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Memorandum

To:	Todd Cowles, P.E.
From:	Duane Anderson, P.E.
Subject:	Port of Anchorage – Pile Conditions and Seismic Vulnerability
Date:	9/19/14
Project #:	1771.03.05

Background

The Port berthing facilities suffer from severe corrosion. Although no specific biological testing has been performed, the form of corrosion most prevalent at the Port is considered to be "Accelerated Low Water Corrosion (ALWC)" or "Lowest Astronomic Tide (LAT)" corrosion. This form of corrosion is the result of iron oxidizing microbes and it typically occurs between MLLW and up to 1 meter below the extreme low tide, or at the Port between MLLW and -8' MLLW. The rate of corrosion is much greater than that of "general" corrosion which is generally considered most severe at the mud line or in the tidal zone (MLLW to MHHW or 0' to +30' MLLW). R&M detailed the ALWC condition in a 2000 Annual Inspection report.

Neither R&M Consultants, nor any other Port Consultants, have prepared a quantitative analysis of the Port's berthing infrastructure vulnerability. Prior inspection reports have noted that, due to corrosion, many of the piles are at the support limit for vertical loads. This statement infers that additional lateral loading from an earthquake could result in significant damage.

We have also expressed concerns associated with the build-up of sediments shoreward and within the footprint of the wharf. Our concern is that the sediments would liquefy in a seismic event and result in significant additional lateral pressure on the piles. This situation was never considered as "design criteria" for Anchorage port facilities. The impact of possible liquefaction of the upland soil is magnified by two factors:

1. The extreme corrosion zone falls close to the mid-height of the pile, which is the critical section for resistance of lateral pile pressure,
2. The piles on POL No. 1, Terminal No. 1, and portions of Terminal no. 2 were installed with a shallow embedment and will behave more like simply supported columns as opposed to deeply embedded pile behavior with "fixity", i.e., they are somewhat inherently more susceptible to damage.

Pile Thickness Measurements

Port Terminal dock piles have been reported to be in poor condition since 2000. In recognition of the Port Expansion project, efforts in the last several years have focused on jacketing the most severely corroded piles identified by visual inspection. The 2014 Pile Enhancement Project obtained photos and pile thickness measurements on 4 to 5 randomly selected piles in each of the Terminals to obtain limited quantitative data on pile conditions. These thickness measurements were taken at 3 elevations or zones: between -2' & -4' MLLW, at -12' MLLW and at the mudline (varies). Three readings were taken in each zone. The average pile wall thickness and average minimum wall thickness (averaging the minimum wall thickness recorded on each pile) was computed and the minimum wall thickness measurements are noted below. A total of 22 pipe piles were measured. Percent loss figures represent the corrosion loss based on the original 7/16" pile wall thickness.

Location	Avg Wall Thickness	% Loss (Avg)	Avg Min Thickness	% Loss based on Avg Min	Minimum Thickness	% Loss based on Min Thickness
POL 1 -2' to -4'	.25"	42%	.25"	51%	.22"	57%
POL 1 -12'	.24"	46%	.21"	52%	.18"	59%
POL 1 Mudline	.20"	54%	.17"	62%	.15"	67%
POL 2 -2' to -4'	.28"	36%	.23"	48%	.18"	60%
POL 2 -12'	.30"	32%	.24"	46%	.21"	52%
POL 2 Mudline	.29"	34%	.23"	48%	.13"	71%
Term 1 -2' to -4'	.25"	42%	.21"	52%	.15"	67%
Term 1 -12'	.32"	28%	.27"	39%	.19"	58%
Term 1 Mudline	.37"	16%	.34"	21%	.23"	47%
Term 2 -2' to -4'	.37"	34%	.25"	42%	.20"	55%
Term 2 -12'	.35"	26%	.31"	38%	.22"	50%
Term 2 Mudline	.42"	20%	.36"	46%	.24"	46%
Term 3 -2' to -4'	.33"	38%	.24"	45%	.18"	59%
Term 3 -12'	.36"	18%	.34"	22%	.19"	58%
Term 3 Mudline	.37"	15%	.32"	26%	.24"	46%

Note, thickness readings were not taken above MLLW as there is minimal corrosion above MLLW. Summarizing the above data obtained by the 2014 Pile Enhancement Project, we note the following:

POL 1: Based on the data obtained, POL 1 appears to show significant corrosion from MLLW to the mudline, in fact data indicates more corrosion with depth. POL 1 is considered to be a relatively lightly loaded structure, at least in terms of live loads. Both average minimum wall thickness and minimum wall thickness observed are less than 0.18".

POL 2: POL 2 is the newest structure at the Port, constructed in about 1990. Data recorded however indicates that it has sustained the highest level of corrosion. POL 2 also shows somewhat increased corrosion with depth, with a recorded minimum pile wall thickness of 0.13". Piles at POS2 are spiral welded pipe. At tides below MLLW, there are at least 3 piles where spiral welds have been consumed revealed by water spouts from the sides of piles.

Terminal 1: Term 1 is the oldest facility at the Port constructed in about 1960. Port offices are located on Terminal 1. Data indicates the average minimum pile wall thickness of from .21" at MLLW to 0.34" near the mudline. The most severe corrosion with the minimum recorded wall thickness of 0.15" was observed slightly below MLLW.

Terminal 2: Term 2 was constructed in phases beginning in 1968. Horizon Lines operates its container cranes along Term 2. Term 2 piles were slightly better than Term 1 with an average minimum wall thickness of 0.25" at MLLW to 0.36" near the mudline. A minimum wall thickness of 0.2" was recorded slightly below MLLW.

Terminal 3: Term 3 was constructed in phases beginning in 1974. Although this terminal is significantly newer than Term 1, data indicates it is in a similar state of corrosion. We consider Terminal 3 lightly loaded compared to Terminal 2, since TOTE uses a RORO system of loading its ships which concentrates loads on Trestles and limited areas of the terminal. Loads to Terminal 3 from the RORO operation are not expected to be as high as the crane loads on Terminal 2.

Additional data collected includes pile thickness measurements at the mudline and 5' below the mudline on 8 piles in the tidal zone, and thickness measurements at the mudline and 8' below the mudline on 4 piles in the tidal zone under Terminal 1. The data obtained generally indicates that piles buried in the mud are significantly less corroded than those in the submerged zone.

We have attached the data and photos obtained during the 2014 Pile Enhancement Project in Appendices A, B & C.

In a 2000 inspection report, R&M noted that a 24" diameter pipe pile with a minimum 0.18" wall thickness was suitable under ideal conditions to support the vertical loads for which the dock was designed. (Ideal conditions refer to concentric loads only, no stress concentrations due to corrosion pitting, no concave welds, and no lateral seismic loads.) Ideal conditions however do not exist due to aggressive corrosion, as constructed pile eccentricities and the continuous build-up or sedimentation of silt. We briefly revisited the earlier calculations to assess reductions due to localized buckling. In addition to the Euler buckling equations for column capacity, design codes also include limitations on pipe D/T (diameter/thickness). Although the piles were likely 35 ksi yield material, the reduced pile wall thickness does not comply with AISC (American Institute of Steel Construction) minimum D/T ratio. D/T varies as a relationship of Fy or yield stress. Back calculating useable yield stress for the reduced wall thickness, we find that with a .125" wall, the associated Fy is 16 ksi and for a .18" wall is 24 ksi. Using these values in the Euler buckling equation, we get an allowable load for "V" row piles of: 77 kips for 0.125" wall thickness and 160 kips for 0.18" wall thickness. "Y" row piles would be slightly less due to the longer length. Plans note that the design pile capacity is 240 kips.

In 2000, we also performed a limited finite element analysis (FEA) of a small portion of the terminal area to evaluate the design crane loading effects. That analysis indicated that "Z" row piles (42" diameter) were loaded to 194 kips and "V" row piles (24" diameter) were loaded to 120 kips (including self-weight of the deck). The crane rails are over pile rows "Z" and "V". (We suspect that "Y" row piles would be no more loaded than the "V" row piles.) If we consider the 600 psf uniform live load of the original design, this results in a pile load of approximately 140 kips (for all rows except "Z" which would be less severe). The 600 psf load is not very relevant at the Port as there is no storage on the terminals.

We present this to note that piles corroded to 0.18" wall thickness do not actually meet the original design capacity requirements noted in the drawings. They do however seem to meet the loading requirements defined by the crane and uniform live loads. This is due to the significant distribution of the crane loads through the longitudinal and transverse concrete pile caps.

While the prior structural analysis demonstrated that, even with significant section loss due to corrosion and there is still adequate vertical load capacity with a 0.18" wall thickness, there is still great risk due to corrosion pitting, concave welds and possible eccentric loads that could result in localized failures in combined bending and axial forces. The failure of a single pile would cause a redistribution of loads to adjacent piles which could cause a progressive failure of portions of the structure.

Generally accepted marine facility inspection standards outline section loss thresholds that automatically trigger certain condition ratings regardless of any structural analysis. For example, draft ASCE Waterfront Inspection Standards outline that any steel element with a section loss of 30% at any point is considered to have "major damage" and any element with greater than 30% at any point is considered to have "severe damage", with >30% loss requiring an element rating of "critical".

Using the above ASCE criteria, all the piles in the survey are considered to be in "critical" condition. Based on our somewhat simplified analyses in 2000, all terminals are near their limit of support for the design loads. Terminal 2, which the limited data indicates is incrementally in better condition than others, is likely the most critical since the design cranes are used on Term 2 and it probably actually sees the loads we have analyzed. Although the sample is limited, based on observations it is fairly representative of pile conditions. The information gathered in this effort is not significantly different from measurements taken in the period between 2000 and 2003. This does NOT mean corrosion has not progressed. Structure to electrolyte measurements obtained during this task and annual CP system reports have indicated the CP system is not providing significant corrosion protection to the piles and the piles are freely corroding.

Port Susceptibility to Earthquake Damage

Since no detailed studies have been performed, we can only provide our expert opinion regarding expected damages. These opinions are substantiated by a 20 year history of working at the Port. The following discussion is based on the OLE, CLE and MCE levels of seismic accelerations defined in the URS Seismic Hazards report (2008) for the Port Expansion Project. The level of potential damage noted in the opinion below is significant. Although POL No. 1 and Terminal No. 1 existed prior to the 1964 earthquake event and sustained "repairable" damages, the structures were nearly new and because of that had additional over-strength (safety factor) since the additional pile wall thickness for corrosion allowance was available to resist the forces, and at that time there was no silt sediment accumulated within and shoreward of the wharf. Now, the piles have significantly exceeded the original design corrosion allowance and the corroded butt weld splices in the critical corrosion zone have further weakened the piles. In other words, there is no ductility in the pile support system and any significant deformation will result in collapse of at least the outer berthing terminals where the cranes or RORO ramps operate, ie. there would be little remaining to repair. Terminal 1 (Port Transit Shed and Port Office is within Term 1) was reinforced in the Port Lateral Stability Project in the mid-70s. Additional batter piles were installed north and south of the Transit Shed. The Transit Shed area is more lightly loaded and is generally over the tidal area where observed corrosion is not as severe and may not sustain the same damage as the berthing terminals. It is however a part of berthing Terminal 1 and would certainly be impacted by potential progressive failure of Terminal 1.

OLE: For the Operating Level Earthquake, we estimate that there is at least a 50% likelihood that Port berths POL No. 1, Terminal No. 1 and the south half of Terminal No. 2 will sustain significant damage. The north end of Terminal No. 2, Terminal No. 3 and POL No. 2 would likely be operational.

CLE: For the Contingency Level Earthquake, we estimate that there is a 90% likelihood that Port berths POL No. 1, POL No. 2, Terminal No. 1 and the south half of Terminal No. 2 will sustain significant damage and a 50% likelihood that the north end of Terminal No. 2, and Terminal No. 3 would be damaged.

MCE: For the Maximum Considered Earthquake, we estimate a 100% likelihood that all Port berths POL No. 1 & 2, Terminal No. 1, Terminal No. 2 and Terminal No. 3 would be damaged.

Pile Jacketing To Date

Although in recent years, there has been an effort to fortify, or more appropriately "enhance", corroded piles with strengthening jackets, the jackets are primarily a "bandaid" to improve the most highly corroded piles to maintain vertical support capacity. Preliminary enhancement concepts in the 2000 report were based on a 20' to 24' repair jacket or total pile replacement. Due to high jacketing costs, the high cost of an enhanced CP system to protect an already aged structure and planned Port expansion, a somewhat lesser repair strategy using 16' to 18' concrete-filled jackets has been employed. The jackets provide some beneficial increase in strength for lateral seismic type loads. The silt sedimentation or deposition aspect at the Port (5' to 7' deposition per year, or more within the shadow of the north expansion) is something that has never been fully accounted for in an analysis of structural wharf solutions. With a pile supported structure, additional dredging must be programmed, perhaps on a 10-year basis to mitigate the slope failure problems; or piling must be designed significantly stronger to resist liquefaction of silt sediments. For the maintenance dredging solution, this would mean dredging within the forest of piles that support the dock, likely requiring the development of specialized dredging equipment.

There are roughly 1,400 piles within the 0' MLLW corrosion zone (counted between grids T & Z, though on some of these, the corrosion zone is partially covered by sedimentation from siltation. We have no idea what the corrosion profile of these buried piles is.

A review of pile repair/enhancement projects over the last 25 years indicates there have been roughly 369 piles jacketed. This leaves up to 1050 additional piles that will likely require repair. Many of the already jacketed piles will likely need additional work as the jackets were considered short term bandaids, uncoated and covering only butt weld deterioration. Many older jackets show significant deterioration and may no longer be very effective. Any costs projected herein are likely on the low side.

At current prices, the cost to jacket the roughly 1,050 remaining piles is estimated at $32 million. These repairs need to occur soon, at least over the next 10 years. This does not account for costs associated with the tons of silt sedimentation that must be removed to view and/or repair the piles.

In addition to the pile jackets, it will also be necessary to perform maintenance dredging within and shoreward of the piles to relieve the liquefaction and slope failure threat during a significant seismic event. To simplify the assessment, we have assumed that dredging would be performed only shoreward of the piles. An estimated 28 CY per lineal foot (of terminal) of sediment would have to be removed to achieve the original 3:1 dredge slope. This would somewhat relieve the lateral pressure on the piling in the event of an earthquake that would trigger slope failure within the sediments and create lateral pressure on the piles. With a total pier length (POL No. 2 to Terminal No.3) of about 3500 feet, this is approximately 98,000 CY of material to remove. This dredge quantity is shoreward of the east edge of the terminal structures and does not include quantities under the Terminals themselves. Dredging material from below the terminals would be difficult.

The current Cook Inlet dredging cost is $10/CY. This cost is based on using an ocean barge dredging platform with ocean disposal. Using a land based dredging operation and disposal area would increase these costs significantly. We roughly estimate $2 to $3 million to dredge behind the pier (present value). This would likely need to be done on a 10 to 15 year periodic basis. This cost does not include dredging within the piles as we have not developed a strategy of efficiently doing this.

Cathodic Protection Improvements

The cathodic protection system on the existing dock facilities will also require improvements to maintain service. Due to CP system failures and deferral of maintenance, the shore based anode system is providing limited to no protection to the piles. The cost of CP System improvements is roughly estimated to be $25M or more.

Past experience at the Port with the cathodic protection system indicates that CP improvements will have an expected life of somewhat less than 25 years, possibly requiring replacement during the expected life of the jacketed piles.

Other Considerations

The pile jackets are comprised of many components (steel jacket sections and high strength bolts). The pile jackets installed prior to 2012 were uncoated, as are the existing piles. The bolts holding the jackets together are also subject to corrosion and if the intent is to maintain the functions of the existing facility for an indefinite time, some type of maintenance will be required to replace bolts and perhaps jackets. Since 2012, pile jackets have been hot dip galvanized in an attempt to extend the useful life. However, due to the large quantity of bare steel piles under the dock, the protective HDG coating will have limited effect. To extend the life of future jackets, say for 25 years, would require better jacket coatings, corrosion caps on bolts, and cathodic protective measures on individual jackets or overall CP system improvements. At best, jackets can be expected to extend the life of the existing piling for no more than 15-20 years. Some of the existing jackets are already that old. Data obtained in the

2014 Pile Enhancement Project indicates that although corrosion in the below MLLW (ALWC) zone is generally the most severe, especially corrosion of pile splice welds occurring in that zone, significant corrosion below that zone was noted. The pile jackets will not be effective in protecting the more extensive corrosion noted and pile replacement will be required. Previously estimated high costs of pile replacement, and the fact that the current Port Terminal design may not meet current design codes will inevitably lead to the conclusion that the Port Terminal facilities should be replaced in their entirety.

A data table of piles jacketed and projections of jacket requirements are noted on the following page.

Moving Forward

The 2000 inspection report recommended jacketing 50 piles per year. Since that report, roughly 350 piles have been jacketed, or half of those recommended over the last 14 years. The primary purpose of the jackets is to strengthen the ALWC zone of the piles where a significant number of pile splice butt welds occur. Corrosion of the butt weld area is more severe than other pile areas. At this point in time, we recommend jacketing a minimum of 100 piles per year until facility replacement.

PILE JACKETING INFORMATION

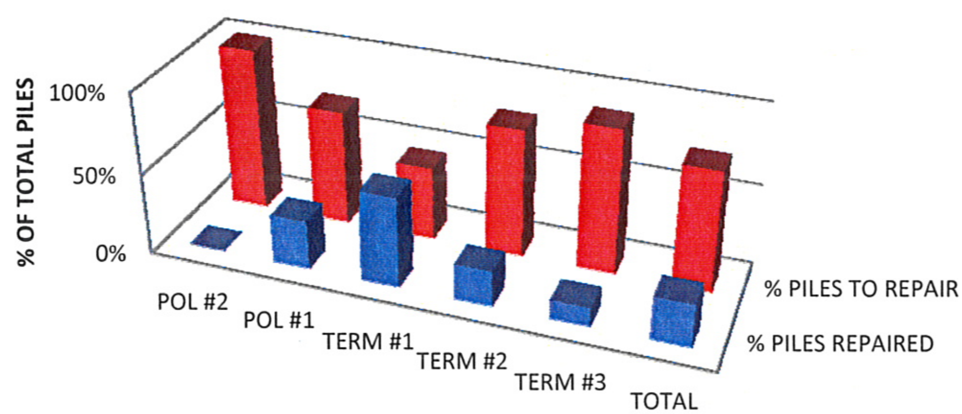
TERMINAL	TOTAL PILES[1]	PILES JACKETED TO DATE	% PILES JACKETED TO DATE	REMAINING PILES TO BE JACKETED	# PILES TO JACKET NEXT 5 YRS	# PILES[2] TO JACKET YEARS 5 TO 10
POL #2	28	0	0%	100%	14	14
POL #1	162	48	30%	70%	57	57
TERM #1	328	181	55%	45%	74	74
TERM #2	372	80	22%	78%	146	146
TERM #3	533	60	11%	89%	237	237
TOTAL	1423	369	26%	74%	527	527
ROM COST IN MILLIONS[3]					$15.8	$15.8

(1) Number of piles seaward of grid U (incl grid U) where repairs are traditionally required.

(2) Without dredging beneath the dock, it may not be possible to identify corrosion or access piling for jacketing.

(3) ROM COST does not include $3M dredging or $25M Cathodic Protection efforts.

PORT PILE STATUS



	POL #2	POL #1	TERM #1	TERM #2	TERM #3	TOTAL
% PILES REPAIRED	0%	30%	55%	22%	11%	26%
% PILES TO REPAIR	100%	70%	45%	78%	89%	74%

Pursuit of pile enhancment in the described 15 year scenario could leave the Port facility vulnerable to damage from significant earthquakes anytime during that period due to progressive failure of deficient piles..

APPENDIX A

Thickness measurements and photos at MLLW, -12' MLLW and at mudline for 22 piles in the submerged zone within Port Terminals.

2014 WHARF PILE REPAIR

ADD ALT. #1 - CLEAN & INSPECT PILES MUDLINE- 22 Pile Count

POL NO 1			Station 1 (-2' to -4') Readings					UT		Station 2 (-12') Readings					UT		Station 3 (Mudline)					UT Readings	
PILE	Pile Size	Mud Elev	1st Read	2nd Read	3rd Read	AVG	MIN	%LOSS (avg)	%LOSS (max)	1st Read	2nd Read	3rd Read	AVG	MIN	%LOSS (avg)	%LOSS (max)	1st Read	2nd Read	3rd Read	AVG	MIN	%LOSS (avg)	%LOSS (max)
2Y	24 in		0.25	0.265	0.315	0.28	0.25	37%	43%	0.285	0.32	0.285	0.30	0.29	32%	35%	0.19	0.145	0.19	0.18	0.15	60%	67%
9Y	24 in		0.245	0.19	0.195	0.21	0.19	52%	57%	0.185	0.21	0.18	0.19	0.18	56%	59%	0.205	0.185	0.21	0.20	0.19	54%	58%
17X	24 in		0.325	0.245	0.195	0.26	0.20	42%	55%	0.195	0.205	0.255	0.22	0.20	50%	55%	0.265	0.19	0.195	0.22	0.19	50%	57%
23Y	24 in		0.235	0.345	0.25	0.28	0.24	37%	46%	0.185	0.235	0.29	0.24	0.19	46%	58%	0.245	0.26	0.145	0.22	0.15	50%	67%
					AVG	0.25	0.22	42%	50%			AVG	0.24	0.21	46%	52%			AVG	0.20	0.17	54%	62%

POL NO 2			Station 1 (-2' to -4') Readings					UT		Station 2 (-12') Readings					UT		Station 3 (Mudline)					UT Readings	
PILE	Pile Size	Mud Elev	1st Read	2nd Read	3rd Read	AVG	MIN	%LOSS (avg)	%LOSS (max)	1st Read	2nd Read	3rd Read	AVG	MIN	%LOSS (avg)	%LOSS (max)	1st Read	2nd Read	3rd Read	AVG	MIN	%LOSS (avg)	%LOSS (max)
2B	24 in		0.39	0.375	0.38	0.38	0.38	13%	14%	0.28	0.25	0.325	0.29	0.25	35%	43%	0.185	0.265	0.27	0.24	0.19	45%	58%
4C	24 in		0.225	0.365	0.18	0.26	0.18	41%	59%	0.36	0.37	0.25	0.33	0.25	25%	43%	0.37	0.37	0.375	0.37	0.37	15%	15%
7C	24 in		0.385	0.19	0.175	0.25	0.18	43%	60%	0.315	0.235	0.37	0.31	0.24	30%	46%	0.235	0.37	0.39	0.33	0.24	24%	46%
9B	24 in		0.18	0.175	0.315	0.22	0.18	49%	60%	0.39	0.21	0.21	0.27	0.21	38%	52%	0.185	0.125	0.35	0.22	0.13	50%	71%
					AVG	0.28	0.23	36%	48%			AVG	0.30	0.24	32%	46%			AVG	0.29	0.23	34%	48%

Terminal No. 1			Station 1 (-2' to -4') Readings					UT		Station 2 (-12') Readings					UT		Station 3 (Mudline)					UT Readings	
PILE	Pile Size	Mud Elev	1st Read	2nd Read	3rd Read	AVG	MIN	%LOSS (avg)	%LOSS (max)	1st Read	2nd Read	3rd Read	AVG	MIN	%LOSS (avg)	%LOSS (max)	1st Read	2nd Read	3rd Read	AVG	MIN	%LOSS (avg)	%LOSS (max)
12X	24 in		0.195	0.18	0.145	0.17	0.15	60%	67%	0.24	0.185	0.35	0.26	0.19	41%	58%	0.23	0.385	0.335	0.32	0.23	28%	47%
16W	24 in		0.175	0.285	0.23	0.23	0.18	47%	60%	0.32	0.305	0.23	0.29	0.23	35%	47%	0.31	0.335	0.315	0.32	0.31	27%	29%
27V	24 in		0.365	0.335	0.36	0.35	0.34	19%	23%	0.405	0.405	0.41	0.41	0.41	7%	7%	0.42	0.415	0.425	0.42	0.42	4%	5%
41Y	24 in		0.295	0.295	0.18	0.26	0.18	41%	59%	0.32	0.24	0.375	0.31	0.24	29%	45%	0.425	0.42	0.42	0.42	0.42	4%	4%
					AVG	0.25	0.21	42%	52%			AVG	0.32	0.27	28%	39%			AVG	0.37	0.34	16%	21%

Terminal No. 2			Station 1 (-2' to -4') Readings					UT		Station 2 (-12') Readings					UT		Station 3 (Mudline)					UT Readings	
PILE	Pile Size	Mud Elev	1st Read	2nd Read	3rd Read	AVG	MIN	%LOSS (avg)	%LOSS (max)	1st Read	2nd Read	3rd Read	AVG	MIN	%LOSS (avg)	%LOSS (max)	1st Read	2nd Read	3rd Read	AVG	MIN	%LOSS (avg)	%LOSS (max)
51X	24 in		0.2	0.385	0.325	0.30	0.20	31%	54%	0.46	0.47	0.45	0.46	0.45	-5%	-3%	0.495	0.485	0.485	0.49	0.49	-12%	-11%
57Y	24 in		0.255	0.24	0.195	0.23	0.20	47%	55%	0.38	0.39	0.29	0.35	0.29	19%	34%	0.495	0.425	0.495	0.47	0.43	-8%	3%
*65X	24 in		0.325	0.29	0.35	0.32	0.29	26%	34%	0.245	0.23	0.37	0.28	0.23	36%	47%	0.42	0.24	0.36	0.34	0.24	22%	45%
75X	24 in		0.375	0.245	0.25	0.29	0.25	34%	44%	0.22	0.3	0.37	0.30	0.22	32%	50%	0.39	0.235	0.45	0.36	0.24	18%	46%
90Y	24 in		0.36	0.28	0.325	0.32	0.28	26%	36%	0.35	0.34	0.38	0.36	0.34	18%	22%	0.46	0.455	0.425	0.45	0.43	-2%	3%
					AVG	0.37	0.25	34%	42%			AVG	0.35	0.31	26%	38%			AVG	0.42	0.36	20%	46%

Terminal No. 3			Station 1 (-2' to -4') Readings					UT		Station 2 (-12') Readings					UT		Station 3 (Mudline)					UT Readings	
PILE	Pile Size	Mud Elev	1st Read	2nd Read	3rd Read	AVG	MIN	%LOSS (avg)	%LOSS (max)	1st Read	2nd Read	3rd Read	AVG	MIN	%LOSS (avg)	%LOSS (max)	1st Read	2nd Read	3rd Read	AVG	MIN	%LOSS (avg)	%LOSS (max)
96X	24 in		0.225	0.33	0.18	0.25	0.18	44%	59%	0.385	0.34	0.38	0.37	0.34	16%	22%	0.405	0.395	0.4	0.40	0.40	9%	10%
112Y	24 in		0.24	0.24	0.245	0.24	0.24	45%	45%	0.37	0.385	0.365	0.37	0.37	15%	17%	0.36	0.245	0.235	0.28	0.24	36%	46%
*123Y	24 in		0.29	0.225	0.245	0.25	0.23	42%	49%	0.425	0.425	0.405	0.42	0.41	4%	7%	0.485	0.44	0.39	0.44	0.39	0%	11%
131X	24 in		0.285	0.325	0.36	0.32	0.29	26%	35%	0.185	0.245	0.215	0.22	0.19	51%	58%	0.4	0.41	0.365	0.39	0.37	10%	17%
151Y	24 in		0.205	0.365	0.245	0.27	0.21	38%	53%	0.415	0.425	0.41	0.42	0.41	5%	6%	0.4	0.235	0.405	0.35	0.24	21%	46%
					AVG	0.33	0.24	38%	45%			AVG	0.36	0.34	18%	22%			AVG	0.37	0.32	15%	26%