

**Table 2. Variability of Maximum Return Velocity Data**

Tow	Calculated Return Velocity*, m/sec	Maximum Measured Return Velocity Normalized to Speed of Tow #Queen C@ m/sec								
		M1001**	M1130	M1131	M999	M1000	M642	M332	M071	M834
A Randl	0.142	-	0.068	0.064	0.097	0.038	0.118	0.202	-	0.287
S Knight	0.148	0.072	-	-	0.065	0.085	0.158	0.134	-	-
J Neal	0.226	0.072	0.042	0.066	0.034	0.043	0.089	0.151	0.085	0.133
Hefing1	0.133	-	0.063	0.080	0.046	0.042	0.207	0.149	-	-
Queen C	0.175	0.057	0.054	0.068	-	0.159	0.138	0.160	-	0.246
Clem2	0.123	0.081	0.057	0.074	-	-	0.305	-	0.134	0.249
Conti K	0.185	0.067	0.063	0.067	0.071	-	0.173	0.073	0.143	0.157
Coop M	0.139	-	-	-	0.064	0.089	0.173	-	-	0.222
Hornet	0.157	0.076	-	0.072	-	0.077	0.109	0.202	0.086	0.197
K Mich	0.142	0.047	0.074	0.076	-	-	0.150	0.192	0.077	-
A Thom	0.137	-	0.101	0.127	-	-	0.160	-	0.130	0.104
Badger	0.200	0.055	0.047	0.064	0.056	0.052	0.083	0.143	0.140	0.137
Dell B	0.148	0.135	0.069	-	-	-	0.130	0.059	0.068	-
Mean		0.073	0.064	0.076	0.062	0.073	0.151	0.147	0.108	0.192
S		0.025	0.016	0.019	0.020	0.040	0.051	0.049	0.031	0.063
CV		0.349	0.257	0.245	0.325	0.550	0.339	0.335	0.291	0.328

\* return velocity calculated using Jansen and Schijf (1953)

\*\* Velocity meter having serial number 1001

**Table 3. WES UMRS Return Velocity and Drawdown Data**

Pool	Month	Rng	Tow Name	Total Area sq m	Area Left* sq m	Total WS m	WS dist left m	Barge Width m	Barge Length m	Draft m	Velocity to grnd m/s	average ambient m/s	dir	WAVE dist to LB LD m	prot total drawdown m	computed total drawdown m	Velocity dist to LB LD m	prot return velocity m/sec	computed return velocity m/sec
8	Nov	1	B05	2742	1667	516	330	32	297.3	2.7	2.2	0.61	u	1.6	0.049	0.047	--	--	-
8	Nov	3	B05	1891.8	859.1	425.5	198.8	32	297.3	2.7	2.5	0.71	u	1.6	0.098	0.073	--	--	-
8	Sept	1	B02	2017.9	1037.7	439	250	32	119	2.7	2.3	0.25	u	4	0.014	0.043**	-	--	-
8	Sept	1	B05	2017.9	980.2	439	189	32	237.8	2.7	3.4	0.25	d	4	0.056	0.063	--	--	-
8	Sept	3	B01	1459.7	604.5	414.6	188.4	32	297.3	2.7	1.9	0.31	u	1.2	0.038	0.045	--	--	-
8	Sept	3	B02	1459.7	604.5	414.6	188.4	32	119	2.7	2.3	0.31	u	1.2	0.048	0.058	--	--	-
8	Sept	3	B03	1459.7	855.2	414.6	226.2	32	297.3	2.7	2.2	0.31	d	1.2	0.021	0.029	--	--	-
8	Sept	3	B05	1459.7	855.2	414.6	226.2	32	237.8	2.7	2.9	0.31	d	1.2	0.062	0.052	--	--	-

\* channel area on port side of vessel centerline

\*\* outlier in MTE/MRE analysis defined as observed/calculated , <0.5 or >2.0.

**Table 3. Completed**

Pool	Month	Rng	Tow Name	Total Area sq m	Area Left* sq m	Total WS m	WS dist left m	Barge Width m	Barge Length m	Draft m	Velocity to grnd m/s	average ambient m/s	dir	WAVE dist to LB LD m	prot total drawdown m	computed total drawdown m	Velocity dist to LB LD m	prot return velocity m/sec	computed return velocity m/sec
LG	July	2	B02	634.1	329.3	155.2	75.1	16.5	162	2.7	3.3	0.49	u	4.5	0.30	0.25	4.5	0.575	0.50
LG	July	2	B04	634.1	304.8	155.2	80.1	32	118.9	2.7**	1.7	0.49	d	4.5	0.034	0.034	4.5	0.185	0.287
LG	July	2	B05	634.1	304.8	155.2	80.1	32	118.9	2.7**	2.8	0.49	d	4.5	0.16	0.121	4.5	0.31	0.45
LG	July	2	B06	634.1	329.3	155.2	75.1	16.5	162	2.7	2.8	0.49	u	4.5	0.162	0.14	4.5	0.357	0.33
LG	July	3	B02	651.9	351.3	157.5	68.1	16.5	162	2.7	3.3	0.48	u	4.5	0.34	0.22	4.5	0.558	0.45
LG	July	3	B05	651.9	300.6	157.5	89.4	32	118.9	2.7**	2.7	0.48	d	4.5	0.077	0.116	4.5	0.315	0.445
LG	July	3	B06	651.9	351.3	157.5	68.1	16.5	162	2.7	2.65	0.48	u	4.5	0.14	0.11	4.5	-	-
LG	July	4	B02	651.9	351.3	157.5	68.1	16.5	162	2.7	3.3	0.48	u	4.5	0.218	0.22	4.5	--	--
LG	July	4	B04	651.9	300.6	157.5	89.4	32	118.9	2.7**	1.7	0.48	d	4.5	0.040	0.033	4.5	--	--
LG	July	4	B05	651.9	300.6	157.5	89.4	32	118.9	2.7**	2.6	0.48	d	4.5	0.13	0.095	4.5	--	--
LG	July	4	B06	651.9	351.3	157.5	68.1	16.5	162	2.7	2.5	0.48	u	4.5	0.10	0.10	4.5	--	--
LG	July	5	B02	616.3	307.2	152.9	82.1	16.5	162	2.7	3.3	0.5	u	4.5	0.35	0.29	4.5	0.486	0.53
LG	July	5	B04	616.3	309.1	152.9	70.8	32	118.9	2.7**	1.7	0.5	d	4.5	0.046	0.037	4.5	-	-
LG	July	5	B06	616.3	307.2	152.9	82.1	16.5	162	2.7	2.5	0.5	u	4.5	0.148	0.12	4.5	0.274	0.28
LG	Sept	2	B02	604.9	298.8	150.9	70.5	32	297.3	2.6	2.0	0.4	u	4.5	0.248	0.17	4.5	0.65	0.57
LG	Sept	2	B03	604.9	298.8	150.9	70.5	32	297.3	2.7	1.6	0.4	u	4.5	0.162	0.124	4.5	0.63	0.49
LG	Sept	2	B04	604.9	298.8	150.9	70.5	32	297.3	2.7**	1.8	0.4	u	4.5	0.162	0.145	4.5	0.66	0.53
LG	Sept	2	B09	604.9	298.8	150.9	70.5	32	154	2.7**	2.3	0.4	u	4.5	0.21	0.23	4.5	0.60	0.68
LG	Sept	2	B10	604.9	306.1	150.9	80.4	21.4	115	1.3**	2.1	0.4	d	4.5	0.071	0.044	4.5	0.112	0.21
LG	Sept	2	B12	604.9	298.8	150.9	70.5	32	178	2.7**	2.1	0.4	u	4.5	0.077	0.074	4.5	--	--
LG	Sept	3	B02	602.5	325.5	141.3	76	32	297	2.6	2	0.38	u	1.3	0.12	0.19	4.5	0.558	0.66
LG	Sept	3	B03	602.5	325.5	141.3	76	32	297	2.7	1.45	0.38	u	1.3	0.155	0.12	4.5	0.571	0.51
LG	Sept	3	B04	602.5	325.5	141.3	76	32	297	2.7**	1.8	0.38	u	1.3	0.183	0.16	4.5	0.65	0.58
LG	Sept	3	B09	602.5	325.5	141.3	76	32	154	2.7**	2.2	0.38	u	1.3	0.181	0.21	4.5	0.496	0.67
LG	Sept	3	B10	602.5	277	141.3	65	21.4	115	2.7**	2.75	0.38	d	1.3	0.045	0.081	4.5	0.254	0.28
LG	Sept	3	B12	602.5	325.5	141.3	76	32	178	1.3**	2.1	0.38	u	1.3	0.106	0.080	4.5	0.31	0.25
LG	Sept	4	B02	602.5	325.5	141.3	76	32	297.3	2.6	2	0.38	u	1.3	0.049	0.17***	12.2	--	--
LG	Sept	4	B03	602.5	325.5	141.3	76	32	297.3	2.7	1.4	0.38	u	1.3	0.106	0.11	12.2	--	--
LG	Sept	4	B04	602.5	325.5	141.3	76	32	297.3	2.7**	1.7	0.38	u	1.3	0.167	0.14	12.2	--	--
LG	Sept	4	B09	602.5	325.5	141.3	76	32	154	2.7**	2.1	0.38	u	1.3	0.142	0.19	12.2	--	--
LG	Sept	4	B10	602.5	277	141.3	65.3	21.4	115	2.7**	3.4	0.38	d	1.3	0.064	0.14***	12.2	--	--
LG	Sept	4	B12	602.5	325.5	141.3	76	32	178.4	1.3**	1.7	0.38	u	1.3	0.055	0.058	12.2	--	--
LG	Sept	5	B02	607.2	272.1	160.4	64.9	32	297.3	2.6	2	0.41	u	4.5	0.055	0.16***	4.5	--	--
LG	Sept	5	B03	607.2	272.1	160.4	64.9	32	297.3	2.7	1.4	0.41	u	4.5	0.093	0.095	4.5	--	--
LG	Sept	5	B04	607.2	272.1	160.4	64.9	32	297.3	2.7**	1.7	0.41	u	4.5	0.15	0.125	4.5	0.31	0.46
LG	Sept	5	B09	607.2	272.1	160.4	64.9	32	154	2.7**	2.1	0.41	u	4.5	0.190	0.175	4.5	0.27	0.55***
LG	Sept	5	B10	607.2	335.1	160.4	95.5	21.4	115	2.7**	3.4	0.41	d	4.5	0.106	0.127	4.5	0.12	0.35***
LG	Sept	5	B12	607.2	272.1	160.4	64.9	32	178.4	1.3**	1.7	0.41	u	4.5	0.052	0.051	4.5	0.13	0.179

\* channel area on port side of vessel centerline

\*\* Tow with mixed loaded and unloaded barges

\*\*\* outlier in MTE/MRE analysis defined as observed/computed <0.5 or >2.0.

**Table 4. GIWW Drawdown and Return Velocity Data.**

<b>Tow Name</b>	<b>Area, m<sup>2</sup></b>	<b>Width m</b>	<b>Beam m</b>	<b>Length m</b>	<b>Draft m</b>	<b>Speed m/sec</b>	<b>Obs Draw, m</b>	<b>Comp Draw, m</b>	<b>Obs V<sub>r</sub>, m/sec</b>	<b>Comp V<sub>r</sub>, m/sec</b>
Norah	389	119	16.5	181	2.90	2.17	0.18	0.11	0.52	0.40
Expres	326	107	16.5	167	2.90	1.66	0.12	0.08	0.33	0.40
C Law	326	107	16.5	84	2.29	2.59	0.20	0.15	0.45	0.46
W Eag	326	107	12.2	150	2.44	2.37	0.13	0.09	0.29	0.31
Irene	326	107	16.0	81	2.75	1.63	0.11	0.07	0.38	0.34
Bill M	325	107	16.5	142	2.68	2.35	0.12	0.15	0.21	0.53

**Table 5. Observed Ship Squat and NAVEFF Maximum Water Level Drawdown**

Name of Vessel	Length m	Beam m	Lock Fore m	Draft Aft m	Observed Squat		VW m/sec	Computed Water Maximum Surface Drawdown		Total Area sq m
					Fore m	Aft m		Width m		
Carl Trautwein	155.18	20.91	7.65	7.71	0.46	0.46	3.53	0.60	105.18	814.71
Cape Breton Miner	207.93	22.41	7.53	7.68	0.43	0.37	3.02	0.41	105.18	814.71
Cate Brovig	159.45	20.30	7.56	7.59	0.37	0.43	3.18	0.40	105.18	814.71
Seaway Queen	218.60	21.52	7.50	7.50	0.27	0.21	2.68	0.30	105.18	814.71
Venus	178.96	21.80	7.77	7.71	0.43	0.37	3.09	0.43	105.18	814.71
Arrow	167.38	20.30	7.44	7.53	0.37	0.43	3.09	0.36	105.18	814.71
Linda	128.96	17.04	7.65	7.71	0.34	0.37	3.31	0.34	105.49	821.13
Venture	177.74	21.52	7.41	7.56	0.70	0.73	3.94	0.95*	105.49	821.13
Atlantic Duke	161.28	20.91	7.68	7.71	0.82	0.40	3.76	0.77*	105.18	814.71
Anna Katrin Fritzen	162.20	20.61	7.68	7.71	0.49	0.34	3.44	0.54	105.18	814.71
Silverweir	152.44	20.03	7.68	7.56	0.49	0.30	3.49	0.52	105.18	811.46
Inverewe	159.76	20.61	7.26	7.47	0.73	0.85	3.85	0.74*	105.18	814.71
Skrim	150.00	18.23	7.65	7.56	0.46	0.27	3.44	0.42	105.18	814.71
Scott Misener	208.84	21.52	7.01	7.10	0.52	0.43	3.27	0.42	105.49	821.13
Umberto D'Amato	132.32	18.23	7.71	7.71	0.30	0.18	3.04	0.31	106.10	833.95
Arna	155.79	19.73	7.74	7.62	0.27	0.09	2.68	0.27	106.10	833.95
Polarglimt	149.39	19.12	7.74	7.71	0.34	0.15	2.92	0.30	106.10	833.95
Argo Navis	152.74	19.12	7.56	7.53	0.46	0.58	3.44	0.45	106.10	833.95
Ilice	160.67	20.61	7.68	7.71	0.64	0.52	3.71	0.70*	105.49	817.97
Bernd Leonhardt	147.87	18.23	7.77	7.77	0.24	0.18	3.18	0.36	104.88	800.21
Silver Isle	222.56	22.41	7.68	7.68	0.00	0.40	3.35	0.62	104.88	800.21
Menihok Lake	217.99	22.41	7.59	7.68	0.55	0.40	3.04	0.43	105.18	808.21
Beltana	152.44	19.73	5.40	5.55	0.58	0.49	4.29	0.63	104.88	800.21
Lake Winnipeg	222.56	22.41	7.65	7.71	0.30	0.27	2.41	0.27	104.88	800.21
Seaway Queen	218.60	21.52	7.70	7.71	0.27	0.27	2.55	0.29	104.88	800.21
Lawrencecliffe Hall	222.56	22.41	7.74	7.68	0.21	0.21	2.66	0.33	104.88	800.21
Morvang	157.93	19.12	7.77	7.77	0.49	0.34	3.53	0.54	104.88	800.21
La Loma	150.61	18.81	7.65	7.62	0.49	0.21	3.04	0.33	104.88	800.21
Saguenay	222.56	22.41	7.65	7.74	0.37	0.30	2.77	0.34	105.18	809.88
Hera	123.48	17.93	7.13	7.04	0.52	0.40	3.80	0.51	105.18	809.88
Holthill	148.48	18.54	7.68	7.68	0.30	0.15	2.91	0.30	105.18	809.88
Quebecois	222.56	22.56	7.59	7.68	0.21	0.15	2.01	0.19	105.49	824.29
Ontario Power	217.07	22.41	7.71	7.68	0.49	0.43	3.09	0.44	105.49	824.29
Wheat King	169.82	21.80	7.68	7.74	0.64	0.40	3.49	0.60	105.79	830.98
Lawrencecliffe Hall	222.56	22.71	7.71	7.77	0.37	0.24	2.77	0.34	105.79	827.54
White River	166.46	20.61	7.62	7.65	0.46	0.34	3.45	0.51	105.79	830.98
Scott Misener	208.84	21.52	7.68	7.65	0.46	0.46	3.27	0.48	105.49	821.13
Cape Breton Miner	207.93	22.41	7.56	7.71	0.52	0.70	3.35	0.57	105.49	821.13
Philip R. Clarke	197.26	20.91	7.50	7.62	0.43	0.30	3.31	0.45	106.10	837.21
Atlantic Duke	161.28	20.91	7.71	7.77	0.37	0.24	2.73	0.30	106.10	837.21
Eshkol	135.37	17.32	6.10	6.16	0.61	0.61	4.60	0.73*	106.10	837.21
Quebecois	222.56	22.56	7.50	7.71	0.24	0.15	2.15	0.21	106.10	833.95
Guido Donegauri	165.55	20.61	7.71	7.71	0.34	0.30	2.73	0.29	106.10	833.95
Montrealais	222.56	22.56	7.62	7.71	0.49	0.43	3.27	0.51	106.10	838.88
Patignies	182.93	22.56	7.68	7.71	0.46	0.58	3.22	0.48	106.10	838.88
Capetan Costis I	156.10	17.32	7.71	7.71	0.21	0.12	2.28	0.17	106.40	848.55
Ferder	151.22	20.91	7.65	7.68	0.43	0.34	3.31	0.44	106.40	848.55
Quebecois	222.56	22.56	7.53	7.68	0.27	0.12	2.50	0.26	107.62	879.50
Forward	134.76	17.04	7.68	7.77	0.21	0.27	3.40	0.34	107.01	863.23
Jarosa	186.59	22.41	7.68	7.62	0.37	0.37	3.13	0.41	107.01	863.23
Don De Dieu	222.56	22.56	7.71	7.71	0.30	0.30	2.33	0.23	107.01	866.49
Silver Isle	222.56	22.41	7.29	7.38	0.52	0.40	3.53	0.59	106.40	843.71
Silver Sea	160.98	20.61	7.71	7.71	0.30	0.24	3.44	0.50	106.40	843.71
Oriental Clipper	174.09	22.41	7.62	7.59	0.40	0.30	3.13	0.42	106.40	843.71

\* Velocity > 90% of the limiting speed

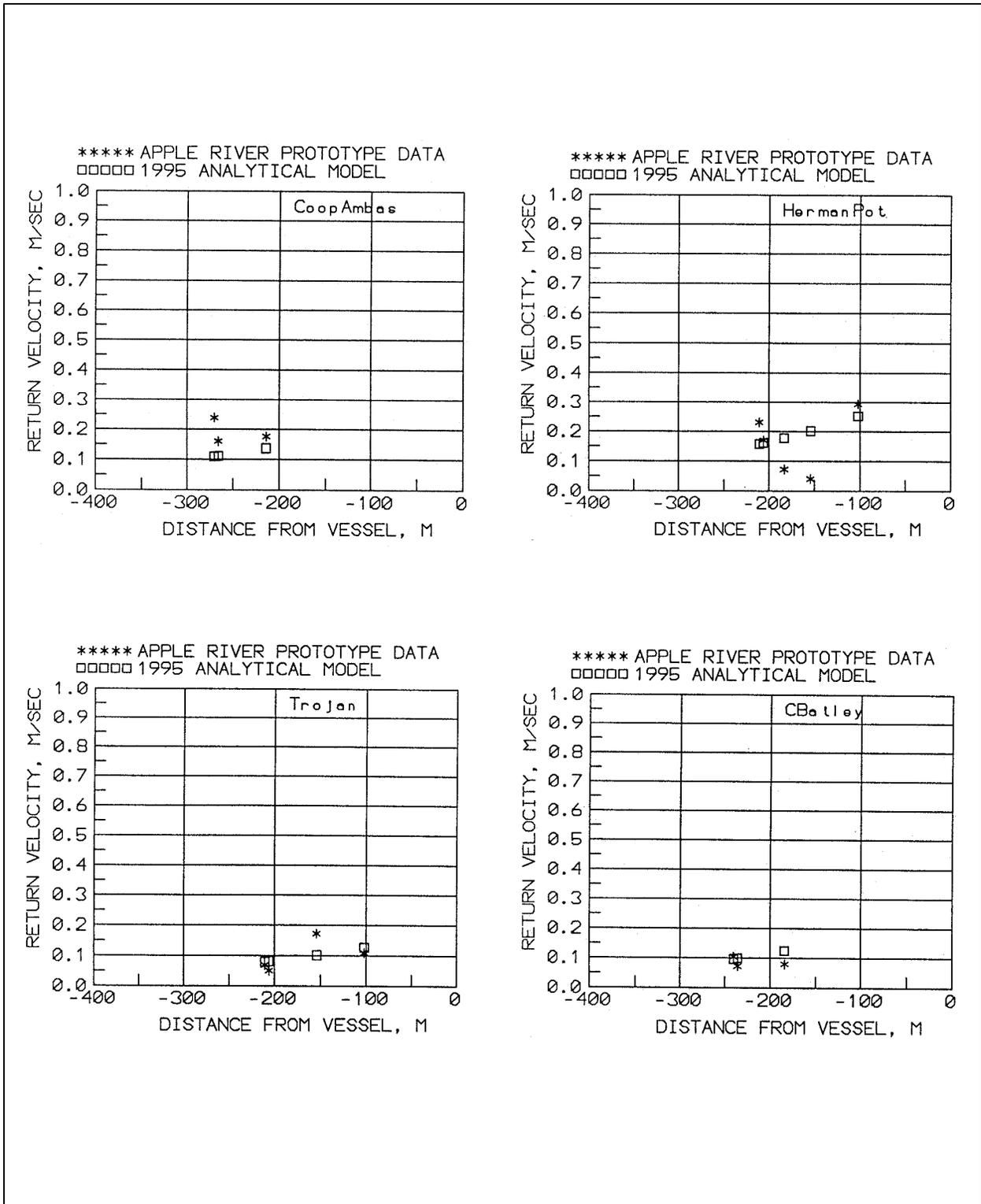


Figure 1. Observed versus computed return velocity at Apple River Island for Coop Ambassador, Herrman Pott, Trojan, and Christine Bailey

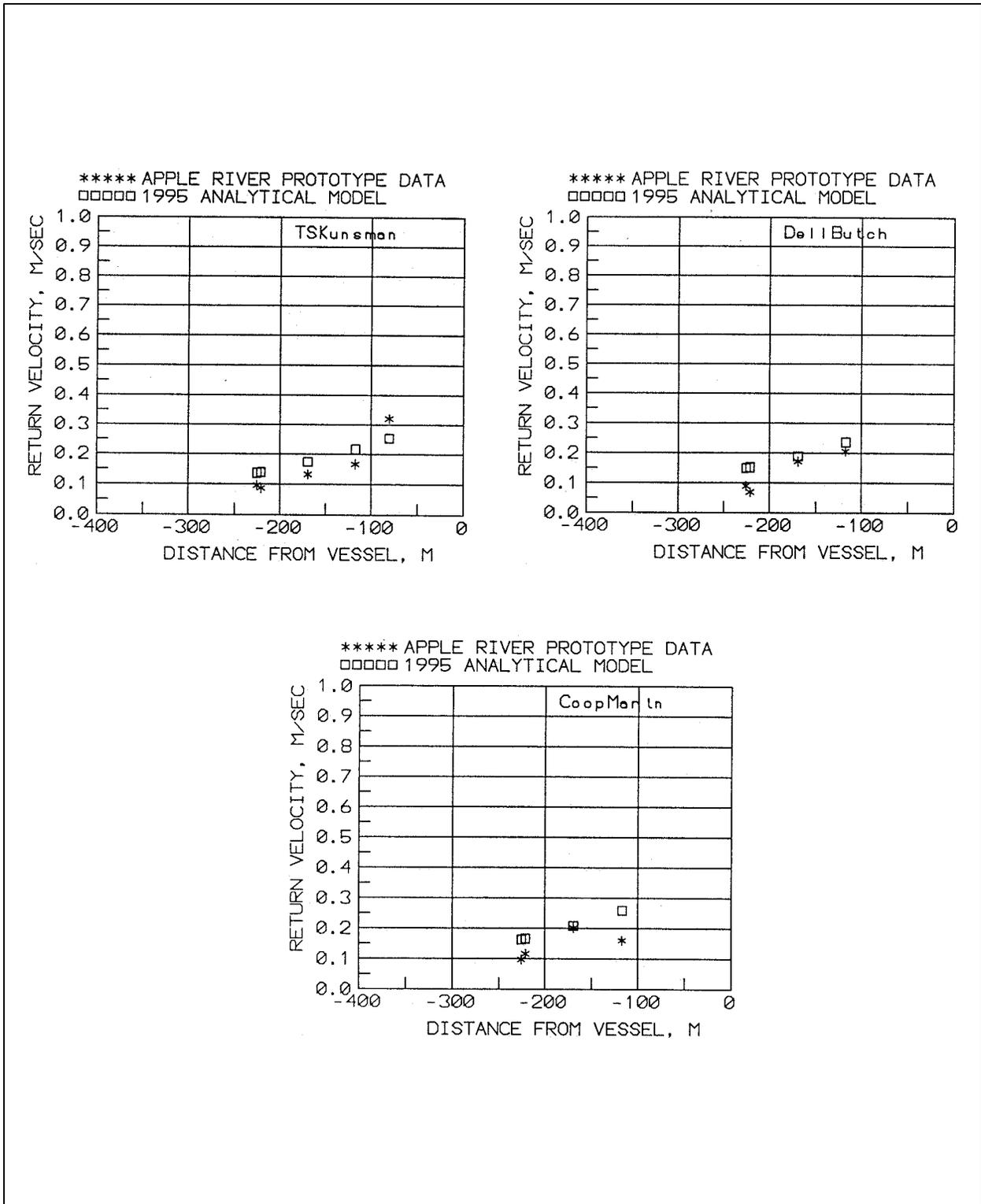


Figure 2. Observed versus computed return velocity at Apple River Island for T. S. Kunsman, Dell Butcher, and Coop Mariner

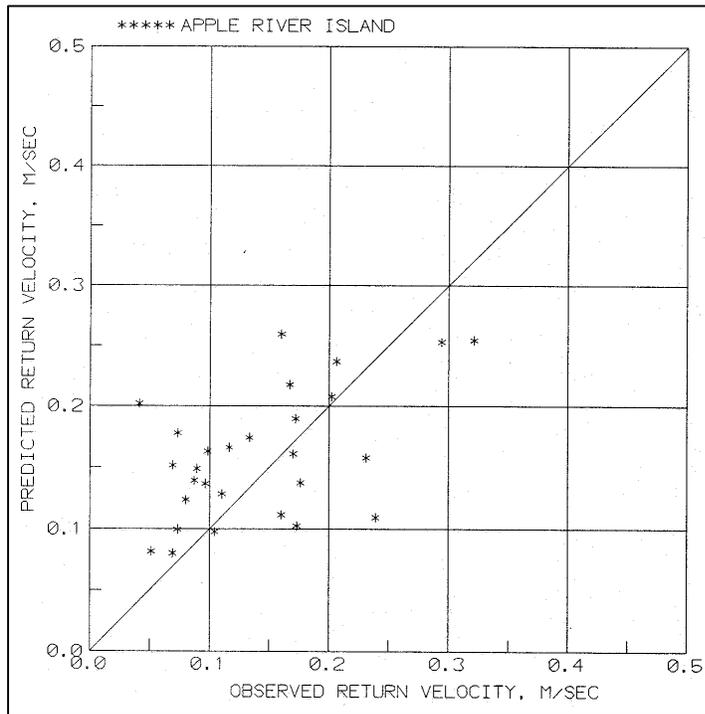


Figure 3. Observed versus computed return velocity at Apple River Island for all data

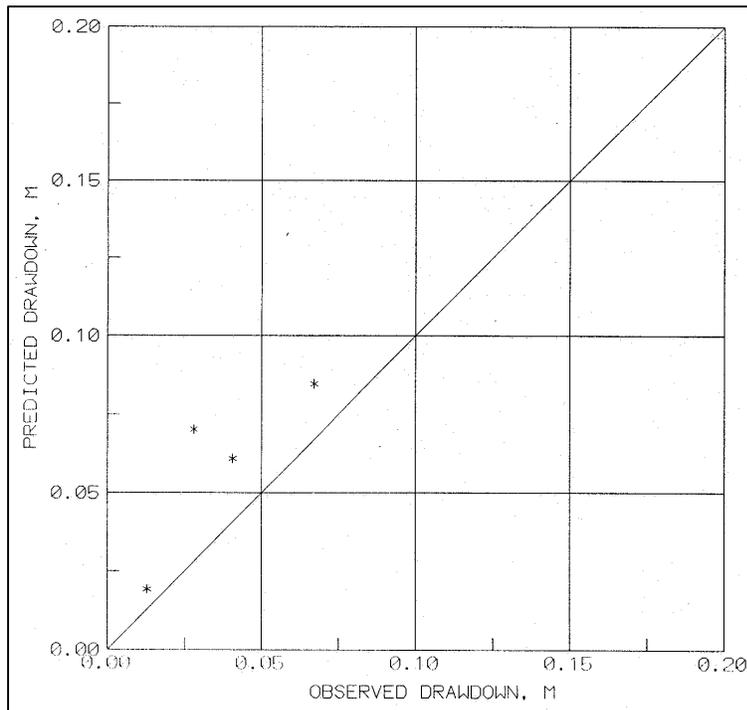


Figure 4. Observed versus computed drawdown at Apple River Island for all data

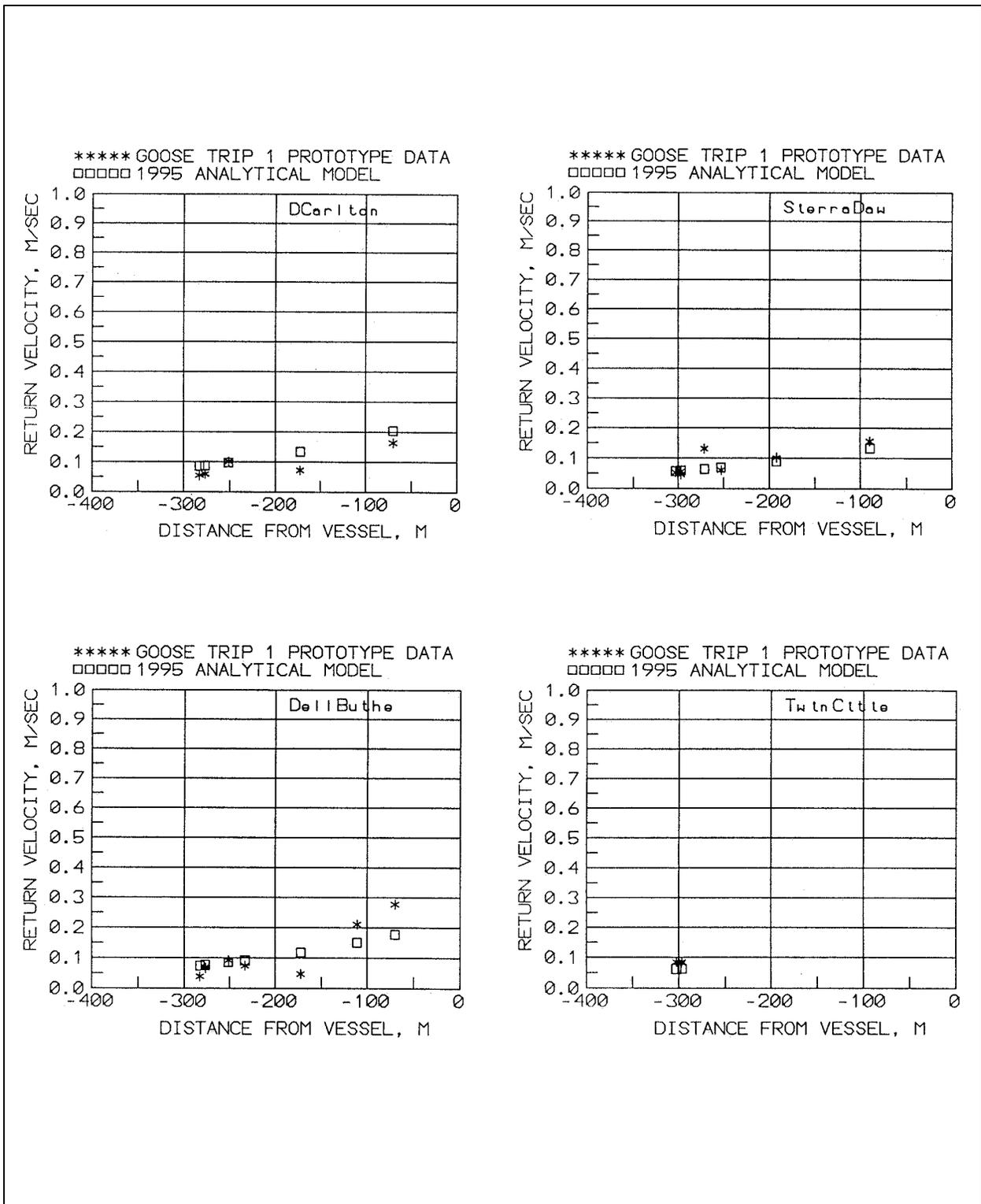


Figure 5. Observed versus computed return velocity at Goose Island Trip 1 for Dare Carlton, Sierra Dawn, Dell Butcher, and Twin City

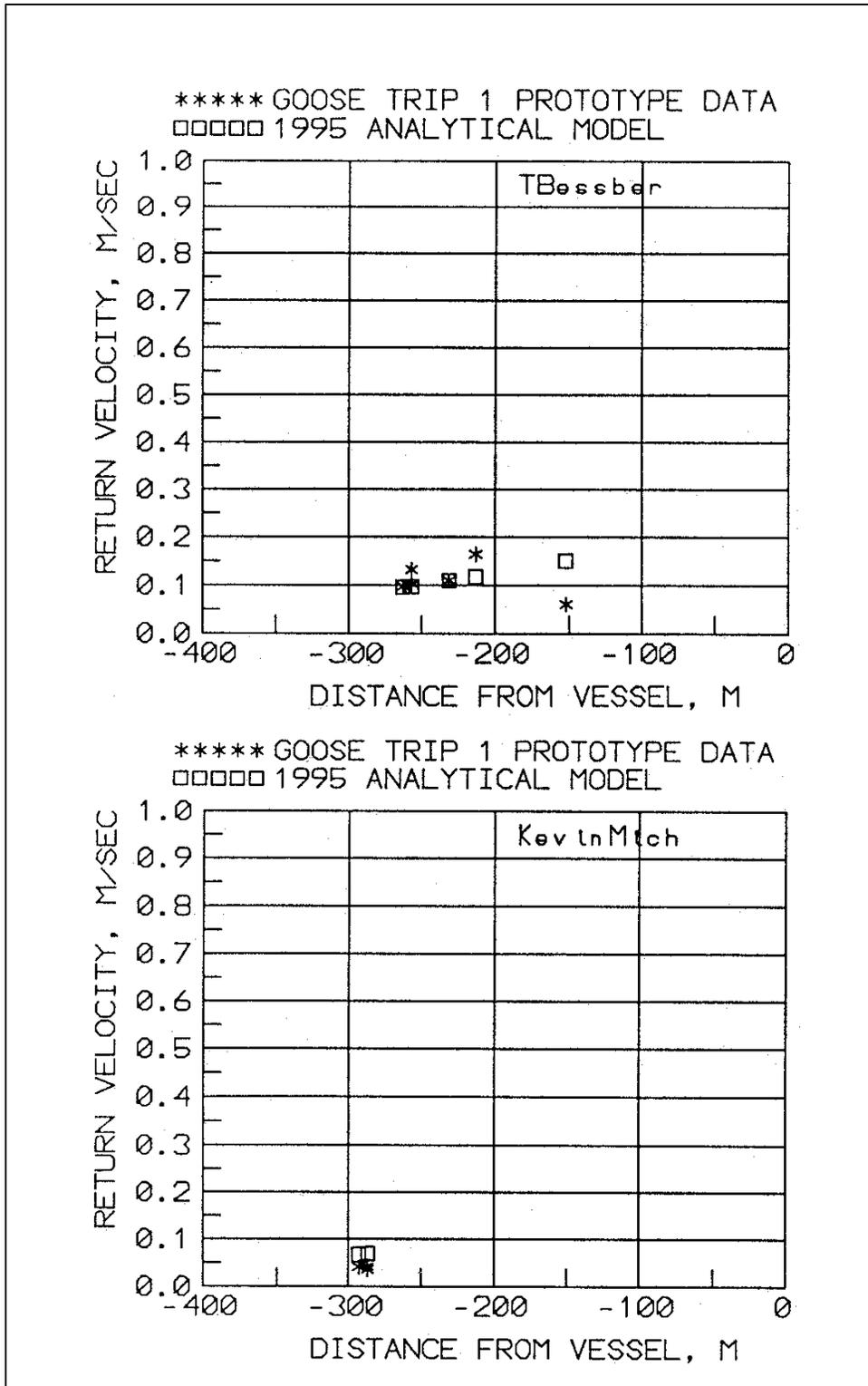


Figure 6. Observed versus computed return velocity at Goose Island Trip 1 for T. R. Beesber and Kevin Michael

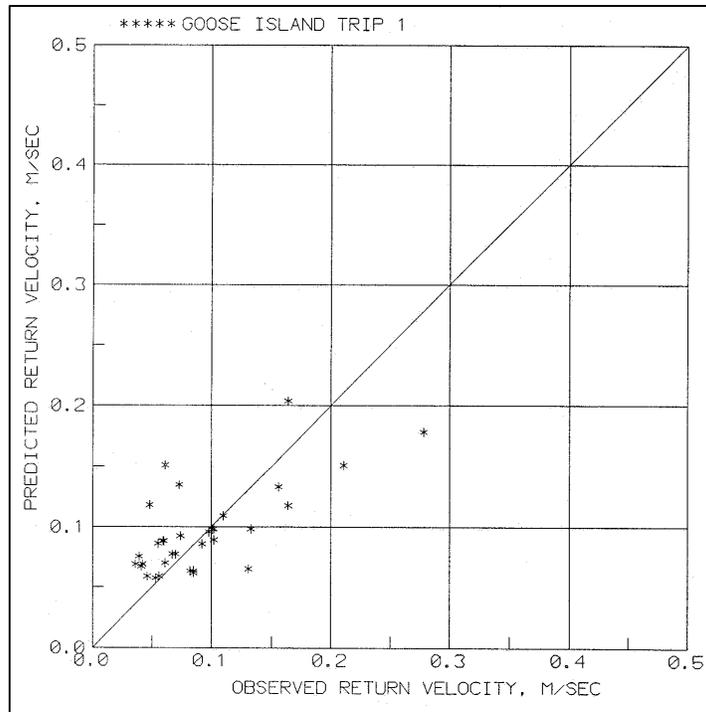


Figure 7. Observed versus computed return velocity at Goose Island Trip 1 for all data

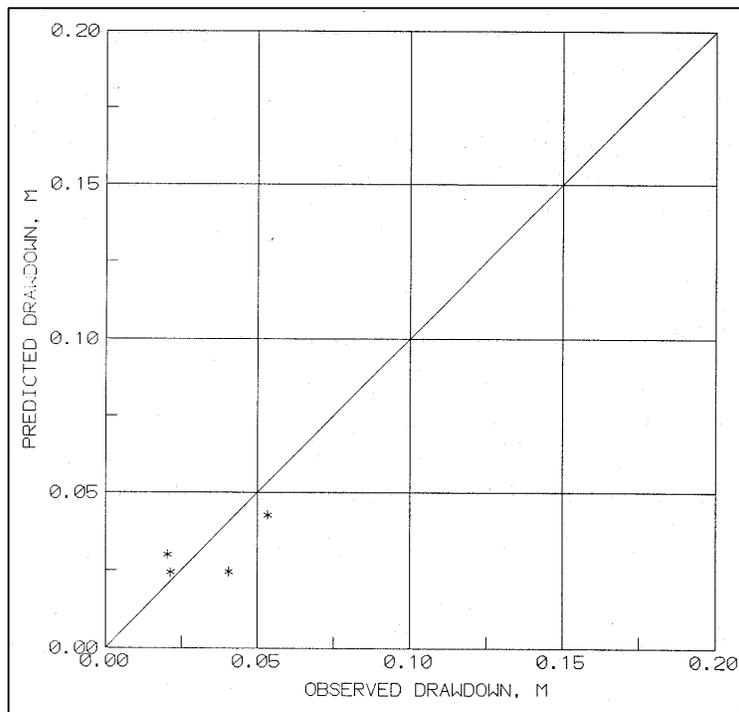


Figure 8. Observed versus computed drawdown at Goose Island Trip 1 for all data

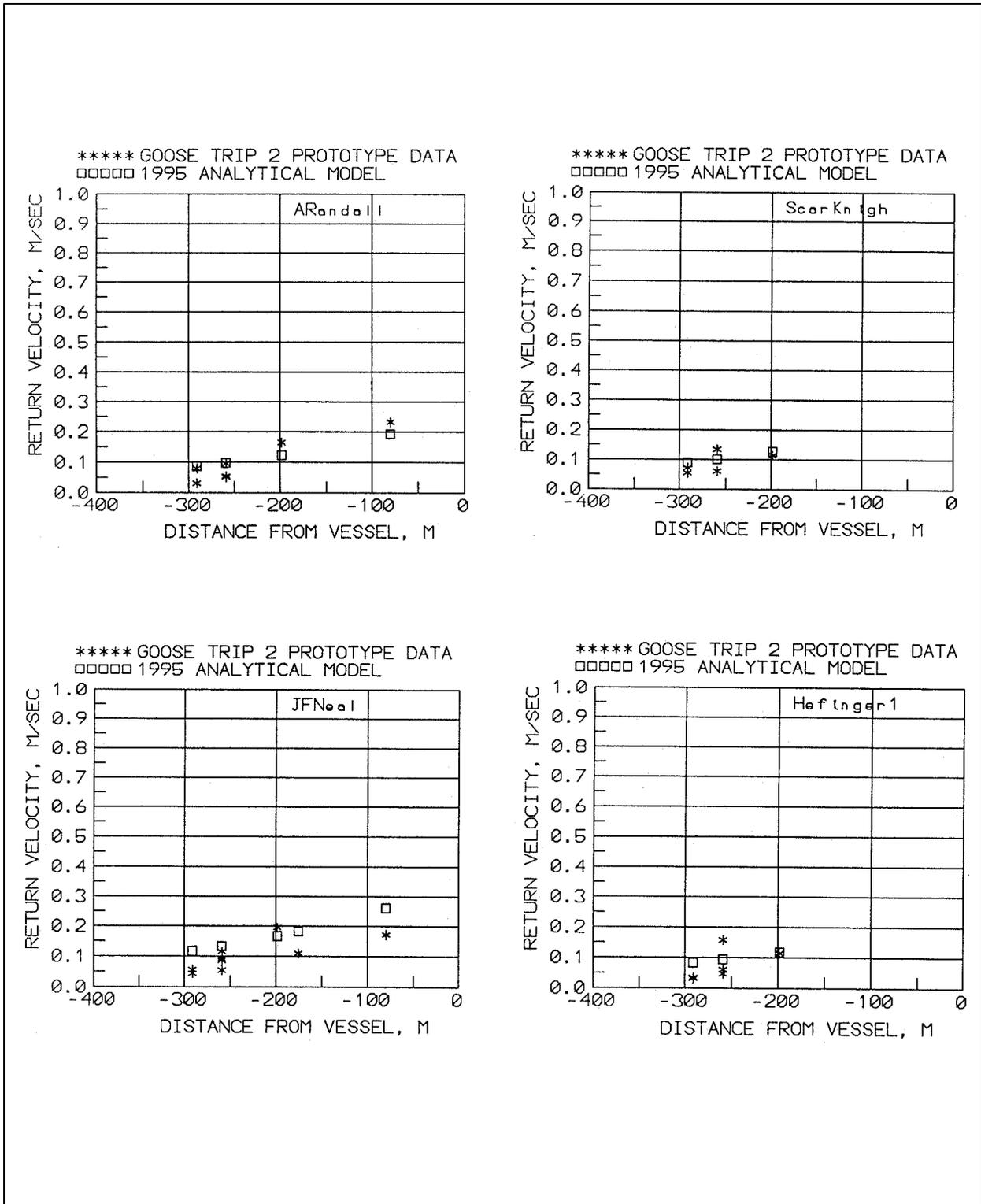


Figure 9. Observed versus computed return velocity at Goose Island Trip 2 for Ardyce Randall, Scarlet Knight, James F. Neal, and Frank T. Heffelfinger

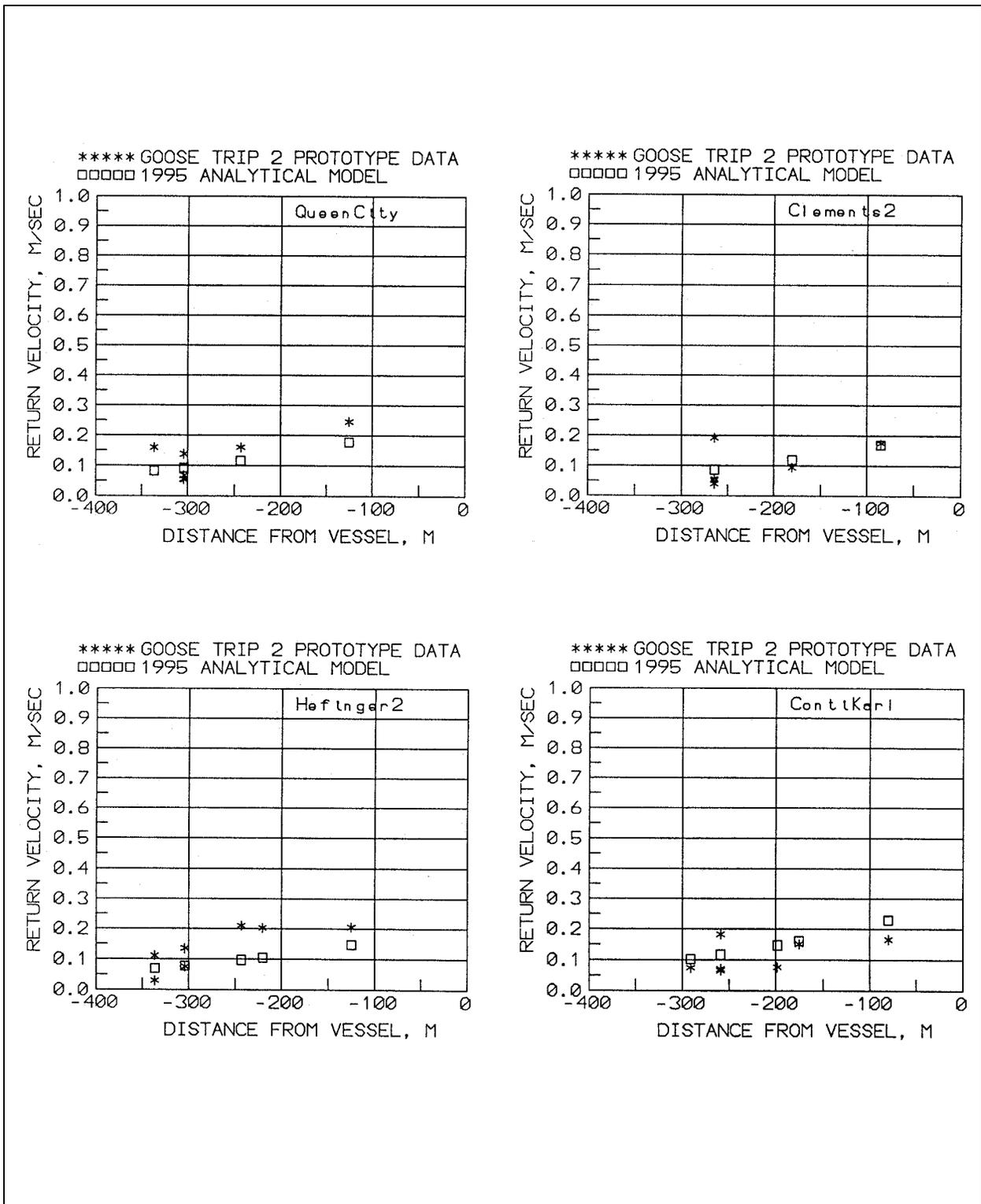


Figure 10. Observed versus computed return velocity at Goose Island Trip 2 for Queen City, Helen M. Clements (2), Frank T. Hefflinger (2), and Conti-Karla