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RACIC report

SWAMP FOREST WARFARE (U)

Report No. BAT-171-45

Prepared Under Contract SD-171

May 16, 1966

by

J. A. Bontadelli, K. L. Nielsen, and W. P. Virgin

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ACKNOWLEDGMENT

(U) This study was conducted under the management of OSD/ARPA Research and Development Field Unit, Viet Nam and Joint Research and Test Activity, Viet Nam (JRATA Project No. 2G-307.1). The work was accomplished by the Battelle Remote Area Conflict Operations Analysis Team, Dr. Kaj L. Nielsen, Manager. The report was written by James Bontadelli, Kaj Nielsen, and William Virgin. Other Battelle personnel who contributed to this report are:

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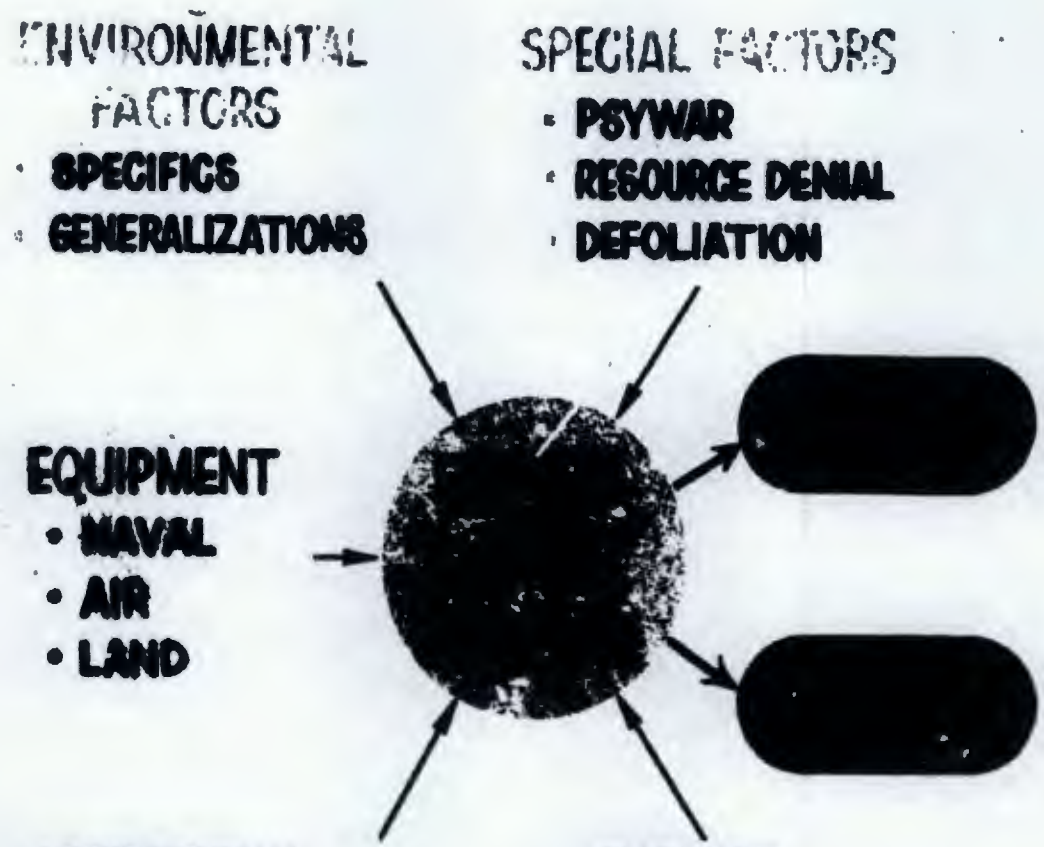
(U) A critical and valuable contribution was made to the study by a group of military advisors who had returned from Vietnam during 1965. They participated in a 2-day working session, especially arranged for this study, at Battelle. The authors are very much indebted to the participants, Lt. Charles R. Fike, USN; Capt. Walter W. Leben, USA; Lt. Norman Mosher, USN; Maj. Edward C. Tipshus, USMC; and Capt. Jack Zorn, USA.

PREFACE

(U) In any operations analysis that is concerned with a concept in the embryo state, the initial efforts must be expended for precise project definitions. This was the case with the swamp forest warfare study. The desired scope of the study is shown in the block diagram of Figure P-1. Because of the urgent need there was a time constraint of less than 4 months. The usual severe obstacles encountered in data and information gathering provided a second constraint. When the objectives were combined with these constraints it became clear that this study could not provide a detailed analysis nor employ sophisticated evaluation techniques for matching equipment with operational requirements. It could provide the basic approach, representative plans and needs, and a delineation of current equipment that could be used to satisfy the needs. The study could also indicate the need for the development of new equipment to make the operations more effective. This report is based on that philosophy.

(U) The information upon which the report is based stems from reports in the Remote Area Conflict Information Center, 60 days in Vietnam by two of the authors, numerous visitations for depth interviews, and the personal experiences and opinions of five military advisors who had been assigned to the specific areas that were chosen for examples. It is possible that information is available that was not brought to light during the time of the study. If this report is the cause of uncovering such information, it has been endowed with an additional purpose beyond the original objectives.


ENVIRONMENTAL FACTORS
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EQUIPMENT
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• AIR
• LAND
OPERATIONAL REQUIREMENTS
• SPECIFIC AREAS
• GENERALIZATION
ANALYSIS METHODOLOGY
• SELECTION
• EVALUATION
• OPTIMIZATION

FIGURE P-1

SWAMP FOREST WARFARE (U)

by

J. A. Bontadelli, K. L. Nielsen, and W. P. Virgin

I. INTRODUCTION

(U) A limited study of applicable weapon systems, general operational concepts, and other associated problems and requirements of combat operations in the swamp forest areas of South Vietnam was accomplished during the period November, 1965 through February, 1966. The study was requested by the Director, OSD/ARPA Research and Development Field Unit, Vietnam, based on a requirement of the Chief, Naval Advisory Group, U.S. Military Assistance Command, Vietnam. This report presents the results of the study.

(U) A summary of the conclusions resulting from the study is presented at the end of each section when appropriate and in a separate management volume. This aids in reviewing the primary results of the study without extensive detailed reading. The second section of the report (ENVIRONMENT) contains a discussion of the environment of the swamp forest areas of the Mekong Delta and the Ca Mau Peninsula. This discussion presents the general characteristics of these areas. Those characteristics which involve a particular constraint, or present a potential advantage, to the conduct of combat operations are highlighted.

(U) Representative combat operational requirements are developed in the third section (RUNG SAT SPECIAL ZONE AND THE NAM CAN FOREST) through general tactical plans for two selected swamp forest areas. These general tactical plans were developed because of the strategic interest of the two areas selected, and to establish a representative combat operational requirements base for the study. Extrapolation from this base is used to determine the applicability of the various weapon systems, development of general operational concepts, and identification of research and development areas to improve in general weapon systems capabilities in swamp forest environments.

(U) In the fourth section of the report (GENERAL DISCUSSION OF OPERATIONS IN SWAMP FOREST ENVIRONMENTS), the information developed in the three previous sections is used to discuss general operational concepts for the conduct of combat operations against the VC threat in swamp forest areas. The last section (RESEARCH AND DEVELOPMENT) lists and discusses those areas where research and development effort appears most urgent and applicable for increasing combat operational effectiveness against the VC threat in the swamp forest areas.

(U) Five appendixes contain supplementary material in the form of environmental tables, lists of equipment and weapons, a discussion of potable water denial, references, and bibliography.

Objectives

(C) The objectives of the study given in the project work statement are listed below:

(1) To describe the physical characteristics of the swamp forest areas of South Vietnam with emphasis on the Mekong Delta and the Ca Mau Peninsula

(2) To describe the threats and potentials of swamp forest warfare in South Vietnam

(3) To describe the U. S. Inventory of weapons systems applicable to swamp forest warfare

(4) To provide a survey of the state of the technical art in the areas of swamp forest weaponry

(5) To relate the results of Objectives (1) through (4) above in such a way as to portray

(a) Preferred weaponry inventories for swamp forest warfare

(b) Preferred operational concepts for weaponry indicated above

(c) Research and development required to improve capabilities currently existing.

(C) The military planner faced with the pressures of present and urgent problems has to regard the value of information or ideas pertinent to the problems as decreasing with time. In the conduct of this study the approach has been to gather, structure, analyse, and present current and available information applicable to the problems of operations in the swamp forest areas of the Mekong Delta and the Ca Mau Peninsula. The emphasis in the study is on operations from the military planner's viewpoint. The intent is to clarify the problems of swamp forest warfare and the total integrated operational effort which appears required to attain relative control from the VC in these areas. This is done to aid the military planner who is responsible for the determination of weapon systems requirements and/or the development of the applicable detailed tactical plans.

(C) Area priority in the study has been first the Rung Sat Special Zone, second the Nam Can Forest (as shown in Figure III-2), and then the remaining swamp forest areas of the Mekong Delta and the Ca Mau Peninsula. The Rung Sat Special Zone and the Nam Can Forest were the two areas selected because of their strategic interest, for which representative general tactical plans were developed to serve as a base for the study. In developing the representative general tactical plans, the benefit of the experience of a group of Navy, Army, and Marine Corps officers familiar with the two areas was obtained and integrated with the other available information.

(C) The survey of the state of the art of weaponry systems applicable to swamp forest warfare from a strictly technical viewpoint would require extensive effort. This is due to the number of areas involved and the amount of information in each, and the extent that the information is scattered among the military departments, research organizations, and industry. Because of this problem, the state of the art is again viewed from the operational viewpoint. As an example – Will a combination of current avionics systems permit the effective use of armed helicopters in night operations for the detection of slow-moving local watercraft on minor channels where some degree of forest canopy exists – versus a technical evaluation of the state of the art in radar systems which operate using the moving target indicator (MTI) mode. No attempt has been made to do the latter.

II. ENVIRONMENT

Introduction

(C) The Mekong Delta area of South Vietnam is an excellent example of an environment for a swamp warfare study. Although the objectives of this study were to consider operations in swamp forests, and the two specific area examples were selected on that basis, the general environmental description of the delta area in this section includes the other generic swamp types. In the present insurgency, the Viet Cong are making extensive use of these swamp areas as support bases and strongholds. As such they form critical parts of the integrated haven system in the southern portion of the country. Because of this, a knowledge and appreciation of the environment of these areas is essential to the planning of military operations and the determination of equipment and weapon requirements. It is the purpose of this section of the report to summarize the available general environmental data and to further extend the description of the physical environment in the two swamp forest areas selected as examples.

(C) The two selected swamp forest areas not only provide excellent material for illustrative purposes but also are of interest for military operations. These areas are the Rung Sat Special Zone, and the Nam Can Forest in the southern Ca Mau Peninsula. These were given first and second priority in that order, respectively. Although general descriptions are desirable and are presented, the value of concrete examples can never be overemphasized. The description will therefore proceed from the general environmental characteristics of Vietnam south of 11°N latitude to the specifics of these two areas. The classical subdivisions of climatology, hydrology, and surface characteristics will be employed with emphasis on the description of a swamp forest.

INFORMATION SOURCES

(C) The information and data pertaining to the general description of hydrology and surface characteristics and generic area classification draw liberally from work done by the Stanford Research Institute in their study of mobility in the Mekong Delta area (Reference 1). Information for the more detailed description of the two selected swamp forest areas was obtained from depth interviews with the military advisors. Ground pictures and aerial photography provided additional information for the two selected areas. Photomosaics were made – a 1:25,000 of the RSSZ and three 1:10,000 of sectors of the Nam Can Forest. Individual aerial photographs were analyzed by stereo equipment. 1:50,000 maps furnished by the Army Map Service were also used. Vegetation information was obtained from Reference 2. Climatological data came from American Institute of Crop Ecology publications, Environmental Protection Research Division, Quartermaster Research and Development Command Reports; reports prepared by the 30th Weather Squadron Air Weather Service, USAF; and publications of the Director of Meteorology, Republic of Vietnam.

CLIMATE SOUTH OF LATITUDE 11°N

(U) The whole of South Vietnam is subject to the same tropical monsoon climatic regime, which annually progresses through four phases. These are:

(1) The southwest monsoon season, which begins in mid-May, ends in early October, and is most intense during July and August

(2) The fall transition period, from early October to early November

(3) The northeast monsoon season, which begins in early November, continues to mid-March, and is most pronounced during December and January

(4) The spring transition period, from mid-March to mid-May.

While weather conditions distinctive to these seasons occur, they differ significantly in the various climatic regions of Vietnam. The climate of the southern lowlands is relatively homogeneous, however, and consequently the local climates of the two areas of interest here are very similar.

(U) The wet season of the southern lowlands, i.e., the delta region, occurs in summer, during the period of the southwest monsoon, and is very pronounced. Having passed over thousands of miles of tropical waters, the air comprising the southwesterly flow arrives over the lowlands in a very warm, humid, and unstable condition. Consequently the weather is characterized by high temperatures and humidities and frequent showers of thunderstorms. The latter are most frequent and severe over the lowlands during the initial "burst" of the monsoon in May. By June, the daily weather follows a monotonous pattern. Typically, only scattered middle and high clouds exist during the latter part of the night. By 0600 LST patches of fog and stratus form near the rivers and marshlands, usually dissipating by 1000 LST. Cumulus clouds then begin to form, and the sky cover by early afternoon becomes broken to overcast. Afternoon and early evening showers occur nearly every day. Rainfall and cloudiness amounts are greatest during July and August.

(U) The fall transition period lasts only about 30 days, and the change from the southwest to the northeast monsoon regime may be abrupt. Although in general the period is characterized by decreasing rainfall and cloudiness, there may be a temporary increase in thunderstorm frequency over the lowlands, accompanying the southward passage of the intertropical convergence zone.

(U) The dry season of the southern lowlands is in winter, during the period of the northeast monsoon. In comparison with its southwest counterpart, the northeast monsoon is relatively cool and dry. Reaching South Vietnam after traversing the South China Sea, the air loses much of its moisture on the windward slopes of the Chaine Annamatique and arrives over the southern lowlands as a cool, dry, northeast wind. Scattered clouds generally prevail, although occasionally there may be broken to overcast conditions at night. There is little or no rain during this season. Patches of fog and stratus form during the early morning hours near rivers and marshlands and visibilities generally are frequently reduced in haze, especially during the latter part of the season.

(U) During the spring transition period, twice as long as that occurring in the fall, the general circulation is weak and indefinite. The cool air of the northeast monsoon has retreated, yet the southwest monsoon has not arrived. Skies are relatively clear, there is little precipitation, and the sun is almost directly overhead. Consequently, this is the hottest period in the southern lowlands. There is a gradual increase in cloudiness and in thunderstorm activity with the approach of the southwest monsoon.

Climatic Elements

General

(U) Available climatic data for South Vietnam south of latitude 11°N are presented in charts and tables in Appendix A, and summarized in the succeeding discussion. The sites at which the data were collected are in some cases at airports or airstrips, in towns or cities, or close to but not in the areas of interest here. Therefore, while depicting the general climate, these data do not necessarily define all elements of the local climates in the field. These, especially the microclimates, are influenced significantly by tropical vegetation, and particularly by tropical forests.

Temperature

(U) South of latitude 11°N in South Vietnam temperatures are high throughout the year everywhere and ranges are small. Figures A-1 through A-4 of Appendix A present mean data on the annual march of temperature for four locations in or on the edge of the southern lowlands. Inspection of these data reveals that the mean temperatures throughout the year consistently remain very close to 80°F, while the absolute range in most cases is less than 40 Fahrenheit degrees. Also, the highest temperatures are shown to occur during the spring transitional period. Table A-1 presents data for Phan Thiet, a station below latitude 11°N but in another climatic regime, that of the southeastern coastal plain. Temperaturewise, however, the climate is practically the same. The only information available as to diurnal temperature ranges is for Saigon. Here the daily range is about 24 Fahrenheit degrees in April, the hottest month, and about 18 Fahrenheit degrees in December, the coldest month. In both cases there is a steep rise of temperature from 6:00 a. m. (min) to 2:00 p. m. (max), and then almost as rapid a fall during the late afternoon and evening. It is probable that this diurnal temperature variation is typical of the southern lowlands. In forests, however, these diurnal ranges will be reduced somewhat, since the temperature will neither rise as high nor fall as low; also, the diurnal maximum will occur somewhat later.

Humidity

(U) As with temperatures, relative humidities below latitude 11°N in South Vietnam are high throughout the year everywhere. Tables A-1 through A-4 include humidity data for four stations. Nighttime humidites approaching saturation, relatively high daytime values, and maxima during the southwest monsoon are evident for the two lowland stations, Saigon (Table A-1) and Can Tho (Table A-3). The influence of the

ocean is evident in the data for Cap St. Jacques (Table A-2), early morning values usually being slightly less and the diurnal range smaller. Again, data for Phan Thiet (Table A-4), not a lowland station, show the coastal effect, and the apparent influence of the northeast monsoon, during which humidities are highest. Humidities along rivers, over marshlands, and in tropical forests normally will be higher than those recorded at standard observation stations. In tropical forests, saturation humidites near the ground throughout the nights are the rule. In the wet season this condition prevails almost continuously, night and day. Very high humidities prevail in the trunk space below the canopy at night, and decrease less by day than do those in nearby open areas.

Rainfall

(C) The seasonal and diurnal occurrences of rainfall over the southern lowlands of South Vietnam have been described. The greatest amounts normally occur on the southwestern coast, the annual average being about 90 inches. Over the Mekong Delta it is about 70 inches, and it increases toward the Chaine Annamatique, Saigon having a mean annual rainfall of about 78 inches. The southeastern coastal plain is drier, Cap St. Jacques at the southern terminus on the edge of the southern lowlands has a mean annual amount of about 50 inches, while at Phan Thiet, further north, it is less. Considerable climatological rainfall data for the area below latitude 11°N are contained in tables and figures attached. Figures A-6 and A-7 provide these data, respectively, for the southern lowlands as a whole south of the Saigon River. Inasmuch as a jungle canopy is only semipermeable to precipitation, it is probable that rainfall amounts in heavily vegetated areas are somewhat less than the values presented here, the excess being evaporated from leaves, trunks, vines, etc.

Ceilings and Visibility

(C) The generalities of sky conditions for the various seasons have been described. Only a limited amount of sky cover data are available. Tables A-1 through A-4 contain tabulations of the incidence of contact flying conditions throughout the year for four stations. Tables A-5 through A-7 for March and A-8 through A-10 for April present the frequencies of occurrence of specified ceiling/visibility conditions, including data for several stations below latitude 11°N in South Vietnam. Over the southern lowlands in general, visibilities are better during the rainy than during the dry season, due to the dispersal of atmospheric contaminants by the widespread convective activity, and the concomitant cleansing action of heavy precipitation. Nevertheless, visibilities of less than 2 miles occur 7 percent of the mornings, and less than 5 miles 17 percent of the mornings. Half of the time these low visibilities continue into the afternoon. In the dry season visibilities are generally poorer because of the contamination of the air by dust and the tendency for all pollutants to be retained in the atmosphere because of its stability and the lack of precipitation. During this period, visibilities of less than 2 miles occur about 17 percent of the mornings and less than 5 miles about 33 percent of the mornings. Early afternoon visibilities are less than 2 miles 1 to 2 percent of the time, and less than 5 miles about 5 percent of the time. Visibilities locally are reduced drastically, of course, in heavy precipitation and fog. The only available quantitative information on the latter phenomenon for the lowlands is that it occurs over the Mekong Delta region an average of 10 days in March, 8 days in April, 1 to 2 days in May, and

1 day in June. It is probable that it occurs locally over rivers and swamplands more frequently.

Winds

(C) In general, surface wind directions over the southern lowlands of South Vietnam reflect the monsoon dominating the area. Generally, except during thunderstorms, or typhoons, wind speeds exceeding 16 knots are infrequent, and those in excess of 27 knots are rare. Surface winds are strongest during the southwest monsoon, 10 to 15 knots being common in the afternoon. Most wind speeds are less than 10 knots during the northeast monsoon. During the entire year, land and sea breezes are common along the coasts. Caused by the differential heating of land and water surfaces, these winds have a pronounced effect as much as 10 miles inland; lesser effects may be noted further from the coast. The sea breeze usually begins about 1000 hours and reaches a maximum sustained speed of about 10 knots in the early afternoon, before decreasing. Gusts may occur to 30 knots. The land breeze, usually weaker and less gusty than the sea breeze, begins after sunset and continues throughout the night. Tropical vegetation drastically reduces wind speeds in the air space which it affects.

Thunderstorms

(C) Thunderstorms over the southern lowlands, as anywhere, temporarily and locally drastically alter the ambient atmospheric conditions. Winds may gust to 50 knots or more, although 30 knots is the usual maximum. Skies become overcast, ceilings lower to 1000 feet or less, and visibility may approach zero in heavy precipitation. Hail occurs in South Vietnam, although very infrequently if at all over the southern lowlands. In July, 1963, a tornado, the first of record in South Vietnam, occurred near Vinh Long.

Typhoons

(C) As with thunderstorms, tropical cyclones and typhoons drastically alter the ambient weather. South Vietnam is subject to invasions by these storms from the South China Sea, but not, it appears, from the Gulf of Siam. The storms occur from April through December, none being of record in January, February, or March during the 81 year period 1884-1964. The months of more frequent occurrence are from August through November, October having the highest frequency - 1 per 2 years during the 81 year period. During the 17 years 1947-1963, 23 tropical storms (winds less than 64 knots) and six typhoons (winds at least 64 knots) affected the coastal weather of South Vietnam. No data are available as to the tracks of these storms. However, the delta lowlands offer no barrier to their invading inland, and an occurrence will result in torrential rains, even by the standards of this region, and extremely high and destructive winds. The diameter of the storm may be as much as 200 miles, and its influence can be felt for a period of several days.

HYDROLOGY

(U) Lowlands and water form the bases for a delta swamp area. Extensive networks of interconnecting rivers, streams, and man-made canals provide a general description of the landscape of the Mekong Delta in South Vietnam. These waterways have combined to form a broad alluvial plain of lowlands with only microrelief. In the lower reaches tidal streams and channels create further subdivision of the land area. During the rainy season vast areas are inundated (see Map 1) and since the drainage is extremely poor, large expanses of terrain remain waterlogged for extended periods of time. This is especially true in the marsh area known as the Plain of Reeds.

(U) In the upper reaches the rivers control the water depth, currents, and bottom conditions. This influence disappears toward the coast where the tidal effects predominate. Tides play an important role in local navigation and the tidal effects merit a detailed discussion.

Tides

(U) The strong tidal influences on currents, depths, and bank and bottom conditions of both man-made canals and tidal streams throughout a large area of the Delta region are extremely important in any consideration of mobility. During the low-water season and the periods of low tide only small and very shallow-draft crafts can navigate many of the canals and streams. Furthermore, the additions to the heights of the banks make landings difficult and would limit the time periods of operation of amphibious equipment which could not climb high mud banks. Patrol boats in the larger streams (especially in the Rung Sat Special Zone) must also tailor their operations to these tidal effects.

(U) Tidal records are available for only a few stations along the coast or major rivers and in general provide inadequate information on which to predict the tidal conditions at a specified time. The influence on water depth has been compiled for stations where data were available and is shown in Table A-11. It is to be noted that daily tidal ranges vary not only during the time of the month but also differ according to location. Thus, the variations at Saigon and Rach Dua are considerably different from those at Tan Chau and Rach Gia. This fact serves as one of many examples of the need to tailor the operations in a swamp warfare to the specific characteristics of the region of combat.

(U) The tides also affect the currents in the major rivers. During the high-water season where the major rivers flow downstream, the maximum velocity may reach 5 knots. However, during the low-water periods at the same locale, the tide may actually reverse the flow and an upstream current of 1 knot has been measured. Currents depend upon depths, shapes, lengths, and tidal action. In the major rivers and canals of the Mekong Delta velocities up to 6 knots have been experienced.

(U) The tidal effects on the current also influence local navigation since the local inhabitants utilize this effect in their shipping. Nonmotorized shipping, in particular, follows the pattern of the tides.

(U) The tides also affect the salt-water intrusion for a large portion of the lower Delta (see Map 1). The high tide inundates the coastal areas daily. Since these areas are predominately swamp forest, this is a standard characteristic of the environment. Salt-water intrusion also reaches far inland to leave its mark on fresh-water swamps, marshes, and paddy lands. This condition necessitates the erection of control devices which must be reckoned with during a military movement. Detailed intelligence of a specific area is again a factor in planning operations in this environment.

Navigability

(U) The navigability of the waterway network of a combat zone is of utmost importance in planning a military operation. Unfortunately, a swamp forest is not a unique characterization to determine navigable waterways. In fact, the two concrete examples clearly illustrate the differences which may exist in two swamp forests of the same basic type. Again it becomes necessary to consider each zone on its own merits and these will be discussed in detail for the two examples. On the positive side, some generalization can be made for the Mekong Delta. The statistics of controlling depths are given in Table A-12. The data should be considered with reservation. They were compiled* from data reported in the National Intelligence Survey on depths of waterways and reflect primarily design data rather than actual data. During a time of war continuous dredging and annual maintenance may not be carried out, and silting is a major factor in this environment. Although the table presents a general description, it should be emphasized that the area is a complete maze of small streams, canals, and drainage ditches which are not shown. The swamp forest also produces growth which tends to deteriorate both natural and man-made waterways as a navigable entity.

(U) It cannot be overemphasized that a meaningful consideration of navigability can be made only for specific areas. The discussion for the two examples, RSSZ and Nam Can Forest, provides excellent illustrations and clearly indicates the appreciable contrasts in different areas. It should also be mentioned that swamp forests exist (e. g., U Minh) which are void of any major useful navigable waterways.

SURFACE CONDITIONS

(U) Almost the entire area of Vietnam south of 11°N is a low, nearly level plain subject to extensive and prolonged inundation. With the exception of the area within the Rach Gia-Ha Tien-Chau Doc triangle, where there are a few isolated hills, the highest of which is 700 meters, and also in the Cap St. Jacques area where there are a few hills rising to approximately 245 meters, the area has virtually no relief other than the microrelief characteristic of stream and canal banks, paddy dikes, and raised roadbeds.

*The compilation was done by Stanford Research Institute.

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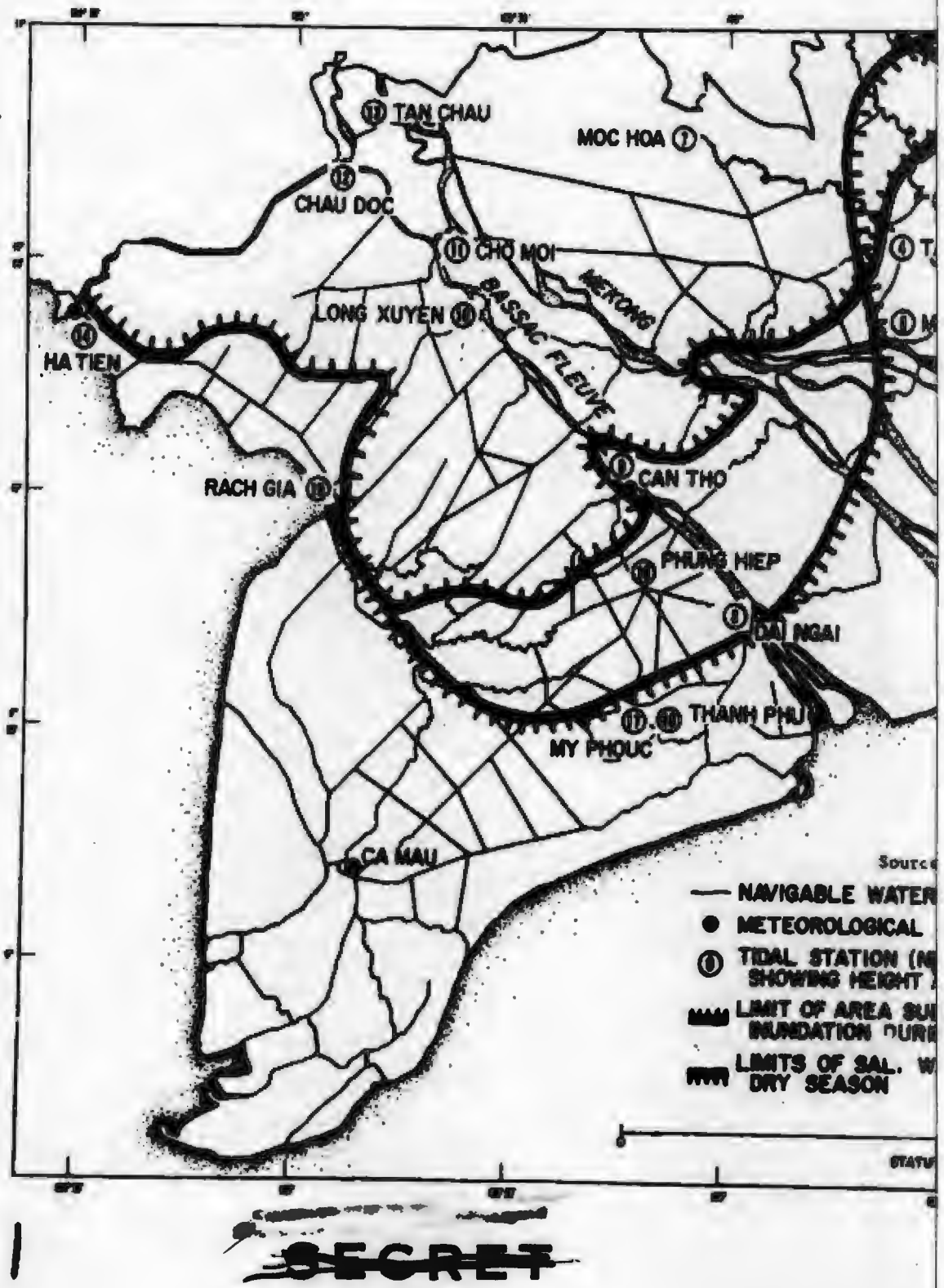

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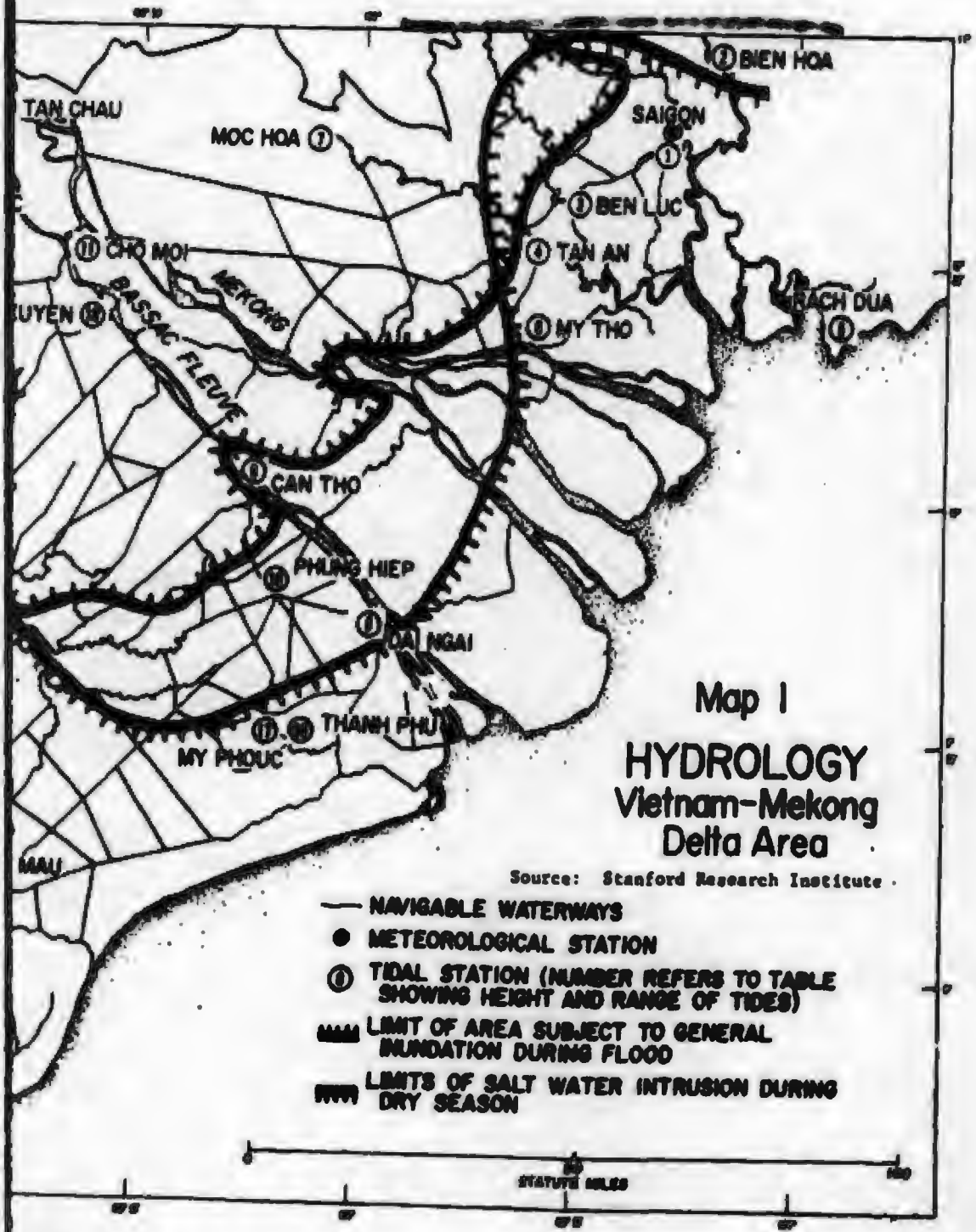


Soils

(C) Soils of this region are largely alluvial. Six classes of alluvium are differentiated on the basis mainly of acidity. All of these are rather rich in nitrogen and potash but poor in lime and phosphoric acid.

(C) For about 10 miles inland from the coast in the entire region, the soils are predominantly tidal saline muds supporting mangrove and back-mangrove vegetation. On the western coast of the lower Ca Mau Peninsula is an extensive area of mixed peat and mud. Typical soil conditions associated with mangrove or back-mangrove vegetation include rating cone indices of 3 at depths of 0" to 6", 14 at 6" to 12", and 20 at 12" to 18". Also, the upper 6 inches contains about 5.13 percent organic matter, 1,400 lb calcium per acre, 260 lb of potassium per acre, 200 lb phosphorus per acre, and 16 lb of nitrogen per acre with a pH of 6.4.

(C) The acid alluvial soils of the lower Ca Mau area seem to be less firm than those north and east of the Bassac River. It has been reported by observers that the mud in the lower Ca Mau area after prolonged inundation, i.e., toward the end of the rainy season seems bottomless, whereas in the region north and east of the Bassac, the soils maintain a reasonably firm base below the top few inches of paddy mud even when wet.

Vegetation

(C) The vegetation in the region of interest can be described in terms of five plant communities: sea grass, mangrove and back-mangroves, palm swamp, sedge marsh, and rice paddies. Characteristics and typical locations of these communities with respect to this region, are discussed below.

Sea-Grass Community

(C) Submerged in salt water, usually in protected places where tides and currents are not so strong, will be thickets of grasslike plants called submarine meadows. Such meadows are common in shallow bays and in pools in tidal flats of more open bays. Vertically they occur from low water mark, where they are sometimes left dry by ebb tide, down to 5 meters. In monsoons, the leaves may be washed up in huge piles which are a serious hazard to navigation.

(C) These meadows, which can be dense enough to cause prop-fouling at low tide, are more common along the west coast and extreme southern region of the Ca Mau Peninsula, and also in the tidal flats of the Rung Sat Special Zone.

Mangroves and Back-Mangroves

(C) Vast expanses of both the east and west coasts of South Vietnam are occupied by the foreboding mangrove community, a barrier to boats at high tide and an equally difficult area for overland mobility at low tides. The extensive development of prop roots make these forests extremely difficult to traverse even on foot. Although these

roots will support a man, they are very slippery and are set at sharp angles and any misstep plunges the foot soldier into deep soft mud. The rate of progress through this mangrove forest is far below the published jungle rate of 1 kilometer per hour.

(C) The mangrove community is encountered along streams but does not extend beyond the reach of brackish water. Although it is not the purpose of this report to digress into a discourse on the scientific terminology, the mangrove community is sufficiently important to justify a clarity in description. This can best be done in terms of specie methodology and some illustrative sketches. The mangrove family (Rhizophoraceae) is composed of the genera Rhizophora, Bruguiera, Ceriops, Carollia, and Kandelia. A description of this classification is shown in Table II-1 (Reference 2).

TABLE II-1. MANGROVE AND BACK-MANGROVE SPECIES

Aegiceras corniculata	Cay Cat	Tree to 10 m
Avicennia officinalis		Tree to 20 m with pneumatophores
Bruguiera cylindrica	Vet	Buttressed tree to 23 m with pneumatophores
Bruguiera gymnorrhiza	Vet re loi	Buttressed tree to 36 m with pneumatophores
Bruguiera paviflora	Vet hoa nho	Buttressed tree to 24 m with pneumatophores
Bruguiera sexangula	Vet den	Buttressed tree to 33 m with pneumatophores
Carallia brachiata	Xang-ma	Stilted ant tree to 50 m
Carallia suffruticosa	Xang-ma	Shrub to 3 m
Ceriops tagal	Cay Net	Stilted shrub or tree to 25 m
Hibiscus tiliaceus	Tre lam cheo	Tree to 10 m
Kandelia candel	Vet dia	Shrub to 7 m with swollen base
Rhizophora apiculata	Duoc-doi	Stilted tree to 30 m
Rhizophora mucronata	Duoc-nhon	Stilted tree to 30 m
Sonneratia caseolaris	Ban trang	Tree to 20 m with stout pneumatophores

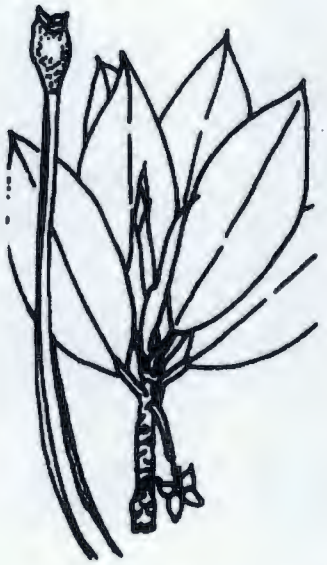
(C) Illustrations of the predominant species in the Vietnam Delta region are shown in Figures II-1 and II-3 (Reference 2).

(C) The normal procedure for the development of the mangrove forest in the lowlands is for the sluggish rivers to deposit banks at the mouth. The resulting breakwater is covered on the seaward edge with a dense growth of Casuarina (Australian pine) – common on the beaches of the Ca Mau Peninsula and the southwest region of Rung Sat – and on the protected side by mangrove forms seeded by the downriver current. As the bank continues to advance it may eventually be broken to form a new mouth. If this happens the old channel silts up and becomes stocked with mangrove species. As time passes the new channel is converted into a mangrove swamp.

(C) The vegetation is quite dense and there is very little light on the forest floor (1 to 5 percent of that in the open). Stands of 500 to 1000 trees, 10 to 30 cm and 6 to 14 meters high have been reported in an area of about 400 acres. In Vietnam the mangrove (Rhizophora apiculata) forms colonies on deep soft muds and seem to be intolerant of harder muds or sand mixtures. The stilt roots of adjacent mangrove trees are intricately interwoven and the vegetation is practically impenetrable by normal means of transportation.

AVICENNIA OFFICINALIS

BRUGUIERA SEXANGULA



RHIZOPHORA MUCRONATA

SONNERATIA CASEOLARIS

FIGURE II-1. MANGROVE SPECIES

AEGICERAS CORNICULATA

CERIOPS TAGAL

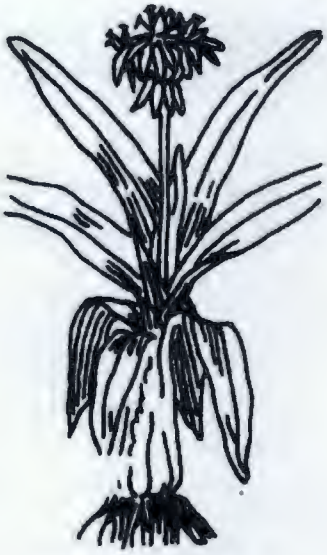
KANDELIA CANDEL

PANDANUS TECTORIUS

FIGURE II-2. BACK-MANGROVE SPECIES

ACROSTICHUM AUREUM

ANNONA RETICULATA



CRINUM ASIATICUM

NIPA FRUTICANS

FIGURE II-3. PALM SWAMP SPECIES

Palm Swamp

(C) In the Saigon region the palm swamp can be divided into four groups:

(1) Species from mangroves

Acanthus ilicifolius	Bruguiera sexangula (Figure II-1)
Carollia lucida	Derris uliginosa
Dolichenodrone rheedii	Flagellaria indica

Nipa fruticans (Figure II-3)

(2) Species from back-mangroves

Acronychia pedunculata	Acrostichum aureum (Figure II-3)
Canthium didymum	Cerebera manghas
Clerodendrum inerme	Ficus benjamina
Melalenca lencadendron	Pandanus tectorius (Figure II-2)

Stenochlaena palustris

(3) Fresh-water gallery species

Barringtonia acutangula and Gluta coarctata.

(4) Rice-paddy weeds

Cyperus procerus, Eleocharis equisetina, and Phragmites karka.

(C) In the Mekong River Delta the palm swamps are composed of the following species:

Acanthus ebracteatus	Crinum asiaticum (Figure II-3)
Cryptocoryne ciliata	Derris uliginosa
Nipa fruticans (Figure II-3)	Sonneratia caseolaris (Figure II-1)

Typha angustifolia

(C) In the riverine complex, the Nipa is usually along the outer banks where the current is greater and the Cryptocoryne ciliata and Crinum asiaticum are associated with the slip-off slopes and areas of heavy sedimentation with fine silts and clays. This fact can be used in navigation to determine where the stronger currents and deeper channels may be. Navigation in smaller streams inhabited with these palms is practically impossible except by sampan-type crafts. The palm swamp often forms a transition to a terrestrial forest, which, therefore, frequently borders these swamps.

Sedge Marsh

(C) Tall sedges and grasses growing in marshes or terrain covered by shallow water during high tide form the community of sedge marshes. Latoritic soils with poor drainage, abandoned fish ponds, and stagnant water marshes form the ideal environment for this growth. Since the same soil is used for rice paddies, these are often made by laborious clearing of a sedge community. The Plain of Reeds area favors the Eleocharis equisetina which rarely grows higher than 2.5 feet. Other species such as the Cyperus which grows in clay silts that are flooded daily by tides may grow up to 2 meters in height and are very difficult to clear out.

(C) For the purpose of clearing it is useful to note that in South Vietnam the seeds of the sedge plants germinate with the beginning of the rainy season and the plants reach sexual maturity and flower in August to September with seeds that mature by November. Some of these species can be destroyed by flame treatment.

Rice Paddies

(C) A large portion of the Mekong Delta area is under cultivation for the production of rice. Although not directly concerned with swamp forest warfare, their proximity to and/or interspersion in the various swamp areas precludes complete elimination of their consideration. Many of the rice areas are obtained by draining, irrigating, and diking sedge marshes. The resulting fields are navigable by boats during the flooded stages but motor boats and amphibious crafts will still experience difficulties from the cyperus weeds, duckweeds, canal dikes, and nonpredictable muddy bottoms.

(C) Figure II-4 is presented as a further generic classification of vegetation in a tropical climate. It places the growth relative to the water level and tidal effects. Table II-2 gives the corresponding common names for greater conversational agility.

TABLE II-2. COMMON NAMES

Scientific Names	Common Names
1. Utricularia	Bladderwort
2. Ceratophyllum	Coontail
3. Vallisneria	Tape grass
4. Nymphaea	Water lily
5. Ipomea	Morning glory
6. Lemna	Duckweed
7. Limnocharis	Velvet leaf
8. Eleocharis	Water chestnut
9. Cyperus	Sedge
10. Cryptocoryne	--
11. Scanthus	--
12. Nipa	Nypa palm
13. Anona	Custard apple
14. Sonneratia	Mangrove
15. Flagelleria	Mangrove fern
16. Litsea	(Terrestrial forest)

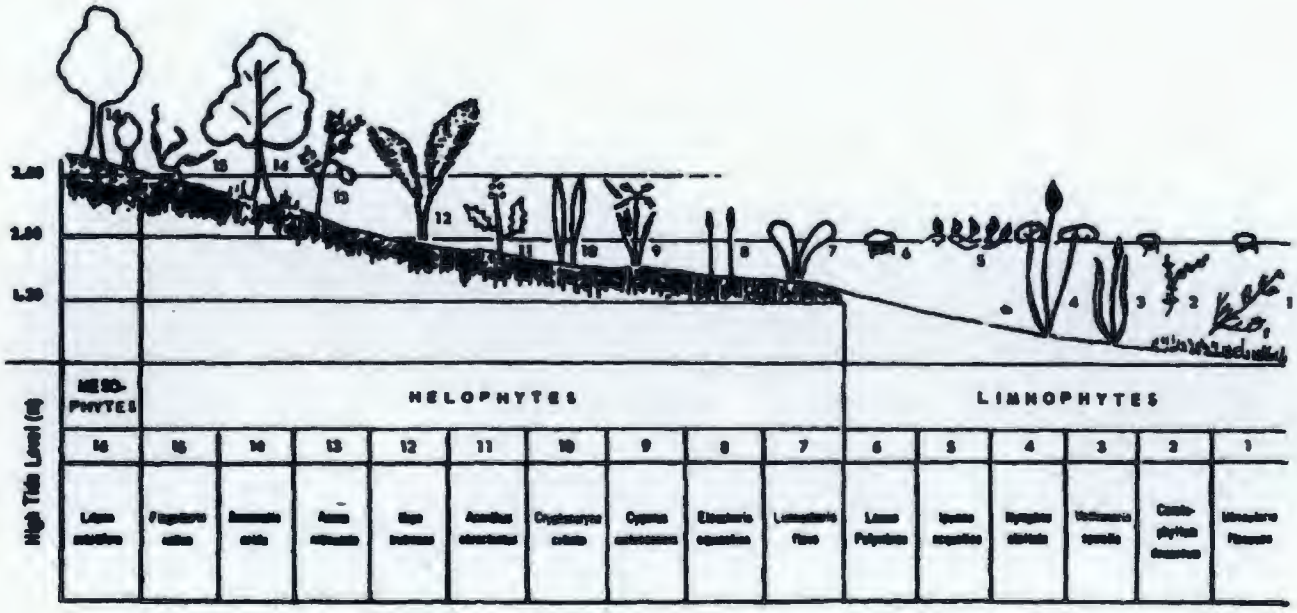


FIGURE II-4. VERTICAL DISPOSITION OF AQUATIC PLANTS
(After Van Cuong)

GENERIC CLASSIFICATION OF REGION SOUTH OF 11°N LATITUDE

(S) The entire region has been classified according to predominant vegetation and surface conditions by the Stanford Research Institute (Reference 1) through detailed analysis of the topographic map coverage on a scale of 1:50,000 and aerial photography on a scale of 1:40,000. Detailed photomosaics on a scale of 1:8,000 or 1:10,000 were utilized for analysis of selected areas. The area was divided into 5 x 5 minute quadrangles (roughly 5 x 5 nautical miles) and the predominant vegetation and surface condition was determined for each quadrangle. The principal categories used were: (1) predominantly paddy; (2) predominantly marsh; and (3) predominantly forest or swamp forest. Subdivisions were also used to include mixed conditions; i. e., predominately rice (paddy) and forest, predominantly marsh and rice, predominantly rice (paddy) and marsh, predominantly forest and rice (paddy). The resulting distributions are shown in Table II-3 and Map 2. This generic classification is used in the general environmental description in this section. A more detailed study was made of the two selected swamp forest areas and is presented in the latter part of this section.

Paddy Land

(U) Although this study is not directed toward operations in paddy lands, they cannot be completely ignored in the general swamp consideration. It is clear (see Map 2) that the greater land area of the Mekong Delta is devoted to rice cultivation and in general paddy lands will border and in some cases be interspersed in the fringes of the various swamp forest areas. Movement in this paddy-land environment will be necessary and should be considered. Reference 1 has classified rice cultivation into three specific types which can be characterized by the particular areas and the associated environment.

Near the Larger Rivers

(U) The floodwaters of the large rivers create heavy inundation for long periods of time and the rice fields usually undergo two transplantings. Floating rice with stems up to 12 feet may also be grown in these areas. The paddy lands are characterized by much water and man-made dikes.

Ca Mau Peninsula

Here the rice culture depends upon rainfalls and there are large open expanses of rice paddies with low field dikes. The area is perforated with dredged canals mostly running in a NW-SW direction intersected with fewer large cross canals. The many small streams and canals prevent off-road movement while limiting water navigation to small shallow drafting crafts which can operate in waterways 2 to 5 meters wide and a depth of around 1 meter.

TABLE II-3. CLASSIFICATION OF PREVAILING SURFACE CONDITIONS

South Vietnam - Mekong Delta Area

Classification Grouping	Number of 5-Minute Quadrangles(a)		Percentage Distribution by Classification Grouping	
Rice Paddy		302		64.3%
Rice paddy	130		23.1%	
Predominantly paddy and forest	126		22.4	
Predominantly paddy and mangrove	36		6.4%	
Predominantly paddy and swamp forest	8		1.4	
Predominantly paddy and plantation or tree lines	65		11.6	
Predominantly paddy and brushwood	17		3.0	
Predominantly paddy and marsh	106		18.8	
Marsh		68		12.1%
Marsh	19		3.4	
Predominantly marsh and paddy	49		8.7	
Forest and Swamp Forest		133		23.6%
Forest and swamp forest	67		11.9	
Mangrove	46		8.1	
Swamp forest	4		0.7	
Predominantly swamp forest and mangrove	1		0.2	
Brushwood	15		2.7	
Dense forest	1		0.2	
Predominantly forest and paddy	66		11.7	
Predominantly mangrove and paddy	25		4.4	
Predominantly swamp forest and paddy	15		2.7	
Predominantly brushwood and paddy	19		3.4	
Predominantly dense forest and paddy	3		0.5	
Predominantly plantation and paddy	4		0.7	

Source: Stanford Research Institute.

(a) Each 5-minute quadrangle has been classified as a unit area on the basis of Army Map Service 1:50,000 topographic mapping and the 1:40,000 photomosaic constructed by the Institute study team.

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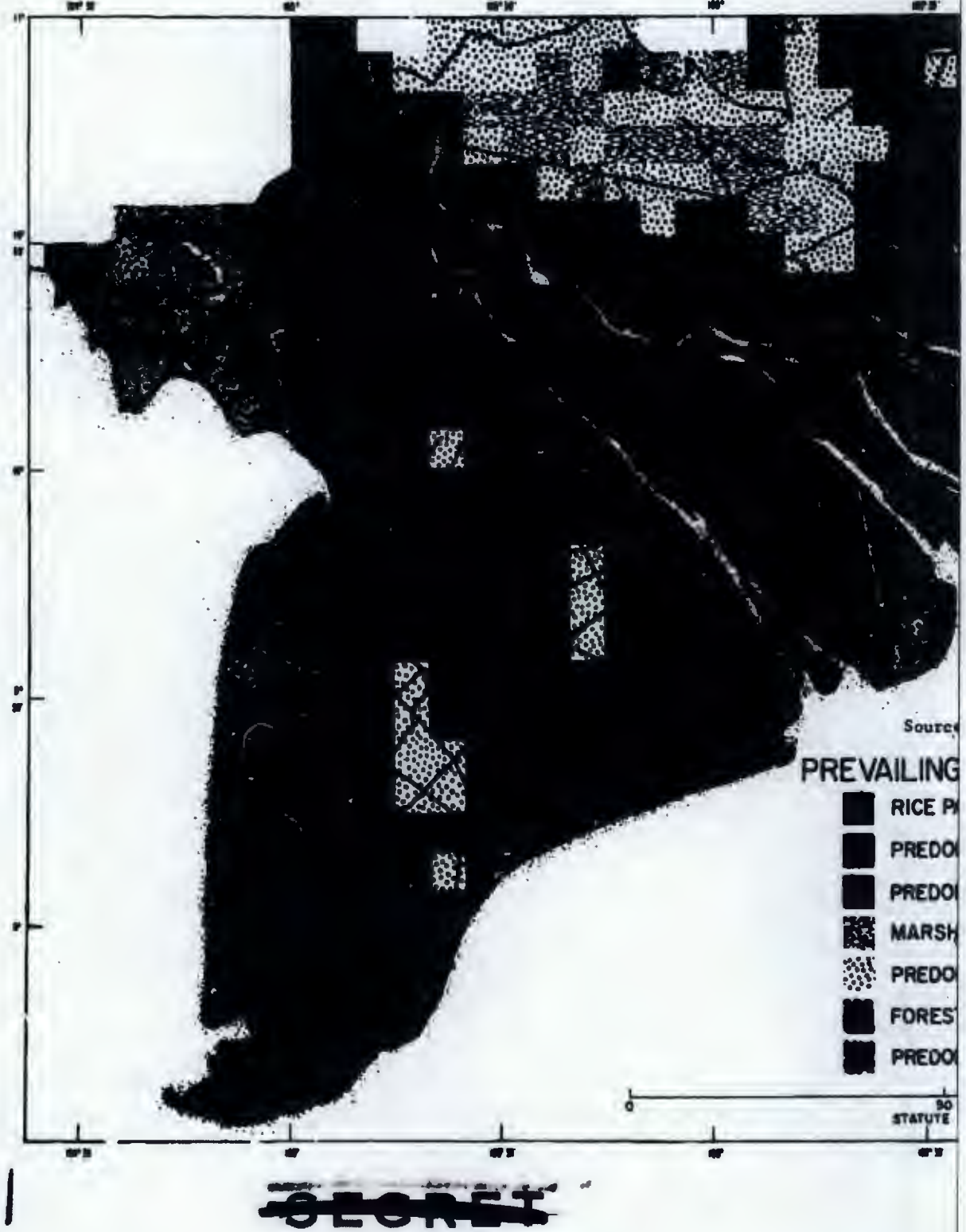

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Northeast of the Bassac

(C) These are the older more densely settled rice paddies with many small streams lined with tiny clusters of houses and trees. Although the field dikes are generally low, a sufficiently large number of larger dikes are encountered to prevent efficient movement by amphibious craft. The development of settlements and trees provides good opportunities for ambush. These rice fields are also intermingled with sugar plantations and deep, narrow ditches provide separations from garden plots.

(C) Operations in a paddy land environment necessitates good intelligences of the particular area under consideration. Topographical mapping is usually not sufficient to specify exact operations. The use of photomosaics can receive greater attention since the canopy is not a deterent.

Marsh

(C) The actual marsh and marsh-paddy mixed areas are very extensive in South Vietnam. The large area between the Mekong River and the Saigon complex known as the Plain of Reeds is a poorly drained marsh environment. Much of the Ca Mau Peninsula is marsh and marsh-paddy mixture. These areas, inundated for extended periods, remain wet during most of the year. The grasses and reeds range from 3 to 7 feet high and will dry up during the dry season making it susceptible to burning. Trees can grow in this marsh environment which forms natural border areas for swamp forests. Although all modes of movement are possible in a marsh area, they are often difficult. Local environment of streams, canals, and dikes provides additional interference.

Forest and Swamp Forest

(C) In the Mekong Delta region, the forests are predominantly along the coasts and most of them are the swamp forest type periodically inundated either by tides or rainy seasons. In this region the tendency is to classify it all as a mangrove forest but it must be realized that it is not limited to a mangrove tree. The trees usually grow at gradually increasing heights from the shoreline ranging from 6 feet to 60 feet. The mangrove tree has aerial roots which grow in all directions. The coastlines are void of undergrowth but low growth of the fern type appears at shore distances from the coast.

(C) The cajaput, a thinly branched, sparsely leaved evergreen tree, grows in the fresh-water swamps. These trees which reach a height of 60 feet form a continuous dense canopy. Some low trees and bushy swamp forests are also present in the northwest area.

(C) Perhaps the most foreboding characterization of a swamp forest is that which classifies it as dense vegetation always flooded and perforated with numerous small streams and precluding reasonable ground movement in any form.

ILLUSTRATIVE ZONES

(C) This study utilizes two selected areas to establish representative operational requirements as an analytical base for the study. Their general locations are shown on Map 3. The environment of these areas is analyzed in greater detail. Although reports, maps, interrogation of military advisors and personal observations provided a great deal of information, it was found that considerable intelligence can be derived from photomosaics. Four mosaics were compiled – one for the entire RSSZ and three for portions of the Nam Can Forest – and individual photographs were studied to lend greater accuracy in the descriptions. These mosaics are shown in Maps 5, 7, 8, and 9.

The Rung Sat Special Zone and Surrounding Area

(C) Total Area. The RSSZ and surrounding area is defined as a coastal swamp consisting of approximately 360 square miles with the following limits. *

North: The road from Xom Quoi Thanh to Phu'ac Tho
West: The Song Nha Be
South: The South China Sea
East: Highway No. 15.

Climate of the Rung Sat Area

(C) No climatological data are available specifically for the Rung Sat area. Although it is located between and not far from the observing stations at Saigon and Vung Tau (Cap St. Jacques), the data of these stations cannot be taken as accurately representing the local Rung Sat area climate. That of Saigon, while probably approximating the generalities, no doubt fails to reflect the influences of the heavily vegetated swampland on humidity, temperatures, and winds. On the other hand, the data of Vung Tau are influenced by the ocean, which influence is less over the swampland. An averaging of the data of the two stations probably is the most practical approach to climatic generalities for the area. The Rung Sat area is, of course, exposed to invasion by tropical storms from the South China Sea.

(C) Topography. Relief in this area is virtually nonexistent, with elevations generally less than 1 or 2 meters. Exceptions are the surrounding Nui Noa mountain area with a maximum elevation of 183 meters and the Cap Saint Jacques (Xa Vung Tau) peninsula with a maximum elevation of 245 meters.

(C) Hydrology. Five main channels penetrate the defined area with an intricate system of waterways. Each channel gradually widens as it approaches the South China Sea. Widening or narrowing, however, occurs in many parts of the channel beds.

*For geographical locations of [redacted] see Map 4.

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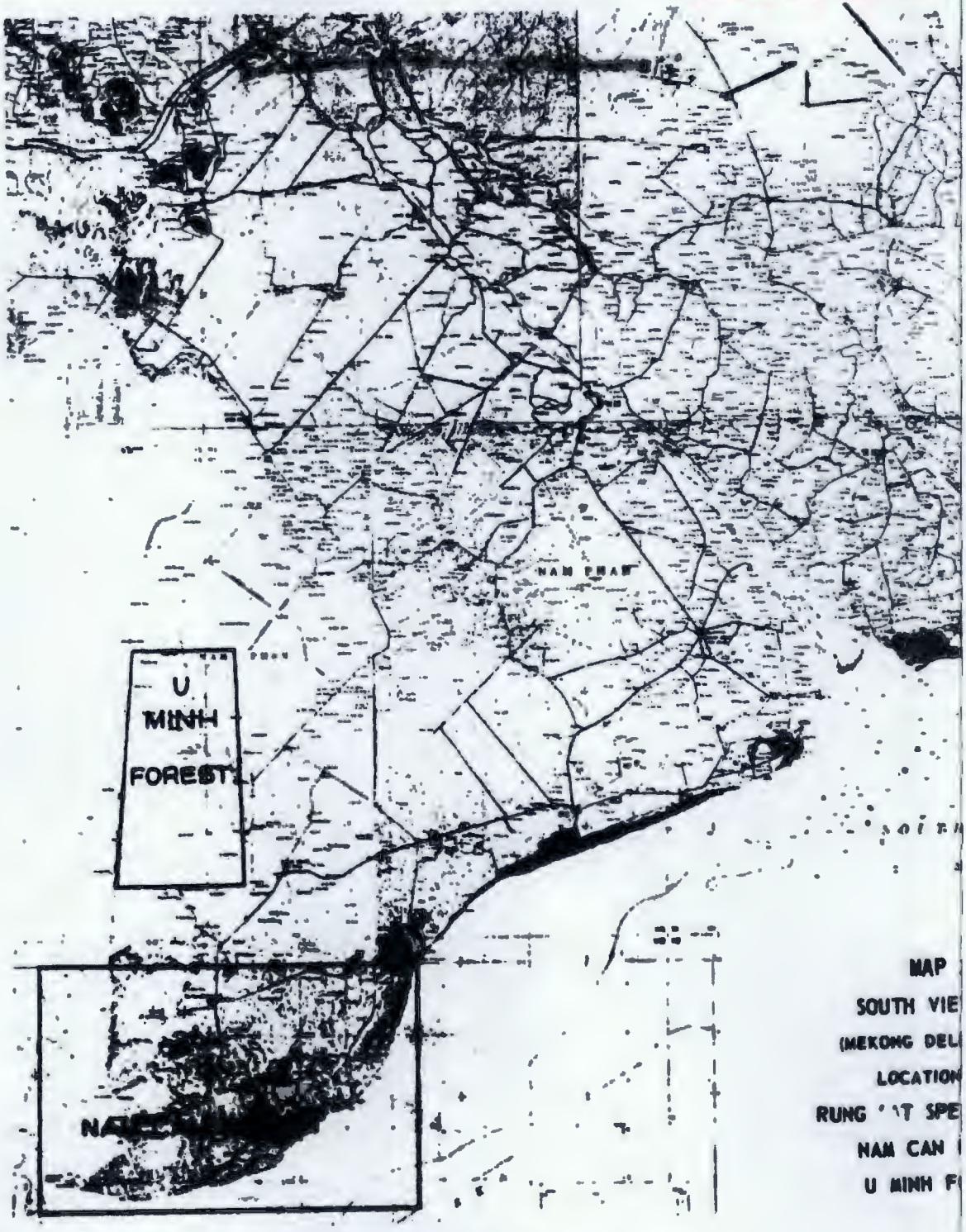

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MAP 3

SOUTH VIET NAM

(MEKONG DELTA AREA)

LOCATIONS OF

RUNG SAT SPECIAL ZONE

NAM CAN FOREST

U MINH FOREST

2

Meandering of each stream is pronounced with bends and turns as much as 180 degrees. Headwaters display a treelike dendritic pattern with tributaries joining the next higher order tributary at 90° angles. A number of channels connect the five main streams so completely that the entire area appears connected by waterways.

(C) There are approximately 300 miles of channel varying in width from 400 to 8,700 feet and in depth between 2 to 29 meters. There are in addition about 100 miles of channel between 200 to 400 feet in width where the water depth is not known.

(C) Map 4 shows the Rung Sat Special Zone and the known channel depths of the waterways.

Classification of Region

(C) The entire Rung Sat area is divided into some 15 islands or subislands separated from each other by channels at least 400 feet wide.

(C) More practically, this area may be arbitrarily divided into three main sections, which distinguish themselves primarily by their hydrology:

(1) The eastern portions including the Song Cai Mep and Song Thi Vai, which display a highly developed dendritic pattern of up to 6th and 7th order. In this region the ratio of water to vegetation appears to be higher than in the other two sectors.

(2) The central part with the main ship channel displaying a tributary pattern of up to 4th or 5th order.

(3) The western part bordered by the Song Nha Be and a tributary pattern of up to 3rd or 4th order. Here the vegetation is most dense with mature mangrove forests. The interlacing of the waterways and the resulting dendritic patterns are clearly evident in the photomosaic included as Map 5.

(C) Surface conditions in these areas appear to consist of dense mangrove and back-mangrove or Nipa forests, the exceptions being a strip about 1,000 to 1,500 feet wide in some places on both banks of the main ship channel which appear to have been defoliated. No roads lead through the Rung Sat Special Zone though examination of aerial photographs indicates the presence of man-made paths or channels.

(C) The Rung Sat area is surrounded by cultivated areas consisting of plantations, hamlets, and rice paddies, with some of these areas showing signs of deterioration. About 70 miles of roads or highway stretch along the eastern and northern part of the surrounding area. Its southern coastline is irregular, with numerous small and large channels emptying into the South China Sea. Dense vegetation lines most of the coast, the exception being the Can Gio peninsula. Here, there is a narrow strip of sandy beach with some scrub vegetation.

(C) Aerial photographs on a scale of approximately 1:25,000 of representative areas 1 mile in radius in each of the three sectors have been analyzed in more detail.

(C) Photo 1 – Map 5. The area is saturated with a treelike network of tributaries of 4, 5, 6, and 7th orders. The tributaries vary in width from 10 to 200 feet and appear very shallow. Exact depth and river profiles are not known. While it appears as if the entire area is covered by water, there are patches of extremely dense vegetation which may conceal slightly elevated land. Overall vegetational coverage is about 40 to 50 percent with bush and trees growing right up to the edge of the tributary channels.

(C) Photo 2 – Map 5. The area is saturated with 3 to 7th order channels with pronounced meandering characteristics and up to 400 feet in width. The number of tributaries can only be described as very numerous. The area appears under water. Vegetation is scattered to dense in some areas. There are no signs of civilization.

Photo 3 – Map 5

(C) This area is located around a right-angle bend of the main ship channel. The channel is here about 1,200 feet wide, this being one of its narrower dimensions. Channel depth is recorded at 9 to 16 meters in the bend. About a dozen tributaries of 3rd to 4th orders are observed varying in width from 200 feet to 10 feet.

(C) The area has been defoiliated, with a few very tall trees standing with denuded tree crowns. Isolated new growth is reappearing.

(C) A small post or fortification is located on the bank of the river. There is a straight channel or patch coming out of the jungle toward this post, of about 5 to 10 feet in width.

(C) Photo 4 – Map 5. The area is thoroughly dissected by a channel of 3rd order with tributaries of 4, 5, and 6th orders arranged in a treelike pattern. Some of these tributaries have their beginning in other large channels. There are some 35 streams, varying in widths from 5 to 200 feet. Much of the area appears to be under water. Vegetation coverage appears scattered in most places, with dense vegetation appearing in some spots. This area is located near a large fortified triangular outpost across a 2nd order channel.

(C) Photo 5 – Map 5. The area is trisected by 2nd and 3rd order channels of 1,400 feet and 300 feet widths, respectively. There are two other 3rd order streams of about 200 feet widths. The depth of the large channels in this area is about 10 meters.

(C) Vegetation appears dense (100 percent) with the tallest trees along the main channels. There are no signs of civilization.

(C) Photo 6 – Map 5. This area is adjacent to the cultivated bank of the Song Nha Be. There is only one 2nd order channel of some 400 feet in width meandering through the area with a tributary of 3rd order about 20 feet wide. Vegetational coverage

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MAP 5. RUNG SAT SPECIAL ZONE

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ZONE

2

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PHOTO 1 - MAP 5

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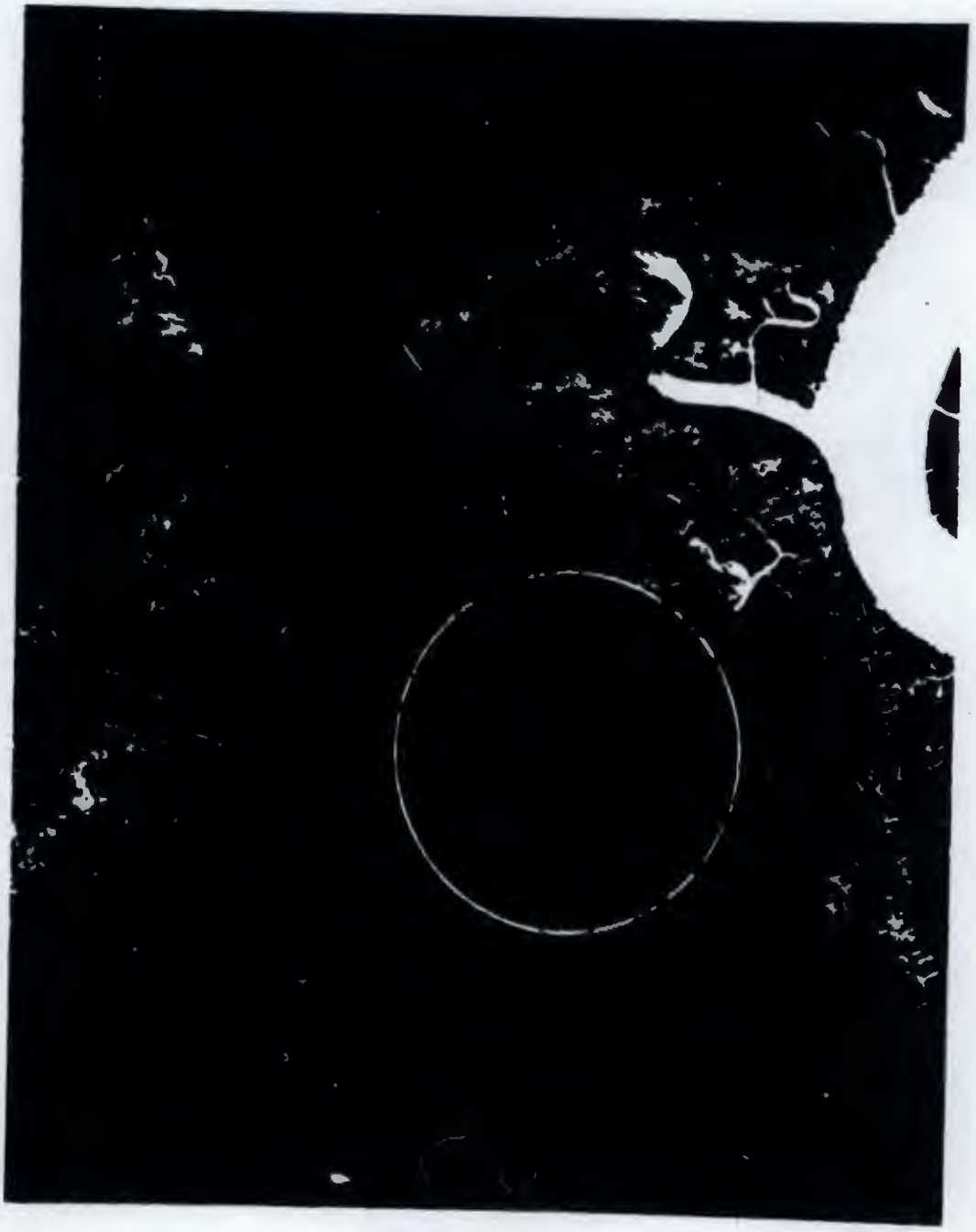

PHOTO 2 - MAP 5

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PHOTO 3 - MAP 5

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PHOTO 4 – MAP 5

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PHOTO 5 – MAP 5

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PHOTO 6 – MAP 5

outside the channel is virtually 100 percent with the trees coming right up to the channel. About three clearings are visible of about 200 foot diameter, however, several trees are standing in the clearings themselves. There are no visible footpaths.

The Nam Can Forest

Climate

(C) For this region also no specific climatological data are available. However, some generalizations peculiar to the region are possible. Being on the coast directly exposed to the onslaught of the southwest monsoon, it experiences higher winds, more cloudiness, and heavier rainfall than the remainder of the southern lowlands. It is also subject to morning invasions by thunderstorms which develop nocturnally over the Gulf of Siam. This is in contrast to the afternoon thunderstorm regime common over most of the southern lowlands. Relatively high on-shore winds occur, possibly because of the reinforcement of the southwest monsoon flow by the sea breeze. Radiation fog is very common in the southern half of the Ca Mau peninsula, presumably including this coastal region. Throughout the year, early morning fog frequently lowers visibilities to less than 1 mile. Again, the vegetation influences certain elements of the local climate in this region.

Hydrology

(C) The hydrology of the Nam Can area is distinctly different from that of the Rung Sat region. Three principal streams, essentially parallel to each other, form the most prominent waterways. The Nam Can area has much fewer waterways than Rung Sat. Also, the waterways are not interlaced and interconnected as they are in Rung Sat. Canals and old drainage ditches are numerous in the Nam Can region as opposed to the absence of any canals in Rung Sat.

(C) On the basis of stream width, the major waterway in the area is the Cua Lon River cutting the region in northeast-southwest direction. Throughout its length this river is 1/4 mile or greater in width. Access to the river can be gained both from the Gulf of Thailand on the west and from the South China Sea on the east through the Bo De River. Tributaries to the Lon River are mostly on the southeast side of the river.

(C) The other two waterways are the Bay Hap River about 6 miles north and the Rach Duong Keo about 8 miles south of the Lon River. The Bay Hap River, about 1/8 of a mile in width, is accessible from the Gulf of Thailand on the south, and from Ca Mau on the north through the Hao River and the Bay Hap Canal. Also, two navigable canals connect the Bay Hap and the Lon River.

(C) The Rach Duong Keo is the smallest stream of the three and navigation in its headwaters southeast of the Bo De River is questionable. The depths of these rivers is shown in Map 6.

Surface Conditions

(C) While both the Nam Can and Rung Sat regions may be classified as forest or swamp forest, characteristics of the surface conditions appear to be considerably different based on analysis of 1:50,000 topographic maps and limited aerial photography on a scale of 1:10,000 (Maps 7 to 9). The Nam Can area apparently at one time supported intensive rice culture, which has since been abandoned to nature. The area appears to comprise about 70 percent forest and 30 percent marsh. Most of the marshlands are probably abandoned rice paddies, and the marshes themselves are rapidly becoming forested. This is a totally different situation than pertains in the Rung Sat Special Zone, where the entire area is swamp forest with little or no marsh nor signs of previous cultivation.

(C) Even the forest regions in the two zones are very different. The Nam Can forests appear to be very dense, mature forests with an almost invariable double canopy consisting of two tree species. The upper canopy is probably formed by Rhizophora mueronata or Brugiera gymnorrhiza, while the lower canopy is probably Brugeria parviflora. The Rung Sat area does not exhibit such dense forests nor a distinct canopy. The principal specie in the Rung Sat area is probably Rhizophora apiculata, characteristic of deep soft estuarine muds.

(C) Another major difference between the Nam Can forest and the Rung Sat Special Zone, indicated by the differences in vegetation and relief, is the soil structure. Wherever the surface is visible through the canopy in the Nam Can forest, it appears to be soil (sand) with some low shrubs. In fact, occasional clearings are readily identifiable in the aerial photographs of the Nam Can forest. In the Rung Sat Special Zone, where the surface is visible, it appears to be water or very wet soil and almost no clearings are recognizable. Furthermore, the average elevation of the Nam Can area is probably slightly higher than that of the Rung Sat region. This is further evidence of a drier, more firm soil in the Nam Can forest. The relief of the Nam Can region ranges from near sea level over much of the region to maximum elevations of about 10 feet. Almost all the Rung Sat area is essentially sea level.

(C) On the basis of drainage patterns, the primary slope of the surface in the Nam Can region is from the northeast to southwest. However, there seems to be an area of higher ground between the Cua Lon and Du'ong Keo rivers. South and east of the Du'ong Keo river the slope orientation is northwest to southeast. North of this river, however, slope orientation is from south to north.

(C) The fact that the Nam Can region has a recognizable drainage pattern is in itself a unique characteristic as compared with the Rung Sat region. No drainage pattern can be identified in the Rung Sat region, the area consisting of a series of interconnecting waterways seemingly randomly oriented.

(C) Three photomosaics (Maps 7 to 9) of three areas in the Nam Can Forest were constructed from 1:10,000 photos. These maps show a general forest area near a river, the forest out to the South China Sea, and a stretch of the South China Sea coastline. Detailed analyses of the aerial photographs of four sites from Map 5 are discussed below. The coastline shown in Maps 6 and 7 is composed of soft estuarine mud. During low tide the mud line extends a considerable distance out to sea. Mud banks up

to 8 feet in height are formed by the tide action. Further inland from the shore a second coastline of higher elevation has been formed to go with the submerged mud shoreline. Here white patches of beach are shown. These, however, do not appear to be sandy beaches but rather mud banks which have been washed by seawater during high tide and salt has been deposited and dried into the mud. Forest vegetation grows in this white soil. Although some sand may be mixed with the mud in these spots, it does not appear to be a firm beach. Two areas have been magnified and are shown in Photos 1 and 2 of Map 8.

(C) Landing men and equipment on this shore does not appear to be possible by conventional means. The shallow water, outer coastline of mud, and an appreciable distance of water-soaked mud to a second shoreline provides an environment which makes mobility nearly impossible except by shallow drafting sam-pan-type craft. It, therefore, appears that landings from the South China Sea would be limited to the mouths of rivers and streams (Rach) and there are few of these in the Nam Can Forest area.

(C) Map 9 shows a cultivated, inhabited area along the Dam Chim River as well as the South China Sea coastline. Photos 1, 2, and 3 of Map 9 are enlargements of the mouths of Rach Nan, Rach Gia Cao, and Rach Bui Gua, respectively.

Photo 1 – Map 7. (C) This area consists of 95 percent very dense jungle. At least two different types of canopies are recognizable, with the two distinguished by their difference in tone and height.

(C) Two channels traverse the area in a north south direction, one naturally meandering, the other straight, apparently man made. Both are about 120 feet wide with trees crowding the banks.

(C) There are also several other meandering smaller tributaries in the area. In addition there appear a number of smaller man-made ditches in the adjacent areas, varying in width from 5, 10, to 40 feet, which show signs of deterioration.

(C) A minute interruption in the canopy may hint a foot path.

Photo 2 – May 7. (C) This area appears to have previously been under cultivation. Numerous irrigation ditches (some seemingly dry) converge upon a slowly meandering channel about 80 to 90 feet wide. The vegetation canopy is multilayered, but has not yet covered the total area, with many clearings being visible, some of them of rather barren appearance.

(C) A number of man-made conical-shaped structures stand in a straight line parallel to the main channel (these appear to be charcoal kilns). This is the only area where the jungle does not border the channel.

Photo 3 – Map 7. (C) The vegetation in this area appears very dense displaying at least two canopies. A channel varying from 10 to 90 feet wide meanders through the area.

(C) In the bend of the channel appears a clearing in which are located four buildings of varying dimensions, the largest being 90 feet long. A pipe line or line crosses the channel from the tallest building to a point in the jungle. For lack of a P.I. key and pictorial resolution no further evaluation of this site can be made.

(C) Again, the jungle grows right up to both banks of the channel except in this particular clearing.

Photo 4 – Map 7. (C) This area consists of relatively thick jungle along the banks of a 400 to 500-foot-wide channel.

(C) Both banks of the channel appear to have been denuded by defoliation, however, new growth is reappearing. The defoliated area is about 400 to 500 feet wide on each side of the channel. Several straight channels and/or irrigation ditches join the main channel at about 45 degree angles in a southerly direction.

(C) An additional sinusoidal meandering stream about 30 feet wide runs parallel to the main stream.

(C) A group of houses (10 to 15) is located along the main channel with a fish trap extending half way into it.

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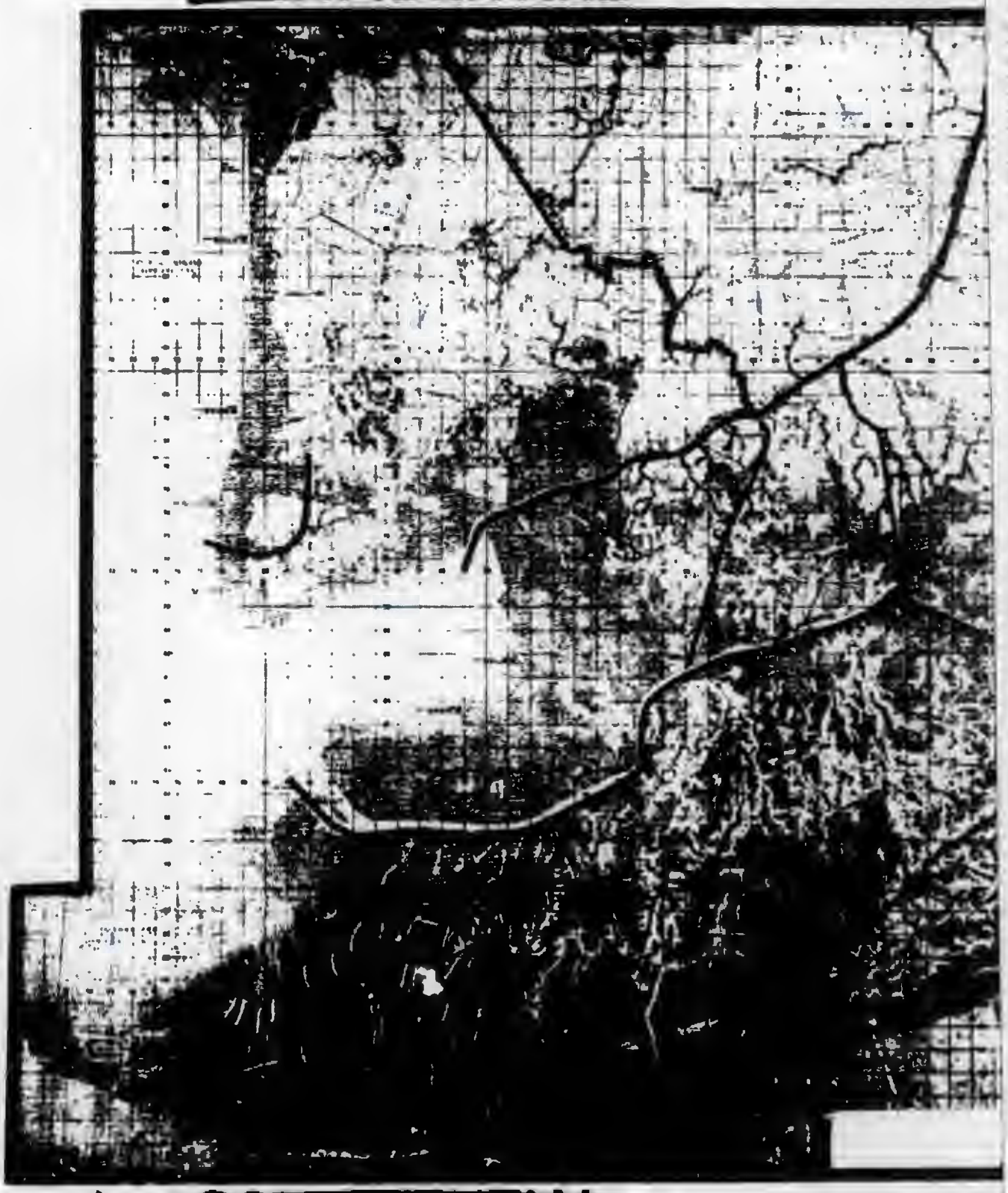

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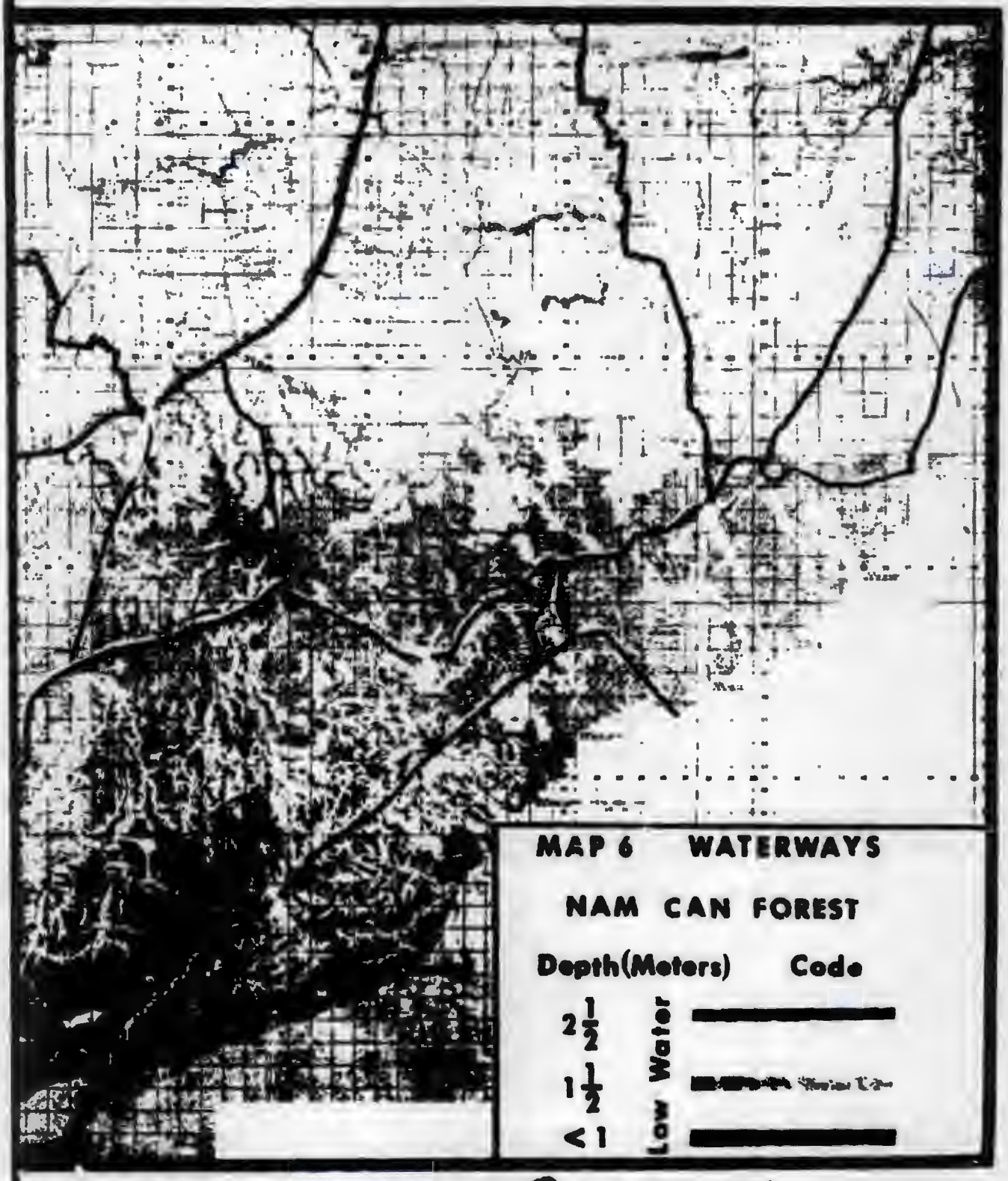

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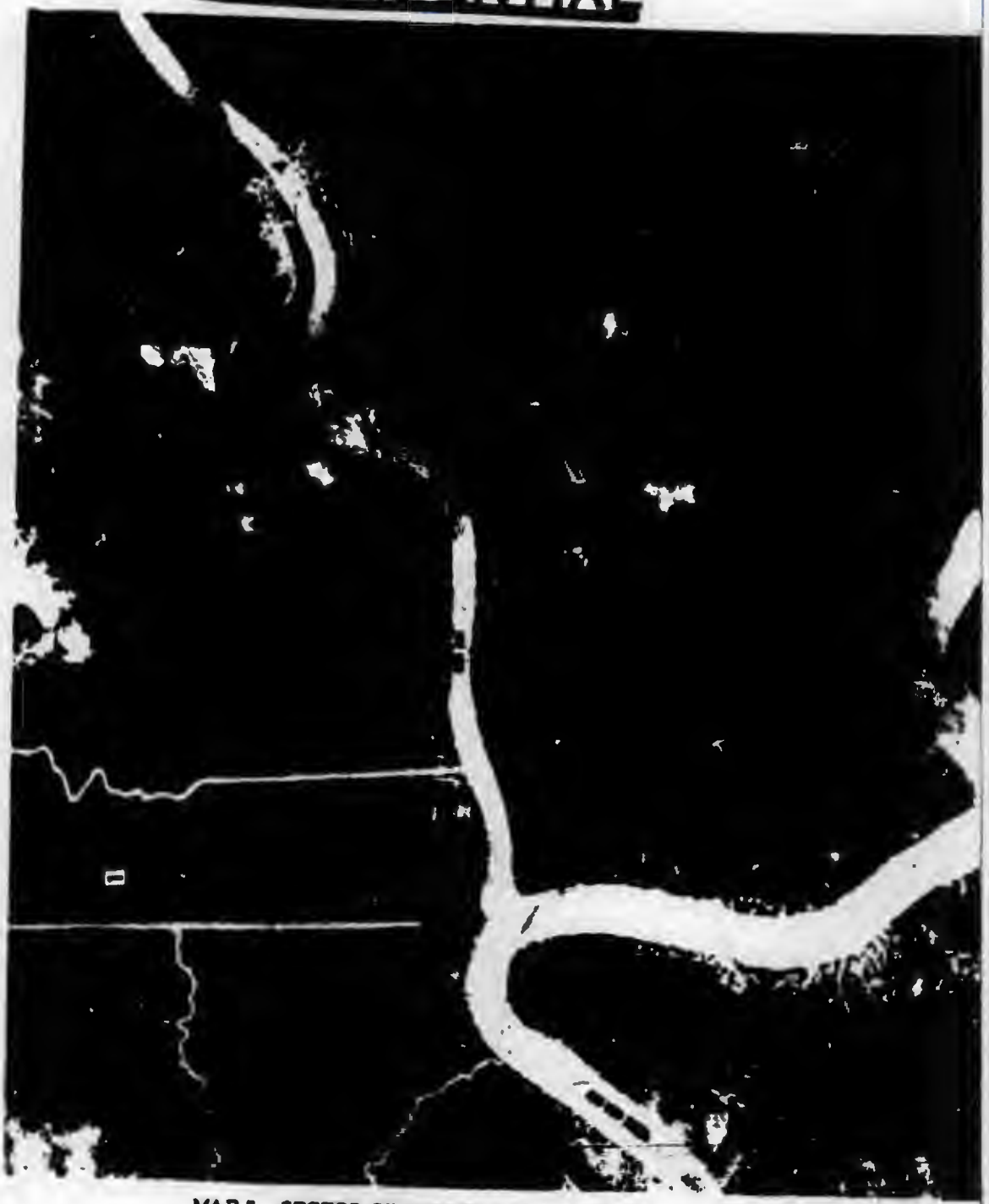

MAP 7. SECTOR OF NAM CAN FOREST

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FOREST

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PHOTO 1 - MAP 7

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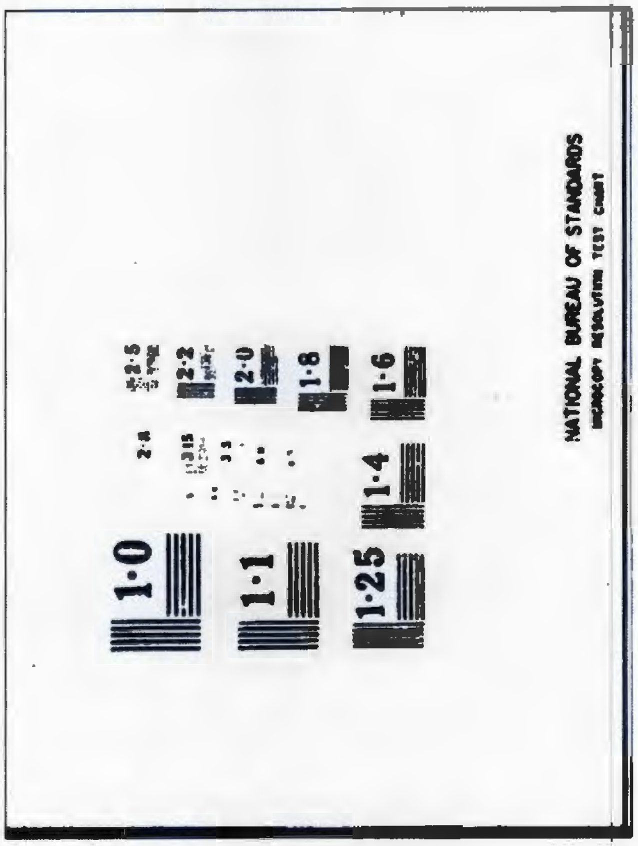

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PHOTO 2 - MAP 7

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PHOTO 3 - MAP 7

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PHOTO 4 - MAP 7

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MAP 8

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PHOTO 1 – MAP 8

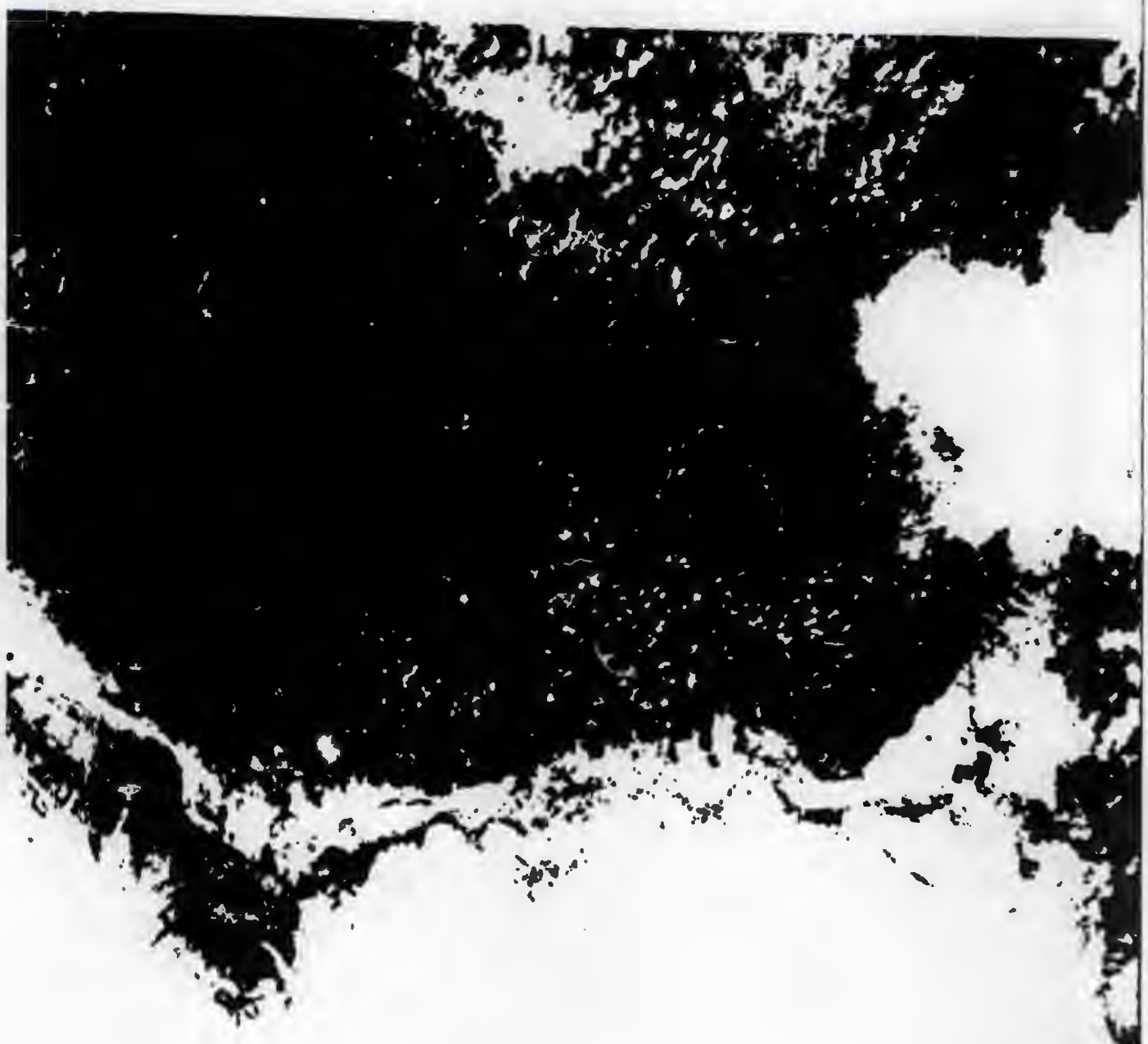

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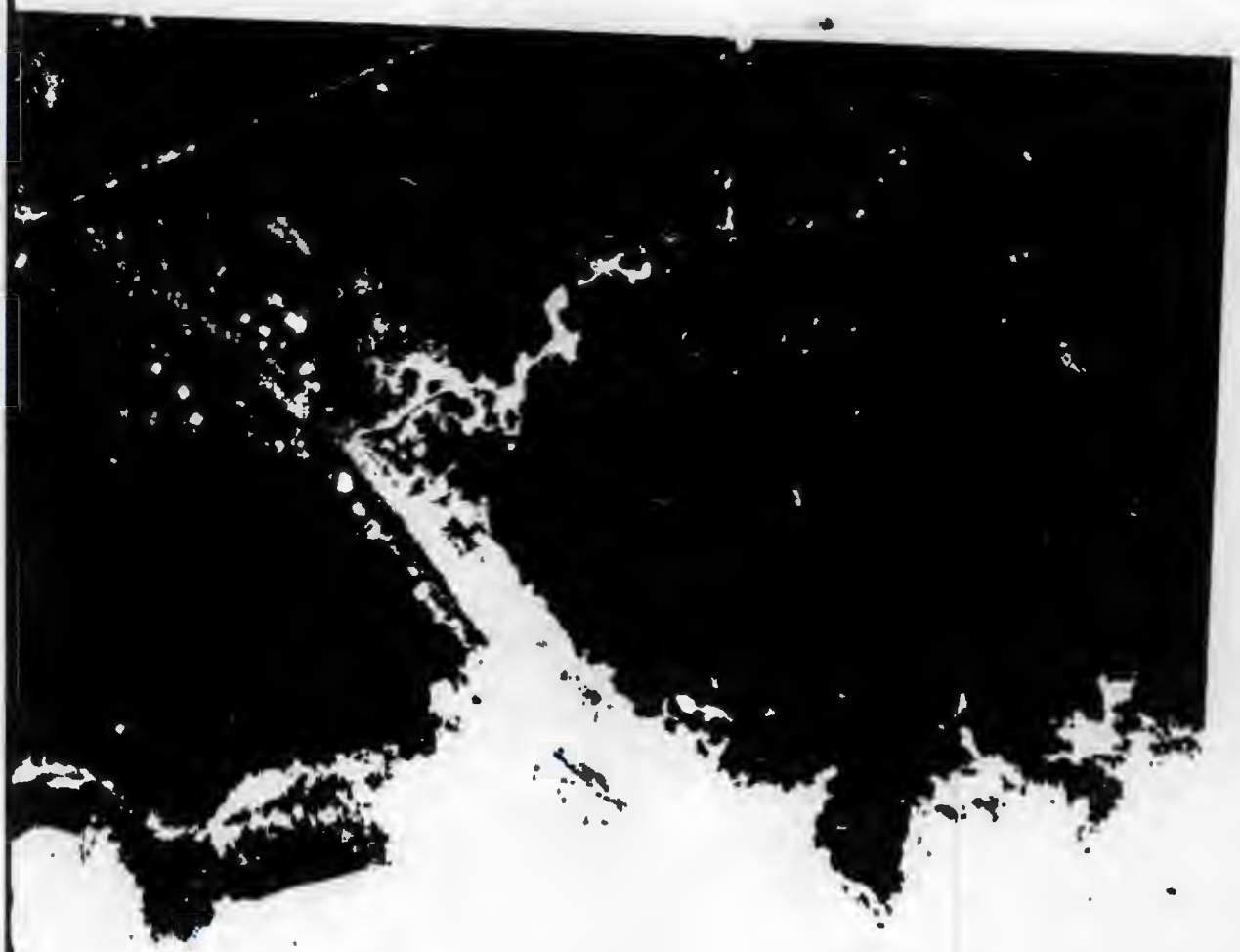
PHOTO 2 – MAP 8



MAP 9

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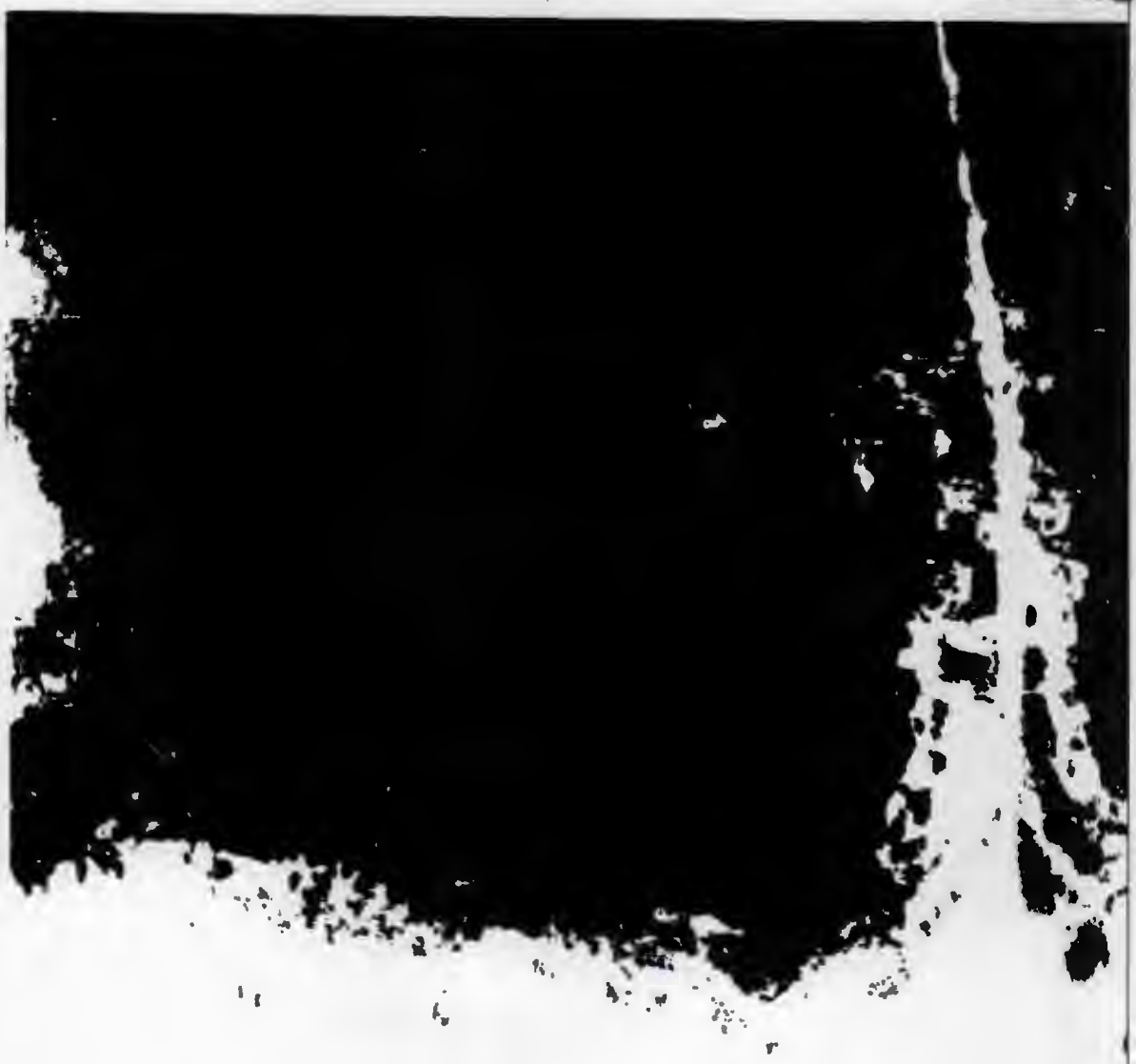

PHOTO 1 – MAP 9

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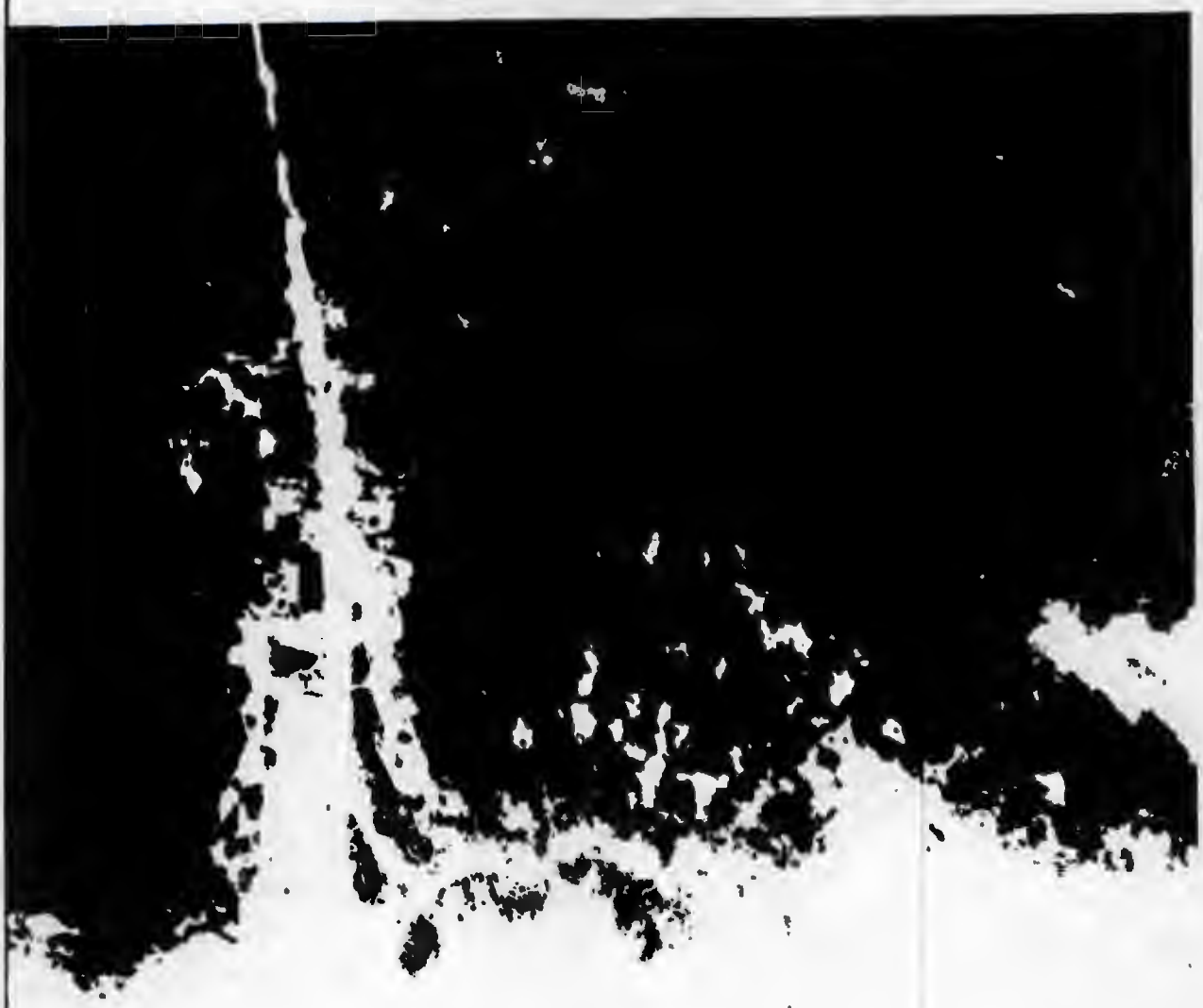

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PHOTO 2 – MAP 9

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PHOTO 3 - MAP 9

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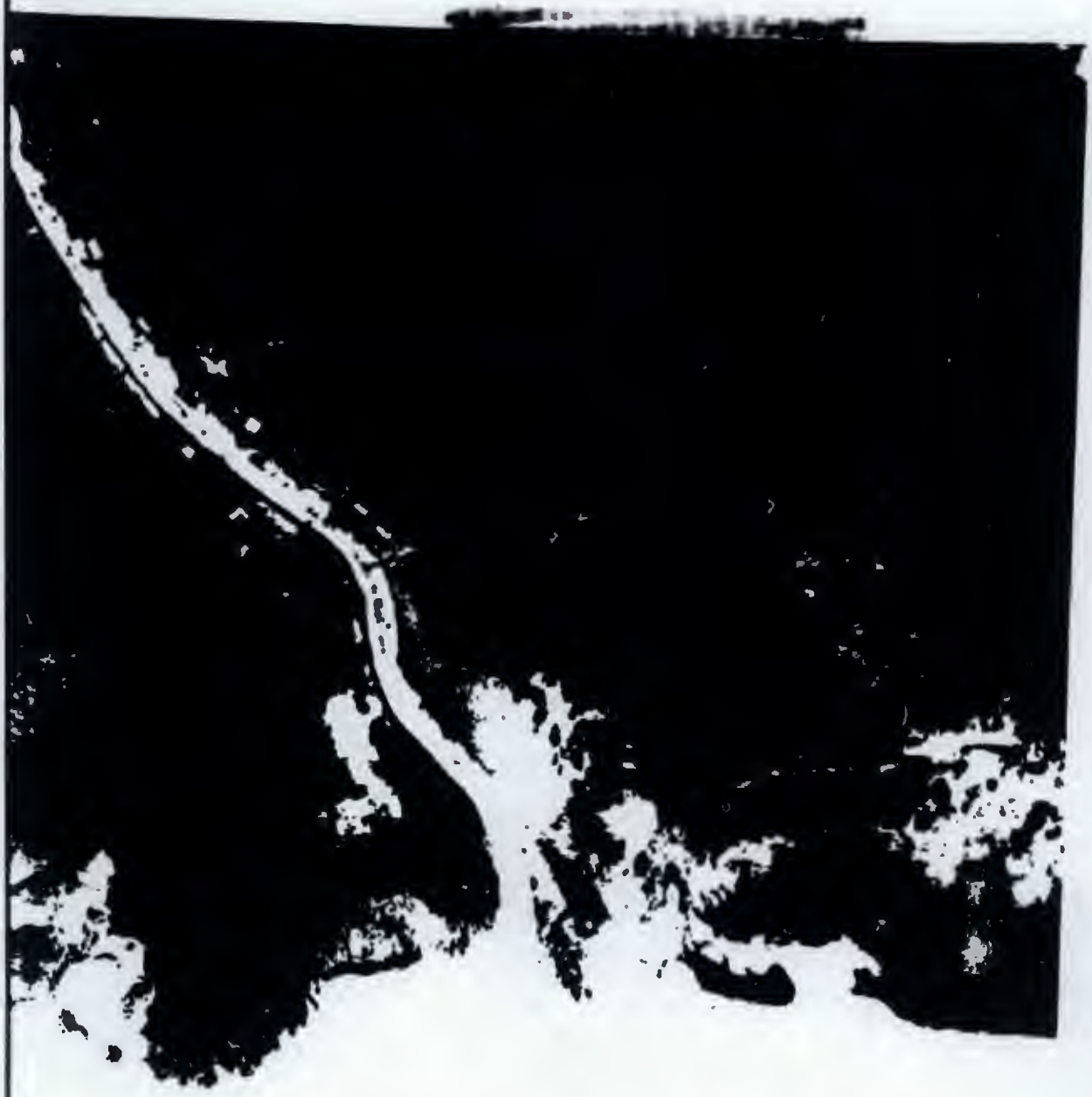

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SUMMARY

(C) The term "swamp" or even "swamp forest" is not sufficiently generic to develop a general warfare concept for the indicated environment. The differences in the number of inland waterways, climate, adjacent land areas, and vegetation among swamp areas located in the same general zone will necessitate variations in operational plans and mixes of force elements. Efficient operations are, therefore, dependent upon the characteristics of the particular swamp area under consideration and a thorough knowledge of the area is necessary. This knowledge can be obtained from local intelligence, maps, photomosaics, and climate data. An integration of this environmental knowledge with the performance of equipment is then made to provide the tactical plans. The environmental characteristics also aid in the development of special operations. The methodology of integration and application to specific examples is developed in the subsequent sections of this report.

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III. RUNG SAT SPECIAL ZONE AND THE NAM CAN FOREST

INTRODUCTION

(C) The selection of preferred weapon systems, development of general operational concepts, and identification of research and development areas to improve the current weaponry capabilities for operations in the swamp-forest areas of South Vietnam require the initial development of a representative operational-requirements base for the study. Comparison of these requirements with the current weaponry inventory will permit the selection of those systems with preferred operational capabilities. Also resulting from this qualitative analysis will be the identification of areas requiring research, development, test, and/or engineering effort to improve present operational capabilities. Extrapolation from the base, in conjunction with the environmental and weapons systems information, will serve as the basis for development of general operational concepts.

(C) In this section, the development of the representative operational-requirements base for the study is accomplished through general tactical plans for the Rung Sat Special Zone and the Nam Can Forest. In addition, these general tactical plans present by illustration the preferred operational concepts for employment of the selected weaponry. Between the two selected areas, priority has been given to the Rung Sat Special Zone.

HAVEN SYSTEM

(S) Before proceeding to a discussion of the Rung Sat Special Zone and Nam Can Forest, it is necessary to place in perspective their position as part of the integrated haven system supporting VC guerrilla and main-force operations in the Mekong Delta and Ca Mau Peninsula. The primary integrated haven system in the southern portion of South Vietnam is composed of Zone D, the Boi Loi Forest, Zone C, the Plain of Reeds, the Rach Gia area northwest towards the Cambodian border, the U Minh Forest, the Nam Can Forest, and the swamp areas along the South China Sea littoral. The Rung Sat Special Zone anchors the northern portion of the swamp areas along the South China Sea littoral. This primary haven system forms a perimeter of interconnected, mutually supporting areas around the southern portion of the country. The lines of communications interconnecting these areas consist of a network of trails which generally parallel portions of the major road and canal nets. In some places sections of these nets are used as part of the VC interconnecting network. Intracoastal movement also forms a part of this network. Definitive information is not available for use in the study to determine the extent that each of these parts contributes to the total interconnecting network.

(S) In general, training, munitions manufacture and repair, supply storage, essential clothing and equipment manufacture, medical, and resting facilities are found in each of the haven areas. However, the primary purpose of a haven area depends

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upon its location, physical characteristics, and local guerrilla and main-force support requirements. The facilities are of the field-expedient type, but effective for the support required. The intermittent destruction of these facilities, even though a serious impediment to VC operations, is not incapacitating. Reconstruction is accomplished at a minimum level, while some support is provided from other parts of the system.

(U) Strategically, the continuous denial of the effective use of these areas is essential to regaining control. The fact that each area is part of an interconnected haven system emphasizes the potential benefits of progressive operations against the system through the initiation of continuous combat operations against selected haven areas. Continuous combat operations in a selected haven area at a level commensurate with the VC threat would make it possible to (1) control the primary lines of communications from that area to the rest of the haven system, and (2) destroy the support effectiveness of the facilities and VC forces in the area by attrition.

(U) With each progressive haven area brought under relative control, the total haven support system is further weakened. Without the effective use of this system, the support of the rural guerrilla and main-force units will become more difficult. More of the support load will have to shift towards the village and urban cell and net structure. This will then further expose the VC logistic base and place higher demands on local support. The strategic potential against the insurgent threat of effective operations in the swamp-forest areas of the Mekong Delta stems from the role of these areas as part of an integrated haven system which forms the primary VC support base.

(U) The Rung Sat Special Zone is valuable to VC operations because of its location. It is close to the major population and logistic center of Saigon and adjoining areas, and contains the ocean-going-ship channel connecting the Saigon port complex to the South China Sea. As part of the integrated haven system it provides a northeast-southwest line of communication south of Saigon with some medical, communication, resupply, and rest facilities for guerrilla or main-force elements in transit. It also supports local guerrilla unit operations.

(U) The Nam Can Forest area in the southern portion of the Ca Mau Peninsula provides the link in the haven system between the areas along the South China Sea littoral and the Gulf of Siam littoral. Its strongest interconnecting links are north to the U Minh Forest. The physical characteristics of the area provide the potential for major access from sea routes and intracoastal movement.

OPERATIONAL OBJECTIVES

(U) The assumed military objectives of combat operations in the two selected swamp-forest areas are (1) the neutralization of the present VC capability to operate

[redacted]

within or from these areas, and (2) denial of the future use of the areas to the VC as effective support bases. These military objectives are based on the fact that the primary support for VC operations in the Mekong Delta emanates from an integrated haven system, and progressive attrition of this system will require the establishment of continuous control over its parts, in some sequence. The attainment of these military objectives in the two selected areas would remove them as effective parts of the haven system. In addition, the attainment of the military objectives would support the overall objective of rural construction.

(U) The general tactical plans developed in this section for each of the areas involve ground, air, and inland-waterway operations. Since more than one of the services has the capability of providing a major part of more than one of the force elements, the representative combat operational concepts are related to the force elements and not the individual services.

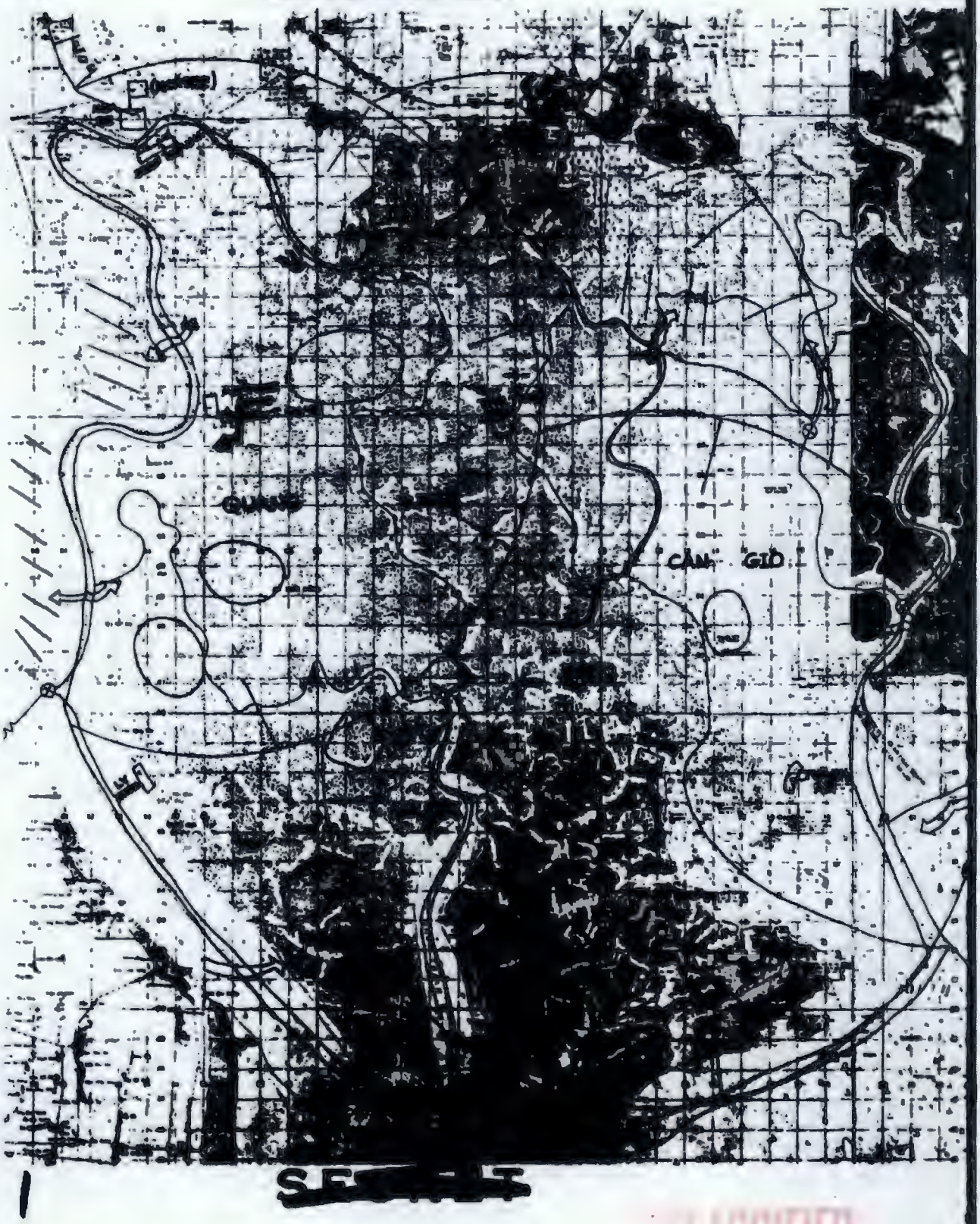
RUNG SAT SPECIAL ZONE

(C) The RSSZ is shown in Figure III-1. (Reference: Maps, Vietnam, 1:50,000, sheets 6342 I, II, III, IV; 6343 II, III; 6442 III, IV; and 6443 III of Series L 701.) The zone is under the administrative control of the Bien Hoa Province Chief who is primarily responsible for all programs and actions except military operations. The zone contains the two districts of Quang Xuyen and Can Gio. Military operations in the zone are under the control of the Vietnamese Navy (VNN), and the chain of command runs from the RSSZ Naval Commander, to Commander River Force, to VNN Headquarters, to the Joint General Staff. The Naval Commander of the zone has operational control over the Regional and Popular Force units in the two districts, the Security Task Force on the Long Tao River, and the Special Zone Command staff. The headquarters for the zone is located at Nha Be (XS938802).

Threat

(S) A primary threat of VC operations in the RSSZ is the security of the main ship channel (Long Tau-Nga Bay river complex). Since this is the only deep-draft ocean-going-ship channel connecting the Saigon port complex with the South China Sea, any blocking would have a significant effect on the logistic support of the counterinsurgency effort. Even though the channel has not yet been blocked, attempts have been made and the increased intensity of the conflict can be expected to present this alternative as an attractive course of action to the VC.

(S) In addition to the threat to the main ship channel, the location of the RSSZ provides a haven for supporting VC operations northwest toward the Saigon military complex. Control of the zone would be a significant factor in reducing the VC threat to this complex. Particularly vulnerable are the POL storage facilities in the Nha Be area. The capability to attack these facilities by mortar fire from the zone has existed for some time.



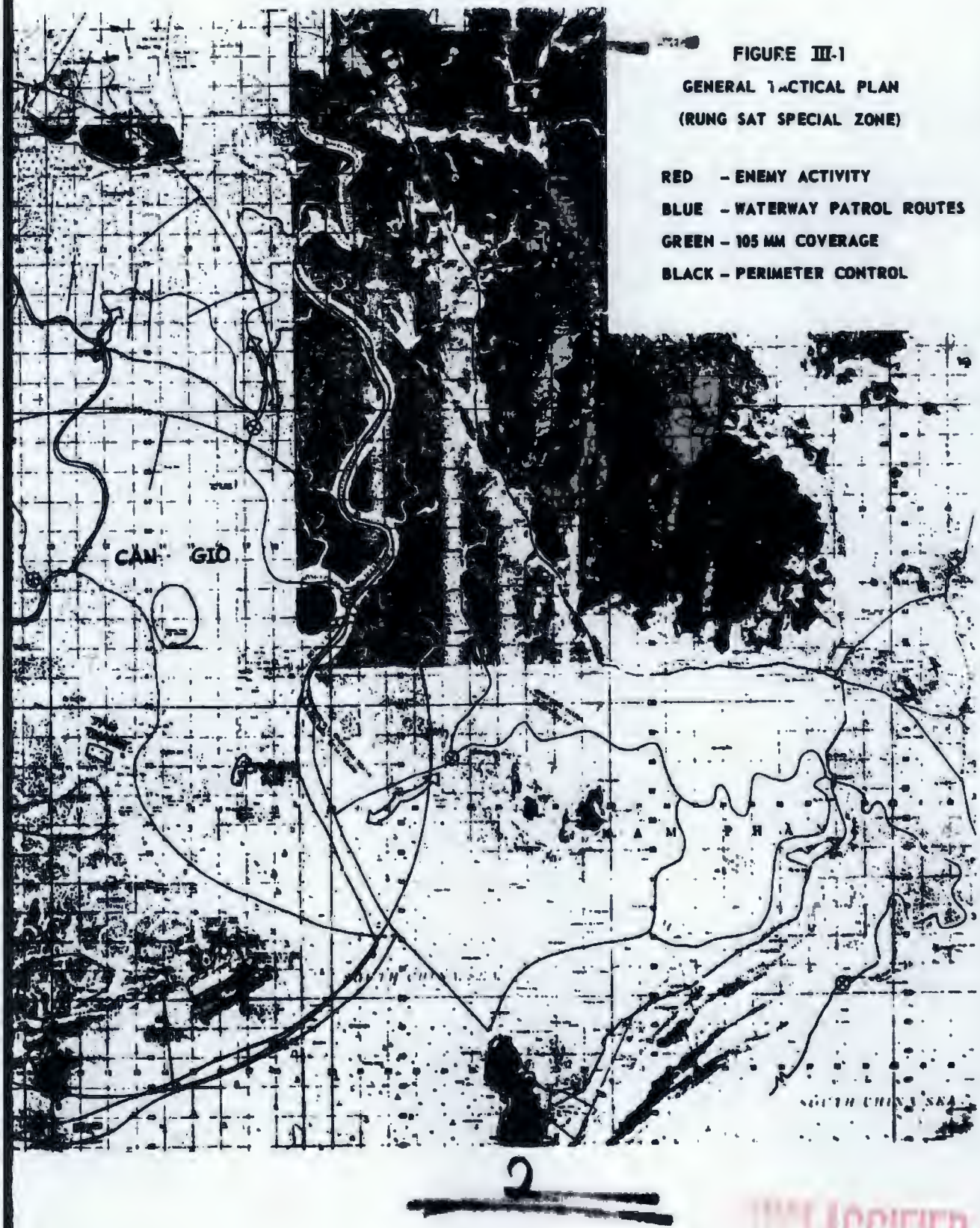


FIGURE III-1

GENERAL TACTICAL PLAN

(RUNG SAT SPECIAL ZONE)

RED – ENEMY ACTIVITY

BLUE – WATERWAY PATROL ROUTES

GREEN – 105 MM COVERAGE

BLACK – PERIMETER CONTROL

(S) The VC facilities in the zone include small-arms manufacture and repair, training and cantonment, communication liaison, and medical facilities. These facilities are used in support of the local guerrilla units as well as main-force units in transit. The area serves as a transit corridor primarily from the NE to the SW. Movement into the area from the west appears to depend on the intensity of government pressure in Long An and Go Cong, or is for reinforcing. The major corridors of movement into and out of the zone are shown in red on the overlay in Figure III-1. General areas of VC operations in the zone are also indicated. Recruiting and the impressing of supplies and recruits are accomplished in the zone.

(S) The facilities for accomplishing these activities are established on the scattered land areas found within the zone. These small land areas are limited in size and form no particular pattern except for the contiguous areas in the north sector, and the Dong Hoa-Long Thanh-Cam Thanh corridor on the southern tip of the zone. The small land areas contain excellent concealment, limited cover, and are very difficult to approach without detection. However, the many small streams and channels throughout the zone provide adequate movement routes for the VC. In general, the foliage and mangrove canopy would preclude the effective use of heliborne forces against these areas without special operation equipment and procedures. The specific restriction is the availability of landing sites.

(S) It is assumed that the VC in the zone can attack selected points with a force up to a reinforced battalion in size (approximately 500-600 personnel). In addition, the VC can send reinforcements from the adjoining areas in strengths ranging from a reinforced company to a reinforced battalion. Reinforcing-heavy-weapons capability from these areas includes recoilless rifles, mortars, automatic weapons, and electrically detonated mines. Even though the terrain impedes the movement of the enemy forces, the concealment available will permit concentration with reasonable security for attacks at this level. This will permit at least the temporary occupation of selected village(s) in the zone, effective neutralization of the population in the village complexes, and represents a continuous and direct threat to the control of the main ship channel and the Nha Be-Saigon logistic complex.

Representative Operational Concepts

General

(S) The assumed military objectives to be attained require the present and future denial of the zone as an effective VC support base. The representative general tactical plan for the zone is directed toward attaining these objectives through continuous combat operations and harassment against the VC elements and support base. The development and discussion of the general tactical plan in this paragraph is to the level required to identify the representative operational concepts, integrate the various elements of the plan, and discuss available equipment and weapons to meet the requirements. The development of the general tactical plan is based on the concepts discussed below. These concepts assume initial primary sweeps or operations as the situation may dictate.

(U) 1. The attainment of control within the zone requires the initial interdiction of the primary lines of communication providing access and egress, and the connection of the zone to the haven system. In addition, corridors of control must be established around the perimeter of the zone. In those sections of the perimeter identified by a primary inland waterway (e.g., the Soirap River), the force element required for interdiction will in effect establish that part of the control corridor. However, the portions of the perimeter involving adjoining land areas require specific ground operations oriented toward maintaining the necessary control corridor. Without these control corridors, the support of the VC elements from the adjoining areas would be possible. The perimeter of the zone (Quang Xuyen and Can Gio Districts) is completely identified by inland-waterway corridors. However, an effective control corridor on the north perimeter should include the inland-waterway patrol route indicated in Figure III-1 as the southern edge of the corridor, and the village complex along the road from Phuoc Ly (XS994867) to Phuoc An (YS140783) as the northern edge of the corridor.

(U) 2. The continuous attack and disruption of VC operating elements in the zone, after it has been cushioned off by the control corridors from the integrated haven system, will destroy its effectiveness as a support base. The effort to operate will then continue to increase for the VC elements in the zone. Well-planned and controlled combat operations adapted to the characteristics of the zone and threat level are the primary factors in attacking and harassing the VC operating elements.

(U) 3. Special operations and harassment techniques (population, water, and food control; psychological warfare; and area degradation by means other than direct combat operations) which take advantage of specific physical and/or demographic characteristics, will effectively supplement combat operations. These special techniques should be directed toward separation of the VC elements from their essential support requirements, lowering the willingness of any elements of the local population to support the VC, and the morale of the individual VC guerrilla himself.

(U) 4. The RSSZ would be designated as a specific area of operations. Operations of forces within the zone would be coordinated with combat operations in adjoining areas.

(U) 5. A U. S. air and inland-waterway force would operate in support of the South Vietnamese Regular, Provincial, and Popular forces in the zone. Centralized control would be exercised through a combined Combat Operations Center. Civil representation at the province and/or district levels in the Combined Operations Center would be used to expedite coordination of actions.

(C) 6. The initial military objectives are only part of the total objective of rural construction. The day-to-day conduct of combat operations must consider the essential elements – the people and the economic base of the area. Initial support of civic programs will rely to a significant extent on military resources.

(C) Additional factors affecting the development of representative combat-operational requirements to attain the military objectives in the RSSZ are listed below:

1. Environmental

(C) a. An inland-waterway network which will permit patrol activities extends around the perimeter of the zone and throughout the interior of the zone, and connects the zone to the surrounding areas.

(C) b. Extensive minor waterway networks exist within the zone which may be exploited for inland-waterway operations.

(C) c. Ground movement by troops is extremely difficult. An optimistic rate of march for planning purposes is 1 kilometer per hour. However, this rate usually cannot be attained because of the extensive minor-stream and channel network, general inundation of the area, heavy vegetation growth, and poor soil conditions for movement on foot.

(C) d. The areas of land relief are scattered throughout the zone. These areas are restricted in size and do not form any particular pattern. The major land areas occur on the southern tip (Dong Hoa-Long Thanh-Cam Thanh strip) and long the interior major waterways.

(C) e. Excellent concealment exists to screen clandestine operations and movement.

(C) f. The extensive minor-stream network provides adequate routes of communication for local watercraft among the scattered land areas. Partial canopy affords some screening along the routes of the minor-stream network.

2. Demographic

(C) a. The population lives in 20 New Rural Life Hamlets (NRLH's) comprising the nine villages in the zone. These villages are located in the southern tip and on the land-relief areas along the major waterways. The estimated population of Quang Xuyen District is 6000; Can Gio District 8650. The estimated population by village in the two districts is listed below:

District	Village	Population
Quang Xuyen	Binh Khanh	4000
	An Thoi Dong	650
	Tam Thom Hiep	450
	Ly Nhon	650
Can Gio	Dong Hoa	1600
	Long Thanh	1250
	Cam Thanh	3500
	Thanh An	1000
	Tan Thanh	600

(U) b. Economy

	Fishermen	Woodcutters	Farmers
Quang Xuyen	10%	20%	70%
Can Gio	70%	25%	5%

The primary woodcutting areas are along the major interior waterways and between these waterways in the north-central part of the zone.

(U) c. The present policial attitude of the population is not known with accuracy. The VC and the Central Government both have elements of support. VC terrorist activities have neutralized the remaining population.

(U) 3. Friendly Forces

a. Regular and Regional Forces:

Location	Force Description	Approximate Strength	Mission
Nha Be	22 RAG	19 Boats	Troop transport - Long Tau River security
	RF units	140	Long Tau River Security
	RF Unit	75	Reaction Force - Can Gio District
	RF Unit	75	Reaction Force - Quang Xuyen District
Binh Khanh	RF Unit	60	Zone security
Ly Nhon	Junk Div 33		Anti-Infiltration patrol (Soirap).

(U) b. Popular Force elements are located at Ginh Thanh, Quang Xuyen, Binh Khanh, Ly Nhon, Tam Thon Hiep, An Thoi Dong, Long Thanh, Can Gio, Dong Hoa, Thanh An, and Tau Thanh.

Inland-Waterway Operations

(U) The primary terrain features of the zone are the major and minor inland-waterway networks. These provide the lines of communication used by the VC in support of activities within the zone, and movement through the zone. These inland waterways are also the transportation routes for the local economy (fishing, wood-cutting, and some movement of agricultural products), and the primary routes of communication for combat operations. The critical Long Tau-Nga Bay-River-complex, which provides the only deep-draft ocean-going-ship channel connecting the Saigon port complex with the South China Sea traverses the interior of the zone. These facts associated with the inland waterways of the zone emphasize the tactical reliance which must be placed upon their control.

(U) Adequate and effective surface patrols are essential to maintain control of the inland-waterway routes. (Supplementary troop and air operations are discussed in the subparagraphs below.) This is a continuous (24-hour) operational requirement. Shown on the overlay in blue are representative primary patrol routes for the zone. The patrol paths on the south, east, and west sections of the perimeter would form the control corridors. In the north section the indicated patrol route is the southern portion of the control corridor. The other patrol routes in the interior of the zone are directed toward the security of the main ship channel. Supplementary patrol routes north and east of Cap Saint Jacques are also indicated. These routes would extend the effective use of the patrol capability.

(U) Since transportation in the zone is dependent on the inland-waterway system, mobile checkpoints are an essential part of the resource-control programs. As an example, the distribution of potable water is effected by utilization of local watercraft. The mobile checkpoints indicated on the overlay are only representative and shown at some major junctions. The day-to-day employment of the checkpoints in both daylight and night operations will have to be adjusted, along with the patrol patterns, based on current intelligence.

(U) In order to effect the inland-waterway patrol requirements of the zone, the boats and weapons listed in the Equipment and Weapons appendix are applicable. Between the choice of fast and slow patrol boats the requirement can best be satisfied with the faster boats. These provide the initial advantages of (1) larger area of effective control per boat, (2) relative speed where significant tidal currents are involved, and (3) reaction time in case of attack or ambush.

(U) The specific candidates from the available fast patrol boats which appear best for meeting the patrol requirements of the zone are the PBR and the PCF (Swift). The PBR has the advantage of smaller size and less draft for operation in the channel complex. The twin .50 caliber machine guns (forward) and single 7.62 mm machine gun (aft) however, appear to be a marginal-weapons complement for the craft employed

in a patrol role. Improvement in this complement would be a coaxial, low velocity, 40 mm grenade launcher mounted aft with the 7.62 mm machine-gun. Another option is a single .50 caliber machine-gun aft with a coaxial, low velocity, 40 mm grenade launcher. Assuming that the PBR will adequately meet its design criteria in actual operations, it would be the preferred system to meet most of the patrol requirements. However, due to its larger size and equipment complement, the PCF (Swift) would be preferred over the PBR in the south control corridor, and the southern portion of the Soirap in the west control corridor. Determination of the requirement for improved fast patrol capability should not be made until after field tests have been completed and experience gained with the PBR.

(C) A very desirable characteristic in patrol boats on inland-waterways is quietness of operation. It is not expected that the PBR[1] will meet the desired operational requirements in this regard. This is further discussed in the Research and Development section.

(C) The specific candidates from the available slow patrol boats are shown in Table B-3 in Appendix B. In addition to the present complement of the RAG's, the LCPL appears to offer the best choice as an interim patrol craft. However, any of the present boats in a patrol role (i.e., the LCPL, LCM(4) or (6), LCVP, and STCAN) need surface radar. Without this modification their capability for night operations is basically nullified. Image intensification equipment as a night-vision aid is also directly applicable to the patrol operations.

(C) The extensive minor channel- and stream network in the zone would make the channel-blocking techniques effective. Patrol craft, supported with control barriers at the entrance to selected secondary channels, could extend their effective area of patrol. (This is based on the assumption that to effect minimum exposure, VC movement across a major channel has to be from a secondary channel to a secondary channel.) The extension of the effective control area of patrol boats by such techniques will reduce the total number of patrol boats required on station at any particular time. In addition, the channelization effect on VC movements would increase the probability of detection.

(C) The erection of barriers can be accomplished by field-expedient techniques such as building earth dams, placing log barriers, and stringing chain or cable barriers. Shallow-water mine barriers are applicable and could be effectively employed in the RSSZ.

(C) It would be prohibitive in craft requirements to attempt to establish each of the patrol routes indicated in Figure III-1 as a 100 percent effective barrier. Current intelligence will have a significant effect on the patterns used and their effectiveness. Integration with the supplementing air and ground actions is critical and will require careful coordination and control. These actions will also effect the number of patrol craft required. However, in order to estimate the required number of patrol craft needed for the zone, the barrier concept may be used. Consider the on-station patrol-boat requirements for establishing the perimeter water routes and the main ship channel as barriers (that is, the patrol activity which would be sufficient for the detection – or observation – of any watercraft crossing these channels at points selected

(1) Limited field tests in South Vietnam (at time of writing) indicate undesirable noise of operation at the higher speeds.

randomly): assuming a patrolling speed of 15 knots, and an effective radar range of 2000 meters against small local watercraft, Table III-1 gives the patrol-boat requirements for the various segments of the perimeter routes and the main ship channel. The segments represent lengths of channel of approximately the same width. The patrol boat requirements for each segment are shown for target crossing speeds of one through six knots.

TABLE III-1. NUMBER OF PATROL CRAFT PLANNING BASE - RSSZ (C)

Segment No.	Coordinates	Length, kilometers	Width, meters	Target Crossing Speed, knots 1	2	3	4	5	6
1	XS 990495 XS 910610	13.75	2750	0.6	1.0	1.3	1.6	1.8	2.0
2	XS 940800	29	1100	2.5	3.8	4.6	5.1	5.5	5.8
3	YS 015750	10	450	1.5	1.9	2.1	2.2	2.3	2.4
4	YS 190760	35	250	6.3	7.6	8.1	8.4	8.6	8.8
5	YS 200550	25	600	3.1	4.2	4.8	5.3	5.6	5.7
6	XS 990495 YS 180530	32.25	4000*	1.0	1.8	2.4	2.9	3.4	3.7
7	YS 110645	16.25	850	1.6	2.4	2.8	3.1	3.3	3.4
8	YS 015750	34.5	400	3.2	4.8	5.3	5.5	5.7	5.8
		TOTALS		19.8	27.5	31.3	34.1	36.1	37.7

*Width for planning purposes of an open corridor.

(S) Using this information, a representative number of patrol boats may be estimated. Since the crossing or movement threat is not actually uniform along the rivers and channels, intelligence information will significantly decrease the patrol requirements at any time. Assume that it is required to cover 60% of the network. Combining this with a 70% estimate of equipment availability and a target crossing-speed threat of four knots gives a requirement for 29 patrol boats [(34)(.6) + (.7) = 29]. Approximately 25-30 patrol boats of the PBR class should be a representative initial requirement for the zone.

(S) To supplement surface-patrol activities for curfew enforcement at night, one team of three armed helicopters (one-illumination; two-attack), or two teams of two armed helicopters (one-illumination; one-attack) would be effective. Their speed would permit intermittent patrol of a number of channel areas (patterns based on current intelligence), or the barrier patrol of selected channel segments.

[redacted]

(S) The moored, controlled mine electrically detonated from the shore is a primary weapon threat against ships and craft using the major channels. The main ship channel through the zone is the most critical of these vulnerable areas. This constant threat has been, and continues to be, within the operational capability of the VC in the zone. The surface patrols and supplementary ground and air operations represent the active measures directed at preventing such a VC action. However, passive measures involving mine-sweeping operations are a critical requirement.

(C) Use of presently available equipment relies primarily on chain-dragging techniques. LCVP's are the principal boats employed. Additional effort on the main ship channel could be effected with VNN capability using MLMS's and MSC's. Due to the criticality of the main ship channel, directing the use of the present capability toward maintaining a current status of the bottom conditions appears essential. However, there is a gap in present capability to meet the inherent threat of the moored mine on inland waterways. Immediate requirements are for a trailing chain which can be pulled at higher speeds, an effective bottom against the moored mine device itself, and an interim sonar system to improve detection capability. These requirements are further discussed in the Research and Development section.

(C) In addition to the surface patrol, and minesweeping and laying requirements of inland-waterway operations in the zone, a troop- and cargo-transport requirement exists. Since this requirement would primarily support ground operations, it is further discussed in that subparagraph.

Direct Fire Support

(S) On-call fire support is essential against the type of threat represented by VC operations in the zone. Since the VC elements will avoid contact unless they have an advantage, the capability to immediately capitalize on any exposure of their operations is required. The area mobility of ground artillery fire and naval gunfire would provide a capability to attack exposed targets of opportunity. Additionally, the support of ground operations and the harassement of VC activities on a continuous basis requires a direct-fire-support capability. The objective of the general harassement tactics in the zone should be to keep the VC elements disrupted 24 hours a day. It is emphasized, however, that the effectiveness of harassement fire is dependent on the accuracy with which area targets have been identified through intelligence operations, and subsequent control by observation.

(S) Three 105 mm positions at An Thoi, Tam Thon Hiep, and Tan Thanh are shown in Figure III-1 (indicated by the green fans). These positions cover over 90% of the zone. However, additional fire support is required around the fringes of the zone and in the dead space at the base of each artillery fan. Table B-5 in Appendix B lists four types of ships with 5" guns potentially applicable to fulfill the naval-gunfire-support requirement. However, there are 16 ships in the VNN with a 3" gun capability. The use of one of these ships on a permanent basis would give the mobile fire support required around the fringes of the zone and supplement the ground artillery in the zone. Mortars (81 mm or 4.2") at Can Gio, An Thoi, Tam Thon Hiep, and Tan Thanh would give the critical, close-in, indirect-fire capability required.

[redacted]

(C) A fire-support capability is also essential in local village defense. Even though ground artillery and naval gunfire would be used, a fast-response capability within the area immediately around a village, and under the control of the local Regional or Popular Force element, is required. This may be effected by assignment of a 60 mm mortar to the Regional and Popular Force elements in other selected villages and hamlets after adequate training in its use.

(C) The capability of present artillery and mortar systems (supplemented with naval gunfire) appears adequate to provide effective dire-t-fire support. This capability also requires supplementing with tactical air support, which is discussed in the air-operations paragraph.

Ground Operations

(C) The objectives of ground operations are to provide security to the main ship channel and village areas, and to conduct clearing operations in the zone as required. It is estimated that an additional troop force of approximately one regular battalion would be required. This is based on the local VC capabilities, and general threat. The actual deployment of the ground force would vary with the changing enemy situation as reflected by current intelligence.

(C) Security of the main ship channel will require continuous and aggressive daylight area patrols adjacent to the channel, and night ambush operations. It is in this phase of ground operations that individual training, small unit training and discipline, and coordination and operational control are the most critical. A limited number of patrols in force along the main channel is not an adequate response to the VC threat. Daylight patrols and night ambushes conducted by small units and shifted in pattern based on current intelligence appear required to adequately support the water- and air-patrol activities in the zone.

(C) Security of the village areas presents a difficult problem. The availability of an additional battalion of troops in the zone should significantly reduce the threat of major attack on any of the nine villages. However, attempted terrorists activities would probably increase for a period of time. Aggressive daylight patrol and night ambush actions around the village areas are required on a continuing basis. These actions would be the responsibility of the popular force units located in the villages, and some regional force units. Well-timed search-and-destroy operations would prevent the VC from staging adequate forces in a particular area for a major village attack.

(C) The control corridor on the north section of the perimeter of the zone requires the establishment of relative ground control along the village complex and road from Phuoc Ly (XS994867) to Phuoc An (XS140783). Emphasis should be placed on ground operations in this area.

(C) Search-and-destroy operations are required within the zone where VC facilities have been established. This will keep constant pressure on the VC support base operated in the zone, and increase the probability of contact under favorable circumstances.

These operations will require larger force actions. Normally, blocking and attack elements will both be used. A primary problem is reaching the areas involved. Ground movement in the zone is slow and difficult, and it is almost impossible to execute and retain any element of surprise. Heliborne operations are constrained by the availability of landing zones. In time, this constraint could be overcome with the progressive clearing of landing zones.

(C) The inland waterways in the zone are the principal lines of communication available for providing mobility to the ground-force elements in the execution of amphibious-type operations. A 100 percent organic lift capability is desirable to provide adequate flexibility in these operations. This would support simultaneous actions of limited size, or a full force operation. The preferred concept for support of the amphibious operations is the present concept of a River Assault Group.

(C) Table B-3 in Appendix B lists the most applicable boats in current inventory to provide the required troop, cargo, and equipment transport, convoy protection and fire support, and mobile command and control required to support amphibious operations. Except for the LCPL and LCPR, the remaining boats are currently used by the VNN. However, the present craft of the River Assault Group have several common deficiencies. These deficiencies involve the resistance of the hulls to the effects of underbottom explosions, sustained and maximum operational speeds, armor protection, weapon systems for delivery of effective anti-personnel munitions, and noise suppression. The LCPL and LCPR do not offer any increase in capability over the present River Assault Group craft complement. It appears that a next generation of craft for operations on inland waterways is required to attain the desired increase in capability. This is further discussed in the Research and Development section. The support of amphibious operations in the zone with current equipment under the general tactical plan would require the assignment of one of the present River Assault Groups to the zone force.

Air Operations

(C) Air support is essential to continuous combat operations in the zone. The required support can be broken down into (1) an organic element of the zone force, and (2) general support elements for specific missions. Aircraft organic to the zone force are required for the following missions:

1. Night patrols, operating in conjunction with surface patrol craft, to enforce a movement curfew within the zone
2. Air escort of major troop movements on the inland waterways, and air cover of shipping on the main channel
3. Fire suppression in support of ground operations
4. Daylight reconnaissance and attack of targets of opportunity

5. Control of direct fire support and tactical air support

6. Support of special programs such as the psychological warfare program.

(C) General support aircraft are required for use in the following missions:

1. Troop and cargo lift

2. Night surveillance

3. Close tactical support

4. Defoliation.

(C) In the night patrols for enforcement of a movement curfew, which would be operated in conjunction with the water patrols, the principal targets are local-type watercraft. The VC elements would be attempting to use these craft for movement across the main channels and within the zone on the secondary channels. The armed helicopter employing the heliborne illumination system would be effective on the main channels and, to a lesser extent, on the secondary channels in meeting this operational requirement. A first-generation heliborne illumination system (Reference 3) has been tested and effectively used in the RVN on various types of waterways for the detection (target acquisition) of watercraft and subsequent illumination of the target for attack by a trailing helicopter(s).

(C) The use of the armed helicopter in an air-escort role would also be effective as a deterrent against VC attacks (ambushes) on major boat movements in support of amphibious operations and shipping in the main channel. The slower speed and hover capability of the rotary-wing system affords an advantage in the air escort of a specific water movement because of improved visual observation. However, the reaction time of a light armed reconnaissance-type fixed-wing system would offer an advantage if air cover over the length of a channel is considered, instead of the air escort of a specific movement.

(C) This highlights the requirement to balance the organic air capability of the zone force between the rotary- and fixed-wing systems. Both systems (assuming armed rotary-wing systems, and light armed reconnaissance-type fixed-wing systems) afford some capability in most of the missions listed above for aircraft organic to the zone force. Both types of systems are applicable for providing fire suppression in support of ground operations. The fixed-wing system would in general be less vulnerable to hostile ground fire. However, target identification in the mangrove forests would be a problem in the employment of either type system, with some advantage to the rotary-wing system.

(C) Aerial reconnaissance is defined for this discussion as a mission undertaken to obtain by visual or other detection methods information about VC activities in the zone. Daylight armed air reconnaissance in the zone could be performed by either type system. Which system is best is a controversial topic. However, the light armed-

reconnaissance-type fixed-wing aircraft (comparable to the design capabilities of the OV-10A) would meet the requirements for reconnaissance and fire control, with additional flexibility for attacking targets of opportunity with a wider range of air weapons.

(C) The rotary-wing type system would offer more flexibility in the support of special programs. This is particularly true when limited personnel and cargo lift into a restricted area as part of the support of the civil program is considered.

(C) A summary of the required roles of aircraft organic to the zone force versus the preferred use of fixed- and rotary-wing type systems is given below:

Mission	Rotary Wing	Fixed Wing
Night patrols – curfew enforcement on waterways	X	
Air escort of epecific water movements	X	
Air cover over length of main channel		X
Fire suppression in support of ground operations	X	X
Daylight armed reconnaissance		X
Attack of targets of opportunity	X	X
Control of direct fire support		X
Control of tactical air support		X
Support of special programs	X	

(C) The general characteristics of current rotary-wing systems are given in Table B-8 in Appendix B. Of these systems, the Bell UH-1B has been the most extensively employed in South Vietnam in an armed helicopter role, and consequently has had the most development and adaptation of weapon subsystems for it. Table B-15 in Appendix B gives basic information on the principal weapon subsystems currently available for the UH-1B. Considering at least two armed helicopters as a fire team, subsystem combinations of the M-5, M-16, and CBU-14B fragmentation-bomb dispensers would be preferred against the expected targets involving small watercraft, personnel, light weapons, and structures and facilities.

(C) The design capabilities of the OV-10A Light Armed Reconnaissance Airplane (LARA) appear to meet the operational requirements for armed daylight reconnaissance, attack of targets of opportunity, and the control of direct support fire and tactical air support. Organic to the zone force, it would also provide the capability of close support with air weapons up to a maximum weight of 1200 pounds. (At the time of writing, the OV-10A aircraft system has not been through acceptance tests.) Until a light armed-reconnaissance aircraft is operationally available, the O-1 type aircraft can be used for visual observation, target marking, and fire control.

(S) The targets for air weaponry in swamp areas will be personnel, weapon emplacements, light facilities and structures, and small boats. Since the ordnance which is currently in use for air delivery has not been specifically evaluated in a swamp forest environment, no comparative selection is possible. This is further discussed in the Research and Development section. In the interim, standard airborne ordnance will be assumed to be applicable. A short table of selected air-deliverable ordnance is given in Appendix B (Table B-17). It appears from the environmental information that canisters with flechette ordnance, conventional bombs with air burst, and fire bombs should have approximately the same effects in a swamp-forest environment as in a jungle environment.

Integration of Area Operations

(C) In determining the representative operational requirements to attain the assumed military objectives in the RSSZ, the concepts of continuous operations and the treatment of the zone as a specific area of operations were used. These are considered essential. An additional critical factor is the structure for exercising control over the combat operations, and the coordination of these with the civil program requirements. A Combined Combat Operations Center would best serve this demand. In addition to the RSSZ naval command and the U. S. force staffs, representatives at the Province and/or district levels could be a part of the staff in the center to effect fast and responsive coordination between the military and civil requirements.

(C) Analysis of the primary terrain characteristics of the zone indicates that it would be feasible to use land bases for the command and control, air, ground, and water elements of the force. The principal factors which bear on this determination are (1) availability of suitable or potential base facilities and areas, (2) security of the base areas, and (3) distances between the base locations and operational areas (response time). In the RSSZ these factors are not restricting to the extent that a water base of operations for some or all of the force elements appears to provide a significant advantage.

(C) A representative base structure to support the zone force is listed below:

1. Command and Control Elements - located at Nha Be.
2. Ground Elements - two primary bases of operation located at Nha Be and Can Gio or Xa Thang Nhut.
3. Inland-Waterway Elements - two primary bases at Nha Be and Xa Thang Nhut.
4. Air Elements - Vung Tau military airport.

[redacted]

Special Operations

(C) Three special operations specifically applicable for supplementing the effectiveness of combat operations in swamp-forest warfare are discussed in this paragraph. These special operations (or programs) are the denial of drinking water, psychological warfare, and defoliation. The denial of drinking water would not be feasible in a fresh-water swamp. However, it is applicable in both the RSSZ and the Nam Can Forest.

Denial of Drinking Water

(S) Geographical Constraints on Water Supply. The Rung Sat and Nam Can Forest areas each have a large number of rivers, streams and channels within their boundaries. Based on reports from advisors who have been in the area and from interpretation of aerial photographs, the RSSZ has many more streams than are shown on the maps. Because the areas have low elevations and because of their proximity to the sea, the streams are tidal. The water is saline and unfit for drinking. Although there have been reports of fresh-water ponds at a few locations, probably resulting from entrapment of rain, the usual primary sources of drinking water are not available to the Viet Cong who live and operate within the zone.

(S) The same characteristics of low elevation prevent the use of deep wells, thus eliminating the type of water source generally used where sufficient surface water is not available.

(S) Water Sources and Storage. Although deep wells cannot be dug, seep wells can be and are used in some locations. Little information is available on the number of seep wells, but because of the terrain it is not thought to be large.

(S) It is very unlikely that fresh-water ponds exist to any extent in the RSSZ. This region is principally mangrove swamp heavily crossed by rivers, streams, and connecting channels, all tidal. The southern area has never been cultivated and so does not contain a network of canals and dikes such as are found in other sections of the country. In the Nam Can Forest there is a distinct possibility that fresh-water ponds can be found. Maps show rice paddies in a number of places. The maps are incorrect in this respect since the paddies have been abandoned and are overgrown. It is entirely possible, however, that at some locations the dikes have been maintained and reservoirs of fresh water are formed. Further light on the question must await the time that patrols begin to penetrate the area, unless some information can be obtained from agents.

(S) On consideration of the terrain it appears that ground water is not a source of drinking water in the southern part of the Rung Sat Special Zone and probably not in the Nam Can Forest.

[redacted]

(S) Water supply for the Viet Cong depends primarily on the entrapment of rain and importation by boat.

Effects of Interruption in Rain Water Supply

(U) Average monthly rainfalls at four stations are given in Tables A-1 through A-4 in Appendix A. The station at Cap St. Jacques is not too far from the RSSZ and the data are probably fairly descriptive for that zone. None of the stations however, are very close to the Nam Can Forest. The Can Tho station, located in the Mekong Delta, will be taken to be the nearest approximation to conditions in the Nam Can Forest.

(U) Examination of the rainfall tables shows that the months of lightest rain extend from December through April at Cap St. Jacques, and through March at Can Tho. It is during these months that water-denial methods will be most effective. During the other months of the year the heavy rains will flush and dilute water storage systems and, even if they are contaminated, provide a ready source of fresh, uncontaminated water. Patrols during the months of May to November should do as much as possible to destroy water storage facilities as a harassing tactic, but the results will not be as critical to the Viet Cong as they will be during the dry months.

(U) Assume that all drinking water is obtained from the entrapment of rain water.

$$A = 7.481 \times L \times W \times R \times F/12$$

$$= 0.6234 \times L \times W \times R \times F$$

where A = amount of water collected, gallons

L, W = horizontal dimensions of collecting area, feet

R = mean monthly rainfall, inches

F = fraction of rain reaching the collecting area.

(U) In open areas F will have a value of 1.0 but where the collecting area is under a full or partial canopy the value of F will fall to some lower number. It is likely that the value of F is a function of the intensity of the rainfall as well as the degree of canopy cover, but this is unknown. Probably a considerable fraction of the rain penetrates the canopy during heavy downpours whereas in light showers most of the rain is stopped by the foliage.

(U) Table III-2 shows the water-supply problem which the Viet Cong might have. The extent of the water-collection facilities is not known, but it has been assumed that for each man there is a 5 x 10-foot collection area and a maximum storage capacity of fifty gallons. It has been further assumed that each man requires about 24 gallons of water per month for drinking and cooking. This is equivalent to 3.17 quarts (3.0 liters) per day. The table shows that there is a deficit of 20 gallons or 39.5 gallons in the

RSSZ, depending on the assumption about the fraction of the rain reaching the ground. For the Viet Cong to exist in the RSSZ from February through April they must either have a larger storage capacity for each man or they must import water. In either case destruction or contamination of stored water early in January will impose a severe burden because of the lack of rain in the following months.

TABLE III-2. ESTIMATED WATER STORAGE IN TWO REGIONS AND FOR TWO FRACTIONS OF RAINFALL REACHING GROUND (U)

		Fraction = 1.0				Fraction = 0.50			
Month	Mean Rainfall (in.)	Stored at Start of Month (gal.)	Rain Collected (gal.)	Water Used (gal.)	Stored at End of Month (gal.)	Stored at Start of Month (gal.)	Rain Collected (gal.)	Water Used (gal.)	Stored at End of Month (gal.)
CAP ST. JACQUES									
November	2.16	50	67	-24	50	50	33.5	-24	50
December	0.58	50	18	-24	44	50	9	-24	35
January	0.10	44	3	-24	23	35	1.5	-24	12.5
February	0.01	23	0	-24	-1	12.5	0	-24	-11.5
March	0.17	0	5	-24	-19	0	2.5	-24	-21.5
April	1.12	0	35	-24	11	0	17.5	-24	-6.5
CAN THO									
November	7.62	50	238	-24	50	50	119	-24	50
December	1.20	50	37	-24	50	50	18.5	-24	44.5
January	.66	50	21	-24	47	44.5	10.5	-24	31.0
February	.26	47	8	-24	31	31.0	4.0	-24	11.0
March	.98	31	31	-24	38	11.0	15.5	-24	2.5
April	2.01	38	63	-24	50	2.5	31.5	-24	10.0

(U) If the mean rainfall figures for Can Tho do apply to the Nam Can Forest, the drinking water problem there is not as great for the Viet Cong. Heavier rains in December and somewhat more rainfall in January, February, and March provide sufficient drinking water under the assumptions given.

(U) It must be stressed that the rainfall figures are averages over ten years. It is possible that, in a given year, the rainfall will be heavier in December or January, thus providing a greater reserve for the drier months. It is equally likely, however, that the rainfall will be lighter than the mean and the resulting reserves will be lower.

(U) As an example of the effectiveness of a program to destroy stores of water, suppose that the 35-gallon reserve shown for Rung Sat at the end of December is destroyed (half rain reaching ground assumption). Then during the months of January through April there will be a 74.5 gallons per man deficit which must be imported if the Viet Cong are to remain in the area. For a force of 100 men this is a total of 7450 gallons or nearly 30 tons of water, a sizeable amount.

(C) Methods of Denial of Drinking Water. Destruction of the stored water can be accomplished by physical emptying of the containers, demolition of the containers, or by addition of materials which by odor or taste will render the water unpalatable.

(S) It has been seen that rainfall is probably insufficient to provide drinking water in all months in the RSSZ. Water supply from the rain is probably marginal in the Nam Can Forest. If this is true, then the Viet Cong must be importing water. It is well known that boats are used either voluntarily or by commandeering to take supplies and weapons into the areas. Water is probably taken in the same way. The proposed system of patrol craft will do much to make the importation of water more difficult.

(C) Consideration should be given to a water-control system for the fishing boats operating in the area. If these boats obtain their drinking water from villages where they can be supervised, it might be possible to limit the amount of fresh water which they take on to that which they can use in one day. In that way boats which take on a surplus for delivery to the Viet Cong will be unable to do so. Because of the number of boats involved, this plan might be impractical.

(S) One final possibility should be noted. If it is possible to identify with reasonable certainty boats which are transporting water to the Viet Cong, their water tanks could be contaminated. This could be done under cover of a stop and search operation. The crew could then be permitted to deliver the contaminated water. This would have the effect, depending on the contaminate used, of denying the ultimate use of the water and creating discord between the VC and their support, or just the latter. The contamination of potable water is further discussed in Appendix C.

Psychological Warfare

(C) Psychological warfare is a critical part of counter-insurgency operations. In swamp-forest warfare this is further emphasized by the increased burdens placed on the insurgent elements by the environment. This, combined with the harassment of continuous combat operations, increases the receptiveness of the individual insurgent to psywar. Under these conditions it should be easier to motivate at least the local guerrilla to return to the village areas.

(S) The operation of the supporting base in the RSSZ involves VC personnel other than those locally recruited. An unknown percentage of the VC "garrison" personnel in the zone have been moved in from other areas. These individuals, like the locally recruited guerrilla, should have specific propaganda oriented to their situation to condition their thoughts and actions, and weaken their will to continue.

(C) The above emphasis was on the individual VC concerned with operating the support base. Another key factor in weakening the base structure is to influence the elements of the local population who actively or passively furnish support and resource to the VC. Erosion of this artery, due to the reliance that must be placed upon it under the environmental conditions, is essential and would have a significant effect.

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Defoliation

(C) In support of the ground operations, effort would be required to limit the advantages of the cover and concealment to VC operations. The primary effort would be to degrade or clear the vegetation cover in selected areas. Maintaining defoliation programs current along the main ship channel and in selected areas along the other major waterways which offer potential ambush sites is necessary. To increase the effectiveness of the defoliation program, commercial woodcutting operations could be accomplished where physical clearing is further required. Assistance with government transportation would enhance this program and aid the local economy. Since the VC operations in the zone are carried on to a significant extent on the small land areas scattered throughout the zone, these could also be defoliated or cleared (at least partially through defoliation and/or woodcutting) after a sweep-and-clear ground operation. This would deny the VC part of the concealment and cover essential to their operations on the limited land areas.

(C) The burning of extensive areas in the RSSZ (or the Nam Can Forest) does not appear feasible. In addition to the problem of the water content of the primary foliage and general inundation of the area, the numerous streams and channels form an extensive system of small, natural fire breaks. This, combined with the variation in density of the vegetation and crown heights, does not present favorable conditions for sustaining a forest fire and attaining a general area of burn.

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SUMMARY (RSSZ)

(S) The Rung Sat Special Zone is valuable to VC operations because of its location. It is close to the major population and logistic center of Saigon and adjoining areas, and contains the ocean-going-ship channel connecting the Saigon port complex to the South China Sea. As part of the integrated haven system it provides a northeast-southwest line of communication south of Saigon with some medical, communication, resupply, and rest facilities for guerrilla or main-force elements in transit. It also supports local guerrilla unit operations.

(S) The attainment of the military objectives of (1) neutralization of the present VC capability to operate within or from the zone, and (2) denial of the future use of the zone to the VC as an effective support base, requires a balanced air, ground, and inland-waterway force adapted to the particular VC threat and zone characteristics. Employment of the force to attain these objectives requires emphasis on continuous combat operations and harassment. The combat operations would be directed toward the interdiction of the VC lines of communications providing access and egress to the zone, isolation or "cushioning-off" of the zone by establishing control corridors around the perimeter, and attrition of the insurgent elements and support base within the zone.

(S) Special operations with emphasis on the denial of potable water during the dry season, psychological warfare, and defoliation are required to supplement the combat operations. In addition, a structure for central command and control of the military operations and coordination with civil programs is required.

(S) The results of the related analysis are given below in summary form. Representative increased combat operations in the RSSZ are based on the general tactical plan, and the preferred equipment and weapons from current inventory to meet these operational requirements are given.

(S) 1. Inland-Waterway Operations

(S) a. Patrolling and operation of mobile checkpoints - Provide a U.S. supplement of 25-30 inland-waterway patrol boats. These patrol boats would be used around and within the zone to interdict clandestine movement and operate mobile checkpoints. The new PBR patrol boat appears to best meet the basic requirement.

[redacted]

[redacted]

The PCF (Swift) would be preferred for patrolling from the Soirap to Vung Tau.

(S) b. Support of amphibious operations – A one-battalion organic lift capability is required. The craft of a present River Assault Group best meets this requirement from current inventory. Support of the increased combat operations under the general tactical plan would require the assignment of a RAG to the zone force.

(S) c. Mine countermeasures – Improve the present operations by increasing the frequency of drag operations and concentrating more VNN capability on the main ship channel. Improved drag equipment and sonar for detection of moored-mine devices should be given priority for use on the main ship channel.

(S) 2. Fire Support :

(S) a. Ground artillery – Establish three 105 mm howitzer positions at An Thoi, Tam Thon Hiep, and Tan Thanh. Provide 81 mm or 4.2" mortars at Can Gio, An Thoi, Tam Thon Hiep, and Tan Thanh. Provide 60 mm mortars at other selected Regional or Popular Force locations.

(S) b. Naval gunfire – Assign one of the 16 ships in the VNN with 3" gun capability to the zone force. This would provide fire support around the fringes of the zone.

(S) 3. Ground Operations

(S) a. Main-zone force – Assign one VNMC batallion to the zone. Use this force to conduct clearing operations and supplement patrol and ambush operations on the main ship channel and VC lines of communications.

(C) b. Regional and Popular Forces – Increase the effectiveness of small-unit patrol and ambush operations. Maintain Regional and Popular Forces at full strength.

(S) c. Adjoining areas – Emphasize ground operations along the village complex and road from Phuoc Ly (XS994867) to Phuoc An (XS140783) to effect

[redacted]

a ground-control corridor north of the zone. Conduct patrols and ambushes in adjoining provinces on VC lines of communication providing access and egress to the zone.

(S) 4. Air Operations

(S) a. Direct support – Requirements exist for organic armed helicopters and light armed-reconnaissance-type aircraft in the zone force. The UH-1B armed helicopter and the O-1 observation aircraft are the preferred systems from current inventory. The latter should be replaced as soon as possible with a light armed-reconnaissance-type aircraft. A U.S. supplement of 5-6 UH-1B helicopters (with mix of M-5, M-16, and the CBU-14B fragmentation-bomb-dispenser weapon subsystems; two Heliborne Illumination Systems; and aircraft audio set for psywar), and two O-1 observation aircraft would be required as part of the zone force under the general tactical plan.

(S) b. General air support – Required for troop and cargo lift in heliborne operations, routine night surveillance flights, close tactical support, and defoliation.

(S) 5. Special Operations

(S) a. Potable water – Place emphasis during the dry season on the control of potable-water distribution and the destruction of storage and catch-basin equipment and supply.

(C) b. Psychological warfare – Develop an integrated program aimed at decreasing the support of the VC operations by local population elements, and increasing the willingness of the individual guerrilla to defect. The latter program should be aimed at the individual guerrilla indigenous to the area, and the guerrilla moved in from adjoining areas.

(C) c Defoliation – Maintain the defoliation program current along the main ship channel and extend to potential ambush sites along the main rivers. Defoliate selected areas after clear-and-sweep operations.

[redacted]

(S) 6. Command, Control, and Base Structure

(C) a. Command and control – Establish a Combined Combat Operations Center at Nha Be. The coordination of military operations with civil program requirements should also be accomplished in the center. This would require civil representation at the Province and/or District levels, and the maintenance of current information on operations in the zone by USAID, USIS, or other agencies.

(C) b. Communications – Ensure adequate communication nets between the COC, district headquarters, villages, and operating elements of the zone force.

(S) c. Base Structure

(1) Command and control – Nha Be

(2) Main ground force – Nha Be, and Can Gio or Xa Thang Nhut

(3) Inland-waterway elements – Nha Be and Xa Thang Nhut

(4) Air element – Vung Tau military airport.

The comparison of the representative operational concepts with the current equipment and weapons inventory revealed areas where improved capability appears required. A summary of general improvements required in inland-waterway operations is given in Section V (Table V-1, p. 69). The basic improvements required in ground operations are associated with improved support of amphibious operations. A summary of general improvements required in air operations is given in the introduction to the air-operations portion of Section V (p. 86).

NAM CAN FOREST (SOUTHERN CA MAU PENINSULA)

(S) The Nam Can Forest is shown in Figure III-2 (Reference: maps, Vietnam, 1:50,000, sheets 5936 I; 5937 I, II; 6037 IV; and 6037 I, II, III, IV). The area is located in An-Xuyen Province, and is part of the IV Corps for military operations. It is estimated that 80 percent of the area is under the control of the VC. Resupply of points in the area has to be accomplished by rotary-wing aircraft or a military operation. Because of the present VC control (and the lack of an adequate securing force), rural construction is not progressing.

(C) In the Rung Sat Special Zone, the geography and friendly and enemy situations permitted a general tactical plan based on the application of integrated operations almost simultaneously throughout the zone. However, in the Nam Can Forest these same factors require a phased implementation of increased combat operations. The general tactical plan developed in this paragraph is based on six progressive phases. The resulting representative operational requirements for the inland-waterway, air, and command and control elements are very similar to those of the RSSZ. Ground operations and direct-fire-support requirements are more extensive.

Threat

(S) The Nam Can Forest is a VC haven area. As such it is used for training, small-arms manufacture and repair, supply storage and buildup, staging, and other combat-support purposes. It is connected by VC lines of communication to the U Minh Forest area north of the Song Doc, and the contiguous swamp-forest areas extending northeast along the South China Sea littoral. Because of its location it forms a critical perimeter link in the integrated haven system between those haven areas along the South China Sea and the Gulf of Siam. The extent of infiltration by sea and intracoastal movement is not known with accuracy. However, the potential for such infiltration into the area is significant due to access from both the South China Sea and the Gulf of Siam. Representative corridors of movement into and out of the area are shown in red in Figure III-2. Other representative locations of VC operations in the area are also shown.

(S) The Nam Can Forest, with its interconnections to the U Minh Forest and the South China Sea littoral is a primary base of operations against the Ca Mau Peninsula. The local economy and population provide a basis of supplies, recruits, and other support in addition to that received by infiltration. The area is used for the withdrawal and resting of VC main-force elements after engagements in other parts of the delta and peninsula. The primary route of withdrawal is through the U Minh Forest following the lines of communications indicated in Figure III-2.

(S) It is assumed that the VC in the area can attack selected points with a force up to reinforced battalion in size (approximately 500-600 personnel). However, the capability of the VC in the Ca Mau Peninsula to mount a regimental (approximately 1000-1500 personnel with supporting-heavy-weapons support) level attack exists. It is

assumed that an attack against this level would not be staged within or from one of the integrated haven areas alone, but would require the support capability of both the U Minh Forest and the Nam Can Forest.

Representative Operational Concepts

General

(S) The assumed military objectives for this area require its present and future denial as an effective VC support base. The general tactical plan for the area is directed toward attaining these objectives through continuous combat operations and harassment. Like the general tactical plan for the RSSZ, the level of detail identifies the representative operational concepts and integrates the various elements of the plan. However, the available equipment and weapons are not discussed except where specific mention is required or a new requirement is encountered which was not previously discussed in the general tactical plan for the RSSZ.

(C) The development of the general tactical plan is based on the same general concepts used for the RSSZ. Some differences in the adaptation of these concepts to the area are discussed below.

(S) 1. The control corridor along the South China Sea and Gulf of Siam would be established by the operation of Junk Force, sea patrol, and Market Time forces. The north control corridor has to be based on land operations supplemented with inland-waterway and air operations. A central control corridor established along the Song Cua Lon and the Song Bo De would be effective in isolating the Southern portion of the area, and permit effective coverage with ground artillery fire.

(S) 2. The designation of the Nam Can Forest as a specific area of operations under IV Corps. Operations of the forces within the area would be coordinated with those in adjoining areas. A U. S. force would operate in support of the Regular, Regional, and Popular forces in the zone. Centralized control would be exercised through a Combined Combat Operations Center. Civil representation at the Province and/or District levels in the Combined Combat Operations Center would be used to expedite coordination of military and civil requirements.

(S) The primary environmental characteristic of the area is the extensive mangrove swamp. An inland-waterway system exists which may be exploited as the principal line of communication within the area. However, it should be noted that the inland-waterway network in this area is not as primary a feature as it was in the RSSZ. Small land areas which provide ample space for VC operations are scattered in the mangrove swamp similar to the RSSZ. The primary land areas are along the major waterways and in the north and northeast sectors. Excellent concealment exists to screen clandestine operations and movements.

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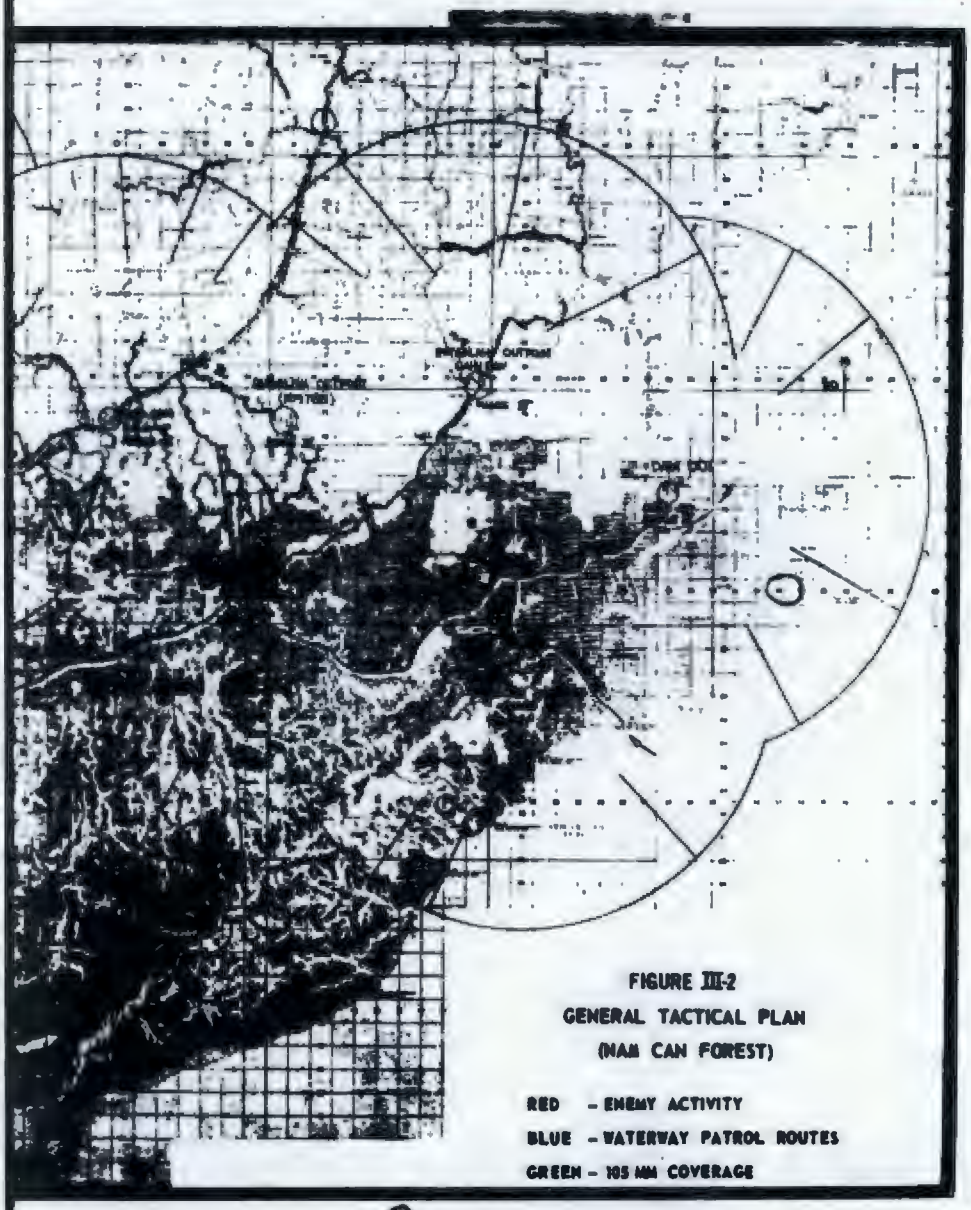

FIGURE III-2
GENERAL TACTICAL PLAN
(NAM CAN FOREST)

RED - ENEMY ACTIVITY
BLUE - WATERWAY PATROL ROUTES
GREEN - 105 MM COVERAGE

2 [redacted]

[redacted]

(C) The principal economic activities in the area are woodcutting and fishing. Since rural construction in the area is the ultimate objective, attainment of the initial military objectives with minimum destruction of the economic resources is essential.

(C) Primary factors affecting the use of sea forces for interdiction and naval-gunfire support are the shallow depths of the Gulf of Siam and South China Sea littoral, and the strong southwest winds prevailing during part of the year. The shallow depths significantly restrict the effective use of naval gunfire in direct support, and the strong winds which occur during part of the year combined with the shallow depths make small boat and craft operations difficult along the coast.

(C) The six phases of the general tactical plan are described in the following subparagraphs.

Phase I

(S) The first phase of the six-phase tactical plan would involve the buildup of a base area from which ground control could be extended across the north portion of the area. Binh Hung (VQ 845819) was selected for this purpose. It offers the advantages of (1) resupply from the sea, (2) a relatively secure area, and (3) proximity to the major VC lines of communication connecting the Nam Can Forest to the U Minh Forest area.

(S) The initial requirement in this phase is channel improvement (dredging). It would be necessary to improve the Rach Cai Doi from its entrance on the Gulf of Siam up to Binh Hung (approximately 7.5 Km). This would give sea access with craft up to approximately 15 feet in draft which would be adequate for logistic purposes.

The availability of an air element to support ground operations beginning with the first phase would be essential. This support, similar to the RSSZ, can be further broken down into (1) an element available for direct-support operations in the area, and (2) elements in general support which would be available for specific missions. Each of these elements is required for the same roles as in the RSSZ. Improvement of existing facilities at Binh Hung would permit the basing of the initial direct-support air element at that location. General-support air elements would be used for troop and major air cargo transport, night air surveillance, tactical air support, and defoliation.

(S) It would be desirable during the initial phase to increase the direct-support artillery-fire capability at Binh Hung with the addition of a 155 mm howitzer. The resulting fan is indicated in green in Figure III-2.

Phase II

(S) The objective of Phase II is to cut the VC lines of communication connecting the Nam Can Forest to the U Minh Forest. Extension of the ground operations to accomplish this requires the establishment of outposts at Cai Bat and Rach Thung, and the buildup of the outpost at Dong Cung. The outpost at Cai Bat would provide additional

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security to the Bing Hung base area, and is a necessary stepping-stone for gaining general-area security. The outpost at Rach Thung would serve the same purposes plus the securing of a base area for establishing initial inland-waterway operations. The buildup of Dong Cung would include the emplacement of one 105 mm howitzer to extend the direct-fire-support capability as indicated by the resulting fan in Figure III-2. Each of the outposts requires an 81 mm or 4.2-inch mortar for close-in indirect fire support.

(S) The initial inland-waterway operations are planned on the Song Bay Hap from Rach Thung to Dong Cung. The initial requirement is for night and daylight patrol actions to interdict VC movements on or across the Bay Hap. Limited troop and cargo transport capabilities are also required during this phase. It is envisioned that secure base facilities for the inland-waterway operations could be established at Rach Thung following adequate search-and-destroy operations from the outposts at Cai Bat, Dong Cung, and Rach Thung. The greatest threat to gaining area control in this triangle is the VC Agroville along the north bank of the Bay Hap. This area may require an initial clear-and-sweep operation by a major force.

(C) (The apparent advantages in securing and supporting the waterway fleet during the early part of this phase by the use of a "mothership" operating a few kilometers off the mouth of the Bay Hap should be noted. Such a ship would provide the capability of water operations at an earlier stage than reliance on a shore facility. This clearly illustrates a typical requirement for the capability to provide a secure operating base for patrol; troop, cargo, and equipment; and fire-support craft independent of shore facilities. A similar requirement also exists with regard to rotary-wing aircraft. Even though a land base was discussed in Phase I, better security could be afforded by a ship designed to support the operations of approximately 5-6 light and medium helicopters. This is again highlighted in Phase IV.)

Phase III

(S) During Phase III an additional outpost in the vicinity of WQ 109785 is required, and the outpost at Dam Doi strengthened. These actions would provide the next stepping-stones in the extension of the ground and inland-waterway operations forming the north control corridor, and strengthen the outpost (Dam Doi) in proximity to the primary VC lines of communication from the Nam Can Forest to the swamp-forest areas along the South China Sea littoral. It is planned that the buildup of Dam Doi would include one or two 105 mm howitzers. Extension of the inland-waterway operations would be along the Bay Hap and then southeast along the Rach Cai Keo to the new outpost. These operations could also be extended further north along the Bay Hap toward Ca Mau. The requirement again is for night and daylight water patrol actions supplemented with armed air patrols to interdict VC movements on or across these lines of communication. Water transport for troops and cargo connecting the new outpost of Dong Cung and Rach Thung is also required.

Phase IV

(S) The objectives of Phase IV are to close the control corridor across the north perimeter of the Nam Can Forest area, and secure the Song Bo De from its mouth on the South China Sea to its junction with the Song Cua Lon. The first objective will complete the "cushioning" of the Nam Can Forest from the other VC sanctuaries around the periphery of the Mekong Delta and Ca Mau Peninsula and greatly decrease the VC threat to the Ca Mau Peninsula from the south. The securing of the Song Bo De from the South China Sea to its junction with the Song Cua Lon, in addition to anchoring the Eastern sector of the control corridor, will permit the exploitation of the Song Cua Lon inland-waterway complex in the central part of the area. Control of this complex and the north corridor will permit combat operations against all points of VC activities in the area. The north and central control corridors and the sea patrols for the interdiction of infiltration and intracoastal movement will isolate the VC operations in the Nam Can Forest from the rest of the haven system. Attrition of the VC elements and support base, and attainment of area control should then be possible over a period of time with continuous combat operations and harassment.

(S) Extension of the ground operations during this phase would be accomplished by the establishment of outposts at Cai Ngay and Tan An. After securing the outpost at Tan An, the establishment of another base at that location for inland-waterway operations would be required. (Again, the advantages offered by a mobile sea base for additional watercraft and an air element are clearly illustrated. This would permit earlier operations of these elements during this phase from a secure base.) Waterway operations from Tan An would establish the Song Bo De and Song Dam Doi as the major line of communication between Tan An and Dam Doi. The emplacement of one 105 mm howitzer at Tan An and Cai Ngay would extend the fire-support capability as indicated in Figure VI-2.

Phase V

(S) Phases V and VI would extend the central control corridor along the Song Cua Lon to the Gulf of Siam. In Phase V an outpost would be established at WQ 090711, and the outpost at Nam Can (1) strengthened. Coverage with artillery fire would be extended by the emplacement of one 105 mm howitzer at each of the two outposts. [The emplacement of the 105 mm howitzer at Nam Can (1) would be temporary, pending the establishment of a 155 mm emplacement during Phase VI at Nam Can (2).]

Notice in this phase that a significant increase in the amount of inland-waterway operations would be required. Operations would have to be extended west along the Song Cua Lon from Cai Ngay to Nam Can (1). In addition, operations along the Rach Cai Ngay and the navigable canal connecting the Song Cua Lon and Song Bay Hap (WQ 088711 to WQ 058804) would have to be initiated. This extension of the inland-waterway operations integrates the primary lines of communications in the Nam Can Forest area. A third operational base for watercraft at Nam Can (1) would be desirable due to its central location.

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Phase VI

(S) This final phase of the tactical plan would extend the central control corridor along the Song Cua Lon to the Gulf of Siam. Another outpost is planned at Nam Can (2) and tentatively in the vicinity of VQ 835622. The outpost at Nam Can (2) will permit the emplacement of a 155 mm howitzer at that location to extend the direct-fire-support capability to the mouth of the Song Cua Lon and into most of the present VC areas of operation south of the Song Cua Lon. The extension of the inland-waterway operations to the Gulf of Siam would complete the establishment of the primary lines of communication within the area.

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SUMMARY (NAM CAN FOREST)

(S) The Nam Can Forest and the U Minh Forest are the principal support areas for VC operations in the Cu Mau Peninsula. The Nam Can Forest provides the link in the VC lines of communication between the areas along the South China Sea and the Gulf of Siam. It contains facilities for VC training, small-arms manufacture and repair, supply storage and buildup, staging, and other combat-support purposes.

(S) The attainment of the minimum military objective of the present and future denial of the area to the VC as an effective support base requires a balanced air, ground, and inland-waterway force adapted to the particular VC threat and area characteristics. Like the RSSZ, the area dependence of the force structure and operations was again illustrated by the general tactical plan. The results of the related analysis are indicated in summary form.

(S) 1. Inland-Waterway Operations

(S) a. Patrolling and operation of mobile checkpoints – The necessary inland-waterway patrol requirement is estimated in the same manner that was employed for RSSZ. The data are shown in Table III-3. An assumption of 60% coverage, target crossing speed of 4 knots, and 70% equipment availability yields an estimate of 20 patrol boats. Approximately 18-22 patrol boats of the PBR class should be a representative initial requirement for the area.

(S) b. Support of amphibious operations – A one-battalion organic lift capability is required. The craft of the present River Assault Group best meets this requirement from current inventory. Support of the increased combat operations under the general tactical plan would require the assignment of a RAG to the zone force.

(S) c. Mine countermeasures – With present equipment, dragging would have to be accomplished on a routine basis and as part of any major water movement.

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TABLE III-3. PATROL-CRAFT PLANNING DATA - NAM CAN FOREST (U)

Segment No.	Coordinates	Length, kilometers	Width, meters	Target Crossing Speed, knots 1	2	3	4	5	6
1	WQ 065807 WQ 982763	11.75	150	2.5	2.8	2.9	3.0	3.0	3.1
2	WQ 880700	11	250	2.0	2.4	2.6	2.7	2.7	2.8
3	WQ 760660 WQ 810635	17.6	4000*	0.6	1.0	1.3	1.6	1.9	2.1
4	WQ 968633	17.5	600	2.4	3.2	3.6	3.8	4.0	4.1
5	WQ 260660 WQ 212720	40	300	6.8	8.3	9.0	9.4	9.7	9.9
6	WQ 283752	8.5	150	1.8	2.0	2.1	2.2	2.2	2.2
			TOTALS	16.1	19.7	21.5	22.7	23.5	24.2

*Width for planning purposes of an open corridor.

(S) 2. Fire Support

(S) a. Ground artillery - A 105 mm howitzer is required at Binh Hung, Dong Cung, Dam Doi (possibly two), Tan An, Cai Ngay, WQ 090711, and Nam Can (1). A 155 mm howitzer is required at Binh Hung and Nam Can (2). Mortars (81 mm or 4.2") are required at each of these locations to provide fire support at the base of each fan.

(S) b. Naval gunfire - The use of naval gunfire is constrained by the shallow depths along the South China Sea. Five-inch guns can be used to cover some of the area along the South China Sea which is outside the maximum range of the ground artillery positions.

(S) 3. Ground Operations

(S) a. Strengthen outposts - Build up the outposts at Dong Cung, Dam Doi, and Nam Can (1).

(S) b. New outposts - Establish outposts at Cai Bat, Rach Thung, WQ 109785, Cai Ngay, and Tan A...

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(S) c. Patrols and ambushes – The establishment of the control corridor from Binh Hung to Dam Doi, and the effectiveness of the central control corridor, is dependent upon the patrol and ambush operations (day and night) from the outposts. Improvement of these actions must be continuously emphasized.

(S) d. Clearing operations – These operations can be accomplished to some extent by the forces at the outposts. However, an area force of one battalion appears to be required for use as the principal force in major clearing operations. An initial sweep in force of some areas such as the VC Agraville on the north bank of the Song Bay Hap would probably be required.

(S) 4. Air Operations

(S) a. Direct support – Requirements exist for organic armed helicopters and light armed-reconnaissance-type aircraft in the zone force. The UH-1B armed helicopter and the O-1 observation aircraft are the preferred systems from current inventory. The latter should be replaced as soon as possible with a light armed-reconnaissance-type aircraft. A U. S. supplement of 5-6 UH-1B helicopters (with mix of M-5, M-16, and the CBU-14B fragmentation-bomb-dispenser weapon subsystems; two Heliborne Illumination Systems; and aircraft audio set for psywar), and two O-1 observation aircraft would be required as part of the zone force under the general tactical plan.

(S) b. General support – Required for troop and cargo lift in heliborne operations, routine night surveillance flights, close tactical support, and defoliation.

(S) 5. Special Operations

(S) a. Potable water – Place emphasis during the dry season on the control of potable-water distribution, and the destruction of storage and catch-basin equipment and supply.

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(C) b. Psychological warfare – Develop an integrated program aimed at decreasing the support of the VC operations by local population elements, and increasing the willingness of the individual guerrilla to defect. The latter program should be aimed at the guerrilla indigenous to the area, and the guerrilla moved in from adjoining areas.

(C) c. Defoliation – Maintain defoliation programs current along the Song Bay Hap, Song Cua Lon, Song Dam Doi, and Song Bo De.

(S) 6. Command, Control, and Base Structure

(C) a. Command and control – Establish a Combined Combat Operations Center for the Nam Can Forest area under IV Corps. The coordination of military operations with civil programs should also be accomplished in the center.

(S) b. Base structure – Develop the Binh Hung area as the initial primary support base.

The development of the general tactical plan for the Nam Can Forest area illustrated the additional requirement for mobile general support of inland-waterway craft and aircraft operations. This requirement is listed as one of the general improvement areas for inland-waterway operations and further discussed in Section V (p. 85).

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IV. GENERAL DISCUSSION OF OPERATIONS IN SWAMP FOREST ENVIRONMENTS

INTRODUCTION

(C) The general tactical plans in Section III for the Rung Sat Special Zone and the Nam Can Forest illustrated the preferred tactical concepts and integration and employment of weapon systems in two swamp-forest environments. The two example areas were similar in many characteristics since both are primarily a mangrove type with a major river and stream network. However, the development of the general tactical plans for each of the areas clearly illustrated two basic principles:

1. Combat operations to attain the minimum military objectives which will permit rural construction requires integrated air, ground, and inland-waterway operations.
2. Specific operations and techniques must be planned and adapted to the threat and characteristics of the particular area.

These two principles imply both common and specific attributes about operations in various swamp-forest areas or environments. Based on the two examples, general concepts common to operations in swamp-forest areas are discussed in this section.

CONCEPT OF OPERATIONS

(C) General concepts of operations for swamp areas were discussed to some extent in Section III because they formed a basis for the development of the general tactical plans for the Rung Sat Special Zone and the Nam Can Forest. These concepts, however, can be further developed within a general context for combat operations in swamp-forest areas against an insurgent threat.

(C) In the discussion of the haven system in Section III, it was noted that the swamp areas in the Mekong Delta and the Ca Mau Peninsula were essential parts of the integrated haven system in the southern portion of South Viet Nam. Even though the environmental characteristics of swamp-forest areas place an additional operational burden on the insurgent elements, these same characteristics afford an inherent degree of protection essential to establishing a support base. A swamp area used as a support base will, in general, be a part of a larger base system. Such an area, if not connected to other haven areas within the country, will usually be connected by lines of communication to an international haven system. It was therefore concluded that the potential of operations against the insurgent threat in swamp-forest areas stems from the role of these areas as part of an integrated haven system.

(C) Let the minimum military objective be that of effecting the present and future denial of a swamp-forest area as an effective support base for insurgent operations. The general concepts of operations in [redacted] be considered in five parts.

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Interdiction

(C) The first general concept of operation is to interdict the primary lines of communications providing access and egress to the swamp-forest area. This will weaken the insurgent capability within the selected area to respond to subsequent combat operations. As clearly illustrated by the two examples, the required method of interdiction will depend upon the environmental characteristics of the specific area.

Isolation

(C) The expected insurgent reaction to operations against the primary lines of communications would be attempts to "spread-out" these lines which afford access and egress, or to take a stand and fight. The latter is a desirable result which is countered by superior forces. If the lines of communications are increased, the second concept of operations – that of isolation – is brought to bear. This concept is to supplement the combat operations of interdiction sufficiently to establish corridors around the swamp area within which relative control is maintained. These actions will have the effect of isolating or "cushioning-off" the swamp-forest area from the larger haven system of sources of direct support. The plan for establishing the control corridors is again dependent upon the specific characteristics of the area and the nature of the threat. Variations in representative operational requirements to effect control corridors were illustrated in the development of the general tactical plans for the two examples (RSSZ and Nam Can Forest), and serve to emphasize the area dependence.

Attrition

(C) The "cushioning-off" of a swamp area sets the stage for application of the third general concept of operations – that of attrition of the insurgent elements and support base by an appropriate level of continuous combat operations and harassment. For the eventual success of the military mission it is this concept which requires the greatest attention and is discussed in more detail.

(C) Continuous combat operations at a level commensurate with the threat is stressed. Occasional clearing actions, even though they have a significant effect on insurgent operations, will not attain the desired minimum military objective of denying to these elements the present and future use of the area as an effective support base. The continuous application of combat operations and other harassing techniques over time is required to (1) increase the effectiveness with which the area is isolated, (2) develop adequate intelligence for responsive day-to-day control of operations, (3) direct operations to attain the necessary attrition rate, and (4) provide the shield and support required for rural construction.

(C) The requirement for integrated air, ground, and inland-waterway elements in the force structure to effect the necessary combat operations in a swamp area was illustrated in the cases of the Rung Sat Special Zone and the Nam Can Forest. The

required balance of force elements in each case is dictated by the threat and environmental characteristics. However, the essential point is that the primary factors in effecting attrition and attaining area control are well-planned combat operations adapted to the threat and area characteristics and persistently applied. Special operations and techniques which supplement the effect of the conventional combat operations are required, but the primary attrition and area-control factors from a military viewpoint are the adapted conventional combat operations.

(C) Ground movement is difficult in a swamp forest. The degree of mobility by means of inland-waterway transportation which may be attained for ground-force elements will vary widely with the specific area. As an example, this ranges from a minimum in the U Minh Forest to a high degree in the Rung Sat Special Zone. In each specific case it is essential to exploit the existing potential for using the inland-waterways as lines of communications. In both of the example swamp-forest areas, inland-waterway operations were a primary part of the representative operational requirements. Any swamp-forest area with major rivers or channels has this requirement. The inland-waterway operational requirements will encompass patrolling; troop, cargo, and equipment transport; convoy protection and fire support; mobile command and control; mine countermeasures; barricading of secondary channels; and general mobile support of watercraft, and rotary- and light fixed-wing aircraft. Even though the inland-waterway operational requirements for swamp-forest warfare will vary more than the air and ground requirements among specific areas, they are a critical part of the total swamp warfare capability.

(C) In the paddy land which usually adjoins a swamp forest, and in the shallow water, mud, and so forth interspersed in a swamp forest where movement by watercraft is restricted, some degree of improved mobility may be attained with amphibian-type vehicles. However, the effective use of these vehicles where applicable will require detailed planning and operational control. Terrain information available only with large-scale photo mosaics (maintained current with local intelligence) is required to avoid the impassable dikes, canals, and ambush sites.

(C) Heliborne operations in swamp-forest areas provide some degree of independence from the surface-mobility problems of ground operations. However, the landing-site problem places a significant constraint on operational flexibility. This is especially true during initial operations in an area before the progressive development of landing sites has been accomplished.

(C) The use of rotary- and light fixed-wing aircraft is essential to a continuous capability for operations and harassment. The proper mix of the two systems is dependent on the particular swamp area. In general, the helicopter is best employed in supplementing and supporting the inland-waterway operations, and in a utility support role. The light armed reconnaissance-type aircraft provides the needed operational capability for area observation, fire control, close troop support, and armed reconnaissance. There is, of course, some overlap of capability among the two types of systems to perform the required air missions.

(C) The required ground operations in swamp areas directed toward the attrition of the insurgent elements and support base may be categorized as (1) clearing operations involving actions in force, and (2) extensive small-unit patrol and ambush

operations. The clearing operations are effective against both the insurgent forces and base facilities. Extensive small-unit patrol and ambush operations are required to restrict the flexibility of movement of the insurgent elements, provide relative security to villages and other key areas or features, and develop the necessary intelligence for operational control. The requirement for effective small-unit operations day and night cannot be overemphasized. A clear example of this is in trying to maintain relative control in a corridor where ground operations have to be primarily used. The effectiveness of the control corridor in this case is directly a function of the small-unit patrol and ambush operations. Periodic patrols in force will not accomplish the task.

(C) Fire support is a critical factor in maintaining constant pressure or insurgent elements in swamp areas. Where fire support is available through ground artillery and/or naval gunfire, the capability exists to respond immediately to any exposure of insurgent operations. Without this dimension in the force balance, targets of opportunity cannot be adequately attacked except by close air support on station.

Special Operations

(C) The fourth general concept of operations is to supplement the harassing effect of continuous combat operations by integrating special techniques which take advantage of specific physical or demographic characteristics of a swamp area. As an example, the availability of potable water in the saline swamps during the dry season is restricted. Control and denial measures directed toward this critical resource would be effective. The inland-waterway patrols and mobile-checkpoints should place specific emphasis on controlling the primary distribution method which is containers on local watercraft. Ground troops and clear-and-sweep operations should ensure the destruction of all containers and rainwater catch systems, and the identification of ground catch-basin areas or local wells.

(C) The general environment of any swamp area places an increased burden on insurgent elements living outside the established village areas. This factor, in combination with harassment from continuous combat operations and other efforts, should increase the receptiveness of the individual insurgent to psychological warfare. In its application toward the insurgent elements, the psychological warfare effort should be viewed as an extension of combat operations and controlled and integrated as such. It can also be used effectively to reduce the willingness of elements of the local population to support insurgent operations.

(C) Population-control techniques are applicable in a swamp area, and the relatively low density of population aids implementation. (The population between various areas, however, can vary considerably depending on the amount of agriculture land within and immediately adjoining the area and other local industries such as fishing and woodcutting.) Relocation measures to place all personnel within the primary village structure may be feasible and affect a small percentage of the population. Where feasible, this removes some of the constraints on combat operations and decreases the difficulty of identifying insurgent operations.

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Central Command and Control

(C) The coordination and control of continuous operations is a factor which requires particular attention. The planning and control of day-to-day operations in any of the major swamp-forest areas of the Mekong Delta and Ca Mau Peninsula would involve civil and military operations. This leads to the fifth general concept of using a combined-combat-operations center as the coordination element; that is, a suitable structure for central coordination of military and civil requirements. The purpose of the center would be to decrease the response time, provide for improved development of intelligence, and integrate the civil and military aspects of the operations. Civil representation in the center should be at the Province and/or District level.

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SUMMARY

(C) The general concepts of operations to deny the present and future use of a swamp-forest area to insurgent elements as a support base are listed below. These concepts have application in general to haven areas.

(C) 1. Interdict the primary lines of communication providing access and egress to the swamp-forest area and connecting it to the other parts of a haven or support-base system.

(C) 2. Isolate or "cushion-off" the swamp area by establishing control corridors around the perimeter.

(C) 3. Accomplish attrition of the insurgent capability and support base within the swamp-forest area through continuous combat operations and harassement. The primary factors to effect the necessary attrition are the use of well-planned combat operations adapted to the threat and characteristics of the specific area, and the employment of an integrated and appropriately balanced force of air, ground, and inland-waterway elements.

(C) 4. Supplement the harassing effect of continuous combat operations with special operations which take advantage of specific environmental or demographic characteristics of the area. Population control, psychological warfare, control of potable water in saline swamps, and salt and food control are essential parts of this effort.

(C) 5. Coordinate the civil and military operations through a combined-combat-operations center which has civil representation at the Province and/or District level.

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V. RESEARCH AND DEVELOPMENT

INTRODUCTION

(C) In Section III (Rung Sat Special Zone and the Nam Can Forest), representative operational requirements for swamp-forest environments were developed through an example general tactical plan for each of the two areas. These representative operational requirements served as a base and the general tactical plans provided a structure for qualitatively screening the present inventory of equipment and weapons against operational needs. Based on this screening, preferred items in the present inventory and equipment and weapon areas requiring improved operational capability were identified.

(C) In this section, the areas are further discussed where gaps appear to exist between the basic capabilities of the present equipment and weapons inventory and operational requirements in the swamp-forest environments of the Mekong Delta. Consideration is given to the need for research, development, testing, and engineering effort. The requirements for improvement in present capability to conduct inland-waterway operations in a swamp forest containing a major river and channel network has been given first priority. A major portion of this section is devoted to a discussion of these improvement requirements. Under air operations, the principal requirement is to increase the capability in night operations. This is discussed in the Air-Operations paragraph. Research and Development requirements for improvement in ground operations are basically covered in the Inland-Waterway-Operations paragraph under Support of Amphibious Operations. A specific problem not further discussed in this report is the ground-location problem while moving in a forested area. This has received some research effort and merits continued support.

INLAND-WATERWAY OPERATIONS

VC Threat to Friendly Operations

(C) Before discussing the areas where improved operational capability appears required, it is necessary to summarize the primary VC threats to inland-waterway operating elements in a swamp forest environment where a major river and channel network exists. The primary threats are mine devices, ambush from shore positions, and limited surface engagement of armed indigenous-type craft.

(C) The principal mine devices used by the VC to date have been moored, locally manufactured, shaped charge-type mines controlled and electrically detonated from the shore. Due to the logistic problems faced by insurgent elements, this is the expected type of mine device which will be experienced in counterinsurgency operations. These crude but very effective devices are manufactured using local resources, skills, and facilities. To the guerrilla, their employment has strategic as well as tactical

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effect – in both cases remunerative to insurgent operations significantly out of proportion to the risk or cost inherent in their employment. Tactically, they have a selective effectiveness against boats on the inland waterways resulting in the sinking and/or damaging of craft, casualties to operating personnel and troops, and loss of cargo essential to the support of military operations and civil programs. Strategically, the mine device restricts the use of the inland waterways by government elements as effective lines of communication. When convoy movements are made, increased government resources must be employed to provide some degree of security.

(S) In addition to the moored, controlled mine, it is feasible for the VC to use a moored contact-type mine. A simple actuating device such as a contact lever (or arm) is capable of being locally fabricated for use. A disadvantage to the guerrilla of the contact-type mine is the loss of target selectivity. Because of this disadvantage and the increased effort of manufacture, the use of the contact-type moored-mine device by the VC will probably not become prevalent unless the threat to guerrillas occupying a shore (or ambush) position becomes significantly greater than it has been in the past. If it is used, its initial employment would probably occur only in areas where the goal is the denial of the use of a waterway, and indiscriminate harassment of local and government elements on the waterway(s) is acceptable to VC operations. With third-country assistance, the magnetic-influence-type mine is also a potential threat.

(S) The limpet-type mine employed by swimmers is a potential threat to ships in harbor facilities. It also poses a threat to inland-waterway craft in a base or harbor facility. It is feasible for the VC to employ the use of swimmers using some limpet-type mine devices. This area has not been analyzed in this study – the purpose of listing it here is to place it in perspective as a feasible and potential threat.

(S) Attack or ambush from a shore position may occur in conjunction with the explosion of a controlled mine device against a selected target. Obstacles of a field-expedient type may also be encountered as part of an attack incident. The attack usually involves fire from small arms, automatic weapons and recoilless rifles. Mortars and grenade launchers may also be employed. The attackers have the advantages of surprise, concealment, and cover.

(S) The requirement to engage armed watercraft on the inland waterways exists, but is not as significant a VC threat as the employment of mine devices and attack from prepared ambush positions. Such incidents usually occur when a VC movement is surprised by a patrol craft.

Associated Research and Development

(S) The areas requiring improved operational capability based on the qualitative screening of the representative inland-waterway operational requirements against the present equipment and weapon inventory (accomplished in Section III) are summarized in Table V-1. On the basis of the qualitative analysis, it is felt that improvement in operational capability is required in these areas to better support and conduct tactical

operations in a swamp-forest environment where a major river and channel system exists. Each of the areas is further discussed in the subparagraphs below.

TABLE V-1: SUMMARY OF GENERAL IMPROVEMENT REQUIRED IN OPERATIONAL CAPABILITY (U)

Operational Concept	General Improvement Required in Operational Capability Over Present Systems
1. Patrolling and operation of mobile check points	- Current improvement requirements will depend to a significant degree on the River Patrol Boat (PBR) field tests which are in progress in VN at time of writing - Preliminary information indicates that the noise level of operation is undesirable
2. Support of amphibious operations	
a. Troop, cargo, and equipment transport	- Increased operational speed - Improved passive resistance of the hull to the effects of an underbottom explosion of a mine device - Improved armor protection for personnel, cargo, and critical craft areas - More effective delivery of anti-personnel fire against area targets - Attainment of mobility in or on shallow water, mud, weed congested areas, marsh areas, and so forth - Noise suppression
b. Convoy protection and fire support	- Same as 2a plus – - Increased capability to close with an attacking element (surface or shore) and press a counterattack
c. Mobile command and control	- Same as 2a
3. Blocking secondary channels	- Increased selection of shallow-water mine systems
4. Mine countermeasures	- Improved dragging for moored, controlled mine devices - Improved detection of mine devices - Additional capability on inland waterways to sweep for contact and magnetic-influence-type mines
5. Mobile general support of inland-waterway craft and aircraft operations	- Present support capability with converted ships is marginal due to draft and number of rotary-wing aircraft which may be supported by one ship

Patrolling and Operation of Mobile Checkpoints

(S) The PCF-Mark 1 (Swift) and the River Patrol Boat (PBR) have added a fast patrol operational capability on inland waterways. Further development, testing, or engineering effort needed to meet this operational requirement will depend to a great extent on the results of operational field tests of the PBR presently in progress. Also applicable are the tests, presently in progress in South Viet Nam, of air-cushion-type vehicles. The armed-reconnaissance version of the Marsh Screw Amphibian suggested later in this section would also be applicable for patrolling in areas not accessible by watercraft.

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(U) The field tests of any new system usually indicate modifications which are required or desirable. Very limited preliminary information on the operational tests of the PBR in South Viet Nam, available at the time of writing, indicates that the noise level during operation (except at low speeds) and the restriction of the operator's area of vision by the forward-gun mount are undesirable. The use of a second .50 caliber machine-gun mount in place of the 7.62 mm machine-gun aft is being evaluated.

(C) Noise suppression (or silent engine operation) is essential for craft used primarily in a patrol function on inland waterways or along coastal areas in a counter-insurgency role. Without the advantages of surprise, the effectiveness of patrol activities to interdict the movement of insurgent elements is significantly reduced. Even though this is commonly known, the urgency of the problem from the viewpoint of field operations suggests expanded research and development effort.

(C) The U. S. Navy Marine Engineering Laboratory is currently obtaining acoustical measurements under controlled conditions on selected craft from the present inventory. The effort also involves a comparison of the noise level of the craft before and after acoustical treatment. This effort will develop an essential set of data regarding the actual noise level of current craft under various operating conditions. It will also furnish data on the degree of noise suppression which is attainable on present craft using a feasible amount of acoustical treatment. From the information and data obtained from this project, it should be possible to identify specific modifications for current craft and the development of improved components which would result in more effective noise suppression. An example of an improved component for current systems would be mufflers adjustable with regard to critical parameters to optimize effectiveness as a function of engine speed. Continuation of research, development, test, and engineering effort in improved acoustical treatment is essential for craft in current inventory, and the development of the next generation of craft.

(C) The most promising areas of research and development for significant improvement in noise suppression appears to be in the use of engines (or systems) other than diesel. The basic alternatives are gasoline, gas-turbine, steam, battery, and fuel-cell. Acoustical treatment of craft using a gasoline power plant will in general be more effective than with a diesel power plant. However (excluding battery and fuel-cell systems from short-range consideration), gas-turbine and steam engines offer the greatest potential for significant improvement in noise suppression. Gas-turbine power plants applicable for use on inland-waterway craft have been developed and tested, and their potential for low-noise-level operations demonstrated. A steam propulsion plant (two-cylinder, vee type, compound, reversible, double-acting engine) was tested at the U. S. Navy Marine Engineering Laboratory in April, 1959. The test bed was a 28-foot personnel boat. The engine tested produced 85 bhp at 1475 rpm, and provided a maximum speed of 11.2 knots. The urgent requirement for quieter operations merits increased emphasis on these two types of systems. Other significant design advantages such as weight and size should also result.

(C) It is feasible at the present to incorporate gas-turbine systems into the design of craft. To ensure the most effective noise suppression with gas-turbines, further development and testing related to acoustical treatment of the system should be accomplished immediately. In addition, a research, development, test, and engineering program for a steam-propulsion system for inland-waterway craft is required.

Priority in this program should be given to an engine for initial use in patrol-type craft.

Support of Amphibious Operations

(C) The support and conduct of military operations in a swamp forest containing a major river and channel network requires the employment of amphibious-type operations. A concept of operations similar to the present River Assault Groups was preferred in Section III for integrating the inland-waterway elements providing troop, equipment, and cargo transport; convoy protection and fire support; and mobile command and control in support of ground operations. However, the presently available equipment to meet these three operational requirements was designed primarily for over-the-beach amphibious operations. With modifications, their utility for use on the inland waterways in counterinsurgency operations has been improved. However, the preferred systems (with modifications) from presently available inventory for each of the three operational requirements (troop, equipment, and cargo transport; convoy protection and fire support; and mobile command and control) have five common general deficiencies. These are discussed below.

(C) 1. The resistance provided by the hull design to the effects of an explosion of a moored mine device is not adequate. One of the objectives in the engineering design should be to minimize the radius of lethal damage to the craft from the explosion of such a device.

(C) The underbottom explosion is a primary threat with which the design engineer should be concerned when considering the passive defense characteristics of a craft. The basic alternatives in hull design to improve the passive defense characteristics against underbottom explosions are: (1) engineering; i.e., rigidity of the hull support and strength of the hull shell itself, (2) use of material in a double-shell hull to improve its explosive resistance and resistance to sinking when the outer hull is ruptured, and (3) use of shock-absorbing material in the bottom of the well as added protection for troops and cargo.

(C) The first priority in this problem area is to build up the available data on the effects of underbottom explosions on inland-waterway craft. This improved data base is needed for determining alternative design criteria, further detailed study of design criteria against assumed tactical situations, and selection of specific areas for continued research and development. Immediate effort to improve the current information in this area should result in obtaining the critical information needed by the design engineer for use in the next generation of craft. The basic program which is immediately required should follow approximately the two steps of investigation described below.

(C) a. The detonation of varying sizes of explosive charges at different depths to obtain pressure measurements in polar planes at depths of 0 to 6 feet is required. The explosive devices used should contain varying amounts of explosive over the range of

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30 to 100 pounds, and the devices should be configured to give the directional explosive effect analogous to the VC moored-mine design which has been and is being used. The depth of detonation during the initial tests should vary from 2 to 20 feet. In addition to measuring the pressure at various depths, the pattern and nature of the bubble produced by each explosion should be recorded for subsequent analysis.

(C) b. The use of hulls of various basic designs (vee, round, catamaran, etc.) and strengths to obtain more test results of effects under controlled conditions is required. Various explosive-resistant and sinking resistant materials in double-shell hulls should be included in this series of tests to determine their effectiveness.

(C) Concurrent with the above effort, testing could be accomplished of various shock-absorbing material and designs for use in the well of a craft. Previous research and development accomplished by the U. S. Army Materiel Command on various materials for use in air-dropping equipment and cargo may be useful in initially selecting material for test, or modification and test, to meet this requirement. However, a specific environmental difference in this case requires that the material and design used undergo no significant degradation in performance when in contact with water.

(C) 2. The maximum-sustained-speed capability is too low. Speed - combined with improved hull design - will significantly decrease the margin of error for a successful mining attack. Increased speed will also provide improved reaction to an attack from a shore position.

(C) The present technology in engines and propulsion systems makes it feasible to obtain the required increase in speed for craft operating on inland waterways in a counterinsurgency role. However, the noise-suppression problem and availability of the "off-the-shelf" diesel engines indicate that the gas-turbine engine should be considered as a primary candidate for use in the next generation of craft. A steam engine research and development program was previously discussed.

(C) 3. The armor protection on present craft used in inland-waterway operations is primarily a part of the modification and results in a compromise of performance capabilities (e.g., speed) as well as protection. Craft to meet each of the three operational requirements in support of amphibious operation require armor protection as an integral part of the design to obtain optimum trade-offs.

(C) Armor protection is required to afford a degree of passive defense to personnel and critical areas. Protection on a craft is required for gun positions, troop and cargo areas, crew positions, and the engine area. At the present, it is feasible to integrate into a craft design protection of these areas from .50 caliber machine-gun fire. Attempts at direct protection with armor above this threat level immediately result in a weight and space problem.

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(C) Above the threat level of the .50 caliber machine gun, the 57 or 75 mm recoilless rifle using either high explosive or armor-piercing rounds is of primary concern. A potential approach to this problem is the use of "space-armor"; i.e., a contact (or detonating) screen placed a prescribed distance from the hull. The purpose of the screen is to detonate the incoming round at a distance which will dissipate its effect and significantly reduce damage to the craft. A research, development, test, and engineering program to determine the degree of protection that may provide inland-waterway craft with this concept should be considered. The basic variables in the test program would be (1) type of round (37 mm, 57 mm R.R., 75 mm R.R.; high explosive, armor-piercing; contact fuze, delayed fuze), (2) design of the detonating screen (vertical overlapping bars, etc.), and (3) offset distance of the screen from the hull. Immediate effort in a program should make it possible to incorporate any favorable results in the initial field tests of a next generation of craft.

(C) 4. The present weapon complements of the modified craft do not contain an adequate anti-personnel area-coverage capability. This is essential for fire suppression when the attacker has the advantages of concealment and cover from a shore position.

(C) The weapon requirements for watercraft operating in the swamp-forest areas of South Viet Nam where a major river or channel network exists are indicated by the nature of the VC threat, operational requirements, environmental characteristics, and actual experience to date. In offensive operations, the weapon systems used must provide fire support for ground elements operating inland from the location of the watercraft and amphibious landings across the banks. The support of infantry operations inland can be accomplished with indirect fire weapons. The range of current mortar systems appears adequate for this role. Considering that the targets which would usually be encountered in a swamp-forest area consist of personnel, light-weapon emplacements, and cantonment or light manufacturing or similar support facilities, mortar fire support would be effective.

(S) In the support of amphibious landings across the banks and general protection during movement on the waterways, direct and indirect fire is required. Automatic weapon systems up to 40 mm are presently being used in this role to provide direct fire support, and are effective to the degree that they offer both area coverage and foliage penetration. However, since personnel (with concealment and limited cover) are the primary targets in direct-fire support of an across-the-bank assault or suppression of an ambush attack, the need exists for the delivery of effective anti-personnel munition. In particular, the present gap in capability exists in delivery of more effective anti-personnel area fire.

(S) Several programs presently in progress will partially fill this capability gap. These programs are for the 40 mm low-velocity grenade launcher, the 40 mm high-velocity grenade launcher, and the 60 mm naval mortar. The 40 mm low velocity grenade launcher is presently scheduled to be available in initial production quantities during August, 1966. A 40 mm high-velocity grenade-launcher system for use on inland-waterway craft will probably require about 9 months depending on status at time of writing. The low-velocity grenade-launcher system will be capable of coaxial mounting with the .30 caliber (or 7.62 mm) and .50 caliber machine-gun systems.

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The 60 mm naval mortar system will be similar to the present MK 2 Mod 0 81 mm mortar system. Prototypes of the 60 mm mortar are presently scheduled for availability during August, 1966.

(S) The most pressing need exists for a weapon which can cover an area approximately 150 meters by 50 meters with effective anti-personnel fire. This weapon capability, in addition to the low- and high-velocity grenade-launcher systems, would significantly increase the counter-threat against a VC attack from a shore position and general fire-suppressing capability. In addition to rapid area coverage, the system should be capable of effective operation with minimum exposure of crew. Specific candidates for adaptation and testing to meet this requirement are the MK 6 Mod 0 depth-charge projector (K-gun) and spigot mortar (Y-gun) systems. White phosphorous and napalm munitions adapted to these systems should be initially investigated. Special high-explosive munitions for area coverage should also be investigated. A particular concept for development of a high-explosive munition is one which would scatter a number of bomblets to obtain the desired area coverage; the bomblets in the munitions load would have a mixed detonation capability, part detonating on contact and part detonating a few feet above the ground.

(C) A mass-launch rocket system also appears applicable to the problem. The area target in the case of an ambush attack or direct support of an amphibious landing across the bank will basically have its longest dimension parallel to the river or stream. A short-range rocket in a mass-fire system using a mix of high-explosive and white phosphorous rounds with contact and delay fuzes should be effective. The nature of the target does not require a high degree of accuracy. This minimizes the fire-control problem from the relatively unstable platform of a craft.

(S) The concept of remotely controlled claymorette type arrays mounted along the sides of a craft to spray an area along a river bank with a shotgun-type fire would be effective in some ambush situations – particularly along the narrower streams and channels. The value of this weapon-system concept is its potentially fast response in attempting to momentarily suppress an attack. The limited range (approximately 60 meters) of the claymorette and shotgun systems previously adapted for use on ordnance vehicles does not make them particularly attractive for inland-waterway craft. However, it appears feasible, using the same basic idea, to develop a system which would fire the low-velocity 40 mm grenade launcher round (maximum range - 400 meters) from a number of short, fixed and mounted firing tubes. The tubes would be electrically fired and mounted to give a desired dispersion pattern which would, with the detonation of each round, give an area coverage.

(S) Based on the above discussion a program is required to accomplish the following:

(S) a. Adapt for use on inland-waterway craft the MK 6 Mod 0 depth-charge projector (K-gun) and/or spigot mortar (Y-gun) to fire anti-personnel-type munitions at an area target (approximately 150 by 50 meters)

(S) b. Develop (or adapt) a white phosphorous bomblet and napalm munition for use by the K- and/or Y-gun systems

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(S) c. Develop a high-explosive bomblet munition with mixed bomblet capability for low airburst detonation and use in a swamp-forest environment.

(C) d. Test the above systems and munitions for effectiveness against simulated personnel targets in controlled experiments using representative concealment and cover

(C) e. Select the best system for deployment and use, as well as areas requiring further research, development, testing, and/or engineering effort.

(C) f. Develop and test a mass-launch rocket system for use against area targets (adaptation of the 2.75-inch folding fin aircraft rocket system should again be considered because of the basic change in target-type priority from previous study. See Reference 4.)

(S) g. Develop and test a system for side mounting on craft a low-velocity 40 mm array (low-velocity grenade-launcher round) using short, fixed and mounted firing tubes.

(S) In addition to the above program to improve the capability of delivering anti-personnel munitions, a current problem exists with the protection of gun crews. Even though some armor protection can be provided, it appears necessary that armored turrets be available for use on most of the gun positions. To date there has been limited effort to develop standard turrets for use on watercraft. A program is required to expedite the initial availability of armored turrets for the .30 caliber (or 7.62 mm) and .50 caliber machine-gun systems (single and twin – with or without coaxial-mounted low-velocity 40 mm grenade launcher), 20 mm gun, and high-velocity 40 mm grenade launcher.

(C) 5. The operational noise level of applicable craft in the current inventory is undesirable. This is an urgent problem since it comprises the effectiveness of inland-waterway operations, particularly with regard to patrol activities.

(C) The basic alternatives and the most promising areas for future research, development, testing, and/or engineering effort associated with noise suppression have been previously discussed.

Troop, Equipment, and Cargo Transport. (C) To support ground operations in swamp-forest areas like the RSSZ and the Nam Can Forest, where a major river and channel network exists, it is necessary to exploit the network as the primary lines of communication. The transport requirement will involve primarily troops and general military cargo (ammunition, supplies, etc.). However, the need also exists to transport vehicles, amphibians, or other equipment. To meet this requirement range it

appears necessary to have transport watercraft in two sizes. The smaller would be designed primarily for the transport of troops and general military cargo. The larger would have the additional capability of handling vehicles and other equipment such as a 105 mm howitzer or two Marsh Screw amphibians.

(C) A program for the two craft would require development, testing, and engineering effort. Development of the craft appears to be within present technical capabilities. However, there is a dependency on the outcome of the research, development, testing, and/or engineering programs previously discussed with regard to the deficiencies of craft in present inventory.

(C) The physical-environmental characteristics suggest that watercraft for inland-waterway operations have a maximum acceptable draft of 1.5 meters and a minimum design draft within this constraint at full-load displacement for a particular craft. A maximum draft of 1.5 meters would permit the use of the primary rivers, channels, and canals in the RSSZ and the Nam Can Forest. In addition, approximately 60 percent of the navigable waterways in the delta (excluding major rivers) would be usable at low water by a craft with maximum draft of 1.5 meters (Reference 1).

(C) Sustained operational speed at full displacement should be at least 17-20 knots. In Section II (Environment), it was noted that approximately 5-knot currents would be encountered during periods of high water flow. A 17-20 knot sustained operational speed capability would give a minimum 12-knot speed relative to the bottom under the higher current conditions.

(C) Based on the above considerations and the representative operational requirements for troop, cargo, and equipment transport, general characteristics for the two craft are given below.

(C) 1. Inland-waterway craft – troop and cargo transport

Maximum Draft	48 inches
Speed (at full displacement):	
Maximum	20-25 knots
Sustained	17-20 knots
Capacity:	
Troops[1]	60-65 combat equipped
Cargo	15-20 tons
Range	150-175 nautical miles

Screw amphibians.

(1) A greater troop capacity is undesirable due to potential losses in the event of a successful attack. Depending on the specific situation, less than the design capacity may be utilized in actual operations.

Armament	2 - High-velocity 40 mm grenade launchers
	2 - Twin .50 caliber machine guns
	1 - Heavy-weapons station for use of either:
	60 mm naval mortar; K-gun;(2) or Y-gun(2)
	Low-velocity 40 mm side-mounted arrays(2)
Armor Protection	(Criteria – .50 caliber machine gun at 20 meters)
	Weapon positions
	Other crew areas
	Troop and cargo well
	Engineroom area
	Space armor(2)
Engine Type	Gas turbine (with acoustical treatment)
General Design Characteristics	Over-the-side loading
	Sliding (or extendable) unloading ramp(3)
	Overpressure design criteria and basic hull-type depending on results of hull test series
	Troop and cargo well
	Gun positions – 2 each side 1 aft (heavy-weapon station)

(1) Depending on development and test program results.
(2) For use as short bridge between craft and bank.

(C) 2. Inland-waterway craft - troop, cargo, and vehicle transport

Maximum draft	54 inches
Speed:	
Maximum	20-25 knots
Sustained	17-20 knots
Capacity(4)	35-40 tons
Range	150-175 nautical miles
Armament	2 - High-velocity 40 mm grenade launchers
	2 - Twin .50 caliber machine guns
	1 - 20 mm gun
	1 - Heavy-weapon station for use of either.
	MK 2 Mod 0 81 mm mortar; K-gun; or Y-gun
	Low-velocity 40 mm side-mounted arrays
Armor Protection	(Criteria - .50 caliber machine gun, 20 meters)
	Weapon positions
	Other crew areas
	Troop and cargo well
	Engineroom area
	Space armor
Engin Type	Gas turbine (with acoustical treatment

(4) Troop capacity would be greater than normally utilized.

General Design Characteristics	Front ramp loading
	Overpressure design criteria selected based on results of the hull test series
	Troop, cargo, and equipment well[5]
	Gun positions – 2 each side 1 aft (20 mm gun) 1 heavy weapon station

(C) The inland waterways and the coastal regions of the Mekong Delta are characterized by extensive shallow-water areas. This problem restricts available landing areas for amphibious operations and may necessitate the undesirable exposure of troops to hostile fire during movement from craft to shore. An additional environmental factor which will hamper inland-waterway operations in some areas is the weed-congestion problem. This problem and other obstacles such as marsh areas will constrain the area mobility of watercraft in a swamp-forest area. Adequate surface movement and support under these conditions dictates that a platform capable of traveling in or over shallow water, mud, weed-congested areas, marsh areas, and similar obstacles is required.

(C) The Marsh Screw Amphibian appears to best meet these basic requirements. General characteristics are given below for an amphibian of this type for troop and cargo transport under the adverse environmental conditions discussed above. Construction of a prototype to meet these characteristics appears feasible based on past research, development, and prototype construction and testing. (Reference 5)

Speed.	
Water	15-17 knots
Marsh	17-20 knots
Mud	20-25 knots
Capacity:	
Troops	25 combat equipped
Cargo	3-1/2 - 4 tons
Range	100-150 nautical miles

(5) Cargo-well size should have minimum dimensions: Length - 36 feet; width - 11 feet; height - 6 feet.

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Armament	1 - Twin .50 caliber machine gun
	1 - High-velocity 40 mm grenade launcher
	Low-velocity 40 mm side mounted arrays
Armor Protection	(Criteria - .50 caliber machine gun, 20 meters)
	Weapon positions
	Other crew areas
	Troop and cargo area
	Engine and drive system
	Space armor

(C) Convoy Protection and Fire Support. The present LCM Monitor used in the River Assault Groups has basically a fire-support mission. Its heavier automatic weapons (20 mm and 40 mm guns) can deliver a volume of direct fire. The 81 mm mortar station also provides an indirect-fire-support capability.

(C) The craft which were previously described in this section for troop, cargo, and equipment transport have had improved operational performance, armor protection, and fire power - particularly for delivery of anti-personnel munition on area targets - incorporated in their general characteristics. This appears to change the requirement for the type of craft needed in the fire-support role. Convoy or movement protection and the ability to deliver interdicting fire in support of the troop and cargo craft during the landing phase of an amphibious assault requires a fast craft that can rapidly close with an attacking element and deliver effective fire. Development of such a craft appears to be within present technical capabilities and would require development, testing, and engineering effort. General characteristics for a fire support craft are given below.

Maximum Draft	36 inches
Speed:	
Maximum	35 knots
Sustained	25-30 knots
Range	150-175 nautical miles

[redacted]

Armament	1 - High-velocity 40 mm grenade launcher
	1 - .30 caliber (or 7.62 mm) machine gun with coaxial low-velocity 40 mm grenade launcher
	2 - Twin .50 caliber machine guns
	1 - Heavy weapon station for use of either:
	60 mm naval mortar; K-gun; or [illegible] gun
	Low-velocity 40 mm side-mounted arrays
Armor Protection	(Criteria - .50 caliber machine gun, 20 meters)
	Weapon positions
	Other crew areas
	Engineroom area
	Space armor
Engine Type	Gas turbine (with acoustical treatment)
Gun Positions	1 each side (Twin .50 caliber MG)
	1 forward (H.V. 40 mm GL)
	1 bridge mounted (.30 caliber MG with coaxial L.V. 40 mm GL)
	1 aft (heavy weapon station)

(C) Overpressure design criteria and basic hull type for this craft would also depend on the results of the hull test series.

(C) A craft with significantly improved general surface mobility is required to improve current capability to press a sustained counterattack against an insurgent attack from a shore position in a swamp-forest environment. This requirement with relation to convoy protection is similar to the problem encountered in the troop and cargo transport requirement where mobility in or on shallow water, mud, weed-congested areas, and marsh areas was needed.

(C) The Marsh Screw Amphibian appears to best meet this basic requirement. An improved, armed-reconnaissance version of the initial prototype is required. In actual employment, the armed-reconnaissance amphibian would either move under its own power with the convoy, or two of the amphibians could be carried in the well of the larger troop, cargo, and equipment inland-waterway craft and launched to press a counterattack when needed. An additional use of this amphibian would be for patrol operations where the area mobility of watercraft is restricted. The general characteristics for an amphibian of this type are given below.

Speed:	
Water	15-17 knots
Marsh	17-20 knots
Mud	20-25 knots
Maximum Dimensions:	
Length	17 feet
Width	10 feet
Range	100-150 nautical miles
Armament	1 - Twin .50 caliber machine gun
	1 - High-velocity 40 mm grenade launcher
Armor Protection	(Criteria - .50 caliber machine gun, 20 meters)
	Weapon positions
	Other crew areas
	Engine and drive system

(C) Mobile Command and Control. Mobile command and control for amphibious operations can be provided by exploiting the flexibility of the troop, cargo, and equipment craft previously described. Either of the two watercraft (and even the troop and cargo Marsh Screw Amphibian) can become a communication and control center with the use of modules designed to fit in the well of the craft. These modules would be easy to place in, or remove from, the well. In this manner, the craft can be easily converted from one role to another. The armor integral to the well designs of the craft would provide partial protection to the modules. The other exposed areas of the modules could be protected to the same threat level as the craft by incorporating additional armor in their design.

(C) The initial command and control module should be developed for the larger troop, cargo, and inland-waterway craft. This would satisfy the primary mobile command and control requirement for a River Assault Group. However, to provide increased capability within a group to support several smaller operations simultaneously, a command and control module would be desirable for the smaller troop and cargo inland-waterway craft.

Channel Blocking

(S) In swamp-forest areas which have major and minor river, stream, and channel networks, it was noted (Section III) that the effectiveness of water-patrol activities can be increased by channelizing attempted insurgent water movements. Field-expedient methods can usually be employed to a limited extent to block access, egress, and movement on selected secondary channels. However, there is a need for contact-type mines in several weights which are effective in water depths of approximately 2-20 feet against indigenous-type craft. These mines should be controllable with regard to activation and deactivation (to facilitate removal or friendly operations) and be capable of being moored to maintain position in shallow water where current is a factor. It appears that mines in total weights of approximately 30-40 lbs., 75-85 lbs., and 120-130 lbs. would provide an adequate range. This would ease the handling of the mines under various conditions as well as laying from swimmer support-type craft or larger patrol or mine-countermeasure craft. The necessary development is within present technology and capability. (6)

Mine Countermeasures

(S) The discussion at the beginning of this section on the VC threat to friendly operations on inland waterways highlighted the significance of the moored-mine device controlled and electrically detonated from the shore and the potential use of contact-type actuating devices on moored mines. Considering both the strategic and tactical effects, mine devices which can be locally manufactured with available resources are the greatest single VC threat to inland-waterway operating elements (assuming that third-country equipment is not employed). The present countermeasure capability against this threat is the most urgent of the areas where improved operational capability is required.

(S) The two principal countermeasure techniques presently available are the chain drag and the AN/SQS-37 sonar modified for mounting on watercraft. With favorable bottom conditions the chain drag has been effective under test conditions. However, the present equipment has to be towed at a slow speed due to drag, and it gives no indication when the control wires of a mine device have been encountered Under test conditions the AN/SQS-37 has been marginally effective at speeds of 4-6 knots and detection ranges of 80-120 meters (Reference 6).

(S) The immediate priority is to provide to the operating elements an increased chain-drag capability and the most effective of the available small sonars that can be

(6) To prevent more restrictive classification of this report, a more detailed discussion is not included.

adapted for improved detection of the mine devices. Recent actions have resulted in design modifications to increase the speed at which the present trailing-type chain-drag equipment can be towed. In addition, a two-boat drag for dragging a channel bottom for the mine itself has been designed. Continued effort to improve dragging and sweeping equipment should be given priority.

(C) The U. S. Navy Mine Defense Laboratory is presently working on a Riverine Sonar Task. The initial effort has been the field testing in CONUS of several available small-craft sonars for use in the detection of a moored-mine device. Further testing of the available small-craft sonars was accomplished in South Viet Nam during April, 1966. Based on the previous tests of the AN/SQS-37 and the current test series of the other systems, the system with the highest potential can be selected. It is essential that the selected system be modified to the extent possible to improve its performance (increased range and probability of detection, and visual display and range analyzer, if feasible). The modified system could then serve as a test vehicle for a longer-range research and development program, and deployed for operational use depending on the degree of effectiveness that has been attained. The urgency of the requirement appears to justify the interim deployment of a marginal system, even if it will offer only a limited increase in capability.

(C) From the longer-range viewpoint, the second objective of the U. S. Navy Mine Defense Laboratories Riverine Sonar Task is the development of a sonar for use on watercraft to effectively detect a mine device in inland waterways. The urgent need for this equipment has been discussed. It appears that the development of suitable equipment is feasible within the present technical state of the art, and the program should be pursued as rapidly as possible.

(C) A mine-countermeasure craft appears to be necessary to meet the urgent operational requirement in this area. This craft should be designed as an equipment system to (1) employ the advanced sonar equipment developed under the longer-range program above, (2) provide an increased sweeping capability on inland waterways against moored mines using contact-actuating devices or magnetic-influence-type mines, and (3) provide an operating platform for diver personnel engaged in neutralizing or destroying the mine devices after detection. General characteristics of this craft are given below

Maximum draft	30 inches
Speed:	
Maximum	20-25 knots
Sustained	17-20 knots
Range	100-150 nautical miles

Armament	1 - Twin .50 caliber machine gun
	1 - High-velocity 40 mm grenade launcher
	Low-velocity 40 mm side-mounted arrays
Mine Countermeasure Equipment	Sonar
	Sweeping equipment against magnetic influence or contact mines
	Diver support
Armor Protection	(Criteria - .50 caliber machine gun, 20 meters)
	Weapon positions
	Other crew areas
	Engineroom area
	Space armor
Engine Type	Gasoline or gas turbine (acoustical treatment with either system)
General Design Characteristics	Low magnetic signature
	Overpressure design criteria selected based on results of the hull test series(7)
	Gun positions - 1 forward 1 aft

Mobile General-Support of Inland-Waterway Operations

(C) The security of land support bases for inland-waterway operations may present a difficult problem during the early stages of operations in a swamp area which contains a major river or channel system. In addition to the security problem, minimum facilities for maintenance and other support must be provided.

(7) If favorable results are obtained in the test series with material in a double-shell hull to improve its explosive resistance and resistance to sinking, the design concept should be incorporated in this craft.

(C) The general support requirements during the early stages of an operation such as the one illustrated by the general tactical plan for the Nam Can Forest involve both watercraft and aircraft. The requirement illustrated by the Nam Can Forest example was for the initial support of 10-12 inland-waterway craft and 5-6 rotary-wing aircraft. Ships of the LST and LSD types can provide this basic support after appropriate conversion. Both types of ships, however, are marginal with regard to draft. From an operational viewpoint, 15 feet is an upper draft limit. Even at this draft, movement is very restricted in the coastal areas, rivers, and channels. From the general analysis accomplished in this study, it appears that a ship designed to provide improved support for 5-8 light and medium helicopters is required. This specific requirement, however, should be further analyzed with regard to the total support requirements of inland-waterway operations in the Mekong Delta before proceeding to preliminary design.

AIR OPERATIONS

Introduction

(U) The roles of rotary- and fixed-wing aircraft systems in swamp-forest warfare were illustrated in the general tactical plans for the Rung Sat Special Zone and Nam Can Forest. Except for the mission of supplementing water-patrol activities, the requirement for air operations does not change appreciably with changes in the physical characteristics of various swamp-forest areas. However, effort to increase the effectiveness of air operations in swamp-forest environments is required primarily with regard to night operations, and the deployment of a light armed-reconnaissance-type aircraft. Research and test effort is also required to improve the information and data available on the degradation in effectiveness of air-delivered munitions in a swamp-forest environment.

Night Operations

(U) The continued need for improving the effectiveness of air, ground, and inland-waterway night operations has been stressed in the report. Past and current research and development effort has and is being placed on this general problem. This study has reaffirmed the priority and urgency of the problem with regard to swamp-forest warfare.

(U) Reliable detection of personnel under a jungle, tropical-forest, or swamp-forest canopy does not appear yet within the technical state of the art. However, the capability of sensor systems for detecting signatures of insurgent operations is improving. Priority should be maintained on these programs.

(U) As a supplementary measure, the increase in operational capability which can be attained with illumination systems should be exploited to the maximum.

Controlled illumination from the air to detect movements on roads, rivers, and canals can be effective, particularly when combined with aerial surveillance employing side-looking radar. This was discussed in the general tactical plan for the Rung Sat Special Zone. The present Heliborne Illumination System (Reference 3) when employed at an altitude of 2500 feet has an illuminated-area diameter of approximately 500 feet with the seven light beams superimposed. This altitude offered the best compromise between effective illumination and sufficient altitude to decrease vulnerability to small-arms fire. An improved system that would provide adequate illumination in an area diameter of 1200-1500 feet at an altitude of 3000-3500 feet should be developed. This would improve the one-pass coverage over major channels and rivers and further decrease the vulnerability of the illumination helicopter to small-arms fire.

Armed and Armored Airborne Tank Concept (Spider)

(C) A system which would combine the mobility of the fixed-wing aircraft with adequate armor protection and firepower, plus some capability of detecting exposed insurgent elements during hours of darkness, could have a wide range of application in counterinsurgency operations. A system concept to accomplish this in part is the armed- and armored-airborne-tank concept (Spider). It is based on a cargo-delivery concept described in Reference 7 for which limited preliminary flight testing has been performed. This flight testing established that (1) a weight at the end of a long cable attached to a circling airplane seeks the center of the circle and remains almost stationary at the point, and (2) the cable assumes a nearly vertical position in the vicinity of the weight.

(C) The Spider concept utilizes these two principles and applies them to the design of an armored and armed gondola containing five combat troops. A method of launching and recovery is to use a Constellation-type aircraft. It appears feasible that a specially constructed armored gondola could be utilized to meet the objective of providing a vehicle to find and destroy enemy troops at short range with a variety of weapons from a mobile, armored elevation and nearly stationary position.

(C) Figure V-1 shows a concept of the armed and armored gondola as it would be attached to the Constellation fuselage for takeoff, landing, and flight to the target area. Also shown is a schematic of the aircraft circling with the gondola extended some 3000 to 5000 feet below the aircraft at the end of a long cable. The gondola would weigh about 16,000 pounds and would contain 350 square feet of armor plate for protection against 50 caliber machine gun fire. The crew of the gondola would be four gunners and a pilot. The gondola would be equipped with a ducted-fan engine in which the rotatable ducted-fan outlet would be controllable by the pilot as to direction of air exit. Therefore, the gondola would be able to travel for short distances forward, backward, and side-to-side and could turn and climb or descend vertically. Immediate control of altitude would be accomplished by the gondola pilot by means of self-contained winches aboard the gondola with which he could change the altitude for several hundred feet up and down. Two additional methods for making larger but less rapid changes in altitude are by command radio link to the pilot of the Constellation, and by separate command radio link to the winch operator in the Constellation aircraft. The gondola pitch would be controlled by the differential use of the winches fore and aft. Installation of the

ducted-fan self-contained all-directional control system would negate the undesirable effects of surface winds. The tactical equipment aboard the gondola would consist of search lights and terrain-avoidance radar which would permit operation in all weather and at night. Armament could include such items as the 7.62 mm Mini gun, flame throwers, recoilless rifles, 2.75-inch rockets, and high-velocity 40 mm grenade launchers. Estimates of the Spider weight indicate that at a total weight of about 17,000 pounds armament may be provided along with supplies of ammunition. This would include the weight of the steel cables. Since the Constellation is designed to carry a cargo of 32,000 pounds over a distance of 3,000 miles, the total weight appears to be well within the aircraft capabilities. This aircraft is surplus and is currently being disposed of by both the military services and the airlines.

(C) Some of the advantages of the Spider appear to be: (1) it would have a speed range from possibly 30 knots in reverse to over 275 knots forward, (2) it would provide a mobile armored-gun-platform equipped with a variety of weapons, (3) it would have a slow armored-reconnaissance capability with a hovering capability of more than 15 hours, (4) it could be used for direct armored support of ground troops along with armed reconnaissance ahead of advancing ground troops, (5) it would utilize surplus airplanes, (6) it would make possible flexible, rapid redirection of armed effort where needed, and (7) it could be employed in night operations with an illumination system for curfew enforcement.

(C) Some disadvantages of the Spider include: (1) it would be vulnerable to heavy anti-aircraft and guided missiles, (2) the cable connection from the mother airplane to the Spider may be a hazard to other aircraft, (3) recoil of weapons being fired would tend to displace the gondola, and (4) provision must be made for safety of the crew.

(C) Theoretical study of the Spider concept made to date and the limited flight testing of the cargo-delivery system on which it is based make the concept appear favorable.

Airborne Ordnance

(C) Although considerable effort is now going into improvement of weapons, the degradation in effectiveness of airborne ordnance when used in a swamp forest has not been sufficiently evaluated. In addition to the canopy and other problems, the ground conditions pose specific fusing problems. A research and test program which would account for these conditions appears to be required. The objective would be to measure the degradation in effect on current ordnance, and identify specific research and development needed to improve current capability. The Joint Evaluation of Environments Program (JEEP) currently in progress at Eglin Air Force Base should be monitored for useful data.

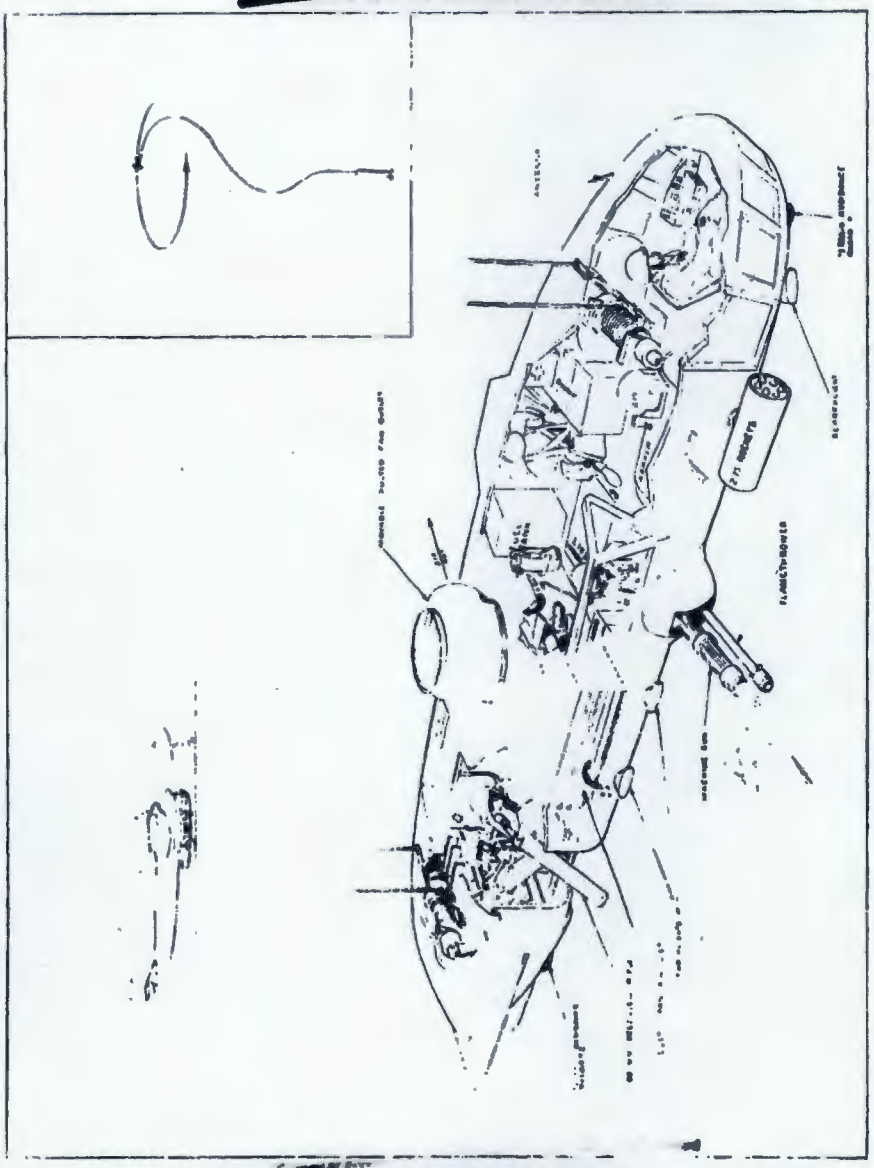


FIGURE V-1. ARMED AND ARMORED GONDOLA

SUMMARY

General

(S) Effective combat operations may be conducted in the swamp-forest environments of the Mekong Delta with the equipment and weapons in current inventory. However, the qualitative analysis conducted in this study, which compared representative operational requirements for these environments with current equipment and weapon capabilities, revealed areas where improvement is required. Consideration of these areas from a research, development, test, and engineering viewpoint indicates that the desired improvement in equipment and weapon characteristics is basically within present technical capability, and that several actions to attain the improvements appear required.

(S) The requirements for improvement in present equipment and weapon capabilities to conduct inland-waterway operations in a swamp forest containing a major river or channel network are the most urgent. Because of this, these requirements are given priority. The major improvements required in ground operations are also included in the inland-waterway requirements under Support of Amphibious Operations. The principal requirement for increased capability in air operations is in night operations – particularly with regard to curfew enforcement.

Inland-Waterway Operations

(S) The improvements which appear required for inland-waterway operations in a swamp forest containing a major river and channel network may be considered in two parts. The first part is the research, development, test, and/or engineering effort in supporting type projects – particularly in the common-deficiency areas associated with current craft. This effort should result in the capability to significantly improve the characteristics of new craft with regard to these present deficiencies. The second effort is that associated with the development of new craft for some of the operational requirements. The priority is for new craft associated with the "support of amphibious operations" and "mine-countermeasure operations".

Supporting Projects

(C) Five common deficiencies in craft available in current inventory for inland-waterway operations are the resistance of the hull to underbottom explosions, sustained and maximum operating speeds, integral armor protection, weapon complement capability to deliver anti-personnel munition on an area target, and noise suppression. The research, development, test, and/or engineering effort which appears required in these areas is summarized in Table V-2.

(S) Other required areas of supporting-project activity are associated with the capability to detect and/or neutralize moored-mine devices as a part of mine-countermeasure operations and shallow-water mines for use in blocking secondary channels. For mine-countermeasure operations the most urgent requirement is completion of the present Riverine Sonar Task at the U.S. Navy Mine Defense Laboratory. First priority is the modification of the "best" of the currently available small-craft sonars (based on field tests in CONUS and SVN) for use on craft in a mine-detection role (D, T, and E). The second objective is the development of an improved sonar to effectively detect a moored-mine device in inland waterways (R, D, T, and E).

(S) There is a need for shallow-water contact-type mines in several weights which are effective in water depths of 2-20 feet against indigenous-type craft. It appears that mines in total weights of approximately 30-40 lbs., 75-85 lbs., and 120-130 lbs. would provide an adequate range (D, T, and E).

New Craft

(C) The PCF-Mark 1 (Swift) and the River Patrol Boat (PBR) have added a fast-patrol capability on inland waterways. Further development, testing, or engineering effort to meet this operational requirement will depend to a great extent on the results of operational field tests of the PBR presently in progress.

(S) The preferred watercraft (with modifications) from current inventory to provide troop, cargo, and equipment transport; convoy protection and fire support; and mobile command and control in support of amphibious operations have the five common general deficiencies previously discussed (Table V-2). Several new craft and amphibians appear to be required to provide the increase in capability needed. There is also a need for a craft to improve mine-countermeasure operations on inland-waterways. Further modification of existing craft does not appear adequate to meet these requirements. The development of each of the new craft

TABLE V-2. SUPPORTING PROJECTS SUMMARY (U)

Deficiency Area	Description of Research, Development, Test, and/or Engineering Effort	Research	Development	Test	Engineering
1. Hull resistance to underbottom explosions.	- Build up the available data on the effects of underbottom explosions on inland-waterway craft				
	a. Detonate varying amounts of explosive over the range 50-100 lbs. The devices should be configured to give the directional explosive effect similar to the VC moored-mine device which has and is being used. Detonation depths should be from 3-20 feet. Pressure measurements should be obtained in polar planes at depths of 0-6 feet. Pattern and nature of the bubble should be recorded.	X		X	
	b. Subject hulls of various basic designs (wee, wood, catamaran, etc.) and strengths to the explosions. Measure resistance and explosive effects under the controlled conditions. Test various explosive resistance and sinking materials in double-shell hulls.	X	X	X	
	- Translate results of test series into hull design criteria and characteristics for new craft listed in Table V-3.				X
	- Identify areas for continuing research.				
2. Sustained and maximum operating speeds.	- Primary emphasis should be placed on the availability of gas-turbine engines for inland-waterway craft. (Also associated with the noise-suppression problem).		X	X	X
	- A program for development and evaluation of steam-engine systems for inland-waterway craft should be initiated. (Also associated with the noise-suppression problem.) Initial priority is for application on patrol-type craft.	X	X	X	X
3. Integral armor protection.	- A program for development and evaluation of "space armor" for use on inland-waterway craft should be initiated. Primary threat is the 57 mm and 75 mm recoilless rifles.				
	a. Develop various detonating-screen designs (vertical overlapping bars, etc.)		X		X
	b. Test the effectiveness of the detonating-screen designs in protecting exposed hull areas above the waterline from 37 mm, 57 mm R.R. and 75 mm R.R. high explosive and armor piercing rounds using contact and delayed fuses. The other critical test parameter is the off-set distance of the detonating screen from the hull.	X		X	
	- If favorable results are obtained, configure criteria and characteristics for space armor on new craft listed in Tables V-3 and V-4.				X
	- Develop armored turrets for 0.30 cal (or 7.62 mm) MG, 0.50 cal MG, 20 mm gun, and HV 40 mm G.L. positions on inland-waterway craft.		X	X	X
4. Weapon systems to deliver anti-personnel munition on an area target.	- Adapt for use on inland-waterway craft the MK 6 Mod 0 depth-charge projector (K-gun) and/or spigot mortar (Y-gun) to fire anti-personnel munition at an area target (approximately 150 by 80 meters).		X		X
	- Develop (or adapt) a white phosphorous bomblet and napalm munition for use by the K- and/or Y-gun systems.				

[redacted]

TABLE V-2. (Continued)

Deficiency Area	Description of Research, Development, Test, and/or Engineering Effort	Research	Development	Test	Engineering
	- Develop a high-explosive bomblet munition with mixed-bomblet detonation capability for part detonating on contact and part detonating a few feet above ground.		X		X
	- Test the above systems and munitions for effectiveness against simulated personnel targets in controlled experiments using representative concealment and cover.			X	
	- Select the best system for use on new craft listed in Table V-3, and determine need for continuing effort.				
	- Develop and evaluate a mass-launch rocket system for use against personnel in a linear area target. (High explosive and white phosphorous rounds with contact and delay fuses should be tested in controlled experiments. (Adaptation of the 2.75-inch FFAR should be considered.)		X	X	X
	- Develop and test a system for side mounting on craft a low velocity 40 mm army (low velocity grenade launcher round) using short, fixed and mounted firing tubes.		X	X	X
5. Noise suppression.	- Complete the present effort to build up available data and information on noise level of current craft before and after a feasible amount of acoustical treatment (present effort at U.S. Navy Marine Engineering Laboratory).			X	X
	- Based on the program results, develop criteria for acoustical treatment of present craft, or new craft with gasoline or diesel engines.				X
	- Develop improved components such as mufflers for gasoline and diesel engines which are adjustable with regard to critical parameters as a function of engine speed.		X	X	X
	- Develop and evaluate improved acoustical treatment for gas-turbine engine systems.		X	X	X
	- Initiate a program for development and evaluation of steam engines for inland-waterway craft. Such engines should be relatively quiet in operation. Initial priority is for application on patrol-type craft.	X	X	X	X

required is within present technical capability and will require development, test, and engineering effort. However, there is a dependency on the supporting projects discussed above. The general characteristics of the suggested watercraft and amphibians are given in Tables V-3 and V-4, respectively. Based on the qualitative analysis accomplished in the study, these craft and amphibians appear to be required to adequately improve operational capability in swamp-forest areas containing a major river or channel network.

Air Operations

(C) The principal improvements which appear to be required in air operations to support combat operations in swamp-forest areas are associated with the deployment of a light armed-reconnaissance-type aircraft, and night operations for enforcement of a curfew. In addition, research and test effort is also required to improve the information and data available on the degradation in effectiveness of air-delivered munitions in a swamp-forest environment.

(S) The detection of personnel under a jungle, tropical forest, or swamp-forest canopy does not appear yet within the technical state of the art. However, the capability of sensor systems to detect signatures of insurgent operations is improving, and priority should be maintained on these programs.

(C) As a supplementary measure, illumination systems for rotary- and fixed-wing aircraft (such as a light reconnaissance-type aircraft) should be exploited. The present heliborne illumination system (Reference 3) should be improved to provide adequate illumination in an area diameter of 1200-1500 feet at an altitude of 3000-3500 feet. This would improve the one-pass coverage over major channels and rivers, and further decrease the vulnerability of the illumination helicopter to small-arms fire.

(S) The concept of an armed and armored airborne tank (Spider) appears applicable for consideration in a curfew-enforcement role at night over a swamp-forest area. The Spider concept involves the use of an armed and armored gondola cable launched and recovered from underneath a Constellation-type aircraft. The gondola would contain five combat troops and approximately 350 square feet of armored plate. Illumination and weapon systems would be an integral part of its design. The gondola would be equipped with a ducted-fan motor for limited control. Other control methods would be cable-control winches abroad the gondola and the aircraft.

TABLE V-3. GENERAL CHARACTERISTICS – INLAND-WATERWAY CRAFT (U)

Mission	Maximum Draft, inches	Speed[1] Maximum knots	Speed[1] Sustained knots	Capacity Troops[2]	Capacity Cargo, tons	Range, nautical miles	Armament	Armor Protection[3]	Engine Type	General Design Characteristics[3]
Troop and cargo transport	48	20-25	17-20	60-65	15-20	150-175	2 – HV 40 mm G.L. 2 – Twin 0.50 cal M.G. 60 mm naval mortar; K-gun; or Y-gun LV 40 mm side-mounted arrays	Weapon positions Other crew areas Troop and cargo well Engineroom area Space armor	Gas turbine[4]	Over-the-side loading Sliding or extendable) unloading ramp Troop and cargo well Gun positions- 2 each side 1 aft (heavy-weapon station)
Troop, cargo, and equipment transport[5]	56	20-25	17-20	(7)	35-40	150-175	2 – HV 40 mm G.L. 2 – Twin 0.50 cal M.G. 1 – 20 mm gun 81 mm naval mortar; K-gun; or Y-gun LV 40 mm side-mounted arrays	Same as above	Gas turbine[4]	Front-ramp loading Troop, cargo, and equipment well minimum dimensions Length – 36 ft Width – 11 ft Height – 6 ft Gun Positions- 2 each side 1 aft (20 mm) 1 heavy weapon station
Convoy protection and fire support	36	35	25-30	--	--	150-175	1 – HV 40 mm G.L. 1 – 0.30 cal (or 7.62 mm) M.G. with coaxial LV 40 mm G.L. 2 – Twin 0.50 cal M.G. 60 mm naval mortar; K-gun; or Y-gun LV 40 mm side-mounted arrays	Same as above (except no troop and cargo well)	Gas turbine[4]	Gun positions – 1 each side (Twin 0.50 cal M.G.) 1 forward 1 bridge-mounted (0.50 cal M.G. with coaxial LV 40 mm G.L. 1 heavy-weapon station

TABLE V-8. (Continued)

Mission	Maximum Draft, inches	Speed[1] Maximum knots	Speed[1] Sustained knots	Capacity Troops[2]	Capacity Cargo, tons	Range, nautical miles	Armament	Armor Protection[3]	Engine Type	General Design Characteristics[3]
Mine-counter-measure craft[8]	30	20-25	17-20	--	--	100-150	1 - Twin 0.50 cal M. G. 1 - HV 40 mm G. L. LV 40 mm side-mounted arrays	Weapon positions Other crew areas Engineroom area Space armor	Gasoline or gas turbine[4]	Low magnetic signature Gun positions- 1 forward 1 aft

(1) At full displacement.
(2) Combat equipped.
(3) Criteria - 0.50 caliber machine gun at 20 meters.
(4) With acoustical treatment.
(5) Overpressure design criteria and basic hull type depending on results of hull test series.
(6) Additional mission of mobile command and control with a communications and control module designed to fit in the well.
(7) Troop capacity would be greater than normally utilized.
(8) Craft designed as a system to employ advance sonar equipment, provide an increased sweeping capability on inland waterways against moored contact mines or magnetic-influence mines, and provide an operating platform for diver personnel engaged in neutralizing or destroying the mine devices after detection.

TABLE V-4. GENERAL CHARACTERISTICS – MARSH SCREW AMPHIBIANS (U)

Mission	Speed(1) Water, knots	Marsh, knots	Mud, knots	Capacity Troops(2)	Cargo, tons	Range, nautical miles	Armament	Armor Protection(3)
Troop and cargo transport	15-17	17-20	20-25	25	3.5-4	100-150	1 – Twin 0.50 cal M3 1 – HV 40 mm G. L. LV 40 mm side-mounted arrays	Weapon positions Other crew areas Troop and cargo area Engine and drive system Space armor
Armed reconnaissance and patrolling(4)	15-17	17-20	20-25	--	--	100-150	Same as above	Same as above (except no troop and cargo area)

(1) At full displacement.
(2) Combat equipped.
(3) Criteria – 0.50 caliber machine gun at 20 meters.
(4) Maximum dimensions: Length – 17 feet, Width – 10 feet.

~~SECRET~~

Theoretical study of the Spider concept to date and the limited flight testing of a cargo delivery system on which the concept is based make it appear favorable.

(C) The effectiveness (or degradation in effectiveness) of airborne ordnance when used in a swamp forest has not been sufficiently evaluated. A research and test program to improve the information and data on this problem is required.

KN:all

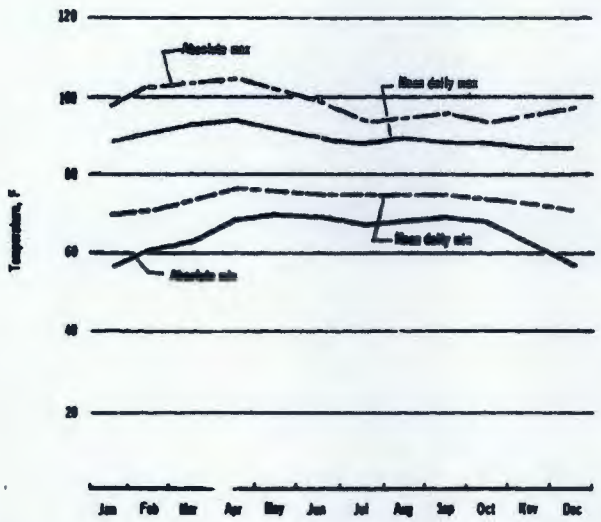
~~SECRET~~

APPENDIX A

ENVIRONMENTAL DATA

APPENDIX A

ENVIRONMENTAL DATA

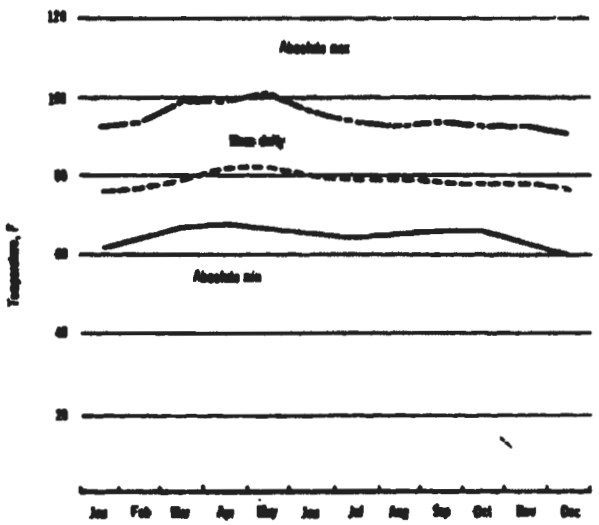


Absolute max	98	102	100	104	102	98	94	96	96	94	95	97
Mean daily max	89	91	93	94	92	89	88	88	87	88	87	87
Mean daily												
Mean daily min	70	71	74	77	76	75	75	75	75	74	73	71
Absolute min	57	61	63	68	70	68	67	68	69	68	63	57

Mean daily temp – temp based on three or more obs per day averaged over the period of record
Mean daily max-min temp – highest-lowest temp averaged over the period of record
Absolute max-min temp – the extreme highest-lowest temp value which occurred during the period of record
Station coordinates – 10°49'N, 106°40'E
Source: Climatic data tabulation – South Vietnam by climatology div, 5 AF CS, 1st Weather Wng, APO 925

FIGURE A-1. TEMPERATURE MARCH AT SAIGON TAN SON NHUT AIRPORT

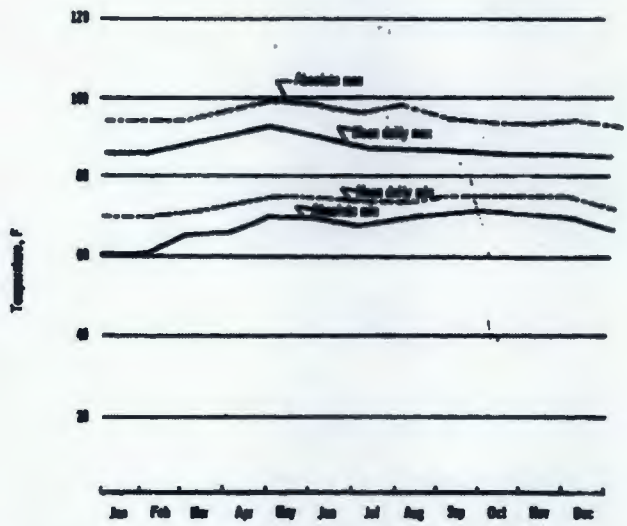
Period, 45 years.



Absolute max	92	93	93	96	101	96	93	92	93	92	92	93
Mean daily max												
Mean daily	76	77	79	82	82	80	79	79	78	78	78	77
Mean daily min												
Absolute min	62	64	67	69	67	65	64	65	65	65	63	60

Mean daily temp – temp based on three or more obs per day averaged over the period of record
Mean daily max-min temp – Highest-lowest temp averaged over the period of record
Absolute max-min temp – the extreme highest-lowest temp value which occurred during the period of record
Station coordinates –
Source: Climatic data translation – South Vietnam by climatology div, 5 S CS, 1st Weather Wing, APO 925

FIGURE A-2. TEMPERATURE MARCH AT VUNG TAU CAP ST. JACQUES



Absolute max	94	96	97	99	98	96	96	94	93	93	94	92
Mean daily max	86	89	91	93	91	89	87	87	86	86	86	85
Mean daily												
Mean daily min	71	72	74	76	76	75	75	75	75	75	75	73
Absolute min	61	65	67	70	70	69	70	71	72	71	70	65

Temp based on three or more obs per day averaged over the period of record

Mean daily max-min temp – highest-lowest temp averaged over the period of record

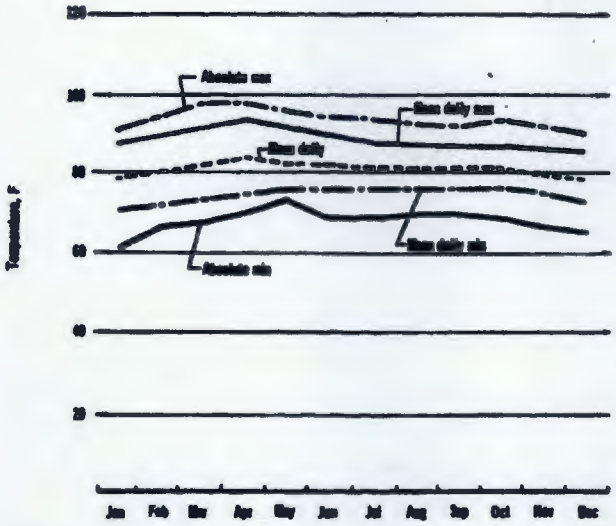
Absolute max-min temp – the extreme highest-lowest temp value which occurred during the period of record

Station coordinates – 10°02'N, 105°47'E

Source: Prepared by Technical Services 20th Weather Squadron APO 96225

FIGURE A-3. TEMPERATURE MARCH AT CAN THO

Period, 9 years.



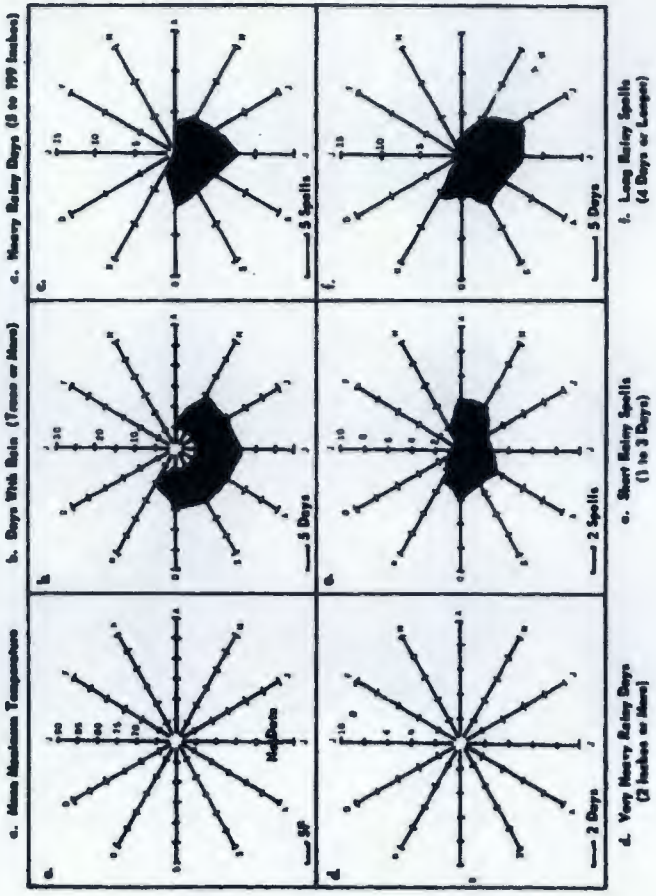


FIGURE A-6. CLIMATIC INFORMATION AT HA TIEN (10°21'N-105°55'E)

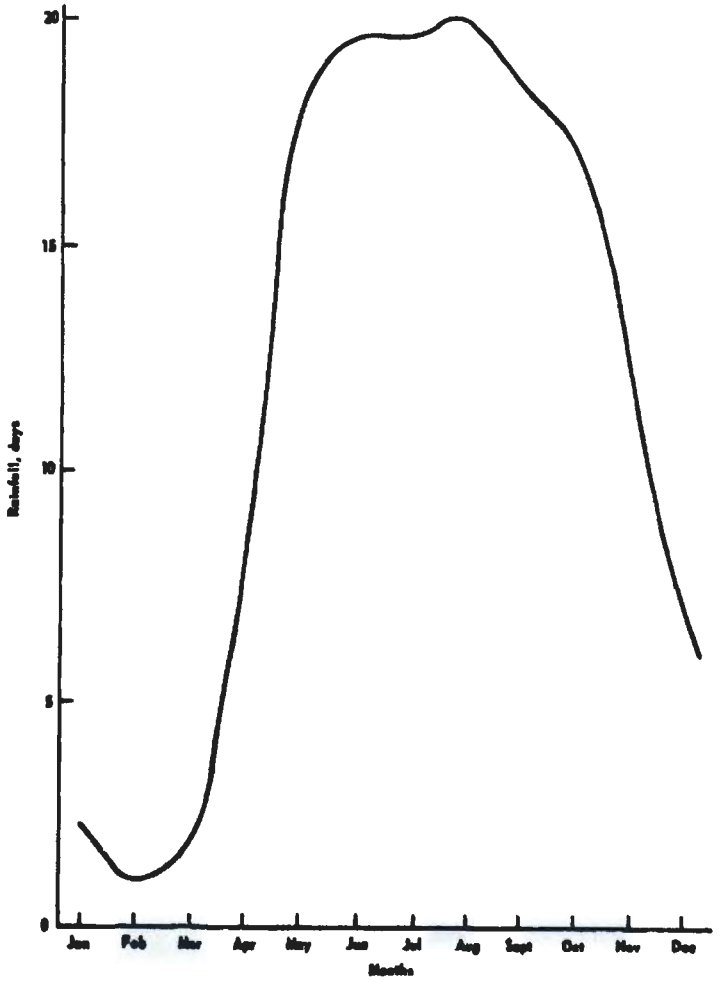


FIGURE A-6. DAYS OF RAINFALL IN THE SOUTHERN LOWLANDS OF SOUTH VIETNAM

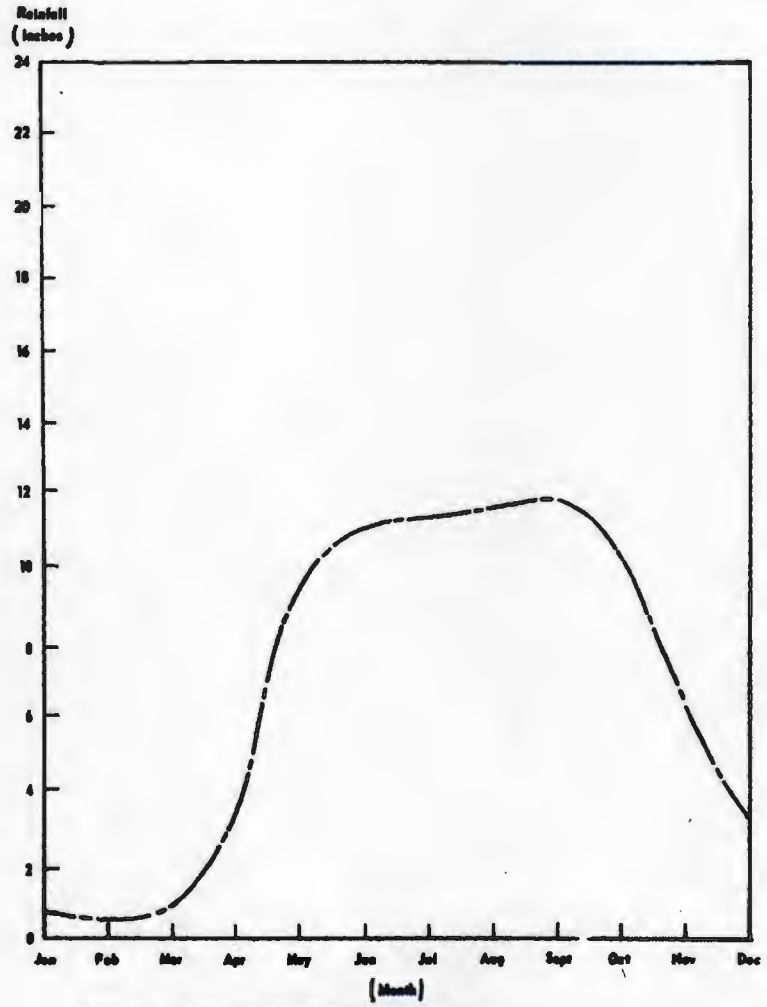


FIGURE A-2 AVERAGE MONTHLY RAINFALL IN THE SOUTHERN LOWLANDS OF SOUTH VIETNAM

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TABLE A-1

SELECTED WEATHER ELEMENTS FOR SAIGON

MONTH	YEARS RECORD	DRY DAYS	SHORT DRY SPELLS 1-3 DAYS	LONG DRY SPELLS 4 DAYS	RAINY DAYS	SHORT RAINY SPELLS 1-3 DAYS	LONG RAINY SPELLS 4 DAYS	LIGHT RAINY DAYS TRACE TO 0.49"	HEAVY RAINY DAYS .50 to 1.99"	VERY HEAVY RAINY DAYS OVER 2.00"	ABSOLUTE MAXIMUM OVER RECORD PERIOD	MEAN RAINFALL FOR MONTH	GREATEST MONTHLY RAINFALL	LEAST MONTHLY RAINFALL	MEAN MAXIMUM TEMPERATURE	EXTREME MAXIMUM TEMPERATURE	[illegible]: RELATIVE HUMIDITY AT 0600 HRS	TEMPERATURE AT 0600 HRS	RELATIVE HUMIDITY AT 1300 HRS	TEMPERATURE AT 1300 HRS	DAYS SUITABLE FOR CONTACT FLIGHT AT 0600	DAYS SUITABLE FOR CONTACT FLIGHT AT 1300
Jan.	19+	25.4	-	-	3.6	-	-	3.4	0.2	-	0.95	0.39	1.03	0.00	89	98	92.7	70.9	31.5	85.9	16.8	29.3
Feb.	3+	26.3			1.7			1.7	-	-	0.07	0.03	0.10	0.00	91	102	90.2	72.3	48.8	88.2	18.9	27.3
Mar.	9+	25.3	-	-	3.7	-	-	5.2	0.4	0.1	4.06	1.16	5.07	6.00	93	103	90.0	76.0	51.3	90.5	19.9	30.6
Apr.	9+	22.0	-	-	8.0	-	-	7.0	0.6	0.4	3.50	2.20	5.31	0.06	95	104	88.5	79.0	53.7	90.7	21.0	28.7
May	9	12.6	-	-	18.4	-	-	12.4	5.4	0.6	6.10	9.28	22.07	3.25	92	102	91.4	79.2	64.1	88.3	25.7	29.3
Jun.	9+	5.8	-	-	24.2	-	-	15.8	7.0	1.4	3.41	13.76	20.55	8.11	89	100	93.4	78.4	69.9	87.0	23.5	28.7
Jul.	9+	5.9	-	-	25.1	-	-	16.1	8.2	0.8	5.09	13.37	22.97	10.64	88	96	95.4	77.7	71.6	85.3	23.3	29.7
Aug.	9+	6.3	-	-	24.7	-	-	18.0	5.6	1.1	6.95	11.88	18.94	6.36	88	95	94.0	77.6	74.6	85.4	24.3	28.2
Sep.	9-	3.9	-	-	26.1	-	-	16.1	6.9	1.1	5.22	12.92	18.66	8.02	88	96	94.9	77 2	75.0	84.5	19.8	29.3
Oct.	9+	8.9	-	-	22.1	-	-	15.5	5.6	1.0	3.63	9.97	15.33	3.58	88	94	94.6	.6.4	71.9	84.8	24.1	30.1
Nov.	9+	14.8	-	-	15.2	-	-	11.5	3.2	0.3	3.16	6.45	10.12	3.28	87	95	93.8	75.4	67.6	85.9	23.4	29.7
Dec.	9+	22.2	-	-	8.8	-	-	8.0	0.7	0.1	2.79	1.67	2.85	0.33	87	97	93.1	71.7	59.7	84.6	20.5	29.3

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TABLE A-2

SELECTED WEATHER ELEMENTS FOR CAP ST JACQUES

MONTH	YEARS RECORD	DRY DAYS	SHORT DRY SPELLS 1-3 DAYS	LONG DRY SPELLS 4 DAYS	RAINY DAYS	SHORT RAINY SPELLS 1-3 DAYS	LONG RAINY SPELLS 4 DAYS	LIGHT RAINY DAYS TRACE TO 0.49"	HEAVY RAINY DAYS .50 to 1.99"	VERY HEAVY RAINY DAYS OVER 2.00"	ABSOLUTE MAXIMUM OVER RECORD PERIOD	MEAN RAINFALL FOR MONTH	GREATEST MONTHLY RAINFALL	LEAST MONTHLY RAINFALL	MEAN MAXIMUM TEMPERATURE	EXTREME MAXIMUM TEMPERATURE	MONTHLY AVERAGE: RELATIVE HUMIDITY AT 0600 HRS	TEMPERATURE AT 0600 HRS	RELATIVE HUMIDITY AT 1300 HRS	TEMPERATURE AT 1300 HRS	DAYS SUITABLE FOR CONTACT FLIGHT AT 0600	DAYS SUITABLE FOR CONTACT FLIGHT AT 1300
Jan.	10	28.5	.3	-	2.5	.8	-	2.5	-	-	0.42	0.10	0.45	0.00	88	91	87.3	72.2	70.1	80.4	30.6	31.0
Feb.	10	27.0	0.5	1.1	1.0	0.1	0.3	1.0	-	-	0.08	0.01	0.08	0.00	83	93	86.0	74.0	72.7	80.7	27.9	27.6
Mar.	10	29.0	0.3	0.1	2.0	0.3	-	1.9	0.1	-	0.36	0.17	1.60	0.00	85	99	85.6	76.7	72.1	83.3	30.8	31.0
Apr.	10	25.7	0.9	0.9	4.3	1.0	0.2	3.7	0.6	-	1.93	1.12	6.22	0.00	89	100	85.4	79.0	70.7	85.7	28.9	29.8
May	10	13.3	4.0	1.2	17.7	4.1	1.1	12.5	4.9	0.3	3.07	7.64	15.01	2.80	90	101	87.6	79.1	76.2	85.1	30.4	30.3
Jun.	10	7.6	6.0	0.6	22.4	3.0	2.0	16.3	5.4	0.7	3.07	8.94	15.92	3.94	87	96	89.6	77.8	78.6	83.5	28.7	29.3
Jul.	10	7.7	6.7	0.6	23.3	3.7	1.6	17.4	5.7	0.2	5.59	8.89	16.59	5.59	85	93	90.3	77.2	81.5	82.0	30.0	29.6
Aug.	10	9.3	5.1	1.1	21.7	4.3	4.7	16.1	5.4	0.2	2.61	6.99	9.17	3.55	85	92	91.3	77.1	81.4	82.3	28.2	28.6
Sep.	10	9.8	4.0	1.2	20.2	5.0	1.2	15.4	4.4	0.4	2.36	7.10	10.83	4.66	85	93	91.1	76.4	79.8	82.4	27.0	28.5
Oct.	10	14.2	3.7	1.4	16.8	3.4	1.4	12.7	3.3	0.8	5.91	7.32	16.61	2.02	84	92	90.9	76.0	78.8	81.7	28.7	29.5
Nov.	10	19.9	2.3	1.4	10.1	2.4	1.0	8.9	1.1	0.1	2.05	2.16	4.58	0.60	83	92	90.5	73.6	77.0	82.0	29.3	29.9
Dec.	10	24.6	0.9	1.7	6.4	2.2	0.4	6.1	0.3	-	0.59	0.38	1.32	0.01	82	91	89.1	72.9	74.2	80.0	29.9	30.0

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TABLE A-3

SELECTED WEATHER ELEMENTS FOR CAN THO

MONTH	YEARS RECORD	DRY DAYS	SHORT DRY SPELLS 1-3 DAYS	LONG DRY SPELLS 4 DAYS	RAINY DAYS	SHORT RAINY SPELLS 1-3 DAYS	LONG RAINY SPELLS 4 DAYS	LIGHT RAINY DAYS TRACE TO 0.49"	HEAVY RAINY DAYS .50 to 1.99"	VERY HEAVY RAINY DAYS OVER 2.00"	ABSOLUTE MAXIMUM OVER RECORD PERIOD	MEAN RAINFALL FOR MONTH	GREATEST MONTHLY RAINFALL	LEAST MONTHLY RAINFALL	MEAN MAXIMUM TEMPERATURE	EXTREME MAXIMUM TEMPERATURE	MONTHLY AVERAGE: RELATIVE HUMIDITY AT 0600 HRS	MONTHLY AVERAGE: TEMPERATURE AT 0600 HRS	MONTHLY AVERAGE: RELATIVE HUMIDITY AT 1300 HRS	MONTHLY AVERAGE: TEMPERATURE AT 1300 HRS	DAYS SUITABLE FOR CONTACT FLIGHT AT 0600	DAYS SUITABLE FOR CONTACT FLIGHT AT 1300
Jan.	10	27.3	.4	1.3	3.8	2.1	-	3.6	0.2	-	1.89	0.66	2.15	0.00	-	-	88.4	73.6	58.8	86.7	26.3	31.0
Feb.	10	27.1	0.4	1.3	1.1	2.1	-	1.0	-	0.1	2.36	0.26	2.62	0.00	-	-	87.2	76.2	53.8	87.2	26.2	28.0
Mar.	10	27.7	6.2	1.2	3.3	1.3	0.1	2.6	0.9	-	1.61	0.98	3.35	0.00	-	-	90.2	76.5	55.7	90.0	19.3	31.0
Apr.	10	26.5	1.8	2.2	5.5	3.8	0.2	4.2	1.1	0.2	2.13	2.01	6.28	0.00	-	-	88.9	78.0	58.3	90.3	22.2	29.2
May	10	16.1	4.6	1.5	16.0	6.6	1.1	10.4	4.0	0.5	3.11	7.86	11.35	2.72	-	-	93.2	78.2	72.5	88.3	21.9	27.7
Jun.	10	11.5	6.4	0.7	18.5	5.9	1.3	13.6	4.7	0.2	2.36	7.25	11.81	6.16	86	93	93.7	77.8	76.9	85.6	28.9	28.1
Jul.	10	8.9	3.6	0.6	22.1	6.3	2.0	16.1	5.5	.5	3.33	9.36	13.07	6.07	87	92	93.2	77.7	72.3	86.1	26.9	29.1
Aug.	10	10.9	5.1	1.2	20.1	4.8	1.3	14.8	5.0	0.3	2.86	7.16	11.56	5.07	86	89	93.3	77.6	73.1	85.8	27.6	28.9
Sep.	10	7.8	4.9	0.8	22.2	3.6	2.1	15.3	5.8	1.1	3.25	10.51	13.66	6.35	86	90	96.3	77.7	76.0	86.6	27.0	28.8
Oct.	10	12.2	6.5	1.6	18.8	5.8	1.6	11.3	6.8	0.7	3.80	10.42	19.22	5.76	85	89	91.6	78.5	71.8	88.5	29.6	30.1
Nov.	10	17.8	3.1	2.0	12.2	4.7	0.7	8.2	3.3	0.7	7.79	7.62	19.46	3.20	85	88	90.4	77.6	69.3	86.1	26.8	29.1
Dec.	16	25.3	1.3	1.8	5.7	3.1	-	4.2	1.1	0.4	1.40	1.20	3.16	0.08	86	88	89.0	76.5	66.3	86.8	27.8	30.7

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TABLE A-4

SELECTED WEATHER ELEMENTS FOR PHAN THIET

MONTH	YEARS RECORD	DRY DAYS	SHORT DRY SPELLS 1-3 DAYS	LONG DRY SPELLS 4 DAYS	RAINY DAYS	SHORT RAINY SPELLS 1-3 DAYS	LONG RAINY SPELLS 4 DAYS	LIGHT RAINY DAYS TRACE TO 0.49"	HEAVY RAINY DAYS .50 to 1.99"	VERY HEAVY RAINY DAYS OVER 2.00"	ABSOLUTE MAXIMUM OVER RECORD PERIOD	MEAN RAINFALL FOR MONTH	GREATEST MONTHLY RAINFALL	LEAST MONTHLY RAINFALL	MEAN MAXIMUM TEMPERATURE	EXTREME MAXIMUM TEMPERATURE	MONTHLY AVERAGE: RELATIVE HUMIDITY AT 0600 HRS	TEMPERATURE AT 0600 HRS	RELATIVE HUMIDITY AT 1300 HRS	TEMPERATURE AT 1300 HRS	DAYS SUITABLE FOR CONTACT FLIGHT AT 0600	DAYS SUITABLE FOR CONTACT FLIGHT AT 1300
Jan.	5	29.5	1.2	.6	1.5	1.6	-	1.5	-	-	0.20	0.10	0.57	0.00	-	-	91.3	60.6	62.8	82.9	25.9	31.0
Feb.	5	26.7	0.6	0.6	1.3	1.4	-	1.3	-	-	0.01	0.08	0.36	0.00	-	-	87.9	69.6	63.5	82.3	22.3	28.0
Mar.	5	30.9	-	0.6	0.2	0.2	-	0.2	-	-	0.01	Trace	0.01	0.00	-	-	86.6	74.0	66.9	84.5	28.6	31.0
Apr.	5	27.5	1.2	0.8	2.5	2.0	-	1.9	0.3	0.3	2.30	1.11	5.59	0.00	-	-	84.8	77.7	66.7	86.9	23.7	28.6
May	5	21.0	3.2	2.6	10.0	4.2	1.0	6.5	3.3	0.2	2.32	4.81	6.67	2.29	-	-	88.3	78.7	67.5	87.3	26.5	30.0
Jun.	5	18.5	4.2	1.8	11.5	5.2	1.6	5.8	5.0	0.7	3.20	6.02	12.50	3.37	-	-	86.7	76.1	68.7	87.1	23.8	28.0
Jul.	5	10.8	3.8	1.0	12.7	3.8	0.6	6.3	6.4	-	1.91	7.91	11.11	3.66	-	-	88.2	77.7	69.8	85.5	25.9	28.0
Aug.	5	20.3	4.2	2.0	10.7	3.6	0.6	6.5	5.8	0.4	3.86	7.51	10.89	5.08	-	-	89.7	77.1	68.5	86.6	23.6	28.5
Sep.	5	20.7	4.2	2.2	9.3	3.8	0.6	5.0	4.1	0.2	6.38	5.72	10.36	1.67	-	-	91.1	75.9	70.6	85.7	19.7	28.3
Oct.	5	24.3	2.2	1.2	6.7	3.4	0.8	3.3	2.9	0.5	4.65	5.47	13.17	1.39	-	-	93.1	75.4	73.1	84.6	20.1	27.9
Nov.	5	28.3	2.0	1.2	1.7	1.8	-	1.2	0.4	0.1	6.96	1.35	4.57	0.00	-	-	92.3	74.3	68.4	85.5	20.9	28.9
Dec.	5	29.2	0.2	0.6	1.8	0.6	-	1.5	0.3	-	0.82	0.35	0.82	0.00	-	-	93.3	70.6	63.8	82.8	26.0	30.4

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TABLE A-5. MEAN PERCENTAGE FREQUENCY OCCURRENCE OF LESS THAN 5/8 CLOUD COVER AND VISIBILITIES GREATER THAN 3 MILES DURING INDICATED 3-HOUR PERIODS

(March)

Station \ Hours, LST	Percentage								
	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24	All Hours
Laos									
Pakse	84	(a)	64	72	70	57	67	(a)	69
Seno	83	84	56	72	66	69	78	86	74
Vientiane	36	32	31	53	61	59	42	38	44
Republic of Vietnam									
Hoang Sa (16.3N 111.3E)	80	61	53	64	70	73	80	83	71
Hue	(a)	39	31	44	54	44	37	(a)	41
Da Nang	34	34	28	38	51	46	34	35	38
Quang Ngai	(a)	60	47	68	73	71	66	(a)	64
Nha Trang	52	52	34	46	51	59	55	58	51
Phan Thiet[b]	(a)	72	67	71	71	64	72	(a)	69
Saigon[b]	79	70	41	56	40	62	72	78	62
Soc Trang[b]	(a)	78	67	54	52	78	92	(a)	70
Rach Gia[b]	(a)	43	31	37	19	32	41	(a)	34
Camau[b]	(a)	56	46	44	43	50	48	(a)	48
Pleiku	(a)	26	40	52	44	48	36	(a)	41
Dalat	(a)	63	60	63	58	59	69	(a)	62
Ban Me Thuot	(a)	51	61	69	55	65	(a)	(a)	60

Note: Less than 5/8 total cloud cover constitutes no ceiling; period of record, 3 to 5 years.
(a) Data not available.
(b) Stations below latitude 11°N.

TABLE A-6. MEAN PERCENTAGE FREQUENCY OCCURENCE WITH CEILINGS 5000 FEET OR MORE AND VISIBILITIES GREATER THAN 5 MILES DURING INDICATED 3-HOUR PERIODS

(March)

Station \ Hours, LST	Percentage								
	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24	All Hours
Laos									
Pakse	61	(a)	77	87	81	75	84	(a)	77
Seno	97	96	68	80	76	83	82	97	85
Vientiane	18	13	20	42	52	49	33	20	31
Republic of Vietnam									
Hoang Sa (16.3N 111.3E)	84	76	69	78	77	81	86	89	81
Hue	(a)	42	38	54	63	60	53	(a)	52
Da Nang	57	50	45	56	72	73	65	54	59
Quang Ngai	(a)	68	61	79	86	87	83	(a)	77
Nha Trang	60	60	52	64	74	82	76	67	67
Phan Thiet[b]	(a)	94	97	96	99	96	96	(a)	96
Saigon[b]	89	85	46	64	48	75	89	87	73
Soc Trang[b]	(a)	72	69	58	55	93	98	(a)	73
Rach Gia[b]	(a)	78	62	70	47	71	74	(a)	67
Camau[b]	(a)	60	51	46	46	61	68	(a)	55
Pleiku	(a)	47	45	60	40	38	61	(a)	48
Dalat	(a)	72	73	72	68	72	88	(a)	74
Ban Me Thuot	(a)	50	63	75	59	74	(a)	(a)	64

Note: Period of record, 3 to 5 years.
(a) Data not available.
(b) Stations below latitude 11°N.

TABLE A-7. MEAN PERCENTAGE FREQUENCY OCCURRENCE WITH CEILINGS 1500 FEET OR MORE AND VISIBILITIES GREATER THAN 3 MILES DURING INDICATED 3-HOUR PERIODS

(March)

Station \ Hours, LST†	Percentage								
	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24	All Hours
Laos									
Pakse	95	(a)	87	90	90	87	92	(a)	90
Seno	99	99	84	95	99	99	97	97	96
Vientiane	50	46	56	80	85	86	65	50	65
Republic of Vietnam									
Hoang Sa (16.3N 111.3E)	94	91	92	94	92	94	97	97	94
Hue	(a)	68	64	73	82	83	81	(a)	75
Da Nang	90	85	74	83	90	87	91	96	86
Quang Ngai	(a)	93	85	98	96	99	99	(a)	95
Nha Trang	92	91	88	87	88	91	93	94	91
Phan Thiet[b]	(a)	97	99	99	99	99	99	(a)	99
Saigon[b]	93	89	65	79	80	84	91	89	84
Soc Trang[b]	(a)	84	73	67	70	86	98	(a)	80
Rach Gia[b]	(a)	88	79	98	99	99	94	(a)	93
Camau[b]	(a)	67	60	83	92	78	91	(a)	78
Pleiku	(a)	60	70	81	76	72	84	(a)	74
Dalat	(a)	76	81	76	79	98	93	(a)	84
Ban Me Thuot	(a)	69	77	88	88	86	(a)	(a)	82

Note: Period of record, 3 to 5 years.
(a) Data not available.
(b) Stations below latitude 11°N.

TABLE A-8. MEAN PERCENTAGE FREQUENCY OCCURRENCE OF LESS THAN 5/8 CLOUD COVER AND VISIBILITIES GREATER THAN 3 MILES DURING INDICATED 3-HOUR PERIODS

(April)

Station \ Hours, LST	Percentage								
	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24	All Hours
Laos									
Pakse	57	(a)	49	55	53	45	48	(a)	51
Seno	93	86	68	79	57	64	67	89	75
Vientiane	37	32	30	50	60	66	41	34	44
Republic of Vietnam									
Hue	(a)	60	52	59	63	49	42	(a)	54
Da Nang	48	49	41	54	62	54	36	50	49
Nha Trang	58	53	41	51	57	59	56	58	54
Saigon[b]	61	62	37	40	31	51	54	61	49
Soc Trang[b]	(a)	73	70	51	35	67	85	(a)	63
Pleiku	(a)	17	31	38	35	40	27	(a)	31
Ban Me Thuot	(a)	62	57	51	39	50	(a)	(a)	52
North Vietnam									
Haiphong	29	16	25	25	31	42	32	50	31
Hanoi	22	24	18	21	27	50	42	26	29
Dong Hoi	(a)	(a)	33	(a)	70	59	(a)	(a)	(a)

Note: Period of record, 3 to 5 years.
(a) Data not available.
(b) Stations below latitude 11°N.

TABLE A-9. MEAN PERCENTAGE FREQUENCY OCCURRENCE WITH CEILINGS 5000 FEET OR MORE AND VISIBILITIES GREATER THAN 5 MILES DURING INDICATED 3-HOUR PERIODS

(April)

Station \ Hours, LST	Percentage								
	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24	All Hours
Laos									
Pakse	60	(a)	69	70	64	62	73	(a)	67
Seno	99	99	92	91	72	81	92	93	90
Vientiane	18	16	18	35	45	49	32	20	29
Luang Prabang	(a)	99	44	63	36	99	74	(a)	(a)
Republic of Vietnam									
Hue	(a)	66	68	76	79	77	74	(a)	73
Da Nang	71	73	69	75	82	85	73	70	74
Nha Trang	69	65	62	69	77	82	85	74	73
Saigon[b]	85	77	50	53	40	69	82	86	68
Soc Trang[b]	(a)	65	65	53	37	70	88	(a)	63
Rach Gia[b]	(a)	82	76	75	55	72	75	(a)	73
Quan Long	(a)	55	53	42	34	46	66	(a)	49
Pleiku	(a)	30	47	56	41	45	40	(a)	43
Dalat	(a)	64	68	71	47	58	76	(a)	63
Ban Me Thuot	(a)	68	71	62	44	63	(a)	(a)	62
North Vietnam									
Haiphong	29	16	25	25	31	42	32	50	31
Hanoi	22	24	18	21	27	50	42	26	29

Note: Period of record 3 to 5 years.
(a) Data not available.
(b) Stations below latitude 17°N.

TABLE A-10. MEAN PERCENTAGE FREQUENCY OCCURRENCE WITH CEILINGS 1500 FEET OR MORE AND VISIBILITIES GREATER THAN 3 MILES DURING INDICATED 3-HOUR PERIODS

(April)

Station \ Hours, LST	Percentage								
	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24	All Hours
Laos									
Pakse	81	(a)	74	77	81	81	84	(a)	80
Seno	99	99	98	99	99	94	98	96	98
Vientiane	43	41	53	76	87	87	62	44	62
Republic of Vietnam									
Hue	(a)	88	84	91	94	95	92	(a)	91
Da Nang	87	88	83	89	91	90	88	91	88
Quang Ngai	(a)	94	92	99	99	99	99	(a)	97
Nha Trang	90	90	87	88	88	89	93	92	90
Phan Thiet[b]	(a)	98	99	99	99	99	99	(a)	99
Saigon[b]	90	83	68	82	83	83	89	93	84
Soc Trang[b]	(a)	78	74	61	58	74	89	(a)	72
Rach Gia[b]	(a)	91	87	99	98	98	92	(a)	94
Quan Long	(a)	59	63	89	85	74	82	(a)	75
Pleiku	(a)	53	65	75	84	69	67	(a)	69
Dalat	(a)	85	86	98	99	98	88	(a)	92
Ban Me Thuot	(a)	80	83	84	78	79	(a)	(a)	81

Note: Period of record, 3 to 8 years.
(a) Data not available.
(b) Stations below latitude 11°N.

TABLE A. 11. COMPARISON OF DAILY HEIGHTS AND RANGES OF TIDES AT SELECTED STATIONS(a)

(South Vietnam – Mekong Delta Area)

Map Number(a)	Station	Tidal Range, meters				Height of Tide, meters	
		Maximum	Average	Minimum	Average During Flood	Maximum	Minimum
1	Saigon	3.0	2.2	1.5	2.0	1.8	-2.3
2	Bien Hoa	2.5	2.0	1.2	2.0	1.6	-1.7
3	Ben Luc	2.6	2.0	1.3	1.5	1.2	-1.8
4	Tan An	2.2	1.8	1.2	1.5	1.4	-1.5
5	Rach Dua	4.0	2.5	1.4	1.4	1.5	-3.0
6	My Tho	2.6	1.5	1.1	1.6	1.6	-1.8
7	Moc Hoa	1.3	0.8	0.0	0.2	3.2	+0.4
8	Dai Ngai	2.7	2.4	2.0	2.3	2.0	-1.9
9	Can Tho	2.5	2.0	0.8	0.8	1.9	-1.2
10	Long Xuyen	1.5	1.0	0.3	0.3	2.5	-0.9
11	Cho Moi	1.5	1.0	0.2	0.2	2.7	-0.6
12	Chau Doc	1.2	0.5	0.0	0.1	3.9	-0.5
13	Tan Chau	1.0	0.75	0.0	0.1	4.4	-0.3
14	Ha Tien	2.0	1.3	0.5	0.5	1.6	-1.0
15	Rach Gia	1.2	0.75	0.3	0.3	1.0	-0.6
16	Thanh Phu	2.2	1.8	0.9	0.9	1.2	-1.4
17	My Phouc	2.2	1.6	1.0	--	1.0	-1.6
18	Phung Hiep	2.1	1.5	0.4	0.4	1.2	-1.3

Original Source: BIEU DO MUC NUOC HANG NAM, Nam (1963).
(a) Number refers to location of station on Map 1.

TABLE A.12. PERCENTAGE DISTRIBUTION OF TOTAL WATERWAY LENGTH CONTROLLED BY MAXIMUM ALLOWABLE SAFE DRAFTS, AS SPECIFIED (S)

(South Vietnam - Mekong Delta Area; Low-Water Condition)

Specified Allowable Draft, meters	Total Length[a], kilometers	Percentage of Total Waterway Length	Cumulative Percentage of Total Waterway Length
	Canals and Lesser Waterways		
Above 3.0	156.6	4.5	4.5
2.6 - 3.0	389.3	11.3	15.8
2.1 - 2.5	930.6	27.0	42.8
1.6 - 2.0	262.0	7.6	50.4
1.1 - 1.5	667.1	19.3	69.7
0.6 - 1.0	993.0	28.8	98.5
0.0 - 0.5	52.7	1.5	100.0
	3,451.3	100.0	
	Major Rivers		
5.1 and above	71.0	5.6	5.6
4.1 - 5.0	228.0	17.9	23.5
3.1 - 4.0	402.3	31.6	55.1
2.6 - 3.0	0	0	55.1
2.1 - 2.5	349.2	27.4	82.5
1.6 - 2.0	117.4	9.2	91.7
1.1 - 1.5	105.4	8.3	100.0
	1,273.3	100.0	

Source: Reference 1.

(a) Total length of individual segments having a depth that limits safe draft to a maximum falling within the specified range (Column 1).

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APPENDIX B

EQUIPMENT AND WEAPONS

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APPENDIX B

EQUIPMENT AND WEAPONS

INTRODUCTION

(C) The many facets of operations in a swamp forest environment make an analysis of the inventory of available equipment a complex and interacting study. Since operations in these environments generally involve air, ground, and inland-waterway force elements, the equipment involved encompasses a wide range of weapons systems. However, the constraints imposed by the environment tend to reduce the equipment which needs to be considered, and in this limited study the effort was concentrated on that equipment which was necessary for the representative cases under study. Although the equipment can be categorized in many ways, a subdivision along functional lines appears to provide the easiest format for consideration in conjunction with the representative operational requirements. The equipment will, therefore, be discussed in the four main categories of naval support, air support, amphibian vehicles, and weapons.

(C) Although the analysis will be current equipment dependent, the requirements will indicate voids where research and development may be needed to increase the operational capabilities in swamp forest environments. In screening the available equipment to obtain those conditions which appeared to be the most applicable, an attempt was made to identify this needed new equipment. The details of the discussion will be proportional to the particular use and length of service of the equipment. Thus, for the listed equipment which is well known, the itemization is limited to simple characteristics and specifications by name and recognizable numbers.

NAVAL SUPPORT SYSTEMS

(C) The general missions of sea power in a COIN situation are (1) to prevent infiltration, (2) to conduct operations along a sea coast and in navigable inland waterways, and (3) to provide logistics waterlift of personnel and equipment. In a swamp environment, these general missions can be made specific. The main functions of inland-waterway operations in swamp warfare are to provide patrol and checkpoint operations, water mining and minesweeping, troop and cargo transport, fire support, and general interception and interdiction operations on inland waterways. Under certain operations, offshore interdiction on the sea is also necessary. These functional characteristics permit a logical subdivision of watercraft.

(C) The environmental specifications of a swamp forest further specify the main characteristics to be associated with the crafts which must be area oriented for maximum efficiency.

Fast Patrol Boats

(C) Operations on inland waterways with appreciable current requires the use of fast, shallow drafting equipment. Table B-1 presents the inventory of applicable craft.

TABLE B-1. FAST PATROL BOATS (C)

Boat	Length	Beam	Speed, knots	Draft	Crew
Dong Nai	14'1"	6'10"	17-20	10"-26"	2
PBR	30'	12'6"	25	2'5"	4
PCR	35'9"	10'4"	15	3'9"	6
PCF (Swift)	50'	13'5"	>30	3'6"	--
Junks	55'9"	15'9"	6-12	2'6"	10
PTF	80'4"	24'7"	41-45	3'7"	19
WPB	82'	17'	17	5'9"	10
WPB	95'	19'	21	5'	15

(C) Additional information on the new PCF-Mark 1 (Swift) and PBR is given below:

PCF-Mark 1 (Swift)

Displacement – light 32,300 pounds
full load 42,500 pounds

Capacity – fuel 800 gallons
fresh water 60 gallons

Propulsion – twin GM diesel 460 HP per engine
twin propellers 28-in. diameter
30-in. pitch
3 blades

Electrical System 24 volt d-c
115 volt a-c
3 kw

Electronics – one decca (Mod 202) radar
one single side band radio (R.F. 301)

Armament – twin 50-cal machine gun
81 mm/50-cal mortar/machine gun
small arms

Ammunition Storage – 16 Mk 1 Mod 0 boxes
57 rounds of mortar ammunition

Searchlight – Portable Light Company (Model 744)-1

Hull – welded aluminum alloy.

River Patrol Boat (PBR)

Construction – fiber glass-reinforced plastic

Range – 75 nautical miles at top speed

Propulsion – two diesel engines
220 HP; water-jet propulsion

Electrical System – 24 volt d-c

Electronics – Raytheon Model 1900 radar
radio (2-GRC-125)

Armament – twin 50-cal machine gun
single 7.62 mm machine gun
or 81 mm/30-cal mortar gun

Comment from operating personnel in Viet Nam:
"The noise is unbearable".

Slow Patrol Boats

(U) The inventory of current boats contains several which can be used in more than one function. Table B-2 exhibits some boats which can be used for patrol on inland waterways.

TABLE B-2. SLOW PATROL BOATS (C)

Boat	Length	Beam	Speed, knots	Draft	Crew
LCVP	35'9"	10'6"	8	2'8"	4-9
LCPL	35'9"	10'6"	10-19	3'5"	'3
STCAN	36'5"	9'7"	10	3'0"	8
LCM(6)	45'1.5"	14'1"	9	3'10"	5
LCM(8)	73'8"	21'0"	9	5'2"	5

Troop and Cargo Transports

(C) The slow patrol boats listed above can also be used to transport men and material. A list of the applicable boats is shown in Table B-3 below:

TABLE B-3. TROOP AND CARGO TRANSPORTS (C)

Boat	Length	Beam	Speed, knots	Draft	Crew	Capacity Men	Capacity Tons	Range, NM
LCVP	35'9"	10'6"	8	2'8"	4-9	12	4.2	80
LCPL	35'9"	10'6"	10-19	3'5"	3	39	4.2	110
LCPR	36'0"	10'9"	10	3'6"	3	39	4.3	110
LCM(6)	56'1.5"	14'1"	9	3'10"	5	90	34	130
LCM(8)	73'8"	21'0"	9	5'2"	5	200	60	190
LCU	115'0"	34'0"	12	4'0"	13	450	90	165
LCU	118'6"	34'3.5"	7	5'2"	19	500	100	165

Minesweepers

(C) Minesweeping is a critical function in the initial phases of combat operations on inland waterways. The LCVP and LCPL can be rigged with sonar and dragging equipment. However, the present sonar equipment [AN/SQS 37(XN)] does not give sufficient range for speeds in excess of 6 knots, which are required by the tactical situation. Additional in-country craft capability exists with 3-MSC and 12-MSML. Two additional boats shown in Table B-4 can be used in the inland waterways which predominate some of the swamp forest regions.

TABLE B-4. MINESWEEPERS (U)

Boat	Length	Beam	Speed, knots	Draft	Crew	Function
MSL	36'0"	11'7"	10	3'8"	4	Minesweeping
MSB	57'6"	15'6"	10	4'0"	6	Minesweeping

Support Ships

(C) For certain operations in delta areas near the sea, or on large navigable rivers, support ships which can provide command headquarters, helicopter bases, patrol craft tenders, and fire support will be needed. In this environment most of the support ships would come from modified LST and LSD class ships. On some off-shore operations, it

may be advantageous to use destroyers with 5-inch guns and on rare occasions an LPH could be used. Table B-5 shows the most likely candidates for support ships from the presently available types.

TABLE B-5. SUPPORT SHIPS (U)

Boat	Length	Beam	Speed, knots	Draft	Crew
LST	300'	50'	17	17	82
LSM(R)	197'	34'6"	12.6	(15)	138
IFS	245'	39'	15	10	162
DE	306'	37'	21	11	150
DE	306'	37'	24	14	220
LPH	500'	65'	19.5	20	540
LSD	457'	72'	15.4	17	265
ARL			Converted LST		

RVN Water Craft

(S) Since the illustrative areas for the swamp forest warfare study were chosen in the Republic of Viet Nam, the current water-craft equipment available in that country is given in Table B-6 (the Junk Fleet is not included).

TABLE B-6. SHIPS AND BOATS, VNN (S)

Craft	Number	Craft	Number	Craft	Number
PCE	3	LST	3	LCM	66
PC	3	LSSL	2	LCVP	71
PGM	12	LSIL	5	STCAN	46
MSC	3	LSM	7	Vedette	21
MSML	12	LCU	7	Service	16

The composition of the VNN River Assault Groups (RAG) is shown in Table B-7.

TABLE B-7. COMPOSITION OF RIVER ASSAULT GROUPS (S)

Boats	21st	22nd	23rd	24th	25th	26th	27th
LCM (Commandament)	1	1	1	1	1	1	1
LCM (Monitor)	1	1	1	1	1	1	1
LCM (Modified)	5	5	5	3	6	5	4
LCVP (Modified)	6	6	8	4	6	8	8
STCAN	4	4	4	4	4	4	2
Total	17	17	19	13	18	19	16

Air-Support Systems

(C) Aircraft systems are required to provide a balanced force capability in combat operations. In general, these systems add to the capability of a force in each of the five functional areas of intelligence, mobility, firepower, command-control communications, and service and general support. Counterinsurgency operations in swamp forest environments are particularly dependent upon the capabilities which can be provided by an appropriate mix of aircraft systems. These requirements are made explicit in Section III.

Rotary-Wing Aircraft

(C) The general characteristics of rotary-wing aircraft systems are given in Table B-8. Rotary-wing aircraft have been particularly useful in counterinsurgency operations due to their hovering and vertical movement capabilities. Since 1962, their use as weapons platforms has significantly increased in South Vietnam.

Light Fixed-Wing Aircraft

(C) The general characteristics of selected light fixed-wing-aircraft systems are given in Table B-9. The new system of particular interest is the OV-10A multiple-mission light-armed reconnaissance aircraft. At the time of report writing, this aircraft system had not been through acceptance tests. Its design capabilities for mission accomplishment include armed reconnaissance, close support, observation, utility/cargo, medical evacuation (2 litters), troop transport (6 troops), and amphibious operation with pontoons.

Amphibian Vehicles

(C) Although amphibian equipment cannot move through a swamp forest with any great agility, there is a need for amphibians to land troops and cargo from waterways which

TABLE 8-6. GENERAL CHARACTERISTICS - ROTARY WING AIRCRAFT SYSTEMS

Aircraft System	Service Designation	General Type	Operational: Gross Weight, lb	Basic Weight, lb	Useful Load, lb	Payload lb	Fuel Capacity, gal	Fuel C.R. gal/hr	Cruising Speed, kn / mph		Endurance, hr	Crew Per Acft.
OH-13 H	(USA)	Observation-reconnaissance	2,700	1,705	994	400	43	17.2	70	80	2.5	1
OH-13 S	USA(a)	Observation-reconnaissance	2,850	1,918	932	400	43	18	75	86	2.3	1
UH-1B	(USA)	Utility	8,500	4,787	3,713	2,440	165	--	110	127	2.5	2
UH-1D	(USA)	Utility	9,500	5,093	4,407	2,108	220	--	110	127	3	2
UH-1E	USN USMC	Utility	Similar to UH-1B with personnel hoist, rotor brace, and USMC electronics, assault support helicopter									
UH-1F	(USAF)	Utility	Similar to UH-1B with winch, rotor, and other modifications; missile base support									
CH-46A	(USMC)	Medium transport	21,600	11,988	--	9,612	--	--	130	150	--	3
UH-46A	(USN)	Medium transport	Similar to CH-46A but configured for resupply missions from AFS and AOE combat supply ships									
CH-47A	(USA)	Medium transport	33,000	17,313	15,688	10,224	630	280	190	150	2.25	3
OH-23	(USA)	Observation-reconnaissance	2,800	1,914	886	400	46	19.6	78	90	2.35	1
OH-6A	USA USMC	Observation-reconnaissance	2,700	1,080	1,620	400	--	--	119	137	3.0	1
HH-43B	(USAF)	Crash-rescue	--	4,469	3,880	--	200	--	96	110	--	2
HH-43F	(USAF)	Crash-rescue	--	4,620	3,970	--	350	--	96	110	--	2
UH-2A/B	(USN)	Utility	10,200	6,100	4,100	--	476	--	122	132	--	2
CH-34A/C	(USA)	Utility (transport)	13,300	7,788	5,512	3,600	262	106	107	124	2.5	3
UH-34D/E	(USMC)	Utility	Similar to H-34A/C									
SH-34G/J	(USN)	Antisubmarine	Configured for antisubmarine application									
SH-3A	(USN)	Antisubmarine	18,100	11,201	7,799	--	700	--	126	145	--	-
RH-3A	(USN)	Mine-countermeasure	Similar to SH-3A but configured for minesweeping									
CH-3C	(USAF)	Transport	Similar to SH-3A but design changes for cargo handling									
CH-54A	(USA)	Transport	38,000	17,240	--	20,000	880	--	94	109	--	3
CH-53A	(USMC)	Assault transport	38,484	20,960	15,524	8,000	680	--			--	3

(a) Other designations: UH-13 (USAF), TH-13 (USN, USMC).

TABLE 8-8A. GENERAL CHARACTERISTICS - ROTARY WING AIRCRAFT SYSTEMS (C)

Aircraft System	Service Designation	Dimensions: Length (R. Def.), ft-in.	Dimensions: Width (Tread), ft-in.	Dimensions: Height (Ext), ft-in.	Dimensions: Diameter F. Rotor, ft-in.	Dimensions: Diameter R. Rotor, ft-in.	Capacity: Troop Seats Ea.	Capacity: Litter Ea.	Capacity: Ext. Load, lb	Capacity: Cargo Capacity, cu ft	Water Landing Capability
CH-13 H	(USA)	44'8"	8'10"	9'6"	35'3"	5'8"	1	2	--	--	(a)
CH-13 S	(USA)(A)	40'3"	7'6"	12'6"	37'6"	5'10"	1	2	--	--	(a)
UH-1B	(USA)	53'0"	9'4"	12'6"	44'0"	8'6"	7	3	4,000	140	(b)
UH-1D	(USA)	56'3"	8'8"	14'6"	48'0"	8'8"	11	6	4,000	220	(c)
UH-1E	USN USMC										
HH-3F	(USAF)										
CH-46A	(USMC)	--	--	--	--	--	25	--	--	--	(d)
UH-46A	(USN)										(d)
CH-47A		99'0"	11'11"	18'8"	59'5"	59'5"	33	24	12,700	1,488	(d)
CH-21	(USA)	39'4"	7'0"	10'3"	35'5"	5'8"	--	2	--	--	(d)
CH-34A	USA USMC	39'3"	6'3"	8'3"	25'6"	4'3"	8	--	--	38	(d)
HH-43B	(USAF)	--	8'6"	15'6-1/2"	47'0"	--	10	4	--	--	(d)
HH-43F	(USAF)	--	8'6"	15'6-1/2"	47'0"	--	10	4	--	--	(d)
UH-34A/B	(USN)	56'3"	10'10"	15'6"	44'0"	8'0"	11	4	--	--	(d)
CH-34A/C	(USA)	65'10"	12'0"	15'10"	56'0"	8'4"	12-18	8	5,000	372	(d)
UH-34D/R	(USMC)										(d)
SH-34G/J	(USN)										(d)
SH-3A	(USN)	72'9"	13'6"	16'6"	62'0"	10'0"	--	--	6,000	--	(d)
HH-3A	(USN)										(d)
CH-3C	(USAF)										(d)
CH-54A	(USA)	88'6"	19'0"	18'7"	72'0"	15'0"		Interchangeable pod:			(d)
CH-53A	(USMC)	88'1-1/2"	19'0"	18'7"	72'0"	15'0"	38	24	--	--	(d)

(a) Air inflated nylon floats may be attached to the skid gear.
(b) None.
(c) Neoprene impregnated float bags with aluminum skids on undersurface for land operations.
(d) Yes. No additional gear required.
(e) Zip-on pontoons attached above skids.
(f) UH-34E has pontoons for emergency operations.

TABLE 9-8. GENERAL CHARACTERISTICS – LIGHT FIXED-WING-AIRCRAFT SYSTEMS (U)

Aircraft System	General Mission	Dimensions: Length, ft-in.	Dimensions: Height, ft-in.	Dimensions: Wing Span, ft-in.	Weights: Empty lb	Weights: Normal T/O, lb	Weights: Max T/O, lb	Weapon Attachment Points: Total	Weapon Attachment Points: Max Single Point Capacity, lb	Weapon Attachment Points: Total Capacity, lb	Operational: T/O Dist. to 50'[a], ft	Operational: Landing From 50'[a], ft	Operational: Cruising Speed, mph	See Note Below
O-1 (USA, USMC)	Light reconnaissance and observation	25'10"	7'6"	36'0"	1,614	--	2,400	4	250	100-500	550	800	104	(b)
U-6 (USA)	Liaison, light transport, communications	30'4"	9'0"	48'0"	3,000	--	5,100				1,015	1,000	125	(b)
OV-1 (USA)	Observation and surveillance	41'0"	12'8"	48'0"	10,370	13,040	--	10	1,000	4,000	950	790	283	(c)
T-28B	Training - adapted to COIN combat support	36'4"	15'7"	40'7"	6,484	8,004	8,496		See Remarks[e]		1,140	--	310	(d)
OV-10A (USN)	Multiple COIN support missions	39'8"	15'0"	30'0"	5,227	--	11,800	5	1,200	2,400	735	790		(b), (e)
U-10 (USA, USAF)	Light reconnaissance and observation	30'4"	9'10"	39'0"	2,037	--	3,811	--	--	--	475	--	133	(b), (f)

(a) Normal take-off (T/O) weight.
(b) Float landing gear available.
(c) Entries for OV-1C which has infrared surveillance equipment. OV-1D has SLAR.
(d) External ordnance attachment points and automatic weapons.
(e) 4 - 7.62 mm M60C machine guns (or 0.50 cal or 20 mm).
(f) U-10A has 60 gallons fuel capacity; U-10B has 120 gallons capacity.

have muddy bottoms and banks. Table B-10 exhibits some characteristics of selected amphibian vehicles.

TABLE B-10. AMPHIBIAN VEHICLES (U)

Vehicle	Length, inches	Width, inches	Ground Pressure, psi	Weight, lb	Payload, lb	Water Speed, knots
M-114	168	94	4.5	15,100	2,000	N.A.
M-116	182	82	2.4	10,600	3,000	3.5
M-113	191	106	7.3	23,860	3,800	3.0
XM-548	227	106	7.4	24,450	10,000	3.1
XM-571	234	64	2.1	7,700	2,000	1.8
Marsh screw			(See below for detailed discussion)			

(U) The design characteristics of the marsh screw indicates its applicability to the swamp forest environment. These characteristics are exhibited in greater detail than those for Table B-10.

(U) Current Marsh-Screw Prototype (Reference B.1)

Mission. "Economically transport six combat equipped troops plus driver through fresh and salt water, over sandy beaches, rice paddies, swamps, mudbanks, earthworks, logs, and occasionally cross hard surface roads."

Weight, pounds

Vehicle	2335
Driver	175
Fuel and oil	175
Payload	1050
Gross weight	3735

Ground pressure is 0.9 psi at 2-1/2 inches penetration for 3735 pounds

Dimensions

Length, overall	13'8"
Width, overall	8'2"
Height, overall	57"
Rotar spacing	66"
Rotar diameter (drum)	26"
Rotar diameter (helix)	32"
Hull ground clearance	20"

Performance (Maximum Speed-Vehicle Loaded)

Mud	8.7-17.4 knots
Water	6.5 knots
Deep snow	20 mph

Engine

Fuel capacity – 45 gallons
Fuel – gasoline
Net horsepower – 116 hp at 3600 rpm

Second Generation (Planned)

The changed characteristics are as follow:

Weight, pounds		Dimensions	
Payload	2000	Length	17'
Hoiting weight	3500	Beam	9'11"
Gross	5500	Height	4'5"
Ground pressure	1 psi	Rotar diameter	28"
		Blades	4"-5"

Engine

160 hp with 10 hours range at maximum speed

Performance (Maximum speed), knots

Water	13
Mud	21.7
Marsh	17.4

Can be made trailerable and towed at 50 mph.

Weapon Systems

(C) This section is primarily concerned with the ordnance and associated equipment. Although there is a large variety of weapons currently available, the environment places many constraints which hamper their effective use. Terrain and vegetation, weapon platforms characteristics and stability, and environmental deterioration of automatic equipment all lend a hand to the negative slope of the effective curves. On the other hand, the prime targets are limited to personnel; relatively small and unarmored watercrafts; and light facilities for training, small arms and weapons manufacture and repair, medical, communications, and supply. Some weapon emplacements involving 0.50-cal machine guns and 57 or 75-mm recoilless rifles will be encountered. The general characteristics of the swamp forest areas precludes extensive tunneling and other heavier field fortifications. In the majority of combat situations, the ranges are fairly short, but rapid fire becomes a requirement. Situations also occur in which there is not a direct line of sight to the target.

(C) The environment, platform characteristics, and the operational requirements have all been taken into account limiting the equipment listed. The following sections itemize that equipment which can be used even though some of it may need upgrading for greater effectiveness.

Small-Boat Armament

(C) Personnel, light automatic weapon emplacements, and local watercraft targets, short-range fire support, and suppression of ambush-type attacks are the principal firepower requirements of patrol, minesweeping, and transport boats. The weapons for this purpose, which can be mounted on the boats under discussion, may be summarized into (1) machine guns, (2) grenade launchers, and (3) mortars. It will be assumed that personnel will also be equipped with appropriate small arms.

(C) The characteristics of applicable ordnance in these armament categories are shown in Tables B-11 through B-13.

TABLE B-11. MACHINE GUNS (U)

Weapon	Weight, lb	Length, in	Vo, ft/sec	Rate of Fire, rd/min			Range, meters	
				Max	Effec	Sus	Max	Effec
5.56 mm	12	31	3,185	750	250	100	2,700	1,000
7.62 mm	23.8	43.1	2,750	650	200	100	3,900	1,100
0.50 cal M85	65	54.5	2,835	950	100	40	6,800	1,800
22 mm MK10	150	--	2,730	--	450	--	4,400	--
40 mm MK3	271	--	2,800	--	120	--	9,950	--

TABLE B-12. GRENADE LAUNCHERS (U)

Weapon	Weight, lb	Action	Dispersion, mils	Rate (Max), rd/min	Range, meters	
					Max	Min
40-mm M79	6.2	Top lever opening	5.30	6	400	30
40-mm How	19	Hand crank	5	250	400	30
40-mm XM129	40	Electric	5	250	2,200	30

TABLE B-13. MORTARS (S)

Weapon	Weight, lb	Dispersion, mils	Ammo. Weight, lb	Rate, rd/min Max	Rate, rd/min Sus	Range, meters Max	Range, meters Min
60-mm M2	42	13	3.2	35	18	1,810	46
81-mm M29	93.5	12	9.1	24	2	3,650	275
81-mm MK2	580	12	9.1	24	2	3,650	275

Large-Boat Armament

(C) The same armament as listed for small watercraft can of course be used on the larger boats. In addition, these boats can use heavier equipment such as recoilless rifles, mine projectors, rockets, flame throwers, and manual guns. The characteristics of this ordnance are given in Table B-14.

TABLE B-14. HEAVY ORDNANCE (S)

Weapon	Weight, lb Weapon	Weight, lb Ammo.	Rate, rd/min Max	Rate, rd/min Sus	Range, meters Max.	Range, meters Min.
Recoilless Rifles						
57-mm M18	44.4	5.6	6	2	4,500	23
75-mm M20	144	22.37	3	1	6,400	30
90-mm M67	35	9.25	10	1	2,300	30
106-mm M40	275	37.0	1	1	7,700	30
Mk6 Mod 2 - Mk7 Mod 4 Projector						
K gun	328	519	1	1	100	45
Rocket Launcher						
3.5-in. M20	15	8.5	12	4	880	180
66-mm M72	4.2	2.3	1	1	1,000	
Flame Throwers						
M8	14	12	4 sec		45-60	
E32RE	24	26	5-6 sec		45-55	

(C) Naval guns (3 and 5 inches) can be used for fire support. The difficulty in a swamp environment is the shallow water which extends a considerable distance from the shoreline. However, these guns can be mounted on the destroyers, inshore fire support ships, and the LSM(R) shown in Table B-5 of the support ships section.

Rotary-Wing-Aircraft Armament

(C) The weapon subsystems currently available which appear the most applicable for consideration in swamp warfare are shown in Table B-15. The principal application of most of these systems to date has been on the UH-1 series aircraft since they have been used the most as an armed helicopter in South Vietnam.

TABLE B-15. ROTARY-WING-AIRCRAFT ARMAMENT (S)

Designation	Weapon(s)	Total Subsystem Weight, lb	Firing Rate
M-6	2 pr - 7.62-mm MG's	822	550 Rd/min/gun
M-16	2 pr - 7.62-mm MG's 7 pr - 2.75-in. FFAR	1,250	550 Rd/min/gun 6 pr/sec
M-2	2 - 7.62-mm MG's	211	550 Rd/min/gun
M-3	24 pr - 2.75-in. FFAR	856	6 pr/sec
M-5	M-75, 40-mm G. L.	--	100-300 rpm
CBU-14B Dispenser	BLU-3/B fragmentation bombs	--	--

Fixed Wing Aircraft Armament

(C) The weapon subsystems which are applicable for consideration in swamp warfare are shown in Table B-16. See Section V for additional comments.

TABLE B-16. FIXED-WING-AIRCRAFT ARMAMENT (9)

Weapon	Weight, lb	Characteristic	Lethal Area ft^2/lb(a) Standing	Prone	Dug In	Reference
		Guns				
7.62 mm	325	6,000 rpm	14	9	--	B.
0.50 cal	465	1,200 rpm	7.25	4.8	--	B.
20 mm	--	6,000 rpm	--	16.8	-	
40 mm	282	240 rpm	186	74	10	B.2
		Rockets				
2.75"	21		242	8.9	--	B.3
2.75" (101B)	21	12,000 Flechettes	660	660	-	B.3
5" HVAR	25	Zuni air burst	480	480	2	B.4
		Flechette				
Lazy Dog Gladeye	1646	600,000 rpm	97	24	--	B-5, B-6
Lazy Dog Sadeye	1180	Opening at 1800 ft	24	97	97	B.
		Fire Bombs				
FAX	80	Fuel air explosive	25	--	10	B.7
Napalm BLU-1/B	700	Area 265' x 85'	21	21	21	B.8
		Bombs				
BLU 20/B23	617	Incapacitation agent	3000+	3000+	3000+	B.8
M 117	750	Surface burst	30	16	0.4	B.9
M 117	750	Air burst	24.6	160	15	B.3
Mk 81	250	Surface burst	60	30	1.2	B.10
Mk 41	20	Fragmentation	144-434	45-135	--	B.10

(a) 50 percent casualty.

[redacted]

APPENDIX C

POTABLE-WATER DENIAL

[redacted]

APPENDIX C

POTABLE-WATER DENIAL

(C) A major objective in any war is that of denying the enemy the resources with which to continue his activities. The swamp forests which are in close proximity to saline water create an environment which places a premium on potable water. The denial of potable water, especially during the dry season, is an effective operation in swamp forest warfare. This appendix is devoted to a brief discussion of water denial.

Man's Water Requirements

(C) In a temperate climate an average adult requires about 2.5 liters of water daily of which about 1.2 liters may be in liquids (Reference C-1). The remainder is obtained from water in solid foods and from oxidation. Even under conditions of fasting about 0.8 liter must be taken in liquid form and as much again obtained from oxidation and release of cellular water. Under extreme conditions of heat the amount of water lost by the body, and hence the amount which must be taken in, will be greatly increased. Survival in desert conditions has been estimated to be 10 days at 70 F, 5 days at 100 F, and 2 days at 120 F when all water intake is stopped. The requirement for water will be drastically increased by any insult to the body which causes sweating, vomiting, diarrhea, or polyuria. As much as 14 liters may be lost daily in sweat and urine and another 8 liters from the gastrointestinal tract.

(C) Using the value of 2.5 liters daily as a very conservative level of requirements for a man in the tropics, we can calculate that each individual requires 20 gallons over the period of a month. For a force of 100 men the necessary 2,000 gallons of water may become a critical item of supply.

Denial of Water Supply

(S) There are three ways by which the water supply can be controlled: source denial, storage destruction, and water contamination. To achieve source denial it is necessary to maintain physical control of the source, as by a permanent military guard at wells or ponds, or to render the source unusable as by filling in wells. Storage destruction requires the demolition of tanks, dams, dikes, or whatever containers are used for the water. Water contamination requires the addition of something to the water which will make it unpotable.

(S) In the swamp forest areas the chief supply of water is from the entrapment of rain water, the importation of water, or both. At the present time control of the rain by forcing clouds to drop their moisture outside of the operational area is not feasible. Denial of rain source water must come from operations against the collection and storage facilities. Denial of imported water can be obtained by interdiction of the importation routes and by action against the storage facilities.

(C) The remainder of this appendix is an investigation of methods for water denial and for offensive action through the water supply by means of chemical contaminants.

Chemical Contamination of Water

(U) The addition of chemical contaminants to water is difficult to obscure because of the taste of many chemicals. However, this fact can be turned to good advantage by deliberately selecting chemicals which have a strong unpleasant odor or taste. The prospective drinker is then repelled by the water. Other additives can be included to produce physiological effects in any who can ignore the bad odor or taste.

Selection of Chemicals

(U) The Miller Research Corporation conducted a search (Reference C-2) for chemicals which would render grain inedible by odor to taste or which would have physiological effects on anyone eating them. The list of candidate chemicals which they compiled was searched for possible materials in the present application, and three materials appear to have application in the water-denial problem. Their properties are shown in Table C-1.

TABLE C-1. PROPERTIES OF THREE POSSIBLE WATER CONTAMINANTS (C)

	BeDAB	Barium Chloride	Carbachol
Effect:	Bitter taste	Cathautic, vomiting, hallucinations	Cramps, hypertension
Medical dose:	10 mg	20 to 30 mg	0.6 mg 0.2 to 0.8 mg
Lethal dose:	820 mg/kg (rats)	0.8 g has been fatal 90 mg/kg	100 mg fatal in less than 3 hours
Color:	Light brown	Colorless crystals	White
Odor:	(Unknown)	(Unknown)	Odorless
Taste:	Extremely bitter	(Unknown)	(Unknown)
Solubility:	1 g/4 ml	1 g/2.8 ml	1 g/1 ml

(S) The first of the three, BeDAB (Benzyl Diethyl Ammonium Benzoate), would be used to impart a bitter taste to the water. Tests by the Miller Research Corporation showed that 0.10 gram per 200 grams of rice made the rice completely inedible. This is a ratio of one part in 20,000. Since BeDAB is detectable in water at one part in 500,000 it seems reasonable to assume that water will be undrinkable at the same ratio as that which made the rice inedible. This will be a concentration of 25 times the detectable concentration. If this is true then it would require only 9 milliliters (0.32 fluid oz) to make 50 gallons of water undrinkable.

(S) Barium chloride when administered in doses of about 25 mg is a cathartic. At higher doses it causes vomiting and hallucinations. The lethal dose is not as far from the effective dose as it is for the other two materials and for this reason there is a higher risk in its use. Safety factors and the attendant risks will be considered in a later section.

(S) Carbachol produces cramps and hypertension. It has a very low effective dose, very desirable here, and a lethal dose which is well above.

(S) Odors can be used to discourage the use of water. Many chemical compounds are extremely odiferous in small amounts, are water soluble and are available commercially. Among the three given in the following paragraphs, one is a gas (hydrogen sulfide), and one, the mercaptans, includes a whole family of compounds, all odiferous.

Hydrogen Sulfide (H_2S)

(S) Hydrogen sulfide is a gas at ordinary temperatures. It is evolved as a waste product in a variety of chemical processes. Its industrial importance lies mainly in its dangerous properties and disagreeable odor.

(S) When exposed to low concentrations of the gas, local irritation of the eyes, nose, and throat ensues. A concentration of 200 parts per million is sufficient to cause symptoms in man. Exposure to 1000 parts per million is rapidly fatal.

(S) Hydrogen sulfide is soluble in water to the extent of 437 ml in 100 ml of cold water, 186 cm^3 in 100 ml at 40 C. Amounts far less than this would make the water very unpleasant to drink. The water could be made potable again by the addition of any of the metallic salts.

Pyridine (C_5H_5N)

(S) Pyridine is a practically colorless liquid having a sharp penetrating odor. It is available commercially and is used in the manufacture of vitamins, sulfa drugs, rubber, and water repellants.

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(U) The immediate effects of inhalation of pyridine in man are flushing of the face, quickening of the pulse and respiration, temporal headache, giddiness, nausea, vomiting, and nervousness. Its toxicity is, however, not very great and a 10 percent solution has been used medicinally in the treatment of asthma. When ingested in large amounts it affects the central nervous system and tends to produce dyspnea and shallow respiration. Large doses act as a heart poison.

(U) Although pyridine has toxic effects when administered in large doses, it should be regarded here as nontoxic. The dilution resulting from addition of pyridine to a water container under field conditions would probably be too low to induce marked toxic effects. Its principal function would be to make water unpalatable because of its odor. The amount of pyridine which it would be necessary to add to a given amount of water in order to make it unpalatable is not known.

Mercaptans

(U) The contamination of water by dispersion of chemicals throughout the volume of the water may prove to be impractical because of the weight of the material which must be added to do an effective job. A more efficient method may result through the use of surface-covering chemicals. Certain alcohols of high molecular weight are used to prevent surface evaporation from large bodies of water. These materials have fairly long molecules, one end of which is hydrophillic and the other is hydrophobic. The molecule thus floats upright on the surface of the water and forms a unimolecular layer. If one of the stronger swelling mercaptans were mixed with the alcohol, it would float on the surface formed by the alcohol and form an extremely odiferous barrier. The barrier thus formed would be nontoxic but would make the water extremely unpleasant to drink, if not impossible. This possibility needs more investigation since the thin layer of mercaptan might be subject to breakdown by ultraviolet light.

(U) Chemical contaminants can also be used as psychological weapons. Pyridium has been suggested (Reference C-2) as an additive to grain contaminants. The effect of pyridium is to turn the urine a bright red. It is nontoxic and is effective in small doses, less than 5 milligrams. Its disadvantages as a water contaminant are that it is not very soluble and that the crystals are a bright red. Water in which the crystals were dissolved would be tinted and, therefore, anyone drinking it would not be too surprised when the urine turned red.

(U) A better psychological weapon would be disodium phenotetrabromophthalein sulfonate (BSP). This drug is used medically in liver "clearance" tests. When ingested it is said to color urine bright red to an intense bluish purple. BSP has a faintly acid taste (Reference C-3) and is relatively colorless. It is not known at this time whether an effective dose can be obtained at levels where the taste and color of the water solution will not be noticeable. If so, this would be a very effective psychological weapon.

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Delivery of Materials

(S) To gain an idea of the amounts of the various materials which would be necessary for a patrol to carry, let

D be the dose to be administered, milligrams

V be the volume of the contaminated water, gallons

S be the sample of water taken from the total volume, in which the dose is administered, fluid ounces

U be the unit amount of contaminating material added to the total volume, milligrams

then the contaminant concentration is U/V and since $D = \frac{US}{V}$

$$U = 128 \frac{DV}{S} .$$

(S) As an example suppose that the water container holds 50 gallons (V = 50) and it is assumed that the dose is to be given in an 8-ounce drink (S = 8). Then U = 800D. A good strong dose of Carbachol is to be given, D = 1.6 mg (double the medical dose). Then U = 1280 mg. This is the amount which must be added to 50 gallons of water to assure a dose of 1.6 mg. At this rate only 0.28 pounds of material are needed to effectively contaminate 150-gallon containers.

(S) Effective amounts of BeDAB could be included with Carbachol to impart a bitter taste to the water and combined in water-soluble capsules. These could be dispensed in the same way as discussed for the biological materials.

(S) Gases can be transported in pressurized containers equipped with a nozzle. The nozzle must be of a type which will release the gas in small bubbles, otherwise the gas will rise to the surface without being absorbed by the water. As an aid in preventing the water near the nozzle from being saturated with the gas, it may be necessary to have the gas dispensed through a length of tubing having many small perforations.

(S) Ordinary aerosol-type cans are not suitable for transporting the gas. They are ordinarily pressurized to about 70 psi, which is too low to hold enough gas for this purpose.

(S) Laboratory bottles of hydrogen sulfide are marketed by the Matheson Company in a 15 x 2-inch size. Their gross weight is 4 pounds and the container weight is 8 ounces. The weight of the container gas is 3.5 pounds. Since H_2S has a specific volume of 11.1 cu ft/lb at 70 F, the volume which the gas will occupy at one atmosphere of pressure and a temperature of 70 F is 11.1 x 3.5 = 38.85 cubic feet. One volume of

water will dissolve 2.9 volumes of H_2S at that temperature so the gas in one bottle will saturate 38.85/2.9 = 13.4 cubic feet, or 100 gallons of water. At this concentration the water would be lethal but it would smell so bad that it would not be possible to drink it.

(S) At the other end of the range, the odor of H_2S in air is detectable when the concentration is as low as one part in 7×10^5. If we arbitrarily assume that water containing dissolved H_2S becomes undrinkable at the concentration which would cause irritation in air (1 part in 5000) then one bottle of the gas is sufficient to render about 145×10^4 gallons of water undrinkable. This is equivalent to about 4.5 acre-feet of water.

(S) The principal disadvantage in using gases to contaminate water is the weight of the container. The best prospective use of gas contaminants is against very large volumes of water and using a gas bottle equipped with a slow dispensing nozzle.

Biological Contamination of Water

(S) Biological materials have a long history of disease resulting from the contamination of pure water. That the results of such contamination can be very serious was demonstrated in the 1933 Chicago epidemic of amoebic dysentery in which 1,409 people were infected and 98 died (Reference C-4) when waste water got into the drinking-water supply. In 1943 harbor water was accidentally introduced into the drinking water on a ship in a West Coast shipyard and 1,719 became ill (Reference C-4).

(S) Biological contamination of water can easily be accomplished. A number of agents have been investigated and various methods of delivery are available. However, a general discussion of this method of water denial has a higher classification than this report.

APPENDIX D

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APPENDIX D

REFERENCES AND BIBLIOGRAPHY

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13. ABSTRACT

Applicable weapon systems, general operational concepts, and associated problems and requirements of combat operation in the swamp forest areas of South Viet Nam are studied. There are discussions on the physical characteristics of the swamp forest areas with emphasis on the Mekong Delta and the Ca Mau Peninsula; threats and potentials of swamp forest warfare; United States inventory of weapons systems applicable to swamp forest warfare; and the state of the technical art in the areas of swamp forest weaponry. Also discussed are the preferred weaponry inventories for swamp warfare, preferred operational concepts for this weaponry, and the research and development required to improve current capabilities. The effect of denying potable water on enemy efficiency in saline swamp forest areas is also considered.

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