Survey and Levelling

Contents

Site Selection

The criteria set out in the establishment of the Australian Baseline Array provide a useful guide to the selection of sites for high precision tidal recording equipment. They may be found in the PCTMSL Site Specification document. Additional guidelines are given in IOC Training Manual Vol. I Section 3.1, updated in Vol II Section 2.5

The tide gauge benchmark for the SEAFRAME at Port Vila known as "Van 14", installed by the Royal Australian Navy. The benchmark is the small knob on which the hammer is resting. A raised mark at the top of the knob is the precise level. A chunk of concrete below the benchmark fell off during a recent earthquake.

Levelling Procedures

This is a topic that has undergone tremendous change in the past decade

due to improved technologies. For a thorough discussion of modern geodetic surveying procedures and definitions (including "class" as a measure of survey accuracy), the ICSM publication SP1, "Standards & Practices for Control Surveys" of 2002 is recommended. The Australian Height Datum (AHD)(see section 3.3) and related topics are defined in the Geodetic Datum of Australia "GDA Technical Manual".

A recent review of levelling for tide gauges was presented in the PCTMSL document Tide gauge survey instructions", October 2003. Topics included in this document are:

1. Work to be carried out at each site
2. Calibration of automatic recorders
3. Tide gauge details sheets
4. Bench marking
5. Levelling to the zero of tide staffs
6. Connection to the National Levelling Survey
7. Photographic record of each site
8. Plan of gauge installation
9. Discussion with owners and operators
10. Notification of PCTMSL
11. Tide gauge details form
12. Tide gauge calibration form
13. Photographic exposure record form

Procedures for establishing benchmarks for differential levelling and GPS surveys were defined in some detail in a report by the National Tidal Facility in 1992, in the early stages of the South Pacific Sea Level and Climate Monitoring Project (which used SEAFRAME stations to monitor sea level).

GEOSCIENCE AUSTRALIA
SPATIAL INFORMATION FOR THE NATION

Geodetic Connections to Tide Gauge at Thevenard

RESULTS OF OPTICAL LEVELLING

Bench Mark Name	AHD Ht (m) Aug 1991	AHD Ht (m) Mar 1992	AHD Ht (m) Apr 1994	AHD Ht (m) May 1995	AHD Ht (m) Jun 1995	AHD Ht (m) Jun 1999	AHD Ht (m) Sep 2002	Comments
BM 1153	2.9350	-	2.9351	-	-	-	-	Datum for AHD heights.
BM 1476	4.4787	4.4787	4.4787	4.4787	4.4787	4.4787	4.4787	Primary Coastal array BM.
BM 1478	4.7812	4.7813	4.7811	4.7814	4.7815	4.7828	4.7828	Coastal array BM.
BM 1479	11.7187	11.7189	11.7186	11.7185	11.7182	11.7184	11.7186	Coastal array BM.
BM 1487	15.9773	15.9780	15.9779	15.9779	15.9778	15.9780	15.9790	Coastal array BM.
5633/1581	4.211	-	4.212	4.212	-	-	-	Seaframe Sensor Recovery Mark
5633/1591	4.4977	4.4979	4.4500	4.4995	4.5001	4.4995	4.4999	Seaframe Sensor BM
5633/1680	-	-	-	16.5410	16.5410	16.5409	16.5422	Coastal array Pillar #

Note 5633/1680 levelled to top of 5/8" threaded stub that is 14mm above the surface of the pillar plate. Ratcliff B, email 2002.

Recording sheet for successive optical levelling surveys at Thevenard, South Australia. The AHD benchmark is BM 1153. BM 1476 is the primary TGBM. The five surveys indicate that the TGBM has retained the constant value of 4.4787 with respect to the AHD benchmark.

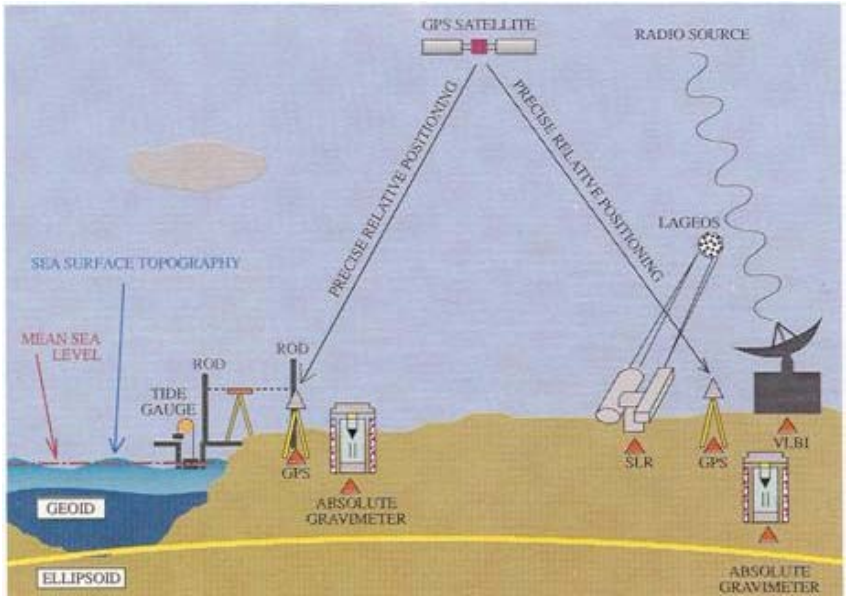
In 2000, this subject was reviewed in detail in the IOC Training Manual Vol. III, Section 4, "Datums and datum connections at tide gauges". For convenience, the topics from Section 4 are listed below:

- 4.1 Some definitions (key terms such as Tide Gauge Benchmark defined)
- 4.2 Levelling between local benchmarks
- 4.3 Levelling between wider area marks

- 4.4 Geodetic fixing of tide gauge benchmarks
- 4.4.1 Introduction
- 4.4.2 Geodetic Coordinates of Tide Gauge Benchmarks and Monitoring of Vertical Land Movements at Tide Gauges
- 4.4.3 GPS measurements
- 4.4.4 DORIS Measurements
- 4.4.5 Absolute gravity measurements
- 4.5 Geodetic contact points

Section 4.1 describes the expanding use of Global Positioning System (GPS) benchmark arrays. Australian practice permits spirit levelling of the TGBM and its supporting recovery benchmarks to an array of GPS–heighted benchmarks.

The original SP9 contained an outline of levelling procedures in Appendix D, "Documentation, bench marking and levelling requirements for tide gauge installations". The material in Appendix D was completely updated in "Tide gauge survey instructions". Levelling was also covered in Chapter 4 of the IOC Training Manual Vol. II (1994), but again, this material is thoroughly covered and updated in Vol. III.



Some technologies for measuring absolute level. Many tide gauges are connected to Continuous GPS sites in order to identify vertical land movement in the sea level records.

The Australian Height Datum

In Section 3.2, mention was made of the AHD, described in detail in the GDA Technical Manual. For convenience, several key paragraphs are reproduced below:

On 5 May 1971 the then Division of National Mapping, on behalf of the National Mapping Council of Australia, carried out a simultaneous

adjustment of 97,230 kilometres of two-way levelling. Mean sea level for 1966-1968 was assigned the value of zero on the Australian Height Datum at thirty tide gauges around the coast of the Australian continent.

The resulting datum surface, with minor modifications in two metropolitan areas, has been termed the Australian Height Datum (AHD) and was adopted by the National Mapping Council at its twenty-ninth meeting in May 1971 as the datum to which all vertical control for mapping is to be referred. The datum surface is that which passes through mean sea level at the thirty tide gauges and through points at zero AHD height vertically below the other basic junction points.

The AHD is an imperfect realisation of mean sea level because some of the tide gauges used for its definition were not well sited; the mean sea level determination was for a limited period and a particular epoch and no allowance was made for sea surface topography. The difference between AHD and mean sea level, which may be of the order of several decimetres, is not significant for conventional propagation of AHD, which is relative to existing AHD bench marks, but may be important if connecting AHD to a recent determination of mean sea level.