Kalihi Kai is, therefore, likely to have significantly higher pollutant concentrations than TAMC.

Carbon monoxide (CO) measurements were made by the U.S. Army Environmental Hygiene Agency and TAMC Health & Environment Activity in 1975 as part of the environmental assessment for a military housing project in Aliamanu Crater about one mile west of TAMC (U.S. Army Support Command Hawaii, 1975). The results of these studies are summarized in Table II-5 and Figures II-12 and II-13. CO levels were found to be well within the State air quality standard of 10 mg/m\textsuperscript{3} average over any one-hour period. This standard is much more stringent than the 40 mg/m\textsuperscript{3} limit contained in the NAAQS. Another study of CO and HC levels in Honolulu included measurement sites on the northeast side of Aliamanu Crater and also along the Moanalua Freeway south of TAMC (Libby, 1976). CO levels were found to be well below limits specified in the State Air Quality Standards, but no determination could be made regarding hydrocarbons since the measurements were of total HC with no fractionation into methane and non-methane components. Results of this study are summarized in Figures II-14 and II-15. As with the Kalihi Kai station, the Aliamanu sampling was done at a location likely to have higher pollutant concentrations than TAMC.

As part of the preparation of a generic EIS for all Army activities in the Pacific Basin, the Army's Environmental Hygiene Agency conducted an assessment of TAMC's impact on air quality. They concluded that such impact was minimal and did not result in violations of Federal or State air quality standards (U.S. Army Environmental Hygiene Agency, April, 1977).

Based on the limited number of reports and data just described and the fact that, with the possible exception of peak-hour traffic, there are no
Table II-5 ALIAMANU CRATER AIR QUALITY MONITORING RESULTS
CARBON MONOXIDE LEVELS

<table>
<thead>
<tr>
<th>Value Number</th>
<th>Number of Times Value Reported</th>
<th>Concentration (ppm)</th>
<th>Percent Less Than</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>481</td>
<td>0.02-0.50</td>
<td>50.84</td>
</tr>
<tr>
<td>2</td>
<td>141</td>
<td>0.51-1.00</td>
<td>65.75</td>
</tr>
<tr>
<td>3</td>
<td>92</td>
<td>1.01-1.50</td>
<td>75.84</td>
</tr>
<tr>
<td>4</td>
<td>125</td>
<td>1.51-2.00</td>
<td>88.69</td>
</tr>
<tr>
<td>5</td>
<td>45</td>
<td>2.01-2.50</td>
<td>93.45</td>
</tr>
<tr>
<td>6</td>
<td>24</td>
<td>2.51-3.00</td>
<td>95.95</td>
</tr>
<tr>
<td>7</td>
<td>13</td>
<td>3.01-3.50</td>
<td>97.36</td>
</tr>
<tr>
<td>8</td>
<td>3</td>
<td>3.51-4.00</td>
<td>97.67</td>
</tr>
<tr>
<td>9</td>
<td>4</td>
<td>4.01-4.50</td>
<td>98.10</td>
</tr>
<tr>
<td>10</td>
<td>3</td>
<td>4.51-5.00</td>
<td>98.41</td>
</tr>
<tr>
<td>11</td>
<td>9</td>
<td>5.01-9.00</td>
<td>99.36</td>
</tr>
<tr>
<td>12</td>
<td>4</td>
<td>9.01-13.00</td>
<td>99.79</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>13.01-17.00</td>
<td>99.89</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>17.01-21.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Place: Building T-52, Aliamanu Crater
Period: 13 January through 2 March 1975
Average CO Concentration: 0.96 ppm
Average Wind Speed: 4.20 mph


Significant sources of air pollution on the TAMC site, it is concluded that external air quality at the project site is generally good, and that both State and Federal air quality standards are presently being met there.

Existing Internal Air Quality
At present, most of the hospital is naturally, rather than mechanically, ventilated (see Table II-6). It is assumed that pollutant concentrations in these spaces are comparable to external ambient levels. As previously indicated, such levels meet current State and Federal ambient air quality
Figure II-12  CARBON MONOXIDE LEVELS VS WIND DIRECTION
ALIAMANU CRATER, 13 JAN. - 2 MAR. '75

Figure II-13  AVERAGE CO CONCENTRATION VS. HOUR OF THE DAY
ALIAMANU CRATER, 13 JAN. - 2 MAR. '75

SOURCE: U.S. Army Support Commands Panel
Department of the Army, Final Environmental Impact Statement
Military Family Housing Project
Aliamanu Military Reservation, Oahu
(March 1975)
Figure II-14  HOURLY HYDROCARBON AVERAGES FOR ALL SAMPLING SITES: ALIAMANU CRATER


![Graph showing hourly hydrocarbon averages for all sampling sites: Aliamanu Crater.](image)

Figure II-15  HOURLY CARBON MONOXIDE AVERAGES FOR SAMPLING SITE 2: ALIAMANU CRATER

- Outside Aliamanu Crater
- Inside Aliamanu Crater
- Fort Shafter
- Airport Runway

![Graph showing hourly carbon monoxide averages for sampling site 2: Aliamanu Crater.](image)
Table II-6 EXISTING AIR-CONDITIONED SPACES

<table>
<thead>
<tr>
<th>Space</th>
<th>Approximate Floor Area (S.F.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PX Cafeteria</td>
<td>10,600</td>
</tr>
<tr>
<td>Conference Center</td>
<td>5,500</td>
</tr>
<tr>
<td>Central Medical Supply</td>
<td>7,100</td>
</tr>
<tr>
<td>Medical Maintenance</td>
<td>1,000*</td>
</tr>
<tr>
<td>Surgery</td>
<td>15,100</td>
</tr>
<tr>
<td>Heart Catheterization</td>
<td>1,000*</td>
</tr>
<tr>
<td>Radiation Therapy</td>
<td>4,800</td>
</tr>
<tr>
<td>Pharmacy</td>
<td>4,000</td>
</tr>
<tr>
<td>Library Reference Room</td>
<td>400</td>
</tr>
<tr>
<td>Delivery Area</td>
<td>4,600</td>
</tr>
<tr>
<td>Nursery</td>
<td>3,200</td>
</tr>
<tr>
<td>Radiology</td>
<td>10,100</td>
</tr>
<tr>
<td>Recovery</td>
<td>8,000</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>75,400</strong></td>
</tr>
</tbody>
</table>

*Estimated

**NOTE:** In addition to the above, it is estimated that about 100 window air-conditioning units are in use. No floor area figures are available.

**SOURCES:** Welton Becket Associates  
Caudill, Rowlett, Scott

... standards designed to protect the general public, but it does not necessarily follow that they provide acceptable protection for a hospital population that contains a disproportionately large number of sick and particularly susceptible individuals. In this regard, it is important to note that the existing natural ventilation system does not meet all of the Army filtration, room pressure, and air changeover rate standards (see Appendix A).

Those spaces that are air-conditioned are served by two chillers described in the section of this chapter dealing with building and utility systems. The 1975 Caudill, Rowlett, Scott, Inc. study concluded that the existing air conditioning supply duct system serving the chillers was too small to handle the hospital's present minimum air requirements. In addition, they found that not only is the existing ductwork too small to carry the required air volumes at reasonable velocities, but it also utilizes ground-level...
fresh air intakes located adjacent to roads and parking areas. These do not meet present code standards and are potential sources of gaseous and particulate contaminants.

Two recent studies provide further evidence that the present air quality situation inside Tripler Army Hospital (TAH) is not acceptable. (Note the distinction made here between TAMC -- the entire reservation and administrative unit, and TAH -- the hospital structure itself.) The first was conducted as part of the economic and functional analysis of TAMC made by Caudill, Rowlett, Scott, Inc. (1975). It concluded that filtration systems in such critical areas as intensive care units and surgical suites do not meet current standards. The second, McGlothlin (1977), reported finding average concentrations of anesthetic gas (NO) of 60 parts per million (ppm) in operating room and 18 to 24 ppm in adjacent hallways.

As indicated previously, the absence of any widely accepted ambient air quality standards for the internal hospital environment make a precise quantitative evaluation of the acceptability of the present air quality inside TAH impossible. However, it is known that the mechanical systems responsible for maintaining adequate air quality do not even come close to meeting modern standards. Hence, it seems reasonable to conclude that, at present, the quality of the air circulating inside the hospital is of a poorer quality than would be allowed in a new facility.

SURFACE WATER HYDROLOGY

General
The Moanalua Stream Basin is drained by Moanalua Stream and its two major tributaries, Manakiki Stream and Kahauiki Stream. The first two originate at the crest of the Koolau Mountains at an elevation of approximately 2,800 feet and join about 1.0 mile from the mouth of Moanalua Stream. The headwaters of Kahauiki Stream are in a forest reserve area at an elevation of about 1,700 feet, and it enters Moanalua Stream only 0.4 miles from its mouth.

The upper two-thirds of the basin consists of narrow, steeply incised valleys covered by dense vegetation. Over their lower third, the streams traverse moderately sloped, heavily populated areas. Below Moanalua Road the flood plain is flat and wide.

Surface runoff from TAMC’S 0.57 square miles drains into Moanalua Stream above its confluence with Manakiki Stream (see Figure 11-16). The total area of this portion of the Moanalua Stream watershed is about 5.4 square miles -- nearly ten times that of the Tripler reservation alone and roughly half that of the entire Moanalua Stream Basin.

The Aliamanu and Salt Lake Crater areas are located west and adjacent to the Moanalua Stream. These drainage areas, not having natural outlets to the sea, drain runoff through a concrete-lined tunnel to Moanalua Stream.
Streamflow records are available from several U.S. Geological Survey gauging stations on Moanalua Stream. Gauge No. 2285, located at an elevation of 100 feet, measured runoff from the upper 4.16 square miles of the basin between 1958 and 1968. The mean annual flood during that period was approximately 2,200 cfs. Analysis of the long-term stream flow records from U.S.G.S. gauge No. 2280 further up the valley (elevation 338 feet, drainage area of 2.73 square miles), indicates that the average annual flood between 1958 and 1968 was markedly higher than the long-term average (1710 cfs versus 1420 cfs). Thus, 2,200 cfs may overestimate the magnitude of the average annual flood at that point. The limited number of years for which flow records are available makes it difficult to predict the 100-year flood with great accuracy, but a flood frequency analysis using the log-Pearson method and a negative skew of 0.5 suggests that it is between 6,000 and 11,000 cfs with a best guess of about 8,000 cfs.

The U. S. Army Corps of Engineers (1976) has conducted a reconnaissance survey of the Moanalua Stream Basin ...."to determine whether further detailed studies and Federal participation in flood-damage reduction improvements would be warranted." At the request of local authorities, the study focused primarily on flooding affecting the Mapunapuna industrial area on the oceanside of the Moanalua Freeway, but the hydrologic investigations included upstream areas (including TAMC and vicinity) as well. As part of this study, estimates were made of the recurrence frequency for various flood magnitudes based on an analysis of existing records and in correlation with adjacent similar stream basins. These estimates are shown on Table II-7.

TAMC Drainage

Approximately 75 percent of the TAMC reservation drains directly into Moanalua Stream through three large gulches (see Figure II-17). Water from the remainder of the site is collected by a number of inlets and channeled through a subsurface drain pipe system to the City and County storm drainage system in Moanalua Subdivision. The discharge from that system is into Moanalua Stream below Maha Place.

The largest of the three gulches draining Tripler begins near the intersection of Jarrett White and Reasoner Roads just below the Family Housing area, and runs down the center of the Reservation before joining Moanalua Stream near the Moanalua Freeway's Ala Aolani Street underpass (see Basin No. 2, Figure II-17). There are three major drainage structures where the gulch is crossed by existing roads. Two of these, a 48-inch diameter reinforced concrete pipe (RCP) culvert under Patterson Road near the hospital and a twin-barreled 48-inch RCP culvert at Krukowski Road near the laundry, are within the TAMC reservation. The third is an eight-foot by six-foot box culvert at Ala Aolani Street. The drainage area, calculated \( Q_{50-year} \) and \( Q_{capacity} \) for each of the structures are given below:

<table>
<thead>
<tr>
<th>Location</th>
<th>Culvert Size</th>
<th>Drainage Area (Acres)</th>
<th>( Q_{50-year} ) (cfs)</th>
<th>( Q_{capacity} ) (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patterson Rd.</td>
<td>1-glass diameter</td>
<td>62</td>
<td>254</td>
<td>375</td>
</tr>
<tr>
<td>Krukowski Rd.</td>
<td>2-glass diameter</td>
<td>98</td>
<td>313</td>
<td>502</td>
</tr>
<tr>
<td>Ala Aolani St.</td>
<td>8' x 6' box</td>
<td>121</td>
<td>404</td>
<td>925</td>
</tr>
</tbody>
</table>
Figure II-17  EXISTING DRAINAGE: TAMC RESERVATION
Table 11-7 ESTIMATED PEAK DISCHARGES AT SELECTED LOCATIONS ON MOANALUA STREAM, OAHU

<table>
<thead>
<tr>
<th>Stream and Location</th>
<th>Drainage Area (sq. mi.)</th>
<th>Discharge (cfs) 50-Year</th>
<th>Discharge (cfs) 100-Year</th>
<th>Standard Project Flood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kahauiki Stream at junction with Moanalua Stream</td>
<td>2.1</td>
<td>4,100</td>
<td>5,300</td>
<td>8,700</td>
</tr>
<tr>
<td>Moanalua Stream at Jarrett White Road Bridge</td>
<td>5.0</td>
<td>8,100</td>
<td>10,200</td>
<td>17,000</td>
</tr>
<tr>
<td>Moanalua and Manaiki Stream at Moanalua Road Bridge</td>
<td>7.7</td>
<td>11,600</td>
<td>15,000</td>
<td>25,000</td>
</tr>
<tr>
<td>Moanalua Stream at Keehi Lagoon outlet</td>
<td>10.5</td>
<td>14,800</td>
<td>19,000</td>
<td>31,000</td>
</tr>
<tr>
<td>Moanalua Stream at outlet including Salt Lake outflow</td>
<td>10.5</td>
<td>15,300</td>
<td>19,600</td>
<td>31,600</td>
</tr>
</tbody>
</table>


The second large gulch drains some 51 acres of steep, mostly undeveloped land on the northwestern side of the Reservation (basin No. 1). Runoff from this basin enters a six-foot by four-foot box culvert located on the northwest boundary of TAMC that carries it through the adjoining subdivision to Moanalua Stream. Q_{50-year} for the basin was calculated as 198 cfs using the "rational" method outlined in the City and County's Storm Drainage Standards. The capacity of the culvert is 422 cfs.

The last of the large gulches originates below the family housing area. Runoff from this basin (number 4 in Figure 11-17) flows into the unnamed stream that drains about 290 acres of land between Moanalua and Manaiki Valleys.

Water from the portion of the family housing area below Reno Road, the existing helipad, and the nurses' quarters drains by sheet flow into the storm drain system located along Jarrett White Road and, thence, via a series of small culverts to outlets located on the sides of the gulch. It follows natural courses from there to the stream. Water from sub-basins...
4a-4d is also channelled into subsurface storm drains via inlets adjacent to Jarrett White Road and the Administration building. Two of these outlet into natural drainage depressions on the side of the gulch, and two discharge into small man-made structures that carry the water down the side of the gulch and into the storm drainage system serving the residential subdivision there. Finally, all the water is discharged into the unnamed stream at the bottom of the gulch.

The 51 acres in drainage basin 3 include much of the main hospital building, parking lots "D" and "E", and the large grassed area downhill from the hospital. These are drained through a series of catch basins (CB) and underground pipes that discharge into the City and County's storm drainage system along the western boundary of the Reservation. The City's system then carries the runoff along Ala Mahamoe Street and Maha Place to Moanalua Stream.

In recent years, flooding has caused property damage in this area at approximately three-year intervals. According to the Final Engineering Report for Moanalua Gardens, Unit 7, Subdivision Relief Drain, prepared by Wilson, Okamoto and Associates, Inc.:

Past experience has demonstrated that the existing drainage facility along Krukowski Road and storm drains within the subdivision system are inadequate to handle storms having recurrence intervals larger than two to five years. The result has been overflow of the catch basins with storm waters overbanking Krukowski Road and flowing into the subdivision.

Since the City and County contracted a $1 million drainage improvement project that would remedy the problem, efforts were made to determine the extent of the relief the Moanalua Gardens, Unit 7, Subdivision Relief Drain would provide. The environmental assessment for the project stated that the T AMC alteration project would have no adverse effects on the adequacy of the system.

A review of the maps and calculations contained in the final engineering report indicates that storm drainage design flows were estimated using the rational method as outlined in the City and County's "Storm Drainage Standards" and a "C" (runoff coefficient) value of 0.7. A "C" factor of this magnitude is appropriate for low- to medium-density residential development, and is considerably higher than the 0.5 to 0.55 that is a reasonable estimate of the present "C" value for the portion of the T AMC site that is tributary to the drain. In view of this, it appears that the proposed storm drain system is designed to handle flows from T AMC of about 230 cfs, i.e., about 25 to 35 percent higher than the 165-180 cfs that would be expected at present. In terms of excess capacity, this means that the system is designed to accommodate from 50-65 cfs more runoff from T AMC than is now generated by a 50-year rainfall. Hence, the relief drain will not only alleviate an existing drainage problem, it will also make it possible to substantially increase surface runoff from the portion of T AMC that is now tributary to the system or to divert into it runoff which presently flows into other drainageways.
GROUNDWATER HYDROLOGY

Tripler Army Medical Center overlies the basal aquifer of southern Oahu. This aquifer is composed primarily of very permeable basalt, and is bounded by the Ko'olau dike system, the high-level groundwater impounded beneath the Schofield Plateau, the southern end of the Waianae Range, and, on its southern side, by a relatively impermeable sedimentary caprock that separates the aquifer from the ocean (see Figure 11-18). Although the aquifer is generally continuous, several different "isopiestic" areas exist and are separated from one another by less permeable sedimentary material that extends far below present sea level under valley floors.

TAMC and the two wells that supply its potable water (Well nos. 3-2153-07 and 08) are situated in hydrologic area 4 bounded by Kalihi Valley and Moanalua Valley. Pumping tests conducted in 1945, shortly after the wells were drilled, showed a drawdown of only 18 inches after 17 hours of continuous pumping at a rate of 2,460 gallons per minute (gpm). Drawdown was measured again in 1969 using a pumping rate of 1,300 gpm. It reached only 8 inches before stabilizing. These results suggest that the wells do indeed tap the basal aquifer. Because the proposed project would not alter the existing rate of withdrawal from the aquifer, no special investigation of the groundwater system was conducted as part of this study.

NOISE

Exterior Ambient Sound Levels

With average exterior background noise levels ranging from less than 40 dB(A) to about 50 dB(A), the TAMC Reservation is a relatively quiet place. In general, total ambient noise levels are below 55 dB(A), but higher levels occur during overflights by helicopters and light aircraft, and as the result of vehicular traffic (Darby, 1977).* Background sound levels in the civilian housing areas immediately adjacent to Jarrett White Road between the Puuloa Interchange and the entrance to the Tripler Reservation are approximate 55 dB(A) during the day.

Traffic volumes and, therefore, traffic-generated noise are greatest along the segment of Jarrett White Road between the interchange and the entrance to TAMC. Peak-hour vehicle-generated $L_{50}$ and $L_{10}$ sound levels of 68 dB(A) and 75 dB(A), respectively, were estimated by Darby (1977) based on a traffic volume of 1,000 vehicles per hour (Belt, Collins & Associates, Ltd., et al., 1977b), and a highway noise prediction model described in Anderson et al. (1973). At 55 dB(A) and 70 dB(A), the $L_{50}$ and $L_{10}$ peak-hour sound levels actually measured adjacent to Jarrett White Road between Ward Road and Patterson Road are much lower. (Note: these exterior noise level estimates are all as measured -- approximately 40 feet from the centerline of the road -- and are believed to be representative of the worst existing conditions.)

*Helicopters occasionally land at TAMC to offload MEDIVAC patients. The flights when they occur create noise levels, which may be annoying to the surrounding populace. However since it is anticipated that the proposed project would not alter the frequency of flight, no special evaluation of helicopter noise was conducted.
Figure II-18  MAJOR GEOHYDROLOGIC FEATURES OF OAHU
Interior Ambient Sound Levels

A 1976 survey of noise levels in the Surgical ICU, the Medical ICU, Wards 51, 82, and 70, and the Emergency Room reported interior background sound levels ranging from 45 dB(A) to 65 dB(A) (Health and Environment Activity-TAMC, April 1976). In all of these spaces except in the Emergency Room and Ward 51, average interior daytime background sound levels exceeded 50 dB(A), i.e., were greater than the average exterior ambient noise level. The primary source of interior noise noted in the survey were ventilation and air-conditioning equipment, refrigerators, ice machines, patient service carts, and human voices.

In order to gain a general understanding of existing sound levels inside Tripler Army Hospital on which predicted project-related construction noises could be superimposed, a simple "walk-through" noise survey was performed in June 1977. Whereas the 1976 noise survey mentioned above measured the total background noise, this latest survey was aimed at determining what will be referred to as the "basic background noise". "Basic background noise" is defined as that noise which no normal administrative controls can eliminate. It includes noise from such sources as air-conditioning and other mechanical equipment and footfalls on the floor above. It also includes such things as the residual noise inside a private room resulting from normal conversations in the corridor when the door is closed. However, it excludes such sounds as conversational noise passing through an open doorway that can be reduced by instituting simple controls - in this case, closing the door. The results from the walk-through noise survey are summarized in Table II-8.

The significance of the noise levels measured in this survey becomes apparent when it is compared to the maximum ambient noise levels recommended for Army medical facilities by the Department of the Army's Office of the Chief of Engineers (May 1976). It can be seen that the majority of the present TAMC "basic background noise" levels measured for this study exceed the recommended levels.

The recommended standards give only single threshold values rather than a series of thresholds with progressively more serious consequences. Neither do they indicate the relative importance of the standards for the various types of spaces. Because of this, they provide little guidance regarding the significance of a particular violation and cannot, therefore, be used to prioritize corrective actions, especially when such actions would still leave sound levels above those recommended.

VEGETATION (see Figure II-19)

Approximately forty percent of the entire TAMC Military Reservation is undeveloped. In those areas, the dominant species is haole koa (Leucaena leucocephala), a large exotic shrub or small tree that is common throughout drier lowland areas in Hawaii. At Tripler, it is mixed with such other exotics as Java Plum (Eugenia cumini), lantana (Lantana camara), and klu (Acacia farnesiana), to form dense thickets on the sides of gulches in and
Table 11-8 EXISTING dB(A) SOUND LEVELS AND RELEVANT dB(A) SOUND LEVEL STANDARDS FOR TRIPLER ARMY HOSPITAL

<table>
<thead>
<tr>
<th>Bldg. Floor</th>
<th>Air Cond</th>
<th>Use</th>
<th>Design Criteria</th>
<th>TAMC Existing</th>
</tr>
</thead>
<tbody>
<tr>
<td>A₁</td>
<td>1</td>
<td>No Acute minor illness exam room*</td>
<td>35-40</td>
<td>42-45</td>
</tr>
<tr>
<td>B₂</td>
<td>1</td>
<td>No Doctor's office*</td>
<td>35-40</td>
<td>43-45</td>
</tr>
<tr>
<td>A₂</td>
<td>4</td>
<td>Yes ICU nurse's office</td>
<td>35-40</td>
<td>37-39</td>
</tr>
<tr>
<td>A₂</td>
<td>4</td>
<td>Yes ICU patient private room*</td>
<td>30-35</td>
<td>49-50</td>
</tr>
<tr>
<td>A₂</td>
<td>4</td>
<td>Yes ICU*</td>
<td>30-35</td>
<td>45-46</td>
</tr>
<tr>
<td>A₂</td>
<td>7</td>
<td>Yes Labor room</td>
<td>35-40</td>
<td>52-54</td>
</tr>
<tr>
<td>A₂</td>
<td>8</td>
<td>No Doctor's office*</td>
<td>35-40</td>
<td>42-45</td>
</tr>
<tr>
<td>A₂</td>
<td>8</td>
<td>No Doctor's office*</td>
<td>35-40</td>
<td>43-46</td>
</tr>
<tr>
<td>A₂</td>
<td>8</td>
<td>No Conference room*</td>
<td>35-40</td>
<td>43-45</td>
</tr>
<tr>
<td>B₁</td>
<td>3</td>
<td>Yes Patient's room</td>
<td>35-40</td>
<td>37-40</td>
</tr>
<tr>
<td>B₂</td>
<td>3</td>
<td>-- Patient's room*</td>
<td>35-40</td>
<td>43-45</td>
</tr>
<tr>
<td>C₂</td>
<td>3</td>
<td>Yes Patient's room*</td>
<td>35-40</td>
<td>40-42</td>
</tr>
<tr>
<td>C₁</td>
<td>3</td>
<td>No Patient's ward</td>
<td>35-40</td>
<td>42-44</td>
</tr>
<tr>
<td>C₁</td>
<td>6</td>
<td>No Dental treatment room</td>
<td>35-40</td>
<td>41-43</td>
</tr>
<tr>
<td>C₁</td>
<td>6</td>
<td>No Dental treatment room*</td>
<td>35-40</td>
<td>45-50</td>
</tr>
<tr>
<td>B₂</td>
<td>2</td>
<td>-- Patient's room*</td>
<td>35-40</td>
<td>45-48</td>
</tr>
<tr>
<td>B₁</td>
<td>2</td>
<td>-- Patient's room*</td>
<td>35-40</td>
<td>43-48</td>
</tr>
<tr>
<td>C₂</td>
<td>2</td>
<td>Yes Private pediatric room</td>
<td>30-35</td>
<td>36-48</td>
</tr>
</tbody>
</table>

* Window(s) open
Figure II-19  EXISTING VEGETATION
around the site. Wild grasses growing beneath the shrubs and in open areas included pancecum (Panicum purpuracens), coarse-leaved Bermuda grass (Cynodon dactylon), and Indian dropseed (Sporobulus diander) (U.S. Army Corps of Engineers, 1977).

There is considerable erosion scarring and open grassland inland of the upper TAMC boundary, and extensive forest does not begin for at least 1,500 meters. There are, however, stands of guava (Psidium guajava L.), monkeypod (Samanea saman), silky oak (Grevillea robusta), paperbark (Melaleuca leucadendra), and various species of eucalyptus on steep slopes on the northeast portion of the Reservation. Some of these trees extend across the entire northern portion of the TAMS site.

The landscaped areas of the site contain a variety of exotic species commonly used in Hawaii. These include Bermuda grass, wedelia, Waipahu fig, Bougainvillea, purple allamanda and, within the housing, hospital, and administrative areas, many large trees such as eucalyptus, palm, Norfolk pine, monkeypod, royal poinciana, and African tulip. The State Department of Forestry has indicated that the TAMS site contains no more than a few remnant trees from the native Hawaiian ohia (Metrosideros collina) and koa forests that once covered the Ko'olau Mountains. None of the species known to be present have been proposed for inclusion on the State or Federal lists of threatened or endangered species.

WILDLIFE

Wildlife surveys of Tripler Army Medical Center were conducted in November 1976, and again during March 1977 (U.S. Army Corps of Engineers, Pacific Ocean Division, 1977b). A summary of the species encountered is shown in Table 11-9.

The combination of forested habitat and urban use present at TAMS forms an ideal habitat for rodents. A 20 snaptrap trap-line set for one night as part of the survey noted above netted three animals, all of them Black (or Roof) rats (Rattus rattus), but it is believed that brown rats (Rattus norvegicus), Polynesian rats (Rattus exulans), and house mice (Mus musculus) are also present. One wild cat (Felis catus) was observed on the southern portion of the site and dog tracks were abundant in that area. The Fort Shafter Game Warden has indicated that both feral dogs and cats are a recurring problem at Tripler, and that there is an ongoing trapping program aimed at controlling the cat population.

Numerous trails and sleeping areas used by pigs are present on the undeveloped portions of the site, and there is evidence of rooting on the northern vegetation slopes. The Shafter Game Warden reports that pigs are quite common in the vegetated gulch adjacent to the Tripler Officers' Club and in the gulch between the gym and BOQs. A box-trapping program operated by the warden catches an average of two to three pigs per month at TAMS.
Table 11-9 SPECIES LIST - TRIPLER ARMY MEDICAL CENTER

<table>
<thead>
<tr>
<th>RECORDED</th>
<th>PROBABLE</th>
<th>POSSIBLE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-Game Birds:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>American Golden Plover</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melodious Laughing-thrush</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red-vented Bulbul</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mockingbird</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shama Thrush</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Japanese White-eye</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common Myna</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spotted Munia (Ricebird)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>House Sparrow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red-crested Cardinal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardinal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>House Finch</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Game Birds:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spotted Dove</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barred Dove</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Non-Game Mammals:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black Rat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dog</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mongoose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cat</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Game Mammals:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feral Pig</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Probable</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Game Birds:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Japanese Bush Warbler</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oahu Elepaio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Game Mammals:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown Rat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polynesian Rat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>House Mouse</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Possible</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Game Birds:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barn Owl</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hawaiian Owl (Pueo)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Source:</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Pluvialis dominica fulva**
**Garrulax canorus**
**Pycnonotus cafer**
**Mimus polyglottos**
**Copsychus malabaricus**
**Zosterops japonica japonica**
**Acridotheres tristis**
**Lonchura punctulata**
**Passer domesticus**
**Paroaria coronata**
**Cardinalis cardinalis**
**Carpodacus mexicanus frontalis**
**Streptopelia chinesis chinesis**
**Geopelia striata striata**
**Rattus rattus**
**Canis familiaris**
**Herpestes auropunctatus**
**Felis catus**
**Sus scrofa**
**Cettia diphone**
**Chasiempsis sandwichensis gayi**
**Rattus norvegicus**
**Rattus exulans**
**Mus musculus**
**Tyto alba**
**Asio flammeus**

**Source:** U.S. Army Corps of Engineers (1977b). "Draft Bird and Mammal Survey."
During the surveys, mongoose scats were observed on the Damon Estate road just above the housing area and on the scarred soil areas on the northern slopes. Two adult mongooses were watched as they fed in garbage that had been tossed over the vegetated slopes behind the auto crafts shop. No other mongooses were observed, although it is certain they are distributed widely on-site. The extensive vegetated gulches that run throughout the Reservation provide a convenient means of undisturbed movement while permitting access to a variety of urban areas and artificial food sources.

Bird species observed during the surveys are shown in Table II-9. The great diversity can be explained by the extensive undisturbed stands of exotic dryland vegetation throughout the site and the forested slopes on the northern edge of the installation. In addition, undeveloped lands off the site along the southern and eastern boundary provide refuge and support for far more birds than the site would be able to sustain by itself. Some artificial sources of food (planted trees, garbage, mowed lawns, water pipes, etc.) provide the attractants necessary to further boost bird populations. Most of the species known to be present in the area are relatively common, and no Federally-listed threatened or endangered species have been observed.

While there are small stands of large exotic trees on the northern slopes and above the site boundary, a distinct break in the vegetation at higher elevations separates Tripler from forested ridges and valleys dominated by native trees. It is likely that native Apapane (Himatione sanguinea) or Amakihi (Loxops virens chloris) rarely, if ever, make it down to the upper limits of the Tripler site, whereas the latter species, at least, is found at lower elevations within the densely forested Moanalua Valley (Berger, 1971) and in expansive stands of ironwood or paperbark above the housing areas of Fort Shafter.

Forest slopes on the north and northeastern portions of the Tripler site provide habitat for a greater diversity of birds than most other areas surveyed, but there is no verified use of this forest by native birds. Elimination of a significant portion of this habitat, either through fire or urban development would probably have a major effect on the numbers and diversity of birds found in the Tripler area. In contrast, elimination of significant amounts of the haole-koa covered slopes within the developed areas of the site would probably have little effect on the species list for the area, although total numbers of some species (e.g., Japanese White-eye) might be reduced proportionately.

Since surface runoff from the site eventually drains into Moanalua Stream and the Pacific Ocean, concern was expressed for the biota within the stream ecosystem. Therefore, a wildlife reconnaissance survey of the stream was conducted by the U.S. Fish and Wildlife Service and is attached to this report as Appendix D.
VISUAL ENVIRONMENT

TAMC, and the hospital building in particular, is both an object that is viewed from other locations, and a place which contains observers who wish to look out. To completely understand the potential impact of the proposed project on the visual environment, it is necessary to consider both of these roles.

TAMC As A View Object

Distant Views  Many factors combine to make Tripler Hospital one of Honolulu's most conspicuous landmarks. First, the building's size and bulk make it unlike any other. Second, its pink color is in contrast to the greens and browns of the surrounding landscape and the light colors of the neighboring residential subdivisions. Third, the building's location on a promontory surrounded by low-profile residential uses and undeveloped natural landscape acts to enhance its visual prominence.

From the Aloha Tower viewpoint in downtown Honolulu, looking toward the northwest over the waterfront area, TAMC is easily seen and recognized in the distance (see Figure II-20). This line of sight is currently unobstructed by any high-rise structures. Despite the fact that it is easily recognizable, it does not appear at all intrusive, and this is true of all distant views of the complex.

Middle Views  Mid-range views are from distances of a mile or less as seen from approach corridors and nearby communities. At this range, some of the hospital's architectural details begin to come into focus (see Figures II-21 and II-22). Again, the building's mass and location on the hill are prime factors which make the hospital a dominant focal point.

Near Views  Near views are from ground level on the TAMC Reservation level and are mainly experienced by hospital users and visitors. Other military personnel who use the Reservation's housing and recreational facilities are considered secondary observers. From the main entry on Jarrett White Road, the view includes Wing E and portions of the upper floors of Wings A, B and C that are visible over the tops of trees lining Jarrett White Road. From this distance, details of the building's fenestration are barely visible (see Figure II-23). Another low-angle frontal view from lower Krukowski Road offers the observer a dramatic full frame view of the entire hospital that is enhanced by the sloping expanse of lawn (see Figure II-24).

A number of rear views of the hospital can be seen from various vantage points. The closest and most familiar view is from the rear parking lot near the hospital's main entry (see Figure II-25). Only the upper five floors of Wing A and the porte cochere are readily visible. The rest of the building is obscured by mature shade trees and landscaping. Note that the street-light standards are a major landscape component.

Chapter II  50
Figure II-20  VIEW OF TAMC FROM DOWNTOWN HONOLULU

TAMC
Figure II-23  VIEW OF HOSPITAL FROM THE TAMC ENTRANCE GATE

Figure II-24  VIEW OF HOSPITAL FROM LOWER Krukowski ROAD
VIEW OF EXISTING MAIN ENTRY FROM OUT-PATIENT/VISITOR PARKING AREA
Views From The Hospital
The hospital's siting and design afford its users unusually fine views of the city. The finest of these are from Wings D and E, and the upper floors of Wings A, B, and C. Depending upon the exact location of the observer, view angles may be as great as 135° to 150°.

From Wing C looking southeast, an observer can see Punchbowl and Diamond Head Craters, the high rises of Waikiki and downtown, and the surrounding low-rise commercial, manufacturing and residential uses on the coastal plain (Figure II-26). The two high-rise buildings seen in the middle-foreground are low-income housing. Figure II-27 shows a view looking directly ahead in a southwesterly direction. In this view, the more easily identifiable areas are the high-density residential development and golf course in Salt Lake crater, and Honolulu International Airport in the background. Figure II-28 is a view looking west from Wing B. The Waianae mountain range and parts of the central Oahu plateau are visible in the background. In the mid-range are the new Aliamanu Military Housing development, Red Hill apartment project, and Moanalua golf course. The cluster of high-rise buildings in the right-center is in Pearl City.

It is important to note that all of the nursing units, i.e., the areas where the sick and injured spend extended periods of time, except those for pediatrics, general medicine, and surgery, have such extended view areas. Even the exceptions listed have views inland of the mountains and down into the landscaped courtyards between Wings A and C and between Wings B and D. It is also worth noting that there are relatively few poles or light standards in the parking areas or along the roadways below the hospital.

ARCHAEOLOGICAL AND HISTORICAL RESOURCES
The broad region in which Tripler Army Medical Center is situated is known as the Moanalua ahupua'a. An ahupua'a is a large native Hawaiian land division that generally extended from the top of one of an island's mountain peaks to the sea. According to Sterling and Summers, the ahupua'a took its name from the great expanse of level land and reef which characterized the region. The inland area that is now occupied by Moanalua Gardens Park was once used for cultivating taro, the staple food of the Hawaiians. These taro patches were irrigated with water from Kalou Stream, a tributary of Moanalua Stream. Southwest of Moanalua stream and extending all the way to the sea were large taro plantations. Some terraces for wet taro farming are known to have existed above Kalou Stream, but most of the inland areas were not well suited for extensive terracing. In addition to wet taro farming, the shore and flat inland areas were also used for fishponds. Six large fishponds, famous for their mullet and crabs, were known to have existed. (Handy, 1972).

To what extent the TAMC Reservation was inhabited or cultivated in pre-contact times is not fully known. Generally speaking, the Hawaiians preferred areas near the shore and flatlands where water for irrigation

Chapter II 55
Figure II-26  VIEW OF DOWNTOWN HONOLULU FROM WING C

Figure II-27  VIEW OF SALT LAKE CRATER AND HONOLULU INTERNATIONAL AIRPORT FROM WING B
Figure II-28  VIEW OF ALIAMANU CRATER, RED HILL, AND THE WAIANAE MOUNTAIN RANGE FROM WING B
was available rather than the dry, upland hills and ridges that make up
the TAMC site. However, topography and rainfall are such that the area
could have been planted in sweet potatoes or bananas. During the years
immediately before construction of the hospital in 1944, pineapple was
grown on the site.

During a U.S. Army Support Command, Hawaii (USASCH) site inventory
conducted on November 10, 1976, two archaeological sites were found in a
broad shallow gully on the northwest side of Tripler Hospital. These sites
are described in Archaeological Inventory and Evaluation Report for
Installation Environmental Impact Statement for USASCH by Dr. Paul
Rosendahl of the Department of Archaeology, B.P. Bishop Museum (1977).
One of the sites, called Moanalua terraces (Hawaii State Site Number
50-80-14-9505, B.P. Bishop Museum Number 50-0a-A7-81) is about 160 feet
by 80 feet and consists of crude retaining walls which define terraces and
possibly a house platform. The second site, called Moanalua complex
(Hawaii State Site Number 50-80-14-9504, B.P. Bishop Museum Number
50-0a-A7-80), is about 300 feet square and consists of a complex with a
small crude platform of stacked stone and several piles of stone from
clearing. Both of these sites could date from either historic or prehistoric
times and are evident on the surface as eroded ruins. See Figure II-1 for
the location of the sites.

The Moanalua terraces and Moanalua complex archaeological sites were
evaluated for their significance by Dr. Rosendahl of the Bishop Museum in
the aforementioned report. The Army's criteria for evaluation categories
(Section 4-1, Historic Property Evaluation; TM 5-801-1: Technical Manual,
Historic Preservation Administrative Procedures, Headquarters Department
of the Army, 1975) were used to rank sites according to their degree of
historic significance and to establish priorities for preservation. In this
system, the top three rankings have degrees of significance ranging from
Category I--historic properties of great importance which must be pre­served, to Category III-- historic properties of value which should be
preserved if practicable. A fourth designation, Category IV, is assigned
to sites that have no significant value. Both sites received an evaluation
rating of Category III. This applies to "historic properties of value which
contribute to the cultural heritage or visual beauty and interest of the
installation and its environs and which should be preserved, if practi­cable." Rosendahl states that "although the sites are of minimal potential
for research and/or interpretation, they are suggestive of patterns of past
human occupation in this dry environment."

The historic value of TAMC's main hospital building is discussed in the
USASCH Historical Property Inventory and Evaluation Report prepared by
the B.P. Bishop Museum and published in April, 1977. The study notes
that the present hospital was built in 1948 as a replacement for the old
Tripler General Hospital in Fort Shafter. The new hospital, like its
predecessor, was named in honor of Brigadier General Charles Stuart
Tripler (1806-1866), medical director of the Army of the Potomac during
the Civil War and author of the Army's manual on recruit standards.
When completed, the new hospital was the largest Army medical facility of
the time and incorporated numerous architectural and structural innovations. Among the more noteworthy of these were structurally isolated units for protection against earthquakes, vertical rather than horizontal movement of interior traffic, and the first pneumatic tube system installed in an Army hospital. The hospital was designed as a group of open pavilions to take advantage of natural light and ventilation and was stepped down the slope to maximize the spectacular views.

CIRCULATION AND PARKING

Off-Site Access
All traffic to and from TAMC must use the single entrance at the southern corner of the Reservation, Jarrett White Road. Jarrett White originates at the Puuloa Interchange of Moanalua Freeway (FAP 78), a major east-west arterial for the City of Honolulu (see Figure 11-29). Moanalua Freeway intersects Interstate Highway H-1 at both of its ends, and is the single most important transportation link between Pearl Harbor/West Honolulu and the remainder of the city. Completion of the portion of H-1 between the Halawa Interchange and Middle Street will lessen Moanalua Freeway's importance somewhat, but traffic volumes are expected to remain high. Puuloa Road provides a link between Moanalua Freeway and Kamehameha and Nimitz Highways, two major east-west routes that run near the shore-line.

It is about one-half mile along Jarrett White Road from the Puuloa Interchange to the boundary of TAMC up a grade that averages five percent. Jarrett White is a four-lane divided road from the interchange up to its intersection with Ala Mahamoe Street about 900 feet below the TAMC entrance. Above this intersection, traffic is almost exclusively associated with TAMC. The road transitions over a 250-foot distance from four (divided) lanes to two 12-foot wide lanes with 8-foot wide paved shoulders. The only non-TAMC traffic above the Ala Mahamoe Intersection turns off on a minor residential road, Apana Street, just below the TAMC entrance. A significant proportion of the traffic to and from Tripler uses Apana Street on its way to the military housing areas and administrative offices located in Fort Shafter.

Tripler is on Route 13 of the "The Bus," the City and County's public transit system. This bus line provides direct service as far as Fort Shafter to the south and the Foster Village residential area to the west. Using transfers, travellers can reach almost any place on the island, and the 50-cent fare makes it a transportation bargain. Buses run every 30 to 90 minutes, depending upon the time of day and week. Despite the low fare, moderate frequency, and modern equipment, a traffic engineering study conducted by the U.S. Army Traffic Engineering Agency's Military Traffic Management and Terminal Service (1972) found that only 4 percent of the staff and 3.6 percent of outpatients and visitors used public transit to and from TAMC, and there is no reason to believe that the percentage has increased. The City and County is presently considering the development of a fixed guideway/feeder-bus mass transit system through
Central Honolulu. The nearest station would be nearly two miles from TAMC, however, and it seems unlikely that the proposed system would result in a major change in mass transit ridership to the hospital.

Primary On-Site Circulation
Two major roads, Jarrett White and Krukowski, form a continuous loop which circumscribes most of the Reservation's vehicular destination areas (see Figure 11-30). Patterson Road, the Reservation's third primary artery, bisects this loop near its midpoint. The hospital is located just below Patterson Road and its main entrance faces onto it. There is a continuous increase in elevation from the southwest side up the ridge to the family housing area well above the hospital, and this slope influences the speeds of most vehicles.

Present average daily traffic on Jarrett White Road at the entrance to the TAMC Reservation is estimated at about 11,000 (Belt, Collins and Associates, Ltd., et al., 1977). Table 11-10 indicates average peak-hour traffic at that location observed over the course of a one-week sampling period in early June 1977, was 957 vph in the morning (0700 hrs - 0800 hrs) and 980 vph in the afternoon (1600 hrs - 1700 hrs). This data suggests that peak-hour traffic into and out of TAMC may have increased by about 20-25 percent since 1971-1972, when the last counts were taken. At least some of this increase may be due to the removal of downstream capacity limits as a result of the completion of the Puuloa Interchange, however, and it would be conjectural to conclude that the number of vehicles wanting to use the road during the peak hour has increased by a like amount. Car-pooling is being encouraged in accordance with Army regulations and policies.

During the morning peak hour (0700-0800), 22 to 26 percent of the traffic on Jarrett White Road at the entrance to TAMC is outbound. These vehicles are assumed to belong primarily to residents of the TAMC Reservation who work elsewhere, such as at Fort Shafter, and to night-shift workers leaving upon completion of their work. Peak outbound volumes were observed from 1600 to 1700 hours. This afternoon peak is believed to consist primarily of staff members leaving at the end of their work day. Between the morning and afternoon peaks, traffic volumes fluctuate between two-thirds and three-quarters of the peak rate.

Parking
A total of 1,421 parking spaces are designated for use by outpatients, visitors, and staff of TAMC hospital (see Figure 11-31). Of these, 554 are reserved for outpatients and visitors, and are relatively close to the various outpatient clinics. Another 667 spaces, the vast majority of them in the D and E lots on the southwest side of the hospital, are designated for the exclusive use of the hospital staff. An additional 200 parking stalls are available at three "overflow lots" situated from 550 to 1,300 feet from the main hospital complex.
Figure II-30  EXISTING ON-SITE CIRCULATION
Table 11-10 PEAK MORNING AND AFTERNOON TRAFFIC VOLUME ON JARRETT WHITE ROAD AT THE TAMC ENTRANCE: JUNE 6 TO 10, 1977

<table>
<thead>
<tr>
<th>Date and Day</th>
<th>Morning Peak-Hour Volume</th>
<th>Afternoon Peak-Hour Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time Interval</td>
<td>Trucks Up- Down- Total</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Buses</td>
</tr>
<tr>
<td>6 June Monday</td>
<td>0700-0800</td>
<td>693</td>
</tr>
<tr>
<td>7 June Tuesday</td>
<td>0700-0800</td>
<td>729</td>
</tr>
<tr>
<td>8 June Wednesday</td>
<td>0700-0800</td>
<td>799</td>
</tr>
<tr>
<td>9 June Thursday</td>
<td>0715-0815</td>
<td>693</td>
</tr>
<tr>
<td>10 June Friday</td>
<td>0715-0815</td>
<td>696</td>
</tr>
<tr>
<td>Average for 5 Days</td>
<td>---</td>
<td>722</td>
</tr>
</tbody>
</table>

Standard Deviation = 42.4

Standard Deviation = 53.7

SOURCE: Belt, Collins and Associates.

Parking surveys conducted for the project found peak use of outpatient/visitor, staff, and "overflow" lots to be about 100 percent, 97 percent, and 73 percent of capacity, respectively. The outpatient/visitor totals may include some illegal parking by TAMC staff members, but the number is not believed to be significant. As a result, it appears that present facilities are fairly well in balance with existing demand.

BUILDING AND UTILITY SYSTEMS

Structural Systems
The existing main hospital building is composed of fourteen distinct structural elements that are separated by narrow (1" to 4") gaps between concrete shear walls. All of the elements are interconnected. While a
Figure II-31 EXISTING HOSPITAL PARKING
given floor is at the same elevation throughout the structure, there is considerable variability in the floor-to-floor heights of different levels (12' 4" to 15' 2"). Most of the structural support is provided by pad footings at column locations.

According to the Caudill, Rowlett, Scott (CRS) study, the lateral stability for the structure is provided by a combination of reinforced concrete shear walls and rigid frames developed primarily at exterior walls. Some interior frames provide additional stiffness, but their contribution is not great. A note on the original drawings indicates that the buildings are designed to resist a seismic factor of two percent times the dead load plus live load \[0.02 \times (DL + LL)\]. The wind load assumed in the design is not known. To put this in perspective, it may help to note that, were the building being designed with the same configuration today, a five to six percent factor would be used. In terms of modern standards, then, it is somewhat underdesigned.

**Water System**

As indicated in the discussion of the area’s groundwater conditions, Tripler's potable water is supplied by two wells that tap the island's basal lens. Together, the wells can produce about 2.5 mgd. Pump house No. 1 provides water for the lower distribution system that services everything below the family housing area and feeds storage tank No. 1, a 500,000-gallon-capacity concrete reservoir (see Figure 11-32). Pump house No. 2 houses two 640-gpm pumps that transfer water to the high-level distribution system and the 500,000-gallon-capacity water storage tank No. 2. Diesel-driven stand-by pumps with capacities of 600 gpm and 580 gpm are located at pump houses No. 1 and No. 2, respectively.

**Sanitary Sewer System**

The existing sanitary sewer system at TAMC has two main branches (see Figure 11-32). With the exception of the segment immediately below the hospital, they follow Jarrett White and Krukowski Roads, respectively. Both depend on gravity flow. Average and peak flows from the entire TAMC Reservation are estimated at 0.31 and 1.65 mgd, respectively. The approximate capacities of selected lines are shown below:

<table>
<thead>
<tr>
<th>Segment</th>
<th>Size (inches)</th>
<th>Capacity (in mgd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jarrett White Road to below Wing A</td>
<td>8</td>
<td>1.00</td>
</tr>
<tr>
<td>Wing B to below Wing A</td>
<td>8</td>
<td>0.68</td>
</tr>
<tr>
<td>Wing E to lower flagpole</td>
<td>8</td>
<td>0.84</td>
</tr>
<tr>
<td>Wing D to lower flagpole</td>
<td>8</td>
<td>0.67</td>
</tr>
<tr>
<td>Flagpole to TAMC Entrance via main lawn</td>
<td>10</td>
<td>3.50</td>
</tr>
<tr>
<td>Nursery to TAMC Entrance via Krukowski Road</td>
<td>12 - 16</td>
<td>0.73</td>
</tr>
<tr>
<td>TAMC Entrance to Shafter Sewage Pump Station</td>
<td>14 - 20</td>
<td>75.80</td>
</tr>
</tbody>
</table>

Chapter II 65
The offsite line between TAMC and the Shafter Sewage Pump Station also carries sewage from the 2,800-unit Aliamanu Family Housing area. Disposal of the effluent is via the City and County's Sand Island Sewage Treatment Plant. This facility provides advanced primary treatment through a deep ocean outfall and is in compliance with State and Federal Regulations.

Steam and Hot Water Supply System
At present, steam and hot water used in the hospital, laundry, officers' club, gymnasium, and nurses' quarters, is generated in a boiler plant located in the support facilities area about 1,400 feet west of the hospital. Equipment there includes three bent-tube water tube boilers, each with a capacity of 13,000 pounds per hour at 125 psi, a de-aerating feed-water heater, circulating pumps, feed-water pumps, fuel oil pumps, chemical cold water feed pumps, air compressor, and an emergency generator which provides back-up electrical power for pumps, lighting, fans, and the boilers' power burners. The boilers were re-tubed in 1974, and they and their appurtenances appear to be in satisfactory working order. Records kept at the plant indicate that present steam use averages about 12,000 pounds per hour, i.e., slightly less than the amount that can be produced by any one of the three boilers. An existing 24-inch steam distribution line runs almost due east from the boiler plant to Patterson Road (see Figure 11-32). It forms a "T" intersection at that point with branches leading in either direction along the road and distribution lines feeding each of the buildings served.

Electrical Power
TAMC receives high-voltage (11,000 volts), three-phase electrical power from the Hawaiian Electric Co. via a dual feed: Normal feeder No. 3 serves radiology and the hospital's Wing A, and normal feeder No. 4 supplies Wings B and C. This power is converted into a form usable in the hospital by GE-Pyranol transformers. Transformer and switchgear capacities are as follows:

- Wing A - 1,200-Kva transformer on feeder No. 3 for switchgear "A" and main breaker protection of 4,000 amps (120 percent of transformer rating).
- Wing B - 750-Kva transformer on feeder No. 4 for switchgear "B" and main breaker protection of 2,500 amps.
- Wing C - same as Wing B.
- Wings D and E - receive power through switchgears "B" and "C", respectively.
- X-ray equipment - 200-Kva transformer.

Estimated average power consumption at TAMC in 1976 was about 1.3 million Kwh/month and the peak or demand figure is reported as about 2,900 Kw. Of this, over 80 percent of the consumption and nearly 90 percent of the demand is attributable to the hospital.

Chapter II
Air-Conditioning
As indicated previously, only a small part of the hospital is supplied with conditioned air at the present time (see Table II-6). The existing central air-conditioning system at TAH consists of two chillers located in the main mechanical room on Level B1. The oldest of these is a steam turbine-driven centrifugal compressor that was installed in 1948. Because it exhausts directly to the atmosphere rather than to a heat recovery system, this unit is extremely inefficient in its use of energy. Its capacity is estimated at from 150 to 175 tons. Currently, this unit is used primarily as a back-up to a 208-ton-capacity steam absorption chiller installed in 1971. This unit was installed in 1971, but was still not operating properly at the time of the CRS study in 1974.

Its reliability has improved somewhat since that time, but the mechanical engineers involved in the present project feel it would be extremely difficult to keep these chillers operational long enough to construct a replacement system. Because of their extremely low capacity, inefficient use of energy, inadequate filtration, and poor mechanical condition, there is absolutely no possibility of re-using any of these units.

In addition to the two large central chillers described above, several package units serve specialized areas such as the telephone equipment room (7.5-ton capacity), the command center, and the theater. Perhaps a hundred window air conditioners are scattered throughout the hospital and provide a modicum of conditioning to individual rooms.

There are four, single-zone, 100 percent outside air handling units located in the same mechanical room as the main chillers; these supply fresh air to most public areas of the hospital through an elaborate system of ductwork. As a result, these areas have a positive pressure. Exhaust fans are located in bathrooms and a few other specialized areas, but, in general, the air must find its own way out of the building. Because of the absence of any zoning system, air moves freely through the hospital. Although steam heating coils were installed that should allow for conditioning of the outside air on cool evenings, complaints that the interior is too cold at night are not uncommon.

Solid Waste
According to the Army Environmental Hygiene Agency's February 1977 survey ("Solid Waste Management Survey No. 26-0001-77, Tripler Army Medical Center, Honolulu, Hawaii, 31 January - 11 February 1977"), the hospital currently generates approximately 12,820 pounds of solid waste per day: this consists of 11,300 pounds of non-infectious, 1,500 pounds of infectious, and 20 pounds of pathological wastes. These estimates are consistent with data collected for the "Waste Disposal" study conducted for this project. The three waste types are defined as follows:

- Infectious wastes are those wastes derived from the diagnosis, care, and treatment of a person or animal that has been exposed to a contagious disease.
o Non-infectious wastes include all solid waste generated by the hospital that is not included in the pathological or infectious classifications.

o Pathological wastes include all anatomical wastes (including placentas) and sacrificed animal carcasses.

The approximately 12,500 pounds of non-pathological wastes now generated by the hospital each day are delivered by the custodial staff to compactor-container units in the receiving area. Each container has a 30-cubic yard capacity and is picked up and transported to the Schofield Barracks Landfill five days each week. Special handling of the infectious portion of these wastes includes placement in two plastic bags at TAMC and transport in compactors. As of October 1, 1980, all wastes, except pathological, will either be disposed of at the City and County's Waipahu Incinerator or at the privately-owned Puu Palailai Landfill.

The approximately 20 pounds of pathological wastes now generated daily in the hospital are initially stored at their points of generation in freezers or formaline solutions. From these locations throughout the hospital, the wastes are taken to the Anatomical Pathology Morgue to be retained for bi-weekly pickup by a private contractor. The contractor takes the wastes to a mortuary for cremation.
LAND-USE RELATIONSHIPS

OVERVIEW
FEDERAL
CONSISTENCY WITH FEDERAL POLLUTION CONTROLS
STATE
STATE LAND USE DISTRICTS
HAWAII STATE PLAN
CITY AND COUNTY OF HONOLULU
GENERAL PLAN
DEVELOPMENT PLANS (PROPOSED)
DETAILED LAND USE MAPS
ZONING
III LAND-USE RELATIONSHIPS

OVERVIEW

This chapter discusses the relationship of the proposed TAMC project to applicable existing and proposed public land use plans, policies, and controls and to other relevant programs on the federal, state, and local levels.

FEDERAL

Tripler Army Hospital is situated in the center of an existing 367-acre military reservation. Because of this, no new acquisition would be required, and the proposed modernization project would therefore be consistent with federal guidelines restricting the acquisition of additional land when suitable areas are already available.

CONSISTENCY WITH FEDERAL POLLUTION CONTROLS

The Federal Water Pollution Control Act as amended requires the individual states to set water quality standards to protect the beneficial use of water. Pursuant to this, the State of Hawaii's Department of Health has established water quality standards for all waters within the state. (Chapters 37 and 37a of the Public Health Regulations). Similarly, effluent standards defining maximum allowable pollutant levels have been set for all discharges that might affect ground, surface, or coastal waters.

The State is participating in the U. S. Environmental Protection Agency's 208 Water Quality Program, and new water quality standards have been proposed based on scientific studies conducted as part of that effort. The proposed new standards are based on an understanding of the functioning of the state's freshwater and marine ecosystems, and represent a significant advance over the existing ones. The proposed project would have no significant effect on water quality and would not result in the violation of existing or proposed water quality standards.

Existing air quality and air quality impacts of the proposed action are discussed in Chapters II and IV of this statement, respectively. As indicated in those sections, air quality in the vicinity of the proposed project currently meets all State and Federal standards. With the possible exception of some very temporary increase in particulate emissions as a result of excavation and grading, the proposed project would not affect air quality and would, therefore, be consistent with existing laws and regulations.
STATE

STATE LAND USE DISTRICTS (ACT 187, SLH 1961)

All lands and inland water bodies within the State of Hawaii are classified by a nine-member Land Use Commission into one of four State Land Use Districts: Urban, Agriculture, Conservation, or Rural. TAMC is located within an extensive linear band of existing Urban District land which comprises the primary urban center of Honolulu. The TAMC Reservation and adjacent residential subdivisions, public schools, recreational areas, and nearby commercial and light industrial areas are classified Urban, a designation used for lands generally having urban activities and facilities with reserve land for future growth. Land uses and detailed planning within this Urban District are administered by the City and County of Honolulu (see Figure III-1).

Lands uphill of TAMC and along portions of its flanking borders are designated Conservation. These areas are part of the Koolau Mountain Range, an area protected for its water resources, forest reserves, wilderness and scenic areas, and because of steep topography. Lands within this adjacent area are regulated by the State Department of Land and Natural Resources and are further classified as General Use (GU) Conservation Subzone. This subzone, unlike the Restricted Watershed (RW) Subzone, allows a limited number of human activities subject to the approval of the Land Board.

HAWAII STATE PLAN

The Hawaii State Plan, mandated by the State Legislature under Chapter 225, Hawaii Revised Statutes, 1975, was developed by the State Department of Planning and Economic Development. It is a comprehensive long-range planning and policies document which serves as a guide for analysis and decision-making regarding the future development of the state. The Plan has an interrelated set of statements concerning general social, economic, environmental, physical, and design objectives. Basically the Plan is organized into four basic components: 1) an overall theme statement, 2) a goal statement that indicates desired end-states, 3) objectives and policies for each area of concern, and 4) an implementation framework. A Policy Council consisting of state and county officials and citizen representatives was established to serve as an advisory body in formulating, reviewing, and resolving conflicts in the Plan. The Plan was signed into law May 22, 1978.

Because of the general nature of the State Plan, it does not directly affect the proposed action. The policy most directly related to the project is in Section 20, "Objectives for socio-cultural advancement--health," policy (3) "Encourage improved cooperation among public and private sectors in the provision of health care to accommodate the total health needs of individuals throughout the State." The State Health Planning and Development Agency (August 1978) has stated that "representatives of Tripler have
Figure III-1  STATE LAND USE DISTRICTS

LEGEND

U  URBAN CONSERVATION
been generous in sharing their plans with us and discussing possible community impact." There does not appear to be any conflict between the State Plan and the proposed TMC project.

CITY AND COUNTY OF HONOLULU

GENERAL PLAN (RESOLUTION 238)

The recently adopted (January 1977) Oahu General Plan is a statement of long-range objectives and broad policies that relate to the desirable and attainable future development of the island. It addresses nine areas of concern ranging from population to culture to recreation, and is intended as a guide for public agencies, private businesses and organizations, and individual citizens. Implementation of the General Plan will be through City and County ordinances, resolutions, rules and regulations, budget proposals and capital improvement programs, and cooperation with other levels of governments. Ordinances such as Development Plans and Zoning that will play a major role in the implementation of the General Plan are discussed later in this Chapter.

Because of the nature of the General Plan, determining whether the proposed project conforms or conflicts with it requires substantial interpretation of its stated objectives and policies. Of the nine areas of concern covered, the following appear most relevant to the Tripler project and are discussed below: 1) population, 2) economic activity, 3) physical development and urban design and 4) health and education.

Population
Specifically, the proposed project is consistent with Objective C, Policy 1, in that modernization of TMC would insure that the military's main health care facility in Hawaii remains in the urban core of the city and, thereby, helps "Facilitate the full development of the primary urban center".

Economic Activities
Specifically applicable objectives and policies are Objective A, "To promote employment opportunities that will enable all the people of Oahu to attain a decent standard of living," and Policy 1, "Encourage the growth and diversification of Oahu's economic base"; and Objective F, "To increase the amount of Federal spending on Oahu," and Policy 1, "Take full advantage of Federal programs and grants." The proposed action is in concurrence with these objectives and policies. It would not, however, be consistent with Policy 3, "Encourage the Federal government to lease new facilities rather than construct them on tax-exempt public land," or Policy 4, "Encourage the military to purchase locally all of the services and supplies it needs which are available on Oahu."

Physical Development and Urban Design
The project would help fulfill Objective A, "To coordinate changes in the physical environment of Oahu to ensure that all new developments are timely and appropriate for the areas in which they are located"; Objective D,
"To create and maintain attractive, meaningful, and stimulating environments throughout Oahu"; and Policy 1, "Prepare and maintain a comprehensive urban-design plan for the island of Oahu." Tripler Army Hospital is a visually commanding structure and ranks as a notable urban design landmark. The proposed renovation would not have a major effect on its appearance and would extend its useful life by at least 25 to 30 years.

Health and Education
The proposed action is in concurrence with Objective A, Policy 1, "To protect the health of the people of Oahu . . . [and] encourage the provision of health care facilities that are accessible to both employment and residential centers," and Policy 2, "Provide prompt and adequate ambulance and first-aid services in all areas of Oahu."

DEVELOPMENT PLANS (PROPOSED)

To implement the objectives and policies of the Oahu General Plan for identified geographic areas of the island, the revised City Charter of Honolulu has mandated the Department of General Planning to create a set of regional Development Plans for the entire island. Such plans will be relatively detailed and will contain maps of the planning area; statements of standards, principles, and controls pertaining to various land uses and urban design; and listings of significant historical, archaeological, architectural, and scenic areas, sites, and structures. In addition, they will establish circulation patterns, examine the location of public buildings and utilities, and may include other optional components as well. Each Development Plan will determine the desirable phasing of development consistent with the overall intent of the General Plan. Citizen participation in the form of neighborhood boards and area-wide organizations will be an integral part of the planning process.

TAMC falls within the area identified by the Oahu General Plan as the primary urban center (Honolulu proper from Waialae-Kahala to Halawa), the first area for which a Development Plan will be prepared. Input from TAMC will probably be requested in formulating this plan. The development planning program is not yet complete; hence, no definitive conclusions about the conformity or nonconformity of the proposed action with the proposed Development Plan can be drawn. However, because TAMC is an established and well-recognized entity of the planning area and because the proposed action would not significantly alter the land use pattern of the surrounding area, conflicts with the proposed plan are not anticipated. In view of this, the effects of the Development Plan on TAMC will most likely be felt indirectly.

As mentioned in the proceeding "General Plan" section, the urban design component proposed for the Development Plan may have direct bearing on TAMC because TAMC may be regarded as a significant urban design landmark. The proposed action would not significantly alter the physical form or visual character of TAMC and, therefore, would probably be in conformity with the intent of the Urban Design component of the Development Plan.
DETAILED LAND USE MAPS

Detailed Land Use Maps (DLUMs) are officially adopted large-scale maps which precisely delineate the land use district boundaries established by the old Oahu General Plan. Under the new General Plan ordinance, these maps will remain in effect until the island-wide set of Development Plans is adopted.

TAMC is covered by the Red Hill-Tripler DLUM (see Figure III-2). It is classified military, a land use designation which generally recognizes the existence of a military land tenure and does not imply planning nor land use control per se. Land use designations as depicted on the DLUM for the surrounding area coincide with the boundaries and use designations of the State Land Use Districts; i.e., conservation areas are designated preservation and urban areas are designated residential, apartment, and recreation. No conflicts between the proposed action and the DLUM exist.

ZONING

Official zoning maps and the Comprehensive Zoning Code (adopted in 1969) are the primary legal mechanisms which regulate land uses within demarcated zones and set standards and restrictions for land use intensities, activities, densities, and building locations, heights, bulks, sizes, and setbacks. Zoning must conform to the City and County's General Plan and Development Plans and to the districts and regulations of the State Land Use Commission.

Despite federal exemption from state and local zoning regulations, TAMC was zoned R-6 (Residential). This zoning classification was applied to all unzoned land on Oahu within the State Urban District prior to 1969 so that a thorough classification of all lands on the island could be made. Immediately surrounding TAMC are lands zoned R-4 and R-5 (Residential zones permitting single family and duplex dwellings on decreasing lot sizes, respectively) and P-1 (Preservation). Other lands in the vicinity are zoned A-2 (Medium Density Apartment), B-2 (Community Business), and I-1 (Light Industry) (see Figure III-3). The R-6 designation allows hospitals as a conditional use and is the classification normally used for those facilities.
Figure III-3  EXISTING ZONING
PROBABLE IMPACTS OF THE PROPOSED ACTION ON THE ENVIRONMENT

HYDROLOGIC IMPACTS
AIR QUALITY IMPACTS
INTRODUCTION
CONSTRUCTION AND RENOVATION
POST-CONSTRUCTION PERIOD
MITIGATIVE MEASURES
NOISE IMPACTS
INTRODUCTION
NOISE IMPACTS ON THE INTERIOR ENVIRONMENT
BIOLOGICAL IMPACTS
TRAFFIC IMPACTS
WATER SUPPLY
SEWAGE
ENERGY
SOLID WASTE DISPOSAL
VISUAL IMPACTS
LOOKING AT THE SITE
VIEWS FROM WITHIN THE HOSPITAL
ARCHAEOLOGICAL/HISTORICAL IMPACTS
ECONOMIC AND SOCIAL IMPACTS
IV PROBABLE IMPACTS OF THE PROPOSED ACTION ON THE ENVIRONMENT

HYDROLOGIC IMPACTS

As indicated in Chapter II, intermittent flooding is already a problem in some of the residential areas adjacent to the TAMC Reservation. Construction of the new wing, parking areas, and roadways that are proposed as part of this project would result in a significant increase in total surface runoff from the area. Because of this, great care had to be taken to insure that the increased flows resulting from the project would be channeled off-site into storm drainage systems having adequate capacity.

The proposed storm drainage system, together with the drainage areas that each major structure would serve, is shown in Figure IV-1. Table IV-1 summarizes the proposed changes in tributary area, runoff coefficient ("C" value), effective rainfall intensity ("I"), and peak discharge from the design storm for each component of the system that would be affected. It also compares the projected design flow with the estimated capacity.

As can be seen from Table IV-1, the flow from TAMC into the Haku Street drainage system east of the reservation would be maintained or decreased by the changes to topography and to ground cover that are under consideration as part of the proposed project. Similarly, surface runoff into the Moanalua Gardens storm drainage system from TAMC drainage basin No. 3 would be the same following completion of the proposed project as it is now. Some temporary increase in run off potential from basin No. 3 would occur during the construction phase of the project from the temporary parking area immediately below parking lot "E." However, even during this period the calculated \( Q_{100} \) of 138 cfs is below the 144 cfs capacity of the recently completed Moanalua Subdivision, Unit No. 7, Relief Drain. Hence no flooding is expected. Only drainage basin No. 2 would experience an increase in flow as a result of the project. Even then, the projected 50-year flood flows in the single 60-inch-diameter reinforced concrete pipe (RCP), the double-barrelled 48-inch-diameter RCP, and the eight-foot by six-foot box culvert would be 127 cfs, 91 cfs, and 454 cfs below their estimated capacities.

The discharge from drainage basin No. 2 into Moanalua Stream from a 50-year storm would increase by about 40 cfs as a result of the project. This is less than one-half of one percent of the estimated discharge at this point resulting from a 50-year storm. While even this is undesirable given the occasional flooding that occurs in the Mapunapuna industrial area along the lower reaches of Moanalua Stream, the increase is so slight that the impact must be considered marginal.
Figure IV-1. TRIPLER RESERVATION PROPOSED DRAINAGE AREAS
Table IV-1  COMPARISON OF EXISTING AND PROJECTED RUNOFF

<table>
<thead>
<tr>
<th>Drainage Location/ Basin Structure</th>
<th>Tributary Area (in Acres)</th>
<th>&quot;C&quot; Values</th>
<th>Design Recurr. Interval (Years)</th>
<th>Runoff (in cfs) for Appropriate Recurrence Interval</th>
<th>Estimated Net Capacity (in cfs)</th>
<th>Capacity (in cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Krukowski 1</td>
<td>3a</td>
<td>Exist. CB</td>
<td>2.3</td>
<td>1.0</td>
<td>17.0</td>
<td>17.6</td>
</tr>
<tr>
<td></td>
<td>3b</td>
<td>CB #1</td>
<td>0.8</td>
<td>0.0</td>
<td>5.7</td>
<td>5.2</td>
</tr>
<tr>
<td></td>
<td>3c</td>
<td>CB #2</td>
<td>5.2</td>
<td>4.1</td>
<td>14.8</td>
<td>17.4</td>
</tr>
<tr>
<td></td>
<td>3d</td>
<td>CB #4</td>
<td>0.0</td>
<td>0.0</td>
<td>3.6</td>
<td>3.6</td>
</tr>
<tr>
<td>Haku Street:</td>
<td>4a</td>
<td>Inlet #1</td>
<td>2.5</td>
<td>0.7</td>
<td>3.9</td>
<td>5.2</td>
</tr>
<tr>
<td></td>
<td>4b</td>
<td>Inlet #2</td>
<td>0.2</td>
<td>0.2</td>
<td>4.5</td>
<td>4.4</td>
</tr>
<tr>
<td></td>
<td>4c</td>
<td>Inlet #3</td>
<td>3.1</td>
<td>4.6</td>
<td>5.7</td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td>4d</td>
<td>Inlet #4</td>
<td>1.7</td>
<td>1.4</td>
<td>7.0</td>
<td>6.3</td>
</tr>
<tr>
<td>Gully:</td>
<td>2</td>
<td>40&quot;/60&quot; Diam. RCP</td>
<td>16.0</td>
<td>10.3</td>
<td>46.0</td>
<td>50.4</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2&quot;-48&quot; Diam. RCP</td>
<td>30.3</td>
<td>20.9</td>
<td>67.7</td>
<td>71.6</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>8&quot;x6&quot; Box Culvert</td>
<td>33.1</td>
<td>43.2</td>
<td>88.1</td>
<td>83.4</td>
</tr>
</tbody>
</table>

1 The figures shown were calculated prior to the completion of the County's Moanalua Subdivision Relief Drain. The new system has sufficient capacity to accommodate the projected flows and should eliminate the flooding that has been experienced in this area.

2 The figures shown for Lower Krukowski Road and Haku Street represent existing flow and are based on the assumption that the system was designed to accommodate that volume of runoff. Since flooding now occurs in these areas, it is likely that the actual capacity of the system is lower than that shown. However, since no additional runoff would be channeled to these lines, no attempt was made to calculate their actual volume.
In addition to permanently increasing the volume of stormwater runoff from the site, the proposed project would result in a temporary, but measurable increase in erosion during construction. The exact amount of erosion would depend upon the exact timing of the various construction activities that would require vegetation removal, as well as on the rainfall experienced at critical times during the process. All practical erosion control techniques would be employed, however, and it is expected that the amount of additional soil appearing as sediment in adjacent streams would be negligible.

During construction, surface water runoff would contain slightly increased levels of several pollutants. Any possible adverse effects on the biological community from these sources would be minimized by the use of proper construction practices.

AIR QUALITY IMPACTS

INTRODUCTION

The proposed modernization and rehabilitation of Tripler Army Medical Center involves a number of actions that could have significant effects on air quality. The most important of these are:

- realignment of on-site roadways and construction of new parking facilities;
- construction of the large new outpatient/diagnostic and treatment wing adjacent to existing Wing A;
- demolition of the existing theater; and
- demolition and reconstruction of essentially all spaces contained within Wings A, B, C and D of the existing hospital building.

The remainder of this section discusses the nature and extent of the air quality impacts that each of these actions is likely to have and, where appropriate, identifies measures that would be used to mitigate or avoid those impacts judged to be significant.

CONSTRUCTION AND RENOVATION

New, temporary sources of air pollutants would be present at TAMC during the proposed construction and renovation period (see Table IV-2). Generally speaking, particulate matter (dust) would present the greatest air quality problem if not controlled. The chief sources would be vehicle movement and excavation. During one phase of the proposed renovation, however, asbestos dust released during the removal of existing asbestos-insulated hot water pipes and asbestos ceiling insulation would constitute a significant danger due to the low concentrations of this material that are medically significant.
<table>
<thead>
<tr>
<th>Source</th>
<th>Pollutants</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vehicular Movement:</strong></td>
<td></td>
</tr>
<tr>
<td>Passenger cars (workers)</td>
<td>CO, HC, NOx, SOx,</td>
</tr>
<tr>
<td>Light duty trucks</td>
<td>Particulates</td>
</tr>
<tr>
<td><strong>Heavy-duty vehicles:</strong></td>
<td></td>
</tr>
<tr>
<td>Bulldozers</td>
<td></td>
</tr>
<tr>
<td>Front-end loaders</td>
<td></td>
</tr>
<tr>
<td>Dump trucks</td>
<td></td>
</tr>
<tr>
<td>Ready-mix concrete trucks</td>
<td></td>
</tr>
<tr>
<td>Forklifts</td>
<td></td>
</tr>
<tr>
<td>Other material handling equipment</td>
<td></td>
</tr>
<tr>
<td><strong>Excavation</strong></td>
<td>Particulate matter</td>
</tr>
<tr>
<td><strong>Construction of new building</strong></td>
<td>Particulate matter</td>
</tr>
<tr>
<td><strong>Renovation of existing buildings</strong></td>
<td>Particulate matter</td>
</tr>
<tr>
<td><strong>Demolition of theater (Bldg. 212)</strong></td>
<td>Particulate matter</td>
</tr>
<tr>
<td></td>
<td>Asbestos dust</td>
</tr>
<tr>
<td><strong>Construction of new roads, parking lots, helipad</strong></td>
<td>Particulate matter</td>
</tr>
<tr>
<td><strong>Waste disposal</strong></td>
<td>Particulate matter</td>
</tr>
<tr>
<td><strong>Movement of building materials</strong></td>
<td>Particulate matter</td>
</tr>
</tbody>
</table>
Because of the upwind location of the proposed new wing (in terms of the most frequent wind conditions) and its close proximity to the existing hospital, the impact of constructing the wing was analyzed in some detail. Using an approximate dust emission factor of 1.2 tons per acre per construction-month of activity (U.S. Environmental Protection Agency, 1972a) and an area source model described by Turner (U.S. Environmental Protection Agency, 1973b), rough estimates of total solid particulate concentrations at each level of the existing hospital were computed. The results are summarized in Table IV-3.

Table IV-3 ESTIMATES OF TOTAL SUSPENDED PARTICULATES (TSP) RESULTING FROM CONSTRUCTION OF THE PROPOSED NEW WING

<table>
<thead>
<tr>
<th>Hospital Level</th>
<th>24-Hour TSP Concentration (mg/m³) at the Specified Hospital Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Typical from Construction</td>
</tr>
<tr>
<td>01</td>
<td>75</td>
</tr>
<tr>
<td>02</td>
<td>70</td>
</tr>
<tr>
<td>03</td>
<td>65</td>
</tr>
<tr>
<td>04</td>
<td>60</td>
</tr>
<tr>
<td>05</td>
<td>50</td>
</tr>
<tr>
<td>06</td>
<td>45</td>
</tr>
<tr>
<td>07</td>
<td>35</td>
</tr>
<tr>
<td>08</td>
<td>20</td>
</tr>
</tbody>
</table>

NOTES: a. "Typical" meteorology:
0730-0830 HST - D stability, 1 m/sec winds
0830-1230 HST - C stability, 4.5 m/sec winds
1230-1630 HST - D stability, 7 m/sec winds

b. "Worst-Case" meteorology:
0830-1630 HST - F stability, 1 m/sec winds

c. Background: 30 mg/m³

A second source of potential short-term air quality impacts would be the internal combustion engine-powered equipment used for, or in support of, construction work. This equipment is of two different types: (1) construction workers' personal vehicles used in commuting to and from the job site, and (2) heavy construction equipment such as dump trucks, bulldozers, cranes, loaders, material supply trucks, air compressors, etc.
In terms of its potential effects on outdoor ambient air quality, the first of these is believed to be the more significant—primarily because emissions from this source peak at the same time that other on-site vehicle emissions are at their highest level as a result of incoming, home-to-work trips, and because the rate of emissions from this source is considerably greater than from construction equipment. As a means of gauging the significance of these emissions, "worst-case" CO concentrations (i.e., the levels that would occur as the result of a combination of peak traffic and low wind speed/stable atmospheric conditions) were calculated for Jarrett White Road during the construction period using procedures outlined by the U.S. Environmental Protection Agency (1975). The results of these calculations are shown in Table IV-4.

Table IV-4 ESTIMATED "WORST-CASE" CO CONCENTRATIONS ALONG JARRETT WHITE ROAD AT THE TAMC ENTRANCE: 1977, 1978, 1982

<table>
<thead>
<tr>
<th>Location</th>
<th>1-Hour CO Concentration (mg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1977</td>
</tr>
<tr>
<td>South of Krukowski Road</td>
<td>11</td>
</tr>
<tr>
<td>North of Krukowski Road</td>
<td>8</td>
</tr>
</tbody>
</table>

CONDITIONS: 1. A.M. peak-hour traffic
2. Wind speed: 1 m/sec
3. Stability: "F"
4. Receptor: 10 m from edge of road
5. Other conditions as reported in U.S. Environmental Protection Agency (1975)

The results of the CO screening analysis indicate that the addition of an estimated 100 vehicles per day belonging to construction workers would not have a substantial impact on air quality. This was the finding despite the conservative assumptions that all 100 vehicles would arrive at the same hour of existing a.m. peak traffic and that wind speed and direction and atmospheric stability would all be "worst-case."

A similar "worst-case" screening of existing conditions suggests that CO levels within ten meters of Jarrett White Road just below the TAMC entrance may currently be at or slightly over the State's one-hour CO standard. The projected improvement in air quality in 1978 and later would be due to Federal vehicle emission control programs which should more than overcome the projected increase in traffic attributable to construction workers. This will be true, at least for the next few years, despite further delays in vehicle emission standards compliance deadlines.
recently approved by Congress. In the case of TAMC, the projected increase in construction-related traffic volume simply would not be of sufficient magnitude to cause serious air quality problems.

The number of pieces of heavy construction equipment operating on the TAMC site at any one time would be quite small when compared to the number of employee, patient, and visitor vehicle trips that would occur. As a result, they would have an extremely minor effect on outside air quality. Because construction equipment and vehicles would operate in close proximity to existing hospital buildings, however, the possibility exists that they might significantly affect the air quality inside the existing hospital. This is particularly so because of its dependence upon natural ventilation and because the existing intakes for the air conditioning system are located at ground level immediately adjacent to the site of the new building.

Of the various heavy construction vehicles that might operate on the site, bulldozers and frontloaders probably have the greatest potential for adversely affecting air quality because of their relatively continuous on-site operation as compared to other vehicles. To examine the probable impact of pollutants from this source, a "worst-case" analysis was performed using emission factors and a line source model developed by the U.S. Environmental Protection Agency (1973a,b). Ground level concentrations of CO, hydrocarbons, NOx, and aldehydes on the northeast (uphill) side of the existing hospital were computed under conditions of "F" stability and one meter/second wind speed. One bulldozer and two frontloaders (all diesel powered) were assumed to be operating continuously on the site of the proposed new building. With the exception of nitrogen oxides, one-hour and eight-hour concentration estimates were well below 0.5 mg/m³.

While there could be times when odors from diesel-powered vehicles operating on the site might be annoying to hospital staff and patients, it is unlikely that construction vehicle activity would cause violations of State air quality standards. However, due to the ground-level location of ventilation system intakes, vehicles operating in their immediate vicinity could cause temporary increases in pollutant gas concentrations inside mechanically ventilated rooms. Unfortunately, this includes such critical areas as surgical suites and intensive care units. To avoid this, intakes would be temporarily elevated or shielded, vehicle activity in their vicinity would be avoided, or both.

For the following reasons, fugitive dust from excavation, demolition, construction, and renovation could potentially present a serious problem within the existing hospital:

- The proposed new building and outpatient/visitor parking lot are in close proximity to the existing facility.
- The hospital would remain in normal operation throughout the modernization period.
Most of the hospital is naturally ventilated, and those areas that are mechanically ventilated do not meet present standards for filtration.

The proposed new outpatient building, main outpatient parking lot, and the theater to be demolished are all located upwind (in terms of most frequent wind directions) of the hospital.

Dust generated in one part of the hospital undergoing renovation could be transported through open doorways, corridors, and windows to other areas still in normal operation.

The intakes for ventilation systems are located at ground level on the windward side of the hospital.

Hot water pipes and many of the ceilings in the existing hospital are insulated with asbestos, a particularly hazardous material if allowed to become airborne.

The concentration estimates presented in Table IV-3 suggest that total suspended particulate concentrations at most levels of the hospital could approach or possibly exceed existing ambient air quality standards even under "typical" meteorological conditions. It should be noted that the estimates are based on an average monthly emission factor, and daily or hourly concentrations could be significantly higher or lower. Based on National Weather Service records at Honolulu International Airport, the months of June, July, and August tend to be the driest and windiest (National Oceanic and Atmospheric Administration, 1976), thus portending a greater fugitive dust problem during those months.

Two further comments on the fugitive dust problem are in order. First, the dust emission factor used (U.S. Environmental Protection Agency, 1973a) is predicated on the assumption of a Semiarid climate with a Thornwaite P/E Index 31 (Thornwaite, 1931). Since T AMC is in an area where the P/E index ranges from 50 to 80, thus overlapping the Subhumid and Humid climatic classifications, it is very likely that dust concentrations have been overestimated. As a rough measure of the magnitude of the error, it could be noted that twice-daily watering has been estimated by the U.S. Environmental Protection Agency (1973a) to result in up to a 50 percent reduction in fugitive dust. This could be effected by naturally occurring showers or artificially as part of a dust-control program. Light morning and afternoon showers are characteristic at the T AMC site and, regardless of what dust-control measures are undertaken by the contractor, would assist in controlling dust. Secondly, asbestos was used extensively to insulate the hot water pipes and ceilings in the existing structure. It will be extremely important for the contractor to comply with Federal and State regulations regarding handling of this material if construction workers, hospital staff, and patients are to be adequately protected; and every effort would be made to insure that this is done.
POST-CONSTRUCTION PERIOD

The air quality along the principal roads at TAMC is expected to improve by the time the proposed construction work would be completed; this is because of the projected reduction in average emissions per vehicle that will occur as the result of stringent Federal emission standards for new vehicles (see Table IV-4). The "worst-case" analysis done in this study dealt with Jarrett White Road immediately below the TAMC entrance, the road segment having the highest average daily traffic. Since meteorological conditions are similar throughout the TAMC Reservation, it can be concluded that all the other on-site roads would have substantially lower CO concentrations. Hence, State air quality standards would be met with no difficulty.

The proposed diversion of more traffic to the west side of the hospital would have a beneficial effect on air quality adjacent to roads and at the hospital itself because it would result in lower vehicle volumes on any given road segment and would be downwind (with respect to the prevailing tradewinds) of the facility. Renovation of the facility would correct the deficiencies present in the existing ventilation system, e.g., ground-level intakes, inadequate filtration, etc., thereby improving interior air quality. Overall, the project itself would neither improve nor degrade long-term ambient air quality on a local or regional basis. Air quality within the hospital would be drastically improved by the installation of a modern, high-filtration air-conditioning system serving all spaces.

MITIGATIVE MEASURES

As noted above, the only potentially serious air quality problems associated with the proposed project are related to fugitive dust emissions, construction-vehicle emissions near ventilation intakes, and removal of asbestos insulation and ceilings. In the case of fugitive dust, the following precautions would be taken:

- strict adherence to Section 10, Chapter 43, Public Health Regulations of the State of Hawaii -- during dry weather, at least twice-daily watering;
- shielding and, perhaps, additional filtration on ventilation intakes;
- monitoring of total suspended particulate levels within selected areas of the hospital by a medical review board; and
- installation of sound traps/dust filters on exposed windows.

Filtration on ventilation intakes would not remove carbon monoxide and other gases. To protect against this type of pollutant, construction vehicle activity in the vicinity of existing ventilation system intakes must be severely limited and ground-level intakes elevated and/or shielded. Compliance with EPA and OSHA regulations regarding asbestos should insure protection of workers and hospital staff, patients, and visitors.
NOISE IMPACTS

INTRODUCTION

A number of different project-related activities would affect sound levels at TAMC. The most important of these are associated with the proposed demolition, construction, and renovation of the hospital itself. Additional noise would be generated by changes in vehicle traffic patterns. This section discusses the extent to which each of these activities would alter the noise environment at Tripler, the significance of these changes in terms of their effect on staff members, patients, and construction workers, and the types of noise abatement measures which would be taken to ameliorate potentially adverse impacts.

General Effects of Noise On Hospital Care

In order to adequately evaluate the potential noise impact of an action, it is necessary first to determine the intensity and character of the sound it would produce and then to estimate the effects that those sound levels could have on persons, animals, structures, and other things of value. The first of these is difficult, but usually possible given the present state-of-the-art of acoustical theory; the second is much more difficult. Scientists have only just begun to understand the relationship between sounds of various types and intensities and biological and physical responses to them. Moreover, most of the research that has been done in this field has involved very loud sounds and healthy organisms. Present OSHA regulations, for example, require protective devices for persons exposed to sound levels in excess of 90 dB(A), but say nothing regarding sounds of a lower intensity. Only recently have scientists, doctors, and medical researchers begun to quantify the effects of moderate sound levels (say, in the 60-90 dB(A) range) on individuals already suffering more or less severe physiological and/or psychological stress, i.e., on the kinds of people typically found in a hospital.

As indicated at the conclusion of the discussion of existing noise levels in Chapter II, once the Army's hospital noise standards have been exceeded (as they are in many spaces at TAH now) there is no officially recognized means of determining the acceptability of a particular noise level in a specific hospital area. For example, when the standard for a particular space is 40 dB(A), the existing level is 47 dB(A), and the projected level during construction without mitigating actions is 64 dB(A), there is no way of knowing what level should be specified as a limit or how much one should be willing to pay to achieve it. There is, however, a growing body of literature that deals with the effects of noise on patient care. While the results of various studies are anything but definitive, they do provide insights and valuable information that can and should be used as guides in determining what noise control procedures ought to be incorporated into the project.

Some of the most important of these studies are discussed below. To provide some structure, the discussion has been divided into three sections. The first deals with problems related to speech interference; the
second with the noise-related degradation of hospital staff performance; and the third with the effects noise can have on patient comfort, recuperation, and physiological well-being.

**Speech Interference**  The effect of noise on the quality of speech communication is graphically illustrated in Figure IV-2. In this case, comprehension is defined as 90 percent correct understanding of phonetically balanced lists of one-syllable words (Miller, 1974). The figure indicates that for face-to-face conversations (where the distance from talker to listener is usually on the order of five feet), "practical" speech communication can proceed in noise levels as high as 66 dB(A). However, if the speaker has a weak voice, such as a sickly patient may have, or if it is important to have 100 percent correct understanding, as it is during critical medical communications, then the separating distance must be lessened or the speaker must raise his or her voice.

**Hospital Staff Task Interference**  There is evidence to suggest that noise does have adverse effects on hospital staff work performance with subsequent effects on the quality of patient care. In the complex hospital environment, employee relationships and effectiveness as a team are important to sustaining patient comfort and recuperation. The presence of higher noise levels due to construction may reduce their effectiveness. It has been argued, for example, that "relatively low levels of environmental noise, i.e., 65 dB(A) and above, significantly affect the level of induced anxiety . . . in groups engaging in social interactions" (Edsell, 1976).

Many of the noises within a hospital can be corrected or at least reduced by effective maintenance and employee awareness, but employees may have little or no control over construction noises. The perception of the degree of control over noise sources does influence task performance. In one study, subjects who had a means of control over a noxious noise source performed significantly better than did those that had no control (Bleckman and Dannemiller, 1976). Kryter (1970) cites a study where increased noise levels contributed to increased sorting errors by postal letter sorters. He goes on to say:

> These results cannot be taken to necessarily mean that the noise per se caused the increase in errors because of some physiological or psychological distractive effect, but could be due to personnel viewing the noise as aversive because it bothered their hearing and/or represented a degradation in the concern of management with their comfort and well-being.

According to Falk, et al. (1973), data-taking errors and serious omissions may result from noise interference masking signals for tasks that involve perception of auditory signals (percussion and auscultation). They go on to state that:

> Tasks that are poorly performed in noisy conditions are those that are familiar and require vigilance (routine physical examination, preparation and administration of most medicines and

---

Chapter IV
Figure IV-2  EFFECT OF NOISE ON VERBAL COMMUNICATION

COMMUNICATION JUDGED TO BE SATISFACTORY

Communication
Impossible

Communication
Very Difficult

Communication
Difficult

Communication
Practical

EXPECTED VOICE LEVEL

SHOUT

MAXIMUM VOCAL EFFECT

SOURCE

COMMUNI CATION

UOGEO------

TO BE SATISFACTORY

Chapter IV

15
Patient monitoring) and those that involve information gathering (history taking), analytical processing (differential diagnosis), and short-term memory (history and physical examination).

Patient Comfort and Recuperation

Bredenberg, et al. (1961) believe that "Peace and quiet are surely a part of good patient care. The hospital should be a place of normal, muted sounds that are soothing and conducive to peace and quiet." That this opinion is shared by hospital administrators and staff is evidenced by the large number of recent articles in the medical literature dealing with hospital noise and implementation of noise abatement programs. (See, for example, Committee on Environmental Hazards, 1974: Turner et al., 1975; and Minckley, 1968.)

Internal hospital noises (conversations, telephones ringing, paging, pans banging, wheels squeaking) are well-documented sources of annoyance and discomfort to patients. One study of noise in a hospital recovery room was summarized as follows:

It was hypothesized that patients' subjective sensation of pain in the immediate post-operative period would be increased at times when noise levels were high; that noise in the external environment represents an increased irritant to the patient who is already experiencing post-operative pain, and that if this were true, more pain medication would be given to patients per capita at times of high noise levels than at times of low noise levels. The results of this five-day study support the hypothesis (Minckley, 1968).

Many of the internal hospital noises can be corrected or subdued, but construction noises can only be minimized by careful planning and implementation of effective acoustical control measures.

Rapid and complete recovery is the primary objective of quality health care. This may not be possible in an overly noisy patient environment. One group of researchers stated that "... healthy organisms can resist injury from noise, but persons with heart disease, high blood pressure, and emotional illness need protection from the additional stress of noise. Rest, relaxation, and peaceful sleep are necessary to all persons who are already tense or ill" (Turner, et al., 1975). Both the type and the duration of noise are factors causing various degrees of interference with sleep and thus lessen the effective recuperative value of sleep.

It is well-documented that differing types of noise can induce various physiological reactions in humans. (See, for example, Dickman, 1977; U.S. Environmental Protection Agency 1973; and Vidyasagen and Joseph, 1976.) One study of the effects of the prolonged exposure of humans to intermittent noise found that there were statistically significant physiological changes in the subjects, including a sharp rise in the mean plasma cortisol and blood cholesterol levels (Cantrell, 1974). A study focusing on hospital noise reported stimulation of the hypophyseal-adrenocortical axis
of patients, peripheral vasoconstriction, and a possible threat to hearing in patients receiving aminoglycosidic antibiotics (Falk, et al., 1973).

The studies cited thus far have concerned themselves with the effects of noise from all sources. In addition to these, there are at least two clinical investigations which have focused on the effects of actual construction noise on staff and patients and have demonstrated fairly conclusively that it can have detrimental effects on the quality of health care provided and, as a corollary, on the speed at which patients recover.

The first of these studies involved the playing of noises recorded at actual construction sites through amplifiers and loudspeakers into hospital spaces and monitoring the responses (Powell, 1973). The researchers reported adverse effects on the performance of the hospital staff and on the recovery rate of patients subjected to the artificially raised noise levels. Commenting on the results, the report states:

Annoyance among staff was common, the intensity (as would be expected) depending on noise level. . . . A major effect was on work, e.g., on verbal or telephonic communication, or making it difficult for nursing staff to do treatments, or impossible for physicians to conduct auscultatory examinations. Some experiments (in progress) on cardiologists making such examinations, suggest that the noise levels at which they cannot detect cardiac murmurs are well within the range of building noise. Adaptation does not occur.

With respect to the effect of the simulated construction noise on patients, the study found that:

A significant number demonstrated an increase in pulse rate over normal, and more increased their rate during the noise period in the affected wards than in the unaffected areas. In contrast, a small sample of fit, resting staff showed no significant alteration in pulse rate, and GSR (galvanic skin response) records showed complete adaptation at 64 dB(A). At the maximum recorded on the wards, 64 dB(A) there was no evidence of adaptation among patients: some had to be removed to a quieter area.

The study also indicated that "... the work load of nursing staff was increased through disturbance to their patients."

A second group of medical researchers studied the effects of construction noise from pile drivers, trucks, and tractors operating directly outside hospital room windows on the average recovery time required by patients who had undergone cataract surgery (Fife and Rappaport, 1976). They summarized their findings as follows:

Length of hospital stay for a simple cataract surgery was compared retrospectively for a period of construction noise and for
two similar periods without construction noise. Hospital stay was significantly longer during the period of construction.

Clearly, then, there is substantial evidence that excessive noise causes physiological and psychological stress in humans and that this results, at least in some instances, in slowed recovery from trauma and, as a result, prolonged hospital stays. While it is impossible to determine the exact extent of the damage that noise can wreak in the hospital environment, the conclusion reached by Falk, et al. (1973) appears valid:

Until enough research has been accomplished to prove that noise-induced physiological alterations are harmless, physicians must consider noise to have possible detrimental effects on human health, especially on the health of hospitalized patients.

NOISE IMPACTS ON THE INTERIOR ENVIRONMENT

Noise and Vibration from New Construction

Site preparation and construction of the proposed new diagnostic and treatment/outpatient clinic wing, helipad, parking areas, energy plant, and roads all involve activities that would produce temporarily increased noise levels at TAMC. Due to its size, location, and general nature, construction of the new wing is by far the most significant of these project-related noise-producing activities, and the remainder of this subsection focuses on it.

The basic problem can be visualized by referring to Figure IV-3. The model assumes that the various noise sources would be randomly located over the footprint of the new building, thereby creating noise transmission paths of various lengths to the exterior walls of TAMC. Inside TAMC it is assumed that a "basic background noise level," $L_A$, exists without the presence of construction activities (see Table IV-5). The $i$-th piece of construction equipment or operation causes a noise level of $L_i$ at a standard reference distance, $r$, of 50 feet (about 15 meters). It is assumed that the noise radiates spherically along distance $r$, decreasing six dB(A) for every doubling of the distance, that is, suffering a Propagation Loss (PL) of $\text{PL}_i = 20 \log_{10} r$. The noise level $L_{1i}$ at the exterior wall of TAMC is assumed to be $L_{1i} = L_i - \text{PL}_i$. The noise level $L_{2i}$ is the interior level caused by the $i$-th noise source at the $i$-th range. The difference between the exterior and interior noise levels is called the Noise Reduction ($\text{NR} = L_{1i} - L_{2i}$) of the window system. For TAMC it was assumed that $\text{NR} = 8$ dB(A) for open windows, and $\text{NR} = 25$ dB(A) for closed windows (Darby, 1977). The difference between the construction noise in the room ($L_{2i}$) and the background noise ($L_A$) is called the Intrusiveness Noise Level.

Appendix B lists 31 specific construction operations which might occur during the site preparation and construction of the new building and identifies 60 different typical noise sources that might be associated with the site operations. The "maximum" noise level shown in it actually represents the normal continuous maximum level during the work cycle and
Figure IV-3 SCHEMATIC DIAGRAM SHOWING BASIC ELEMENTS IN THE NOISE TRANSMISSION MODEL
excludes various transient noise levels which exceed the "maximum" (Bolt, Beranek and Newman, 1971). In order to simplify this evaluation, an average noise level of 85 dB(A) was assumed for all noise sources.

Figure IV-4 shows a plan view of the proposed construction site and the existing buildings. The maximum and minimum slant distances to construction noise sources are shown at sample locations on the exterior face of the existing exposed buildings. Using a noise source level of $L_{0j} = 85$ dB(A), the propagation losses based on maximum and minimum ranges as shown above, and the noise reduction levels for open and closed windows previously cited, a range of estimated interior noise levels for rooms in wings "A" and "C" facing the new construction was obtained. These are shown in Figure IV-4. Note that the wings have been categorized further as "B_1" and "B_2," and "C_1" and "C_2." Wing B is expected to experience sound levels similar to those shown for Wing C. Construction noise in Wings D and E should not be intrusive due to the acoustical shielding from Wings A, B, and C and is, therefore, not shown. Table IV-5 summarizes the projected interior sound levels in selected hospital spaces that would result from construction of the new wing and compares those with present Army standards and existing noise levels inside the hospital. The predicted noise levels are represented as ranges to account for the varying distances (between $r_{min}$ and $r_{max}$ in Figure IV-3) at which the equipment would be situated. (Note: these figures probably underestimate the actual noise levels because they do not account for those times when heavy equipment would be operating closer to the existing hospital structure than its footprint.) In all cases the predicted sound levels exceed those specified in the Army's standards; moreover, noise during construction would be considerably higher than it is at present.

When the design and the construction schedule for the proposed new building are better defined, definitive estimates of the construction noise level would be made for spaces of concern to the TAMC medical staff. Once this has been accomplished, a noise abatement program would be developed that is based on:

- the refined noise level predictions;
- the existing noise environment at TAH;
- the noise suppresssion devices available for construction equipment; and
- expert opinion from qualified medical personnel regarding the noise limits that must be enforced in order to maintain quality health care.

In addition to coordinating construction operations with hospital operating requirements and insuring that construction contracts specify maximum noise emissions allowed from construction equipment, suitable noise abatement techniques would be included in the project's noise abatement program.
SOURCE: RONALD A. DARBY AND ASSOC.

FIGURE IV-4

TAMC SPACES IMPACTED BY NEW CONSTRUCTION
RANGE OF ESTIMATED INTERIOR NOISE LEVELS IN EXISTING

Max. dBA - Open Windows
Max. dBA - Closed Windows
Table IV-5 EXAMPLES OF PROJECTED NOISE LEVELS INSIDE TRIPLER
ARMY HOSPITAL DURING CONSTRUCTION

<table>
<thead>
<tr>
<th>Wing</th>
<th>Level</th>
<th>Air Cond</th>
<th>Use</th>
<th>Basic Background Noise dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Design Criteria</td>
</tr>
<tr>
<td>A1</td>
<td>1</td>
<td>No</td>
<td>Acute Minor Illness Clinic</td>
<td>35 to 40&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
<tr>
<td>A1</td>
<td>3</td>
<td>Yes</td>
<td>Surgery</td>
<td>35 to 40</td>
</tr>
<tr>
<td>A2</td>
<td>4</td>
<td>Yes</td>
<td>Surgical ICU</td>
<td>30 to 35</td>
</tr>
<tr>
<td>A2</td>
<td>7</td>
<td>Yes</td>
<td>Labor &amp; Delivery</td>
<td>35 to 40</td>
</tr>
<tr>
<td>A2</td>
<td>8</td>
<td>No</td>
<td>OB/GYN Offices</td>
<td>35 to 40</td>
</tr>
<tr>
<td>B2</td>
<td>1</td>
<td>No</td>
<td>Emergency Receiving</td>
<td>40 to 45</td>
</tr>
<tr>
<td>B2</td>
<td>2,3,4</td>
<td>No</td>
<td>Wards</td>
<td>35 to 40</td>
</tr>
<tr>
<td>B1</td>
<td>2,3,5,8</td>
<td>No</td>
<td>Wards</td>
<td>35 to 40</td>
</tr>
<tr>
<td>C2</td>
<td>2,3,4</td>
<td>No</td>
<td>Wards</td>
<td>35 to 40</td>
</tr>
<tr>
<td>C1</td>
<td>3,4,5,7 &amp; 8</td>
<td>No</td>
<td>Wards</td>
<td>35 to 40</td>
</tr>
<tr>
<td>C1</td>
<td>6</td>
<td>No</td>
<td>Dental</td>
<td>35 to 40</td>
</tr>
</tbody>
</table>

1 See Figure II-3 for diagram showing location of each space.

2 Source: Department of the Army, Office of the Chief of Engineers (May 1976). "Acoustical Design Criteria for Army Medical Facilities" (see Appendix C).

3 No official standards are known to exist. The 35-40 dB(A) figure shown was arrived at by examining standards for spaces which appeared to have similar function.
A number of different mitigation measures have been investigated during the preliminary design phase of the project. Included among these were the following possibilities:

- Closing and sealing the windows could provide sound reduction on the order of 15 dB(A). Window air-conditioners would be needed to provide proper ventilation.

- Rooms on the exposed sides of the existing hospital buildings could be vacated and converted into sound traps that would reduce noise levels on the "quiet" side by about ten dB(A).

- Exterior sound traps could be constructed between the existing sun shades on the side of Wings A, B, and C closest to the proposed new building. Used in conjunction with large, low-speed fans exhausting air toward the construction site, this could provide noise reduction to ten to 20 dB(A).

- Noise shields could be built around construction sites. However, because of the size of the new building, the shields would have to be extremely massive in order to be effective.

The approach favored at the present time, and which will be tested during the Early Prep Work Phase using a full-scale prototype, is a derivative of two of these methods. It would involve the construction of sound-traps that could be placed in the existing window openings. As shown in Figure IV-5, these sound traps would consist of stock duct silencer units, modified by a bird screen on the outside and a disposable filter and sheet metal door on the inside. Preliminary estimates indicate that sound attenuation of about 14 dB(A) can be achieved using the trap, the same as if the existing windows were closed. The prototype sound traps being studied would also reduce air flow as compared to the open-window situation, probably by 70 to 80 percent. During testing the sound traps will be modified as required to obtain the necessary air circulation and noise attenuation. The fact that the prevailing tradewinds are so strong that the windows are often kept only partly opened is reason to believe that the prototype will provide satisfactory ventilation. It should also be noted that the design allows the window above the sound trap to be opened. This means that, during nighttime and weekend periods when no work is being done, the air flow through the sound trap could be supplemented by opening these windows.

Noise from Explosives

It is anticipated that the use of explosive charges would be unavoidable during the demolition and excavation phases of the project. Both airborne and ground-borne shock waves would be generated depending upon charge size (in equivalent pounds of TNT), local acoustic shielding and treatment, and charge location (above-ground, ground-level, or below-ground). Within 600 feet of occupied TAMC spaces, the use of above-ground and ground-level charges in excess of eight ounces (TNT equivalent) would be
Figure IV-5 EXAMPLES OF EXTERIOR SOUND TRAPS

Typical Section Detail

- Neoprene Seals
- Metal Frame Bolted to Wall
- New Sheet Metal Door Closure
- Disposable Filter
- Duct Silencer
- Sponge Neoprene
- Sound Trap Support
- Bird Screen
- Existing Wall
carefully assessed in respect to possible harmful effects such as hearing loss, window breakage, and structural damage from airborne energy.

Real-time acoustic monitoring of peak over-pressure would be performed for detonations which are predicted to generate peak sound levels greater than 110 dB(C) within occupied TAMC spaces. Also, TAMC staff would be kept informed of exact times of all detonations in order to reduce startle effects among staff and patients and in order to allow them to adjust their schedules accordingly.

Structure-borne shock and vibration is anticipated during the proposed demolition, excavation, and foundation-laying phases of construction. Structure-borne energy emanates from the source and travels through the ground to the foundation and basement of the building. Inspection and observations of equipment and structures in the existing building would be conducted during the initial blasting and any subsequent blasting that might have a greater effect.

Noise and Vibration from Renovation

Proposed demolition and renovation in the existing TAMC buildings would obviously impact adjoining spaces which are in use. Some construction activities would generate only airborne noise, e.g., cutting with power saws. Others would produce both direct airborne noise and significant structure-borne noise energy. Typical sources of this latter type of noise include jack hammers, pneumatic chippers, hammers, etc. Airborne noise from construction activities can be transmitted to other spaces via a variety of paths including:

- horizontally throughout reverberant corridors and vertically through stairwells;
- out the open windows of the work space and in through open windows to occupied spaces;
- horizontally through party walls separating the work space and adjacent occupied space; and
- through air conditioning ducts and air shafts.

Should a typical wing at TAMC be vacated for alterations, the space within it would become even more reverberant than at present. If left uncorrected, this situation could lead to unnecessarily high construction noise levels. If noisy operations need to continue for extensive periods after the space is basically gutted, acoustic absorption material could be used to reduce the reverberant noise field. For example, in a gutted ward space 12 feet by 48 feet by 180 feet with all glazing removed, reverberation times in excess of five seconds would be typical. The addition of approximately 200 two-foot by four-foot sound-absorption batts hanging on wires near the ceiling would reduce the reverberant noise levels within the work space by an appreciable five dB (Crocker, 1975). This would not only
benefit the workmen within the area under construction, but also persons in medical spaces that would be affected by noise transmitted by the four noise transmission paths mentioned above.

Figure IV-6 illustrates the extent to which noise is transmitted through corridors and stairwells. In the figure it is assumed that a 90 dB(A) construction operation occurs in Wing A near the entrance to the corridor of Wing B. Using theoretical expressions from Galaitsis, et al. (1976), it can be seen (in Row 1 of the figure) that unacceptable noise levels of 72 to 77 dB would exist in Wards 33 and 31, respectively, if the doors to the wards were open. If the existing doors could remain closed, reduction of 15 to 20 dB(A) should occur in the corridor. However, standard doors often are not closed during periods of high construction and/or hospital activity, and it is likely that any attempt to change this through the promulgation of an administrative directive would be ineffective. If acoustical absorption material was added in the corridor at the density of about six sabines per running foot, it should reduce noise levels five to 12 dB(A) below those that would occur in the untreated open door case. (Note: A sabine is a measure of the sound absorption of a surface: one sabine is equivalent to the absorption by one square foot of perfectly absorptive material, i.e., one which does not reflect any of the acoustical energy that is incident upon it.) Pairs of two-foot by four-foot sound absorption batts on wires spaced about four feet apart along the corridor ceiling could provide the required absorption. Consideration would also be given to using sound-reducing curtains formed from overlapping strips of heavy, transparent vinyl, causing a ten to 12 dB(A) noise reduction (anonymous, 1977). Figure IV-6 also compares noise levels that would result from the use of one sound-reducing curtain with those that could be achieved using two curtains. The major advantage of the curtain is that it allows persons and mobile equipment to pass through and always closes.

Demolition and construction noise emanating from open windows can cause a significant impact on naturally ventilated medical spaces in the same building as well as other buildings. To guard against this possibility, the fenestration which was treated to abate construction noise from the new building would be left intact in occupied spaces during renovation of the existing building. Excessive airborne transfer through ducts and airshafts would be stopped by blocking the noise paths at the source. If it is necessary to have the ducts or shafts operative in the source room, then noise attenuators or sound traps would be utilized.

Phasing for demolition and construction in existing TAMC spaces would take into account the potential noise and vibration impacts summarized above. As in the case of new construction impacts, the literature on the effects of noise on the ill and on hospital operations referenced in this study would be reviewed by qualified medical experts in conjunction with acoustical engineers on the design team, and maximum allowable noise levels would be established and used to guide development of an effective construction-noise mitigation program.
Figure IV-6  EXAMPLES OF NOISE TRANSMISSION AND MITIGATION MEASURES IN CORRIDORS: 90 dB(A) SOURCE

<table>
<thead>
<tr>
<th>Treatment</th>
<th>dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1.) No Treatment</td>
<td>72 74 75 77 90</td>
</tr>
<tr>
<td>(2.) Acoustic Material in Corridor</td>
<td>60 62 68 72 90</td>
</tr>
<tr>
<td>(3.) Sound Curtain</td>
<td>50 52 58 62 90</td>
</tr>
<tr>
<td>(4.) Sound Lock (2 Curtains)</td>
<td>40 42 48 52 90</td>
</tr>
</tbody>
</table>

Chapter IV  27
Noise from Construction Vehicles
During the proposed renovation period, the movement of noisy diesel trucks in and out of the TAMC Reservation is anticipated to increase traffic noise exposure to civilian residents along Jarrett White Road. Although the exact mix and number of heavy vehicles associated with the possible TAMC renovation is unknown, only limited off-site hauling of dirt and demolition and excavation materials would be required. Heavy trucks would amount to no more than ten to 20 percent of all construction traffic and less than one percent of all traffic.

The transport of heavy construction equipment, trash and debris, building materials, and concrete would be required, but a continuous flow of diesel trucks throughout the renovation period is not anticipated. Therefore, diesel truck noise exposure to civilian residents along Jarrett White Road is expected to be intermittent in nature, with peak exterior noise levels of 80 to 90 dB(A) (28 feet from the curb line) occurring during the passage of a single truck. In order to minimize the degree of annoyance to the residents the following mitigation measures would be effected during the construction/renovation period:

- Heavy trucks with low-loss or defective mufflers would be prohibited.
- From-site (downhill) movement of heavy trucks would be prohibited during nighttime hours and prior to the start of the morning rush hour (7:15 a.m.). It would be encouraged during the morning rush hour (7:15 a.m. to 8:15 a.m.) and during the day prior to the afternoon rush hour.
- To-site (uphill) movement of heavy trucks would be prohibited during nighttime hours.

Noise Levels Following Completion of Construction
Exterior noise levels following completion of the proposed project would be almost entirely a function of the natural background noise (birds, wind, etc.) and vehicular traffic volume. Since the proposed project would affect neither of these, it would not result in an appreciable change in exterior sound levels.

Changes to the hospital itself would increase the sound attenuation provided by the wall systems and would, therefore, reduce the amount of external noise entering the building. Because the dominant sources of interior noise are located inside the hospital, this change would not be significant. In all probability, the most significant change in the internal noise environment would be the decreases in sound levels that would result from such things as the shift from wards to smaller patient rooms (one-, two-, and four-bed), changes in the materials used for floors, ceilings, and walls, and better separation of high-volume clinic areas from inpatient facilities. Thus, in the long run, the proposed project would result in a significantly quieter hospital -- one that meets accepted hospital standards.
BIOLOGICAL IMPACTS

The biological system described separately in Section II under the headings Vegetation and Wildlife would be both directly and indirectly affected by the proposed action. The impacts, however, would be minor. Direct impacts would be the physical removal of some plant materials and soil organisms. Indirect impacts are not as readily apparent. These include a reduction in the amount of vegetated area available as a habitat for wildlife, the introduction of different plant materials as part of new landscaping, and possible slight changes in water quality during the construction period with concomitant minor effects on freshwater and estuarine biota. There are no plants nor animals proposed for or currently listed as protected by the Endangered Species Act of 1973 (16 USC 1531 et. seq.) within TAMC Military Reservation or that would otherwise be affected by the proposed action.

Direct changes to the biological system would center around new construction areas of the hospital and its immediate surroundings, i.e., about ten acres. Construction of the new wing and the adjacent parking and access road on the uphill side would eliminate some existing landscaping, i.e., introduced trees and ground cover, and the existing bank of natural vegetation separating the "A" parking lot and BOQ area. The bank is covered by a dense thicket of haole koa and some stands of Java Plum and possibly functions as a habitat for a few birds and rodents. These animals, nearly all of which use the area only for forage anyway, would be deprived of the limited natural food sources present and would, in all likelihood, increase their use of nearby undeveloped slopes and gulches. A similar change would occur in the area where the central plant would be built. Elimination of some of the dense thickets could reduce the population of some bird species, e.g., Japanese White-eye. This is unlikely to be of much significance, however, because the area of habitat to be removed is minimal compared to the amount of undeveloped areas nearby.

The proposed new parking areas and revised vehicular circulation would increase the paved area on the Reservation. This would eliminate some existing grass, ground cover, and trees. To counter this loss, the proposed action includes a comprehensive landscape program which would have the net effect of increasing the total amount of trees and attractive shrubs on the Reservation. Conceptual landscape plans developed thus far have been designed to enhance visibility and views, screen and shade parking, and generally improve the landscaping around the main hospital. Healthy and movable trees that are now growing in the proposed construction areas would be relocated whenever possible. The rows of street trees lining Jarrett White Road would be thinned on the lower elevations near the main entry to improve visibility of the hospital and would be thickened in other areas to reinforce the formal tree-lined effect. Whereas the present parking areas are relatively devoid of trees, the proposed ones would have large canopy shade trees spaced at intervals of 50 to 100 feet.
TRAFFIC IMPACTS

Introduction
The proposed modernization of Tripler Army Medical Center is not expected to affect the volume of vehicular traffic moving on and off the site. It would, however, necessitate significant physical changes to roadways and parking areas within the Reservation's boundaries. This section discusses the changes that are proposed, the reasons for them, the extent to which the system would be able to meet the demands that can be expected to be placed on it, and the side effects of the physical changes that are involved.

Physical Changes in the Circulation System
Construction of the proposed new wing on the uphill side of the hospital would eliminate most of existing Patterson Road and portions of outpatient/visitor parking lots A, B, and C. This would remove the only major mid-Reservation link between Jarrett White and Krukowski Roads. It would also reduce the number of parking stalls far below the level needed to adequately serve the facility. The proposed departmental moves within the complex would also change the use patterns of the parking areas and necessitate adjustments.

To accommodate the new hospital layout, the new circulation system shown in Figure IV-7 has been recommended. It includes new, realigned, and upgraded roads and parking areas as well as a comprehensive system of directional signs and traffic controls near the helipad. The most important features of the proposed plan are:

- Expansion and/or reconstruction of surface parking facilities above, below, and to the west of the hospital and elimination of lower D lot.
- Construction of a new road linking Jarrett White and Krukowski Roads via a route running along the uphill edge of the proposed upper parking areas.
- Construction of an entry, unloading area, ambulance parking, and emergency parking adjacent to the new emergency room.
- Construction of a new road from Jarrett White Road along the downhill edge of the lower hospital parking area and up the west side of the hospital to the main service docks and to a new staff parking lot to be built on fill between the hospital and the education center.
- Extension of the existing road linking Krukowski Road with lower D lot as far as the new staff parking/service dock access road below the hospital.
- Upgrading of Jarrett White Road, including widening and construction of adequate turning lanes on Jarrett White Road in the vicinity of the entrance to the TAMC Reservation and at its intersections with Krukowski Road, the proposed new staff parking/service access road, and Ward Road.
Installation of traffic control devices on Jarrett White Road near the helipad.

Traffic Volumes Compared to Roadway Capacities
As indicated in Chapter II, the highest traffic volumes on the Reservation occur on Jarrett White Road just inside the entrance gate, and this would continue to be true with the proposed plan. Since even here the capacity of the present roadway exceeds the observed volume by a substantial amount (several hundred vehicles per hour), and the capacity of proposed roads would be equal to or greater than those in the existing system, it follows that the capacity of the proposed system would be adequate.

Parking Lot Capacity Compared to Projected Usage
The parking surveys conducted for the Site Traffic Study (Belt, Collins and Associates, 1977b) indicated that peak usages in staff and outpatient/visitor lots are about 765 and 565 vehicles, respectively. Allowing for short-term variations not revealed by the survey and providing additional stalls to facilitate efficient functioning of the lots and to account for slight changes in demand, the proposed plan contains a total of 918 staff stalls and 604 outpatient/visitor stalls (see Table IV-6). This is more than sufficient to meet the parking needs of the project.

Physical Impacts
The proposed circulation system makes considerable use of existing facilities, but some completely new construction is involved as well. Perhaps the most obvious changes would be the construction of a large new parking lot on fill in the gully that now separates the hospital and the Education Center, the extension of the existing D and E lots and elimination of lower D lot, and the construction of a new road along the downhill side of the lower parking areas. In all, the amount of paved surface would be increased by about 120,000 square feet, and this would have a concomitant effect on surface runoff/groundwater recharge. Some temporary increase in erosion is to be expected until the landscaping has taken hold on exposed cut and fill slopes, but, overall, total soil loss from the site should decline in the long run. The hydrological, visual, and air quality impacts associated with the circulation system are discussed elsewhere in this Chapter.

The proposed changes in the roadway and parking areas would result in significantly better service than is provided by the existing system. Among the more important benefits would be:

- Better separation of outpatient, staff, and service traffic with a consequent decrease in conflicts between these different types of users.

- Shorter and more direct access to the emergency room for vehicles arriving from off the Reservation and from the MEDEVAC helipad.

- Smoother traffic flow and greater safety as a result of improved intersection design.
<table>
<thead>
<tr>
<th>Location</th>
<th>Full-Size</th>
<th>Compact</th>
<th>Handicapped</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency Room Lot</td>
<td>28</td>
<td>--</td>
<td>--</td>
<td>28</td>
</tr>
<tr>
<td>Emergency Subtotal</td>
<td>28</td>
<td>--</td>
<td>--</td>
<td>28</td>
</tr>
<tr>
<td>Upper Outpatient/Visitor Lot</td>
<td>319</td>
<td>155</td>
<td>11</td>
<td>485</td>
</tr>
<tr>
<td>Lower Outpatient/Visitor Lot</td>
<td>116</td>
<td>--</td>
<td>3</td>
<td>119</td>
</tr>
<tr>
<td>Outpatient/Visitor Subtotal</td>
<td>435</td>
<td>155</td>
<td>14</td>
<td>604</td>
</tr>
<tr>
<td>Emergency Room Lot</td>
<td>--</td>
<td>--</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Central Plant</td>
<td>10</td>
<td>--</td>
<td>--</td>
<td>10</td>
</tr>
<tr>
<td>Upper Staff Lot (Large)</td>
<td>266</td>
<td>95</td>
<td>--</td>
<td>361</td>
</tr>
<tr>
<td>Upper Staff Lot (Small)</td>
<td>44</td>
<td>--</td>
<td>4</td>
<td>48</td>
</tr>
<tr>
<td>Lower Staff Lot</td>
<td>237</td>
<td>150</td>
<td>7</td>
<td>394</td>
</tr>
<tr>
<td>H-Lot</td>
<td>57</td>
<td>--</td>
<td>--</td>
<td>57</td>
</tr>
<tr>
<td>PX-Lot</td>
<td>41</td>
<td>--</td>
<td>3</td>
<td>44</td>
</tr>
<tr>
<td><strong>Staff Subtotal</strong></td>
<td><strong>655</strong></td>
<td><strong>245</strong></td>
<td><strong>18</strong></td>
<td><strong>918</strong></td>
</tr>
</tbody>
</table>

**TOTAL STALLS**

1,550

1 Full-size stalls are nine feet wide and are in 66-foot-wide, double-loaded bays.

2 Compact stalls are 7.5 feet wide and are in 54-foot-wide, double-loaded bays.

3 Stalls for the handicapped are 13 feet wide.

- Provision of parking areas that are closer to user destinations, have the needed capacity, and have better internal circulation.

**WATER SUPPLY**

TAMC would continue to rely on the existing deep wells at the base of Moanalua Ridge for all its normal water needs. Because there would be no increase in the number of patients it serves or the size of its staff, the
only potential changes in water consumption are those that might result from the tenfold enlargement of the air-conditioning system that is proposed or from changes in the per capita consumption rate.

Since it is estimated that evaporative losses from the cooling tower and "blow down" water requirements would each average about 25 gallons per minute, average daily water use for air conditioning would be about 70,000 gallons. Despite its much lower capacity, the existing air-conditioning system consumes at least this much. Hence, it is not expected that there would be an increase in water consumption for this purpose.

Some increase in water consumption might be expected to occur as the result of both the additional plumbing fixtures that would be provided in conjunction with the shift in nursing unit layout from wards to private and semi-private rooms and the introduction of automatic cart washing equipment. However, inasmuch as new fixtures are available that have considerably lower consumption rates than those that are presently installed, the overall use is not expected to change significantly.

The capacity of the existing transmission lines is sufficient to meet the needs of the reconstructed hospital. Hence, the only changes necessary are those of involving the realignment of several water mains in the immediate vicinity of the hospital. The construction impacts associated with this work are minimal.

SEWAGE

As indicated elsewhere, the proposed project would neither result in an increase in the number of persons at TAMC nor result in a significant change in the per capita water-use rate. Because of this, it is believed that, overall, sewage flows from the TAMC Reservation would remain at their present levels.

While the total volume of sewage effluent generated would not change, several of the mains would need to be relocated and/or combined because of the proposed new construction, and an entirely new line would be required to serve the new central plant. The modifications required are summarized below:

- Addition of 800 feet of six-inch sewer line from the proposed central plant to the existing line along Krukowski Road.
- Abandonment of the 1,300-foot main that runs from the lower side of Wing A to a juncture with the Jarrett White Road line about 400 feet above the Jarrett White Road/Krukowski Road intersection.
- Construction of a new ten-inch line approximately 1,500 feet in length and parallel to Jarrett White Road below the hospital, as a replacement for the smaller line that now exists there.
Relocation of portions of about 800 feet of sewer mains in three lines that would be covered by the proposed new main entry and by the addition of the cafeteria.

Installation of all of these lines would require excavation, pipe laying, and other construction activities that are potential minor noise, dust, and sediment generators. These activities would be confined to but a small fraction of the total construction time, however, and are not believed to be significant. No off-site sewer improvements are needed or planned as part of the project since it would not affect sewage volume. Hence, no significant impact is expected on the City and County's system.

ENERGY

Recommended Energy System
As part of the design process for the proposed project, a feasibility study was conducted of alternate conventional energy systems (Lyon Associates, Inc., March 1977). Three major types of systems were studied:

- Conventional Energy (CE) systems which use commercial electric power purchased from the Hawaiian Electric Company and generate steam in a self-contained boiler plant. Chilled water for air-conditioning is produced in a central mechanical room.

- Total Energy (TE) systems which produce all electrical power on-site. These maximize fuel-efficiency by using waste heat for space cooling and are completely independent of commercial power.

- Selective Energy (SE) systems that produce only a part of the electrical power needed on-site and depend on commercial sources for the balance of the power required. Like the TE systems, they are designed to maximize fuel efficiency by using waste heat for space cooling.

All of the systems would provide the increased amount of space cooling and heating, electrical power, and process steam required by the enlarged and renovated hospital and existing laundry facility.

Based on the results of this study, it was recommended that Tripler Army Medical Center be provided with a Conventional Energy system using commercial electric power for the hospital electricity requirements. Chilled water for air-conditioning would be generated by electric-motor-driven centrifugal chillers. A waste heat recovery system would be incorporated into the chiller condenser water system for use in preheating the hospital's domestic hot water supply. There would be no on-site generation of prime power electricity, but diesel generators capable of meeting the hospital's critical needs would be installed for use in case of a failure in the main power supply.

As indicated above, all the energy systems considered for the project were designed to the same standards, i.e., all would provide the same level of service to the renovated facility. The Conventional Energy system
described above was recommended for two reasons. First, it has life-cycle costs at least 25 percent below those achievable with the best TE and SE systems that were examined. Second, because it involves the least on-site construction and emissions, it is also the most desirable with respect to its effect on the TAMC environment.

The two areas where the Conventional Energy system recommended does not rank as the best of the alternatives are fuel efficiency and total emissions. With respect to the first of these, the best Total Energy system showed an energy savings of about eleven percent in comparison with the recommended system. To put this in perspective, it may help to note that this means that it would cost about $25 million extra over the life of the system to reduce fuel consumption by 21,600 gallons per year. This amounts to a price of over $45 for each gallon saved. Given the other worthwhile purposes to which this money could be put, the selection of a slightly less fuel-efficient system appears justified.

With respect to total emissions, because the SE and TE systems would consume less fuel (and would burn what they do need in an environmentally clean fashion), they would produce fewer emissions than would the CE system that has been recommended. On the other hand, some or all of the emissions from the SE and TE systems would occur on the TAMC site in the heart of Honolulu, whereas the increment of power needed for the CE system would cause increased emissions at the Hawaiian Electric Company's relatively isolated Kahe power plant. As a result, the SE and TE systems' effect on pollutant concentrations in populated areas might actually be worse than that of the CE system.

The increased energy demand resulting from the proposed project would be small relative to the capacity of even a single generating unit in HECO's system and would not, in and of itself, require the installation of additional capacity. The TAMC project would, of course, hasten the day when such expansion would be necessary; hence it might reasonably be argued that it should be assigned a pro-rated share of the construction impacts that would result. While this means that the off-site construction impacts associated with the CE system are not zero, TAMC's urban location and moderately steep slopes probably mean that the construction required for the TE and SE systems would result in greater impacts than would development of an equal amount of generating capacity at Kahe.

In order to meet the increased electrical power requirements that would result from the proposed project, the Hawaiian Electric Company would construct a new distribution substation. It would consist of one 43.9- to 13.09-Kv transformer, one 15-Kv, 1200-ampere circuit breaker, and associated equipment to terminate a 46-Kv feeder circuit. This new 46-Kv circuit would originate at HECO's existing Halawa No. 1 Circuit on Aolani Street. The new transmission line would be overbuilt on an existing 11.5-Kv circuit within the Hawaiian Electric Company easement now serving TAMC. Once the new substation has been placed in operation, the existing 11.5-Kv circuit, together with one other existing circuit that also serves the Tripler Army Medical Center Reservation, would be removed.
Changes in Energy Use

Thus far the discussion has focused on the question of which of the alternative systems considered would best meet the energy needs of the proposed project. In this analysis it has been assumed that the power requirements were fixed and that the only possible variations were in the way that they were met. It is important to note, however, that the energy requirements themselves are an inevitable outgrowth of specific official design requirements established for the project. The fact that the size of the hospital and the capacity and sophistication of its mechanical systems would be greatly increased means that the project would cause a significant increase in power use at TAMC. The remainder of this section discusses the magnitude of this increase and indicates the reasons for it.

If the proposed project is implemented, it is estimated that average annual source energy consumption by the hospital, i.e., the amount of energy contained in the fuel that is burned, would rise from 259.4 x 10^7 BTU per year to 704.3 x 10^7 BTU per year, an increase of about 170 percent (see Table IV-7). In contrast, the net energy consumption, i.e., the energy actually consumed by the equipment that performs the ultimate work, would increase by only 70 percent, from 137.4 x 10^7 BTU per year to 234.9 x 10^7 BTU per year. The reasons for this are of some interest, and are discussed in more detail below.

As indicated elsewhere in this report, the floor area of the hospital would be increased by about two-thirds by the proposed additions. Moreover, the tenfold increase in air-conditioning capacity, the upgrading of lighting and other electrical equipment, the introduction of an automatic supply cart handling system, and other changes would place new energy demands on the facility. Despite this, its net energy requirement would rise by only 70 percent, little more than the increase in floor area.

The much larger increase in source energy consumption that is indicated by the table is largely a result of the fact that the proposed project would involve the installation of hospital-wide air-conditioning. In fact, the 296.5 x 10^7 BTU per year that it would consume would constitute about 42 percent of total projected energy consumption. While no exact figures are available regarding present energy use for hospital air-conditioning, a rough estimate suggests that it is probably on the order of 30 x 10^7 BTU per year, or ten percent of the projected level. Subtracting this from the projected use of 296.5 x 10^7 BTU per year, it is apparent that the need to air-condition the entire hospital in accordance with Army standards would result in an energy use of about 265 x 10^7 BTU per year, or slightly more than is consumed for all purposes at the present time. From an energy consumption viewpoint, anything that could be done to reduce the amount of non-renewable energy used for this purpose would be desirable.

Solar Energy Options

The 1977 feasibility study of alternate energy systems for TAMC was limited by the Army to non-solar sources. Subsequently in response to economic and energy policy considerations, the Army commissioned a solar energy study which was to address the following points:
Table IV-7 AVERAGE ENERGY USE

<table>
<thead>
<tr>
<th>Type</th>
<th>Source Energy Consumption(^1) (in 10^9 BTU/Year)</th>
<th>Net Energy Consumption(^1) (in 10^9 BTU/Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Present</td>
<td>Proposed</td>
</tr>
<tr>
<td>Fuel Oil</td>
<td>118.6</td>
<td>54.8</td>
</tr>
<tr>
<td>Gas</td>
<td>1.5</td>
<td>0.1</td>
</tr>
<tr>
<td>Electricity</td>
<td>139.3</td>
<td>649.4</td>
</tr>
<tr>
<td>Heating, Ventilating, and Air Conditioning</td>
<td>N.A.</td>
<td>296.5</td>
</tr>
<tr>
<td>Other</td>
<td>N.A.</td>
<td>352.5</td>
</tr>
<tr>
<td>TOTAL</td>
<td>259.4</td>
<td>704.3</td>
</tr>
</tbody>
</table>

\(^1\) Source energy is the energy contained in the amount of fuel that would be burned. The estimates shown were calculated using the following conversion factors:

- Fuel oil: 138,600 BTU/Gallon
- Gas: 95,500 BTU/Gallon
- Electricity: 11,600 BTU/KWH

\(^2\) Net energy consumption is the energy actually used by the equipment and processes in the hospital. As such, it takes into account all of the inefficiencies that exist in converting source energy into the type of energy that is needed. The estimates shown were calculated using the following conversion factors:

- Fuel oil: 110,880 BTU/Gallon
- Gas: 95,500 BTU/Gallon
- Electricity: 3,413 BTU/KWH
o the extent to which a solar energy system could augment the conventional energy system;

o the type of solar energy system which would result in the greatest benefits for the cost;

o estimated construction cost and payback periods -- needed for budgeting purposes; and

o the impact of implementing a solar energy system on the conventional energy system.

Three schemes for incorporating solar energy into the energy system for TAMC were studied. Scheme I involved the use of solar energy to provide domestic and process hot water. Scheme II intended to provide a portion of the air conditioning requirements (not all, because of limitations on the area available for solar collectors). Scheme III involved the use of solar energy to provide both hot water and air-conditioning. Various systems for each of the above schemes were developed and analyzed. Alternate collector types and system arrangements were considered. Within each scheme a preferred solar energy system was identified. Preference was based on initial costs, life cycle costs, energy savings, energy saved per dollar invested, and payback period. In reaching final conclusions and recommendations, both the energy conservation aspects and the economics of each system were carefully examined.

Based on this study the Army has tentatively decided to include a Scheme I system involving solar hot water heating only as an option in the construction bid package. An absorption chiller which can handle about one-sixth of the air-conditioning demand (or the emergency load) and which runs on hot water, rather than electricity, would be installed along with three electric-motor-driven centrifugal chillers. This would allow conversion of this portion of the air-conditioning system to solar in the future.

Use of the Scheme I solar energy system would effect savings of 47,000 gallons of fuel oil per year (approximately $6 \times 10^7$ BTU per year) by providing approximately 85 percent of the annual energy required to generate 110-degree hot water. This system has an initial construction cost of approximately $1$ million, and a calculated payback period of 15.5 years.

SOLID WASTE DISPOSAL

Hospital Waste
The Office of the Surgeon General has indicated that there would be no increase in the size of the hospital staff or outpatient load as a result of the proposed project. Furthermore, a solid waste study prepared for the project (Belt, Collins and Associates, 1977c) concluded that, while the U.S. Army Environmental Hygiene Agency's estimates of present per capita
solid waste generation by TAH are probably on the high side, it is reasonable to believe that they are close to the per capita levels that would be experienced by the time the proposed new facility is fully operational. There is nothing in the design of the proposed project that would necessarily lead to higher per capita rates of waste generation than would otherwise occur. Hence, it does not appear that the project would result in an increase in the amount of solid waste that is generated. (As a corollary, of course, it should also be noted that there is nothing included within its scope that would lead to a reduction in the amount of solid waste produced.)

Not only would the project not affect the amount of waste that is generated, it would not involve any change in the disposal method used. The scheme now being used at TAMC involves the disposal of all non-pathological wastes at the Schofield Barracks Landfill. Infectious wastes are double bagged and placed in compactors for transport. After October 1, 1980, a new solid waste contract for the Army will start and all wastes from TAMC, except for pathological wastes, will be disposed of at either the Waipahu Incinerator or the Puu Palailai Landfill. This change in disposal sites is in response to the Honolulu Board of Water Supply's concern about the possibility of groundwater contamination. Incineration or use of the Puu Palailai landfill pose no threat to groundwater resources. The State Department of Health, who has conferred with the Board of Water Supply, found these alternatives satisfactory.

The present contracted method of disposing of pathological wastes by cremation would be continued. It has adequate safeguards, and the emissions from the incinerator meet State and Federal air-quality standards.

Construction Wastes
Proposed construction of the new wing and central plant would generate relatively little in the way of construction wastes other than the usual scrap lumber from concrete forms, packing material, and other combustible material. None of the wastes are hazardous, their volume is quite limited, and all could be readily disposed of in a sanitary landfill.

In addition to the same types of waste that would result from the new construction, renovation of the existing building would involve the removal of significant quantities of used materials. While most of this material would be chemically inert, it would be unsuitable for use in a structural fill. Because of this, the waste would have to be trucked to a suitable disposal area off-site. No estimate of the volume is available but it is expected to be sizeable. As a result, the amount of available landfill space on Oahu would be slightly decreased. The primary hazardous material that would need to be disposed of is the asbestos that has been used for insulation in the existing structure. To insure an adequate level of protection for those exposed to the asbestos, stringent safety precautions would be taken. More specifically, the contractor would be required to provide personal and environmental protection in accordance with the Occupational Safety and Health Act of 1970 as published in 29 CFR 1910.1001 - Air Contaminants: Asbestos, and EPA regulations 40 CFR 61 - National Emission Standard for Hazardous Air Pollutants: Asbestos.
VISUAL IMPACTS

This analysis of the visual impact of the proposed modernization of TAMC follows the same format used in the description of the existing visual environment found in Chapter II. As before, photographs have been used in lieu of words wherever possible.

LOOKING AT THE SITE

Distant Views
Because most of the new construction is tucked behind (uphill of) the existing hospital building, and because there would be no significant change to the facade or color of the existing structure, the proposed project would not have a significant effect on distant views of the site.

Middle Views
Most middle views of the hospital are from a lower ground elevation. From there, only the front of the hospital is visible, and the proposed new construction at the rear would be completely hidden. The only visible change from this frontal view would be part of the new canopy at the B2 level in the front-center of the hospital. This amounts to no more than a minor change in an architectural detail; however, and would not significantly alter the structure's appearance.

The middle view that would experience the greatest change is the one of the hospital from the Red Hill overpass. From this western viewpoint an observer would be able to see portions of the new wing on the uphill side of the hospital, the new central plant, and slight changes in the parking and landscaping. As can be seen in Figure IV-8, the proposed additions would not substantially alter the form, mass, or color of the hospital, and cannot be said to have a significant visual impact.

Near Views
The only changes to the hospital visible from below would be the new command entry, the extension of the lower parking area, the enclosure of the balconies with glass panels, and the addition of awnings and sun shades. These would not significantly change the appearance of the building.

The greatest visual impacts from the project would occur on the uphill side of the hospital where the new wing would be constructed, the parking areas relocated and expanded, Patterson Road re-routed above the parking, and an entirely new entrance created. Once cars have turned off Jarrett White Road onto Patterson, the new wing would obscure much of occupants' view of the existing hospital. Thus, the facade of the proposed new structure would replace that of Wings A, B, and C as the dominant visual influence. Levels 7 and above would still be visible from the road, but even these would be hidden once the vehicle has entered the outpatient/visitor parking area (see Figure IV-9).
Figure IV-8  VIEW OF TRIPLER ARMY HOSPITAL FROM THE RED HILL OVERPASS

PROPOSED HOSPITAL ADDITION

PROPOSED CENTRAL PLANT
Figure IV-9  VIEW OF RENOVATED TRIPLER ARMY MEDICAL HOSPITAL FROM THE LOWER OFFICERS CLUB PARKING LOT

PROPOSED HOSPITAL ADDITION
Because the main outpatient/visitor parking area would be closer to the hospital building than is presently the case, there would be less opportunity to see the complex as a coherent architectural whole. At the same time, however, outpatients would finally have the benefit of one convenient, easily discernible entrance. Moreover, the proposed landscape treatment and articulated facade would create a more natural and intimate setting than is presently the case.

VIEWS FROM WITHIN THE HOSPITAL

Views available to persons within the hospital would be affected by the proposed project in two different ways. First, the movement of departments from their existing locations to new ones would mean that the observers' positions would be different than they are now. Second, the construction of the new wing would obstruct some of the views now available. (As a corollary, of course, it would also create a new viewing platform and, hence, new views.)

Wings D and E would not be affected at all by the new wing, but the proposed expansion of the existing downhill parking areas would slightly alter the terrain immediately below these two buildings. The new lot would be tucked in below the existing ones, however, and would be invisible from all but the upper floors of the hospital. A few additional ornamental trees may be added to the courtyard areas between Wings A and C and between B and D, but no major landscaping changes are envisioned there.

Views from the downhill side of the main hospital building would not be affected at all except by the landscaping changes mentioned above and the increase in the number of lighting fixtures in the parking areas. On the opposite (uphill) side, however, the new wing would obstruct most views that are now available to observers on level 4 and below of the existing building.

Combining this information with that provided by the proposed departmental block plan (see Figure II-3), it is possible to obtain a general perspective on the extent to which the views available from various nursing units would be affected. Changes to views from outpatient areas will not be discussed because the nature of their operation, particularly the short periods of time that an individual usually spends in them, renders such changes less significant than those affecting spaces used by inpatients.

The movement of the psychiatric department from Wing D to Wing C would eliminate the sweeping views presently available to patients in those units. In its place, patients would have a view only of the inner courtyard.

At present, the majority of the medical nursing units are situated in Wings D and E. As a result, most of the patients can enjoy wide views of the city and ocean. Nearly all of the surgical beds are in Wings A, B, and C, but they are scattered through levels 2-5. Since the proposed new layout would have a considerable number of medical/surgical beds on levels...
6 and 7, i.e., high enough to see over both Wings D and E and the proposed new wing, views for patients in these units should be equal to or better than they are now.

OB/GYN beds would be concentrated on level 5 in Wings A and B in the proposed layout as contrasted to their present location on levels 7 and 8. Downhill views may be slightly worse because of the presence of Wings D and E, but those towards the mountains would remain unchanged.

Finally, pediatrics would also be situated on level 5. Hence, views for pediatric surgery patients would remain unchanged, but those for pediatric medicine would improve over what they are from the present Wing C, level 2 location.

ARCHAEOLOGICAL/HISTORICAL IMPACTS

As indicated in Section II, the two archaeological sites known to exist on the TAMC reservation have minimal research and/or interpretation potential. More importantly, construction and operation of the proposed project would not affect the condition of these sites in any way.

Although there is no evidence of past human habitation near the proposed new construction, excavation for the new building block and roads would be carefully monitored, and an archaeologist would be called for salvage work if any archaeological sites are found. If human remains were encountered, appropriate State offices would be contacted (Department of Health, Historic Preservation Office), and the remains would be blessed and reinterred nearby.

The Historical Property Inventory and Evaluation Report, referenced previously in the Archaeological/Historical section of Chapter II, attached much less importance to the historical significance of Tripler Hospital's external appearance than it did to its specific architectural and conceptual features. Aside from being a unique example of massive, public architecture for Hawaii and known for its open design, the building was thought to be heavy and not an outstanding example of this particular architectural style. Consequently, the building was assigned Category III significance, i.e., the lowest category with any preservation value. The Bishop Museum concluded that the proposed changes to the building would not have a significant effect on historical values, but it did recommend a full photographic documentation of the interior and exterior prior to the modernization. This would be done.

Although the functional demands of the hospital took priority over the physical preservation of the building in the design of the proposed project, the facility was, nonetheless, treated as a significant historical landmark. The existing architectural character was considered in design studies, and proposed changes attempt to avoid adverse effects by placing major new construction in the rear of and below the existing building.
ECONOMIC AND SOCIAL IMPACTS

The major economic impacts of the proposed project on the State of Hawaii can be stated in terms of (1) the changes in gross sales or output by businesses within the State, (2) the changes in personal income brought about by construction expenditures, and (3) the number of jobs thus created. Because the project would not alter existing land use or employment patterns, its social impacts would be minor and almost entirely secondary in nature, i.e., the indirect result of project-related expenditures.

These changes can best be estimated by the use of the interindustry model that has been prepared by the State's Department of Planning and Economic Development (DPED). The model was first developed in the mid-60s and has subsequently undergone periodic improvements and updates. The unpublished figures derived from the model that are used in this report are the most recent available, and are believed to be the most accurate of available sources. The State's interindustry model is constructed in accord with standard economic methodology and is directly comparable to numerous models used elsewhere. The wealth of experience with such interindustry models clearly demonstrates their value in estimating certain types of economic impacts for certain limited economic events, and it is believed that it is applicable to the present situation.

The accuracy of the estimates contained in this report is largely dependent on: (1) the accuracy of the sectorial coefficients of the interindustry model; (2) the validity of the estimating procedures used to correct for inflation; and (3) the assumption that this particular construction activity would not have indirect and induced economic effects that are measurably different from those of Hawaii's construction industry as a whole.*

Business Sales

Assuming that the project is contracted locally, the gross sales or output of Hawaii's economy would increase by the project's "direct" costs. This one-shot expenditure "multiplies" by virtue of the fact that non-construction firms would be able to increase their sales of goods and services to the construction industry as the result of the direct expenditures for the project. The interindustry model indicates that such "indirect" purchases by the construction industry are about 19 percent of total sales by the construction industry itself.

* Other technical limitations of the estimating procedure are well documented in the economics literature, but they are not believed to be important for a project that involves such a small proportion of the total construction activity in the State. These limitations result from the basic assumptions that there are no externalities, that each economic sector evidences a linear input function, that only one technique can be used in the production of the sectorial grouping of the commodities, and that each sector's output is homogeneous.
Further "multiplier" effects occur as the incomes (wages, dividends, proprietors' incomes, etc.) generated by these sales enter the spending cycle within the State's economy. The total amount of sales "induced" by this re-spending process is estimated by the interindustry model to be about 109 percent of "direct" plus "indirect" sales.

The addition of the "direct" expenditure, plus the "indirect" sales, plus the "induced" sales gives a total of $345 million in sales (output) within Hawaii's economy that would be brought about by construction of the proposed project.

**Incomes**

The interindustry model can also be used to estimate the impact of the construction of the project on incomes (wages, dividends, etc.) throughout the state. The model indicates that 50.5 per cent of construction costs would be paid out as wages or other forms of income. The vast bulk of this is for labor, and it agrees closely with the estimate provided by the individuals who prepared the preliminary construction cost projections. They estimated that labor and materials would be roughly equal for the construction portion of the project. The fact that the two different estimates agree so closely tends to confirm the belief that use of the interindustry model is a valid means of estimating economic impact for the proposed project.

The "indirect" and "induced" multiplier effects on income are estimated by the model in a fashion paralleling the preceding discussion of impact on sales. Incomes "indirectly" generated by industries supplying the construction industry are estimated to be about 18 per cent of the incomes generated "directly" by the construction industry. As these incomes further enter into Hawaii's economy as purchases of various goods and services, another $32 million in income would be "induced".

All in all, the construction of the project would bring about (through the multiplier process) an increase in income for residents of the state of about $114 million.

**Employment**

The employment created by the project within the construction industry can be inferred from the latest estimates of output/labor ratios for Hawaii's construction industry. This ratio is consistent with figures used in the interindustry model. The apparent stability of this ratio (varying by only 11 per cent in the past five years) indicates that it can usefully be applied to the estimation of the employment impact of the TAMC project. Applying the ratio, it is estimated that about 2,300 job-years (defined throughout our discussion as one person being employed full-time for one year) would be created.

This estimate of 2,300 job-years has, for the sake of convenience in calculation, been treated as though the project would be completed in one year and as though employment would be level throughout that period. In reality, the project would take about four years to complete, which means
that, on the average, about 600 construction workers would be employed at any one time. (The actual number at any one time would vary in a fashion that is not yet estimated.) This is only 2.5 per cent of total 1976 construction employment in Hawaii.

Since no sizeable amount of peculiar construction skills would be employed on the project, and since it would utilize such a small percentage of Hawaii's construction labor force, there is every reason to believe the State's labor force (primarily on Oahu) would be the source of such labor to the same extent as it has been in the recent past. The anticipated continuation of hiring procedures under present collective bargaining agreements would further insure that this would be the case.

Drawing again from the State's interindustry model, it is possible to estimate the "multiplier" effects on employment. It is estimated that the additional "indirect" jobs created by the firms supplying the construction industry would amount to 29 percent of the jobs created within the construction industry. Reverting for convenience to the figure of 2,300 construction job-years (as though the project were to be completed in one year and employment were level throughout that time), this many construction jobs would be associated with about 700 additional job-years created in firms supplying the construction industry.

As the incomes generated by these economic activities enter the spending cycle of the State's economy, additional job-years would be created. According to the interindustry model, this total of "induced" job-years would be about 1,700, in addition to the 700 "indirect" and the 2,300 "direct" job-years created.

Addition of these figures gives a grand total of about 4,700 job-years. In reality, this is a generous estimate of the employment impact. A more conservative estimation procedure frequently used by economists is to include only "direct" and "indirect" employment. In this case, it would amount to about 3,000 job-years. This can be justified, in part, on the basis that a loss of a job in our modern society does not necessarily mean a proportionate loss of expenditures. (More technical arguments involving "excess capacity" and "non-linear input functions" also support such a more conservative estimating procedure.) Consequently, it is reasonable to view 4,700 job-years as a maximum estimate and 3,000 as a minimum estimate.

Economic Leakages
Although such eventualities are not anticipated, it may be important to note in passing that the preceding estimates of the magnitudes of economic benefits to the State's economy would be lessened to the extent that services and materials are brought in from outside the State to a greater degree than has been the practice in the State's construction industry during the late 1960s and early 1970s. As a point of comparison, the smaller nature of Kauai's economy, and its consequent lesser depth and diversification, requires that the construction industry there import a
larger portion of the goods and services it sells than the State's construction industry as a whole. Consequently, the average construction dollar spent on Kauai creates only about 3/4 the income there as is created by the average construction dollar spent in the State.

Impact of Equipment Costs
Thus far, this discussion of economic impact has not dealt with the anticipated expenditure of $30 million for equipment. In part, this is because the dearth of data makes it impossible to demonstrate with useful precision the nature of the economic impacts involved. Nevertheless, some crude estimates can be inferred from the few facts available. Given the sophisticated nature of the commodities involved, it is reasonable to conclude that virtually none of the items would be manufactured in Hawaii. Hence, the purchases would impact primarily on economies elsewhere. Similarly, it is reasonable to assume that the transportation and installation costs impacting Hawaii's economy would be only a small portion of the overall acquisition costs. Since specialized equipment costs would run about 20 per cent of construction costs, and since the per-dollar impact on the State's economy would be far less than would be the case for the construction expenditures, it may be sufficiently accurate to estimate that the economic impacts in Hawaii of the equipment purchases would be about $3 million for transportation, storage and installation. If this proves true, the total statewide impacts derived from the interindustry model would be about $7 million in sales, $2 million in income, and 130 job-years. The most important observation to make is that the impact of this portion of the project is small in comparison with the construction portion.

Social Impacts
Based on the Office of the Surgeon General's indication that there would be no increase in staffing at TAMC as a result of the project, it is clear that the proposed action would not have any significant employment-related, long-term social impacts. Similarly, the fact that it is limited to an existing facility within a long-established military reservation means that it would not involve any land-use changes or lasting social disruptions to an existing community. Thus, it appears that the only significant social impacts that might result from the project are those related to employment and to the improved medical care and educational opportunities that the modernized and expanded hospital could provide.

The construction employment generated by the proposed project could help reduce the unemployment rate in the State's construction industry. Since unemployment tends to cause major stresses within families, this would tend to lead to an improvement in social welfare. At the very least, it could provide an important source of temporary construction jobs at a time when the construction industry as a whole is in the process of shrinking from the size it reached during the boom years of the late 60s and early 70s. By so doing, it would provide construction workers additional time to find alternative employment.

The most significant social impact from the project would be in the form of the improved medical care that it would permit.
Finally, it should be noted that the proposed project would eliminate many existing deficiencies which, if allowed to persist, could eventually result in its loss of accreditation. Given the fact that TAMC is one of Hawaii's few teaching hospitals, this would have serious detrimental effects on the State's medical education programs.
ALTERNATIVES TO THE PROPOSED ACTION

INTRODUCTION
ALTERNATIVE ONE: DO NOTHING
ALTERNATIVE TWO: CONSTRUCTION OF A NEW HOSPITAL
ALTERNATIVE THREE: RENOVATION AND ADDITION
RELATIVE ENVIRONMENTAL IMPACTS OF
THE ALTERNATIVES CONSIDERED
V ALTERNATIVES TO THE PROPOSED ACTION

INTRODUCTION

This environmental impact statement contains a detailed evaluation of a specific proposal for the modernization of TAMC. However, it must be emphasized that the proposed plan is not the only alternative being considered. In general, the alternatives fall into three major categories:

- Continue to use the hospital without undertaking major changes. This is, in effect, the "do-nothing" alternative.
- Replace TAMC with a new facility located on another site.
- Renovate the existing hospital.

In most cases, each general alternative has more than one sub-alternative; because of this, both the replacement and renovation alternatives were explored through the analysis and evaluation of a number of different schemes.

ALTERNATIVE ONE: DO NOTHING

The Department of Defense Area Survey of Health Care Facilities in Hawaii (January, 1974) concluded that TAMC was no longer functionally organized to deliver quality health care. The subsequent Caudill, Rowlett, Scott, Inc. (CRS) Functional and Economic Analysis of TAMC (June, 1974) identified the following deficiencies:

- an inability to adjust to the change in emphasis that has occurred from inpatient to outpatient services;
- confused and inadequate vehicular and internal circulation;
- obsolete mechanical, plumbing, electrical, and communication systems;
- insufficient space (especially in clinics and high technology areas); and
- conflicts in internal circulation caused by scattered functional areas and reliance on labor-intensive material handling techniques.

These deficiencies mean that, from a medical point of view, the "do-nothing" alternative would perpetuate a situation already known to be substandard. Moreover, if the existing facility and its operations are not improved, deficiencies would tend to be aggravated by technological and operational obsolescence. This, in turn, would eventually lead to other negative consequences such as a loss of accreditation from the Joint Commission on Accreditation of Hospitals (JCAH) and a drop from its present
rank as one of the best military teaching hospitals in the nation. Most importantly, perhaps, it would make it impossible to provide high-quality health care to the individuals served by TAMC. Aside from the obvious implications that this would have for the health of those persons, it would also have a significant effect on morale and would make it more difficult to attract and retain the personnel necessary to support the "all-volunteer" armed forces.

ALTERNATIVE TWO: CONSTRUCTION OF A NEW HOSPITAL

Whether to replace the existing hospital with an entirely new facility either on or off the TAMC Reservation or to renovate the existing structure is being considered. In the case of the "New Construction" alternative, it involves deciding what and where to build as well.

Alternative Sites
A study of alternative hospital sites was conducted as part of Caudill, Rowlett, Scott, Inc.'s Functional and Economic Analysis of TAMC. Four sites selected by the Corps of Engineers, Pacific Ocean Division (POD), were examined. The sites were: (1) Helemano Radio Receiving Station, (2) Lualualei Naval Magazine, (3) Bellows Air Force Station, and (4) Tripler Army Medical Center. (See Figure V-1.)

Each of the four sites was investigated in some detail by the Caudill, Rowlett, Scott, Inc. study team and rated according to its accessibility, site development potential, support facility requirements, and compatibility with existing and proposed uses. Their findings are summarized below:

Helemano Radio Receiving Station This site is located in Central Oahu approximately three miles northeast of Schofield Barracks and 18 miles northwest of downtown Honolulu. Accessibility to patients and staff and to support facilities is fair. Approximately 34 percent of the patient population and 24 percent of the staff live within ten miles, and logistical support facilities in Pearl Harbor and Honolulu are between 15 and 20 miles away.

According to the Caudill, Rowlett, Scott, Inc. analysis, topographic conditions are adequate and sufficient land is available there. However, water and sewage treatment facilities would need to be provided. Development of the hospital would also be constrained by the continued operation of the radio receiving station. Expensive protective measures would be required to guard against radio interference, and security would pose considerable problems. This incompatibility is reflected in the Military Property Requirements in Hawaii (MILPRO-HI) study, completed by the Navy in 1979, which classified the Helemano site as 100 percent utilized. Clinical support facilities could be provided by Schofield Barracks, but the increased distance from Fort Shafter and the University of Hawaii College of Health Science and Social Welfare would be disadvantageous.
FIGURE V-1 ALTERNATE SITES CONSIDERED FOR A REPLACEMENT FACILITY

Chapter V
Naval Magazine, Lualualei (NAVMAG Lualualei), Headquarters Branch This site is located in Lualualei Valley on the western shore of the island of Oahu. It is the least accessible to patients and staff of all those examined. Only two percent of the potential patients and four percent of the present TAMC staff live within a ten-mile radius. Furthermore, port facilities are 20 to 25 miles away. Although topography and acreage are not constraints, all utilities are inadequate and would need upgrading.

The Caudill, Rowlett, Scott, Inc. study concluded that a replacement hospital at this site would be severely restricted. First, the proximity of the proposed tri-service ammunition storage depot would necessitate limitations on access and strict security measures. Second, the existence of the Lualualei Naval Radio Station on the western boundary of the site would require similar controls over radio frequency generating sources as those needed for the Helemano site. Clinical support facilities at Fort Shafter and the University of Hawaii are farther from this site than any of the others, and new facilities for other support functions would need to be constructed. Finally, explosive safety quantity distance (ESQD) circles from ammunition magazines and operating buildings cover all but 25 acres of the open buildable land at the Naval Magazine. Federal regulations preclude the construction of buildings intended for human occupancy within these circles. Both communications and ammunition-storage functions will continue for the foreseeable future; hence, the site is not considered a viable location for a major medical center.

Bellows Air Force Station Bellows Air Force Station is located on the eastern side of the Island of Oahu approximately ten miles from downtown Honolulu. About 14 percent of the patient population and 23 percent of the staff population live within a ten-mile distance. Pearl Harbor and downtown Honolulu logistical support facilities are 12 to 17 miles away. Clinical support facilities are at Kaneohe Marine Corps Air Station, approximately six miles away, and the University of Hawaii, approximately 12 miles away.

Caudill, Rowlett, Scott, Inc. found that, except for a 500-foot wide tsunami (tidal wave) inundation zone, the majority of the 1,493-acre site could be used for the hospital facility. Similarly, existing water and sewer lines were judged adequate for some of the hospital requirements, and an existing sewage treatment plant in the nearby community of Waimanalo could support the increased demand generated by the new hospital. Electrical and communication lines would need upgrading.

A general aviation airport was proposed by the State of Hawaii for a 135-acre parcel located on the southern portion of the site, but the action was never completed. In any case, the Caudill, Rowlett, Scott, Inc. study reported that this would place no significant development restrictions on the proposed hospital in terms of the amount of land available, since the airport would require only about ten percent of the total acreage. However, it also stated that a general aviation airport in such close proximity to a hospital facility could pose safety and operational problems and
hamper MEDEVAC operations. Similar problems could occur with the continued operation of the Marine Corps helicopter training facilities located on the northern portion of the site. Support facilities such as warehouses would be needed because the Bellows site is virtually undeveloped.

They concluded that the proposed hospital would be incompatible with the proposed general aviation airport for safety and operational reasons. In addition, the continued operation of the Air Force Communications Station requires measures to protect against radio interference similar to those required for the Helemano and Lualualei sites. The Marine Corps has also indentified a continuing requirement for the whole of Bellows Air Force Station for training.

Tripler Army Medical Center The existing 367-acre TAMC site is the most accessible of all the sites evaluated. Approximately 56 percent of the patient population and 73 percent of the staff population live within ten miles. Logistical support facilities at Pearl Harbor and Honolulu are only five miles away. Topography, utilities, and acreage pose no major site-development restrictions, although some minor modifications of the principal utility lines could be required depending on whether or not the existing hospital building were to be reused for administrative functions.

There are no development controls or restrictions on the use of the site. Also, all support facilities required are more than adequately met because of the existing hospital use of the site and close proximity to Fort Shafter and the University of Hawaii. The proposed replacement facility would be compatible if a non-disruptive use were assigned to the vacated TAMC facility.

Conclusion Regarding the Best Site For A Possible Replacement Facility Caudill, Rowlett, Scott, Inc.'s ranking of the various sites is summarized in Table V-1. Based on this evaluation, they concluded that the area immediately below the existing hospital building was the most suitable of the sites considered for possible construction of a new hospital.

The prototypical replacement facility evaluated by the CRS study team for this site was a seven-story, fully air-conditioned structure located on axis with the existing hospital (see Figure V-2). In it, major functions were zoned vertically to maximize use of the site and to minimize internal horizontal movement. Outpatient and related diagnostic and treatment functions were on the first two floors; service support, material handling, and food and administrative services were on the 3rd and 4th floors; inpatient facilities, surgery, and delivery were on the top floors. Outpatient and visitor access and parking were located at the front of the building while staff parking and access were at the rear.

The study estimated that the new 946,019 gross square foot building could be built over a four-year period at an estimated cost of $101 million (1975 construction cost exclusive of escalation beyond that date). If the existing TAMC facility was converted to office space as well, an estimated $28 million would have been added to the total cost of this alternative.
Figure V-2 CRS REPLACEMENT HOSPITAL PROTOTYPE

LEGEND
- PROPOSED NEW CONSTRUCTION
- PROPOSED PARKING AND ROeways
- EXISTING HOSPITAL

PROPOSED REPLACEMENT HOSPITAL

EXISTING HOSPITAL
Table V-1  ALTERNATE SITE ANALYSIS RANKINGS

<table>
<thead>
<tr>
<th>Site Criteria</th>
<th>Helemano Radio Station</th>
<th>Lualualei Naval Magazine</th>
<th>Bellows Air Force Station</th>
<th>Tripler Army Medical Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessibility</td>
<td>Fair</td>
<td>Poor</td>
<td>Poor</td>
<td>Good</td>
</tr>
<tr>
<td>Development</td>
<td>Poor</td>
<td>Poor</td>
<td>Fair</td>
<td>Good</td>
</tr>
<tr>
<td>Potential</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Support Facilities</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
<td>Good</td>
</tr>
<tr>
<td>Compatibility</td>
<td>Poor</td>
<td>Poor</td>
<td>Fair</td>
<td>Good</td>
</tr>
</tbody>
</table>

SOURCE: Caudill, Rowlett, Scott, Inc., 1975

ALTERNATIVE THREE: RENOVATION AND ADDITION

In addition to looking at the feasibility of a replacement facility, the Caudill, Rowlett, Scott, Inc. study simultaneously examined the feasibility of renovating the existing facility. Modernization consisted of reorganizing the major functional areas of the hospital, improving vehicular and internal circulation, adding floor space, and providing improved mechanical, plumbing, electrical, communications, and transportation systems (see Figure V-3).

In this conceptual alternative, a prototypical design was developed in which outpatient functions were concentrated in Wings D and E, inpatient functions were located in Wings A, B, and C and diagnostic and treatment functions were centrally located in new space built between the two areas. Entrance roads and parking for the outpatient clinics, located in the front of the building, were separated from inpatient and staff parking and access in back. Air conditioning was provided throughout the facility, and all open wards were to be converted to private, semi-private, and 4-bed patient rooms.

The modernized hospital outlined in the Caudill, Rowlett, Scott, Inc. study had 996,959 gross square feet, about 23 percent more than the present facility. It was estimated that construction would take five years and cost about $85 million (1975 construction cost exclusive of escalation). The additional year required for construction (as compared to entirely new construction) was due to phasing schedules designed to keep the hospital operational at all times.
Caudill, Rowlett, Scott, Inc. analyzed the two basic approaches that could be taken in response to the inadequacies that had been identified: modernization and new construction. They went on to evaluate, in qualitative terms, a hypothetical design developed for each. Their study did not, however, select one above the other as a recommended scheme, and it is impossible to be certain which of the approaches—totally new construction or modernization—they may have favored. From their narrative discussion, however, one can infer that they did not believe that replacement was justified. To quote from the CRS conclusion:

From the beginning, it was assumed by all team members—both client representatives and CRS personnel—that the replacement hospital would provide many functional efficiencies which could not be achieved through renovation of a 26-year-old building. However, as documented in the detailed evaluations which follow, it has become apparent that the replacement facility would provide only a moderate improvement in internal functional efficiency (primarily reduced travel distances between departments having few affinities) at significant functional, economic and aesthetic costs. (pg. 259)

Subsequent to the completion of the CRS study and its review by the Army, attention has focused on the modernization alternative.

Architectural and Site Planning Alternatives
The firms of Belt, Collins and Associates, Ltd./Lyon Associates, Inc. and Welton Becket Associates, in joint venture, were selected by the Department of the Army, Corps of Engineers as consulting architects and engineers to develop plans based on the recommended modernization alternative. The plan development process consists of two phases: a "preconcept phase," during which alternative modernization concepts are formulated and evaluated and a final design concept selected, and a final design phase during which detailed designs are developed, plans and specifications drawn up, and final cost estimates made. At this time, the first phase work has been complete, and this environmental impact statement is based on the final design concept as it existed on March 10, 1978.

The work performed during the pre-concept development phase of the project fell into three general categories: (1) Background Studies, (2) Planning Analysis, and (3) Formulation and Evaluation of Alternative Schemes. The first two provided the information and analytical framework that were used to accomplish the third.

In all, six different schemes for the hospital were developed and evaluated with regard to their performance in seven different categories. These categories and the relative importance that was attached to each of them are:

1. Architectural -- 15%

Chapter V 11
2. Seismic Analysis -- 10%

3. Site Considerations -- 10%

4. Flexibility -- 5%

5. Functional Relationships -- 30%

6. Material Distribution -- 15%

7. Phasing -- 15%

Each category had a number of items which were assigned points according to how well the specified criteria were satisfied. An above average evaluation received +2 points, average +1, and below average -1. The 2-point differential between an average and a below average evaluation was used to highlight the less desirable points by numerically biasing the scores. When the analysis uncovered major problems with the design, it was adjusted until they had been eliminated.

A numerical rating for each category was obtained by summing the number of points received for each scheme evaluated and multiplying it by a constant (category) factor. The factor was based on a formula which divided the percentile weight of the category by the number of items in that category. (See example in Figure V-4.)

Following this initial screening, three of the six schemes (Numbers 1, 2, and 5) were refined, evaluated by the consultants, and submitted for consideration (see Figures V-5, V-6, and V-7). As indicated in Table V-2, Scheme 5, the alternative recommended for selection by the consultants, had the highest ranking based on the evaluation parameters listed above. It was followed by Scheme 1 and Scheme 2, in that order.

Table V-2 SUMMARY OF SCORES RECEIVED BY THE THREE HIGHEST-RATED SCHEMES

<table>
<thead>
<tr>
<th>Scheme Number</th>
<th>1</th>
<th>2</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architectural</td>
<td>15%</td>
<td>22.50</td>
<td>10.00</td>
</tr>
<tr>
<td>Seismic</td>
<td>10%</td>
<td>10.00</td>
<td>6.00</td>
</tr>
<tr>
<td>Site</td>
<td>10%</td>
<td>14.43</td>
<td>4.44</td>
</tr>
<tr>
<td>Flexibility</td>
<td>5%</td>
<td>3.75</td>
<td>1.25</td>
</tr>
<tr>
<td>Functions</td>
<td>30%</td>
<td>22.50</td>
<td>30.00</td>
</tr>
<tr>
<td>Distribution</td>
<td>15%</td>
<td>20.00</td>
<td>16.25</td>
</tr>
<tr>
<td>Phasing</td>
<td>15%</td>
<td>11.00</td>
<td>10.00</td>
</tr>
<tr>
<td>Total Points</td>
<td>104.18</td>
<td>45.94</td>
<td>132.41</td>
</tr>
</tbody>
</table>
FLEXIBILITY

- NEW CONSTRUCTION CAN ADAPT TO FUTURE NEW CONSTRUCTION
- CLINIC AREAS CAN EXPAND
- STAFFING OF NURSING UNITS FOR CHANGES IN OCCUPANCY
- FUTURE ABILITY OF "HARD" AREAS FOR EXPANSION INTO ADJACENT "SOFT" AREAS

SOURCE: WELTON BECKET ASSOCIATES

SUBTOTALS

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>5%</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 ITEMS</td>
<td></td>
<td>1.25x</td>
</tr>
<tr>
<td>1</td>
<td>=</td>
<td>1.25</td>
</tr>
<tr>
<td>1.25x</td>
<td>=</td>
<td>1.25</td>
</tr>
</tbody>
</table>
FIGURE V-6 MODERNIZATION SCHEME 2

LEGEND

PROPOSED ROADWAY SYSTEM
PROPOSED NEW CONSTRUCTION
PROPOSED PARKING
EXISTING HOSPITAL

E EMERGENCY
O OUT-PATIENT
V VISITOR, IN-PATIENT
S SERVICE

Chapter V 15
LEGEND

PROPOSED ROADS\NY SYSTEM
PROPOSED NEW CONSTRUCTION
PROPOSED PARKING
EXISTING HOSPITAL

E EMERGENCY
O OUT-PATIENT
V VISITOR IN-PATIENT
S SERVICE

Chapter V 16
The recommended scheme (No. 5) received a total evaluation score of 132.4, 27 percent higher than second-ranked Scheme No. 1. Moreover, it was highest-ranked in four of the seven categories and second-ranked in the remaining three.

**RELATIVE ENVIRONMENTAL IMPACTS OF THE ALTERNATIVES CONSIDERED**

The functional requirements associated with the provision of quality health care have not been the only factors considered in developing the present proposal. In addition, the effects that each alternative would have on the physical, biological, and cultural environments have also been considered. Although the effects of the alternates have not been analyzed to the same extent as those of the proposed plan, sufficient information is available that the fundamental differences in impacts between the project as it is now proposed and those of the alternatives being considered are clear.

**No Project**
The no-project alternative would entail none of the adverse construction-related impacts that have been outlined in the preceding chapter of this document. On the other hand, the hospital's ability to accomplish its assigned mission would gradually diminish.

**New Construction On An Alternative Site**
New construction, regardless of the particular site, would result in a significantly different set of impacts than would the renovation/addition project now proposed. In general, it would have much greater effects on the surrounding natural environment and on public facilities and somewhat reduced impacts on the quality of patient care during construction. A brief summary of these differences is presented below.

Regardless of where a new hospital were located, it would have to be built from the ground up. With the exception of the alternate TAMC site, it would require the construction of some or all of the necessary support facilities as well. Hence, this alternative would involve construction-related impacts such as noise, construction traffic, vegetation removal, increased surface runoff, and air pollution, well in excess of what would be experienced as a result of the proposed renovation. Since none of the alternate sites appear to have special conditions that would require unusual engineering solutions, the magnitude of such impacts would be proportional to the amount of new construction required. Based on the CRS report, the construction impacts of a new facility would be least for the alternate TAMC site and would be progressively greater for the Bellows, Helemano, and Lualualei locations, in that order.

Off-site impacts would be least for the TAMC site as well, because it would involve a continuation of the existing pattern. In terms of energy use, the TAMC site's proximity to the user population makes it the best. The same feature, together with the fact that it is close to two freeways and two major east-west arterials means that the TAMC site entails the fewest

Chapter V 17
adverse effects on traffic flows. The other three sites are served by only one rural highway each, a significant consideration in view of the 7,000 to 8,000 vehicle trips per day that are generated by the present hospital.

While new construction would generally have much greater impacts than would renovation of the existing facility, there are exceptions to this rule, and most of these have to do with construction-related interference with ongoing hospital operations. Construction is an inherently dusty and noisy undertaking, and it would take considerable skill and planning to insure that renovation work does not adversely effect the quality of care provided to patients. While the proposed mitigation measures would make near-normal operation of the existing facility possible during the renovation, there is no doubt that construction of a completely new facility would entail fewer problems and fewer temporary dislocations for the hospital staff and patients.

Alternative Renovation Schemes
As previously indicated, a number of different addition/alteration schemes have been developed and evaluated as part of the planning process. They are essentially the same as the proposed scheme in terms of their impacts on the surrounding environment, but none is as good at meeting the operational needs of the hospital.
PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED
VI PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

IMPACTS

Air Quality Impacts
Because the existing hospital is naturally ventilated, proposed construction activity could cause a serious, but temporary, degradation of interior air quality there. Dust appears to be the greatest potential problem, but construction vehicles operating close to TAMC's ground-level air intakes could also introduce unacceptably high levels of carbon monoxide. Removal of asbestos-insulated hot water pipes and ceilings during renovation of the existing hospital spaces could subject workers to hazardous levels of this material.

Every effort would be made to mitigate the adverse impacts listed above that would occur during the construction phase. All windows facing the construction area would have noise/dust traps installed. Where necessary, hospital spaces would be sealed and air-conditioned. Air intakes would be moved to locations better shielded from construction dust and gaseous emissions. Workers removing the asbestos insulation used in the existing building would follow procedures established by OSHA and EPA. Temporary parking areas would have a bituminous surface treatment over an aggregate base course as a means of limiting dust generated by vehicular movement. Exposed dirt surfaces would be watered frequently to reduce fugitive dust.

Noise Impacts
Project-related demolition and construction activities would produce high noise levels that could have serious adverse effects on hospital patients unless adequate noise control measures are taken, particularly during construction of the new wing. A noise mitigation program (including the noise/dust traps mentioned above) would be included as part of the project and would reduce noise levels far below what they might otherwise be, but some temporarily elevated noise levels must be expected given the constraints imposed by other aspects of the project.

Hydrologic Impacts
The increased extent of impermeable surface that would result from the proposed construction of the new wing and additional road and parking facilities would result in a net increase in surface runoff from the TAMC site of about 40 cfs for a 50-year storm. Discharge into Moanalua Stream from the eight-foot by six-foot box culvert at the northwest corner of the Reservation would increase by about 60 cfs while flows into other off-site drainage systems would either remain the same or decrease. This would contribute marginally to the flooding problem in the Mapunapuna area along the lower reaches of Moanalua Stream, but the change would be so slight
as to be almost imperceptible. Some temporary reduction in the water quality of the stream might occur if heavy rains fell on the site before cut and fill areas had been paved or re-vegetated, but a comprehensive erosion control program would be incorporated into the project that would reduce the potential impact from such an occurrence to a minimum. Groundwater recharge would be reduced by an amount roughly proportionate to the increase in impermeable surface.

Visual Impacts
The visual impact of the proposed hospital addition would be slight because it is screened from below (i.e., the direction from which it is most commonly seen) by the existing structure. Only on the uphill side of the hospital would there be a major change in the appearance of the hospital, and it cannot be fairly said that the change would be a detrimental one. Undoubtedly, the hospital and surroundings would take on a cluttered look during construction as a result of the excavation, demolition, storage, and other activities that would take place, but this disruption would be temporary. Moreover, every possible effort would be made to insure that the area is kept neat and attractive during this period.

Energy Consumption
While many of the mechanical components in the proposed hospital would be more efficient than the existing one in terms of the output obtained from a unit input of electricity, the fact remains that the total source energy consumed by the hospital would increase significantly as a result of the project. The increase is due to the significantly increased size of the facility, the addition of equipment and lighting not present in the existing facility, and the installation of hospital-wide air-conditioning.

MITIGATION OF ADVERSE IMPACTS

Insofar as possible, the proposed project attempts to avoid adverse impacts through good design rather than to rely on corrective measures taken after the basic design has been fixed. There are, however, some adverse effects which could not be completely eliminated. For these, a variety of mitigating measures would be employed to keep them within reasonable bounds. These are summarized in Table VI-1.
### SUMMARY OF MEASURES THAT WOULD BE USED TO MITIGATE POTENTIAL ADVERSE IMPACTS

<table>
<thead>
<tr>
<th>Potential Adverse Impact(s)</th>
<th>Project Phase during which Primary Impacts Would Occur</th>
<th>Proposed Mitigation Measures</th>
</tr>
</thead>
</table>
| Soil Erosion                | Construction                                            | A variety of erosion control measures would be employed as necessary, including:  
|                             |                                                        | o keeping the area of land exposed (i.e., stripped of its vegetative cover) at any one time to a minimum;  
|                             |                                                        | o retention of existing vegetation wherever possible;  
|                             |                                                        | o use of temporary ditches, dikes, vegetation, and or mulching to protect critical areas;  
|                             |                                                        | o regular application of water or other dust suppressors to exposed areas;  
|                             |                                                        | o carefully regulating use of fill in drainage-ways; and  
|                             |                                                        | o avoid locating temporary storage and shop areas in areas that are erosion-prone. |
| Flooding                    | Construction and Post-Construction                      | The proposed storm drainage system would channel the increased stormwater runoff that is expected into existing drainage systems having sufficient excess capacity to accommodate them without significantly increasing the danger of flood damage to adjoining properties. |
| Degradation of Air Quality  | Construction                                            | The following precautions would be taken with respect to fugitive dust:  
|                             |                                                        | o the provisions of Section 10, Chapter 43, of the State Public Health Regulations would be strictly adhered to;  
|                             |                                                        | o shielding and, perhaps, additional filtration would be provided on ventilation intakes;  
<p>|                             |                                                        | o Noise/dust traps would be installed on all windows facing the construction area. |</p>
<table>
<thead>
<tr>
<th>Potential Adverse Impact(s)</th>
<th>Project Phase during which Primary Impacts Would Occur</th>
<th>Proposed Mitigation Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degradation of Air Quality (continued)</td>
<td>Construction</td>
<td>TSP levels within the hospital would be monitored, and, if deemed necessary by a medical review board, temporary mechanical ventilation would be provided where needed. In addition, construction vehicle activity in the vicinity of existing ventilation intakes would be severely limited, and ground-level intakes would be elevated and/or shielded. EPA and OSHA regulations governing the handling of asbestos and other dangerous materials would be strictly adhered to.</td>
</tr>
<tr>
<td>Noise</td>
<td>Construction</td>
<td>Once the detailed design and the construction schedule for the project are finalized, a detailed noise abatement program would be developed based on refined noise level predictions, official hospital noise standards, knowledge of the noise suppression devices that are available, and expert medical opinion regarding the noise limits that must be enforced in order to maintain the quality of health care at a high level. The noise control program would indicate the maximum noise emissions allowed from construction equipment, suitable noise abatement techniques, and contract specifications necessary to insure that the controls are implemented. Among the measures that could be employed are the following:</td>
</tr>
</tbody>
</table>

- closure and air-conditioning of spaces within the existing building likely to be adversely affected by construction noise from the construction activity;
- conversion of rooms on the uphill side of the existing hospital into sound traps;
- construction of exterior sound traps on the sides of the existing building closest to the proposed new construction;
- limiting the size of the explosive charges used to excavate the site of the new wing;
### Potential Adverse Impact(s) and Proposed Mitigation Measures

<table>
<thead>
<tr>
<th>Adverse Impact(s)</th>
<th>Project Phase during which Primary Impacts Would Occur</th>
<th>Proposed Mitigation Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise (continued)</td>
<td>Construction</td>
<td>o careful scheduling of blasting so as to avoid times when activities particularly susceptible to disruption by noise are most likely to occur;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o imposition of strict limitations on the hours during which construction activity may occur and during which construction vehicles may enter and leave the site.</td>
</tr>
<tr>
<td>Biological</td>
<td>Construction and Post-Construction</td>
<td>The proposed action includes a comprehensive landscape program that would have the net effect of increasing the total amount of trees and shrubs on the reservation. Thus, while the area covered by vegetation would decrease slightly, the biological productivity would actually be increased. Wherever possible, mature trees would either be left in their present location or transplanted. The erosion control measures described previously would minimize the rate of sedimentation and, therefore, the project's effect on water quality and aquatic biota.</td>
</tr>
<tr>
<td>Disruption to Vehicular Circulation and Parking</td>
<td>Construction</td>
<td>Temporary parking areas and access roads would be provided as needed for TAMC staff, patients, visitors, and construction workers. A shuttle service would be established between distant parking areas and the hospital. Changes in access route and parking assignments would be announced well in advance of their occurrence, and adequate signs would be erected to guide drivers.</td>
</tr>
<tr>
<td>Increased Energy Use</td>
<td>Post-Construction</td>
<td>Because of the increased floor area of the hospital, the increase in energy-using electrical equipment, the provision of hospital-wide air-conditioning, and other factors, energy use at TAMC would increase as a result of the project. However, the extent of the increase would be minimized by the use of energy-efficient equipment, the inclusion of heat-recovery systems, and by the use of solar energy for some of the heating, and, possibly, for some of the cooling.</td>
</tr>
<tr>
<td>Potential Adverse Impact(s)</td>
<td>Project Phase during which Primary Impacts Would Occur</td>
<td>Proposed Mitigation Measures</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>--------------------------------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Changes to a Prominent Visual Landmark</td>
<td>Post-Construction</td>
<td>For the most part, the proposed additions would be hidden behind the existing hospital building, and they would be barely visible from most vantage points. The Central Plant would have a low profile, and would be nestled against the hillside. Only minor changes would be made to the exterior walls of existing buildings.</td>
</tr>
<tr>
<td>Possible Loss of Features of Historical Value</td>
<td>Construction and Post-Construction</td>
<td>Before demolition or construction is begun, a comprehensive photographic record would be made of TAMC as it exists today. This record would be available for future reference and, possibly, for display following completion of the proposed alterations and additions.</td>
</tr>
</tbody>
</table>
RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN’S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY
Elsewhere in this report it has been estimated that the proposed project would generate up to $345 million in sales, $114 million in personal income, and 4,700 job-years of work in the local economy over a period of four to five years. This would constitute a significant and immediate boost to a construction industry that is currently in a somewhat depressed state, and to a construction labor force that has high unemployment. The other short-term effects of the project—increased traffic, noise, air pollution, etc.—are typical of all construction projects and, in general, would be deleterious. With the application of reasonable controls on the construction activity, all of these adverse effects would be kept within reasonable bounds.

When the magnitude of the long-term gains to be had from the project are compared with the relatively minor short-term disruptions that its construction would entail, the full worth of the proposed modernization and addition becomes apparent. As has been indicated, nearly all of the adverse impacts associated with the proposed project would occur as a result of the construction activity rather than the operation of the completed facility. The payoff for acceptance of these temporary problems is great and includes:

- significant improvements in the quality of inpatient and outpatient care;
- a drastic extension of the useful life of the hospital; and
- the continuation of medical education programs that are important to the local community.

The proposed project would foreclose very few future options. It would be possible to list such things as alternative uses for the building materials or the petroleum products consumed, but the amounts of such things that are involved are so minute, relative to the supply, that the action would contribute extremely little to overall consumption of the various items.

Theoretically, the structure could be razed at any time and the land returned very nearly to its present state or converted to some other use. Realistically, however, it is unlikely that such a major investment would be abandoned for some time. Hence, construction of the project probably means that most of the area physically occupied by the hospital and its support facilities would be pre-empted from alternative uses for at least 25 to 30 years. Unlike typical private development of a like area, however, ownership of the land would not be fragmented. This means that the Federal Government would retain considerable latitude when it comes to altering use of the site if future conditions warrant it.
IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES
The purpose of this Chapter is to identify the irrevocable effects that the proposed renovation of Tripler Hospital would have on human, natural and socio-economic resources. With regards to this concern, it is important to state again that the focus of the proposed project is principally on the renovation and modernization of the existing complex, with some expansion of medical and support facilities. The project does not involve the substantial construction of new facilities or significant qualitative or quantitative changes in land use. Therefore, it would not substantially alter the existing environment or generate considerable additional long-term employment or other economic effects.

As stated in Section IV, the Office of the Surgeon General has indicated that no net increase in labor needs for the operation and maintenance of TAMC is expected as a result of the project. Hence, the need for additional labor would exist only during the actual period of renovation and in the construction of improvements. The project would require an average construction labor force of some 600 persons during the estimated four-year construction period. This temporary construction labor requirement, which represents only 2.5 percent of the State's total 1976 construction employment, could be filled almost entirely from the local labor pool. Oahu, and the State in general, are currently experiencing relatively high unemployment rates in the construction industry. Because of this, it is anticipated that an adequate construction work force will be available for the duration of the Tripler modernization program. Further, the local construction labor pool is large enough so as to preclude the need for importation of a significant number of workers from outside the State. Given the inelasticity in the construction labor supply caused by the willingness of construction workers to suffer through relatively long periods of unemployment or underemployment rather than abandon the industry for another one, it appears reasonable to believe that many of the workers needed for its construction would not find a productive use for their time if the Tripler project were not undertaken.

With respect to material resources, the project is not unlike most other renovation/construction projects in that there would be an irretrievable commitment of common construction materials (wood, steel, aggregates, etc.). The project is relatively small in scale, and would not cause a serious depletion of materials on Oahu. No scarce metals would be utilized or consumed other than those which are an integral part of certain medical equipment. Wood and steel would be used and would be supplied from stocks imported to the Islands. The project would, of course, have a long-term energy requirement, and most of this would be derived from the combustion of fossil fuels, mostly petroleum.

It is not anticipated that the proposed project would have a significant adverse impact on cultural and natural resources. The renovations and
site improvements would not disturb or destroy any known archaeological sites nor would they disrupt family life patterns or require the relocation of families from the site.

Also, there would be no significant or lasting new social or economic effect on the surrounding community. Some existing open space would be lost because of the construction of additional parking areas and service drives; however, the general character and low density environment of the area would be maintained. The renovations would have little long-range effect on the existing flora and fauna found on and around the site.
OTHER INTERESTS AND CONSIDERATIONS OF FEDERAL POLICY THAT OFFSET THE ADVERSE ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION

COUNTERVAILING BENEFITS OF THE PROPOSED ACTION
COUNTERVAILING BENEFITS OF ALTERNATIVES
Chapter IX

OTHER INTERESTS AND CONSIDERATIONS OF FEDERAL POLICY
THAT OFFSET THE ADVERSE ENVIRONMENTAL EFFECTS OF THE
PROPOSED ACTION

COUNTERVAILING BENEFITS OF THE PROPOSED ACTION

The vast majority of the potential adverse impacts that have been identi­
fied and discussed in the preceding chapters are short-term ones and are
the result of construction activities rather than the ongoing operation of
the completed facility. Hence, while there is no denying that noise, dust,
temporary dislocations, and other project-related effects could have a
measurable adverse impact on the hospital's performance during the con­
struction period unless they are carefully monitored and controlled, the
potential negative impacts are relatively minor in comparison to the benefits
that the proposed improvements would bring.

In a hospital, success or failure is measured in terms of life and death,
and it often hinges on such things as the availability of specific pieces of
equipment, the ability to maintain a sterile environment, and quick access
to emergency life-support systems. Inspecting agencies and commissions
have repeatedly found fault with the present facilities at TAMC, and the
situation is worsening as more and more of the hospital's features become
outdated or simply worn out. Indications are that this deterioration cannot
continue much longer if TAMC is to continue to receive accreditation from
the Joint Commission on Hospital Accreditation. Loss of this would pre­
clude use of the hospital for medical training and cause considerable prob­
lems for the State's medical education programs. Implementation of the
proposed project would result in a hospital designed to provide the highest
possible quality of medical care.

COUNTERVAILING BENEFITS OF ALTERNATIVES

Alternative means of achieving the desired objectives were discussed in
Chapter V of this report. As indicated there, many of the beneficial
effects that would result from the proposed project could be obtained from
a new hospital constructed on a different site. None of the other available
sites is as well situated as TAMC with respect to the user population or
support facilities. Moreover, all of the alternative sites would require
construction of an entirely new complex rather than continued use of the
existing one. This, in turn, would entail a significantly greater amount of
sitework and disruption to the existing natural environment than would the
proposed project. Thus, while a similar health care facility could be
constructed elsewhere, when compared with the proposed project, it would
not provide service of equivalent quality, would cost more, and could have
greater long-term effects on the surrounding environment.
The one advantage that new construction alternatives have over the proposed renovation and expansion is that they would minimize adverse construction-related effects on hospital patients and staff. In particular, construction of an entirely new hospital on a new site would eliminate the possibility that noise, dust, and other construction-related problems would interfere with the ongoing operation of the hospital. It is believed that, given the application of the mitigating measures outlined in Chapters IV and VI, this single advantage is of limited significance and is more than offset by the considerations listed above.
REFERENCES
REFERENCES


(1977b). Tripler Army Medical Center Hospital Addition/Alteration Project: Special Study Final Draft - Site Traffic. Author: Honolulu.

(1977c). Tripler Army Medical Center Hospital Addition/Alteration Project: Special Study Final Draft - Solid Waste. Author: Honolulu.


Department of the Army, Tripler Army Medical Center (January 1975). Environmental Impact Assessment: Upgrading Health Care Facilities at Tripler Army Medical Center, Oahu, Hawaii. Author: Honolulu.


First Hawaiian Bank (monthly). Economic Indicators. Author: Honolulu.


Chapter X
Hawaii, State of, Department of Health (1972a). *Public Health Regulations, Chapter 42, Ambient Air Quality Standards.*

_______ (1972b). *Public Health Regulations, Chapter 43, Air Pollution Control.*

Hawaii, State of (1975). Department of Labor and Industrial Relations, Division of Occupational Safety and Health. *Occupational Safety and Health Standards, Rules, and Regulations with changes and addenda.*


_______ (yearly). *Data Book.* Author: Honolulu.


Chapter X

6


Chapter X 7


APPENDICES

APPENDIX A. VENTILATION DESIGN CRITERIA FOR ARMY MEDICAL FACILITIES
APPENDIX B. NOISE SOURCES AND SPECIFIC CONSTRUCTION OPERATIONS
APPENDIX C. ACOUSTIC DESIGN CRITERIA FOR ARMY MEDICAL FACILITIES
APPENDIX D. SPECIES OBSERVED OR CAUGHT AT MOANALUA COLLECTING SITES
APPENDIX E. COORDINATION
## Appendix A. VENTILATION DESIGN CRITERIA FOR ARMY MEDICAL FACILITIES

### Table II

**DESIGN CONDITIONS FOR SPECIFIC AREAS**

<table>
<thead>
<tr>
<th>Area Designation</th>
<th>Room Pressure (1)</th>
<th>Minimum Total Air Supply, CH/HR (2)</th>
<th>Minimum Outside Air Supply, CH/HR (3)</th>
<th>Intermediate Filtration % Efficiency (4)</th>
<th>Final Filtration % Eff. (OP Test) (5)</th>
<th>MUST Exhaust to Outdoors</th>
<th>Recirculation Within Room Permitted</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Anesthesia Storage</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>2. Animal Room</td>
<td>--</td>
<td>15</td>
<td>15</td>
<td>78</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>3. Autopsy, Morgue</td>
<td>-</td>
<td>15</td>
<td>3</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>4. Bathrooms, All</td>
<td>v</td>
<td>10</td>
<td>0</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>5. Central Medical Supply</td>
<td>-</td>
<td>8</td>
<td>2</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Solled/Decomment Room</td>
<td>-</td>
<td>6</td>
<td>2</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Clean Wardroom</td>
<td>+</td>
<td>4</td>
<td>1</td>
<td>90</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Unsterile Supply Storage</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Sterile Supply Storage</td>
<td>+</td>
<td>6</td>
<td>2</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>6. Corridors</td>
<td>-</td>
<td>6</td>
<td>2</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Patient Areas</td>
<td>-</td>
<td>12</td>
<td>3</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Surgery, OB, Nursery</td>
<td>+</td>
<td>4</td>
<td>1</td>
<td>90</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>7. Change Rooms</td>
<td>-</td>
<td>25</td>
<td>5</td>
<td>90</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Surgery, OB, Nursery</td>
<td>+</td>
<td>6</td>
<td>2</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>8. Delivery Room</td>
<td>++</td>
<td>6</td>
<td>2</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>9. Emergency Room</td>
<td>-</td>
<td>6</td>
<td>2</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>10. Exam/Treat. Dental</td>
<td>-</td>
<td>8</td>
<td>3</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Clinics</td>
<td>+</td>
<td>8</td>
<td>3</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Hospitals</td>
<td>-</td>
<td>8</td>
<td>3</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>11. Exam/Treat. Medical</td>
<td>0</td>
<td>6</td>
<td>2</td>
<td>78</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>12. Food Service</td>
<td>-</td>
<td>10</td>
<td>2</td>
<td>78</td>
<td>No</td>
<td>Yes</td>
<td>(9)</td>
<td></td>
</tr>
<tr>
<td>Dining</td>
<td>+</td>
<td>10</td>
<td>2</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>(9)</td>
<td></td>
</tr>
<tr>
<td>Food Preparation</td>
<td>-</td>
<td>10</td>
<td>2</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>(9)</td>
<td></td>
</tr>
<tr>
<td>Food Service</td>
<td>+</td>
<td>10</td>
<td>2</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>(9)</td>
<td></td>
</tr>
<tr>
<td>Dry Storage</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>(9)</td>
<td></td>
</tr>
<tr>
<td>Dishwashing</td>
<td>-</td>
<td>10</td>
<td>0</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>(9)</td>
<td></td>
</tr>
<tr>
<td>13. Intensive Care</td>
<td>++</td>
<td>12</td>
<td>5</td>
<td>90</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>14. Isolation Bedroom Normal</td>
<td>--</td>
<td>12</td>
<td>5</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>(7)</td>
</tr>
<tr>
<td>15. Isolation Anteroom Normal</td>
<td>-</td>
<td>12</td>
<td>5</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>(7)</td>
</tr>
<tr>
<td>16. Janitor's Closet</td>
<td>-</td>
<td>10</td>
<td>0</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>(5)</td>
</tr>
<tr>
<td>Laboratory, General</td>
<td>-</td>
<td>6</td>
<td>2</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>(2)</td>
</tr>
<tr>
<td>Laboratory, Special</td>
<td>-</td>
<td>6</td>
<td>2</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>(2) &amp; (8)</td>
</tr>
<tr>
<td>19. Linen/Trash Room</td>
<td>-</td>
<td>10</td>
<td>0</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>20. Linen, Soiled Sort Storage</td>
<td>--</td>
<td>12</td>
<td>4</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>21. Linen, Clean Sort Storage</td>
<td>+</td>
<td>4</td>
<td>2</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>22. Nurse's, General</td>
<td>++</td>
<td>12</td>
<td>3</td>
<td>90</td>
<td>99.97</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>23. Nurse's, Special</td>
<td>++</td>
<td>12</td>
<td>3</td>
<td>90</td>
<td>99.97</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>24. Operating Room</td>
<td>++</td>
<td>25</td>
<td>5</td>
<td>90</td>
<td>99.97</td>
<td>No</td>
<td>No</td>
<td>(9)</td>
</tr>
<tr>
<td>25. Patient Rooms</td>
<td>0</td>
<td>6</td>
<td>2</td>
<td>78</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>26. Pharmacy</td>
<td>+</td>
<td>4</td>
<td>2</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>27. Physical &amp; Hydrotherapy</td>
<td>-</td>
<td>6</td>
<td>2</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>28. Recovery Room</td>
<td>++</td>
<td>12</td>
<td>5</td>
<td>90</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>29. Refuse Room</td>
<td>--</td>
<td>10</td>
<td>0</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>(5)</td>
<td></td>
</tr>
<tr>
<td>30. Special Procedures Room</td>
<td>--</td>
<td>25</td>
<td>5</td>
<td>90</td>
<td>99.97</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

Chapter XI


<table>
<thead>
<tr>
<th>Area Designation</th>
<th>Room Pressure (1)</th>
<th>Minimum Total Air Supply, Ch/hr (2)</th>
<th>Minimum Outside Air Supply, Ch/hr (2)</th>
<th>Intermediate Filtration Eff. (3)</th>
<th>Final filtration % Eff. to Outdoors (4)</th>
<th>MUST Exhaust to Outdoors</th>
<th>Recirculation Permitted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sterilizer Room</td>
<td>0</td>
<td>10</td>
<td>2</td>
<td>78</td>
<td>Yes</td>
<td>No</td>
<td>(10)</td>
</tr>
<tr>
<td>Utility Room, Clean</td>
<td>+</td>
<td>4</td>
<td>2</td>
<td>78</td>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Utility Room, Bulled</td>
<td>-</td>
<td>4</td>
<td>2</td>
<td>78</td>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>X-Ray, Fluoroscopy</td>
<td>-</td>
<td>6</td>
<td>2</td>
<td>78</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>X-Ray, Diagnostic/ Treatment</td>
<td>0</td>
<td>6</td>
<td>2</td>
<td>78</td>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**

(1) Room Pressure:
- Room exhaust and/or return 25% less than supply.
- Room exhaust and/or return 10% less than supply.
- Room exhaust and/or return equal to supply.
- Room exhaust and/or return 10% more than supply.
- Room exhaust and/or return 25% more than supply.

(2) Ventilation rates are considered the minimum required for normal health and comfort consideration. Additional air may be required for temperature, dilution, and odor control, as well as air requirements for such items as hoods, glove boxes, clean-air stations, combustion apertures, and dust collectors.

(3) Air systems for all areas in medical facilities, except dedicated systems for refuse rooms, general storage areas, electrical/chemical spaces, shall be provided with filters having an average dust spot efficiency of 78%, tested in accordance with ASHRAE standard 52-76. Filter banks shall be located in mechanical spaces down-stream of major air handling equipment, such as fans, coils, washers, high/flow, etc. All fresh air and return air shall have 78% efficient filters up-stream of major air handling equipment and shall be tested in accordance with ASHRAE Standard 52-76.

(4) Rooms or areas requiring high (95%) and ultra high (99.97%-HEPA) filtration efficiencies shall be provided with filter banks in addition to system filters, as indicated. These filter banks shall be placed downstream of all duct-installed equipment and shall be tested, after installation, using the DOP method for efficiency performance. Duct-work downstream of high or ultra-high efficient filter banks, and supply diffusers and grills shall be made of stainless steel, or other non-corrosive material compatible with the cleaning agents used in maintaining the area.

(5) Air supply will, in general, be obtained from adjacent areas; mechanical exhaust will be provided.

(6) See DOD Manual 4270.1-M for additional requirements.

(7) Supply and exhaust volumes shall be designed to maintain the pressure relationship between the isolation room and the anteroom to the adjacent areas.

(8) Special laboratories include media transfer, viral specimen preparation, egg inoculation, tissue cultures, and nuclear.

(9) Oral Surgery Rooms in hospitals will be treated as medical operating rooms. Dental clinics operating in conjunction with a service general hospitals will be provided with Oral Surgery Rooms; however, filtration will be 30%, ASHRAE Dust Spot Intermediate, in lieu of 99.97% for Oral Surgery Rooms, in hospitals.

(10) Special hoods shall be provided to entrapping and exhaust heat and moisture from autoclaves and sterilizers.

**TABLE II**

**DESIGN CONDITIONS FOR SPECIFIC AREAS**

---

Chapter XI

4
# Appendix B. NOISE SOURCES AND SPECIFIC CONSTRUCTION OPERATIONS

<table>
<thead>
<tr>
<th></th>
<th>Flat Rollers</th>
<th>Rock Drill &amp; Splitter</th>
<th>Drill Auger</th>
<th>Power Shovel</th>
<th>Crane</th>
<th>Power Saw</th>
<th>Concrete Pumps</th>
<th>Diesel</th>
<th>Gas or Electric Site Mixer</th>
<th>Concrete Pressure Creep</th>
<th>Gas Waterer</th>
<th>Electric Trowel</th>
<th>Vibrating Screed</th>
<th>Mechanical Trowel</th>
<th>Electr. Pumps</th>
<th>Conveyors (Electric)</th>
<th>Conveyor (Gas)</th>
<th>Nail Gun &amp; Compressor</th>
<th>Pre-Tension Off-Site</th>
<th>Staple Gun &amp; Compressor</th>
<th>Tarring</th>
<th>Insulation Blowing</th>
<th>Welders</th>
<th>Pipe Threaders</th>
<th>Power Drills</th>
<th>Steel Sheets</th>
<th>Asphalt Paver</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>dBA at 15m</strong></td>
<td>78 98</td>
<td>71 83 89 82</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demolition (Upper Structure)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demolition (Foundation)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Removal of Material From Site</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clearing and Grading Trees and Brush</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clearing and Grading Rock Removal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth Removal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grading</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excavation &amp; Draining</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utilities Placement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Backfilling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compacting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slabs on Soil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foundation Excavation Hauling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pile Driving and Caisson</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foundation Forming</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete Supply</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete Transfer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pouring and Finishing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material Supply</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material on Building</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exterior Work Masonry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roofing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exterior Siding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interior</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground Preparation &amp; Sprinkler System</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curbing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roads</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------</td>
<td>--------------</td>
<td>---------------</td>
<td>----------</td>
<td>------------</td>
<td>-----------</td>
<td>------------------</td>
<td>--------------</td>
<td>-------------------</td>
<td>----------</td>
<td>----------------</td>
<td>----------------------</td>
<td>------------</td>
<td>--------------</td>
<td>-------------------</td>
<td>-------------</td>
<td>-----------</td>
<td>----------</td>
<td>-------------------</td>
<td>--------</td>
<td>-----------</td>
<td>-------------</td>
<td>----------------</td>
<td>----------------------</td>
<td>----------------</td>
<td>----------------</td>
<td>----------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>dBa at 15m</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dBa at 15m</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dBa at 15m</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Appendix C. Acoustic Design Criteria for Army Medical Facilities

### Table: Acoustical Requirements

<table>
<thead>
<tr>
<th>SPACE TYPES</th>
<th>AMBIENT NOISE LEVELS</th>
<th>PRIVACY</th>
<th>VIBRATION SENSITIVITY</th>
<th>QUIET REQUIRED</th>
<th>NON-CRITICAL BUFFER SPACE</th>
<th>HIGH NOISE LEVELS</th>
<th>SOUND ABSORPTION RECOMMENDED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MC 25 - MC 30</td>
<td>Not Critical</td>
<td>Confidential</td>
<td>Privacy</td>
<td>Not Critical</td>
<td>Critical</td>
<td>Moderate</td>
</tr>
<tr>
<td>OUTPATIENT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exam &amp; Treatment Rooms</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Interview Room</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECG &amp; Endoscopic Rooms</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consultation</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharmacy Dispensing</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency Room</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYSICAL MEDICINE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrotherapy Area</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupational Therapy</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical Therapy</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrective Therapy</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exercise &amp; Treatment Areas</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RADIOLOGY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Therapy Rooms</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Film Processing Room</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>SURGERY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Room</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Recovery Room</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Chapter XI
<table>
<thead>
<tr>
<th>SPACE TYPES</th>
<th>AMBIENT NOISE LEVELS</th>
<th>PRIVACY</th>
<th>VIBRATION SENSITIVITY</th>
<th>ACTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NC 25 - NC 30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NC 30 - NC 35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NC 35 - NC 40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nursing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient Bedroom</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient Ward</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toilet</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tub &amp; Shower</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dayroom</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exam &amp; Treatment Rooms</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nurses' Station</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICU &amp; CCU</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doctors' Dictation</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obstetrics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labor Room</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delivery Room</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recovery Room</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orthopedics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brace &amp; Workshops</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cast Room</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Chapter XI
### Table: Acoustical Requirements

<table>
<thead>
<tr>
<th>SPACE TYPES</th>
<th>AMBIENT NOISE LEVELS</th>
<th>PRIVACY</th>
<th>VIBRATION SENSITIVITY</th>
<th>ACTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EQL 30</td>
<td>EQL 35</td>
<td>EQL 40</td>
<td>Noise Critical</td>
</tr>
<tr>
<td>Laboratory Areas [Clinical &amp; Research]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EGG Room</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electron Microscope Areas</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preparation Areas</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class Washing</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autopsy &amp; Necropsy Areas</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morgue</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal Holding</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laundry</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean &amp; Soiled Linen Storage Areas</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laundry Processing Room</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neurology</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group Therapy Room</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interview Room</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Newborn</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nurseries</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formula Room</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


**NOTE:** dB(A) _ NC level +5.
Vegetation at station consisted of a few recently planted coconut palms and ironwood. Shores of Mokapu and Kahakole streams opposite station were unvegetated. East shore had mangrove also.

Mangrove thicket on shore. Blue pincher crab Thalamita crenata 1 Encrusting and filamentous algae on rubble and snags. Eagle ray Aetobatus narinari observed Mullet Mugil cephalus observed Barracuda Sphyraena barracuda 1 Tilapia T. nilotica sp. Thousands seen Live-bearers Poecilia latipinna observed Ruddy turnstones Arenaria interpres observed Black-crowned night heron Nycticorax nycticorax hoactli observed

Mangrove thicket on shore. Wide variety of fouling organisms in pilings. Dominant species near water surface was acorn barnacle, Balanus Sp., of thick branching algae. Zone below algae dominance was covered by orange sponge, principally Rosenvingea Mycale intricata. Crab Peronan abbreviatum 3 Crabid crab Planes minutus 2 Mantis shrimp Squilla oratoria 2 Eagle ray Aetobatus narinari observed Mullet Mugil cephalus observed Yellowfin croaker Seriola dorsalis observed Tilapia T. nilotica sp. Thousands observed Live-bearers Poecilia latipinna observed Ruddy turnstones Arenaria interpres observed Black-crowned night heron Nycticorax nycticorax hoactli observed

Vegetation at station consisted of a few recently planted coconut palms and ironwood. Shores of Mokapu and Kahakole streams opposite station were unvegetated. East shore had mangrove also.
Station | Vegetation | Animals | No. Collected
---|---|---|---
5 | East bank reveted. West bank south of bridge had mixture of mangrove, kiawe, and haole koa. Rubble on stream bottom, north of bridge is denuded soil with occasional mangrove or haole koa sprouting. | Bridge Supports and shore revetments covered by acorn barnacles at water level. Species list same as station 4. | 
6 | Banks south of bridge recently denuded but with California grass, Pluchia sp., Batis sp., haole koa, and mangrove returning. | Same species as station 3. | 
7 | Both banks dominated by California grass with occasional haole koa and mangrove. | Tilapia, Live-bearers, Aholehole | 
8 | Beneath bridge, California grass clogs cement channel upstream. Army started clearing channels upstream from station while we collected. | Same species as station 3. | 
9 | West bank is revetment. East bank was eroded soil and start of revetment that continued north. | Tilapia, Live-bearers, Aholehole | 
10 | Both banks were revetments. Occasional mangrove rooted in gravel streamed. | Same species as station 3. | 
11 | Banks dominated by California grass, haole koa, but no mangrove present. | Hawaiian prawn, Macrobrachium grandimanus, Tilapia, Pocelliidae, Eleotris sandwicensis | 
12 | Lined channel that is half-filled with California grass. | Tilapia, Live-bearers, Aholehole | 

APPENDIX E. COORDINATION

A-95 CONSULTATION PROCESS

As part of the planning process for this project, prior to completion of the Draft Environmental Impact Statement, appropriate State and County agencies were notified on November 6, 1976. This review was in accordance with procedures established by the Area-wide Clearing House (Department of General Planning, City and County of Honolulu), pursuant to the provisions of OMB Circular No. A-95. All of the organizations that responded indicated either that they concurred with the proposal or that it was not related to their activities in any way.

SUMMARY OF COMMENTS AND RESPONSES RELATING TO DRAFT EIS

The Draft Environmental Impact Statement was delivered to the Council on Environmental Quality on 22 June 1979, and notice of its availability was published in the Federal Register of 28 June 1979. Following a 45-day review period, letters were received from the agencies and organizations listed below. Their comments are summarized and responded to in the following pages. Reproductions of their letters and the responses that were sent are also attached.

LIST OF AGENCIES COMMENTING ON THE DRAFT EIS

FEDERAL AGENCIES

- U.S. Fish and Wildlife Service, Hawaii
- U.S. Fish and Wildlife Service, Oregon
- Headquarters, Naval Base Pearl Harbor
- Headquarters, 15th Air Base Wing, Hickam Air Force Base
- U.S. Department of Agriculture, Soil Conservation Service
- U.S. Environmental Protection Agency

STATE AGENCIES

- Office of Environmental Quality Control
- Department of Transportation
- Department of Defense
- Department of Agriculture
- Department of Health
- Department of Accounting and General Services
- Department of Education
- Department of Land and Natural Resources

CITY AND COUNTY AGENCIES

- Board of Water Supply
- Department of General Planning
- Department of Land Utilization
- Department of Public Works
- Department of Housing and Community Development
- Department of Parks and Recreation
- Department of Transportation Services
SUMMARY OF COMMENTS ON THE DRAFT EIS

FEDERAL AGENCIES

Agency: U.S. Fish and Wildlife Service, Hawaii
Comment: They determined that the proposed project will have little, if any, adverse impact on fish and wildlife resources.

Agency: U.S. Fish and Wildlife Service, Portland
Comment: They concur with the conclusion reached in the DEIS that no endangered or threatened plants or animals, listed or proposed, would be affected by the proposed project.

Agency: Headquarters, Naval Base Pearl Harbor
Comment: They requested modifications to some sections of Chapter V regarding alternate sites, in order to make these sections conform to the Department of Defense land use policies as promulgated by the Military Property Requirements in Hawaii study, and conform with the explosive safety terminology and public statement policy normally used for ammunition areas.
Response: The requested changes have been made in the Final Environmental Impact Statement.

Agency: Headquarters, 15th Air Base Wing, Hickam Air Force Base
Comment: They have no comments to offer.

Agency: U.S. Department of Agriculture, Soil Conservation Service
Comment: They have no comments to offer.

Agency: U.S. Environmental Protection Agency
Comment: EPA has no objection to the proposed action and has classified the DEIS as adequate.
Comment: Diplomatic personnel who use TAMC services should have been included on Table II-1.

Response: The number was so small (average 14 visits a year) it was not included.

Comment: Further discussion of waste disposal was requested.

Response: At present, all wastes, except tissue wastes which are cremated, are disposed of at the Schofield Barracks landfill. Special handling of the infectious portion of these wastes includes placement in two plastic bags at TAMC and transport in compactors. On October 1, 1980, a new waste disposal contract will go into effect and all wastes, except tissue wastes, will either be disposed of at the City and County's Waipahu incinerator or at the privately-owned Puu Palailai Landfill. This course of action has been approved by the State Department of Health. The proposed project would not increase waste generation or affect any of these procedures.

Comment: The use of air quality data recorded at Aliamanu was questioned.

Response: The primary point of using this data was to show the kinds of pollutant concentration that might be present at TAMC. Since existing air pollutant concentrations are almost certainly higher at Aliamanu than at TAMC, and air quality standards are not violated there, it follows that they would not be violated at TAMC either. The proposed project would not significantly alter the concentration of air pollutants in the vicinity so a more detailed air quality study was deemed inappropriate.

Comment: A discussion of helicopter noise was requested.

Response: Existing helicopter noise levels would not be affected by the proposed project. In the absence of any projected noise impact, it is believed that a detailed description of existing helicopter-related noise is not warranted in the EIS.

Comment: They wished to see a discussion of traffic impacts on Jarrett White Road at non-peak hours, as well as a discussion of the use of Army buses for military personnel.

Response: There would only be construction-related increases in traffic, and no long-term increase due to the project. Since present and proposed roads and parking layout are capable of handling the peak-hour conditions, it follows that they are adequate for off-peak conditions as well. No change in the use of Army buses is expected as a result of the project.

Comment: A discussion of the odor from the sewer system along Jarrett White Road was requested.

Response: The proposed project would not affect sewage flows from the TAMC facility. However, the Army is aware of the existing odor
problem, and has commissioned a study aimed at determining its cause and identifying possible solutions to it.

Comment: They recommended that the discussion of land use policies include the Coastal Zone Management policy.

Response: The State's Coastal Zone Management Policy has been reviewed. The proposed project appears to be fully consistent with it.

Agency: Department of Transportation

Comment: They have no comments to offer.

Agency: Department of Defense

Comment: They have no comments to offer at this time.

Agency: Department of Agriculture

Comment: They have no comments to offer.

Agency: Department of Health

Comment: On the basis that the project will comply with all applicable Public Health Regulations, they have no objections to the project. However, they reserve the right to impose environmental restrictions on the project at the time final plans are submitted for their review.

Agency: Department of Accounting and General Services

Comment: They state that the project will not have any adverse environmental effect on any existing or planned facilities serviced by their department.

Agency: Department of Education

Comment: They noted a report on flood damage reduction for Moanalua Stream; otherwise, they had no comments to offer.

Agency: Department of Land and Natural Resources

Comment: The DEIS was found adequate as a disclosure document with respect to wildlife except that impacts on Pacific golden plover, and the Hawaiian owl, or pueo, were not discussed.

Response: The pueo was added to the list of animals possibly present on the TMC reservation (see Table II-9). The impact of the project on all the bird species present there is discussed on page IV-31 of the Draft EIS.
Comment: The department requested a listing of the aquatic organisms in Moanalua Stream that may be potentially impacted.

Response: A list compiled by the U.S. Fish and Wildlife Service, of species observed in and around the stream, is attached as an Appendix.

Comment: They suggested that the discussion of the disposal and handling of infectious solid wastes could be supplemented. They also noted that a discussion of drug control, handling of toxic materials, and radiation hazards was lacking.

Response: Since the proposed project would not involve any change in the amount of infectious wastes generated at TAMC or in the methods that are used to handle or dispose of it, the topic is not covered in detail in the DEIS. Present practices at TAMC relating to drug control, toxic materials, radiation, and other hazards conform to all applicable Federal, State, and County laws and regulations; this would continue following implementation of the proposed project.

CITY AND COUNTY AGENCIES

Agency: Board of Water Supply

Comment: They recommend that the Army dispose of its infectious wastes either by incineration or at a landfill where there is no possibility of contaminating potable groundwater resources.

Response: The Army will start a new solid waste contract on October 1, 1980. After that date it is planned that all of the TAMC wastes, except tissue wastes which are cremated, will be disposed of at either the City and County's Waipahu Incinerator or the Puu Palailai Landfill. This course of action was satisfactory to the Department of Health, who had conferred with the Board of Water Supply on the matter.

Agency: Department of General Planning

Comment: Quantification of the volume of traffic on Apana Street that was going between Tripler and Fort Shafter was requested.

Response: Informal observations suggest that during the afternoon peak hour, approximately ten percent of the traffic leaving TAMC, or less than 75 vehicles, turn left onto Apana Street.

Comment: A discrepancy in the numbers for parking spaces was noted.

Response: The EIS has been changed to show the correct figures.

Comment: Average daily water use for hospital operations and for the housing and other support functions are not indicated. The capacities of pumps in Pump House No. 1 are not given.

Response: The proposed project would not affect the amount of water used at TAMC, and no significant changes to the water supply system are contemplated or necessary as part of the project. Hence, the
discussion in the EIS of the existing water supply, storage, and distribution system was purposely brief.

**Comment:** Ownership information was requested for the land on which the upper reservoir is located and for the conservation-zoned lands along portions of the TMC border.

**Response:** The land around and leading to the reservoir is owned and maintained by the Army. The conservation-zoned lands adjacent to TMC are owned by the Samuel M. Damon Trust Estate.

**Comment:** A lack of discussion of the impact of the proposed project on the State Health Planning and Development Agency plans was noted.

**Response:** During the A-95 consultation process, the State Health Planning and Development Agency (SHPDA) was contacted in an attempt to determine what, if any, impacts the proposed addition and renovation project would have on its plans. The agency's response noted that persons eligible for treatment at TMC often use civilian facilities for some of their medical services, that this complicates its task. It went on to state that they "are unable to accurately predict the effect this project will have [on their plans]..." In view of this uncertainty, the impacts that the proposed project would have on the achievement of SHPDA's plans could not be discussed in the EIS.

**Agency:** Department of Land Utilization

**Comment:** The use of 50-year, rather than 100-year, flood flows was questioned. Information on the difference in run-off volume between the 50-year and 100-year event and comparison of the 100-year flow with the estimated capacities of the drainage system was requested.

**Response:** Because the City and County's storm drainage standards for basins smaller than 100 acres are based on 50-year flows, the DEIS discussed these, rather than 100-year flows. The differences in rainfall, and runoff (if other factors in the equation remain constant), is about ten percent. This amount of increase, at the location where flow would be affected by the proposed project (drainage basin No. 2), would not cause its capacity to be exceeded. However, this increase could slightly aggravate problems at the few locations where occasional flooding already occurs.

**Agency:** Department of Public Works

**Comment:** Completion of the Moanalua Gardens, Unit 7, Subdivision Relief Drain, which was designed to handle the flows from TMC, was noted. Capacity at the Sand Island Sewage Treatment plant was declared adequate to handle the flows from TMC. The question of the Army's payment of sewer user charges to the City was raised.

**Response:** The Navy has the authority from the Department of Defense to negotiate such matters as sewage user charges (including TMC's). It has been negotiating with the City and County of Honolulu, and it is hoped that this matter will be settled in the near future.
Agency: Department of Housing and Community Development

Comment: They have no comments to offer.

Agency: Department of Parks and Recreation

Comment: They have no objections to the project.

Agency: Department of Transportation Services

Comment: They found that the traffic issues were adequately addressed.

UNIVERSITY OF HAWAII

Agency: Environmental Center

Comment: They thought the statement adequately addressed the environmental impacts of the proposed project.

Agency: Water Resources Research Center

Comment: Comparisons between the 1945 and 1969 pump tests were questioned.

Response: It was not intended that these rates be compared. The discussion in the final EIS will be reworded to make that clearer.

Comment: The use of the 100-year flood flow or 1/2 the probable maximum flood flow as design criteria was suggested.

Response: This general comment regarding the appropriateness of the City's drainage standards raises issues beyond the scope of the EIS.
Re: Draft EIS for Tripler Army Medical Center, Hospital Addition/Alteration Project, Oahu, Hawaii

Dear Sirs:

We have reviewed referenced Draft Environmental Impact Statement and determined that the proposed project will have little if any adverse impacts on fish and wildlife resources. In view of this we have no additional comments to offer.

We appreciate this opportunity to comment.

Sincerely yours,

Maurice H. Taylor
Field Supervisor
Division of Ecological Services

Office of Environmental Quality Control
550 Hakauiwa Street, Room 301
Honolulu, Hawaii 96813

Mr. Maurice H. Taylor
Field Supervisor
Division of Ecological Services
United States Department of the Interior
300 Ala Moana Boulevard
P.O. Box 50167
Honolulu, Hawaii 96850

Dear Mr. Taylor:

Draft Environmental Impact Statement for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center.

Thank you for your letter of July 16, 1979 regarding the Draft Environmental Impact Statement for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center. We are pleased that you found the document adequately addressed your concerns.

Sincerely,

Thomas A. Smith
SFC (P), USA
Adjutant

TAS:FW:cld
In reply refer to:
AFA-SE

Mr. R. Kahler Martinson
United States Department of the Interior
Fish and Wildlife Service
Lloyd 500 Building, Suite 1692
500 N.E. Multnomah Street
Portland, Oregon 97232

Dear Mr. Martinson:

Thank you for your department’s letter of 1 October 1979 (your reference AFA-SE) regarding the Draft Environmental Impact Statement for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center. We are pleased that you found the document adequately addressed your concerns.

Sincerely,

Thomas A. Smith
SFC (P), USA
Adjutant

TAS/PJM:cld
From: Commander Naval Base, Pearl Harbor
To: Division Engineer, U. S. Army Engineer Division, Pacific Ocean
Subj: Draft Environmental Impact Statement (DEIS) Hospital Addition/Alteration Project, Tripler Army Medical Center, Oahu, Hawaii, March 1978 (Revised December 1978)

Enc: (I) Proposed modification regarding NAVMAG Lualualei

1. The subject DRAFT EIS, which was transmitted on 11 July 1979 by the Office of Environmental Quality Control, State of Hawaii, has been reviewed, and the following comments are submitted:

a. It is noted that the Army's own Helemano site evaluated on page 4 of Chapter V is considered 100 percent utilized in MILPRO-HI (Military Property Requirements in Hawaii) and is, therefore, presumably not available for a hospital.

b. Enclosure (I) provides proposed modifications to those paragraphs evaluating alternate sites at Naval Magazine, Lualualei and Bellows Air Force Station. The modifications are necessary in order to make these sections conform to the Department of Defense land use policies promulgated by MILPRO-HI and to conform with the explosive safety terminology and public statement policy normally used for ammunition areas.

2. It is requested that copies of the Final EIS be provided to this Command; Commander, Pacific Division, Naval Facilities Engineering Command; and Commanding Officer, Naval Magazine, Lualualei.

R. D. Eber
BY DIRECTION

Copy to: HQ Tripler Army Medical Center
Tripler AMC, Hawaii 96859
COMPAHNAVFACIHCOM
CO NAVMAG Lualualei

MODIFIED PARAGRAPHS

Chapter V, page 6

[Changes are in brackets]

This site is located in Lualualei Valley on the western shore of the Island of Oahu. It is the least accessible to patients and staff of all those examined. Only 2 percent of the potential patients and 4 percent of the present TAHC staff live within a 10-mile radius. Furthermore, port facilities are 20 to 25 miles away. Although topography and acreage are not constraints, all utilities are inadequate and would need upgrading.

The Caudill, Rowlett, Scott, Inc. study concluded that a replacement hospital at this site would be severely restricted. First, the proximity of the proposed tri-service ammunition storage depot would necessitate limitations on access and strict security measures. Second, the existence of the Lualualei Naval Radio Station on the western boundary of the site would require similar controls over radio frequency generating sources as those needed for the Helemano site. Clinical support facilities at Fort Shafter and the University of Hawaii are further from this site than any of the others, and new facilities for other support functions would need to be constructed. Finally, explosive safety quantity distance (ESQD) circles from ammunition magazines and operating buildings cover all but about 25 acres of the open buildable land at the Naval Magazine. Federal regulations preclude the construction of buildings extending for human occupancy within these circles. Both communications and ammunition-related functions will continue for the foreseeable future, so that the site is not considered a viable location for a major medical center.]
Bellows Air Force Station. Bellows Air Force Station is located on the eastern side of the island of Oahu, approximately 10 miles from downtown Honolulu. About 14 percent of the patient population and 23 percent of the staff population live within a 10-mile distance. Pearl Harbor and downtown Honolulu logistical support facilities are 12 to 17 miles away. Clinical support facilities are at Kaneohe Marine Corps Air Station, approximately 6 miles away, and the University of Hawaii, approximately 12 miles away.

Caudill, Roulet, Scott, Inc. found that, except for a 500-foot wide tsunami (tidal wave) inundation zone, the majority of the 1,493-acre site could be used for the hospital facility. Similarly, existing water and sewer lines were judged adequate for some of the hospital requirements, and an existing sewage treatment plan in the nearby community of Waimanalo could support the increased demand generated by the new hospital. Other electrical and communication lines would need upgrading.

A general aviation airport (was) proposed by the State of Hawaii for a 1,155-acre parcel located on the southern portion of the site, but the action was never completed. In any case, the Caudill, Roulet, Scott, Inc. study reported that this would place no significant development restrictions on the proposed hospital in terms of the amount of land available, since the airport would require only about ten percent of the total acreage. However, it also stated that a general aviation airport in such close proximity to a hospital facility could pose safety and operational problems and hamper MEDVAC operations. Similar problems could occur with the continued operation of the Marine Corps helicopter training facilities located on the northern portion of the site. Support facilities such as warehouses would be needed because the Bellows site is virtually undeveloped.

They concluded that the proposed hospital would be incompatible with the proposed general aviation airport for safety and operational reasons. In addition, the continued operation of the Air Force Communications Station requires measures to protect against radio interference similar to those required for the Helemano and Lualualei sites. The Marine Corps has also identified a continuing requirement for the whole of Bellows Air Force Station for training.

DEPARTMENT OF THE ARMY
HEADQUARTERS, TRIPPER ARMY MEDICAL CENTER
TRIPPER AMD, HAWAII 96859
July 14, 1980

Commander R. D. Eber
Headquarters, Naval Base Pearl Harbor
Box 110
Pearl Harbor, Hawaii 96860

Dear Commander Eber:

Thank you for your letter of 9 August 1979 (reference 002:09P: Jof/Ser 1599) regarding the Draft Environmental Impact Statement (DEIS) for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center. We appreciate the time spent by you and your staff reviewing the document.

As a result of your comments, the DEIS will be modified as follows before release as a Final Environmental Impact Statement.

1. The MILPRO-HI finding that Helemano Radio Receiving Station is considered fully utilized has been added at the bottom of page V-4.

2. The discussions of alternate sites at Naval Magazine, Lualualei and Bellows Air Force Station have been modified as you suggested.

If you have any further questions regarding the DEIS, please contact Mr. Steven Kim at 433-6693.

Sincerely,

Thomas A. Smith
SFC (P), USA
Adjutant
DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 15TH AIR BASE WING (PACAF)
HICKAM AIR FORCE BASE, HAWAII 96853

DEPARTMENT OF THE ARMY
HEADQUARTERS, TRIPLER ARMY MEDICAL CENTER
TRIPLER AFB, HAWAII 96859

15 AUG 1979

Director of Civil Engineering
Department of the Air Force
Headquarters, 15th Air Base Wing (PACAF)
Hickam Air Force Base, Hawaii 96853

Dear Sir:

Draft Environmental Impact Statement for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center

Thank you for your letter of August 15, 1979 regarding the Draft Environmental Impact Statement for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center. We are pleased that you found the document adequately addressed your concerns.

Sincerely,

Thomas A. Smith
SFC (P), USA
Adjutant

TAS:PJM:cld
August 21, 1979

Mr. Richard L. O'Connell
Director, Office of Environmental
Quality Control
550 Halekauwila St., Room 301
Honolulu, HI 96813

Dear Mr. O'Connell:

Subject: Draft Environmental Impact Statement for Hospital Addition
and Alteration Project, Tripler Army Medical Center

We have reviewed the subject draft environmental impact statement and
have no comments to offer.

Thank you for the opportunity to review this document.

Sincerely,

[Signature]

Jack P. Kanalz
State Conservationist

July 14, 1980

Mr. Jack P. Kanalz
State Conservationist
Soil Conservation Service
United States Department
of Agriculture
P. O. Box 50004
Honolulu, Hawaii 96850

Dear Mr. Kanalz:

Draft Environmental Impact Statement for the
Proposed Hospital Addition/Alteration Project,
Tripler Army Medical Center

Thank you for your letter of August 21, 1979 regarding the Draft
Environmental Impact Statement for the Proposed Hospital Addition/
Alteration Project, Tripler Army Medical Center. We are pleased that
you found the document adequately addressed your concerns.

Sincerely,

Thomas A. Smith
SFC (P), USA
Adjutant

[Signature]
Dear General Huycke:

The Environmental Protection Agency (EPA) has received and reviewed the draft environmental impact statement (DEIS) titled HOSPITAL ADDITION/ALTERATION PROJECT, TRIPLET ARMY MEDICAL CENTER, HAWAII.

The EPA's comments on the DEIS have been classified as Category LO-1. Definitions of the categories are provided on the enclosure. The classification and the date of the EPA's comments will be published in the Federal Register in accordance with our responsibility to inform the public of our views on proposed federal actions under Section 309 of the Clean Air Act. Our procedure is to categorize our comments on both the environmental consequences of the proposed action and the adequacy of the environmental statement.

The EPA appreciates the opportunity to comment on this draft environmental impact statement and requests three copies of the final environmental impact statement when available.

If you have any questions regarding our comments, please contact Betty Jankus, EIS Coordinator, at (415) 556-6695.

Sincerely yours,

[Signature]

Diana M. Wiman
Acting Director, Office of External Relations

Enclosure

EIS CATEGORY CODES

Environmental Impact of the Action

LO--Lack of Objections

EPA has no objection to the proposed action as described in the draft impact statement; or suggests only minor changes in the proposed action.

ER--Environmental Reservations

EPA has reservations concerning the environmental effects of certain aspects of the proposed action. EPA believes that further study of suggested alternatives or modifications is required and has asked the originating federal agency to reassess those aspects.

EU--Environmentally Unsatisfactory

EPA believes that the proposed action is unsatisfactory because of the potentially harmful effect on the environment. Furthermore, the agency believes that the potential safeguards which might be utilized may not adequately protect the environment from hazards arising from this action. The Agency recommends that alternatives to the action be analyzed further (including the possibility of no action at all).

Adequacy of the Impact Statement

Category 1--Adequate

The draft impact statement adequately sets forth the environmental impact of the proposed project or action as well as alternatives reasonably available to the project or action.

Category 2--Insufficient Information

EPA believes that the draft impact statement does not contain sufficient information to assess fully the environmental impact of the proposed project or action. However, from the information submitted, the Agency is able to make a preliminary determination of the impact on the environment. EPA has requested that the originator provide the information that was not included in the draft statement.

Category 3--Inadequate

EPA believes that the draft impact statement does not adequately assess the environmental impact of the proposed project or action, or that the statement inadequately analyzes reasonably available alternatives. The Agency has requested more information and analysis concerning the potential environmental hazards and has asked that substantial revision be made to the impact statement.

If a draft impact statement is assigned a Category 3, no rating will be made of the project or action, since a basis does not generally exist on which to make such a determination.
Mr. William McNiece, Director
Office of External Relations
United States Environmental Protection Agency, Region IX
215 Fremont Street
San Francisco, California 94105

Dear Mr. McNiece:

Draft Environmental Impact Statement for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center

Thank you for your department's letter of August 15, 1979 regarding the Draft Environmental Impact Statement for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center. We are pleased that you found the document adequately addressed your concerns.

Sincerely,

Thomas A. Smith
SFC (P), USA
Adjutant

TAS:PJW:clid
We have reviewed the subject statement and offer the following comments for your consideration:

Chapter II, page 6

Table II-1 indicates the population served by Tripler Medical Center. However, it should be noted that people in the diplomatic services both foreign and U.S. have also used TAMC services.

Chapter II, page 14

The EIS states, "A new decontamination holding tank would be provided in the Emergency area for temporary storage of radiological and other hazardous wastes". Where are these wastes eventually disposed of?

Further on page 71, the EIS states that 12,500 lbs. of non-pathological waste are transported to a landfill. There should be an expanded discussion as to the location and ownership of the landfill, the possibility of leachate, and what mitigation measures are implemented to avoid any possible threat of public health.

Chapter II, page 32

Table II-5 gives the CO levels from the Aliamanu Crater. Although we agree that the Tripler expansion will probably have less impact than Aliamanu, the comparison is questionable. First, the table does not reflect the worst condition. Secondly, the topography of the TAMC is not comparable since it sits on a slope while Aliamanu is within a crater.

Chapter II, pages 44-48

There is no mention here or elsewhere of the impact of noise generated from the helicopters traveling to and from Tripler. Because much of the helicopter traffic affects nearby residences, a discussion is warranted. Moreover, the discussion should include the timing and frequency of the helicopter flights, resulting ambient noise levels, and the routes of the aircraft arrivals and departures.

Chapter II, pages 63-66

Table II-10 indicates the peak morning and afternoon traffic volume at the TAMC entrance. However, consideration should be given to the impact of the proposed expansion upon Jarrett White Road traffic at other times.

In addition, there should be a discussion of the use of the Army buses for military personnel.

Chapter II, page 68

The residents of Moanalua Gardens are concerned about the odor from the sewer system along Jarrett White Road. The sewage from Aliamanu housing is connected with the Tripler off-site line for transport to the City's sewer system. Therefore, a discussion should be presented on the odor of the off-site line.

Land Use Policies

In addition to the discussion regarding land use policies, we recommend that consideration be given to the Coastal Zone Management policy.

We thank you for the opportunity to review this document. For convenience, we have attached a sheet which lists the commenting agencies and organizations. We are also enclosing copies of those comments.

We would like to request twenty-two copies of the final environmental impact statement when it becomes available.

Sincerely,

Richard L. O'Connell
Director

Attachments
Mr. Richard L. O’Connell, Director
Office of Environmental Quality Control
Office of the Governor
State of Hawaii
550 Halauaua Street, Room 301
Honolulu, HI 96813

Dear Mr. O’Connell:

Thank you for your letter of August 30, 1979 regarding the draft Environmental Impact Statement for the Hospital Addition/Alteration Project, Tripler Army Medical Center (TAMC). We appreciate the time that you and your staff reviewing the document. Responses to each of your comments are given below.

Chapter II, Page 6. Between October 1976 and September 1979, there were only 32 outpatient visits to TAMC by members of the diplomatic services. This is an average of 14 per year. This number is extremely small in comparison to the total patient load. For this reason, this population has not been included in Table II-1.

Chapter II, Page 14.

a. At the time the Draft EIS was written, the plans for TAMC included the decontamination holding tank described on page II-14. This tank was intended to receive washdown water from persons entering the emergency area who had been exposed to radiation and had already been washed. The initial washing of these individuals would be conducted close to the site where they were exposed in order to minimize the length of exposure time. Subsequent investigation has shown that the residual radiation would be so low as to make a separate washdown water system unnecessary at TAMC, and so the decontamination holding tank has been deleted from the design.

b. At present, all nonpathological wastes are disposed of at the Schofield Barracks Landfill. Special handling of the infectious portion of these wastes includes placement in two plastic bags at TAMC and transport in compactors. As of October 1, 1981, all wastes, except for tissue waste which are crepted, will either be disposed of at the City and County’s Jalapahu Incinerator or at the privately owned Pau Palais.
Landfill, which is north of the Kālaeoa Boulevard/II-1 Interchange in Dau.
This course of action has been approved by the State Department of Health.
The proposed project would not increase waste generation or affect any of those
procedures.

Chapter II, Page 32. Our discussion doesn't compare the impact of the proposed
TANC project with the impact of the Allamanu Crater military housing area
located nearby. It simply presents data collected as part of the environmental
studies done for the Allamanu project as an indication of the kinds of pollutant
concentrations that might be present at TANC. As you note, TANC is on an
exposed slope rather than in a crater. Hence, existing air pollutant concentra-
tions are almost certainly lower there than they are at Allamanu. It follows,
then, that if air quality standards are not violated at Allamanu, they are not
violated at TANC either, and that was the primary point to the discussion.
Since the proposed project contains nothing that would significantly alter the
concentration of air pollutants in the vicinity, a more detailed investigation of
existing conditions seemed inappropriate.

Chapter II, Pages 44-49. Existing helicopter noise levels would not be affected
by the proposed project. In the absence of any projected noise impact, we
believe that a detailed description of existing helicopter-related noise is not
warranted in the EIS.

Chapter II, Pages 63-66.

a. There would be no long-term increase in vehicular traffic as a result of
the proposed project, and construction-related increases would not cause the
roadway capacities to be exceeded. The traffic-impact analysis contained in the
EIS focuses on peak hours because they are the most critical to a judgment of the
system's adequacy. Since the present and proposed road and parking layouts are
capable of handling the worst-case conditions (i.e., peak hour), it follows
that they are adequate for off-peak conditions as well.

b. Currently, Army buses are used as appropriate for the transport of
persons to and from TANC. No change is expected as a result of the proposed
alterations and additions.

Chapter III, Page 90. The proposed project would not affect sewage flows from
the TANC facility. However, the Army is aware of the odor problem and has
commissioned a study aimed at determining its cause and identifying possible
solutions to it.

Land Use Policies. We have reviewed the State's Coastal Zone Management Policy.
It is our belief that the proposed TANC Addition/Alteration Project is fully
consistent with it.
Office of Environmental Quality Control
550 Nailekauila St., Room 301
Honolulu, Hawaii 96813

Dear Sirs:

Subject: Draft EIS - Hospital Addition/Alteration Project
Tripler Army Medical Center

Thank you very much for giving us the opportunity to review the above-captioned draft Environmental Impact Statement. We have no substantive comments which could improve the document.

Very truly yours,

[Signature]

Ryokichi Higashionna

---

Dr. Ryokichi Higashionna, Director
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, Hawaii 96813

Dear Dr. Higashionna:

Draft Environmental Impact Statement for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center

Thank you for your letter of July 19, 1979 regarding the Draft Environmental Impact Statement for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center. We are pleased that you found the document adequately addressed your concerns.

Sincerely,

Thomas A. Smith
SFC (F), USA
Adjutant
Office of Environmental Quality Control  
550 Halekauwila Street, Room 301  
Honolulu, Hawaii 96813

Gentlemen:  

Hospital Addition/Alteration Project  
Tripler Army Medical Center  
Oahu, Hawaii

Thank you for sending us a copy of the "Hospital Addition/Alteration Project, Tripler Army Medical Center" Environmental Impact Statement Draft. We have no comments to offer at this time. The attached document is returned for your use.

Yours truly,

[Signature]

Walter R. Nishimura  
Chief, CZ, HANO  
Contracting and Engineering Officer

Enclosure

Captain Jerry Matsuda  
Contracting and Engineering Officer  
Office of the Adjutant General  
Department of Defense  
State of Hawaii  
3949 Diamond Head Road  
Honolulu, Hawaii 96816

Dear Captain Matsuda:

Draft Environmental Impact Statement for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center.

Thank you for your department's letter of July 20, 1979 regarding the Draft Environmental Impact Statement for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center. We are pleased that you found the document adequately addressed your concerns.

Sincerely,

Thomas A. Smith  
SFC (P), USA  
Adjutant

TAS: PJW: cld
Draft Environmental Impact Statement for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center.

Thank you for your letter of July 23, 1979 regarding the Draft Environmental Impact Statement for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center. We are pleased that you found the document adequately addressed your concerns.

Sincerely,

Thomas A. Smith
SFC (P), USA
Adjutant

July 23, 1979

Department of Agriculture has no comments.
DEPARTMENT OF THE ARMY
HEADQUARTERS, TRIPLET ARMY MEDICAL CENTER
TRIPLET ARMY MEDICAL CENTER
JULY 14, 1980

Mr. Helvin K. Koizumi
Deputy Director for Environmental Health
Department of Health
State of Hawaii
1250 Punchbowl Street
Honolulu, Hawaii 96813

Dear Mr. Koizumi:

Draft Environmental Impact Statement for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center

Thank you for your department's letter of July 30, 1979 regarding the Draft Environmental Impact Statement for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center. We are pleased that you found the document adequately addressed your concerns. We understand that you reserve the right to impose restrictions on the project as necessary when detailed plans are submitted for review.

Sincerely,

Thomas A. Smith
SFC (P), USA
Adjutant

TAS:FW11cld
Office of Environmental Quality Control
550 Halekauwila Street
Room 301
Honolulu, Hawaii 96813

Gentlemen:

Subject: Hospital Addition/Alteration Project, Tripler Army Medical Center

Oahu, Hawaii

Thank you for this opportunity to review and comment on the subject project.

The project will not have any adverse environmental effect on any existing or planned facilities serviced by our department.

Very truly yours,

RIKIO NISHIOKA
State Public Works Engineer

Mr. Rikio Hishioka
State Public Works Engineer
Division of Public Works
Department of Accounting and General Services
State of Hawaii
P. O. Box 119
Honolulu, Hawaii 96810

Dear Mr. Hishioka:

Thank you for your letter of August 6, 1979 (your reference number (P) 1771.9), regarding the Draft Environmental Impact Statement for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center. We are pleased that you found the document adequately addressed your concerns.

Sincerely,

Thomas A. Smith
SFC (P), USA
Adjutant
Mr. Richard L. O'Connell, Director
Office of Environmental Quality Control
550 Halaula Street, Room 301
Honolulu, Hawaii 96813

Dear Mr. O'Connell:

SUBJECT: Draft Environmental Impact Statement
Hospital Addition/Alteration Project
Tripler Army Medical Center

Thank you for providing us the opportunity to review the subject document. We have no comment to make other than to note for your information the May 1979 Reconnaissance Report for Flood Damage Reduction, Halaula Stream, Oahu, Hawaii by the U.S. Army Engineers, Honolulu, Hawaii.

Sincerely,

CHARLES G. CLARK
Superintendent

cc: Mr. James E. Edington

---

Mr. Charles G. Clark
Superintendent
Department of Education
State of Hawaii
P. O. Box 2360
Honolulu, Hawaii 96804

Dear Mr. Clark:

Draft Environmental Impact Statement for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center

Thank you for your letter of August 6, 1979 regarding the Draft Environmental Impact Statement for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center. We are pleased that you found the document adequately addressed your concerns.

Sincerely,

THOMAS A. SMITH
SFC (P), USA
Adjutant

TAS:RJW:cll

AN EQUAL OPPORTUNITY EMPLOYER
Office of Environmental
Quality Control
State of Hawaii
Honolulu, HI

Gentlemen:

We have reviewed the EIS for renovating and expanding Tripler's facilities.

The discussions on wildlife impacts are for the most part factual and complete and accurately depict adverse impacts. It should be stated that the building construction and paving may eliminate habitat for the Pacific golden plover, a native migratory bird. However as this is a very common species in Hawaii, such impact could be listed as "minor". Another species which should be listed as "possible" is the Hawaiian owl, or pueo, which is endangered on Oahu (State listed). Other than this the EIS is adequate as a disclosure document with respect to wildlife.

The draft EIS recognizes that intermittent flooding is already a problem in residential areas adjacent to the Tripler Army Medical Center Reservation and mentions that practical erosion techniques will be employed particularly during the construction phase of the project. Although we do not anticipate the project to produce significant adverse effects to fisheries values in the nearby Hoanalu Stream, the document should include a listing of the aquatic organisms that may be potentially impacted (as provided for with the wildlife descriptions).

The discussion on disposal of infectious solid waste could be supplemented with the following:

1. A description of the virulence and viability of infectious waste.


3. A description of the location and character of the landfill site.

The EIS is also silent on drug control, handling of toxic materials and radiation hazards.

Very truly yours,

SUSUHU OGU, Chairman
Board of Land and Natural Resources
Mr. Susumu Ono, Chairman
Board of Land and Natural Resources
State of Hawaii
P. O. Box 621
Honolulu, Hawaii  96809

Dear Mr. Ono:

Draft Environmental Impact Statement for the
Proposed Hospital Addition/Alteration Project,
Tripler Army Medical Center

Thank you for your letter dated August 7, 1979 (your reference number APD-69B) regarding the Draft Environmental Impact Statement for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center (TAMC). We appreciate the time spent by you and your staff reviewing the document. The questions raised in your letter are discussed below.

Wildlife Impacts

Based on your comments, the Hawaiian Owl or Pueo (Asio flammeus) has been added to the list of animals possibly present on the TAMC reservation (see Table II-9). The impact that the project could have on the Golden Plover and other species is discussed on page IV-31 of the Draft EIS.

Maunalua Stream

As you noted in your letter, the proposed project is not expected to have a significant adverse effect on the value of Maunalua Stream as a fishery. However, in order to provide a more complete description of the existing aquatic environment of Maunalua Stream, a list of the species known to inhabit the stream and its immediate environs has been attached to the EIS as an appendix.

Handling of Infectious Waste and Other Hazardous Material

The proposed project would not involve any change in the amount of infectious waste generated at TAMC or in the methods that are used to dispose of it. Because of this, the topic is not covered in detail in the DEIS. Present practices at TAMC relating to drug control, toxic materials, radiation, and other hazards conform to all applicable Federal, State, and County laws and regulations; this would continue to be the case following implementation of the proposed project.

Thank you again for your comments.

Sincerely,

Thomas A. Smith
SFC (P), USA
Adjutant

DEPARTMENT OF THE ARMY
HEADQUARTERS, TRIPLER ARMY MEDICAL CENTER
TRIPLER AMC, HAWAII 96859

July 14, 1980
Mr. Richard L. O'Connell, Jr.
Page 2
July 31, 1979

Mr. Richard L. O'Connell, Jr.
Director
Office of Environmental Quality Control
Room 301
550 Halekauwila Street
Honolulu, Hawaii 96813

Dear Mr. O'Connell:

Subject: Draft Environmental Impact Statement for Hospital Addition/Alteration Project, Tripler Army Medical Center, Oahu, Hawaii

We do not object to the proposed project but recommend that the Army dispose of their 1,500 lbs. of infectious solid waste either by incineration or at a landfill where there is no possibility of contaminating potable groundwater resources. The impact statement mentions that 20 lbs. of pathological wastes are incinerated and 11,300 lbs. of non-infectious wastes plus the 1,500 lbs. of infectious wastes are disposed at the Schofield Landfill.

Although a study by the U.S. Army's Environmental Hygiene Agency "concluded that the hydrogeological characteristics of the Schofield site were acceptable for hospital waste disposal," we do not agree with their conclusion. There is evidence that irrigation waters percolate to the groundwater body. As we have not seen the Army's study, we wonder what mechanisms were discussed that would prevent the infectious organisms from contaminating the groundwater body, what kind of leachate monitoring is being performed, and what kind of action would the Army pursue if groundwater pollution is detected.

We suggest that Tripler Hospital contact the State Department of Health regarding the landfill disposal of the 1,500 lbs. of infectious wastes. If they confirm that the waste material is not a threat to our groundwater supply, then we would have no objections to their disposal of the infectious waste material at the Schofield Landfill.

Should you have questions or require additional information, please call Lawrence Whang at 548-5221.

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer
DEPARTMENT OF THE ARMY

HIST-PV-V

Mr. Kazu Hayashida
Manager and Chief Engineer
Board of Water Supply
City and County of Honolulu
939 South Merrick Street
Honolulu, Hawaii 96813

Dear Mr. Hayashida:

Thank you for your letter of July 31, 197__ regarding the Draft Environmental Impact Statement (DEIS) for the Proposed Hospital Addition/ Alteration Project, Tripler Army Medical Center (TAMC). Your concerns regarding the disposal of infectious solid waste are discussed below.

The Army will start a new solid waste contract on October 1, 197__.

Beginning on that date, it is planned that all of the TAMC waste, except for tissue waste which are cremated, will be disposed of at either the City and County of Honolulu’s Waipahu Incinerator or at the Pau Palailai Landfill. This landfill is not near any potable ground water. This course of action was satisfactory to the Department of Health, who had conferred with the Board of Water Supply on the matter.

If you have any additional questions regarding this matter, please contact Mr. Steven Hir at 437-6093.

Sincerely,

EUGENIO R. CHERRY, III
CPT(P), ASC
Adjutant General
Mr. Richard L. O'Connell, Director
Office of Environmental Quality Control
State of Hawaii
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Dear Mr. O'Connell:

Draft - Environmental Impact Statement for Hospital Addition/Alteration Project, Tripler Army Medical Center, Oahu, Hawaii, Received March 1978, Revised December 1978
Comments Requested July 11, 1979

We offer the following comments.

Traffic

It is indicated that "a significant amount of traffic to and from Tripler uses Apona Street on its way to the military housing areas and administrative offices located in Fort Shafter" (p. II-61). Quantification should be provided so that one may know what is considered significant. What is this average daily traffic in relation to total daily traffic on Apona Street?

Parking

The total parking spaces is indicated--1,460. The number of spaces for outpatients (567), hospital staff (620), and in the "overflow lots" (248) falls short of the total of 1,460 (p. II-66).

Water

Well capacity, reservoir capacities, and pump capacities for one of the pump houses are given. Average daily water use for hospital operations and for the housing and other support functions are not indicated. The capacities of pumps in Pump House No. 1 are not given (p. II-68).

It appears that the upper reservoir is not within the 367-acre TNC boundary (Fig. II-32, p. II-70). On whose land is it located? Who built it? Who maintains the area leading to and around it? These and other related aspects should be discussed.

Surrounding lands

It is indicated that "lands uphill and along portions of (TNC's) boundaries are designated Conservation" and are "regulated by the State Department of Land and Natural Resources and are further classified as General Use (GU) Conservation Subzone" (p. III-4). The ownership of these lands should be indicated, insofar as that might have a bearing on hospital operations.

Relationship to State/County Plans

Reference is made to State and County plans as they might affect TANC or be affected by TANC (Chapter III). The possible impact of TANC additions/alterations on State Health Planning and Development Agency (SHPDA) plans is not discussed.

Thank you for affording us the opportunity of reviewing the draft impact statement.

Sincerely,

[Signature]

GEORGE S. HURICICHI
Chief Planning Officer

Mr. Richard L. O'Connell
Page 2
Dear Mr. Moriguchi:

Draft Environmental Impact Statement for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center

Thank you for your letter of July 26, 1979 commenting on the Draft Environmental Impact Statement (DEIS) for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center (TAMC). Responses to the questions you raised are presented below.

Traffic

As indicated in the EIS, the proposed project would not increase vehicular traffic to and from the TAMC reservation. Hence, while a detailed analysis of on-site circulation and parking patterns was conducted as part of the planning for the proposed project, no attempt was made to quantify the volume of traffic using Apona Street. The term "significant" used on page II-61 and referred to in your letter was meant to convey the idea that Apona Street is used on a regular basis. Conversations with persons who observed the Apona Street - Jarrett White Road intersection during peak periods suggest that during the afternoon peak hour, approximately ten percent of the downhill traffic leaving TAMC, or less than 75 vehicles, turn left off of Jarrett White Road onto Apona Street.

Parking

The parking stall figures contained in the text on page II-66 were based on a preliminary count and are incorrect. The correct totals are:

- Outpatients and Visitors - 554
- Staff Only - 667
- Overflow (mostly staff) - 200

TOTAL 1,421

The EIS has been modified to show the correct figures.

Water

The proposed project would not affect the amount of water used at TAMC, and no significant changes to the water supply system are contemplated or necessary as part of the proposed project. Because of this, our discussion of the existing supply, storage, and distribution system was purposely brief. We do not believe that the insertion of additional descriptive material would add to the usefulness of the EIS.

The land around and leading to the upper reservoir is owned and maintained by the Army. The reservoir was built by the Army in 1948.

Surrounding Lands

The conservation-zoned lands along portions of the TAMC border are owned by the Samuel M. Damon Trust Estate.

Relationship to State/County Plans

During the A-95 consultation process, the State Health Planning and Development Agency (SHPDA) was contacted in an attempt to determine what, if any, impacts the proposed addition and renovation project would have on its plans. The agency's response noted that persons eligible for treatment at TAMC often use civilian facilities for some of their medical services, and that this complicates their task. It went on to state that they "are unable to accurately predict the effect this project will have on [their plans for] the entire community." In view of this uncertainty, the impacts that the proposed project would have on the achievement of SHPDA's plans could not be discussed in the EIS.

Sincerely,

Thomas A. Smith
SPC (P), USA
Adjutant

TAS:PBW:Clf
August 6, 1979

Mr. Richard O'Connell, Director
Office of Environmental Quality Control
State of Hawaii
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Dear Mr. O'Connell:

Draft Environmental Impact Statement
Hospital Addition/Alteration Project
Tripler Army Medical Center
Oahu, Hawaii

We have reviewed the above Draft EIS, and find the document to be comprehensive in identifying and discussing impacts associated with the proposed project.

Our only comment questions the use of 50-year flood flows, rather than the 100-year event. When discussing anticipated increases in storm run-off (Hydrologic Impacts; Ch. IV, Pg. 5), what is the run-off volume differential between the 50-year event and the 100-year event, and how does the 100-year event compare to the estimated capacities of the drainage system?

Should you have any questions on the above, please contact Scott Ezer of my staff at 523-4077.

Very truly yours,

Tyrone T. Kusao
Director of Land Utilization

July 14, 1980

Mr. Tyrone T. Kusao, Director
Department of Land Utilization
550 South King Street
Honolulu, Hawaii 96813

Dear Mr. Kusao:

Draft Environmental Impact Statement for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center

Thank you for your letter dated August 6, 1979 regarding the Draft Environmental Impact Statement (DEIS) for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center (TAMC). We are pleased that you found the document to be comprehensive in its analysis of potential impacts.

The DEIS discussed 50-year, rather than 100-year, flood flows because the City and County's storm drainage standards for basins smaller than 100 acres are based on the former. As you know, the 100-year flood would produce higher flows than those cited in the EIS. Based on data presented in U.S. Weather Bureau Technical Paper No. 43, Rainfall Frequency Atlas of the Hawaiian Islands, the 100-year rainfall for the TAMC site is about ten percent higher than the 50-year rainfall. With other factors in the equation remaining constant, one would expect that runoff would also increase by about ten percent.

Reviewing the information contained in Table IV-1, it can be seen that a 10 percent increase in runoff at the locations where flow would be affected by the proposed project, i.e., at structures in Drainage Basin No. 2, would not cause their capacity to be exceeded. However, the 100-year rainfall could slightly exacerbate existing problems at the few locations where occasional flooding already occurs.

If you have any questions regarding this letter, please contact Mr. Steven Kim at 433-6693.

Sincerely,

Thomas A. Smith
SFC (P), USA
Adjutant

TAS: PAM: tid
Office of Environmental Quality Control  
550 Halekauwila Street  
Room 301  
Honolulu, Hawaii 96813  

Gentlemen:

Subject: Draft EIS for Hospital Addition/Alteration Project  
Tripler Army Medical Center, Oahu, Hawaii

We have reviewed the draft EIS and have the following comments:

a. The Moanalua Gardens, Unit 7, Subdivision Relief Drain has been completed at a cost of about $480,000. The relief drain was designed to handle the flows from Tripler Army Hospital based on the City drainage design standards.

b. Sewage treatment capacity at the Sand Island plant is adequate to handle the flows from Tripler Army Hospital. We wish to add, however, that the Army has consistently delayed paying reasonable sewage user charges to the City.

Very truly yours,

[Signature]

Director and Chief Engineer
August 13, 1979

Office of Environmental Quality Control
550 Malakauwila Street, Room 301
Honolulu, Hawaii 96813

Gentlemen:

Subject: Hospital Addition/Alteration Project
Tripler Army Medical Center, Oahu, Hawaii
Draft Environmental Impact Statement

We have reviewed the TAMC Draft Environmental Impact Statement and have no comment.

Thank you for forwarding the statement for our review.

Very truly yours,

Barry Chung

Mr. Barry Chung, Director
Department of Housing and Community Development
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Chung:

Draft Environmental Impact Statement for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center

Thank you for your letter dated August 13, 1979, regarding the Draft Environmental Impact Statement for the Proposed Addition/Alteration Project, Tripler Army Medical Center. We are pleased that you found the document adequately addressed your concerns.

Sincerely,

Thomas A. Smith
SFC (P), USA
Adjutant

TAS: PJW: cld
Mr. Donald A. Brenner, Chairman  
Office of Environmental Quality Control  
State of Hawaii  
550 Halekauwila Street, Room 301  
Honolulu, Hawaii 96813  

Dear Mr. Brenner:  

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT  
HOSPITAL ADDITION/ALTERATION PROJECT  
TRIPLER ARMY MEDICAL CENTER  
OAHU, HAWAII, DECEMBER 1978  

The Department of Parks and Recreation finds no objections to the proposed Hospital Addition/Alteration Project to Tripler Army Medical Center.  

Warm regards.  

Sincerely,  

Ramon Duran, Director  

August 16, 1979

Mr. Ramon Duran, Director  
Department of Parks and Recreation  
City and County of Honolulu  
550 South King Street  
Honolulu, Hawaii 96813  

Dear Mr. Duran:  

Draft Environmental Impact Statement for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center  

Thank you for your letter dated August 16, 1979, regarding the Draft Environmental Impact Statement for the Proposed Addition/Alteration Project, Tripler Army Medical Center. We are pleased that you found the document adequately addressed your concerns.  

Sincerely,  

Thomas A. Smith  
SFC (P), USA  
Adjutant
Environmental Quality Commission
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Gentlemen:

Subject: Your Transmittal Dated July 11, 1979 Regarding Draft EIS for Hospital Addition/Alteration Project, Tripler Army Medical Center

We find that the traffic issues have been satisfactorily addressed in the draft.

Robert R. Way
Director

cc: OEQC

-----

Mr. Akira Fujita, Acting Director
Department of Transportation Services
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Fujita:

Draft Environmental Impact Statement for the Proposed Hospital Addition/Alteration Project, Tripler Army Medical Center

Thank you for your department's letter dated August 22, 1979, regarding the Draft Environmental Impact Statement for the Proposed Addition/Alteration Project, Tripler Army Medical Center. We are pleased that you found the document adequately addressed your concerns.

Sincerely,

Thomas A. Smith
SFC (P), USA
Adjutant

TAS: PJW:cld
DEPARTMENT OF THE ARMY
HEADQUARTERS, TRIPPER ARMY MEDICAL CENTER
TRIPPER ANG, HAWAII 96849
July 14, 1980

Dr. Doak C. Cox, Director
Environmental Center
University of Hawaii at Manoa
Crawford 317
2550 Campus Road
Honolulu, Hawaii 96822

Dear Dr. Cox:

Drift Environmental Impact Statement for the
Proposed Hospital Addition/Alteration Project,
Tripler Army Medical Center

Thank you for your letter dated August 24, 1979, (your reference number RE:083), regarding the Draft Environmental Impact Statement for the Proposed Addition/Alteration Project, Tripler Army Medical Center. We are pleased that you found the document adequately addressed your concerns.

Sincerely,

Thomas A. Smith
SFC (P), USA
Adjutant

TAS: PJW:cl

Dr. Doak C. Cox, Director
Environmental Center
University of Hawaii at Manoa
Crawford 317
2550 Campus Road
Honolulu, Hawaii 96822

Dear Mr. O’Connell:

Draft Environmental Impact Statement
Hospital Addition/Alteration Project
Tripler Army Medical Center, Oahu

The Environmental Center has been assisted in its review of the above cited DEIS by Jerome Peck, Acting Dean of the John A. Burns School of Medicine; Barbara Vogt and Doak Cox, Environmental Center.

In general, we conclude that the statement as presented adequately addresses the environmental impacts that might be expected to result from such a project. In addition, the proposals discussing the conservation and exploration of determined sources of energy appear reasonable as well as far sighted. We are pleased to note that the noise abatement procedures have also been given ample consideration.

Our reviewers are also in agreement with the conclusion stated in the DEIS that alternatives such as relocation to other sites would be unfortunate. The plan as presented are expected to increase the educational aspects for the University Medical School.

We appreciate the opportunity to comment on this document.

Sincerely,

Doak C. Cox
Director

cc: Jerome Peck
Barbara Vogt
24 September 1979

Office of Environmental Quality Control
550 Halekauila St.
Honolulu, Hawaii

Cgentlemen:

Subject: Comments on the Draft EIS for the Tripler Hospital Addition

We have reviewed the subject EIS and have the following comments:

1. p. 44, under groundwater hydrology. The pump test of 1969 was only 52.6% of the rate of the 1945 test, and the 1969 duration was not reported so that comparison between the tests is questionable.

2. The flood criteria in urban areas might well be considered identical to that for small dams, that is, the design recurrence interval at least the 100-year or 1/2 the probable maximum flood.

Sincerely,

Paul C. Ekern, Ph.D.
WRRC EIS Coordinator

cc: Y.S. Fok

DEPARTMENT OF THE ARMY
HEADQUARTERS, TRIPPER ARMY MEDICAL CENTER
TRIPPER AMC, HAWAII 96859

July 14, 1980

Paul C. Ekern, Ph.D.
Water Resources Research Center
University of Hawaii
2540 Dole Street
Honolulu, Hawaii 96822

Dear Dr. Ekern:

Draft Environmental Impact Statement for the Proposed Alterations and Additions to the Tripler Army Medical Center

Thank you for your letter of 24 September 1979 regarding the Draft Environmental Impact Statement for the Hospital Addition/Alteration Project, Tripler Army Medical Center. We appreciate the time spent by you and your staff reviewing the document. A point-by-point response to your comments is presented below.

1. Groundwater Hydrology. We agree that the 1945 and 1969 pump tests of wells serving the Tripler Army Medical Center (TAMC) are not directly comparable. It was not our intention that the two rates given in the EIS on page II-44 be compared and/or used to draw conclusions about possible changes (or the absence of change) in groundwater conditions between the two years. The discussion in the final EIS will be reworded to make that clearer.

The proposed TAMC project would not affect the amount of water being used by the facility; hence, pumping from the wells would remain unchanged. In view of this, we did not undertake the detailed hydrologic analysis of the well/aquifer system's sustainable yield that would have been warranted if increased withdrawals were proposed.

2. Your general comment regarding the appropriateness of the City's drainage standards raises issues beyond the scope of the EIS. However, it should be noted that a truly rational decision as to what recurrence interval should be used in the design of drainage structures in urban areas must be based on the basis of a detailed risk assessment of the affected area. In cases where even limited flooding could cause extensive property damage or loss of life, designing for a flow with a recurrence interval of 100 years could be considered too risky. In situations where the flooding would be limited to areas where the damage potential is low, e.g., urban streets, golf courses, or parks, it would be wasteful to design all facilities to accommodate a 100-year flood.

Thank you again for your comments. If you have any additional questions, please contact Mr. Steven Kim at 433-6693.

Sincerely,

Thomas A. Smith
SFC (P), USA
Adjutant

TAS:PM:cld