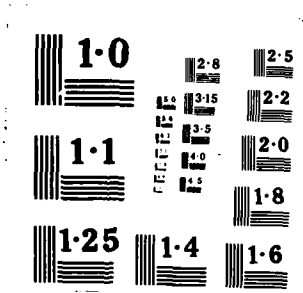
AD-A167 529 UNDERWATER FACILITIES INSPECTIONS AND ASSESSMENTS AT EXPLOSIVE HANDLING M... (U) MITRE CORP MCLEAN VA JASON PROGRAM OFFICE JUN 81 CNES/NAVFAC-FPO-1-82(81) 1/1

UNCLASSIFIED N62477-80-C-0233 F/G 13/2 NL

END
DATE FILMED
6-86
DTIC


1·0
1·1
1·25
2·8
3·15
3·5
4·0
4·5
1·4
2·5
2·2
2·0
1·8
1·6

UNDERWATER FACILITIES
INSPECTIONS
AND
ASSESSMENTS
AT

EXPLOSIVE HANDLING WHARF 1

STRATEGIC WEAPONS FACILITY PACIFIC

BANGOR, WASHINGTON

FPO-1-82 (01) JUNE, 1981

Performed for:
OCEAN ENGINEERING AND CONSTRUCTION PROJECT OFFICE
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D. C. 20374

Under:
CONTRACT N62477-80-C-0233 - Task #5

By: WISWELL, INC.
3280 POST ROAD
SOUTHPORT, CONNECTICUT 06490

ADA 167529

Unclassified
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION AVAILABILITY OF REP. Approved for public release; distribution is unlimited
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER	5. MONITORING ORGANIZATION REPORT # FPO-1-82(1)
6a. NAME OF PERFORM. ORG. 6b. OFFICE SYM Wiswell, Inc.	7a. NAME OF MONITORING ORGANIZATION Ocean Engineering & Construction Project Office CHESNAVFACENGCOM
6c. ADDRESS (City, State, and Zip Code) 3280 Post Road Southport, CT 06490	7b. ADDRESS (City, State, and Zip) BLDG. 212, Washington Navy Yard Washington, D.C. 20374-2121
8a. NAME OF FUNDING ORG. 8b. OFFICE SYM	9. PROCUREMENT INSTRUMENT INDENT # N62477-80-C-0233, Task 5
8c. ADDRESS (City, State & Zip)	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT # / PROJECT # / TASK # / WORK UNIT ACCESS #

11. TITLE (Including Security Classification)
Underwater Facilities Inspections & Assessments at Explosive Handling Wharf 1 Strategic Weapons Facility Pacific Bangor, Washington

12. PERSONAL AUTHOR(S)

13a. TYPE OF REPORT	13b. TIME COVERED FROM	TO	14. DATE OF REP. (YYMMDD)	15. PAGES
			81-06	63

16. SUPPLEMENTARY NOTATION

17. COSATI CODES FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS (Continue on reverse if nec.)
Explosive Handling Wharf 1, Strategic Weapons Facility Pacific, Bangor, WA
Underwater inspection, Mooring inspection

19. ABSTRACT (Continue on reverse if necessary & identify by block number)
The major objective of the underwater facility assessments conducted at Strategic Weapons Facility, Pacific (SWFPAC), Naval Submarine Base Bangor in Bangor, Washington, was to assess the general underwater structural condition of Explosive Handling Wharf. Also, for describing potentially (Con't)

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT SAME AS RPT.	21. ABSTRACT SECURITY CLASSIFICATION
22a. NAME OF RESPONSIBLE INDIVIDUAL Jacqueline B. Riley	22b. TELEPHONE 22c. OFFICE SYMBOL 202-433-3881

DD FORM 1473, 84MAR

SECURITY CLASSIFICATION OF THIS PAGE

BLOCK 19 (Con't)

deleterious conditions affecting the structure such as marine biofouling, corrosion, deficiencies in coatings, grouting, and cathodic protections, etc. This data will enable comparisons to be made in subsequent periodic inspections so as to determine progressive deterioration with time.

Explosive Handling Wharf EHW-1 was inspected in this survey. Critical conditions discovered during the survey were documented by photographs. In addition, photographs representative of marine growth on the concrete piles were secured.

The inspection of this facility revealed that piles supporting the Wharf do not show signs of any severe cracking, spalling, or other serious damage or deterioration. The inspection did reveal that one concrete pile had exposed reinforcing steel. Many concrete piles were found to have rust marks where the lifting rings were removed and coated with epoxy.

Other than the deficiencies listed above, the facility was found to be in a condition predictable for the environment and age of the facilities.

FOREWORD

The scope of the underwater inspection of the Explosive Handling Wharf, EHW-1, Bangor, Washington, and the detail to which it was performed and reported was tailored specifically to the conditions at this facility. This report and the procedure associated with its formation are not intended to be standards for inspections or reports covering other activities. Attempts are being made, however, toward establishing standards for procedures and formats for inspection and assessment reports. Through these standards, inspections performed by different persons, on many facilities and under a wide range of conditions can be effectively compared. It is expected that the inspection and assessment of the Explosive Handling Wharf, EHW-1, like previous operations mandated under the underwater portion of the Specialized Inspection Program, will contribute significantly toward achieving that objective.

It should be noted that the choice of the level of inspection and the procedural detail to be employed will be an engineering judgement made separately for each activity/facility to suit its unique situation and needs. Accordingly, the procedures used at the EHW-1, rather than serve as a detailed model for inspections elsewhere, will provide guidance with general applicability to future inspections.

EXECUTIVE SUMMARY

The major objective of the underwater facility assessments conducted at Strategic Weapons Facility, Pacific (SWFPAC), Naval Submarine Base Bangor in Bangor, Washington, was to assess the general underwater structural condition of Explosive Handling Wharf. Also, for use in the long range foster facility study, data was recorded describing potentially deleterious conditions affecting the structure such as marine biofouling, corrosion, deficiencies in coatings, grouting, and cathodic protection, etc. This data will enable comparisons to be made in subsequent periodic inspections so as to determine progressive deterioration with time.

Explosive Handling Wharf EHW-1 was inspected in this survey. Critical conditions discovered during the survey were documented by photographs. In addition, photographs representative of marine growth on the concrete piles were secured.

The inspection of this facility revealed that piles supporting the Wharf do not show signs of any severe cracking, spalling, or other serious damage or deterioration. The inspection did reveal that one concrete pile had exposed reinforcing steel. Additionally, a few piles were found to have exposed reinforcing steel. Many concrete piles were found to have rust marks where the lifting rings were removed and coated with epoxy.

Other than the deficiencies listed above, the facility was found to be in a condition predictable for the environment and age of the facilities. Refer to the following Executive Summary Table for an overview of the facility's construction, recommended repairs and estimated cost of repairs.

STRATEGIC WEAPONS FACILITY PACIFIC

BANGOR, WASHINGTON

EXECUTIVE SUMMARY TABLE

Facility	Year Built or Modified	No. of Vertical Bearing Piles	No. of Batter Piles	Facility Size	Structure	Recommendations
Explosive Handling Wharf 1 (EHW-1)	1975	297	561	Main Wharf - 640' x 70' plus outboard support 30' x 605', North Approach Trestle 34' x 560', South Approach 34' x 420', and Fragmentation Barrier	24" and 16-1/2" octagonal concrete piles	Repair spalled area on one pile with epoxy grout. Re-inspect wharf in seven years.

STRATEGIC WEAPONS FACILITY PACIFIC

BANGOR, WASHINGTON

EXECUTIVE SUMMARY TABLE

No. of Batter Piles	Facility Size	Structure	Recommendations	Est. Cost of Recommendations
561	Main Wharf - 640' x 70' plus outboard support 30' x 605', North Approach Trestle 34' x 560', South Approach 34' x 420', and Fragmentation Barrier	24" and 16-1/2" octagonal concrete piles	Repair spalled area on one pile with epoxy grout. Re-inspect wharf in seven years.	$700.00

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF PHOTOGRAPHS

LIST OF PHOTOGRAPHS CONT'D.

SECTION 1 INTRODUCTION

This report is a product of the underwater inspection program conducted by the Ocean Engineering & Construction Project Office (FPO-1), Chesapeake Division, Naval Facilities Engineering Command (NAVFACENGCOM) under NAVFAC'S Specialized Inspection Program.

This report specifically addresses below water conditions of the Explosive Handling Wharf EHW-1 at the Strategic Weapons Facility, Pacific (SWFPAC), U. S. Naval Submarine Base, Bangor, Washington. The purpose of this program is to sponsor in-depth study, base-line assessment, and structural analysis of the underwater portions of selected Naval waterfront facilities. All services required to produce this report were provided by Wiswell, Inc. under Contract No. N62477-80-C-0233, Task No. 5.

1.1 TASK DESCRIPTION

The scope of work for this portion of the program required the inspection of the underwater portion of the Explosive Handling Wharf EHW-1, at the Strategic Weapons Facility, Pacific (SWFPAC) at the U. S. Naval Submarine Base Bangor in Bangor, Washington. The quality of the inspection had to be sufficient to provide an adequate general structural assessment of the facilities and to identify areas of sufficient damage and/or deterioration to warrant downrating the structure's capacity, immediate repair, or future, more detailed investigations.

This inspection is part of a new, long range "foster facility study" of underwater structural deterioration and damage. The objective of this study is to establish the "as built" condition of these relatively new structures as a baseline for the subsequent detection of long range degrading influences and the

documentation of the effectiveness of protective measures, repairs, and maintenance. This future tracking of damage and deterioration, and of repair response, required that this inspection should document various conditions potentially conducive to structural degradation so as to form a basis for future reference.

1.2 REPORT CONTENT

The report contains a description of inspection procedures, the results of the inspection and analysis of the findings, accompanied by pertinent drawings and photographs. Specifically, the inspection results include a description of the location, construction and function of each facility examined, its observed condition and a structural assessment of that condition. Recommendations for each facility, including cost estimates for any repair work, are also included. Structural assessment calculations and cost estimate breakdowns can be found in the Appendix. Also, as supplementary information, a brief description of the Naval Submarine Base is provided to define its location, mission, history, existing facilities, climate and other pertinent data.

SECTION 2.0 ACTIVITY DESCRIPTION

The purpose of this section is to provide a general description of the Naval Submarine Base in Bangor, Washington. Included in this section will be brief discussions on the Naval Submarine Base's location, mission, history, existing facilities, climatological and meteorological data, and hydrology. This information is provided to supplement the later sections of this report and to support all considerations necessary to accurately assess the structural condition of the facility inspected in this survey.

2.1 LOCATION OF ACTIVITY

Naval Submarine Base Bangor is located on Kitsap Peninsula in Puget Sound, due west of Seattle, Washington. The site is rural in nature, situated on the eastern shore of the Hood Canal. Bremerton, the site of the Puget Sound Naval Shipyard, is 13 miles to the south of Naval Submarine Base Bangor. See figures 1 and 2.

2.2 MISSION OF ACTIVITY

The functions of the Naval Submarine Base Bangor are to provide special maintenance and supply support for the Trident system, including the major tasks of:

1) Ship refit. This function performs resupply, refit and repair operations. The refit facilities include shops, storage, staging and management center, dry-dock, and two refit berths.
2) Missile support. This function, The Strategic Weapons Facility, Pacific (SWFPAC) includes explosive handling wharves, storage facilities for the missiles and the production and assembly facilities. These facilities are similar in capacity to the Polaris missile facilities located at the present Polaris Missile Facility, Pacific, (POMFPAC).
3) Site support. This function, the Trident Support Facility, (TSF) provides the necessary phyical security,

Figure 1 Location Map - Regional

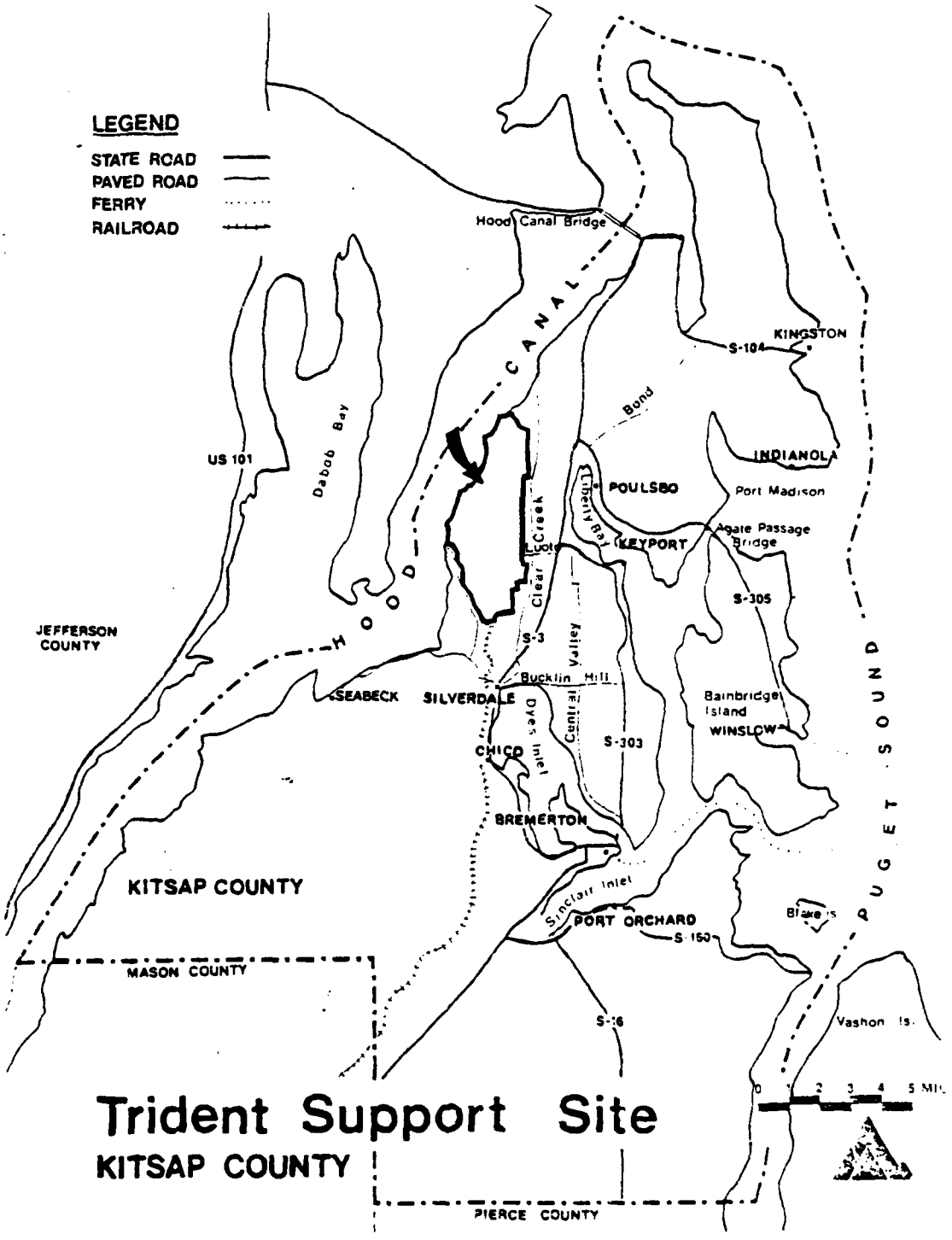


Figure 2 Location Map - Vicinity

administration, public works, housing, and other community and personnel support services and facilities required to maintain the site.

4) Training personnel support. The Trident Training Facility (TRITRAFAC) provides basic courses and refresher training for personnel to initiate and maintain professional skills necessary for operation of this system.

2.3 HISTORY OF FACILITY

Bangor Annex was originally known as the U. S. Naval Magazine facility, established between 1944 and 1945, as the Pacific coast trans-shipment point for ammunition and explosives. In 1950, the Bangor Annex was consolidated with NTS, Keyport, to form the U. S. Naval Ordnance Depot, Puget Sound, Keyport, Washington. In April, 1952, the two activities were returned to independent status. The Bangor Annex was then titled the Naval Ammunition Depot (NAD), Bangor. In 1962, the Secretary of the Navy selected NAD, Bangor as the proposed site for the Polaris facilities to service the Pacific fleet. The Polaris Missile Facility, Pacific (POMFPAC) was established as a tenant of NAD, Bangor, in September, 1963 and went into full operation in December, 1964. In October, 1970, NAD, Bangor, was placed in inactive status and again made the annex of NTS, Keyport. In 1972 it was assigned an ordnance trans-shipment mission in support of southeast Asia operations.

The Bangor Annex consists of over 8500 acres. The major land uses consist of an Administrative and Personnel support area, a family housing area, industrial and production facilities, various type of magazines and barricaded sidings, Marginal Wharf, out-loading facilities, the Polaris Missile Facility, Pacific, and a number of tenant activities.

2.4 EXISTING ACTIVITIES

The Naval Submarine Base Bangor is the homeport of the

Trident system in the Pacific areas. At present the base services and supports the Polaris Missile system while awaiting Trident.

The waterfront facilities of this activity provide the interface between the submarines and the shore support activity. Five functional areas are required, i.e, 1) Refit, 2) Explosive handling, 3) Deperming/Degaussing, 4) Service, and 5) Marginal Wharf. The first three are program requirements for Trident Support Facilities. The fourth is a facility for NTS, Keyport, which replaces similar facilities displaced by Trident. The fifth is the existing Marginal Wharf, with a reduced mission Polaris missile loading and off-loading.

The Explosive Handling area provides missile loading and off-loading capability and operates as the interface between the submarine and the Strategic Weapons Facility, Pacific (SWFPAC). Two Explosive Handling Wharves (EHW) are required for the 10-ship program and one additional EHW is required for the 20-ship program. Each wharf will be covered, allowing loading and off-loading of missiles and other ordnance in any weather.

2.5 CLIMATOLOGICAL & METEOROLOGICAL DATA

Climatic conditions at the Naval Submarine Station Bangor are representative of the Kitsap Peninsula with short, cool, dry summers and mild, wet winters. Conditions are dependent upon the Pacific high and the flow of moisture-laden air which accompanies winter storms from the southwest. Annual precipitation, within a 30-mile radius of Subase Bangor, varies from 30 to 70 inches. Approximately 75 to 80 percent of annual rainfall occurs from October through March. Temperatures above 100° F. and below 0° F. are uncommon. The Kitsap Peninsula and Hood Canal areas are susceptible to slightly higher winds than other areas of the Puget Sound lowlands. For design purposes, the Bremerton figure of 38.66" of annual rainfall has been assumed for Subase Bangor.

2.6 TOPOGRAPHY

The Hood Canal shore of Subase Bangor is for the most part erosional with steep wave-cut slopes rising to more than 100' above sea level. The sea-shore environment is characterized by slow erosion of the cliff and the deposition of the erosional debris (silts and sands) from the streams to the off-shore deltas. The sea bottom slopes uniformly down twoard the depths of the Hood Canal, generally at a slope of about one in ten. This slope is found to be steeper in front of the Marginal Wharf and outside other spits but flatter in the bay, between the Small Craft Pier and Marginal Wharf.

2.7 SOIL CONDITIONS AND HYDROLOGY

A major portion of the Subase Bangor area is covered with glacial till, a dense gravel-sand-silt mixture deposited and compressed by the weight of the glacial ice. The till is relatively impermeable. The thickness of the glacial till varies from 0 to more than 40', the thickest being in the southern portion of the annex. Older gravel deposits were found outcropping beneath the silt in the vicinity of Marginal Wharf. These older gravels were found to be very dense and where exposed, are generally weathered with layers up to 10' thick of hard silt and clay containing organic zones. Off shore, along the Subase Bangor shoreline, the sea floor is covered with loose to medium dense granular materials of varying depth. At some locations a wedge of till follows, thickening towards the center of the canal.

In the off shore area, artesian conditions occur in areas where silt strata exist. Presumably, water seeping towards the canal in these areas is trapped beneath the silt hence high water pressures can build up under silt layers whenever the distance to the nearest sea floor seepage outlet is more than several

hundred feet. The existance, at several locations, of relatively impermeable till above appears to increase this artesian pressure. There is a balance of water recharge, slowly seeping to the upland hills into the underlying sands, and water seepage from these sands into Hood Canal. The balance is maintained by a head of water corresponding to the inland water table level, driving the ground water slowly into the canal through the soils. This seepage is quite irregular along the shoreline.

Tide level data for this facility is as follows:

Extreme High Water	(EHW)	Elev. + 8.7
Mean Higher High Water	(MHHW)	Elev. + 5.0
Mean Sea Level	(MSL)	Elev. + 0.00
Mean Lower Low Water	(MLLW)	Elev. - 6.7
Extreme Low Water	(ELW)	Elev. - 11.1

SECTION 3 INSPECTION PROCEDURE

3.1 Level of Inspection

From May 26, 1981 through June 5, 1981, an inspection team consisting of one engineer/diver and three inspection divers performed a Level one underwater inspection of the Explosive Handling Wharf #1, EHW-1, at the Strategic Weapons Facility, Pacific (SWFPAC) at the Naval Submarine Base in Bangor, Washington.

Level I underwater inspections of varied scope assess the general condition of a structure utilizing visual/tactile inspection techniques. In an open-type structure, this evaluation generally consists of a close inspection of the majority of the exterior vertical and batter piling and some percentage of the interior piling, as well as a superficial check of all remaining piles. For bulkhead-type structures, visual/tactile observations of the structure's condition at mudline, mid-depth, and splash zone levels are performed. This level of inspection is designed to give a general condition assessment of the structure and should identify any areas that have been mechanically damaged or are in advanced states of deterioration. Documentation (utilizing underwater photography and/or television) and limited physical measurements are provided for verification of the findings.

Level II underwater inspections quantify the structural condition of the facility through definitive engineering-data-measurement techniques. This type of inspection is required in cases where engineering evaluation, structural analysis, and design of repairs are required. Level II inspections normally include visual documentation using underwater television and/or photography and ultrasonic testing techniques. Physical measurements, as outlined in Level I inspections are included, as well as additional measurements of pertinent areas of deterioration or damage.

3.2 Inspection Procedure

Past experience, combined with engineering theory, the level of inspection to be performed, the type of structure being inspected, and the actual on-site conditions dictated the inspection procedures to be used.

The task description called for the inspection of all concrete pilings under the Explosive Handling Wharf #1 (EHW-1), the trestle approaches, and the radio tower adjacent to it. Fender piles were not included in the task but were superficially examined during the detailed inspection of the supporting piles.

The underwater inspection team consisted of one engineer/diver and three inspection diver/tenders. Due to the configuration of the structure, the depths involved, and to insure an accurate inspection and accurate note-taking, surface-air-supplied diving was employed. The dive station consisted of a compressor, volume tank, two-way communications radio, pneumofathometer, and back-up air supply system. Inspection depths and dive durations required a decompression chamber to be operational at the dive location during the deepest dives. The surface-air-supplied method of diving allowed the inspecting diver to describe, in detail, any damage or deterioration that was encountered via two-way communications. The inspecting diver would inspect a pile, cleaning growth as necessary, looking for cracks, voids, rust stains, exposed reinforcing steel, and other signs of damage or deterioration. After descending down one pile, inspecting it in a semi-spiral fashion to view each face, the engineer/diver would move to the next pile and ascend while inspecting for damage or deterioration. (See Fig. 3)

The inspection of the facility included close examination for 3 major types of problems. These problems were mechanical damage after construction, damage during construction, and deterioration

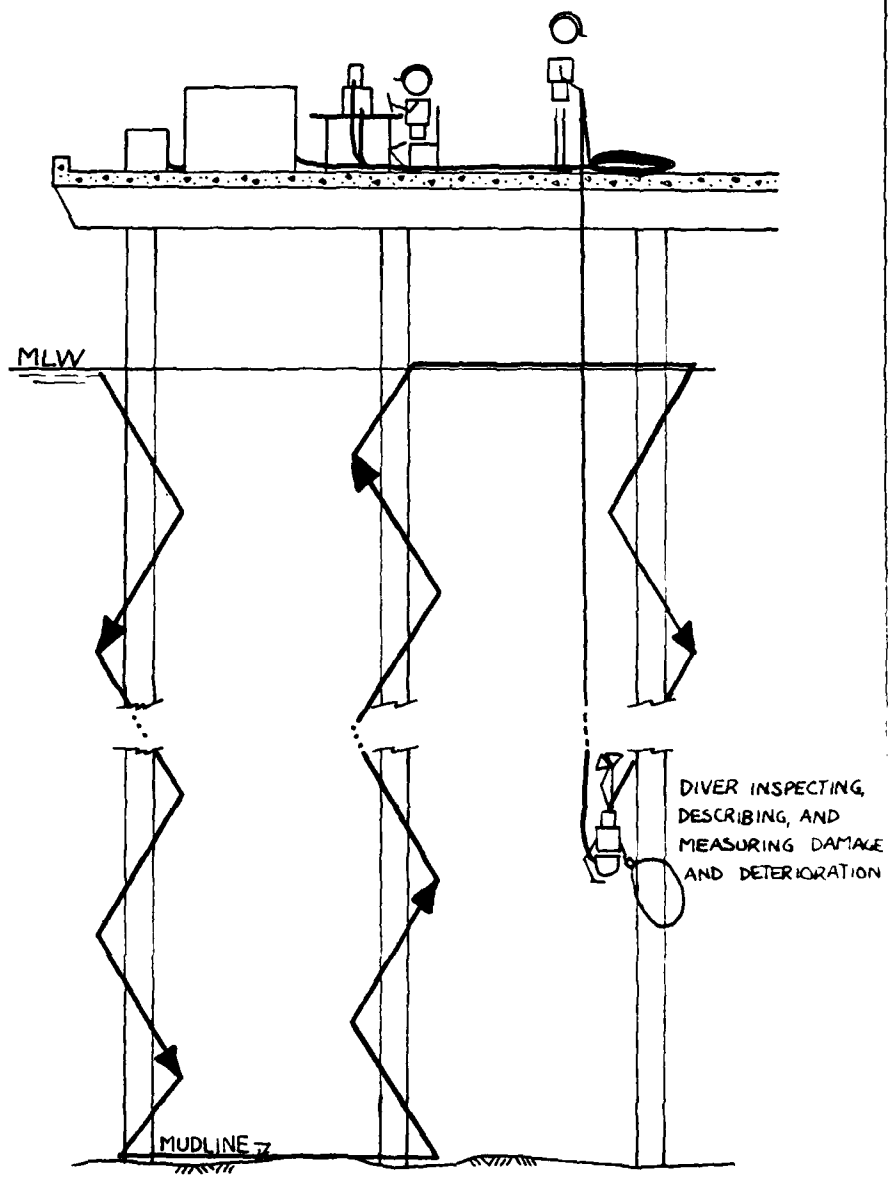


FIG. 3 TYPICAL DIVER INSPECTION PATH

WISWELL, INC. 3280 POST RD. SOUTHPORT, CT	CHESAPEAKE DIVISION NAVFACENGCOM WASHINGTON, DC	EHW-1 STRATEGIC WEAPONS FACILITY BANGOR, WASHINGTON

occurring since construction. Mechanical damage after construction was primarily limited to damage due to impact of berthing vessels. This damage was limited to the outer rows of each bent and the connecting pile cap. Damage during construction would primarily be cracks in the piles, when driven, which would then allow water intrusion into the piles and allow spalling and oxidation of the reinforcing steel. Deterioration of the piles would be in the form of erosion and chemical attack on the concrete piles and rusting of any exposed reinforcing steel or unprotected lifting eyes.

Documentation in the form of still photographs was obtained of typical and irregular conditions. Photographs of damage and deterioration both under-water and above-water, but below deck level, were taken. Soundings were taken at locations along each bent and are presented on the pile plans in the appendix.

3.3 Inspection Equipment

Equipment used for inspection of the piles included a sharp pointed probe, a Nikonos II under-water camera with Vivitar strobe, dive lights, 100' sounding tape, scraping tools and dive knives.

Choice of equipment was made as a result of past experience, chosen for its effectiveness and ease of operation in an under-water environment.

The dominant feature noted when examining the concrete piles at Explosive Handling Wharf EHW-1 is the abundance and variety of marine growth present. Marine growth may have a significant effect on the structural integrity of piling and the rate of deterioration, and is thus of interest to this study.

The composition of the marine growth varies considerably with depth and location of the piles, thus making it difficult and somewhat arbitrary to select any single pile and consider it as being representative. Enough similarities among the piles carry over, however, to make the selection valuable.

Included in this study are photographs documenting the structural condition of the piles as well as the levels and composition of growth on representative piles.

4.1 Explosive Handling Wharf No. 1, EHW-1

4.1.1 Description

Explosive Handling Wharf 1 consists of reinforced concrete decks supported by concrete plumb and batter piles. The concrete piles are 24 inch precast hollow octagonal piles and 16-1/2 inch precast solid octagonal piles.

Pile Design Capacities:

24" Hollow Octagon	380K Compression, 80K Tension
16-1/2" Octagon	220K Compression, 68K Tension

The approach trestles to EHW-1 are composed of a reinforced concrete deck supported by concrete plumb and batter piles. These piles are 16-1/2 inch precast octagonal piles with a maximum length of 100 feet. The North Trestle consists of 138 piles, arranged in 30 bents, 25 of which consist of four batter piles. Each of these bents contains 2 pairs of batter piles, one pair of piles opposing each other battered in the north-south direction, and the other pair opposing each other battered in the east-west direction.

The South Trestle of EHW-1 is supported by 108 piles, arranged in 23 bents, 19 of which consist of four batter piles. Each of these bents contains 2 pairs of batter piles which are battered in the same manner as the North Trestle.

EHW-1 is a U-shaped structure which allows submarines to berth in a deep-water, weather protected berth for the loading and off-loading of missiles and ordnance. The facility is approximately 209 feet by 640 feet, with a berth of 96 feet by 600 feet. The facility is supported by 679 concrete piles. The adjacent EHW-1 Lightning Tower is supported by 14 concrete piles and one steel cylindrical pile, and was also inspected as part of this task.

4.1.2 Observed Inspection Condition

As a baseline assessment of the condition of a recently built facility, the inspection team was not surprised in not finding extensive deterioration. The amount of marine growth present on the concrete piles was very heavy in some areas. This marine growth varied between the outer rows of piles and inner rows of piles as well as elevation on the piles.

Findings on the composition and levels of marine growth in this report are summarized in three ways. Levels of marine growth are summarized by assigning to each pile a number from one (1) to three (3) indicating the degree of growth coverage on the pile, and a letter from a to c indicating the overall thickness of coverage. The breakdown of this system appears below:

A. Percent Coverage
   1 - heavy (80-100%)
   2 - medium (60-80%)
   3 - light (less than 60%)

B. Thickness of Coverage
   a - thick (1-1/2 inches or greater)
   b - average (3/4 inch to 1-1/2 inches)
   c - thin (3/4 inch or less)

It should be noted that the thickness measure refers to growth consisting primarily of barnacles, mussels, oysters, scallops, and other "hard" fouling organisms rather than to anemones and tube worms, for example, which are often found in clusters up to two feet in length. It should also be understood that these assigned values represent an overall description of a pile and conditions may vary at specific depths. This data is presented in the appendix.

Marine growth on the concrete piles was found to be divided into four major zones:

A. Zone 1: +8' to -8' M.L.L.W.
   "Hard" fouling zone: barnacles, mussels, oysters.
B. Zone 2: -8' to -20' M.L.L.W.
   Tubeworm zone.
C. Zone 3: -20' to -65' M.L.L.W.
   Anemone zone.
D. Zone 4: -65' and deeper M.L.L.W.
   Light growth zone.

It should be recognized that there is considerable overlapping of these zones and that they are not distinguishable on all of the pilings. Figure 4 shows the approximate ranges of these types of marine growth for the concrete piles.

Zone 1 encompasses the splash zone, the intertidal zone, and the upper subtidal zone. In this zone the thickest growth is encountered and the piles are nearly always 100 percent covered. Growth in the splash zone, where there is only intermittent wetting, consists primarily of a thin covering of barnacles and scattered mussels. The intertidal zone, immediately below the splash zone, contains approximately ten vertical feet of heavy mussel, oyster and barnacle growth, frequently in excess of two inches thick (see photographs 1 and 2).

Zone 2 is characterized by a heavy concentration of tube worms varying in length from a few inches to nearly two feet. Barnacles and mussels are also present in large numbers in this zone, along

with red and yellow sponges, nudibranchs, tunicates and a few anemones (see photograph 3).

Zone 3 represents an area of heavy anemone growth frequently occurring in lengths up to two feet. The majority of the anemones are plumose anemones and were white, orange, or brown in color. In addition to anemones there are scattered appearances of sea urchins, sea cucumbers, calcareous tube worms, oysters, mudibranchs, tunicates, sea squirts, chitons, sea stars, and scallops (see photograph 4).

In Zone 4 marine growth gradually diminishes leaving only a thick covering of barnacles approximately one-half inch thick toward the mudline. Interspersed among the barnacles are very small scallops and oysters along with occasional concentrations of calcareous tube worms, sea squirts, and small anemones (see photograph 5).

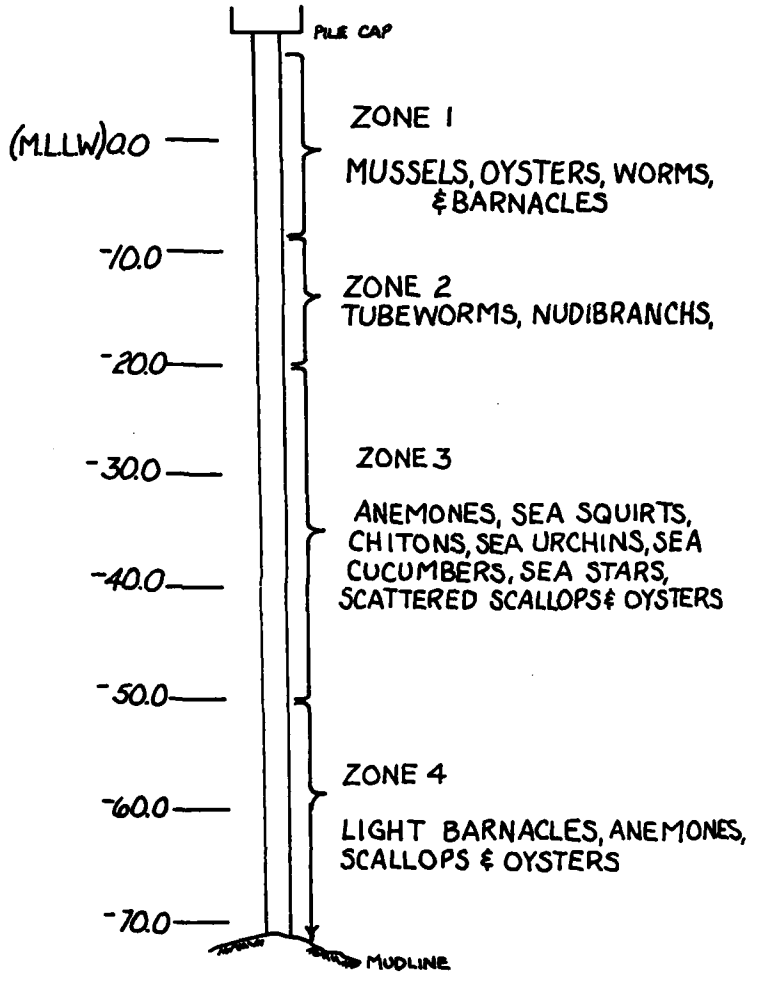


FIG. 4 MARINE GROWTH PROFILE - CONCRETE PILES

WISWELL, INC. 3280 POST RD. SOUTHPORT, CT	CHESAPEAKE DIVISION NAVFACENGCOM WASHINGTON, DC	EHW-1 STRATEGIC WEAPONS FACILITY BANGOR, WASHINGTON

Photograph 1

Pile D-19, showing typical marine growth in intertidal zone, Zone 1.

Photograph 2

Pile E5, showing typical marine growth in intertidal zone, zone 1.

Photograph No. 3

Pile C-12, Elevation -15.0, showing heavy tubeworm concentration in Zone 2.

Photograph No. 4

Pile C-12, Elevation -25.0, showing heavy anemone growth with sea urchins and sea cucumbers.

Photograph No. 5

Pile C-12, Elevation -50.0, showing Zone 4 with barnacles and small oysters and sea anemones.

The amount of available illumination is the primary limiting factor in determining the degree of thickness and the coverage of marine growth on the piles. As anticipated, growth is found to be heaviest on outboard piles where sunlight is available (see photograph 6). In these areas, coverage is 100 percent and thickness is often greater than two inches. Coverage on the same piles generally decreases to 80 to 90 percent at mid-depths and continues to decrease near the mudlines.

In interior regions where piles are shaded from illumination, marine growth is dramatically reduced. This is particularly evident among the piles under the central section of the Explosives Handling Wharf. Some of these piles are well over one hundred feet from any direct light due to the overhead structure on EHW-1. Growth coverage is generally diminished to the 50 percent range with a thickness of approximately one-half inch. In contrast to the outer piles, there is very little variation in growth coverage and thickness along the length of the pile.

Not only the amount of growth, but the variety of organisms on the piles decline in the interior sections. Noticeably absent are mussels, oysters, and all but a few anemones. Tube worms fare significantly better in this area and are often found in heavy concentrations below the low water mark. The majority of the few barnacles to be found in these areas are dead and are easily removed by light scraping.

4.1.3 Structural Condition Assessment

The purpose of this section is to present a qualitative description of the structural condition of the facilities based upon inspection date. Each concrete pile supporting Explosive Handling Wharf #1, EHW-1, was examined. Pile plans presenting the findings of the structural condition assessment are included in the appendix.

The following rating system was employed to describe the overall

Photograph 6

Bent D looking north from Southern trestle showing heavy marine growth on bent exposed to sunlight.

condition of the concrete piles:

A. No damage, deterioration, or structural problems noted.
B. Minor spalls, rough, uneven surface.
C. Large spalls, cracks, exposed rebar.
D. Severely damaged pile.
E. Splices, spacers.

In general the piles of EHW-1 were found to be in excellent condition with dense, hard concrete and sharp, well-defined edges. Many of the piles inspected exhibited a large number of small air pockets left by the original forming process. These pockets were generally less than 1/4 inch deep and one square inch in area. There was no evidence of exposed reinforcing steel.

A total of 679 twenty-four inch and sixteen and one-half inch octagonal concrete plumb and batter piles were inspected at EHW-1. The condition rating breakdown shows 668 of the piles with an "A" or undamaged rating, only ten with a "B" rating for rough surfaces and one "C" rating, pile 7-6, for exposed reinforcing steel.

In addition to the inspection of the piles supporting EHW-1, the piles supporting the EHW-1 Lightning Tower were inspected. The tower is supported by 15 piles, 14 being sixteen and one-half inch octagonal concrete piles and one pile, pile No. 1, being a 30" diameter steel pile with 3/8" walls.

Additionally, a brief inspection was made of the cathodic protection system as the supporting piles were inspected. Rather heavy marine growth was present on the anodes suspended below the facility (see photograph 7).

The inspection found several cases of piles that had been repaired above the Mean Sea Level elevation. These repairs, for the most part, were limited to under the trestles at the shore aprons (see photographs 8, 9, and 10). However, some signs of repair were noticed under the main wharf section (see photograph 11).

One pile, designated as pile D-18, was an extra pile not on the

Photograph 7

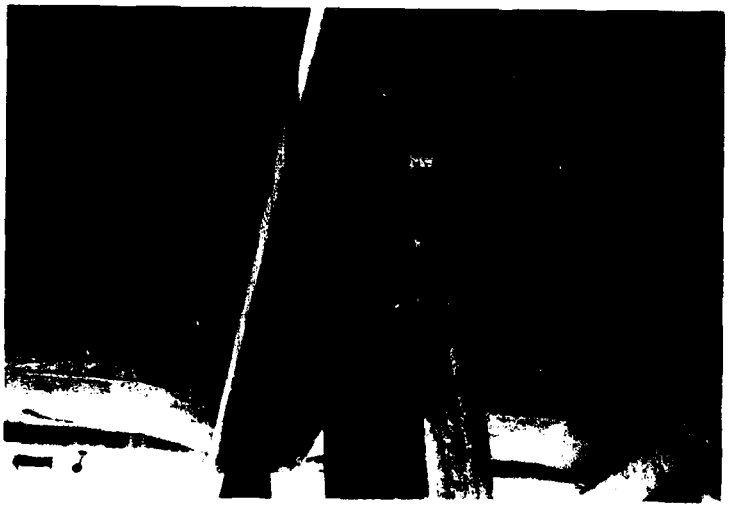
Anode of Cathodic Protection System on EHW-1, showing accumulated marine growth.

Photograph 8

Pile TT-1, showing concrete patch on concrete pile just above the tidal zone.

Photograph 9

Pile TT-1, South side, showing same repair as Photograph 7



Photograph 10

Pile SS-4, showing repairs made to piles, near pile cap, during construction. Note change of pile axis in second pile.

Photograph 11

Pile 3-4 showing double pile installation. Pile on left shows formwork from repairs. Double piles indicate one failed during placement, requiring second pile.

original plans. This pile appeared to be a splice of a sixteen and one-half pile with a 24 inch pile, the 24 inch section being in the upper section. The work on this pile was very poor, with spacers readily visible and concrete of poor quality (see photographs 12 through 17).

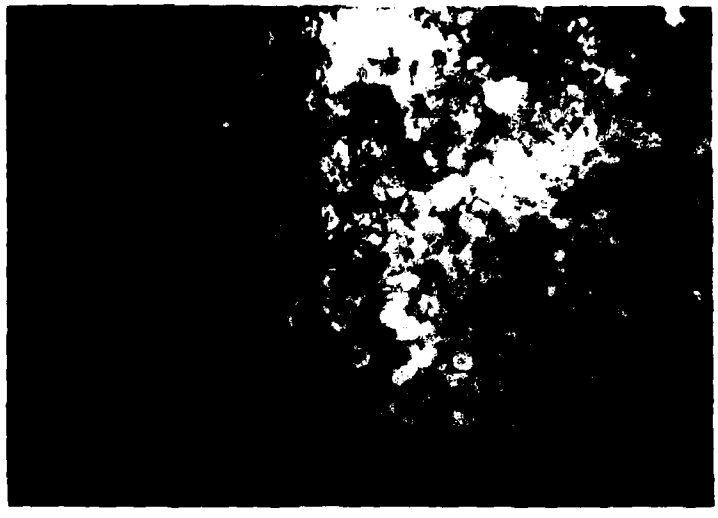
Pile 7-6 was found to have a small depressed area measuring 8 inches long and 3 inches wide with exposed reinforcing steel. The depression was found at 39 feet below mean sea level on the south face of the pile.

Several piles were found to have rust marks on the piles following a two or four spot pattern. These were found to be the stubs from the lifting eyes used to handle the concrete piles. In most cases these were not protected and showed signs of rusting, although most topside stubs were properly cut and coated with epoxy (see photographs 18 through 20).

4.1.4. Recommendations

It is recommended that repairs be made to the one pile, pile 7-6, that was found to have exposed reinforcing steel. This repair would cost approximately $700 with $650 being for the diver and tender and $50 for an epoxy grout material. Additionally, it is recommended that this structure be re-inspected within the next 7 years to document if the exposed, rusting steel stubs of the lifting eyes are causing damage to the piles. If the oxidizing steel is found to be causing significant spalling, at that time an epoxy grout repair should be considered.

The one steel pile located in the EHW-1 system, in the Lightning Tower should be re-inspected carefully to note the continued extent of oxidation taking place. If significant deterioration is noted, the tidal zone area of the pile and perhaps the entire length should be cleaned and re-coated with an appropriate epoxy.

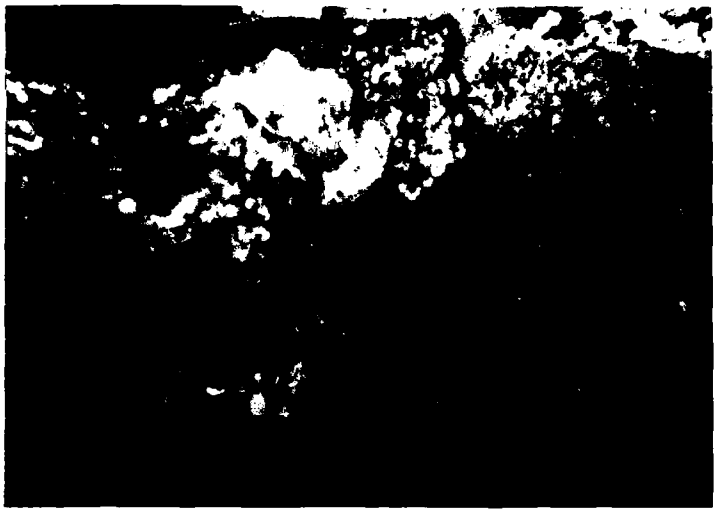


Photograph 12

Pile D-18 showing cleaned pile at -6.0 Elevation, showing good concrete found in upper section of pile.

Photograph 13

Pile D-18, Elevation -11.0, South face, showing spacers used to hold forms off of original pile. Note deterioration of adjacent concrete.



Photograph 14

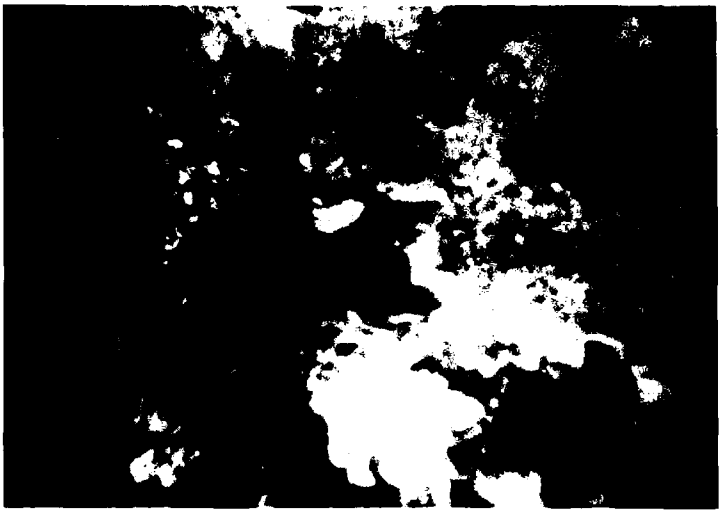
Pile D-18, Elevation -14.0 on North face, showing inlet nozzle and seal for concrete repair.

Photograph 15

Pile D-18, Elevation -18.0, showing bottom of concrete repair and top of 24 inch octagonal section.

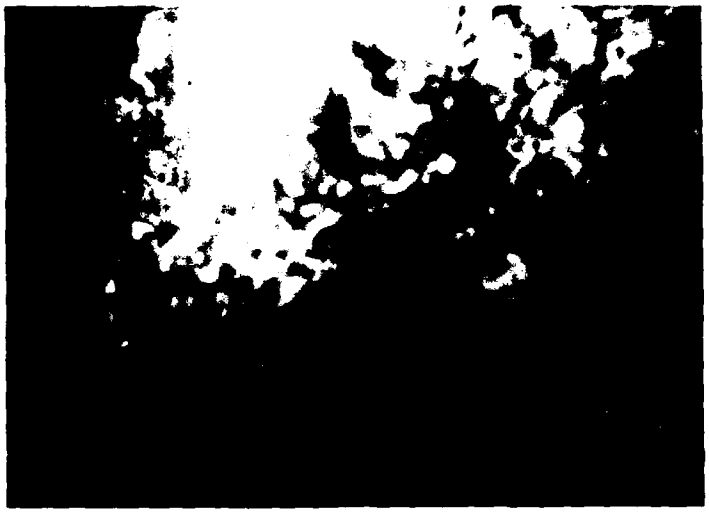
Photograph 16

Pile D-18, Elevation -18.0, showing close-up bottom of concrete repair in Photograph 15. Exposed aggregate was encountered and concrete was loose and very easily removed.



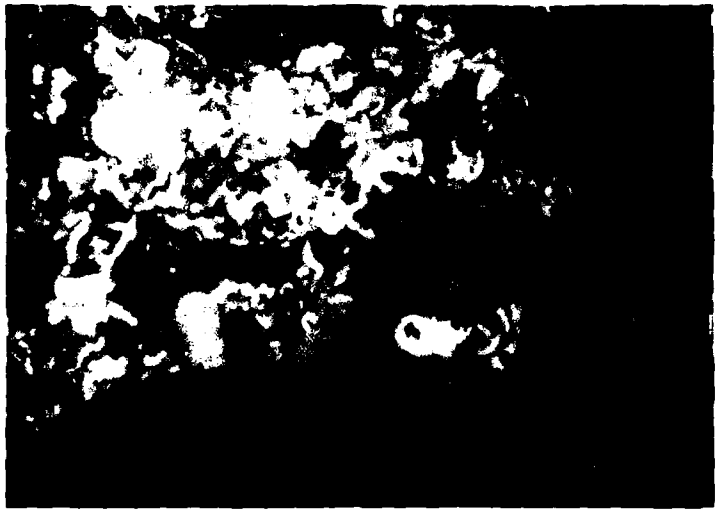
Photograph 17

Pile D-18, Elevation -18.0, showing rusted clamp at bottom of concrete repair with loose concrete above it.



Photograph 18

Pile 7-5, Elevation -40.0, South side, showing two steel lifting eye stubs with rust.



Photograph 19

Pile 7-5, Elevation -39.0, South side, showing two steel lifting eye stubs one foot above those in Photograph 18, after scraping.

Photograph 20

Pile SS-3, Elevation +2.0, South side, showing epoxy coating over lifting eye stubs, as encountered topside.

TABLE OF CONTENTS FOR APPENDIX

STRUCTURAL ANALYSIS CALCULATIONS

In that the investigation found no serious damage or deterioration of the supporting piles at this time, the structure is considered as-built structurally. Those conditions which will lead to structural weakening of the structure have been presented and discussed elsewhere in the report.

CUMULATIVE LIST OF MARINE ORGANISMS
IDENTIFIED DURING PILING INSPECTION
AT REFIT-1, REFIT-2, EHW-1

Family/Species	Common Name
MOLLUSCA	
Chlamys hastata hericia	Pacific pink scallop
Chlamys rubida	Pacific pink scallop
Crassostrea gigas	Pacific oyster
Hinnites giganteus	Purple-hinged scallop
Mytilus californignus	California mussel
Mytilus edulis	Bay or Blue mussel
Octopus dofleini	Pacific octopus
Archidoris montereyensis	Sea lemon
Armina californica	Striped nudibranch
Triopha catilinae	Common orange spotted nudibranch
Acmaea mitra	Whitecap limpet
Diodore aspera	Keyhole limpet
Searlesia dira	Spindle whelk
ECHINODERMATA	
Leptasterias hexactis	Six-ray star
Parastichopus californicus	Californic sea cucumber
Pycnopodia helianthoides	Sunflower star
Solaster dawsoni	Morning sun star
Strongylocentrotus droebachiniensis	Green sea urchin
CORDATA	
Ascidia paratropa	Glassy sea squirt
Corella willmeriana	Transparent sea squirt
Halocynthia aurantium	Sea peach
ANNELIDA	
Dodecaceria fewkesi	Cemented tube worm
Eudistylia Vancouveri	Feather duster worm
Serpula vermicularis	Calcareous tube worm
PLATYHELMINTHES	
Tubulanus polymorphus	Primitive ribbon worm
Tubulanus sexlineatus	Lined ribbon worm
COELENTERATA	
Metridium senile	Plumose anemone
ARTHROPODA	
Balanus glandula	Acorn barnacle
Balanus nubilus	Giant barnacle
Pandalus dance	Coonstripe shrimp
Cancer magister	Dungeness crab
Cancer productus	Red rock crab
Ellassochirus gilli	Orange hermit crab
Oedignathus intermis	Granular claw crab
Oregonia gracilis	Decorator crab
Pugettia producta	Kelp crab

CUMULATIVE LIST OF MARINE ORGANISMS
IDENTIFIED DURING PILING INSPECTION
AT REFIT-1, REFIT-2, EHW-1

Family/Species	Common Name
PORIFERA	
Adocia mollis	White encrusting sponge
Cliona celata	Yellow boring sponge
Halichondria panicea	Crumb of bread sponge
Ophlitaspongia pennata	Red sponge

CUMULATIVE LIST OF MARINE ORGANISMS
IDENTIFIED DURING PILING INSPECTION
AT REFIT-1, REFIT-2, EHW-1

Fish Species

Family/Species	Common Name
CHIMAERIDAE	
Hydrolagus colliei	Ratfish
CLUPEIDAE	
Clupea havengus pallasi	Pacific herring
EMBIOTOCIDAE	
Cymatogaster aggregata	Shiner perch
Embiotoca lateralis	Striped perch
Rhacochilus vacca	Pile perch
SCORPAENIDAE	
Sebastes auriculatus	Brown rockfish
Sebastes caurinus	Copper rockfish
Sebastes flavidus	Yellowtail rockfish
HEXAGRAMMIDAE	
Hexagrammos decagrammus	Kelp greenling
Ophiodon elongatus	Lingcod
COTTIDAE	
Artedius harringtoni	Scalyhead sculpin
Enophrys bison	Buffalo sculpin
Scorpaenichthys marmuratus	Cabezon
STICHAEIDAE	
Anoplarchus purpurescens	High cockscomb
Anarrichthys ocellatus	Wolf-eel

EHW-1

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
1-1	A	2b	2B-3	A	2b
1-2	A	2b	2B-4	A	2b
1-3	A	2b	2B-5	A	2b
1-4	A	2b	2B-6	A	2b
1-5	A	2b	2B-7	A	2b
1-6	A	2b	2B-8	A	1b
1-7	A	2b	2B-9	A	2b
1-8	A	2b	3A-1	A	1a
2-1	A	1a	3A-2	A	1a
2-2	A	1a	3A-3	A	1a
2-3	A	1a	3A-4	A	1a
2-4	A	1b	3A-5	A	1a
2-5	A	1b	3A-6	A	1a
2-6	A	1b	3A-7	A	1a
2-7	A	1b	3A-8	A	1a
2-8	A	1b	3A-9	A	1a
2A-1	A	1a	3-1	A	1a
2A-2	A	1b	3-2	A	1a
2A-3	A	1b	3-3	A	1a
2A-4	A	1a	3-4	A	1b
2A-5	A	1b	3-5	A	1b
2A-6	A	1b	3-6	A	1b
2A-7	A	2b	3-7	A	1b
2A-8	A	2b	3-8	A	1b
2A-9	A	2b	3B-1	A	1a
2A-10	A	2b	3B-2	A	1a
2A-11	A	1b	3B-3	A	1a
2A-12	A	1a	3B-4	A	1a
2A-13	A	1b	3B-5	A	1a
2A-14	A	1a	3B-6	A	1a
2A-15	A	2b	3B-7	A	1a
2A-16	A	2b	3B-8	A	1a
2A-17	A	2b	3B-9	A	1a
2A-18	A	2b	3B-10	A	1a
2A-19	A	2b	3B-11	A	1a
2A-20	A	2b	3B-12	A	1a
2A-21	A	2b	3B-13	A	1a
2A-22	A	2b	3B-14	A	1a
2A-23	A	2b	3B-15	A	1a
2A-24	A	2b	3B-16	A	1a
2A-25	A	2b	3B-17	A	1a
2A-26	A	2b	3B-18	A	1a
2A-27	A	2b	3B-19	A	1c
2B-1	A	2b	3B-20	A	1c
2B-2	A	2b	3B-21	A	1c

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
11-8	A	2b	15-6	A	2b
12A-1	A	1a	15-7	A	2b
12A-2	A	1a	15-8	A	2b
12A-3	A	1a	16A-1	A	2a
12A-4	A	1a	16A-2	A	2b
12-1	A	1a	16A-3	A	2b
12-2	A	1a	16A-4	A	2a
12-3	A	1a	16-1	A	1b
12-4	A	1b	16-2	A	1b
12-5	A	1b	16-3	A	1b
12-6	A	1b	16-4	A	1b
12-7	A	1b	16-5	A	1b
12-8	A	2b	16-6	A	2b
12-9	A	2b	16-7	A	2b
12B-1	A	2a	16-8	A	2b
12B-2	A	2a	16-9	A	2b
12B-3	A	2a	16B-1	A	2c
12B-4	A	1a	16B-2	A	2c
13-1	A	1a	16B-3	A	2c
13-2	A	1a	16B-4	A	2c
13-3	A	1a	17-1	A	1a
13-4	A	1b	17-2	A	1a
13-5	A	1b	17-3	A	1a
13-6	A	1b	17-4	A	2b
13-7	A	2b	17-5	A	2b
13-8	A	2b	17-6	A	1b
14A-1	A	1a	17-7	A	1b
14A-2	A	2a	17-8	A	1b
14A-3	A	2a	18A-1	A	1a
14A-4	A	1a	18A-2	A	1a
14-1	A	1a	18A-3	A	1a
14-2	B	1a	18A-4	A	1a
14-3	A	1a	18-1	A	1b
14-4	A	1b	18-2	A	1b
14-5	A	1b	18-3	A	1b
14-6	A	1b	18-4	A	1c
14-7	A	1b	18-5	A	1c
14-8	A	2b	18-6	A	2b
14-9	A	2b	18-7	A	2b
14B-1	A	2a	18-8	A	2b
14B-2	A	2a	18-9	A	2b
14B-3	A	2a	18B-1	A	1a
14B-4	A	2a	18B-2	A	1a
15-1	A	1b	18B-3	A	1a
15-2	A	1b	18B-4	A	1a
15-3	A	1b	19-1	A	2b
15-4	A	1b	19-2	A	2b
15-5	A	1b	19-3	A	2b

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
3B-22	A	1c	8-6	A	1b
3B-23	A	1a	8-7	A	1b
3B-24	A	1a	8-8	A	1b
3A-25	A	1a	8A-1	A	1a
3A-26	A	1a	8A-2	A	1b
3A-27	A	1a	8A-3	A	1b
4-1	A	1a	8A-4	A	1a
4-2	A	1a	9A-1	A	1c
4-3	A	1a	9A-2	A	1a
4-4	A	1b	9A-3	A	1a
4-5	A	1b	9A-4	A	1a
4-6	A	1b	9-1	A	1a
4-7	A	1b	9-2	A	1a
4-8	A	1b	9-3	A	1b
4A-1	A	1a	9-4	A	1b
4A-2	A	1a	9-5	A	1b
5-1	A	1a	9-6	A	1b
5-2	A	1a	9-7	A	1b
5-3	A	1c	9-8	A	1b
5-4	A	1b	9-9	A	1b
5-5	A	1b	9B-1	A	1a
5-6	A	1b	9B-2	A	1a
5-7	A	1b	9B-3	A	1a
5-8	A	1b	9B-4	A	1a
6-1	A	1a	10A-1	A	1a
6-2	A	1b	10A-2	A	1a
6-3	A	1b	10A-3	A	1a
6-4	A	1b	10A-4	A	1a
6-5	A	1b	10-1	A	1a
6-6	B	1b	10-2	A	1a
6-7	A	1b	10-3	A	1c
6-8	A	1b	10-4	A	1c
6A-1	A	1a	10-5	A	1a
6A-2	A	1a	10-6	A	1a
7-1	A	1c	10-7	A	1a
7-2	A	1c	10-8	A	1a
7-3	A	1b	10-9	A	1a
7-4	A	1b	10B-1	A	1a
7-5	A	1b	10B-2	A	1a
7-6	C	1b	10B-3	A	1a
7-7	A	1b	10B-4	A	1a
7-8	A	1b	11-1	A	1a
8-1	A	1a	11-2	A	1a
8-2	A	1a	11-3	A	1a
8-3	A	1a	11-4	A	1b
8-4	A	1b	11-5	B	1b
8-5	A	1b	11-6	A	1b
			11-7	B	1b

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
19-4	A	2b	23-1	A	1b
19-5	A	2b	23-2	A	1a
19-6	A	2b	23-3	A	2b
19-7	A	2b	23-4	A	2b
19-8	A	2b	23-5	A	2b
20A-1	A	1b	23-6	A	2b
20A-2	A	1b	23-7	A	2b
20A-3	A	1b	23-8	A	2b
20A-4	A	1b	24A-1	A	1a
20-1	A	2b	24A-2	A	1a
20-2	A	2b	24A-3	A	1b
20-3	A	2b	24A-4	A	1a
20-4	A	2b	24-1	A	1a
20-5	A	2b	24-2	A	1a
20-6	A	2b	24-3	A	1a
20-7	A	2b	24-4	A	1a
20-8	A	2b	24-5	A	2b
20-9	A	1b	24-6	A	2b
20B-1	A	1a	24-7	A	2b
20B-2	A	1a	24-8	A	3b
20B-3	A	1a	24-9	A	3b
20B-4	A	1a	24B-1	A	1a
21-1	A	2b	24B-2	A	1a
21-2	A	2b	24B-3	A	1a
21-3	A	2b	24B-4	A	1a
21-4	A	2b	25A-1	A	1a
21-5	A	2b	25A-2	A	1a
21-6	A	2b	25A-3	A	1a
21-7	A	1b	25A-4	A	1a
21-8	A	1b	25-1	A	2b
22A-1	A	1a	25-2	A	2b
22A-2	A	1a	25-3	A	3b
22A-3	A	1a	25-4	A	2b
22A-4	A	1a	25-5	A	1b
22-1	A	1a	25-6	A	1b
22-2	A	1b	25-7	A	1b
22-3	A	1b	25-8	A	1b
22-4	A	2b	25B-1	A	1b
22-5	A	2b	25B-2	A	1b
22-6	A	2b	25B-3	A	1b
22-7	A	2b	25B-4	A	1b
22-8	A	2b	26-1	A	1a
22-9	A	2b	26-2	A	1b
22B-1	A	1a	26-3	A	1b
22B-2	A	1a	26-4	A	1b
22B-3	A	1a	26-5	A	1b
22B-4	A	1a	26-6	A	2b

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
26-7	A	1b	30B-1	A	1a
26-8	A	1b	30B-2	A	1a
27-1	A	2b	30B-3	A	1a
27-2	A	2b	30B-4	A	1a
27-3	A	2b	31-1	A	2b
27-4	A	2b	31-2	A	2b
27-5	A	2b	31-3	A	2b
27-6	A	2b	31-4	A	2b
27-7	A	2b	31-5	A	1b
27-8	B	2b	31-6	A	2b
27A-1	A	1b	31-7	A	2b
27A-2	A	1b	32-1	A	2b
27A-3	A	1b	32-2	A	2b
27A-4	A	1b	32-3	B	2b
28-1	A	2b	32-4	A	2b
28-2	A	2b	32-5	A	2b
28-3	A	2b	32-6	A	2b
28-4	A	2b	33-1	A	1b
28-5	A	2b	33-2	A	1b
28-6	A	2b	33-3	A	1b
28-7	A	2b	33-4	A	1b
28-8	A	2b	33-5	A	1b
29-1	A	3b	D-1	A	1b
29-2	A	3b	D-2	A	1b
29-3	A	3b	D-3	A	1b
29-4	A	3b	D-4	A	1b
29-5	A	3b	D-5	A	1b
29-6	A	3b	D-6	A	1b
29-7	A	3b	D-7	A	1b
29-8	A	3b	D-8	A	1b
29A-1	A	1a	D-9	A	1b
29A-2	A	1a	D-10	A	1b
29A-3	A	1a	D-11	A	2b
29A-4	A	1a	D-12	A	2b
30A-1	A	1a	D-13	A	2b
30A-2	A	1a	D-14	A	2b
30A-3	A	1a	D-15	A	2b
30A-4	A	1a	D-16	B	2b
30-1	A	1b	D-17	A	2b
30-2	A	2b	D-18	B	2b
30-3	A	2b	D-19	A	2b
30-4	A	2b	D-20	A	1b
30-5	A	2b	D-21	A	2b
30-6	A	2b	D-22	A	2b
30-7	A	2b	D-23	A	2b
30-8	A	2b	D-24	A	2b

EHW-1

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
D-25	A	2b	D-72	A	2b
D-26	A	2b	D-73	A	2b
D-27	A	2b	D-74	A	2b
D-28	A	2b	D-75	A	2b
D-29	A	2b	D-76	A	2b
D-30	A	2b	D-77	A	2b
D-31	A	2b	D-78	A	3b
D-32	A	2b	D-79	A	2b
D-33	A	2b	D-80	A	2b
D-34	A	2b	D-81	A	2b
D-35	A	2b	D-82	A	2b
D-36	A	2b	D-83	A	2b
D-37	A	2b	D-84	A	2b
D-38	A	2b	D-85	A	2b
D-39	A	2b	D-86	A	1b
D-40	A	2b	D-87	A	2b
D-41	A	2b	D-88	A	1b
D-42	A	2b	D-89	A	1b
D-43	A	2b	D-90	A	1a
D-44	A	2b	D-91	A	1a
D-45	A	2b	D-92	A	1b
D-36	A	2b	D-93	A	1b
D-47	A	2b	D-94	A	2b
D-48	A	2b	D-95	A	2b
D-49	A	2b	D-96	A	1b
D-50	A	2b	D-97	A	1b
D-51	A	2b	D-98	A	1b
D-52	A	2b	D-99	A	2b
D-53	A	2b	D-100	A	2b
D-54	A	2b	D-101	A	2b
D-55	A	2b	D-102	A	1b
D-56	A	2b	D-103	A	1b
D-57	A	2b	D-104	A	1b
D-58	A	2b	D-105	A	1b
D-59	A	2b	D-106	A	2b
D-60	A	2b	D-107	A	2b
D-61	A	2b	D-108	B	2b
D-62	A	2b	D-109	A	2b
D-63	A	1b	D-110	A	2b
D-64	A	2b	D-111	A	2b
D-65	A	2b	D-112	A	2b
D-66	A	2b	D-113	A	2b
D-67	B	2b	D-114	A	3b
D-68	A	2b	D-115	A	3b
D-69	A	2b	D-116	A	3b
D-70	A	2b	D-117	A	3b
D-71	A	2b	D-118	A	3b

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
D-119	A	2b	C1-5	A	3b
D-120	A	2b	C1-6	A	3b
D-121	A	3b	C1-7	A	2b
D-122	A	3b	C1-8	A	2b
D-123	A	3b	C1-9	A	2b
D-124	A	2b	C1-10	A	1b
D-125	A	2b	C1-11	A	2b
D-126	A	2b	C1-12	A	2b
D-127	A	2b	C1-13	A	1b
D-128	A	3b	C1-14	A	1a
D-129	A	3b	C1-15	A	1b
D1-1	A	3b	C1-16	A	1b
D1-2	A	1b	C1-17	A	2b
D1-3	A	1b	C1-18	A	2b
D1-4	A	2b	C1-19	A	1b
D1-5	A	1b	C1-20	A	2b
C-1	A	1b	C1-21	A	2b
C-2	A	1b	C1-22	A	2b
C-3	A	1b	C1-23	A	2b
C-4	A	2b	C1-24	A	2b
C-5	A	1b	C1-25	A	2b
C-6	A	3b	C1-26	A	2b
C-7	A	2b	C1-27	A	2b
C-8	A	2b	C1-28	A	2b
C-9	A	2b	C1-29	A	2b
C-10	A	2b	C1-30	A	2b
C-11	A	2b	C1-31	A	2b
C-12	A	2b	C1-32	A	2b
C-13	A	1b	C1-33	A	2b
C-14	A	1b	C1-34	A	3b
C-15	A	1b	C2-1	A	1b
C-16	A	2b	C2-2	A	1b
C-17	A	1b	C2-3	A	2b
C-18	A	2b	C2-4	A	2b
C-19	A	1b	C2-5	A	2b
C-20	A	1b	B-1	A	2b
C-21	A	1b	B-2	A	2b
C-22	A	2b	B-3	A	2c
C-23	A	2b	B-4	A	2c
C-24	A	2b	B-5	A	2b
C-25	A	2b	B-6	A	2b
C-26	A	2b	B-7	A	2c
C-27	A	2b	B-8	A	2c
C-28	A	2b	B-9	A	2c
C-29	A	2b			
C-30	A	2b			
C-31	A	2b			
C-32	A	2b			
C-33	A	2b			
C-34	A	2b			
C1-1	A	2b			
C1-2	A	2b			
C1-3	A	2b			
C1-4	A	3b			

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
B-10	A	2b	A-1	A	2b
B-11	A	2b	A-2	A	2b
B-12	A	2b	A-3	A	2b
B-13	A	2b	A-4	A	2b
B-14	A	2b	A1-1	A	2b
B-15	A	2b	A1-2	A	2b
B-16	A	2b	A1-3	A	2b
B-17	A	2b	A1-4	A	2b
B-18	A	2b			
B-19	A	2b			
B-20	A	2b			
B-21	A	2b			
B-22	A	2b			
B-23	A	2b			
B-24	A	2b			
B-25	A	2b			
B-26	A	2b			
B-27	A	2b			
B-28	A	2b			
B-29	A	2b			
B-30	A	2b			
B1-1	A	2b			
B1-2	A	2b			
B1-3	A	2b			
B1-4	A	2b			
B1-5	A	2b			

LIGHTNING TOWER

1	A	2c
2	A	2c
3	A	2c
4	A	2c
5	A	2c
6	A	2c
7	A	1b
8	A	1a
9	A	1a
10	A	1a
11	A	2c
12	A	1b
13	A	2c
14	A	2c
15	A	2c

EHW-1

SOUTH TRESTLE

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
AA-1	A	2b	MM-3	A	2c
AA-2	A	2b	MM-4	A	2c
AA-3	A	2b	NN-1	A	2c
AA-4	A	2b	NN-2	A	2c
BB-1	A	2c	NN-3	A	2c
BB-2	A	2c	NN-4	A	2c
BB-3	A	2c	PP-1	A	2c
BB-4	A	2c	PP-2	A	2c
CC-1	A	2c	PP-3	A	2c
CC-2	A	2c	PP-4	A	2c
CC-3	A	2c	QQ-1	A	2c
CC-4	A	2c	QQ-2	A	2c
DD-1	A	2c	QQ-3	A	2c
DD-2	A	2c	QQ-4	A	2c
DD-3	A	2c	RR-1	A	2c
DD-4	A	2b	RR-2	A	2c
EE-1	A	2c	RR-3	A	2c
EE-2	A	2c	RR-4	A	2c
EE-3	A	2c	SS-1	A	2c
EE-4	A	2c	SS-2	A	2c
FF-1	A	2c	SS-3	B	2c
FF-2	A	2c	SS-4	E	2c
FF-3	A	2c	TT-1	E	2c
FF-4	A	2c	TT-2	A	2c
GG-1	A	2c	TT-3	A	2c
GG-2	A	2c	TT-4	A	2c
GG-3	A	2c	UU-1	A	-
GG-4	A	2c	UU-2	A	-
HH-1	A	2c	UU-3	A	-
HH-2	A	2c	UU-4	A	-
HH-3	A	2c	UU-5	A	-
HH-4	A	3c	VV-1	A	-
JJ-1	A	2c	VV-2	A	-
JJ-2	A	2c	VV-3	A	-
JJ-3	A	2c	VV-4	A	-
JJ-4	A	2c	VV-5	A	-
KK-1	A	2c	VV-6	A	-
KK-2	A	2c	VV-7	A	-
KK-3	A	2c	VV-8	E,C	-
KK-4	A	2c	WW-1	A	-
LL-1	A	2c	WW-2	A	-
LL-2	A	2c	WW-3	A	-
LL-3	A	2c	WW-4	E	-
LL-4	A	2c	WW-5	E	-
MM01	A	2c	WW-6	A	-
MM-2	A	2c	WW-7	A	-

EHW-1

SOUTH TRESTLE

PILE	CONDITION	MARINE GROWTH
WW-8	A	-
WW-9	A	-
XX-1	A	-
XX-2	A	-
XX-3	A	-
XX-4	A	-
XX-5	A	-
XX-6	A	-
XX-7	A	-

EHW-1

NORTH TRESTLE

PILE	CONDITION	MARINE GROWTH	PILE	CONDITION	MARINE GROWTH
AA-1	A	2b	MM-2	A	2b
AA-2	A	2b	MM-3	A	2b
AA-3	A	2b	NN-1	A	2b
AA-4	A	2b	NN-2	A	2b
BB-1	A	2b	NN-3	A	2b
BB-2	A	2b	NN-4	A	2b
BB-3	A	2b	PP-1	A	2b
BB-4	A	2b	PP-2	A	2b
CC-1	A	2b	PP-3	A	2b
CC-2	A	2b	PP-4	A	2b
CC-3	A	2b	QQ-1	A	2b
CC-4	A	2b	QQ-2	A	2b
DD-1	A	3c	QQ-3	A	2b
DD-2	A	3b	QQ-4	A	2b
DD-3	A	3b	RR-1	A	2b
DD-4	A	3b	RR-2	A	2b
EE-1	A	3b	RR-3	A	2b
EE-2	A	3c	RR-4	A	2b
EE-3	A	3c	SS-1	A	2b
EE-4	A	3b	SS-2	A	2b
FF-1	A	3b	SS-3	A	2b
FF-2	A	3b	SS-4	A	2b
FF-3	A	3b	TT-1	A	-
FF-4	A	3b	TT-2	A	-
GG-1	A	3b	TT-3	A	-
GG-2	A	2b	TT-4	A	-
GG-3	A	2b	UU-1	A	-
GG-4	A	2b	UU-2	A	-
HH-1	A	2b	UU-3	A	-
HH-2	A	2b	UU-4	A	-
HH-3	A	2b	VV-1	A	-
HH-4	A	2b	VV-2	A	-
JJ-1	A	2b	VV-3	A	-
JJ-2	A	2b	VV-4	A	-
JJ-3	A	2b	WW-1	A	-
JJ-4	A	2b	WW-2	A	-
KK-1	A	2b	WW-3	A	-
KK-2	A	2b	WW-4	A	-
KK-3	A	2b	XX-1	A	-
KK-4	A	2b	XX-2	A	-
LL-1	A	2b	XX-3	A	-
LL-2	A	2b	XX-4	A	-
LL-3	A	2b	YY-1	A	-
LL-4	A	2b	YY-2	A	-
MM-1	A	2b	YY-3	A	-
MM-2	A	2b	YY-4	A	-

EHW-1

NORTH TRESTLE

PILE	CONDITION	MARINE GROWTH
ZZ-1	A	-
ZZ-2	A	-
ZZ-3	A	-
ZZ-4	A	-
AB-1	A	-
AB-2	A	-
AB-3	A	-
AB-4	A	-
AC-1	A	-
AC-2	A	-
AC-3	A	-
AC-4	A	-
AD-1	A	-
AD-2	A	-
AD-3	A	-
AD-4	A	-
AD-5	A	-
AD-6	A	-
AD-7	A	-
AE-1	A	-
AE-2	A	-
AE-3	A	-
AE-4	A	-
AE-5	A	-
AE-6	A	-
AE-7	A	-
AE-8	A	-
AE-9	A	-
AE-10	A	-
AE-11	A	-
AF-1	A	-
AF-2	A	-
AF-3	A	-
AF-4	A	-
AF-5	A	-
AF-6	A	-
AF-7	A	-
AF-8	A	-
AF-9	A	-
AF-10	A	-
AF-11	A	-
AF-12	A	-

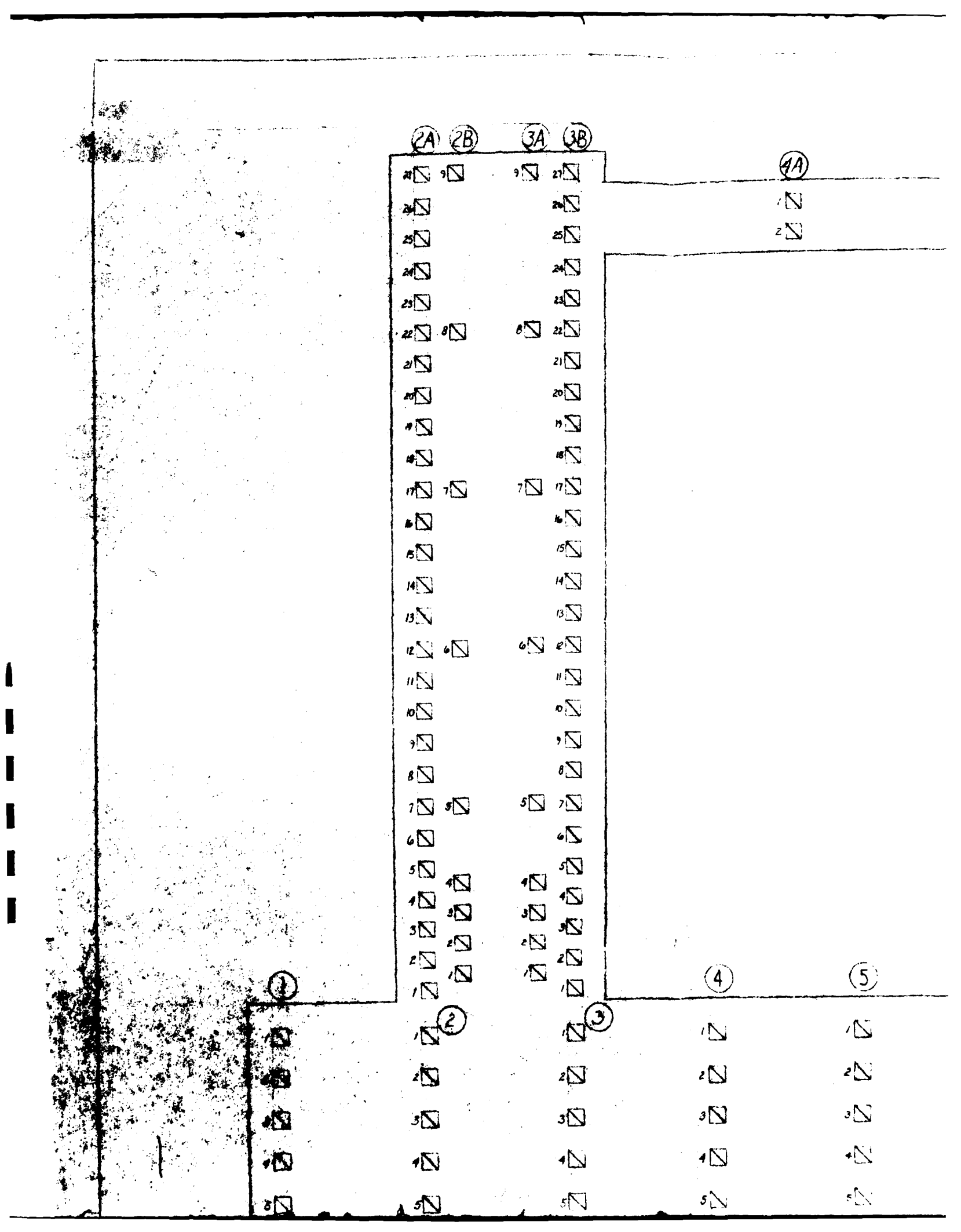
KEY TO DATA PAGES

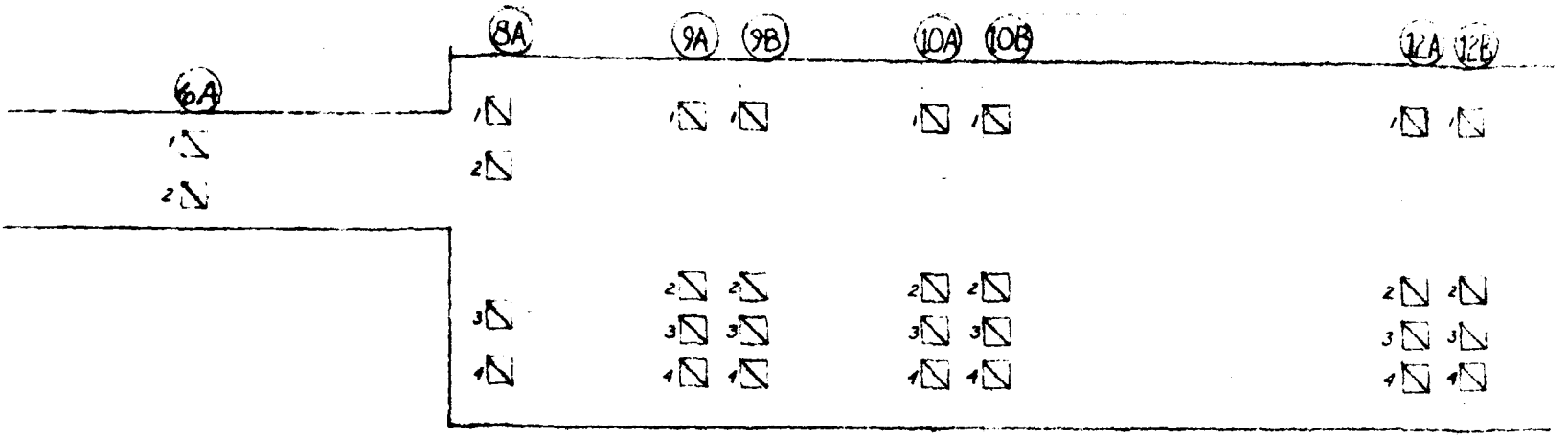
CONDITION

A-No damage, deterioration or structural problems noted.
B-Minor spalls, rough, uneven surface
C-Large Spalls, cracks, exposed rebar.
D-Severely damaged pile
E-Splices, spacers.

MARINE GROWTH

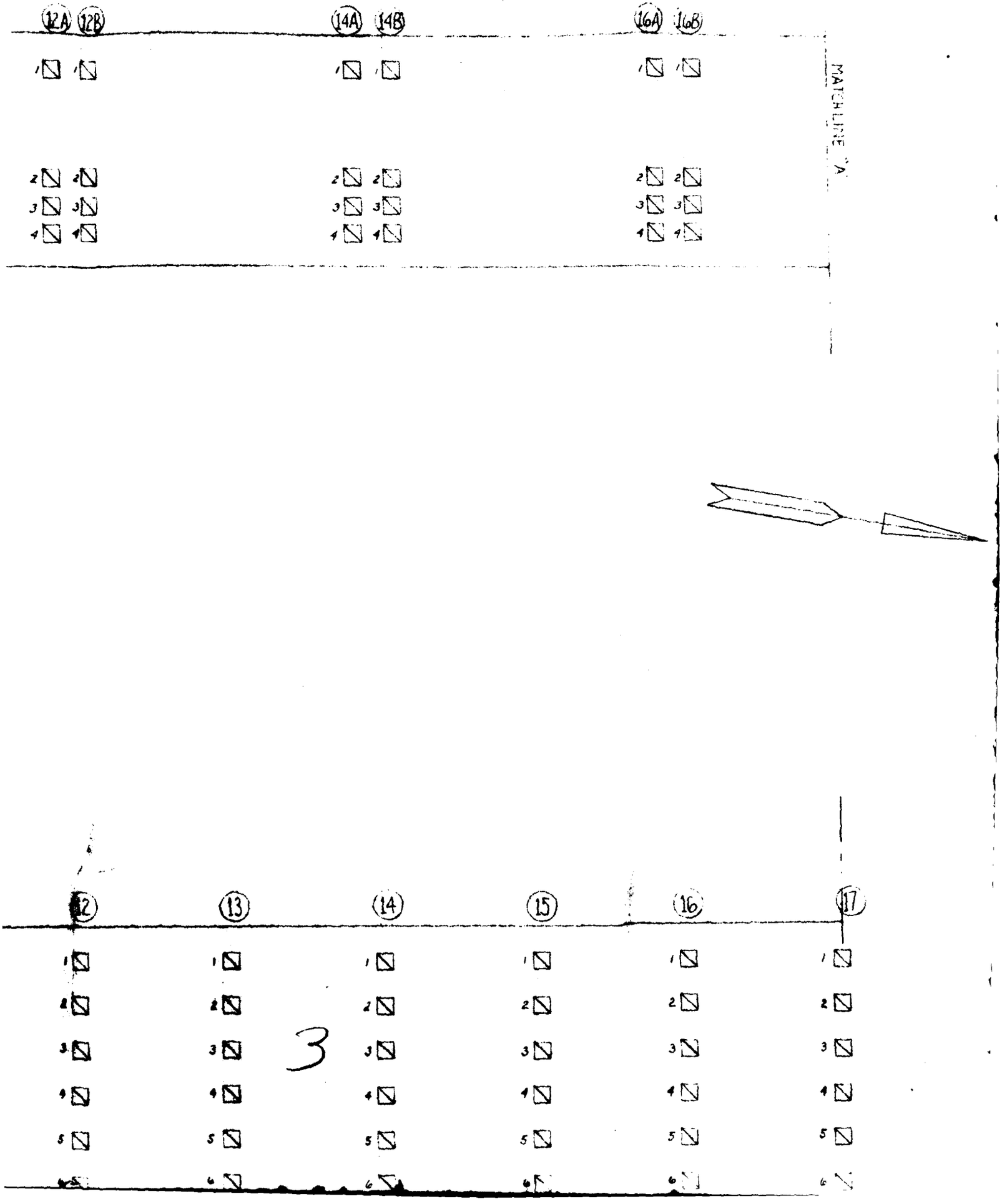
1-Heavy coverage (80-100% area)
2-Medium coverage (60-80% area)
3-Light coverage (less than 60% area)
a-Thick coverage (1 1/2" or greater)
b-Average coverage (3/4" to 1 1/2")
c-Thin coverage (3/4" or less)

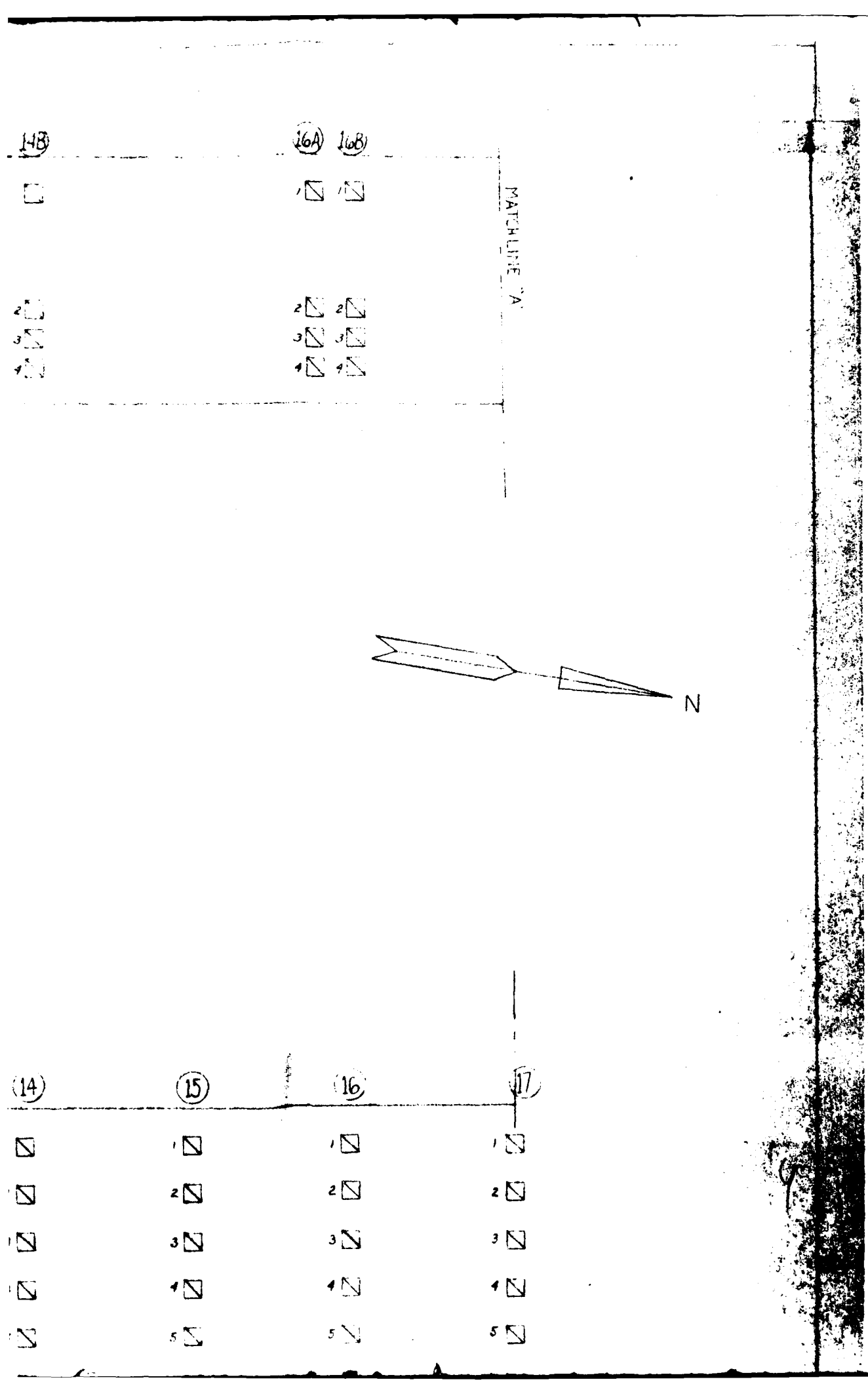

2A
2B
3A
3B
4A
1
2
3
4
5

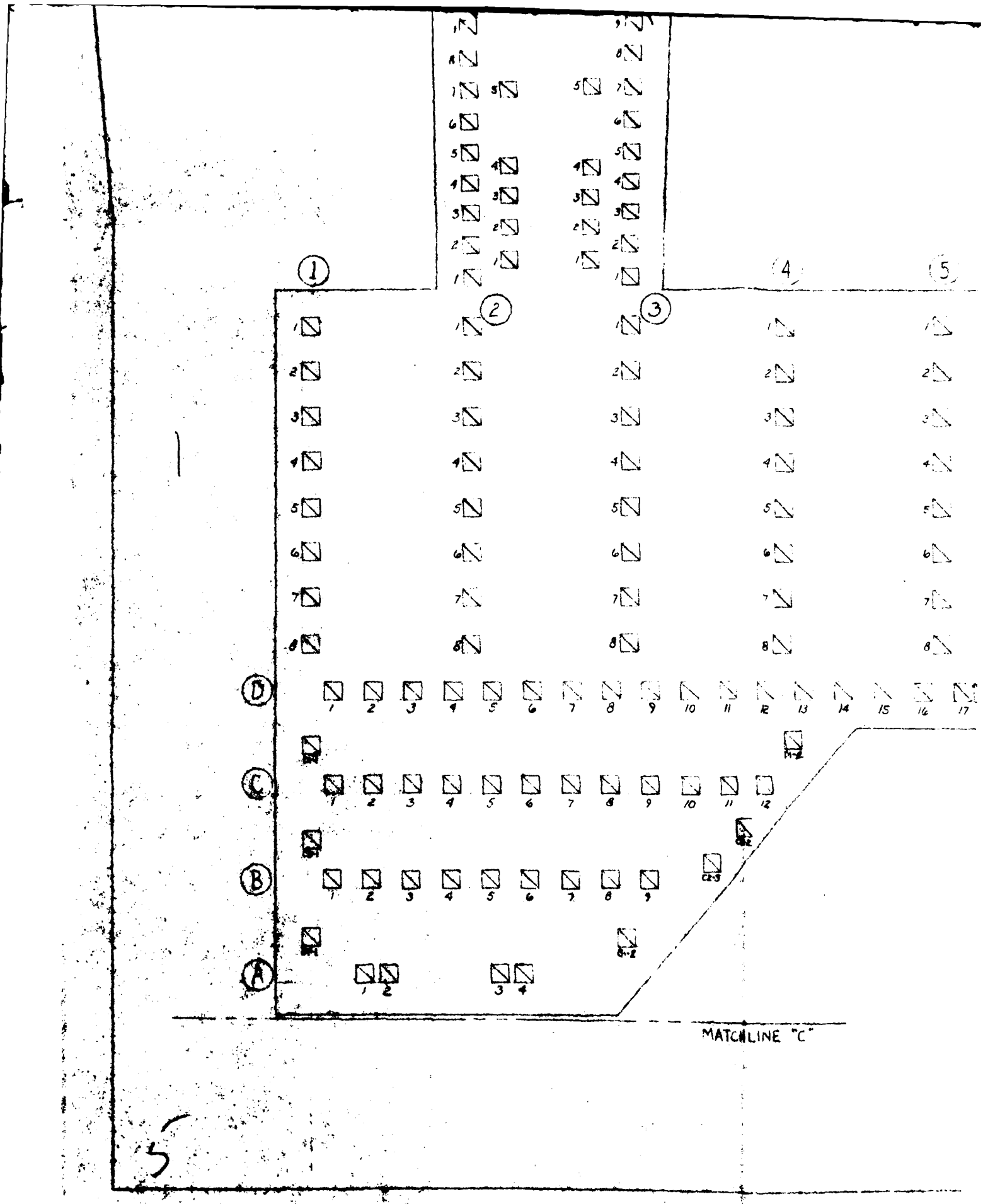


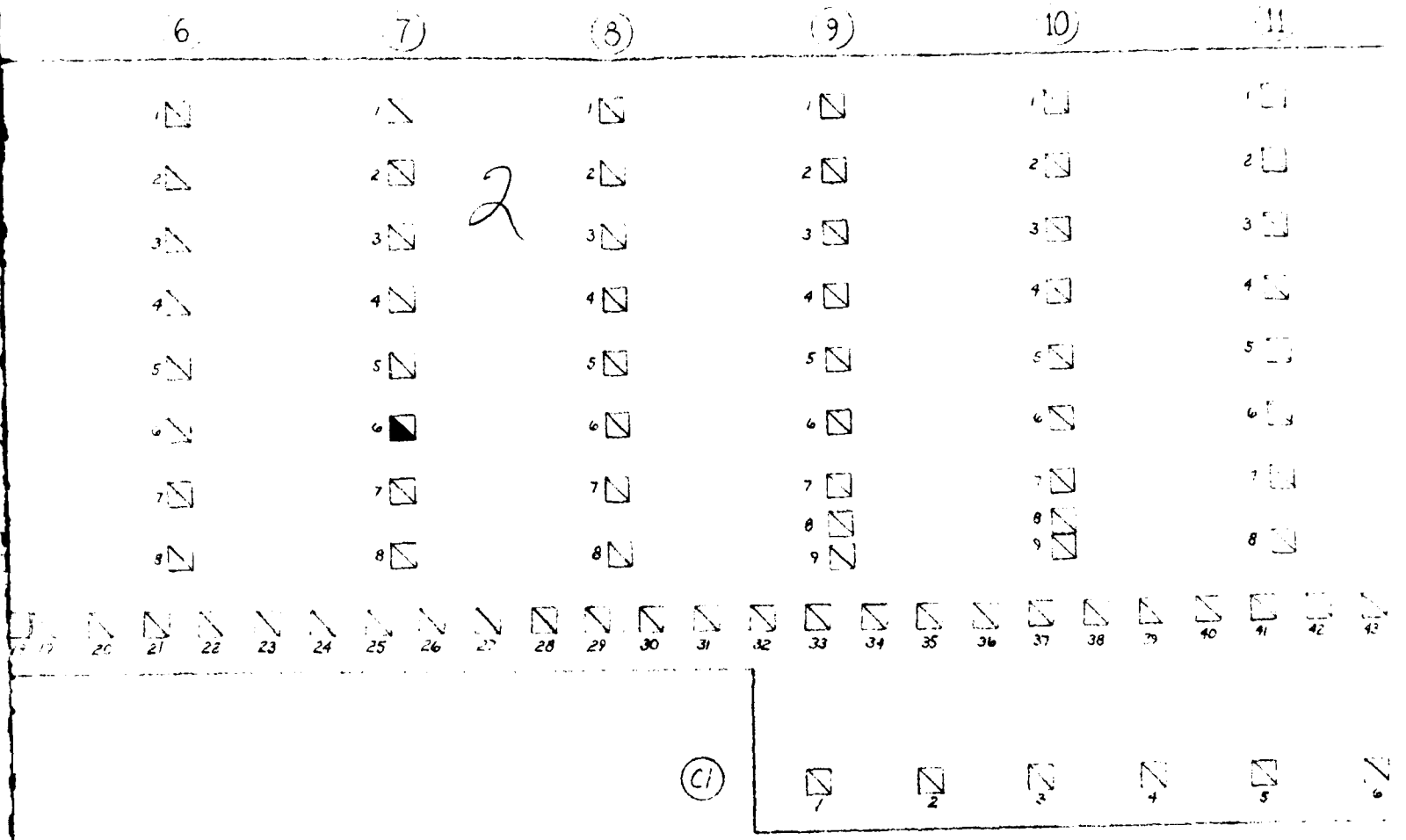
6	7	8	9	10	11	12
1	1	1	1	1	1	1
2	2	2	2	2	2	2
3	3	3	3	3	3	3
4	4	4	4	4	4	4
5	5	5	5	5	5	5
						6

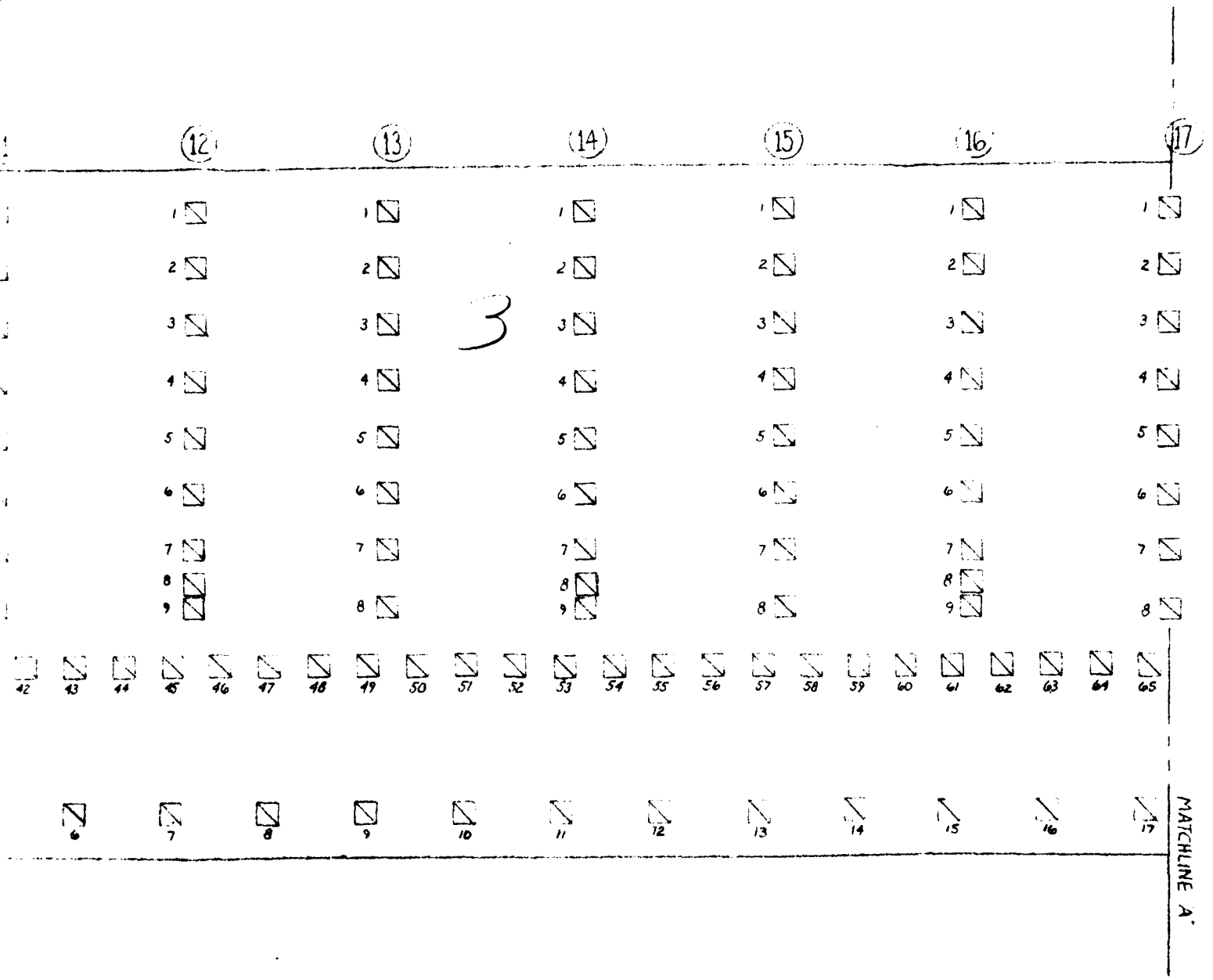
2


12A
12B
14A
14B
16A
16B
MATCHLINE "A"
12
13
14
15
16
17
3


14B
16A
16B
MATCHLINE "A"
N
14
15
16
17


1
2
3
4
5
D
C
B
A
MATCHLINE "C"


6
7
8
9
10
11
2
C1



KEY

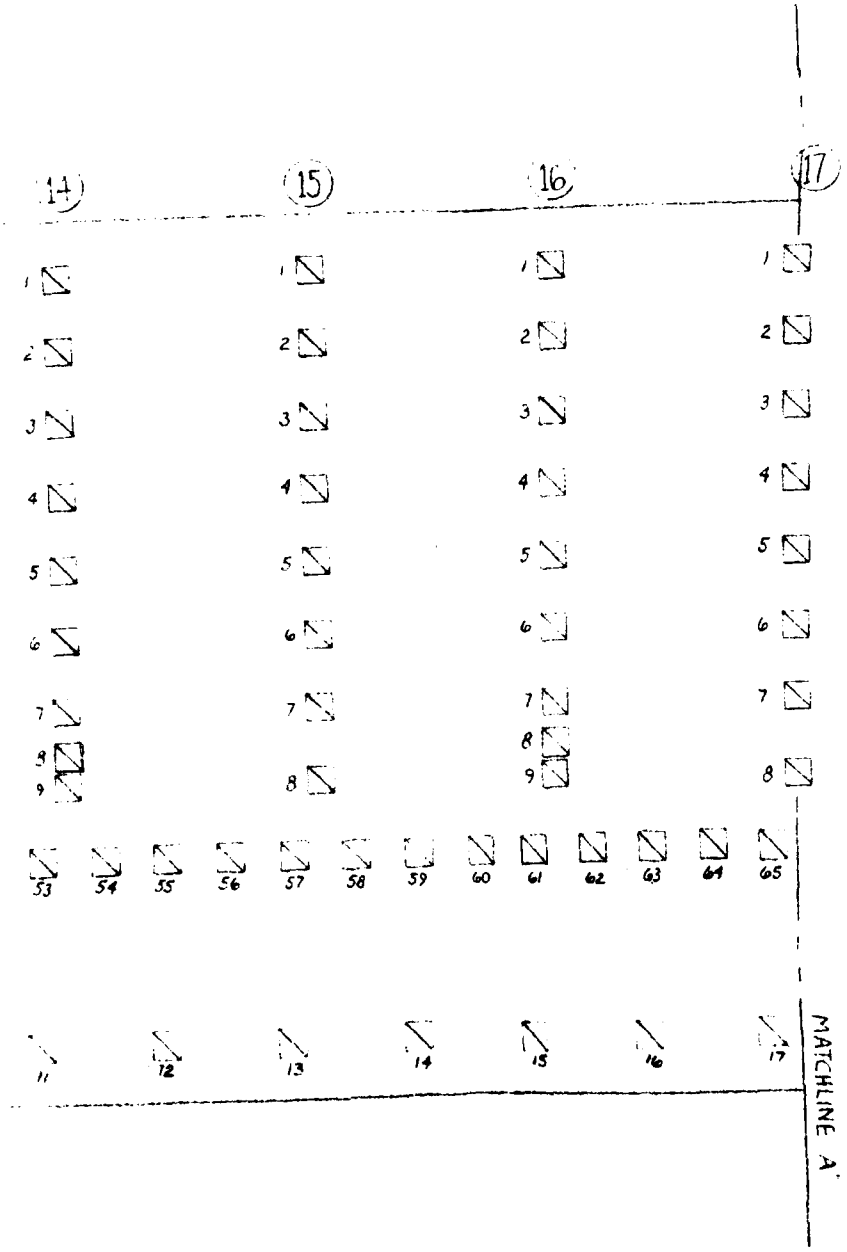
- SUPPORT PILE
- SUPPORT PILE, INSPECTED 6/81, GOOD CONDITION
- DAMAGED PILE
- BENT DESIGNATION

DRWG 1 OF 3

PILE PLAN – EHW
STRATEGIC WEAPONS FACILITY PACIFIC,

UNDERWATER FACILITY ASSESSMENT
CHESDIV, NAVFACENGCOM
CONTRACT N- 62477-80-C-0233
WISWELL, INC., SOUTHPORT, CT.

7



4

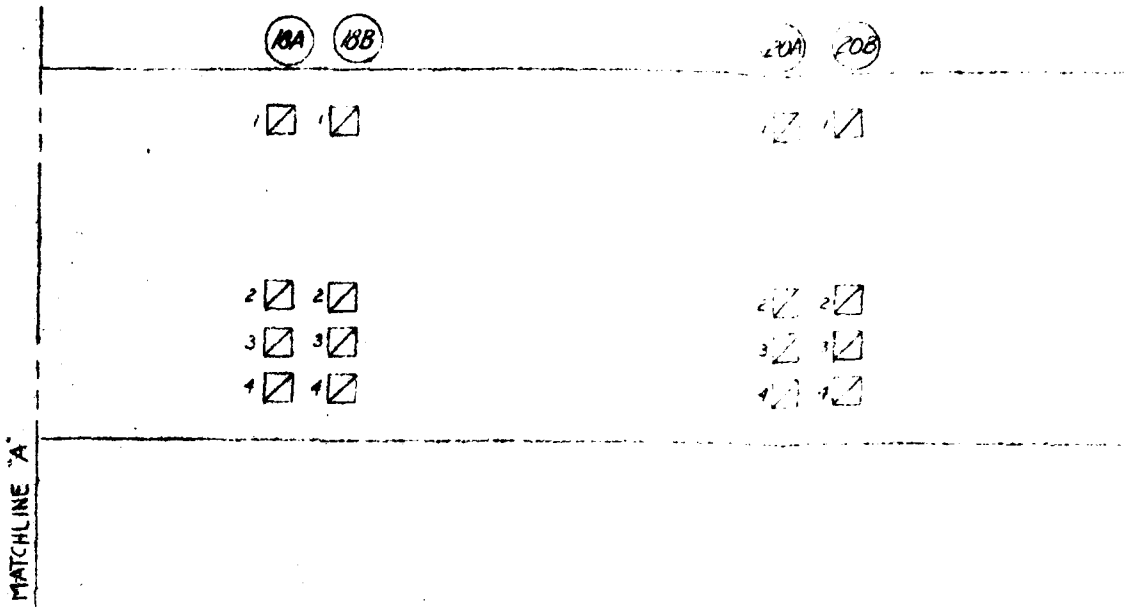
DRWG 1 OF 3

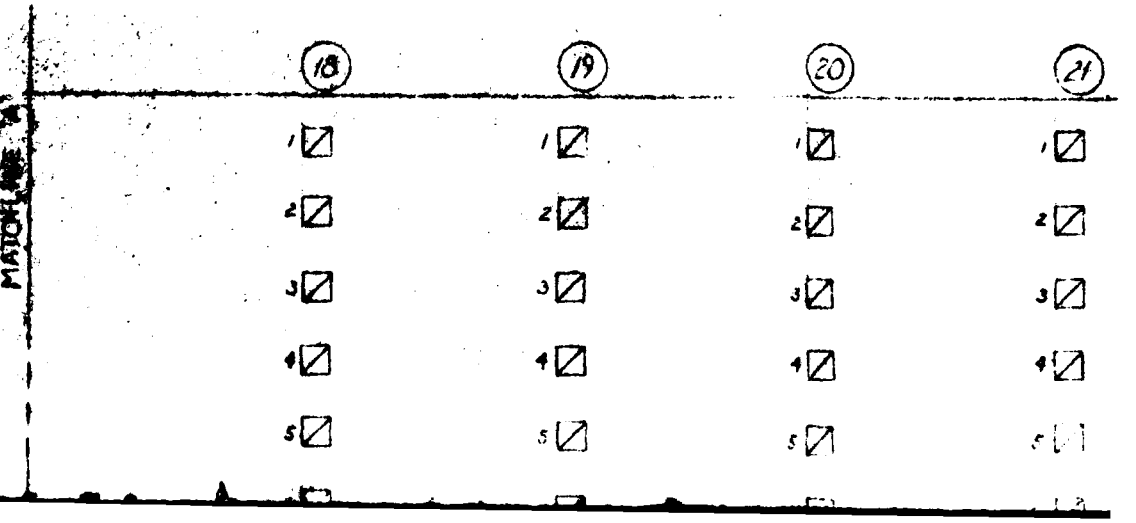
PILE PLAN – EHW-1

STRATEGIC WEAPONS FACILITY PACIFIC, BANGOR, WASHINGTON

UNDERWATER FACILITY ASSESSMENT CHESDIV, NAVFACENGCOM CONTRACT N-62477-80-C-0233 WISWELL, INC., SOUTHPORT, CT.	DATE: 9/20/81 SCALE: NOT TO SCALE DRW BY SMJ, APP BY: RHJ REVISED

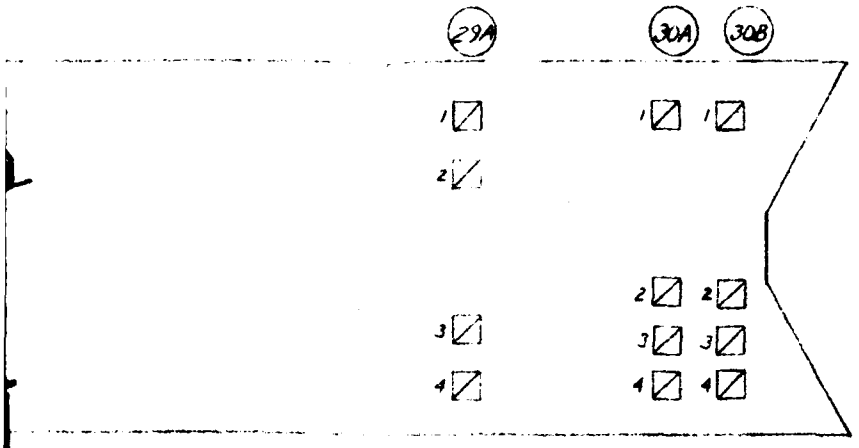
...SPECTED 6/81,
...ITION
...E
BY
...ON

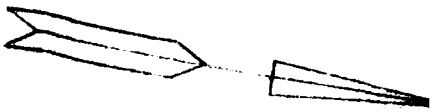

18A
18B
20A
20B
1
2
3
4
MATCHLINE "A"

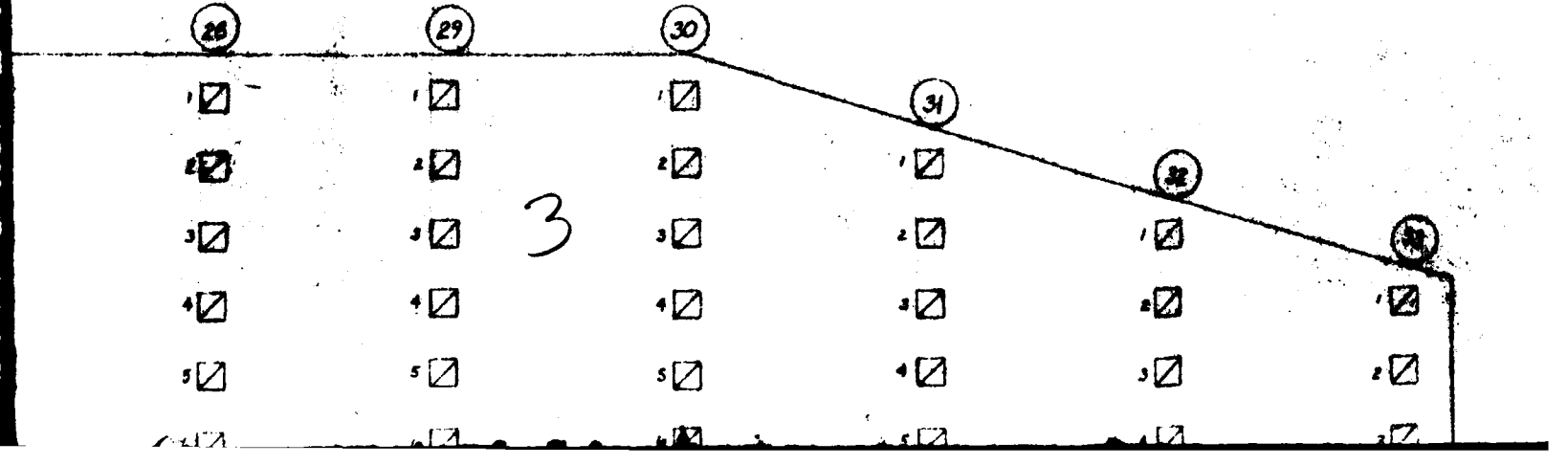

18
19
20
21
1
2
3
4
5
MATCHLINE "A"

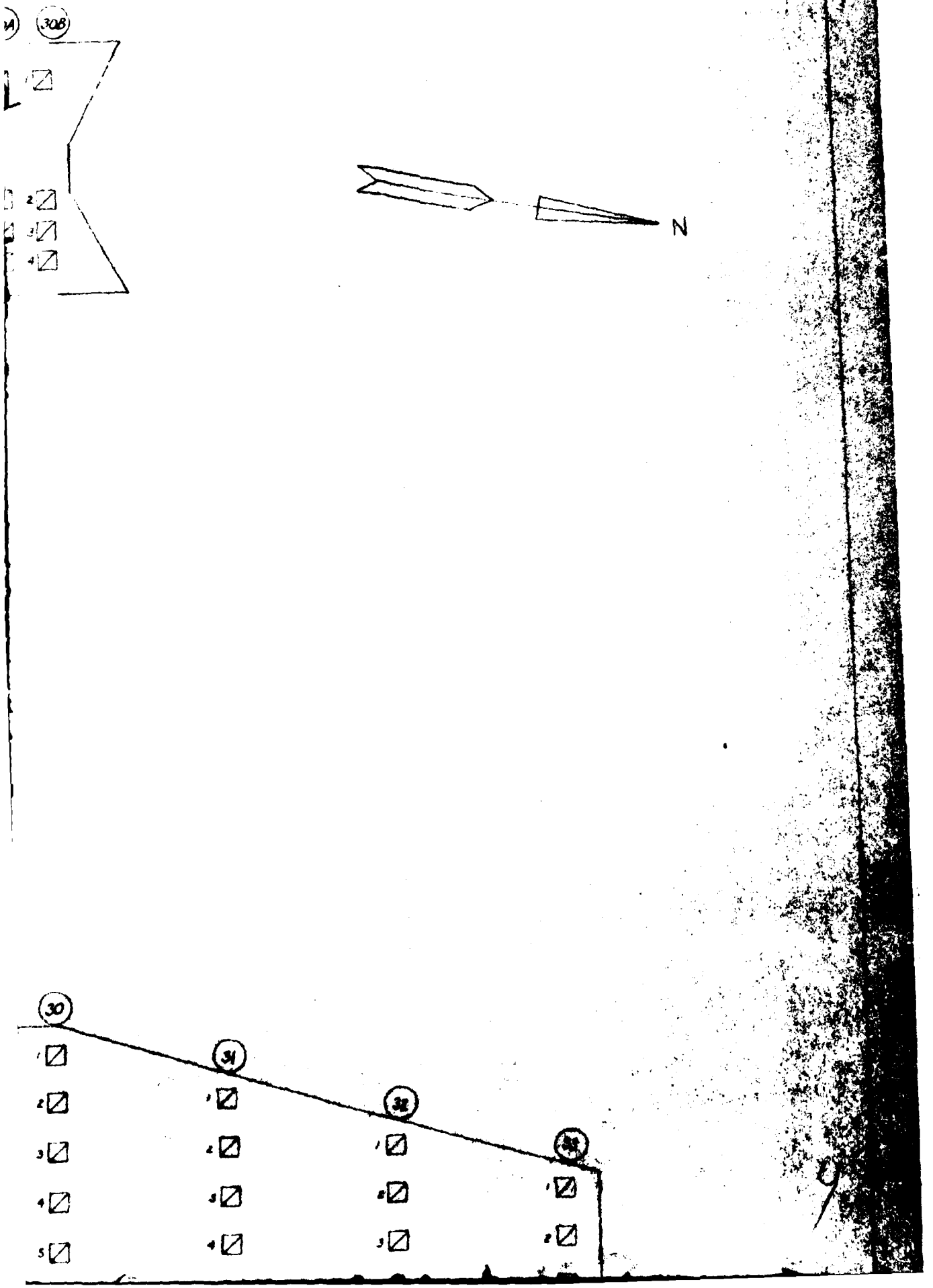
22A	22B	24A	24B	25A	25B	27A
1 ☒	1 ☒	1 ☒	1 ☒	1 ☒	1 ☒	1 ☒
						2 ☒
2 ☒	2 ☒	2 ☒	2 ☒	2 ☒	2 ☒	
3 ☒	3 ☒	3 ☒	3 ☒	3 ☒	3 ☒	3 ☒
4 ☒	4 ☒	4 ☒	4 ☒	4 ☒	4 ☒	4 ☒

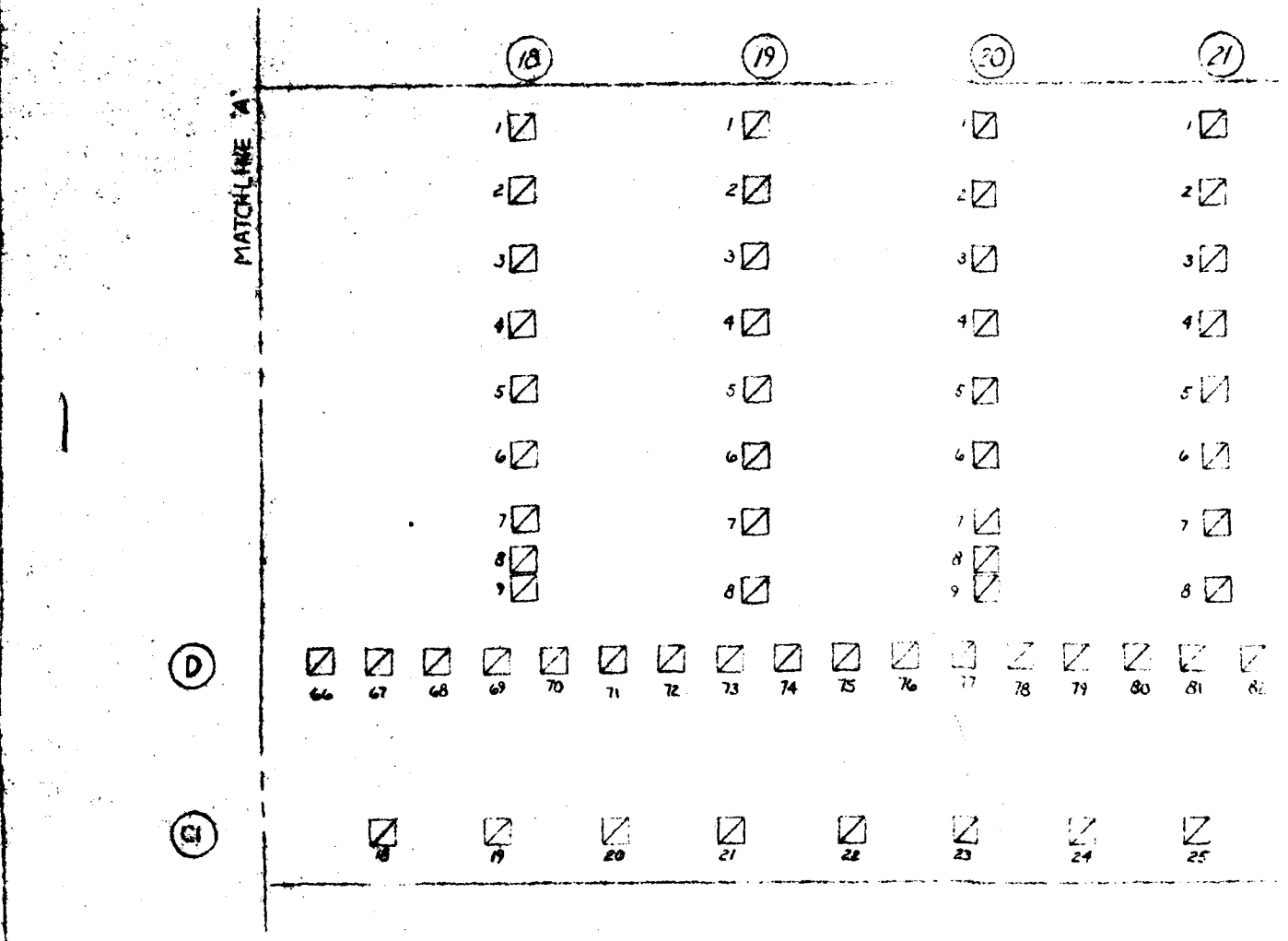
22	23	24	25	26	27
1 ☒	1 ☒	1 ☒	1 ☒	1 ☒	1 ☒
2 ☒	2 ☒	2 ☒	2 ☒	2 ☒	2 ☒
3 ☒	2 3 ☒	3 ☒	3 ☒	3 ☒	3 ☒
4 ☒	4 ☒	4 ☒	4 ☒	4 ☒	4 ☒
5 ☒	5 ☒	5 ☒	5 ☒	5 ☒	5 ☒
6 ☒	6 ☒	6 ☒	6 ☒	6 ☒	6 ☒

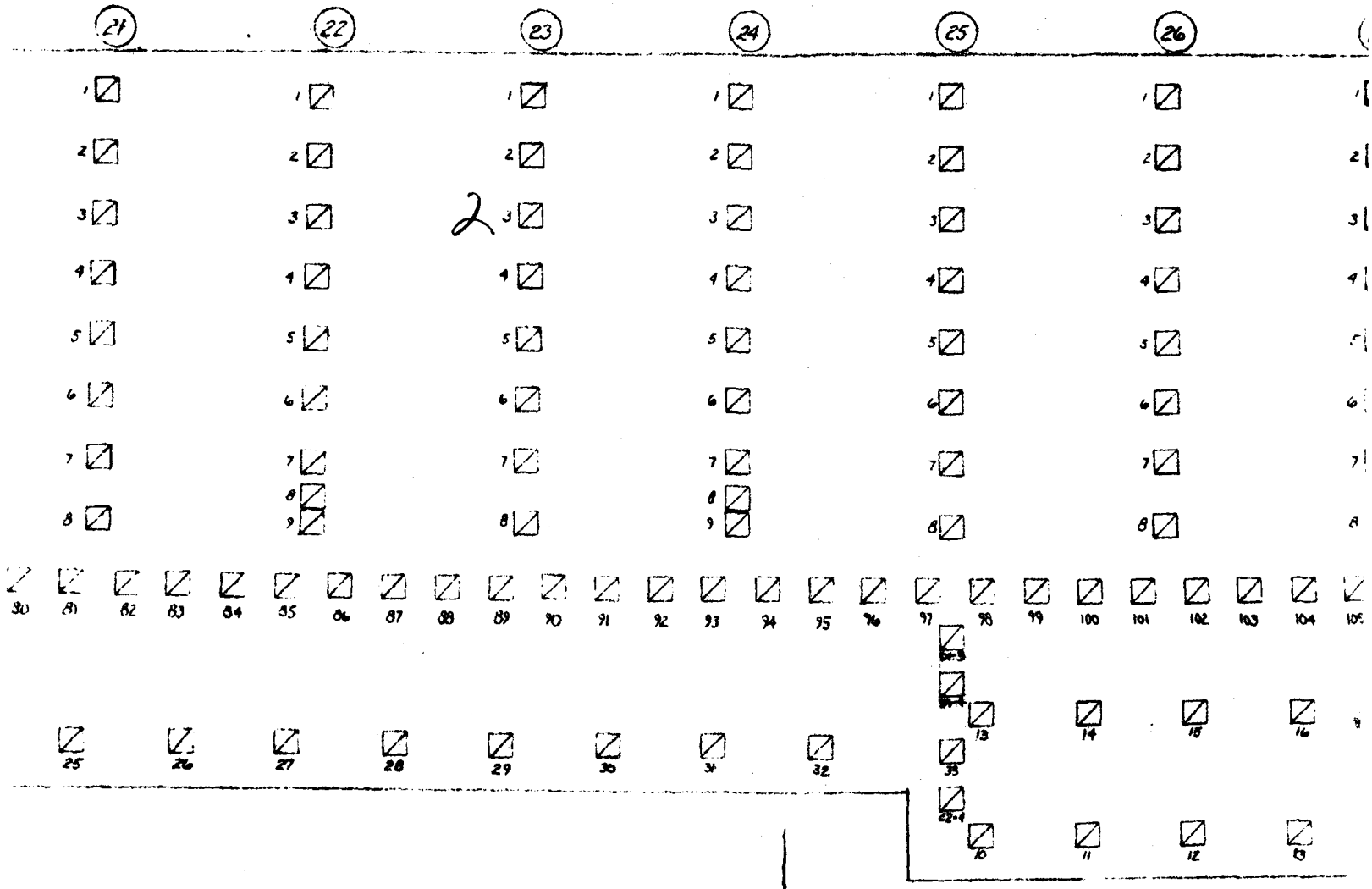

29A
30A
30B

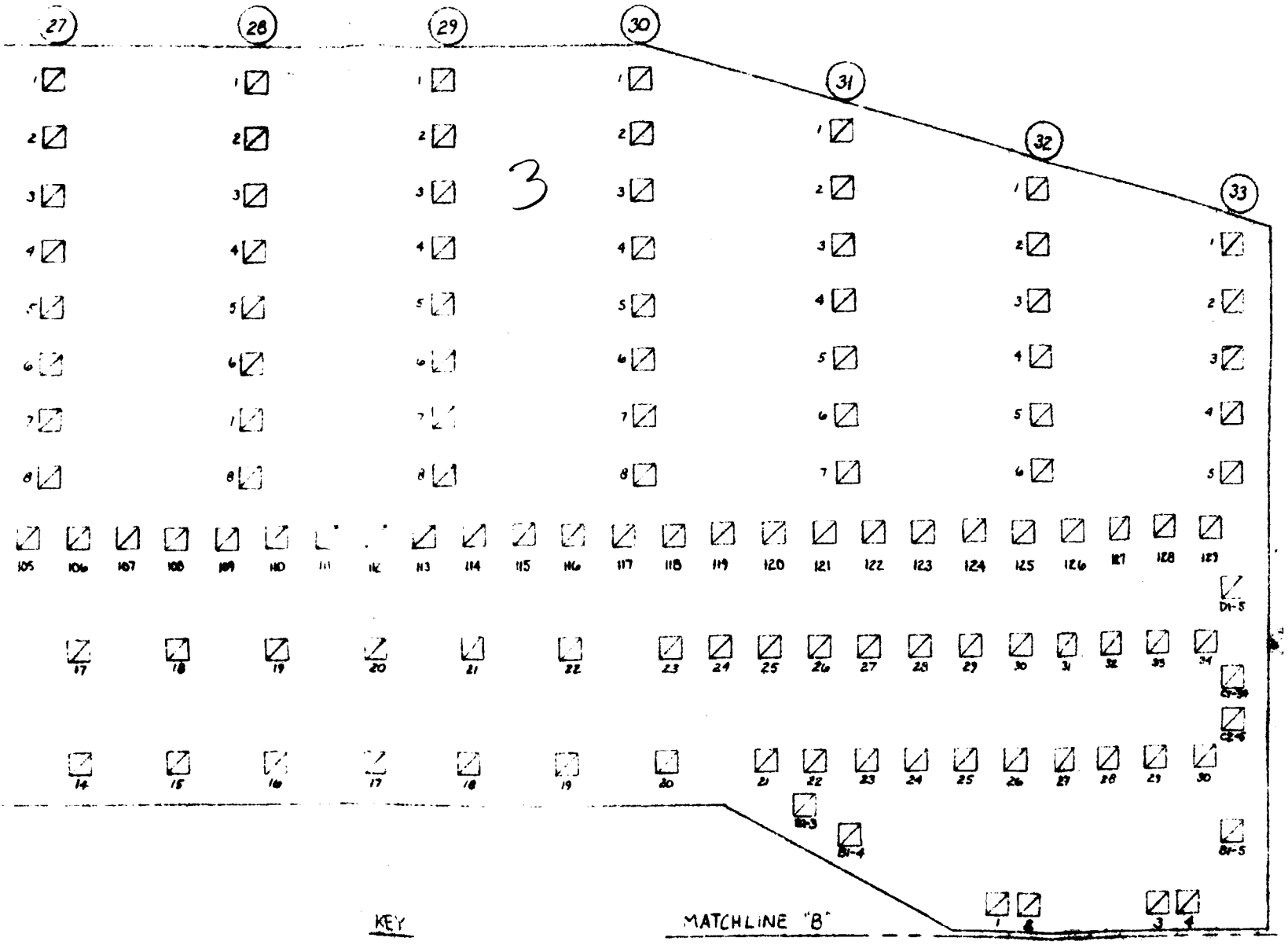



28
29
30
31
32
33


30
31
32
N


MATCHLINE "A"
18
19
20
21
1
2
3
4
5
6
7
8
9
D
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
C1
18
19
20
21
22
23
24
25


21
22
23
24
25
26
2
6

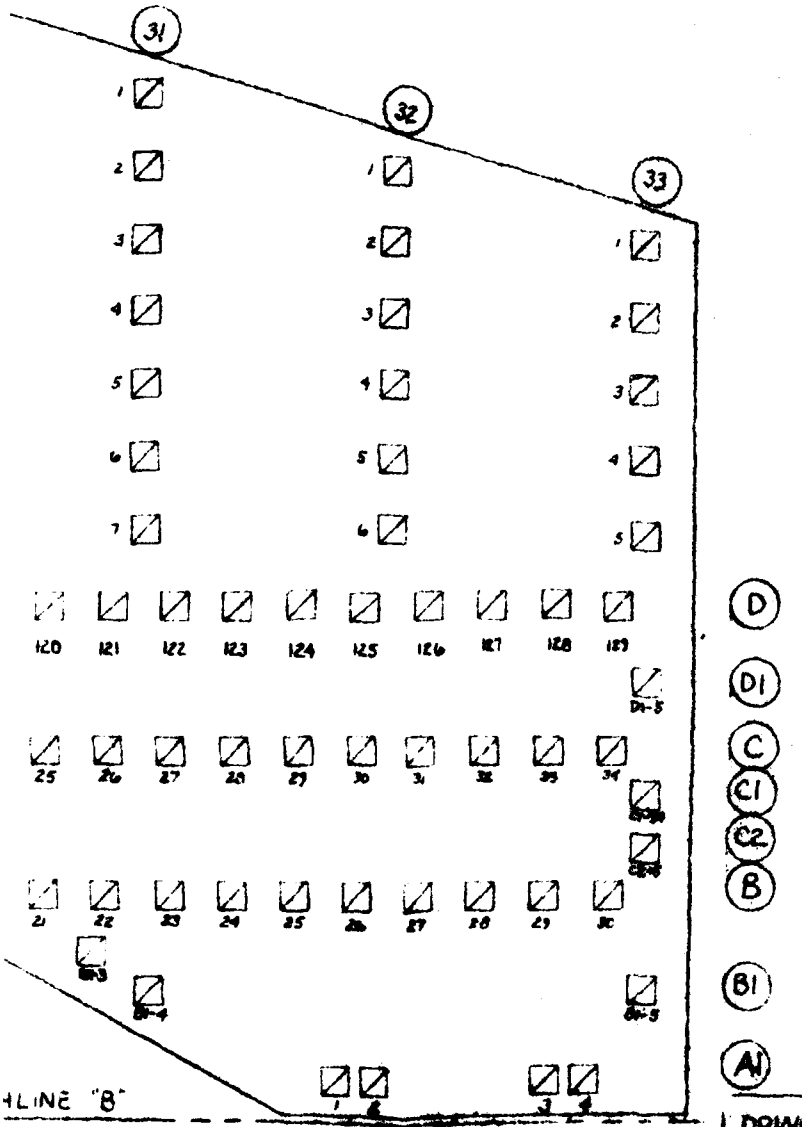


KEY

- SUPPORT PILE
- SUPPORT PILE, INSPECTED 6/8' GOOD CONDITION
- DAMAGED PILE
- BENT DESIGNATION

PILE PLAN - EHW-1
STRATEGIC WEAPONS FACILITY PACIFIC

UNDERWATER FACILITY ASSESSMENT
CHESDIV, NAVFACENGCOM
CONTRACT N-62477-80-C-0233
WISWELL, INC., SOUTHPORT, CT



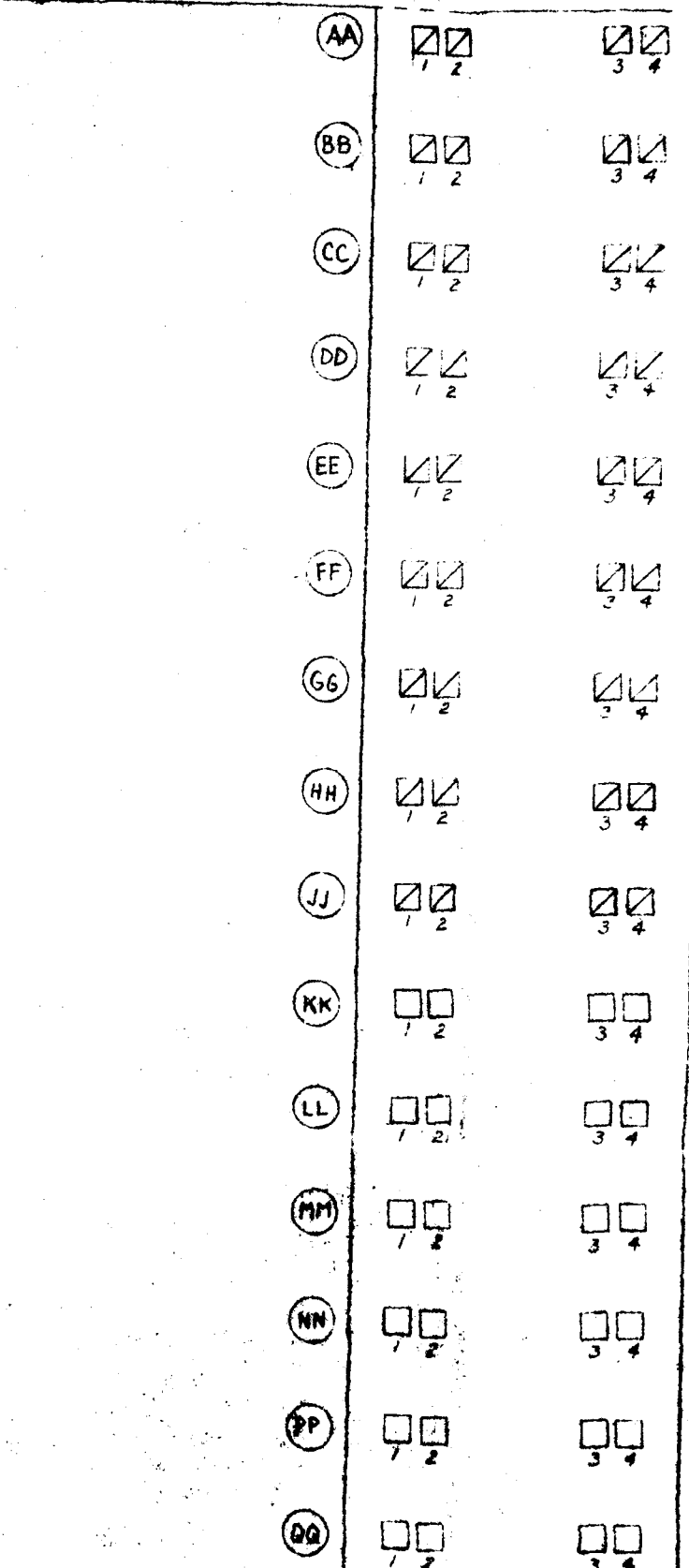
DRWG 2 OF 3

PILE PLAN - EHW-1
STRATEGIC WEAPONS FACILITY PACIFIC, BANGOR, WASHINGTON

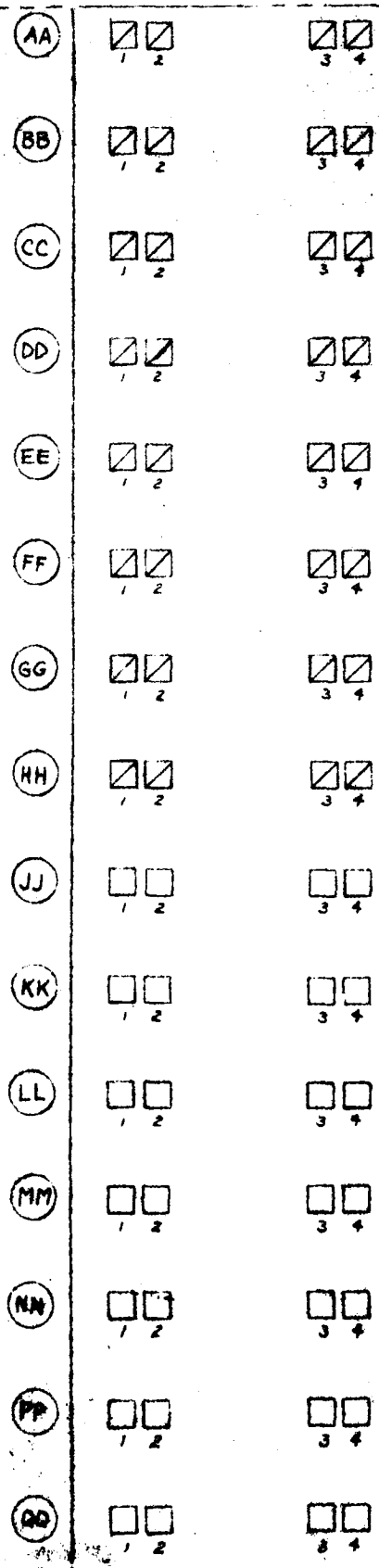
UNDERWATER FACILITY ASSESSMENT
CHESDIV, NAVFACENGCOM
CONTRACT N-62477-80-C-0233
WISWELL, INC., SOUTHPORT, CT

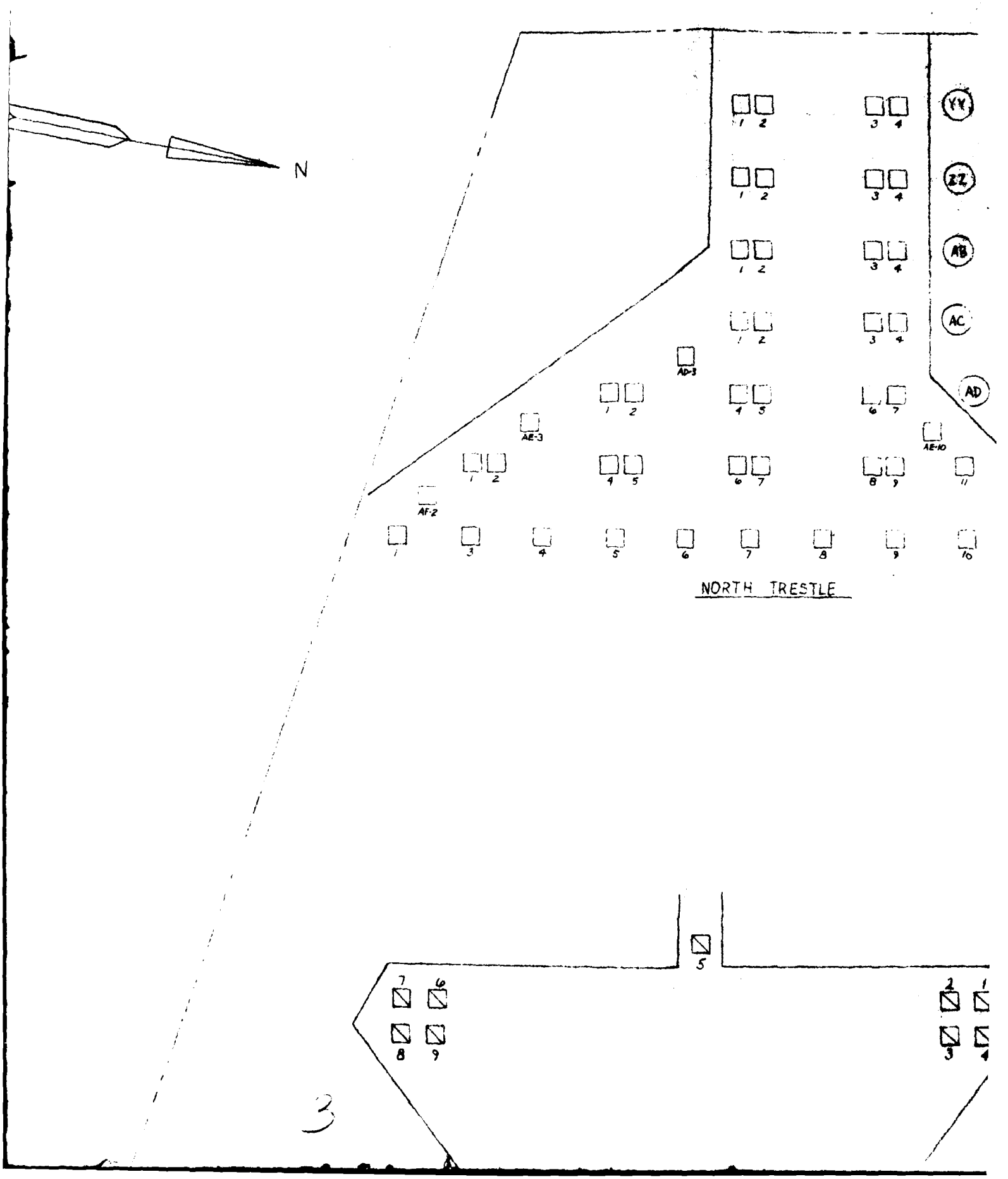
DATE: 9/20/81
SCALE: NOT TO SCALE
DRWN BY: SMJ, APP BY: RHJ
REVISED:

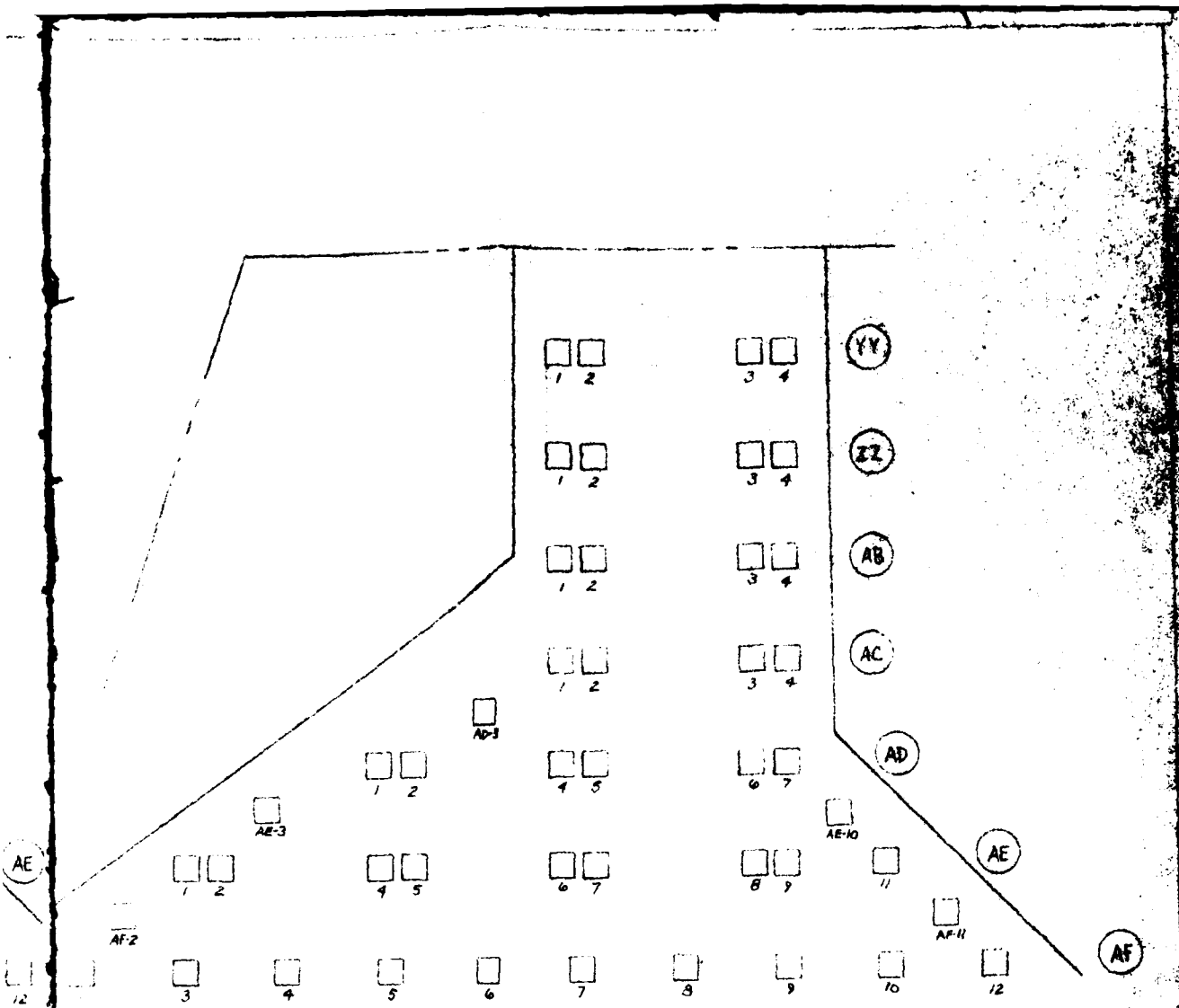
MATCHLINE "C"

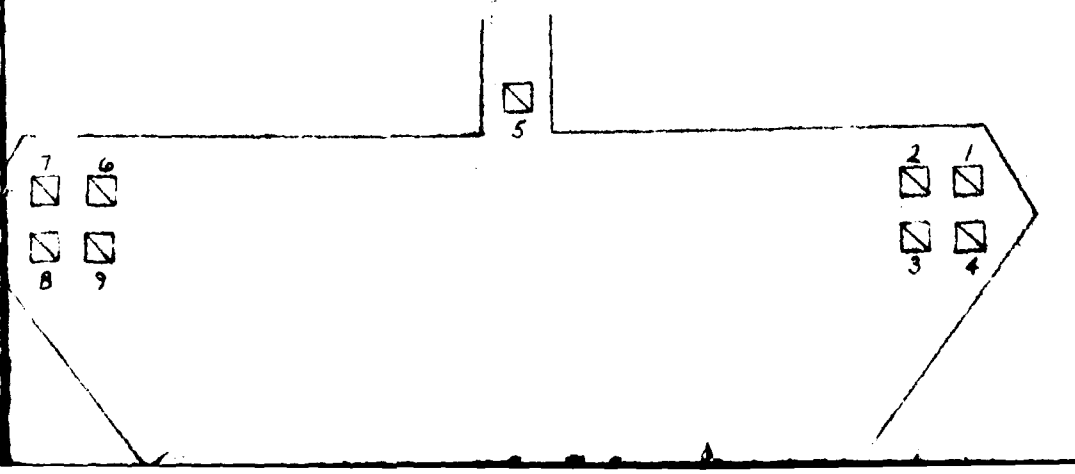

AA
1 2
3 4
BB
1 2
3 4
CC
1 2
3 4
DD
1 2
3 4
EE
1 2
3 4
FF
1 2
3 4
GG
1 2
3 4
HH
1 2
3 4
JJ
1 2
3 4
KK
1 2
3 4
LL
1 2
3 4
MM
1 2
3 4
NN
1 2
3 4
PP
1 2
3 4
QQ
1 2
3 4

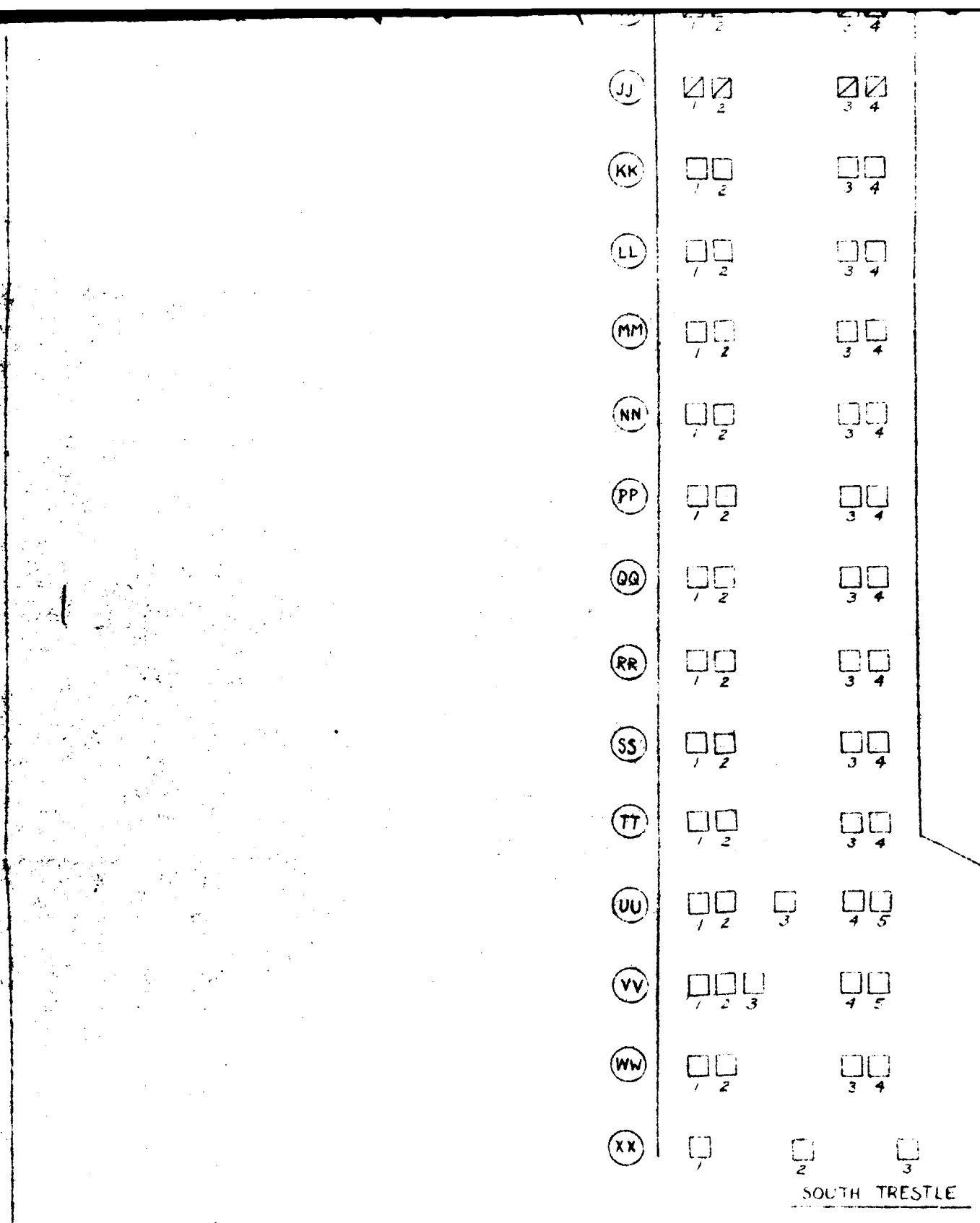
MATCHLINE "B"

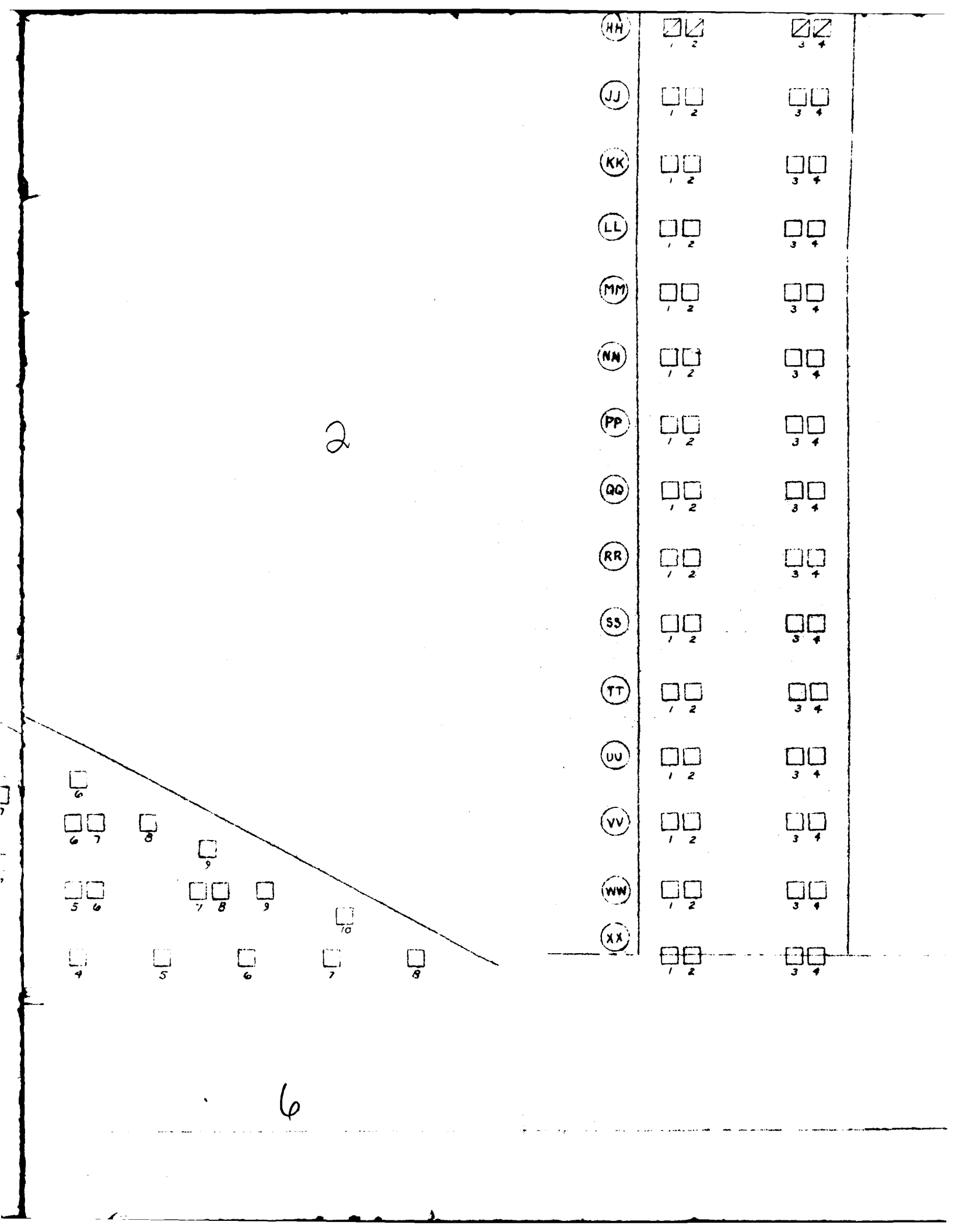



N
YY
ZZ
AB
AC
AD
AD-3
AE-3
AE-10
AF-2
NORTH TRESTLE

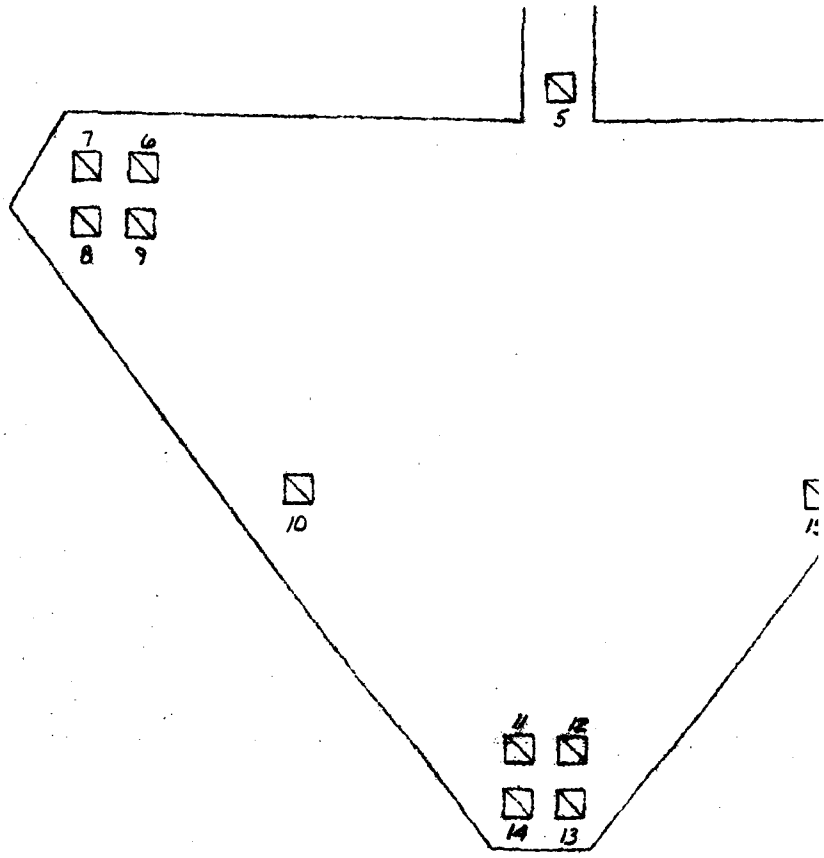

YY
ZZ
AB
AC
AD
AE
AF
AD-3
AE-3
AE-10
AF-2
AF-11
NORTH TRESTLE




JJ
KK
LL
MM
NN
PP
QQ
RR
SS
TT
UU
VV
WW
XX
SOUTH TRESTLE


HH
JJ
KK
LL
MM
NN
PP
QQ
RR
SS
TT
UU
VV
WW
XX
1 2
3 4
2
6
6 7 8
9
5 6 7 8 9
10
4 5 6 7 8
6

NORTH TRESTLE



LIGHTNING TOWER

KEY

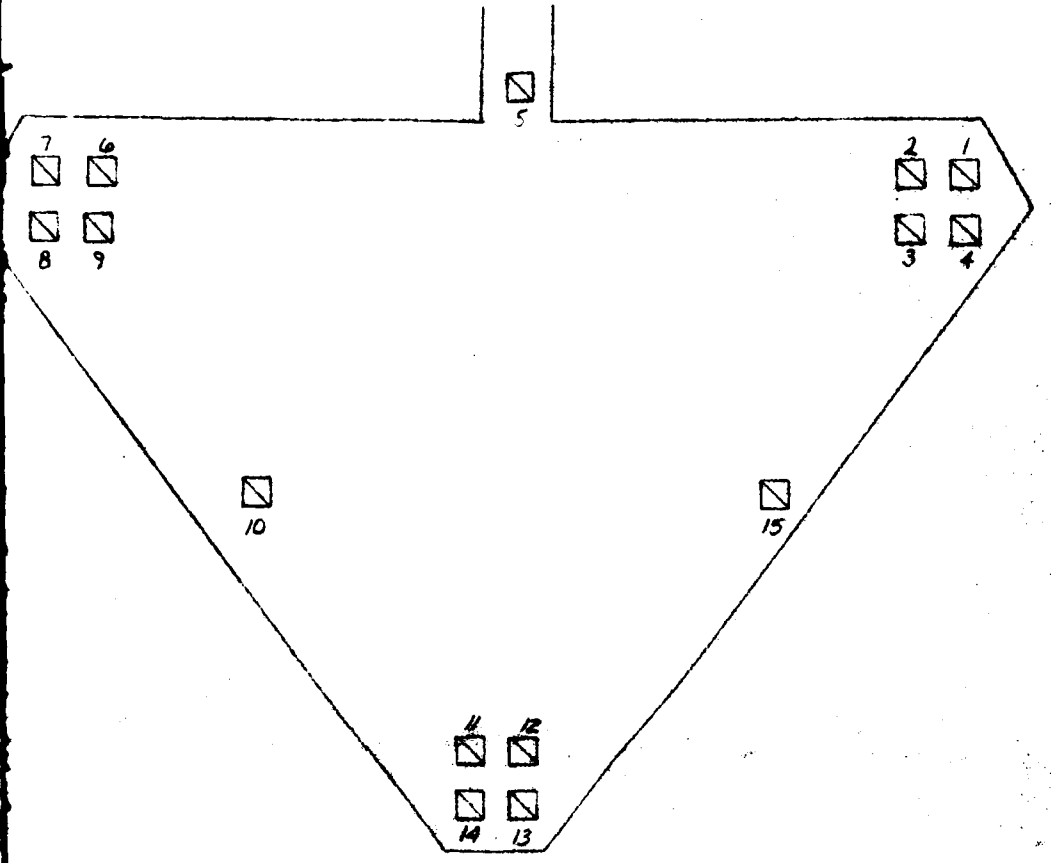
- SUPPORT PILE
- SUPPORT PILE, INSPECTED 6/81, GOOD CONDITION
- DAMAGED PILE
- BENT DESIGNATION

DRWG 3

PILE PLAN -
STRATEGIC WEAPONS FACILITY

UNDERWATER FACILITY ASSESSMENT
CHESDIV, NAVFACENGCOM
CONTRACT N-62477-80-C-0233
WISWELL, INC., SOUTHPORT, CT

NORTH



LIGHTNING TOWER

TED 6/81.

DRWG 3 OF 3

PILE PLAN – EHW-1
STRATEGIC WEAPONS FACILITY PACIFIC, BANGOR, WASHINGTON

UNDERWATER FACILITY ASSESSMENT	DATE: 9/20/81
CHESDIV, NAVFACENGCOM	SCALE: NOT TO SCALE
CONTRACT N-62477-80-C-0233	DRWN BY: SMJ, APP BY:
WISWELL, INC., SOUTHPORT, CT	REVISED:

8

END

DATE
FILMED

6-86

DTIC