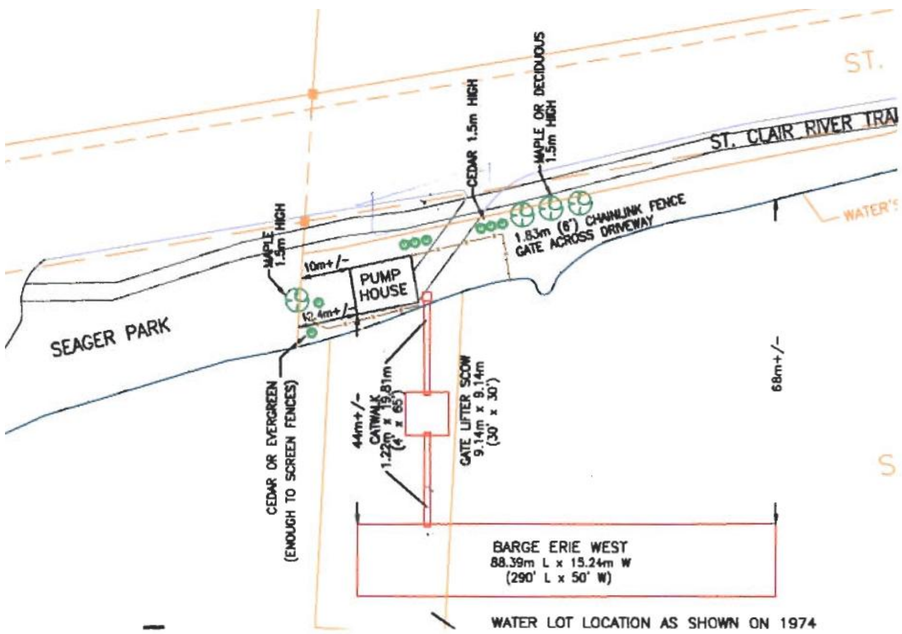
Project Document No.:	Revision:	Date:	GBS Area	Comp/Cell/Ext
Project 67 – CRI	**0**	**14-Mar-2014**		
Temporary Dock Installation Report				

Document Number / rev:	67 – CRI Deception Bay

MCKEIL MARINE
TEMPORARY DOCK INSTALLATION REPORT



A0	14-Mar-2014	Review	**Chris Kirby** Director – Project/Engineering	**N/A**	**N/A**	**N/A**
Rev.	Date	Reason for issue	Made by	Checked by	Discipline Approval	Project Approval

CRI Mooring Project

Mckeil Marine Limited

MCKEIL

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Table of Contents

Revision Details

Rev.	Location of Change	Brief description of Change

1 PURPOSE & INTRODUCTION

This document will highlight, by example, the experience McKeil Marine has with designing and installing temporary dock structures.

Over the years, McKeil has been approached by several Customers to propose and subsequently execute the installation of various types of dock structures in order to accommodate the loading of liquid, and project cargos.

In some circumstances the structures/docks are mobilized for a one-time use. This is typically for oversize project cargo that cannot be economically transported over-road from an existing Port. We have been very successful in developing cost-saving measures for our Clients by developing a solution to off-load a barge much closer to the final location for the cargo.

In other cases, while still temporary from a permit perspective, we have provided solutions for year over year service. The benefits for this type of dock can been realized on several fold;

- Expedited permit process
- Minimal environmental impact
- Rapid mobilization and installation
- Lower capital costs
- Little to no remedial work on de-mob

This option often allows our Customers to “rent” an asset as opposed to the burden of an outright purchase or construction of a permanent facility. With our access to various types and sizes of marine plant, in-house and sub-contract Naval Archs and Engineers and vast experience in this type of work, McKeil has a proven track record of successful planning, installation and maintenance of temporary docks.

The following will detail the most recent projects we have completed and the challenges over-come.

2 AMHERSTBURG, ON

Located on the lower Detroit River, Amherstburg was the site of one of our longer term docks. The existing site had (3) dolphins piers but they were essentially unusable for larger marine assets due to water depth limitations. General Chemical was realizing an increase in product demand and we were asked to add additional, larger vessels to their contracted service. In order to meet this demand, McKeil Marine had to develop a solution for mooring and loading vessels in deeper water.

The solution was (2) spacer barges. The inshore barge was fitted with spuds and the offshore barge was secured with wire and anchor chain to the interior barge and shore. We also installed several on-shore mooring for both the vessel and ship. The final dock proved successful for the berthing and loading of a 440 ft tanker in all wind and ice conditions. This facility was in service (year-round and in various arrgt’s) from the mid-90’s until 2004.

3 COURTRIGHT, ON

As General Chemical grew in Southern Ontario their requirements for tank storage of liquid calcium grew. In 2002 they identified a tank facility in Courtright, ON. The site they wanted to further develop for their business with Pollard Trucking was approx 2 miles from the St Clair River. McKeil was asked to survey several locations and come up with a proposal for a long-term temporary dock and pipeline. We looked at a few existing docks but determined that due to scheduling conflicts, they would not work. The ideal situation for Pollard was to have their own facility. Over the fall and winter of 2002/03, McKeil conducted site visits, met with Local, Provincial and Federal Authorities and completed Engineering for a dock.

The final design required the outboard edge of the dock to be approx 190ft from the shoreline. The solution involved the placement of (2) barges. The “Gate Lifter” (30’ x 30’) was used as an intermediate support for the cat-walk and pipeline and the barge “Erie West” (290’ x 50’) was used as the actual dock. Engineering was completed to analyze the holding power of (6)-32” spuds. Having proved the proposal, spuds and spud wells were fabricated and installed on the barge. The installation of the spudwells required internal stiffening of the side shell as well. Final fit-out included the installation of Nav and work lighting, fendering and a cargo loading pipeline.

McKeil Mobilized the (2) barges as well as a 3rd spud barge to assist with the installation in the summer of 2003. The barge continues to be in operation for Pollard Trucking to date.

4 SARNIA, ON

While the dock discussed above met the longer term requirements of GC and Pollard, McKeil was charged with the responsibility of coming up with a short-term storage and loading facility. The immediate need was to receive cargo by truck, transfer it to a floating storage/docking barge, and then transfer to ship. In Dec 2002, McKeil mobilized the barge “Ocean Hauler” to an old CN Rail dock in Sarnia, ON. The existing facility was not adequate to berth a ship so the “Ocean Hauler’ severed both as a dock and storage tank. In addition to docking requirements, McKeil designed and installed a liquid discharge and transfer manifold on shore.

This 4 month winter set-up was crucial for the intermediate needs of our Customer and served them well until the Courtright dock was established.

5 WOLFE ISLAND/KINGSTON, ON

With our JV Partner Mammoet Canada Eastern and our affiliate Company Nadro Marine, McKeil came up with a temporary docking solution to accommodate the loading of windmill sections in Kingston, ON for discharge at a new wind farm on Wolfe Island, ON. The town of Kingston gave a small access in the Port but the location was not set-up to allow loading of large barges. With the need to bridge a 100 ft gap between shallow and deep water, McKeil proposed the use of our jack-up barge “J/U 600”.

Engineering and design work was completed and the necessary ramps fabricated. We also provided a temporary facility on the island by driving pile and pouring a concrete cap to form a shore abutment for ramps. The dock provided un-interrupted service in 2008 and again in 2009.

6 SARNIA, ON

In an earlier project with Mammoet, McKeil was involved with the transport and off-load of several modules for Suncor for the Genesis project. This project involved bringing in several tanks for their refinery upgrades. The transport barge specified for the project was 240' x 70'. Current in this part of the St Clair River was 3-4 kts.

Suncor had a small ramp structure, but in it's existing state, the barge could not be held on station for roll-off. McKeil mobilized a spud barge to assist with this operation. The spud barge was positioned just downstream of the ramp and was utilized in 2 ways. The transport barge first landed alongside the spudbarge and then rotated on the bow of the spud barge until it was perpendicular to the river. The spud barge was then used as a mooring to hold the bow of the transport barge. Further assist tugs and a series of lines run to excavators were used to hold the stern in position during the roll-off. This arrg't was used on a few occasions in 2004 to deliver the required number of modules.

7 MONT-LOUIS, QC

In early 2011, McKeil was approached by another long term Customer, Bellemare Transport. Bellemare was looking for a cost-effective solution for the transport of modules destined for a power sub-station near Mont-Louis, QC. As the transformers were over-sized, road transport had to be as limited as possible. With no nearby port, they came to us for options.

In addition to the challenge of no dock, the tidal range and shallow water added to the issues. As the job was only for 2 voyages, a very temporary and inexpensive solution was required.

After visiting the site, McKeil proposed an intermediate structure to support (2) sets of ramps. With the water depth considered, a single set was not an option to span the distance between the barge and roadway. A day in advance of the barge arrival, the timber crib support structure was built on the shores of the St Lawrence River. Upon completion of the roll-off it was dismantled and set aside for use on the 2nd voyage.

8 CONCLUSION

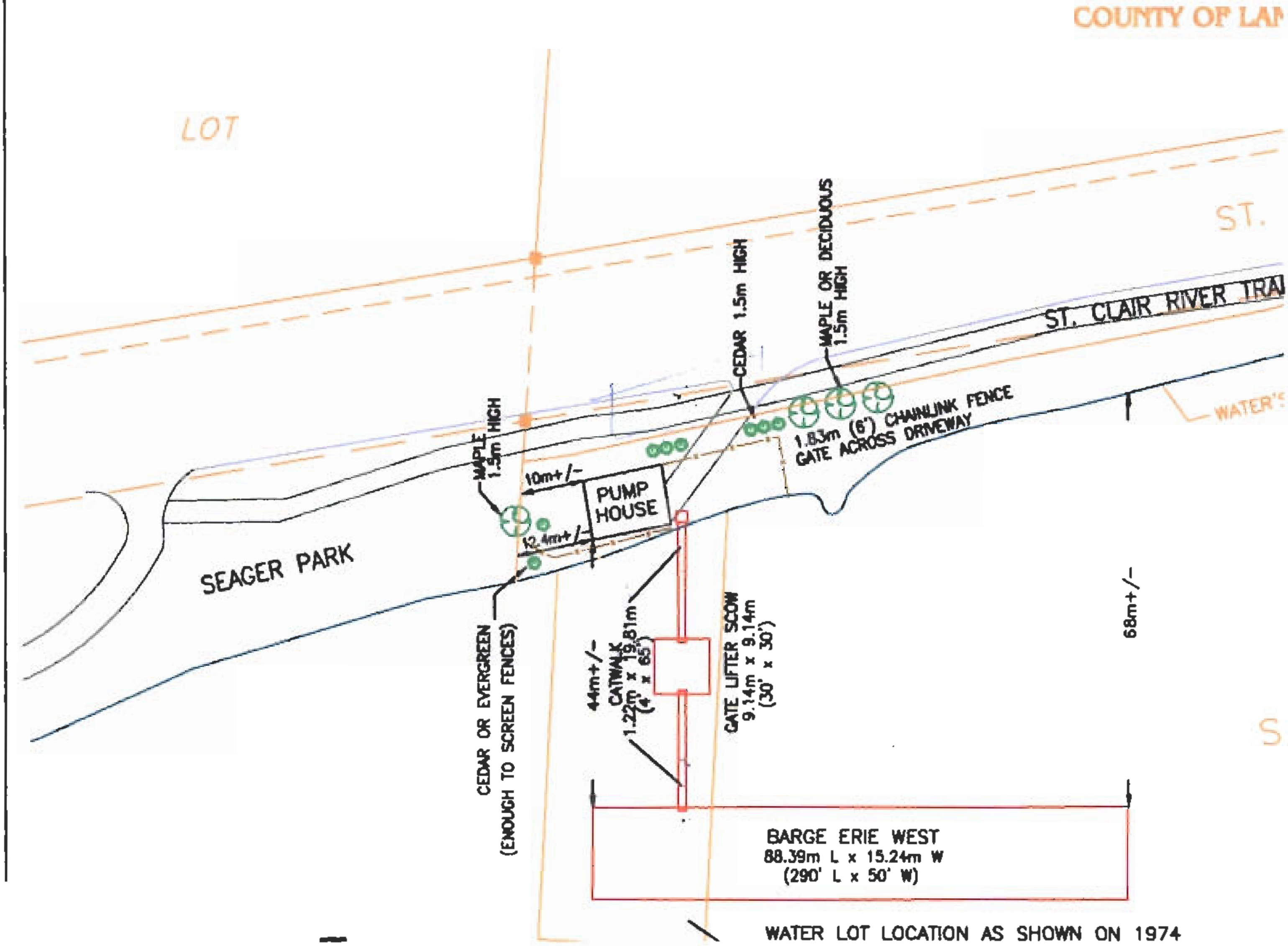
The preceding examples are only a snapshot of what McKeil has done, and can do for their Customers. While Lake and Liner service Ship Owners have the luxury of well established docks, McKeil, by nature of their Customers, cargos and assets, has to be flexible and adaptive. We have the experience and expertise both in-house and sub-contracted to offer turn-key solutions.

Finding the "bridge" between shore and vessel is part of the services we offer.

9 APPENDIX

Appendix Number	Appendix Title
1	Capt Ralph Tucker alongside in Amherstburg
2	Courtright Dock Arrg't
3	Barge Alongside Erie West
4	Erie West Spud Arrg't
5	Erie West Docking Study
6	Erie West Spud Dwg
7	Ocean Hauler as Storage Dock
8	Jack-Up 600 Dock
9	Jack-Up 600 Ramp
10	Jack-Up 600 with Ramps Deployed
11	Suncor Dock
12	GC No. 37 Discharge at Mont-Louis


1803



COUNTY OF LAM
LOT
ST.
ST. CLAIR RIVER TRAI
WATER'S
CEDAR 1.5m HIGH
MAPLE OR DECIDUOUS 1.5m HIGH
1.83m (6') CHAINLINK FENCE
GATE ACROSS DRIVEWAY
MAPLE 1.5m HIGH
10m+/-
PUMP HOUSE
12.4m+/-
SEAGER PARK
CEDAR OR EVERGREEN (ENOUGH TO SCREEN FENCES)
44m+/-
CATWALK 1.22m x 19.81m (4' x 65')
GATE LIFTER SCOW 9.14m x 9.14m (30' x 30')
68m+/-
S
BARGE ERIE WEST
88.39m L x 15.24m W
(290' L x 50' W)
WATER LOT LOCATION AS SHOWN ON 1974

Executive Summary

A study on the proposed anchoring system for the new dock facility at Courtwright, Ontario was conducted by KAM Technology. The proposed dock facility includes a deck barge (Erie West) located at approximately 150' off the shoreline in a north/south direction. The barge will be supported by a number of spuds at the inboard side. Up to 20' of water depth is expected at the inboard side of the barge. Additional mooring lines off the bow and stern will be fitted to further secure the dock.

The study investigated the docking of the vessel Ralph Tucker under various environmental conditions. Results indicate that using 6 spuds of 32" diameter x 1" wall thickness, the dock will withstand the load imposed by the vessel with a bow current of up to 3 knots and wind speed up to 60 knots. As the dock runs parallel to the current, load imposed by the vessel with a side current is highly unlikely; however, the system is still good for a side current of up to 2 knots and wind speed up to 40 knots.

In conclusion, the proposed new dock facility is capable to withstand the dynamic forces resulting from the docking vessel as stated in this report.

Report submitted without prejudice:

Kevin Yik
Member – The Society of Naval Architects and Marine Engineers

Issued	Rev.0	Rev.A	Rev.B	

Approvals by:	Rev.0	Rev.A	Rev.B	
				References

Client/Owner:	Project/Vessel:
McKeil Marine Ltd. Hamilton, Ontario	Barge Erie West to serve as Dock Facility at Courtwright, Ontario

Title:

Environmental Forces Study
(Revised)

Prepared By:	Report No. Rev. A	Date:	May 26 2003
		Scale:	Nil
KAM Technology	EN03192-R01	Job No,	EN03192
3 Keholme Cresc. Thorold		Calc.	KY
Ontario Canada L2V 4C1	Total pages including cover	Checked	

Wind Loading

P = 0.00338 V^2 Ch Cs lb/ft^2

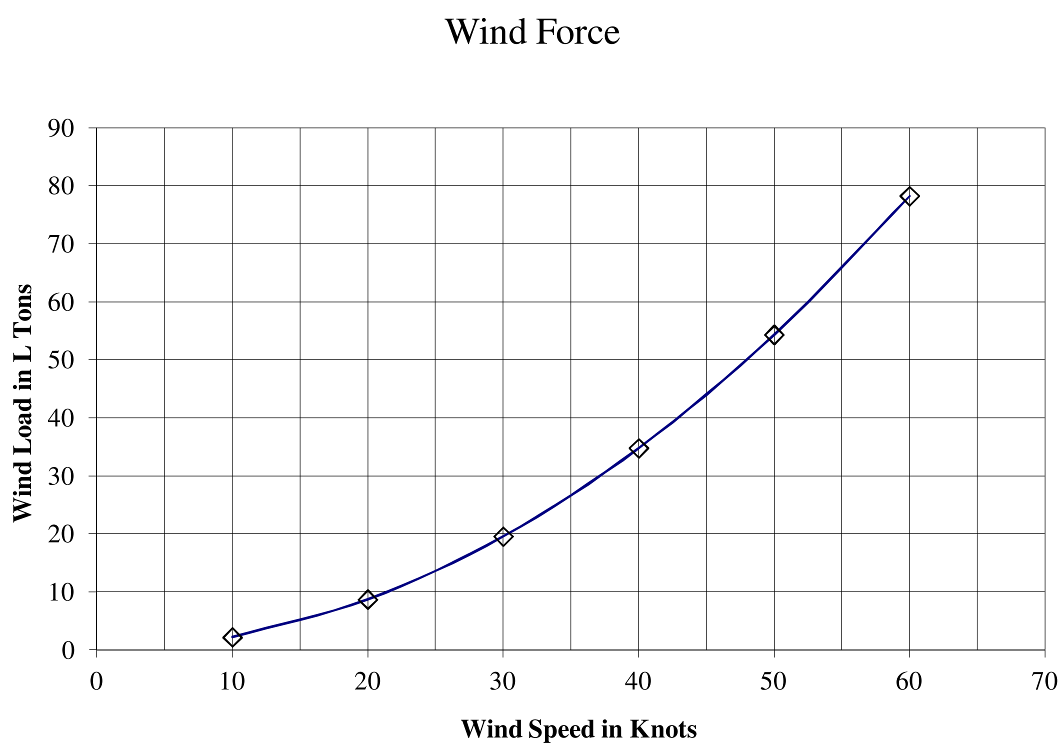
where: Vk = wind velocity in knots

Ch = height coefficient (1.0)

Cs = shape coefficient

Vessel's Particulars	(ft)		(ft^2)	Cs	Gross Area
Length	413	Superstructure	2760	1.0	2760
Beam	60	Cat-walk & Focle	3160	1.5	4740
Depth	31	Main Hull ab. WL	6897	1.0	6897
B. Draft	14.3				14397

Speed	10	20	30	40	50	60 (knots)
V^2	100	400	900	1600	2500	3600
Angle	90	90	90	90	90	90
Proj Area	14397	14397	14397	14397	14397	14397
Force(lbs)	4866	19465	43796	77860	121655	175184
(L tons)	2.17	8.69	19.55	34.76	54.31	78.21



Current Loading

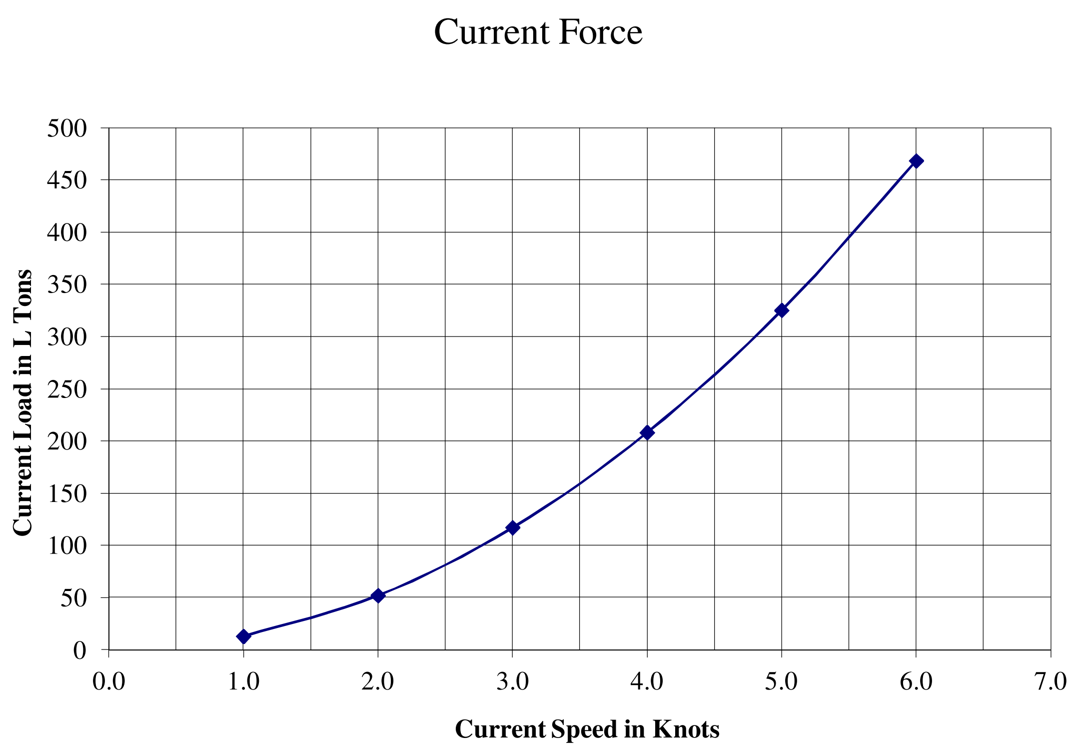
$fD = 0.5Cd\rho V^2 A$ (consistent units)

where:	fD = drag force per unit length	ρ = mass density
	Cd = drag coefficient	
	V = velocity of the current in ft/sec	
	A = projected area per unit length	

Vessel's Particulars

(Ralph Tucker)	(ft)		(ft^2)	Cd
Length	413	Underwater Hull	10532	1.0
Beam	60	Mass density ρ	1.94	
Depth	31			
Draft Loac	25.5			

Knots	1.0	2.0	3.0	4.0	5.0	6.0
ft/sec	1.689	3.378	5.067	6.756	8.445	10.134
V^2	2.85	11.41	25.67	45.64	71.32	102.70
Drag force	29142	116569	262279	466274	728553	1049117
(L tons)	13.01	52.04	117.09	208.16	325.25	468.36



Combined Forces - Scenario (1)

Vessel parallel to the dock side and drifted by wind and current

Vessel docking speed =	0	knots
Total rubber tires fitted at barge side =	10	
Contact area of each tire	87	sq. ft.
Tires in contact with vessel (assumed 50%) =	5	
Limiting pressure on hull =	1230	lbs/sq. ft

Table (1a) - 1 knot current Current force = 13.01 tons

Wind Speed	Wind Force	Combined Force	Force per tire (tons)	Deflection (inches)	Pressure (lbs/ft^2)
10	2.17	15.18	3.04	0.62	78
20	6.69	19.70	3.94	0.80	101
30	19.55	32.56	6.51	1.32	168
40	34.76	47.77	9.55	1.94	246
50	54.31	67.32	13.46	2.74	347
60	78.21	91.22	18.24	3.71	470

Table (1b) - 2 knots current Current force = 52.04 tons

Wind Speed	Wind Force	Combined Force	Force per tire (tons)	Deflection (inches)	Pressure (lbs/ft^2)
10	2.17	54.21	10.84	2.21	279
20	6.69	58.73	11.75	2.39	302
30	19.55	71.59	14.32	2.91	369
40	34.76	86.80	17.36	3.53	447
50	54.31	106.35	21.27	4.33	548
60	78.21	130.25	26.05	5.30	671

Table (1c) - 3 knots current Current force = 117.09 tons

Wind Speed	Wind Force	Combined Force	Force per tire (tons)	Deflection (inches)	Pressure (lbs/ft^2)	
10	2.17	119.26	23.85	4.85	614	
20	6.69	123.78	24.76	5.04	637	
30	19.55	136.64	27.33	5.56	704	
40	34.76	151.85	30.37	6.18	782	
50	54.31	171.40	34.28	6.97	883	4.31 t/m^2
60	78.21	195.30	39.06	7.94	1006	

Combined Forces - Scenario (1) continue

Vessel parallel to the dock side and drifted by wind and current

Vessel docking speed =	0
Total rubber tires fitted at West side =	10
Contact area of each tire	87
Tires in contact with vessel (assumed 50%) =	5
Limiting pressure on hull =	1230

Table (1d) - 4 knot current   Current force = 208.16 tons

Wind Speed	Wind Force	Combined Force	Force per tire (tons)	Deflection (inches)	Pressure (lbs/ft^2)
10	2.17	210.33	42.07	8.56	1083
20	6.69	214.85	42.97	8.74	1106
30	19.55	227.71	45.54	9.26	1173
40	34.76	242.92	48.58	9.88	1251
50	54.31	262.47	52.49	10.68	1352
60	78.21	286.37	57.27	11.65	1475

Table (1e) - 5 knots current   Current force = 325.25 tons

Wind Speed	Wind Force	Combined Force	Force per tire (tons)	Deflection (inches)	Pressure (lbs/ft^2)
10	2.17	327.42	65.48	13.32	1686
20	6.69	331.94	66.39	13.50	1709
30	19.55	344.80	68.96	14.03	1776
40	34.76	360.01	72.00	14.64	1854
50	54.31	379.56	75.91	15.44	1955
60	78.21	403.46	80.69	16.41	2078

Table (1f) - 6 knots current   Current force = 468.36 tons

Wind Speed	Wind Force	Combined Force	Force per tire (tons)	Deflection (inches)	Pressure (lbs/ft^2)
10	2.17	470.53	94.11	17.10	2423
20	6.69	475.05	95.01	17.10	2446
30	19.55	487.91	97.58	17.15	2512
40	34.76	503.12	100.62	17.20	2591
50	54.31	522.67	104.53	17.25	2691
60	78.21	546.57	109.31	17.30	2815

Combined Forces - Scenario (2)

Vessel at 5 degrees to the dock side and drifted by wind and current

Vessel docking speed =	0	knots
Total rubber tires fitted at West side =	10	
Contact area of each tire	87	sq. ft.
Tires in contact with vessel (conservative) =	1	
Limiting pressure on hull =	1230	lbs/sq. ft

Table (2a) - 1 knot current Current force = 13.01 tons

Wind Speed	Wind Force	Combined Force	Force per tire (tons)	Deflection (inches)	Pressure (lbs/ft^2)
10	2.17	15.18	15.18	3.09	391
20	6.69	19.70	19.70	4.01	507
30	19.55	32.56	32.56	6.62	838
40	34.76	47.77	47.77	9.72	1230
50	54.31	67.32	67.32	13.69	1733
60	78.21	91.22	91.22	18.55	2349

Table (2b) - 2 knots current Current force = 52.04 tons

Wind Speed	Wind Force	Combined Force	Force per tire (tons)	Deflection (inches)	Pressure (lbs/ft^2)	
10	2.17	54.21	54.21	11.03	1396	
20	6.69	58.73	58.73	11.95	1512	
30	19.55	71.59	71.59	14.56	1843	
40	34.76	86.80	86.80	15.80	2235	
50	54.31	106.35	106.35	17.00	2738	13.36 t/m^2
60	78.21	130.25	130.25	17.30	3354	

Table (2c) - 3 knots current Current force = 117.09 tons

Wind Speed	Wind Force	Combined Force	Force per tire (tons)	Deflection (inches)	Pressure (lbs/ft^2)
10	2.17	119.26	119.26	> 17	3071
20	6.69	123.78	123.78	> 17	3187
30	19.55	136.64	136.64	> 17	3518
40	34.76	151.85	151.85	> 17	3910
50	54.31	171.40	171.40	> 17	4413
60	78.21	195.30	195.30	> 17	5028

Computing Kinetic Docking Energy

Ref: Marine Fendering Systems - Uniroyal, P.6~7
Guideline: Dock Facility - Engineering Report Vol.I, Nov.1, 1974
Formula: K.E. = 1/2 x (W/g) V^2
All loads expressed through out this report are in tons (Long) of 2240 lbs.

Assessment:

Vessel	Disp. Tons (Long)	Velocity (ft/sec)	Gravity (ft./sec^2)	K.E. Ft-Tons	
					<- Total energy of docking vessel
A	30000	0.84	32.2	329	
Ralph Tucker	10100	1.68	32.2	443	<- use this for subsequent calculations

K.E. absorbed by the fender = K.E. ship x Cm x Ce x Cs

Cm = Additiona mass of the vessel caused by the compression of the sea water against the side of the ship when the ship is stopped by the fenders. For the subject dock, less than 50% length of the vessel shall be acting at the jetty. Therefore, Cm = 1.3*.5 = 0.65 is adequate
Ce = eccentricity factor, use 0.50
Cs = Softness factor, use 0.90

Hence, total energy received by the fenders is:

443 x .65 x 0.50 x 0.90 = 129.5 ft-tons

Assume one rubber tire in contact with the vessel (conservative approach)

Refer to Energy Vs Deflection Curve derived from actual test (see appendix)
Deflection of rubber tire fender = 17.1 inches
Corresponding load = 110

Contact area of the 140"OD x 60"ID tire is 87 sq. ft
Average pressure (Load/area =) 1.26 Tons/sq. ft
or = 2832 lbs./sq. ft.

Lloyds Pressure Formula for Scantling Design

Formula: t = 0.00455s(pdHk)^.5

where:
- s = stiffener spacing (mm)
- pd = 1/C (tonnes/m^3)
- H = height from hopper slope plate to top of cargo
- k = higher tensile steel factor (245/yield)

Stress Criteria: (a) Bottom Structure and double hull structure:

Girders	fb = 9.5/k	kg/mm^2	(outer hull)
	fb = 11.0/k		(inner bottom and above)
	fv = 8.5/k		
	fc = 15.0/k		
Floors/web	fb = 12.5/k		
	fv = 8.5/k		
	fc = 18.0/k		

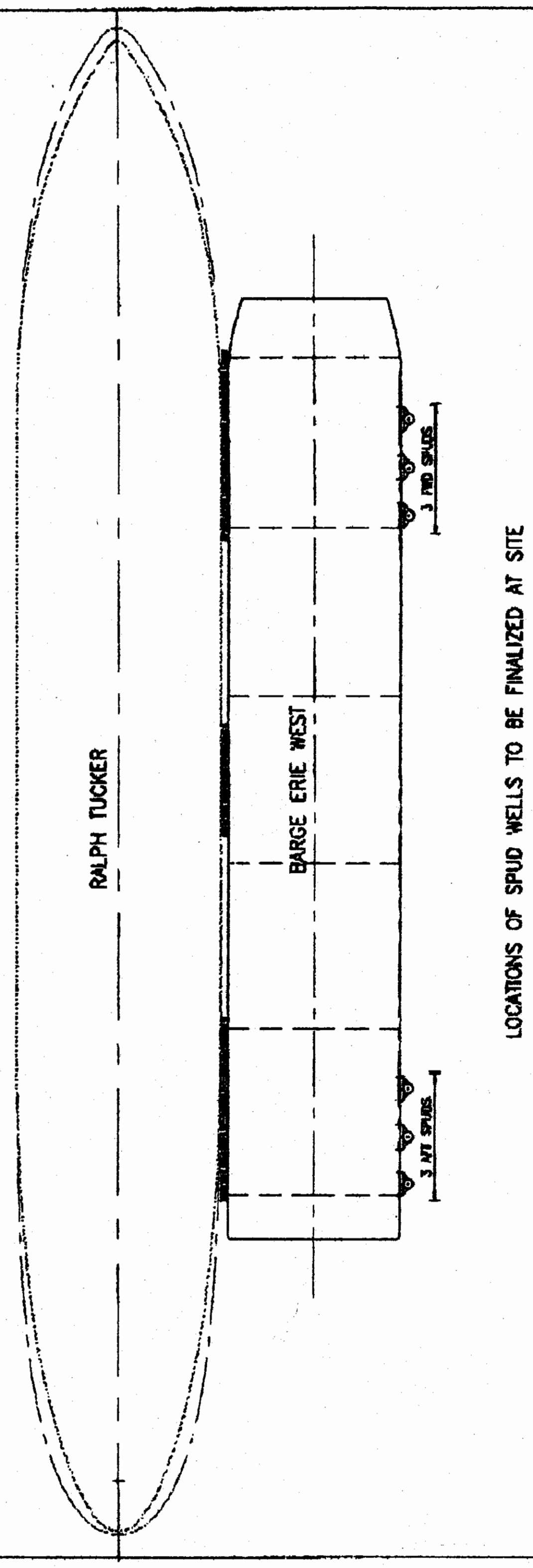
Buckling Criteria:

Static Conditions	1.2	
Corrosion Allowance	2 mm	internal structure of ballast tanks
	1 mm	others

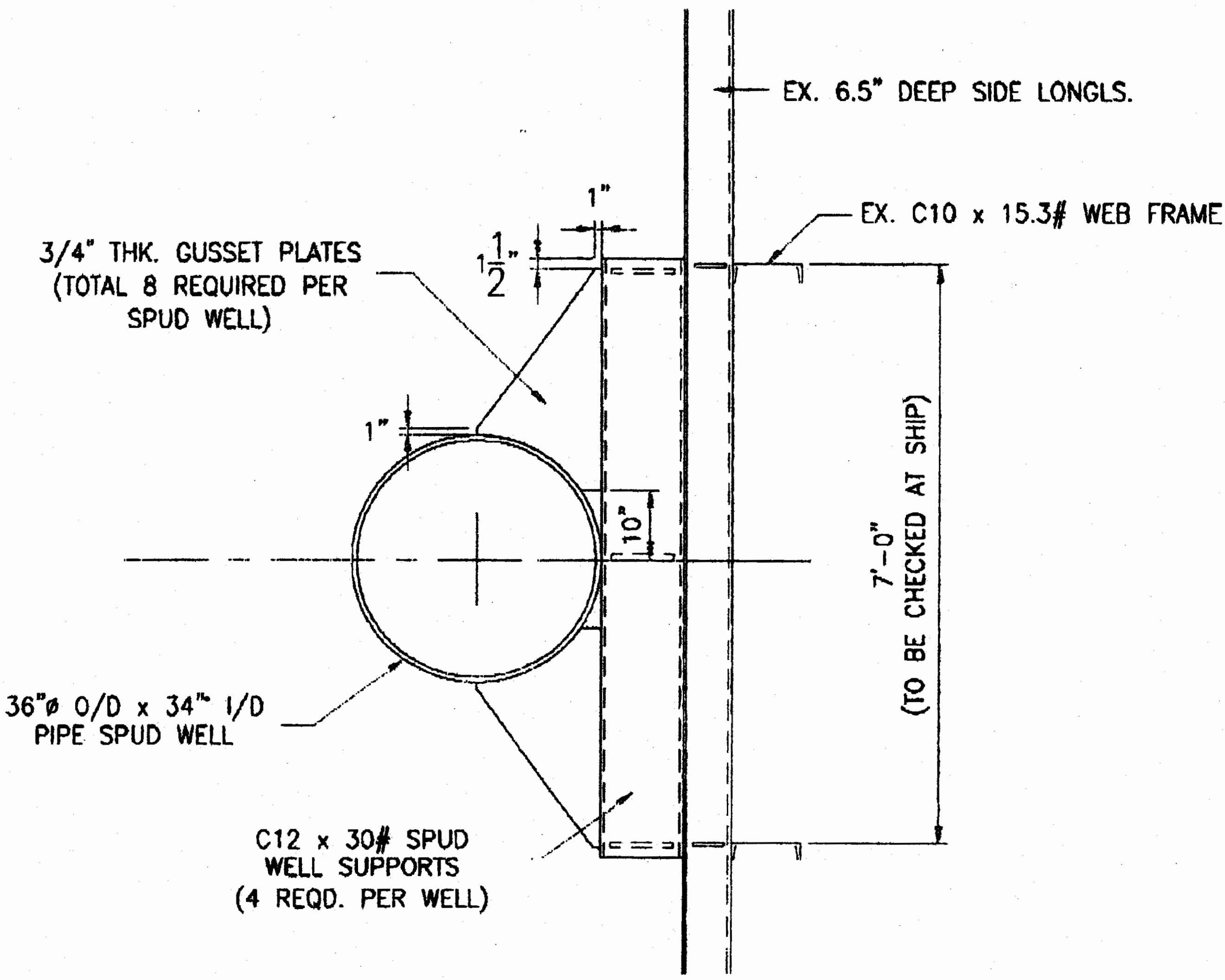
Side plating	*s*	*pd*	*H*	*k*	*ε Load/m^2*	*(t)*	as-fitted *9.5 mm*
case 1	483.00	1.00	4.00	1.000	4.00	**4.40**	
case 2	813.00	1.00	6.00	1.000	6.00	**9.06**	
case 3	813.00	1.00	8.00	1.000	8.00	**10.46**	
case 4	813.00	1.00	10.00	1.000	10.00	**11.70**	
case 5	813.00	1.00	12.00	1.000	12.00	**12.81**	

Structural Support	*UDL (tonnes/m)*	*span (m)*	*Moment (wl^2/12)*	*allowable stress*	*Z required (cm^3)*	*as fitted 211 cm^3*
case 1 = 4 t/m^2	1.92	2.00	0.64	13.46	**47.55**	
case 1 = 6 t/m^2	2.88	2.00	0.96	13.46	**71.32**	
case 1 = 8 t/m^2	3.84	2.00	1.28	13.46	**95.10**	
case 1 = 10 t/m^2	4.80	2.00	1.60	13.46	**118.87**	
case 1 = 12 t/m^2	5.76	2.00	1.92	13.46	**142.64**	

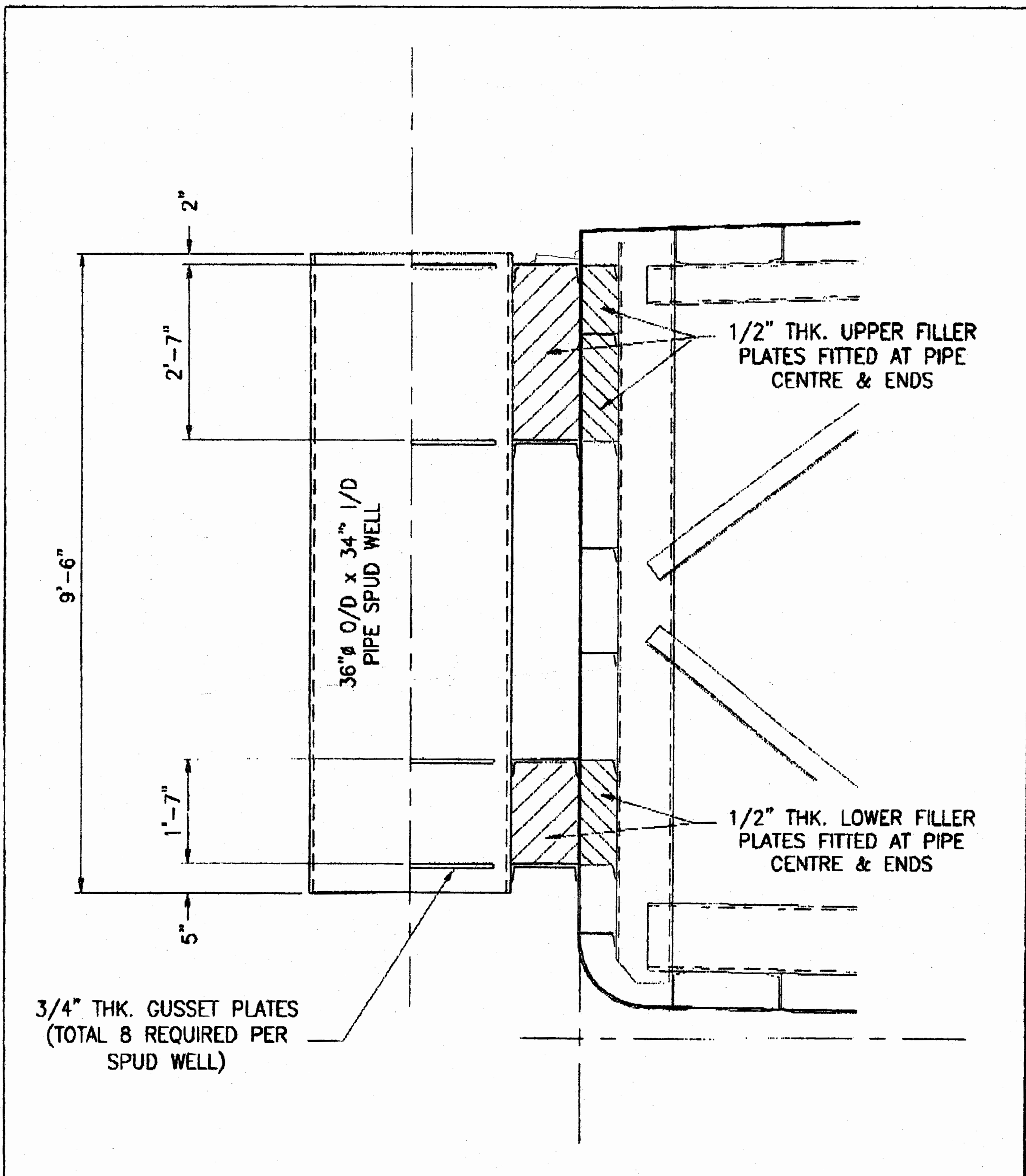
Welding Notes:
1. Gusset plates to pipe: 3/8" DCFW
2. Gusset plates to 12" channel: Full penetration butt weld.
3. Fillet plates to shell, pipe or channels: 1/4" DCFW
4. 12" Channels to shell: 3" intermittent @ 12" spacing where shell plate is smooth and straight. Otherwise, use filler plate where gap is less than 3/4" wide. For wider gap, use horizontal gusset plates to fill up the space between channel and shell.



PROJECT Spud Well on Barge Erie West		TITLE KEY PLAN OF SPUD WELL LAYOUT & WELDING NOTES	
KAM Technology 3 Keholme Cresc. Thorold ON L2V 4C1 TEL/FAX : (905) 227 7388	CLIENT McKeil Marine Ltd.	DRAWN KY	JOB NO. EN03192
		CHK'D	DWG NO. EN03192-1 REV 0
		SCALE 1/2"=1'-0"	DATE MAY 2003 SHEET 1 OF 3



PROJECT: Spud Well on Barge Erie West	TITLE: SPUD WELL CONSTRUCTION DETAILS PLAN VIEW			
KAM Technology, 3 Keholme Cresc. Thorold ON L2V 4C1, TEL/FAX : (905) 227 7388	CLIENT: McKeil Marine Ltd.			
	DRAWN: KY	JOB NO.: EN03192	DWG NO.: EN03192-1	REV: 0
	CHK'D:			
	SCALE: 1/2"=1'-0"	DATE: MAY 2003	SHEET: 2 OF 3	



PROJECT Spud Well on Barge Erie West		TITLE SPUD WELL CONSTRUCTION DETAILS SECTIONAL VIEW			
KAM Technology 3 Keholme Cresc. Thorold ON L2V 4C1 TEL/FAX : (905) 227 7388	CLIENT McKeil Marine Ltd.	DRAWN KY	JOB NO. EN03192	DWG NO. EN03192-1	REV 0
		CHK'D			
		SCALE 1/2"=1'-0"	DATE MAY 2003	SHEET 3 OF 3	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'03 2 5


'03 2 6


S LTD.
- 1080


400


BELLEMARE
MCKEIL
TEREX AMIDA