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UNDERWATER FACILITIES INSPECTION AND ASSESSMENT AT
DEEPENING PIER TRIDENT (U) AGI (J) AND ASSOCIATES INC
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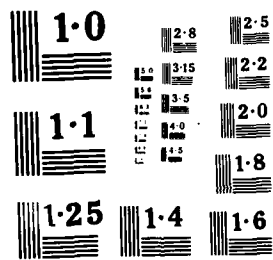
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UNDERWATER FACILITIES
INSPECTION AND ASSESSMENT

AT

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**DEPERMING PIER
TRIDENT REFIT FACILITY
BANGOR, WASHINGTON**

FPO-L-85 (6)

January, 1985

Performed for:

Ocean Engineering and Construction Project Office
Chesapeake Division
Naval Facilities Engineering Command
Washington, D.C. 20374

Under:

Contract N62477-84-D-0024
Amendment No: 0002

By:

J. Agi & Associates Inc.
1414 Alaskan Way, Suite 600
Seattle, Washington 90101

Project No.: 84-5-2-166

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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-1-85(6)	
6a. NAME OF PERFORM. ORG. J. Agi & Associates		7a. NAME OF MONITORING ORGANIZATION Ocean Engineering & Construction Project Office CHESNAVFACENCOM	
6b. OFFICE SYM		7b. ADDRESS (City, State, and Zip) BLDG. 212, Washington Navy Yard Washington, D.C. 20374-2121	
6c. ADDRESS (City, State, and Zip Code) 1414 Alaskan Way, Suite 600 Seattle, WA 90101		9. PROCUREMENT INSTRUMENT INDENT # N62477-84-D-0190-0024 Amendment No: 0002	
8a. NAME OF FUNDING ORG.		10. SOURCE OF FUNDING NUMBERS	
8b. OFFICE SYM		PROGRAM PROJECT TASK WORK UNIT ELEMENT # # # ACCESS #	
8c. ADDRESS (City, State & Zip)		11. TITLE (Including Security Classification) Underwater Facilities Inspections and Assessments at Deperming Pier Trident Refit Facility Bangor, Washington	
12. PERSONAL AUTHOR(S)			
13a. TYPE OF REPORT		13b. TIME COVERED	
FROM TO		14. DATE OF REP. (YYMMDD) 15. PAGES 85-01 71	
16. SUPPLEMENTARY NOTATION			
17. COSATI CODES		18. SUBJECT TERMS (Continue on reverse if nec.)	
FIELD	GROUP	SUB-GROUP	Underwater inspection, Deperming Pier Trident Refit Facility, Bangor, Bangor, WA
19. ABSTRACT (Continue on reverse if necessary & identify by block number) All timber braces in the intertidal and submerged zones of the Magnetic Silencing Facility Deperming Pier at the Trident Refit Facility, Naval Submarine Base Bangor, Washington were subjected to Level I and II examination. This inspection was carried out to determine the overall--(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	
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condition of the members and to identify specific defective member which might require maintenance and repair.

The overall condition of the members ranged from very good to fair. The intertidal diagonal braces and horizontal wales were found to be in very good condition with only 4% of the members found attacked or damaged. The submerged zone timbers such as the "X" and "Z" loop trays and tray support timbers were found to be in fair to good condition, with several members having sustained significant marine borer attack or damage. The total number of defective timbers found is approximately 283. It is recommended that these timbers be subjected to preventative or restorative maintenance and repair.

It is estimated that repairs to defective timbers will cost between \$230,000 and \$290,000 depending on repair methods used. These fees are based on replacing damaged members with either high retention (20 lbs/ft.³) creosote treated pre-drilled timbers or with molded fiberglass members. The choice of material and repair/replacement techniques will affect the final fee. Subsequent to necessary repairs, it is also recommended that periodic examinations be carried out to monitor the condition of the members. These examinations will, as in the case of the current inspection, identify specific members that may require maintenance.

EXECUTIVE SUMMARY

All timber braces in the intertidal and submerged zones of the Magnetic Silencing Facility Deperming Pier at the Trident Refit Facility, Naval Submarine Base Bangor, Washington were subjected to Level I and II examination. This inspection was carried out to determine the overall condition of the members and to identify specific defective members which might require maintenance and repair.

The overall condition of the members ranged from very good to fair. The intertidal diagonal braces and horizontal wales were found to be in very good condition with only 4% of the members found attacked or damaged. The submerged zone timbers such as the 'X' and 'Z' loop trays and tray support timbers were found to be in fair to good condition, with several members having sustained significant marine borer attack or damage. The total number of defective timbers found is approximately 283. It is recommended that these timbers be subjected to preventative or restorative maintenance and repair.

It is estimated that repairs to defective timbers will cost between \$230,000 and \$290,000 depending on repair methods used. These fees are based on replacing damaged members with either high retention (20 lbs/ft.³) creosote treated pre-drilled timbers or with molded fiberglass members. The choice of material and repair/replacement techniques will affect the final fee. Subsequent to necessary repairs, it is also recommended that periodic examinations be carried out to monitor the condition of the members. These examinations will, as in the case of the current inspection, identify specific members that may require maintenance.

Keywords: Under-water inspection; Washington (State).

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DEPERMING PIER
EXECUTIVE SUMMARY TABLE FOR
TIMBER BRACING

<u>STRUCTURAL ELEMENTS</u>	<u>SIZE</u>	<u># OF MEMBERS/LF</u>	<u>MEMBERS MATERIAL</u>	<u>RECOMMENDED MAINTENANCE</u>	<u>ESTIMATED COST OF REPAIRS</u>
A. Cable assembly support timber					
1. X-loop tray support timbers at pole ends	4" x 8" x 8'	240/-	Timber	Repair/replace 53 attacked or damaged timbers	As a unit cost tidal and under-water work
2. Z-loop tray support timbers	4" x 8" x 8'	160/-	Timber	Replace 12 attacked or damaged timbers	
3. X-loop cleats Bents 66-71 only	4" x 8" x 8'	72/-	Timber	Replace 16 damaged timbers	
4. Miscellaneous Timbers	4" x 8" x 8'	100/	Timber	Replace approximately 119 defective timbers	
B. Z-loop tray timbers	4" x 8"	-/2400	Timber	Replace 52 attacked or damaged timbers	Estimated at \$230,000 to \$290,000
C. Pile bracing Timber	4" x 8" x 20'	600/	Timber	Replace 31 attacked or damaged timbers	
		<u>T 1172/2400</u>		<u>T 283 damaged timbers</u>	<u>T 300K</u>

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SECTION 1 - INTRODUCTION

1.1 CONTRACT

Department of the Navy
Chesapeake Division, Naval Facilities Engineering Command
Building 212
Washington Navy Yard, Washington, D.C. 20374

1.2 CONTRACT NO

N62477-84-D-0024
Amendment/Modification No. 0002

1.3 INSPECTION DATE

7-11 January, 1985

1.4 CONTRACT DESCRIPTION

The contractor shall provide the personnel and equipment necessary to perform an underwater inspection of the cable assembly support timbers, Z-loop tray timbers and pile bracing timbers. The quality of the inspection shall be such as to allow the contractor to assess the general physical condition of the pier's cable support members which are submerged and/or subject to frequent wetting by wave or tidal action. After first studying the G.F.I., the contractor shall perform a Level I and II examination as follows:

Level I (see Section 1.6 for definition)

A Level I general examination shall be performed on all timber members supporting the X and Z loop cable trays, the longitudinal cable trays and the cross-bracing underneath the decking.

Level II (see Section 1.6 for definition)

A Level II examination shall be performed on all cable support members and 10% of the cross members. Each member must be cleaned on each end and along its length to the extent necessary to properly evaluate the condition and degree of damage or deterioration of the member.

The general pattern of inspection to be followed will be determined by mutual agreement between the contractor and the on-site government representative. That decision should be based upon the Level I findings.

1.5 INTRODUCTION TO PROJECT

This report is prepared under the Underwater Inspection Program conducted by the Ocean Engineering and Construction Project Office (FPO-1), Chesapeake Division, Naval Facilities Engineering Command as part of NAVFAC's Specialized Inspection Program. This is a task oriented engineering service program in support of inspection, analysis and design of repairs of the submerged portions of Navy Waterfront Facilities.

This report covers the inspection carried out on the Deperming Pier at the Magnetic Silencing Facility, Naval Submarine Base, Bangor, Washington. The purpose of the underwater assessment is to provide

a structural condition assessment and repair requirements report on the designated facilities within the activity.

A description of the facility, its location and mission is provided. Detailed results with respect to individual timber members and overall assessment of structural condition and recommendations are also given.

1.6 DEFINITIONS: LEVEL I AND II EXAMINATIONS

The following levels of examination are to be construed only as general guidelines and not specific task procedures. Within the description of any specific task, the level and complexity required in an inspection will probably be a blend or combination of the different levels of examination. Specific task descriptions will use these definitions as a reference.

Level I: General Examination: This type of examination is essentially a "swim-by" overview, which does not involve cleaning of any structural elements, and can therefore be conducted much more rapidly than the other levels of inspection. The Level I examinations should confirm as-built structural plans and detect obvious major damage or deterioration due to over-stress (ship impact, ice), severe corrosion, or extensive biological growth and attack. The underwater inspector shall rely primarily on visual and/or tactile observations (depending on water clarity) to make condition assessments. These observations are normally made over the specified exterior surface area of the underwater structure whether it is a quaywall, bulkhead, seawall, pile or mooring. Visual documentation (utilizing underwater television and/or

photography), may be included with the quantity and quality adequate for documentation of the findings which will be representative of the facility.

Level II: Detailed Examination: This type of inspection is directed toward detecting and describing damaged/deteriorated areas which may be hidden by surface biofouling or deterioration and toward obtaining a limited amount of deterioration measurements. This data should be sufficient to enable gross estimates to be made of facility load capability. Level II examination will often require cleaning of structural elements. Since cleaning is time consuming, it is generally restricted to areas that are critical or which may be representative of the entire structure itself. The amount and thoroughness of cleaning to be performed is governed by what is necessary to discern the general condition of the overall facility. Simple instruments such as calipers, measuring scales, and ice picks are commonly used to take physical measurements. However, a small percentage of more accurate measurements may also be taken with more sophisticated instruments for several reasons. These measurements will validate large numbers of simple measurements and in some hard-to-measure areas will actually be easier and faster to obtain. Where the visual scrutiny, cleaning, and/or simple measurements reveal extensive deterioration, a small sampling of detailed measurements will enable gross estimates to be made of the structure's integrity. For example, on extensively corroded steel 'H' piles, a small percentage should receive ultrasonic thickness measurements to determine typical cross-section profiles. The cross-sections determined by these spot checks would

be used to determine individual 'H' pile load capability which would then be extrapolated to obtain a "ballpark" estimate of overall facility load capability. Visual documentation (utilizing underwater television and/or photography) should be included with the quantity and quality adequate to be representative of the range of facility damage/deterioration.

1.7 POST INSPECTION BRIEFING

Following standard practice in the Underwater Inspection Program, an exit briefing was given to MSF/TRF personnel on 11 January 1985 by Mr. Wade F. Casey of Chesapeake Division, Naval Facility Engineering Command and Mr. Erling Vegsund of J. Agi and Associates, Inc.

Attendees were:

At TRF:

Mr. T. Forstall, Support Engr. Dept. Hd.
Mr. R. Bushnell, Facility Equipment
Maintenance Division Ltd.
Mr. D. Johnson, Engr. Tech.

At MSF:

Mr. G. Grade, Tech. Dir. MSF

The observations of the inspection prior to structural analysis were provided as a "heads up" on the apparent overall condition of the facilities. Subsequent engineering analysis, as indicated in this report, have elaborated on these observations with no significant changes in the general conclusion.

SECTION 2 - ACTIVITY DESCRIPTION

2.1 NAME OF ACTIVITY

Trident Refit Facility, Bangor, Washington

2.2 LOCATION OF ACTIVITY

The Trident Refit Facility is located at the Naval Submarine Base on Kitsap Peninsula in Puget Sound, due west of Seattle, Washington. The site is rural in nature and the nearest urban areas are Silverdale, Poulsbo and Keyport, with approximate populations of 1,000, 1,700, and 500 respectively. The Greater Seattle Metropolitan area with a population of approximately 500,000 is about one hour east by ferry and highway. Bremerton, site of the existing Naval Shipyard, is located 13 miles south of the Bangor Annex. The Naval Torpedo Station, Keyport, is located four miles east of the Submarine Base. (See Figures 2 and 3).

2.3 DESCRIPTION OF ACTIVITY

This activity maintains waterfront facilities which provide the interface between the submarines and the shore support activity. The task under the current contract covers only the Magnetic Silencing Facility Deperming Pier.

The Deperming/Degaussing area provides the facilities to detect and remove the magnetic forces in the submarine. The facility consists of two principal components, the Deperming Pier and the Degaussing Range. The Deperming Pier is a non-magnetic wood pile pier adequate in size to berth a TRIDENT submarine and is equipped to remove magnetic forces which develop in the submarine. This project was carried out to inspect the intertidal zone brace timbers and all underwater cable assembly support timbers.

SECTION 3 - INSPECTION PROCEDURE

An underwater inspection was carried out to assess the integrity of the intertidal zone brace timbers and the structural members supporting the magnetic silencing cables in the Deperming Pier of the Magnetic Silencing Facility, Naval Submarine Base, Bangor, Washington, during the week of January 7, 1985.

3.1 LEVEL OF EXAMINATION

A Level I and II examination was carried out on the timber braces and the electrical cable assembly support timbers as specified in paragraph 1.4, Contract Description.

3.2 INSPECTION PATTERN/SCOPE OF WORK

A Level I general examination and a Level II detailed cleaning and examination was carried out on the following members:

<u>STRUCTURAL ELEMENTS</u>	<u>SIZE</u>	<u># OF MEMBERS/LF</u>	<u>MEMBERS MATERIAL</u>
A. Cable assembly support timber			
1. X-loop tray support timbers at pole ends	4" x 8" x 8'	240/-	Timber
2. Z-loop tray support timbers	4" x 8" x 8'	160/-	Timber
3. X-loop cleats bents 66-71 only	4" x 8" x 8'	72/-	Timber
4. Miscellaneous timbers	4" x 8" x 8'	100/-	Timber
B. Z-loop tray timbers	4" x 8"	-/2400	Timbers

Note, in this inspection item No. 1 specifies only the X-loop tray support timbers at pole ends. In a previous inspection carried out under the 1984 underwater inspection Report Number FPO-1-84(15), June 1984 the condition of the 30 X-loop cable troughs or poles was reported. It was in fact this inspection that revealed that deterioration of the cable support timbers had occurred and led to this current detailed cable assembly inspection.

A Level I examination of all pile bracing timbers in the four sections of the structure (Approachway, Header Pier and East and West Piers) was carried out. In addition, detailed Level II inspection was carried out on 10% of the braces.

3.3 EQUIPMENT

- Underwater telephone
- Nikonos IVA Camera and Model SB101 underwater strobe
- Miscellaneous cleaning tools, calipers, rulers
- SCUBA equipment

SECTION 4 - FACILITY INSPECTED

4.1 FACILITY INSPECTED

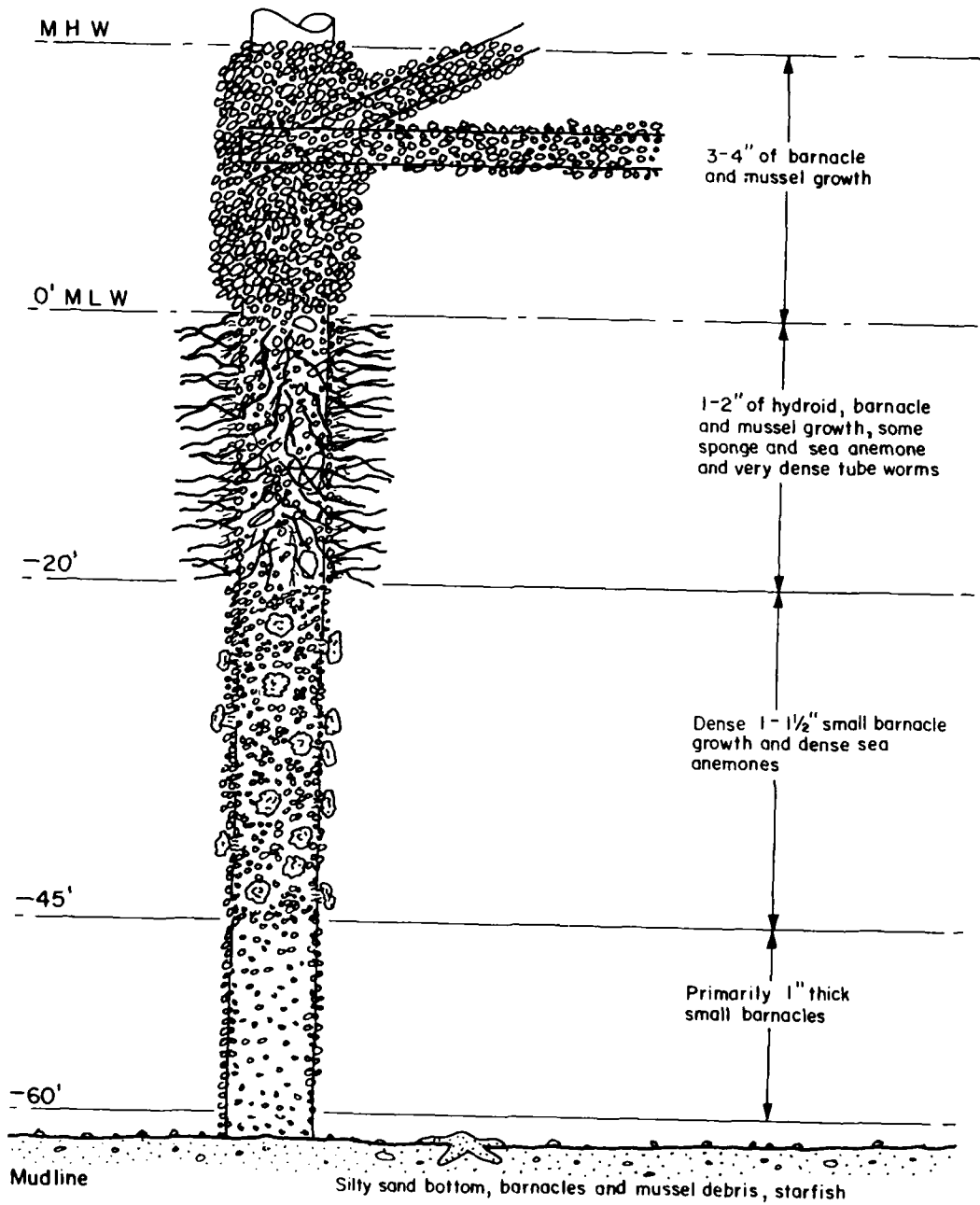
Deperming Pier, Magnetic Silencing Facility (MSF), Naval Submarine Base, Bangor, Washington.

The discussion of the facility is presented in four sections: (1) A description of the overall facility and its operations as well as a specific detailing of the construction and identification of the examined members; (2) A detailing of the observed condition of the facility as determined by the field inspection; (3) A quantitative assessment of the structural condition of the facility based on the observed condition; and (4) Recommendations for maintenance to ensure the structural integrity of the facility. Tables detailing the condition of the inspected members as well as cost breakdowns for any necessary repairs are included in the accompanying appendices. Water depths ranged up to 65 feet at the north end of the finger piers. Underwater visibility during the inspection ranged from two to five feet.

Extensive marine fouling growth was found throughout the inter-tidal and immersed zones with an observed significant increase in growth since a previous 1980 inspection. Specifically the fouling growth pattern was as follows:

Intertidal zone	-	Dense barnacle and mussel growth
Upper immersed zone (0' to -20')	-	Primarily dense tubeworms also hydroids, barnacles, mussels, sea anemones and sponges.
Lower immersed zone (-20' to -45')	-	Dense, 1" - 1 1/2", barnacle growth and dense sea anemones.
Mudline	-	Primarily dense barnacle cover.

The following Figure 1 and all photographs illustrate the typical condition found.



J. Agi & Associates Co. Ltd. Suite 600, 1414 Alaskan Way, Seattle, WA		CHESNAVFACENGCOM	
Not to scale		MAGNETIC SILENCING FACILITY BANGOR, WA.	
January, 1985.		Fig. 1	

4.2 FACILITY DESCRIPTION

The Magnetic Silencing Facility is located at the extreme north end of the Naval Submarine Base, Bangor. The structure extends out approximately 700 feet perpendicular to the shore. A 567 foot long by 15 foot wide Access Trestle joins a Header Pier and the 730 foot by 15 foot East and 745 by 15 foot West Piers. The entire structure is constructed of treated Douglas Fir piles in accordance with ASTM D25 specifications. The pile bents in the Access Trestle are composed of four and six piles each. The bents are numbered one through 29.5 from the shore and the pile rows are designated by consecutive numbers from the east. The Header Pier runs from Bent 30 to Bent 36.5 and the piles are designated by consecutive numbers from the "inside" of the pier. The West Pier runs from Bent 37W to 77W and the East Pier extends from Bent 40E to Bent 77E. In both piers the piles are numbered from the outside towards the center line of the pier. See the accompanying site plan (Dwg. No. 1) for overall layout and pile numbering.

4.2.1 INTERTIDAL ZONE BRACE TIMBERS

Extensive timber bracing extends down 12 feet from the pile tops. The commercial Grade, No. 2, 4" x 8" Douglas Fir-Larch bracing extends both with the rows and bents. For identification purposes, the members are named for the piles they span, with the upper position of the member given first, i.e. Bent 23 - 1-3E Diag. is a diagonal brace located on the east side of Bent 23 spanning from the top of Pile 1 to the intertidal zone of Pile 3. For a detailed description of the brace identification, see Drawing 1, section A-A and B-B.

The mudline to cap pile lengths range from 35 feet in the approach to 75 feet in the piers. Mean pile diameter in the Access Trestle ranged from 11" to 15". The pile butt diameters ranged from 16" to 19" with the average being about 17".

Maximum water depth encountered was approximately 65 feet (at MHW) at the north end of the East and West Piers. Underwater visibility ranged from two to five feet with some suspension turbidity encountered throughout the facility.

The two main piers, east and west, support the deperming mechanism. Above water this consists of cables extending between the piers supported by 50 foot poles on each pier. Underwater, the cables are supported by troughs constructed of timber poles and/or 4" x 8" timbers. The cables rest inside these troughs with the trough being attached to finger pier bents by timber framing.

There are two groups of submerged timber troughs, the X-loop assemblies which run east-west across the two finger piers, and the Z-loop assemblies which run north-south along the axis of the two piers. This project covered the inspection of the following timbers.

4.2.2 X-LOOP TRAY SUPPORTS

As illustrated on Drawing 1, and detailed on Drawing 2, Detail K, the X-loop trays consist of two creosote treated poles which are anchored to pile 3E of the West Pier and 3W of the East Pier. These tray support timbers are 4" x 8", 4" x 10" or 4" x 14" members which clamp the poles to the piles. For identification purposes, individual timbers have been designated numbers 1-4. In some locations more than one timber is located at each site. In these instances, the individual timbers have been designated consecutive letters a-b-c- (for further information, see Drawing No. 2, Detail K).

4.2.3 Z-LOOP TRAY SUPPORTS

The Z-loop tray supports are parallel 4" x 8" timbers which support the Z-loop trays in the Header and East and West Piers. The support timbers which span two piles are attached to the piles by means of

two or more clamping bolts. The Z-loop trough is attached to the upper surface of the Z-loop tray supports by means of non-metallic strapping (See Drawing 2, Detail H). For identification purposes the members are identified relative to the side of the bent they are attached to i.e. Bent 66N is the Z-loop tray support member on the north side of Bent 66. For further information on member identification and condition, see Table 3.

4.2.4 Z-LOOP TRAYS

The Z-loop trays extend along the length of the Header Pier from south of Bent 40 through 77 in the East Pier and from Bent 39 through 77 in the West Pier. The trays are made up of two parallel 4" x 8" timbers which span bent to bent and serve to support the Z-loop cables. These members are strapped to and supported by the Z-loop tray support timbers.

For identification purposes, the two members are designated east or west trough timbers in the East and West Piers and north and south trough timbers in the Header Pier. For further detail on member identification, see Table 2 and Drawing 2, Detail Section G-G and Detail H.

In addition to the main Z-loop trays, there are two timber pole troughs (identical to the X-loop troughs) spanning Bents 76 and 77. The two poles are identified as north and south and the pole support/restraint members are numbered 1-4 identically to the X-loop trough support timbers. For further information on the identification of these members see Table 6.

4.2.5 X-LOOP CLEATS

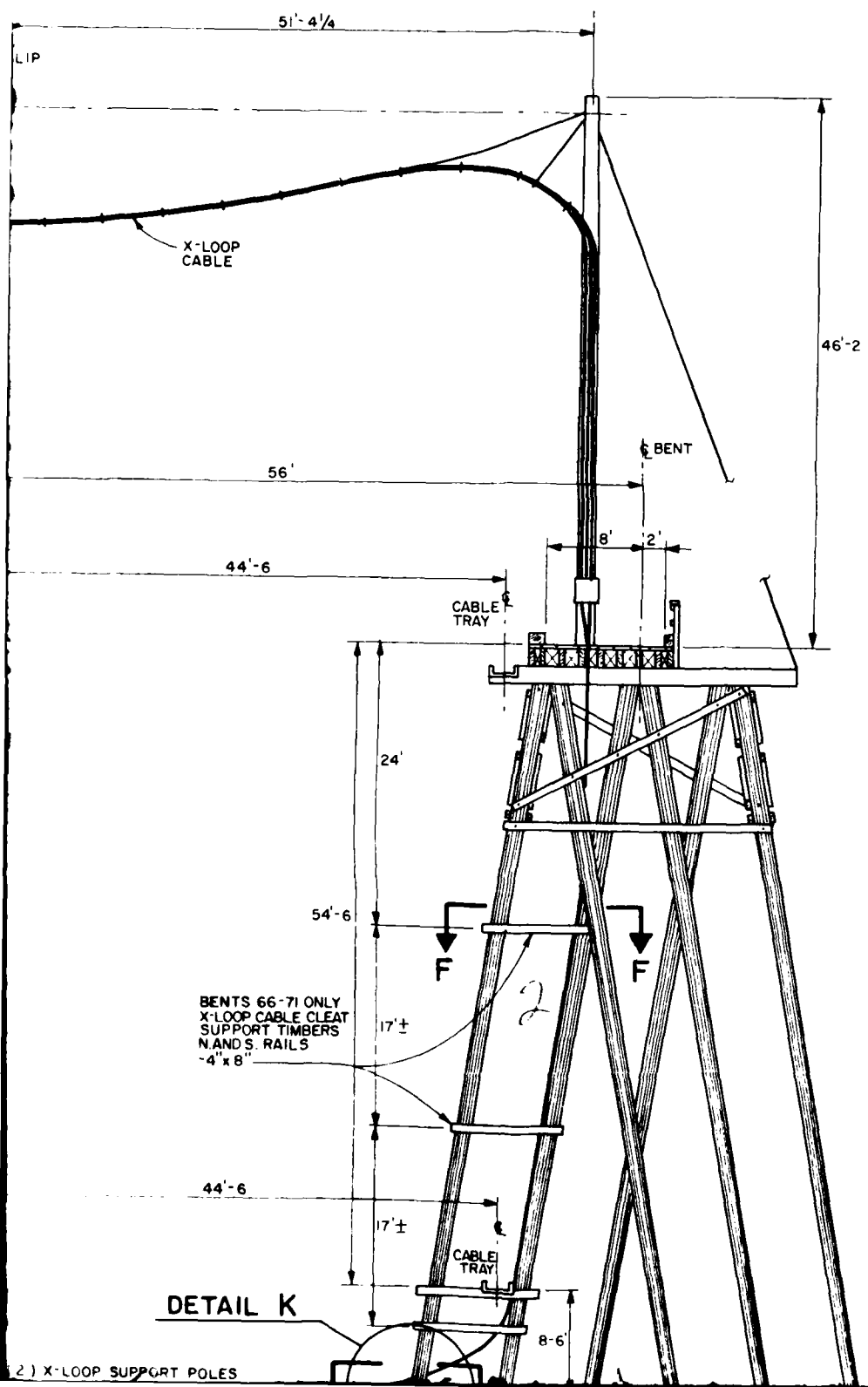
The X-loop cleats are located in Bents 66 through 71 of the East and West Piers. These members serve to support the X-loop cables from the intertidal zone to the X-loop troughs. The three elevations of cleats are made up of two parallel 4" x 8" timbers (cleat supports) clamped to

piles 3W and 2W in the East Pier and 3E and 2E in the West Pier. Running perpendicular to the cleat supports is a single 4" x 8" timber (cleat) to which the X-loop cables are attached. For identification purposes, the individual timbers are identified relative to elevation and to the side (north or south) of the bent to which they are attached i.e. north upper cleat support, south upper cleat support, north mid cleat support etc. The single cleat member is identified relative to its elevation; upper, mid or lower. For further details on member identification, see Table 5 and Drawing 2, Section F-F.

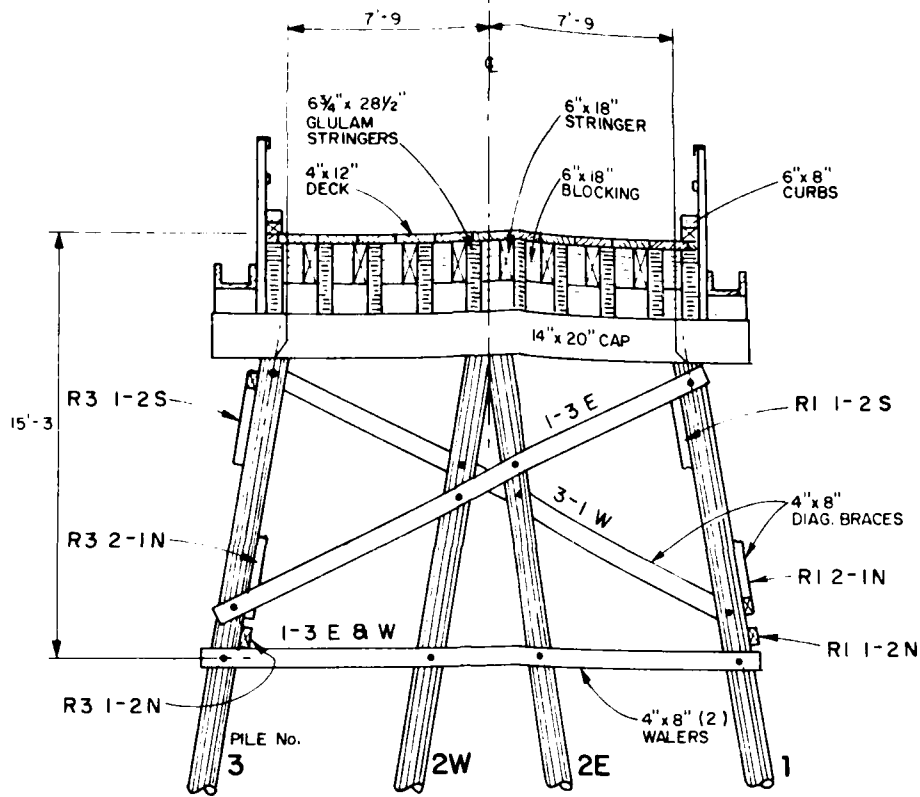
4.2.6 MISCELLANEOUS TIMBERS

The miscellaneous timbers covered by this inspection include the Z-loop clamp timbers located at Bent 40 and 77 of the East Pier and Bent 39 and 77 of the West Pier. As illustrated on Drawing 2, Section D-D and Detail E, these timbers serve to support the massive bundles of Z-loop cables that run into/out of the water at these locations. In addition to the above Z-loop clamping timbers, the miscellaneous component of the inspection also included the above noted Z-loop troughs (poles) plus trough supports which span Bents 76W-76F and 77W to 77E and the trough bottom timbers along the Z-loop troughs. For further details on these members, see Table 6 and Drawing 2, Section C-C.

Construction of the facility was complete in 1978. Approximately two years ago, pile dolphins were added to the outside ends of the finger piers. See the accompanying Drawings, 1, 2 and 3 which are based on NAVFAC Drawing numbers 6045178, 6045179, 6045180, 6045186, 6045217, 6144576, for detailed layout. The accompanying photographs also illustrate various features of the facility.

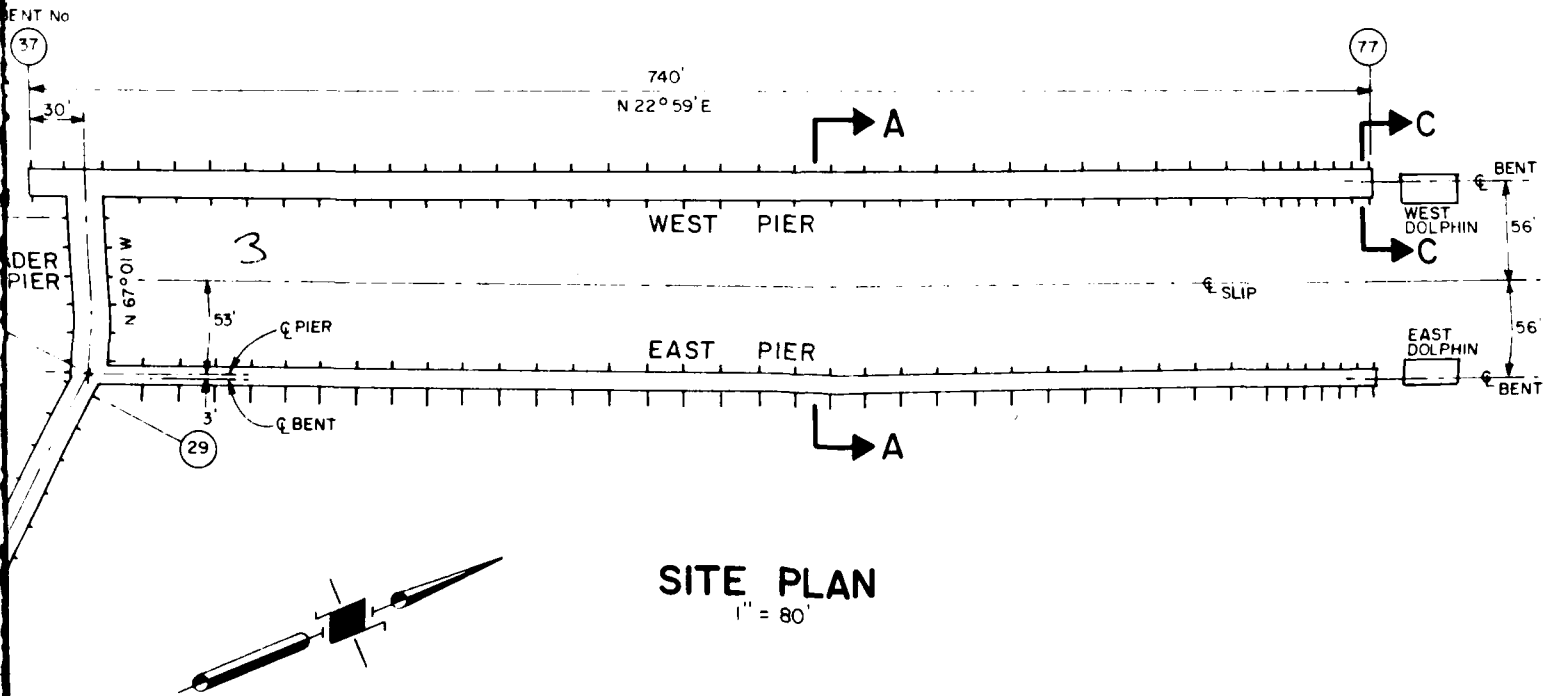


2) X-LOOP SUPPORT POLES



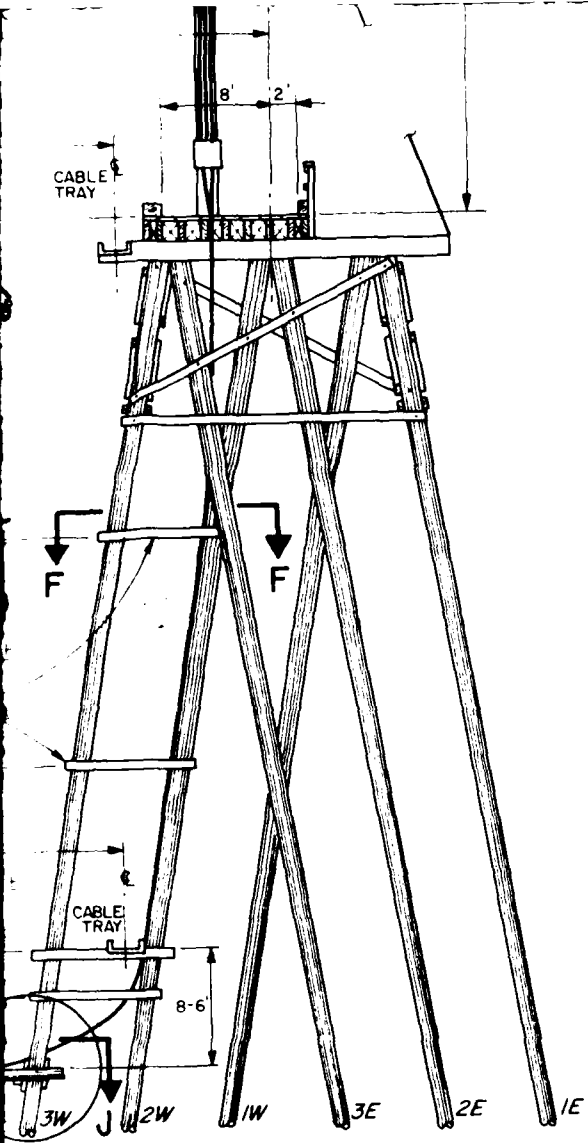
**SECTION B-B
ACCESS TRESTLE - BENT 1**

$\frac{3}{16}'' = 1'-0''$

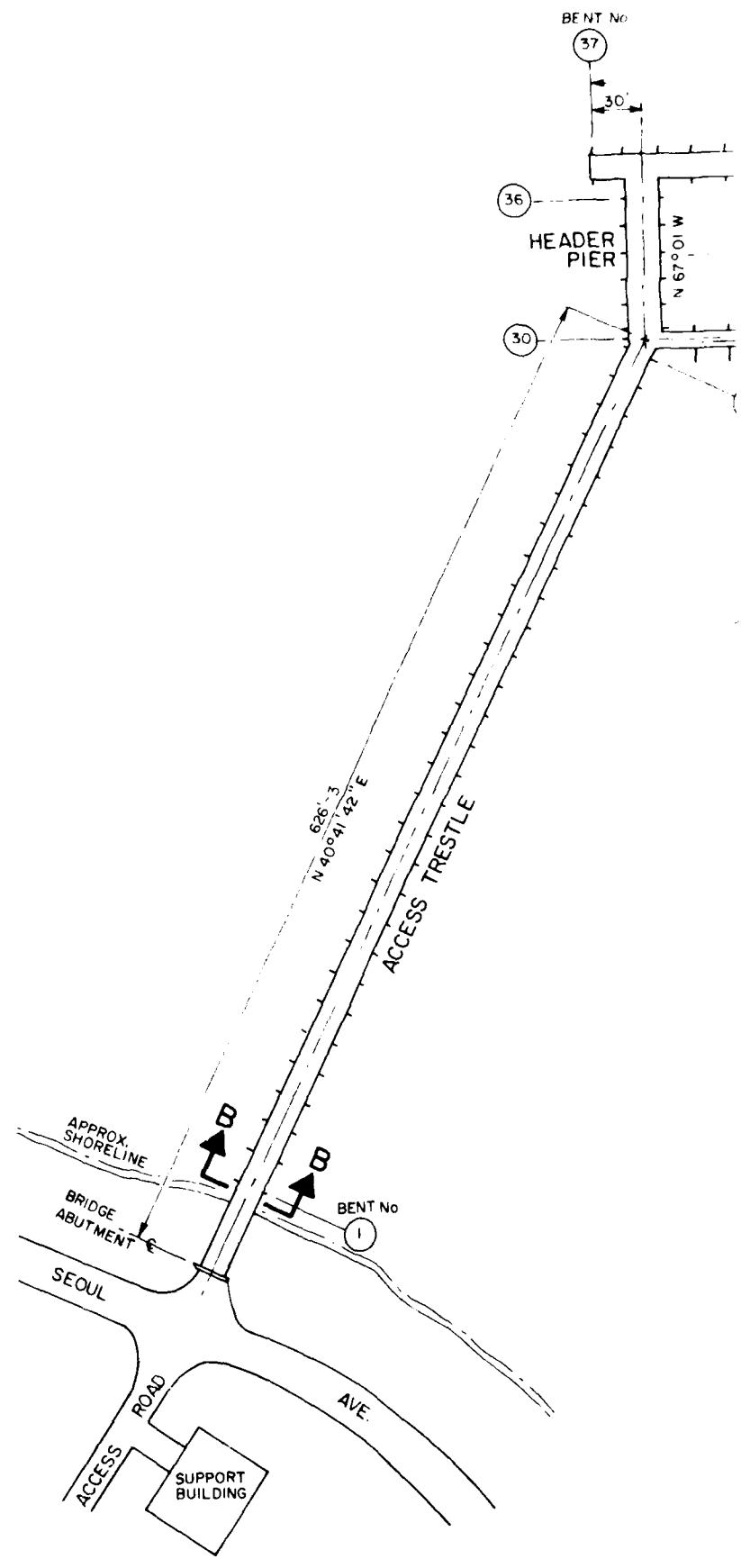


SITE PLAN

$1'' = 80'$

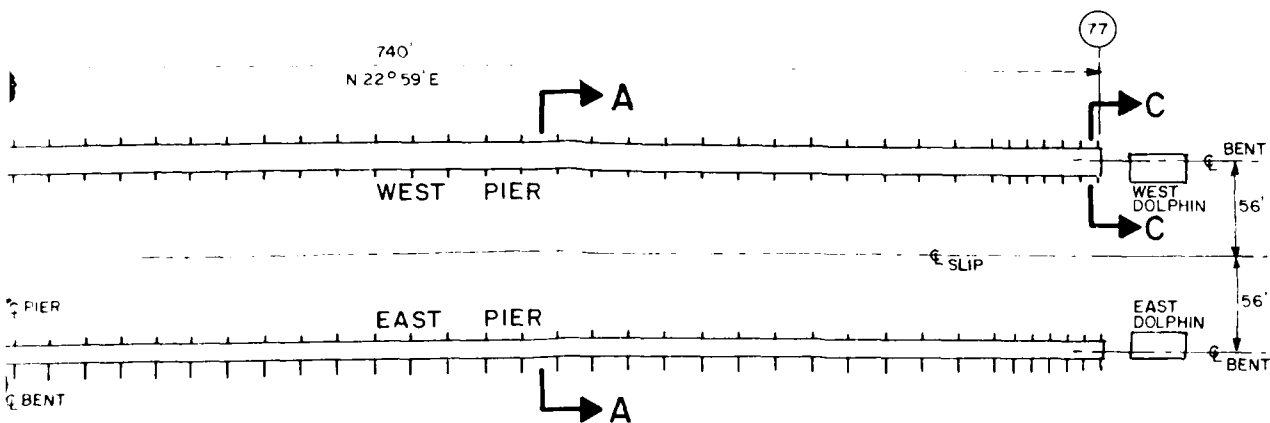


EAST PIER



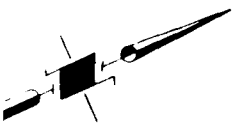
5

3/16" = 1'-0"



SITE PLAN

1" = 80'



Reference Drawings

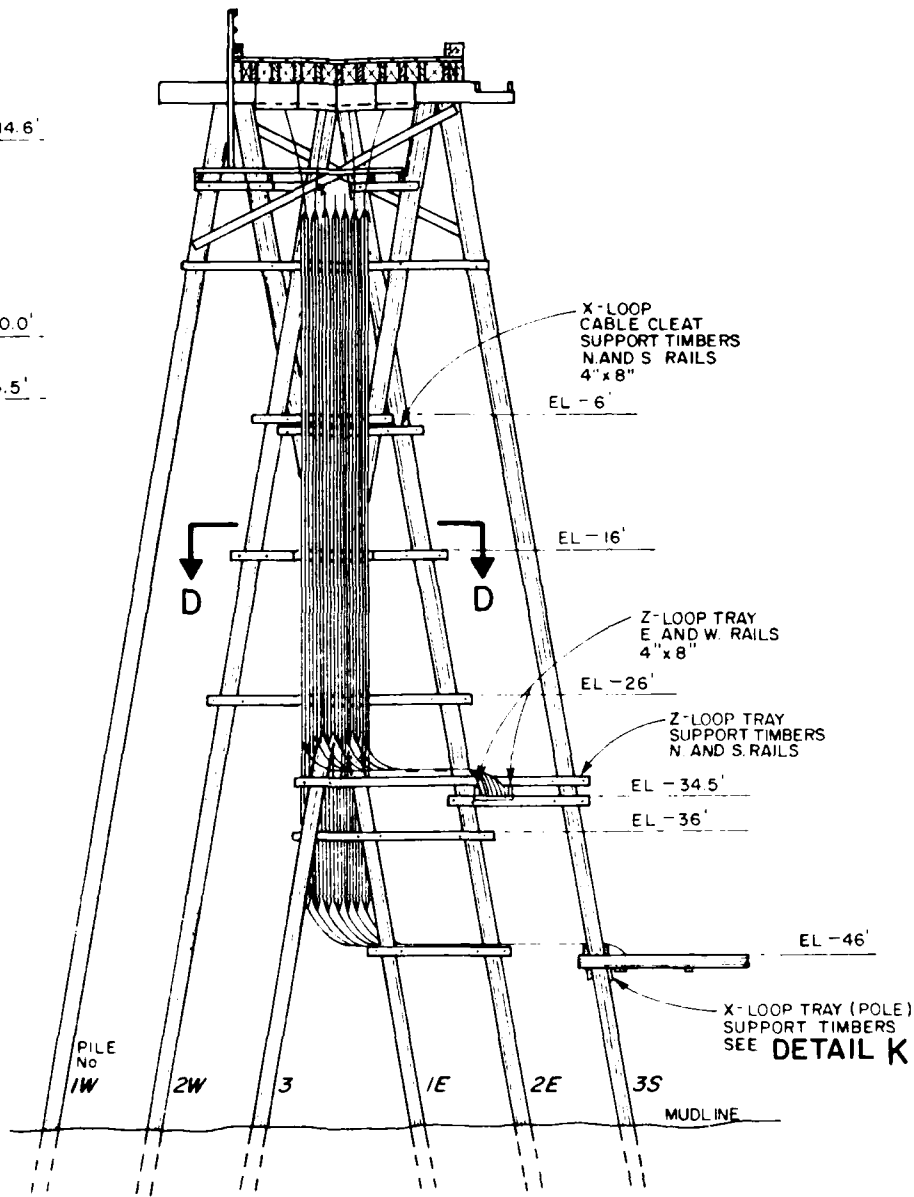
Navfac Dwg. No. 6045178
 " " " 6045186
 " " " 6045217

J. AGI & ASSOCIATES Suite 600, 1414 Alaskan Way, Seattle, WA	SCALE AS SHOWN
	DRAWN F P
PLAN SHOWING TYPICAL SECTIONS AND SITE PLAN DEPERMING PIER TRIDENT REFIT FACILITY BANGOR, WASHINGTON	CHECKED <i>EBV</i>
	APPROVED <i>A</i>
	DATE FEB. 7, 1985.
CHESNAVFACENCOM REPORT No. FPO-1-85-(6) CONTRACT No. N62477-84-D-0024 AMMENDMENT No. 0002-TASK 2 DWG. No. 1	PROJECT No 84-5-2-166

E H W +14.6'

M L L W 0.0'

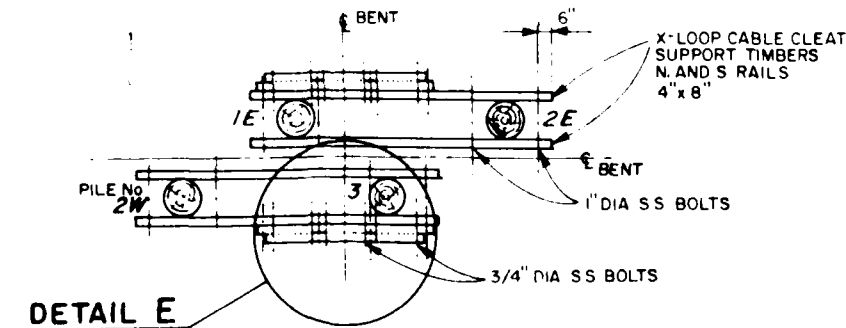
E L W -4.5'



**SECTION C-C
WEST PIER - BENT 77**

NOTE :- Details for cable clamps are similar at Bents 39W, 40E & 77E

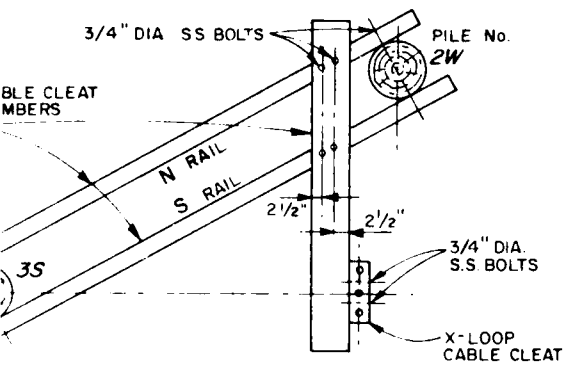
$\frac{3}{32}'' = 1'-0$



DETAIL E

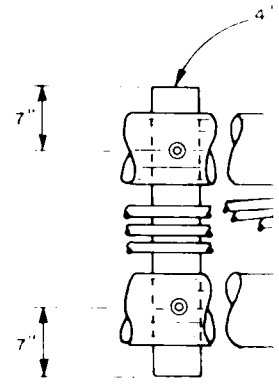
SECTION D-D

$\frac{3}{16}'' = 1'-0$

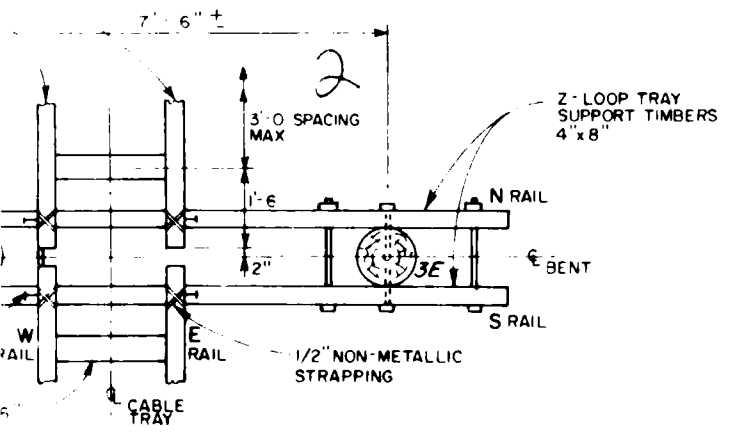
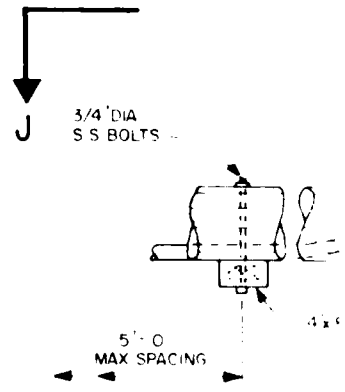


SECTION F-F

Local Bents 66 through 71 - E. and W. Piers
 1/2" = 1'-0"

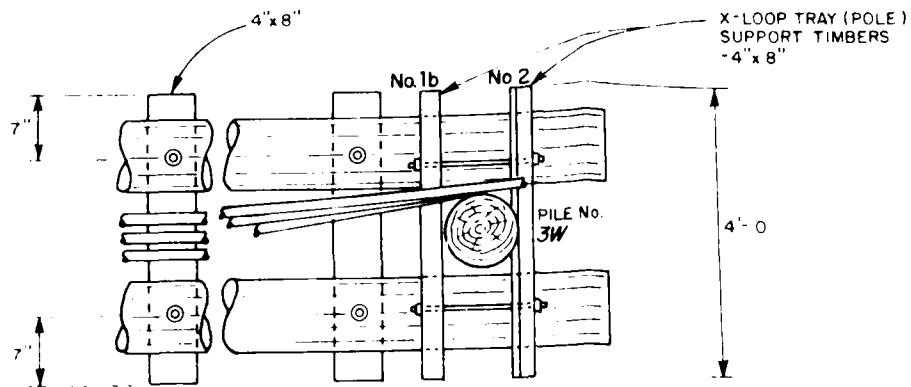


SECTION J

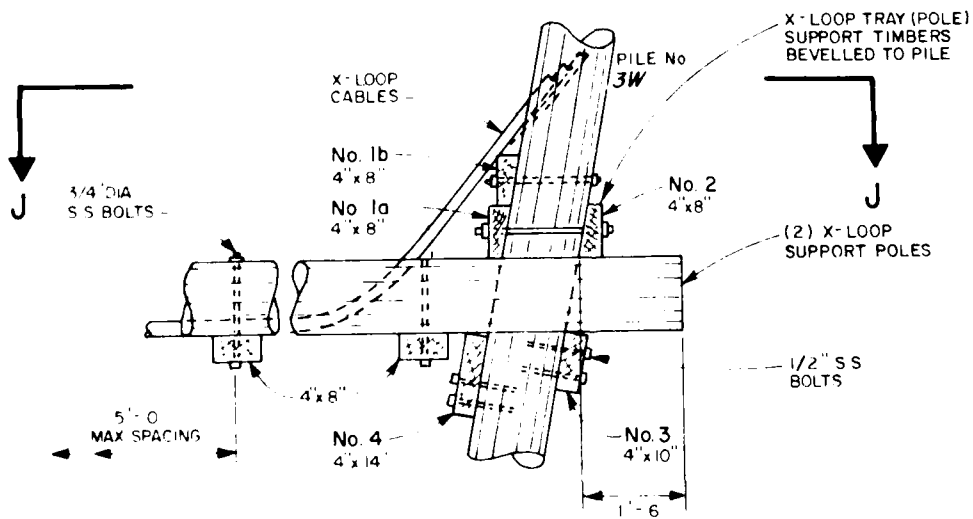


SECTION G-G

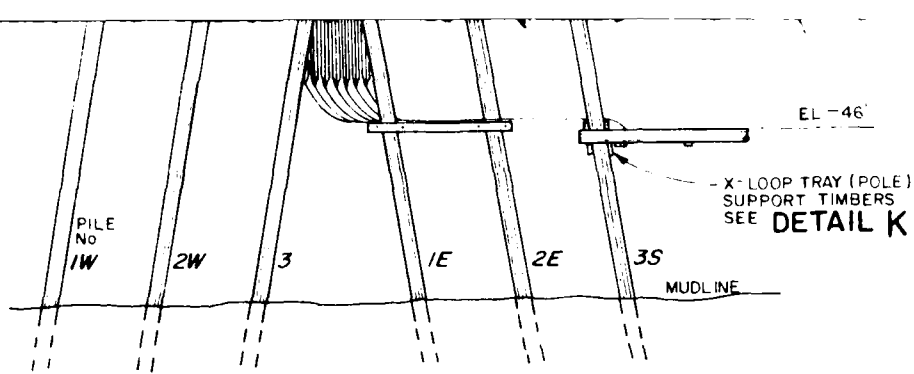
1/2" = 1'-0"



SECTION J-J
NO SCALE

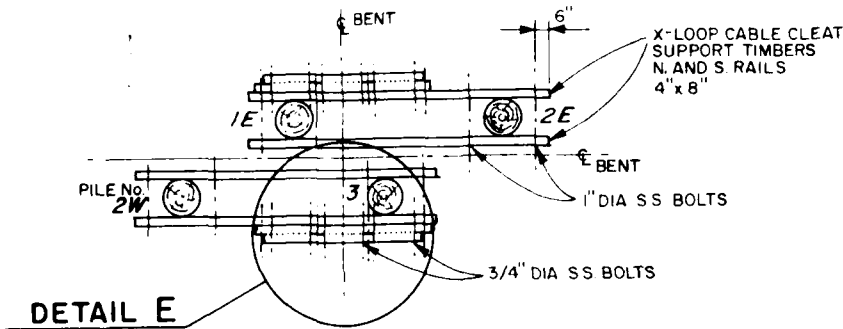


DETAIL K
NO SCALE



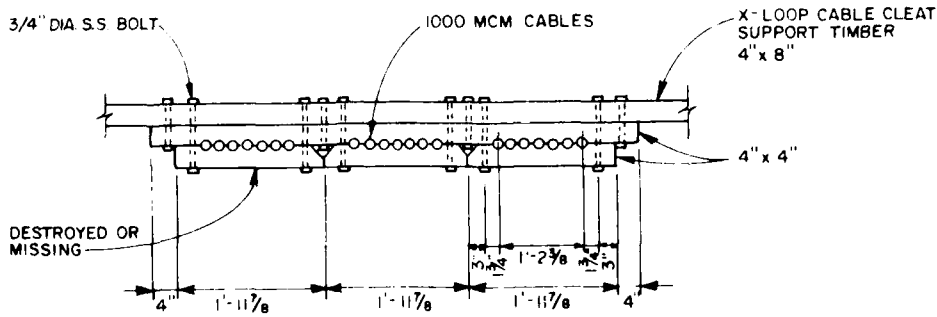
**SECTION C-C
WEST PIER - BENT 77**

NOTE :- Details for cable clamps are similar at Bents 39W, 40E & 77E
 $\frac{3}{32}'' = 1'-0$



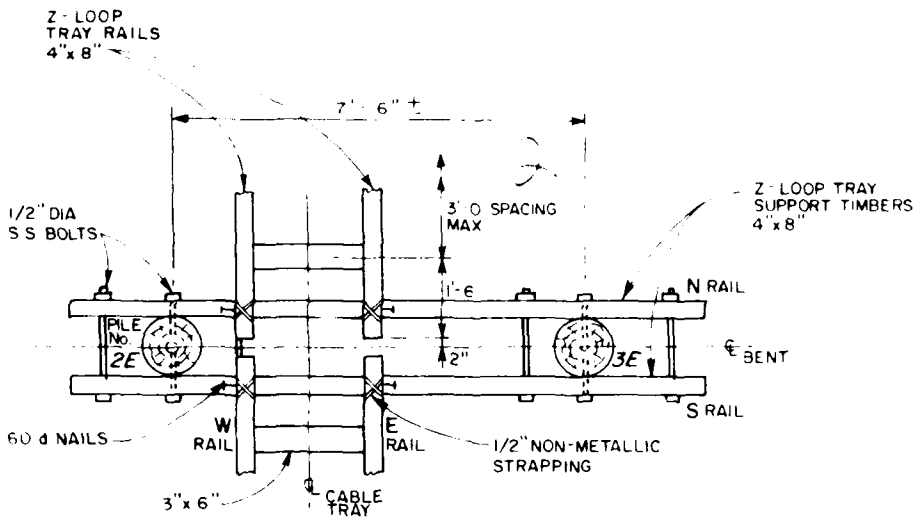
SECTION D-D

$\frac{3}{16}'' = 1'-0$



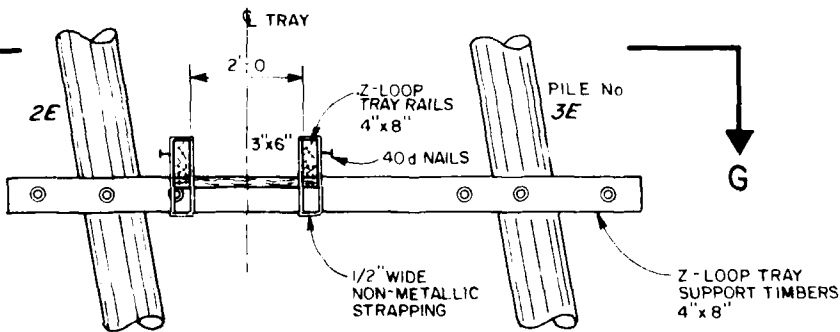
DETAIL E

$\frac{1}{2}'' = 1'-0$



SECTION G-G

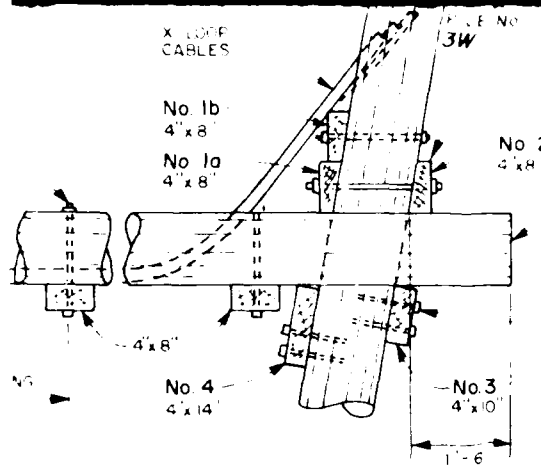
1/2" = 1'-0



DETAIL H

1/2" = 1'-0

5



DETAIL K
NO SCALE

BEVELLED TO PILE
↓
J
(2) X-LOOP
SUPPORT POLES
1/2" S S
BOLTS

Reference Drawings:

- Navfac Dwg. No. 6045217
- " " " 6045218
- " " " 6045219
- " " " 6045221

<p align="center">J. AGI & ASSOCIATES Suite 600, 1414 Alaskan Way, Seattle, WA</p>	SCALE AS SHOWN
	DRAWN F P
<p align="center">PLAN SHOWING TYPICAL SECTIONS AND DETAILS DEPERMING PIER TRIDENT REFIT FACILITY BANGOR, WASHINGTON</p> <p align="center">CHESNAVFACENCOM REPORT No. FPO-1-85 - (6) CONTRACT No. N62477-84-D-0024 AMMENDMENT No. 0002-TASK 2</p> <p align="center">DWG. No. 2</p>	CHECKED <i>EBV</i>
	APPROVED <i>J</i>
	DATE FEB. 7, 1985.
	PROJECT No 84-5-2-166

4.3 OBSERVED INSPECTED CONDITION

4.3.1 INTERTIDAL ZONE BRACE TIMBERS

The detailed inspection results listing the condition of all diagonal timber braces and horizontal timber wales is presented in Table 1. The overall condition of the examined braces is very good. Of the total 781 braces examined, 750 (96%) are undamaged (see Photograph 1); 10 (1%) of the timbers have sustained minor mechanical damage or light marine borer attack to the ends of the timbers (see Photographs 2 and 3). This attack is approximately limited to the outer one inch of the member. A total of 21 (3%) of the examined timbers have sustained damage. Two of these members illustrated in Photographs 4 and 5 have sustained mechanical damage from berthing vessels or drift logs. In the case of the brace in Photograph 5, it appears that the borer damage may have occurred subsequent to the impact damage. The remaining members have been damaged by marine borer infestation at the ends of the timbers.

4.3.2 X-LOOP TRAY SUPPORTS

The condition of the X-loop trays or troughs was reported in detail in the CHESNAVFAC REPORT FPO-1-84-(15) June, 1984. As stated in the report, these members are in good condition.

The condition of the X-loop tray support timbers as detailed in Table 4 is only fair. Of a total of 186 members inspected, 133 (72%) are undamaged (see Photograph 6). Thirteen (7%) members were found to have sustained light to moderate marine borer attack at their ends. Typically this attack has progressed up to 1-2 inches from the ends of the timbers (see Photograph 8). A total of 40 (21%) timbers have sustained heavy damage. Photograph 7 illustrates how on some members, marine borer

attack has progressed in from the ends to the point where it becomes significant damage i.e. the timber adjacent to the clamping bolt is hollow. In Photograph 9 the mid section of the trough support timber is hollow as a result of marine borers gaining access to the untreated center of the brace through a large check or crack.

4.3.3 Z-LOOP TRAY SUPPORTS

The detailed inspection results of the Z-loop tray or trough support timbers is presented in Table 3. The overall condition of these members is fair to good. Of the 77 members inspected 65 (84%) are undamaged. Two (3%) timbers were found to have sustained attack and 10 (13%) were found to have sustained heavy marine borer damage. In Photograph 10, evidence of the internal borer *Bankia* and the surface borer *Limnoria* was found adjacent to the bolt which attaches the member to the support pile in the Header Pier.

In Photograph 11, the left half of the support timber has broken off leaving the upper Z-loop tray unsupported. A close examination of this member revealed that extensive *Bankia* damage had occurred to the brace, this damage likely led to the failure of the member. In Photograph 12, the member is hollow adjacent to an unused bolthole. It appears that these timbers were drilled after preservation treatment (drilled holes were found in timbers throughout the structure). The majority of the open drilled holes were, however, found to be undamaged.

As shown in Photograph 15, one section of the Z-loop tray was found to be unsupported. This section is in Bent 75-77 of the West Pier. In this instance, the tray support timbers are undamaged, however, the tray has been knocked off of the support timbers. This damage may have occurred during the earlier noted impact damage to Bent 77 reported in the CHESNAVFAC REPORT FPO-1-80-(13), October 1980.

4.3.4 Z-LOOP TRAYS

The inspection results of the Z-loop tray-trough rails is detailed in Table 2. The overall condition of these members is fair. Of the 152 individual timbers inspected, 100 (66%) are undamaged (see Photograph 15). Twenty-one (14%) of the timbers (rails) were found to have sustained marine borer attack to a depth of 1-2 inches at the timber ends. This attack has been caused by both *Bankia* and *Limonria*. As illustrated in Photographs 13 and 14, a total of 31 (20%) timbers have sustained heavy damage at their ends. In several instances this damage has progressed in from the end past the point of support provided by the Z-loop support timbers. In no instance, however, was the member observed to have failed as a result of this damage. In addition to the main rails, the condition of the cross support rails on the bottom of the tray was found to be fair to good.

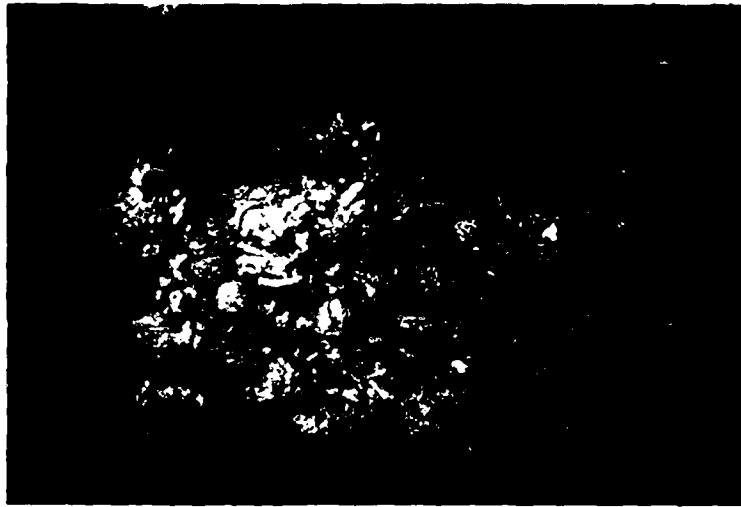
Two Z-loop troughs cross over between Bents 76W-76E and 77W-77E. These troughs are identical in cross structure to the X-loop troughs which span between Bents 42-71 of the East and West Piers. As detailed in Table 6, the condition of the individual poles or piles which make up the troughs is good. The condition of the trough support timbers is however, poor. As shown in Photographs 16 and 17 several of the members have sustained heavy damage from the timber ends in past the attachment bolts.

4.3.5 X-LOOP CLAMPS

Due to the change in the configuration or direction of the X-loop cables as they run vertically in Bents 66 through 71 of the East and West Piers, a clamping or support system exists to support the X-loop cables in these bents. A total of 60 individual timbers make up these clamps. The results of the inspection of these members is detailed in Table 5. Of the 60 members inspected, 44 (73%) are undamaged, 9 (15%) have sustained marine borer attack and 7 (12%) have sustained significant damage. Photograph 18 illustrates the degree of damage found.

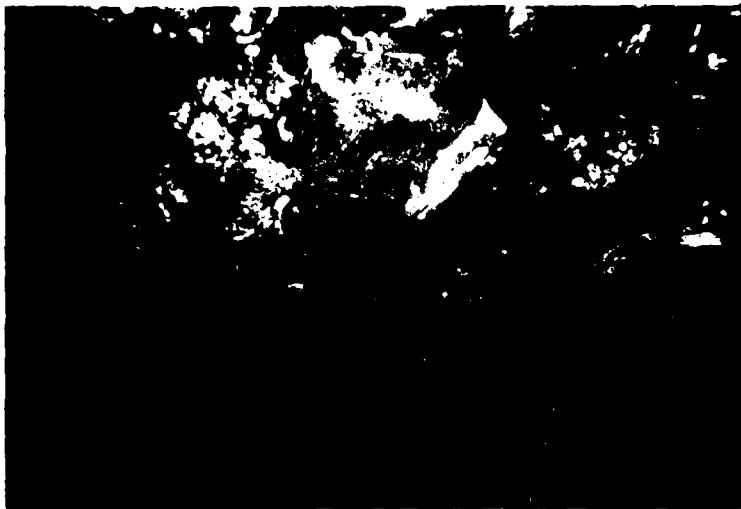
4.3.6 MISCELLANEOUS TIMBERS

Detailed inspection results covering the inspection of the miscellaneous timbers including the Z-loop clamps, Z-loop troughs and Z-loop trough supports at Bents 76 and 77 and the Z-loop trough bottom member, is presented in Table 6. As shown on Drawing 2, Section C-C and D-D and Detail E, mass of X and/or Z-loop cables are supported vertically by clamping timbers. As shown in Photographs 19-23, virtually all of these members (clamping units) have sustained extensive damage and are not providing support to the bundles of cable. As represented in Detail E and shown in Photograph 20 and 22, the backing timbers (i.e. those clamped to the piles) are in good condition, however, the outer timbers which are bolted over the cables tightly to the backing timber, have all been heavily infested (destroyed) by *Limoria* and *Bankia*. Of the total of 23 miscellaneous timbers inspected, 4 (17%) are undamaged, the remaining 19 (83%) have sustained significant deterioration.



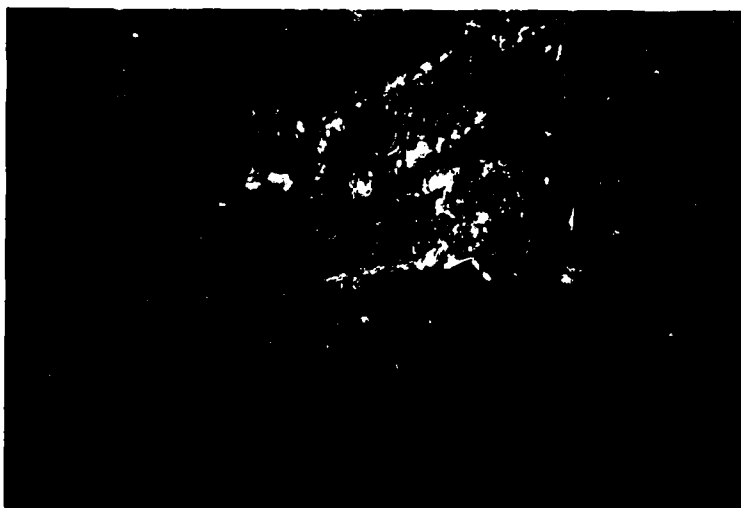
PHOTOGRAPH NO. 1

The Row 3 wale from Bent 67-68 of West Pier. The member is undamaged.



PHOTOGRAPH 2

Limoria attack to Row 1 East Wale in Pent 34 of Header Pier.



PHOTOGRAPH NO. 3

Bent 77 Row 1-3 South Wale of West Pier, brace is split at end to attachment bolt.



PHOTOGRAPH NO. 4

Broken diagonal brace timber - Row 3, Bent 23-24 South Diagonal of Approachway. All other braces are undamaged.



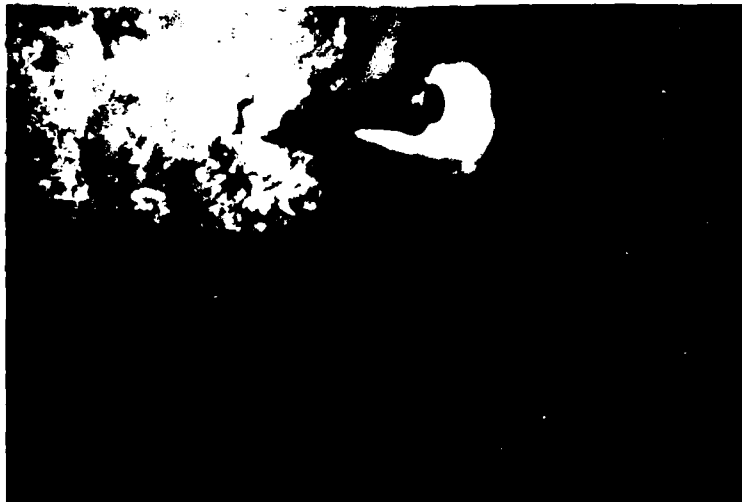
PHOTOGRAPH NO. 5

The Row 3 wale from Bent 59-60 of West Pier is broken off and hanging adjacent to pile 59-3. Note the extensive teredine damage evident adjacent to ruler.



PHOTOGRAPH NO. 6

Undamaged X-Loop support timber at Bent 43 of the East Pier. Note the X-Loop trough pole is buried in the midline.



PHOTOGRAPH NO. 7

Marine borer damage to end of the Number 1 - X-Loop trough support timber at Bent 67 of the East Pier. Note the damage progresses in to the vicinity of the clamping bolt which attaches the two timbers to Bent 67 pile.



PHOTOGRAPH NO. 8

X-Loop trough support timbers at Bent 71 of the West Pier. Note timber No. 1 in foreground is hollow in approximately 4" in from end, timber No. 2 in background is hollow in approximately 2" from the end.



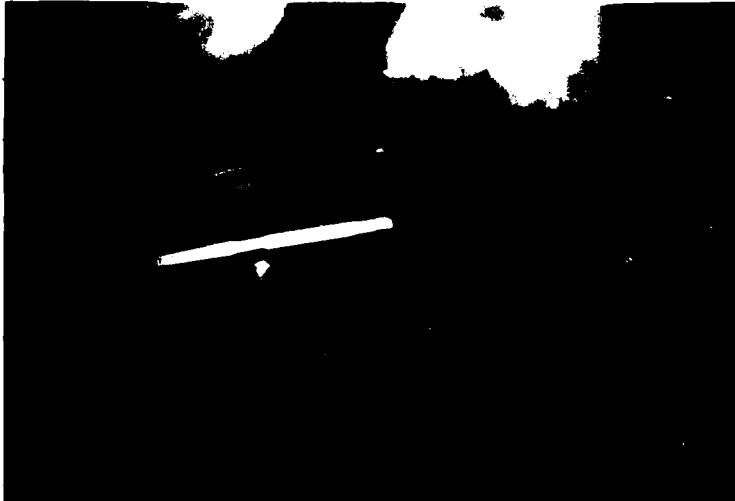
PHOTOGRAPH NO. 9

X-Loop trough support timber No. 2 at Bent 66 of the West Pier. The member is hollow due to marine borer damage through a check or crack.



PHOTOGRAPH NO. 10

West Z-Loop tray support timber on Bent 31 of the Header Pier. Note extensive Limnoria and Bankia damage adjacent to the attachment bolt.



PHOTOGRAPH NO. 11

North Z-Loop tray support timber on Bent 65 of the West Pier. The member has sustained extensive marine borer damage and has failed. (note: the left side of member is missing)



PHOTOGRAPH NO. 12

North Z-Loop tray support timber on Bent 75 of the East Pier. The member has sustained heavy marine borer damage at an unused bolt hole.



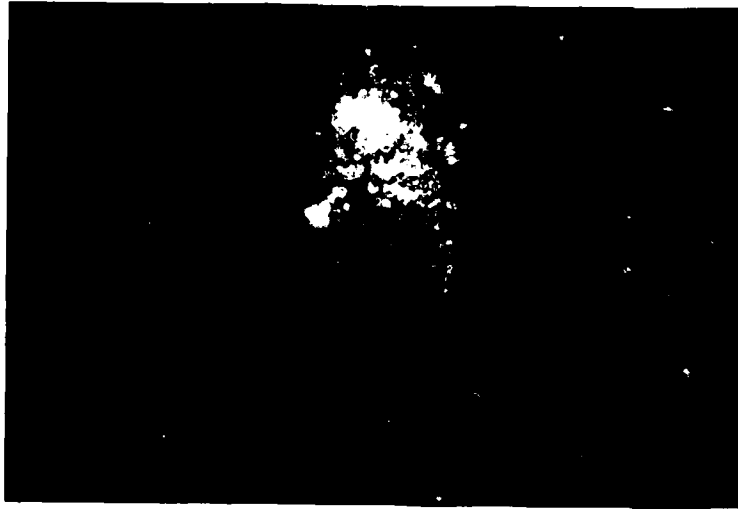
PHOTOGRAPH NO. 13

Marine borer damage to East rail
of Z-Loop trough at Bent 66 of
West Pier.



PHOTOGRAPH NO. 14

Marine borer damage to end of West Z-Loop trough timber
at Bent 66 of the West Pier.



PHOTOGRAPH NO. 15

North end of the West trough timber of the Z-Loop tray at Bent 77 of the West Pier. Note both trough members are not supported at Bent 77 and are hanging from Bent 75.



PHOTOGRAPH NO. 16

Z-Loop pole support timbers at Bent 77 of the West Pier. Note damage to the end of timber No. 2 at left of photo.



PHOTOGRAPH NO. 17

Close up of timber No. 2, Z-Loop pile support at Bent 77. Note member is hollow at end in to the vicinity of the bolt which clamps the two timbers to the pile.



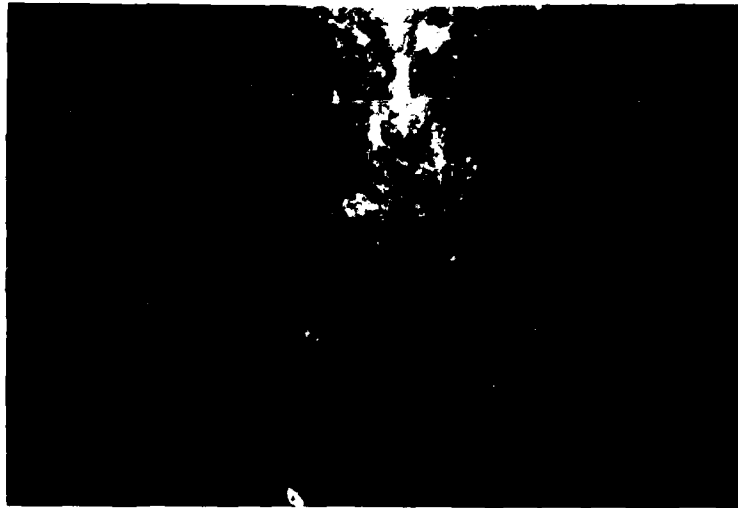
PHOTOGRAPH NO. 18

Typical damage to X-Loop cable cleat and support timbers found in Bents 66-71 of West and East Piers. The damage pictured is to the cleat member at Bent 57 of the West Pier.



PHOTOGRAPH NO. 19

Z-Loop clamping timbers at Bent 40 of the East Pier. Note stainless steel bolt to the left of the knife and the electrical wires to the right of the knife are exposed as a result of heavy damage to the outer clamping timber.



PHOTOGRAPH NO. 20

X-Loop clamping timber at Bent 39 of West Pier. Note the outer clamping timber are missing resulting in no support to the bundle of electric cables.

4-11



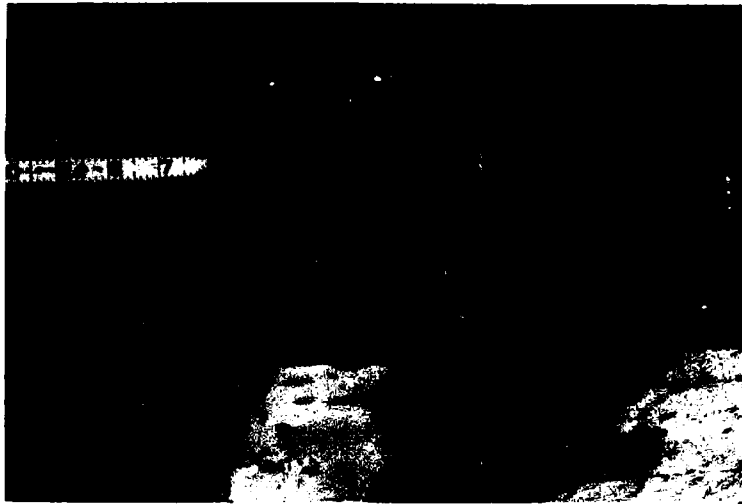
PHOTOGRAPH NO. 21

Close up of Z-Loop clamp at Bent 39 of West Pier. Note the washer and nut assembly on the stainless steel bolt at center of photo. The position of the washer indicates original dimension of the outer clamping timber.



PHOTOGRAPH NO. 22

Z-Loop tray support clamp at Bent 77 of the East Pier. Note extensive teredine damage visible at stainless steel bolt.



PHOTOGRAPH NO. 23

Sample of outer clamping timber from Bent 77 of East Pier. Note the extensive teredine damage.

4.4 STRUCTURAL CONDITION ASSESSMENT

The overall condition of the intertidal zone braces is good, however, evidence of both mechanical impact damage and marine borer infestation was found. In order to restore the structure to its original designed condition, these members should be scheduled for maintenance/repair.

As detailed in a previous report, FPO-1-84(15), the condition of the major X-loop poles and troughs is good. Similarly, the two Z-loop troughs (4 poles) located at the north end of the facility (Bents 76 and 77) are in good condition. The members which support these poles (both X-loop and Z-loop) were found to be in only fair condition, with several members having sustained heavy marine borer damage from their ends, in past the attachment bolts. These members were designed to support (fix in place) the troughs. The possibility exists that if the deterioration continues the trays may shift and result in damage to the cables. For this reason, repair/replacement of defective members should be carried out.

The condition of the timbers which make up the Z-loop trays; Z-loop tray supports and the various X-loop and Z-loop cleats or clamps is generally fair to good. Several members were, however, found to have sustained significant marine borer attack or damage. As referenced above and as illustrated in the case of the Z-loop tray at Bent 65 of the West Pier, if the damage is allowed to continue unchecked, failure of some timbers may occur (see Photograph 11). To prevent possible damage to the cables, replacement of defective timbers should be carried out.

4.5 RECOMMENDATIONS

Given the level of damage found in the intertidal and submerged zone timbers, preventative and/or restorative maintenance of defective members should be carried out. A total of approximately 283 timbers were found to have sustained significant marine borer attack or damage. The approximate cost to refurbish the structure has been estimated in the order of \$230,000 to \$299,000. This fee is based on removing the deteriorated timbers and replacing them with either high retention creosote treated timbers or by similar dimensioned molded fiberglass members. The treated timbers would be pre-drilled and specified for high creosote retention of 20 lbs/ft.³ This level of preservation should provide adequate protection from future marine borer attack. If molded fiberglass materials were used, similar dimensional members (i.e. 4"x8" timbers vs 5"x7" fiberglass) would have to be employed in order to ensure the maintenance of the alignment of the troughs and the compatibility of bolting undamaged timbers to the fiberglass members.

The fees have been prepared based on replacement of the approximately 283 defective timbers noted in this report. It is likely that additional timbers may be exposed or damaged during the removal phase. A contingency covering the extra members has been included in the estimates. The final decision on the choice of materials prescribed for maintenance should be based on the cost effectiveness of the materials and the overall maintenance plan for the facility. For a detailed breakdown of the costs of maintenance, see the accompanying Appendix A.B

Once necessary repairs have been carried out, it is also recommended that periodic inspections at approximately three year intervals be scheduled. This is particularly significant in this structure since

widespread *Limoria* and *Bankia* damage was found throughout. Regular inspection of both the timber braces, cable supports and piles will serve to identify any deficient areas and thereby assure the structural integrity of the facility. All subsequent inspections should use this report as well as the two previous CHESDIV REPORTS FPO-1-80-3-(13) and FPO-1-84(15) as datum or base lines.

LEGEND TO TABLES

A	=	Attack
D	=	Damaged
Diag.	=	Diagonal
E	=	East
H	=	Heavy
<u>L.</u>	=	Limnoria
L	=	Light
LA	=	Limited Access
Mech.	=	Mechanical
MBD	=	Marine Borer Damage
N	=	North
S	=	South
SB	=	Spacer Block
UD	=	Undamaged
W	=	West

TABLE 1
 CONDITION OF INTERTIDAL ZONE
 BRACE TIMBERS

Project No: 84-5-2-166

BENT	ROW	SIDE OF BENT/ROW	TYPE	CONDITION
<u>ACCESS TRESTLE</u>				
1				All braces UD .
2				All braces UD .
3				All braces UD .
4				All braces UD .
5				All braces UD .
6				All braces UD .
7				All braces UD .
8				All braces UD .
9				All braces UD .
10				All braces UD .
11				All braces UD .
12				All braces UD .
13				All braces UD .
14				All braces UD .
15				All braces UD .
16				All braces UD .
17				All braces UD .
18				All braces UD .
19				All braces UD .
20				All braces UD .
21				All braces UD .
22				All braces UD .
23*	1-3	E	Diag.	UD
	3-1	W	Diag.	UD
	1-3	E	Wale	UD
Note: Level two inspection on these members				
			T-2	

TABLE 1

CONDITION OF INTERTIDAL ZONE
BRACE TIMBERS

Project No: 84-5-2-166

BENT	ROW	SIDE OF BENT/ROW	TYPE	CONDITION
23*	1-3	W	Wale	UD
24	1-3	E	Diag	UD
	3-1	W	Diag.	UD
	1-3	E	Wale	UD
	1-3	W	Wale	UD
24-23	1	N	Diag.	UD
23-24	1	S	Diag.	UD
23-24	1	N	Wale	UD
23-24	3	S	Wale	UD
24-23	3	N	Diag.	UD
23-24	3	S	Diag.	Broken .
25				All braces UD .
26				All braces UD .
27				All braces UD .
28				All braces UD .
29				All braces UD .
<u>HEADER PIFR</u>				
30				All braces UD .
31				All braces UD .
32*	1-3	E	Wale	UD
	1-3	W	Wale	UD
	1-3	E	Diag.	UD
	3-1	W	Diag.	UD
33*	1-3	E(1)	Wale	UD
		E(2)	Wale	UD
		W(1)	Wale	UD
		W(2)	Wale	UD
			T-3	

TABLE 1
 CONDITION OF INTERTIDAL ZONE
 BRACE TIMBERS

Project No: 84-5-2-166

BENT	ROW	SIDE OF BENT/ROW	TYPE	CONDITION
33*	1-3	E	Diag.	Heavy <u>L.</u> attack at end in 1".
	3-1	W	Diag.	UD
32-33	1	N	Wale	UD
33-32	1	N	Diag.	UD
32-33	1	S	Diag.	UD
32-33	3	N	Wale	UD
33-32	3	N	Diag.	Light <u>L.</u> attack at end in 1/8".
32-33	3	S	Diag.	UD
34	1-3	E	Wale	<u>L.</u> damage in 2"
35				All braces UD.
36				All braces UD.
<u>WEST PIER</u>				
37				All braces UD.
38				All braces UD.
39				All braces UD.
40				All braces UD.
41				All braces UD.
42				All braces UD.
43				All braces UD.
44				All braces UD.
45				All braces UD.
46				All braces UD.
47				All braces UD.
48				All braces UD.
* Note: Level two inspection on these members				
T-4				

TABLE 1

CONDITION OF INTERTIDAL ZONE
BRACE TIMBERS

Project No: 84-5-2-166

BENT	ROW	SIDE OF BENT/ROW	TYPE	CONDITION
49				All braces UD.
50				All braces UD.
51	1-3	N	Wale	SB at pile 1 - heavy damage All other braces UD.
52				All braces UD.
53	1-3	S	Diag.	A.
	1-3	S	Wale	D to SB.
	1-3	N	Wale	Hollow 6" at pile 1 (D). All other braces UD.
54				All braces UD.
55	1-3	N	Diag.	L. A 1". All other braces UD.
56	1-3	S	Wale	D to SB. All other braces UD.
56-57	1	E	Wale	D at 56. All other braces UD.
57				All braces UD.
58				All braces UD.
59*	1-3	S	Wale	UD
	1-3	N	Wale	UD
	1-3	N	Diag.	UD
	3-1	S	Diag.	UD
60*	1-3	S	Wale	UD
	1-3	N	Wale	UD
	1-3	N	Diag.	UD
	3-1	S	Diag.	UD
59-60	1	W	Wale	UD
59-60	1	W	Diag.	UD
60-59	1	E	Diag.	UD
59-60	3	E	Wale	Broken off.
59-60	3	W	Diag.	UD
60-59	3	E	Diag.	UD

TABLE 1

CONDITION OF INTERTIDAL ZONE
BRACE TIMBERS

Project No: 84-5-2-166

BENT	ROW	SIDE OF BENT/ROW	TYPE	CONDITION
61				All braces UD.
62				All braces UD.
63				All braces UD.
64				All braces UD.
65				All braces UD.
66	1-3	N	Diag.	Split 12" at end D. All other braces UD.
67				All braces UD.
68	1-3	N	Diag.	Split 10" at end D. All other braces UD.
69				All braces UD.
70	1-3	N	Wale	Damaged SB at pile 1. All other braces UD.
71				All braces UD.
72	1-3	N	Wale	Attack at end. All other braces UD.
73				All braces UD.
74				All braces UD.
75	1-3	N	Wale	SB at pile 1. Attack 1". All other braces UD.
76				All braces UD.
77	1-3	S	Wale	Split at end D. All other braces UD.
<u>EAST PIER</u>				
40	1-3	N	Wale	1/2" L. attack to SB. All other braces UD.
41	1-3	E	Wale	MBD to SB at pile 1. All other braces UD.
42				All other braces UD.
			T-6	

TABLE 1

CONDITION OF INTERTIDAL ZONE
BRACE TIMBERS

Project No: 84-5-2-166

BENT	ROW	SIDE OF BENT/ROW	TYPE	CONDITION
43				All braces UD.
44				All braces UD.
45				All braces UD.
46				All braces UD.
47				All braces UD.
48				All braces UD.
49				All braces UD.
50				All braces UD.
51				All braces UD.
51-52	3	W	Wale	Split 9" D.
52				All braces UD.
53	1-3	S	Wale	4" D.
	1-3	N	Wale	Light B. attack. All other braces UD.
54	1-3	S	Wale	MBD 2". All other braces UD.
55	3-1	S	Diag	Light <u>L</u> . attack.
	1-3	N	Wale	3" D. All other braces UD.
56				All braces UD.
57				All braces UD.
58				All braces UD.
59				All braces UD.
60*	1-3	S	Wale	UD
	1-3	N	Wale	UD
	3-1	S	Diag.	UD
	1-3	N	Diag.	UD
61*	1-3	S	Wale	UD, SB attack at pile 1.
	1-3	N	Wale	UD
	3-1	S	Diag.	UD
	1-3	N	Diag.	UD

TABLE 1
CONDITION OF BRACE TIMBERS

Project No: 84-5-2-166

BENT	ROW	SIDE OF BENT/ROW	TYPE	CONDITION
60-61	1	E	Wale	UD
60-61	1	W	Diag.	UD
61-60	1	E	Diag.	UD
60-61	3	W	Wale	UD
60-61	3	W	Diag.	UD
61-60	3	E	Diag.	UD
62-63	1	E	Wale	Minimum mech. D.
62*	1-3	S	Wale	SB at pile 1. Attack. All other braces UD.
	1-3	N	Wale	SB at pile 1, D.
63				All braces UD.
64	1-3	S	Wale	SB at pile 1, D. All other braces UD.
65				All braces UD.
66				All braces UD.
67				All braces UD.
68	1-3	N	Wale	D. All other braces UD.
68-69	3	E	Wale	SB D.
69				All braces UD.
70				All braces UD.
71				All braces UD.
72				All braces UD.
73				All braces UD.
74				All braces UD.
75				All braces UD.
75-76	1	W	Wale	D. SB at 76. All other braces UD.
76				All braces UD.
77				All braces UD.
			T-8	

TABLE 2
 INSPECTION RESULTS OF
 "Z" LOOP TRAY
 HEADER PIER

Project No: 84-5-2-166

BENT/BENT	CONDITION OF NORTH RAIL	CONDITION OF SOUTH RAIL	BENT/BENT	CONDITION OF NORTH RAIL	CONDITION OF SOUTH RAIL
31-32	UD.	UD.			
32-33	UD.	UD.			
33-34	UD.	UD.			
34-35	UD.	UD.			
35-36	UD.	UD.			
36-36.3	UD.	UD.			

TABLE 2
INSPECTION RESULTS OF
"Z" LOOP TRAY
WEST PIER

Project No: 84-5-2-166

BENT/BENT	CONDITION OF WEST RAIL	CONDITION OF EAST RAIL	BENT/BENT	CONDITION OF WEST RAIL	CONDITION OF EAST RAIL
39-40	UD.	UD.	61-62	L. damage at 61 (LA). Remaining UD.	L. attack 1" at 61 (LA).
40-41	UD.	UD.			
41-42	UD.	B. attack.	62-63	UD	3" L. damage at 62.
42-43	UD.	UD.			
43-44	UD.	UD.	63-64	L. 4" damage at 63.	UD at 63.
44-45	UD.	UD.			
45-46	UD.	UD.	64-65	UD.	UD.
46-47	UD.	UD.	65-66	Damage in 6" at 65.	UD.
47-48	UD.	UD.			
48-49	UD.	B. attack at end at 49.	66-67	Damage in 6" at 66. UD at 67.	Damage in 2". UD at 67.
49-50	UD.	B. attack at 49.	67-68	Attack 1". L B. attack at 68.	Damage 2" at 67. UD at 68
50-51	UD.	UD.	68-69	L. attack 3" UD.	Attack 1". 1" attack at 69.
51-52	B. attack at end at 51 (UD at 52).	B. & L. attack at end in 2" at 51 (UD at 52).	69-70	UD	B. attack.
52-53	UD.	UD.	70-71	Damage in 2". UD at 70.	UD.
53-54	UD.	UD.	71-73	Damaged.	A
54-55	L. damage in 2" at 54 (UD at 55).	UD.	73-75	UD.	UD.
55-56	UD.	UD.	75-77	Not attached at 77 (Hanging).	Not attached at 77 (Hanging).
56-57	UD.	UD.			
57-58	L. damage 6" at 58.	L. in 2". Damage			
58-59	UD.	L. damage in 4"			
59-60	4" damage at 59.	3" damage at 59.			
60-61	L. attack 1" at 61	UD.			

TABLE 2
INSPECTION RESULTS OF
"Z" LOOP TRAY
EAST PIER

Project No: 84-5-2-166

BENT/BENT	CONDITION OF WEST RAIL	CONDITION OF EAST RAIL	BENT/BENT	CONDITION OF WEST RAIL	CONDITION OF EAST RAIL
South-End 40	UD.	UD.	66-67	UD.	Damage at 66.
40-41	UD.	UD.	67-68	Attack at 68.	Attack at 68.
41-42	Damage. (H L. & B. at 42)	UD.	68-69	UD.	Damage at 68.
42-43	Attack.	Damage.	69-70	UD.	UD.
43-44	Damage (2" bearing on North tray support	Attack.	70-71	UD.	Damage at 70.
			71-73	Damage.	Damage.
44-45	UD.	Attack.	73-75	UD.	UD.
45-46	UD.	Damage at 45.	75-77	UD.	UD.
46-47	UD.	UD.			
47-48	UD.	UD.			
48-49	UD.	Attack at 49.			
49-50	UD.	Damage at 50.			
50-51	UD.	Attack at 50.			
51-52	UD.	UD.			
52-53	UD.	UD.			
53-54	UD.	UD.			
54-55	Attack at 54.	UD.			
55-56	Attack at 55.	UD.			
56-57	Damage at 57.	UD.			
57-58	Damage at 58.	Damage at 58.			
58-59	UD.	Damage at 59.			
59-60	Damage at 59.	Damage at 59.			
60-61	UD.	UD.			
61-62	UD.	UD.			
62-63	Misaligned	UD.			
63-64	UD.	UD.			
64-65	UD.	UD.			
65-66	UD.	Damage at 66.			

TABLE 3
INSPECTION RESULTS OF
"Z" LOOP TRAY SUPPORT TIMBERS
HEADER PIER

Project No: 84-5-2-166

BENT	ROW	CONDITION	BENT	ROW	CONDITION	BENT	ROW	CONDITION
31	W	Damaged. (Hollow at bolt).						
	E	UD.						
32	W	UD.						
	E	UD.						
33	W	UD.						
	E	UD.						
34	W	UD.						
	E	UD.						
35	W	UD.						
	E	UD.						
36	W	UD.						
	E	UD.						

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TABLE 3
INSPECTION RESULTS OF
"Z" LOOP TRAY SUPPORT TIMBERS
WEST PIER

Project No: 84-5-2-166

BENT	ROW	CONDITION	BENT	ROW	CONDITION	BENT	ROW	CONDITION
39	N	UD.	53	N	UD.	67	N	UD.
	S	UD.		S	UD.		S	UD.
40	N	UD.	54	N	UD.	68	N	UD.
	S	UD.		S	UD.		S	UD.
41	N	UD.	55	N	UD.	69	N	UD.
	S	UD.		S	UD.		S	UD.
42	N	UD.	56	N	UD.	70	N	UD.
	S	UD.		S	UD.		S	UD.
43	N	UD.	57	N	UD.	71	N	UD.
	S	UD.		S	UD.		S	UD.
44	N	UD.	58	N	UD.	73	N	UD.
	S	UD.		S	UD.		S	UD.
45	N	UD.	59	N	UD.	75	N	UD.
	S	UD.		S	UD.		S	UD.
46	N	UD.	60	N	UD.	77	N	UD.
	S	UD.		S	UD.		S	UD. Not supporting
47	N	UD.	61	N	UD.			"Z" loop trays,
	S	UD.		S	UD.			hanging from Bent
48	N	UD.	62	N	UD.			75.
	S	MBD in middle.		S	UD.			
49	N	UD.	63	N	UD.			
	S	UD.		S	UD.			
50	N	UD.	64	N	UD.			
	S	UD.		S	UD.			
51	N	UD.	65	N	UD.			
	S	B. damage.		S	UD.			
52	N	UD.	66	N	Hollow at east end.			
	S	UD.		S	Broken.			

TABLE 3
INSPECTION RESULTS OF
"Z" LOOP TRAY SUPPORT TIMBERS
EAST PIER

Project No: 84-5-2-166

BENT	ROW	CONDITION	BENT	ROW	CONDITION	BENT	ROW	CONDITION
40	N	UD.	53	N	UD.	67	N	Damaged.
	S	Damaged.		S	UD.		S	Attack.
41	N	UD.	54	N	UD.	68	N	UD.
	S	UD.		S	UD.		S	UD.
42	N	UD.	55	N	UD.	69	N	UD.
	S	UD.		S	UD.		S	UD.
43	N	UD.	56	N	UD.	70	N	UD.
	S	UD.		S	UD.		S	UD.
44	N	UD.	57	N	UD.	71	N	UD.
	S	UD.		S	UD.		S	UD.
45	N	UD.	58	N	UD.	73	N	UD.
	S	UD.		S	B. attack.		S	UD.
46	N	UD.	59	N	UD.	75	N	Damaged.
	S	UD.		S	UD.		S	UD.
47	N	UD.	60	N	UD.	77	N	UD.
	S	UD.		S	UD.		S	UD.
48	N	UD.	61	N	UD.			
	S	UD.		S	UD.			
49	N	UD.	62	N	Damaged.			
	S	UD.		S	UD.			
50	N	UD.	63	N	UD.			
	S	UD.		S	UD.			
51	N	UD.	64	N	UD.			
	S	UD.		S	UD.			
52	N	UD.	65	N	UD.			
	S	UD.		S	UD.			
			66	N	UD.			
				D	UD.			

TABLE 4

INSPECTION RESULTS OF
"X" LOOP TRAY (POLE) SUPPORT TIMBERS
WEST AND EAST PIER

Project No: 84-5-2-166

BENT	CONDITION OF WEST PIER SUPPORT TIMBERS				CONDITION OF EAST PIER SUPPORT TIMBERS			
	1	2	3	4	1	2	3	4
42	UD	UD	UD	-	UD	UD	-	-
43	UD	UD	UD	-	UD	UD	-	-
44	UD	UD	L. & B. Damage at end in 8".	-	UD	UD	-	-
45	UD	UD	-	B. damage.	UD	UD	-	-
46	UD	UD	-	UD	UD	UD	-	Attack.
47	UD	UD	Damage in 6".	-	UD	UD	Damaged.	-
48	*a) UD b) UD	a) UD b) UD	L. attack.	-	UD	UD	Damaged.	-
49	UD	UD	UD	-	UD	UD	Attack.	-
50	UD	UD	Damage in 6".	-	UD	UD		
51	a) UD b) UD	a) UD b) UD	L. damage in 3"	-	UD	UD	Damaged.	-
52	a) UD b) UD	a) UD b) UD	-	B. attack at end.	UD	UD	Attack.	-
53	a) UD b) UD	a) UD b) UD	L. & B. attack in 1".	-	UD	UD	Damaged.	-
54	a) UD b) UD c) UD	a) UD b) UD c) UD	MBD in 2"	-	a) Damage b) UD	a) UD b) Damage	Damaged.	-
55	UD	UD	MBD in 3"	-	UD	UD	Attack.	-
56	a) UD b) UD	a) UD b) UD	L. L. attack.	-	UD	UD	UD	-
57	a) UD b) UD	c) UD d) UD	MBD 6"	-	UD	UD	Damaged.	-

Three elevations of Support Timbers, each identified individually as Timber a, b, or c. Refer to Drawing No. 2, detail K for details.

TABLE 4
INSPECTION RESULTS OF
"X" LOOP TRAY (POLE) SUPPORT TIMBERS
WEST AND EAST PIER

Project No: 84-5-2-166

BENT	CONDITION OF WEST PIER SUPPORT TIMBERS				CONDITION OF EAST PIER SUPPORT TIMBERS			
	1	2	3	4	1	2	3	4
58	a) UD b) UD	a) UD b) UD	MBD in 10"	-	Damaged.	UD	-	Attack.
59	a) MBD entire length b) UD	a) MBD 8" b) UD	B. attack at both ends.	-	UD	UD	Damaged.	-
60	UD	UD	Attack 1".	-	UD	UD	Damaged.	-
61	UD	UD	Damage 6".	-	UD	UD	Attack.	-
62	UD	UD	Damage in 10".	-	UD	UD	Damaged.	-
63	UD	UD	Damage 4".	-	UD	UD	Damaged.	-
64	a) Damage 1" at top. b) UD	a) Damage 2". b) UD	Damage 4". MBD.	-	UD	UD	Damaged.	-
65	UD	UD	Damage 6".	-	UD	UD	-	-
66	UD	Damaged. Hollow.	-	-	Damaged.	UD	-	-
67	UD	UD	-	-	Damaged	UD	-	-
68	UD	UD	-	-	Damaged	UD	-	-
69	1% mech. shake.	UD	-	-	Damaged	UD	-	-
70	UD	UD	-	-	Damaged	UD	-	-
71	Damage 4".	Damage 2"	-	-	UD	UD	-	-

TABLE 5
INSPECTION RESULTS OF
"X" LOOP CABLE CLEAT SUPPORTS AND CLEAT
WEST PIER

Project No: 84-5-2-166

BENT	CONDITION OF CLEAT SUPPORTS AND CLEAT								
	UPPER NORTH	UPPER SOUTH	CLEAT	MIDDLE NORTH	MIDDLE SOUTH	CLEAT	LOWER NORTH	LOWER SOUTH	CLEAT
66	UD	UD	UD	UD	UD	UD	UD	UD	UD
67	UD	-	UD	UD	UD	UD	UD	UD	Damage 8".
68	B. attack at end	UD	UD	UD	UD	Damage 6"	UD	B. damage 3"	UD
69	UD	UD	UD	L. B. attack	1" attack	UD	UD	UD	UD
70	Note: No members present			this bent.					
71	UD	UD	UD	UD	UD	UD	UD	UD	UD

TABLE 5
INSPECTION RESULTS OF
"X" LOOP CABLE CLEAT SUPPORTS AND CLEAT

EAST PIER

Project No: 84-5-2-166

BENT	CONDITION OF CLEAT SUPPORTS AND CLEAT								
	UPPER NORTH	UPPER SOUTH	CLEAT	MIDDLE NORTH	MIDDLE SOUTH	CLEAT	LOWER NORTH	LOWER SOUTH	CLEAT
66	UD	UD	Attack	Damage	Damage	UD	UD	UD	Attack
67	UD	UD	Attack	UD	UD	UD	UD	UD	Damage
68	No cleats this bent.								
69	UD	UD	UD	UD	Attack	UD	UD	UD	UD
70	UD	UD	UD	UD	UD	Attack	UD	UD	Attack
71	UD	UD	UD	UD	UD	UD	Damage	UD	UD

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TABLE 5
INSPECTION RESULTS OF
MISCELLANEOUS TIMBERS

Project No: 84-5-2-166

BENT	ROW	SIDE OF BENT/ROW	TYPE	CONDITION
40 E	3	-	"Z" loop clamping timbers	3 elevations of clamping timbers all destroyed.
39 W	3	-	"Z" loop clamping timbers	1 elevation of clamping timber destroyed. MBD.
77 E	1-3	-	"Z" loop clamping timbers	3 elevation of clamping timbers destroyed. MBD.
77 W	1-3	-	"Z" loop clamping timbers	3 elevation of clamping timbers destroyed. MBD.
77			"Z" loop trough that spans from E pier to W pier	W pier support timbers 1,2, & 4 are damaged. No. 3 is UD. E pier 1 and 2D, 3 UD.
76			N trough pole	UD
			S trough pole	UD
			"Z" loop trough that spans from E pier to W pier	W pier 1,2,3,4, damaged. E pier 1,2, only UD.
			N trough pole	UD
			S trough pole	UD

A.A ENVIRONMENTAL DATA

The facility is located on the eastern shore of Hood Canal on the Kitsap Peninsula (see Figures 2-4). The region is a long, north-south lowland situated between mountain ranges on the east and west. The region's ecology is characterized by dense conifer forests.

The topography of Bangor Annex is predominantly flat to gently rolling. Hills and valleys on site are irregular but have a general north-south trend. Three major streams and numerous minor drainages run through the site towards Hood Canal to the west.

The Hood Canal shore of the Bangor Annex is for the most part erosional, with steep wave cut slopes rising to more than 100 feet above sea level. The seashore environment is characterized by a slow erosion of the cliff and deposition of erosional debris (silts and sands) from the streams to offshore deltas.

The sea bottom slopes uniformly down toward the Hood Canal in a slope of about one in 10. Soils data indicates a major portion of the Bangor Annex is covered with a glacial till of a dense gravel-sand-silt mixture. This relatively impermeable material varies in thickness from zero to more than 40 feet, with the thickest layer being in the southern portion of the site. Much of the till is covered by a relatively thin layer (10 feet) of medium dense sand and gravel with some areas of surface soils and gravel deposits.

Offshore, along the Bangor shoreline, the sea floor is covered with recent loose to medium dense granular materials at varying depths. At some locations, a wedge of till follows, thickening towards the center of the Canal. These sloping soils overlie and truncate a series of essentially horizontal sand silt strata. In the offshore areas, artesian conditions occur in areas where these silt strata exist. Offshore soil conditions were found to be generally good for offshore construction. Exceptions to this were found in areas where less suitable soil artesian conditions and till deposits occur and may

require some remedial preparation for emplacement of waterfront facilities.

Climatic conditions of Bangor Annex are representative of the Kitsap Peninsula, with short, cool, dry summers and mild, wet winters. Annual precipitation varies from 30 to 70 inches with 75 to 80 percent of the annual rainfall occurring from October to March. The Kitsap Peninsula and Hood Canal are susceptible to slightly higher winds than other areas of the Puget Sound lowlands. The strongest winds are from the south and southwest and usually occur when intense Pacific storms move inland.

Precipitation Averages:

Keport	-	30.66 inches annual rainfall
Bremerton	-	38.66 inches annual rainfall
Seattle	-	34.10 inches annual rainfall
Quilcene	-	50.90 inches annual rainfall

Tidal range at the site is:

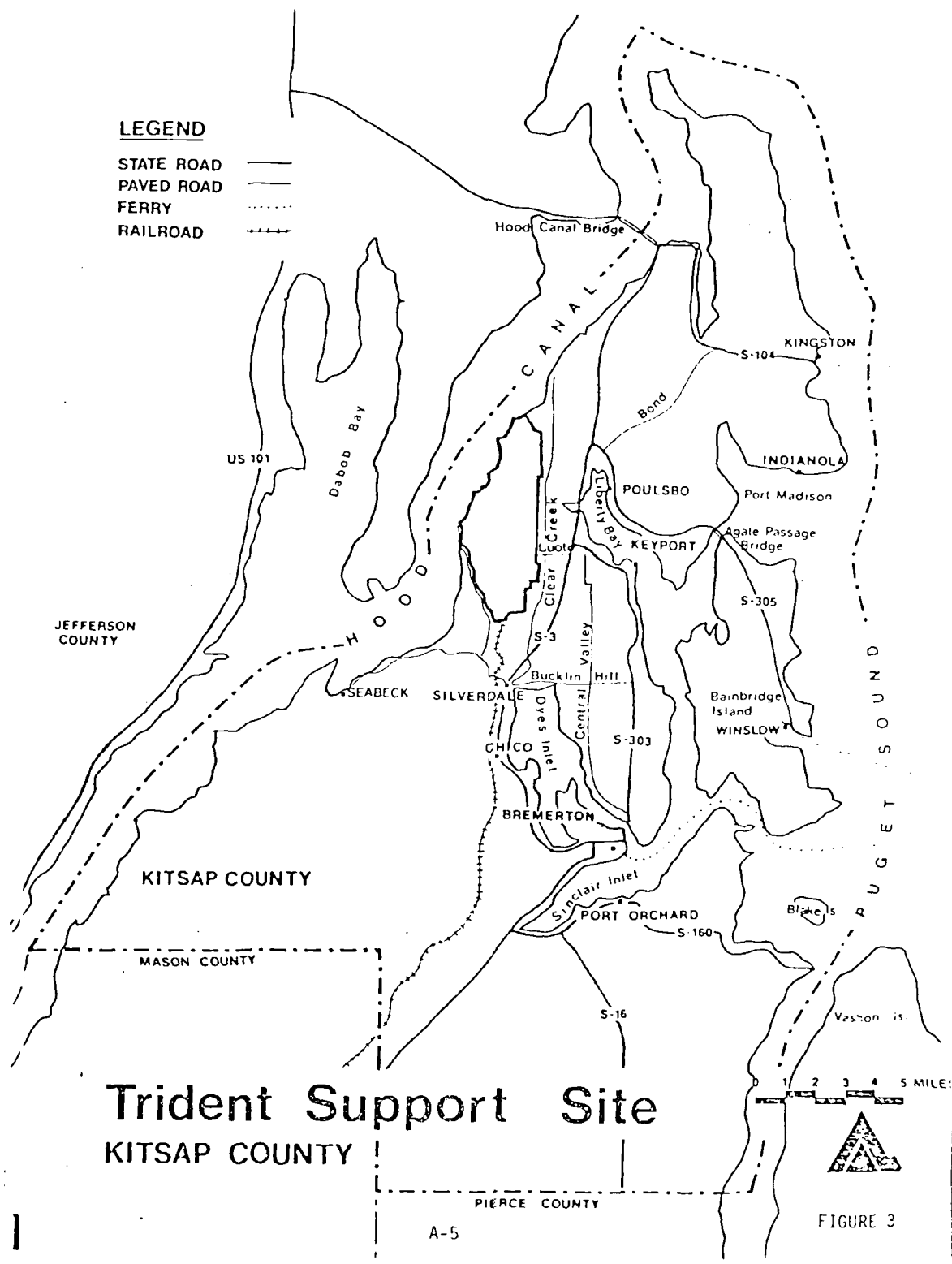
Extreme High Water (EHW)	-	+14.6 feet.
Mean Higher High Water (MHHW)	-	+10.9 feet
Mean Tide Level (MTL)	-	+ 6.4 feet
Mean Lower Low Water (MLLW)	-	0.0 feet
Extreme Low Water (ELW)	-	- 4.5 feet

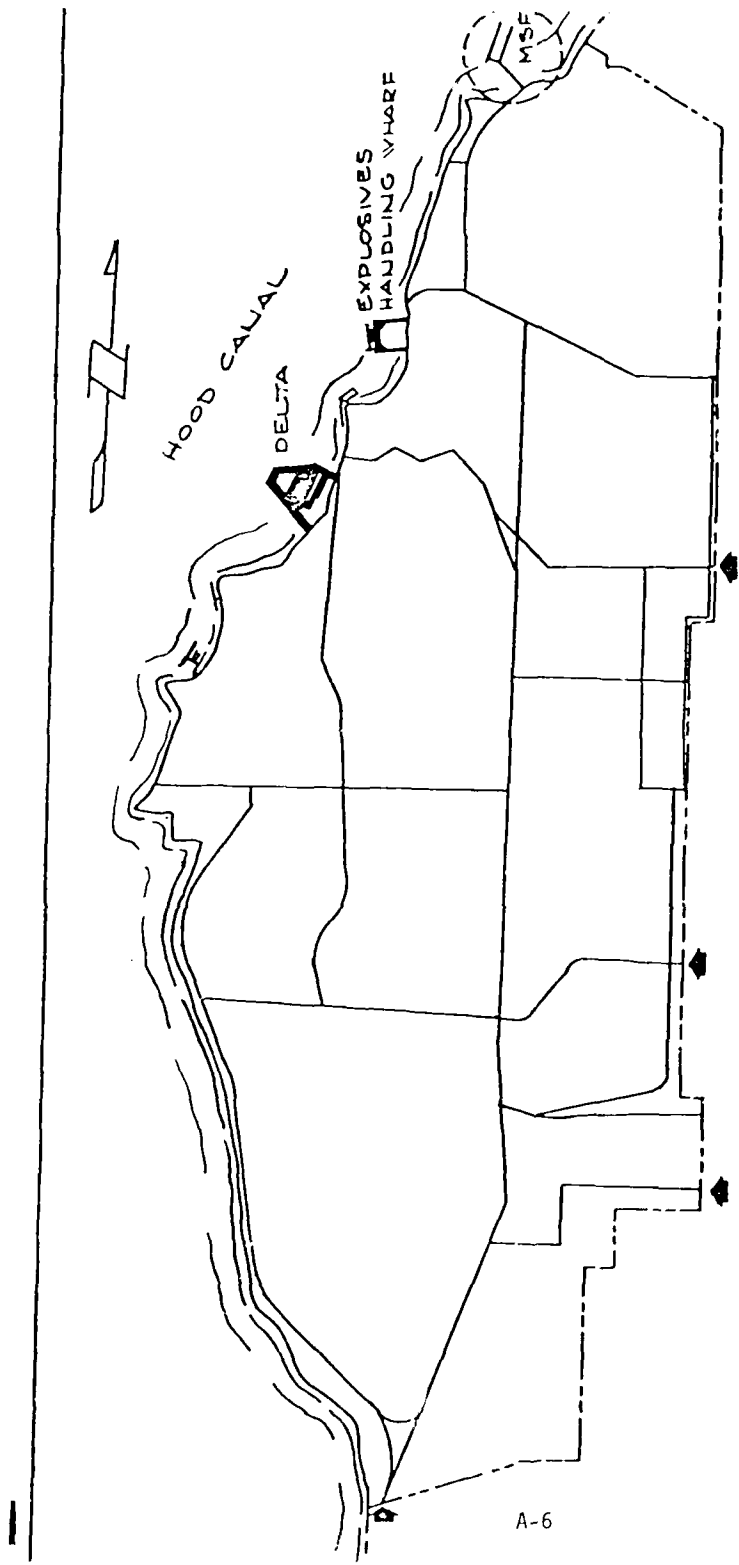
Elevations are based on Mean Lower Low Water which is 6.146 feet below Geodetic sea level datum of 1929 through the Pacific Northwest supplementary adjustment of 1947.

Wave forces at the site are based on an estimated significant wave height for 75 MPH wind velocity over a maximum fetch of 12 miles.

Earthquake criteria established for Seismic Probability Zone 3 in accordance with NAVFAC P-355 and Collapse Resistance Criteria for critical load structures in accordance with NAVFAC DM-2 Lateral Seismic Load Factors:

K = 1.0
C = $0.05/T^{1/3}$ for each structural element
Z = 1.00





TRIDENT SUPPORT SITE GENERAL PLAN

LEGEND

- ◻ LAND ENTRANCE
- ROAD
- - - BOUNDARY

1000' 2000' 3000' 4000'

FIGURE 4

A.B REPAIR ALTERNATIVES

The following breakdown and the accompanying appendix table details the costs for two maintenance alternatives to replace defective timbers identified in the current project. The accompanying appendix table lists unit costs for materials including fasteners, and number and lengths of timbers required for replacement. Labor costs are based on average fees for Northwest area underwater contractors.

	Repair/Replacement Material	
	Creosote Treated Members	Molded Fiberglass Members
Material and Fasteners	\$ 17,100.00	\$ 68,065.00
Labor		
removal of defective members	\$ 58,000.00	58,000.00
installation of new members	\$ 87,000.00	\$ 87,000.00
Mobilization-Demobilization	\$ 5,000.00	\$ 5,000.00
Equipment Rental	\$ 10,000.00	\$ 10,000.00
Contingency (covering additional damaged members)	\$ <u>44,275.00</u>	\$ <u>57,020.00</u>
Total	\$ ~230,000.00	\$ ~290,000.00

APPENDIX TABLE

Structural Members	Site	No. of Damaged Members	Length of Member (L.H. Ft.)	Estimated Cost for Fiberglass Members	Estimated Cost for Timber Members	Size of Bolts/Strap	No. of Bolts/Strap	Estimated Cost Fiberglass Bolts	Estimated Cost Stainless Steel Bolts	Size of Nuts	No. of Nuts	Estimated Cost for Fiberglass Nuts	Estimated Cost for Stainless Steel Nuts	Size of Washers	No. of Washers	Estimated Cost Fiberglass Washers	Estimated Cost for Stainless Steel Washers
1-Loop Top Support Timbers	4" x 8" x 8'	53	624	\$10,000.00	\$ 700.00	3/4" x 2 1/2"	212	\$1,400.00	\$ 3,300.00	3/4"	212	\$ 600.00	\$140.00	3/4"	424	\$ 90.00	\$145.00
2-Loop Top Support Timbers	6" x 8" x 8'	17	96	\$ 2,500.00	\$ 300.00	1/2" x 2 1/2"	72	\$ 500.00	\$ 800.00	1/2"	72	\$ 200.00	\$ 15.00	1/2"	144	\$ 30.00	15.00
1-Loop Chais (4" x 8" x 10')	4" x 8" x 10'	16	128	\$ 3,000.00	\$ 200.00	3/4" x 1 1/2"	96	\$ 600.00	\$ 1,100.00	3/4"	160	\$ 450.00	\$100.00	3/4"	320	\$ 70.00	\$110.00
2-Loop Chais (4" x 8" x 10')	4" x 8" x 10'	19	152	\$ 3,500.00	\$ 300.00	3/4" x 1 1/2"	114	\$ 680.00	\$ 2,000.00	3/4"	238	\$ 330.00	\$150.00	3/4"	476	\$100.00	\$160.00
2-Loop Top Support Timbers	4" x 8" x 10'	100	200	\$ 2,000.00	\$ 200.00	3/4" x 2 1/2"	104	\$ 210.00	\$ 210.00	3/4"	124	\$ 350.00	\$ 80.00	3/4"	248	\$ 55.00	\$ 85.00
2-Loop Top Support Timbers	4" x 8" x 10'	52	1,040	\$25,000.00	\$1,500.00	1/2" x 4 1/2" x 4 1/2" Strap	104	\$ 210.00	\$ 210.00	3/4"	124	\$ 350.00	\$ 80.00	3/4"	248	\$ 55.00	\$ 85.00
2-Loop Top Support Timbers	4" x 8" x 10'	31	620	\$14,000.00	\$1,000.00	3/4" x 2 1/2"	124	\$ 700.00	\$ 3,900.00	3/4"	124	\$ 350.00	\$ 80.00	3/4"	248	\$ 55.00	\$ 85.00
Totals			2,660 L.H. Ft.	\$61,700.00	\$4,200.00			\$4,090.00	\$10,710.00			\$11,920.00	\$485.00			\$345.00	\$515.00

END

DATE
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