Public Works
Manly Hydraulics Laboratory

TIDE GAUGE HISTORIES
METADATA FOR NATIONAL AND NSW TIDE GAUGES

Report MHL2179
October 2013

NSW Office of Environment and Heritage

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Foreword

Manly Hydraulics Laboratory (MHL) is a business unit within NSW Public Works, a division of the Department of Finance and Services. The NSW Office of Environment and Heritage (OEH) commissioned MHL to undertake an investigation to capture metadata histories of each of the long-term (>50 years) Australian tide gauge records in order to evaluate data quality, understand inconsistencies and justify the selection of data sets for inclusion in current and future work by OEH. The investigation was also to include metadata on gauges in NSW which have shorter record lengths but still provide valuable historical water level information.

This report presents the metadata for both the national and NSW tide gauges, together with preliminary data checks and details of information uncovered from archival sources during the investigation.

Contents

1. Introduction

Investigations into sea level changes depend on the accuracy, quality and completeness of available long-term sea level data. Long-term sea level monitoring programs are generally varied through time with shifting priorities and improving technologies. Metadata for the available tide gauges is often limited, inconsistent and hard to find, making the review of available data difficult.

The NSW Office of Environment and Heritage is working with collaborators on an authoritative analysis of historical sea level trends around Australia based on data which is available on the Permanent Service for Mean Sea Level (PSMSL). The research team draws expertise from CSIRO, University of Tasmania, University of Western Australia, Southampton University (UK) and OEH. The project will assess the quality and completeness of available long-term Australian sea level data, review relevant Australian sea level research publications, investigate spatial and temporal variability of sea level data, and analyse long-term sea level trends. As part of this project, OEH commissioned Manly Hydraulics Laboratory to investigate and develop detailed metadata statements for selected Australian tide gauges.

This study presents metadata histories of each of the selected long-term Australian and NSW tide gauge records in order to evaluate data quality, understand inconsistencies and justify the selection of data sets for inclusion in future work.

The metadata statements were determined by reviewing the histories of tide gauge data sets collected by a number of organisations at key locations around Australia. The metadata statements include the following information:

- when the original tide gauge was installed and whether the gauge has been changed, moved or the technology upgraded
- details of the respective tide gauge technology/data capture over time
- details concerning the location of the tide gauge and whether it has changed over time
- if the original tidal charts exist, and if so, where they are located, and
- identify other issues that may relate to the gauge information including land subsidence, tectonics, reclamation works, riverine influences or major changes in entrance configuration affecting tidal harmonics(for estuary sites).

The metadata statements and associated information regarding the tide gauges are contained within this report.

Tide gauging in Australia has advanced in distinct steps, though not uniformly across the country. From around 1880, regular, well-documented tide records are available at many locations around the coast, in the form of tide books documenting high and low tide times and levels, and monthly statistics. From the turn of the 20th century automated gauging was increasingly used, and the technology used steadily improved. The original records can sometimes be found, but is more generally available in tide books as high and low times. Rarely these have been converted to digital format, at locations such as Fort Denison and Fremantle. From the late 1980s to 1990s digital sensing and recording equipment became more accessible and resulted in upgrades to existing stations, a proliferation of new tide stations, and the dense spatial and temporal records that we have access to today. This is apparent in the OEH network in NSW and similar networks in Queensland and other states. Continuing improvements to the recording equipment allow improved accuracy, less data loss, higher sampling rates and real time data streams. The advent of satellite surveying has allowed improved referencing of gauge datums.

2. Sites

2.1 Long Australian Gauge Records

The national gauges represent those sites where long-term digitised data is available. The primary metadata is obtained from the National Tidal Centre (NTC), while supporting information was provided by data custodians and State Records.

It should be recognised that there are significant hard copy records of tides, generally tide highs and lows but sometimes irregular readings of 10-60 minutes, dating back to the 1880s for many locations in Australia, including sites listed in Table 2.1 and others with shorter digitised records. The significant effort required to digitise this data and correlate it to a datum make these data sets largely inaccessible.

Table 2.1 National Gauges Used in this Study

Site	Location (Lat.Long)	First Record	Data Start	Data End	Current Gauge Owner
Darwin	-12.4719 130.8458	1954	1961	Current	Darwin Port Authority
Townsville			1959	Current	Queensland EPA
Newcastle	-32.9240 151.7886	1889	1926	Current	Newcastle Port Corporation
Sydney (Camp Cove)	-33.833333 151.283333	1916	1949	Current	Sydney Water
Sydney (Fort Denison)	-33.8547 151.2258	1866	1886	Current	Sydney Ports Corporation
Williamstown	-37.8667 144.9167	1895	1895	Current	Port of Melbourne
Point Lonsdale	-38.2933 144.6150		1928	Current	Port of Melbourne
Port Adelaide (Inner)	-34.85 138.50	1880	1882	Current	Flinders Ports Corporation
Port Adelaide (Outer)	-34.779761 138.480728	1937	1941	Current	Flinders Ports Corporation
Port Pirie	-33.177644 138.01165	1883	1941	Current	Flinders Ports Corporation
Bunbury	-33.323444 115.659972	1897	1924	Current	Bunbury Port Authority
Fremantle	-32.05 115.73333	1873	1897	Current	Fremantle Port Authority

2.2 NSW Gauge Records

The NSW gauges used in this study are taken from the OEH network managed by MHL. Some NSW sites - Fort Denison, Camp Cove and Newcastle - are listed as national gauges so are not included in this list.

The primary sources of metadata come from MHL's and the NTC's archives, with significant historical data and metadata available at NSW State Records.

Table 2.2 OEH/MHL Gauges Used in this Study

Site Name	Location (Lat.Long)	First Record	Period of Data Collected	Location Description
Onshore Open Ocean or Open Bay Sites				
Norfolk Island	-29:03:30.05 +167:57:12.67	n/a	1995-present	On Kingston public jetty located on southern side of the island. Fringing reef surrounds the gauge and exposes the site to high surge and wave activity
Lord Howe Island	-31:31:24.96 +159:03:30.24	n/a	1995-present	On public jetty off Lagoon Road. Gauge approx. 500 m from fringing reef on southern side of the island
Coffs Harbour	-30:18:10.29 +153:08:45.82	1951	1987-present	Boat harbour within Coffs Harbour, approx. 0.9 km from entrance to Coffs Harbour. Entrance to Coffs Harbour approx. 350 m wide, depths of 2-4 m in the boat harbour
Crowdy Head	-31:50:19.47 +152:45:00.19	1971	1986-present	Boat harbour on northern side of Crowdy Head
Port Stephens	-32:42:53.57 +152:10:56.06	1967	1985-present	Southern side of Port Stephens at Shoal Bay, approx. 0.5 km from entrance to port. Port entrance approx. 1.8 km wide, depths of 10-20 m at entrance, 3-5 m at the gauge
Sydney	-33:49:31.56 +151:15:30.72	1987	1987-present	Northern side of Middle Head in Hunters Bay, Sydney Harbour, approx. 3 km upstream of Sydney Harbour entrance. Sydney Harbour entrance approx. 2 km wide, depths of 20-30 m at entrance, depths of 3-7 m in Hunters Bay
Port Hacking	-34:04:36.88 +151:08:45.89	1988	1988-present	Located centrally approx. 1.5 km upstream on Port Hacking River. River entrance approx. 1 km wide and depths of 11-13 m at entrance
Jervis Bay	-35:07:19.21 +150:42:27.36	1914	1989-present	Deepwater harbour 6 km upstream of Jervis Bay entrance on southern side. Bay entrance approx. 5 km wide
Ulladulla	-35:21:27.54 +150:28:35.51	1967	2007-present	On southern end of jetty within Ulladulla Harbour. Approx. 350 m from entrance to harbour
Eden	-37:04:16.87 +149:54:29.55	1954	1986-present	Eden Wharf in Snug Cove, within Twofold Bay, approx. 5 km from entrance to Twofold Bay. Depths of 36-40 m at entrance to Twofold Bay, 4-8 m at Eden Wharf
Onshore River Entrance Sites				
Tweed Heads	-28:10:10.02 +153:32:58.71	1968	1987-present	Northern breakwater of Tweed River, approx. 0.6 km upstream of entrance. River entrance approx. 150 m wide, depth of 3-4 m to gauge. Shoal approx. 1-2 m deep 150 m on ocean side of breakwaters

Site Name	Location (Lat.Long)	First Record	Period of Data Collected	Location Description
Brunswick Heads	-28:32:12.52 +153:33:07.6	1988	1988-present	Southern training wall of Brunswick River, approx. 0.6 km upstream of entrance. River entrance approx. 60 m wide, depths of 1-3 m from entrance to gauge
Ballina	-28:52:30.6 +153:34:42.07	1889	1986-2011	Southern breakwater of Richmond River, approx. 0.9 km upstream of entrance. River entrance approx. 300 m wide, depths of 2-8 m from entrance to gauge. Affected by the training wall with low tides cut off
Ballina Breakwater	-28:52:29.56 +153:34:57.81	2010	2010-present	Southern breakwater of Richmond River, approx. 0.75 km upstream of entrance. River entrance approx. 300 m wide, depths of 2-8 m from entrance to gauge. Now located outside of the training wall
Yamba	-29:25:44.51 +153:21:44.24	1900	1986-present	Southern breakwater of Clarence River, approx. 0.9 km upstream of entrance. River entrance approx. 400 m wide, depths of 3-10 m from entrance to gauge
Port Macquarie	-31:25:36.45 +152:54:39.54	1978	1986-present	Southern breakwater of Hastings River, approx. 0.7 km upstream of entrance. River entrance approx. 200 m wide, depths of 3-7 m from entrance to gauge
Forster	-32:10:26.36 +152:30:29.56	1978	1986-present	Approx. 0.35 km upstream of Cape Hawke Harbour entrance to Wallis Lake. Entrance approx. 120 m wide
Crookhaven Heads	-34:54:19.4 +150:45:33.25	1991	1991-present	Southern side of Crookhaven River approx. 1 km from entrance and 100 m from local jetty. Entrance is approx. 750 m wide
Bermagui	-36:25:34.82 +150:04:17.52	1970	1987-present	On jetty approx. 0.5 km from Bermagui River entrance. River entrance approx. 100 m wide

3. Sources and Data Availability

The information for this report was collated from a range of sources including national and state bodies that collect and disseminate tidal data as well as state archives. A summary of the sources, the information and records available and records that are likely to provide useful information but could not be captured in this project are included in this section.

3.1 National Tidal Centre

The National Tidal Centre (NTC) is the Australian repository for tide data. Data for all primary sites and many secondary gauges are sent to the NTC for storage and processing. The NTC was one of the primary sources of metadata for this report.

Station summaries were available for each station in this report (apart from a few MHL gauges) at the NTC office in Kent Town, Adelaide. These provide details about the station location, instrumentation, benchmark and survey information, gauge calibrations and other relevant information. There appears to have been a push to capture benchmark and gauge information through the 1980s, but there is very little correspondence with the gauge owners after that time for most sites.

Another document was also used, 'Survey Paper No. 6' by E.A. Easton, which provides a detailed background of the gauges, installation, site effects, instrumentation and benchmarks up to the date of publishing in 1968. It includes Point Lonsdale, Bunbury, Fremantle, Darwin and Townsville. Other sites in South Australia, Victoria, Queensland, Western Australia and Northern Territory are also available, but New South Wales and Tasmania are not included in the report.

Also available from the NTC was a series of papers by Capt. A. Inglis, describing early tidal analysis and monthly means from early in the 20th century.

All of these documents were scanned and are available in the data accompanying this report.

3.2 Manly Hydraulics Laboratory

MHL manages and maintains the majority of the gauges on the NSW coast for the NSW Office of Environment and Heritage. Information relating to the history of the gauges and benchmarks is contained in hardcopy station files available at head office in Manly Vale.

Substantial historical records are available at MHL that have not been digitised, or have not been able to be reliably related to a datum. These comprise mostly tide books with high and low tide records and monthly average summaries. Some of this data is digitised but requires quality checks and tying to datum. A summary of these records is provided in Appendix B.

3.3 NSW State Records

Much of the historical Public Works correspondence and records are held by NSW State Records. This information is not well indexed and it can be difficult to find useful metadata.

Due to time limitations and limited indexing of the records, a conclusive list of all gauge records could not be achieved. The records found all related to current gauging locations and there were no sites found that have been decommissioned without further gauging at the site.

The most likely place for tide recorder descriptions is in the Harbours and Rivers (Public Works) records. There seemed to be a series of harbours records where harbours correspondence is located, and two very useful files were found containing correspondence between the head office and the Coffs Harbour and Port Kembla gauge operators. These give details of the instruments from early design drawings and site plans, issues with instrumentation, data gaps, surveying information and other details. These can be found in series 17-967 (Coffs Harbour) and 17-1235 (Port Kembla) which relate to the original Harbours and Rivers records HR 1017/29 and HR 1045/9 respectively. It is anticipated that similar records could be found at State Records in the same series, but as the index to the series is in hardcopy form and not searchable it may take some time to find.

Reference to HR 1035/176 and HR 1035/29 was found in:

Doc to seek	Referring doc	Site/comment
HR 1035/176 HR 1035/29	SRNSW 6/3929	Newcastle
HR 1016/92	SRNSW 6/3929	Clarence River - Iluka

Also on record at the State Records are the original tide recorder sheets, tide books containing high and low tides and monthly statistics for many sites, some as far back as the 1880s, and other correspondence relating to the gauges. Much of the information sighted during the visit to the State Archives was photographed and is supplied as images in the digital data records accompanying this report.

3.4 SA State Records

More detailed information on the histories and metadata of the gauges is likely to be found in the Harbours Board records, in particular the series SRSA GRG 51/170. There is no index to these files, but reference to particular files can be found in the records. Uncovering metadata for particular gauges would be a time-consuming search.

One particularly useful document is SRSA GRS 8420-4-1 ‘Tidal Data and Pool Levels Including the River Murray’ which has levelling summaries for stations in South Australia. Information included covers approximately 1900–1970 and references Harbours Board documents that may provide more detailed information.

Four stations are particularly well represented in the early records back to 1883: Semaphore, Port Augusta, Port Pirie and Port Adelaide (Inner). Presumably there is older data for some of these sites.

3.5 Sydney Ports Corporation

Sydney Ports Corporation is the owner and operator of the Fort Denison tide gauge. A visit was made by MHL staff to copy relevant hardcopy information available about the gauge.

3.6 Flinders Ports Corporation

Current information relating to the three South Australian gauges was supplied by Flinders Ports Corporation who currently manages the sites – Inner Harbour, Outer Harbour and Port Pirie. This came in the form of metadata summaries for each site. Other information, such as that relating to land subsidence around Port Adelaide, was obtained through communications with Greg Pearce of Flinders Ports Corporation. Specific details on land subsidence in this area can be found in Belperio (1993)

3.7 MSQ - Port of Townsville

Maritime Safety Queensland operates the Townsville gauge in conjunction with Queensland EPA. MSQ supplied gauge information summaries for each of the four installations on record.

The Queensland Department of Environment and Heritage Protection manages 20 gauges along the state coastline as part of the Storm Tide Monitoring network. These additional sites have not been included in this report.

3.8 Other Sources

Australian Tide Gauges (1963)

A report by B.V. Hamon from 1963 provides an important snapshot of all of the gauges in Australia at that time. This provides a half page metadata summary of each gauge.

B.V. Hamon (1963) Australian tide recorders. Technical paper (CSIRO. Division of Fisheries and Oceanography), no. 15.

4. Gauge History Summaries

A brief description of the gauge histories for the national sites is provided here, summarising the detailed metadata provided.

4.1 Bunbury

Bunbury tide gauge was first installed in 1897, and digital data is available from 1924. The original gauge was subject to a wide set of factors likely to disturb the tide record, including a nearby railway line, wave action, wind around the mechanism, friction and severe timing errors.

Reference to a potential installation of a Stevens recorder was made in 1968 but little could be found about this installation in the records available for this study, except that it would be located at a new site across the harbour.

The current gauge was installed in 2001 and is a Floatwell with Hydromace encoder.

4.2 Camp Cove

The majority of the Camp Cove data has been recorded by the Harrison chart recorder installed there in March 1916. The recorder was changed to a Hydromace shaft encoder and logger on 1 January 1991.

A common complaint throughout the records is the lag between ocean and stilling well levels. The inlet arrangement was usually blamed, through several reworkings of the inlet. Response errors of up to 20 cm/40 min were noted in 1988. The entrance pipe for the stilling well was removed altogether in January 1990. It was also noted that for a period up to 1981 the pen was reset at each field check, introducing the potential for a datum shift each time.

4.3 Darwin

The Darwin site has had several gauges over its lifetime, located at two separate wharfs but within a few hundred metres of each other so should not be hydrodynamically different. The first install was in 1954 on Fort Hill wharf. Very little information about this gauge is available, but presumably it was not successful as a second gauge was installed in 1957 on Stokes Hill wharf. This used a Leupold and Stevens recorder and the data from this site is available up to 1986.

A later model Leupold and Stevens recorder was installed on Fort Hill wharf in 1981 but the decommissioning date is not known. A modern sonic sensor and data logger were installed in 1990 and again upgraded in 2009.

4.4 Fremantle

The earliest noted records from Fremantle date back to visual observations in 1873. The first automatic tide recorder was a Bailey recorder installed on 10 January 1897. This was quite unreliable, with large data gaps of up to a year, up to at least 1943. A secondary recorder, an Evershed and Vignols, was located alongside the Bailey gauge in 1965 to provide an electronic record as well as the chart record, but there seems very little information about this dataset.

The gauge was upgraded with a Leupold and Stephens recorder on 17 March 1967, and was also relocated by about 20 m.

It is likely that regular onshore winds and shallow bathymetry around Fremantle create setup that affects the tide records. While this has not been investigated it is likely that wind setup introduces a seasonal signal to the record. Also it could potentially introduce some climatic signals due to changing wind patterns associated with, for example, El Niño/La Niña cycles or the Southern Annular Mode. In the context of sea level rise, it should be recognised that signals of this kind are evident in all gauge records, only the mechanism may be different for this site, so does not diminish its value as a measure of long-term trends.

4.5 Newcastle

Newcastle consists of three different gauge sites. The oldest and current site is located in the pilot station in the small harbour immediately west of Nobbys Beach Reserve. Following the convention used by Peter Blume this is site III. Newcastle I is located near the pilot station on what was known as Kings Wharf. Newcastle II is located across the harbour at the south end of Berth 2, also known as the State Dockyard. Comparisons between gauges have been made over time, so there is cross-validation for some periods and significant periods have been discounted due to discrepancies.

For example: ‘In comparing the PSMSL annual means for Newcastle I and III, there is reasonable agreement from 1928 to 1934. However, from 1935 to 1959 there are considerable differences all in the one direction (11 to 99 mm with I values being higher than II). For 1960 the difference is in the other direction (-12 mm) . Does this mean something happened to one of the gauges around those years?’ Peter Blume, Port Surveyor, letter to the National Tidal Facility 28 November 1990. Later analysis of mean range suggests III gauge was erroneous until its replacement in 1959.

Subsidence is apparent at some of the benchmarks, with 7 mm drop noted during one survey. Generally the benchmarks have been regularly surveyed to the central Newcastle benchmark BM No.1 at the Customs House Clock Tower. It should be noted that much of the Newcastle CBD in the vicinity of Customs House and the gauging locations has been subject to mine subsidence over the last century, and has been discussed in some detail in Watson (2011).

All of Newcastle sites are subject to flood flows that may affect the results.

This site has a complex history, with three unique sites contributing to the tide record and observed subsidence problems. However, periods of overlapping data and a reasonably well documented history may prove sufficient to reconstruct the sea level over the history of the gauge. The extensive benchmark survey information in particular could not be untangled within the scope of this project. The data in its current state should be used with caution.

Further hardcopy historical information is available from Newcastle Ports Authority. It is understood that OEH has digital copies of this record (Tim Pritchard pers. comms).

For future accuracy in monitoring at Newcastle (Pilot Station) and Fort Denison, a collaborative effort between OEH, NPC, SPC and LPI has installed CORS stations (see section 5.1) at these two sites. This will allow accurate measurement of the land level changes at the sites and thus absolute sea level variations. This is described in Watson et al. (2012).

4.6 Point Lonsdale

Point Lonsdale is located at the narrow entrance to Port Phillip Bay. Strong currents are present between the heads, generated by the hydraulic gradient across the entrance and complicated by waves and reefs. It is likely that this affects water levels at the gauge. A reef protects the gauge from swell, but probably contributes to wave setup at the gauge. A signal with a period of around 45 min is also noticeable at the gauge, probably due to a seiche in the bay. Winds can affect levels, as well as considerably changing tide phases and high/low times.

The gauge is located at the end of a small jetty, and has been destroyed by storms several times over its life, initiating a change in instrumentation each time. The first Kelvin gauge started recording in 1929. This was upgraded to a Munro gauge in 1962, and a more modern Munro gauge in 1984. After more storm damage in 1994 the gauge was upgraded to an acoustic sensor.

4.7 Port Adelaide (Inner)

The Port Adelaide (Inner) gauge, a Thompsons gauge, was first installed in 1880, though continuous records are only available from 1917. This was replaced in 1962 by a Leupold and Stephens recorder, and then again to a later model Leupold and Stephens in 1982. Due to work in the port the gauge was moved to a temporary site at berth 25, but also upgraded to an acoustic sensor and electronic logger. This has recently (2010) been moved back to its permanent location at berth 17.

Land subsidence has been a major issue for both of the Port Adelaide sites as the subsidence covers a substantial area of northern Adelaide. Further complicating the extraction of sea level trends at the site is the benchmarks in the region also being subject to subsidence. See Belperio (1993) for further information.

4.8 Port Adelaide (Outer)

The Port Adelaide (Outer) gauge digital records began in November 1943 with a Ballout chart recorder and float. This was upgraded to a Leupold and Stephens recorder in May 1982. The site was then upgraded again to an air bubbler type instrument with a Mindata/Handar recorder at the start of 1996.

Older records are available at South Australian State Records, in the form of tide books with tide highs and lows, with monthly statistics. Some of these records were photographed for this study but further investigations should reveal more records. The earliest date captured for this site was March 1937-July 1941.

Land subsidence has been a major issue for both of the Port Adelaide sites as the subsidence covers a substantial area of northern Adelaide. Further complicating the extraction of sea level trends at the site is the benchmarks in the region also being subject to subsidence. See Belperio (1993) for further information.

4.9 Port Pirie

The Port Pirie gauge has been operational since at least 1883. Tide books of high/low times and heights are available back to this time, but no information relating to the datums or installation could be found. Presumably this is contained in the Harbours and Rivers correspondence files currently at SA State Archives. Some correspondence from up to 1916 about the datum and tide recordings was found in early Harbour and Rivers correspondence (GRG 51-170 80-16, 1916), though this has not been examined in detail for this report.

Digital records for Port Pirie begin in July 1917 with a Negretti and Zambra chart recorder, possibly followed by an Esdaile in 1956, but these records are uncertain. A Leupold and Stevens installed in 1962 is more reliably described. An air bubbler system with an electronic recorder was installed in February 1992.

The site is well protected from wave action and probably has very little floodwater effects. However, there may be some setup associated with persistent southerly winds that drive water to the shallow northern tip of Spencer Gulf. It appears that the location of this gauge has not changed over the record.

4.10 Sydney (Fort Denison)

The Sydney (Fort Denison) gauge is one of the most studied gauges in Australia due to its long record, with digitisation back to its early records.

Gauging began on 11 May 1866 with a Smalleys chart recorder. This has been considered unreliable by those who have studied the gauge in depth and is not generally used in any records. It was replaced with a Russels gauge on 27 June 1872 which ran till June 1914. These records are also problematic and are also usually excluded from detailed analysis. Reliable recordings began with a Harrisons recorder in 1914, and parts of these have been digitised by several different groups. A Vetel acoustic sensor was installed in 1996, providing a digital record at 1-minute intervals. This was upgraded with a SeaRanger acoustic sensor installed in 2007.

A thorough description of the site and records are available in Hamon (1986). The site is well protected from wave action and is unaffected by flood flows and wind setup.

For future accuracy in monitoring at Newcastle (Pilot Station) and Fort Denison, a collaborative effort between OEH, NPC, SPC and LPI has installed CORS stations (see section 5.1) at these two sites. This will allow accurate measurement of the land level changes at the sites and thus absolute sea level variations. This is described in Watson et al. (2012).

4.11 Townsville

The Townsville record consists of four campaigns in two locations within the port of Townsville, with overlapping records.

Gauging began on the No.6 wharf on the eastern side of the harbour on 19 November 1948, using an Amsler chart recorder. This continued until 31 December 1993.

A second gauge was installed on the western side of the harbour at the Roll On-Roll Off wharf with a Leupold and Stephens recorder. This gauge was upgraded on 15 June 1984 with a Mace digital recorder and encoder attached to the chart recorder. The chart recorder was removed from the system in 2002. Recording at this site ended in September 2011, and the gauge is currently located at the original site on No. 6 wharf.

4.12 Williamstown

The digital record of the Williamstown gauge begins in September 1949 with a Neuman and Verner gauge. This was upgraded to a Leupold and Stevens A71 in February 1976, and again upgraded to an acoustic sensor and digital recorder in 1991.

The gauge has maintained the same location over the life of the record. Williamstown is well protected from ocean waves but may be susceptible to wind-driven setup in the bay.

5. Other Influences

5.1 Tectonic Movement and Land Subsidence

Tectonic movement and land subsidence affect sea level rise calculations by moving the gauge itself relative to the water level. Clearly this should be removed when assessing *absolute* sea level rise, but should be included when considering *relative* sea level rise. It is relative sea level rise that is of most concern to coastal communities, but any land movement will provide context for absolute sea level rise.

Several organisations were approached for information relating to tectonic movement, including Survey and Spatial Information Services (Department of Finance and Services), Land and Property Information (Department of Finance and Services), the Mine Subsidence Board and Geoscience Australia (GA).

The only definitive information available was from Nick Dando at GA, relating to the Continuously Operating Reference Stations (CORS) network. One use of this network of GPS reference stations is to measure the motion of the reference stations and infer regional land movement. However, this has only been operational for a few years, and there is insufficient data to determine the motion of the stations (the error bars on the velocity are much greater than the velocity itself).

Details of each station can be found at:

http://192.104.43.25/status/solutions/analysis.html

and

http://www.ga.gov.au/earth-monitoring/geodesy/asia-pacific-reference-frame.html

Other sources of information relating to land subsidence for specific stations has been included in Section 5, and includes Belperio (1993), Watson (2011) and Watson et al. (2012).

5.2 Bathymetric and Entrance Effects

A key factor in the reliability of gauge records is their susceptibility to changing bathymetry and entrance conditions. This is particularly important for sites located inside entrances, where water levels are affected by freshwater flows and the entrance affects the propagation of the tide into the estuary.

Tidal amplitudes will generally decay through an entrance and upstream, though there are instances of amplification upstream in NSW. The propagation of a tide upstream is dependent on factors such as the size of the entrance, tidal prism, bed friction and freshwater flows. These are all dynamic and can change due to natural processes such as

flooding, accretion and erosion, as well as anthropogenic changes such as dredging, engineering works and hydrologic impacts. In cases with a very constricted entrance it is possible that this will affect long-term mean water levels, and hence sea level rise estimates.

Similarly the bathymetry around a gauge may affect levels at a gauge. This would generally be associated with other effects such as currents or wave action that may cause setup in the region of the gauge which are themselves influenced by the local bathymetry. The effect on mean sea level and sea level rise estimates is difficult to quantify as the effect is intermittent (associated with meteorological or coastal processes) and requires detailed studies or modelling to estimate the magnitude of the setup.

6. Conclusions and Recommendations

This report summarises efforts to capture available metadata relating to long-term gauges in Australia. The results are contained in metadata summaries for each of the sites, providing information about the history of each gauge's instrumentation, location, benchmarks and operation. This metadata is included as appendices to this report.

The metadata is also summarised in this report as brief station summaries, with particular emphasis on changes to the instrumentation and gauging location. Also included is any other useful information that may guide the application of the data.

The results are limited by access to records, difficulties in finding relevant information in large and poorly referenced repositories, inconsistent or lack of feedback by some custodians and limitations in the time and effort available to research the information available. Where possible, the researchers have attempted to photograph or scan the most relevant hardcopy records, and provide direction for further research. Thus, much of the effort has been in making the records easily distributable, rather than trying to interpret the records.

As such there are some important areas for further study:

- Very little work was done in this study in checking the benchmarks. A substantial amount of work is needed to check the consistency of the surveys through time to ensure that no subsidence is occurring at the gauges.
- State repositories contain a wealth of hardcopy information about the gauges, including gauge designs, installation reports, data gaps, calibration reports, tide records, monthly and annual statistics and general correspondence about the operation of the gauges. This provides an opportunity to extend the record length of many of the gauges in Australia.

It is anticipated that there will be more information and clarifications as further research is conducted into the sites. To capture and share this information it is important to facilitate a central repository for further amendments to the metadata, possibly the National Tidal Centre or PSMSL.

7. References

Belperio, AP 1993, 'Land Subsidence and sea level rise in the Port Adelaide estuary: implication for monitoring the greenhouse effect', *Australian Journal of Earth Sciences*, 40: 4,359 – 368.

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Watson, PJ 2011, 'Is There Evidence Yet of Acceleration in Mean Sea Level Rise around Mainland Australia?', *Journal of Coastal Research*, 368-377.

Watson P, R Commins, V Janssen, S McElroy, G Batman and D Conners 2012, 'Augmenting the Utility of NSW Longest Tide Gauge Records with Continuous GNSS Technology', *Proceedings of the 21st NSW Coastal Conference*, Kiama, 2012.

Appendix A

Metadata Summaries

Identification				Source	
			Station Name	2	Ballina
			Station identifier/number (owner)	2	Richmond River at Ballina Breakwall
			ANTT no.	1	60090
			Tidal port no	1	60090
			GLOSS number	1	081
			AWRC Number	2	202470
			Other Ref		
			Country		Australia
			State		NSW
			Ocean		Tasman Sea / Pacific Ocean
			Catchment/River		Richmond River
			Site Description	2	Guage is located in river approximately 700m upstream of the entrance. It is located inside the 1/2 tide wall. The river entrance is maintained open by a training wall on either side of the river.
Authority					
			Responsible country		
		Data Owner			
			Organisation		Office of Environment and Heritage
			Address		Level6, 10 Valentine Ave, Parramatta NSW 2124
			Contact		Martin Fitzhenry
			Phone		(02) 9895 5968
			Fax		(02) 9895 7263
			Email		Martin.Fitzhenry@environment.nsw.gov.au
			Website		www.environment.nsw.gov.au/
			Contact #2		Bruce Coates
			Phone		(02) 4904 2593
			Fax		(02) 9895 7263
			Email		Bruce.Coates@environment.nsw.gov.au
		Data Custodian			
			Organisation		Manly Hydraulics Laboratory
			Contact		Edward Couriel / Rob Jacobs
			Address		110B King St, Manly Vale, NSW 2093
			Phone		(02) 9949 0200
			Email		Edward.Couriel@mhl.nsw.gov.au / Rob/Jacobs@mhl.nsw.gov.au
			Website		www.mhl.nsw.gov.au
		Gauge Maintained by			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		Levelling			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		GLOSS			
			GLOSS contact		
			Committed to GLOSS		
			Operational		
Time Frame			First Recoords		1889
			Digital Record Start	2	Mar-86
			Record End	2	May-11
			Record Gaps	2	11/1990 - 10/1991, 12/1998 - 3/1999
			Time Zone	2	AEST (GMT+10hr)
Horizontal Datum					
			Latitude	2	-28:52:30.6
			Longitude	2	+153:34:42.07
			Ref Frame (Name)	2	GDA 1994 / MGA
			Zone	2	56
			Easting	2	556399.59
			Northing	2	6805707.26
Vertical Datum					
	Current				
			Name	2	Low Water Ordinary Springs
			Date Range	2	1986 - 2011
			Gauge Datum	2	zero Low Water Ordinary Springs
			Level	2	TGZ is 0.860 below Australian Height Datum (AHD)
			Gauge Plate????	2	no
			Tide Gauge Benchmark1 -ID	2	PWD99
			- Elevation	2	6.678 (Richmond River Valley Datum)
			Tide Gauge Benchmark2 -ID	2	PWD100
			- Elevation	2	5.581 (Richmond River Valley Datum)

			Tide Gauge Benchmark3 -ID		
			- Elevation		
			Leveling System ???		
	Historical 1				
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevation		
			Tide Gauge Benchmark2 -ID		
			- Elevation		
			Leveling System ???		
			Comments		
		Historical 2			
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevation		
			Tide Gauge Benchmark2 -ID		
			- Elevation		
			Leveling System ???		
			Comments		
Instrumentation					
	Current				
		Instrument	Date Range	2	all data
			Instrument Type	2	Electronic Wave Staff
			Instrument (Make/Model)	2	MHL Custom
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1 sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp.
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	6m
			Datum??	2	
	Secondary Instrument		Instrument Type -B	2	Pressure sensor
			Instrument (Make/Model) -B	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp.
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Other		
	Field Validation		Method	2	observation of stilling tube attached to gauge plate or measured from site TBM
			Reolution	2	10mm
			Frequency	2	3 monthly
	Data Processing /QA		Chart reading		*n/a*
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal	2	automatic threshold exceedence correction for values <-200m
			Missing data handling	2	filled where possible from 2nd sensor
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description	2	MHL WISKI database
	Historical 1				
		Instrument			
			Date Range	2	1973 -1975 digital data
	Records Location		Physical Location, Description	2	MHL WISKI database
	Historical 2				
		Instrument			
			Date Range	2	1959 -1963 Microfiche
	Records Location		Physical Location, Description	2	State Archives
	Historical 3				
		Instrument			
			Date Range	2	1889-1901, 1898-1909 books containing manual High and Low tide records only
			Datum??	2	zero of tide gauge 44.75 (= Low Water shown on Harbour Plans)
	Records Location		Physical Location, Description	2	State Archives

Other Information				2	Guage is located in river approximately 700m upstream of the entrance. It is located inside the 1/2 tide wall. The data may be effected by not reording full extent of some of the low tides due to the 1/2 tide wall. The river entrance is maintained open by a training wall on either side of the river.
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			
			-date		
			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.		
1	NTC	ANTT
2	MHL	LO File D03/183 and WISKI database
3		

Identification				Source	
			Station Name	2	Ballina Breakwall
			Station identifier/number (owner)	2	Richmond River at Ballina Breakwall
			ANTT no.		Not Applicable
			Tidal port no		Not Applicable
			GLOSS number		Not Applicable
			AWRC Number	2	202471
			Other Ref		
			Country		Australia
			State		NSW
			Ocean		Tasman Sea / Pacific Ocean
			Catchment/River		Richmond River
			Site Description	2	Guage is located in river approximately 500m upstream of the entrance. The river entrance is maintained open by a training wall on either side of the river.
Authority					
			Responsible country		
		Data Owner			
			Organisation		Office of Environment and Heritage
			Address		Level6, 10 Valentine Ave, Parramatta NSW 2124
			Contact		Martin Fitzhenry
			Phone		(02) 9895 5968
			Fax		(02) 9895 7263
			Email		Martin.Fitzhenry@environment.nsw.gov.au
			Website		www.environment.nsw.gov.au/
			Contact #2		Bruce Coates
			Phone		(02) 4904 2593
			Fax		(02) 9895 7263
			Email		Bruce.Coates@environment.nsw.gov.au
		Data Custodian			
			Organisation		Manly Hydraulics Laboratory
			Contact		Edward Couriel / Rob Jacobs
			Address		110B King St, Manly Vale, NSW 2093
			Phone		(02) 9949 0200
			Email		Edward.Couriel@mhl.nsw.gov.au / Rob/Jacobs@mhl.nsw.gov.au
			Website		www.mhl.nsw.gov.au
		Gauge Maintained by			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		Levelling			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		GLOSS			
			GLOSS contact		
			Committed to GLOSS		
			Operational		
Time Frame					
			Record Start	2	Dec 2008
			Record End	2	current
			Record Gaps		
			Time Zone	2	AEST (GMT+10hr)
Horizontal Datum					
			Latitude	2	-28:52:29.56
			Longitude	2	+153:34:57.81
			Ref Frame (Name)	2	GDA 1994 / MGA
			Zone	2	56
			Easting	2	556826.12
			Northing	2	6805737.18
Vertical Datum					
	Current				
			Name	2	Richmond River Valley Datum
			Date Range	2	Dec 2008 to current
			Gauge Datum	2	zero Richmond River Valley Datum
			Level	2	TGZ is 0.860 below Australian Height Datum (AHD)
			Gauge Plate????	2	yes
			Tide Gauge Benchmark1 -ID	2	PWD99
			- Elevatior	2	6.678 (RRVD)
			Tide Gauge Benchmark2 -ID	2	PWD100

			- Elevatior	2	5.581 (RRVD)
			Tide Gauge Benchmark3 -ID		
			- Elevatior		
			Leveling System ???		
	Historical 1				
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
		Historical 2			
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
Instrumentation					
	Current				
		Instrument	Date Range	2	2008 to current
			Instrument Type	2	Pressure sensor
			Instrument (Make/Model)	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Datum??	2	
		Secondary Instrument	Instrument Type -B	2	Pressure sensor
			Instrument (Make/Model) -B	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	30mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Other		
		Field Validation	Method	2	observation of stilling tube attached to gauge plate or measured from site TBM
			Reolution	2	10mm
			Frequency	2	3 monthly
		Data Processing /QA	Chart reading		*Not Applicable*
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal	2	automatic threshold exceedence correction for values <-200m
			Missing data handling	2	filled where possible from 2nd sensor
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description	2	MHL WISKI database
	Historical 1				
		Instrument			
			Date Range		
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		

			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Datum??		
			Other		
		Field Validation	Method		
			Reolution		
			Frequency		
		Data Processing /QA	Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
		Historical 2			
			Date Range		
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Datum??		
			Other		
		Field Validation	Method		
			Reolution		
			Frequency		
		Data Processing /QA	Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
		Historical 3			
			Date Range		
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
		Historical 4			
			Date Range		
			Instrument Type		
			Sample Rate		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
		Records Location	Physical Location, Description		
Other Information				2	Guage is located in river approximately 500m upstream of the entrance. The river entrance is maintained open by a training wall on either side of the river.
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			

			-date		
			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.		
1	NTC	ANTT
2	MHL	LO File DEC0011 and WISKI database
3		

Identification				Source	
			Station Name	2	Bermagui Harbour at Bermagui
			Station identifier/number (owner)	2	Bermagui Harbour at Bermagui
			ANTT no.	1	60500
			Tidal port no	1	60500
			GLOSS number		Not Applicable
			AWRC Number	2	219470
			Other Ref		
			Country		Australia
			State		NSW
			Ocean		Tasman Sea / Pacific Ocean
			Catchment/River		Bermagui River
			Site Description	2	Gauge is located in river approximately 500m upstream of the entrance. The river entrance is maintained open by a training wall on either side of the river.
Authority					
			Responsible country		
		Data Owner			
			Organisation		Office of Environment and Heritage
			Address		Level6, 10 Valentine Ave, Parramatta NSW 2124
			Contact		Martin Fitzhenry
			Phone		(02) 9895 5968
			Fax		(02) 9895 7263
			Email		Martin.Fitzhenry@environment.nsw.gov.au
			Website		www.environment.nsw.gov.au/
			Contact #2		Bruce Coates
			Phone		(02) 4904 2593
			Fax		(02) 9895 7263
			Email		Bruce.Coates@environment.nsw.gov.au
		Data Custodian			
			Organisation		Manly Hydraulics Laboratory
			Contact		Edward Couriel / Rob Jacobs
			Address		110B King St, Manly Vale, NSW 2093
			Phone		(02) 9949 0200
			Email		Edward.Couriel@mhl.nsw.gov.au / Rob/Jacobs@mhl.nsw.gov.au
			Website		www.mhl.nsw.gov.au
		Gauge Maintained by			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		Levelling			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		GLOSS			
			GLOSS contact		
			Committed to GLOSS		
			Operational		
Time Frame					
			Record Start	2	Jul-87
			Record End	2	current
			Record Gaps	2	2-4/1988, 10/1988-3/1990, 8-9/1998, 7-8/2000
			Time Zone	2	AEST (GMT+10hr)
Horizontal Datum					
			Latitude	2	-36:25:34.82
			Longitude	2	+150:04:17.52
			Ref Frame (Name)	2	GDA 1994 / MGA
			Zone	2	56
			Easting	2	237458.21
			Northing	2	5964776.65
Vertical Datum					
	Current				
			Name	2	Bermagui Local Hydro Datum
			Date Range	2	all data
			Gauge Datum	2	zero Bermagui Local Hydro Datum
			Level	2	TGZ is 0.714 below Australian Height Datum (AHD)
			Gauge Plate????	2	yes
			Tide Gauge Benchmark1 -ID	2	PM12910
			- Elevatior	2	3.166 (BLHD)
			Tide Gauge Benchmark2 -ID	2	BM12911

			- Elevatior	2	4.736 (BLHD)
			Tide Gauge Benchmark3 -ID		
			- Elevatior		
			Leveling System ???		
	Historical 1				
			Name		as above
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
		Historical 2			
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
Instrumentation					
	Current				
		Instrument	Date Range	2	to current
			Instrument Type	2	Pressure sensor
			Instrument (Make/Model)	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Datum??	2	
		Secondary Instrument	Instrument Type -B	2	Pressure sensor
			Instrument (Make/Model) -B	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Other		
		Field Validation	Method	2	observation of stilling tube attached to gauge plate or measured from site TBM
			Reolution	2	10mm
			Frequency	2	3 monthly
		Data Processing /QA	Chart reading		*n/a*
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal	2	automatic threshold exceedence correction for values <-200m
			Missing data handling	2	filled where possible from 2nd sensor
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description	2	MHL WISKI database
	Historical 1				
		Instrument			
			Date Range	2	Mar 94 - Jul 09
			Instrument Type	2	Floatwell
			Instrument (Make/Model)	2	Hydrological Services AD375 quadrature shaft encoder
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	MACE Hydromace 2000
			Sample Rate	2	15 minute
			Averaging Protocol		n/a
			Time Resolution		
			Vertical Resolution	2	1.0mm

			Calibration		
			Est Accuracy/Uncertainty	2	+/- 20mm
			Range		
			Datum??		
			Other		
		Field Validation	Method	*2*	Observation of onsite tide board
			Reolution	2	10mm
			Frequency	2	6 weekly
		Data Processing /QA	Chart reading		n/a
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description	2	MHL WISKI database
		Historical 2			
			Date Range	2	Mar 89 - Mar 94
			Instrument Type	2	Floatwell
			Instrument (Make/Model)	2	Stevens 'Hydromark'
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Stevens 'Hydromark'
			Sample Rate	2	15 minute
			Averaging Protocol		n/a
			Time Resolution		
			Vertical Resolution	2	1.0mm
			Calibration		
			Est Accuracy/Uncertainty	2	+/- 20mm
			Range		
			Datum??		
			Other		
		Field Validation	Method		Audible dip tape down floatwell, measuring from a known level in the cabinet
			Reolution		5mm
			Frequency		6 weekly
		Data Processing /QA	Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description	2	MHL WISKI database
		Historical 3			
			Date Range	2	Jul 87 - Mar 89
			Instrument Type	2	Floatwell
			Instrument (Make/Model)	2	MHL 'Shaft Encoder'
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	MHL 'Mark 1" digital
			Sample Rate	2	15 minute
			Averaging Protocol		n/a
			Time Resolution		
			Vertical Resolution	2	2.5mm
			Calibration		
			Est Accuracy/Uncertainty	2	+/- 20mm
			Datum??		
			Other		
		Historical 4			
			Date Range		
			Instrument Type		
			Sample Rate		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
		Records Location	Physical Location, Description	2	MHL WISKI database
Other Information					
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			
			-date		

			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.		
1	NTC	ANTT
2	MHL	LO File B32 and WISKI database
3		

Identification				Source	
			Station Name	2	Brunswick Heads
			Station identifier/number (owner)	2	Brunswick River at Brunswick Heads
			ANTT no.	1	60080
			Tidal port no	1	60080
			GLOSS number		Not Applicable
			AWRC Number	2	202403
			Other Ref		
			Country		Australia
			State		NSW
			Ocean		Tasman Sea / Pacific Ocean
			Catchment/River		Brunswick River
			Site Description	2	Gauge is located in river approximately 500m upstream of the entrance. The river entrance is maintained open by a training wall on either side of the river.
Authority					
			Responsible country		
		Data Owner			
			Organisation		Office of Environment and Heritage
			Address		Level6, 10 Valentine Ave, Parramatta NSW 2124
			Contact		Martin Fitzhenry
			Phone		(02) 9895 5968
			Fax		(02) 9895 7263
			Email		Martin.Fitzhenry@environment.nsw.gov.au
			Website		www.environment.nsw.gov.au/
			Contact #2		Bruce Coates
			Phone		(02) 4904 2593
			Fax		(02) 9895 7263
			Email		Bruce.Coates@environment.nsw.gov.au
		Data Custodian			
			Organisation		Manly Hydraulics Laboratory
			Contact		Edward Couriel / Rob Jacobs
			Address		110B King St, Manly Vale, NSW 2093
			Phone		(02) 9949 0200
			Email		Edward.Couriel@mhl.nsw.gov.au / Rob/Jacobs@mhl.nsw.gov.au
			Website		www.mhl.nsw.gov.au
		Gauge Maintained by			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		Levelling			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		GLOSS			
			GLOSS contact		
			Committed to GLOSS		
			Operational		
Time Frame					
			Record Start	2	Feb-86
			Record End	2	current
			Record Gaps	2	Oct 1986 - Mar 1987, Apr - Jul 1989, Dec 1993 - Feb 1994, Jul2009
			Time Zone	2	AEST (GMT+10hr)
Horizontal Datum					
			Latitude	2	-28:32:12.52
			Longitude	2	+153:33:07.6
			Ref Frame (Name)	2	GDA 1994 / MGA
			Zone	2	56
			Easting	2	554013.91
			Northing	2	6843205.65
Vertical Datum					
	Current				
			Name	2	Brunswick River Flood Mitigation Datum
			Date Range	2	all
			Gauge Datum	2	zero Brunswick River Flood Mitigation Datum
			Level	2	TGZ is 0.046 below Australian Height Datum (AHD)
			Gauge Plate????	2	yes
			Tide Gauge Benchmark1 -ID	2	SSM 63714
			- Elevatior	2	104.603
			Tide Gauge Benchmark2 -ID		

			- Elevatior		
			Tide Gauge Benchmark3 -ID		
			- Elevatior		
			Leveling System ???		
	Historical 1				
			Name		as above
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
		Historical 2			
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
Instrumentation					
	Current				
		Instrument	Date Range	2	to current
			Instrument Type	2	Pressure sensor
			Instrument (Make/Model)	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Datum??	2	
		Secondary Instrument	Instrument Type -B	2	Pressure sensor
			Instrument (Make/Model) -B	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Other		
		Field Validation	Method	2	observation of stilling tube attached to gauge plate or measured from site TBM
			Reolution	2	10mm
			Frequency	2	3 monthly
		Data Processing /QA	Chart reading		
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal	2	automatic threshold exceedence correction for values <-200m
			Missing data handling	2	filled where possible from 2nd sensor
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
	Historical 1				
		Instrument			
			Date Range	2	May 94 - Jun 09
			Instrument Type	2	Floatwell
			Instrument (Make/Model)	2	Hydrological Services AD375 quadrature shaft encoder
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	MACE Hydromace 2000
			Sample Rate	2	15 minute
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution	2	1.0mm

			Calibration		
			Est Accuracy/Uncertainty	2	+/- 20mm
			Range		
			Datum??		
			Other		
		Field Validation	Method	2	Observation of onsite tide board
			Reolution	2	10mm
			Frequency	2	6 weekly
		Data Processing /QA	Chart reading		
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
		Historical 2			
			Date Range	2	Jul 92 - May 94
			Instrument Type	2	Floatwell
			Instrument (Make/Model)	2	MHL 'Aquadata'
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	MHL 'Aquadata" digital
			Sample Rate	2	15 minute
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution	2	2.5mm
			Calibration		
			Est Accuracy/Uncertainty	2	+/- 20mm
			Range		
			Datum??		
			Other		
		Field Validation	Method	2	Observation of onsite tide board
			Reolution	2	10mm
			Frequency	2	6 weekly
		Data Processing /QA	Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
		Historical 3			
			Date Range	2	Feb 86 - Jul 92
			Instrument Type	2	Floatwell
			Instrument (Make/Model)	2	MHL 'Shaft Encoder'
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	MHL 'Mark 1" digital
			Sample Rate	2	15 minute
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution	2	2.5mm
			Calibration		
			Est Accuracy/Uncertainty	2	+/- 20mm
			Datum??		
			Other		
		Historical 4			
			Date Range		
			Instrument Type		
			Sample Rate		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
		Records Location	Physical Location, Description		
Other Information				2	Gauge is located in river approximately 500m upstream of the entrance. The river entrance is maintained open by a training wall on either side of the river.
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			

			-date		
			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.		
1	NTC	ANTT
2	MHL	LO File D03/204 and WISKI database
3		

Identification				Source	
			Station Name	1	Bunbury
			Station identifier/number (owner)	1	834
			ANTT no.	4	62190
			Tidal port no		
			GLOSS number		
			AWRC Number		
			Other Ref		
			Country	1	Australia
			State	1	WA
			Ocean	1	Indian
			Catchment/River		
			Site Description	2	The BPA currently has tide gauges on the outer most channel marker Beacon 3 and at Beacon 10 in Koombana Bay.
Authority					
			Responsible country		
		Data Owner			
			Organisation	2	Bunbury Port Authority
			Address	2	PO Box 4 Bunbury 6231 WA
			Contact		
			Phone	2	08 9729 7020
			Fax		
			Email		
			Website	2	www.byport.com.au
			Contact #2		
			Phone		
			Fax		
			Email		
		Data Custodian			
			Organisation	1	National Tide Centre
			Contact	1	25 College Road, SA 5071
			Address	1	Paul Davill - Data Manager
			Phone	1	08 8366 2730
			Email	1	08 8366 2651
			Website	1	ntc@bom.gov.au
				1	www.bom.gov.au/oceanography
Time Frame					
			Record Start	1	1957
			Record End	1	2010
			Record Gaps	1	91% completeness
			Time Zone		
Horizontal Datum					
			Latitude	1	-33.323444 (Station was originally in outer harbour at -33'18'34.8" moved to current location in inner harbour in september 2001)
			Longitude	1	115.659972 (Station was originally in outer harbour at 115'38'28.1" moved to current location in inner harbour in september 2001)
			Ref Frame (Name)		
			Zone		
			Easting		
			Northing		
Vertical Datum					
	Current				
			Name		
			Date Range	1	September 2001 - current
			Gauge Datum		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID	1	A426
			- Elevatior	1	3.698m above Chart Datum
			Tide Gauge Benchmark2 -ID	1	Tidal BM 2001
			- Elevatior	1	3.939 above Chart Datum
			Tide Gauge Benchmark3 -ID	1	RLR (2008)
			- Elevatior	1	defined as 10.2m below Tidal BM 2001
			Tide Gauge Benchmark4 -ID		
			- Elevatior	2	Chart Datum (below AHD) -0.64m
			Leveling System ???		
	Historical 1				
			Name		
			Date Range	1	1957-2001?
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID	1	A103
			- Elevatior	1	3.951 above Chart Datum
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		

Instrumentation					
	Current				
		Instrument	Date Range	4	25/09/2001- current
			Location	4	Bunbury Inner Harbour (33° 19' 24.4" S, 115° 39' 35.9" E)
			Instrument Type	4	Floatwell
			Instrument (Make/Model)	4	In-house custom & Handar 436A shaft encoder
			Recorder Type	4	Electronic logger
			Recoder (Make/Model)	4	Handar 550B
			Sample Rate	4	5 min 'point sampling'
			Averaging Protocol		
			Time Resolution	4	seconds
			Vertical Resolution	4	mm
			Calibration		
			Est Accuracy/Uncertainty	4	+/-0.01m
			Range		
		Field Validation	Method	4	Check against tide staff
			Reolution	4	0.02m
			Frequency	4	Yearly
		Data Processing /QA	Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
	Historical 1				
			Date Range	3	after approx 1968
			Location	3	concrete wharf near the breakwater
			Instrument Type	3	Floatwell
			Instrument (Make/Model)		
			Recorder Type	3	Stevens A35 recorder
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Datum??		
			Other		Very little information available about this installation
		Field Validation	Method		
			Reolution		
			Frequency		
		Data Processing /QA	Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
	Historical 2				
		Instrument			
			Date Range	3	Installed 1897, available records start 1924. 1956 different counterweights and floats trialled and a new well installed in 1961. Recorder replaced by Stevens A35 recorder on the concrete wharf near the breakwater
			Location		Elbow of the breakwater
			Instrument Type	3	Bailey Recorder
			Instrument (Make/Model)		
			Recorder Type	3	Chart
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		-1'-6'
			Datum??	3	Gauge zero is 10.22' below lip of well. Chart Datum is 1.21' below ISLW
			Other		24" well, 20"float, 4 or 1 x 1"holes
		Field Validation	Method	3	Checked each working day, height read from wooden dipstick
			Resolution	3	dipstick graduated every 0.1'

			Frequency	3	checked each working day, drum chart changed weekly, tide well cleaned monthly
		Data Processing /QA	Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other	3	Time errors up to 6 hours, and height error of 1 foot have have been noted from trains travelling along the jetty. In general gauge has too much friction, keeps time badly. Errors due to wind around the mechanism were noted but repaired by 1968. Affected by wave and weather.
		Records Location	Physical Location, Description		
Other Information					
				2	1937- A tide of 7'2" (seven feet, 2 inches) or 2.18m was recoded on 17th February.
				2	1978 - Cyclone 'Alby' hits Bunbury, causing widespread damage. At 9:30pm the tide is recorded as 7 feet 3 inches (2.21m). At 10:30pm it is 4 feet 3 inches (1.29m).
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			
			-date		
			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.	
1	PSMSL
2	Bunbury Port Authority
3	Survey Paper No. 6
4	NTC website metadata

Identification				Source	
			Station Name	1	Camp Cove
			Station identifier/number (owner)	1	549
			ANTT no.		
			Tidal port no		
			GLOSS number		
			AWRC Number		
			Other Ref		
			Country	1	Australia
			State	1	NSW
			Ocean	1	Pacific
			Catchment/River		
			Site Description	2	Recorder located in hut on outer of of catwalk
Authority					
			Responsible country		
		Data Owner			
			Organisation		Sydney Port Corporation (formerly Maritime Services Board,NSW)
			Address		Gate B103, Penrhyn Road, Port Botany, NSW 2036
			Contact		Gary Batman
			Phone		02 9296 4999
			Fax		
			Email		
			Website		
			Contact #2		Tony Nusco
			Phone		02 9296 4999
			Fax		
			Email		
Time Frame					
			Record Start	2	1916
			Record End	1	Records discontinued after 1989
			Record Gaps	1	95 % Completness
			Time Zone		
Horizontal Datum					
			Latitude	1	-33.833333
			Longitude	1	151.283333
			Ref Frame (Name)		
			Zone		
			Easting		
			Northing		
Vertical Datum					
	Current				
			Name		
			Date Range	2	1914-1989
			Gauge Datum	2	AHD height of tide stafe zero= -0.923, recorder zero = -0.926
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID	2	(a) PM 83
			- Elevation	2	Above tide staff zero = 2.937, above recorder zero = 2.940, above AHD = 2.014, above chart datum = 2.940
			Tide Gauge Benchmark2 -ID	2	(b) PM 84
			- Elevation	2	Above tide staff zero = 2.441, above recorder zero = 2.444, above AHD = 1.518, above chart datum = 2.444
			Tide Gauge Benchmark3 -ID	2	(c) BM 823, (d) SSM 23009, (e) TBM 8384
			- Elevation	2	Above tide staff zero = (c) 2.423 (d) 6.091 (e) 2.932, above recorder zero = (c) 2.426 (d) 6.094 (e) 2.935, above AHD = (c) 1.500 (d) 5.168 (e) 2.009, above chart datum = (c) 2.426
			Leveling System ???		
			Comments	2	Camp Cove datum lower 0.51 feet below original datum on 1st september 1950 to accord with uniform ocean datum (ISLW). Hence MSL prior to 31/12/46 = 2.40, as lowered on 31/12/46 = 2.86, as lowered on 1/9/50 = 2.90 (measurements in feet)
Instrumentation					
	Current				
		Instrument	Date Range	2	1 January 1991 - current
			Instrument Type	2	floatwell
			Instrument (Make/Model)	2	
			Recorder Type		Shaft Encoder
			Recoder (Make/Model)		"Hydromace", Mace
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration	2	Calibrated visually against tide staff
			Est Accuracy/Uncertainty		
			Range		-0.3 to 2.5 m
	Field Validation		Method	*2*	height check by dip stick , time checked by operators watch

			Reolution	2	dip stick marked every 20mm
			Frequency	2	weekly
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
	Historical 1				
		Instrument			
			Date Range	2	March 1916 - 1 January 1990
			Location	2	In hut at the end of the jetty
			Instrument Type	2	Harrison Recorder
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Other		A common complaint throughout the records is the lag between ocean and stilling well levels. The inlet arrangement was usually blamed, through several reworkings of the inlet. Response error of up to 20cm/40min were noted in 1988. The entrance pipe for the stilling well was removed altogether in January 1990. 1988: 'This gauge does not meet national network standards for tidal gauging' 1981: Noted that the pen was reset at each field check, introducing a datum shift each time.
	Field Validation		Method	2	dip stick and watch comparision
			Reolution	2	dip stick marked every 20mm
			Frequency	2	checked twice per week
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
Other Information					
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			
			-date		
			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.	
1	PSMSL
2	NTC Standard files
3	

Identification				Source	
			Station Name	2	Coffs Harbour Inner Pumpout Jetty
			Station identifier/number (owner)	2	Tasman Sea at Coffs Harbour
			ANTT no.	1	60180
			Tidal port no	1	60180
			GLOSS number	3	111
			AWRC Number	2	205470
			Other Ref	2	205470
			Country		Australia
			State		NSW
			Ocean		Tasman Sea / Pacific Ocean
			Catchment/River		Coffs Inner Harbour
			Site Description	2	Gauge is now located within Coffs Inner Harbour. The Inner Harbour experiences seiche waves. Originally the location of the tide gauge was at the eastern end of the outer harbour jetty, a survey in June 1987 revealed that the jetty was actually oscillating. It should be noted that the gauge was relocated to the inner harbour when construction work began on the outer harbour jetty (shortening of the jetty by approx. 90m). Gauge located in Outer Harbour till 1996 then relocated to inner Harbour at Water Police Jetty 1990 to 1996 then relocated to current location 1996 to present
Authority					
			Responsible country		
		Data Owner			
			Organisation		Office of Environment and Heritage
			Address		Level6, 10 Valentine Ave, Parramatta NSW 2124
			Contact		Martin Fitzhenry
			Phone		(02) 9895 5968
			Fax		(02) 9895 7263
			Email		Martin.Fitzhenry@environment.nsw.gov.au
			Website		www.environment.nsw.gov.au/
			Contact #2		Bruce Coates
			Phone		(02) 4904 2593
			Fax		(02) 9895 7263
			Email		Bruce.Coates@environment.nsw.gov.au
		Data Custodian			
			Organisation		Manly Hydraulics Laboratory
			Contact		Edward Couriel / Rob Jacobs
			Address		110B King St, Manly Vale, NSW 2093
			Phone		(02) 9949 0200
			Email		Edward.Couriel@mhl.nsw.gov.au / Rob/Jacobs@mhl.nsw.gov.au
			Website		www.mhl.nsw.gov.au
		Gauge Maintained by			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		Levelling			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		GLOSS			
			GLOSS contact		
			Committed to GLOSS		
			Operational		
Time Frame			Earliest Data	2	1951
			Digital Record Start	2	Aug 1996
			Record End	2	current
			Record Gaps	2	-
			Time Zone	2	AEST (GMT+10hr)
Horizontal Datum					
			Latitude	2	-30:18:10.29
			Longitude	2	+153:08:45.82
			Ref Frame (Name)	2	GDA 1994 / MGA
			Zone	2	56
			Easting	2	514044.29
			Northing	2	6647645.68
Vertical Datum					
	Current				
			Name		Coffs Port Datrum
			Date Range		Aug 1996 - current
			Gauge Datum		

			Level	2	TGZ is 0.882 below Australian Height Datum (AHD)
			Gauge Plate????	2	no
			Tide Gauge Benchmark1 -ID	2	SSM59001
			- Elevation	2	2.096 (AHD)
			Tide Gauge Benchmark2 -ID	2	BM1/C
			- Elevation	2	1.567 (AHD)
			Tide Gauge Benchmark3 -ID		
			- Elevation		
			Leveling System ???		
	Historical 1				
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevation		
			Tide Gauge Benchmark2 -ID		
			- Elevation		
			Leveling System ???		
			Comments		
		Historical 2			
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevation		
			Tide Gauge Benchmark2 -ID		
			- Elevation		
			Leveling System ???		
			Comments		
Instrumentation					
	Current				
		Instrument	Date Range	2	29/11/2012 to current
			Instrument Type	2	Radar
			Instrument (Make/Model)	2	Vega puls 61
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	30mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Datum??	2	
	Secondary Instrument		Instrument Type -B	2	Pressure sensor
			Instrument (Make/Model) -B	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Other		
	Field Validation		Method	2	observation of stilling tube attached to gauge plate or measured from site TBM
			Reolution	2	10mm
			Frequency	2	3 monthly
	Data Processing /QA		Chart reading		
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal	2	automatic threshold exceedence correction for values <-200m
			Missing data handling	2	filled where possible from 2nd sensor
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description	2	MHL WISKI database
	Historical 1				
			Date Range	2	3/4/12 to 29/11/2012
			Instrument Type	2	Pressure sensor
			Instrument (Make/Model)	2	Druck PDCR 1830
					other protocols as per current instrumentation

	Historical 2				
		Instrument			
			Date Range	2	8/1996 to 3/4/2012
			Instrument Type	2	Electromagnetic Wave Staff (EWS)
			Instrument (Make/Model)	2	Electromagnetic Wave Staff (EWS)
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	30mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	4m
			Datum??		
			Other		
		Field Validation	Method	2	observation of stilling tube attached to gauge plate or measured from site TBM
			Reolution	2	10mm
			Frequency	2	3 monthly
	Data Processing /QA		Chart reading		
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal	2	automatic threshold exceedence correction for values <-200m
			Missing data handling	2	filled where possible from 2nd sensor
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description	2	MHL WISKI database
	Historical 3				
			Date Range	2	Sep 86 - Aug 96
			Instrument Type	2	Electromagnetic Wave Staff (EWS)
			Instrument (Make/Model)	2	Electromagnetic Wave Staff (EWS)
			Recorder Type	2	Digital
			Recoder (Make/Model)		
			Sample Rate	2	1 sec
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty	2	+/- 20mm
			Range	2	4m
			Datum??		
			Other	2	A survey in June 1987 revealed that the jetty was actually oscillating. The location of the tide gauge was at the eastern end of the outer harbour jetty. It should be noted that the gauge was relocated to the inner harbour when construction work began on the outer harbour jetty (shortening of the jetty by approx. 90m). Gauge located in Outer Harbour till 1996 then relocated to inner Harbour at Water Police Jetty 1990 to 1996 then relocated to current location 1996 to present
		Field Validation	Method	*2*	*Screwdriver' short between inner and outer tubing and measured from a know level*
			Reolution		
			Frequency	2	yearly or on demand
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
		Historical 4			
			Date Range	2	1951-1952, 1953-1956, 1957-1960,1961-1964, 1966-1972, 1972-1973
			Other Information	2	Unknown.
			Other	2	combination of books containing manual High and Low tide records. Microfiche cartridges containg tidalchart traces.
		Records Location	Physical Location, Description	2	State Archives / some of the data available in MHL WISKI Database
Other Information				2	Gauge is located within Coffs Inner Harbour. The Inner Harbour experiences seiche waves,
Subsidence					
			- estimated ave rate		

			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			
			-date		
			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.		
1	NTC	ANTT
2	MHL	LO File B33 and WISKI database
3	GLOSS	website

Identification				Source	
			Station Name	2	Crookhaven
			Station identifier/number (owner)	2	Crookhaven River at Crookhaven Heads
			ANTT no.		
			Tidal port no		
			GLOSS number		
			AWRC Number	2	215471
			Other Ref		
			Country		Australia
			State		NSW
			Ocean		Tasman Sea / Pacific Ocean
			Catchment/River		Shoalhaven / Crookhaven River
			Site Description	2	Gauge is located in river approximately 500m upstream of the entrance. The river entrance is maintained open by a training wall on either side of the river.
Authority					
			Responsible country		
		Data Owner			
			Organisation		Office of Environment and Heritage
			Address		Level6, 10 Valentine Ave, Parramatta NSW 2124
			Contact		Martin Fitzhenry
			Phone		(02) 9895 5968
			Fax		(02) 9895 7263
			Email		Martin.Fitzhenry@environment.nsw.gov.au
			Website		www.environment.nsw.gov.au/
			Contact #2		Bruce Coates
			Phone		(02) 4904 2593
			Fax		(02) 9895 7263
			Email		Bruce.Coates@environment.nsw.gov.au
		Data Custodian			
			Organisation		Manly Hydraulics Laboratory
			Contact		Edward Couriel / Rob Jacobs
			Address		110B King St, Manly Vale, NSW 2093
			Phone		(02) 9949 0200
			Email		Edward.Couriel@mhl.nsw.gov.au / Rob/Jacobs@mhl.nsw.gov.au
			Website		www.mhl.nsw.gov.au
		Gauge Maintained by			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		Levelling			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		GLOSS			
			GLOSS contact		
			Committed to GLOSS		
			Operational		
Time Frame					
			Record Start	2	Mar-92
			Record End	2	current
			Record Gaps	2	5-6/1998, 3-5/2002, 1-2/2006, 6-7/2007
			Time Zone	2	AEST (GMT+10hr)
Horizontal Datum					
			Latitude	2	-34:54:19.4
			Longitude	2	+150:45:33.25
			Ref Frame (Name)	2	GDA 1994 / MGA
			Zone	2	56
			Easting	2	295273.35
			Northing	2	6135157.4
Vertical Datum					
	Current				
			Name	2	Australian Height Datum (AHD)
			Date Range	2	all data
			Gauge Datum		
			Level	2	TGZ is zero AHD
			Gauge Plate????	2	yes
			Tide Gauge Benchmark1 -ID	2	SSM119226
			- Elevatior	2	1.795 AHD

			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Tide Gauge Benchmark3 -ID		
			- Elevatior		
			Leveling System ???		
	Historical 1				
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
		Historical 2			
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
Instrumentation					
	Current				
		Instrument	Date Range	2	to current
			Instrument Type	2	Pressure sensor
			Instrument (Make/Model)	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Datum??	2	
		Secondary Instrument	Instrument Type -B	2	Pressure sensor
			Instrument (Make/Model) -B	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	30mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Other		
		Field Validation	Method	2	observation of stilling tube attached to gauge plate or measured from site TBM
			Reolution	2	10mm
			Frequency	2	3 monthly
		Data Processing /QA	Chart reading		
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal	2	automatic threshold exceedence correction for values <-200m
			Missing data handling	2	filled where possible from 2nd sensor
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description	2	MHL WISKI database
	Historical 1				
		Instrument			
			Date Range		
			Instrument Type	2	EWS decomm 6/4/2011
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		

			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Datum??		
			Other		
		Field Validation	Method		
			Reolution		
			Frequency		
		Data Processing /QA	Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
		Historical 2			
			Date Range		
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Datum??		
			Other		
		Field Validation	Method		
			Reolution		
			Frequency		
		Data Processing /QA	Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
		Historical 3			
			Date Range		
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
		Historical 4			
			Date Range		
			Instrument Type		
			Sample Rate		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
		Records Location	Physical Location, Description		
Other Information					Gauge is located in river approximately 500m upstream of the entrance. The river entrance is maintained open by a training wall on either side of the river.
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					

		Event 1			
			-date		
			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.		
1	NTC	ANTT
2	MHL	LO File D03/670 and WISKI database
3		

Identification				Source	
			Station Name	2	Crowdy Head
			Station identifier/number (owner)	2	Tasman Sea at Crowdy Head Boat Harbour
			ANTT no.	1	60235
			Tidal port no	1	60235
			GLOSS number		
			AWRC Number	2	208471 (& 208470 Fuel wharf location)
			Other Ref		
			Country		Australia
			State		NSW
			Ocean		Tasman Sea / Pacific Ocean
			Catchment/River		Crowdy Head Harbour
			Site Description	2	Gauge Located within Crowdy Head Harbour on Fishermans Wharf. The gauge was originally located on the Fuel wharf but was moved on 10/4/2013 to the Fishermans Wharf
Authority					
			Responsible country		
		Data Owner			
			Organisation		Office of Environment and Heritage
			Address		Level6, 10 Valentine Ave, Parramatta NSW 2124
			Contact		Martin Fitzhenry
			Phone		(02) 9895 5968
			Fax		(02) 9895 7263
			Email		Martin.Fitzhenry@environment.nsw.gov.au
			Website		www.environment.nsw.gov.au/
			Contact #2		Bruce Coates
			Phone		(02) 4904 2593
			Fax		(02) 9895 7263
			Email		Bruce.Coates@environment.nsw.gov.au
		Data Custodian			
			Organisation		Manly Hydraulics Laboratory
			Contact		Edward Couriel / Rob Jacobs
			Address		110B King St, Manly Vale, NSW 2093
			Phone		(02) 9949 0200
			Email		Edward.Couriel@mhl.nsw.gov.au / Rob/Jacobs@mhl.nsw.gov.au
			Website		www.mhl.nsw.gov.au
		Gauge Maintained by			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		Levelling			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		GLOSS			
			GLOSS contact		
			Committed to GLOSS		
			Operational		
Time Frame					
			Record Start	2	Jul-86
			Record End	2	current
			Record Gaps	2	2-3/1986, 12/1997, 2-3/2006, 4/2007, 10-11/2007
			Time Zone	2	AEST (GMT+10hr)
Horizontal Datum					
			Latitude	2	-31:50:19.47
			Longitude	2	+152:45:00.19
			Ref Frame (Name)	2	GDA 1994 / MGA
			Zone	2	56
			Easting	2	476350
			Northing	2	6477411
Vertical Datum					
	Current				
			Name	2	Crowdy Head Datum
			Date Range	2	all data
			Gauge Datum		
			Level	2	TGZ is 0.911m below AHD
			Gauge Plate????	2	no
			Tide Gauge Benchmark1 -ID	2	SSM59002
			- Elevatior	2	3.072 (AHD)
			Tide Gauge Benchmark2 -ID	2	SSM15291

			- Elevatior	2	2.379 (AHD)
			Tide Gauge Benchmark3 -ID		
			- Elevatior		
			Leveling System ???		
	Historical 1				
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
		Historical 2			
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
Instrumentation					
	Current				
		Instrument	Date Range	2	10/4/2013 to current
			Instrument Type	2	Radar
			Instrument (Make/Model)	2	Vega puls 61
			Recorder Type	2	digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	6m
			Datum??	2	
		Secondary Instrument	Instrument Type -B	2	Pressure sensor
			Instrument (Make/Model) -B	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	30mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Other		
		Field Validation	Method	2	observation of stilling tube attached to gauge plate or measured from site TBM
			Reolution	2	10mm
			Frequency	2	3 monthly
		Data Processing /QA	Chart reading		
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal	2	automatic threshold exceedence correction for values <-200m
			Missing data handling	2	filled where possible from 2nd sensor
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description	2	MHL WISKI database
	Historical 1				
		Instrument	Date Range	2	1/7/1986 to 10/4/2013
			Instrument Type	2	Electromagnetic Wave Staff (EWS)
			Instrument (Make/Model)	2	Electromagnetic Wave Staff (EWS)
			Recorder Type	2	digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp

			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	6m
			Datum??	2	
	Secondary Instrument		Instrument Type -B	2	Pressure sensor
			Instrument (Make/Model) -B	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	30mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Other		
	Field Validation		Method	2	observation of stilling tube attached to gauge plate or measured from site TBM
			Reolution	2	10mm
			Frequency	2	3 monthly
	Data Processing /QA		Chart reading		
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal	2	automatic threshold exceedence correction for values <-200m
			Missing data handling	2	filled where possible from 2nd sensor
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description	2	MHL WISKI database
	Historical 2				
			Date Range		
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Datum??		
			Other		
	Field Validation		Method		
			Reolution		
			Frequency		
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
Other Information				2	Gauge Located within Crowdy Head Harbour on Fuel Wharf. Tide records subject to seiching within harbour
				2	Gauge Located within Crowdy Head Harbour on Fishermans Wharf. The gauge was originally located on the Fuel wharf but was moved on 10/4/2013 to the Fishermans Wharf
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			
			-date		
			-event		
			-effect		
		Event 2			
			-date		

			-event		
			-effect		

Sources

No.		
1	NTC	ANTT
2	MHL	LO File D03/185 and WISKI database
3		

Identification				Source	
			Station Name	1	Darwin
			Station identifier/number (owner)	4	935
			ANTT no.	1	63230
			Tidal port no		
			GLOSS number	1	62
			AWRC Number		
			Other Ref	1	BoM = 014072
			Country	1	Australia
			State	1	NT
			Ocean	2	Indian
			Catchment/River		
			Site Description	1	Fort Hill Wharf (gauge previously on Stokes Hill Wharf before 1981 to 1990?)
Authority					
			Responsible country		
		Data Owner			
			Organisation	1	National Tide Centre
			Address	1	25 College Road, SA 5071
			Contact	1	Paul Davill - Data Manager
			Phone	1	08 8366 2730
			Fax	1	08 8366 2651
			Email	1	ntc@bom.gov.au
			Website	1	www.bom.gov.au/oceanography
		Gauge Maintained by			
			Organisation	4	Darwin Port Authority
			Contact		
			Address	4	GPO Box 390, Darwin, NT 0801
			Phone		
			Email		
			Website		
Time Frame					
			Record Start	1	1954
			Record End	1	Current
			Record Gaps		
			Time Zone	1	UTC
Horizontal Datum					
			Latitude	1	-12.4719 +/-3m
			Longitude	1	130.8458 +/-3m
			Ref Frame (Name)		
			Zone		
			Easting		
			Northing		
Vertical Datum					
	Current				
			Name		
			Date Range	1	13 Sept 2010 to current
			Gauge Datum	1	LAT which is 0.13m below old TGZ and 4.105m below AHD
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID	1	BM 4566 SEAFRAME sensor benchmark
			- Elevatior	1	6.374m AHD or 10.479 LAT =/-2mm
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Tide Gauge Benchmark3 -ID		
			- Elevatior		
			Leveling System ???		
	Historical 1				
			Name		
			Date Range	1	1990 - 13 Sept 2010
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments	1	Datum Changed to LAT 01:11 UTC 13-sept-2012. Data has been re-processed by adding 130mm to previous data
		Historical 2			
			Name		
			Date Range	5	1981-1990?
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID	5	BM 70/8 at corner of kitchener drive and boom shed road
			- Elevatior	5	RL +10.335 ACD (+6.360 AHD)
			Tide Gauge Benchmark2 -ID		

			- Elevatior		
			Leveling System ???		
			Comments	5	BM is 10.335 above recorder zero. AHD height of -3.975 at recorded zero, -4.105 LAT
		Historical 3			
			Name		
			Date Range	5	1957-1986
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID	5	(a) BM100 - 10 x 30mm brass block in Concrete retaining wall, height of bench marks above tide staff zero and recorder zero = 9.992 Admiralty Datum. Other Bench marks (b) NMV/G/650 and (c) NMV/G/651.
			- Elevation	5	Height of BMs above recorded zero: (a) 9.968, (b) 9.758, (c) 10.562. Height of BMs above AHD (a) 6.004, (b) 5.794, (c) 6.598
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
Instrumentation					
	Current				
		Instrument	Date Range	1	17 sept 2009 to current
			Location		
			Instrument Type	1	Telmet T320
			Instrument (Make/Model)	1	Telmet 320 RTU
			Recorder Type	1	Acoustic-in-air sensor
			Recoder (Make/Model)	1	Aquatrak NG XCR
			Sample Rate	1	1-minute (average of 60, 1-second samples) 6-minutes (weighted average of 4, 1-minute readings) Hourly (filtered with a cut-off of 2 hours)
			Averaging Protocol	1	See above. 1-minute samples are logged at the end of each minute, 6-minute centred on 0.1-hour increments
			Time Resolution	1	GPS Satellite Clock
			Vertical Resolution	1	1mm +/-
			Calibration	1	every 18 months
			Est Accuracy/Uncertainty		
			Range		
		Field Validation	Method		
			Reolution		
			Frequency		
	Data Processing /QA		Chart reading		
			Instrument Bias Correction	1	Standard deviations
			Outlier detection/removal	1	reported
			Missing data handling	1	recovered where possible
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
	Historical 1				
		Instrument			
			Date Range	1	1990 - 17 sept 2009
			Location		
			Instrument Type	1	Acoustic
			Instrument (Make/Model)	1	Sutron Logger
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate	1	6-minute samples average of 181, 1 second samples
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Other		
		Field Validation	Method		
			Reolution		
			Frequency		
	Data Processing /QA		Chart reading		as above
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
	Historical 2				
			Date Range	2	1/12/1981- circa 1990

			Location	2	Fort Hill Wharf
			Instrument Type	2	Float/stilling well
			Instrument (Make/Model)	5	PAV-C 676 Leupold and Stevens
			Recorder Type	5	Chart
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		1.15min
			Vertical Resolution		1.25m
			Calibration	5	Height and Time checked daily by Adjacent graduated pole, graduated float tape and time by "Radio TS".
			Est Accuracy/Uncertainty		
			Range		0-6.5m
			Other	5	Mean sea level above staff zero, recorder zero and height of MSL determined as +4.115 ACD (+0.140 AHD). Some surging by wave action is apparent
		Field Validation	Method	*5*	Comparison with tide pole by operator
			Reolution	5	weekly
			Frequency		
		Data Processing /QA	Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
		Historical 3			
			Date Range	2	1957-1986
			Location		Stokes Hill Wharf
			Instrument Type	2	Float/stilling well
			Instrument (Make/Model)	5	Leupold and Stevens A71
			Recorder Type	5	Graphical Strip Chart (Reversal)
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration	5	Height and time checked weekly, height checked using graduated float tape, time checked on wristwatch
			Est Accuracy/Uncertainty		
			Datum??	5	(a) BM100 - 10 x 30mm brass block in Concrete retaining wall, height of bench marks above tide staff zero and recorder zero = 9.992 Admiralty Datum. Other Bench marks (b) NMV/G/650 and (c) NMV/G/651.
			Other	5	Height of BMs above recorded zero: (a) 9.968, (b) 9.758, (c) 10.562. Height of BMs above AHD (a) 6.004, (b) 5.794, (c) 6.598
		Historical 4			
			Date Range	2	1954-1959
			Location		Fort Hill Wharf
			Instrument Type	2	Float/stilling well
			Sample Rate		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
		Records Location	Physical Location, Description		
Other Information				1	Earlier data read from analogue tide gauge traces on the hour
			Auxiliary Benchmarks	2	BM 100: 10x30mm brass block with identification tag set in concrete retaining wall at the abutment of Stokes Hill Wharf. BM 3046: top of south east corner holding down bolt on base plate of power pole at the abutment of Fort Hill Wharf. BM 3047: bolt near the tide gauge hut, Fort Hill Wharf. NTS302 NM/G/21 = Pillar = Coastal Array Primary BM BM491 Datum for AHD Heights = 28.542m AHD and 32.517m = above Chart Datum BM 4566 = SEAFRAME Sensor BM =3D 6.374m AHD and 10.349m above Chart Datum BM 4565 = 27.298m AHD and 31.273m above Chart Datum BM 4564 = 27.228m AHD and 31.203m above Chart Datum BM 4479 = 6.368m AHD and 10.343m above Chart Datum BM 4480 = 6.343m AHD and 10.318m above Chart Datum BM 4478 = 6.309m AHD and 10.284m above Chart Datum BM 4481 = 5.491m AHD and 9.466m above Chart Datum BM 4482 = 5.801m AHD and 9.776m above Chart Datum
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			
			-date		

			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.	
1	NTC
2	GLOSS
3	
4	PSMSL
5	NTC Standard files
6	Survey paper 6

Identification				Source	
			Station Name	2	Eden
			Station identifier/number (owner)	2	Tasman Sea at Eden Boat Harbour
			ANTT no.	1	60530
			Tidal port no	1	60530
			GLOSS number		
			AWRC Number	2	220470
			Other Ref		
			Country		Australia
			State		NSW
			Ocean		Tasman Sea / Pacific Ocean
			Catchment/River		Eden Harbour
			Site Description	2	Located on jetty inside Snug Cove
Authority					
			Responsible country		
		Data Owner			
			Organisation		Office of Environment and Heritage
			Address		Level6, 10 Valentine Ave, Parramatta NSW 2124
			Contact		Martin Fitzhenry
			Phone		(02) 9895 5968
			Fax		(02) 9895 7263
			Email		Martin.Fitzhenry@environment.nsw.gov.au
			Website		www.environment.nsw.gov.au/
			Contact #2		Bruce Coates
			Phone		(02) 4904 2593
			Fax		(02) 9895 7263
			Email		Bruce.Coates@environment.nsw.gov.au
		Data Custodian			
			Organisation		Manly Hydraulics Laboratory
			Contact		Edward Couriel / Rob Jacobs
			Address		110B King St, Manly Vale, NSW 2093
			Phone		(02) 9949 0200
			Email		Edward.Couriel@mhl.nsw.gov.au / Rob/Jacobs@mhl.nsw.gov.au
			Website		www.mhl.nsw.gov.au
		Gauge Maintained by			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		Levelling			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		GLOSS			
			GLOSS contact		
			Committed to GLOSS		
			Operational		
Time Frame			Earliest Data	2	1954
			Digital Record Start	2	Sep-86
			Record End	2	current
			Record Gaps	2	5/1987, 4-5/1995, 1-2/1999, 9/11/2007
			Time Zone	2	AEST (GMT+10hr)
Horizontal Datum					
			Latitude	2	-37:04:16.87
			Longitude	2	+149:54:29.55
			Ref Frame (Name)	2	GDA 1994 / MGA
			Zone	2	55
			Easting	2	758549.55
			Northing	2	5893254.78
Vertical Datum					
	Current				
			Name	2	Twofold Bay Hydro Datum
			Date Range	2	all data
			Gauge Datum	2	Twofold Bay Hydro Datum
			Level	2	TGZ is 0.924 below AHD
			Gauge Plate????	2	no
			Tide Gauge Benchmark1 -ID	2	SSM86057
			- Elevation	2	6.744 AHD
			Tide Gauge Benchmark2 -ID	2	PM28485
			- Elevation	2	9.446 AHD
			Tide Gauge Benchmark3 -ID		
			- Elevation		

			Leveling System ???		
	Historical 1				
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevation		
			Tide Gauge Benchmark2 -ID		
			- Elevation		
			Leveling System ???		
			Comments		
		Historical 2			
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevation		
			Tide Gauge Benchmark2 -ID		
			- Elevation		
			Leveling System ???		
			Comments		
Instrumentation					
	Current				
		Instrument	Date Range	2	23/3/2011 to current
			Instrument Type	2	Radar
			Instrument (Make/Model)	2	Vega puls 61
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Datum??	2	
		Secondary Instrument	Instrument Type -B	2	Pressure sensor
			Instrument (Make/Model) -B	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	30mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range		
			Other		
		Field Validation	Method	2	observation of stilling tube attached to gauge plate or measured from site TBM
			Reolution	2	10mm
			Frequency	2	3 monthly
		Data Processing /QA	Chart reading		
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal	2	automatic threshold exceedence correction for values <-200m
			Missing data handling	2	filled where possible from 2nd sensor
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description	2	MHL WISKI database
	Historical 1				
		Instrument			
			Date Range	2	stopped using EWS on 23/3/2011 replaced with radar and druck
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Datum??		

			Other		
		Field Validation	Method		
			Reolution		
			Frequency		
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
	Historical 2				
			Date Range	2	1978 - 1986
			Instrument Type	2	Fieldman (type unknown)
			Other		
		Records Location	Physical Location, Description	2	MHL WISKI Database
		Historical 3			
			Date Range	2	1954 - 1956
			Other	2	Microfiche cartridge containg tidalchart traces.
		Records Location	Physical Location, Description	2	State Archive
		Historical 4			
			Date Range		
			Instrument Type		
			Sample Rate		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
		Records Location	Physical Location, Description		
Other Information					
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			
			-date		
			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.		
1	NTC	ANTT
2	MHL	LO File T28 and WISKI database
3		

Identification				Source	
			Station Name	2	Forster
			Station identifier/number (owner)	2	Wallis Lake Entrance at Forster
			ANTT no.	1	60250
			Tidal port no	1	60250
			GLOSS number		
			AWRC Number	2	209470
			Other Ref		
			Country		Australia
			State		NSW
			Ocean		Tasman Sea / Pacific Ocean
			Catchment/River		Wallis Lake
			Site Description	2	Gauge is located in river approximately 500m upstream of the entrance. The river entrance is maintained open by a training wall on either side of the river.
Authority					
			Responsible country		
		Data Owner			
			Organisation		Office of Environment and Heritage
			Address		Level6, 10 Valentine Ave, Parramatta NSW 2124
			Contact		Martin Fitzhenry
			Phone		(02) 9895 5968
			Fax		(02) 9895 7263
			Email		Martin.Fitzhenry@environment.nsw.gov.au
			Website		www.environment.nsw.gov.au/
			Contact #2		Bruce Coates
			Phone		(02) 4904 2593
			Fax		(02) 9895 7263
			Email		Bruce.Coates@environment.nsw.gov.au
		Data Custodian			
			Organisation		Manly Hydraulics Laboratory
			Contact		Edward Couriel / Rob Jacobs
			Address		110B King St, Manly Vale, NSW 2093
			Phone		(02) 9949 0200
			Email		Edward.Couriel@mhl.nsw.gov.au / Rob/Jacobs@mhl.nsw.gov.au
			Website		www.mhl.nsw.gov.au
		Gauge Maintained by			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		Levelling			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		GLOSS			
			GLOSS contact		
			Committed to GLOSS		
			Operational		
Time Frame					
			Record Start	2	Mar-86
			Record End	2	current
			Record Gaps	2	10/11/1992
			Time Zone	2	AEST (GMT+10hr)
Horizontal Datum					
			Latitude	2	-32:10:26.36
			Longitude	2	+152:30:29.56
			Ref Frame (Name)	2	GDA 1994 / MGA
			Zone	2	56
			Easting	2	453635.6
			Northing	2	6440172.73
Vertical Datum					
	Current				
			Name	2	Forster Hydro Datum
			Date Range	2	all data
			Gauge Datum	2	xero Forster Hydro Datum
			Level	2	TGZ is 1.061m below AHD
			Gauge Plate????	2	no
			Tide Gauge Benchmark1 -ID	2	SSM 57816
			- Elevatior	2	3.366 FHD
			Tide Gauge Benchmark2 -ID	2	SSM57816

			- Elevatior	2	2.305 AHD
			Tide Gauge Benchmark3 -ID		
			- Elevatior		
			Leveling System ???		
	Historical 1				
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
		Historical 2			
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
Instrumentation					
	Current				
		Instrument	Date Range	2	22/2/2011 to current
			Instrument Type	2	Pressure sensor
			Instrument (Make/Model)	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	30mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Datum??		
		Secondary Instrument	Instrument Type -B	2	Pressure sensor
			Instrument (Make/Model) -B	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	30mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Other		
		Field Validation	Method	2	observation of stilling tube attached to gauge plate or measured from site TBM
			Reolution	2	10mm
			Frequency	2	3 monthly
		Data Processing /QA	Chart reading		
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal	2	automatic threshold exceedence correction for values <-200m
			Missing data handling	2	filled where possible from 2nd sensor
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description	2	MHL WISKI database
	Historical 1				
		Instrument			
			Date Range	2	to 22/2/2011
			Instrument Type	2	Electromagnetic Wave Staff (EWS)
			Instrument (Make/Model)	2	Electromagnetic Wave Staff (EWS)
			Recorder Type	2	digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp

			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	6m
			Datum??		
			Other		
		Field Validation	Method	2	observation of stilling tube attached to gauge plate or measured from site TBM
			Reolution	2	10mm
			Frequency	2	3 monthly
		Data Processing /QA	Chart reading		
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal	2	automatic threshold exceedence correction for values <-200m
			Missing data handling	2	filled where possible from 2nd sensor
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description	2	MHL WISKI database
		Historical 2			
			Date Range		
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Datum??		
			Other		
		Field Validation	Method		
			Reolution		
			Frequency		
		Data Processing /QA	Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
			Historical 3		
			Date Range		
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
			Historical 4		
			Date Range		
			Instrument Type		
			Sample Rate		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
		Records Location	Physical Location, Description		
Other Information				2	Gauge is located in river approximately 500m upstream of the entrance. The river entrance is maintained open by a training wall on either side of the river.
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		

Hydrodynamic Changes					
		Event 1			
			-date		
			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.		
1	NTC	ANTT
2	MHL	LO File D03/114 and WISKI database
3		

Identification				Source	
			Station Name	2	Fremantle
			Station identifier/number (owner)	2	111
			ANTT no.		
			Tidal port no		
			GLOSS number	1	53
			AWRC Number		
			Other Ref		
			Country	2	Australia
			State	2	NSW
			Ocean	2	Indian
			Catchment/River		
			Site Description	4	newer gauge was installed approx. 20m away from old gauge on end of wharf.
Authority					
			Responsible country		
		Data Owner			
			Organisation	1	Fremantle Port Authority
			Address	3	1 Cliff Street, Fremantle WA 6160
			Contact		
			Phone	3	08 9430 3555
			Fax		
			Email	3	mail@fremantleports.com.au
			Website	3	www.fremantleports.com.au
		Data Custodian			
			Organisation	2	National Tide Centre
			Contact	2	25 College Road, SA 5071
			Address	2	Paul Davill - Data Manager
			Phone	2	08 8366 2730
			Email	2	08 8366 2651
			Website	2	ntc@bom.gov.au
Time Frame					
			Record Start	1	1893
			Record End		
			Record Gaps	4	Gaps in the Bailey records include: March 1898, Oct-Dec 1899, May Aug Sept &Dec 1990, all 1902, 07, 10, 11, Jan-Jun 12, Jul-Dec 13, Jan-Mar 14, All 1926, Feb-Oct 42, Jan 43
			Time Zone	1	GMT + 8hrs
Horizontal Datum					
			Latitude	1	-32.05
			Longitude	1	115.73333
			Ref Frame (Name)		
			Zone		
			Easting		
			Northing		
Vertical Datum					
	Current				
			Name		
			Date Range	1	1897 -Onwards
			Gauge Datum	1	Tide gauge zero (TGZ) = Fremantle Low Water Datum
			Level	1	TGZ = 3.320m below NMV/F/6A
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID	1	NMV/F/6A: A Lands & Survey precise order benchmark, a brass plate set in concrete below a cover plate at the inshore corner of "A" berth landing. Replaced NMV/F/6 is 1982 when it became in accessible.
			- Elevation	4	2.598m AHD, 3.314m above recorder zero and hydrographic chart datum
			Tide Gauge Benchmark2 -ID	4	UF 61: precise order bench mark used as principle bench mark by FPA
			- Elevation	4	2.301m AHD, 3.0166m above recorder zero and hydrographic chart datum
			Tide Gauge Benchmark3 -ID		
			- Elevatior		
			Leveling System ???		
			Comments	1	Auxiliary benchmarks: FRE 53
Instrumentation					
	Current				
		Instrument	Date Range	4	17th March 1967 -current
			Location	4	Forrest Landing, Arthur Head
			Instrument Type	4	Float type
			Instrument (Make/Model)		
			Recorder Type	4	Stevens Recorder
			Recoder (Make/Model)	4	Stevens type A35
			Sample Rate		
			Averaging Protocol		
			Time Resolution		0.76cm/hr
			Vertical Resolution		0.1m/cm
			Calibration	4	Calibrated visually against tide staff

			Est Accuracy/Uncertainty		
			Range		
			Datum??		
			Other		
		Field Validation	Method	*4*	*Dip stick and wristwatch check*
			Reolution		
			Frequency	4	twice weekly
		Data Processing /QA	Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description	4	FPA
		Historical 1			
		Instrument			
			Date Range	4	10th Jan 1897 - Unknown (last noted in 1968)
			Instrument Type	4	Float type
			Instrument (Make/Model)	4	W.H. Bailey & Co Ltd
			Recorder Type	4	Bailey Recorder
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Datum??		
			Other	4	Large data gaps are present (up to a year) to at least 1943
		Secondary Instrument	Date Range	4	From 13th April 1965
			Instrument Type -B		
			Instrument (Make/Model) -B		
			Recorder Type	4	Electronic strip chart
			Recoder (Make/Model)	4	Evershed and Vignols
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Other	4	Connected to the Bailey gauge. Probably included some form of filtering before recording
		Field Validation	Method	*4*	*Height and time checked by dip stick and telecom time signal*
			Reolution	4	feet and inches (unreliable and no longer used)
			Frequency	4	every 1-2 days
		Data Processing /QA	Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description	4	FPA
		Historical 2			
			Date Range	4	1873-4 and May 1895 to December 1896
			Instrument Type	4	Visual observations
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Datum??		
			Other		
		Field Validation	Method		
			Reolution		
			Frequency		

		Data Processing /QA	Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
Other Information					
				4	Markey in 1967 measured the difference in height between the zero of the tide staff and UF61 as 3.017m, however the value 3.024m was adopted. The explaination is not evident.
				4	Tide staff is situated under the wharf and is very difficult to read and almost impossible to level to (1973).
				4	The flat bathymetry and regular strong onshore winds are likely to influence the relatively small tides
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			
			-date		
			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.	
1	GLOSS
2	PSMSL
3	Fremantle Port Authority
4	**NTC standard files**

Identification				Source	
			Station Name	2	Jervis Bay HMAS Creswell
			Station identifier/number (owner)	2	Jervis Bay at HMAS Creswell
			ANTT no.	1	60440
			Tidal port no	1	60440
			GLOSS number		
			AWRC Number	2	216470
			Other Ref		
			Country		Australia
			State		NSW
			Ocean		Tasman Sea / Pacific Ocean
			Catchment/River		Jervis Bay
			Site Description	2	Located on jetty inside HMAS Creswell boat harbour
Authority					
			Responsible country		
		Data Owner			
			Organisation		Office of Environment and Heritage
			Address		Level6, 10 Valentine Ave, Parramatta NSW 2124
			Contact		Martin Fitzhenry
			Phone		(02) 9895 5968
			Fax		(02) 9895 7263
			Email		Martin.Fitzhenry@environment.nsw.gov.au
			Website		www.environment.nsw.gov.au/
			Contact #2		Bruce Coates
			Phone		(02) 4904 2593
			Fax		(02) 9895 7263
			Email		Bruce.Coates@environment.nsw.gov.au
		Data Custodian			
			Organisation		Manly Hydraulics Laboratory
			Contact		Edward Couriel / Rob Jacobs
			Address		110B King St, Manly Vale, NSW 2093
			Phone		(02) 9949 0200
			Email		Edward.Couriel@mhl.nsw.gov.au / Rob/Jacobs@mhl.nsw.gov.au
			Website		www.mhl.nsw.gov.au
		Gauge Maintained by			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		Levelling			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		GLOSS			
			GLOSS contact		
			Committed to GLOSS		
			Operational		
Time Frame			Earliest Data	2	1914
			Digital Record Start	2	Sep-89
			Record End	2	current
			Record Gaps	2	9-10/1989, 12/2002 - 3/2003
			Time Zone	2	AEST (GMT+10hr)
Horizontal Datum					
			Latitude	2	-35:07:19.21
			Longitude	2	+150:42:27.36
			Ref Frame (Name)	2	GDA 1994 / MGA
			Zone	2	56
			Easting	2	291106.67
			Northing	2	6111022.19
Vertical Datum					
	Current				
			Name	2	Jervis Bay Chart Datum
			Date Range	2	all data
			Gauge Datum	2	Jervis Bay Chart Datum
			Level	2	TGZ is 1.070 below AHD
			Gauge Plate????	2	no
			Tide Gauge Benchmark1 -ID	2	BM89/4
			- Elevation	2	3.227 AHD
			Tide Gauge Benchmark2 -ID	2	PM170184
			- Elevation	2	3.464 AHD
			Tide Gauge Benchmark3 -ID		
			- Elevation		

			Leveling System ???		
	Historical 1				
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevation		
			Tide Gauge Benchmark2 -ID		
			- Elevation		
			Leveling System ???		
			Comments		
		Historical 2			
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevation		
			Tide Gauge Benchmark2 -ID		
			- Elevation		
			Leveling System ???		
			Comments		
Instrumentation					
	Current				
		Instrument	Date Range	2	15/6/2011 to current
			Instrument Type	2	Radar
			Instrument (Make/Model)	2	Vega puls 61
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	30mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Datum??	2	
	Secondary Instrument		Instrument Type -B	2	Pressure sensor
			Instrument (Make/Model) -B	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range		
			Other		
	Field Validation		Method	*2*	observation of stilling tube attached to gauge plate or measured from site TBM
			Reolution	2	10mm
			Frequency	2	3 monthly
	Data Processing /QA		Chart reading		
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal	2	automatic threshold exceedence correction for values <-200m
			Missing data handling	2	filled where possible from 2nd sensor
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description	2	MHL WISKI database
	Historical 1				
		Instrument			
			Date Range	2	EWS decommissioned 15/6/2011replaced with drucks till Radar installed on 24/3/2011
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		

			Datum??		
			Other		
	Field Validation		Method		
			Reolution		
			Frequency		
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
	Historical 2				
			Date Range	2	1914 - 1919
			Other	2	Books containing manual High and Low tide records only
	Records Location		Physical Location, Description	2	State Archives / some of the data available in MHL WISKI Database
		Historical 3			
			Date Range		
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
		Historical 4			
			Date Range		
			Instrument Type		
			Sample Rate		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
	Records Location		Physical Location, Description		
Other Information					
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			
			-date		
			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.		
1	NTC	ANTT
2	MHL	LO File D03/285 and WISKI database
3		

Identification				Source	
			Station Name	2	Lord Howe Island
			Station identifier/number (owner)	2	Tasman Sea at Lord Howe Island
			ANTT no.	1	57720
			Tidal port no	1	57720
			GLOSS number	3	121
			AWRC Number	2	240402
			Other Ref		
			Country		Australia
			State		NSW
			Ocean		Tasman Sea / Pacific Ocean
			Catchment/River		Tasman Sea / Pacific Ocean
			Site Description	2	Located on Jetty
Authority					
			Responsible country		
		Data Owner			
			Organisation		Office of Environment and Heritage
			Address		Level6, 10 Valentine Ave, Parramatta NSW 2124
			Contact		Martin Fitzhenry
			Phone		(02) 9895 5968
			Fax		(02) 9895 7263
			Email		Martin.Fitzhenry@environment.nsw.gov.au
			Website		www.environment.nsw.gov.au/
			Contact #2		Bruce Coates
			Phone		(02) 4904 2593
			Fax		(02) 9895 7263
			Email		Bruce.Coates@environment.nsw.gov.au
		Data Custodian			
			Organisation		Manly Hydraulics Laboratory
			Contact		Edward Couriel / Rob Jacobs
			Address		110B King St, Manly Vale, NSW 2093
			Phone		(02) 9949 0200
			Email		Edward.Couriel@mhl.nsw.gov.au / Rob/Jacobs@mhl.nsw.gov.au
			Website		www.mhl.nsw.gov.au
		Gauge Maintained by			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		Levelling			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		GLOSS			
			GLOSS contact		
			Committed to GLOSS		
			Operational		
Time Frame					
			Record Start	2	Aug-94
			Record End	2	current
			Record Gaps	2	9-11/2007, 2-3/2008, 4-5/2008
			Time Zone	2	AEST (GMT+10:30hr)
Horizontal Datum					
			Latitude	2	-31:31:24.96
			Longitude	2	+159:03:30.24
			Ref Frame (Name)	2	GDA 1994 / MGA
			Zone	2	57
			Easting	2	5924427.23
			Northing	2	4864084.38
Vertical Datum					
	Current				
			Name	2	Lord Howe Island Hydro Datum
			Date Range	2	all data
			Gauge Datum	2	Twofold Bay Hydro Datum
			Level	2	TGZ is 0.144 above Local AHD
			Gauge Plate????	2	yes
			Tide Gauge Benchmark1 -ID	2	PSM1084
			- Elevatior	2	7.680m AHD
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Tide Gauge Benchmark3 -ID		

			- Elevatior		
			Leveling System ???		
	Historical 1				
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
		Historical 2			
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
Instrumentation					
	Current				
		Instrument	Date Range	2	20/6/2012 to current
			Instrument Type	2	Radar
			Instrument (Make/Model)	2	Vega puls 61
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	30mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Datum??	2	
	Secondary Instrument		Instrument Type -B	2	Pressure sensor
			Instrument (Make/Model) -B	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	30mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range		
			Other		
	Field Validation		Method	2	observation of stilling tube attached to gauge plate or measured from site TBM
			Reolution	2	10mm
			Frequency	2	3 monthly
	Data Processing /QA		Chart reading		
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal	2	automatic threshold exceedence correction for values <-200m
			Missing data handling	2	filled where possible from 2nd sensor
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description	2	MHL WISKI database
	Historical 1				
		Instrument			
			Date Range	2	stopped using Floatwell on 20/6/2012 replaced with radar and druck
			Instrument Type	2	Floatwell
			Instrument (Make/Model)		
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm

			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	4m
			Datum??		
			Other		
		Field Validation	Method	2	observation of stilling tube attached to gauge plate or measured from site TBM
			Reolution	2	10mm
			Frequency	2	3 monthly
	Data Processing /QA		Chart reading		
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal	2	automatic threshold exceedence correction for values <-200m
			Missing data handling	2	filled where possible from 2nd sensor
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description	2	MHL WISKI database
	Historical 2				
			Date Range		
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Datum??		
			Other		
		Field Validation	Method		
			Reolution		
			Frequency		
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
		Historical 3			
			Date Range		
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
		Historical 4			
			Date Range		
			Instrument Type		
			Sample Rate		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
		Records Location	Physical Location, Description		
Other Information				2	Significant variation from predicted tide occurs at this site indicating 2-3monthly time scale events occuring that are outside astronomical predictions. Possibly EAC effects
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					

		Event 1			
			-date		
			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.		
1	NTC	ANTT
2	MHL	LO File D03/646 and WISKI database
3	GLOSS	Website

Identification				Source	
			Station Name	1	Newcastle
			Station identifier/number (owner)	2	320
			ANTT no.		
			Tidal port no	1	60310
			GLOSS number		
			AWRC Number		
			Other Ref		
			Country	1	Australia
			State	1	NSW
			Ocean	1	Pacific
			Catchment/River	1	Hunter River
			Site Description	1	western end of the pilot station jetty, approximately 1.5km inside the breakwater entrance to the Hunter River.
Authority					
			Responsible country		
		Data Owner			
			Organisation	1	Newcastle Port Corporation
			Address	1	Street Address Cnr Scott & Newcomen Sts, Newcastle NSW
			Contact	1	Dave Connors
			Phone	1	02 4985 8222
			Fax	1	Fax 02 4925 0600
			Email	1	mail@newportcorp.com.au
			Website	1	www.newportcorp.com.au
Time Frame					
			Record Start	1	Paper: April 1925 -May 1992 (various gauges)
				1	Digital: May 1992 - present (Various gauges)
			Record End		
			Record Gaps		
			Time Zone	1	AEST
Horizontal Datum					
			Latitude	1	32' 55' 26.4" (primary)
			Longitude	1	-151' 47' 18.9" (primary)
			Ref Frame (Name)		
			Zone	1	Map Number: 9232-2-S
			Easting	1	386734
			Northing	1	6356488
Vertical Datum					
	Current				
			Name		
			Date Range		
			Gauge Datum		
			Level	1	Tide gauge zero is at RL -1.009 AHD
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID	1	PM 60000 also known as BM No 1
			- Elevatior	1	3.258 AHD
			Tide Gauge Benchmark2 -ID	1	TBM2 - Aluminium plug in concrete kerb opposite 4th light west of pilot station entrance gate
			- Elevatior	1	2.299 AHD
			Tide Gauge Benchmark3 -ID	3	BM 1/H triangle cut in concrete beside the pilot station tide gauge well housing
			- Elevatior	3	2.214 AHD
			Leveling System ???		
	Historical 1				
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID	3	PM 5634 in the footpath of Watt Street, near BM No 1, established 1964, disturbed by roadworks in 1987
			- Elevatior	3	2.232 AHD
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
		Historical 2			
			Name		
			Date Range	4	1946
			Level	4	BM No.1 14feet above tide gauge zero
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID	4	BM No.1
			- Elevatior		
Instrumentation					
	Current				
		Instrument	Date Range	1	2002- present
			Instrument Type	1	Float activated
			Instrument (Make/Model)	1	Unidata 6541C

			Recorder Type	1	rotary encoder
			Recoder (Make/Model)		
			Sample Rate	1	6 times per minute
			Averaging Protocol	1	linear average of 6 readings
			Time Resolution		
			Vertical Resolution	1	+/- 1mm
			Calibration	1	annually
			Est Accuracy/Uncertainty	1	0.01m height (st dev)
			Range		
			Datum??		
	Secondary Instrument		Instrument Type -B	1	Radar - Water level measurement
			Instrument (Make/Model) -B	1	VegaPuls 62
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate	1	6 times per minute
			Averaging Protocol	1	linear average of 6 readings
			Time Resolution		
			Vertical Resolution	1	+/- 2mm
			Calibration	1	annually
			Est Accuracy/Uncertainty	1	0.01m height (st dev)
			Range		
			Other	1	This gauge September 2008 to present
	Field Validation		Method	*1*	*water level checks*
			Reolution		
			Frequency	1	weekly
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal	1	filtering process used whereby 10 second raw data points are collected into a 1 minute array and a standard deviation approach is used to reject outliers. Daily tide plots are produced where further gross errors are visually checked for and removed.
			Missing data handling	1	Breaks in the data are replaced with secondary gauge information if required.
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
	Historical 1				
		Instrument			
			Date Range	3	4 January 1991 - unknown
			Instrument Type	3	Acoustic
			Instrument (Make/Model)	3	Sonar Research and Development
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Datum??		tide staff zero = -1.010 AHD (levelled 1993)
			Other		
	Field Validation		Method	*3*	*time check: operators watch set to standard time via Telecom, Height checked visually against tide staff outside the boat dock*
			Reolution	3	tide staff graduations = 1cm,
			Frequency	3	time checked daily, height checked at least 3 times per week
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
	Historical 2				
			Date Range	3	30 August 1985 - mid 1991
			Instrument Type	3	Float
			Instrument (Make/Model)	3	Munro IH 109 Water Level Recorder
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration	3	calibrated by quarter hourly readings on tide staves located outside and inside the pilot station boat dock
			Est Accuracy/Uncertainty		
			Range		

			Datum??	3	tide staff zero = -1.012 (outer), -1.005 (Inner) (levelled december 1990). Recorder zero = -1.010 (nominal)
			Other		Problems with the clock were improved in 1989, but still had timing errors of up to 5min
	Field Validation		Method	*3*	*checked against tide staffs and operators watch*
			Reolution	3	1cm tide staff graduations
			Frequency	3	Monday to Friday, often twice daily
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
		Historical 3			
			Date Range	3	November 1971 - circa 1984
			Instrument Type	3	Mechanical cloack/float portable gauge
			Instrument (Make/Model)	3	E. Esdaile & Sons Pty Limited (manufactured 1938)
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration	3	annually
			Est Accuracy/Uncertainty		
			Datum??		
			Other	3	gauge mounted on eastern end of the former passenger ferry wharf at State Dockyard Berth No. 2. Wharf is scheduled to be demolished (around 1984)
		Historical 4			
			Date Range	4	August 1956 - unknown
			Location	4	Kings Wharf (presumabaly the wharf nearest Nobby's Beach Reserve), it is likely that the guage was moved
			Instrument Type		chart recorder
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
		Historical 5			
			Date Range	4	prior to 1946 - August 1956
			Location	4	"in boat harbour" - Pilot station
			Instrument Type		chart recorder
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
Other Information					
				3	Benchmark values available before and after 28/12/89 earthquake.
				4	Check the paper "The Port of Newcastle and Hydrographic Surveying" P.Blume (1972) 15th Survey Congress
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
				3	For further investigation: Check the movement of benchmarks from 1970 - 96 in 'Tide Gauge Calibration Bench Mark Values' in img-X16152039.pdf
				4	possibly 7mm subsidence due to blasting for the port expansion
Hydrodynamic Changes					
		Event 1			
			-date		
			-event		

			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.	
1	NTC metadata
2	PSMSL
3	NTC Standard files
4	NSW State A 6-3929

Identification				Source	
			Station Name	2	Norfolk Island
			Station identifier/number (owner)	2	Tasman Sea at Norfolk Island
			ANTT no.	1	57700
			Tidal port no	1	57700
			GLOSS number	3	091
			AWRC Number	2	240401
			Other Ref		
			Country		Australia
			State		NSW
			Ocean		Tasman Sea / Pacific Ocean
			Catchment/River		Tasman Sea / Pacific Ocean
			Site Description	2	Located on Kingston Jetty
Authority					
			Responsible country		
		Data Owner			
			Organisation		Office of Environment and Heritage
			Address		Level6, 10 Valentine Ave, Parramatta NSW 2124
			Contact		Martin Fitzhenry
			Phone		(02) 9895 5968
			Fax		(02) 9895 7263
			Email		Martin.Fitzhenry@environment.nsw.gov.au
			Website		www.environment.nsw.gov.au/
			Contact #2		Bruce Coates
			Phone		(02) 4904 2593
			Fax		(02) 9895 7263
			Email		Bruce.Coates@environment.nsw.gov.au
		Data Custodian			
			Organisation		Manly Hydraulics Laboratory
			Contact		Edward Couriel / Rob Jacobs
			Address		110B King St, Manly Vale, NSW 2093
			Phone		(02) 9949 0200
			Email		Edward.Couriel@mhl.nsw.gov.au / Rob/Jacobs@mhl.nsw.gov.au
			Website		www.mhl.nsw.gov.au
		Gauge Maintained by			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		Levelling			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		GLOSS			
			GLOSS contact		
			Committed to GLOSS		
			Operational		
Time Frame					
			Record Start	2	Sep-94
			Record End	2	current
			Record Gaps	2	1-6/2001, 9-10/2002, 12/2004, 6-7/2006
			Time Zone	2	AEST (GMT+11:30hr)
Horizontal Datum					
			Latitude	2	-29:03:30.05
			Longitude	2	+167:57:12.67
			Ref Frame (Name)	2	GDA 1994 / MGA
			Zone	2	58
			Easting	2	787578.64
			Northing	2	6781947.87
Vertical Datum					
	Current				
			Name	2	Norfolk Island Tidal Datum
			Date Range	2	all data
			Gauge Datum	2	Norfolk Island Tidal Datum
			Level		
			Gauge Plate????	2	yes
			Tide Gauge Benchmark1 -ID	2	SSM 167258 (NITD)
			- Elevatior	2	3.573
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Tide Gauge Benchmark3 -ID		

			- Elevatior		
			Leveling System ???		
	Historical 1				
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
		Historical 2			
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
Instrumentation					
	Current				
		Instrument	Date Range	2	to current
			Instrument Type	2	Floatwell
			Instrument (Make/Model)		
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	30mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Datum??		
	Secondary Instrument		Instrument Type -B	2	Pressure sensor
			Instrument (Make/Model) -B	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range		
			Other		
	Field Validation		Method	2	observation of stilling tube attached to gauge plate or measured from site TBM
			Reolution	2	10mm
			Frequency	2	3 monthly
	Data Processing /QA		Chart reading		
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal	2	automatic threshold exceedence correction for values <-200m
			Missing data handling	2	filled where possible from 2nd sensor
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description	2	MHL WISKI database
	Historical 1				
		Instrument			
			Date Range		
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		

			Range		
			Datum??		
			Other		
		Field Validation	Method		
			Reolution		
			Frequency		
		Data Processing /QA	Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
		Historical 2			
			Date Range		
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Datum??		
			Other		
		Field Validation	Method		
			Reolution		
			Frequency		
		Data Processing /QA	Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
		Historical 3			
			Date Range		
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
		Historical 4			
			Date Range		
			Instrument Type		
			Sample Rate		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
		Records Location	Physical Location, Description		
Other Information					
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			
			-date		
			-event		
			-effect		

		Event 2			
			-date		
			-event		
			-effect		

Sources

No.		
1	NTC	ANTT
2	MHL	LO File D03/647 and WISKI database
3	GLOSS	website

Identification				Source	
			Station Name		Point Lonsdale
			Station identifier/number (owner)		
			ANTT no.		
			Tidal port no		
			GLOSS number		
			AWRC Number		
			Other Ref		
			Country		Australia
			State		VIC
			Ocean		
			Catchment/River		
			Site Description		Northern side of the Point Lonsdale Jetty
Authority					
			Responsible country		
		Data Owner			
			Organisation	1	Port of Melbourne Authority
			Address	2	Level 4, 530 Collins Street
			Contact		
			Phone	2	1300 857 662
			Fax		
			Email		
			Website	2	http://www.portofmelbourne.com/
Time Frame					
			Record Start		
			Record End		
			Record Gaps		
			Time Zone		
Horizontal Datum					
			Latitude		-38.2933
			Longitude		144.6150
			Ref Frame (Name)		
			Zone		
			Easting		
			Northing		
Vertical Datum					
	Current				
			Name		
			Date Range		
			Gauge Datum		
			Level		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Tide Gauge Benchmark3 -ID		
			- Elevatior		
	Historical 1				
			Name		
			Date Range		Feb 1991
			Level		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Comments		
		Historical 2			
			Name		
			Date Range		
			Level		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Comments		tide staff was check levelled on 31 May 1988 and reset to the correct poistion at -0.860m AHD
Instrumentation					
	Current				
		Instrument	Date Range		1994-current
			Location		
			Instrument Type		Acoustic
			Instrument (Make/Model)		PTG500
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		

			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Other		
		Field Validation	Method		
			Reolution		
			Frequency		
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
	Historical 1				
		Instrument			
			Date Range		1984-1994
			Location		
			Instrument Type		float operated, analogue
			Instrument (Make/Model)		Munro IH 109
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		-0.2 to + 2.2m
			Other		Destroyed by storms in 1994
		Field Validation	Method		*comparison with adjacent tide staff and operators watch*
			Reolution		tide staff graduations in decimetres
			Frequency		twice weekly
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
	Historical 2				
			Date Range		1962-1984
			Location		End of Point Lonsdale jetty
			Instrument Type		Floatwell
			Instrument (Make/Model)		Munro IH 40
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		-0.60 to +3.06m
			Other		Destroyed by storms in 1984
		Field Validation	Method		*actual measurement of water level inside and outside the stilling well from a BM on top of well. Comparision with operator's watch*
			Reolution		tide staff graduations in decimetres
			Frequency		weekly
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
		Historical 3			
			Date Range		1929-1962
			Location		
			Instrument Type		
			Instrument (Make/Model)		Kelvin tide gauge (serial 10)
			Recorder Type		

			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Datum		13.780m below the door sill of the Pt Lonsdale Lighthouse, or 0.092m below ISLW.
			Other		
	Records Location		Physical Location, Description		
Other Information					
					Affected by wave setup and a strong rip current through the heads. Presumably there is a hydraulic gradient across the entrance through the mid tide. 45min seiche from Port Phillip Bay is also apparent in the record.
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			
			-date		
			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.	
1	NTC Standard files
2	Port of Melbourne Authority
3	

Identification				Source	
			Station Name	1	Port Adelaide (Inner)
			Station identifier/number (owner)		
			ANTT no.		
			Tidal port no		
			GLOSS number		
			AWRC Number		
			Other Ref		
			Country	1	Australia
			State	1	SA
			Ocean		
			Catchment/River		
			Site Description	1	tide gauge hut and board gauge are located at edge of wharf near fuel shed
Authority					
			Responsible country		
		Data Owner			
			Organisation	3	Flinders Ports (previously Dept. Of Marine and Harbours)
			Address	2	296 St Vincent Street, Port Adelaide, SA 5015
			Contact		Greg Pearce 8447 0657
			Phone	2	08 8447 0611
			Fax	2	08 8447 0606
			Email	2	flindersports@flindersports.com.au
			Website	2	www.flindersports.com.au
		Data Custodian			
			Organisation	1	National Tide Centre
			Contact	1	Paul Davill - Data Manager
			Address	1	25 College Road, SA 5071
			Phone	1	08 8366 2730
			Email	1	ntc@bom.gov.au
			Website	1	www.bom.gov.au/oceanography
Time Frame					
			Record Start	1	1880
				1	Continuous records available from 1917 onwards
			Record End	5	current
			Record Gaps		
			Time Zone		
Horizontal Datum					
			Latitude		34'51' S
			Longitude		138'30'E
			Ref Frame (Name)		
			Zone		
			Easting		
			Northing		
Vertical Datum					
			Name	5	27/04/2011
			Date Range	5	unknown
			Gauge Datum	5	Chart Datum (2001)
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID	5	Bolt (nut) set in wall of Signal Station
			- Elevatior	5	+ 5.984 metres +/- 2mm above Chart Datum (2001)
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Tide Gauge Benchmark3 -ID		
			- Elevatior		
	Historical 1				
			Name		
			Date Range	6	2007
			Gauge Datum	6	Chart Datum (2001) - approx LAT
			Level		
			Tide Gauge Benchmark1 -ID	6	PSMP 6628/36025
			- Elevatior	6	2.640 AHD
			Tide Gauge Benchmark2 -ID	6	Hilti in centre of No 25 berth dolphin
			- Elevatior	6	2.717 AHD
			Tide Gauge Benchmark3 -ID		
			- Elevatior		
	Historical 2				
			Name		
			Date Range		2001
			Gauge Datum	1	Chart Datum (2001) - approx LAT
			Level	1	-1.450 inferred from outer harbour adjustment
			Tide Gauge Benchmark1 -ID	1	Iron rail bedded in rock near gauge in Glanville Dockyard (probably PSMP 6628/36025)
			- Elevatior	1	2.165 AHD
			Tide Gauge Benchmark2 -ID		

			- Elevatior		
			Tide Gauge Benchmark3 -ID		
			- Elevatior		
	Historical 3				
			Name		
			Date Range		1971, 1974, 1991
			Gauge Datum	1	Hydrographic Chart Datum - Port Adelaide Low Water Datum
			Level	1	zero of gauge is -1.683m AHD
			Tide Gauge Benchmark1 -ID	1	Dept. Of Marine and Harbours TGBM - railway rail in conc. At south end of plant shed
			- Elevation	1	2.170m AHD (3.853m above zero of gauge) in 1974 2.165m AHD in 1991
			Tide Gauge Benchmark2 -ID	1	NMV/E/52 - brass rod in conc. At NE corner of Plant shed inside dockyard
			- Elevatior	1	2.829m AHD (4.512m above zero of gauge)
			Tide Gauge Benchmark3 -ID	1	NMV/E/53 - brass rod in conc. At NW corner of building on eastern side of entrance to dockyard
			- Elevatior	1	2.810m AHD (4.493m above zero of gauge)
Instrumentation					
	Current				
		Instrument	Date Range	5	21/10/10- Current;
			Description	5	Gauge moved from temporary location at 25 berth, Inner Harbor to 17 berth, Inner Harbor
			Latitude	5	34 50.16 +/-3m
			Longitude	5	138 30.53 +/-3m
			Instrument Type	5	Acoustic
			Instrument (Make/Model)	5	Siemans Probe
			Recorder Type	5	Digital
			Recoder (Make/Model)	5	Bruttour Ceetide
			Sample Rate	5	5min
			Averaging Protocol	5	60 x 1second samples for the minute before the timestamp
			Time Resolution	5	<second. 15 second drift per month. Clock reset monthly
			Vertical Resolution	5	0.001m
			Calibration	5	Prior to deployment and as required
			Est Accuracy/Uncertainty	5	0.03m Standard Deviation
			Range		
		Field Validation	Method	5	Visual check
			Reolution		
			Frequency	5	Annually
		Data Processing /QA	Chart reading		-
			Instrument Bias Correction		-
			Outlier detection/removal	5	By comparison with the prediction
			Missing data handling	5	Left as missing data
			Time stretching? -charts	5	n/a
			Other		
		Records Location	Physical Location, Description		
	Historical 1				
		Instrument	Date Range	6	Feb 1998 - 21/10/10
			Description	6	Temporary location at berth 25 inner harbour
			Latitude	6	34 49 46.6
			Longitude	6	138 30 38.7
			Instrument Type	6	Acoustic
			Instrument (Make/Model)	6	Bruttour Ceetide
			Recorder Type	6	Digital
			Recoder (Make/Model)	6	Bruttour Ceetide
			Sample Rate	6	5min
			Averaging Protocol	6	60 x 1second samples for the minute before the timestamp
			Time Resolution	6	<second. 15 second drift per month. Clock reset monthly
			Vertical Resolution	6	0.001m
			Calibration	6	Prior to deployment and as required
			Est Accuracy/Uncertainty	6	+/- 0.05% of full range
			Range		
		Field Validation	Method	6	Visual check
			Reolution		
			Frequency	6	Annually
		Data Processing /QA	Chart reading		-
			Instrument Bias Correction		-
			Outlier detection/removal	6	By comparison with the prediction
			Missing data handling	6	Left as missing data
			Time stretching? -charts	6	n/a
			Other		
		Records Location	Physical Location, Description		
	Historical 2				

		Instrument			
			Date Range	1	3/03/1982 - Feb 1998
			Location	1	Berth 17
			Instrument Type	1	Float
			Instrument (Make/Model)	1	Leupold & Stevens A71
			Recorder Type	1	Strip Chart
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range	1	-.5m to 4.5m
			Other		
		Field Validation	Method	*1*	*daily check against board gauge and operator's watch*
			Reolution		
			Frequency	1	daily
		Data Processing /QA	Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
		Historical 3			
			Date Range	1	14/05/1962 - 3/03/1982
			Instrument Type	1	Float
			Instrument (Make/Model)	1	Leupold & Stevens Type A35
			Recorder Type	1	Strip Chart
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		3cm = 1hr
			Time Resolution		1cm = 0.1m
			Vertical Resolution		
			Calibration	1	Calibrated over 25 hours against board gauge
			Est Accuracy/Uncertainty		
			Range	1	-0.5m to 4.5m
			Other		10in float, 12 inch well, 3off 3x1in slots
		Field Validation	Method	*1*	*check against board gauge and operator's watch*
			Reolution		
			Frequency	1	daily
		Data Processing /QA	Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
		Historical 4			
			Date Range	1	1880 - 14/5/1962
			Instrument Type	1	Float
			Instrument (Make/Model)	1	Sir W. Thomsons Tide Gauge No. 5 (J. White, Glasgow).
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		1 inch = 1.27hrs
			Vertical Resolution		1inch = 3feet
			Calibration		
			Est Accuracy/Uncertainty		
			Other		4 5/8 inch diam float
Other Information					
Subsidence					
			- estimated ave rate	4	Land subsidence estimated at 2.8 mm/year is associated with the central zone of depressed groundwater levels.
			- source/ref (authority)		
			Other	4	Although outside the zone of greatest land subsidence, three-quarters of the secular rise in mean sea level of 2.5–2.9 mm/year indicated by the tide gauge records can be attributed to land level changes. Hence the local sea level trend is a rise of 0.7mm/year
Hydrodynamic Changes					
		Event 1			
			-date		

			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.	
1	NTC Standard files
2	Flinders Ports
3	PCTMSL
4	**Belperio (1993)**

Identification				Source	
			Station Name	2	Port Adelaide (Outer Harbour)
			Station identifier/number (owner)	2	448
			ANTT no.	5	61600
			Tidal port no		
			GLOSS number		
			AWRC Number		
			Other Ref		
			Country	2	Australia
			State	2	SA
			Ocean		
			Catchment/River		
			Site Description	1	Tide gauge hut and board gauge are located on small jetty at SW end of main wharf at outer harbour
Authority					
			Responsible country		
		Data Owner			
			Organisation	1	Flinders Ports (previously Dept. Of Marine and Harbours)
			Address	3	296 St Vincent Street, Port Adelaide, SA 5015
			Contact		
			Phone	3	08 8447 0611
			Fax	3	08 8447 0606
			Email	3	flindersports@flindersports.com.au
			Website	3	www.flindersports.com.au
			Contact #2		
			Phone		
			Fax		
			Email		
		Data Custodian			
			Organisation	2	National Tide Centre
			Contact	1	Paul Davill - Data Manager
			Address	1	25 College Road, SA 5071
			Phone	1	08 8366 2730
			Email	1	ntc@bom.gov.au
			Website	1	www.bom.gov.au/oceanography
		Gauge Maintained by			Flinders Ports as above
			Organisation		
			Contact		
			Address		
			Phone		
			Email		
			Website		
		Levelling			
			Organisation		
			Contact		
			Address		
			Phone		
			Email		
			Website		
		GLOSS			
			GLOSS contact		
			Committed to GLOSS		
			Operational		
Time Frame					
			Record Start	2	1940
			Record End		
			Record Gaps	2	96% completeness
			Time Zone		
Horizontal Datum					
			Latitude	2	-34.779761
			Longitude	2	138.480728
			Ref Frame (Name)		
			Zone		
			Easting		
			Northing		
Vertical Datum					
	Current				
			Name		
			Date Range		
			Gauge Datum	1	zero of gauge at -1.666m AHD
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID	1	Dept of Marine and Harbours TGBM - brass coach screw in foundation of old signal tower
			- Elevatior	1	4.582m AHD (6.248m above zero of gauge)
			Tide Gauge Benchmark2 -ID	1	NMV/E/54 - brass rod in conc block near pilot launch berth

			- Elevatior	1	2.530m AHD (4.196m above zero of gauge)
			Tide Gauge Benchmark3 -ID	1	NMV/E/55 - brass rod in conc beside DMH watchman's hut
			- Elevatior	1	4.263m AHD (5.929m above zero of gauge)
			Leveling System ???		
			Comments	1	1945 MSL (365 days) = 1.494m from hourly heights for one year 1965 MSL (369 days) = 1.544m
Instrumentation					
	Current				
		Instrument	Date Range	5	Jan 1996 - current
			Location	5	End of jetty near No.1 berth Outer Harbour
			Instrument Type	5	Air Bubbler
			Instrument (Make/Model)	5	ES&S 2100P
			Recorder Type	5	Digital
			Recoder (Make/Model)	5	Mindata/Handar 4500/555
			Sample Rate	5	5 min
			Averaging Protocol	5	Average of 60 x 1second samples up to the sample time.
			Time Resolution	5	<ms
			Vertical Resolution	5	1mm
			Calibration		
			Est Accuracy/Uncertainty	5	15sec/month, 0.03m
			Range		
			Datum??		
		Field Validation	Method		
			Reolution		
			Frequency	5	Annually
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal	5	visual using Hydrotel
			Missing data handling	5	uncorrected
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
	Historical 1				
		Instrument			
			Date Range	1	19/5/1982 - unknown
			Instrument Type	1	Float
			Instrument (Make/Model)	1	
			Recorder Type	1	Chart
			Recoder (Make/Model)	1	Leupold & Stevens A35
			Sample Rate		
			Averaging Protocol		
			Time Resolution	1	1inch = 1hour
			Vertical Resolution	1	3/4inch = 1foot
			Calibration		
			Est Accuracy/Uncertainty		
			Range	1	-0.5 to 4.5m
			Datum??		
			Other		
		Field Validation	Method		visual check against board gauge
			Reolution		
			Frequency		3 times per week
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
	Historical 2				
			Date Range	1	November 1943 - 1982
			Instrument Type	1	Float
			Instrument (Make/Model)		
			Recorder Type	1	Strip Chart
			Recoder (Make/Model)	1	Ballout (Seth Thomas clock), serial #: STG 521
			Sample Rate		
			Averaging Protocol		
			Time Resolution	1	1 inch = 1 hour
			Vertical Resolution	1	3/4 inch = 1 foot
			Calibration	1	Calibrated against board gauge 25th-27th june 1973
			Est Accuracy/Uncertainty		
			Range	1	-2ft to +15ft
			Datum??		
			Other	1	Chart changed monthly, float diameter = 8 1/2 inches
		Field Validation	Method	*1*	*comparison with watch and tide board gauge*
			Reolution		

			Frequency	1	3 times per week
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
		Historical 3			
			Date Range	6	March37 - July 1941
			Instrument Type	6	Tide Books - High/Low times and heights
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
		Historical 4			
			Date Range		
			Instrument Type		
			Sample Rate		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
	Records Location		Physical Location, Description		
Other Information					
					Genally well protectd by long breakwaters, but may be subjet to setup by Sw winds.
Subsidence					
			- estimated ave rate	4	Land subsidence estimated at 2.8 mm/year is associated with the central zone of depressed groundwater levels.
			- source/ref (authority)		
			Other	4	Although outside the zone of greatest land subsidence, three-quarters of the secular rise in mean sea level of 2.5–2.9 mm/year indicated by the tide gauge records can be attributed to land level changes. Hence the local sea level trend is a rise of 0.7mm/year
Hydrodynamic Changes					
		Event 1			
			-date		
			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.	
1	NTC Station files
2	PSMSL
3	Flinders Ports
4	Belperio (1993)
5	Flinders Ports Metadata for Data Exchange
6	SA State Archives GRS 8039-2-1

Identification				Source	
			Station Name	2	Port Hacking
			Station identifier/number (owner)	2	Port Hacking at Port Hacking
			ANTT no.	1	60400
			Tidal port no	1	60400
			GLOSS number		
			AWRC Number	2	213473
			Other Ref		
			Country		Australia
			State		NSW
			Ocean		Tasman Sea / Pacific Ocean
			Catchment/River		Hacking River
			Site Description	2	Gauge Located within entrance to Port Hacking
Authority					
			Responsible country		
		Data Owner			
			Organisation		Office of Environment and Heritage
			Address		Level6, 10 Valentine Ave, Parramatta NSW 2124
			Contact		Martin Fitzhenry
			Phone		(02) 9895 5968
			Fax		(02) 9895 7263
			Email		Martin.Fitzhenry@environment.nsw.gov.au
			Website		www.environment.nsw.gov.au/
			Contact #2		Bruce Coates
			Phone		(02) 4904 2593
			Fax		(02) 9895 7263
			Email		Bruce.Coates@environment.nsw.gov.au
		Data Custodian			
			Organisation		Manly Hydraulics Laboratory
			Contact		Edward Couriel / Rob Jacobs
			Address		110B King St, Manly Vale, NSW 2093
			Phone		(02) 9949 0200
			Email		Edward.Couriel@mhl.nsw.gov.au / Rob/Jacobs@mhl.nsw.gov.au
			Website		www.mhl.nsw.gov.au
		Gauge Maintained by			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		Levelling			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		GLOSS			
			GLOSS contact		
			Committed to GLOSS		
			Operational		
Time Frame					
			Record Start	2	Nov-87
			Record End	2	current
			Record Gaps	2	6/1988 - 7/1990, 10-11/2011
			Time Zone	2	AEST (GMT+10hr)
Horizontal Datum					
			Latitude	2	-34:04:36.88
			Longitude	2	+151:08:45.89
			Ref Frame (Name)	2	GDA 1994 / MGA
			Zone	2	56
			Easting	2	328937.76
			Northing	2	6227765.23
Vertical Datum					
	Current				
			Name	2	Indian spring Low Water
			Date Range	2	all data
			Gauge Datum		
			Level	2	TGZ is 0.925m below AHD
			Gauge Plate????	2	no
			Tide Gauge Benchmark1 -ID	2	SSM35214
			- Elevatior	2	4.650 AHD
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Tide Gauge Benchmark3 -ID		

			- Elevatior		
			Leveling System ???		
	Historical 1				
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
		Historical 2			
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
Instrumentation					
	Current				
		Instrument	Date Range	2	to current
			Instrument Type	2	Electromagnetic Wave Staff (EWS)
			Instrument (Make/Model)	2	Electromagnetic Wave Staff (EWS)
			Recorder Type	2	digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	30mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	6m
			Datum??		
	Secondary Instrument		Instrument Type -B	2	Pressure sensor
			Instrument (Make/Model) -B	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Other		
	Field Validation		Method	2	observation of stilling tube attached to gauge plate or measured from site TBM
			Reolution	2	10mm
			Frequency	2	3 monthly
	Data Processing /QA		Chart reading		
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal	2	automatic threshold exceedence correction for values <-200m
			Missing data handling	2	filled where possible from 2nd sensor
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description	2	MHL WISKI database
	Historical 1				
		Instrument			
			Date Range		
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		

			Range		
			Datum??		
			Other		
		Field Validation	Method		
			Reolution		
			Frequency		
		Data Processing /QA	Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
		Historical 2			
			Date Range		
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Datum??		
			Other		
		Field Validation	Method		
			Reolution		
			Frequency		
		Data Processing /QA	Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
		Historical 3			
			Date Range		
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
		Historical 4			
			Date Range		
			Instrument Type		
			Sample Rate		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
		Records Location	Physical Location, Description		
Other Information					
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			
			-date		
			-event		
			-effect		

		Event 2			
			-date		
			-event		
			-effect		

Sources

No.		
1	NTC	ANTT
2	MHL	LO File P31 and WISKI database
3		

Identification				Source	
			Station Name	1	Port Pirie
			Station identifier/number (owner)	1	216
			ANTT no.	3	61800
			Tidal port no		
			GLOSS number		
			AWRC Number		
			Other Ref		
			Country	1	Australia
			State	1	SA
			Ocean		
			Catchment/River		
			Site Description	4	tide gauge is located in a shed at the oil berth directly east of DMH office
Authority					
			Responsible country		
		Data Owner			
			Organisation	2	Flinders Ports (previously Dept. Of Marine and Harbours)
			Address	3	296 St Vincent Street, Port Adelaide, SA 5015
			Contact		
			Phone	3	08 8447 0611
			Fax	3	08 8447 0606
			Email	3	flindersports@flindersports.com.au
			Website	3	www.flindersports.com.au
		Data Custodian			
			Organisation	1	National Tide Centre
			Contact	1	Paul Davill - Data Manager
			Address	1	25 College Road, SA 5071
			Phone	1	08 8366 2730
			Email	1	ntc@bom.gov.au
			Website	1	www.bom.gov.au/oceanography
Time Frame					
			Record Start	4	July 1917
					Register of tides (monthly) exists for oct 1898 - nov 1907 at SA state archives
			Record End		
			Record Gaps	1	99% Completeness (1941-2010)
			Time Zone		
Horizontal Datum					
			Latitude	1	-33.177644
			Longitude	1	138.01165
			Ref Frame (Name)		
			Zone		
			Easting		
			Northing		
Vertical Datum					
	Current				
			Name		
			Date Range		
			Gauge Datum	4	zero of gauge at -1.898m AHD (1973), previously -1.930m AHD (unknown epoch)
			Level		
			Tide Gauge Benchmark1 -ID	4	Arrow cut into rear doorstep of DMH office Ellen St Port Pirie
			- Elevatior	4	3.168m AHD (5.066m above zero of gauge)
			Tide Gauge Benchmark2 -ID	4	NMV/E/60 - brass rod in conc, SW foundation black of radio transmitter tower outside DMH office
			- Elevatior	4	2.858m AHD (4.756m above zero of gauge)
			Tide Gauge Benchmark3 -ID	4	NMV/E/61 - Star picket with conc collar at northern end of silos
			- Elevatior	4	3.032m AHD (4.930m above zero of gauge)
			Comments	4	difference in height between the arrow in the doorstep and the zero of the gauge is given by DMH as 5.096m
Instrumentation					
	Current				
		Instrument	Date Range		Feb 1992 - current
			Instrument Type		Air Bubbler
			Instrument (Make/Model)		ES&S 2100P
			Recorder Type		Mindata/Handar 4500/555
			Recoder (Make/Model)		
			Sample Rate		5min
			Averaging Protocol		60 x 1sec samples up to the log time
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		0.03m (st dev.)
			Range		
			Datum??		
		Field Validation	Method		
			Reolution		

			Frequency		Annually
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
	Historical 1				
		Instrument			
			Date Range	4	22/01/1982 - unknown
			Location		On the Oil Berth east of DMH office
			Instrument Type	4	Float
			Instrument (Make/Model)	4	Leupold and Stevens type A35: serial #: 32699-61
			Recorder Type	4	Strip Chart
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Datum??		
			Other		
	Field Validation		Method		
			Reolution		
			Frequency		
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
	Historical 2				
			Date Range	4	sept 1962 - unknown
			Instrument Type	4	Float
			Instrument (Make/Model)	4	Leupold and Stevens type A35, serial #: 32700-61
			Recorder Type	4	Strip Chart
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution	4	3cm on chart = 1 hour
			Vertical Resolution	4	1 cm on chart = 0.1m
			Calibration	4	Calibrated over 25 hrs (2/8/73) by visually checking every 15 mins. Inlets weren't inspected at time of calibration due to dangerous diving conditions
			Est Accuracy/Uncertainty		
			Range	4	-0.5m to +4.5m
			Datum??		
			Other	4	Chart changed every 28 days, diameter of well = 0.75m
	Field Validation		Method	*4*	*comparison with board gauge and operator's watch*
			Reolution		
			Frequency	4	3 times per week
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
		Historical 3			
			Date Range	4	2 sept 56 - 2 sept 62 uncertain. Possibly Esdaile
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		

			Est Accuracy/Uncertainty		
			Datum??		
			Other		
		Historical 4			
			Date Range	4	July 1917 to 2 sept 1956
			Instrument Type	4	Float
			Instrument (Make/Model)		
			Recorder Type	4	Chart
			Recoder (Make/Model)	4	Negretti and Zambra
			Sample Rate		
			Averaging Protocol		
			Time Resolution	4	1 hr = 1 inch
			Vertical Resolution	4	1 ft = 1 inch
			Calibration		
			Est Accuracy/Uncertainty		
			Datum??		
			Other	4	Float 4 3/4 inch diameter
		Historical 5			
			Date Range	5	1883 -1907
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type	5	Tide Books - High/Low records
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
Other Information					
				4	MSL above gauge zero determined as 1.646m (from hourly heights over 10 years from july 36 to july 45
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			
			-date		
			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.	
1	PSMSL
2	PCTMSL
3	Flinders Ports
4	NTC station files
5	SA State Archives (GRS 8420-2-2, GRS 8420-2-4, GRS 8420-2-5, GRS 8420-2-6)

Identification				Source	
			Station Name	2	Port Macquarie
			Station identifier/number (owner)	2	Hastings River at Port Macquarie
			ANTT no.	1	60220
			Tidal port no	1	60220
			GLOSS number		
			AWRC Number	2	207422
			Other Ref		
			Country		Australia
			State		NSW
			Ocean		Tasman Sea / Pacific Ocean
			Catchment/River		Hastings River
			Site Description	2	Gauge is located in river approximately 500m upstream of the entrance. The river entrance is maintained open by a training wall on either side of the river.
Authority					
			Responsible country		
		Data Owner			
			Organisation		Office of Environment and Heritage
			Address		Level6, 10 Valentine Ave, Parramatta NSW 2124
			Contact		Martin Fitzhenry
			Phone		(02) 9895 5968
			Fax		(02) 9895 7263
			Email		Martin.Fitzhenry@environment.nsw.gov.au
			Website		www.environment.nsw.gov.au/
			Contact #2		Bruce Coates
			Phone		(02) 4904 2593
			Fax		(02) 9895 7263
			Email		Bruce.Coates@environment.nsw.gov.au
		Data Custodian			
			Organisation		Manly Hydraulics Laboratory
			Contact		Edward Couriel / Rob Jacobs
			Address		110B King St, Manly Vale, NSW 2093
			Phone		(02) 9949 0200
			Email		Edward.Couriel@mhl.nsw.gov.au / Rob/Jacobs@mhl.nsw.gov.au
			Website		www.mhl.nsw.gov.au
		Gauge Maintained by			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		Levelling			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		GLOSS			
			GLOSS contact		
			Committed to GLOSS		
			Operational		
Time Frame					
			Record Start	2	Feb-86
			Record End	2	current
			Record Gaps	2	3-6 1986, 10-12 1986, 7-12 1990
			Time Zone	2	AEST (GMT+10hr)
Horizontal Datum					
			Latitude	2	-31:25:36.45
			Longitude	2	+152:54:39.54
			Ref Frame (Name)	2	GDA 1994 / MGA
			Zone	2	56
			Easting	2	491540.01
			Northing	2	6523093.83
Vertical Datum					
	Current				
			Name	2	Australian Height Datum (AHD)
			Date Range	2	all data
			Gauge Datum		
			Level	2	TGZ is zero AHD
			Gauge Plate????	2	yes
			Tide Gauge Benchmark1 -ID	2	SSM10544
			- Elevatior	2	2.399 (AHD)
			Tide Gauge Benchmark2 -ID	2	PM173977

			- Elevatior	2	2.83 (AHD)
			Tide Gauge Benchmark3 -ID	2	PM11970
			- Elevatior	2	3.262 (AHD)
			Leveling System ???		
	Historical 1				
			Name		as above
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
		Historical 2			
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
Instrumentation					
	Current				
		Instrument	Date Range	2	9/4/2013 to current
			Instrument Type	2	Radar
			Instrument (Make/Model)	2	Vega puls 61
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Datum??		
		Secondary Instrument	Instrument Type -B	2	Pressure sensor
			Instrument (Make/Model) -B	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Other		
		Field Validation	Method	2	observation of stilling tube attached to gauge plate or measured from site TBM
			Reolution	2	10mm
			Frequency	2	3 monthly
		Data Processing /QA	Chart reading		
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal	2	automatic threshold exceedence correction for values <-200m
			Missing data handling	2	filled where possible from 2nd sensor
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description	2	MHL WISKI database
	Historical 1				
		Instrument	Date Range	2	6/09 to 9/4/2013
			Instrument Type	2	Pressure sensor
			Instrument (Make/Model)	2	Druck PDCR 1830
					other protocols as per current instrumentation
	Historical 2				
		Instrument			
			Date Range	2	Dec 96 - Jun 09
			Instrument Type	2	Gas purge

			Instrument (Make/Model)	2	MHL 'Sensym'
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	MACE Hydromace 2000
			Sample Rate	2	15 minute
			Averaging Protocol		n/a
			Time Resolution		
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/- 20mm
			Range	2	3.5m
			Datum??		
			Other		
	Field Validation		Method	2	Observation of onsite tide board
			Reolution	2	10mm
			Frequency	2	8 weekly
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
	Historical 3				
			Date Range	2	May 93 - Dec 96
			Instrument Type	2	Floatwell
			Instrument (Make/Model)	2	Hydrological Services AD375 quadrature shaft encoder
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	MACE Hydromace 2000
			Sample Rate	2	15 minute
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution	2	1.0mm
			Calibration		
			Est Accuracy/Uncertainty	2	+/- 20mm
			Range		
			Datum??		
			Other		
	Field Validation		Method	2	Observation of onsite tide board
			Reolution	2	10mm
			Frequency	2	6 weekly
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
		Historical 4			
			Date Range	2	Sep 86 - May 93
			Instrument Type	2	Floatwell
			Instrument (Make/Model)	2	MHL 'Aquadata'
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	MHL 'Aquadata" digital
			Sample Rate	2	15 minute
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution	2	2.5mm
			Calibration		
			Est Accuracy/Uncertainty	2	+/- 20mm
			Datum??		
			Other		
		Historical 5			
			Date Range	1	- Sep 86
			Instrument Type	1	Hydrological Services chart
			Sample Rate	1	Chart
			Est Accuracy/Uncertainty	1	+/- 20mm
			Datum??		
			Other		
	Records Location		Physical Location, Description		
Other Information				2	Gauge is located in river approximately 500m upstream of the entrance. The river entrance is maintained open by a training wall on either side of the river.

Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			
			-date		
			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.		
1	NTC	ANTT
2	MHL	LO File D03/119 and WISKI database
3		

Identification				Source	
			Station Name	2	Port Stephens
			Station identifier/number (owner)	2	Port Stephens at Tomaree
			ANTT no.	1	60290
			Tidal port no	1	60290
			GLOSS number		
			AWRC Number	2	209471
			Other Ref		
			Country		Australia
			State		NSW
			Ocean		Tasman Sea / Pacific Ocean
			Catchment/River		Port Stephens
			Site Description	2	Site located about 500m inside entrance to Port Stephens on southern side adjacent to Yaccaba Head
Authority					
			Responsible country		
		Data Owner			
			Organisation		Office of Environment and Heritage
			Address		Level6, 10 Valentine Ave, Parramatta NSW 2124
			Contact		Martin Fitzhenry
			Phone		(02) 9895 5968
			Fax		(02) 9895 7263
			Email		Martin.Fitzhenry@environment.nsw.gov.au
			Website		www.environment.nsw.gov.au/
			Contact #2		Bruce Coates
			Phone		(02) 4904 2593
			Fax		(02) 9895 7263
			Email		Bruce.Coates@environment.nsw.gov.au
		Data Custodian			
			Organisation		Manly Hydraulics Laboratory
			Contact		Edward Couriel / Rob Jacobs
			Address		110B King St, Manly Vale, NSW 2093
			Phone		(02) 9949 0200
			Email		Edward.Couriel@mhl.nsw.gov.au / Rob/Jacobs@mhl.nsw.gov.au
			Website		www.mhl.nsw.gov.au
		Gauge Maintained by			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		Levelling			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		GLOSS			
			GLOSS contact		
			Committed to GLOSS		
			Operational		
Time Frame			Earliest record	2	1967
			Digital Record Start	2	Sep-85
			Record End	2	current
			Record Gaps	2	4-6/1989, 2-4/1990, 4-5/1998
			Time Zone	2	AEST (GMT+10hr)
Horizontal Datum					
			Latitude	2	-32:42:53.57
			Longitude	2	+152:10:56.06
			Ref Frame (Name)	2	GDA 1994 / MGA
			Zone	2	56
			Easting	2	423362.42
			Northing	2	6380025.11
Vertical Datum					
	Current				
			Name	2	Port Stephens Hydro Datum
			Date Range	2	all data
			Gauge Datum	2	zero Port Stephens Hydro Datum
			Level	2	TGZ is 0.944 below AHD
			Gauge Plate????	2	no
			Tide Gauge Benchmark1 -ID	2	TBM1
			- Elevation	2	3.341 (PSHD)
			Tide Gauge Benchmark2 -ID	2	SSM8255
			- Elevation	2	3.024 (PSHD)
			Tide Gauge Benchmark3 -ID		

			- Elevation		
			Leveling System ???		
	Historical 1				
			Name	2	as above
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevation		
			Tide Gauge Benchmark2 -ID		
			- Elevation		
			Leveling System ???		
			Comments		
		Historical 2			
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevation		
			Tide Gauge Benchmark2 -ID		
			- Elevation		
			Leveling System ???		
			Comments		
Instrumentation					
	Current				
		Instrument	Date Range	2	23/11/2010 to current
			Instrument Type	2	Radar
			Instrument (Make/Model)	2	Vega puls 61
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Datum??		
		Secondary Instrument	Instrument Type -B	2	Pressure sensor
			Instrument (Make/Model) -B	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range		
			Other		
		Field Validation	Method	2	observation of stilling tube attached to gauge plate or measured from site TBM
			Reolution	2	10mm
			Frequency	2	3 monthly
		Data Processing /QA	Chart reading		
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal	2	automatic threshold exceedence correction for values <-200m
			Missing data handling	2	filled where possible from 2nd sensor
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description	2	MHL WISKI database
	Historical 1				
		Instrument			
			Date Range	2	May 94 - Nov 10
			Instrument Type	2	Floatwell
			Instrument (Make/Model)	2	Hydrological Services AD375 quadrature shaft encoder
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	MACE Hydromace 2000
			Sample Rate	2	15 minute
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution	2	1.0mm
			Calibration		
			Est Accuracy/Uncertainty	2	+/- 20mm
			Range		

			Datum??		
			Other		
	Field Validation		Method	2	Audible dip tape down floatwell, measuring from a known level above the floatwell
			Reolution	2	10mm
			Frequency	2	6 weekly
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
	Historical 2				
			Date Range	2	Sep 85 - May 94
			Instrument Type	2	Floatwell
			Instrument (Make/Model)	2	MHL 'Shaft Encoder'
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	MHL 'Mark 1" digital
			Sample Rate	2	15 minute
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution	2	2.5mm
			Calibration		
			Est Accuracy/Uncertainty	2	+/- 20mm
			Range		
			Datum??		
			Other		
	Field Validation		Method	2	Audible dip tape down floatwell, measuring from a known level above the floatwell
			Reolution	2	10mm
			Frequency	2	6 weekly
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
		Historical 3			
			Date Range	2	1973 -1 1975
			Other	2	unknown station and instrument details
	Records Location		Physical Location, Description	2	MHL WISKI Database
		Historical 4			
			Date Range	2	1967 - 1969
			Other	2	Books containing manual High and Low tide records only. Unknown station and instrument details
	Records Location		Physical Location, Description	2	State Archives
Other Information				2	Site located about 500m inside entrance to Port Stephens on southern side adjacent to Yaccaba Head
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			
			-date		
			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.		
1	NTC	ANTT
2	MHL	LO File D03/184 and WISKI database
3		

Identification				Source	
			Station Name	1	Sydney (Fort Denison)
			Station identifier/number (owner)		
			ANTT no.	1	60370
			Tidal port no	1	60370
			GLOSS number	1	57
			AWRC Number		
			Other Ref	2	UHSLC 333, PSMSL code 680/141
			Country		Australia
			State		NSW
			Ocean		Tasman Sea / Pacific Ocean
			Catchment/River		Sydney/Parramatta
			Site Description		Fort Denison on Pinchgut Isalnd in Sydney Harbour near the city centre
Authority					
			Responsible country		
		Data Owner			
			Organisation	1	Sydney Ports Corporation
			Address	1	207 Kent Street Sydney NSW Australia
			Contact	1	Gary Batman
			Phone	1	02 9296 4668
			Fax	1	02 9296 4772
			Email	1	gbatman@sydneyports.com.au
			Website	1	http://www.sydneyports.com.au/wave/weather_original.asp
			Contact #2	1	Tony Nusco - Snr Hydro Surveyor
			Phone	1	02 9296 4997
			Fax	1	02 9296 4772
			Email	1	tnusco@sydneyports.com.au
Time Frame					
			Record Start	2	1885
				3	11 May 1866
			Record End	1	Current
			Record Gaps		
			Time Zone	1,2	AEST (GMT+10hr)
Horizontal Datum					
			Latitude	1	33° 51' 16.8"
			Longitude	1	151° 13' 32.8"
			Ref Frame (Name)		GDA94?
			Zone		56?
			Easting		
			Northing		
Vertical Datum					
	Current				
			Name	1	Zero Fort Denison
			Date Range	3	01/01/1954 - current
			Gauge Datum	1	Zero Fort Denison Tide Gauge
			Level	1	TGZ = 0.925m below Australian Height Datum (AHD)
			Tide Gauge Benchmark1 -ID	2	PM 50000 Plug in northern wall of the Department of Lands Building, Bridge Street, Sydney.
			- Elevatior	2	Tide Gauge Zero (TGZ) = 9.700m below TGBM.
				3	Tide Gauge Zero (TGZ) = 9.707m below TGBM.
			Tide Gauge Benchmark2 -ID	1,2	PM 101 (Dept. of Lands) - Brass Plug
			- Elevatior	1,2	6.647m (ZFDTG datum)
			Tide Gauge Benchmark3 -ID	1,2	PM 102 (Dept. of Lands) - Brass Plug
			- Elevatior	1,2	6.635m (ZFDTG datum)
	Historical 1				
			Name	3	Zero Fort Denison
			Date Range	3	to 01/01/1954
			Level		
			Tide Gauge Benchmark1 -ID	3	assumed to be: PM 50000 Plug in northern wall of the Department of Lands Building, Bridge Street, Sydney.
			- Elevatior	3	Tide Gauge Zero (TGZ) = 9.580m below TGBM.
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Comments	3	TGZ was lowered by 5inches on 01/01/1954
		Historical 2			
			Name	3	H.M.S. Herald mark
			Date Range	3	1857-current
			Level	3	1.903m above current TGZ
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Comments	3	Mark on the NE wall of the tower
Instrumentation					
	Current				
		Instrument	Date Range	4	2007 - current
			Instrument Type	1	SONIC WATER LEVEL SENSOR

			Instrument (Make/Model)	1	SEA RANGER, Model SR-10
			Recorder Type	1	Digital
			Recoder (Make/Model)	1	SEA RANGER, Model SR-10
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Datum??		
			Other	4	Vitel digital gauge installed in 1996 and used concurrently with the Harrison gauge until replaced by sonic water level sensor
		Field Validation	Method		
			Reolution		
			Frequency		
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
	Historical 1				
		Instrument			
			Date Range	4	1996-unknown
			Instrument Type	4	Acoustic
			Instrument (Make/Model)	4	Vetel
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate	4	1 min
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Other		
		Field Validation	Method		
			Reolution		
			Frequency	4	6 months
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
	Historical 2				
		Instrument			
			Date Range	4	June 1908 - 2007
			Instrument Type	3	Chart Recorder
			Instrument (Make/Model)	3	Harrison Recorder
			Recorder Type	3	Paper
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		Hour lines on the chart
			Vertical Resolution	3	0.1' (chart reading resolution)
			Calibration		
			Est Accuracy/Uncertainty		Chart reading reolution: 30mm (0.1') Chart printing MSL error :3-10mm Chart printing time error: 0.57% Height Scale error (due to drum-wire up to 6/6/1986): 3% Friction error: <10mm
			Range		
			Other	3	Chart Reading: 1914-1940 Hamon 1940 - 1968 CSIRO (D-MAC or Sumnagraphics) 1965 -1986 Flinders Uni.
		Field Validation	Method		
			Reolution	3	Daily from circa 1940
			Frequency		
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		

			Outlier detection/removal		
			Missing data handling	3	1914-40 <24hrs interpolated with linear residual
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
	Historical 3				
			Date Range	3	27 June 1872 -June 1914
			Instrument Type	3	Chart Recorder
			Instrument (Make/Model)	3	Russels Gauge
			Recorder Type	3	Paper
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty	3	Low waters not acurately measured due to siltationa and infilling Issues with gauge zero due to breaking of the cable (float-drum)
			Range		
			Other	3	HiLos also avilable an may provide more accurate analysis
	Field Validation		Method		
			Reolution		
			Frequency		
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
	Historical 4				
			Date Range	3	11 May 1866 - 1872
			Instrument Type	3	Chart Recorder
			Instrument (Make/Model)	3	Smalleys Gauge
			Recorder Type	3	Paper
			Recoder (Make/Model)		
			Sample Rate	3	Continuous
			Averaging Protocol		n/a
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Other	3, 4	Dismissed by Hamon and Russell as inaccurate so very little information is known. High/Low observations may provide a better data. Inaccuracy as a result of use of hempen cord between float and instrument (expands and contracts under varying conditions)
	Historical 5				
			Date Range	3	11 May 1866 to ...
			Instrument Type	3	Observations
			Sample Rate	3	High/Low
			Est Accuracy/Uncertainty		
			Other		
	Records Location		Physical Location, Description	3	Uncertain, possibly NSW Maritime as Tide Registers
Other Information					
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			
			-date		
			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.	
1	NTC Metadata from website

2 GLOSS Metadata from website
3 Hamon (1986)
4 **Files from Sydney Ports Corp.**

Identification				Source	
			Station Name	2	Sydney
			Station identifier/number (owner)	2	Sydney Port Jackson at HMAS Penguin
			ANTT no.	1	60370
			Tidal port no	1	60370
			GLOSS number		
			AWRC Number	2	213470
			Other Ref		
			Country		Australia
			State		NSW
			Ocean		Tasman Sea / Pacific Ocean
			Catchment/River		Sydney Harbour / Parrammatta River
			Site Description	2	Site located on wharf at HMAS Penguin near Middle Head
Authority					
			Responsible country		
		Data Owner			
			Organisation		Office of Environment and Heritage
			Address		Level6, 10 Valentine Ave, Parramatta NSW 2124
			Contact		Martin Fitzhenry
			Phone		(02) 9895 5968
			Fax		(02) 9895 7263
			Email		Martin.Fitzhenry@environment.nsw.gov.au
			Website		www.environment.nsw.gov.au/
			Contact #2		Bruce Coates
			Phone		(02) 4904 2593
			Fax		(02) 9895 7263
			Email		Bruce.Coates@environment.nsw.gov.au
		Data Custodian			
			Organisation		Manly Hydraulics Laboratory
			Contact		Edward Couriel / Rob Jacobs
			Address		110B King St, Manly Vale, NSW 2093
			Phone		(02) 9949 0200
			Email		Edward.Couriel@mhl.nsw.gov.au / Rob/Jacobs@mhl.nsw.gov.au
			Website		www.mhl.nsw.gov.au
		Gauge Maintained by			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		Levelling			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		GLOSS			
			GLOSS contact		
			Committed to GLOSS		
			Operational		
Time Frame					
			Record Start	2	Sep-87
			Record End	2	current
			Record Gaps	2	2/1993, 8/1993
			Time Zone	2	AEST (GMT+10hr)
Horizontal Datum					
			Latitude	2	-33:49:31.56
			Longitude	2	+151:15:30.72
			Ref Frame (Name)	2	GDA 1994 / MGA
			Zone	2	56
			Easting	2	338841.59
			Northing	2	6255835.75
Vertical Datum					
	Current				
			Name	2	Zero Camp Cove
			Date Range	2	all data
			Gauge Datum	2	zero Camp Cove
			Level	2	TGZ is 0.925 below AHD
			Gauge Plate????	2	no
			Tide Gauge Benchmark1 -ID	2	HS007
			- Elevatior	2	2.526 AHD
			Tide Gauge Benchmark2 -ID	2	SSM 20725
			- Elevatior	2	28.887
			Tide Gauge Benchmark3 -ID		

			- Elevatior		
			Leveling System ???		
	Historical 1				
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
		Historical 2			
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
Instrumentation					
	Current				
		Instrument	Date Range	2	29/2/2012 to current
			Instrument Type	2	Radar
			Instrument (Make/Model)	2	Vega puls 61
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Datum??		
	Secondary Instrument		Instrument Type -B	2	Pressure sensor
			Instrument (Make/Model) -B	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	30mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range		
			Other		
	Field Validation		Method	2	observation of stilling tube attached to gauge plate or measured from site TBM
			Reolution	2	10mm
			Frequency	2	3 monthly
	Data Processing /QA		Chart reading		
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal	2	automatic threshold exceedence correction for values <-200m
			Missing data handling	2	filled where possible from 2nd sensor
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description	2	MHL WISKI database
	Historical 1				
		Instrument			
			Date Range	2	to 20/8/2010 EWS then double drucks till Radar installed on 29/2/2012
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		

			Est Accuracy/Uncertainty		
			Range		
			Datum??		
			Other		
		Field Validation	Method		
			Reolution		
			Frequency		
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
	Historical 2				
			Date Range		
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Datum??		
			Other		
		Field Validation	Method		
			Reolution		
			Frequency		
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
		Historical 3			
			Date Range		
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
		Historical 4			
			Date Range		
			Instrument Type		
			Sample Rate		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
		Records Location	Physical Location, Description		
Other Information					
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			
			-date		
			-event		
			-effect		

		Event 2			
			-date		
			-event		
			-effect		

Sources

No.		
1	NTC	ANTT
2	MHL	LO File S64 and WISKI database
3		

Identification				Source	
			Station Name	1	Townsville
			Station identifier/number (owner)		
			ANTT no.		
			Tidal port no		
			GLOSS number		
			AWRC Number		
			Other Ref		
			Country		
			State		
			Ocean		
			Catchment/River		
			Site Description	1	Northern End of No.6 Wharf, approx 0.8km from the harbour entrance.
Authority					
			Responsible country		
		Data Owner			
			Organisation		Townsville Port Authority,
			Address		PO Box 1031, Townsville, Qld 4810, Australia
			Contact		
			Phone		
			Fax		
			Email		
			Website		
			Contact #2		
			Phone		
			Fax		
			Email		
		Data Custodian			
			Organisation		
			Contact		
			Address		
			Phone		
			Email		
			Website		
		Gauge Maintained by			
			Organisation		
			Contact		
			Address		
			Phone		
			Email		
			Website		
		Levelling			
			Organisation		
			Contact		
			Address		
			Phone		
			Email		
			Website		
		GLOSS			
			GLOSS contact		
			Committed to GLOSS		
			Operational		
Time Frame					
			Record Start		
			Record End		
			Record Gaps		
			Time Zone		
Horizontal Datum					
			Latitude	1	19deg 15.2' S
			Longitude	1	146deg 50.0' E
			Ref Frame (Name)		
			Zone		
			Easting		
			Northing		
Vertical Datum					
	Current				
			Name		
			Date Range		
			Gauge Datum		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID	1	NMV/B/309A, Brass rod in concrete footing of loading conveyor on wharf No.6
			- Elevation	1	Tide staff Zero: 6.154m (1967), 6.071 (1976), 6.063 (1983) Recorder Zero: 6.081m (1976) AHD: 4.523m

				2	Tide Gauge Zero (TGZ) = 6.379m below NMV/B/309A. TGZ = 9.025m below BM 10011. TGZ = 1.856m below Australian Height Datum (AHD).
			Tide Gauge Benchmark2 -ID	1	NMV/B/310A, Brass rod in concrete near edge of Wharf No.6
			- Elevatio		
			Tide Gauge Benchmark3 -ID	1	TBH Master BM / PSM47788 (from sept 1983) Brassrod in concrete under stell plate No 4 Wharf
			- Elevatio		
				1	Seven BM's given in the reference
			Leveling System ???		
	Historical 1				
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatio		
			Tide Gauge Benchmark2 -ID		
			- Elevatio		
			Leveling System ???		
			Comments		
		Historical 2			
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatio		
			Tide Gauge Benchmark2 -ID		
			- Elevatio		
			Leveling System ???		
			Comments		
Instrumentation					
	Current				
		Instrument	Date Range	3	27-Jun-11
			Location	3	East side of harbour (Station #100447)
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Datum??		
			Other	3	MSQ VTS gauge to be installed by late September 2011.
		Field Validation	Method		
			Reolution		
			Frequency		
		Data Processing /QA	Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
	Historical 1				
		Instrument			
			Date Range	3	1 Jan 1994 to Sep 2011
			Location	3	RO-RO Whraf (Station #055003A "Storm Surge gauge")
			Instrument Type	3	Float well
			Instrument (Make/Model)	3	Shaft encoder
			Recorder Type		Digital (Analog up to 2002)
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol	3	point samples
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty	3	0.05m
			Range		
			Chart change rate		
			Other		Wind chop is <20-30cm
		Field Validation	Method		Visual against tide pole
			Resolution		
			Frequency		

	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
			Other		
	Historical 2				
		Instrument			
			Date Range	3	1976 to 1994
			Location	3	(Station #055001A)
			Instrument Type		Float
			Instrument (Make/Model)		
			Recorder Type		Chart
			Recoder (Make/Model)		Leupold and Stephens A71 upto 15th June 1984 Mace digital recorder from 15th June 1984
			Sample Rate		
			Averaging Protocol		
			Time Resolution		10min from 15/6/84
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		up to 11.87m above gauge zero
			Chart change rate		
			Other		
	Field Validation		Method		
			Resolution		
			Frequency		
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
			Other		
	Historical 3				
		Instrument			
			Date Range	3	19 November, 1948 to 31 Dec 1993
			Location	3	Northern end of No.6 Wharf (Station #055005A)
			Instrument Type	1	Stilling well, float, drum recorder
			Instrument (Make/Model)	1	A.J. Amsler & Co, Switzerland
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution	1	19.05mm = 1hour
			Vertical Resolution	1	83.3mm= 1meter
			Calibration	1	1974, 1976 over 25hrs with visual observation against tide staff
			Est Accuracy/Uncertainty		
			Range	1	-0.6 to 4.9m
			Chart change rate	1	Weekly
			Other	1	Float Diameter= 0.283mm, Well diam =-.792m, 2 Inlets at 16mm (but with marine growth to 10mm)
	Field Validation		Method	*1*	Tape measure from sea level outside well to top of post on wharf, adopted at 5.35m above TBHdatum, and found to be 3.77m above AHD
			Resolution		
			Frequency	1	Check height and time daily except weekends and holidays
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
			Other	1	1967: Fouling of the well inlets was cleared (but no noticeable change to recordings) 1967: Small errors due to the the paper not laying flat to the drum 1976: Float wire rubbing against the the wharf, but does not seem to affect readings 1983: time errors of up to 12min per week in winter.

				3	"The original charts from 1959 - 1964 have a penciled not inked tide trace and thus were difficult to read which generated some digitizing and timing errors."
Other Information					
					located inside sheltered harbour inside the Great Barrier Reef
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			
			-date		
			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.
1
2
3

Identification				Source	
			Station Name	2	Tweed Heads
			Station identifier/number (owner)	2	Tweed River at Tweed Heads
			ANTT no.	1	60071
			Tidal port no	1	60071
			GLOSS number		
			AWRC Number	2	201470
			Other Ref		
			Country		Australia
			State		NSW
			Ocean		Tasman Sea / Pacific Ocean
			Catchment/River		Tweed River
			Site Description	2	Gauge is located in river approximately 500m upstream of the entrance. The river entrance is maintained open by a training wall on either side of the river.
Authority					
			Responsible country		
		Data Owner			
			Organisation		Office of Environment and Heritage
			Address		Level6, 10 Valentine Ave, Parramatta NSW 2124
			Contact		Martin Fitzhenry
			Phone		(02) 9895 5968
			Fax		(02) 9895 7263
			Email		Martin.Fitzhenry@environment.nsw.gov.au
			Website		www.environment.nsw.gov.au/
			Contact #2		Bruce Coates
			Phone		(02) 4904 2593
			Fax		(02) 9895 7263
			Email		Bruce.Coates@environment.nsw.gov.au
		Data Custodian			
			Organisation		Manly Hydraulics Laboratory
			Contact		Edward Couriel / Rob Jacobs
			Address		110B King St, Manly Vale, NSW 2093
			Phone		(02) 9949 0200
			Email		Edward.Couriel@mhl.nsw.gov.au / Rob/Jacobs@mhl.nsw.gov.au
			Website		www.mhl.nsw.gov.au
		Gauge Maintained by			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		Levelling			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		GLOSS			
			GLOSS contact		
			Committed to GLOSS		
			Operational		
Time Frame					
			Record Start	2	1978-1980 then from Jan 1987
			Record End	2	current
			Record Gaps	2	Nov-Dec 1990, Feb-Dec 1993, Feb 2000 to Jun 2002
			Time Zone	2	AEST (GMT+10hr)
Horizontal Datum					
			Latitude	2	-28:10:10.02
			Longitude	2	+153:32:58.71
			Ref Frame (Name)	2	GDA 1994 / MGA
			Zone	2	56
			Easting	2	553957.84
			Northing	2	6883904.37
Vertical Datum					
	Current				
			Name	2	Tweed River Hydro Datum
			Date Range	2	Jan 1987 to current
			Gauge Datum	2	zero Tweed River Hydro Datum
			Level	2	TGZ is 0.893 below Australian Height Datum (AHD)
			Gauge Plate????	2	yes
			Tide Gauge Benchmark1 -ID	2	NMV/B/412
			- Elevation	2	4.584 (TRHD)
			Tide Gauge Benchmark2 -ID	2	PWD65
			- Elevation	2	4.557 (TRHD)

			Tide Gauge Benchmark3 -ID	2	PWD64
			- Elevation	2	15.155 (TRHD)
			Leveling System ???		
	Historical 1				
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevation		
			Tide Gauge Benchmark2 -ID		
			- Elevation		
			Leveling System ???		
			Comments		
		Historical 2			
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevation		
			Tide Gauge Benchmark2 -ID		
			- Elevation		
			Leveling System ???		
			Comments		
Instrumentation					
	Current				
		Instrument	Date Range	2	25/5/2011 to current
			Instrument Type	2	Pressure sensor
			Instrument (Make/Model)	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Datum??		
		Secondary Instrument	Instrument Type -B	2	Pressure sensor
			Instrument (Make/Model) -B	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Other		
		Field Validation	Method	2	observation of stilling tube attached to gauge plate or measured from site TBM
			Reolution	2	10mm
			Frequency	2	3 monthly
		Data Processing /QA	Chart reading		
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal	2	automatic threshold exceedence correction for values <-200m
			Missing data handling	2	filled where possible from 2nd sensor
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description	2	MHL WISKI database
	Historical 1				
		Instrument			
			Date Range	2	Jun 90 - 25/5/2011
			Instrument Type	2	Electromagnetic Wave Staff (EWS)
			Instrument (Make/Model)	2	Electromagnetic Wave Staff (EWS)
			Recorder Type	2	digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	3mm

			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	6m
			Datum??		
			Other		
	Field Validation		Method		
			Reolution		
			Frequency		
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
	Historical 2				
			Date Range	2	Jan 87 - Jun 90
			Instrument Type	2	Floatwell
			Instrument (Make/Model)	2	MHL 'Shaft Encoder'
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	MHL 'Mark 1" digital
			Sample Rate	2	15 minute
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution	2	2.5mm
			Calibration		
			Est Accuracy/Uncertainty	2	+/- 20mm
			Range		
			Datum??		
			Other		
	Field Validation		Method	2	Observation of onsite tide board
			Reolution	2	10mm
			Frequency	2	6 weekly
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
		Historical 3			
			Date Range	2	circa 83 - Jan 87
			Instrument Type	2	Floatwell
			Instrument (Make/Model)	2	Fieldman 300R strip chart
			Recorder Type	2	Chart
			Recoder (Make/Model)	2	Fieldman 300R strip chart
			Sample Rate	2	Chart
			Averaging Protocol		
			Time Resolution	2	Significant time drift during deployments - in excess of 15mins
			Vertical Resolution	2	2.5mm
			Calibration		
			Est Accuracy/Uncertainty	2	+/- 20mm
			Datum??		
			Other		
		Historical 4			
			Date Range	2	Jan1978 - Dec 1980
			Instrument Type	2	Unknown
			Sample Rate		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
	Records Location		Physical Location, Description	2	MHL WISKI database
Other Information				2	Gauge is located in river approximately 500m upstream of the entrance. The river entrance is maintained open by a training wall on either side of the river.
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			
			-date		

			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.		
1	NTC	ANTT
2	MHL	LO File D03/142 and WISKI database
3		

Identification				Source	
			Station Name	2	Ulladulla
			Station identifier/number (owner)	2	Tasman Sea at Ulladulla Boat Harbour
			ANTT no.	1	60460
			Tidal port no	1	60460
			GLOSS number		
			AWRC Number	2	216471
			Other Ref		
			Country		Australia
			State		NSW
			Ocean		Tasman Sea / Pacific Ocean
			Catchment/River		Ulladulla Harbour
			Site Description	2	Located on Jetty inside Ulladulla Harbour
Authority					
			Responsible country		
		Data Owner			
			Organisation		Office of Environment and Heritage
			Address		Level6, 10 Valentine Ave, Parramatta NSW 2124
			Contact		Martin Fitzhenry
			Phone		(02) 9895 5968
			Fax		(02) 9895 7263
			Email		Martin.Fitzhenry@environment.nsw.gov.au
			Website		www.environment.nsw.gov.au/
			Contact #2		Bruce Coates
			Phone		(02) 4904 2593
			Fax		(02) 9895 7263
			Email		Bruce.Coates@environment.nsw.gov.au
		Data Custodian			
			Organisation		Manly Hydraulics Laboratory
			Contact		Edward Couriel / Rob Jacobs
			Address		110B King St, Manly Vale, NSW 2093
			Phone		(02) 9949 0200
			Email		Edward.Couriel@mhl.nsw.gov.au / Rob/Jacobs@mhl.nsw.gov.au
			Website		www.mhl.nsw.gov.au
		Gauge Maintained by			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		Levelling			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		GLOSS			
			GLOSS contact		
			Committed to GLOSS		
			Operational		
Time Frame					
			Record Start	2	Jan-08
			Record End	2	current
			Record Gaps	2	mostly complete
			Time Zone	2	AEST (GMT+10hr)
Horizontal Datum					
			Latitude	2	-35:21:27.54
			Longitude	2	+150:28:35.51
			Ref Frame (Name)	2	GDA 1994 / MGA
			Zone	2	56
			Easting	2	270710.93
			Northing	2	6084370.72
Vertical Datum					
	Current				
			Name	2	Australian Height Datum (AHD)
			Date Range	2	all data
			Gauge Datum	2	AHD
			Level	2	TGZ is zero AHD
			Gauge Plate????	2	no
			Tide Gauge Benchmark1 -ID	2	PM27335
			- Elevatior	2	6.225 AHD
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Tide Gauge Benchmark3 -ID		

			- Elevatior		
			Leveling System ???		
	Historical 1				
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
		Historical 2			
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
Instrumentation					
	Current				
		Instrument	Date Range	2	all data
			Instrument Type	2	Pressure sensor
			Instrument (Make/Model)	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	30mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Datum??		
	Secondary Instrument		Instrument Type -B	2	Pressure sensor
			Instrument (Make/Model) -B	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Other		
	Field Validation		Method	2	observation of stilling tube attached to gauge plate or measured from site TBM
			Reolution	2	10mm
			Frequency	2	3 monthly
	Data Processing /QA		Chart reading		
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal	2	automatic threshold exceedence correction for values <-200m
			Missing data handling	2	filled where possible from 2nd sensor
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description	2	MHL WISKI database
	Historical 1				
		Instrument			
			Date Range		
			Instrument Type	2	EWS in place Dec2007 but problems on site with electrical interference led to no data till replaced with Druck Jan 2008
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		

			Est Accuracy/Uncertainty		
			Range		
			Datum??		
			Other		
		Field Validation	Method		
			Reolution		
			Frequency		
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
	Historical 2				
			Date Range		
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Datum??		
			Other		
		Field Validation	Method		
			Reolution		
			Frequency		
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
		Historical 3			
			Date Range		
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
		Historical 4			
			Date Range		
			Instrument Type		
			Sample Rate		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
		Records Location	Physical Location, Description		
Other Information				2	Located on Jetty inside Ulladulla Harbour. Seiche waves occur in Harbour at times
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			
			-date		
			-event		

			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.		
1	NTC	ANTT
2	MHL	LO File EDP8-2176 and WISKI database
3		

Identification				Source	
			Station Name	1	Williamstown (Breakwater Pier)
			Station identifier/number (owner)		
			ANTT no.		
			Tidal port no		
			GLOSS number		
			AWRC Number		
			Other Ref		
			Country		
			State		
			Ocean		
			Catchment/River		
			Site Description	1	Outer end of the concrete caisson on the outer end of the Breakwater Pier
Authority					
			Responsible country		
		Data Owner			
			Organisation	1	Port of Melbourne Corporation
			Address	2	Level 4, 530 Collins Street, Melbourne, VIC 3000
			Contact		
			Phone	2	1300 857 662
			Fax	2	03 9683 1570
			Email		
			Website	2	www.portofmelbourne.com
Time Frame					
			Record Start	1	1872
			Record End		
			Record Gaps	1	Unreliable data from 1872 to sept 1943. Reliable data from sept 1949 to present.
			Time Zone		
Horizontal Datum					
			Latitude	1	-37deg 52'
			Longitude	1	144deg 55'
			Ref Frame (Name)		
			Zone		
			Easting		
			Northing		
Vertical Datum					
	Current				
			Name		
			Date Range	1	1976 - current
			Gauge Datum	1	recorder zero = -0.613m AHD (july 1987 calibration),tide staff zero = -0.540m
			Level	1	hydrographic chart datum = -0.524 by definition
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID	1	Time Ball Tower BM - DLS BM 90-N, a bench cut in the bluestone of the N corner of the Williamstown Time Ball Tower
			- Elevation	1	3.322 AHD, 3.862m above tide staff zero, 3.935 above recorder zero (July 1987 calibration)
			Tide Gauge Benchmark2 -ID	1	HSM 1410-03, Brass cap fitted to a deep driven rod (type 10 mark) with steel cover plate approx 5 metres E of the Time Ball Tower.
			- Elevation	1	2.914 AHD, 3.454m aove tide staff zero, 3.527m above recorder zero (July 1987 calibration)
			Tide Gauge Benchmark3 -ID	1	BM Bolt on Bollard - Bolt marked with cross on second bollard on the inside of the concrete caisson, opposite the dolphin mooring
			- Elevation	1	3.216 AHD, 3.756m above tide staff zero, 3.829m above recorder zero (july 1987 calibration)
			Tide Gauge Benchmark4 -ID	1	BM Bolt on Bracket - SE bolt on the bracket mounting the tide gauge shed to the end of the concrete caisson.
			- Elevation	1	3.241 AHD, 3.781m above tide staff zero, 3.854m above recorder zero (July 1987 calibration)
			Leveling System ???		
			Comments	1	1986 MSL determined (365 days) = 0.5563m above recorder zero. MSL = 0.028m AHD based on height of the tape reader used to set the recorder being 5.011m above chart datum as levelled on 1 july 1986. Tape reader levelled to be 5.007m above chart datu, on 16 July 1987
	Historical 1				
			Name		
			Date Range	1	1949 -1975
			Level	1	Recorder zero at -0.528 AHD
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID	1	MMB 14
			- Elevatior	1	2.257 AHD (2.781 above recorder zero)
			Tide Gauge Benchmark2 -ID	1	NMV/D/3
			- Elevatior	1	2.576 AHD (3.104 above recorder zero)
			Tide Gauge Benchmark3 -ID	1	MMB 15
			- Elevatior	1	1.472 AHD (2.000 above recorder zero)
			Leveling System ???		
			Comments	1	Williamstown time ball tower BM also used.
		Historical 2			

			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevatior		
			Tide Gauge Benchmark2 -ID		
			- Elevatior		
			Leveling System ???		
			Comments		
Instrumentation					
	Current				
		Instrument	Date Range	1	1991 - current
			Instrument Type	1	Acoustic
			Instrument (Make/Model)	1	Sutron/Aquatrak acoustic gauge
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Range		
			Datum??		
			Other		
		Field Validation	Method		
			Reolution		
			Frequency		
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
	Historical 1				
		Instrument			
			Date Range	1	27/2/1976 - unknown
			Location	1	North Side of Point Lonsdale jetty
			Instrument Type	1	to
			Instrument (Make/Model)	1	Leupold and Stevens A71
			Recorder Type	1	Strip Chart (chart changed weekly)
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution	1	244mm = 24 hours
			Vertical Resolution	1	100mm = 1 metre
			Calibration	1	Calibrated 16th July 1987 against permanent tide staff
			Est Accuracy/Uncertainty		
			Range	1	Not Limited
			Datum??		
			Other	1	Float diameter = 0.254m, well diameter = 0.610m Gauge originally installed on 23/7/75 on Ann Street Pier before being moved to present site on 27/2/76
		Field Validation	Method	*1*	*Precise level survey to tape reader (yearly). Graduated tape against reader (weekly). Liquid crystal clock mounted on gauge.*
			Reolution		
			Frequency	1	Year for RL of tape reader. Weekly for time and height.
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
		Records Location	Physical Location, Description		
	Historical 2				
			Date Range	1	Sept 1949 to 23 July 1975 (gauge operated at the Ann Street Pier)
			Instrument Type	1	Float
			Instrument (Make/Model)	1	Newman & Verner gauge
			Recorder Type	1	Strip Chart (changed twice weekly)
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution	1	1 inch = 4 hours
			Vertical Resolution	1	3.92 inchs = 4 feet

			Calibration	1	28-29 May 1973 visually against tide staff
			Est Accuracy/Uncertainty		
			Range	1	-5 inches to +5ft 7 inches
			Datum??		
			Other	1	Float diameter = 9 inches, well diameter = 3 feet
	Field Validation		Method	*1*	*comparison with dial gauge at change of chart. Dial gauge is checked regularly by dip stick in stilling well*
			Reolution		
			Frequency	1	twice weekly
	Data Processing /QA		Chart reading		
			Instrument Bias Correction		
			Outlier detection/removal		
			Missing data handling		
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description		
Other Information					
				1	From 1858 to sept 1949 visual observations were made from the Signal Station, Breakwater Pier
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			
			-date		
			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.	
1	NTC Station files
2	Port of Melbourne Corporation
3	

Identification				Source	
			Station Name	2	Yamba
			Station identifier/number (owner)	2	Clarence River at Yamba
			ANTT no.	1	60130
			Tidal port no	1	60130
			GLOSS number	3	101
			AWRC Number	3	204470
			Other Ref		
			Country		Australia
			State		NSW
			Ocean		Tasman Sea / Pacific Ocean
			Catchment/River		Clarence River
			Site Description	2	Gauge is located in river approximately 500m upstream of the entrance. The river entrance is maintained open by a training wall on either side of the river.
Authority					
			Responsible country		
		Data Owner			
			Organisation		Office of Environment and Heritage
			Address		Level6, 10 Valentine Ave, Parramatta NSW 2124
			Contact		Martin Fitzhenry
			Phone		(02) 9895 5968
			Fax		(02) 9895 7263
			Email		Martin.Fitzhenry@environment.nsw.gov.au
			Website		www.environment.nsw.gov.au/
			Contact #2		Bruce Coates
			Phone		(02) 4904 2593
			Fax		(02) 9895 7263
			Email		Bruce.Coates@environment.nsw.gov.au
		Data Custodian			
			Organisation		Manly Hydraulics Laboratory
			Contact		Edward Couriel / Rob Jacobs
			Address		110B King St, Manly Vale, NSW 2093
			Phone		(02) 9949 0200
			Email		Edward.Couriel@mhl.nsw.gov.au / Rob/Jacobs@mhl.nsw.gov.au
			Website		www.mhl.nsw.gov.au
		Gauge Maintained by			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		Levelling			
			Organisation		as above
			Contact		
			Address		
			Phone		
			Email		
			Website		
		GLOSS			
			GLOSS contact		
			Committed to GLOSS		
			Operational		
Time Frame			earliest data	2	1900
			Digital Record Start	2	Jul 1986
			Record End	2	current
			Record Gaps	2	Jan - Feb 1990, Dec 1995 - Feb 1996, Nov 2003 - Jan 2004
			Time Zone	2	AEST (GMT+10hr)
Horizontal Datum					
			Latitude	2	-29:25:44.51
			Longitude	2	+153:21:44.24
			Ref Frame (Name)	2	GDA 1994 / MGA
			Zone	2	56
			Easting	2	535140.44
			Northing	2	6744425.36
Vertical Datum					
	Current				
			Name	2	Iluka Port Datum
			Date Range	2	Jul 1986 to current
			Gauge Datum	2	zero Iluka Port Datum
			Level	2	TGZ is 0.895 below Australian Height Datum (AHD)
			Gauge Plate????	2	no
			Tide Gauge Benchmark1 -ID	2	BM9SS
			- Elevation	2	6.499 (IPD)
			Tide Gauge Benchmark2 -ID	2	BM1/F
			- Elevation	2	5.44 (IPD)

			Tide Gauge Benchmark3 -ID		
			- Elevation		
			Leveling System ???		
	Historical 1				
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevation		
			Tide Gauge Benchmark2 -ID		
			- Elevation		
			Leveling System ???		
			Comments		
		Historical 2			
			Name		
			Date Range		
			Level		
			Gauge Plate????		
			Tide Gauge Benchmark1 -ID		
			- Elevation		
			Tide Gauge Benchmark2 -ID		
			- Elevation		
			Leveling System ???		
			Comments		
Instrumentation					
	Current				
		Instrument	Date Range	2	21/8/2013 to current
			Instrument Type	2	Radar
			Instrument (Make/Model)	2	Vega puls 61
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	30mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Datum??		
	Secondary Instrument		Instrument Type -B	2	Pressure sensor
			Instrument (Make/Model) -B	2	Druck PDCR 1830
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	30mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	10m
			Other		
	Field Validation		Method	2	observation of stilling tube attached to gauge plate or measured from site TBM
			Reolution	2	10mm
			Frequency	2	3 monthly
	Data Processing /QA		Chart reading		
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal	2	automatic threshold exceedence correction for values <-200m
			Missing data handling	2	filled where possible from 2nd sensor
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description	2	MHL WISKI database
	Historical 1				
		Instrument			
			Date Range	2	25/5/11 to 21/8/2013
			Instrument Type	2	Pressure sensor
			Instrument (Make/Model)	2	Druck PDCR 1830
					other protocols as per current instrumentation
	Historical 2				
		Instrument			
			Date Range	2	to 25/5/2011
			Instrument Type	2	Electromagnetic Wave Staff (EWS)

			Instrument (Make/Model)	2	Electromagnetic Wave Staff (EWS)
			Recorder Type	2	Digital
			Recoder (Make/Model)	2	Campbells CR800
			Sample Rate	2	1sec
			Averaging Protocol	2	120 x 1 sec samples averaged 1min before and after 15min time stamp. 60 x 1sec samples averaged 30 seconds before and after 1min tome stamp
			Time Resolution	2	0.5 sec per month
			Vertical Resolution	2	1mm
			Calibration	2	every 2 years
			Est Accuracy/Uncertainty	2	+/-20mm
			Range	2	6m
			Datum??		
			Other		
	Field Validation		Method	*2*	observation of stilling tube attached to gauge plate or measured from site TBM
			Reolution	2	10mm
			Frequency	2	3 monthly
	Data Processing /QA		Chart reading		
			Instrument Bias Correction	2	corrected using Observer readings conducted on site visits
			Outlier detection/removal	2	automatic threshold exceedence correction for values <-200m
			Missing data handling	2	filled where possible from 2nd sensor
			Time stretching? -charts		
			Other		
	Records Location		Physical Location, Description	2	MHL WISKI database
	Historical 3				
			Date Range	2	1900 - 1904, 1909 - 1913, 1913 - 1917, 1921 - 1924, 1957 - 1958
			Other	2	Books containing manual High and Low tide records only
	Records Location		Physical Location, Description	2	State Archives
		Historical 4			
			Date Range		
			Instrument Type		
			Instrument (Make/Model)		
			Recorder Type		
			Recoder (Make/Model)		
			Sample Rate		
			Averaging Protocol		
			Time Resolution		
			Vertical Resolution		
			Calibration		
			Est Accuracy/Uncertainty		
			Datum??		
			Other		
Other Information				2	Gauge is located in river approximately 500m upstream of the entrance. The river entrance is maintained open by a training wall on either side of the river.
Subsidence					
			- estimated ave rate		
			- source/ref (authority)		
Hydrodynamic Changes					
		Event 1			
			-date		
			-event		
			-effect		
		Event 2			
			-date		
			-event		
			-effect		

Sources

No.		
1	NTC	ANTT
2	MHL	LO File D03/112 and WISKI database
3	GLOSS	website

Appendix B

Historical MHL Data

Table B1 Summary of Available Historical Data and Metadata at MHL

Coastal Region	Site Name	Gauge Location	Period of Record	Books sighted July 2011	Location	Comment
North	Tweed Regional	Breakwater	1914 – 1916	Multi site book	RJ Office	
North	Tweed Regional	Breakwater	1968 and 1971			
North	Tweed Regional	Breakwater	1978 – 1987			
North	Brunswick River	Breakwater	1983			
North	Richmond River	Breakwater	1989 - 1912	Digitised	BALLINA 1889-1912.DAT	Now in Wiski
North	Richmond River	Breakwater	1898 – 1901	Book with HILOs	RJ Office	
North	Richmond River	Breakwater	Jan1901 – Feb1905	Book with HILOs	RJ Office	
North	Richmond River	Breakwater	Mar1905 – May1909	Book with HILOs	RJ Office	
North	Richmond River	Breakwater	1914 – 1916	Multi site book	RJ Office	
North	Richmond River	Breakwater	1898 – 1916			
North	Richmond River	Breakwater	1973 – 1975		5/73 – 8/73 in WISKI Ballina decomm Level 3	
North	Richmond River	Breakwater	1979 – 1980			
North	Richmond River	Ballina	May 1959 to Jun 1963	Microfiche MC1	RJ Office	
North	Evans River	Breakwater	1964 – 1965			
North	Evans River	Breakwater	1968 – 1974			
North	Evans River	Breakwater	1978 – 1979			
North	Evans River	Breakwater	1981 – 1984			
North	Clarence River	Yamba	1900 – 1924	Digitised	YAMBA 1900-1924.DAT	Now in Wiski
North	Clarence River	Iluka	1956 – 1969	Digitised	CILUKA 1956-1969.DAT	
North	Clarence River	Breakwater	Jul1900 – Aug1904	Book with HILOs	RJ Office	
North	Clarence River	Breakwater	Jan1909 – Jun1913	Book with HILOs	RJ Office	
North	Clarence River	Breakwater	Jul1913 – Sep1917	Book with HILOs	RJ Office	
North	Clarence River	Breakwater	1914 – 1916	Multi site book	RJ Office	

Coastal Region	Site Name	Gauge Location	Period of Record	Books sighted July 2011	Location	Comment
North	Clarence River	Breakwater	1921 – 1924	Book with HILOs	RJ Office	
North	Clarence River	Breakwater	Jan1957 – Jun1957	Book with HILOs	RJ Office	
North	Clarence River	Breakwater	Jun1957 – Dec1957	Book with HILOs	RJ Office	
North	Clarence River	Breakwater	Dec1957 – May1958	Book with HILOs	RJ Office	
North	Clarence River	Breakwater	1909 – 1917			
North	Clarence River	Iluka Boat Harbour	1956 – 1962			
North	Clarence River	Iluka Boat Harbour	1979			
North	Coffs Harbour	Main harbour	1966 – 1968 1969 - 1972	3M Cartridge	RJ Office	
North	Coffs Harbour	Main harbour	Mar 1972 to May 1972 Sep 1972 to Feb 1973	3M Cartridge	RJ Office	
North	Coffs Harbour	Main harbour	Jan 61 to Dec 64	Book with HILOs	RJ Office	
North	Coffs Harbour	Main harbour	July 52 to Dec 52	Book with HILOs	RJ Office	
North	Coffs Harbour	Main harbour	Aug 51 to Feb 52	Book with HILOs	RJ Office	
North	Coffs Harbour	Main harbour	1953 to 1956 1957 to 1960	Microfiche MC1	RJ Office	
North	Coffs Harbour	Main harbour	1951 – 1983		Some in Wiski big gaps	
North	Coffs Harbour	Boat harbour	1983 – 1986			In Wiski
North	Bellinger/Kalang River	Entrance	1914 – 1916	Multi site book	RJ Office	
North	Nambucca River	Entrance	1914 – 1916	Multi site book	RJ Office	
North	Macleay River			digitised	MACLEAY 1901-1913.DAT	
North	Macleay River	Entrance	Apr1901 – Jun1905	Book with HILOs	RJ Office	
North	Macleay River	Entrance	Jan1902 – Nov1903	Book with HILOs	RJ Office	
North	Macleay River	Entrance	Jul1905 – Aug1909	Book with HILOs	RJ Office	

Coastal Region	Site Name	Gauge Location	Period of Record	Books sighted July 2011	Location	Comment
North	Macleay River	Entrance	Sep1909 – Nov1913	Book with HILOs	RJ Office	
North	Macleay River	Entrance	1914 - 1916	Multi site book	RJ Office	
Mid North	Hastings River	Breakwater	1914 – 1916	Multi site book	RJ Office	
Mid North	Hastings River	Breakwater	1978 – 1979			
Mid North	Camden Haven River	Breakwater	1914 – 1916	Multi site book	RJ Office	
Mid North	Camden Haven River	Breakwater	1951			
Mid North	Crowdy Head	Harbour	1971 – 1973			
Mid North	Crowdy Head	Harbour	1977 – 1980			
Mid North	Crowdy Head	Harbour	1983 – 1985			
Mid North	Manning River	Entrance	1914 – 1916	Multi site book	RJ Office	
Mid North	Manning River	Entrance	1980			
Mid North	Forster	Breakwater	1914 – 1916	Multi site book	RJ Office	
Mid North	Forster	Breakwater	1978			
Central	Port Stephens	Tomaree wharf	1967 – 1970	2 Books with HILOs Dec 1967 to Nov 1969	RJ Office	
Central	Port Stephens	Tomaree wharf	1973 – 1975	In Wiski	Scaling issue	
Central	Newcastle	Boat Harbour	1899-1921	digitised	NEWDIG 1899-1921.DAT	
Central	Newcastle	Breakwater	1899 – 1904			
Central	Newcastle	Breakwater	1946 – 1961			
Central	Newcastle	Breakwater	Jan1989 – Dec1902	Book with HILOs	RJ Office	
Central	Newcastle	Breakwater	Jan1903 – Jun1907	Book with HILOs	RJ Office	
Central	Newcastle	Breakwater	May1903 – Jan 1904	Book with HILOs	RJ Office	
Central	Newcastle	Breakwater	Jul1907 – Aug1911	Book with HILOs	RJ Office	
Central	Newcastle	Breakwater	Jun1909 – Jan1913	Book with HILOs	RJ Office	

Coastal Region	Site Name	Gauge Location	Period of Record	Books sighted July 2011	Location	Comment
Central	Newcastle	Breakwater	1915 – 1921	Book with HILOs	RJ Office	
Central	Newcastle	Breakwater	1946 – 1961			
Central	Newcastle	Breakwater	1968			
Central	Swansea	Breakwater	Dec 1987 – Apr 1991	Not found in Wiski		
Central	Broken Bay	Patonga wharf	1977			
Central	Broken Bay	Little Patonga wharf	1977			
Central	Pittwater	Palm Beach wharf	1975 – 1976			
Central	Pittwater	Newport wharf	1975 – 1976			
Central	Port Jackson	Fort Denison	1914, 1918, 1922			In Wiski
Central	Port Jackson	Fort Denison	1926, 1931, 1935			In Wiski
Central	Port Jackson	Fort Denison	1939, 1943			In Wiski
Central	Port Jackson	Fort Denison	1947 – 1960			In Wiski
Central	Port Jackson	Fort Denison	1962 – 1987			In Wiski
Central	Port Jackson	Fort Denison	Jan 1956 to Aug 1959	Microfiche MC1	RJ Office	In Wiski
Central	Botany Bay	Shell Point	1941 – 1942			
Central	Botany Bay	Shell Point	1948 – 1952			
Central	Port Kembla	No. 3 jetty	1957 – 1981			
Central	Port Kembla		Aug 1957 to Dec 1960 Sep 1959 to Oct 1959 Jan 1961 to May 1965	Microfiche MC1	RJ Office	
Central	Shoalhaven River	Entrance	1914 – 1916			
Central	Shoalhaven River	Entrance	1982			
Central	Crookhaven River	Entrance	1914 – 1916	Multi site book	RJ Office	
Central	Jervis Bay	HMAS Creswell	Apr1914 - Sep1919 -	Book with HILOs	RJ Office	
Central	Jervis Bay	HMAS Creswell	1914 – 1919	Digitised	JERVIS 1914-1919.DAT	In Wiski

Coastal Region	Site Name	Gauge Location	Period of Record	Books sighted July 2011	Location	Comment
Central	Jervis Bay	HMAS Creswell	1970 – 1975			
South	Ulladulla	Harbour	1967			
South	Batemans Bay	Fishermens wharf	1979			
South	Batemans Bay	Offshore	1987-88	In Wiski hourly data Aanderaa assumed location see Rep 556	WISKI (4/87 to 10/88)	
South	Moruya River	Entrance	1914 – 1916	Multi site book	RJ Office	
South	Moruya River	Entrance	Sep1951 – Feb1952	Book with HILOs	RJ Office	
South	Moruya River	Entrance	Mar1952 – Aug1952	Book with HILOs	RJ Office	
South	Moruya River	Entrance	Aug1952 – Sep1952	Book with HILOs	RJ Office	
South	Moruya River	Entrance	1951 – 1952	In Wiski (Moruya Heads) hourly data HIS WL	WISKI	
South	Wagonga River	Entrance	1971			
South	Bermagui	Harbour	1970 – 1973			
South	Merimbula	Entrance	1978 – 1979			
South	Eden	Snug Cove	Jan 1954 to Mar 1956	Microfiche MC1	RJ Office	
South	Eden	Snug Cove	1954 – 1972			
South	Eden	Snug Cove	1978 – 1986	AJ found and put in WISKI	Eden as fieldman level TS	In Wiski no QA

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