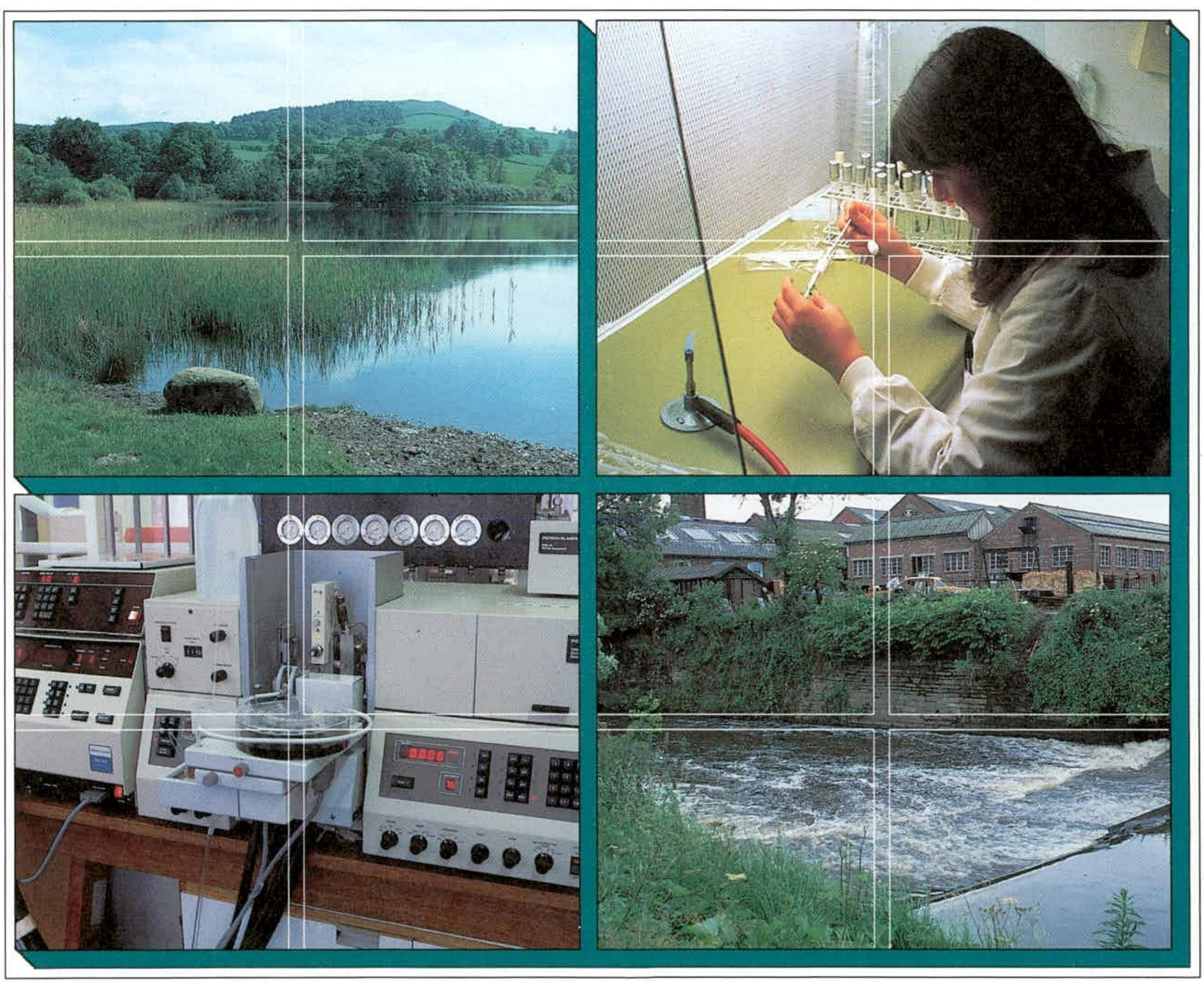
RL

Institute of Freshwater Ecology

Tidal water heights at Bunny Meadows salt marsh, River Hamble, Warsash, Hampshire

F.H. Dawson, PhD MIWEM CBiol FIBiol
P. Henville



Natural Environment Research Council

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Project leader:	F.H.Dawson
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CONTENTS

SUMMARY

Sea water levels were monitored inside and outside the sea wall separating the salt marsh from the estuary during summer and autumn 1992.

The culvert restricted the water flow to the salt marsh and mud flat and reduced the tidal range by about a half inside the sea wall but this varied a little between spring and neap tides The upper limit was reduced by about 0.6 m on average whereas the lower limit was restricted by the level of the bed of the culvert.

Complex variation and interactions were monitored for other environmental variables in the water supplying and draining the mud flats such as daytime heating and nighttime cooling of the water, possible variations in oxygen related to irradiance, variations in optical density and small changes conductivity. Further analysis could be undertaken of such data or tidal water heights could be corrected to standard pressure.

1. INTRODUCTION

1.1 Background

Concern has been expressed about the possible extent of changes in the vegetation resulting from the construction of tidal barrages on estuaries. Such changes could include invasion or decline of vegetated areas with the associated direct effects on mud deposition or erosion but also consequential effects on biota such as feeding areas for wading birds. Such effects are thought likely to occur as a result of the asymmetrical changes to the tidal cycle primarily within the barrage in order to optimise power generation.

A site was identified on the River Hamble at Bunny Meadows, Warsash, during a survey of the Solent Estuary, which had the criteria both of typical vegetation and an altered tidal inundation regime (Appendix 2.). Sea water exchange was modified by construction of a bank to reclaim this area. The bank was breached, probably during the 1939-45 war, and reinstated in the mid 1980's with four openings of three single and one double culverts of 1.9 m wide by 1.5 m high, set approximately about the middle of the mean sea water level. A public path lies on top of the reinstated bank.

Vegetation has probably changed with a general decrease in *Spartina townsendii* more recently although there is a relatively large stand of *Phragmites australis* to the south-eastern end of the area; there is no discrete freshwater inflow in this area. *S. townsendii* may have extended it range down the tidal range but there is a general erosion mud from the flats to the channels (excavated?) and they are being filled except near the culverts where high erosive velocities and considerable scouring of bed and banks occur. There is no bed or bank protection near the culverts either to the seaward or marshward side except at one site where a incomplete low dam with little power dissipation and the absence of castellations, has been constructed.

1.2 Objective

Continuous monitoring of seawater level inside the wall to allow water depth or inundation and exposure, to be deduced for the salt marsh. Water temperature and water turbidity together with light intensity were also measured in part to allow for correction of the effects of variation in temperature of the height sensor and in part to give the opportunity for a fuller picture of the changes that occur during a lunar tidal cycle in a salt marsh. Seawater conductivity and dissolved oxygen changes were also measured for a short period.

2. METHODS

2.1 Monitoring of seawater level.

Levels were monitored using a multi-channel computerized field data collection system installed in agreement with Alan Grey of The Institute of Terrestrial Ecology, Furzebrook, at the northernmost culvert; in addition an extra sensor was installed to the seaward side of this culvert. The data collection system (Convertor 6) was fitted with sensors for water level, water temperature(using a thermistor mounted in a dissolved oxygen sensor, water turbidity.

Water depth was recorded using strain gauge pressure transducers (Sandhurst Scientific Instrument Company) mounted firmly just below the culvert level inside the wall and below mean low water springs to the seaward side of the wall. The transducer measures gauge pressure in the form of differential pressure using atmospheric pressure as a reference. This is achieved by venting the rear of the sensor through a tube within the cable. The sensors were calibrated in a 4 m water column in the laboratory before use and on return (Appendix 1). Water levels were corrected to Chart Datum using data supplied by Alan Gray. Barometric pressure was measured using a sealed differential pressure transducer (Penny & Giles D5148/8) with a range of 950 - 1050 mb, powered by a standard voltage reference cell.

The water turbidity and water temperature/dissolved oxygen sensors were suspended in a shallow pool excavated within 3 m of the culvert and at a depth to ensure they were always covered with water. The temperature was measured using a Mackereth-type oxygen sensor.

Water turbidity (expressed as optical density; the logarithm of the ratio of the intensity of incident to transmitted light) was measured using single gap turbidity sensors operating in the infra red region so as to reduce problems associated with algal fouling of optical surfaces.

Mean surface irradiance was measured in an unshaded area using energy irradiance sensors (Skye Instruments).

1.2 Site visits

Periodic site visits were made to download data from the micro-computer and the following tasks were performed when visiting the monitoring sites:

1) Water level was recorded from the monitoring system and compared to that measured to the top edge of the north side of the culvert from the water surface

2) Any extraneous matter, eg. floating aquatic weed, was removed from the sensors and their surfaces carefully cleaned using a damp tissue or soft clean cloth.

3) Batteries were replaced by fully charged ones and recorded data downloaded to a portable computer for processing at the laboratory (Appendix 3.).

4) Any relevant environmental observations were recorded.

3. RESULTS

Sea water levels were monitored on the inside of the sea wall separating the salt marsh from the estuary during periods from June to November (Figure 1), but only outside the sea wall during June. Repeated attempts to monitor sea water levels failed due to damage to sensors and to cables; more substantial sensors and supports would be need to be installed if records were to be made in the future.

Comparison of water levels inside and outside the sea wall show that the tidal range was reduced by about a half inside the sea wall but this varied a little between spring and neap tides (Figure 2). The upper limit was reduced by about 0.6 m on average because the culvert restricted the water flow to the large open areas of mudflat inside the wall which failed to fill before the tide ebbed outside the wall (figure 3). The reverse situation occurred to some extent but the lower limit was restricted by the level of the bed of the culvert (Figure 4).

Complex variation and interactions were monitored between water level and other environmental variables which could be investigated further (Figure 5). Interaction noted in the water supplying and draining the mud flats at Bunny Meadows during several tidal cycles in June 1992 included:

1. daytime heating and nighttime cooling of the water depending upon the tidal cycle relative to the time of day or night
2. probable variation in oxygen (or local effects in the water surrounding the sensor)
3. correlation of 'oxygen' effect with irradiance
4. extreme and variable ranges of optical density
5. small but significant variation in conductivity.

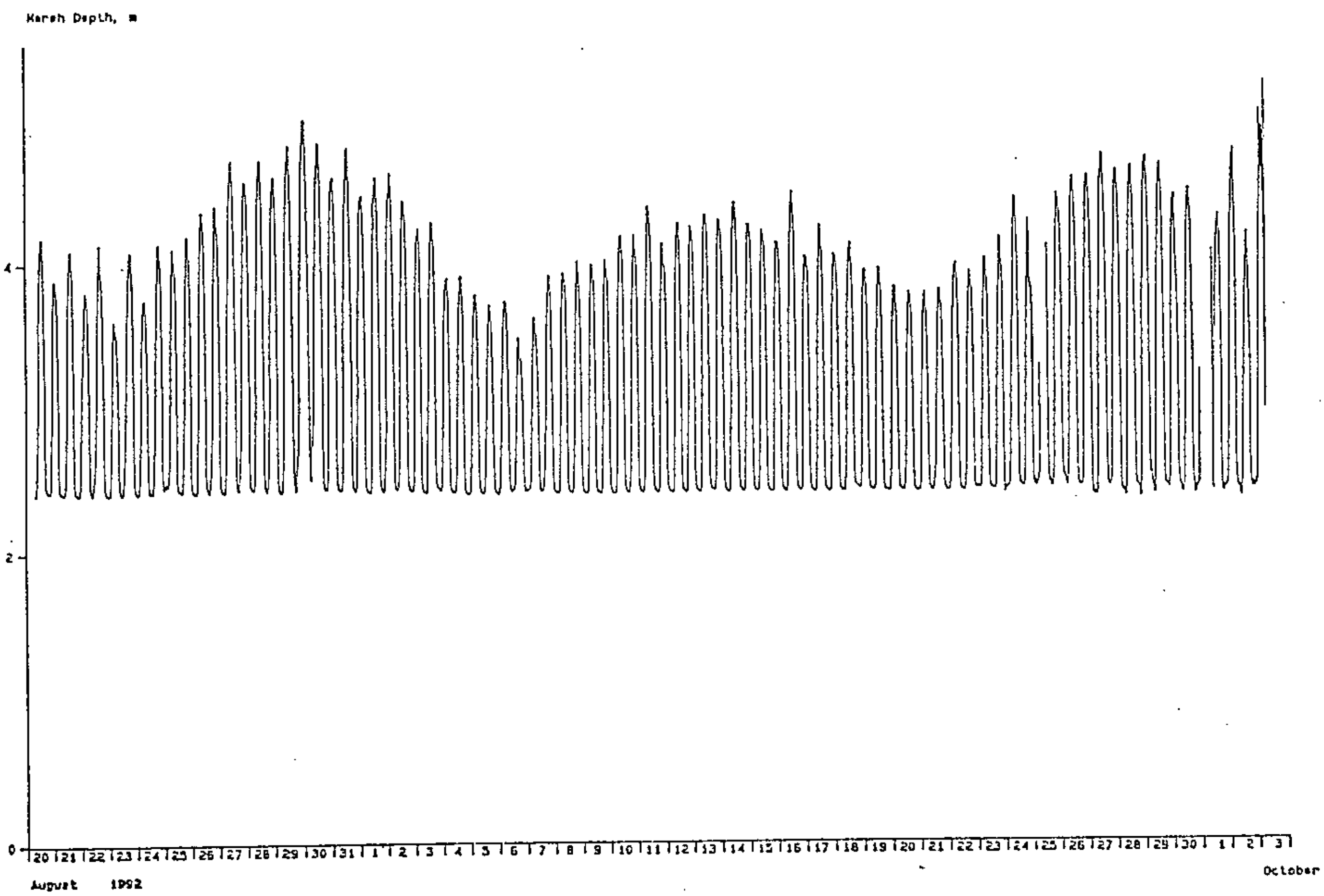


Figure 1. Water levels, corrected to Chart Datum, on the salt marsh side of the wall at Bunny Meadows, Warsash, on the River Hamble, from late August to early October during several tidal cycles.

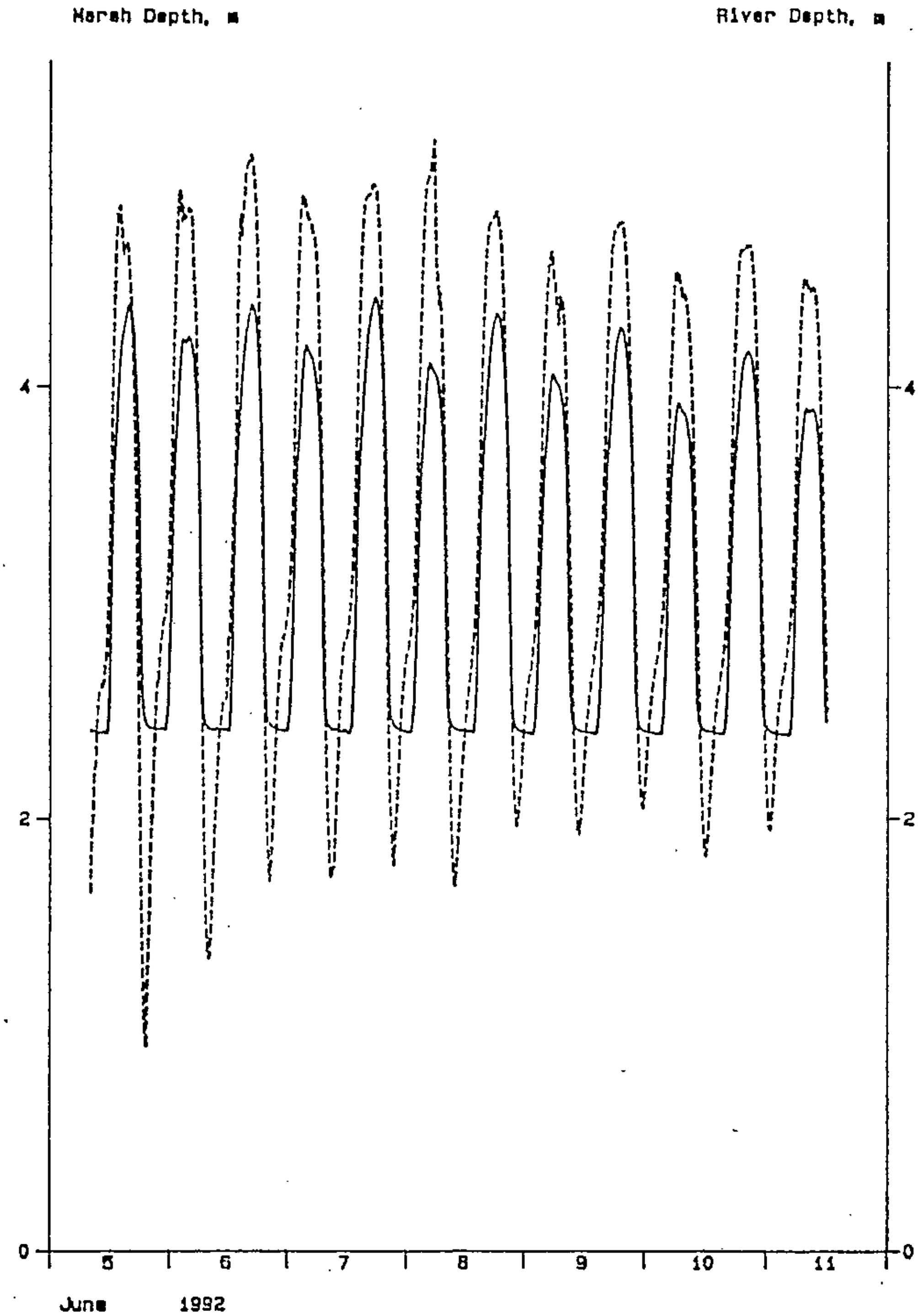


Figure 2. Comparison of water levels corrected to Chart Datum, on the salt marsh side (solid line) and on the estuary side of the sea wall on the River Hamble, Bunny Meadows, Warsash, from spring to neap tides during June 1992.

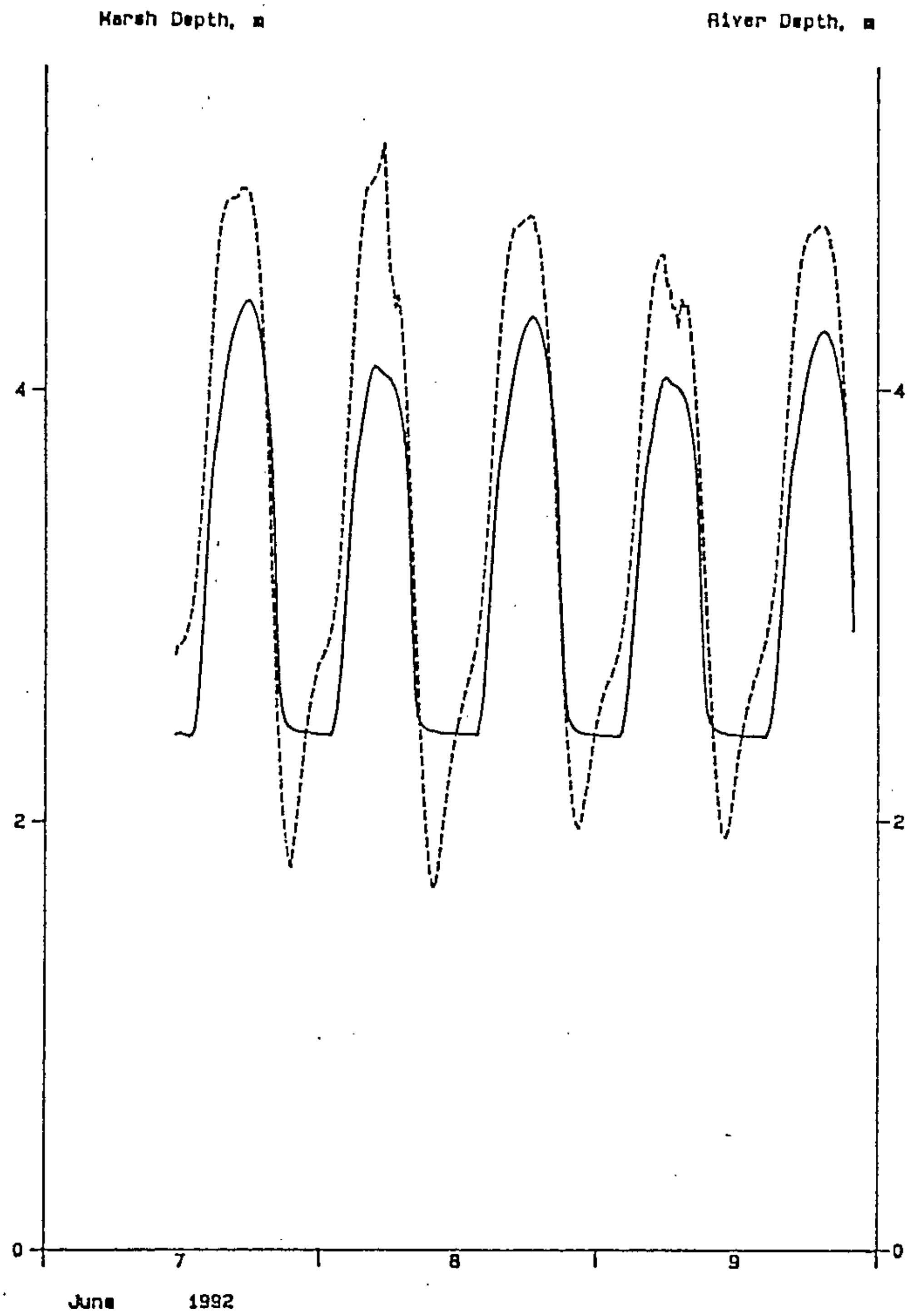


Figure 3. Detail of comparison of water levels, corrected to Chart Datum, on the salt marsh side (solid line) and on the estuary side of the sea wall on the River Hamble, Bunny Meadows, Warsash, near the neap tides during June 1992.

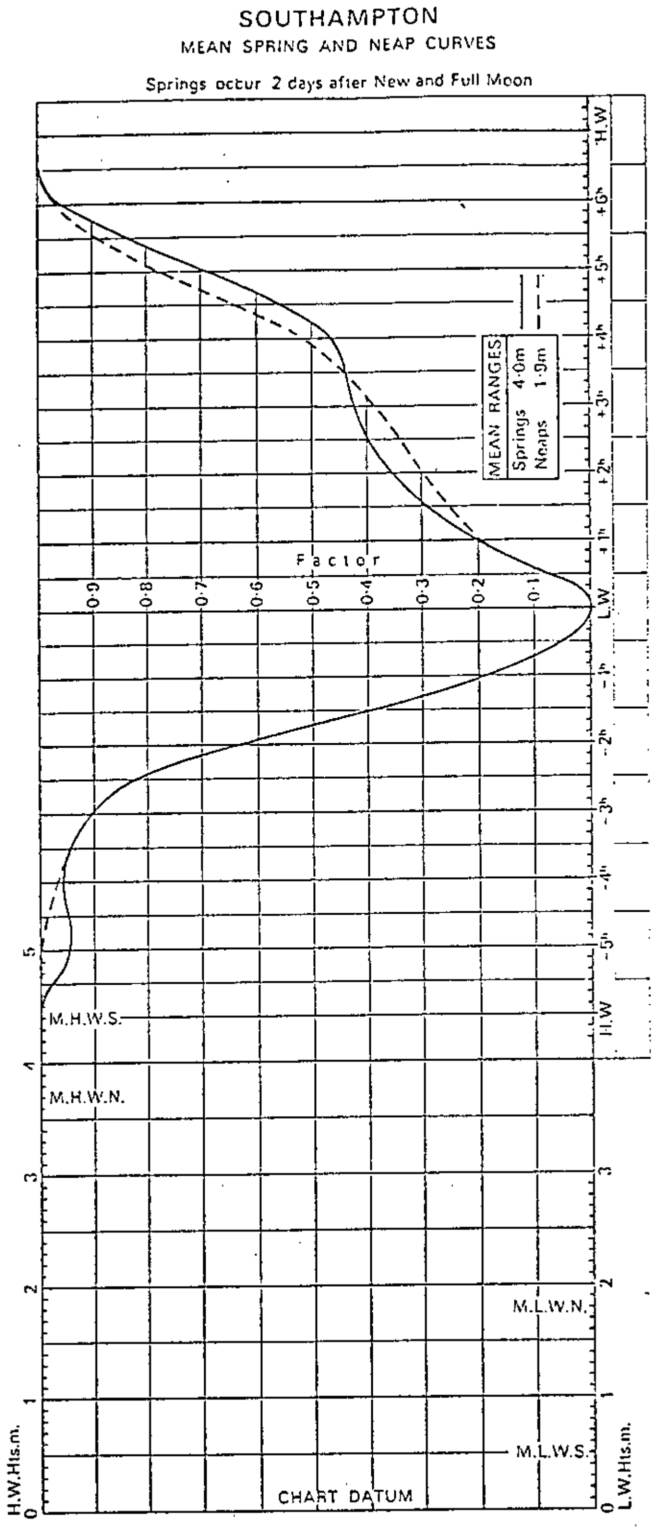


Figure 4. Spring and neap water level standard curves for Southampton (from Practical Boat Owner Cruising Almanac for 1992, data from Admiralty Tide Tables).

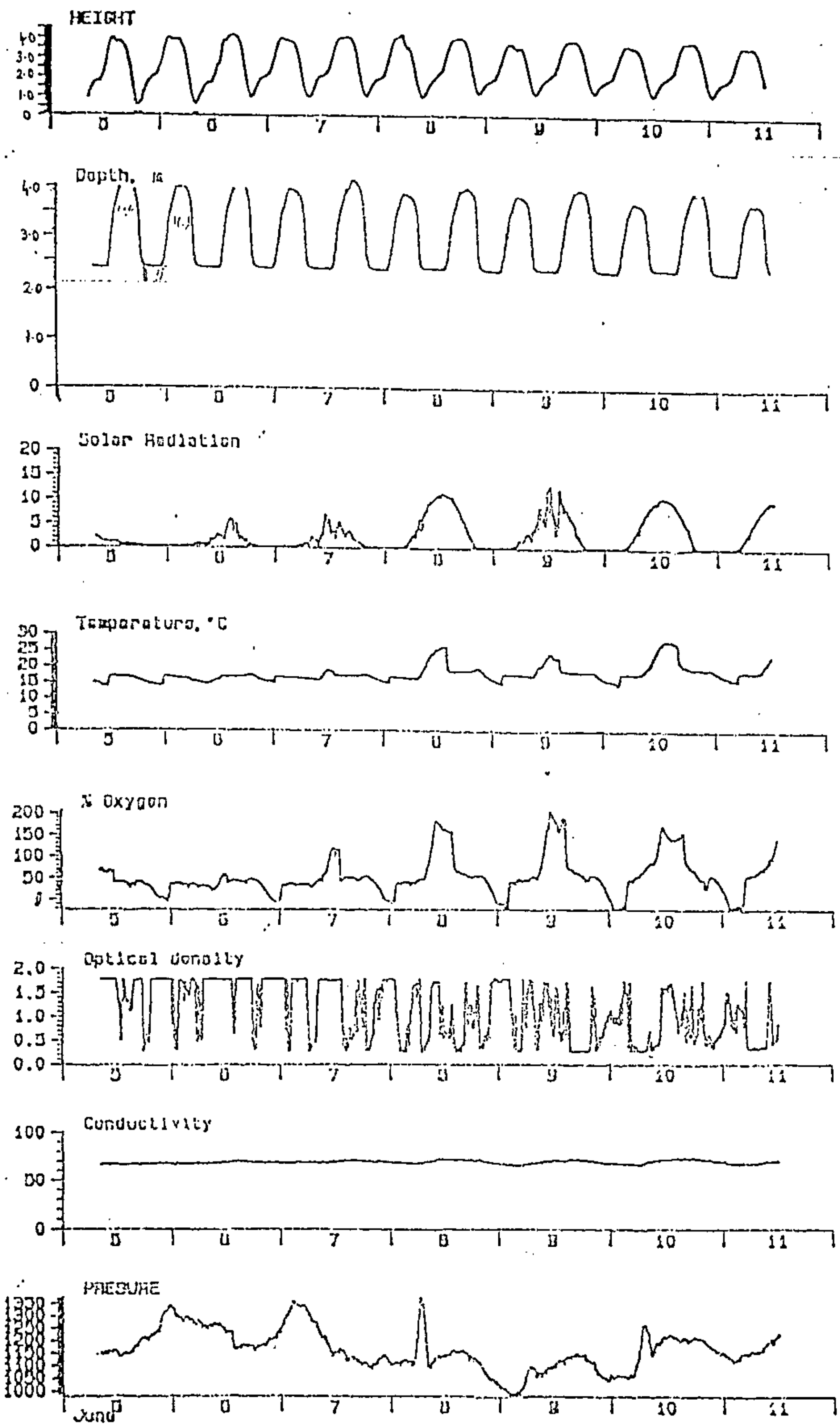


Figure 5. Variation in environmental variables of water supplying and draining Bunny Meadows, Warsash, on the River Hamble, during several tidal cycles, June 1992 .

4. ACKNOWLEDGEMENTS

Thanks are due to Richard Levett, area warden (office 0329-662145, home 0489-582503) and to Barry Duffin, both of Hampshire County Council (0329-662145); to the Harbour Master Capt. C.J. Nicholl (0489-576387 for arranging vehicle access for transport of the monitoring equipment to the northern end of the Bunny Meadows;

APPENDICES

APPENDIX 1 Water depth calibration.

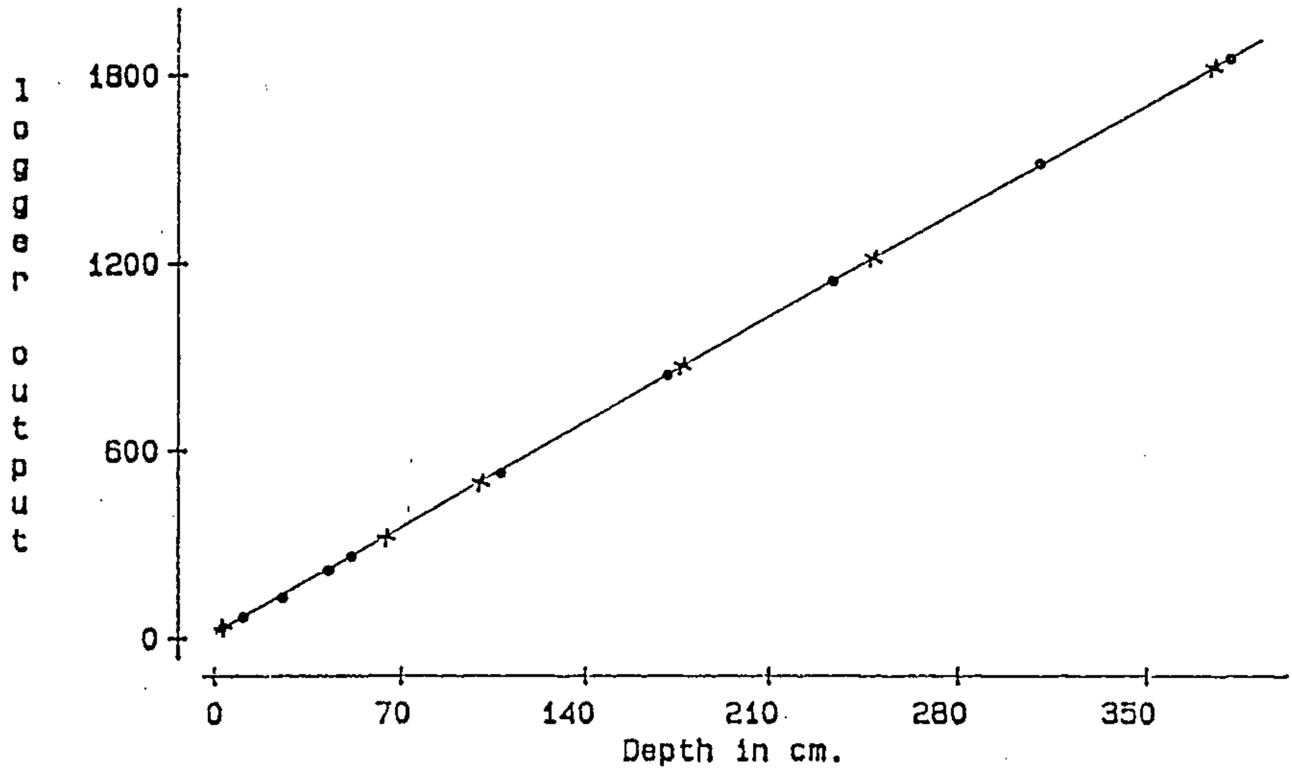
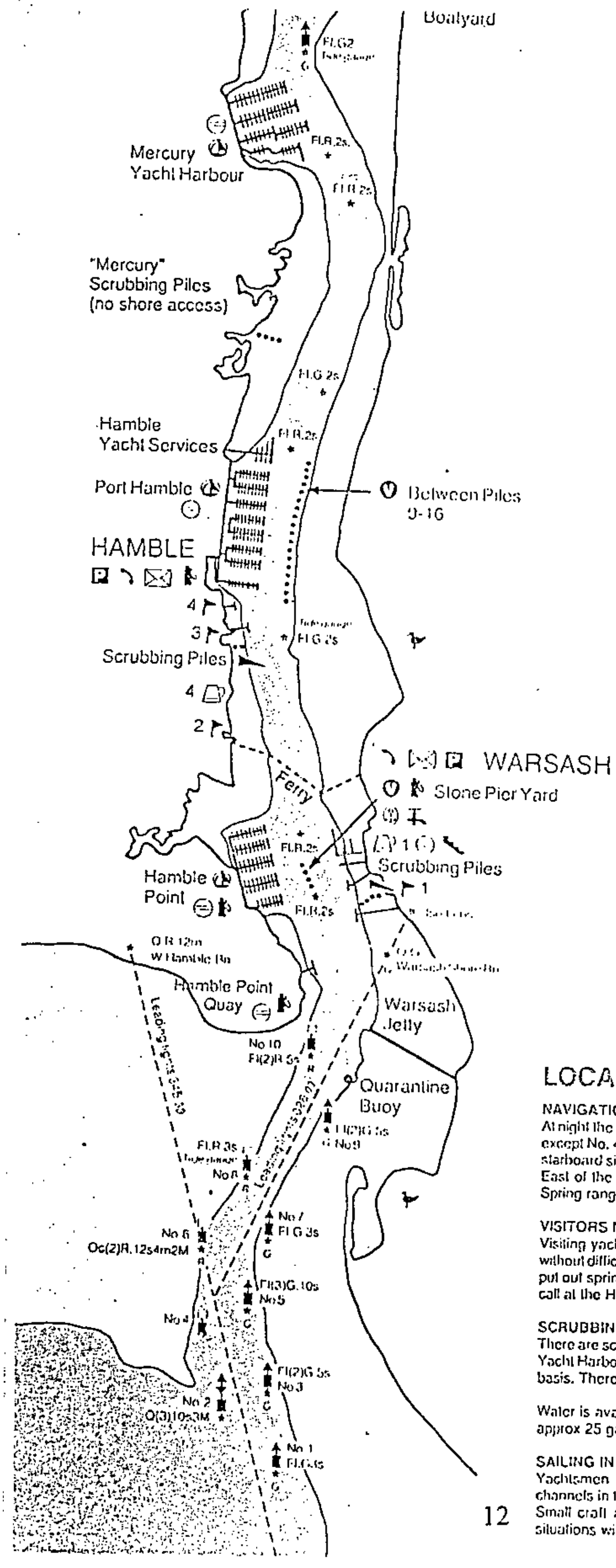


Figure A1. Relationship between sensor output and water depth. (for equation see program, Appendix 4).

APPENDIX 2. Map, tidal, and local information on lower Hamble River and Bunny Meadows, Warsash, Southampton.



HELP KEEP RABIES OUT OF BRITAIN

NOT TO BE USED FOR NAVIGATION

LOCAL HARBOURS

HARBOUR	HARBOUR MASTER TELEPHONE
Portsmouth (O.H.M.)	(0705) 822351 Ext 23694
Beaulieu River	(0590) 616200/616234
Southampton	(0703) 330022
Poole	(0202) 685261
Lymington	(0590) 672014
Yarmouth	(0983) 760321
Cowes	(0983) 293952
Gosport	See Portsmouth
Chichester	(0243) 512301
Brighton	(0273) 693636
Bembridge	(0983) 872828
Newport	(0983) 525994

LOCAL INFORMATION

NAVIGATION

At night the outer leading line of lights (345° 30') is clearly visible. All entrance piles except No. 4 are lit. The inner transit line (026° 09') is less obvious and keeps to the starboard side of the channel. Mariners are advised to be careful not to stray to the East of the transit into shoal water. Tides are as for Southampton + 8 minutes. Spring range 4.5m. There is a double high water.

VISITORS MOORINGS

Visiting yachts should be moored so that other craft secured inside can cast off without difficulty. Use separate lines fore and aft not one continuous rope. For safety put out springs and plenty of fenders. If not seen by the Harbour Master on patrol call at the Harbour Office to pay dues.

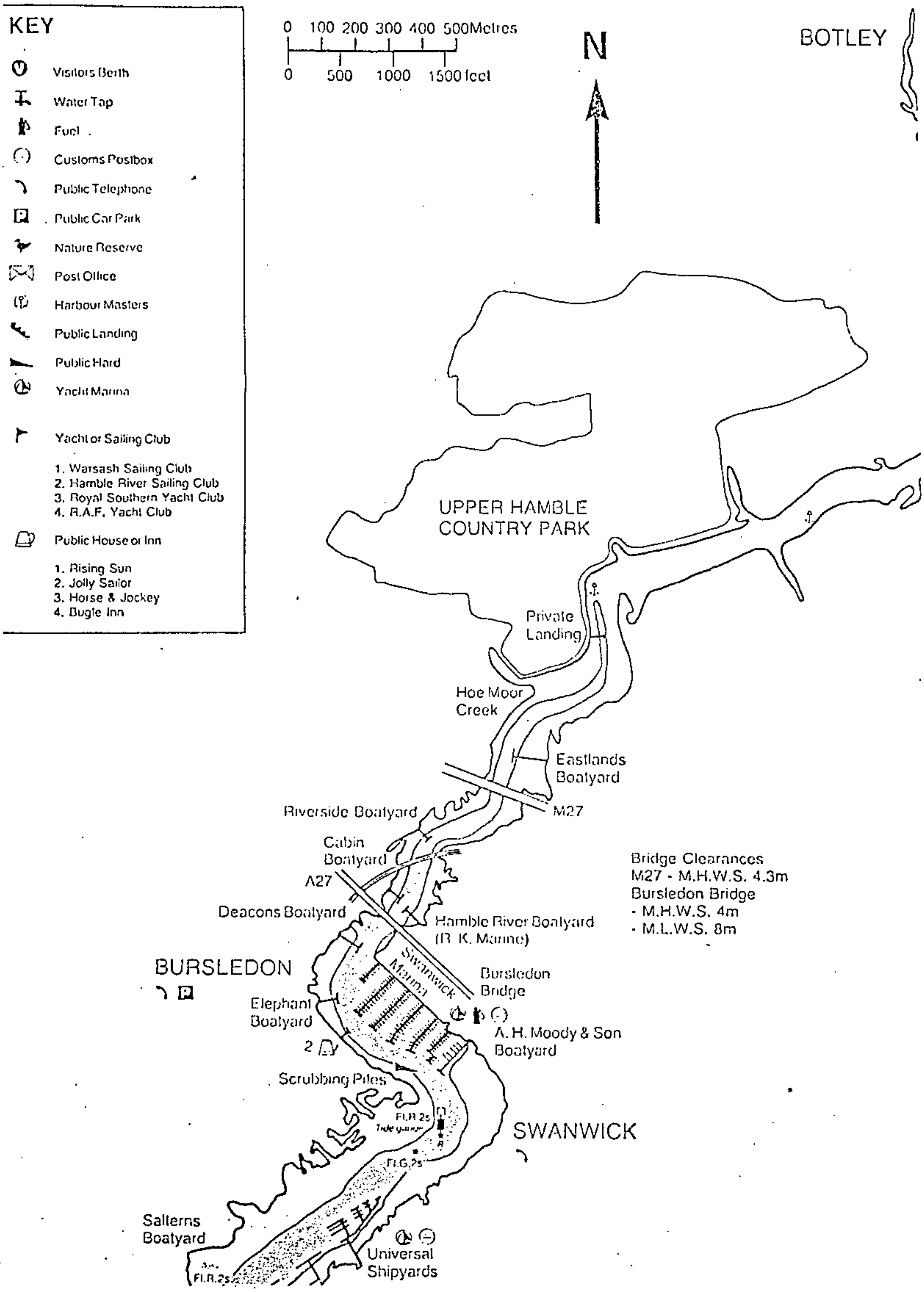
SCRUBBING PILES/FRESH WATER

There are scrubbing piles at Warsash, Hamble, between Port Hamble and Mercury Yacht Harbour and Lands End Hard (Bursledon). Use is on a first come first served basis. There is no charge for the first 48 hours.

Water is available at the Harbour Master's Jetty at Warsash. A meter dispenses approx 25 gallons for 10p.

SAILING IN THE SOLENT

Yachtsmen are reminded of the regulations concerning the use of the main channels in the Solent. Deep draughted vessels do not have room to manoeuvre. Small craft are required to keep clear of these channels. Avoid close quarter situations with large ships.


KEY
Visitors Berth
Water Tap
Fuel
Customs Postbox
Public Telephone
Public Car Park
Nature Reserve
Post Office
Harbour Masters
Public Landing
Public Hard
Yacht Marina
Yacht or Sailing Club
1. Warsash Sailing Club
2. Hamble River Sailing Club
3. Royal Southern Yacht Club
4. R.A.F. Yacht Club
Public House or Inn
1. Rising Sun
2. Jolly Sailor
3. Horse & Jockey
4. Bugle Inn
0 100 200 300 400 500Metres
0 500 1000 1500 feet
N
BOTLEY
UPPER HAMBLE COUNTRY PARK
Private Landing
Hoe Moor Creek
Eastlands Boatyard
M27
Riverside Boatyard
Cabin Boatyard
A27
Deacons Boatyard
Hamble River Boatyard (R K. Marine)
Bridge Clearances
M27 - M.H.W.S. 4.3m
Bursledon Bridge
- M.H.W.S. 4m
- M.L.W.S. 8m
BURSLEDON
Swanwick Marina
Bursledon Bridge
Elephant Boatyard
A. H. Moody & Son Boatyard
2
Scrubbing Piles
Fl.R.2s
Fl.G.2s
SWANWICK
Salterns Boatyard
Fl.R.2s
Universal Shipyards

LOCAL INFORMATION

Harbour Master's Office	
Shore Road, Warsash.	0489 576387
Harbour Master	
Captain C. J. Nicholl, OBE.,	Residence: 0489 582406
Assistant Harbour Master	
Mr. D. Walker	Residence: 0329 283944

Visitors Moorings
Piles B4 to B7 off Warsash, and 9 to 16 off Port Hamble.

Coastguards/Customs etc.

H.M. Coastguards	0705 552100
H.M. Customs	0703 827350
Southampton Port Health Authority	0703 226631

Yacht and Sailing Clubs

Hamble River Sailing Club, Hamble.	0703 452070
Royal Air Force Yacht Club, Hamble.	0703 452208
Royal Southern Yacht Club, Hamble.	0703 453271
Warsash Sailing Club, Warsash. (Hon. Secretary)	0489 574702

Marinas and Boatyards

Cabin Boatyard (Slipway, pontoon, repairs, crane)	0703 402516
Crableck Boatyard (Pontoons, water)	0489 572570
Deacons Boatyard (Pontoon, cranage, repairs, water)	0703 402253
Eastlands Boatyard (Hauling out, repairs)	0703 403556
Elephant Boatyard Ltd. (Pontoon, slipway, repairs)	0703 403268
Hamble Point Marina (M.D.L. Marinas) Ltd. (Repairs, fuel, water, chandlery, boat storage)	0703 452464
Hamble Point Quay (Pontoon, slipway, dry boat storage, cranage, repairs, fuel, water)	0703 452464
Hamble River Boatyard, R.K. Marine Ltd. (Pontoons, slipway, marine engineers)	0489 583572/583585
Hamble Yacht Services, Port Hamble (Pontoons, boat hoist, building, repairs, laying-up, etc.)	0703 454111
Mercury Yacht Harbour (M.D.L. Marinas) Ltd. (Marina, boat hoist, chandlery)	0703 455994
Port Hamble Marina (M.D.L. Marinas) Ltd. (Marina, chandlery)	0703 452741
Riverside Boatyard, Foulkes & Son. (Pontoon, repairs, salvage, diving, towing)	0703 406349
Salterns Boatyard	0703 403911
Stone Pier Yard (Victoria Rampart Ltd.) (Yacht building, refits, repairs, pontoons, fuel)	0489 885400
Swanwick Marina, A. H. Moody & Son Ltd. (Marina, cranage, building, repairs, fuel, water, chandlery)	0489 885000
Universal Shipyard (Solent) Ltd. (Pontoons, boat hoist, repairs, water)	0489 574272

Marine Engineers

Alpha Marine, (sterndrives) (Yamaha Agent)	
Eastlands Boatyard	0489 582777
Cougar Marine, Hamble	0703 453513
Marine Power Ltd. (Engine repairs), Cabin Boatyard	
Office: 0703 403910. After hours:	0489 573596
M.R. Yacht Engineers (Evinrude Agent)	0703 456175
J. Poulter Marine Services, (Outboards)	
Eastlands Boatyard	0489 582777
R.K. Marine Ltd. (Volvo Agent)	
Hamble River Boatyard	0489 583572/583585

Electrics/Electronics – Sales, repairs

Greenham Marine Ltd.	
Port Hamble	0703 455044
Hudson Marine Electronics	
Hamble Point	0703 454618
Mercury Yacht Harbour	0703 455129

Sailmakers

Bruce Banks Ltd, Park Gate	0489 582444
Richardson Sails, Elephant Boatyard	0703 403914
Shore Sails, Stone Pier Yard	0489 589450
Sobstad Sailmaker (UK) Ltd.	
Mercury Yacht Harbour	0703 456205
Technique Sails, Deacons Boatyard	0703 405822
Ullman Sails (UK) Ltd., Port Hamble	0703 454254
J. R. Williams Ltd., Hamble	0703 453109

Yacht Chandlers

Aladdins Cave, Deacons Boatyard	0703 402182
Compass Point, Hamble	0703 452388
Sea Fever, Warsash	0489 582004
The Solent Trading Co.	
Mercury Yacht Harbour	0703 454849
Warsash Nautical Bookshop, Warsash	0489 572384
Yachtmail Co. Ltd.	
Hamble Point Marina	0703 455058
Port Hamble	0703 454858

Moorings, Mooring Maintenance, Divers, Salvage, Towing

Andark Diving, Lower Swanwick	0489 581755
	Out of hours 0489 786006
Bayline Marine, (diving)	0489 582685
Blue Star Boats, Hamble (towing)	0703 453542
	Out of hours 0489 572840
D. H. Etheridge, Hythe	0703 843710
Foulkes & Sons, Riverside Boatyard	0703 406349
Maytree Marine, (moorings)	0703 454757
R. Sedgwick, (moorings)	0703 454512
Tucker & Munday, Mercury Yacht Harbour	0703 453124
Warsash Divers	0329 822397

Boat Trips/Charter Boats/River Taxi

Blue Star Boats (based at Hamble foreshore)	0703 453542
	Out of hours 0489 572840

Transport

Ferry: Between Hamble and Warsash. Based at Hamble, from Warsash go to 'Ferry Hut' and wave.
Buses: From Bursledon, Hamble, Swanwick and Warsash to Fareham, Portsmouth and Southampton.
Trains: From Bursledon and Hamble stations to all destinations.

Places of Worship

Hamble: St. Andrews, High Street, C. of E.
Warsash: St. Mary's, Hook with Warsash, C. of E.
St. Margaret Mary, Park Gate.

ENGLAND, SOUTH COAST - SOUTHAMPTON

LAT 50°54'N LONG 1°24'W

TIME ZONE UT(GMT) — TIMES AND HEIGHTS OF HIGH AND LOW WATERS — YEAR 1992

JUNE

Day	Time	m	Time	m	Time	m	Time	m
1 M	0409	0.6	1047	4.3	1630	0.7	● 2300	4.4
2 TU	0455	0.5	1131	4.4	1718	0.7	2343	4.5
3 W	0542	0.4	1217	4.4	1806	0.7		
4 TH	0029	4.4	0628	0.4	1306	4.4	1853	0.7
5 F	0117	4.4	0713	0.5	1357	4.4	1939	0.8
6 SA	0210	4.3	0800	0.7	1454	4.4	2030	1.0
7 SU	0308	4.2	0852	0.9	1555	4.3	2127	1.2
8 M	0414	4.1	0953	1.1	1702	4.2	2231	1.3
9 TU	0525	4.0	1059	1.2	1809	4.2	2339	1.3
10 W	0636	4.0	1206	1.2	1912	4.2		
11 TH	0045	1.2	0742	4.0	1313	1.2	2006	4.2
12 F	0145	1.1	0837	4.1	1412	1.1	2057	4.3
13 SA	0240	0.9	0928	4.2	1503	1.0	2141	4.3
14 SU	0328	0.8	1013	4.2	1551	0.9	2222	4.3
15 M	0412	0.7	1056	4.3	1634	0.9	○ 2301	4.3
16 TU	0452	0.7	1137	4.2	1713	0.9	2340	4.2
17 W	0528	0.7	1216	4.2	1748	1.0		
18 TH	0016	4.2	0602	0.8	1253	4.2	1821	1.1
19 F	0052	4.1	0632	0.9	1329	4.1	1854	1.2
20 SA	0129	4.0	0706	1.0	1407	4.0	1929	1.3
21 SU	0209	3.9	0741	1.2	1449	3.9	2010	1.4
22 M	0255	3.8	0823	1.4	1536	3.9	2055	1.6
23 TU	0347	3.7	0912	1.5	1629	3.8	2152	1.7
24 W	0445	3.7	1011	1.7	1730	3.6	2255	1.7
25 TH	0551	3.5	1119	1.7	1831	3.6		
26 F	0003	1.6	0655	3.7	1227	1.6	1930	3.9
27 SA	0106	1.4	0800	3.8	1330	1.4	2023	4.1
28 SU	0205	1.2	0854	4.0	1428	1.2	2112	4.2
29 M	0259	0.9	0945	4.2	1522	1.0	2159	4.3
30 TU	0351	0.6	1032	4.3	1615	0.8	● 2244	4.4

JULY

Day	Time	m	Time	m	Time	m	Time	m
1 W	0441	0.4	1119	4.5	1707	0.6	2330	4.5
2 TH	0531	0.3	1206	4.6	1757	0.5		
3 F	0016	4.5	0619	0.3	1254	4.6	1844	0.5
4 SA	0104	4.5	0705	0.3	1342	4.6	1930	0.6
5 SU	0154	4.4	0748	0.4	1434	4.5	2015	0.7
6 M	0248	4.3	0834	0.7	1528	4.4	2103	0.9
7 TU	0347	4.3	0925	0.9	1628	4.3	2158	1.2
8 W	0454	4.0	1024	1.2	1734	4.1	2301	1.4
9 TH	0608	3.9	1133	1.4	1842	4.0		
10 F	0014	1.5	0722	3.9	1245	1.5	1947	4.0
11 SA	0123	1.4	0828	4.0	1353	1.5	2044	4.1
12 SU	0224	1.2	0922	4.1	1451	1.4	2130	4.1
13 M	0316	1.1	1008	4.1	1539	1.2	2213	4.2
14 TU	0400	0.9	1048	4.2	1619	1.1	○ 2249	4.2
15 W	0438	0.8	1125	4.2	1655	1.0	2324	4.2
16 TH	0510	0.7	1158	4.3	1728	1.0	2357	4.2
17 F	0541	0.7	1230	4.3	1800	1.0		
18 SA	0028	4.2	0611	0.8	1301	4.2	1830	1.0
19 SU	0101	4.2	0642	0.8	1334	4.2	1902	1.1
20 M	0136	4.1	0712	1.0	1408	4.1	1935	1.2
21 TU	0215	4.0	0746	1.1	1448	4.0	2013	1.3
22 W	0300	3.9	0826	1.4	1536	3.9	2101	1.6
23 TH	0352	3.8	0917	1.6	1632	3.9	2159	1.7
24 F	0500	3.7	1024	1.8	1739	3.5	2314	1.8
25 SA	0615	3.7	1144	1.8	1849	3.9		
26 SU	0032	1.6	0732	3.8	1302	1.7	1956	4.0
27 M	0142	1.3	0836	4.0	1410	1.4	2051	4.2
28 TU	0244	1.0	0930	4.2	1510	1.0	2142	4.3
29 W	0337	0.6	1018	4.4	1603	0.7	● 2228	4.5
30 TH	0428	0.4	1103	4.6	1654	0.5	2313	4.6
31 F	0517	0.2	1149	4.7	1741	0.4	2359	4.6

AUGUST

Day	Time	m	Time	m	Time	m	Time	m
1 SA	0604	0.1	1233	4.6	1828	0.3		
2 SU	0045	4.6	0648	0.1	1318	4.6	1911	0.4
3 M	0131	4.6	0729	0.3	1405	4.6	1952	0.6
4 TU	0222	4.4	0809	0.6	1455	4.4	2034	0.8
5 W	0318	4.2	0853	1.0	1551	4.2	2121	1.2
6 TH	0421	3.9	0948	1.4	1656	4.0	2224	1.5
7 F	0538	3.8	1100	1.7	1811	3.9	2343	1.7
8 SA	0705	3.7	1222	1.8	1927	3.8		
9 SU	0105	1.7	0821	3.8	1340	1.8	2032	3.9
10 M	0214	1.5	0917	4.1	1441	1.6	2122	4.0
11 TU	0306	1.3	1001	4.3	1527	1.4	2200	4.1
12 W	0348	1.0	1035	4.4	1603	1.1	2235	4.2
13 TH	0420	0.8	1105	4.3	1636	1.0	○ 2305	4.3
14 F	0450	0.7	1134	4.4	1705	0.9	2334	4.3
15 SA	0520	0.7	1202	4.4	1736	0.8		
16 SU	0003	4.3	0548	0.7	1230	4.4	1805	0.8
17 M	0033	4.3	0617	0.7	1258	4.4	1836	0.8
18 TU	0105	4.3	0645	0.8	1330	4.3	1906	1.0
19 W	0139	4.2	0715	1.0	1406	4.2	1939	1.2
20 TH	0222	4.0	0750	1.3	1450	4.1	2020	1.5
21 F	0313	3.9	0837	1.6	1545	3.9	2116	1.7
22 SA	0419	3.7	0946	1.9	1654	3.8	2235	1.9
23 SU	0546	3.7	1116	2.0	1818	3.8		
24 M	0008	1.8	0714	3.8	1247	1.8	1935	4.0
25 TU	0127	1.4	0822	4.1	1358	1.4	2035	4.2
26 W	0231	1.0	0915	4.3	1457	1.0	2126	4.4
27 TH	0322	0.6	1000	4.6	1548	0.6	2211	4.6
28 F	0411	0.3	1043	4.7	1636	0.4	● 2254	4.7
29 SA	0457	0.1	1124	4.9	1722	0.2	2338	4.7
30 SU	0542	0.0	1207	4.9	1806	0.2		
31 M	0022	4.7	0626	0.1	1249	4.8	1847	0.3

SEPTEMBER

Day	Time	m	Time	m	Time	m	Time	m
1 TU	0107	4.6	0706	0.3	1335	4.6	1925	0.5
2 W	0155	4.4	0744	0.6	1421	4.4	2003	0.8
3 TH	0248	4.1	0823	1.1	1514	4.1	2045	1.3
4 F	0350	3.9	0915	1.6	1617	3.8	2145	1.7
5 SA	0508	3.7	1026	2.0	1735	3.6	2309	2.0
6 SU	0642	3.6	1158	2.1	1903	3.6		
7 M	0043	2.0	0805	3.7	1321	2.0	2014	3.7
8 TU	0156	1.7	0901	3.9	1421	1.8	2104	3.9
9 W	0247	1.4	0940	4.1	1507	1.4	2141	4.1
10 TH	0326	1.1	1011	4.2	1541	1.1	2212	4.2
11 F	0356	0.9	1039	4.3	1610	0.9	2241	4.3
12 SA	0425	0.7	1106	4.4	1639	0.7	○ 2310	4.4
13 SU	0454	0.6	1133	4.5	1710	0.7	2338	4.5
14 M	0524	0.6	1200	4.5	1742	0.6		
15 TU	0007	4.4	0554	0.6	1226	4.5	1812	0.7
16 W	0038	4.4	0623	0.7	1257	4.4	1842	0.8
17 TH	0113	4.3	0652	1.0	1334	4.3	1913	1.1
18 F	0155	4.1	0728	1.3	1417	4.1	1954	1.4
19 SA	0246	3.9	0814	1.6	1512	4.0	2048	1.7
20 SU	0355	3.6	0925	1.9	1625	3.6	2211	1.9
21 M	0526	3.7	1100	2.0	1756	3.8	2347	1.8
22 TU	0657	3.9	1232	1.8	1917	3.9		
23 W	0109	1.4	0804	4.2	1344	1.4	2019	4.2
24 TH	0212	1.0	0854	4.4	1439	0.9	2107	4.4
25 F	0303	0.6	0937	4.7	1527	0.6	2151	4.6
26 SA	0349	0.3	1019	4.8	1613	0.3	● 2233	4.7
27 SU	0435	0.1	1059	4.9	1658	0.2	2317	4.8
28 M	0520	0.1	1140	4.9	1741	0.2		
29 TU	0000	4.7	0602	0.2	1223	4.8	1822	0.3
30 W	0045	4.6	0641	0.5	1306	4.6	1858	0.5

OCTOBER

Day	Time	m	Time	m	Time	m	Time	m
1 TH	0130	4.4	0717	0.8	1351	4.3	1933	0.9
2 F	0222	4.1	0755	1.2	1439	4.0	2014	1.3
3 SA	0320	3.8	0843	1.7	1537	3.7	2107	1.7
4 SU	0433	3.6	0949	2.1	1651	3.5	2227	2.0
5 M	0604	3.5	1118	2.2	1819	3.5		
6 TU	0001	2.1	0728	3.6	1243	2.1	1937	3.6
7 W	0116	1.9	0826	3.8	1346	1.9	2031	3.8
8 TH	0212	1.6	0905	4.0	1432	1.5	2111	4.0
9 F	0252	1.2	0938	4.2	1507	1.2	2143	4.2
10 SA	0323	1.0	1006	4.3	1540	0.9	2214	4.3
11 SU	0354	0.8	1034	4.5	1611	0.7	○ 2243	4.4
12 M	0425	0.7	1102	4.5	1644	0.6	2314	4.5
13 TU	0458	0.6	1132	4.6	1717	0.6	2345	4.5
14 W	0532	0.7	1201	4.6	1751	0.6		
15 TH	0018	4.4	0605	0.8	1234	4.5	1824	0.7
16 F	0057	4.3	0640	0.9	1313	4.3	1859	0.9
17 SA	0140	4.2	0718	1.2	1357	4.2	1941	1.2
18 SU	0235	4.0	0807	1.5	1455	4.0	2037	1.5
19 M	0344	3.9	0916	1.8	1606	3.9	2154	1.7
20 TU	0509	3.9	1043	1.9	1733	3.6	2324	1.7
21 W	0633	4.0	1209	1.7	1855	4.0		
22 TH	0043	1.4	0740	4.2	1319	1.3	1957	4.2
23 F	0147	1.0	0830	4.5	1415	0.9	2047	4.4
24 SA	0238	0.7	0915	4.6	1503	0.5	2132	4.5
25 SU	0325	0.4	0956	4.7	1549	0.4	● 2215	4.6
26 M	0411	0.3	1036	4.8	1634	0.3	2258	4.7
27 TU	0456	0.3	1118	4.7	1717	0.3	2342	4.6
28 W	0539	0.5	1159	4.6	1758	0.4		
29 TH	0026	4.5	0619	0.7	1240	4.4	1833	0.6
30 F	0111	4.3	0654	1.0	1323	4.2	1908	0.9
31 SA	0159	4.1	0731	1.3	1409	4.0	1946	1.3

NOVEMBER

Day	Time	m	Time	m	Time	m	Time	m
1 SU	0252	3.9	0814	1.7	1500	3.8	2032	1.6
2 M	0353	3.7	0908	2.0	1601	3.6	2134	1.9
3 TU	0506	3.6	1021	2.2	1716	3.5	2254	2.0
4 W	0622	3.6	1140	2.1	1833	3.5		
5 TH	0014	2.0	0727	3.7	1249	1.9	1938	3.7
6 F	0117	1.7	0816	3.9	1343	1.6	2027	3.8
7 SA	0204	1.4	0855	4.1	1426	1.3	2107	4.0
8 SU	0244	1.2	0929	4.2	1504	1.0	2143	4.2
9 M	0320	1.0	1002	4.4	1541	0.8	2216	4.4
10 TU	0357	0.8	1034	4.5	1618	0.7	○ 2253	4.4
11 W	0435	0.7	1108	4.6	1658	0.6	2328	4.5
12 TH	0514	0.7	1142	4.6	1736	0.6		
13 F	0007	4.5	0554	0.8	1219	4.5	1815	0.6
14 SA	0047	4.4	0634	0.9	1300	4.4	1853	0.8
15 SU	0134	4.3	0717	1.1	1348	4.3	1937	1.0
16 M	0229	4.2	0607	1.3	1443	4.1	2031	1.2
17 TU	0331	4.1	0907	1.5	1550	4.0	2136	1.4
18 W	0444	4.1	1019	1.6	1706	3.9	2252	1.5
19 TH	0601	4.1	1136	1.5	1824	4.0		
20 F	0008	1.3	0708	4.2	1246	1.3	1932	4.1
21 SA	0115	1.1	0804	4.4	1347	1.0	2028	4.3
22 SU	0211	0.9	0852	4.5	1440	0.8	2117	4.4
23 M	0303	0.7	0937	4.6	1528	0.6	2203	4.5
24 TU	0351	0.6	1018	4.5	1614	0.5	● 2247	4.5
25 W	0437	0.6	1101	4.6	1658	0.5	2330	4.5
26 TH	0520	0.7	1142	4.5	1737	0.6		
27 F	0014	4.4	0558	0.8	1222	4.4	1813	0.7
28 SA	0057	4.3	0634	1.0	1301	4.2	1847	0.9
29 SU	0138	4.2	0709	1.2	1341	4.0	1921	1.2
30 M	0223	4.0	0746	1.5	1426	3.9	1958	1.4

HIGH WATERS - IMPORTANT NOTE. DOUBLE HIGH WATERS OCCUR AT SOUTHAMPTON. THE PREDICTIONS ARE FOR THE FIRST HIGH WATER.

APPENDIX 3.

Listing of Fortran 77c program for conversion of voltage outputs to oxygen saturation, optical density, temperature, water depth and solar irradiance.

```
      DIMENSION Y0(12),Y9(12),YMIN(12),YMAX(12),YNAME(12),Z(12)
      DIMENSION N(12,2)
      DIMENSION YRANGE(10),YTICK(10),NTICK(10)
      DIMENSION YP0(12),YP9(12),IPLIM(12)
      DIMENSION TIME(6000),Y(6000,12),YC(6000)
      DIMENSION MDAYS(12),CMON(12)
      CHARACTER FNAME*17,GNAME*17,YNAME*20,CMON*9,TNAME*20,ALINE*80
      DATA CMON/'January ','February ','March    ','April    ',
     &'May      ','June     ','July     ','August   ','September',
     &'October  ','November ','December '/
      DATA MDAYS/31,28,31,30,31,30,31,31,30,31,30,31/
      DATA YMIN/0,0,0,0,0,0,0,0,0,0,0,0/
      DATA YMAX/30,5.50,200,20,2.0,32.0,5.50,99,20.00,99,99,20.0/
C Plot Tick limits follow :
      DATA YRANGE/2.0,5,14,30,50,100,300,1000,3000,10000/
      DATA  YTICK/0.5,1,02,05,10,020,050,0100,0500,01000/
      DATA NTICK/5,2,1,5,2,2,5,2,5,2/
      J=0
      WRITE(6,100)
  100 FORMAT(/' Program LOGGERPLOT2.NWP :'/
     &' Plots out Logger data for NW Pipeline Study :')
      WRITE(6,210)
  210 FORMAT(' Input Name of Logger Data File :')
      READ(5,'(A17)') FNAME
      OPEN(UNIT=7,FILE=FNAME,STATUS='OLD')
      WRITE(6,220)
  220 FORMAT(' Input Name for Output Calibrated Data File :')
      READ(5,'(A17)') GNAME
      OPEN(UNIT=8,FILE=GNAME,STATUS='UNKNOWN')
      WRITE(6,222)
  222 FORMAT(' Year of Data (eg 1992) :')
      READ(5,*) IYEAR0
      WRITE(6,225)
  225 FORMAT(' Logger Calibration to be used (1-8) :')
      WRITE(6,226)
  226 FORMAT(' ENTER THE NUMBER CORRESPONDING TO THE CHOSEN
LOGGER:'/
     &' (1) = LOGGER 1; RVX 116, 104, 8(UPSTREAM)'/
     &' (2) = LOGGER 2; RVX 4, 8, 14, 6, 110, 101'/
     &' (3) = LOGGER 3; RVX 63, 107,milstream'/
     &' (4) = LOGGER 4; RVX 140, 130 (A), 8'/
     &' (5) = LOGGER 5; RVX 1, 24 '/
```

```
     &' (6) = LOGGER 6; RVX 116,HAMBLE'/
     &' (7) = LOGGER 7; RVX 130 (B-  )'/
     &' (8) = LOGGER 8; OLD CONVERTOR, RVX 140, '/
     &'     ')
      READ(5,*) LOGGER
      WRITE(6,232)
  232 FORMAT(' Print out each Time Point Line of Input on Screen ',
     &'(No=0;Yes=1) :')
      READ(5,*) IPRIN
C KVAR8 = Maximum no. of variables recorded in a logger file :
      KVAR8=12
C
C Name the Variables in Microchannel screen order :
C ie in array Z order.
      YNAME(1)='Temperature, C '
      YNAME(2)='Marsh Depth, m        '
      YNAME(3)='% Oxygen'
      YNAME(4)='Solar Radiation      '
      YNAME(5)='Optical density      '
      YNAME(6)='Conductivity '
      YNAME(7)='River Depth, m'
      YNAME(8)='NOT USED'
      YNAME(9)='Barometric Pressure'
      YNAME(10)='NOT USED'
      YNAME(11)='NOT USED'
      YNAME(12)='Battery Power'
C
      WRITE(6,235) (K,YNAME(K),K=1,KVAR8)
  235 FORMAT(' Original Order of Variables in Logger ='/,
     &(I5,' = ',A20))
      WRITE(6,237)
  237 FORMAT(/' No. of graphs required on the page (1-12) :')
      READ(5,*) KVAR9
      WRITE(6,238)
  238 FORMAT(/' Each graph contains a continuous line plot of the first',
     &' selected variable'/' and optionally a dotted line plot of the ',
     &'second selected variable.'/' (Enter -1 for the second variable ',
     &' if not required for that particular plot)'/
     &' eg to plot Depth as a solid line, and %Oxygen dotted,',
     &' enter 2,3'/
     &'    to only plot say Conductivity on a graph, enter 6,-1')
      DO 241 K=1,KVAR9
      WRITE(6,240) K
  240 FORMAT(' Enter First,Second variable to be plotted on graph ',I2)
      READ(5,*) N(K,1),N(K,2)
  241 CONTINUE
C KPROB = Missing value used where required for 'problem values' :
      KPROB=-999999
```

```
      WRITE(6,246) KPROB
  246 FORMAT(' What to do with problems values as defined in the',
     &' logger calibration section of this program :'/
     &'  (1) = Leave Problem values unaltered'/
     &'  (2) = Set Problems value to previous valid value'/
     &'  (3) = Set Problem values to a missing value : ',I8)
      READ(5,*) IPROB
C Set CONDUCT and POWER to missing values in case they were not recorded
C on the selected logger :
      CONDUCT=KPROB
      POWER=KPROB
C Read in Data calculating the range of each Variable :
C
      DAY0=999999
      DAY=-999999
      DO 250 K=1,KVAR8
      Y0(K)=999999
      Y9(K)=-999999
  250 CONTINUE
C
  300 CONTINUE
      DO 305 K=1,KVAR8
  305 Z(K)=-999

      IF (LOGGER.EQ.1) THEN
C Logger Calibration 1 :
      READ(7,*,END=500) IDAY,IMON,IHOUR,IMIN,TMV,DEPTH,DOMV,
     &AKIPP,CONDUCT,TURBID,POWER
      TEMP=11.4+0.000666*TMV
      DOST=EXP((3.3654+0.028505*TEMP)*2.303)
      OXYGEN=-((DOMV/DOST)*100.0)
      AKIPP=-AKIPP/1000
      DEPTH=(+0.00199*-DEPTH)+0.41



      TURBID=1.12+0.000036*TURBID
      ENDIF
C
      IF (LOGGER.EQ.2) THEN
C Logger Calibration 2 :
      READ(7,*,END=500) IDAY,IMON,IHOUR,IMIN,TMV,DEPTH,DOMV,
     &AKIPP,CONDUCT,TURBID,POWER
      TEMP=(10.7+0.000631*TMV)
      DOST=EXP((3.3802+0.0198*TEMP)*2.303)
      OXYGEN=(DOMV/DOST)*100.0-35
      AKIPP=-AKIPP/1000*5+0.4
      DEPTH=-0.00203*DEPTH+0.20
```

```
      TURBID=0.955+0.000032*TURBID
      ENDIF
C
      IF (LOGGER.EQ.3) THEN
C Logger Calibration 3 :
c turb changed was 0.973+(0.000034*turb)on 9692
      READ(7,*,END=500) IMON,IDAY,IHOUR,IMIN,TMV,DEPTH,DOMV,
     &AKIPP,CONDUCT,TURBID,POWER
      TEMP=10.5+0.000631*TMV
      DOST=EXP((3.6902+0.0243*TEMP)*2.303)
      OXYGEN=(-DOMV/DOST)*100
      DEPTH=0.00187*(-DEPTH)

      TURBID=1.2+0.0000382*TURBID
      AKIPP=-AKIPP/1000+0.037
      ENDIF
C
      IF (LOGGER.EQ.4) THEN
C Logger Calibration 4 :
      READ(7,*,END=500) IMON,IDAY,IHOUR,IMIN,TMV,DEPTH,DOMV,
     &AKIPP,CONDUCT,TURBID,POWER
      TEMP=10.1+0.000675*TMV
      DOST=EXP((3.8451+0.0233*TEMP)*2.303)
      OXYGEN=(-DOMV/DOST)*100-10
      DEPTH=0.00164*DEPTH-0.10
      TURBID=1.05+0.000035*TURBID
      AKIPP=-AKIPP/1000+0.01
      ENDIF
C
      IF (LOGGER.EQ.5) THEN
      READ(7,*,END=500) IDAY,IMON,IHOUR,IMIN,TMV,DEPTH,DOMV,
     &AKIPP,CONDUCT,TURBID,POWER
      TEMP=10.2+0.000618*TMV
      DOST=EXP((3.869+0.0069*TEMP)*2.303)
      OXYGEN=(DOMV/DOST)*100.0+6
      AKIPP=-AKIPP/1000
      TURBID=0.857+0.000029*TURBID+0.1
      DEPTH=0.00186*DEPTH
      ENDIF
C
      IF (LOGGER.EQ.6) THEN
C Logger Calibration 6 :
      READ(7,*,END=500) IDAY,IMON,IHOUR,IMIN,TMV,DEPTH,DOMV,
     &AKIPP,CONDUCT,TURBID,RDEPTH,PRESSURE,POWER
      TEMP=10.1+0.000681*TMV
      DOST=EXP((3.6902+0.0243*TEMP)*2.303)
      OXYGEN=(-DOMV/DOST)*100.0
      AKIPP=-AKIPP/1000
```

```
      count=depth
      DEPTH=((0.208*depth+ -9.54)/100)+2.21
      rcount=rdepth
      RDEPTH=((0.0349*RCOUNT+6.87)/100.0)+1.26
      TURBID=0.973+0.000034*TURBID
      PRESSURE =PRESSURE/100
      ENDIF
C
      IF (LOGGER.EQ.7) THEN
C Logger Calibration 7 :
      READ(7,*,END=500) IMON,IDAY,IHOUR,IMIN,TMV,DEPTH,DOMV,
     &AKIPP,CONDUCT,TURBID,POWER
      TEMP=9.98+0.000610*TMV+0.7
      DOST=EXP((3.6902+0.0243*TEMP)*2.303)
      OXYGEN=-DOMV/DOST*100+15
      AKIPP=-AKIPP/1000+0.1
      DEPTH=(((0.207*depth)+12.2)/100)+1.97
      TURBID=1.12+0.000036*TURBID-0.1
      CONDUCT=CONDUCT/1000.0
      POWER=POWER/1000.0
      ENDIF
C
      IF (LOGGER.EQ.8) THEN
C Logger Calibration 8 :
      READ(7,*,END=500)IMON,IDAY,IHOUR,IMIN,TMV,DEPTH,DOMV,
     &AKIPP,TURBID
      TEMP=16.4+(0.681*TMV)
      DOST=EXP((0.4843+0.0244*TEMP)*2.303)
      OXYGEN=-DOMV/DOST*100.0+0.5
      AKIPP=-AKIPP+0.23
      DEPTH=DEPTH+0.40
      TURBID=1.13+0.05*(TURBID*-1.0)
      ENDIF
C
C Check use of 'E OF' to Linearise FTU's.
C
C
      Z(1)=TEMP
      Z(2)=DEPTH
      Z(3)=OXYGEN
      Z(4)=AKIPP
      Z(5)=TURBID
      Z(6)=CONDUCT
      Z(7)=RDEPTH
      Z(8)=BLANK8
      Z(9)=PRESSURE
      Z(10)=BLANK10
      Z(11)=BLANK11
```

```
      Z(12)=POWER
C
C Set Time features :
      J=J+1
      TIME(J)=IDAY+FLOAT(IHOUR)/24+FLOAT(IMIN)/(24*60)
      IF (J.EQ.1) THEN
      IMON0=IMON
      IDAY0=IDAY
      ENDIF
      IF (IMON.NE.IMON0) THEN
      IMON1=IMON0
  410 TIME(J)=TIME(J)+MDAYS(IMON1)
      IMON1=IMON1+1
      IF (IMON1.GT.12) IMON1=1
      IF (IMON.NE.IMON1) GOTO 410
      ENDIF
      IF (IPRIN.EQ.1) THEN
      WRITE(6,315) IDAY,IMON,IHOUR,IMIN,TEMP,DEPTH,OXYGEN,AKIPP,
     &TURBID,RDEPTH,PRESSURE,POWER
      ENDIF
      WRITE(8,315) IDAY,IMON,IHOUR,IMIN,TEMP,DEPTH,OXYGEN,AKIPP,
     &TURBID,RDEPTH,PRESSURE,POWER
  315 FORMAT(4I4,8F10.3)

      DO 370 K=1,KVAR8
      YN=Z(K)
      IF (YN.LT.Y0(K)) Y0(K)=YN
      IF (YN.GT.Y9(K)) Y9(K)=YN
  370 Y(J,K)=YN
      IF (J.EQ.6000) THEN
      WRITE(6,*) ' Maximum No. of Time Points = 6000'
      STOP
      ENDIF
      IMON9=IMON
      IDAY9=IDAY
C
      GOTO 300
C
  500 CONTINUE
C End of reading in data.
      J9=J
      TIME0=AINT(TIME(1))
      TIME9=AINT(TIME(J9))+1
      WRITE(6,502) TIME0,TIME9
  502 FORMAT(/' DATA LIMITS (Min , Max Days) = ',2F7.0)
      WRITE(6,503)
  503 FORMAT(' Input Min,Max Day number to be plotted :')
      READ(5,*) TIME0,TIME9
```

```
      WRITE(6,504)
  504 FORMAT(/10X,' VARIABLE LIMITS :',8X,'STANDARD',12X,'THIS DATA'/
     &32X,'Min      Max         Min         Max')
      DO 508 K=1,KVAR8
      IF (Y9(K).LT.999999) THEN
      WRITE(6,505) K,YNAME(K),YMIN(K),YMAX(K),Y0(K),Y9(K)
  505 FORMAT(I4,1X,A20,2F10.2,2X,2F10.2)
      ELSE
      WRITE(6,506) K,YNAME(K),YMIN(K),YMAX(K),Y0(K),Y9(K)
  506 FORMAT(I4,1X,A20,2F10.2,2X,2E10.5)
      ENDIF
  508 CONTINUE
      WRITE(6,510)
  510 FORMAT(/' Input Numbers (1-12) of the variables for which data ',
     &' rather than standard'/' limits are to be used in the plots :'/
     &' (hit RETURN to use standard limits for all variables) :')
      DO 512 K=1,KVAR8
      YP0(K)=YMIN(K)
      YP9(K)=YMAX(K)
  512 IPLIM(K)=-9
      READ(5,'(A80)') ALINE
      READ(ALINE,*,END=514) (IPLIM(K),K=1,KVAR8)
  514 DO 515 K=1,KVAR8
      K1=IPLIM(K)
      IF (K1.GT.0) THEN
      YP0(K1)=Y0(K1)
      YP9(K1)=Y9(K1)
      ENDIF
  515 CONTINUE
C Initialise Plotting
      WRITE(6,518)
  518 FORMAT(' PLOTTER:'/'  (1)=HP7475 ; (2)=HP7470 ;',
     &' (3) = Versatec ; (4)=Tektronics 4207 ; (9)=END :')
      READ(5,*) IPDEV
      IF (IPDEV.EQ.9) GOTO 9000
      IF (IPDEV.EQ.3) IDEV=3436
      IF (IPDEV.EQ.4) IDEV=4207
      IF (IPDEV.EQ.2) THEN
      IPSIZE=1
      ELSE
      WRITE(6,520)
  520 FORMAT(' PAPER SIZE: (1)=A4 ; (2)=A3 :')
      READ(5,*) IPSIZE
      ENDIF
      IF (IPDEV.LE.2) THEN
      WRITE(6,530)
  530 FORMAT(' LONG SIDE is : (1)=Vertical ; (2)=Horizontal :')
      READ(5,*) IPLONG
```

```
      IDEV=747000+(2-IPDEV)*500+(5-IPSIZE)*10+IPLONG
      ENDIF
      IF (IPSIZE.EQ.1) THEN
      Z1=275.0
      Z2=190.0
      ELSE
      Z1=400.0
      Z2=275.0
      ENDIF
      IF (IPLONG.EQ.1) THEN
      XDAREA=Z2
      YDAREA=Z1
      ELSE
      XDAREA=Z1
      YDAREA=Z2
      ENDIF
      XDAREA=XDAREA-20
      YDAREA=YDAREA-20
      XPAGE=XDAREA+40
      YPAGE=YDAREA+40
      CALL DEVICE(IDEV)
      CALL PAGMAP(1)
      CALL PAGE2(XPAGE,YPAGE)
      CALL PAGBEG
C
C Set plotting limits to edge of page to get all points/errors drawn :
      CALL GRASET
      TLEN=2.4
      CALL CHHITS(TLEN)
      DO 2000 K=1,KVAR9
      YS0=15+(1-FLOAT(K)/KVAR9)*YDAREA
      CALL SHIFT0
      CALL SHIFT2(25.0,YS0)
      YDAT=YDAREA/KVAR9-15
      CALL GRAFIX(XDAREA,YDAT,0.0)
C
C Plot axes and data for first(L=1) and then possible the second variable(L=2)
C on this graph :
      DO 1800 L=1,2
      K1=N(K,L)
      IF (K1.EQ.-1) GOTO 1800
      CALL DEFLA2(TIME0,TIME9,YP0(K1),YP9(K1))
      CALL POILIM(TIME0,TIME9,1)
      CALL POILIM(YP0(K1),YP9(K1),2)
      YR=ABS(YP9(K1)-YP0(K1))
C
      IF (L.GT.1) GOTO 1000
```

```
C Section to Draw and Label the Time axis neatly :
      CALL ANNINT(3)
      CALL TL2BEG(1)
      TIME1=TIME0
  900 CALL ANMSEL(1.0,0.0,1.4,0.0)
      CALL TICLA2(TIME1,0)
      CALL ANMSEL(0.0,0.0,0.0,0.0)
      DAY=TIME1
      IF (DAY.GT.MDAYS(IMON0)) DAY=DAY-MDAYS(IMON0)
      DAY1=TIME1+0.5
      IF (TIME1.LT.TIME9) CALL TICLB2(DAY1,DAY,1)
      TIME1=TIME1+1
      IF (TIME1.LE.TIME9) GOTO 900
      CALL TL2END
      IF (K.EQ.KVAR9) THEN
      TIME1=TIME0+0.1
      Y1=YP0(K1)-0.05*YR*KVAR9
      WRITE(ALINE,'(A9,I5)') CMON(IMON0),IYEAR0
      CALL TEXLA2(TIME1,Y1,ALINE,1,14,1)
      IF (IMON9.GT.IMON0) THEN
      TIME1=TIME9-0.9
      CALL TEXLA2(TIME1,Y1,CMON(IMON9),1,9,1)
      ENDIF
      ENDIF
C
 1000 CALL ANMSEL(1.0,0.0,0.5,0.0)
      JTIC=0
 1020 JTIC=JTIC+1
      IF (YR.GT.YRANGE(JTIC)) GOTO 1020
      IF (YTICK(JTIC).LT.1) THEN
      CALL ANNFIX(4,1)
      ELSE
      CALL ANNINT(4)
      ENDIF
C Draw secondary Y axis if L>1 :
      IF (L.GT.1) CALL GRISEL(0,3,0)
      CALL AXILB2(YTICK(JTIC),NTICK(JTIC),2)
      IF (L.GT.1) CALL GRISEL(3,0,0)
      Y1=YP9(K1)+YR/30
      IF (L.EQ.1) TIME1=TIME0+0.2
      IF (L.GT.1) TIME1=TIME0+0.8*(TIME9-TIME0)
      CALL TEXLA2(TIME1,Y1,YNAME(K1),1,20,1)
      IF (K1.EQ.1) THEN
C Put o in Degrees C :
      TNAME='.                '
      TNAME(13:13)=CHAR(24)
      CALL CHSETS(3)
      CALL TEXLA2(TIME1,Y1,TNAME,1,20,1)
```

```
      CALL CHSETS(-1)
      ENDIF
      CALL LINSEL(1)
      CALL MARSEL(0)
C Plot second variable N2(K) as dotted line, if requested :
      DO 1200 J=1,J9
 1200 YC(J)=Y(J,K1)
      IF (L.GT.1) CALL LNSETS(2)
      CALL PLOLA2(TIME,YC,J9)
      IF (L.GT.1) CALL LNSETS(1)
 1800 CONTINUE
C
 2000 CONTINUE
      CALL PAGEND
      CALL GCLOSE
      WRITE(6,'(1X,A80)') ALINE
 9000 STOP
      END
```

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