STATE OF WASHINGTON
ARTHUR B. LANGLIE, GOVERNOR

WASHINGTON
STATE HIGHWAY COMMISSION
DEPARTMENT OF HIGHWAYS

OFFICE OF DISTRICT ENGINEER
4200 MAIN STREET
VANCOUVER, WASHINGTON

October 16, 1952

Mr. W. A. Bugge
Director of Highways
Olympia, Washington

Attention Mr. Carl Minor

PSH No. 12, L-764
South Bend Vicinity
Station 19+50 to Station 32+00

Dear Sir:

A soil survey has been completed on the above-numbered location. Eighty-one, two-inch undisturbed tube samples were submitted to the Laboratory for testing. A map with cross sections has been prepared as well as six pages of photographs and is included with this report.

General Conditions

On this project it is proposed to correct the uneven settlements of the existing roadway surface, possibly by adding the necessary thickness of surfacing materials to bring the pavement surface to the proper grade. Since this particular section in the city of South Bend has always been a source of trouble with regards to settlements, it was believed essential that the project include the stabilization of the area in order to prevent further settlements.

The City Council is also concerned with this settlement, in as much as a letter was sent to Mr. Bugge, dated February 26, 1952, and a section is quoted:

> "The condition continues to grow worse, and the north side of the highway has settled to such an extent, that during the icy condition last month, it was difficult to hold a car on the highway, due to the slope toward the river.
>
> "Also, as you know, the city desires to replace the pedestrian walk on the north side of the street, which

has fallen in and is now closed to all foot traffic, but such improvement cannot be made until the city is advised of what changes will be made in the roadway.

"The City also has a project ready for replacement of the water main under Water Street, through the area, which also depends on what work will be done on the roadway."

This condition may be noted in Figure 1 if attention is directed along the right-hand curb line as shown in the picture. Present local settlements may be seen in Figure 2 and Figure 3.

History of Settlements

Prior to the year 1933, settlements were observed in this area at approximately the same locations as they are now. This may be seen in Figure 4 and Figure 5. Therefore, under Contract No. 1807 during the winter of 1933-1934, treated anchor piling and treated timber sheet piling was installed between Station 19+86 to Station 24+70 as well as between Station 27+19 to Station 28+01 (see Figure 6). Above the sheet piling bulkhead, riprap was placed as shown in Figure 7. In the sections not improved by this contract there already existed riprap on the slope between the River and the curbing and its condition at the present time may be noted in Figure 8.

The areas that had settled were backfilled with a soft basalt having a brown gritty clay matrix as shown in Figure 9 and then paved with a Portland Concrete Cement pavement. These sections were Station 19+81 to Station 21+16, Station 21+30 to Station 21+95, and Station 23+59 to Station 24+69.

Present Condition

An attempt was made to determine the amount of settlement that had occurred since the year 1933 but no records could be found for the section Station 19+50 to Station 24+50 although the settlement is noticeable as noted in Figure 2 and Figure 3. Between Station 25+00 and Station 32+00 records were found that gave elevations of the top of the cement concrete curb approximately 24 feet left of center line and the amounts of settlement from the year 1933 to the present time are as follows:

Station	Settlement in Feet	Station	Settlement in Feet
25+00	0.14	29+00	0.15
25+50	0.11	29+50	0.12
26+00	0.09	30+00	0.24
26+50	0.11	30+50	0.27
27+00	0.19	31+00	0.16

Station	Settlement in Feet	Station	Settlement in Feet
27+50	0.51	31+50	0.05
28+00	0.59	32+00	0.02
28+50	0.20		

In addition to the settlement that was observed in the pavement, some side-thrust of the sheet piling bulkhead was also noted. This may be seen by comparing Figure 7 and Figure 11. The sideward movement of the bulkhead is probably due to the fact that practically all of the cables that tie the anchor piles to the sheet piling have become corroded and broken.

Also, you will note by comparing the two photographs that during the past nineteen years there has been some settlement of the riprap itself.

Another observation that was noted is shown in Figure 3 by the settlement of the concrete sidewalk slab and how the present wooden sidewalk is blocked up to meet the grade of the highway pavement.

Soil Investigation

To determine the nature and characteristics of the foundation soil in this area, six test holes were drilled and undisturbed samples taken, the location of the holes and the depths at which the samples were extracted are shown on the attached drawing.

It is therefore requested of the Laboratory to test the submitted samples for strength and consolidation. The tests should be of the order to determine the possibility of future movement of the area as well as the amount of settlement that might occur in the next twenty years.

Field Observations and Recommendations

1. As mentioned in the letter from the City Council, the City is proposing to replace their water main which is located approximately 20 feet right of center line under the pavement section of Water Street. It is quite possible that there are leaks in this old water main and the escaping water could be aggravating the settlement condition. If there are leaks in the main the replacement of the pipe by the City will undoubtedly improve conditions noticeably.

2. In most cases it was noted that the greater settlements were located in the vicinity of storm or sanitary sewers. It is believed that the settlements in this area have broken most of the sewer lines and it is recommended that an improvement of this section include a replacement of all broken sewer lines.

3. In all test holes excepting hole No. 1, the bottom of the soft blue clay could not be found with the drilling equipment available in the District. Therefore to try to stabilize the entire area would be impractical from a standpoint of piling in as much as there is nothing to anchor the piling to and from the standpoint of a retaining wall since there is no foundation to adequately support a wall.

It is believed that the proper method of improvement is to correct all obvious conditions that are causing settlement and instability and then bring the roadway section to grade with surfacing material with the understanding that some future settlement will be experienced.

4. As mentioned previously, it was noted that in some places the sheet piling bulkhead had moved and that some of the supporting cables had broken. It is suggested that this project include the replacing of the cables where practicable and the bulkhead straightened.

5. As shown in Figure 8, it was noted that certain areas of riprap were being undermined by wave action from the Willapa River. The improvement of this condition would also prove beneficial.

Yours very truly,

P. J. McKAY
District Engineer

D. W. Trotland

By: D. W. TROTLAND
District
Soils Engineer

PJM:dk
DWT

Enc.

c.c. - Mr. Minor
Mr. Nielson
District Soils File

Fig. 1 Looking westerly along Water Street from Sta. 31+25 Note the uneven settlements along the right-hand curb line.

Fig. 2 Settlement of wooden sidewalk out beyond curb line, Sta. 20+70 looking easterly. Test hole #4 is located as shown by arrow.

Fig. 3 Settlement of concrete sidewalk and blocking-up of existing wooden sidewalk at Sta. 20+25.

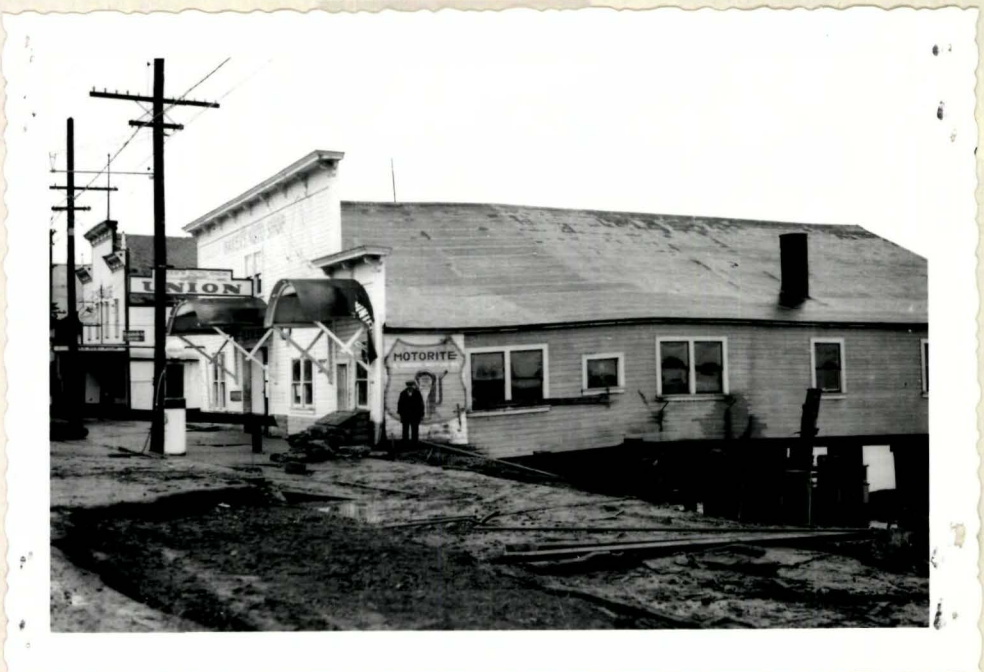


Fig. 4 Settlement of pavement, sidewalk, and garage in the year 1933 as seen from Sta. 21+50 looking in a northwesterly direction.

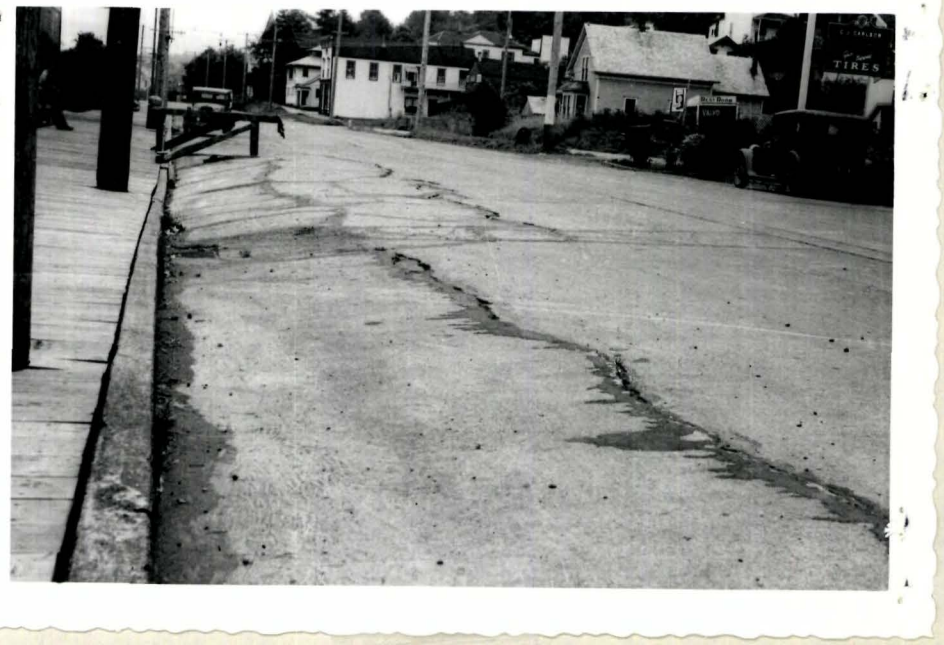


Fig. 5 Settlement of curb and pavement in the year 1933 at Sta. 23+00 looking easterly down Water Street.

Fig. 6 Installation of treated anchor piling and treated timber sheet piling during the year 1933 as seen from Sta. 24+00 looking easterly.

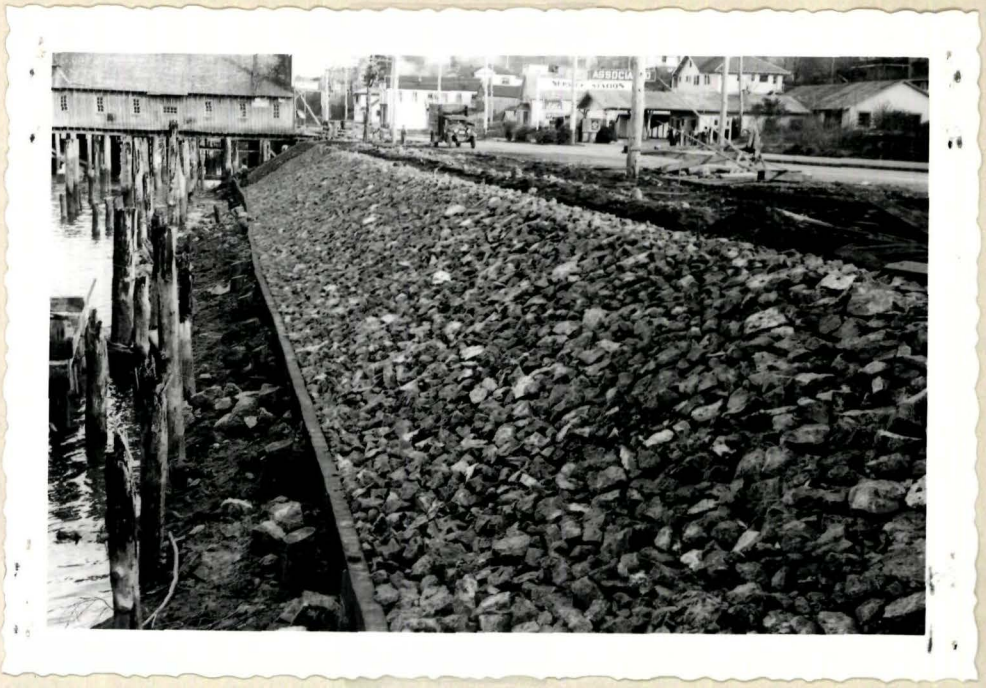


Fig. 7 Riprap as placed in 1933 as seen from Sta. 21+00 looking easterly.

Fig. 8 Riprap as placed prior to 1933 in its present condition as seen from Sta. 29+50 looking easterly.

Fig. 9 Backfilling settled area with soft basalt having a brown gritty clay matrix during construction in 1933. View taken from Sta. 20+10 looking easterly.

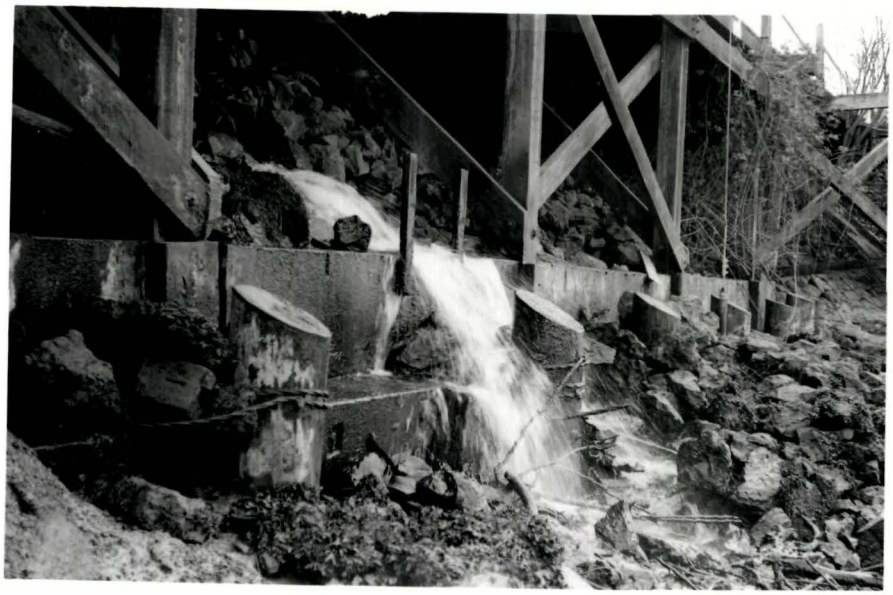


Fig. 10 Treated timber sheet piling at outfall for storm and sanitary sewer as seen from Sta. 27+50 looking westerly.

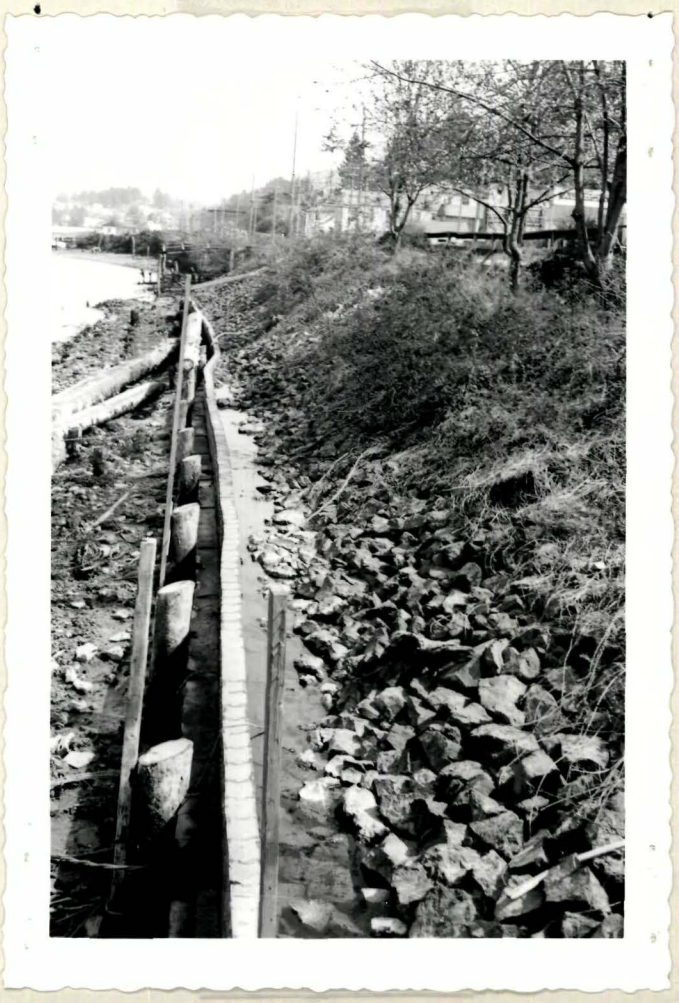
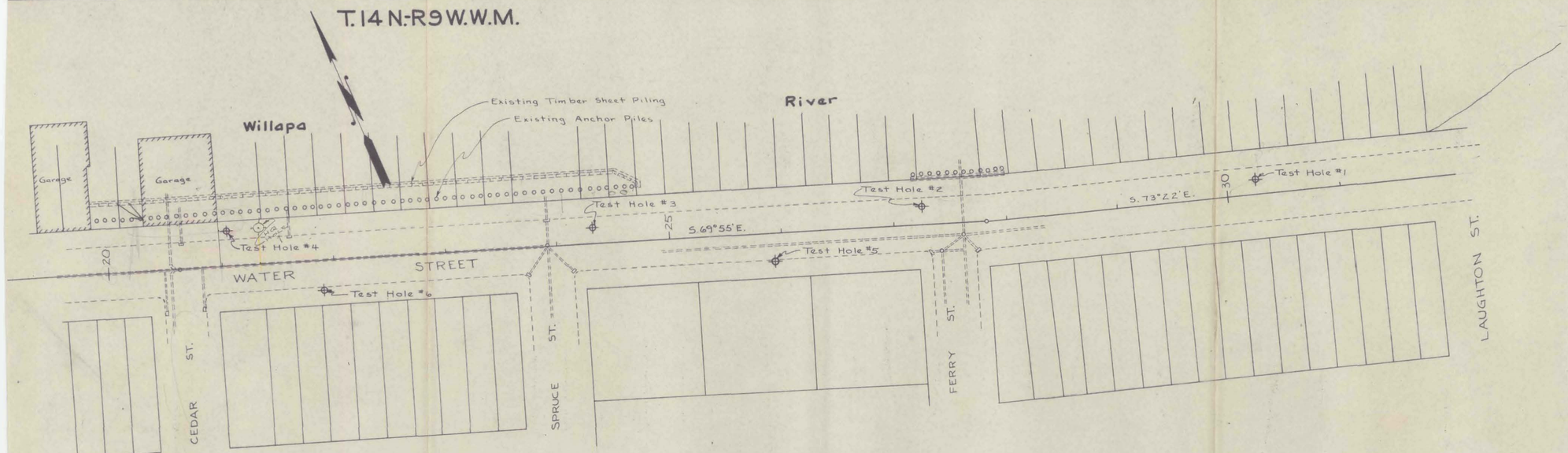
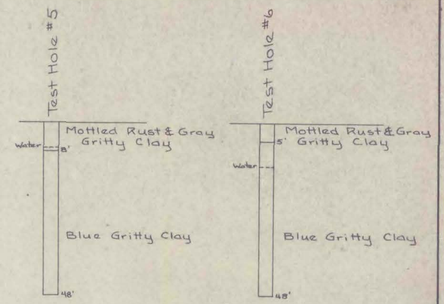
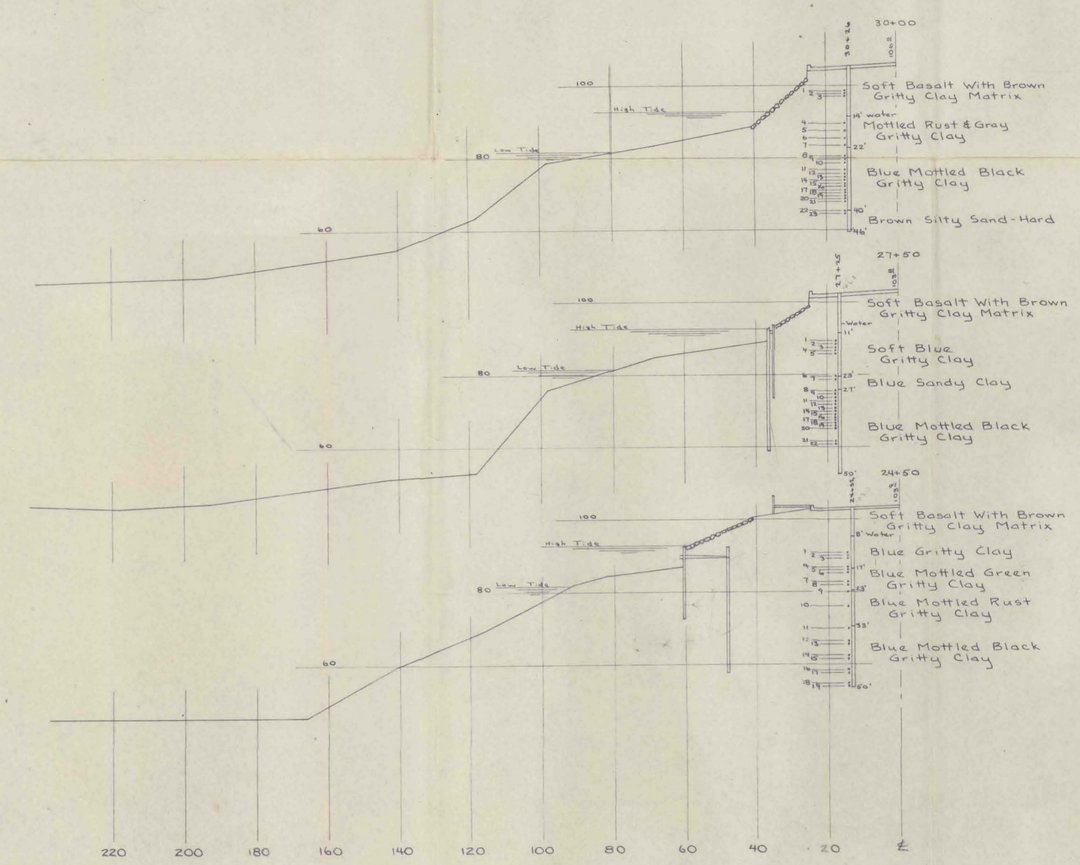


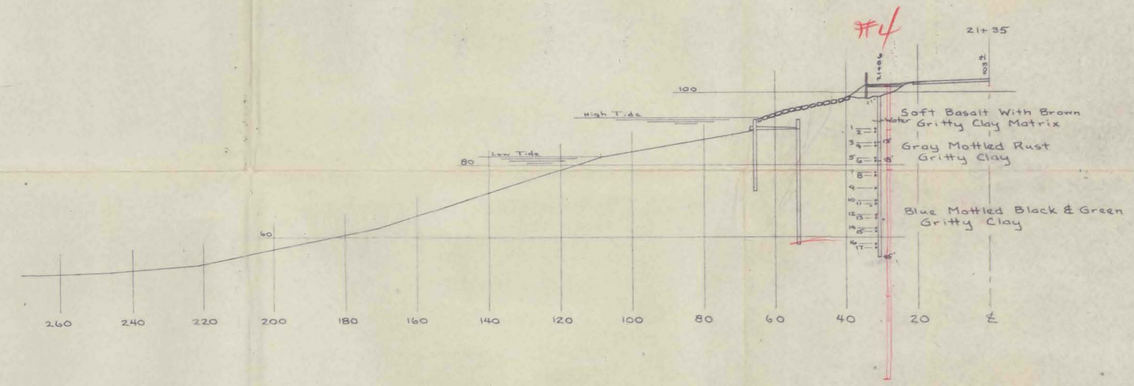
Fig. 11 View showing treated timber sheet piling and riprap in its present condition as seen from Sta. 21+75 looking easterly.

T. 14 N.-R 9 W.W.M.









P. S. H. No. 12

SOUTH BEND VICINITY

PACIFIC COUNTY

Job No. L-764

Scale: Map 1" = 50'
X-Sec. 1" = 20'

DISTRICT ENGR. P. J. McKAY
DIST. SOIL ENGR. D. W. TROTLAND

August 1952