

MEMORANDUM

W.P. 113-62

To: Mr. A. M. Toye,
Bridge Engineer,
Bridge Division.

FROM: Foundation Section,
Materials & Research Division,
Room 107, Lab. Bldg.

Attention: Mr. S. McCombie

DATE: March 6, 1964

OUR FILE REF.

IN REPLY TO

SUBJECT:

PILE LOAD TEST

Proposed Crossing, Hwy. #624
and Blanche River, Dist. #14.

W.J. 63-F-145 -- W.P. 113-62

Attached, we are sending you the above-mentioned report for your use. We believe that it contains all information necessary for your future design work and that, also, adequate data for construction purposes is provided. However, should you feel that there are some additional problems that you would like to discuss, please do not hesitate to contact our Office.

AGS/MdeF
Attach.

cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
H. D. McMillan
H. McArthur
R. S. Chapman
E. R. Saint
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A. G. Stermac
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PRINCIPAL FOUNDATION ENGINEER

Foundations Office
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92-31-20

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PILE LOAD TEST

Proposed Crossing, Hwy. #624
and Blanche River, Dist. #14.

W.J. 63-F-145 - W.P. 113-62

1. INTRODUCTION:

A verbal request was received from Mr. J. McAllister during March 1963, by this office to initiate and subsequently carry out a series of pile loading tests at the site of the proposed Hwy. #624 and Blanche River crossing.

A scheme was devised by this Section which involved the testing of one 20" diameter, 30' long concrete caisson and three 40' long Class 'B' timber piles. The piles, together with the reaction beam system, were installed by Teck Northern Roads Ltd. under W.O. #63-32222 during August 1963. Load testing was carried out by personnel from this Section during the following three months.

This report contains the results of the loading tests, together with our recommendations as to the most suitable type of piled foundations for the future project and the appropriate design loads.

2. DESCRIPTION OF SITE:

The site is located approximately 2.5 miles north-east of Englehart in Ewanturel Township, District of Timiskaming, and is situated some 1500' downstream from the existing crossing of Hwy. #624 and the Blanche River. At this point, the river flows

2. DESCRIPTION OF SITE: (cont'd.) ...

in a north-west to south-east direction. The width of the river at periods of low water level is about 130' and the maximum depth is about 12'. During flood conditions, the river rises to a maximum of about 30' above the low water level, thus extending the width to about 350'. The banks of the river show many signs of instability in the form of progressive slope failures. In the immediate vicinity of the site, the vegetation consists mostly of poplar and birch.

Physiographically, the area lies in the region referred to as the 'Timiskaming Clay Plain'.

3. SUBSOIL CONDITIONS:

Subsoil at the site consists of an extensive deposit of varved clay some 120' in thickness which is underlain by various stratified and predominantly granular deposits. Bedrock is located some 25 to 50 feet below the varved clay. During the original investigation (October - November 1962), artesian water was encountered in the above-mentioned granular strata with a pressure of some 20 p.s.i. at the ground surface. It was observed that this pressure dissipated uniformly from a maximum in the free draining granular strata to zero at a depth of about 5' below ground level. A detailed description of the overall soil conditions is given in Foundation Report #62-F-120, where it is concluded that conditions are generally uniform.

Adjacent to the locations of the test piles, an additional boring was carried out to a depth of 53' below the ground surface. The results of this boring was in general agreement with borings done in the original field investigation. A description of the

cont'd. /3 ...

3. SUBSOIL CONDITIONS: (cont'd.) ...

material encountered in the later boring (B.H. #10) is as follows:

The upper 10' consists of very stiff to firm silty clay to clayey silt, oxidized and somewhat desiccated. Although no definite stratification is visible to the naked eye, a plot of the liquid and plastic limits indicates alternate layers of material of slightly higher and lower plasticity. The range of plastic limits is small being between 19% and 22%, whilst the range of liquid limits is between 24% and 42%. The natural moisture content varies between 21% and 29%. The results of field and laboratory tests to determine the undrained shear strength indicate that the upper 5' is in the order of 2500 to 1500 p.s.f. and the lower 5' varies randomly from 2200 to about 300 p.s.f.

From 10' to 22' the subsoil consists of layers of clayey silt and silty clay, the latter being of the order of 1/4" or less in thickness, spaced about 1 1/2" apart. The stratification, which is inclined 35° to 45° to the horizontal, is clearly visible to the naked eye. The plastic limits of the clayey silt layers range from 18% to 22% and the liquid limits from 24% to 27%. No Atterberg limit tests were carried out on the silty clay because of the small quantity of material available in the layers: classification is therefore, based on visual observation. The natural moisture content of the overall stratum ranges from 19% to 27%. The undrained shear strength, according to field and laboratory tests, varies randomly between 200 p.s.f. and 600 p.s.f.

From 23' to 53', which was the maximum depth penetrated in B.H. #10, the deposit consists of alternate layers of clayey silt

cont'd. /4 ...

3. SUBSOIL CONDITIONS: (cont'd.) ...

and clay of high plasticity. The stratification which is inclined in a similar fashion to that of the higher layers is visible to the naked eye. The clay layers range in thickness from $3/8"$ to $1\frac{1}{2}"$ and are spaced apart from $1/8"$ to $1/4"$ down to 40' and from $3/8"$ to $1\frac{1}{4}"$ between 40' and 53'. The plastic limits of the clay layers range from 22% to 29% and the liquid limits from 55% to 62%. The corresponding ranges for the clayey silt layers are 18% to 22% and 22% to 35%. Natural moisture contents averaged about 57% and 25% for the clay and clayey silt layers, respectively. The undrained shear strength, according to field and laboratory tests, ranges from 600 p.s.f. to about 1000 p.s.f.

The results of field and laboratory tests, together with the inferred subsoil stratigraphy, are shown on the borelog sheet which accompanies this report. A curve is also included in the Appendix which shows the estimated variation of undrained shear strength with depth from ground level to 53.0'.

4. GROUND WATER CONDITIONS:

A number of piezometers were installed adjacent to the location of the test piles, for the purpose of measuring the pore water pressure at various depths down to 42'. All piezometers eventually stabilized at levels ranging from el. 605.0 to el. 610.0 before any piles were driven. That the artesian pressures in the granular strata were still active was evidenced by the fact that water was still flowing from the deep boreholes drilled during the original foundation investigation on both sides of the river.

cont'd. /5 ...

4. GROUND WATER CONDITIONS: (cont'd.) ...

A gauge was attached to a piezometer installed during the 1962 investigation and a pressure of 11 p.s.i. was recorded. It was observed that local slope failures had occurred between the periods of the two investigations at the locations where water was flowing out from the boreholes.

5. PILE DRIVING:

Seven Class 'B' treated timber piles were driven at the test site by means of a 3000 lb. drop hammer having a free fall of 5.0'. Three of the piles No's T-1, T-2 and T-3 were the actual piles to be load tested and were driven to a depth of about 40' below ground level. The other four timber piles No's A-1, A-2, A-3 and A-4, were driven some 48' into the ground, their purpose being to serve as anchors for the reaction beam system. The locations and elevations of all piles are shown on the accompanying Dwg. No. 63-F-145A. All recorded data pertaining to the actual driving of the piles is shown on the Pile Driving Records contained in the Appendix of this report. Total time of continuous driving required to install piles T-1, T-2 and T-3, was 20 minutes, 25 minutes and 13 minutes, respectively.

6. CAISSON INSTALLATION:

At completion of pile driving, a 31' long 20" diameter, cast in-situ concrete caisson was installed midway between anchor piles No's A-3 and A-4. The method of installation consisted simply of augering a 20" hole to the required depth, then pouring concrete

6. CAISSON INSTALLATION: (cont'd.) ...

into it. No casing was necessary during the above operations as the augered hole remained quite dry and stable until the concrete was placed. The caisson was finally capped with an 18" diameter 12" high concrete cap upon which was placed a 24" square 1" thick steel plate.

Total time of augering for the caisson installation was 30 minutes. For the placing of the concrete, a further 70 minutes was required.

Recorded data pertaining to the caisson is included with the Appendix of this report.

7. LOAD TESTING PROCEDURES:

The layout of the test piles, test caisson, anchor piles and the reaction beams is shown on Dwg. No. 63-F-145B. Each pile to be tested was located midway between two anchor piles 12' apart to which was attached a reaction beam consisting of a specially reinforced section of 14 BP at 73. Loads were then applied to the particular pile or caisson to be tested by jacking against the reaction beam. A hydraulic jack of maximum capacity 100 tons was used during the actual tests. Steel bearing plates 1" thick were placed on the caisson and test pile tops to ensure a satisfactory bearing surface between the piles and the jack. Vertical deflections of the pile under test were measured by means of four dial gauges, one placed at each corner of the bearing plate, which recorded the vertical displacement relative to two independently supported reference beams. Frequent checks were taken to ensure that the reference beams

cont'd. /7 ...

7. LOAD TESTING PROCEDURES: (cont'd.) ...

remained at a constant level for the duration of the test. The true deflection of the pile was taken to be the mean of the four deflections measured on the dial gauges.

During the testing, the following procedure was adhered to: Initially, a load of 10 tons was applied to the pile under test. This load was maintained until the rate of settlement decreased to a value of 0.01" per hour or for two hours - whichever was the shorter period. Thereafter, loads were increased in increments of 5 tons in the same manner until the rate of settlement was such that pressure could no longer be maintained by the jack. When this point was reached, the load was decreased by increments of 50%, 25%, 15% and 10% of the maximum load achieved. Settlement readings were taken at intervals ranging from 1 to 15 minutes, depending on the rate of settlement of rebound prevailing. For each test the following curves have been plotted: (1) Load versus Time; (2) Time versus Settlement; and (3) Load versus Settlement. These curves are included in the Appendix of this report.

The following table shows the dates of installation of the various piles and the dates that different load tests were carried out:

Pile	Date Installed	No. of Tests	Dates of Testing
T-1	Aug. 9/63	3	Aug. 27, Sept. 10, Oct. 10/63
T-2	Aug. 9/63	2	- Sept. 12, Oct. 18/63
T-3	Aug. 9/63	1	- - Oct. 19/63
Caisson	Aug. 14/63	3	Aug. 28, Sept. 11, Oct. 17/63

8. LOAD TEST RESULTS:

From the curves plotted for each loading test of load versus settlement, the ultimate bearing capacity of the pile has been estimated. Since the increments of loading were small (5 tons) the failure point was generally clearly defined within a small range, the latter being a rapid and significantly large change in curve gradient. The results so obtained are tabulated below.

The strength of a friction pile in clay consists of two parts: one being the adhesion between the pile shaft and the surrounding soil, and the other being the bearing capacity of the soil at the pile tip. The latter in the case of soft or firm clays, is generally small in comparison with the former and can be neglected without serious error for estimation purposes. The ultimate bearing capacity is given as:

$$Q = 9 A_b C_b + A_s C_a$$

where A_b = Area of pile base

C_b = Undrained shear strength of clay at the pile base

A_s = Area of pile shaft in contact with the clay

C_a = Average adhesion between pile shaft and surrounding soil.

The theoretical ultimate capacity of each pile has been computed using values of shear strength measured during the field and laboratory investigations of the subsoil at the test locations. The results of these computations, together with the ultimate pile capacities obtained from each load test, are tabulated below. A curve showing undrained shear strength with depth, is included in the Appendix of this report. The average line assumed to apply to a depth of 42 feet is indicated on this curve.

Pile	Ab ft. ²	As ft. ²	Ca p.s.f.	Cb p.s.f.	Q (Theoretical)	Q Test (1)	Q Test (2)	Q Test (3)
T-1	.352	107.4	750	900	42 tons	30 tons	35 tons	40 tons
T-2	.442	127.3	750	900	50	37	50	-
T-3	.323	107.8	750	900	42	36	-	-
Caisson	2.660	178.0	750	750	77	10	25	35

It can be observed that in the case of the three timber piles T-1, T-2 and T-3, good agreement exists between the theoretical ultimate capacity and the actual capacity obtained from the final (10 weeks after driving) load test. In the case of the caisson, poor agreement exists and for this, little or no explanation is readily apparent. The test result indicates that only 50% of the theoretical capacity has been achieved.

For each test performed on the timber piles, the shear strength or adhesion Ca has been calculated from the following:

$$Ca = \frac{Q}{As} \text{ (actual)}$$

This involves a small error in the order of 2% to 3% only. The value of Ca so obtained, has been plotted against time, zero time being the day on which the piles were driven. This curve shows the shear strength regain with time and indicates that close to 100% of the original shear strength has been mobilized in a period of about 10 weeks. The curve is included in the Appendix of this report.

cont'd. /10 ...

9. DISCUSSION & RECOMMENDATIONS:

The following conclusions have been drawn from the results of the series of load tests carried out at this site:

(1) The ultimate capacity of timber piles driven into this type of subsoil is approximately equal to the undrained shear strength of the soil multiplied by the surface area of the embedded pile length.

(2) The maximum capacity of the piles will be achieved within a period of about 2 months after driving.

(3) The cast in-situ concrete caisson installed at this site did not achieve the indicated theoretical ultimate capacity by a wide margin. The reason for this cannot be deduced from the results of a single installation.

Based on the above conclusions, and taking into account the overall site conditions, the following recommendations are made with regard to the proposed structure foundations:

Class 'B' timber piles driven approximately 45 feet into the subsoil can achieve a safe load of 15 tons per pile. Piles not remaining wholly below the ground water level should be treated to prevent decay.

10. SUMMARY:

The results of a series of pile loading tests carried out on three timber piles and a single concrete caisson at the site of the proposed Hwy. 624 and Blanche River crossing is reported.

Subsoil at the site consists of an extensive deposit of varved

10. SUMMARY: (cont'd.) ...

clay some 120' in thickness. The timber piles averaging 12" diameter were driven about 42' into the soil. The caisson which was 20" in diameter and 31' long, was cast in-situ.

The loading tests showed that the timber piles achieved close to 100% of the theoretical ultimate capacity within 2 months, whilst the concrete caisson achieved less than 50% in the same period.

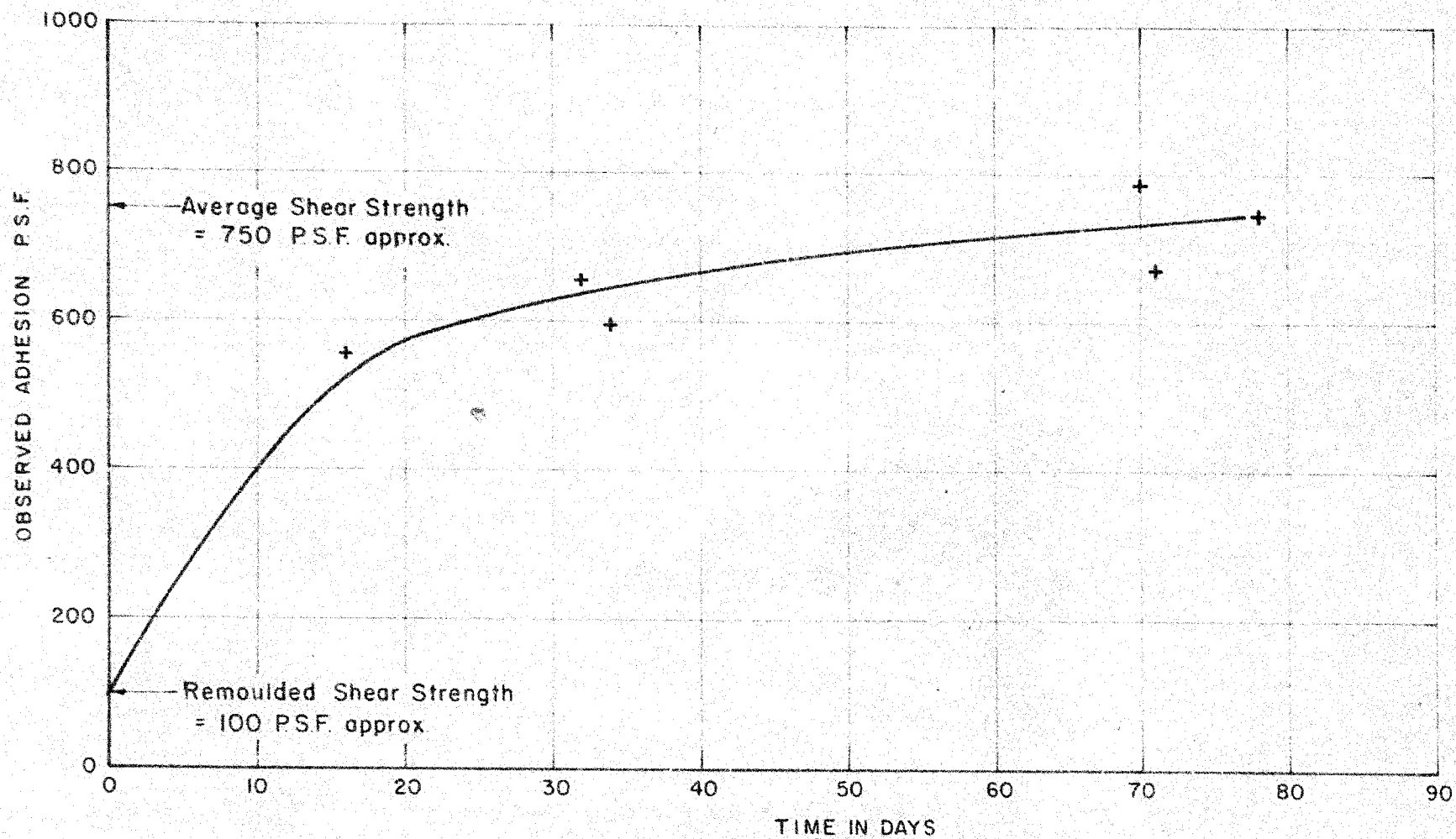
Recommendations pertaining to piled foundations for the proposed structure are given in the main body of this report.

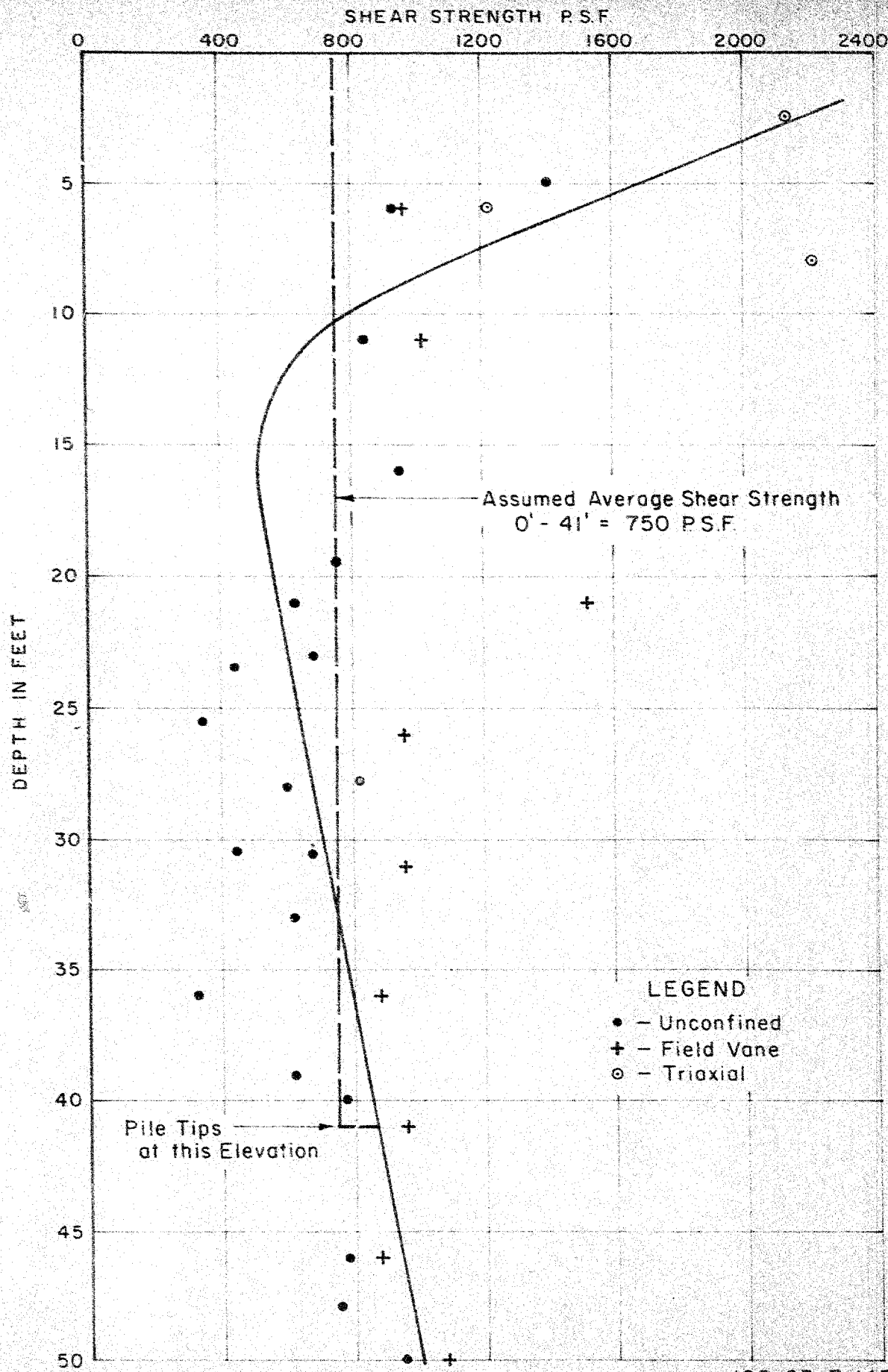
11. MISCELLANEOUS:

The installation of the test piles and anchorage system was carried out by Teck Northern Roads, Ltd., during August 1963. The load tests were carried out by Messrs. B. Kliem, H. Szymanski and K. Selby, during August, September and October 1963. This report was written by Mr. K. Selby.

March 1964

APPENDIX I.

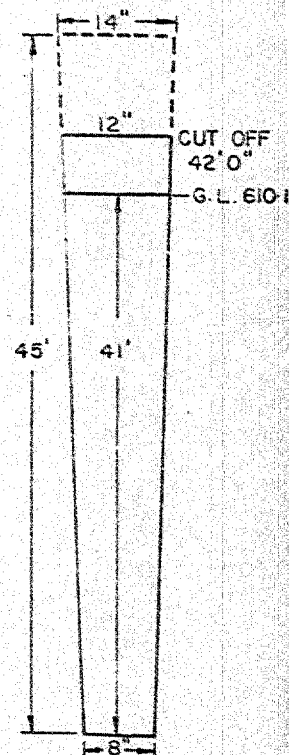




BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 14 W.O. NO. 63-32222 STRUCTURE BLANCHE RIVER - HWY. 624
 CONTRACTOR TECK NORTHERN RDS. DESIGN LOAD OF PILE TO BE DETERMINED
 HAMMER DETAILS: TYPE DROP HAMMER WEIGHT 3000 HEIGHT OF FALL OR ENERGY 15000^{ft}/lb
 TYPE OF ANVIL OR CAP FOLLOWER WEIGHT OF ANVIL OR CAP 1300 lb.
 PILE DETAILS TIMBER PILE CLASS 'B' TREATED
 PILE NO. T1 LOCATION STA. 17 + 69.30 E DATE DRIVEN 9/8/63

TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.
45'	1	2		26	7		51	
9:05 AM	2	5		27	7		52	
	3	5		28	10		53	
	4	4		29	9		54	
	5	2		30	10		55	
	6	4		31	8		56	
	7	4		32	9		57	
	8	3	9:20-9:26	33	9		58	
	9	3		34	11		59	
	10	3		35	11		60	
	11	5		36	12		61	
	12	3		37	11		62	
	13	5		38	11		63	
	14	4		39	12		64	
	15	3	9:32-9:50	40'5"	11+4	REBOUNDS FROM		
	16	5	9:52 AM	41	9	40'5" -	66 41'0"	
	17	4		42			67	
	18	5		43			68	
	19	5		44			69	
	20	5		45			70	
	21	4		46			71	
	22	6		47			72	
	23	6		48			73	
	24	7		49			74	
	25	7		50			75	



DETAILS FOR FINAL SIX INCHES OF PENETRATION	1	2	3	4	5	6
BLOWS PER INCH	1.3	1.3	1.3	1.3	1.3	1.3
MEASURED REBOUND IN INCHES	0.5	0.5	0.5	0.5	0.5	0.5
FINAL LENGTH OF PILE	42.0'			FINAL CUT OFF ELEVATION		
				611.1		

REPORT TO BE SENT TO: - PRINCIPAL FOUNDATION ENGINEER
 MATERIALS & RESEARCH DIVISION
 DEPARTMENT OF HIGHWAYS
 PARLIAMENT BUILDINGS
 TORONTO, ONTARIO

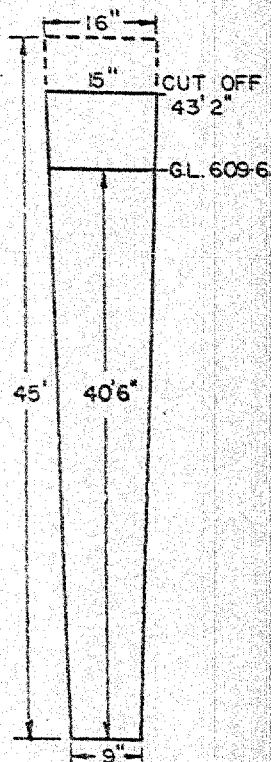
SIGNED H. Szyn
 NAME (PRINT) H. SZYN ISKI
 DATE MAR. 18, 1964

ATTACH SKETCH OF PILE NUMBERING SYSTEM

BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 14 W.O. NO. 63-32222 STRUCTURE BLANCHE R. - HWY. 624
 CONTRACTOR TECK NORTHERN RDS. DESIGN LOAD OF PILE TO BE DETERMINED
 HAMMER DETAILS: TYPE DROP HAMMER WEIGHT 3000 HEIGHT OF FALL OR ENERGY 15000 F²/LB.
 TYPE OF ANVIL OR CAP FOLLOWER WEIGHT OF ANVIL OR CAP 1300 LB.
 PILE DETAILS TIMBER PILE - CLASS 'B' TREATED
 PILE NO. T2 LOCATION STA. 17+74 2.9' RT. E DATE DRIVEN 9/8/63

TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS/FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS/FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS/FT.
<u>45'</u> <u>10:18 AM</u>	1	4		26	8		51	
	2	5		27	10		52	
	3	4		28	9		53	
	4	4		29	11		54	
	5	4		30	14		55	
	6	3	<u>10:31-10:34</u>	31	14		56	
	7	3		32	13		57	
	8	5		33	16		58	
	9	3		34	17		59	
	10	5		35	17		60	
	11	3		36	17		61	
	12	5		37	19		62	
	13	6		38	19		63	
	14	7		39	19		64	
	15	7	<u>10:44-10:48</u>	40	17	<u>REBOUND TEST</u>		
	16	6	<u>10:48-10:49</u>	40'6"	10	<u>FROM 40'68 40'6"</u>		
	17	8		42			67	
	18	7		43			68	
	19	7		44			69	
	20	6		45			70	
	21	7		46			71	
	22	7		47			72	
	23	7		48			73	
	24	8		49			74	
	25	8		50			75	



DETAILS FOR FINAL SIX INCHES OF PENETRATION	1	2	3	4	5	6
BLOWS PER INCH	<u>1.7</u>	<u>1.7</u>	<u>1.7</u>	<u>1.7</u>	<u>1.7</u>	<u>1.7</u>
MEASURED REBOUND IN INCHES	<u>0.5</u>	<u>0.5</u>	<u>0.5</u>	<u>0.5</u>	<u>0.5</u>	<u>0.5</u>
FINAL LENGTH OF PILE	<u>43.2'</u>			FINAL CUT OFF ELEVATION		
				<u>612.3</u>		

REPORT TO BE SENT TO: - PRINCIPAL FOUNDATION ENGINEER
 MATERIALS & RESEARCH DIVISION
 DEPARTMENT OF HIGHWAYS
 PARLIAMENT BUILDINGS
 TORONTO, ONTARIO

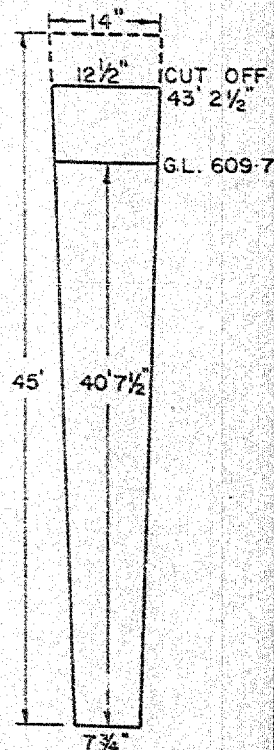
SIGNED H. Szymanski
 NAME (PRINT) H. SZYMANSKI
 DATE MAR. 18, 1964

ATTACH SKETCH OF PILE NUMBERING SYSTEM

BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 14 W.O. NO. 63-32222 STRUCTURE BLANCHE R. - HWY. 624
CONTRACTOR TECK NORTHERN RDS. DESIGN LOAD OF PILE TO BE DETERMINED
HAMMER DETAILS: TYPE DROP HAMMER WEIGHT 3000 HEIGHT OF FALL OR ENERGY 15000 F⁴/b
TYPE OF ANVIL OR CAP FOLLOWER WEIGHT OF ANVIL OR CAP 1300 lb.
PILE DETAILS TIMBER PILE CLASS 'B' TREATED
PILE NO. T3 LOCATION STA. 17+74.50 - 3.2' LT. E DATE DRIVEN 9/8/63

TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.
45'	1	2		26	6		51	
11:26 A.M.	2	2		27	5		52	
	3	2		28	7		53	
	4	3		29	6		54	
	5	3		30	7		55	
	6	2		31	7		56	
	7	2		32	7		57	
	8	2		33	8		58	
	9	3		34	8		59	
	10	4		35	9		60	
	11	4		36	9		61	
	12	4		37	10		62	
	13	4		38	11		63	
	14	5		39	11		64	
	15	6	11:38 - 11:43	40	11	REBOUND 65 TEST		
	16	5	11:44 A.M.	40 7 1/2"	8	FROM 40' 65" 40' 7 1/2"		
	17	5		42			67	
	18	4		43			68	
	19	4		44			69	
	20	5		45			70	
	21	5		46			71	
	22	5		47			72	
	23	5		48			73	
	24	4		49			74	
	25	5		50			75	



DETAILS FOR FINAL SIX INCHES OF PENETRATION	1	2	3	4	5	6
BLOWS PER INCH	1.07	1.07	1.07	1.07	1.07	1.07
MEASURED REBOUND IN INCHES	0.5	0.5	0.5	0.5	0.5	0.5
FINAL LENGTH OF PILE	43.2'		FINAL CUT OFF ELEVATION			
			612.3			

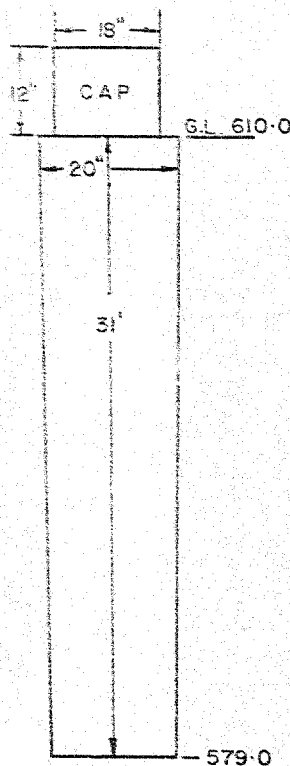
REPORT TO BE SENT TO: - PRINCIPAL FOUNDATION ENGINEER
MATERIALS & RESEARCH DIVISION
DEPARTMENT OF HIGHWAYS
PARLIAMENT BUILDINGS
TORONTO, ONTARIO

SIGNED H. Szymanski
NAME (PRINT) H. SZYMANSKI
DATE MAR. 18, 1964

ATTACH SKETCH OF PILE NUMBERING SYSTEM

BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 14 W.O. NO. 63-3222 - STRUCTURE BLANCHE RIVER - HWY. 624
CONTRACTOR TECK NORTHERN PDS DESIGN LOAD OF PILE TO BE DETERMINED
PILE DETAILS 20" DIA. CAST INSITU CONCRETE CAISSON
PILE NO. C-1 LOCATION STA. 17+79.40 64' LT. E DATE INSTALLED 14/8/63



REPORT TO BE SENT TO: - PRINCIPAL FOUNDATION ENGINEER
MATERIALS & RESEARCH DIVISION
DEPARTMENT OF HIGHWAYS
PARLIAMENT BUILDINGS
TORONTO, ONTARIO

SIGNED H. Szymanski
NAME (PRINT) H. SZYMANSKI
DATE MAR. 18, 1964

ATTACH SKETCH OF PILE NUMBERING SYSTEM

RECORD OF BOREHOLE NO. 10

1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 26

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CONFIDENTIAL A.S.

14-00000

Sept 1941

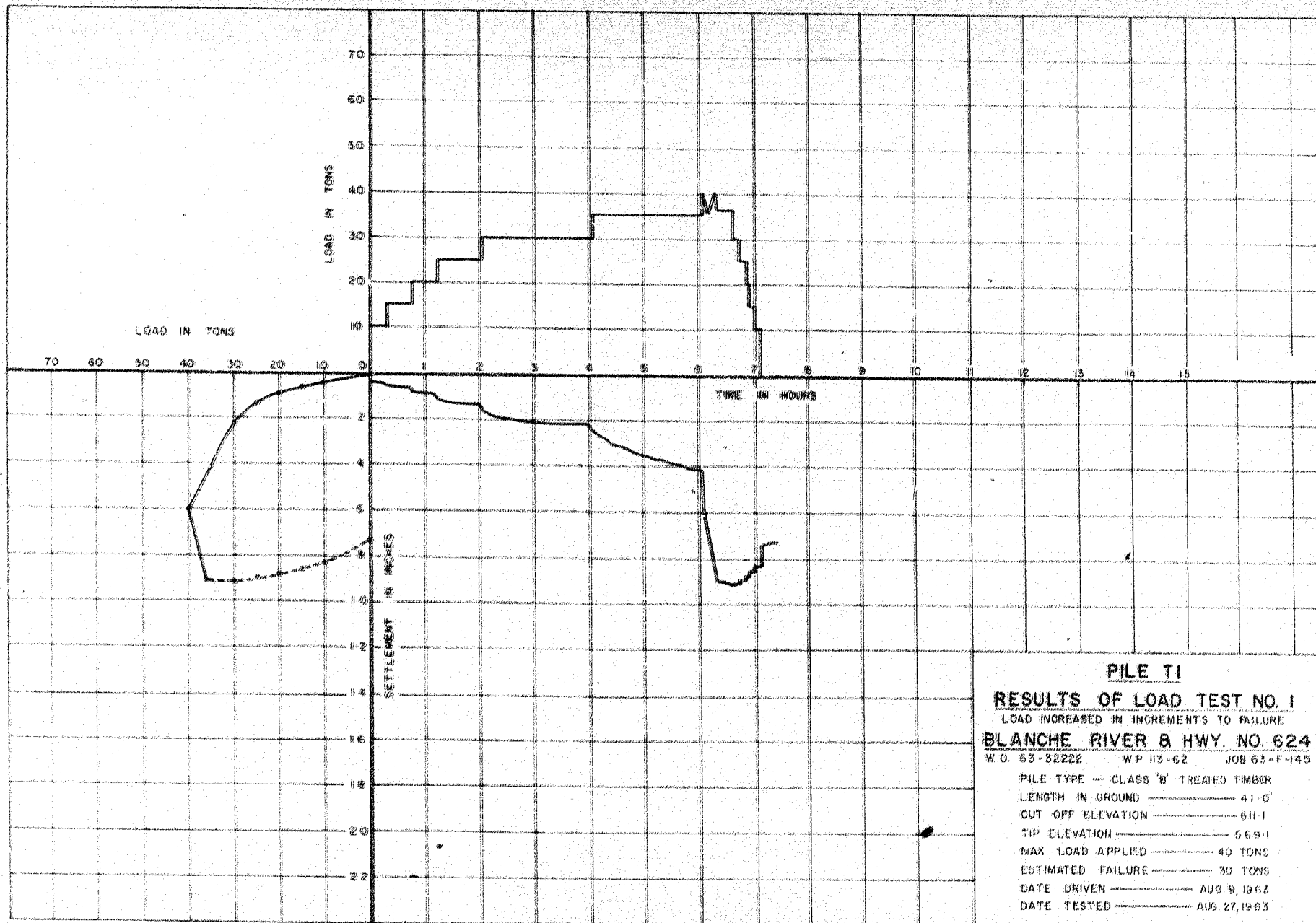
U.S.S.

Goodbye

Nashboro in Casino.

1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 26

				FIELD VANE + NATURAL		● REMOLDED		○ UNCONFINED		△ TRIAXIAL		25		50		75		REMARKS			
								400		800		1200		1600		2000		Piezometer Head.			
610.0	Groundlevel																				
0.0	Silty clay to clayey silt.	1	TW	31															125		
	Very stiff to firm.	2	TW	P															116		
		3	TW	P															127		
599.5		4	TW	18															123		
10.5	1 1/2" layers of clayey silt with 1/4" layers of silty clay.	5	TW	P															130		
		6	TW	P															130		
		7	TW	P															122		
588.0	Firm.	8	TW	P															106		
22.0		9	TW	P															120		
	3/8" to 1 1/2" layers of highly plastic clay with	10	TW	P															100		
	1/8" to 1/4" layers of clayey silt.	11	TW	P															105		
	Firm to stiff.	12	TW	P															103		
		13	TW	P															105		
		14	TW	P															106		
		15	TW	P															114		
		16	TW	P															116		
		17	TW	P															107		
		18	TW	P															114		
558.5		19	TW	P																	
53.5	End of borehole	20	TW	P																	



PILE T1

RESULTS OF LOAD TEST NO. 1

LOAD INCREASED IN INCREMENTS TO FAILURE

BLANCHE RIVER & HWY. NO. 624

W.O. 63-3222

WP 113-62

JOB 63-F-145

PILE TYPE --- CLASS 'B' TREATED TIMBER

LENGTH IN GROUND ----- 41'-0"

CUT OFF ELEVATION ----- 611.1

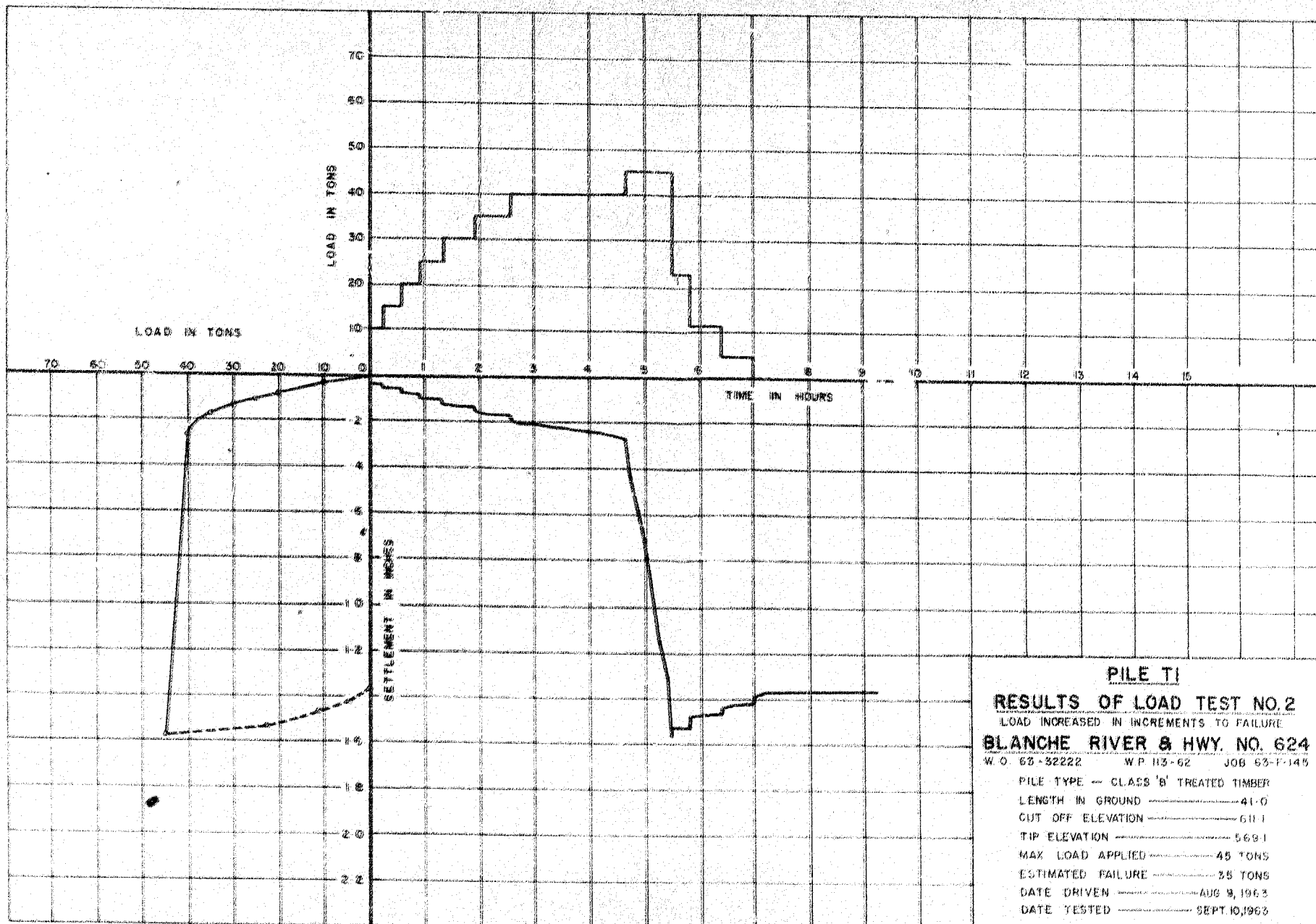
TIP ELEVATION ----- 569.1

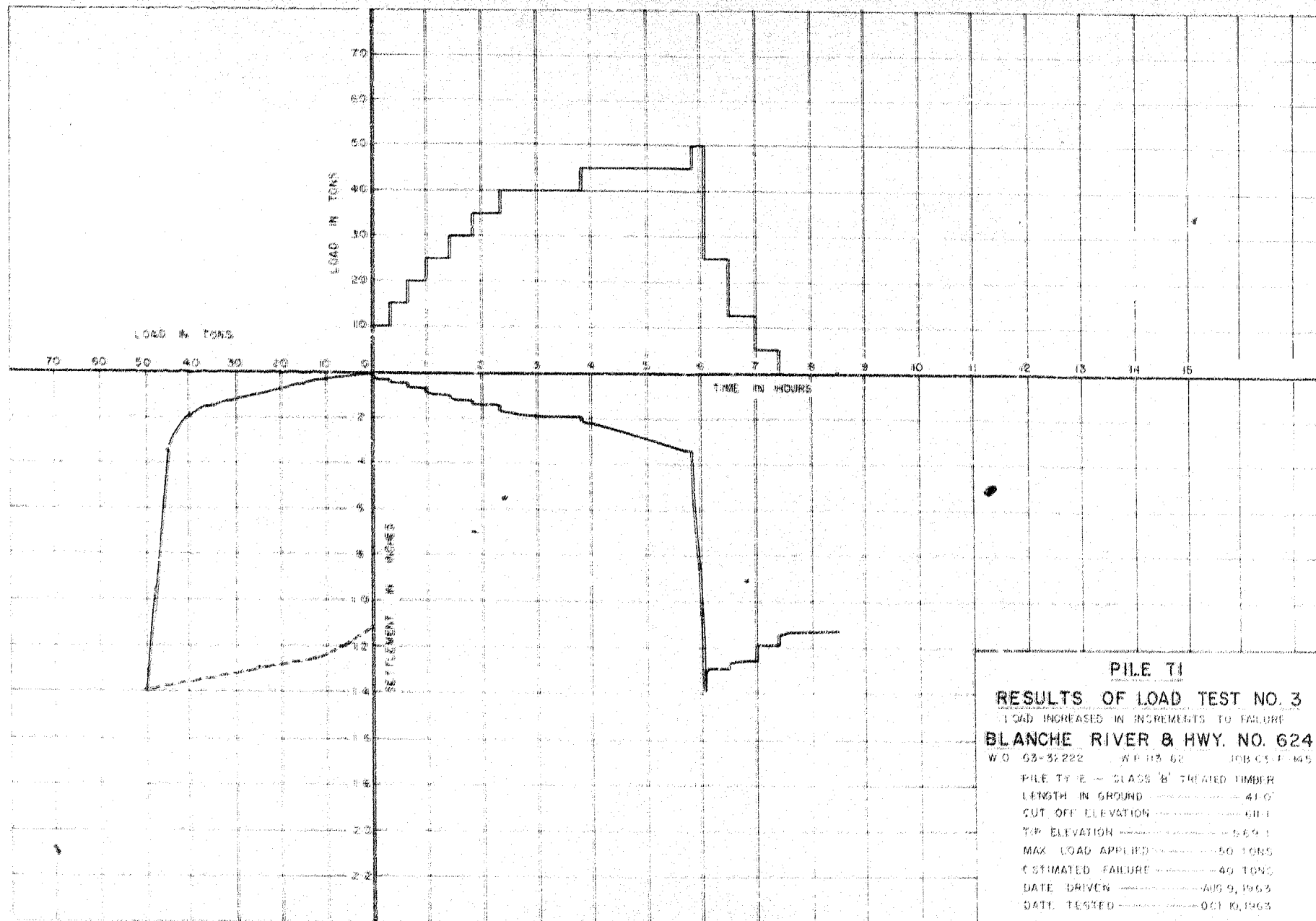
MAX. LOAD APPLIED ----- 40 TONS

ESTIMATED FAILURE ----- 30 TONS

DATE DRIVEN ----- AUG 9, 1963

DATE TESTED ----- AUG 27, 1963





PILE T1

RESULTS OF LOAD TEST NO. 3

LOAD INCREASED IN INCREMENTS TO FAILURE

BLANCHE RIVER & HWY. NO. 624

W.O. 63-3222 W.F. 13 62 JOB C5-F 45

PILE TYPE - CLASS 'B' TREATED TIMBER

LENGTH IN GROUND - 41'-0"

CUT OFF ELEVATION - 611.1

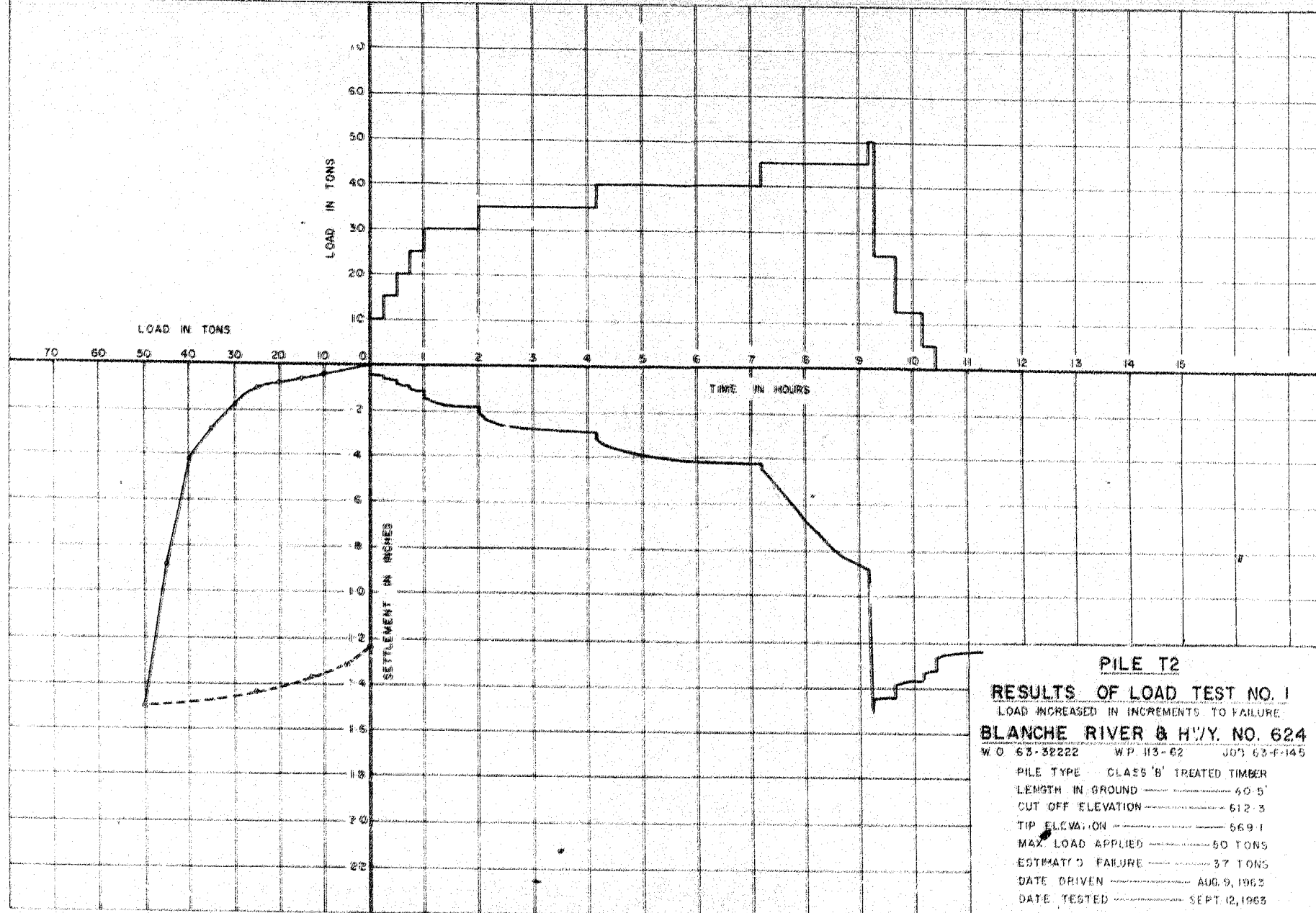
TOP ELEVATION - 569.1

MAX. LOAD APPLIED - 50 TONS

ESTIMATED FAILURE - 40 TONS

DATE DRIVEN - AUG 9, 1963

DATE TESTED - OCT 10, 1963



PILE T2

RESULTS OF LOAD TEST NO. 1

LOAD INCREASED IN INCREMENTS TO FAILURE

BLANCHE RIVER & H'Y. NO. 624

W.O. 63-3222 WP. 113-62 JON 63-F-145

PILE TYPE CLASS 'B' TREATED TIMBER

LENGTH IN GROUND 40.5'

CUT OFF ELEVATION 612.3

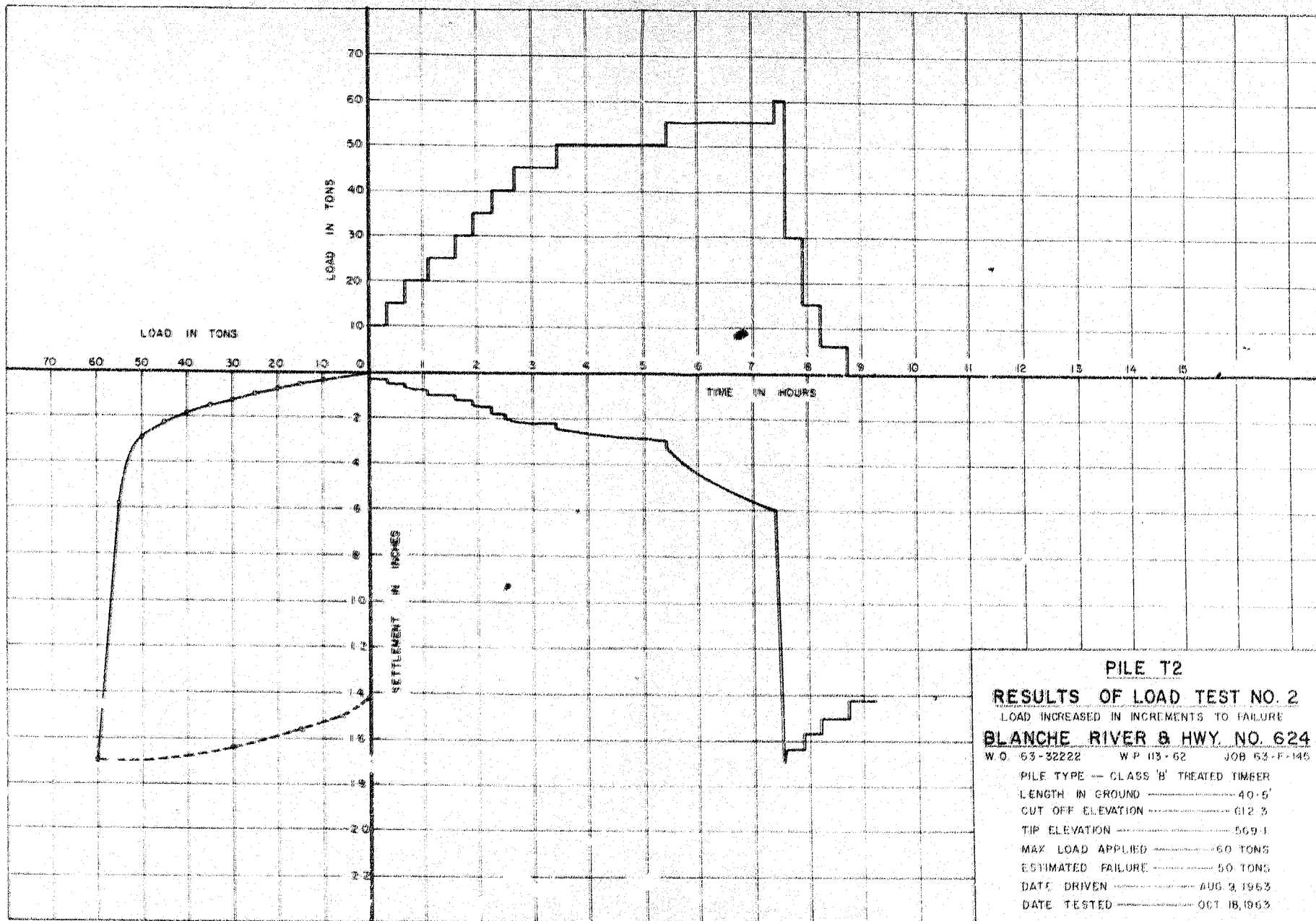
TIP ELEVATION 569.1

MAX. LOAD APPLIED 50 TONS

ESTIMATED FAILURE 37 TONS

DATE DRIVEN AUG. 9, 1963

DATE TESTED SEPT. 12, 1963



PILE T2

RESULTS OF LOAD TEST NO. 2

LOAD INCREASED IN INCREMENTS TO FAILURE

BLANCHE RIVER & HWY NO. 624

W.O. 63-32222 W.P. 113-62 JOB 63-F-146

PILE TYPE -- CLASS 'B' TREATED TIMBER

LENGTH IN GROUND ----- 40.5'

CUT OFF ELEVATION ----- 612.3

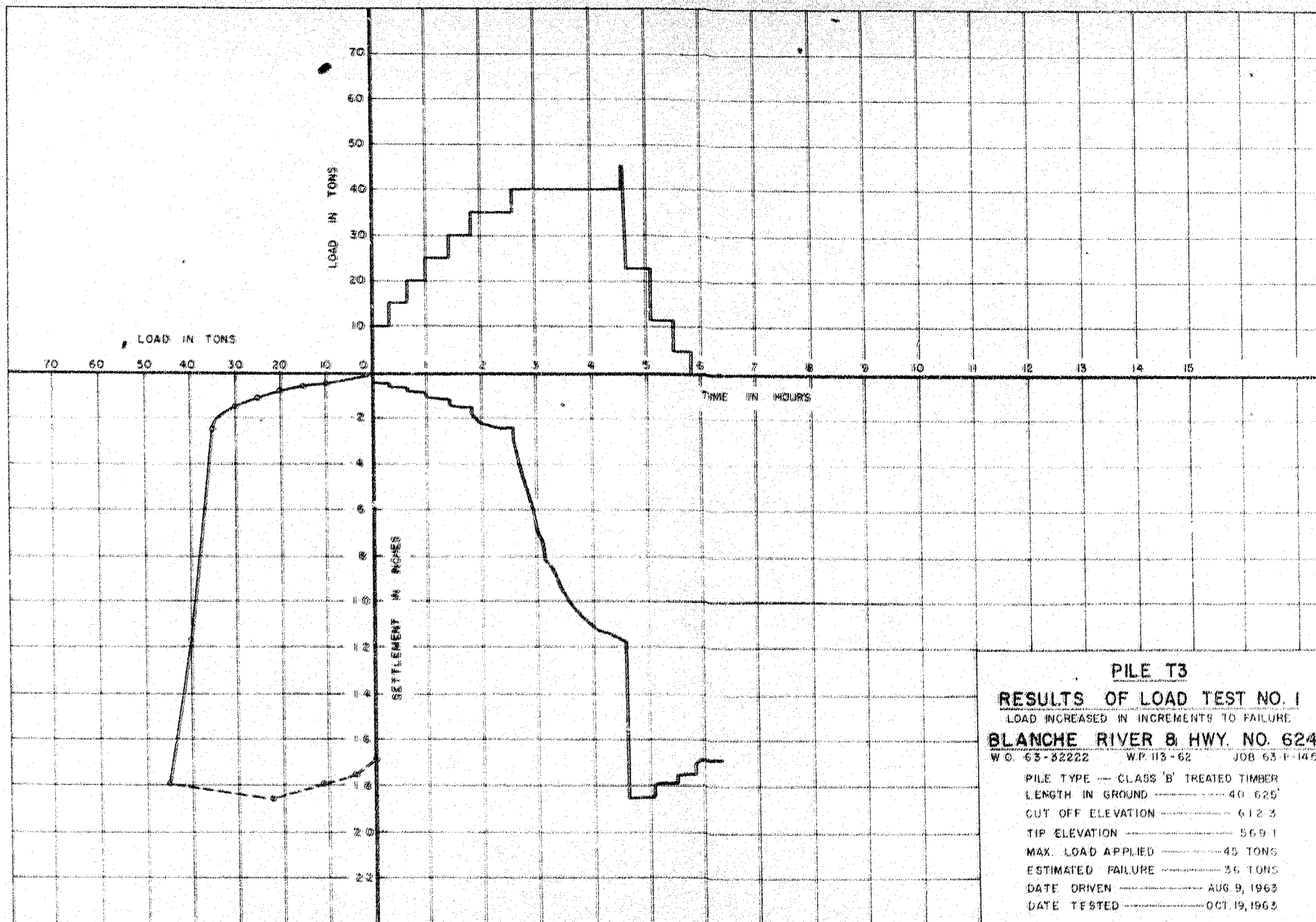
TIP ELEVATION ----- 569.1

MAX. LOAD APPLIED ----- 60 TONS

ESTIMATED FAILURE ----- 50 TONS

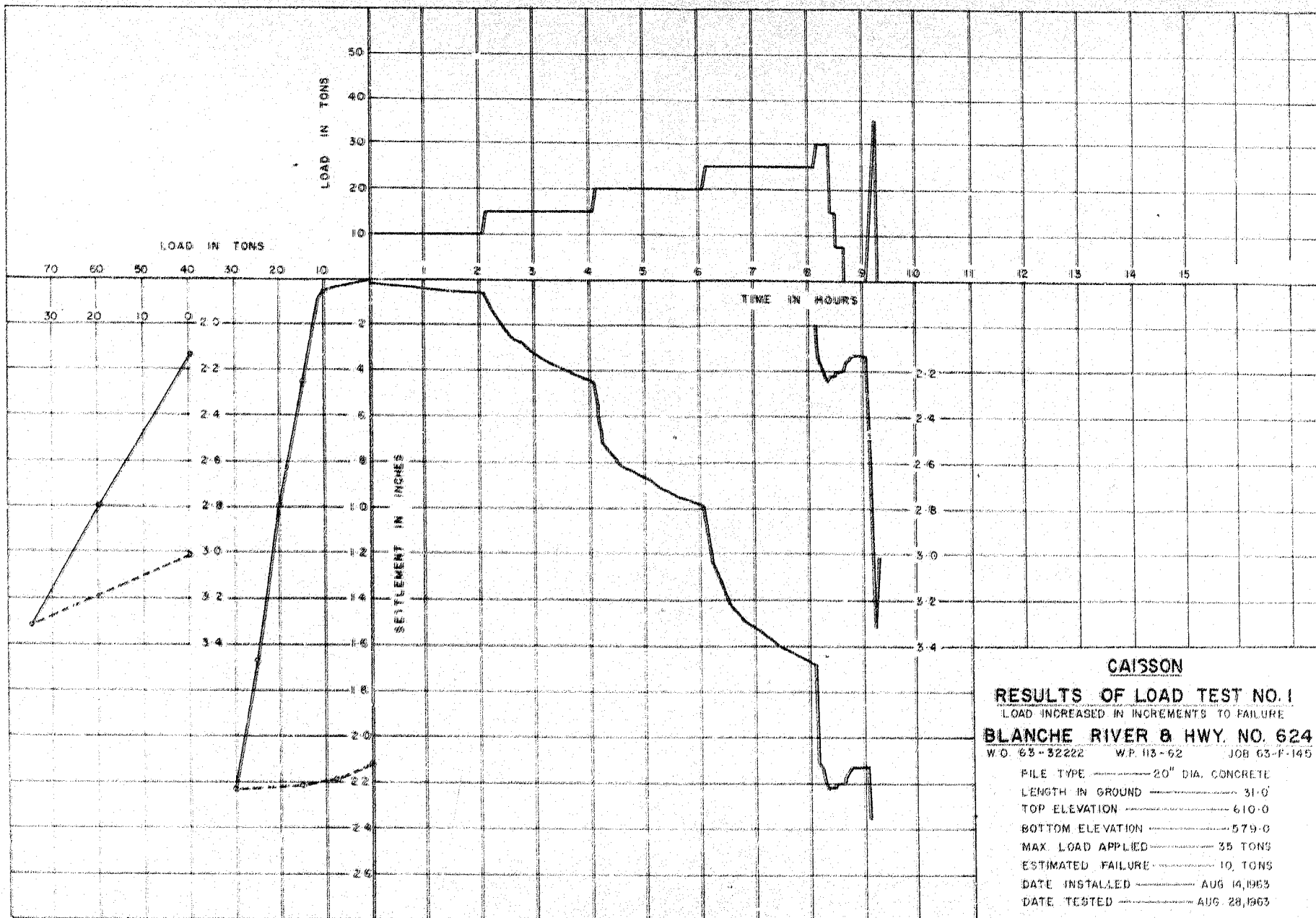
DATE DRIVEN ----- AUG. 2, 1963

DATE TESTED ----- OCT. 18, 1963



PILE T3
RESULTS OF LOAD TEST NO. 1
 LOAD INCREASED IN INCREMENTS TO FAILURE
BLANCHE RIVER B HWY. NO. 624
 W.O. 63-52222 W.P. 113-62 JOB 63-P-145

PILE TYPE --- CLASS 'B' TREATED TIMBER
 LENGTH IN GROUND ----- 40.625'
 CUT OFF ELEVATION ----- 612.3
 TIP ELEVATION ----- 569.1
 MAX. LOAD APPLIED ----- 45 TONS
 ESTIMATED FAILURE ----- 36 TONS
 DATE DRIVEN ----- AUG 9, 1963
 DATE TESTED ----- OCT 19, 1963



CAISSON

RESULTS OF LOAD TEST NO. 1

LOAD INCREASED IN INCREMENTS TO FAILURE

BLANCHE RIVER & HWY. NO. 624

W.O. 63-32222

W.P. 113-62

JOB 63-F-145

PILE TYPE 20" DIA. CONCRETE

LENGTH IN GROUND 31.0'

TOP ELEVATION 610.0

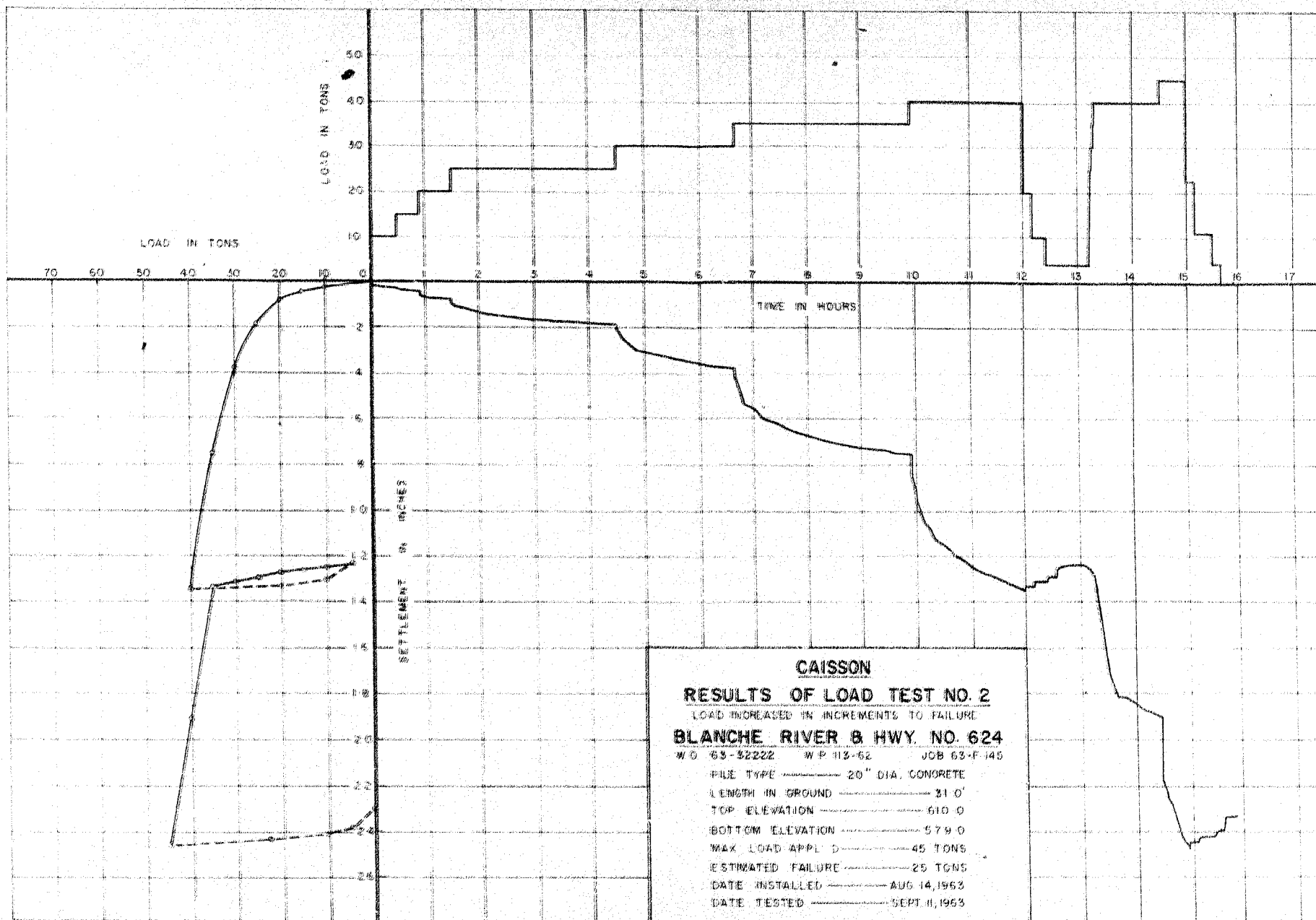
BOTTOM ELEVATION 579.0

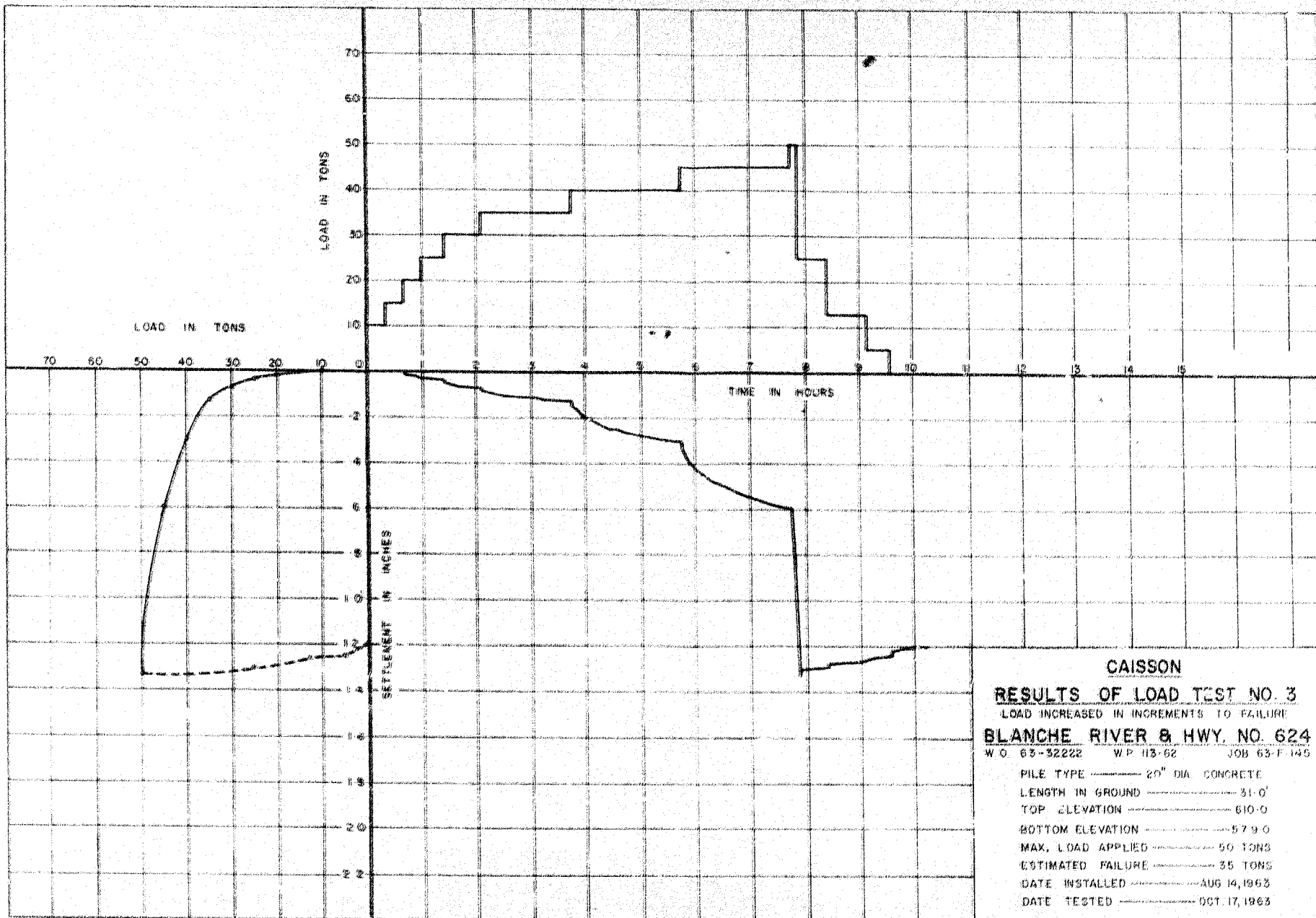
MAX. LOAD APPLIED 35 TONS

ESTIMATED FAILURE 10. TONS

DATE INSTALLED AUG 14, 1963

DATE TESTED AUG 28, 1963





CAISSON

RESULTS OF LOAD TEST NO. 3

LOAD INCREASED IN INCREMENTS TO FAILURE

BLANCHE RIVER & HWY. NO. 624

W.O. 63-32222 W.P. 113-62 JOB 63-F-145

PILE TYPE 20" DIA. CONCRETE

LENGTH IN GROUND 31'-0"

TOP ELEVATION 610.0

BOTTOM ELEVATION 579.0

MAX. LOAD APPLIED 50 TONS

ESTIMATED FAILURE 35 TONS

DATE INSTALLED AUG 14, 1963

DATE TESTED OCT. 17, 1963

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL. THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL PIPE
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.S.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

SOIL TESTS

Q _u	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Q _{cu}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q _d	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_p	PLASTIC LIMIT
I_p	PLASTICITY INDEX
s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
I_c	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE = $\frac{-\Delta e}{(1+e)\Delta\sigma}$
C_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX = $\frac{\Delta e}{\Delta \log_{10} \sigma}$
T_v	TIME FACTOR = $\frac{C_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE OR FRICTION
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF σ
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF σ TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
$\bar{\sigma}$	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL

MEMORANDUM

To: Mr. A.G. Stermac,
Principal Foundation Engineer,
Materials & Testing Division.

From: Insurance & Claims Office,
Downsview, Ontario.

Date: March 6, 1967

Our File Ref. 524-66-G.L.

In Reply To

SUBJECT:

Re: Well complaint, Mr. J. Foster, Twp. of Marter
Contract 66-65

Refer to - 62-F-120

Further to ours of January 3, 1967 we find that we have a problem in regards to Mr. Foster's well and a question of overburden and the rock formation and would appreciate it if we could have your reports concerning the test holes carried out by your section adjacent to Mr. Foster's property and we understand went down to 185' where one of the bore holes became a flowing artesian spring.

This work was carried out under contract 66-65 and trust we will have your report as quickly as possible.

F. W. Spickett
FRANK F. W. Spickett, *per F.B.*
Supervisor,
Insurance & Claims Office.

FWS:it

- c.c. - Mr. A.C. Suter, Principal Chem. Engineer.
- c.c. - Mr. E.J. Orr, Att:- Mr. G.W. Raycroft.
- c.c. - Mr. W.G. Cooke, Superintendent of Equipment.
Att:- Mr. J.R. Fitzpatrick.
- c.c. - Ontario Water Resources Commission,
Att:- Mr. D.N. Jeffs.
- c.c. - Mr. D.A. Osborn-White, Dist. Eng., New Liskeard.
Att:- Mr. J.K. Livingston, Const. Engineer.

Mr. C. S. Grebski,
Bridge Design Engineer,
Bridge Division,
Main Bldg.

Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

January 20, 1967

refer to 62-F-120

Blanche River Bridge,
Sec. Hwy. No. 624,
Twp. of Avanturel,
R.F. 113-62,
District 14 (New Liskeard)

The investigation for the above structure was carried out during the latter part of 1962. A pile loading test was carried out one year later. During the investigation, an artesian water condition was encountered. Apparently, no attempt was made after the completion of the investigation, to seal the water-producing boreholes.

In the latter part of 1966, a complaint was received by the District, that a well in the neighbourhood had dried out because of the loss of water through one of the boreholes.

A very serious attempt was made to seal the water-producing hole, but with no success. The flow of water was stopped at the borehole location, but water appeared at another location - this time, some 30 feet from the toe of the approach embankment.

There is no doubt that this represents a rather serious condition. Whether the condition should be considered critical is yet impossible to say. The adverse weather conditions make the assessment of the problem at this stage, impractical. It is, however, believed that measures to intercept this water and thus control it, can be conceived and implemented. This operation would, in all probability, eliminate the present problem. Before this problem is resolved and taken care of, no construction can be started.

It has been agreed upon with the District representatives that the problem will be dealt with sometime in the spring of 1967 when the ground and weather conditions will permit such an operation.

cont'd. /2 ...

January 20, 1967

As far as the bridge construction itself is concerned, we would recommend that the piers be completed before any construction of the abutments is started. This sequence is recommended because the pier construction (i.e., pier pile driving and footing construction) represents a more delicate operation and it is reasoned that if some damage does occur, it should be attempted to keep it at a minimum. We would also recommend that in the "Special Provisions" a paragraph be inserted which would forewarn the contractor that a sequence of pile driving may be requested by the Engineer at the time of construction, which he would have to follow.

It would also be essential to specify that no material can be placed on the slopes at any time, and that the shape of the slope cannot be altered without specific written permission by the Engineer. This would serve as a precaution that the conditions of stability of the banks not be unfavourably changed during construction.

It is also suggested that the contractor submit for approval, his scheme of shoring and protecting the pier foundation excavations. He should also indicate the area where the excavated material is to be placed.

From the previous correspondence regarding the stability of the river banks, you may gather that the margin of safety is not too great, and we would therefore like to point out the need for adhering strictly to the recommendations. The benefit of close supervision cannot be overemphasized in this particular instance.

ACS/adeP

A. G. Sternac

A. G. Sternac

PRINCIPAL FOUNDATION ENGINEER

cc: Foundations Files/

Gen. Files

MEMORANDUM

23-66-65, Re:

Well Complaint
Mr. J. Foster.

To: Mr. A.G.Stermac
Principal Foundation Eng.
Materials & Testing Division

FROM: Insurance & Claims Office

DATE: January 3, 1967

OUR FILE REF. 524-66-GL

IN REPLY TO

SUBJECT:

Well complaint, Mr. J. Foster, Twp. of Marter
Contract #66-65

refer to
62-F-120

WP 113-62

Blanche River
Bridge
Englehardt

Further to your memorandum of December 23, 1966, please be advised, we received a report from Mr. Livingston from our New Liskeard Office, which stated that they had tried every means to stop the flow of water, even to sealing and plugging which was unsuccessful and as such it has been recommended that we obtain from Mr. Foster the cost of a deep well water pump and "WITHOUT PREJUDICE" we have written to the above gentlemen asking for estimates and a credit value on the existing pump.

Upon receipt of his reply we will consider this matter again in an effort to resolve this problem as far as Mr. Foster is concerned.

However, this does not eliminate the Department's problem and would appreciate every assistance you can give along with our Mr. Fitzpatrick, in sealing off this apparently flowing well from our test bore holes as it would appear from all reports, including our own that this could cause a problem when construction starts.

FWS/dp



F.W. Spickett, Supervisor
Insurance & Claims

CC: E.J.Orr, Mtce. Eng., Att: Mr. G.Raycroft, Spec. Mtce. Serv. Eng.
CC: Mr. J.R.Fitzpatrick, Lab. Bldg.
CC: Mr. D.A.Osborne-White, Dist. Eng., New Liskeard, Ontario
Att: Mr. J.K.Livingston, Mtce. Eng.

MEMORANDUM
New Liskeard23-46-65 Le
Well Complaint
Mr. J. Foster,To: Mr. F. W. Spickett
Supervisor
Insurance & Claims Office

FROM: J. K. Livingston

DATE: December 20, 1966

OUR FILE REF.

IN REPLY TO

SUBJECT: Your file ref. 524-66-GL
Claim for Loss of Water - Mr. J. Foster
South half of Lot 7, Con. 1 Twp. of Marter
Contract 66-65

refer to
62-F-120

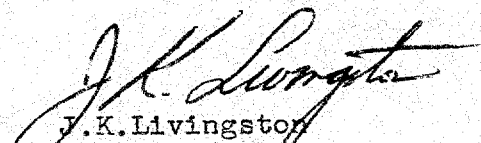
To-date, we have been unsuccessful in our attempts to control the flow from the borehole.

The recommendations contained in Mr. J. R. Fitzpatrick's memo of November 21st, 1966, were followed and the borehole was successfully sealed off at the 60' level. However, when the casing was being withdrawn a further flow of water was encountered at approximately the 30' level. In an attempt to control this flow a 4" casing was driven approximately 30', and pumping was carried out until the grout which was placed under pressure around the casing had set. The casing was then plugged with a wooden plug with a 3/4" pipe with a shut-off tap. This confined the flow for a very short time after which it came up around the casing again.

However, during the period when the flow was cut off water erupted from another area approximately 30' away at the foot of the approach fill presently under construction. It would therefore appear that if we successfully cut off the flow at its present outlet that the problem will re-occur elsewhere and possibly in an area where it might have a detrimental effect on the approach fill.

To-date we have spent approximately \$1,000.00 and appear to be no nearer a solution.

We would therefore recommend that no further funds be expended and that Mr. Foster be compensated in an amount sufficient to install a deep-well pump.


J.K. Livingston
Dist. Const. Eng.
JKL/kd

c.c. J.B. Wilkes
R. Fitzpatrick
A. Stermac

refer to 62-F-120

Contract No 56-65 Blanche River Br. Prop. of Quarter

Note:

Jan 5, 1967.

Telephone conversation with Ken Livingstone
New Liskeard.

Most of the grading contract is completed and
therefore a moving of the crossing location
would be extremely costly.

Water is coming out of the ground in spite of
the very low temperature (30° below zero).

It is felt that an effective sealing of the artesian
water is impractical and that the only way is
to intercept the water and lead it away into
the river.

It was agreed that a meeting should be held
in the spring at the site and that a decision
as to how to cope with the problem be reached.

A significant indication regarding the stability
of the banks will be the performance of the
approach fills in the spring of 1967. At this
stage some additional remedial measures
may be initiated or even some changes in the
bridge design may be required.

Alfs.

Note: Ch. Gieski is to send us a set of bridge
plans which we will keep for the above
occasion.

Foundation File

23-66-65
Will Complain
Mr. J. Foster
ref to
2-F-120
W.P. 113-62
Blanche River
Bridge

Mr. F. W. Spickett
Supervisor
Insurance & Claims Office

Foundation Section
Materials & Testing

December 23, 1966

Your file ref. 524-66-GL
Claim for Loss of Water - Mr. J. Foster
South half of Lot 7, Con. 1Twp. of Marter
Contract 66-65

With reference to Mr. J. K. Livingston's letter of December 20, 1966 to you regarding the sealing of boreholes at the site of Contract 66-65, we would like to make the following suggestion:

Due to the present winter conditions it is doubtful whether the full extent of water seepage can be properly established. We would therefore recommend that nothing be done before next spring when a meeting of all parties concerned should be held at the site and further necessary steps be agreed upon. The fact that water has come up at the toe of the approach fill presently under construction clearly indicates the seriousness of the matter and points to the necessity of a careful overall study of the problem.

We would appreciate being advised whether our suggestion is acceptable.

Alf Sternmac

AGS:mt

A. G. Sternmac
Principal Foundation Engineer

cc: J. B. Wilkes
R. Fitzpatrick
J. K. Livingston

Department of Highways Ontario

Copy for the information of

A. Stermac

Principal Found. Eng.

Materials & Research

Mr. F. W. Spickett

Supervisor

Insurance & Claims Office

New Liskeard

J. K. Livingston

December 20, 1966

Your file ref. 524-66-GL

Claim for Loss of Water - Mr. J. Foster

South half of Lot 7, Con. 1 Twp. of Marter

Contract 66-65

To-date, we have been unsuccessful in our attempts to control the flow from the borehole.

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To-date we have spent approximately \$1,000.00 and appear to be no nearer a solution.

We would therefore recommend that no further funds be expended and that Mr. Foster be compensated in an amount sufficient to install a deep-well pump.

J.K.Livingston
Dist. Const. Eng.
JKL/kd

c.c. J.B. Wilkes
R. Fitzpatrick
A. Stermac

Department of Highways Ontario

Copy for the information of

A. Sterman

Principal Foundation Eng.

Mr. C. S. Grahski

Bridge Design Engineer

How Lisheard

J. K. Livingston

November 30, 1957

Blanche River Bridge
Sec. Hwy. No. 524
Township of Eventual
W.P. 113-62, District 14

With regard to the artesian condition existing at the bridge site, we would recommend that a meeting be held on the site by the interested parties during the latter part of April.

If you will arrange for a date convenient to the various Head Office parties concerned the District will have a representative attend the meeting.

J. K. Livingston
Dist. Chast. Eng.
JKL/nd

c.c. J. Walter
E. Davis
H. Stoyanoff
A. Sterman ✓

23-66-65..

refer to 62-F-12

Mr. D.A. Osborne-White, Dist.Eng.,
District #14, NEW LISKEARD.

J. R. Fitzpatrick,
Equip. Operations Engineer.

Attention: Mr. K. Livingston,
Construction Eng.

21st November, 1966.

Alleged Well Complaint -
Mr. J. Foster, Englehart, Ont.

The problem of sealing off the test bore hole has been discussed with Mr. Stermac of Materials & Testing Division.

Bore hole 2, at Station 17 plus 50, your drawing 62-F-120A, started as a 4" one, and was tapered to approximately 2" in its length.

To plug this hole, we would suggest that a well driller be brought in.

We also suggest that a 4" casing be driven approximately 60 ft. if possible from elevation 610 to 550 or below, and that a machined wooden plug 6 to 8 ft. in length (machined to a diameter so that it will just fit inside the 4" casing) be driven down through the casing into the hole to stop the flow of water. When the flow is stopped, then some burlap should be thrown in, to rest on top of the wooden plug, then concrete poured on top of the burlap. The casing could then be drawn.

The driller may find conditions somewhat different than we envisage them, and might suggest some changes to the suggested procedure as outlined above.

W. G. COOKE,
Superintendent of Equipment.

J. R. Fitzpatrick

JRF:mmm

By: J. R. FITZPATRICK,
Equipment Operations Engineer.

c.c.: F. Spickett, Insurance & Claims
A. Stermac, Materials & Testing. ✓

Department of Highways Ontario

Copy for the information of

Mr. A. Stermac, Principal Foundation Engineer,
Room 107, Lab. Building

Mr. J.K. Livingston,
District Construction Engineer,
New Liskeard District

Bridge Division,
Downsview, Ontario

February 2, 1967

Blanche River Bridge
Sec. Hwy. No. 624
Township of Evanurel
W.P. 113-62, District 14

*refer to
62-F-120*

This will acknowledge receipt of your recent letter regarding the artesian condition existing at this bridge site.

We will arrange a meeting at the site for sometime in April as you suggest. Further details will be given to you at a later date.

CSG:rd

C.S. Grebaki,
Bridge Design Engineer

c.c. J. Walter
B. Davis
K. Stoyanoff
A. Stermac

MEMORANDUM

John 3231 23-66-65

To: Mr. A. Sterrac
Principal Foundation Engineer,
Lab Building,
Materials & Testing Section.

FROM: Insurance & Claims Office,
Downsview, Ontario.

DATE: November 17, 1966

OUR FILE REF. 524-66-G.L.

IN REPLY TO

refer to 62-F-170

SUBJECT:

Re: Claim, Mr. J. Foster, Township of Marter,
Contract 66-65

Please be advised we have received from our District Offices in New Liskeard a claim by Mr. Foster for loss of water to his well which has been investigated on our behalf by the Ontario Water RESources Commission.

While there is no liability on the Crown we find from Mr. Livingston, our Construction Engineer in New Liskeard, that approximately 7 to 8 years ago your Section was testing holes in the area at a depth of 183 feet and apparently on one of the holes an adjacent spring was struck which we now find out at this late date is still flowing. It is apparent the District have been unsuccessful in sealing same and we have asked Mr. Fitzpatrick who is quite familiar with this problem to look into this matter but before doing so we would appreciate the reports covering your Section's work in this area. We understand from Mr. Livingston this was Project WP 113-62 District 14, Job 62F-120 Blanche River and Secondary Highway Number 624.

We trust we may have your co-operation in borrowing your records for a review by Mr. Fitzpatrick and ourselves to attempt to finalize this matter.

F. W. Spickett
F. W. Spickett,
Supervisor,
Insurance & Claims Office

FWS:it

refer to
62-F-120

Mr. A.G. Stermac,
Principal Foundations Engineer.

Soils Section.

June 11th, 1963.

W.P. 113-62, Sec. Hwy. #624,
Proposed New Bridge Site over Blanche River

Attached is the seismic survey report of the investigation carried out along the Blanche River. This investigation was made at your request to establish whether a better crossing is feasible over this river than the one proposed.

Seismic cross-sections were run at 500 foot intervals on both sides of the existing structure. These cross-sections extend from both banks of the Blanche River for 400 feet.

This survey indicated that the depth of bedrock does not essentially differ from the findings of the core drill investigation along line "B". Two copies of the seismic cross-sections are being forwarded to you for your information.

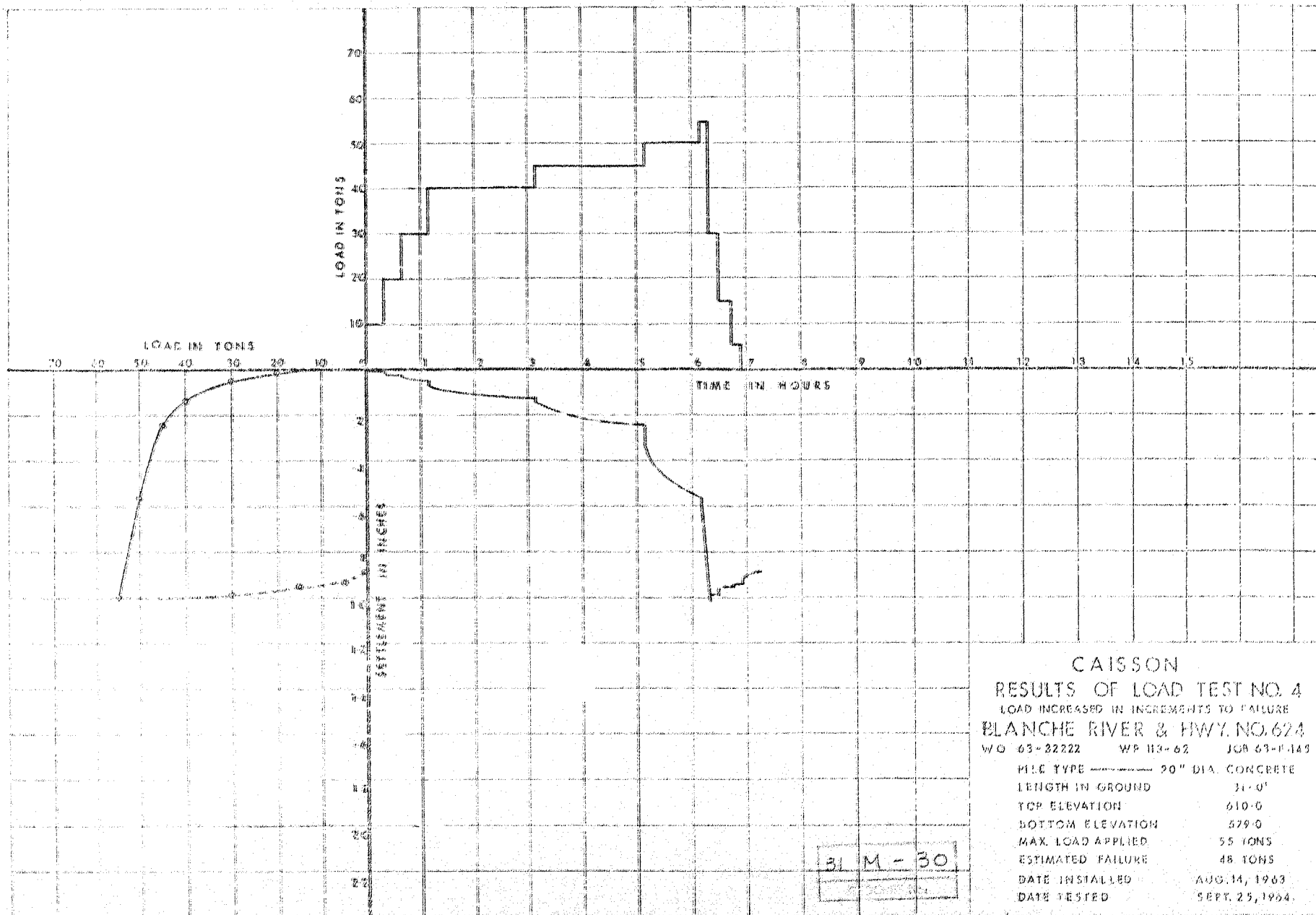
Should you have any queries regarding the information presented please contact Alex Szenasi.

G.A. Wrong

G.A. Wrong,
Principal Soils Engineer.

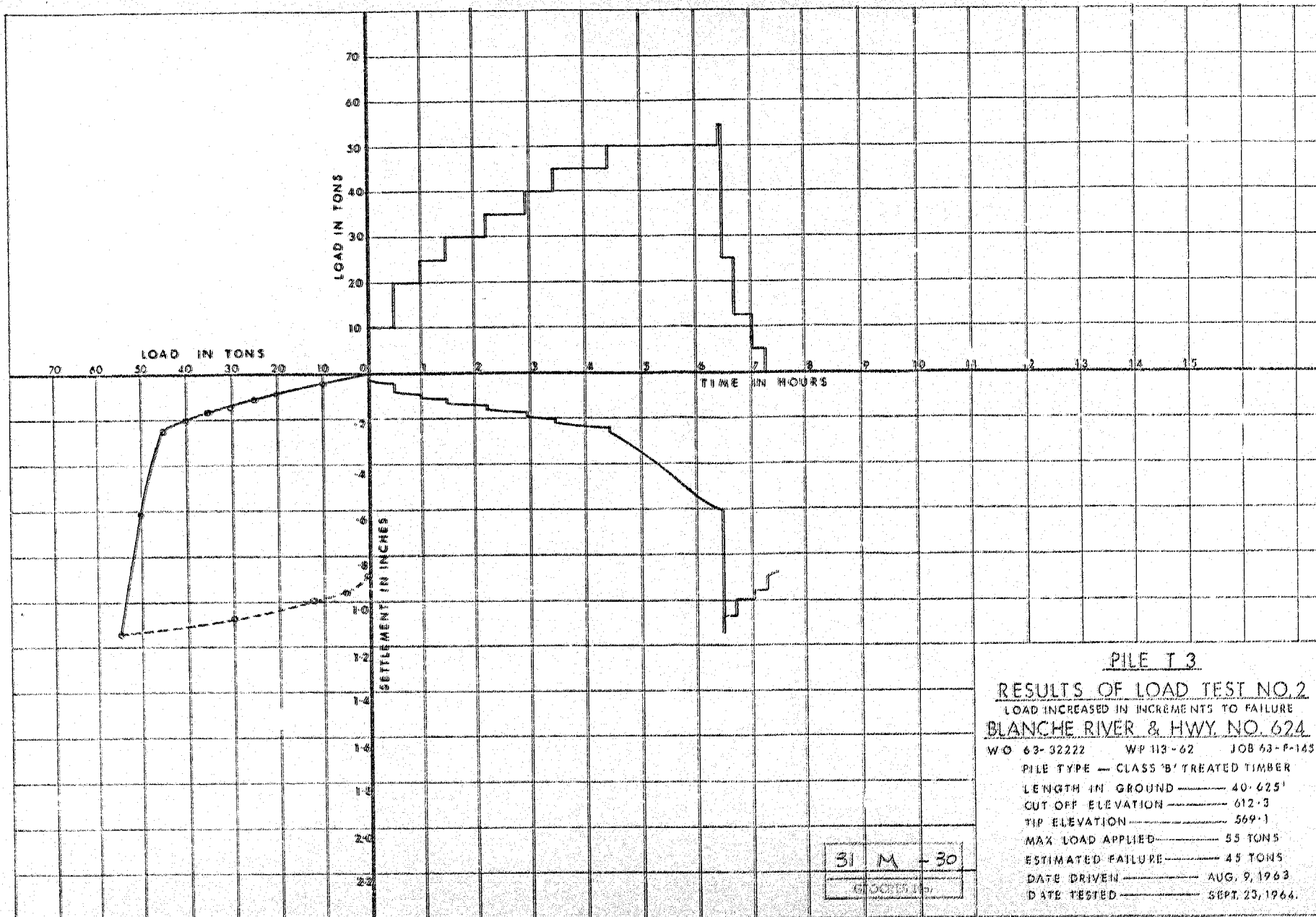
GAS/bc
c.c. E. Saint
A. Szenasi
File ✓

*Seismic Survey report
filed in drawer with
correspondence to large
for files.*



CAISSON
 RESULTS OF LOAD TEST NO. 4
 LOAD INCREASED IN INCREMENTS TO FAILURE
 BLANCHE RIVER & HWY. NO. 624
 WO 63-2222 WP 113-62 JOB 63-1149
 PILE TYPE 20" DIA. CONCRETE
 LENGTH IN GROUND 31'-0"
 TOP ELEVATION 610.0
 BOTTOM ELEVATION 579.0
 MAX. LOAD APPLIED 55 TONS
 ESTIMATED FAILURE 48 TONS
 DATE INSTALLED AUG. 14, 1963
 DATE TESTED SEPT. 25, 1964

31 M - 30



PILE T 3

RESULTS OF LOAD TEST NO. 2

LOAD INCREASED IN INCREMENTS TO FAILURE
 BLANCHE RIVER & HWY. NO. 624

WO 63-32222 WP 113-62 JOB 63-P-145

PILE TYPE — CLASS 'B' TREATED TIMBER

LENGTH IN GROUND — 40'-625"

CUT OFF ELEVATION — 612.3

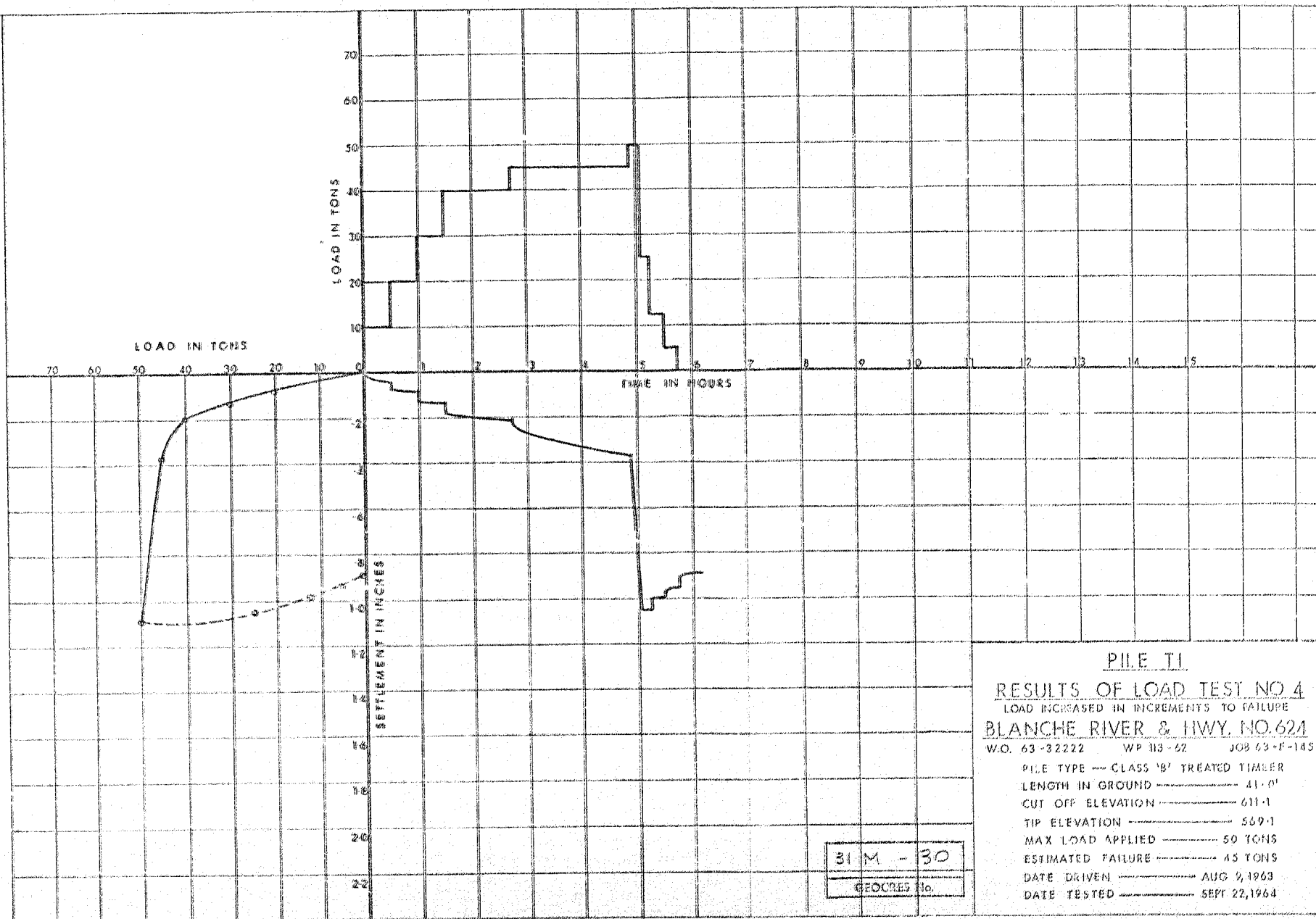
TIP ELEVATION — 569.1

MAX LOAD APPLIED — 55 TONS

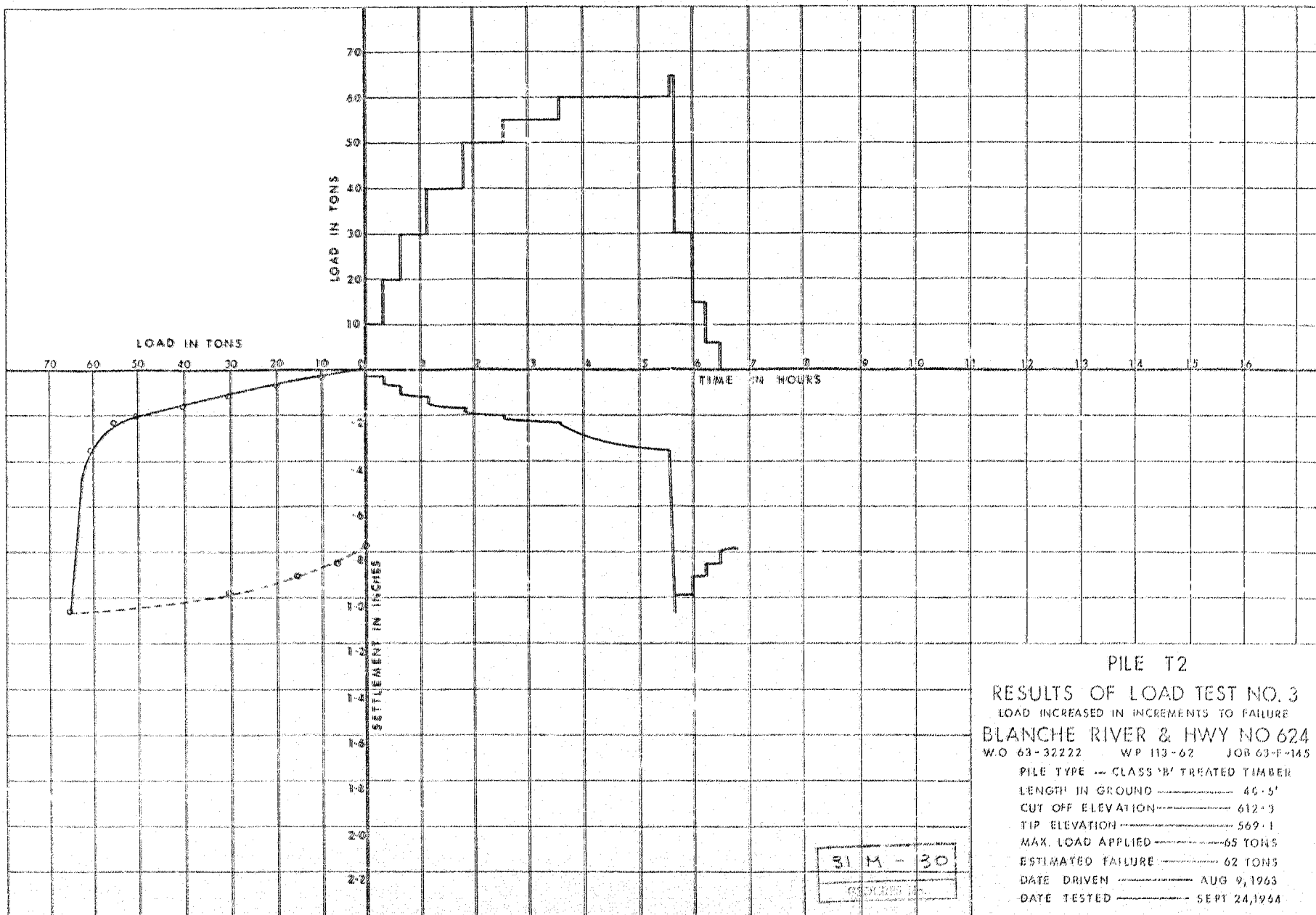
ESTIMATED FAILURE — 45 TONS

DATE DRIVEN — AUG. 9, 1963

DATE TESTED — SEPT. 23, 1964.



PILE TI
RESULTS OF LOAD TEST NO 4
 LOAD INCREASED IN INCREMENTS TO FAILURE
BLANCHE RIVER & HWY. NO. 624
 W.O. 63-32222 WP 113-52 JOB 63-F-145
 PILE TYPE --- CLASS 'B' TREATED TIMBER
 LENGTH IN GROUND --- 41.0'
 CUT OFF ELEVATION --- 611.1
 TIP ELEVATION --- 569.1
 MAX LOAD APPLIED --- 50 TONS
 ESTIMATED FAILURE --- 45 TONS
 DATE DRIVEN --- AUG 9, 1963
 DATE TESTED --- SEPT 22, 1964



PILE T2

RESULTS OF LOAD TEST NO. 3
 LOAD INCREASED IN INCREMENTS TO FAILURE
 BLANCHE RIVER & HWY NO 624
 W.O 63-32222 WP 113-62 JOB 63-F-145
 PILE TYPE -- CLASS 'B' TREATED TIMBER
 LENGTH IN GROUND ----- 46.5'
 CUT OFF ELEVATION----- 612.3
 TIP ELEVATION----- 569.1
 MAX. LOAD APPLIED-----65 TONS
 ESTIMATED FAILURE ----- 62 TONS
 DATE DRIVEN ----- AUG 9, 1963
 DATE TESTED ----- SEPT 24, 1964

31 M - 30
 GROUP 10

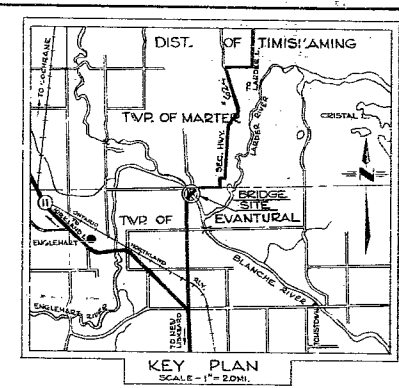
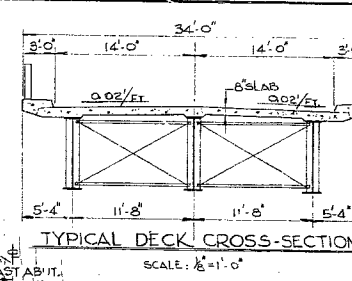
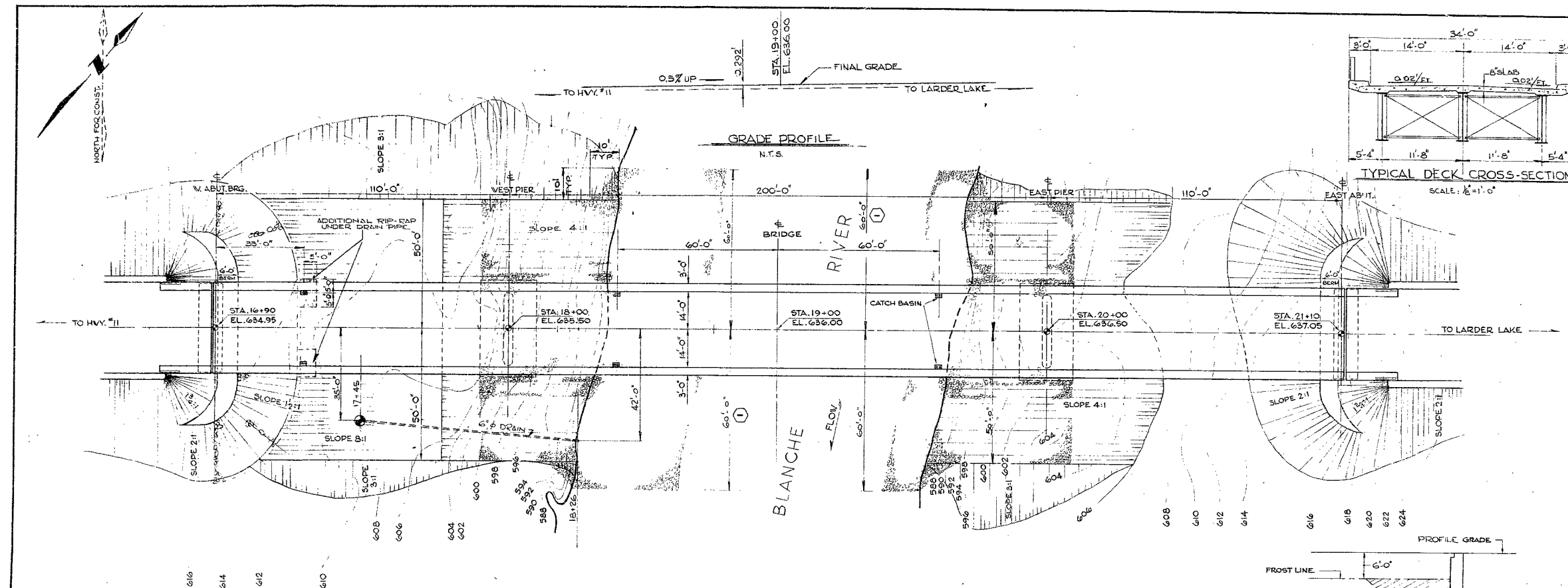
63-F-145

W.P. # 113-62

Hwy. # 624 E'

BLANCHE RIVER

BRIDGE

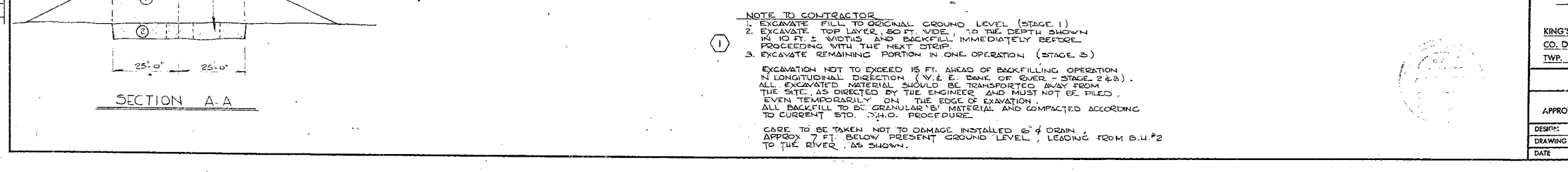
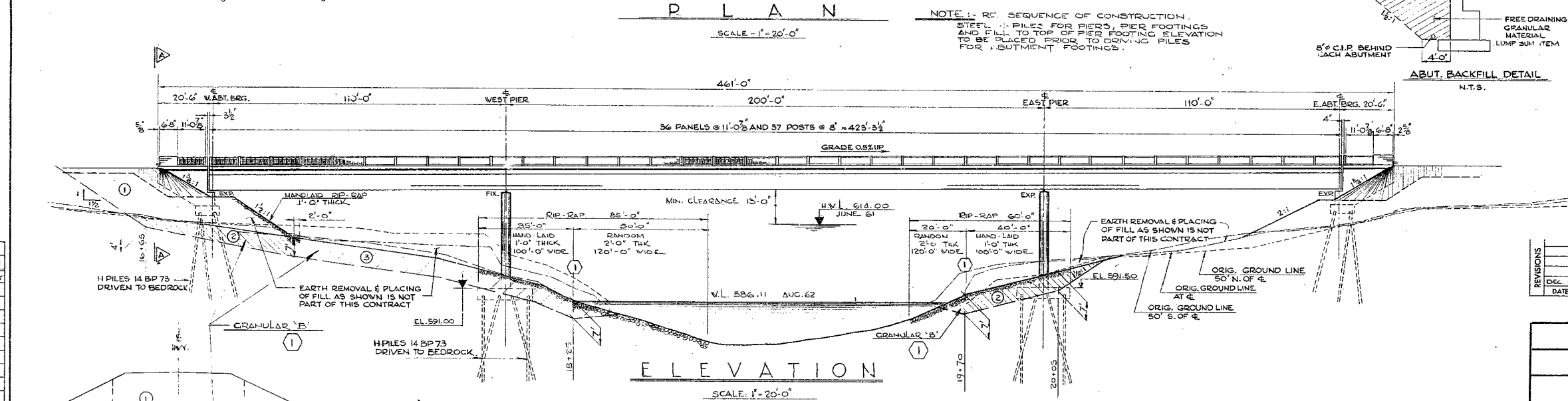


GENERAL NOTES

CLASS OF CONCRETE
PIERS, DECK & CURBS - 4,000 P.S.I.
ABUTMENTS & PIER FOOTINGS - 3,000 P.S.I.

CLEAR COVER ON REINFORCING STEEL
FOOTINGS ABUTS. & PIERS DECK CURBS
3" 3" TOP 1 1/2" BOT. 1"

CONSTRUCTION NOTES
THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF $\pm 1/8$ INCH. NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL THE CONCRETE IN THE DECK HAS BEEN PLACED.



LIST OF DRAWINGS

D-5320-1 GENERAL LAYOUT
2 BORE HOLE LOCATIONS & SOIL STRATA
3 FOOTING LAYOUT & PIER DETAILS
4 ABUTMENTS
5 DECK DETAILS
6 STRUCTURAL STEEL
7 BEARING DETAILS
8 EXP. JOINT & DECK DRAIN DETAILS
9 STD. DETAILS 10-BZ DATE & SITE NO. DET.
11 HANDRAIL DETAILS

G.B.M. NO. 200-E, ELEV. 730.643
GEODETIC DATUM - O.N.R.Y. SECTION HOUSE, DIRECTLY BEHIND STATION, WEST SIDE WALL IN CONCRETE FOUNDATION, 3 FEET FROM SOUTHWEST CORNER OF MAIN SECTION AND 20 INCHES BELOW WOODRACK, BOLT SET HORIZONTALLY, PUBLICATION NO. 20 "HEASUP"

REVISIONS	DATE	BY	DESCRIPTION
1	DEC. 68	W.V.	WIDTH OF RIP-RAP INCREASED (1)

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

BLANCHE RIVER BRIDGE
3 MI. NORTH OF SEC. HWY. #569

KING'S HIGHWAY No. SEC. HWY. #624 DIST. No. 14
CO. DIST. OF TIMISKAMING
TWP. EVANTURAL LOT 6 CON. VI

GENERAL LAYOUT

APPROVED	DATE	SITE No.	W.P. No.
SMC	47-25	113-62	
DESIGNER	CHECK	CONTRACT	
AR	CS	68-45	68-45
DRAWING	CHECK	DRAWING	
DL	AR	No.	D-5320-1
DATE	SEPT. 65	LOADING	H20-S16

REF NO. E-4128