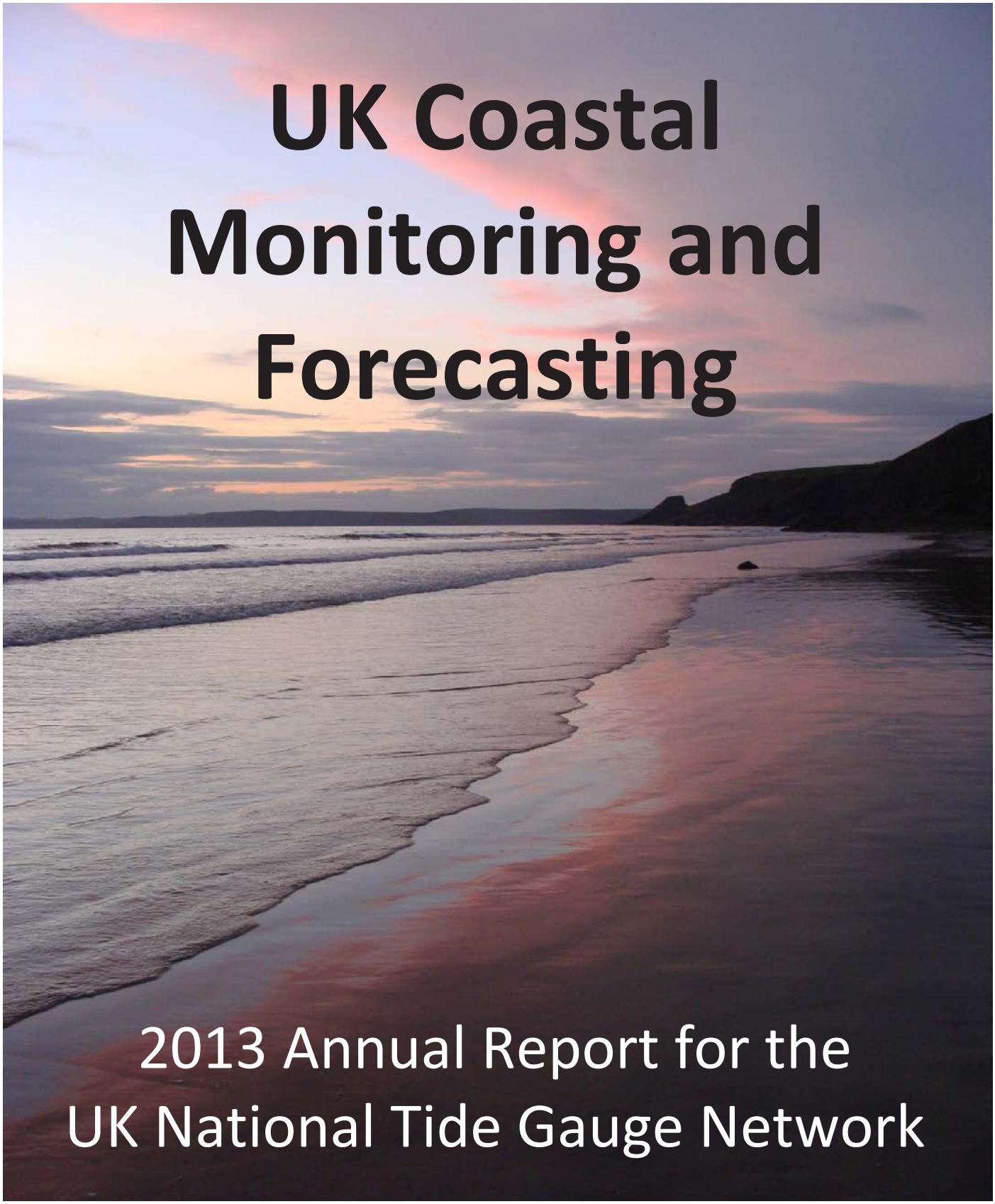

UK Coastal Monitoring and Forecasting

2013 Annual Report for the UK National Tide Gauge Network

British Oceanographic Data Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

Environment Agency

NERC SCIENCE OF THE ENVIRONMENT

Cyfoeth Naturiol Cymru
Natural Resources Wales

RIVERS Agency

SEPA
Scottish Environment Protection Agency

National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNC

UK Coastal Monitoring and Forecasting: Annual Report for 2013 for the UK National Tide Gauge Network

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Thanks also to all those involved in maintenance of the network, data retrieval, processing, quality control and delivery.

Contents

Foreword

UK Coastal Monitoring and Forecasting (UKCMF) is a partnership between the Environment Agency, Scottish Environment Protection Agency, Natural Resources Wales and Rivers Agency Northern Ireland. Working in partnership, we define the standards and performance for coastal flood forecasting and monitoring for the UK. We use the same strategic coastal models and data sources as inputs to locally developed systems to provide the operational flood forecasting and monitoring service within each of our national boundaries.

Central to UKCMF is the UK strategic Tide Gauge Network. This network consists of 43 strategically important tide gauges that continually record sea level around the UK coastline. The gauges primary use is in operational coastal flood forecasting but they also provide important data for a variety of other uses such as long-term sea level monitoring studies.

The data from the network is Quality Controlled and archived by British Oceanographic Data Centre from where it is freely available (https://www.bodc.ac.uk/data/online_delivery/ntslf)

BODC work with UKCMF ensuring that data from our strategic tide gauge network is checked and archived to a common internationally recognised standard and that the archive record is easily accessible for all those that want to use it.

This annual report for 2013 explains the data management and quality control processes undertaken, gives details and maps of the location of each gauge, and statistics of the data at each site. The statistics include a monthly summary of the data completeness and quality throughout the year for each site. Also included is a summary of data downloads from the website for the entire UKCMF gauge network. I hope you find it both interesting and useful.

Liz Anspoks
National Flood Forecasting Manager – Environment Agency
UKCMF Leadership Group Chair

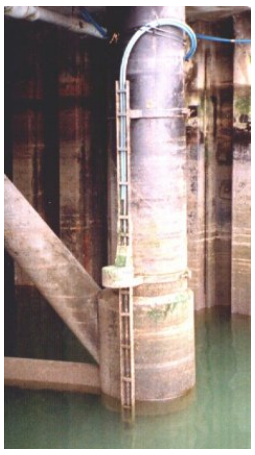
Tide Gauge Instruments

Full-tide Bubbler

The full tide bubbler system normally consists of two independent measuring systems. The pressure points are mounted approx 1m below Admiralty Chart Datum (ACD) so that negative surges can be recorded. The pressure points visible underwater in the photograph resemble an inverted bucket with a copper nozzle mounted on the side. This nozzle is the actual measuring point. A low flow of dry air (normally 7ml/min) is fed down an air tube to the top of the pressure point. When the air pressure in the tube equals the pressure exerted by the column of water above it, then the excess air is released as bubbles through the nozzle. This means the pressure in the air line is proportional to the weight of the water column.

Mid-tide Bubbler

The operation of the mid tide bubbler is similar to that of the full-tide system, except that the measuring point is mounted at the mid tide height. This means that the pressure point is only immersed for half of the tidal cycle. This is so that when the measuring point is exposed as in the photograph it can be levelled accurately into the geodetic network. Once this is accomplished the full tide pressure points can be fitted to match the tidal curve produced by the mid tide pressure point, thereby connecting them to the geodetic network.

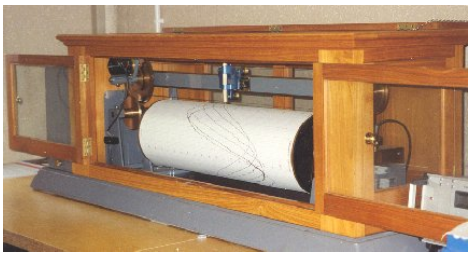


Pressure Transducer

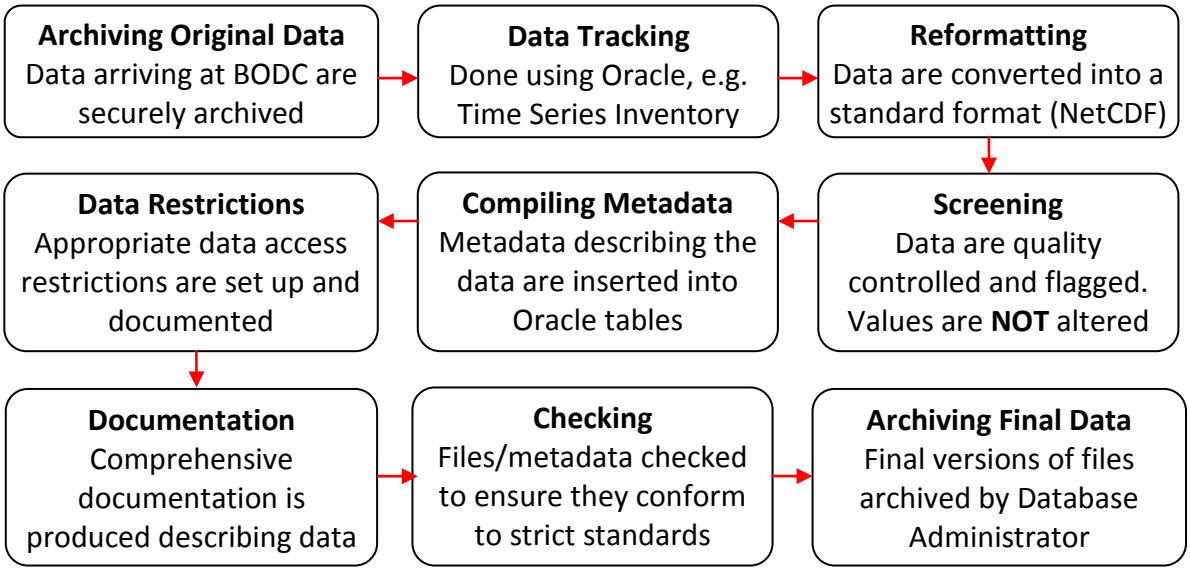
These are differential transducers contained in a watertight housing. The reference port is vented to atmosphere via the power supply and signal cable tube, while the measuring port of the transducer is connected to a copper outlet nozzle on the top of the transducer housing. The nozzle, transducer measuring port and connecting tube are filled with oil. The pressure is transmitted to the crystal element via the oil, keeping the transducer components free from the effects of the saltwater.

Munro Float Gauge

The Munro gauge measures sea level using a float in a stilling well. The float is about 45cm in diameter - the large diameter reduces inevitable errors in buoyancy due to friction of the gearing and small changes in the length of float wire. This wire is coiled round a drum on the end of the gauge. Another drum contains a counterbalance wire. The drum is geared to a slotted tape attached to a pen carriage, which traces the tide curve on the chart. A precision potentiometer is attached to the gauge to provide an input to the data logger.



Data Processing



Flowchart summarising BODC data processing steps

Data arrive at BODC every week, where they are screened. The data are reviewed and then uploaded to the BODC website each month. They are reviewed annually before being banked (archived) in BODC's National Oceanographic Database. This process is described in more detail below.

Quality Control

All data arriving at BODC are converted to a common standard format. This makes storage and distribution much easier and ensures that parameter codes, flags, units, absent data values, etc, are consistent between different sources. We use a platform-independent binary format called QXF, a sub-set of NetCDF.

Data are quality-controlled weekly, monthly and annually using in-house software. This involves inspecting both recorded values and non-tidal residuals. Examining residuals is especially useful for detecting instrument faults (timing errors, datum shifts, spikes). Harmonic constants may be severely corrupted if the site has highly nonlinear tides, or is influenced by rivers/estuaries or particularly complex basin configuration. To produce more accurate predicted tides, we compute 'fresh' tidal constants from recent data, using Doodson harmonic analysis, rather than just relying upon historical values.

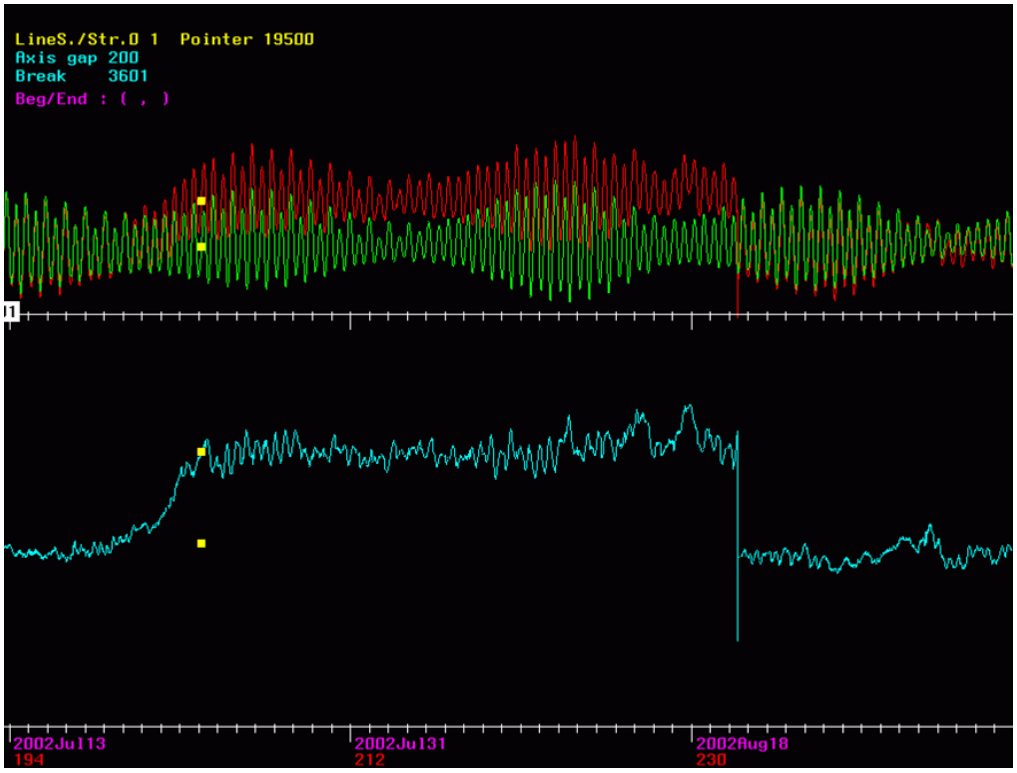
The standard procedure at BODC for the weekly quality control of sea level data includes, where possible:

- Screening the series, looking for spikes, gaps, timing errors and datum shifts
- Screening the series with previous series from the same site
- Screening the series with neighbouring stations covering the same period
- Displaying other parameters, such as sea temperature and atmospheric pressure, to aid quality control

Monthly processing includes checking the statistics produced, e.g., mean sea level, with those produced in previous years.

The annual quality-control process involves producing a tidal analysis and comparing M2, S2, N2, K1, O1 and Z0 constituents with previous data series, adjacent sites and the Admiralty Tide Tables for the closest site.

Data values are considered suspicious if the measured value differs by more than approximately 20mm (for a site of average tidal range) from either the mid-tide channel (if one exists at the site) or the predicted value. The person screening the data will often have to use their own judgement. Suspicious data points are flagged '**M**' and any timing errors or datum shifts are noted. An '**N**' flag is assigned to those values that are null. No data values are changed. The data quality is noted in accompanying documentation.



Screenshot of BODC visualisation software showing data, analysis and residual
(Legend: Tidal observations (m), Tidal predictions (m) and Residual (m))

Metadata and Documentation

Additional information (metadata) is needed not only for quality control and archiving, but also for exchanging data or integrating them into a regional or global data set. Basic metadata quality control includes checking that, for example, latitude and longitude or start/end dates of records are reasonable.

Sufficient documentation should accompany each data series to ensure that the data can be used with confidence by a secondary user. This documentation should be stored alongside the data, and where applicable, should cover:

Site information

- Brief description of location of tide gauge peculiar characteristics of the tide gauge site (for example, complex local geography, seiching, silting of the harbour, river mouths) (including maps, photos)
- Description of tide gauge benchmarks, their history and method of determination (including maps, photos)
- Datum relationships - Measurements must be relative to a fixed and permanent local tide gauge bench mark (TGBM). This should be connected to auxiliary marks to guard against its movement or destruction. Connections between the TGBM and the gauge zero should be made to an accuracy of a few millimetres regularly (e.g. annually)

Data sampling and processing details

- Sampling scheme e.g. continuous recording, instantaneous, averaged
- Interval between samples and duration of individual samples (raw data)
- Nominal interval of processed data
- Gaps in the data record
- Timing and/or datum corrections applied
- De-spiking/smoothing/interpolating methods and editing procedures

Instrument information

- Instrument description, manufacturer, model, principle of measurement, method of recording - refer to publication or briefly describe
- Instrument modifications and their effect on the data
- Method and times of calibration, calibration factors
- Frequency of cleaning, control of biological fouling
- Operational history
- Pertinent instrument characteristics; for example, for a conventional stilling well, information should include well diameter, orifice depth below mean water level and orifice height above sea bed; for a bubbler gauge - tube length, tube diameter, orifice diameter, density value used to convert to elevation, acceleration due to gravity and the formula used to compensate for tube length.

Auditing and Banking

The metadata and documentation are checked before banking. A Matlab script cross-references the data header files against the metadata to ensure no data-entry errors have been made. Another script checks the data files to make sure timing errors, out-of-range values and nulls have been dealt with.

Datasets that have been completely processed are audited. A second data scientist completes a series of final checks. Any differences of opinion are highlighted and re-examined. Files are then archived and marked as 'banked'. Finally, monthly files are concatenated into yearly files and the yearly file metadata are banked in a database.

Calculating Statistics

Edserplo calculates four types of summary information

- a history of when the tide gauge has been in operation (“history”)
- monthly extremes (“extremes”)
- monthly extreme surges (“surges”)
- monthly and daily mean sea level (“MSL”)

Gaps greater than 4.1 hours in the primary channel are registered as gaps in the history.

Extremes are the maximum and minimum calculated over all sampled data during the month. This excludes any interpolated data but may include rapidly sampled data. Extreme surges (residuals) are calculated in the same way from tidal residuals. Tidal residuals are defined to be the measured water level minus the predicted tide. The predictions derive from the database of tidal constants maintained by NOC’s Applications Group (as defined at the time of the calculation) for the ports of the UK and elsewhere.

Mean Sea Level is calculated from a filter working on quarter-hourly values derived from one or more cubic splines applied to the raw data. The filter is a convolution of Vassie’s 03B filter, which converts 15-minute data to hourly values, and Doodson’s X0 filter. Splines are not applied across gaps as defined above. Short gaps can therefore lead to the loss of a day of output data (the half length of the filter is 91 and a day is 96 samples). Provided there are some daily (@12:00Z) values these are then averaged to provide the monthly value.

The Permanent Service for Mean Sea Level (PSMSL) recommend refraining from computing a mean sea level value there isn't sufficient data available. Consequently, the monthly statistics given in this report do not feature a mean sea level value for any month where more than 15 days of data are missing (the values given for extremes and surges for these months should be treated with caution). Similarly, there is no yearly mean sea level figure given if more than two monthly mean values are missing. If there are 11 monthly means available, the annual mean is calculated from a weighted average of these (the weight for each month being the number of days for which readings exist).

UK Tide Gauge Network Map

Image ©2012 Aerodata International Surveys
Image ©2012 TerraMetrics
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
©2012 Cnes/Spot Image

UK Tide Gauge Data Completeness (%), January to December 2013

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Aberdeen	100	100	100	100	100	100	100	100	100	100	100	100
Bangor	100	100	100	100	100	100	100	100	100	100	100	100
Barmouth	100	100	100	100	100	100	100	100	100	100	100	100
Bournemouth	100	100	100	100	100	100	100	100	100	100	100	100
Cromer	100	100	100	100	100	100	100	100	100	100	100	100
Devonport	100	100	100	100	100	100	100	100	100	100	100	100
Dover	79	100	100	100	100	100	100	100	100	100	100	100
Fishguard	100	100	100	100	100	100	100	100	100	100	100	100
Harwich	100	100	100	100	100	100	100	100	100	100	100	100
Heysham	100	100	100	100	100	100	100	100	100	100	100	100
Hinkley Point	100	100	100	100	100	100	100	100	100	100	100	100
Holyhead	100	100	100	100	100	100	100	100	100	100	100	100
IOM Port Erin	100	100	100	100	100	100	100	100	100	100	100	99
Islay Port Ellen	0	0	0	0	0	0	0	0	0	0	0	0
Ilfracombe	100	100	100	100	100	100	100	100	100	100	100	100
Immingham	100	100	100	100	100	100	100	100	100	100	100	100
Jersey	100	100	100	100	100	100	100	100	100	100	100	100
Kinlochbervie	100	100	100	100	100	100	100	100	100	100	100	100
Leith	100	100	100	100	100	100	100	100	100	100	100	100
Lerwick	100	100	100	100	100	100	100	100	100	100	100	100
Liverpool	100	100	100	100	100	100	100	100	100	100	100	100
Llandudno	100	100	100	100	100	100	100	100	100	100	100	100
Lowestoft	100	100	100	100	100	100	100	100	100	100	100	100
Milford Haven	100	100	100	100	100	100	100	100	100	100	100	100
Millport	100	100	100	100	100	100	100	100	100	100	100	100
Mumbles	100	100	100	100	100	100	100	100	100	100	100	100
Newhaven	100	100	100	99	100	100	100	100	100	100	100	100
Newlyn	100	100	100	100	100	100	100	100	100	100	100	100
Newport	100	100	100	100	100	100	100	100	100	100	100	100
North Shields	100	100	100	100	100	100	100	100	100	100	100	100
Portbury	100	100	100	100	100	100	100	100	100	100	100	90
Portpatrick	100	100	100	100	100	100	100	100	100	100	100	100
Portrush	100	100	100	100	100	100	100	100	100	100	100	100
Portsmouth	100	100	100	100	100	100	100	100	100	100	100	100
Sheerness	100	100	100	100	100	100	100	100	100	100	100	100
St Marys	100	100	99	100	100	100	100	100	100	100	100	100
Stornoway	100	100	100	100	100	100	100	79	100	100	100	100
Tobermory	100	100	100	100	100	100	100	100	100	100	100	100
Ullapool	100	100	100	100	100	100	100	100	100	100	100	100
Weymouth	100	100	100	100	100	100	100	100	100	100	100	100
Whitby	100	100	100	100	100	100	100	100	100	100	100	100
Wick	100	100	100	99	100	100	100	100	100	100	100	100
Workington	100	100	100	100	100	100	100	100	100	100	100	100

Notes

- Completeness refers to whether data was received, regardless of its quality.
- Statistics were compiled using monthly values from the better of each site's channels (statistics for the transfer channel are only available for part of the year).
- No data was collected at Islay as the gauge has been removed from the network. Work on a replacement installation is ongoing.

UK Tide Gauge Data Quality (%), January to December 2013

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Aberdeen	73	100	100	100	100	100	100	100	100	100	100	100
Bangor	78	100	100	100	100	100	100	100	100	100	100	99
Barmouth	38	54	80	72	100	99	100	100	100	98	100	100
Bournemouth	100	100	98	96	95	100	100	100	100	87	0	0
Cromer	100	95	94	99	100	100	100	94	71	88	90	97
Devonport	100	100	100	100	100	100	100	100	100	100	100	100
Dover	99	100	100	100	100	99	100	100	100	100	100	100
Fishguard	0	0	0	0	0	0	43	100	100	100	99	99
Harwich	100	100	100	100	100	100	100	100	100	100	100	99
Heysham	100	99	100	100	100	100	86	65	92	100	97	100
Hinkley Point	98	90	91	95	93	100	94	98	99	100	96	98
Holyhead	100	100	100	100	100	99	100	100	100	100	100	100
IOM Port Erin	99	100	100	100	100	100	100	100	100	99	100	100
Islay Port Ellen	0	0	0	0	0	0	0	0	0	0	0	0
Ilfracombe	98	99	96	100	100	100	100	100	100	100	98	99
Immingham	100	100	100	100	100	100	100	100	100	100	99	68
Jersey	100	100	100	100	100	100	100	100	100	100	100	100
Kinlochbervie	100	100	100	100	100	100	99	100	100	100	100	100
Leith	100	99	100	100	99	100	100	100	100	100	100	100
Lerwick	100	100	100	100	100	100	100	100	100	100	100	100
Liverpool	100	100	100	100	4	0	0	27	100	100	77	71
Llandudno	100	100	100	100	100	99	99	97	99	100	93	99
Lowestoft	100	100	100	100	100	100	100	100	100	100	100	99
Milford Haven	100	100	99	100	100	100	100	100	100	100	100	100
Millport	100	99	100	100	100	100	100	100	100	100	100	100
Mumbles	100	100	100	100	100	100	100	100	100	100	100	99
Newhaven	100	100	100	100	100	99	100	100	100	100	100	99
Newlyn	100	100	100	100	100	100	100	100	100	99	91	100
Newport	100	99	86	100	100	100	100	100	100	100	100	96
North Shields	100	99	100	100	99	100	100	100	100	100	100	100
Portbury	99	100	100	100	100	100	100	100	100	99	99	45
Portpatrick	100	99	100	100	100	100	100	100	100	100	100	100
Portrush	99	100	100	100	100	100	100	100	99	100	100	100
Portsmouth	100	100	100	100	100	100	100	100	100	100	100	100
Sheerness	99	100	100	100	100	99	100	100	100	100	100	100
St Marys	95	94	76	73	0	0	0	0	0	0	52	91
Stornoway	100	100	99	100	100	100	100	89	100	100	100	99
Tobermory	100	100	99	100	100	100	100	100	100	100	100	100
Ullapool	99	100	99	100	100	100	99	100	100	100	100	100
Weymouth	99	100	100	100	100	100	100	99	99	100	100	100
Whitby	99	98	100	99	99	99	99	99	99	100	99	100
Wick	99	98	100	99	99	99	99	99	99	100	99	100
Workington	100	100	100	100	100	100	97	100	100	100	100	100

Notes

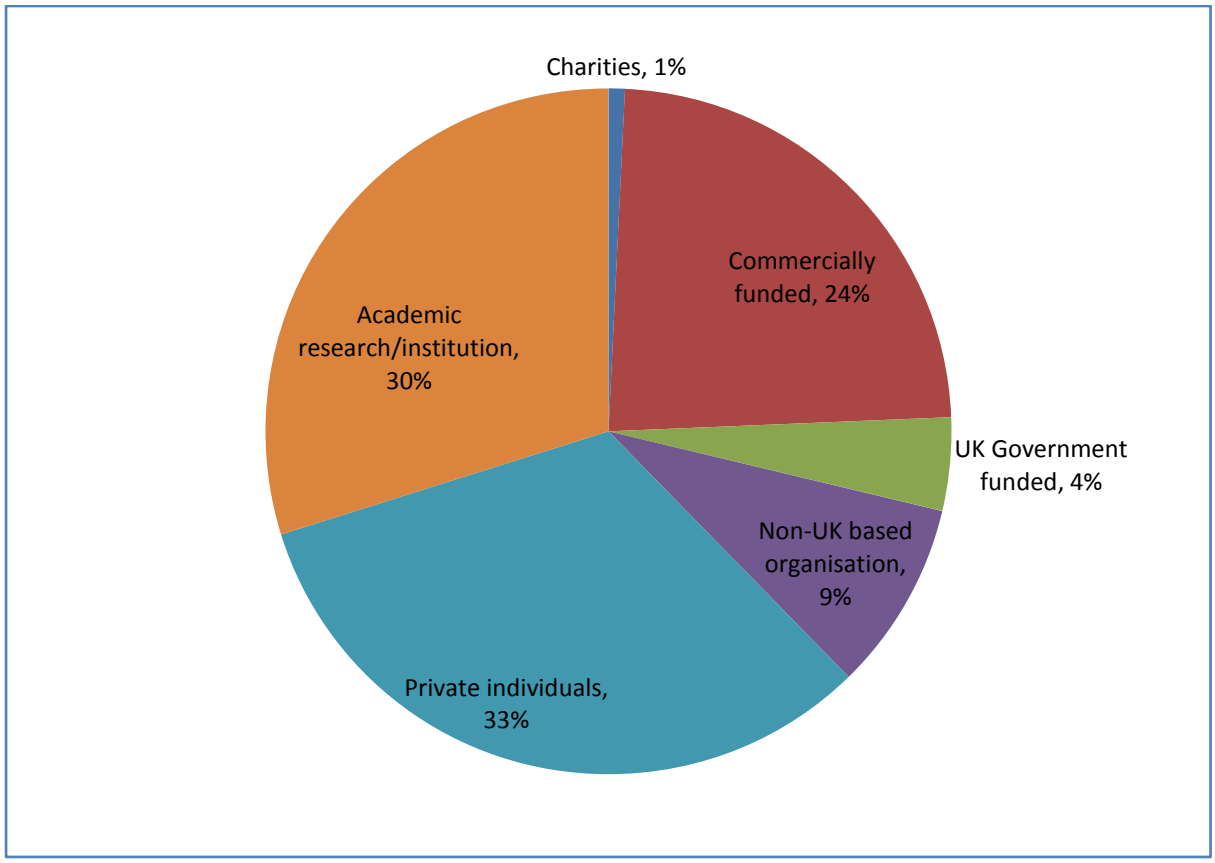
- Quality refers to the proportion of present data that meet BODC's quality standards (see 'Quality Control', Page 6)
- Statistics were compiled using monthly values from the better of each site's channels (statistics for the transfer channel are only available for part of the year).
- Data quality issues are described and explained on the individual site pages.
- No data was collected at Islay as the gauge has been removed from the network. Work on a replacement installation is ongoing.

Requests for UKCMF Sea Level Data, January to December 2013

Site	TOTAL Downloads	Heights		Surges		Extremes		Means	
		No of Downloads	Site Years	No of Downloads	Site Years	No of Downloads	Site Years	No of Downloads	Site Years
Aberdeen	331	161	1668.24	60	815.16	54	360.25	56	396
Avonmouth	221	134	661.83	24	140	26	164.17	37	299
Bangor	117	56	164.08	18	47.5	22	105.5	21	69.25
Barmouth	113	45	212.08	21	84.83	27	153.83	20	106.5
Bournemouth	141	73	241.16	19	113.92	25	184.92	24	145.58
Cromer	143	77	330.66	19	78.66	27	244.25	20	73.08
Devonport	302	156	345.73	43	177.41	51	299.24	52	163.83
Dover	266	152	1323.49	35	235.58	42	375.33	37	407.92
Fishguard	55	43	333.08	3	14	5	58	4	23
Harwich	158	74	378.99	27	47.75	32	95.91	25	50.58
Heysham	169	79	828.16	21	71.08	48	560.5	21	70.08
Hinkley Point	153	83	514	21	128.17	28	243.17	21	106.17
Holyhead	125	67	373.58	17	74.75	24	158.75	17	72.75
IOM Port Erin	70	34	133.25	11	14.92	13	71.92	12	15.92
Islay Port Ellen	37	18	156	5	13	8	56	6	36
Ilfracombe	100	61	339.58	11	36.83	16	119.83	12	36.83
Immingham	177	93	788.16	26	152	30	214.42	28	167.08
Jersey	119	59	306.41	19	120.17	22	142.92	19	119.33
Kinlochbervie	81	42	166.33	13	55.67	14	115.58	12	94.08
Leith	130	61	400.67	18	105.67	24	187.08	27	204.83
Lerwick	144	69	602.83	23	97.58	25	139.25	27	196.75
Liverpool	299	145	523.82	48	128.25	59	194.5	47	129.33
Llandudno	113	56	314.92	16	75.67	25	175.5	16	57.67
Lowestoft	197	94	1010	31	187.42	40	373	32	166.67
Milford Haven	101	43	352.92	18	31.75	21	114.17	19	58.75
Millport	56	25	191.58	9	41.08	12	87.25	10	63.25
Mumbles	141	63	284.25	25	126.33	27	147.33	26	102.42
Newhaven	150	73	436.92	26	132.75	28	228.17	23	92.58
Newlyn	199	126	939.83	20	85.5	26	222.5	27	229.16
Newport	157	94	283.82	19	88.25	21	129.25	23	127.58
North Shields	139	75	757.25	16	125.5	26	329	22	194.67
Portpatrick	53	33	282.5	6	16	8	60	6	27
Portrush	67	41	126.5	8	20.75	10	56.75	8	22.5
Portsmouth	234	109	395.75	34	311.92	48	389.83	43	464.08
Sheerness	173	87	938.66	27	233	35	322	24	199
St Marys	92	51	187.16	13	37.08	15	75.08	13	37.08
Stornoway	88	46	258.08	13	39.92	14	61.58	15	81.92
Tobermory	78	35	142.58	12	39.58	15	88.58	16	66.83
Ullapool	74	33	340.75	11	78.75	14	127.75	16	175.08
Weymouth	153	80	249.91	20	96.25	30	273.92	23	102.67
Whitby	162	74	611.91	29	314.41	31	376.92	28	246.58
Wick	133	68	559	18	122.25	20	166.25	27	314.33
Workington	136	61	279.58	21	37.75	26	123.67	28	68.33
TOTALS	**6110**	**3131**	**19580**	**889**	**4981.81**	**1106**	**8117.82**	**984**	**5846.04**

'Download' is defined here as a request for a data set of a specific type for a single site. One data request may be for multiple data sets of different types from more than one site.

Requests for UKCMF Sea Level Data for 2013 by User Category



Aberdeen – Tide Gauge Information

Latitude 57° 08' 38.5" N **Longitude** 02° 04' 38.5" W **Grid Ref** NJ 9525 0591

Instrument Data acquisition system with two full tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Waterloo Quay
Measuring Points The South West corner of Telford Dock

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	NJ 9525 0590	New bolt N side jetty Waterloo Quay
Aux1	NJ 9572 0593	Building NW side York Place SE face E angle
Aux2	NJ 9586 0571	Observatory Pocra Quay N face NW angle
Aux3	NJ 9524 0600	Building NE side Waterloo Quay SW face S angle

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.25m below Ordnance Datum Newlyn (ODN)
TGZ = 6.318m below TGBM

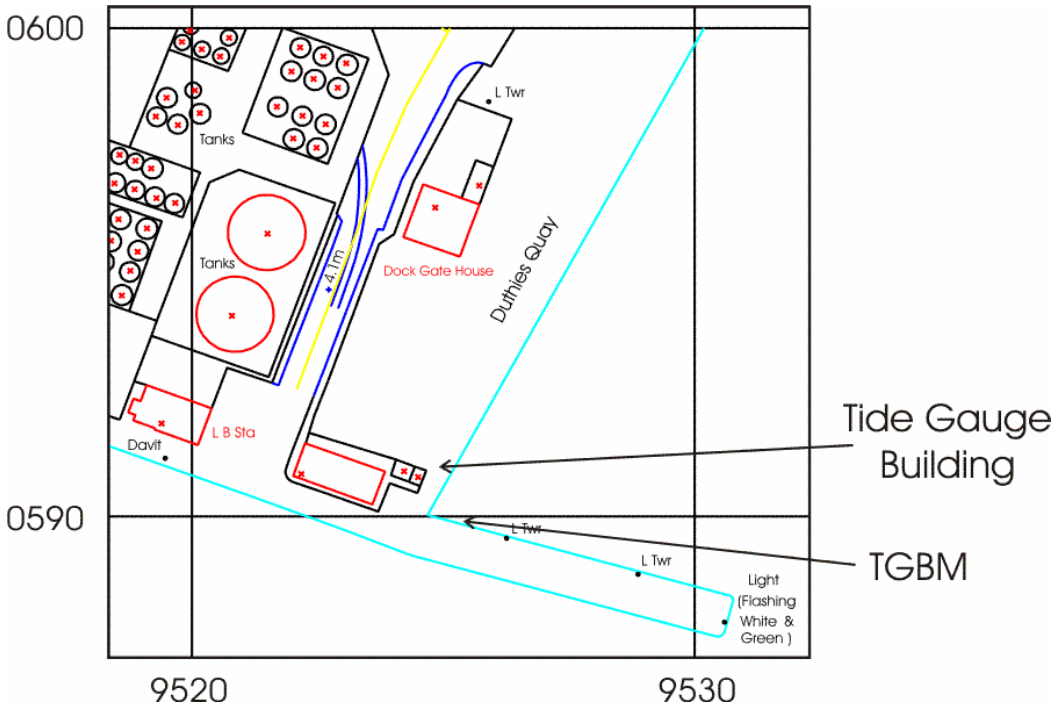
Levelling No levelling was carried out in 2013

Site visits

03/05/2013 (Day 123)	Carried out general maintenance, changed compressor and investigated BT line fault

Notes on Data Quality
The site was dived on in October 2012 and the blocking nozzle/fittings were cleaned and cleared. Subsequently the channels were reading ~40-60mm high. This was acceptable for operational purposes but not for monitoring long-term sea level trends. The channels were realigned with the mid tide sensor in January 2013.

Aberdeen – Map & Images of Site



Tide gauge location

Aerial view of site

Aberdeen – Statistics

Surge maxima	Value	Day	Time
January	0.844	30	09:30:00
February	0.556	04	13:45:00
March	0.218	18	23:00:00
April	0.521	15	14:45:00
May	0.214	10	04:30:00
June	0.249	22	23:45:00
July	0.211	01	04:15:00
August	0.419	18	05:15:00
September	0.159	02	01:45:00
October	0.469	28	05:45:00
November	0.355	01	23:00:00
December	0.777	19	12:45:00

Surge minima	Value	Day	Time
January	-0.359	22	19:00:00
February	-0.486	13	23:30:00
March	-0.361	01	11:45:00
April	-0.252	30	15:30:00
May	-0.295	03	00:30:00
June	-0.268	04	05:00:00
July	-0.281	08	09:30:00
August	-0.182	22	10:15:00
September	-0.134	03	09:45:00
October	-0.311	11	11:30:00
November	-0.438	30	06:00:00
December	-0.482	06	23:30:00

Extreme maxima	Value	Day	Time
January	4.72	29	14:30:00
February	4.426	01	16:30:00
March	4.45	12	13:45:00
April	4.472	28	15:00:00
May	4.53	27	14:45:00
June	4.487	23	00:30:00
July	4.656	25	02:30:00
August	4.613	24	03:00:00
September	3.958	03	23:45:00
October	4.571	07	02:00:00
November	4.745	05	14:00:00
December	5.229	05	15:00:00

Extreme minima	Value	Day	Time
January	0.088	13	20:30:00
February	0.072	11	20:15:00
March	0.264	28	20:15:00
April	0.263	26	19:30:00
May	0.365	24	18:30:00
June	0.076	26	09:15:00
July	0.153	24	08:00:00
August	0.117	22	07:45:00
September	1.063	03	05:45:00
October	0.503	18	06:30:00
November	0.68	15	05:15:00
December	0.309	06	21:30:00

Mean sea level	Days	MSL
January	20	2.561
February	28	2.433
March	31	2.404
April	30	2.499
May	31	2.461
June	30	2.433
July	31	2.486
August	31	2.551
September	2	*
October	31	2.637
November	30	2.611
December	31	2.752
	Sum	Avg
	295	2.530

* No mean sea level value as more than 15 days of data missing

Bangor – Tide Gauge Information

Latitude 54° 39' 53.1" N **Longitude** 05° 40' 10.1" W **Grid Ref** NW 6340 3620

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Central Pier at Bangor Marina
Measuring Points The seaward side of the open pier, directly beneath the tide gauge building

Datum All data refer to Admiralty Chart Datum (ACD)

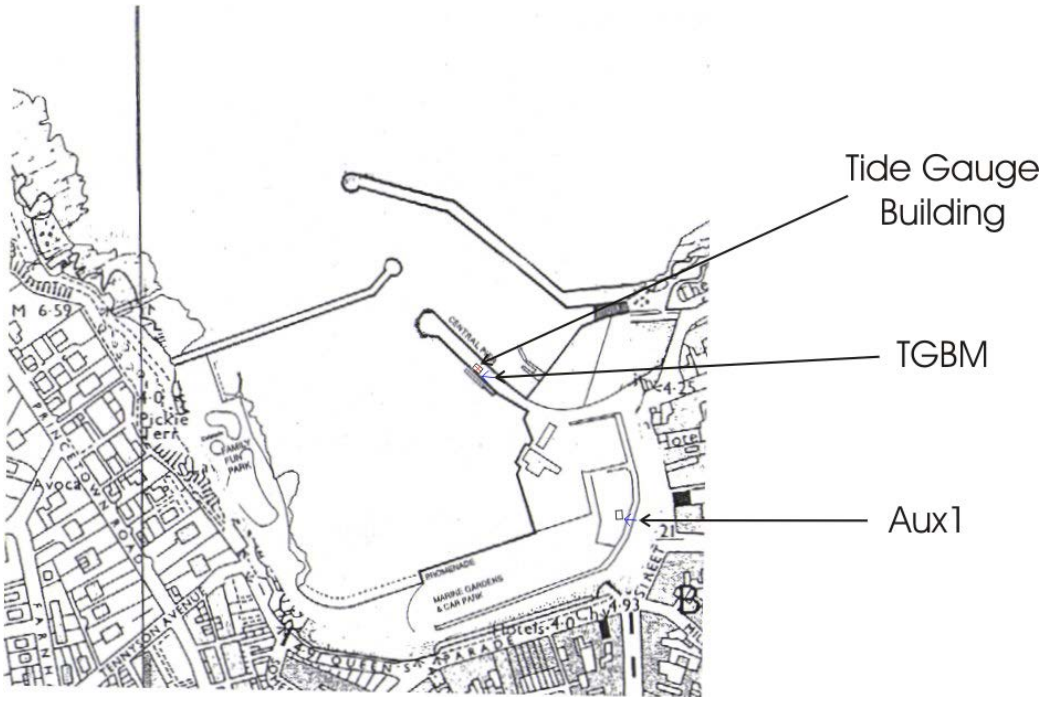
Benchmark	Grid Ref	Description
TGBM	5043 8212 (Sheet 115)	S S Pin Tide gauge building Central Pier
Aux1	5038 8200 (Sheet 115)	Cut mark Clock tower

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.01m below Ordnance Datum Belfast (ODB)
TGZ = 5.592m below TGBM

Levelling Site was levelled by TGI on 11/09/2013

Site visits
15/01/2013 (Day 015) Attempted to clear blocked channel
11/09/2013 (Day 254) Carried out general maintenance and dive to investigate blocked channel

Bangor – Map & Images of Site



Bangor – Statistics

Surge maxima	Value	Day	Time
January	0.764	28	22:30:00
February	0.441	4	08:30:00
March	0.299	15	11:30:00
April	0.775	17	23:00:00
May	0.417	9	16:15:00
June	0.359	14	23:00:00
July	0.277	2	16:15:00
August	0.436	17	17:15:00
September	0.477	15	14:45:00
October	0.633	27	15:00:00
November	0.685	2	16:15:00
December	1.147	27	12:30:00

Surge minima	Value	Day	Time
January	-0.276	6	04:00:00
February	-0.676	6	06:15:00
March	-0.369	1	00:15:00
April	-0.422	27	11:30:00
May	-0.375	24	21:45:00
June	-0.332	23	22:45:00
July	-0.286	8	09:30:00
August	-0.263	31	05:45:00
September	-0.304	10	13:00:00
October	-0.358	10	03:15:00
November	-0.801	21	00:15:00
December	-0.517	6	00:00:00

Extreme maxima	Value	Day	Time
January	4.078	31	13:45:00
February	3.847	13	13:00:00
March	3.684	15	13:15:00
April	3.849	15	01:45:00
May	3.784	27	12:30:00
June	3.646	22	09:45:00
July	3.821	26	01:15:00
August	3.718	23	00:00:00
September	3.696	20	23:30:00
October	3.887	22	13:00:00
November	3.923	2	21:45:00
December	4.133	23	14:45:00

Extreme minima	Value	Day	Time
January	0.313	11	16:30:00
February	0.024	11	17:45:00
March	0.213	1	19:15:00
April	0.065	27	05:45:00
May	0.182	29	08:00:00
June	0.047	26	07:00:00
July	0.268	24	05:45:00
August	0.242	22	05:30:00
September	0.262	20	05:00:00
October	0.483	10	08:00:00
November	0.314	21	19:00:00
December	0.298	4	17:45:00

Mean sea level	Days	MSL
January	22	2.157
February	28	1.940
March	31	1.988
April	30	2.017
May	31	1.966
June	30	1.941
July	31	1.980
August	31	2.043
September	30	2.026
October	31	2.190
November	30	2.032
December	31	2.279
	Sum	Avg
	356	2.047

Barmouth – Tide Gauge Information

Latitude 52° 43' 09.6" N **Longitude** 04° 02' 42.1" W **Grid Ref** SH 6197 1548

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Toll booth on the north end of Barmouth railway bridge
Measuring Points Attached to the first leg of the railway bridge in the deep channel

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	SH 6197 1548	NBM rivet concrete 2.9M NE wall junction
Aux 1	SH 6173 1558	Rivet step NE side of road NW entrance path
Aux 2	SH 6186 1556	Rivet wall SE side road 17.6M E steps
Aux 3	SH 6196 1550	Rivet step E side lifeboat station

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.44m below ODN
TGZ = 10.363m below TGBM

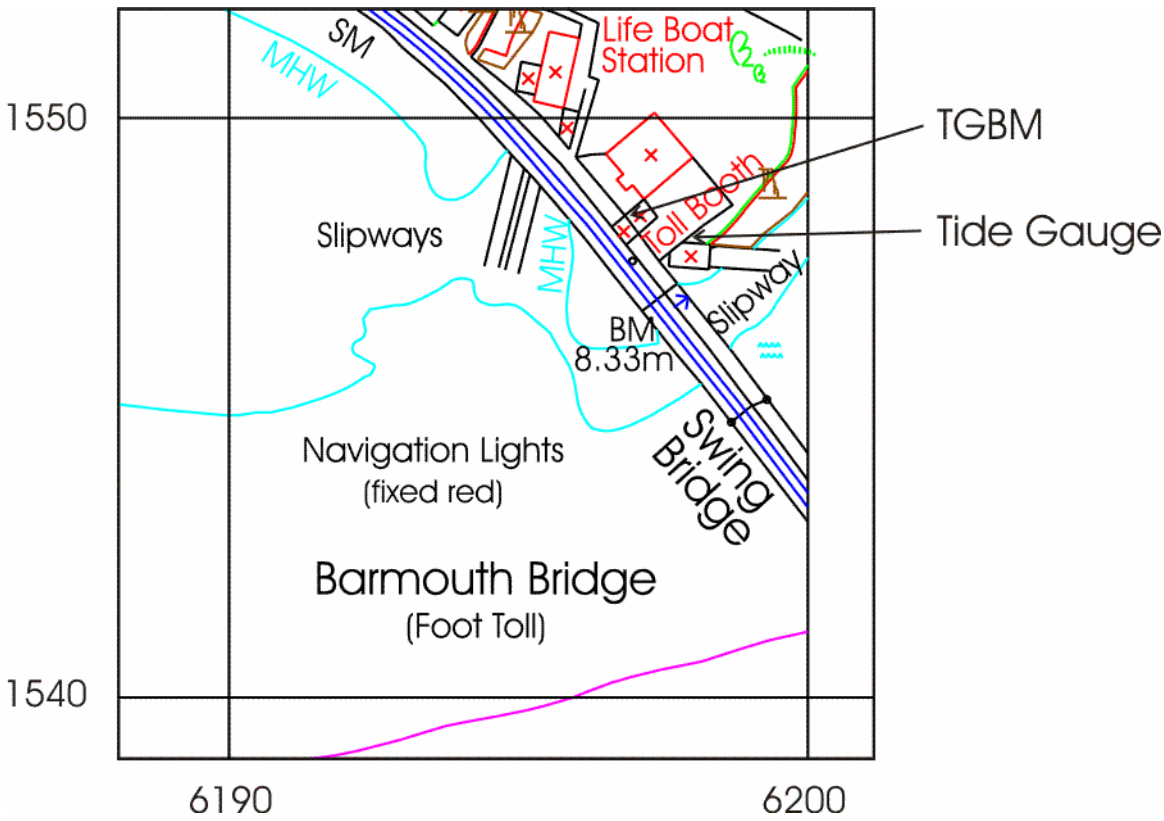
Levelling No levelling was carried out in 2013

Site visits

09/02/2013 (Day 040)	Investigated damage to pressure points
12/02/2013 (Day 043)	Carried out temporary repair to pressure points
09/04/2013 (Day 099)	Changed compressor and restarted power, which had been accidentally switched off

Notes on Data Quality
On 14/01/2013, the pressure points and mounting steelwork were torn off leaving just the end of the pole and pneumatic tubes loose. A temporary repair was made on 12/02/2013 and the pressure lines were terminated and secured. The local council had inadvertently switched off the power to the tide gauge and misplaced the key to the Toll Booth. At the beginning of April there was no power to the tide gauge building and both channels were flagged. TGI were on site on 09/04/2013 to install a new compressor and reinstate the power.

Barmouth – Map & Images of Site



Barmouth – Statistics

Surge maxima	Value	Day	Time
January	0.31	1	06:15:00
February	0.4	14	05:45:00
March	0.329	15	10:30:00
April	1.027	17	19:15:00
May	0.832	9	12:15:00
June	0.497	14	19:15:00
July	0.382	25	05:00:00
August	0.493	17	16:00:00
September	0.582	15	12:30:00
October	0.866	16	13:45:00
November	1.285	2	15:45:00
December	1.768	27	07:00:00

Surge minima	Value	Day	Time
January	-0.271	12	12:00:00
February	-0.424	26	11:45:00
March	-0.389	1	18:45:00
April	-0.368	27	05:15:00
May	-0.368	24	17:00:00
June	-0.292	26	13:45:00
July	-0.294	7	22:30:00
August	-0.294	31	04:30:00
September	-0.345	10	06:30:00
October	-0.445	11	21:30:00
November	-0.886	20	19:30:00
December	-0.458	1	09:45:00

Extreme maxima	Value	Day	Time
January	5.328	12	08:15:00
February	5.363	13	10:30:00
March	5.361	13	09:15:00
April	5.248	28	22:15:00
May	5.41	27	09:30:00
June	5.278	24	21:00:00
July	5.684	24	21:30:00
August	5.637	22	21:15:00
September	5.528	20	20:45:00
October	5.474	19	20:30:00
November	5.77	5	08:45:00
December	5.853	5	09:30:00

Extreme minima	Value	Day	Time
January	0.82	11	15:30:00
February	0.754	25	03:00:00
March	0.743	13	17:00:00
April	0.739	28	05:00:00
May	0.74	24	14:45:00
June	0.74	25	17:30:00
July	0.742	23	04:00:00
August	0.776	22	16:45:00
September	0.754	22	17:15:00
October	0.802	6	04:15:00
November	0.792	15	01:30:00
December	0.739	3	03:15:00

Mean sea level	Days	MSL
January	9	2.703
February	15	2.582
March	25	2.672
April	21	2.719
May	31	2.652
June	30	2.636
July	31	2.654
August	31	2.715
September	30	2.693
October	29	2.858
November	30	2.686
December	31	2.956
	Sum	Avg
	313	2.711

Bournemouth – Tide Gauge Information

Latitude 50° 42' 51.6" N **Longitude** 01° 52' 29.5" W **Grid Ref** SZ 0893 9053

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Electrical room at the west side of the South Pier
Measuring Points Directly below the electrical room, on a pier leg

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
Aux1	SZ 0869 9066	Cut mark Wall
Aux2	SZ 0893 9083	Cut mark Pillar
REF A	SZ 0893 9052	Steelwork clamp
REF B	SZ 0893 9052	Mid-tide pressure point nozzle

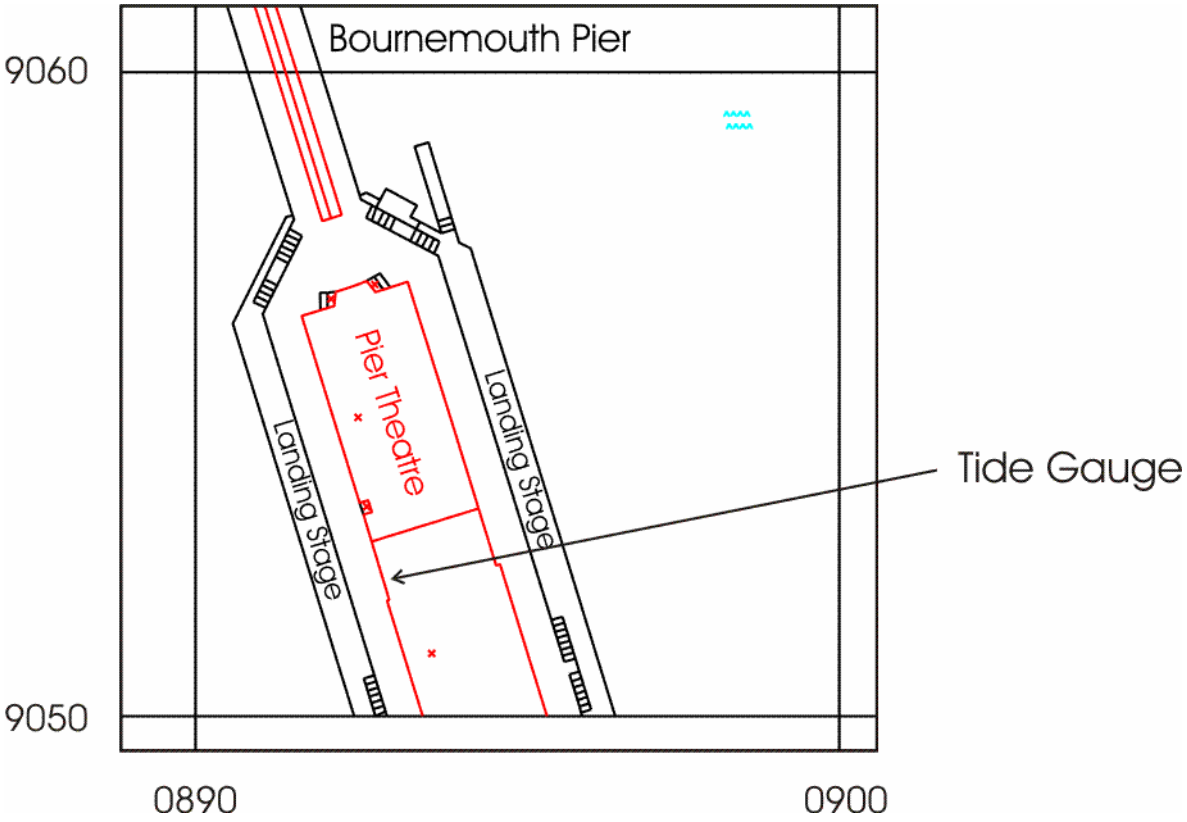
Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 1.40m below ODN
TGZ = 5.96m below Aux1

Levelling No levelling was carried out in 2013

Site visits
12/08/2013 (Day 224) Carried out general maintenance and changed compressor
05/11/2013 (Day 309) Carried out survey of storm damage

Notes on Data Quality
The steelwork was damaged in a storm on the 29/10/2013. TGI attended on 05/11/2013 and confirmed that the lower steelwork section was missing. The refurbishment has been put on hold as a dive is required to survey the damage and measure for new steelwork.

Bournemouth – Map & Images of Site



Bournemouth – Statistics

Surge maxima	Value	Day	Time
January	0.134	13	16:45:00
February	0.118	26	16:15:00
March	0.101	11	15:30:00
April	0.175	27	04:15:00
May	0.22	26	04:00:00
June	0.037	26	05:30:00
July	0.21	24	04:15:00
August	0.183	22	04:15:00
September	0.3	21	04:15:00
October	0.436	6	04:00:00
November			
December			

Surge minima	Value	Day	Time
January	-0.246	21	15:45:00
February	-0.45	14	15:15:00
March	-0.313	11	11:15:00
April	-0.279	20	05:00:00
May	-0.262	1	03:00:00
June	-0.284	26	13:30:00
July	-0.205	8	11:30:00
August	-0.201	31	23:45:00
September	-0.334	15	21:00:00
October	-0.334	11	16:00:00
November			
December			

Extreme maxima	Value	Day	Time
January	2.648	12	08:45:00
February	2.469	10	08:30:00
March	2.454	13	09:45:00
April	2.488	11	21:45:00
May	2.451	27	22:15:00
June	2.356	24	21:30:00
July	2.545	24	22:00:00
August	2.539	22	21:45:00
September	2.447	20	21:15:00
October	2.517	20	09:15:00
November			
December			

Extreme minima	Value	Day	Time
January	0.134	13	16:45:00
February	0.118	26	16:15:00
March	0.101	11	15:30:00
April	0.175	27	04:15:00
May	0.22	26	04:00:00
June	0.037	26	05:30:00
July	0.21	24	04:15:00
August	0.183	22	04:15:00
September	0.3	21	04:15:00
October	0.436	6	04:00:00
November			
December			

Mean sea level	Days	MSL
January	31	1.653
February	28	1.525
March	29	1.606
April	25	1.563
May	27	1.560
June	30	1.544
July	31	1.579
August	31	1.613
September	30	1.623
October	26	1.717
November	0	*
December	0	*
	Sum	Avg
	288	**

* No mean sea level value as more than 15 days of data missing
** No yearly average value as more than one month's MSL missing

Cromer – Tide Gauge Information

Latitude 52° 56' 03.7" N **Longitude** 01° 18' 05.9" E **Grid Ref** TG 2198 4254

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Within Cromer lifeboat station
Measuring Points Attached to a leg of the lifeboat slipway

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	TG 2193 4233	S Steel bolt on top of wall opposite E side of pier
Aux1	TG 2198 4253	Rivet on steps of catwalk NE angle of LB station
Aux2	TG 2195 4233	S Steel bolt bottom ramp S side at W corner

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.75m below Ordnance Datum Newlyn
TGZ = 10.117m below TGBM

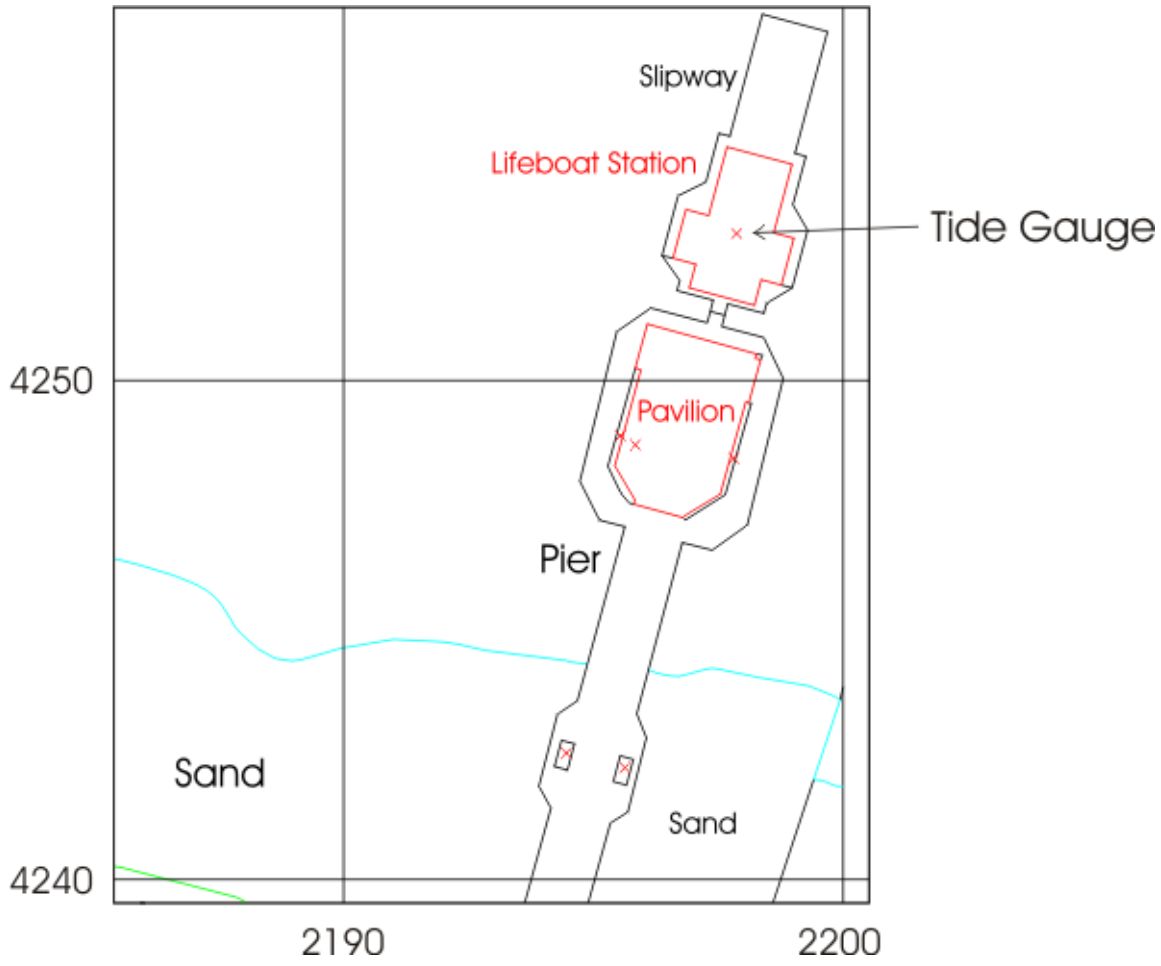
Levelling No levelling was carried out in 2013

Site visits
25/04/2013 (Day 115) Carried out repair of all 3 pneumatic lines and general maintenance
05/12/2013 (Day 339) Changed compressor

Notes on Data Quality
From mid-July 2012 the primary channel was reading ~50mm high, which was acceptable for operational purposes but not for monitoring long-term sea level trends. The secondary channel was available. The mid tide tube had been severed and the full tide tubes were damaged. Channel 1 failed during the repair of the mid tide. The primary channel has been functioning since the site visit in December 2012. In September 2013, channel 2 was ~20mm high at times. The data were acceptable for monitoring extremes but were flagged as unacceptable for the purposes of long-term sea level monitoring. On 10-11/09/2013, there were also issues at site that caused both channels to be flagged.

NB: During surges at high water on spring tides, swells from a certain direction may cause high water to be under-recorded in the two full tide channels. The effect is due to drawdown of air in the pneumatic tubing.

Cromer – Map & Images of Site



Cromer – Statistics

Surge maxima	Value	Day	Time
January	0.969	30	17:00:00
February	0.925	3	20:15:00
March	0.333	13	02:45:00
April	0.556	17	07:30:00
May	0.69	23	21:00:00
June	0.25	23	02:45:00
July	0.343	5	01:15:00
August	0.552	18	12:45:00
September	0.906	16	00:15:00
October			
November	0.767	14	11:15:00
December	1.638	6	04:00:00

Surge minima	Value	Day	Time
January	-0.622	27	09:00:00
February	-1.284	14	05:45:00
March	-0.736	22	12:45:00
April	-0.59	18	07:45:00
May	-0.457	3	08:00:00
June	-0.294	29	20:45:00
July	-0.28	8	15:30:00
August	-0.425	17	19:15:00
September	-0.724	15	16:15:00
October			
November	-1.04	11	10:30:00
December	-1.169	27	12:00:00

Extreme maxima	Value	Day	Time
January	5.473	30	20:15:00
February	5.386	1	21:45:00
March	5.445	12	19:00:00
April	5.159	26	18:45:00
May	5.292	28	08:15:00
June	5.328	27	09:00:00
July	5.495	25	08:00:00
August	5.493	24	08:15:00
September	5.591	20	06:30:00
October			
November	5.333	5	19:15:00
December	5.633	19	19:30:00

Extreme minima	Value	Day	Time
January	0.325	14	02:30:00
February	-0.471	14	04:00:00
March	0.55	29	02:00:00
April	0.386	28	02:30:00
May	0.514	27	14:30:00
June	0.406	25	14:30:00
July	0.415	24	14:15:00
August	0.4	23	14:45:00
September	0.538	19	13:00:00
October			
November	0.705	3	00:30:00
December	0.283	21	03:15:00

Mean sea level	Days	MSL
January	31	2.938
February	24	2.851
March	24	2.817
April	29	2.908
May	31	2.921
June	30	2.887
July	31	2.932
August	26	2.976
September	18	3.017
October	0	*
November	2	*
December	24	2.969
	Sum	Avg
	270	**

* No mean sea level value as more than 15 days of data missing

** No yearly average value as more than one month's MSL missing

Devonport (Plymouth) – Tide Gauge Information

Latitude 50° 22' 06.2" N **Longitude** 04° 11' 06.9" W **Grid Ref** SX 4469 5434

Instrument Data acquisition system with two full-tide bubbler gauges
Location **Tide Gauge Building** No. 1 Jetty in Devonport Royal Naval base
Measuring Points Attached to the stilling well beneath the building

Datum All data refer to Admiralty Chart Datum (ACD)

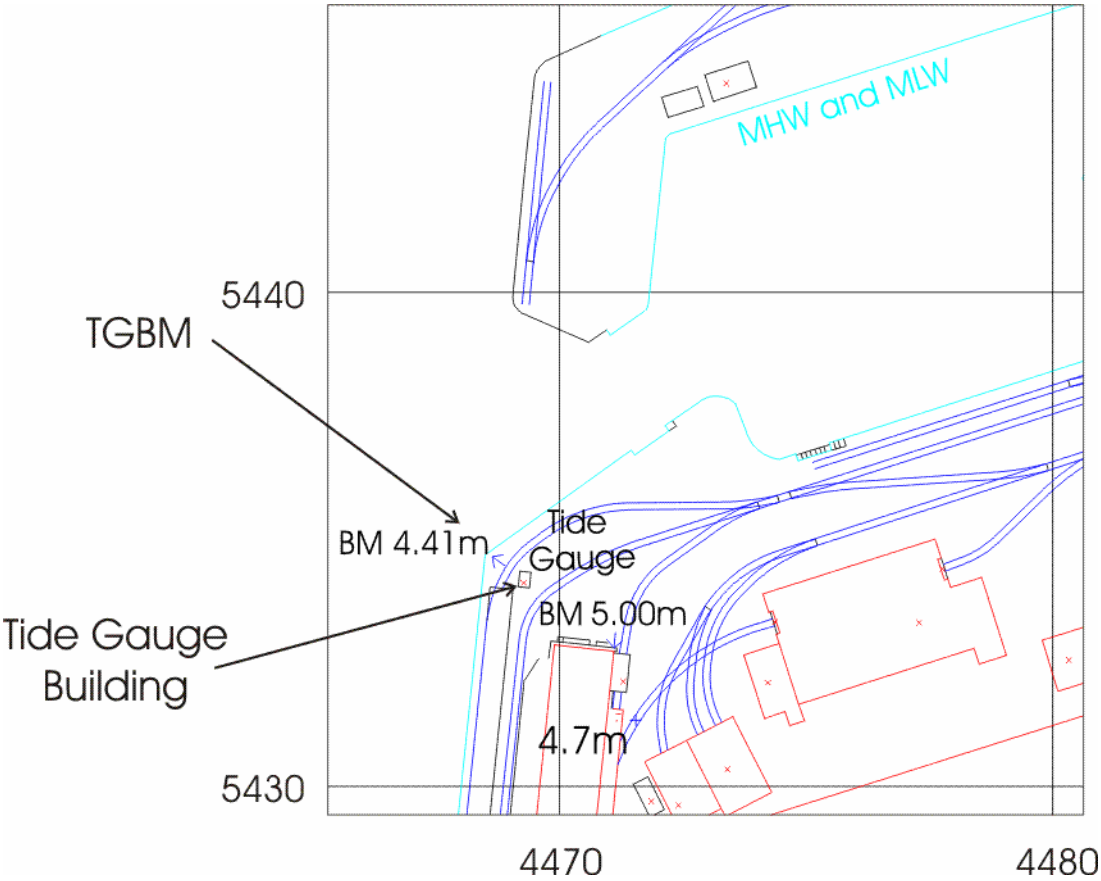
Benchmark	Grid Ref	Description
TGBM	SX 4468 5434	Bolt on jetty wall. 6.6m NW angle T G building
Aux1	SX 4471 5433	Building N face NE angle
Aux2	SX 4487 5425	Bldg NW face W angle
Aux3	SX 4501 5454	Fl Br 11818 bldg W face NW angle

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 3.22m below ODN
TGZ = 7.631m below TGBM

Levelling No levelling was carried out in 2013

Site visits
No site visits were carried out in 2013

Devonport (Plymouth) – Map & Images of Site



Devonport (Plymouth) – Statistics

Surge maxima	Value	Day	Time
January	0.487	29	20:15:00
February	0.248	1	10:15:00
March	0.41	21	21:30:00
April	0.472	12	00:45:00
May	0.341	14	15:30:00
June	0.255	12	00:15:00
July	0.323	28	15:30:00
August	0.288	2	03:15:00
September	0.262	29	04:15:00
October	0.676	28	03:15:00
November	0.5	3	18:15:00
December	0.892	23	21:30:00

Surge minima	Value	Day	Time
January	-0.246	5	21:15:00
February	-0.37	6	17:45:00
March	-0.241	2	15:30:00
April	-0.266	30	16:00:00
May	-0.229	1	17:00:00
June	-0.258	28	17:00:00
July	-0.192	7	03:00:00
August	-0.176	13	16:15:00
September	-0.22	11	15:15:00
October	-0.305	11	16:45:00
November	-0.383	30	23:30:00
December	-0.369	5	16:15:00

Extreme maxima	Value	Day	Time
January	6.019	12	05:45:00
February	5.92	11	06:15:00
March	5.86	29	07:00:00
April	5.786	11	18:30:00
May	5.857	27	19:15:00
June	5.707	25	19:15:00
July	6.005	24	19:00:00
August	5.935	22	18:45:00
September	5.819	20	18:30:00
October	5.874	20	06:15:00
November	6.037	3	18:00:00
December	5.873	18	18:45:00

Extreme minima	Value	Day	Time
January	0.461	13	13:00:00
February	0.473	11	12:45:00
March	0.554	1	14:15:00
April	0.356	27	00:30:00
May	0.491	26	00:15:00
June	0.31	26	01:45:00
July	0.502	24	00:45:00
August	0.413	23	01:00:00
September	0.518	21	00:45:00
October	0.728	7	00:45:00
November	0.866	5	13:00:00
December	0.405	5	13:30:00

Mean sea level	Days	MSL
January	31	3.467
February	28	3.337
March	31	3.472
April	30	3.391
May	31	3.364
June	30	3.343
July	31	3.385
August	31	3.399
September	30	3.418
October	31	3.56
November	30	3.416
December	31	3.516
	Sum	Avg
	365	3.422

Dover – Tide Gauge Information

Latitude 51° 06' 51.8" N **Longitude** 01° 19' 21.6" E **Grid Ref** TR 3265 4026

Instrument Data acquisition system with two full tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Prince of Wales Pier, Western Dock (just before the lighthouse)
Measuring Points Attached to the stilling well

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	TR 3193 4074	Fl Br G4868 building. East side of works entrance
Aux 1	TR 3195 4095	No 29 Waterloo Crescent SW face S angle
Aux 2	TR 3228 4053	Rivet pier wall NE side of pier F junction
Aux 3	TR 3265 4026	Rivet steps NE side P of W pier 1.0M SE W angle

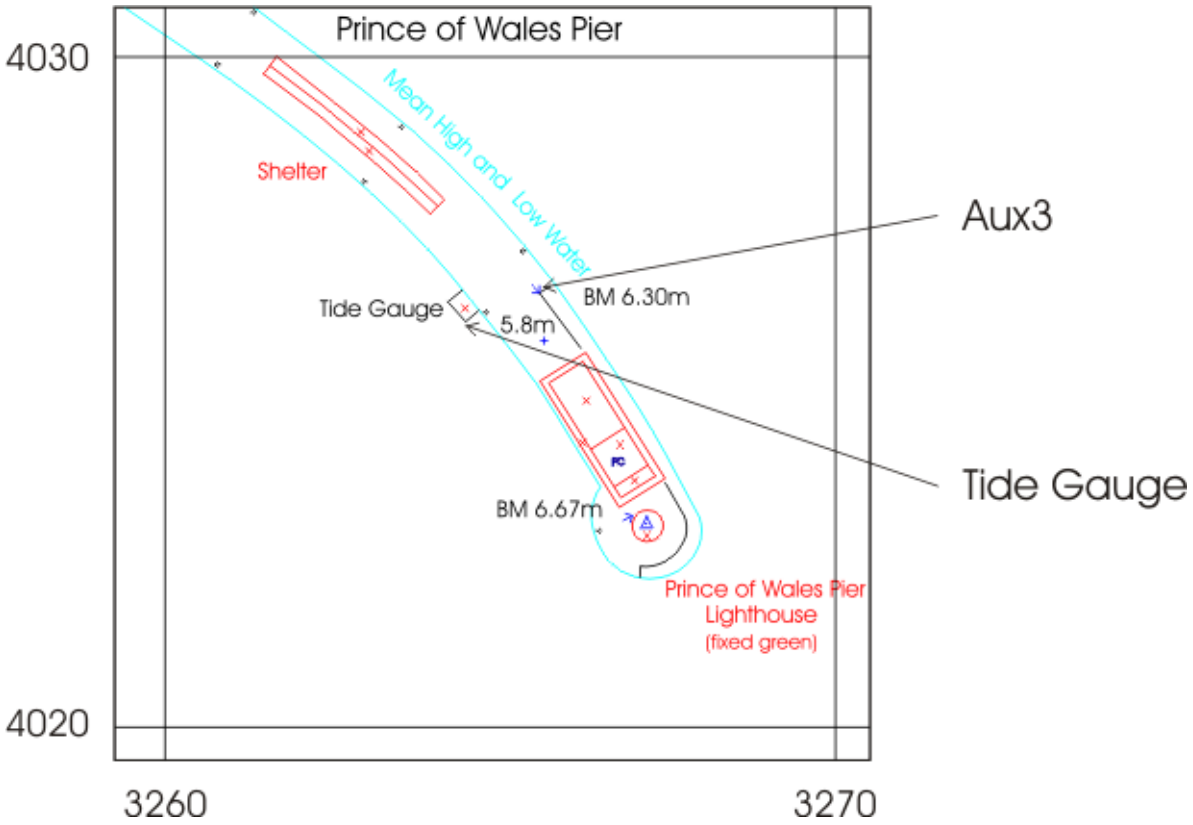
Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 3.67m below Ordnance Datum Newlyn (ODN)
TGZ = 10.491m below TGBM

Levelling No levelling was carried out in 2013

Site visits
07/01/2013 (Day 007) Changed compressor and replaced faulty outstation and power supply
04/06/2013 (Day 155) Carried out general maintenance

Notes on Data Quality
In December 2012 the outstation failed. Another outstation was bench tested and installed in January. The primary channel was up to ~100m high in places and has been flagged - the backup channel was available throughout this period. From October to December 2013, the primary channel was up to ~100m high in places and has been flagged. The secondary channel was available throughout this period.

Dover – Map & Images of Site



Dover – Statistics

Surge maxima	Value	Day	Time
January			
February			
March			
April			
May	0.168	15	06:00:00
June			
July			
August	0.056	6	22:30:00
September	0.158	18	21:30:00
October	0.316	23	23:45:00
November	0.863	30	03:45:00
December	1.527	6	00:45:00

Surge minima	Value	Day	Time
January			
February			
March			
April			
May	-0.007	15	10:45:00
June			
July			
August	0.032	6	22:00:00
September	-0.24	23	11:15:00
October	-0.219	26	02:45:00
November	-0.426	30	19:15:00
December	-0.524	5	13:00:00

Extreme maxima	Value	Day	Time
January			
February			
March			
April			
May	5.315	15	03:45:00
June			
July			
August	6.308	6	23:00:00
September	6.929	21	12:00:00
October	6.794	18	10:15:00
November	7.399	4	11:00:00
December	8.449	6	00:45:00

Extreme minima	Value	Day	Time
January			
February			
March			
April			
May	1.588	15	09:00:00
June			
July			
August	5.914	6	22:00:00
September	4.056	23	11:00:00
October	1.755	24	09:00:00
November	1.076	5	19:30:00
December	0.718	7	09:15:00

Mean sea level	Days	MSL
January	0	*
February	0	*
March	0	*
April	0	*
May	0	*
June	0	*
July	0	*
August	0	*
September	0	*
October	0	*
November	0	*
December	0	*
	Sum	Avg
	0	**

* No mean sea level value as more than 15 days of data missing

** No yearly average value as more than one month's MSL missing

Fishguard – Tide Gauge Information

Latitude 52° 00' 47.6" N **Longitude** 04° 59' 01.5" W **Grid Ref** SM 9534 3918

Instrument Data acquisition system with two full tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** On Fishguard Quay, adjacent to the RNLI station
Measuring Points Approximately 10m from the end of the quay

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	SM 9534 3918	OSBM bolt on quay 3.6M NE end of railings (1987)
Aux1	SM 9513 3874	OS bolt con base railings 6.4M NW angle TG hut
Aux2	SM 9489 3849	Rivet step top of Goodwick Quay
Aux3	SM 9455 3820	Fl Br 11518 building SW side railway bridge SE Face

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.44m below ODN
TGZ = 7.88m below TGBM

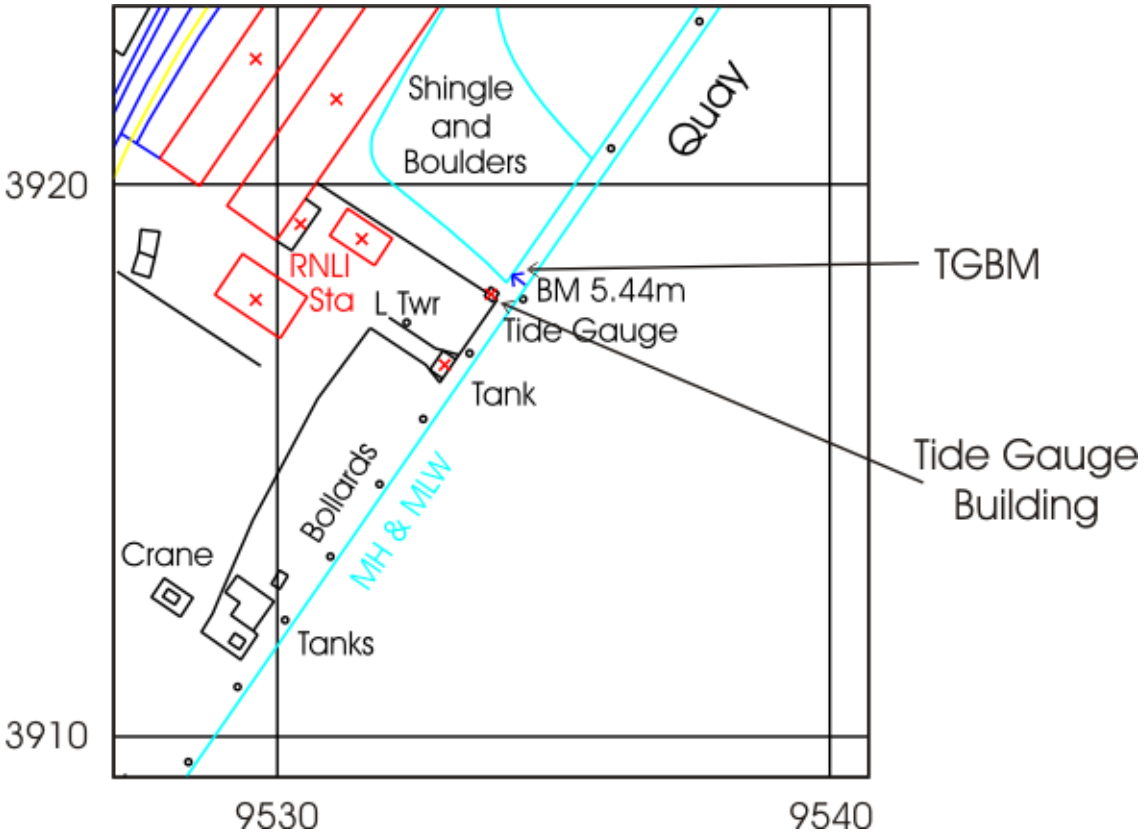
Levelling Site was levelled by TGI on 09/03/2013

Site visits

09/03/2013 (Day 068)	Carried out general maintenance, changed compressor and carried out diving and levelling to investigate difference between channels
18/07/2013 (Day 199)	Carried out general maintenance and dive to clear silted pressure points and check their operation

Notes on Data Quality
On inspection the full tide channels were found to be in the mud but recording very similar levels. The channels were ~40mm high, which was acceptable for monitoring extremes but were flagged as unacceptable for the purposes of long-term sea level monitoring. TGI were on site on 18/07/2013 to dig out the silted pressure points and to check the operation of the full and mid-tide pressure points.

Fishguard – Map & Images of Site



Fishguard – Statistics

Surge maxima	Value	Day	Time
January			
February			
March			
April			
May			
June			
July	0.301	28	18:30:00
August	0.402	17	14:45:00
September	0.36	15	13:45:00
October	0.459	22	18:15:00
November	0.61	2	14:15:00
December	0.893	27	06:15:00

Surge minima	Value	Day	Time
January			
February			
March			
April			
May			
June			
July	-0.059	19	10:15:00
August	-0.199	31	04:45:00
September	-0.217	13	08:15:00
October	-0.242	10	04:15:00
November	-0.553	20	19:15:00
December	-0.416	5	18:45:00

Extreme maxima	Value	Day	Time
January			
February			
March			
April			
May			
June			
July	5.415	24	20:30:00
August	5.353	22	20:15:00
September	5.254	19	19:00:00
October	5.234	19	19:30:00
November	5.403	5	08:00:00
December	5.26	5	08:30:00

Extreme minima	Value	Day	Time
January			
February			
March			
April			
May			
June			
July	0.575	24	02:30:00
August	0.483	22	02:15:00
September	0.561	20	01:45:00
October	0.825	7	02:30:00
November	0.886	19	14:15:00
December	0.479	4	14:30:00

Mean sea level	Days	MSL
January	0	*
February	0	*
March	0	*
April	0	*
May	0	*
June	0	*
July	13	2.801
August	31	2.751
September	30	2.754
October	31	2.913
November	30	2.731
December	31	2.907
	Sum	Avg
	166	**

* No mean sea level value as more than 15 days of data missing

** No yearly average value as more than one month's MSL missing

Harwich – Tide Gauge Information

Latitude 51° 56' 52.8" N **Longitude** 01° 17' 31.7" E **Grid Ref** TM 2634 3284

Instrument Data acquisition system with two full tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Seaward end of Harwich Haven Authority jetty
Measuring Points On the jetty, directly below the tide gauge cabinet

Datum All data refer to Admiralty Chart Datum (ACD)

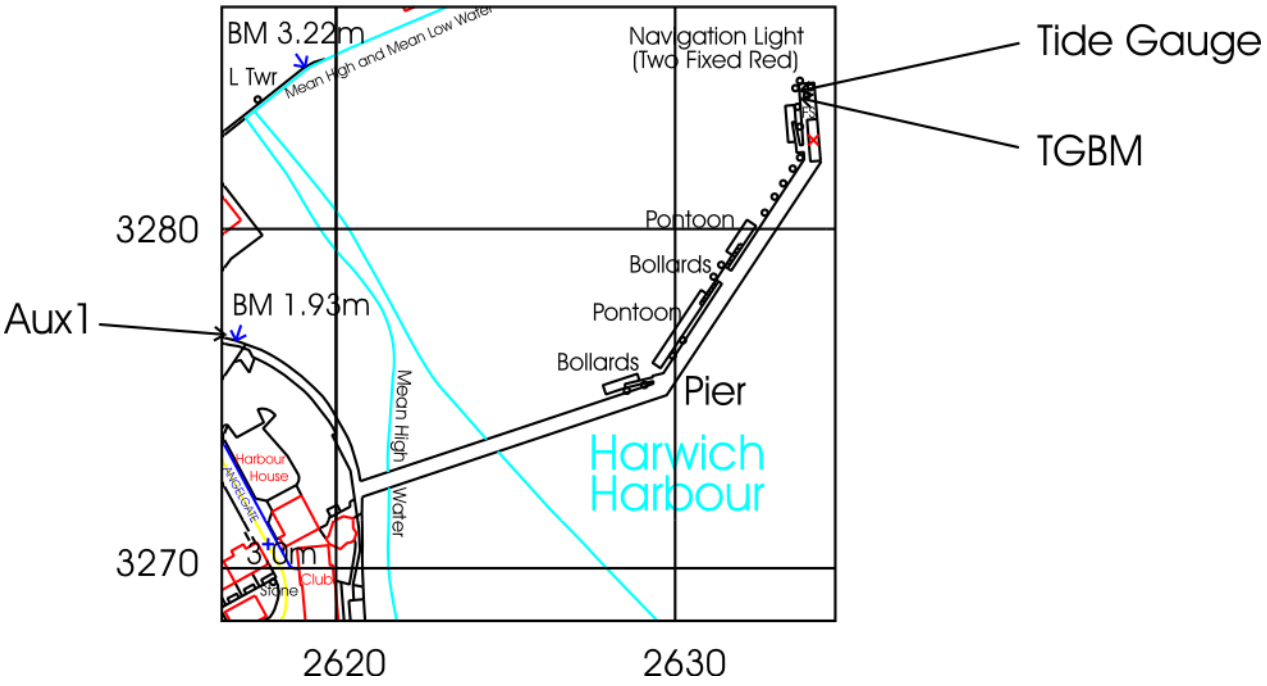
Benchmark	Grid Ref	Description
TGBM	TM 2634 3284	Bolt at base of flag staff
Aux1	TM 2617 3277	Cut mark quay edge
Aux2	TM 2608 3271	Cut mark NW face of Bank building
Aux3	TM 2610 3258	Cut mark N side of entrance St Nicholas's church

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.02m below ODN
TGZ = 6.17m below TGBM

Levelling No levelling was carried out in 2013

Site visits
04/12/2013 (Day 338) Carried out general maintenance and changed compressor

Harwich – Map & Images of Site



Harwich – Statistics

Surge maxima	Value	Day	Time
January	0.776	30	20:45:00
February	0.831	3	23:30:00
March	0.417	12	07:45:00
April	0.593	19	02:15:00
May	0.564	24	00:45:00
June	0.279	13	23:45:00
July	0.319	3	20:00:00
August	0.672	31	09:00:00
September	0.826	10	21:30:00
October	1.088	10	09:30:00
November	0.68	3	21:15:00
December	0.896	19	20:00:00

Surge minima	Value	Day	Time
January	-0.737	27	12:45:00
February	-1.213	14	09:30:00
March	-0.592	22	16:15:00
April	-0.542	14	15:15:00
May	-0.471	3	04:00:00
June	-0.4	30	03:30:00
July	-0.256	4	17:30:00
August	-0.462	17	21:30:00
September	-0.675	15	17:15:00
October	-0.576	31	04:15:00
November	-0.759	3	00:00:00
December	-1.127	27	07:45:00

Extreme maxima	Value	Day	Time
January	4.422	29	13:00:00
February	4.383	2	03:15:00
March	4.251	13	12:45:00
April	4.282	12	12:45:00
May	4.393	28	01:30:00
June	4.237	25	00:30:00
July	4.349	25	01:00:00
August	4.262	24	13:45:00
September	4.336	19	23:45:00
October	4.449	10	15:30:00
November	4.664	3	23:30:00
December	4.384	20	01:00:00

Extreme minima	Value	Day	Time
January	0.074	14	07:00:00
February	-0.509	14	08:15:00
March	0.179	2	08:15:00
April	0.127	28	07:00:00
May	0.266	27	19:00:00
June	0.112	25	19:00:00
July	0.162	24	18:45:00
August	0.13	22	18:30:00
September	0.197	19	17:30:00
October	0.287	18	17:00:00
November	0.476	3	04:30:00
December	-0.058	30	16:00:00

Mean sea level	Days	MSL
January	31	2.155
February	28	2.123
March	31	2.093
April	30	2.140
May	31	2.145
June	30	2.107
July	31	2.150
August	31	2.194
September	30	2.227
October	31	2.243
November	9	*
December	12	*
	Sum	Avg
	325	**

* No mean sea level value as more than 15 days of data missing

** No yearly average value as more than one month's MSL missing

Heysham – Tide Gauge Information

Latitude 54° 01' 54.6" N **Longitude** 02° 55' 12.9" W **Grid Ref** SD 3982 5993

Instrument Data acquisition system with two full tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** South side of the entrance to Heysham harbour
Measuring Points Heysham harbour

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	SD 4030 6012	OSBM bolt on south quay 40.8m SW from SE angle of dock
Aux1	SD 4141 6005	Bridge parapet, E side of road
Aux2	SD 4026 6033	Pivot pin harbour wall 6.1M SW N angle of harbour
Aux3	SD 4026 6033	Rivet harbour wall 5.7M SW of N angle of Harbour
Aux4	SD 3982 5992	Brass bolt quay edge

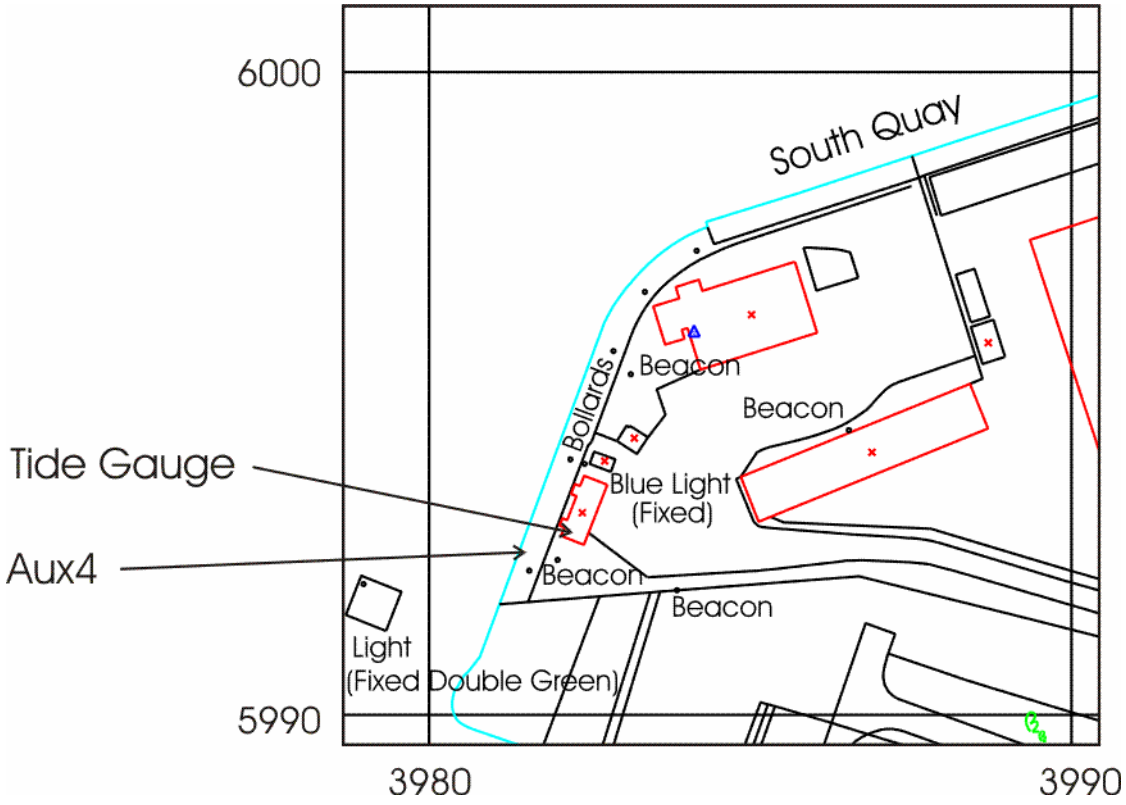
Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 4.90m below Ordnance Datum Newlyn (ODN)
TGZ = 12.098m below TGBM

Levelling No levelling was carried out in 2013

Site visits
05/02/2013 (Day 036) Changed compressor
05/09/2013 (Day 248) Carried out general maintenance

Notes on Data Quality
In July and August 2013 channel 2 was 20-40mm high. This was acceptable for monitoring extremes but flagged as unacceptable for the purposes of long-term sea level monitoring. When channel 2 was flagged, the secondary channel was available.

Heysham – Map & Images of Site



Heysham – Statistics

Surge maxima	Value	Day	Time
January	1.081	28	21:15:00
February	0.608	4	10:00:00
March	0.414	15	11:00:00
April	1.401	17	22:45:00
May	0.709	9	14:45:00
June	0.571	14	23:15:00
July	0.365	31	22:00:00
August	0.669	17	17:00:00
September	0.859	15	14:00:00
October	0.938	27	10:45:00
November	1.013	2	14:45:00
December	2.15	27	09:30:00

Surge minima	Value	Day	Time
January	-0.509	15	04:15:00
February	-0.805	6	09:15:00
March	-0.441	11	20:30:00
April	-0.507	27	09:15:00
May	-0.464	24	16:45:00
June	-0.312	24	01:00:00
July	-0.138	5	17:00:00
August	-0.208	13	02:15:00
September	-0.339	13	12:00:00
October	-0.488	11	11:30:00
November	-1.007	20	22:30:00
December	-0.623	5	21:45:00

Extreme maxima	Value	Day	Time
January	10.351	30	13:15:00
February	10.115	13	13:15:00
March	10.084	29	12:15:00
April	10.041	28	12:45:00
May	10.175	27	00:00:00
June	10.113	26	00:45:00
July	10.516	25	00:30:00
August	10.1	20	22:45:00
September	10.3	19	23:00:00
October	10.096	19	23:30:00
November	10.391	5	12:00:00
December	11.046	5	12:15:00

Extreme minima	Value	Day	Time
January	0.469	12	18:15:00
February	0.179	11	18:45:00
March	0.518	11	17:45:00
April	0.463	27	06:30:00
May	0.687	24	17:00:00
June	0.469	26	07:45:00
July	0.58	24	06:45:00
August	1.156	20	04:45:00
September	0.71	20	06:00:00
October	1.069	7	06:45:00
November	1.123	4	05:45:00
December	0.798	5	19:30:00

Mean sea level	Days	MSL
January	31	5.241
February	28	5.040
March	31	5.054
April	30	5.144
May	31	5.129
June	30	5.108
July	15	5.235
August	19	5.272
September	24	5.182
October	31	5.333
November	27	5.151
December	31	5.477
	Sum	Avg
	328	5.197

Hinkley Point – Tide Gauge Information

Latitude 51° 12' 38.2" N **Longitude** 03° 07' 52.8" W **Grid Ref** ST 2107 4632

Instrument Dataring system with dual underwater pressure transducers
Location **Tide Gauge Building** Hinkley Point "A" power station
Measuring Points Underwater vented chambers suspended from a steel pole attached to a water intake tower (400m offshore)

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	ST 2104 4634	Bolt on wall 0.962m NE of SE corner of steps
Aux1	ST 2078 4626	Rivet on sea wall 41.28m SW of corner of outfall
Aux2	ST 2094 4631	Bolt on sea wall 31.245m SW of end of railings
Aux3	ST 2123 4634	Bolt sea defence wall

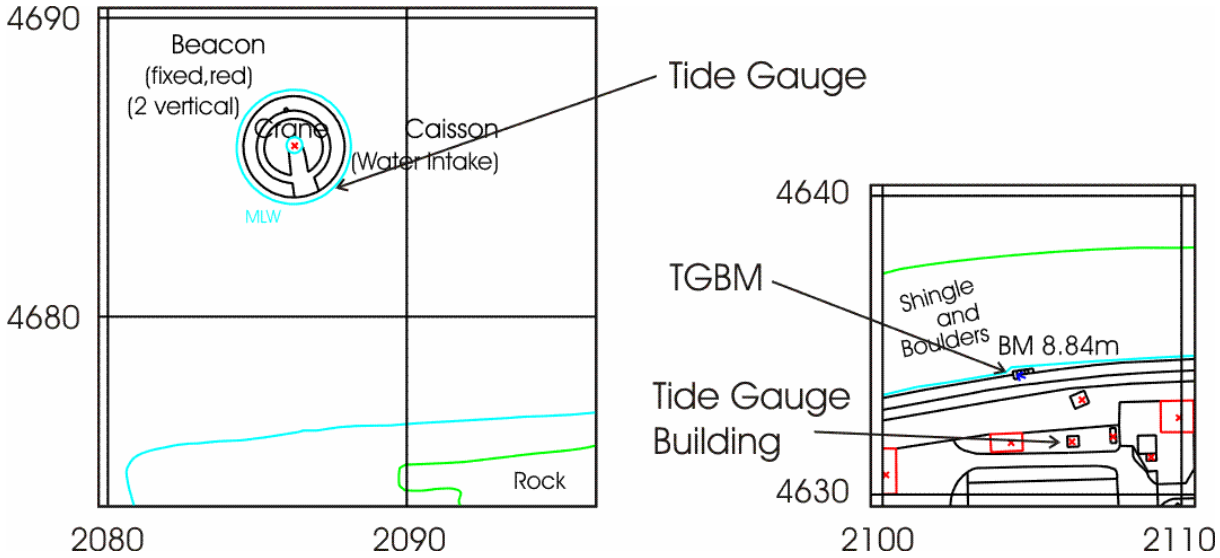
Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 5.80m below Ordnance Datum Newlyn (ODN)
TGZ = 14.639m below TGBM

Levelling No levelling was carried out in 2013

Site visits
No site visits were carried out in 2013

Notes on Data Quality
The original sensors had started to foul up, so new additional sensors were installed in May 2012, leaving the originals in place. The data received from the original primary sensor has been flagged, but the new backup sensor has been available.

Hinkley Point – Map & Images of Site



Hinkley Point – Statistics

Surge maxima	Value	Day	Time
January	0.86	31	05:00:00
February	0.75	5	01:00:00
March	0.548	15	14:00:00
April	0.704	17	19:00:00
May	0.665	9	12:45:00
June	0.63	13	13:00:00
July	0.354	29	03:45:00
August	0.341	5	10:00:00
September	0.499	19	12:00:00
October	0.934	28	04:45:00
November	0.807	2	12:30:00
December	1.319	23	23:15:00

Surge minima	Value	Day	Time
January	-0.513	8	20:00:00
February	-0.663	6	10:45:00
March	-0.412	1	17:30:00
April	-0.459	27	16:15:00
May	-0.359	14	19:30:00
June	-0.373	27	06:30:00
July	-0.437	8	15:15:00
August	-0.352	14	07:00:00
September	-0.368	13	07:15:00
October	-0.437	10	07:30:00
November	-0.672	20	17:00:00
December	-0.503	5	19:45:00

Extreme maxima	Value	Day	Time
January	12.513	14	08:30:00
February	12.452	12	08:15:00
March	12.407	13	07:45:00
April	12.272	26	19:15:00
May	12.339	26	19:45:00
June	12.312	25	20:15:00
July	12.712	24	20:00:00
August	12.62	22	19:45:00
September	12.421	20	19:30:00
October	12.203	19	19:00:00
November	12.726	5	07:30:00
December	12.554	5	08:15:00

Extreme minima	Value	Day	Time
January	0.32	12	13:15:00
February	0.462	13	03:00:00
March	0.737	31	03:15:00
April	0.268	27	01:45:00
May	0.506	26	01:15:00
June	0.304	26	02:45:00
July	0.329	25	02:30:00
August	0.255	23	02:15:00
September	0.432	21	01:45:00
October	0.721	7	02:00:00
November	0.951	6	02:15:00
December	0.212	4	13:45:00

Mean sea level	Days	MSL
January	31	6.275
February	26	6.142
March	27	6.263
April	27	6.233
May	29	6.226
June	24	6.214
July	31	6.219
August	31	6.243
September	30	6.239
October	31	6.386
November	26	6.288
December	29	6.419
	Sum	Avg
	342	6.262

Holyhead – Tide Gauge Information

Latitude 53° 18' 50.2" N **Longitude** 04° 37' 13.6" W **Grid Ref** SH 2553 8287

Instrument Data acquisition system with a full-tide and a mid-tide bubbler gauge, with a back-up Munro float gauge

Location **Tide Gauge Building** Salt Island jetty, close to the old harbour lighthouse
Measuring Points As above

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	SH 2553 8287	Bolt on concrete foundation, north side of tide gauge building
Aux1	SH 2556 8289	Cut mark lighthouse
Aux3	SH 2506 8292	Bolt Salt Island bridge

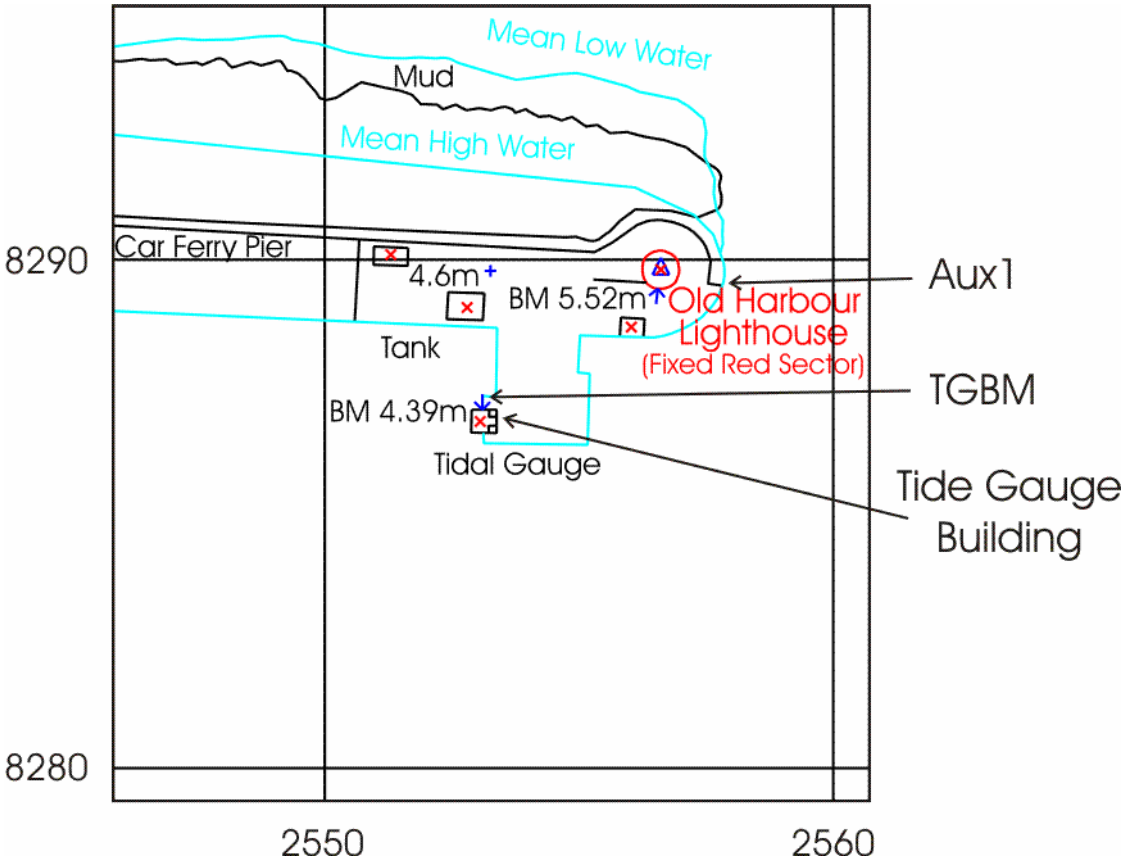
Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 3.05m below Ordnance Datum Newlyn (ODN)
TGZ = 7.436m below TGBM

Levelling Site was levelled by TGI on 13/03/2013

Site visits

13/03/2013 (Day 072)	Carried out levelling and calibration check
11/06/2013 (Day 162)	Carried out general maintenance and changed compressor
03/07/2013 (Day 184)	Serviced gauge to improve data quality
18/11/2013 (Day 322)	Removed radar gauge for testing
17/12/2013 (Day 351)	Carried out testing of installed radar gauge

Holyhead – Map & Images of Site



Holyhead – Statistics

Surge maxima	Value	Day	Time
January	0.789	28	18:00:00
February	0.264	13	22:45:00
March	0.294	15	11:30:00
April	0.764	17	21:00:00
May	0.586	9	13:00:00
June	0.439	14	20:45:00
July	0.263	28	08:00:00
August	0.472	17	15:00:00
September	0.516	15	13:45:00
October	0.568	27	11:45:00
November	0.76	2	15:45:00
December	1.158	27	08:30:00

Surge minima	Value	Day	Time
January	-0.354	15	02:45:00
February	-0.711	6	07:45:00
March	-0.304	1	20:45:00
April	-0.374	27	08:00:00
May	-0.323	24	18:30:00
June	-0.304	26	15:15:00
July	-0.272	7	07:45:00
August	-0.294	31	03:45:00
September	-0.283	13	08:30:00
October	-0.339	10	03:15:00
November	-0.621	21	01:30:00
December	-0.453	6	00:00:00

Extreme maxima	Value	Day	Time
January	6.089	13	11:15:00
February	6.003	13	12:15:00
March	6.008	29	11:30:00
April	5.829	11	10:45:00
May	5.979	27	11:45:00
June	5.868	25	23:45:00
July	6.196	24	23:30:00
August	6.163	22	23:15:00
September	6.084	20	22:45:00
October	6.074	19	22:30:00
November	6.219	5	11:00:00
December	6.552	5	11:45:00

Extreme minima	Value	Day	Time
January	0.258	12	16:30:00
February	0.058	11	17:15:00
March	0.329	11	16:15:00
April	0.142	27	04:45:00
May	0.344	25	16:15:00
June	0.138	26	06:00:00
July	0.309	24	05:00:00
August	0.229	22	04:45:00
September	0.338	20	04:15:00
October	0.664	6	04:30:00
November	0.727	4	04:15:00
December	0.326	4	17:00:00

Mean sea level	Days	MSL
January	31	3.333
February	28	3.157
March	31	3.254
April	30	3.245
May	31	3.207
June	30	3.187
July	31	3.225
August	31	3.274
September	30	3.267
October	31	3.437
November	30	3.267
December	31	3.496
	Sum	Avg
	365	3.279

Ilfracombe – Tide Gauge Information

Latitude 51° 12' 40.1" N **Longitude** 04° 06' 44.6" W **Grid Ref** SS 5255 4789

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** North west corner of the car park, east of Lantern Hill
Measuring Points Seaward side of Ilfracombe pier at the harbour entrance

Datum All data refer to Admiralty Chart Datum (ACD)

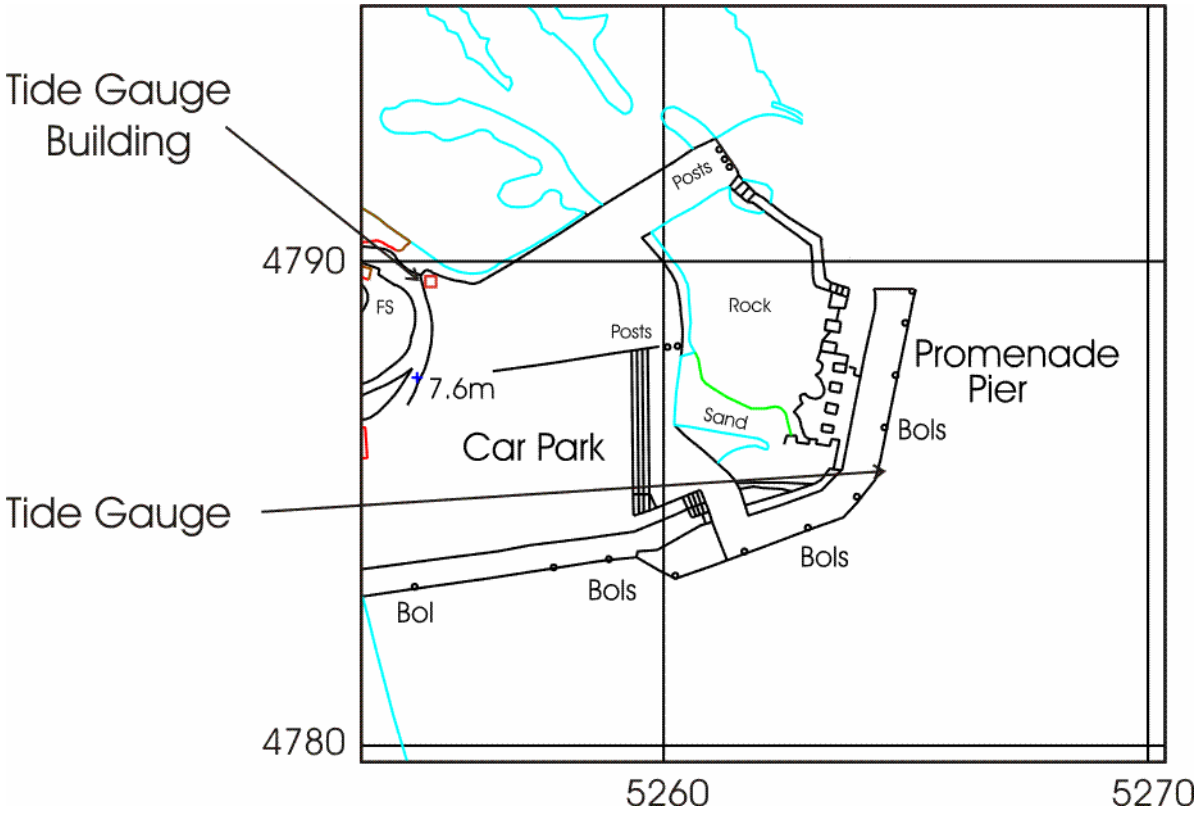
Benchmark	Grid Ref	Description
TGBM	SS 5263 4791	OSBM Bolt on concrete pier, south angle of tide gauge hut
Aux1	SS 5245 4782	Pier Hotel, The Quay
Aux2	SS 5251 4789	St Nicholas chapel N face 6.1m from NW angle

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 4.80m below Ordnance Datum Newlyn (ODN)
TGZ = 12.379m below TGBM
TGZ = 10.76m below Aux1
TGZ = 32.541m below Aux2

Levelling No levelling was carried out in 2013

Site visits
07/02/2013 (Day 038) Carried out general maintenance, changed compressor and fitted new V2.02 DQ cards and SIM

Ilfracombe – Map & Images of Site



Ilfracombe – Statistics

Surge maxima	Value	Day	Time
January	0.674	31	04:00:00
February	0.489	4	23:45:00
March	0.431	22	15:45:00
April	0.615	17	18:15:00
May	0.635	9	10:15:00
June	0.359	12	00:30:00
July	0.339	29	02:00:00
August	0.361	17	12:30:00
September	0.404	19	10:30:00
October	0.621	28	03:15:00
November	0.693	2	13:45:00
December	1.162	24	01:00:00

Surge minima	Value	Day	Time
January	-0.232	6	06:30:00
February	-0.565	6	09:45:00
March	-0.235	1	01:30:00
April	-0.292	30	18:45:00
May	-0.254	1	19:15:00
June	-0.263	27	06:45:00
July	-0.205	7	14:30:00
August	-0.19	13	06:00:00
September	-0.233	13	06:45:00
October	-0.258	11	20:00:00
November	-0.532	20	16:00:00
December	-0.505	5	18:00:00

Extreme maxima	Value	Day	Time
January	9.82	13	06:45:00
February	9.801	11	06:30:00
March	9.739	29	07:00:00
April	9.536	27	19:00:00
May	9.681	26	18:45:00
June	9.638	25	19:30:00
July	10.029	24	19:15:00
August	10.004	22	19:00:00
September	9.862	20	18:30:00
October	9.699	19	18:00:00
November	10.015	5	06:45:00
December	9.764	5	07:15:00

Extreme minima	Value	Day	Time
January	0.465	13	13:00:00
February	0.403	12	13:15:00
March	0.451	1	01:45:00
April	0.278	27	00:30:00
May	0.518	26	00:15:00
June	0.357	26	01:45:00
July	0.485	24	00:30:00
August	0.384	23	01:00:00
September	0.548	21	00:30:00
October	0.797	7	00:45:00
November	0.963	5	12:45:00
December	0.474	4	12:30:00

Mean sea level	Days	MSL
January	26	5.054
February	26	4.913
March	27	5.049
April	30	4.977
May	31	4.960
June	30	4.941
July	31	4.982
August	31	5.012
September	30	5.021
October	31	5.175
November	26	5.003
December	30	5.158
	Sum	Avg
	349	5.020

Immingham – Tide Gauge Information

Latitude 53° 37' 48.8" N **Longitude** 00° 11' 14.7" W **Grid Ref** TA 1996 1638

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge

Location
Tide Gauge Building Entrance to Immingham Docks, east of the lock gates
Measuring Points Fixed to a leg of the lead-in jetty on the east side of the dock entrance

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	TA 1989 1630	Docks office, north angle, north east face
Aux1	TA 2005 1631	Customs house, east angle, north east face
Aux2	TA 1994 1640	Bolt on concrete base of tide gauge building
Aux3	TA 2000 1648	Stud in camera tower

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 3.90m below ODN
TGZ = 9.131m below TGBM

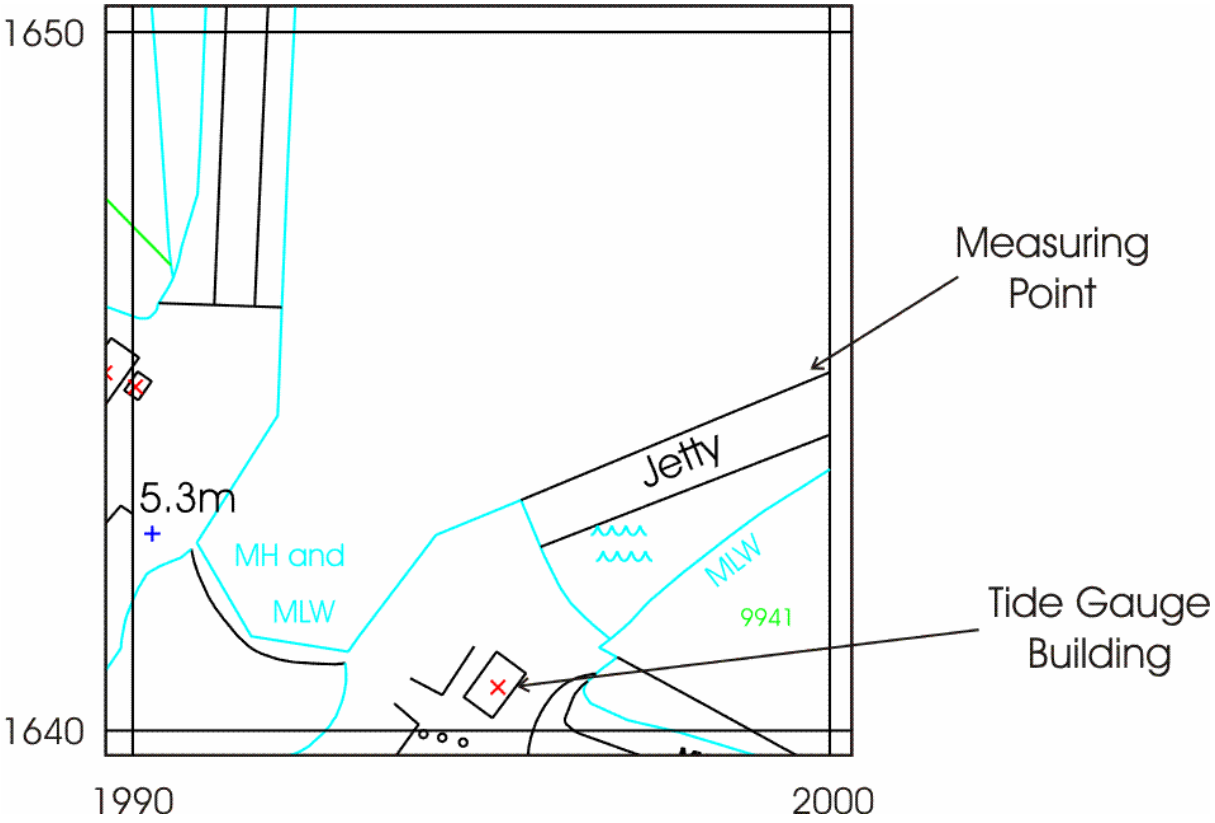
Levelling No levelling was carried out in 2013

Site visits

13/11/2013 (Day 317)	Carried out general maintenance
12/12/2013 (Day 346)	Changed compressor and restarted power - site had flooded (approx. 350mm of water)

Notes on Data Quality
Flooding at the port on 07/12/2013 caused a power failure, with communication and power loss to the whole site. Only ABP staff were initially allowed site access.

Immingham – Map & Images of Site



Immingham – Statistics

Surge maxima	Value	Day	Time
January	0.663	30	15:15:00
February	0.66	3	19:15:00
March	0.299	12	00:00:00
April	0.523	15	17:15:00
May	0.409	23	23:30:00
June	0.136	23	01:00:00
July	0.236	27	14:45:00
August	0.523	31	04:15:00
September	0.758	15	23:15:00
October	0.969	10	04:00:00
November	0.993	29	23:00:00
December	1.969	5	17:30:00

Surge minima	Value	Day	Time
January	-0.673	27	07:30:00
February	-1.153	14	03:30:00
March	-0.53	22	12:00:00
April	-0.691	18	02:00:00
May	-0.561	3	00:45:00
June	-0.411	3	02:15:00
July	-0.371	4	11:45:00
August	-0.461	17	19:45:00
September	-0.735	15	15:15:00
October	-0.729	30	23:30:00
November	-0.919	11	11:30:00
December	-1.167	5	13:00:00

Extreme maxima	Value	Day	Time
January	7.395	14	19:45:00
February	7.384	11	18:45:00
March	7.536	12	18:30:00
April	7.229	9	17:15:00
May	7.354	28	07:45:00
June	7.352	27	08:30:00
July	7.627	25	07:15:00
August	7.586	22	06:15:00
September	7.632	20	06:00:00
October	7.366	7	07:00:00
November	7.655	4	18:15:00
December	9.116	5	19:15:00

Extreme minima	Value	Day	Time
January	0.255	14	01:45:00
February	-0.183	14	02:45:00
March	0.572	29	01:15:00
April	0.404	28	01:45:00
May	0.566	27	13:45:00
June	0.389	25	13:45:00
July	0.379	24	13:30:00
August	0.38	22	13:15:00
September	0.554	20	12:45:00
October	0.762	6	13:00:00
November	0.905	2	23:30:00
December	-0.051	5	13:00:00

Mean sea level	Days	MSL
January	31	4.077
February	28	4.023
March	31	4.043
April	30	4.055
May	31	4.043
June	30	4.009
July	31	4.065
August	31	4.105
September	30	4.137
October	31	4.204
November	30	4.181
December	9	*
	Sum	Avg
	343	4.095

* No mean sea level value as more than 15 days of data missing

Port Erin (Isle of Man) – Tide Gauge Information

Latitude 54° 05' 07.4" N **Longitude** 04° 46' 05.0" W **Grid Ref** SC 1904 6904

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge

Location

Tide Gauge Building	Port Erin lifeboat station
Measuring Points	Close to the end of the lifeboat slipway (the mid-tide pressure point is attached to a concrete leg of the boathouse)

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	SC 1904 6901	Bolt SE corner of the RNLI boathouse
Aux 2		Bolt on seawall NW of Marine labs
Aux 3	SC 1928 6903	Bolt base of light tower Raglan pier

Benchmark Relationships

TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.75m below Ordnance Datum Local (ODL)
TGZ = 9.288m below TGBM

Levelling No levelling was carried out in 2013

Site visits

30/01/2013 (Day 030)	Carried out general maintenance, changed compressor and fitted new V2.02 DQ cards and SIM
08/10/2013 (Day 281)	Carried out general maintenance and changed compressor

Port Erin (Isle Of Man) – Map & Images of Site

Image: Isle of Man Government ©Google 2013

Port Erin (Isle Of Man) – Statistics

Surge maxima	Value	Day	Time
January	0.844	28	19:30:00
February	0.33	4	07:30:00
March	0.333	15	10:30:00
April	0.83	17	22:30:00
May	0.521	9	15:30:00
June	0.476	14	21:30:00
July	0.34	2	14:45:00
August	0.485	17	16:45:00
September	0.481	15	15:15:00
October	0.632	27	12:00:00
November	0.789	2	17:00:00
December	1.22	27	11:15:00

Surge minima	Value	Day	Time
January	-0.301	15	01:15:00
February	-0.744	6	06:30:00
March	-0.324	1	00:15:00
April	-0.397	27	08:45:00
May	-0.334	24	21:45:00
June	-0.249	26	15:45:00
July	-0.257	8	10:00:00
August	-0.265	31	05:45:00
September	-0.282	10	11:00:00
October	-0.352	10	03:00:00
November	-0.799	21	00:15:00
December	-0.499	6	00:00:00

Extreme maxima	Value	Day	Time
January	5.761	31	13:30:00
February	5.727	13	13:15:00
March	5.621	29	12:15:00
April	5.456	11	11:45:00
May	5.689	27	12:30:00
June	5.477	26	00:45:00
July	5.825	25	00:30:00
August	5.755	23	00:15:00
September	5.678	20	23:45:00
October	5.706	18	22:45:00
November	5.835	5	12:00:00
December	5.948	5	12:30:00

Extreme minima	Value	Day	Time
January	-0.014	14	19:15:00
February	-0.184	11	18:15:00
March	0.042	11	17:00:00
April	-0.155	27	05:45:00
May	0.072	24	16:30:00
June	-0.128	26	07:00:00
July	0.062	24	06:00:00
August	0.001	22	05:45:00
September	0.084	20	05:15:00
October	0.41	6	05:30:00
November	0.378	20	19:00:00
December	0.102	4	18:00:00

Mean sea level	Days	MSL
January	31	2.985
February	28	2.796
March	31	2.877
April	30	2.886
May	31	2.844
June	30	2.825
July	31	2.862
August	31	2.920
September	30	2.899
October	30	3.073
November	30	2.903
December	31	3.181
	Sum	Avg
	364	2.921

Port Ellen (Isle of Islay) – Tide Gauge Information

Latitude 55° 37' 39.3" N **Longitude** 06° 11' 23.7" W **Grid Ref** NR 3636 4508

Instrument Data acquisition system with two full-tide bubbler gauges. Decommissioned February 2011.

Location
- **Tide Gauge Building** Caledonian MacBrayne storeroom next to Port Ellen ferry terminal
- **Measuring Points** South west of the ferry terminal offices

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	NR 3635 4507	Bolt SE side Booking Office
Aux1	NR 3642 4515	Rivet angle wall NW side entrance to pier
Aux2	NR 3651 4526	Police Station SE side of road SW face W angle
Aux3	NR 3635 4521	Sea Farm C gable NW face W angle

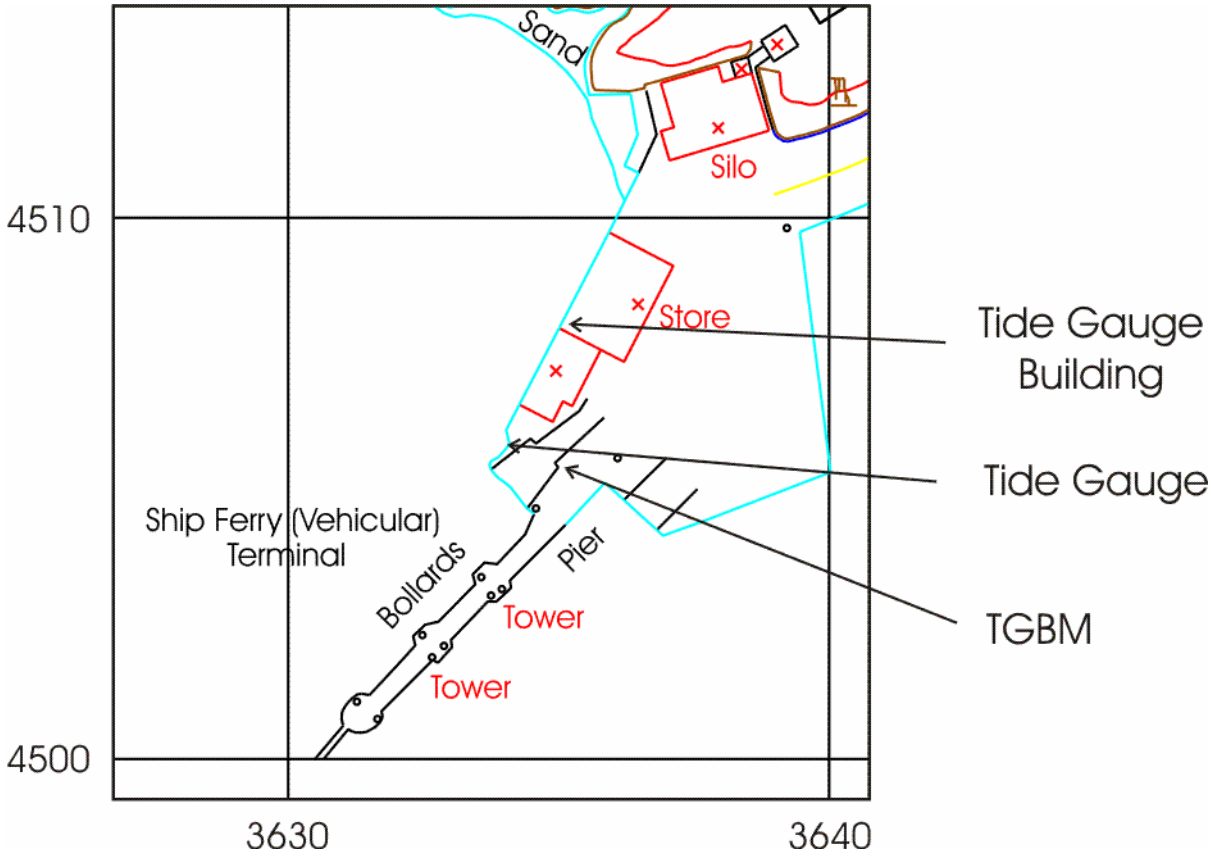
Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 0.19m below Ordnance Datum Newlyn (ODN)
TGZ = 2.839m below TGBM

Levelling No levelling was carried out in 2013

Site visits
No site visits were carried out in 2013

Notes on Data Quality
No data as gauge was removed from network due to harbour redevelopment on 08/02/2011. Work on a replacement installation has commenced and is ongoing.

Port Ellen (Isle of Islay) – Map & Images of Site



Port Ellen (Isle of Islay) – Statistics

The gauge wasn't operational during 2013, so no statistics were produced.

St Helier (Jersey) – Tide Gauge Information

Latitude 49° 10' 34" N **Longitude** 02° 06' 51 " W **Grid Ref** 13/11 6466 4763

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Victoria Pier, adjacent to the Port Control building
Measuring Points inside wall of the pier, 2m from the tide gauge building

Datum All data refer to Admiralty Chart Datum (ACD)

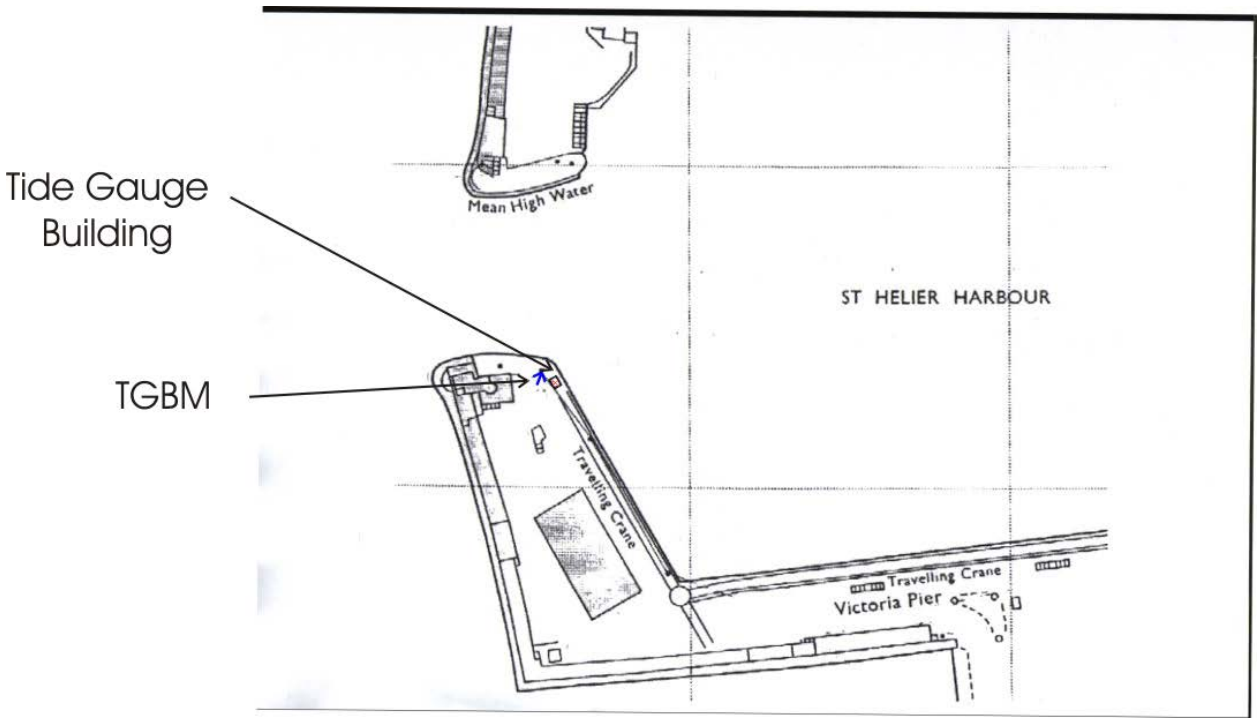
Benchmark	Grid Ref	Description
TGBM	13/11 6465 4764	Pin bollard Victoria Pier
Aux1	13/11 6516 4764	Cut mark wall N side of road Mount Bingham
Aux2	13/11 6509 4780	"J" stone E face wall car park South Hill
Aux3	13/11 6507 4779	Cut mark S face wall car park South Hill
Aux4	13/11 6506 4784	Cut mark E face wall E side Commercial Rd

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 5.88m below Ordnance Datum Local (ODL)
TGZ = 13.658m below TGBM

Levelling No levelling was carried out in 2013

Site visits
No site visits were carried out in 2013

St Helier (Jersey) – Map & Images of Site



St Helier (Jersey) – Statistics

Surge maxima	Value	Day	Time
January	0.494	29	23:00:00
February	0.537	5	04:15:00
March	0.434	17	14:00:00
April	0.474	10	21:30:00
May	0.416	14	20:15:00
June	0.345	22	21:15:00
July	0.303	29	00:00:00
August	0.258	5	10:00:00
September	0.401	17	21:00:00
October	0.805	28	05:30:00
November	0.696	3	20:45:00
December	1.05	24	00:30:00

Surge minima	Value	Day	Time
January	-0.325	4	19:15:00
February	-0.47	2	19:00:00
March	-0.443	2	18:15:00
April	-0.399	30	18:30:00
May	-0.357	1	07:00:00
June	-0.418	27	07:00:00
July	-0.367	8	15:30:00
August	-0.324	14	07:00:00
September	-0.354	11	06:15:00
October	-0.35	11	17:15:00
November	-0.568	21	17:30:00
December	-0.471	5	04:45:00

Extreme maxima	Value	Day	Time
January	11.658	13	07:30:00
February	11.631	11	07:15:00
March	11.527	29	07:30:00
April	11.433	27	19:45:00
May	11.511	27	20:00:00
June	11.446	25	20:00:00
July	11.806	24	19:45:00
August	11.811	22	19:30:00
September	11.558	20	19:00:00
October	11.368	19	18:45:00
November	11.677	5	07:15:00
December	11.341	5	07:45:00

Extreme minima	Value	Day	Time
January	0.687	13	14:15:00
February	0.707	11	14:00:00
March	0.898	29	02:00:00
April	0.707	27	01:45:00
May	0.858	27	02:15:00
June	0.583	26	02:45:00
July	0.729	24	02:00:00
August	0.653	22	01:30:00
September	0.821	21	01:45:00
October	1.167	7	02:00:00
November	1.449	5	01:30:00
December	0.868	4	13:45:00

Mean sea level	Days	MSL
January	31	6.095
February	28	5.965
March	31	6.093
April	30	6.016
May	31	6.026
June	30	5.981
July	31	6.016
August	31	6.044
September	30	6.066
October	31	6.207
November	30	6.071
December	31	6.148
	Sum	Avg
	365	6.061

Kinlochbervie – Tide Gauge Information

Latitude 58° 27' 23.8" N **Longitude** 05° 03' 01.3" W **Grid Ref** NC 2213 5608

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** In the ice plant, on the pier
Measuring Points On a leg of the jetty beneath the ice plant

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	NC 2206 5613	Bolt S side harbour 19.5M SE angle of building
Aux1	NC 2210 5612	Rivet iceplant 7.45M from S angle of building
Aux2	NC 2210 5614	Rivet inside iceplant 3.5M E door
Aux3	NC 2203 5626	Rivet 12.3M SE N angle of building
Aux4	NC 2213 5621	Rivet 2.5M NW inside corner NE steps

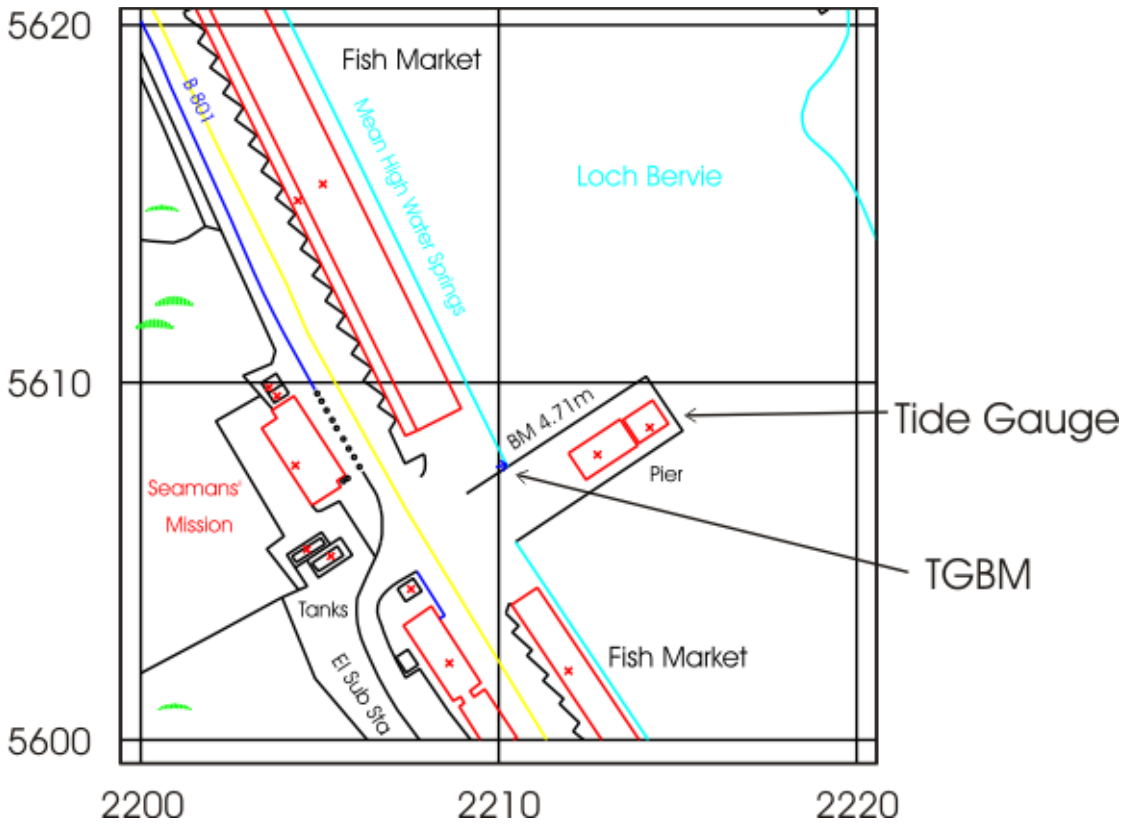
Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.50m below Ordnance Datum Newlyn (ODN)
TGZ = 7.213m below TGBM

Levelling No levelling was carried out in 2013

Site visits

26/03/2013 (Day 085)	Carried out general maintenance
16/07/2013 (Day 197)	Carried out general maintenance, changed compressor and fitted new V2.02 DQ cards

Kinlochbervie – Map & Images of Site



Kinlochbervie – Statistics

Surge maxima	Value	Day	Time
January	1.195	30	04:45:00
February	0.543	4	06:45:00
March	0.259	15	04:15:00
April	0.78	15	05:15:00
May	0.444	13	14:30:00
June	0.334	15	11:15:00
July	0.344	2	20:45:00
August	0.517	2	23:30:00
September	0.552	15	10:00:00
October	0.619	27	16:45:00
November	0.527	1	07:00:00
December	1.192	24	17:45:00

Surge minima	Value	Day	Time
January	-0.325	14	22:15:00
February	-0.611	6	17:45:00
March	-0.336	1	03:30:00
April	-0.309	26	23:00:00
May	-0.267	24	06:45:00
June	-0.293	26	12:45:00
July	-0.221	7	20:30:00
August	-0.17	22	05:30:00
September	-0.276	10	16:45:00
October	-0.361	10	06:30:00
November	-0.588	21	10:15:00
December	-0.419	6	05:45:00

Extreme maxima	Value	Day	Time
January	5.629	30	09:00:00
February	5.294	13	09:15:00
March	5.051	12	07:30:00
April	5.11	28	21:00:00
May	5.291	27	20:45:00
June	5.128	22	18:15:00
July	5.354	24	20:15:00
August	5.325	22	19:45:00
September	5.306	20	19:45:00
October	5.24	19	19:15:00
November	5.388	5	08:00:00
December	5.734	19	08:15:00

Extreme minima	Value	Day	Time
January	0.29	14	15:15:00
February	0.151	12	15:00:00
March	0.275	28	14:00:00
April	0.16	27	14:15:00
May	0.386	24	12:30:00
June	0.135	26	03:15:00
July	0.258	25	02:45:00
August	0.14	22	01:45:00
September	0.393	19	00:45:00
October	0.61	18	00:30:00
November	0.682	4	01:15:00
December	0.376	6	15:45:00

Mean sea level	Days	MSL
January	31	2.991
February	28	2.807
March	31	2.764
April	30	2.877
May	31	2.798
June	30	2.780
July	31	2.831
August	31	2.915
September	30	2.884
October	31	3.025
November	30	2.930
December	31	3.236
	Sum	Avg
	365	2.903

Leith – Tide Gauge Information

Latitude 55° 59' 23.4"N **Longitude** 03° 10' 54.1"W **Grid Ref** NT 2638 7806

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Lead-in jetty, east of the entrance to Leith docks
Measuring Points As above

Datum All data refer to Admiralty Chart Datum (ACD)

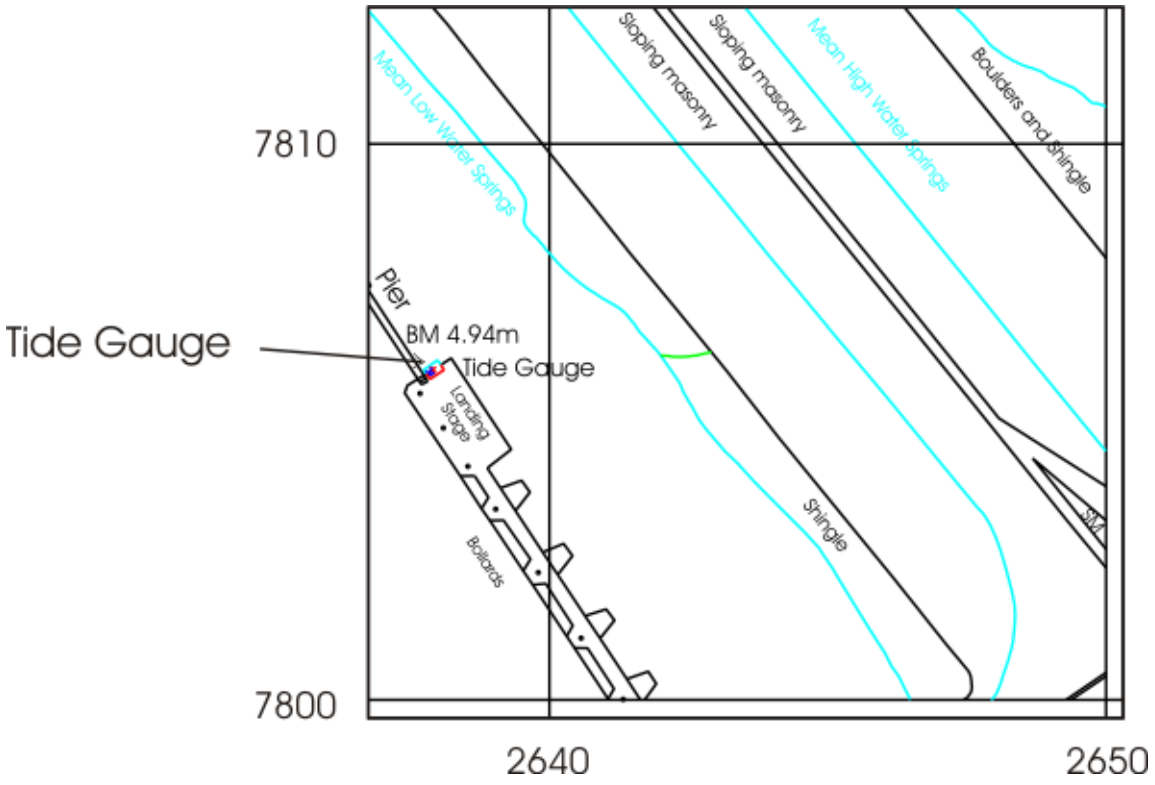
Benchmark	Grid Ref	Description
TGBM	NT 2643 7797	OSBM Bolt SE end of TG pier 0.9m N angle of pier
Aux1	NT 2648 7797	Rivet on top step SW side of road 1.6m S angle of building
Aux2	NT 2653 7789	Rivet top step SW side of road 11.9M W angle of building

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.90m below Ordnance Datum Newlyn (ODN)
TGZ = 7.84mm below TGBM

Levelling No levelling was carried out in 2013

Site visits
26/02/2013 (Day 057) Carried out general maintenance and fitted new V2.02 DQ cards
02/05/2013 (Day 122) Carried out general maintenance and changed compressor

Leith – Map & Images of Site



Leith – Statistics

Surge maxima	Value	Day	Time
January	0.807	30	12:00:00
February	0.634	3	15:45:00
March	0.372	18	23:00:00
April	0.629	15	16:30:00
May	0.334	9	17:00:00
June	0.333	22	21:15:00
July	0.282	29	09:45:00
August	0.439	18	07:45:00
September	0.553	15	20:15:00
October	0.582	28	06:15:00
November	0.607	29	19:30:00
December	1.024	5	12:45:00

Surge minima	Value	Day	Time
January	-0.571	30	00:30:00
February	-0.609	3	06:15:00
March	-0.328	3	12:30:00
April	-0.412	16	12:45:00
May	-0.403	3	00:00:00
June	-0.239	25	19:45:00
July	-0.305	8	10:00:00
August	-0.183	31	19:30:00
September	-0.293	15	10:30:00
October	-0.315	30	20:15:00
November	-0.555	20	00:30:00
December	-0.856	5	08:00:00

Extreme maxima	Value	Day	Time
January	6.01	29	15:45:00
February	5.773	1	17:45:00
March	5.846	29	16:00:00
April	5.77	28	16:15:00
May	5.984	27	16:15:00
June	5.831	23	01:45:00
July	6.092	25	04:00:00
August	6.001	22	02:45:00
September	6.048	20	02:30:00
October	5.895	7	03:30:00
November	6.146	5	15:30:00
December	6.606	5	15:15:00

Extreme minima	Value	Day	Time
January	0.077	13	22:00:00
February	0.062	13	22:45:00
March	0.316	28	21:30:00
April	0.261	27	21:30:00
May	0.388	26	09:00:00
June	0.102	25	09:45:00
July	0.133	24	09:30:00
August	0.125	22	09:15:00
September	0.366	20	09:00:00
October	0.613	6	08:45:00
November	0.659	3	07:45:00
December	0.132	5	09:00:00

Mean sea level	Days	MSL
January	31	3.220
February	28	3.106
March	31	3.121
April	30	3.160
May	31	3.135
June	30	3.113
July	31	3.161
August	31	3.213
September	30	3.214
October	31	3.310
November	30	3.250
December	31	3.335
	Sum	Avg
	365	3.195

Lerwick – Tide Gauge Information

Latitude 60° 09' 14.5" N **Longitude** 01° 08' 25.1" W **Grid Ref** HU 4783 4137

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Inner wall at breakwater entrance to the small boat harbour, south of Victoria Pier
Measuring Points As above

Datum All data refer to Admiralty Chart Datum (ACD)

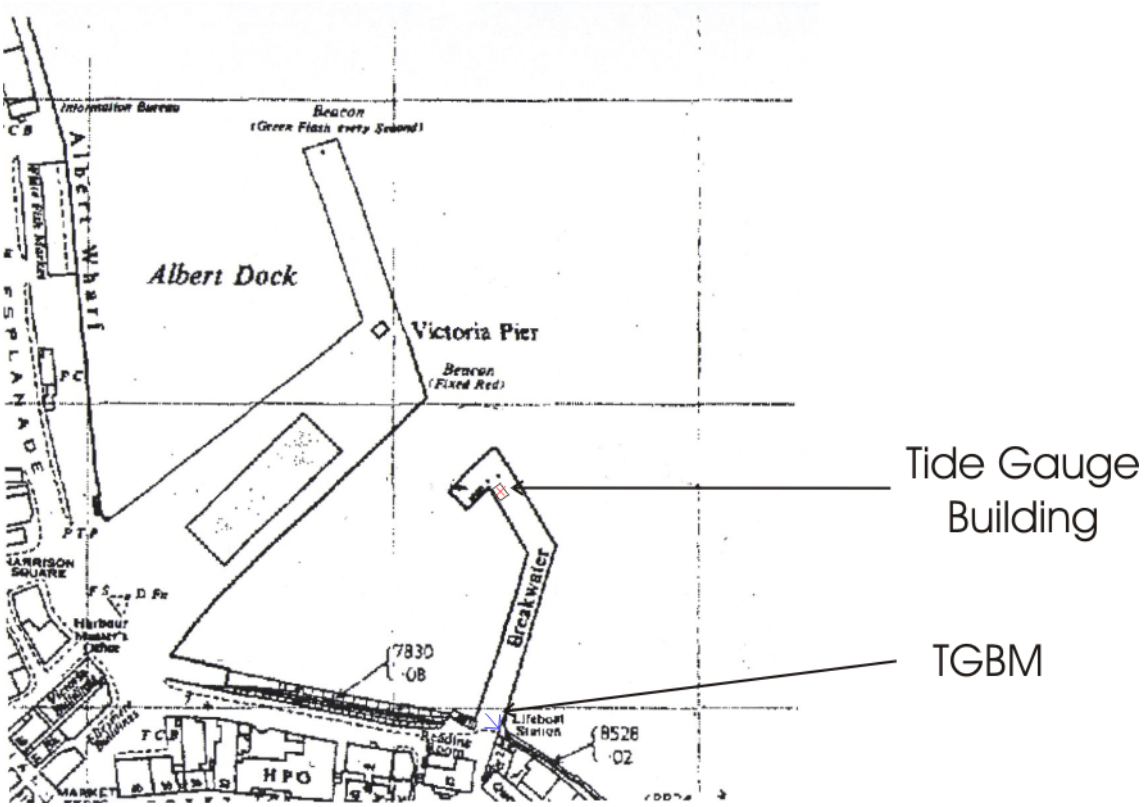
Benchmark	Grid Ref	Description
TGBM	HU 4783 4129	OSBM bolt on breakwater wall
Aux1	HU 4784 4125	Queen's Hotel 7.5m SW face south angle
Aux2	HU 4777 4110	Lerwick Parish Church North face NW angle

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 1.22m below Ordnance Datum Local (ODL)
TGZ = 4.57m below TGBM

Levelling No levelling was carried out in 2013

Site visits
No site visits were carried out in 2013

Lerwick – Map & Images of Site



Lerwick – Statistics

Surge maxima	Value	Day	Time
January	0.595	30	06:15:00
February	0.453	5	09:15:00
March	0.146	15	08:15:00
April	0.434	22	21:15:00
May	0.294	14	07:15:00
June	0.256	13	13:00:00
July	0.222	1	12:15:00
August	0.312	18	06:15:00
September	0.374	16	18:45:00
October	0.453	28	21:15:00
November	0.348	1	00:45:00
December	0.73	25	01:15:00

Surge minima	Value	Day	Time
January	-0.234	24	16:45:00
February	-0.264	6	16:00:00
March	-0.257	1	12:30:00
April	-0.155	30	12:00:00
May	-0.149	24	13:45:00
June	-0.18	26	05:00:00
July	-0.154	8	05:00:00
August	-0.163	22	09:45:00
September	-0.223	7	02:30:00
October	-0.272	12	08:15:00
November	-0.336	25	15:15:00
December	-0.35	6	21:15:00

Extreme maxima	Value	Day	Time
January	2.608	30	12:45:00
February	2.295	13	12:45:00
March	2.198	12	11:15:00
April	2.315	28	12:30:00
May	2.319	28	00:45:00
June	2.298	22	21:45:00
July	2.366	25	00:15:00
August	2.342	22	23:30:00
September	2.431	18	22:00:00
October	2.422	23	13:15:00
November	2.594	5	11:45:00
December	2.737	19	12:15:00

Extreme minima	Value	Day	Time
January	0.119	14	19:00:00
February	-0.016	11	17:45:00
March	0.09	10	16:00:00
April	0.117	27	05:30:00
May	0.174	26	05:15:00
June	-0.004	26	06:45:00
July	0.075	24	05:30:00
August	0.041	22	05:30:00
September	0.261	20	05:00:00
October	0.371	18	04:00:00
November	0.458	21	18:45:00
December	0.24	6	20:00:00

Mean sea level	Days	MSL
January	31	1.362
February	28	1.220
March	31	1.169
April	30	1.288
May	31	1.238
June	30	1.215
July	31	1.270
August	31	1.329
September	30	1.335
October	31	1.421
November	30	1.408
December	31	1.589
	Sum	Avg
	365	1.320

Liverpool – Tide Gauge Information

Latitude 53° 26' 58.9" N **Longitude** 03° 01' 04.8" W **Grid Ref** SJ 3249 9525

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** In the old Lock Keeper's office at the entrance to Gladstone Dock
Measuring Points Seaward side of Gladstone Dock

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	SJ 3249 9525	NBM rivet NE face E angle base of building
Aux1	SJ 3250 9523	Rivet E side of quay above hinge SW dock gate
Aux2	SJ 3244 9538	Building wall E face SE angle
Aux3	SJ 3294 9558	Rivet concrete adjacent to building No 335

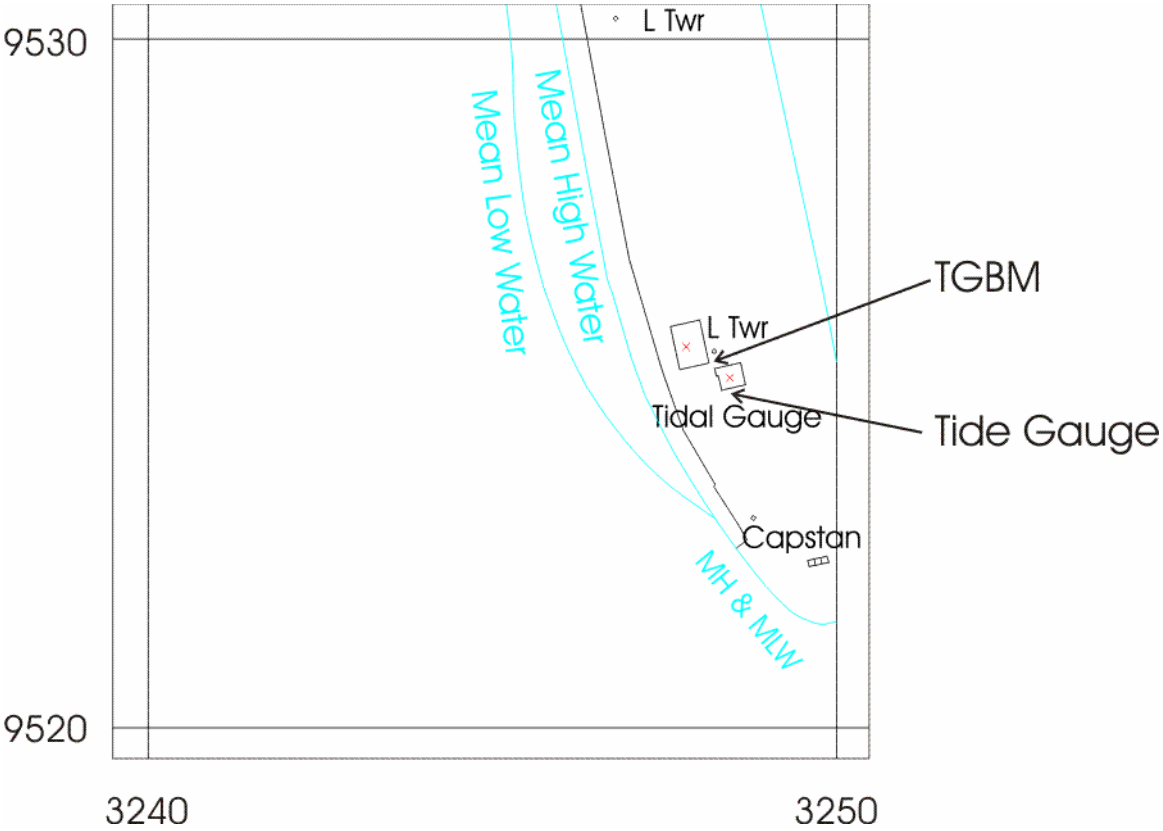
Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 4.93m below Ordnance Datum Newlyn (ODN)
TGZ = 14.475m below TGBM

Levelling Site was levelled by TGI on 06/03/2013

Site visits
16/01/2013 (Day 016) Carried out installation in the refurbished building
06/03/2013 (Day 065) Established two new bench marks at either end of Gladstone Dock
12/11/2013 (Day 316) Carried out site survey and met with surveyors

Notes on Data Quality
The pier is subsiding. From April to May 2013, both channels have been flagged as they were reading ~40mm high, which was acceptable for monitoring extremes but unacceptable for the purposes of long-term sea level monitoring. Two new benchmarks have been established at either end of the dock to monitor any movement. By the end of July, channel 2 was fluctuating between 20mm low to 30mm high and was mostly flagged. In September 2013, channel 2 was less than 20mm out from the mid-tide so was no longer flagged. From November, channel 2 was flagged ~60mm low on several falling tides, which was acceptable for monitoring extremes but were flagged as unacceptable for the purposes of long-term sea level monitoring.

Liverpool – Map & Images of Site



Liverpool – Statistics

Surge maxima	Value	Day	Time
January	1.317	28	20:30:00
February	0.73	4	22:30:00
March	0.499	15	09:45:00
April	1.292	17	22:45:00
May	0.087	1	13:00:00
June			
July			
August	0.385	30	21:00:00
September	1.051	15	15:15:00
October	0.916	27	11:15:00
November	1.4	2	17:30:00
December	1.737	27	09:30:00

Surge minima	Value	Day	Time
January	-0.401	15	04:45:00
February	-0.575	8	05:30:00
March	-0.3	11	19:30:00
April	-0.349	27	08:00:00
May	-0.236	2	00:00:00
June			
July			
August	-0.221	31	03:15:00
September	-0.248	13	11:30:00
October	-0.332	11	11:00:00
November	-0.604	20	21:15:00
December	-0.39	6	00:00:00

Extreme maxima	Value	Day	Time
January	10.138	14	12:45:00
February	9.843	10	11:00:00
March	9.92	29	12:15:00
April	9.776	29	01:00:00
May	8.851	1	02:45:00
June			
July			
August	10.018	24	00:45:00
September	10.074	19	23:00:00
October	9.85	19	23:15:00
November	10.232	5	11:45:00
December	11.148	5	12:30:00

Extreme minima	Value	Day	Time
January	0.567	12	18:15:00
February	0.327	11	18:45:00
March	0.683	11	17:45:00
April	0.52	27	19:00:00
May	1.61	1	09:30:00
June			
July			
August	0.575	23	07:15:00
September	0.766	20	06:15:00
October	1.066	6	06:15:00
November	1.207	4	05:45:00
December	0.852	4	18:45:00

Mean sea level	Days	MSL
January	31	5.399
February	28	5.227
March	31	5.255
April	30	5.318
May	0	*
June	0	*
July	0	*
August	8	*
September	30	5.333
October	31	5.473
November	9	*
December	7	*
	Sum	Avg
	205	**

* No mean sea level value as more than 15 days of data missing
** No yearly average value as more than one month's MSL missing

Llandudno – Tide Gauge Information

Latitude 53° 19' 54.0" N **Longitude** 03° 49' 30.8" W **Grid Ref** SH 7855 8319

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge

Location

Tide Gauge Building A sub-platform under the pavilion at the end of Llandudno pier

Measuring Points A leg of the pier below the tide gauge building

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	SH 7834 8292	Rivet stone butt gate entrance
Aux1	SH 7827 8255	OSBM bolt concrete step SE side of slipway
Aux2	SH 7840 8243	OSBM bolt bottom concrete step
Aux3	SH 7864 8229	OSBM bolt concrete ramp 6.5M NW C slipway

Benchmark Relationships

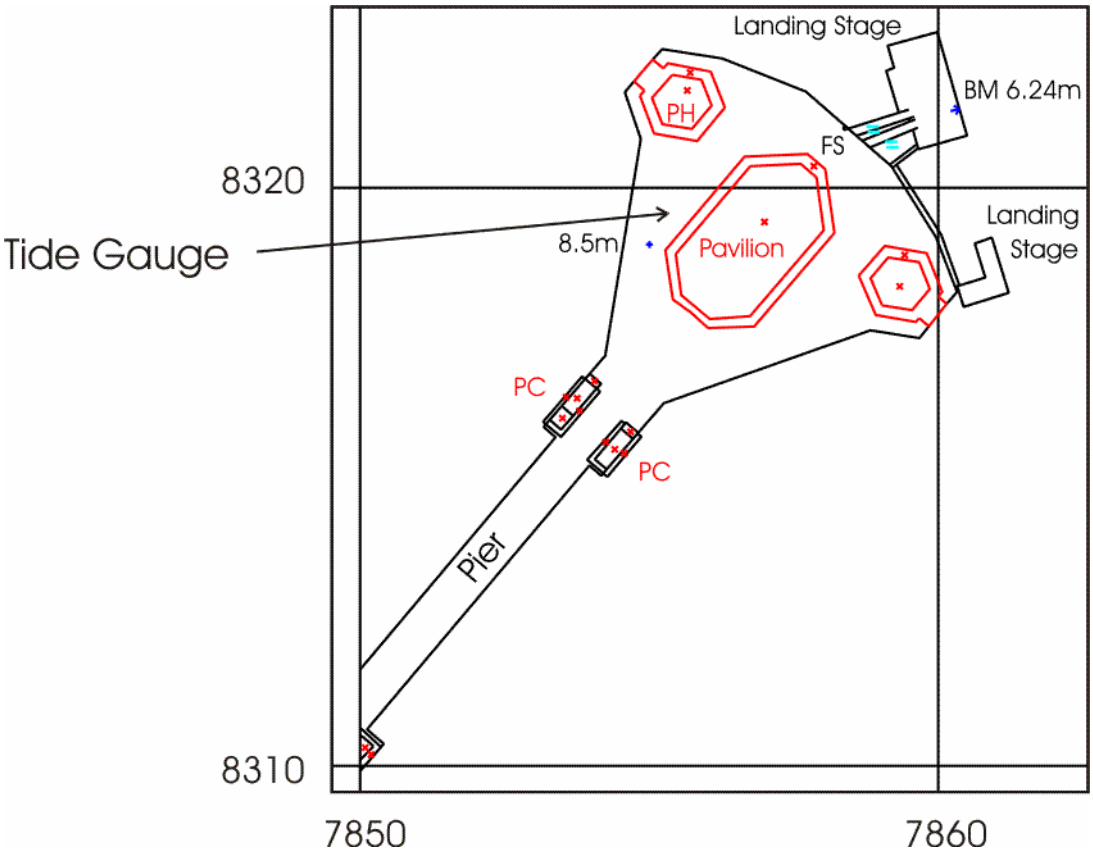
TGZ = Admiralty Chart Datum (ACD)
TGZ = 3.85m below Ordnance Datum Newlyn (ODN)
TGZ = 12.558m below TGBM

Levelling No levelling was carried out in 2013

Site visits

04/07/2013 (Day 185)	Carried out general maintenance, changed compressor and carried out survey
19/12/2013 (Day 353)	Inspected site for storm surge damage and investigated phone line fault

Llandudno – Map & Images of Site



Llandudno – Statistics

Surge maxima	Value	Day	Time
January	0.898	28	19:45:00
February	0.355	13	21:45:00
March	0.375	15	09:15:00
April	0.842	17	22:30:00
May	0.575	9	13:30:00
June	0.48	14	22:15:00
July	0.3	2	14:15:00
August	0.546	17	15:30:00
September	0.715	15	14:30:00
October	0.696	27	11:15:00
November	0.869	2	16:30:00
December	1.308	27	10:00:00

Surge minima	Value	Day	Time
January	-0.434	15	04:30:00
February	-0.878	6	07:00:00
March	-0.338	11	08:30:00
April	-0.445	27	09:00:00
May	-0.437	24	16:45:00
June	-0.291	23	22:45:00
July	-0.289	8	09:00:00
August	-0.354	31	03:45:00
September	-0.3	10	10:30:00
October	-0.408	10	03:15:00
November	-0.562	14	18:30:00
December	-0.561	5	22:30:00

Extreme maxima	Value	Day	Time
January	8.206	14	12:15:00
February	8.09	13	12:45:00
March	8.083	29	11:45:00
April	7.859	28	12:15:00
May	8.063	27	12:00:00
June	7.986	26	00:15:00
July	8.351	25	00:00:00
August	8.306	22	23:45:00
September	8.188	20	23:15:00
October	8.088	19	22:45:00
November	8.286	5	11:30:00
December	8.911	5	12:00:00

Extreme minima	Value	Day	Time
January	-0.087	12	17:30:00
February	-0.299	11	18:00:00
March	-0.01	11	17:00:00
April	-0.151	27	05:45:00
May	0.035	24	16:15:00
June	-0.106	26	07:00:00
July	0.026	24	06:00:00
August	-0.033	22	05:30:00
September	0.046	20	05:15:00
October	0.436	7	06:00:00
November	0.501	4	05:00:00
December	0.104	4	17:45:00

Mean sea level	Days	MSL
January	31	4.128
February	28	3.941
March	31	4.010
April	30	4.041
May	31	4.004
June	26	4.000
July	31	4.034
August	25	4.085
September	28	4.066
October	31	4.223
November	24	4.114
December	31	4.304
	Sum	Avg
	347	4.079

Lowestoft – Tide Gauge Information

Latitude 52° 28' 23.2" N **Longitude** 01° 45' 00.4" E **Grid Ref** TM 5478 9274

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** East of the Harbour Master's office
Measuring Points On the quay wall, east of the tide gauge building

Datum All data refer to Admiralty Chart Datum (ACD)

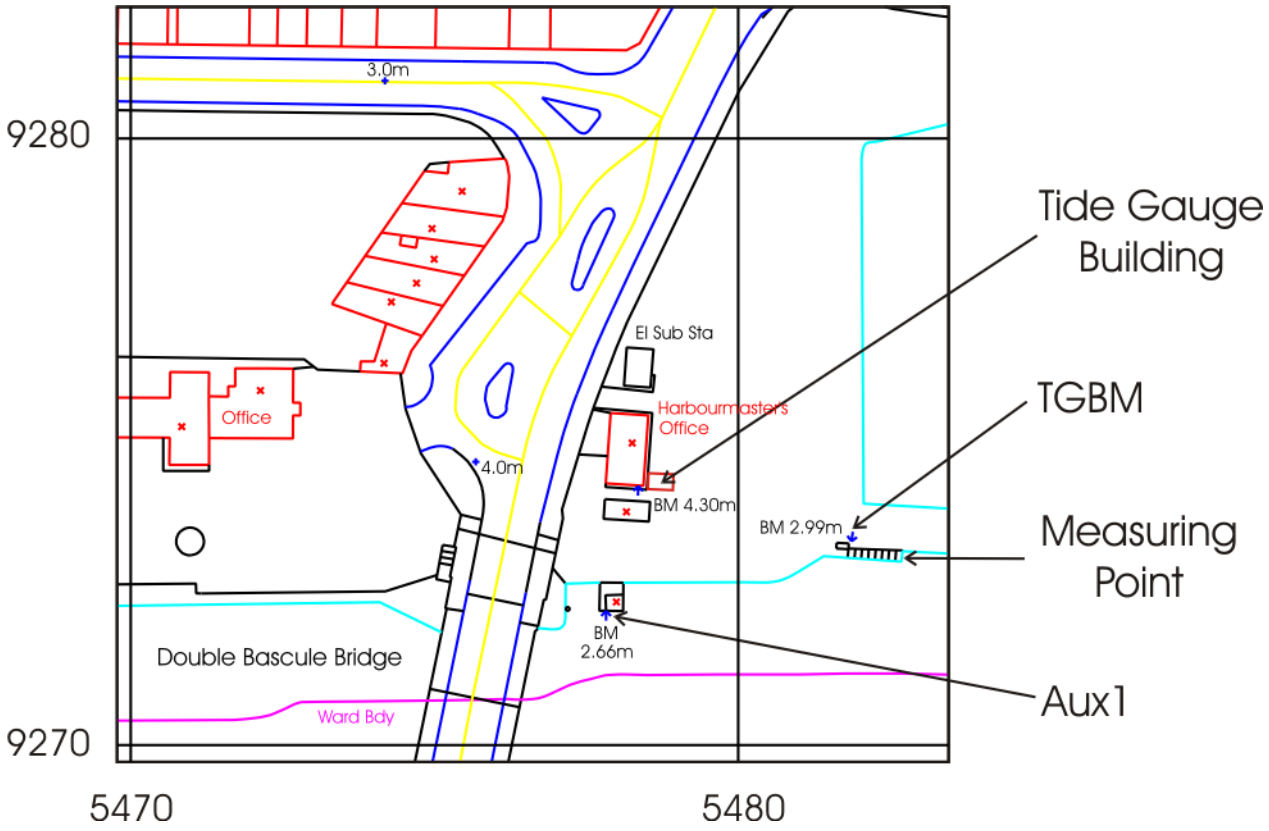
Benchmark	Grid Ref	Description
TGBM	TM 5482 9273	Bolt on quay wall S side of pier
Aux1	TM 5477 9272	Bolt on concrete jetty at SW corner of TG building
Aux2	TM 5478 9274	CM Harbour Masters Office SE angle S face

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 1.50m below Ordnance Datum Newlyn (ODN)
TGZ = 4.483m below TGBM

Levelling No levelling was carried out in 2013

Site visits
04/12/2013 (Day 338) Carried out general maintenance and changed compressor

Lowestoft – Map & Images of Site



Lowestoft – Statistics

Surge maxima	Value	Day	Time
January	0.801	30	19:00:00
February	0.849	3	22:00:00
March	0.255	5	23:30:00
April	0.492	19	00:00:00
May	0.637	23	23:00:00
June	0.243	29	10:00:00
July	0.259	5	03:15:00
August	0.547	31	08:15:00
September	0.791	16	01:45:00
October	0.998	10	07:45:00
November	1.265	30	00:45:00
December	2.179	5	22:00:00

Surge minima	Value	Day	Time
January	-0.643	27	10:00:00
February	-1.16	14	03:45:00
March	-0.622	22	15:15:00
April	-0.503	18	09:00:00
May	-0.421	3	02:45:00
June	-0.262	30	02:15:00
July	-0.238	8	17:00:00
August	-0.456	17	21:45:00
September	-0.698	15	17:00:00
October	-0.547	31	01:30:00
November	-0.901	11	15:15:00
December	-1.041	27	13:00:00

Extreme maxima	Value	Day	Time
January	3.228	30	23:30:00
February	3.097	2	01:00:00
March	2.806	12	22:00:00
April	2.68	12	23:00:00
May	2.906	23	19:30:00
June	2.792	27	12:00:00
July	2.871	27	12:30:00
August	2.874	24	11:15:00
September	2.984	20	09:30:00
October	3.277	10	12:30:00
November	3.117	4	22:00:00
December	4.764	5	22:30:00

Extreme minima	Value	Day	Time
January	0.142	14	05:15:00
February	-0.591	14	06:15:00
March	0.329	2	06:15:00
April	0.263	28	05:00:00
May	0.337	27	17:15:00
June	0.213	26	17:45:00
July	0.223	24	17:00:00
August	0.198	23	17:15:00
September	0.273	19	15:30:00
October	0.335	18	15:00:00
November	0.216	11	09:45:00
December	-0.06	21	05:45:00

Mean sea level	Days	MSL
January	31	1.660
February	28	1.627
March	31	1.568
April	30	1.627
May	31	1.642
June	30	1.604
July	31	1.649
August	31	1.701
September	30	1.731
October	31	1.746
November	30	1.805
December	31	1.714
	Sum	Avg
	365	1.673

Milford Haven – Tide Gauge Information

Latitude 51° 42' 26.6" N **Longitude** 05° 03' 05.5" W **Grid Ref** SM 8925 0537

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Store room at the shore end of Milford Haven Port Authority jetty
Measuring Points Seaward end of the jetty

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	SM 8921 0536	OSBM Bolt on wall W side of entrance to jetty
Aux1	SM 8918 0541	Fl Br G4977 office buildings. SW face NW angle.
Aux2	SM 9001 0601	OSBM bolt wall Victoria Road

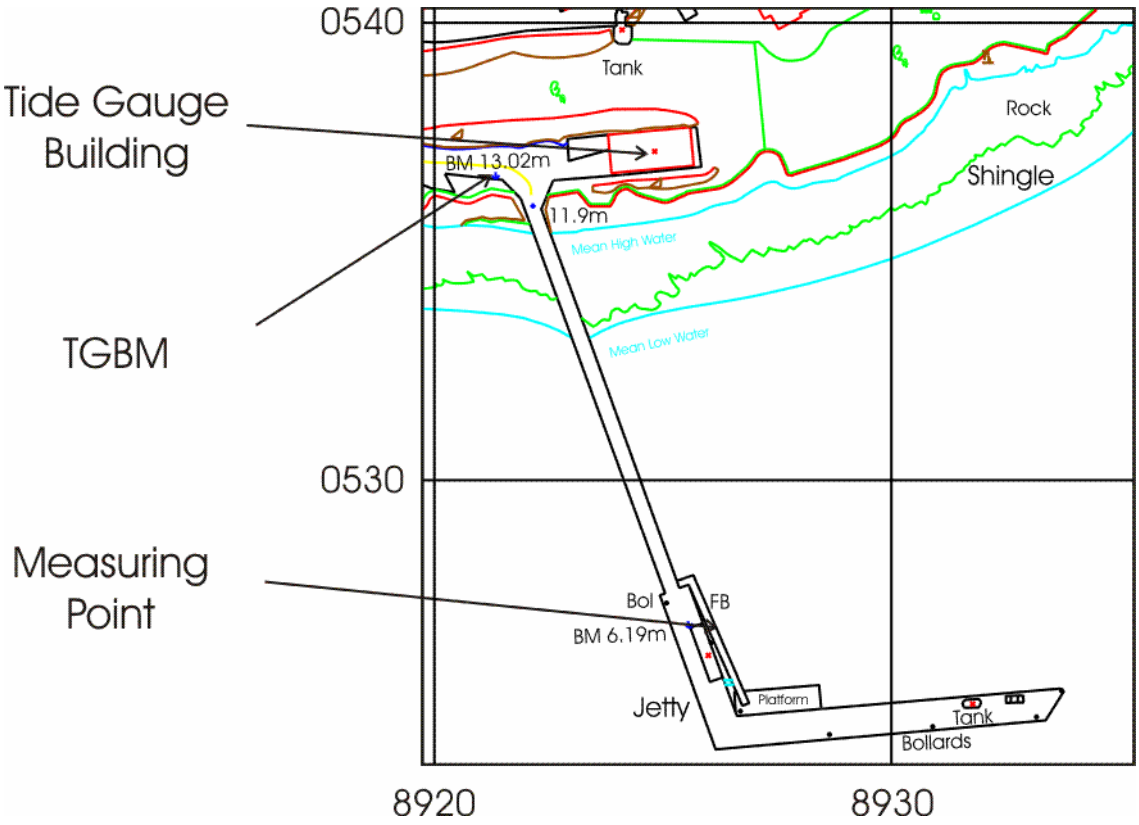
Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 3.71m below Ordnance Datum Newlyn (ODN)
TGZ = 16.734m below TGBM

Levelling No levelling was carried out in 2013

Site visits
10/03/2013 (Day 069) Carried out general maintenance and diving to check MT and FT channels
18/07/2013 (Day 199) Carried out general maintenance and changed compressor

Notes on Data Quality
The primary channel was occasionally out by 40-50mm, which was acceptable for monitoring extremes but was flagged as unacceptable for the purposes of long-term sea level monitoring. The secondary channel was available. The channels were cleaned and the operation checked during a site visit on 10/03/2013.

Milford Haven – Map & Images of Site



Milford Haven – Statistics

Surge maxima	Value	Day	Time
January			
February			
March			
April			
May	0.269	27	10:45:00
June	0.366	14	18:30:00
July	0.329	28	17:45:00
August	0.364	17	13:45:00
September	0.301	19	11:00:00
October	0.536	25	13:45:00
November	0.704	2	13:00:00
December	1.028	26	23:15:00

Surge minima	Value	Day	Time
January			
February			
March			
April			
May	-0.262	24	15:15:00
June	-0.231	24	00:45:00
July	-0.19	7	03:45:00
August	-0.172	31	03:00:00
September	-0.194	10	06:30:00
October	-0.231	11	21:30:00
November	-0.452	14	14:00:00
December	-0.011	19	16:15:00

Extreme maxima	Value	Day	Time
January			
February			
March			
April			
May	7.404	27	19:45:00
June	7.32	24	18:45:00
July	7.719	24	19:30:00
August	7.669	22	19:15:00
September	7.555	20	18:45:00
October	7.526	19	18:15:00
November	7.729	5	07:00:00
December	7.408	18	19:00:00

Extreme minima	Value	Day	Time
January			
February			
March			
April			
May	0.433	26	00:45:00
June	0.271	26	02:00:00
July	0.46	24	01:00:00
August	0.346	22	00:45:00
September	0.472	20	00:30:00
October	0.759	7	01:15:00
November	0.887	5	13:15:00
December	1.453	20	01:30:00

Mean sea level	Days	MSL
January	0	*
February	0	*
March	0	*
April	0	*
May	17	3.809
June	30	3.825
July	31	3.871
August	31	3.904
September	30	3.912
October	31	4.086
November	11	*
December	3	*
	Sum	Avg
	184	**

* No mean sea level value as more than 15 days of data missing

** No yearly average value as more than one month's MSL missing

Millport – Tide Gauge Information

Latitude 55° 44' 59.3" N **Longitude** 04° 54' 22.8" W **Grid Ref** NS 1769 5454

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Store room at the shore end of the University Marine Biological Station pier
Measuring Points Seaward end of the pier

Datum All data refer to Admiralty Chart Datum (ACD)

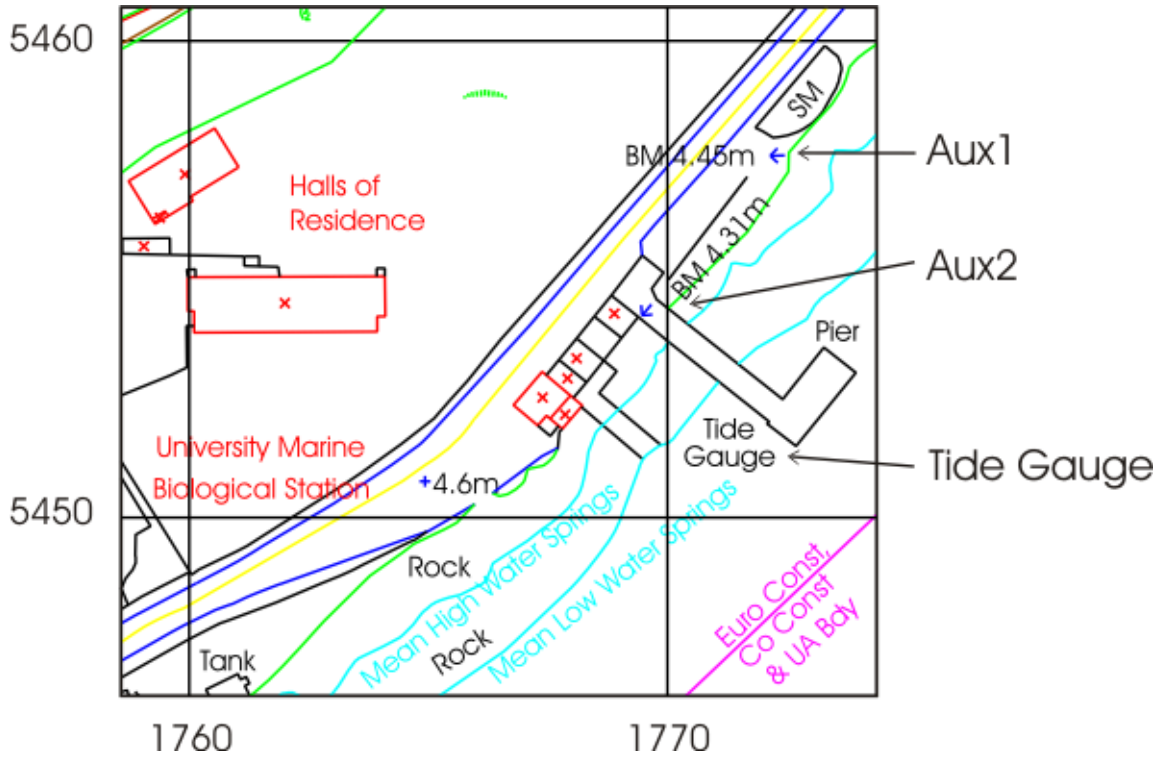
Benchmark	Grid Ref	Description
TGBM	NS 1757 5449	Fl Br G4602 Marine station
Aux1	NS 1772 5457	OSBM bolt rock SE side Rd 5M NE end wall
Aux2	NS 1769 5454	Rivet pier 0.8M prod SE face of TG building
Aux3	NS 1718 5451	No 45 Marine Parade NW angle N face

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 1.62m below Ordnance Datum Newlyn (ODN)
TGZ = 7.825m below TGBM

Levelling No levelling was carried out in 2013

Site visits
26/02/2013 (Day 057) Fitted new V2.02 DQ cards
18/10/2013 (Day 291) Carried out inspection dive

Millport – Map & Images of Site



Millport – Statistics

Surge maxima	Value	Day	Time
January	1.053	31	08:45:00
February	0.581	4	07:30:00
March	0.306	15	10:30:00
April	0.994	18	00:30:00
May	0.491	27	10:15:00
June	0.516	15	00:45:00
July	0.377	2	16:00:00
August	0.49	17	17:00:00
September	0.497	15	13:00:00
October	0.864	27	15:00:00
November	0.741	2	16:45:00
December	1.477	27	12:00:00

Surge minima	Value	Day	Time
January	-0.405	15	07:45:00
February	-0.883	6	05:30:00
March	-0.387	1	00:15:00
April	-0.421	27	05:45:00
May	-0.412	24	20:30:00
June	-0.334	26	14:15:00
July	-0.263	8	22:30:00
August	-0.296	31	06:00:00
September	-0.347	10	12:00:00
October	-0.452	10	02:30:00
November	-1.022	21	01:00:00
December	-0.619	6	01:00:00

Extreme maxima	Value	Day	Time
January	4.203	31	14:45:00
February	3.955	13	14:15:00
March	3.708	15	14:30:00
April	3.982	15	02:45:00
May	3.658	13	02:00:00
June	3.654	12	02:00:00
July	3.765	26	02:30:00
August	3.651	23	01:30:00
September	3.62	21	01:00:00
October	3.898	26	16:30:00
November	4.012	7	15:00:00
December	4.541	19	01:15:00

Extreme minima	Value	Day	Time
January	0.029	14	19:45:00
February	-0.196	11	18:30:00
March	-0.021	11	17:30:00
April	-0.21	27	06:15:00
May	-0.034	29	08:30:00
June	-0.174	26	07:30:00
July	0.042	24	06:30:00
August	0.006	22	06:15:00
September	0.078	20	05:45:00
October	0.253	9	20:15:00
November	0.153	21	07:45:00
December	-0.065	5	19:30:00

Mean sea level	Days	MSL
January	31	2.101
February	28	1.886
March	31	1.923
April	30	1.978
May	31	1.922
June	30	1.890
July	31	1.923
August	31	2.004
September	30	1.968
October	31	2.142
November	30	1.981
December	31	2.315
	Sum	Avg
	365	2.003

Mumbles – Tide Gauge Information

Latitude 51° 34' 12.0" N **Longitude** 03° 58' 31.6" W **Grid Ref** SS 6319 8753

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Mumbles lifeboat station
Measuring Points Near the end of the lifeboat slipway

Datum All data refer to Admiralty Chart Datum (ACD)

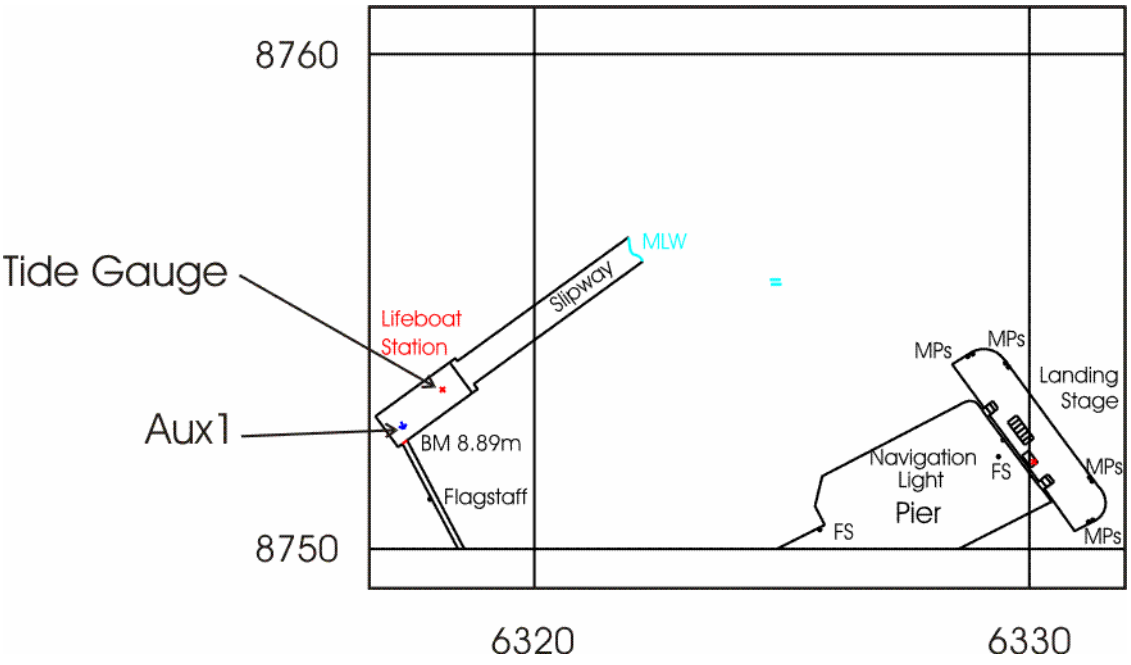
Benchmark	Grid Ref	Description
TGBM	SS 6298 8743	OSBM bolt living rock S side of road
Aux1	SS 6317 8752	OSBM bolt lifeboat station Mumbles Pier
Aux2	SS 6284 8750	OSBM bolt concrete base bollard Lifeboat Cottages
Aux3	SS 6258 8760	Rivet SE side concrete chamber

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 5.00m below Ordnance Datum Newlyn (ODN)
TGZ = 13.821m below TGBM

Levelling No levelling was carried out in 2013

Site visits
06/12/2013 (Day 340) Changed compressor

Mumbles – Map & Images of Site



Mumbles – Statistics

Surge maxima	Value	Day	Time
January	0.687	31	04:00:00
February	0.438	5	01:45:00
March	0.366	15	11:30:00
April	0.6	17	18:00:00
May	0.696	9	10:30:00
June	0.345	15	02:30:00
July	0.338	29	02:15:00
August	0.309	17	12:45:00
September	0.415	19	10:30:00
October	0.555	16	10:30:00
November	0.676	2	14:00:00
December	1.179	24	01:30:00

Surge minima	Value	Day	Time
January	-0.314	6	07:00:00
February	-0.718	6	10:15:00
March	-0.377	1	17:15:00
April	-0.39	30	19:00:00
May	-0.363	1	19:45:00
June	-0.352	27	06:15:00
July	-0.323	8	14:45:00
August	-0.325	13	06:15:00
September	-0.379	13	07:00:00
October	-0.404	11	19:30:00
November	-0.702	20	16:15:00
December	-0.502	5	18:30:00

Extreme maxima	Value	Day	Time
January	10.016	13	07:15:00
February	9.997	11	07:00:00
March	9.927	29	07:15:00
April	9.726	11	06:45:00
May	9.892	26	19:15:00
June	9.839	25	19:45:00
July	10.222	24	19:30:00
August	10.204	22	19:15:00
September	10.057	20	18:45:00
October	9.931	19	18:30:00
November	10.243	5	07:00:00
December	10.002	5	07:45:00

Extreme minima	Value	Day	Time
January	0.596	14	14:00:00
February	0.445	11	13:00:00
March	0.588	1	02:00:00
April	0.422	27	00:45:00
May	0.627	26	00:30:00
June	0.463	26	02:00:00
July	0.611	24	01:00:00
August	0.511	22	00:45:00
September	0.659	21	01:00:00
October	0.91	7	01:00:00
November	1.095	5	13:15:00
December	0.576	4	13:00:00

Mean sea level	Days	MSL
January	31	5.263
February	28	5.106
March	31	5.220
April	30	5.166
May	31	5.150
June	30	5.129
July	31	5.167
August	31	5.200
September	30	5.196
October	31	5.359
November	30	5.194
December	31	5.370
	Sum	Avg
	365	5.210

Newhaven – Tide Gauge Information

Latitude 50° 46' 54.4" N **Longitude** 00° 03' 25.3" E **Grid Ref** TQ 4511 0004

Instrument Data acquisition system with two full-tide bubbler gauges
Location **Tide Gauge Building** Within the Port Control building on West Pier
Measuring Points On the pier wall, south east of the Port Control building

Datum All data refer to Admiralty Chart Datum (ACD)

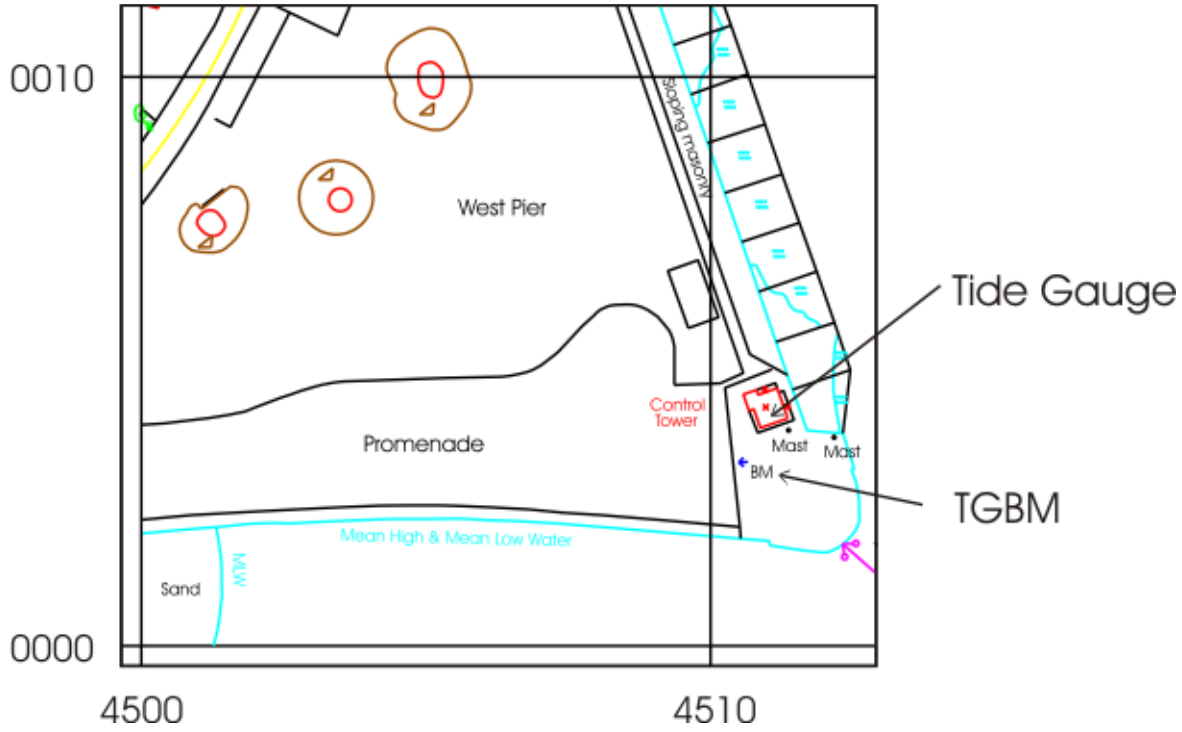
Benchmark	Grid Ref	Description
TGBM	TQ 4510 0003	Bolt concrete 7.4M SW of SW angle of tower
Aux1	TQ 4495 0001	OSBM bolt concrete sea wall 154.3M SW of tower
Aux2	TQ 4503 0008	Steel ball Gun mount

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 3.52m below Ordnance Datum Newlyn (ODN)
TGZ = 8.783m below TGBM

Levelling No levelling was carried out in 2013

Site visits
06/01/2013 (Day 006) Carried out repair and servicing of the Ott gauge
04/06/2013 (Day 155) Carried out general maintenance and changed compressor

Newhaven – Map & Images of Site



Newhaven – Statistics

Surge maxima	Value	Day	Time
January	0.487	29	22:45:00
February	0.543	4	03:00:00
March	0.307	16	05:30:00
April	0.393	16	04:30:00
May	0.486	14	23:15:00
June	0.261	23	01:30:00
July	0.317	27	18:30:00
August	0.295	18	19:15:00
September	0.484	16	06:45:00
October	0.845	28	08:45:00
November	0.769	4	01:45:00
December	0.939	6	02:00:00

Surge minima	Value	Day	Time
January	-0.35	21	19:15:00
February	-0.577	14	13:30:00
March	-0.498	11	21:15:00
April	-0.293	30	12:00:00
May	-0.33	1	00:30:00
June	-0.31	26	11:00:00
July	-0.292	8	09:15:00
August	-0.209	21	09:00:00
September	-0.268	1	03:00:00
October	-0.313	11	13:00:00
November	-0.497	15	19:45:00
December	-0.613	30	21:00:00

Extreme maxima	Value	Day	Time
January	6.995	12	11:15:00
February	6.885	10	23:30:00
March	7.003	29	00:00:00
April	6.953	12	00:00:00
May	6.95	27	00:00:00
June	6.873	25	00:00:00
July	7.083	25	13:00:00
August	7.007	23	12:30:00
September	7.07	20	11:30:00
October	6.911	21	12:15:00
November	7.445	3	22:45:00
December	7.79	6	01:15:00

Extreme minima	Value	Day	Time
January	0.413	13	18:30:00
February	0.348	11	18:15:00
March	0.434	11	17:30:00
April	0.4	28	06:45:00
May	0.49	27	06:30:00
June	0.325	26	07:15:00
July	0.448	24	06:15:00
August	0.445	22	06:00:00
September	0.558	21	06:15:00
October	0.721	6	18:00:00
November	0.883	5	18:30:00
December	0.375	5	19:00:00

Mean sea level	Days	MSL
January	31	3.687
February	28	3.585
March	31	3.625
April	30	3.617
May	31	3.639
June	30	3.592
July	31	3.623
August	31	3.664
September	30	3.689
October	31	3.787
November	30	3.720
December	31	3.754
	Sum	Avg
	365	3.665

Newlyn – Tide Gauge Information

Latitude 50° 06' 10.8" N **Longitude** 05° 32' 34.2" W **Grid Ref** SW 4676 2856

Instrument Data acquisition system with a full-tide and mid-tide bubbler gauge and a back-up potentiometer attached to a Munro float gauge

Location **Tide Gauge Building** Tidal Observatory at the end of South Pier, next to the lighthouse

Measuring Points Seaward side of the pier, behind the lighthouse

Datum All data refer to Admiralty Chart Datum (ACD)

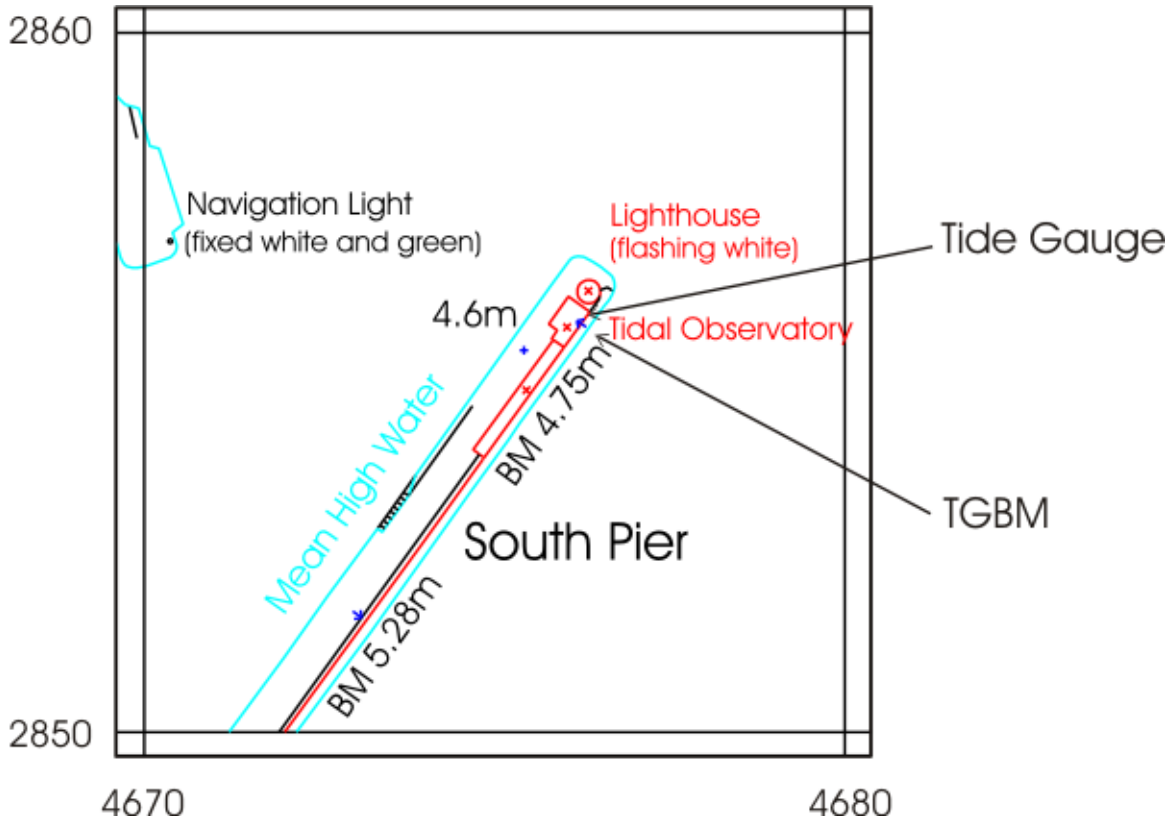
Benchmark	Grid Ref	Description
TGBM	SW 4677 2856	Brass bolt in the floor of the recorder hut.
Aux1	SW 4673 2851	Flush Bracket 1565 on wall S pier NW face 17.8m SW
Aux2	SW 4659 2841	F Bracket 1520 wall SE side of S Pier Rd NW face

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 3.05m below Ordnance Datum Newlyn (ODN)
TGZ = 7.801m below TGBM

Levelling No levelling was carried out in 2013

Site visits
22/10/2013 (Day 295) Carried out general maintenance and changed compressor

Newlyn – Map & Images of Site



Newlyn – Statistics

Surge maxima	Value	Day	Time
January	0.542	18	03:45:00
February	0.268	21	18:45:00
March	0.47	21	16:45:00
April	0.435	11	23:00:00
May	0.366	14	13:30:00
June	0.244	12	12:00:00
July	0.359	28	15:00:00
August	0.27	2	02:15:00
September	0.289	29	04:15:00
October	0.46	28	01:15:00
November	0.369	3	17:30:00
December	0.751	23	20:15:00

Surge minima	Value	Day	Time
January	-0.222	5	21:15:00
February	-0.355	6	19:45:00
March	-0.188	2	15:45:00
April	-0.246	30	17:15:00
May	-0.219	1	17:15:00
June	-0.237	28	18:00:00
July	-0.168	7	04:00:00
August	-0.134	13	17:45:00
September	-0.177	10	16:15:00
October	-0.193	11	18:00:00
November	-0.377	14	11:15:00
December	-0.385	5	16:30:00

Extreme maxima	Value	Day	Time
January	6.026	12	04:45:00
February	5.945	11	05:15:00
March	5.958	29	05:45:00
April	5.81	11	05:00:00
May	5.881	27	18:30:00
June	5.744	25	18:00:00
July	6.099	24	17:45:00
August	6.018	22	17:30:00
September	5.877	20	17:15:00
October	5.912	18	16:00:00
November	5.955	3	16:15:00
December	5.834	6	06:45:00

Extreme minima	Value	Day	Time
January	0.497	13	12:15:00
February	0.481	11	12:00:00
March	0.618	1	01:00:00
April	0.39	26	23:45:00
May	0.512	25	23:30:00
June	0.369	26	01:00:00
July	0.566	23	23:45:00
August	0.499	21	23:30:00
September	0.593	19	23:15:00
October	0.773	7	00:15:00
November	0.901	3	10:30:00
December	0.478	5	12:45:00

Mean sea level	Days	MSL
January	31	3.275
February	28	3.151
March	31	3.322
April	30	3.214
May	31	3.174
June	30	3.164
July	31	3.222
August	31	3.23
September	30	3.244
October	31	3.384
November	26	3.173
December	31	3.315
	Sum	Avg
	361	3.239

Newport – Tide Gauge Information

Latitude 51° 33' 00.0" N **Longitude** 02° 59' 14.8" W **Grid Ref** ST 3163 8392

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** West side of the entrance to Newport Docks
Measuring Points Attached to the dock wall on the west side of the dock entrance, close to the lock gates

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	ST 3163 8392	Brass bolt adjacent to TG building
Aux1	ST 3160 8414	Pin in quay west side of South Lock
Aux2	ST 3160 8426	Pin in quay east side of South Lock
Aux3	ST 3147 8427	Pin in quay south west corner of South Dock

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 5.81m below Ordnance Datum Newlyn (ODN)
TGZ = 14.525m below TGBM

Levelling No levelling was carried out in 2013

Site visits
08/02/2013 (Day 039) Changed compressor
05/12/2013 (Day 339) Carried out general maintenance

Notes on Data Quality
In March 2013, the primary channel was blocking, reading up to ~80mm high and flagged in places. The secondary channel was up to ~20mm low and flagged, but was still acceptable for monitoring extremes. From April to September the primary channel was blocking, up to 70mm high, but the secondary channel was available throughout this period.

Newport – Map & Images of Site

Newport – Statistics

Surge maxima	Value	Day	Time
January	1.419	31	05:00:00
February	0.969	11	14:30:00
March	0.719	20	06:30:00
April	0.507	1	03:00:00
May			
June			
July			
August			
September			
October			
November			
December			

Surge minima	Value	Day	Time
January	-0.765	12	15:00:00
February	-0.753	6	21:45:00
March	-0.709	1	04:30:00
April	-0.461	5	11:15:00
May			
June			
July			
August			
September			
October			
November			
December			

Extreme maxima	Value	Day	Time
January	12.943	14	08:45:00
February	12.929	12	08:30:00
March	12.768	29	08:15:00
April	11.614	1	10:15:00
May			
June			
July			
August			
September			
October			
November			
December			

Extreme minima	Value	Day	Time
January	0.313	14	16:15:00
February	0.317	28	03:45:00
March	0.228	30	04:00:00
April	0.712	1	04:45:00
May			
June			
July			
August			
September			
October			
November			
December			

Mean sea level	Days	MSL
January	31	6.241
February	28	6.102
March	17	6.158
April	4	*
May	0	*
June	0	*
July	0	*
August	0	*
September	0	*
October	0	*
November	0	*
December	0	*
	Sum	Avg
	80	**

* No mean sea level value as more than 15 days of data missing
** No yearly average value as more than one month's MSL missing

North Shields – Tide Gauge Information

Latitude 55° 00' 26.8" N **Longitude** 01° 26' 23.2" W **Grid Ref** NZ 3592 6823

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** North side of the River Tyne, close to the Port of Tyne Authority offices
Measuring Points As above

Datum All data refer to Admiralty Chart Datum (ACD)

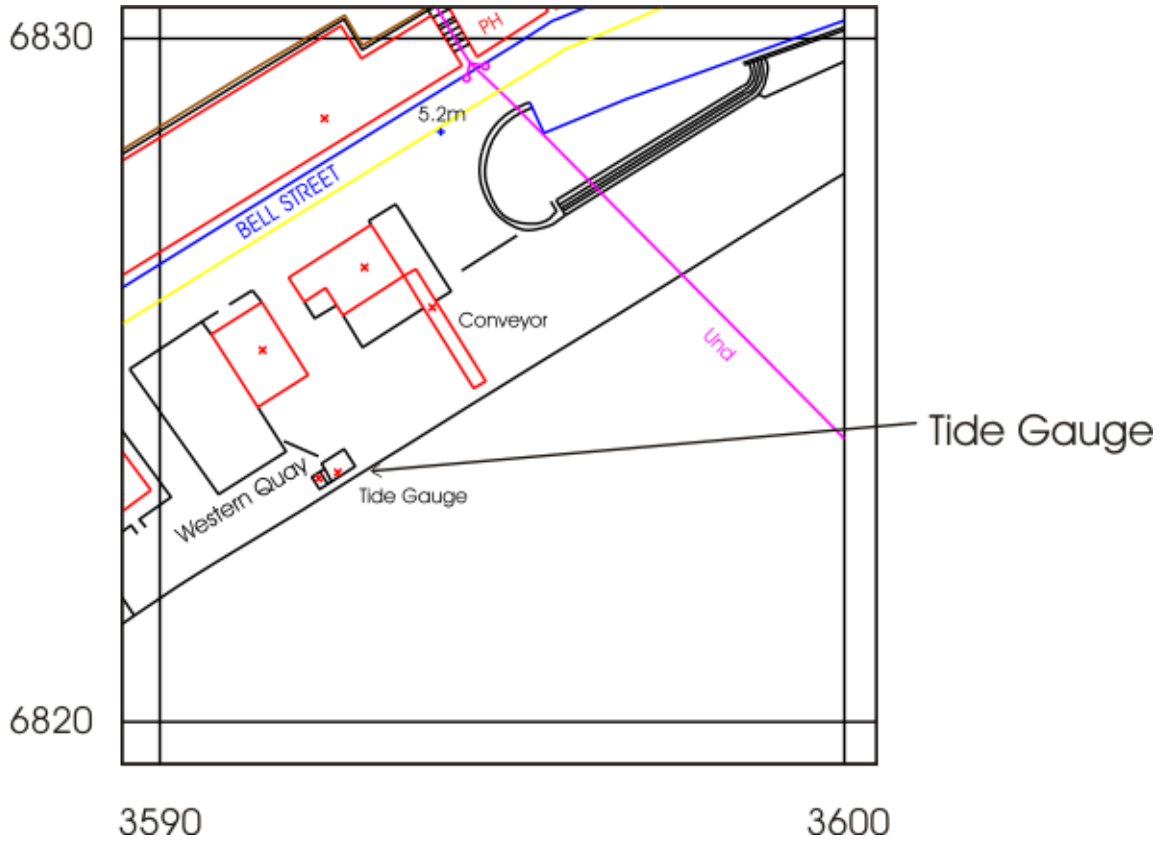
Benchmark	Grid Ref	Description
TGBM	NZ 3592 6823	Bolt adjacent to tide gauge building
Aux1	NZ 3626 6842	PA Bolt low lighthouse W face SW angle
Aux2	NZ 3630 6895	PA Bolt butt N side railway

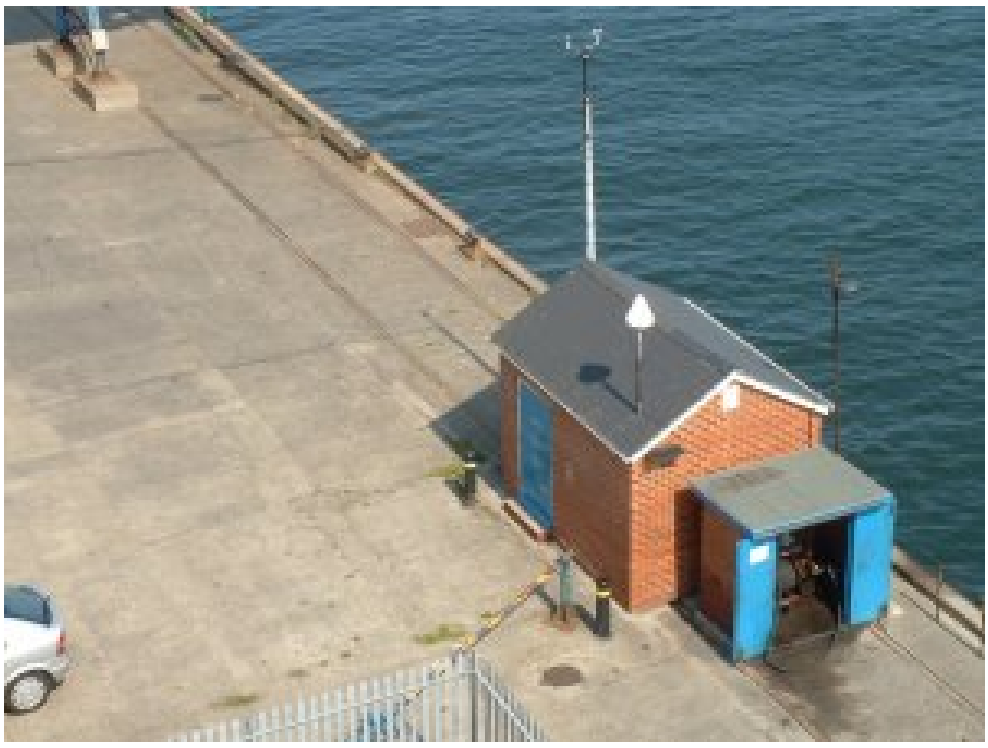
Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.60m below Ordnance Datum Newlyn (ODN)
TGZ = 6.754m below TGBM

Levelling Site was levelled by TGI on 16/05/2013

Site visits
28/02/2013 (Day 059) Investigated phone line fault
16/05/2013 (Day 136) Carried out general maintenance and changed compressor

North Shields – Map & Images of Site





North Shields – Statistics

Surge maxima	Value	Day	Time
January	0.731	30	12:15:00
February	0.592	4	14:15:00
March	0.185	19	01:15:00
April	0.515	15	15:45:00
May	0.387	23	19:45:00
June	0.268	22	23:00:00
July	0.252	28	04:45:00
August	0.475	18	08:45:00
September	0.512	15	21:45:00
October	0.543	10	00:00:00
November	0.683	29	20:30:00
December	1.329	5	15:15:00

Surge minima	Value	Day	Time
January	-0.336	27	05:45:00
February	-0.776	13	21:00:00
March	-0.392	22	08:45:00
April	-0.32	14	05:30:00
May	-0.386	3	01:15:00
June	-0.237	4	04:15:00
July	-0.246	8	13:00:00
August	-0.213	17	15:00:00
September	-0.304	15	12:00:00
October	-0.335	30	20:45:00
November	-0.592	11	08:00:00
December	-0.772	5	08:30:00

Extreme maxima	Value	Day	Time
January	5.456	29	16:45:00
February	5.387	1	18:30:00
March	5.388	12	15:45:00
April	5.283	28	17:00:00
May	5.387	27	17:00:00
June	5.299	27	05:45:00
July	5.582	25	04:45:00
August	5.521	22	03:30:00
September	5.58	20	03:15:00
October	5.406	7	04:15:00
November	5.626	4	15:30:00
December	6.575	5	16:15:00

Extreme minima	Value	Day	Time
January	0.101	13	23:00:00
February	-0.136	14	00:00:00
March	0.346	28	22:30:00
April	0.277	27	22:45:00
May	0.443	26	10:15:00
June	0.163	26	11:45:00
July	0.177	24	10:30:00
August	0.163	22	10:15:00
September	0.339	20	10:00:00
October	0.588	18	09:00:00
November	0.717	19	22:45:00
December	0.474	7	00:30:00

Mean sea level	Days	MSL
January	31	2.974
February	28	2.876
March	31	2.861
April	30	2.920
May	31	2.908
June	30	2.874
July	31	2.925
August	31	2.979
September	30	2.991
October	31	3.069
November	30	3.056
December	31	3.093
	Sum	Avg
	365	2.961

Portbury – Tide Gauge Information

Latitude 51° 30' 00.0" N **Longitude** 02° 43' 42.5" W **Grid Ref** ST 4953 7815

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Western, seaward side of the jetty
Measuring Points On the wall below the tide gauge cabinet

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	ST 4953 7815	Brass bolt quay edge adjacent to tide gauge
AUX 1	ST 4986 7774	Brass pin coping stone SW corner Portbury Dock

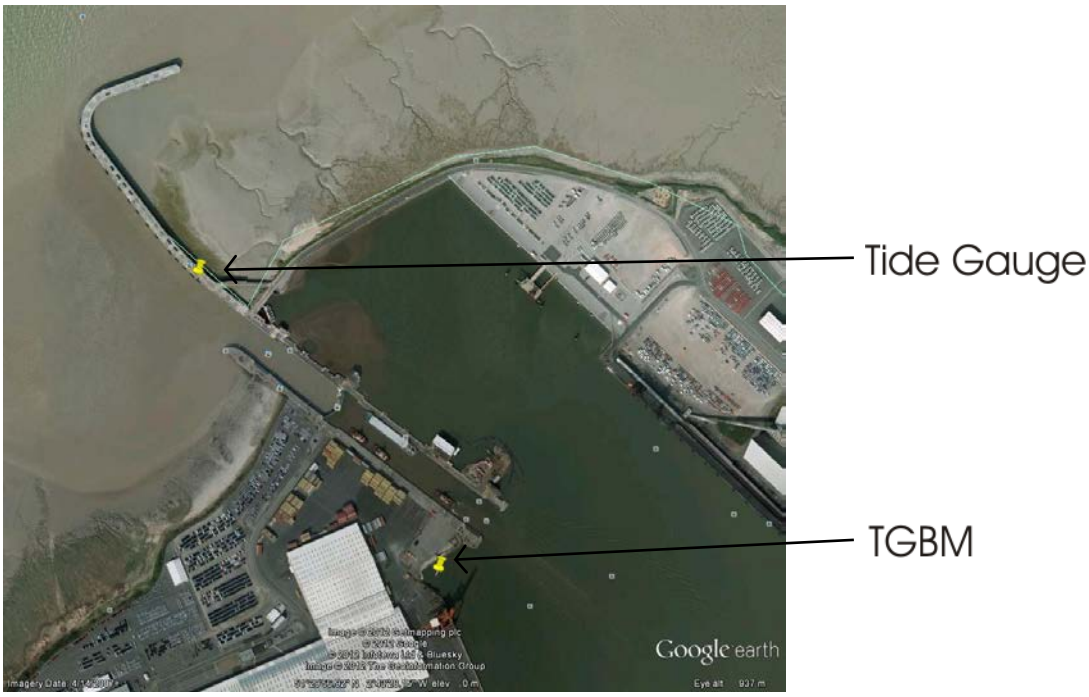
Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 6.50m below Ordnance Datum Newlyn (ODN)
TGZ = 9.226m below TGBM

Levelling No levelling was carried out in 2013

Site visits
21/10/2013 (Day 294) Carried out general maintenance

Notes on Data Quality
The power supply was out of commission from 14/12/2013. TGI contacted the port and were informed that the cable feed to the gauge was faulty and would not be rectified until the New Year. The Electrical Supervisor was due to attend in January 2014.

Portbury – Map & Images of Site



Portbury – Statistics

Surge maxima	Value	Day	Time
January	1.233	31	05:15:00
February	0.905	19	21:15:00
March	0.962	20	06:45:00
April	1.155	17	18:00:00
May	0.994	9	14:00:00
June	0.667	15	05:45:00
July	0.659	26	03:45:00
August	0.672	13	12:15:00
September	0.674	19	13:30:00
October	1.256	27	06:30:00
November	1.046	2	13:45:00
December	0.896	5	15:00:00

Surge minima	Value	Day	Time
January	-0.846	13	00:45:00
February	-0.862	26	15:00:00
March	-0.745	11	14:30:00
April	-0.802	27	06:30:00
May	-0.635	24	15:30:00
June	-0.747	29	06:15:00
July	-0.603	16	08:30:00
August	-0.61	13	07:30:00
September	-0.677	11	17:30:00
October	-0.589	12	06:00:00
November	-0.822	21	16:00:00
December	-0.829	1	16:45:00

Extreme maxima	Value	Day	Time
January	14.126	14	09:00:00
February	14.073	12	08:45:00
March	13.994	13	08:15:00
April	13.869	26	19:45:00
May	13.992	26	20:15:00
June	13.943	24	20:00:00
July	14.349	24	20:30:00
August	14.352	22	20:15:00
September	14.208	20	20:00:00
October	13.886	19	19:30:00
November	14.343	5	08:00:00
December	14.222	5	08:45:00

Extreme minima	Value	Day	Time
January	0.389	12	14:30:00
February	0.379	11	15:15:00
March	0.445	11	14:00:00
April	0.445	27	15:15:00
May	0.665	26	02:30:00
June	0.506	25	03:15:00
July	0.66	25	03:45:00
August	0.581	23	03:30:00
September	0.75	21	03:00:00
October	1.004	7	03:15:00
November	1.073	4	02:15:00
December	0.651	4	15:00:00

Mean sea level	Days	MSL
January	31	7.064
February	28	6.921
March	31	7.008
April	30	7.010
May	31	7.030
June	30	6.994
July	31	7.034
August	31	7.087
September	30	7.086
October	31	7.237
November	27	7.076
December	12	*
	Sum	Avg
	343	7.050

* No mean sea level value as more than 15 days of data missing

Portpatrick – Tide Gauge Information

Latitude 54° 50' 33.2" N **Longitude** 05° 07' 12.1" W **Grid Ref** NW 9976 5421

Instrument Data acquisition system with a full-tide bubbler gauge and a potentiometer attached to a Munro float gauge

Location **Tide Gauge Building** The western corner of Portpatrick harbour

Measuring Points The stilling well is directly underneath the tide gauge building

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	NW 9976 5421	Bolt Harbour wall 13.84M NE angle of building
Aux1	NW 9977 5411	Rivet E side of Jetty wall 16.6M SE angle Lifeboat HQ
Aux2	NW 9995 5412	Rivet S angle No 53 Main St
Aux3	NX 0006 5423	Church hall SE side of Rd W angle

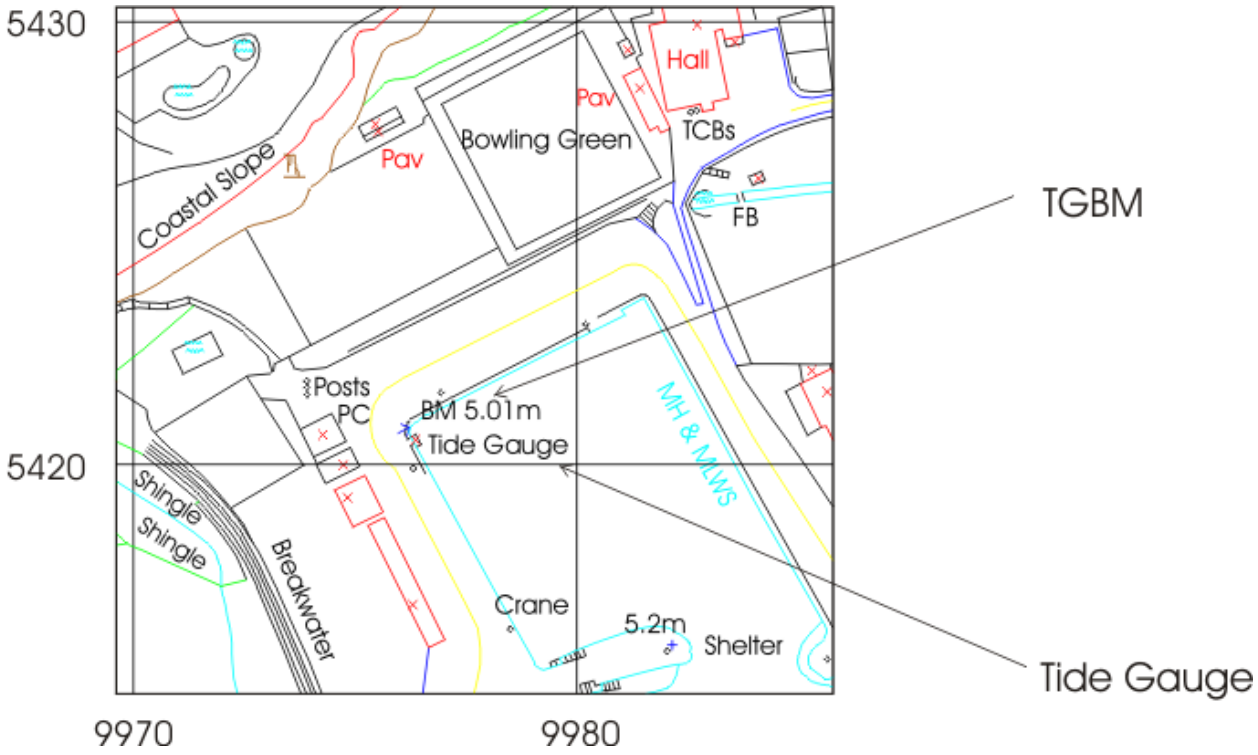
Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 1.80m below Ordnance Datum Newlyn (ODN)
TGZ = 6.827m below TGBM

Levelling No levelling was carried out in 2013

Site visits
27/02/2013 (Day 058) Carried out general maintenance and changed compressor

Notes on Data Quality
The float gauge was recording over 1m high and has been flagged. There is an issue with power to the gauge - when the float gauge loses power it loses calibration. The issue will be investigated at the next general maintenance visit. The bubbler gauge was available throughout this period.

Portpatrick – Map & Images of Site



Portpatrick – Statistics

No statistics could be calculated as all data for the primary channel was subsequently flagged as unreliable for the purposes of long-term sea level monitoring. The secondary channel was generally functional during this time.

Portrush – Tide Gauge Information

Latitude 55° 12' 24.4" N **Longitude** 06° 39' 24.6" W **Grid Ref** NW 0416 9952

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Portrush RNLI boathouse
Measuring Points Fixed to a leg of the boathouse slipway

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	NR 0385 0018	Pin RNLI slipway
Aux1	NR 0395 0008	Cut mark wall Kerr St
Aux2	NW 0406 9992	Cut mark wall Kerr St

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 1.24m below Ordnance Datum Belfast (ODB)
TGZ = 2.844m below TGBM

Levelling No levelling was carried out in 2013

Site visits

14/01/2013 (Day 014)	Installed new GSM antenna to improve data retrieval and fitted new V2.02 DQ cards
12/09/2013 (Day 255)	Carried out general maintenance and diving maintenance

Portrush – Map & Images of Site

Portrush – Statistics

Surge maxima	Value	Day	Time
January	0.734	28	23:30:00
February	0.476	4	07:15:00
March	0.265	15	10:00:00
April	0.742	16	09:00:00
May	0.295	27	09:30:00
June	0.329	15	10:00:00
July	0.285	2	17:45:00
August	0.391	2	15:00:00
September	0.479	15	12:45:00
October	0.597	27	14:30:00
November	0.568	2	17:45:00
December	1.153	19	02:00:00

Surge minima	Value	Day	Time
January	-0.278	15	00:15:00
February	-0.624	6	14:00:00
March	-0.35	1	00:00:00
April	-0.376	27	13:30:00
May	-0.294	24	13:45:00
June	-0.301	23	22:15:00
July	-0.249	8	06:15:00
August	-0.2	25	20:30:00
September	-0.304	10	13:15:00
October	-0.357	10	04:00:00
November	-0.581	21	00:00:00
December	-0.394	1	23:00:00

Extreme maxima	Value	Day	Time
January	2.705	31	08:30:00
February	2.422	10	06:15:00
March	2.362	29	19:45:00
April	2.33	14	20:45:00
May	2.456	27	20:00:00
June	2.399	22	17:30:00
July	2.57	24	19:30:00
August	2.561	21	18:30:00
September	2.677	19	18:15:00
October	2.527	19	18:30:00
November	2.786	2	17:45:00
December	2.996	5	08:00:00

Extreme minima	Value	Day	Time
January	0.136	15	02:15:00
February	-0.082	12	01:00:00
March	-0.016	1	02:00:00
April	-0.07	27	13:30:00
May	0.107	24	11:45:00
June	0.059	26	14:15:00
July	0.222	24	13:15:00
August	0.132	22	13:00:00
September	0.186	20	12:30:00
October	0.411	5	12:00:00
November	0.183	21	01:30:00
December	0.21	6	02:00:00

Mean sea level	Days	MSL
January	31	1.358
February	28	1.185
March	31	1.210
April	30	1.266
May	31	1.198
June	30	1.185
July	31	1.227
August	31	1.308
September	30	1.267
October	31	1.417
November	30	1.278
December	31	1.529
	Sum	Avg
	365	1.286

Portsmouth – Tide Gauge Information

Latitude 50° 48' 08.1" N **Longitude** 01° 06' 40.5" W **Grid Ref** SU 6273 0068

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Victory Jetty in Portsmouth Royal Naval base
Measuring Points On a leg at the north west corner of the jetty

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	SU 6269 0053	Bolt in concrete jetty TG building S angle
Aux1	SU 6330 9996	GP N side entrance to HMS Vernon
Aux2	SU 6274 0039	Building SW face 0.6M S angle
Aux3	SU 6283 0050	Building SW side of Main Rd NE face N angle

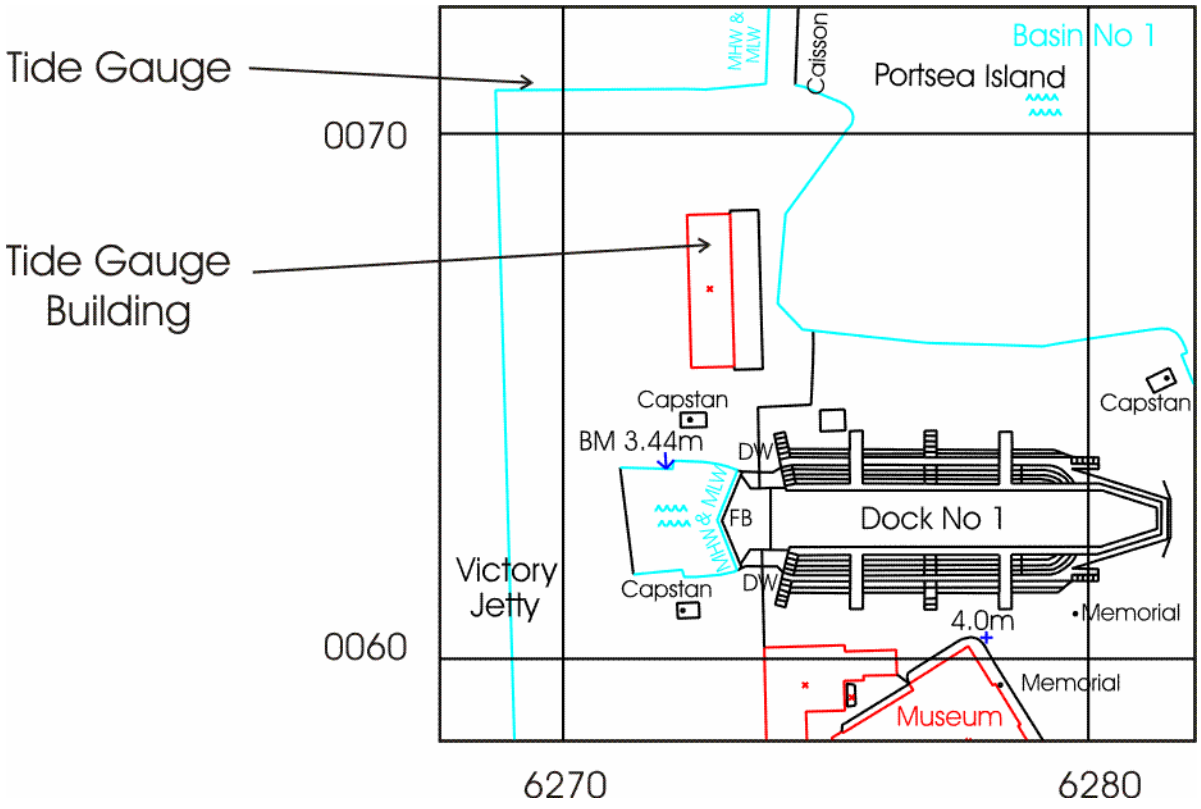
Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.73m below Ordnance Datum Newlyn (ODN)
TGZ = 6.007m below TGBM

Levelling No levelling was carried out in 2013

Site visits
No site visits were carried out in 2013

Notes on Data Quality
From April to July 2013 channel 2 was recording a constant -1.124m and the data were flagged. This was due to a leak on the system. The secondary channel was available throughout this period.

Portsmouth – Map & Images of Site



Portsmouth – Statistics

Surge maxima	Value	Day	Time
January			
February			
March			
April			
May			
June			
July	0.332	28	19:30:00
August	0.281	31	13:45:00
September	0.504	16	07:30:00
October	0.881	28	05:30:00
November	0.805	4	03:30:00
December	0.854	6	03:00:00

Surge minima	Value	Day	Time
January			
February			
March			
April			
May			
June			
July	-0.099	26	15:15:00
August	-0.181	31	23:45:00
September	-0.37	15	21:00:00
October	-0.273	11	15:00:00
November	-0.506	11	18:45:00
December	-0.467	30	22:00:00

Extreme maxima	Value	Day	Time
January			
February			
March			
April			
May			
June			
July	4.998	25	13:15:00
August	4.634	10	13:30:00
September	4.979	20	11:45:00
October	5.055	21	12:30:00
November	5.405	3	22:30:00
December	5.564	6	01:00:00

Extreme minima	Value	Day	Time
January			
February			
March			
April			
May			
June			
July	0.54	25	06:00:00
August	0.85	10	06:15:00
September	0.527	21	05:30:00
October	0.695	6	05:00:00
November	0.806	15	15:00:00
December	0.347	5	18:15:00

Mean sea level	Days	MSL
January	0	
February	0	
March	0	
April	0	
May	0	
June	0	
July	6	*
August	18	2.899
September	28	2.924
October	31	3.024
November	30	2.925
December	31	2.994
	Sum	Avg
	144	**

* No mean sea level value as more than 15 days of data missing

** No yearly average value as more than one month's MSL missing

Sheerness – Tide Gauge Information

Latitude 51° 26' 44.3" N **Longitude** 00° 44' 36.4" E **Grid Ref** TQ 9074 7542

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** On the jetty at Garrison Point, Port of Sheerness
Measuring Points As above

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	TQ 9080 7549	Flush bracket 11859, Garrison Fort, S angle, SW building
Aux1	TQ 9133 7532	Flush bracket G.4790, on house, NW angle, N face
Aux2	TQ 9115 7533	Wall on SW side of road, NE angle
Aux3	TQ 9147 7516	Bolt Ch. Dis, SW side of road, E face, NE angle

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.90m below Ordnance Datum Newlyn (ODN)
TGZ = 7.532m below TGBM

Levelling Site was levelled by TGI on 08/01/2013

Site visits

08/01/2013 (Day 008)	Changed compressor, fitted new V2.02 DQ cards and investigated blocked channel
05/06/2013 (Day 156)	Carried out general maintenance

Notes on Data Quality
The primary channel has been recording a constant value of around -1.026m. A site visit was made on 08/01/2013 to perform levelling and to investigate the blocking of the primary channel. The channel could not be cleared and will require diving. The secondary channel was not affected.

Sheerness – Map & Images of Site

Sheerness – Statistics

No statistics could be calculated as all data for the primary channel was subsequently flagged as unreliable for the purposes of long-term sea level monitoring. The secondary channel was generally functional during this time.

St Mary's (Isles of Scilly) – Tide Gauge Information

Latitude 49° 55' 04.3" N **Longitude** 06° 19' 02.0" W **Grid Ref** SV 9021 1090

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Cabinet in the Harbour Office storeroom on the quay, Hugh Town
Measuring Points End of the quay

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	N/A	Bolt by VTS
Aux1	N/A	Bolt by VTS 2
Aux2	N/A	Bolt by top of steps
Aux3	N/A	Bolt by top of steps
Aux4	SV 9028 1097	Point above pressure points
Aux5	SV 9014 1071	Cut Mark east angle Mermaid Inn
Aux6	SV 9007 1065	Cut Mark Guard House top of Garrison Hill
VTS	SV 9023 1091	Tide staff 7.210 metre mark
VTS2	N/A	Tide staff 7.245 metre mark

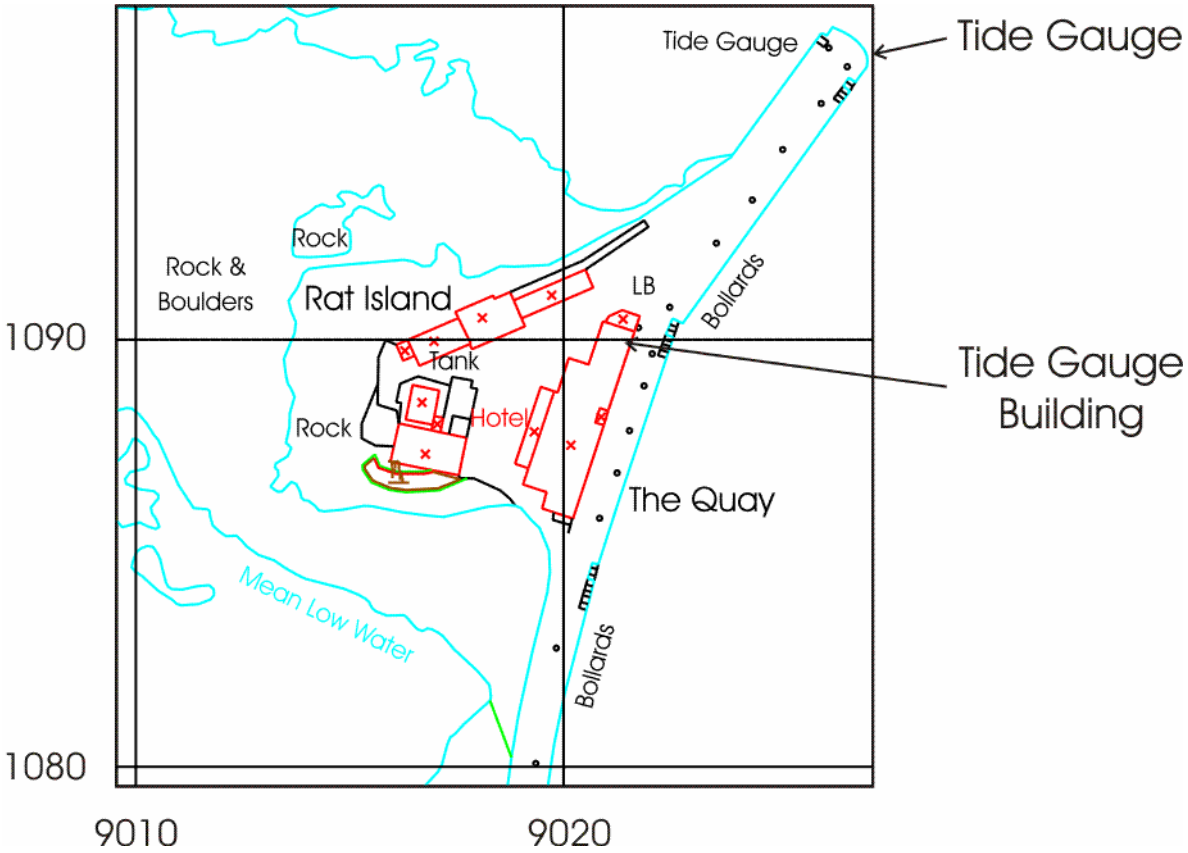
Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.91m below Ordnance Datum Local (ODL)
TGZ = 7.425m below TGBM
TGZ = 7.399m below Aux 1
TGZ = 6.776m below Aux 2

Levelling No levelling was carried out in 2013

Site visits
23/10/2013 (Day 296) Carried out general maintenance and changed compressor

Notes on Data Quality
Both channels were suspected of blocking. The primary channel was recording ~140mm low and flagged. The secondary channel was recording ~30mm high, which was acceptable for monitoring extremes but was flagged as unacceptable for the purposes of long-term sea level monitoring.

St Mary's (Isles of Scilly) – Map & Images of Site



St Mary's (Isles of Scilly) – Statistics

Surge maxima	Value	Day	Time
January	0.344	18	02:30:00
February	0.174	1	12:15:00
March	0.306	31	23:30:00
April	0.373	11	21:30:00
May			
June			
July			
August			
September			
October			
November	0.211	9	19:00:00
December	0.614	23	22:45:00

Surge minima	Value	Day	Time
January	-0.228	5	20:15:00
February	-0.341	6	20:00:00
March	-0.25	1	16:45:00
April	-0.208	20	08:45:00
May			
June			
July			
August			
September			
October			
November	1.019	30	21:00:00
December	0.38	4	11:30:00

Extreme maxima	Value	Day	Time
January	6.094	12	04:45:00
February	6.053	11	05:15:00
March	6.107	29	05:45:00
April	5.894	11	05:00:00
May			
June			
July			
August			
September			
October			
November	5.657	8	07:45:00
December	5.871	6	06:45:00

Extreme minima	Value	Day	Time
January	0.368	13	12:00:00
February	0.295	11	11:45:00
March	0.512	1	00:45:00
April	0.848	9	22:45:00
May			
June			
July			
August			
September			
October			
November	1.019	30	21:00:00
December	0.38	4	11:30:00

Mean sea level	Days	MSL
January	25	3.212
February	22	3.082
March	20	3.264
April	17	3.199
May	0	*
June	0	*
July	0	*
August	0	*
September	0	*
October	0	*
November	13	*
December	19	3.188
	Sum	Avg
	116	**

* No mean sea level value as more than 15 days of data missing
** No yearly average value as more than one month's MSL missing

Stornoway – Tide Gauge Information

Latitude 58° 12' 28.1" N **Longitude** 06° 23' 20.3" W **Grid Ref** NB 4228 3274

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge

Location
- **Tide Gauge Building** By the weighbridge at the entrance to Stornoway Port Authority, No. 2 wharf
- **Measuring Points** Attached to a leg on the east side of the wharf

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	NB 4228 3264	OSBM bolt E side of No 2 wharf
Aux1	NB 4215 3271	OSBM bolt STS NE angle King Edwards Wharf
Aux2	NB 4212 3275	Amity House E side of Espl Rd N face NW angle
Aux3	NB 4223 3280	BK S side Worth Beach NW angle N face

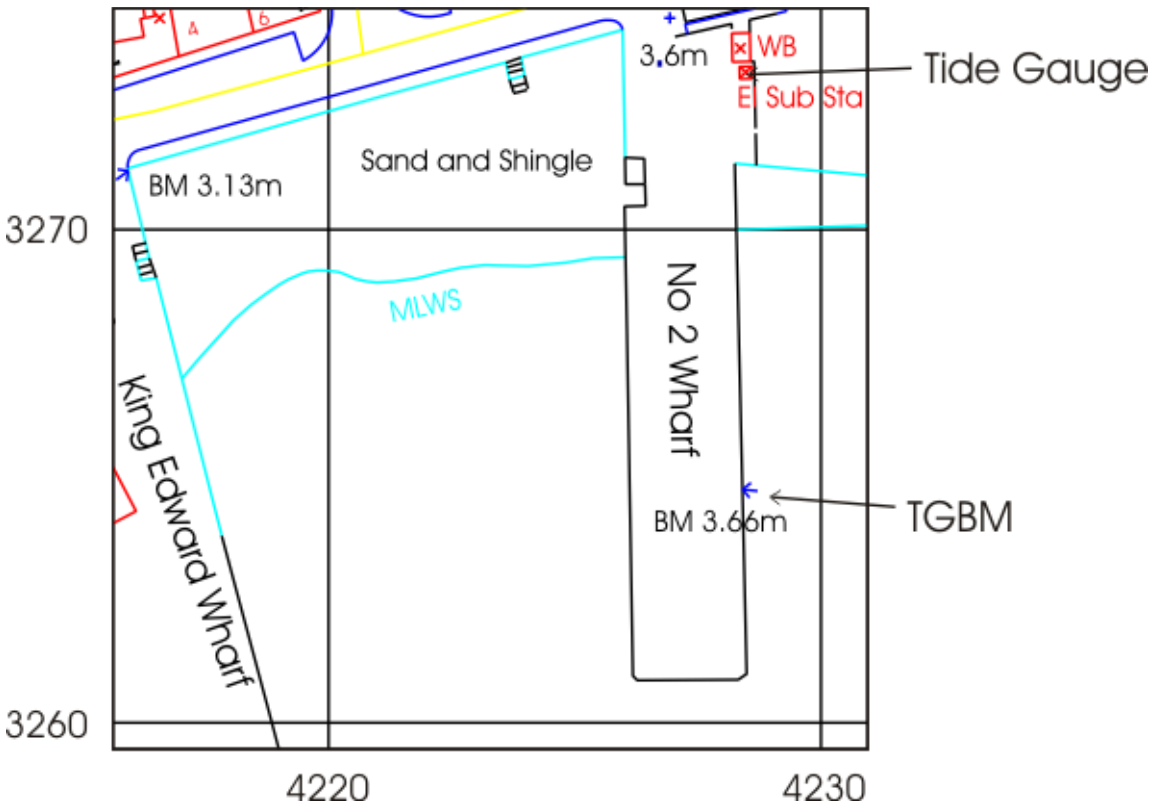
Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.71m below Ordnance Datum Local (ODL)
TGZ = 6.368m below TGBM

Levelling No levelling was carried out in 2013

Site visits

21/03/2013 (Day 080)	Carried out general maintenance
19/08/2013 (Day 231)	Carried out general maintenance and replaced faulty power supply
11/12/2013 (Day 345)	Changed compressor

Stornoway – Map & Images of Site



Stornoway – Statistics

Surge maxima	Value	Day	Time
January	0.811	30	04:30:00
February	0.561	4	07:00:00
March	0.25	15	16:15:00
April	0.706	15	00:00:00
May	0.366	13	13:15:00
June	0.349	15	10:45:00
July	0.31	2	19:30:00
August	0.476	2	23:15:00
September	0.463	15	08:15:00
October	0.587	27	15:15:00
November	0.463	1	07:00:00
December	1.057	24	18:00:00

Surge minima	Value	Day	Time
January	-0.287	14	23:15:00
February	-0.494	6	16:15:00
March	-0.313	1	10:00:00
April	-0.272	27	04:00:00
May	-0.237	23	13:15:00
June	-0.266	26	12:00:00
July	-0.181	8	07:00:00
August	-0.147	28	07:30:00
September	-0.241	10	05:15:00
October	-0.333	10	06:00:00
November	-0.5	20	16:45:00
December	-0.395	1	07:45:00

Extreme maxima	Value	Day	Time
January	5.483	30	08:30:00
February	5.266	13	08:45:00
March	5.079	12	07:00:00
April	5.054	28	20:30:00
May	5.3	27	20:30:00
June	5.13	22	17:45:00
July	5.404	24	20:00:00
August	5.41	22	19:45:00
September	5.341	19	18:45:00
October	5.242	19	18:45:00
November	5.367	5	07:45:00
December	5.663	5	07:30:00

Extreme minima	Value	Day	Time
January	0.363	13	14:00:00
February	0.245	11	14:00:00
March	0.334	28	13:45:00
April	0.197	27	14:00:00
May	0.403	25	13:00:00
June	0.203	26	02:45:00
July	0.359	25	02:30:00
August	0.263	22	01:30:00
September	0.451	20	01:00:00
October	0.7	18	00:00:00
November	0.736	4	00:45:00
December	0.472	6	15:15:00

Mean sea level	Days	MSL
January	31	3.015
February	28	2.845
March	31	2.815
April	30	2.902
May	31	2.834
June	30	2.821
July	31	2.875
August	19	2.947
September	30	2.920
October	31	3.056
November	30	2.952
December	30	3.215
	Sum	Avg
	352	2.933

Tobermory – Tide Gauge Information

Latitude 56° 37' 23.2" N **Longitude** 06° 03' 51.2" W **Grid Ref** NM 5079 5531

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** In the Caledonian MacBrayne ferry terminal on Mishnish Pier
Measuring Points Attached to a leg of the pier

Datum All data refer to Admiralty Chart Datum (ACD)

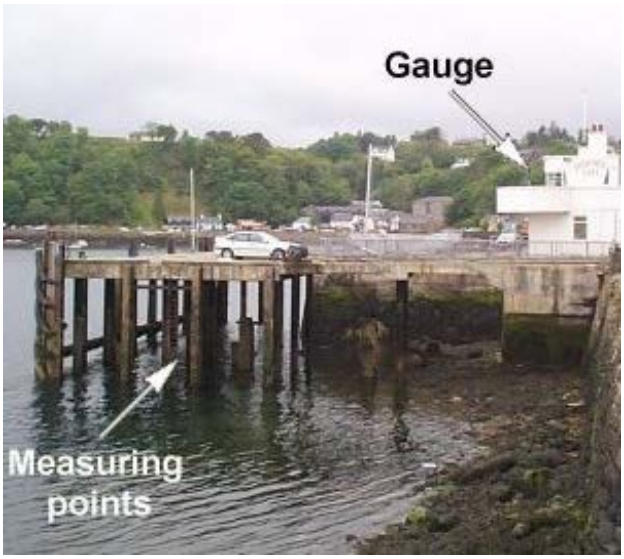
Benchmark	Grid Ref	Description
TGBM	NM 5069 5530	F bracket G5186 on SW angle of Royal bldg
Aux2	NM 5077 5529	NBM rivet in sea wall of Mishnish Pier

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.39m below Ordnance Datum Newlyn (ODN)
TGZ = Chart Datum = 6.856m below TGBM

Levelling No levelling was carried out in 2013

Site visits
26/03/2013 (Day 085) Carried out general maintenance and replaced faulty power supply
29/08/2013 (Day 241) Carried out general maintenance and diving maintenance
15/10/2013 (Day 288) Installed new supporting clamps

Tobermory – Map & Images of Site



Tobermory – Statistics

Surge maxima	Value	Day	Time
January	0.875	29	20:00:00
February	0.393	4	06:15:00
March	0.286	15	04:15:00
April	0.847	16	09:30:00
May	0.358	13	22:45:00
June	0.37	15	04:15:00
July	0.319	2	18:45:00
August	0.473	2	20:00:00
September	0.448	15	12:30:00
October	0.767	27	15:30:00
November	0.596	7	16:00:00
December	1.424	19	00:45:00

Surge minima	Value	Day	Time
January	-0.288	14	22:15:00
February	-0.697	6	09:15:00
March	-0.319	1	02:30:00
April	-0.358	27	05:45:00
May	-0.292	23	11:15:00
June	-0.271	23	22:00:00
July	-0.231	8	06:00:00
August	-0.18	25	22:30:00
September	-0.302	10	04:45:00
October	-0.416	10	04:15:00
November	-0.645	21	03:00:00
December	-0.431	6	04:45:00

Extreme maxima	Value	Day	Time
January	5.313	29	19:15:00
February	4.907	13	07:45:00
March	4.875	29	19:15:00
April	4.698	28	19:45:00
May	4.986	27	19:30:00
June	4.761	22	17:00:00
July	5.071	24	19:00:00
August	5.063	22	18:45:00
September	5.072	19	17:45:00
October	4.985	19	18:00:00
November	5.025	5	06:30:00
December	5.599	5	07:00:00

Extreme minima	Value	Day	Time
January	0.376	15	02:15:00
February	0.174	12	01:15:00
March	0.303	1	02:00:00
April	0.186	27	00:30:00
May	0.421	26	00:15:00
June	0.297	25	13:30:00
July	0.452	24	13:15:00
August	0.359	22	13:00:00
September	0.475	20	12:30:00
October	0.784	8	14:00:00
November	0.617	21	01:45:00
December	0.473	6	02:00:00

Mean sea level	Days	MSL
January	31	2.834
February	28	2.642
March	31	2.666
April	30	2.726
May	31	2.655
June	30	2.635
July	31	2.674
August	31	2.753
September	30	2.716
October	31	2.876
November	30	2.728
December	31	3.042
	Sum	Avg
	365	2.746

Ullapool – Tide Gauge Information

Latitude 57° 53' 42.9" N **Longitude** 05° 09' 28.4" W **Grid Ref** NH 1293 9391

Instrument Data acquisition system with a full-tide and a mid-tide bubbler gauge and a back-up potentiometer attached to a Munro float gauge

Location **Tide Gauge Building** On the Ullapool harbour pier
Measuring Points Below the tide gauge building

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	NH 1288 9391	OSBM Pier NW Para 8.2M NE steps
Aux1	NH 1303 9425	PA bolt Church SW side of road NE face N angle
Aux2	NH 1288 9398	No 8 Shore Street SE face 0.3M S angle
Aux3	NH 1253 9376	Rivet Fnd No 21 West Shore Street S angle

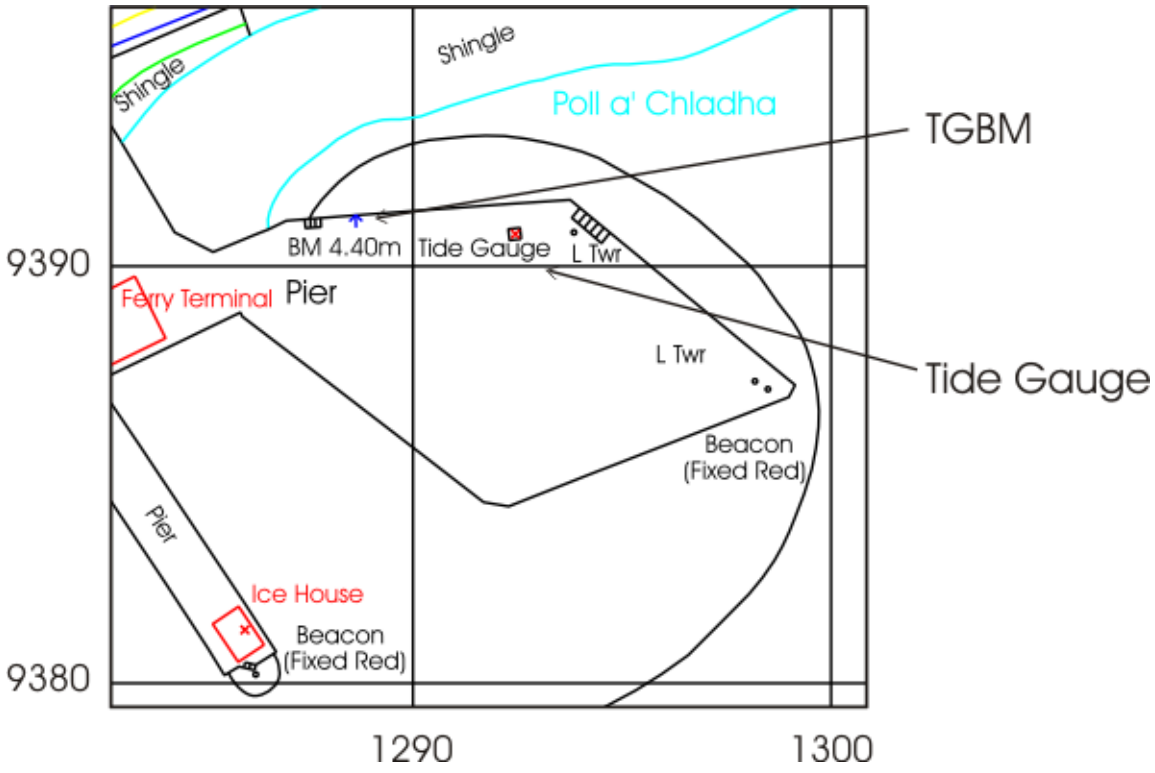
Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.75m below Ordnance Datum Newlyn (ODN)
TGZ = 7.155m below TGBM

Levelling No levelling was carried out in 2013

Site visits

27/03/2013 (Day 086)	Carried out general maintenance
17/07/2013 (Day 198)	Carried out general maintenance, changed compressor and sealed leaks in roof joint

Ullapool – Map & Images of Site



Ullapool – Statistics

Surge maxima	Value	Day	Time
January	0.942	30	05:30:00
February	0.493	4	11:00:00
March	0.27	15	04:15:00
April	0.712	15	01:15:00
May	0.394	13	22:15:00
June	0.336	15	11:15:00
July	0.331	2	19:00:00
August	0.499	2	23:15:00
September	0.511	15	08:15:00
October	0.642	27	16:15:00
November	0.513	1	07:15:00
December	1.13	24	17:30:00

Surge minima	Value	Day	Time
January	-0.318	14	22:30:00
February	-0.652	6	16:30:00
March	-0.38	1	05:15:00
April	-0.323	27	04:15:00
May	-0.282	24	06:30:00
June	-0.298	23	21:45:00
July	-0.235	7	14:45:00
August	-0.188	28	08:00:00
September	-0.323	10	17:45:00
October	-0.384	10	06:00:00
November	-0.613	21	11:00:00
December	-0.426	1	13:30:00

Extreme maxima	Value	Day	Time
January	5.816	30	08:30:00
February	5.559	13	09:00:00
March	5.394	12	07:15:00
April	5.399	28	20:45:00
May	5.611	27	20:30:00
June	5.453	22	18:00:00
July	5.683	24	20:00:00
August	5.702	22	19:45:00
September	5.659	20	19:15:00
October	5.549	19	19:00:00
November	5.671	5	07:45:00
December	6.253	5	07:15:00

Extreme minima	Value	Day	Time
January	0.348	13	14:15:00
February	0.197	12	14:45:00
March	0.33	28	13:45:00
April	0.196	27	14:15:00
May	0.449	25	13:00:00
June	0.193	26	03:00:00
July	0.344	25	02:45:00
August	0.236	22	01:30:00
September	0.469	20	01:00:00
October	0.666	18	00:15:00
November	0.735	4	01:00:00
December	0.444	6	15:30:00

Mean sea level	Days	MSL
January	31	3.188
February	28	3.012
March	31	2.976
April	30	3.080
May	31	3.008
June	30	2.989
July	30	3.032
August	31	3.114
September	30	3.086
October	31	3.224
November	30	3.129
December	31	3.421
	Sum	Avg
	364	3.105

Weymouth – Tide Gauge Information

Latitude 50° 36' 30.6" N **Longitude** 02° 26' 52.6" W **Grid Ref** SY 6840 7885

Instrument Data acquisition system with two full-tide bubbler gauges
Location **Tide Gauge Building** Commercial Pier, next to the ferry terminal
Measuring Points On the pier wall, directly in front of the tide gauge building

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	SY 6826 7882	Bolt corner of quay wall NW side N angle
Aux1	SY 6822 7886	Bolt sea wall 5.5M W steps
Aux2	SY 6813 7888	Right base NW pillar NE entrance Alexandra gardens
Aux3	SY 6810 7893	Bolt sea wall 10.1M NW shelter
Aux4	SY 6806 7908	Bolt N base STS aquarium E side of esplanade
REFBM	SY 6837 7884	Bolt concrete SW corner of building next to tide gauge hut

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 1.02m below Ordnance Datum Newlyn (ODN)
TGZ = 4.334m below TGBM

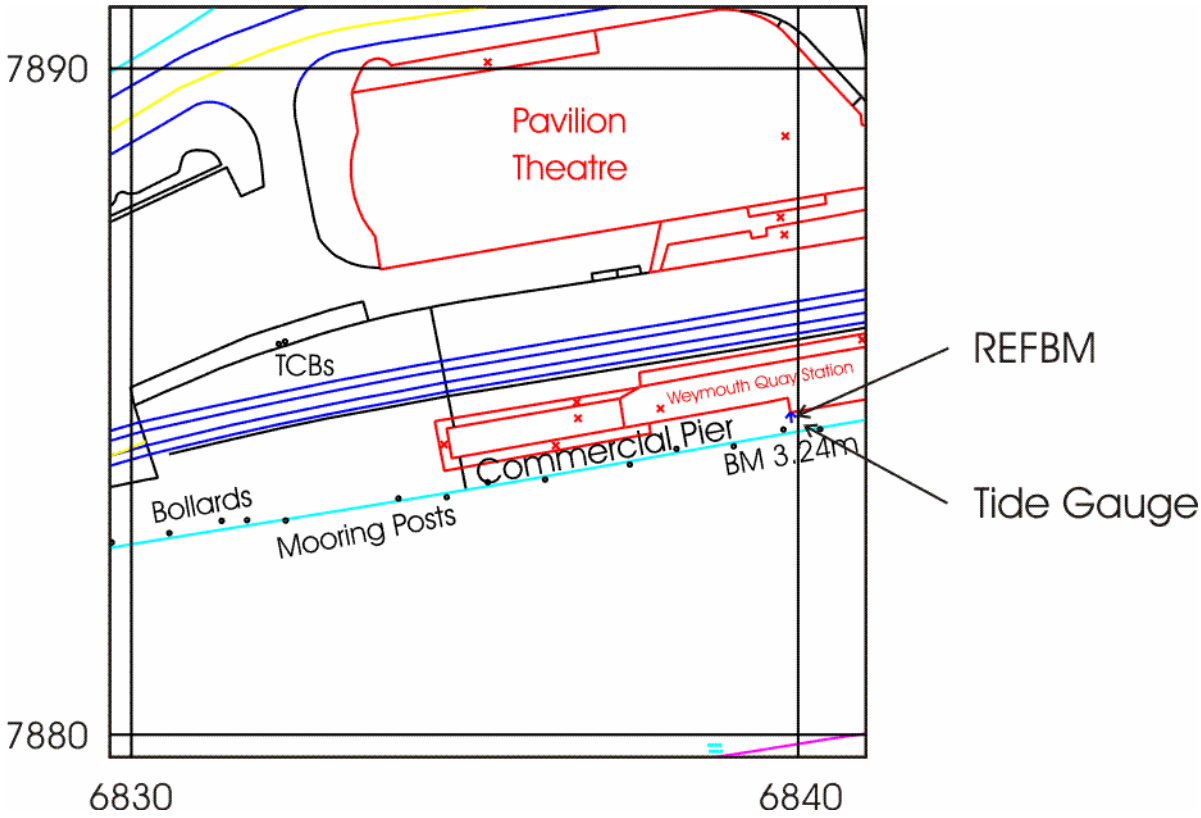
Levelling No levelling was carried out in 2013

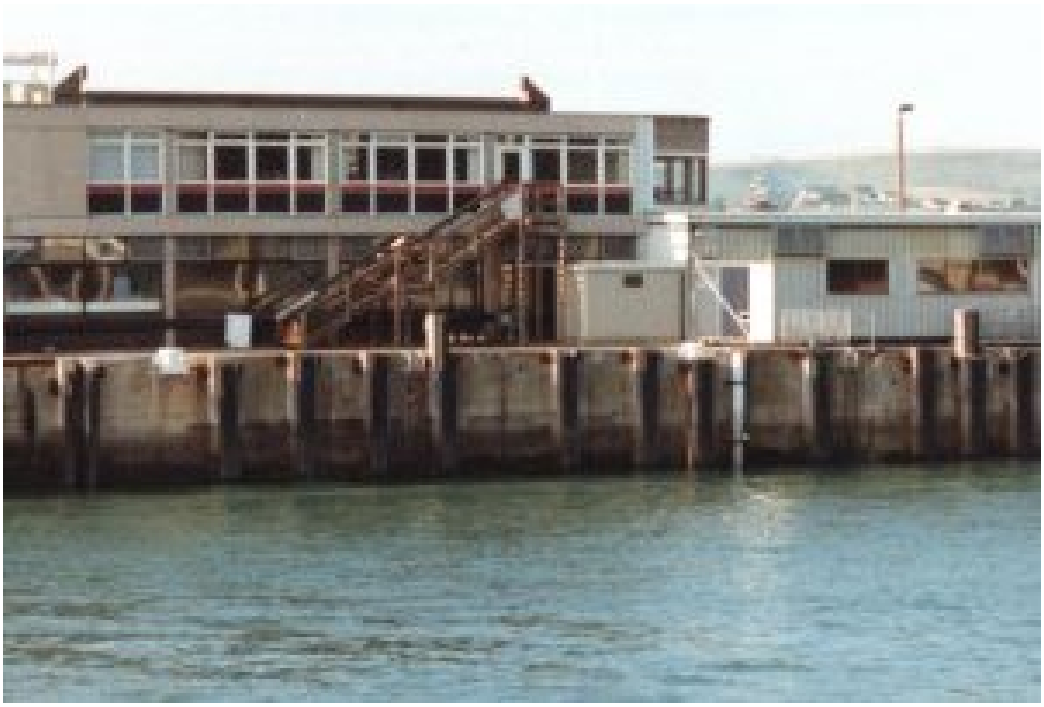
Site visits

11/08/2013 (Day 223)	Carried out general maintenance, changed compressor and investigated blocking channel

Notes on Data Quality
In May 2013, the primary channel started blocking and was recording over 20mm high, which was acceptable for monitoring extremes but was flagged as unacceptable for the purposes of long-term sea level monitoring. The secondary channel was available throughout this period.

Weymouth – Map & Images of Site





Weymouth – Statistics

Surge maxima	Value	Day	Time
January	-0.16	13	16:00:00
February	-0.171	11	15:45:00
March	-0.095	11	14:45:00
April	-0.089	27	03:30:00
May	0.212	1	03:00:00
June			
July			
August	-0.127	22	03:15:00
September	0.015	20	02:45:00
October	0.186	6	03:15:00
November	0.064	15	22:00:00
December	-0.143	5	16:30:00

Surge minima	Value	Day	Time
January	-0.325	6	08:15:00
February	-0.43	6	17:15:00
March	-0.302	1	07:00:00
April	-0.324	30	14:45:00
May	-0.287	1	15:30:00
June			
July			
August	-0.215	13	17:00:00
September	-0.33	15	23:00:00
October	-0.403	11	16:00:00
November	-0.438	21	19:00:00
December	-0.422	5	14:45:00

Extreme maxima	Value	Day	Time
January	2.645	12	07:00:00
February	2.439	10	07:00:00
March	2.43	13	08:00:00
April	2.44	11	19:45:00
May	1.725	1	23:15:00
June			
July			
August	2.542	22	20:00:00
September	2.44	20	19:30:00
October	2.496	20	07:30:00
November	2.699	5	07:45:00
December	2.591	6	08:45:00

Extreme minima	Value	Day	Time
January	-0.16	13	16:00:00
February	-0.171	11	15:45:00
March	-0.095	11	14:45:00
April	-0.089	27	03:30:00
May	0.212	1	03:00:00
June			
July			
August	-0.127	22	03:15:00
September	0.015	20	02:45:00
October	0.186	6	03:15:00
November	0.064	15	22:00:00
December	-0.143	5	16:30:00

Mean sea level	Days	MSL
January	22	1.135
February	26	1.024
March	31	1.139
April	30	1.088
May	3	*
June	0	*
July	0	*
August	19	1.098
September	30	1.136
October	31	1.262
November	30	1.140
December	31	1.225
	Sum	Avg
	253	**

* No mean sea level value as more than 15 days of data missing

** No yearly average value as more than one month's MSL missing

Whitby – Tide Gauge Information

Latitude 54° 29' 24.0" N **Longitude** 00° 36' 52.9" W **Grid Ref** NZ 8984 1140

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** In the Harbourmaster's office
Measuring Points Underneath the quay, next to the Harbour Office

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	NZ 8986 1141	E side of Pier Rd
Aux1	NZ 8992 1105	Bolt butt of Whitby Bridge
Aux2	NZ 8985 1134	Rivet quayside SE side of Pier Rd
Aux3	NZ 8983 1142	Rivet wall angle S side of road angle of lifeboat museum

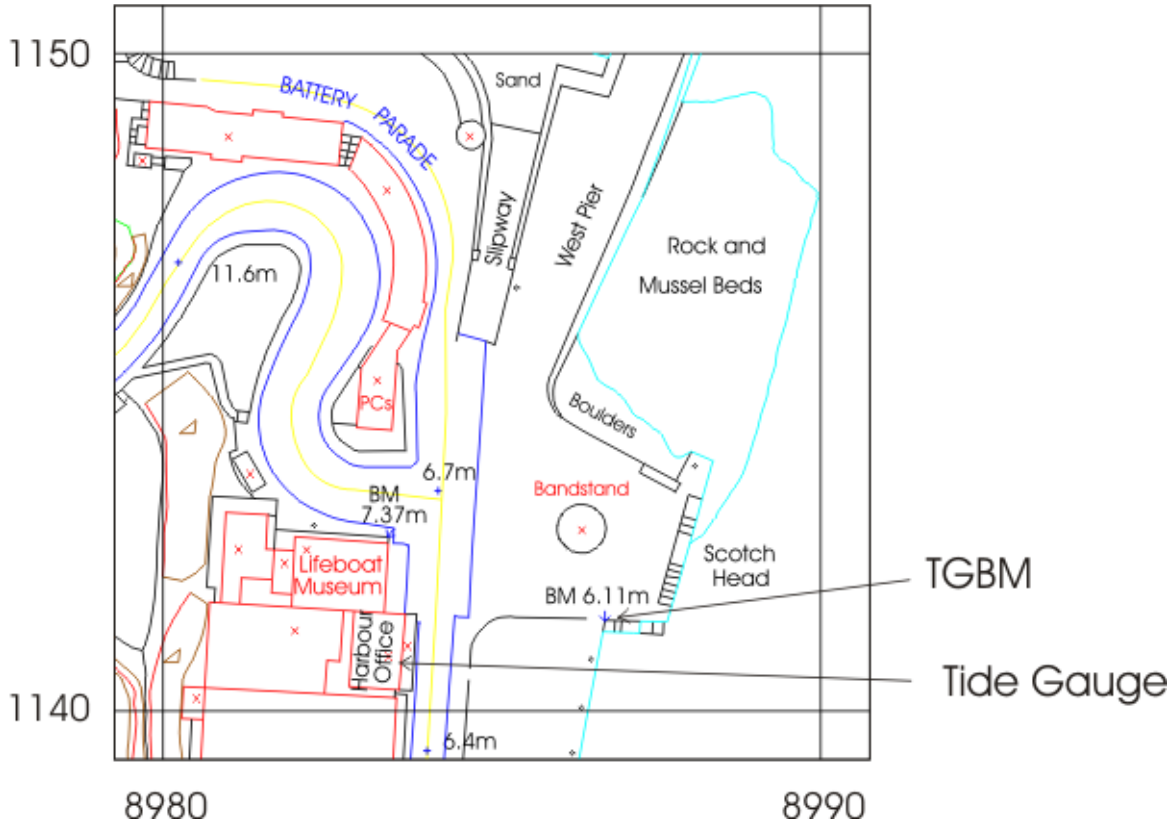
Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 3.00m below Ordnance Datum Newlyn (ODN)
TGZ = 9.105m below TGBM

Levelling Site was levelled by TGI on 14/05/2013

Site visits
14/05/2013 (Day 134) Carried out general maintenance and changed compressor
22/05/2013 (Day 142) Carried out mid tide survey and measurements using pilot boat
14/11/2013 (Day 318) Held site meeting to discuss network electrical installations

Notes on Data Quality
In June 2013, the primary channel was recording up to ~40mm high, which was acceptable for monitoring extremes but was flagged as unacceptable for the purposes of long-term sea level monitoring. The secondary channel was available.

Whitby – Map & Images of Site



Whitby – Statistics

Surge maxima	Value	Day	Time
January	0.814	30	13:00:00
February	0.735	4	15:15:00
March	0.392	12	21:15:00
April	0.589	15	17:45:00
May	0.749	23	21:30:00
June	0.333	22	23:45:00
July	0.328	4	22:30:00
August	0.581	18	09:00:00
September	0.66	15	22:15:00
October	0.909	10	01:15:00
November	0.902	29	20:45:00
December	1.631	5	15:45:00

Surge minima	Value	Day	Time
January	-0.277	25	11:00:00
February	-0.789	14	02:45:00
March	-0.411	22	09:45:00
April	-0.232	28	00:30:00
May	-0.321	3	04:15:00
June	-0.142	4	08:15:00
July	-0.169	8	12:15:00
August	-0.151	17	16:00:00
September	-0.284	15	12:45:00
October	-0.314	30	20:30:00
November	-0.564	11	08:15:00
December	-0.695	5	09:15:00

Extreme maxima	Value	Day	Time
January	6.016	30	18:00:00
February	5.988	1	19:00:00
March	5.959	12	16:30:00
April	5.83	28	17:45:00
May	5.747	23	14:15:00
June	5.901	27	06:30:00
July	6.165	25	05:15:00
August	6.114	22	04:15:00
September	6.17	20	04:00:00
October	5.971	7	05:00:00
November	6.219	4	16:00:00
December	7.319	5	17:15:00

Extreme minima	Value	Day	Time
January	0.755	12	22:15:00
February	0.754	13	00:45:00
March	0.754	1	00:00:00
April	0.755	26	22:15:00
May	1.215	11	10:45:00
June	0.76	27	13:00:00
July	0.813	25	11:00:00
August	0.767	22	10:00:00
September	0.758	19	09:45:00
October	0.909	18	09:30:00
November	1.038	19	23:15:00
December	0.894	7	00:30:00

Mean sea level	Days	MSL
January	21	3.474
February	28	3.388
March	28	3.353
April	23	3.413
May	22	3.406
June	26	3.387
July	30	3.431
August	29	3.492
September	30	3.507
October	31	3.579
November	30	3.568
December	31	3.581
	Sum	Avg
	329	3.465

Wick – Tide Gauge Information

Latitude 58° 26' 27.5" N **Longitude** 03° 05' 10.7" W **Grid Ref** ND 3668 5081

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Northwest corner of Wick harbour, next to the ship repair slipway
Measuring Points Attached to an unused stilling well beneath the building

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	ND 3667 5081	New OSBM bolt quay E angle tide gauge building
Aux1	ND 3670 5084	Rivet base of wall 15.5M NE angle of building
Aux2	ND 3670 5083	NBM rivet base SE end of wall NE side of N pier
Aux3	ND 3705 5055	Wall base of steps SE side of pier

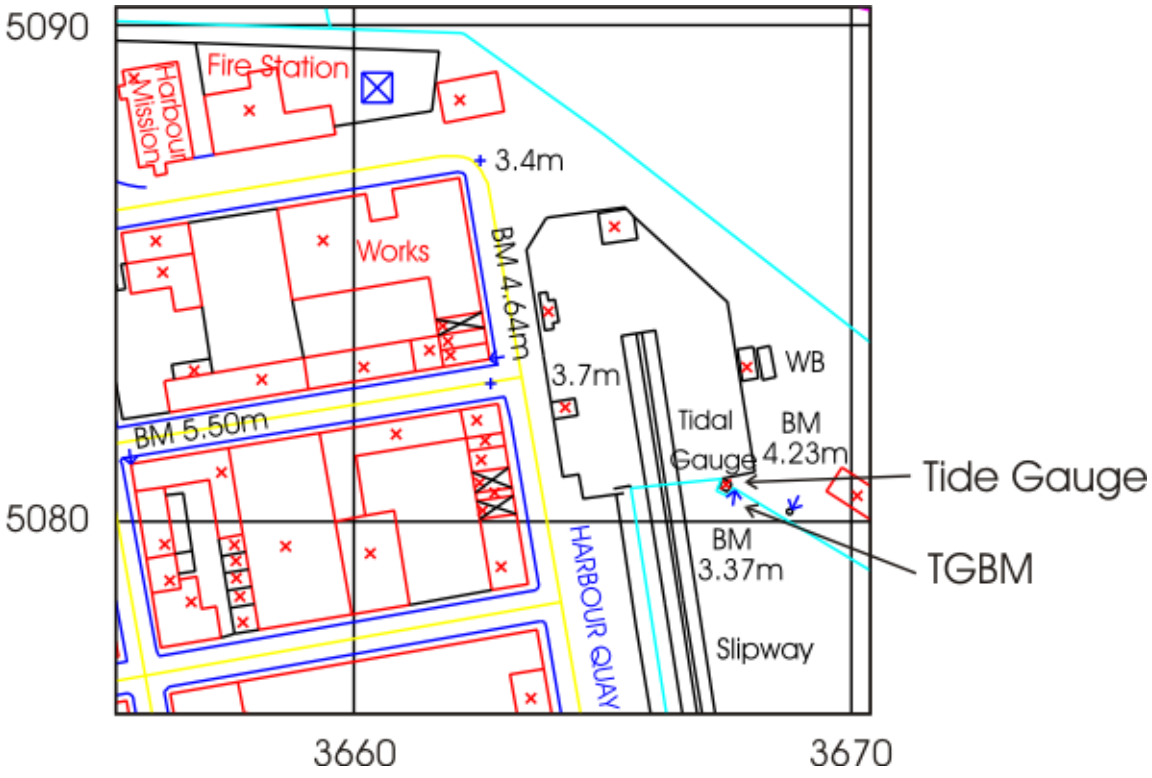
Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 1.71m below Ordnance Datum (ODN)
TGZ = 5.084m below TGBM

Levelling No levelling was carried out in 2013

Site visits
06/02/2013 (Day 037) Carried out general maintenance and investigated blocking channel
14/04/2013 (Day 104) Repaired both channels (one blocked and relief valve leaking on other)
15/07/2013 (Day 196) Changed compressor

Notes on Data Quality
The primary channel started blocking at the end of March 2013 and was flagged accordingly. The secondary channel was recording a constant value. A visit to site was made in April 2013 and the two channels were repaired (one was blocked; the other had a leaking relief valve). Both channels were flagged in parts during April, but at least one channel was operational for 75.5% of the month. In May, the primary channel was blocking but the secondary channel was available. From mid-July 2013 onwards channel 2 was flagged as there was an issue on the falling tide. The secondary channel was available throughout this period.

Wick – Map & Images of Site



Wick – Statistics

Surge maxima	Value	Day	Time
January	0.877	30	07:30:00
February	0.544	4	13:30:00
March	0.182	16	17:00:00
April	0.59	15	10:15:00
May	0.239	27	17:00:00
June	0.262	22	19:00:00
July	0.235	1	01:45:00
August	0.097	31	22:45:00
September	0.481	15	16:00:00
October	0.11	17	05:15:00
November	0.163	29	11:00:00
December	0.716	19	10:30:00

Surge minima	Value	Day	Time
January	-0.318	22	16:15:00
February	-0.469	6	15:30:00
March	-0.331	1	10:00:00
April	-0.198	27	07:45:00
May	-0.223	24	15:00:00
June	-0.214	4	18:30:00
July	-0.221	8	09:00:00
August	-0.02	31	17:00:00
September	-0.217	7	20:15:00
October	-0.321	11	09:45:00
November	-0.493	21	01:45:00
December	-0.426	1	17:45:00

Extreme maxima	Value	Day	Time
January	4.032	30	13:15:00
February	3.631	14	13:45:00
March	3.618	12	11:45:00
April	3.478	15	14:15:00
May	3.731	27	12:45:00
June	3.679	22	22:15:00
July	3.238	12	01:30:00
August	2.859	31	20:15:00
September	3.852	19	23:15:00
October	3.229	2	21:45:00
November	3.538	18	11:30:00
December	4.147	5	12:45:00

Extreme minima	Value	Day	Time
January	0.172	13	18:15:00
February	0.082	11	18:15:00
March	0.186	11	17:15:00
April	0.245	27	05:30:00
May	0.329	24	16:30:00
June	0.073	26	07:00:00
July	0.526	11	06:45:00
August	1.569	31	13:30:00
September	0.343	20	05:30:00
October	0.48	18	04:15:00
November	0.58	15	03:00:00
December	0.248	6	20:00:00

Mean sea level	Days	MSL
January	31	2.131
February	28	1.977
March	29	1.934
April	13	*
May	12	*
June	30	1.951
July	13	1.993
August	0	*
September	30	2.075
October	1	*
November	14	*
December	17	2.234
	Sum	Avg
	218	**

* No mean sea level value as more than 15 days of data missing

** No yearly average value as more than one month's MSL missing

Workington – Tide Gauge Information

Latitude 54° 39' 02.6" N **Longitude** 03° 34' 01.8" W **Grid Ref** NX 9898 2953

Instrument Data acquisition system with two full-tide bubbler gauges
Location **Tide Gauge Building** North side of the dock entrance
Measuring Points Behind fender piles on the north seaward side of the dock gates

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
Aux1	NX 9917 2928	Building SW face 3.7M from S angle Workington Dock
Aux2	NX 9948 2967	NBM works building S side Rd N face NE angle

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 4.20m below Ordnance Datum Newlyn (ODN)
TGZ = 11.59m below Aux1

Levelling No levelling was carried out in 2013

Site visits
18/02/2013 (Day 049) Repaired leak in pneumatic panel
28/07/2013 (Day 209) Carried out general maintenance and repaired relief valve

Workington – Map & Images of Site

Workington – Statistics

Surge maxima	Value	Day	Time
January	1.116	28	19:45:00
February	0.36	4	09:30:00
March	0.299	15	10:30:00
April	1.305	17	22:15:00
May	0.655	9	14:30:00
June	0.557	14	23:15:00
July	0.353	31	23:00:00
August	0.529	17	17:30:00
September	0.701	15	13:45:00
October	0.828	27	09:45:00
November	0.972	2	14:45:00
December	1.868	27	09:15:00

Surge minima	Value	Day	Time
January	-0.539	15	04:30:00
February	-1.009	6	05:00:00
March	-0.489	11	21:45:00
April	-0.558	27	09:15:00
May	-0.522	24	10:45:00
June	-0.373	29	02:00:00
July	-0.365	8	09:30:00
August	-0.367	31	05:45:00
September	-0.405	10	10:30:00
October	-0.57	12	01:45:00
November	-1.242	20	23:00:00
December	-0.831	5	22:45:00

Extreme maxima	Value	Day	Time
January	8.87	13	12:15:00
February	8.892	13	13:30:00
March	8.712	29	12:30:00
April	8.552	28	13:00:00
May	8.807	27	12:45:00
June	8.642	26	01:00:00
July	9.008	25	00:45:00
August	8.966	23	00:30:00
September	8.848	21	00:00:00
October	8.725	19	23:45:00
November	8.952	5	12:15:00
December	8.973	5	12:30:00

Extreme minima	Value	Day	Time
January	0.352	12	18:15:00
February	0.075	11	18:45:00
March	0.331	11	17:45:00
April	0.188	27	06:30:00
May	0.464	25	17:45:00
June	0.227	26	07:45:00
July	0.373	24	06:30:00
August	0.326	22	06:15:00
September	0.465	20	06:00:00
October	0.835	7	06:45:00
November	0.832	4	05:45:00
December	0.565	5	19:30:00

Mean sea level	Days	MSL
January	31	4.584
February	28	4.369
March	31	4.400
April	30	4.468
May	31	4.427
June	30	4.407
July	29	4.426
August	31	4.514
September	30	4.480
October	31	4.645
November	30	4.482
December	31	4.819
	Sum	Avg
	363	4.502