



Australian Government
Department of Defence



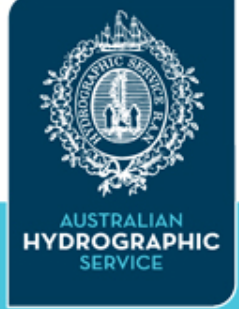
Establishment of a LAT Hydroid Model for a Port 22 NM long Shipping Channel

.....and its 'impact'



Australian Government
Department of Defence

Minimum requirements for a Hydrographic survey:



Benchmark



Surveyor



Tide Gauge



Survey Boat



Australian Government
Department of Defence

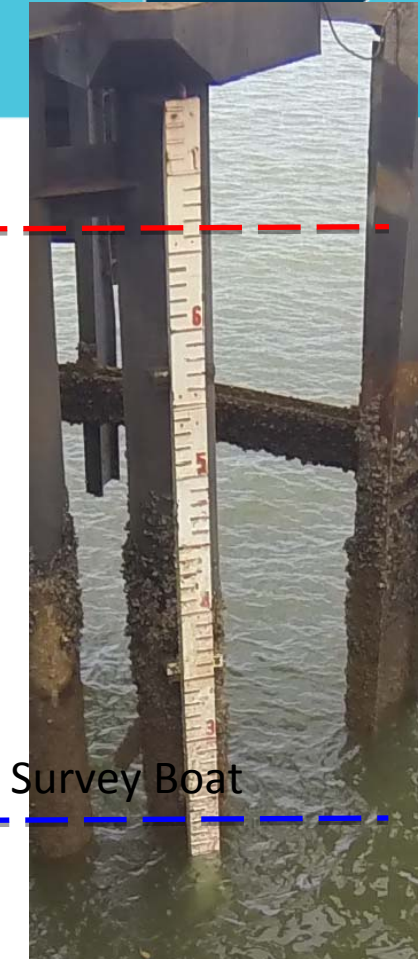
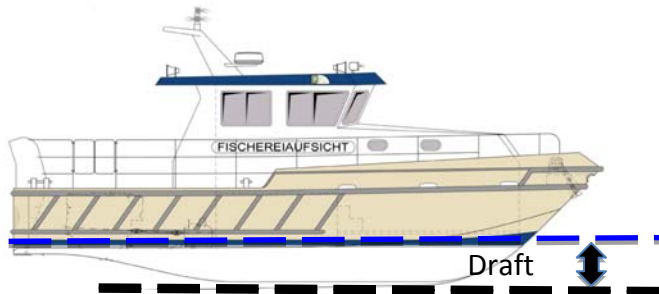
Preliminary work for a Hydrographic survey:



Benchmark



Surveyor

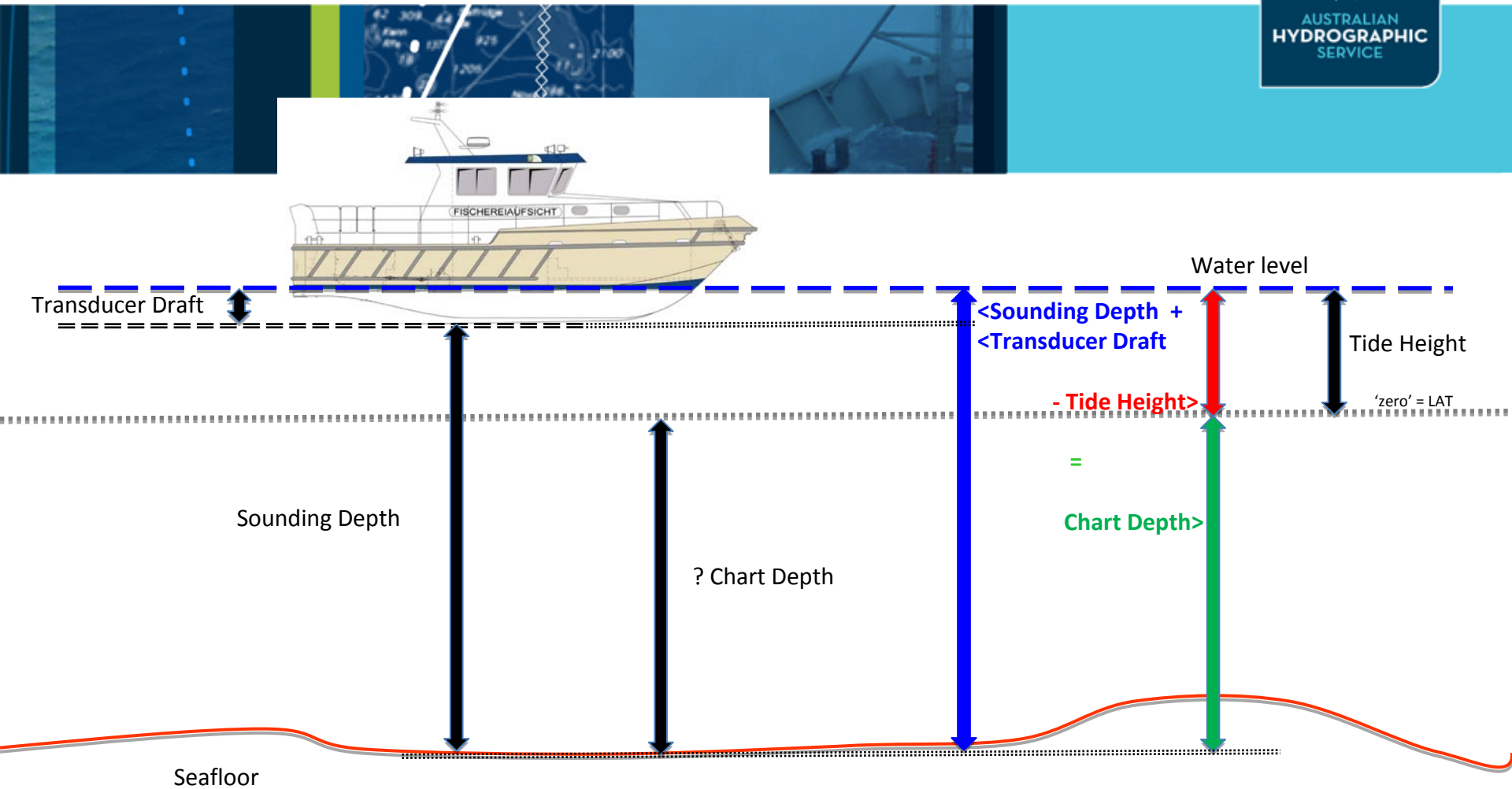


Survey Boat

Tide Gauge



Principle of a Hydrographic survey:

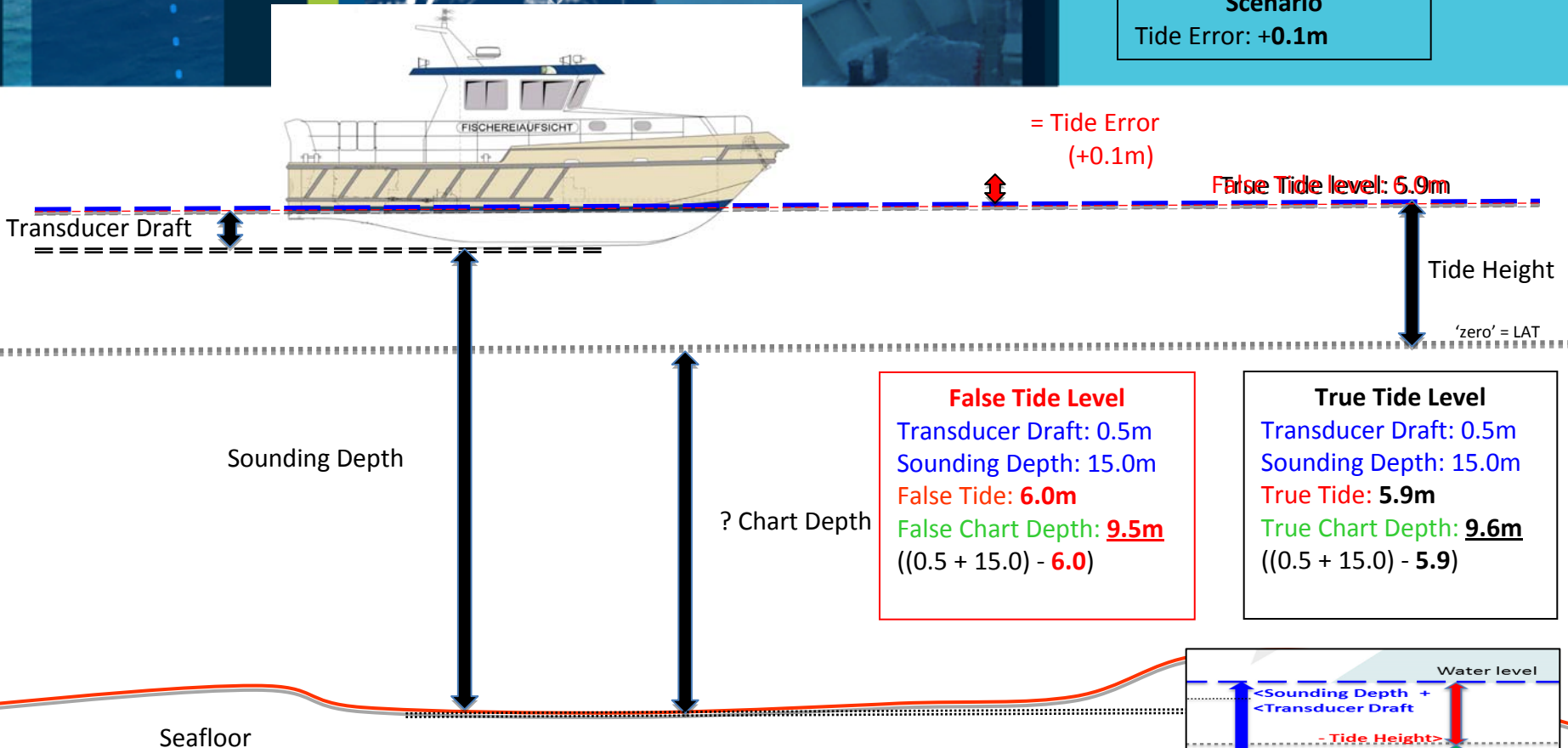




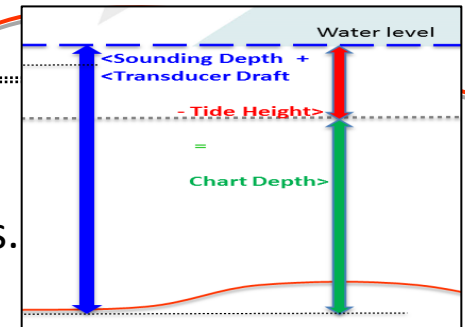
The importance of the tide in a Hydrographic survey:



Scenario
Tide Error: +0.1m



When the Tide Gauge reads too high...Chart Depth falsely decreases.



The effect of a 'survey tide error' on Port Capacity

How to address it?

Scenario

Draft restricted Vessel
Bottom Clearance (BC): 1.0m
Tide: 6.0m
(True) Chart Depth: 9.6m
(False) Chart Depth: 9.5m

Effect of 0.1m 'Survey Tide Error'

Vessel Draft Loss: 0.1m
0.1m Draft: ~**1200 ton**
Cargo value: ~**\$135/ton**
Loss per Vessel: ~**\$162k**
No. of Cape Size: ~**2000 year**

Tide Height
6.0m CD
'zero' = LAT

Vessel Draft:
14.5m

Vessel Draft:
14.6m

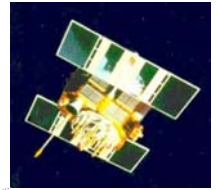
Bottom Clearance: 1.0m

False Chart Depth: 9.5m

True Chart Depth: 9.6m

Seafloor

The port would lose approximate over \$300,000,000 - in export value with a 10 centimetre 'survey tide error'.



Ellipsoidal Depth

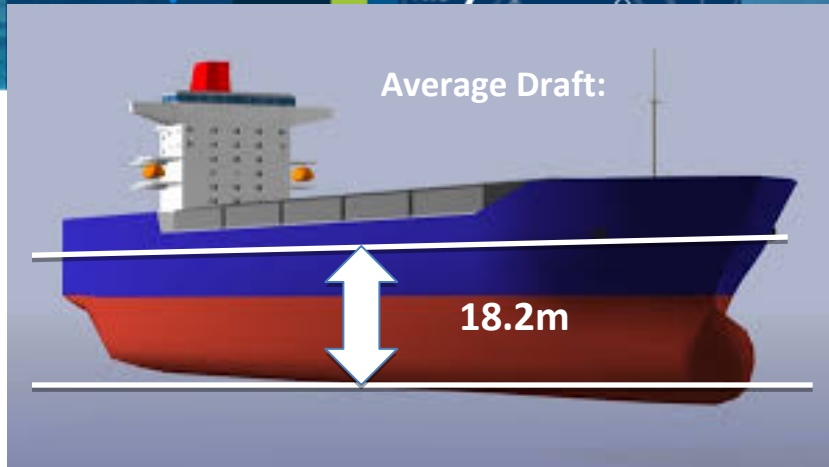
‘Surveying to the Ellipsoid minimizes ‘Survey and Tide Errors’...but...
...you must have this correct....



Study Purpose: Improve UKC



Loading....



..½ hour apart..



Tide



Berth Pockets to 20.0m CD

Swing Basin to
14.5m CD

15.0m CD

16.0m CD

Indian Ocean

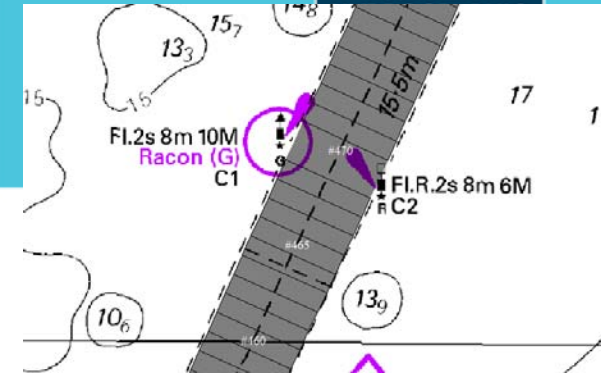
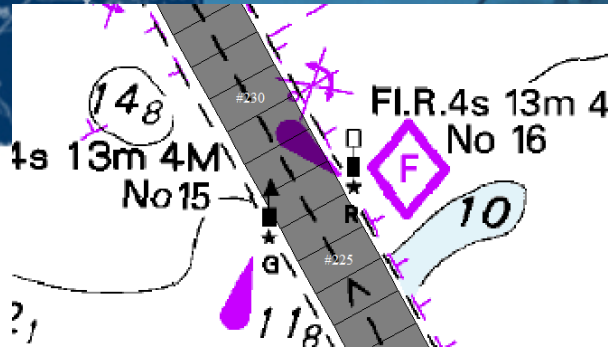
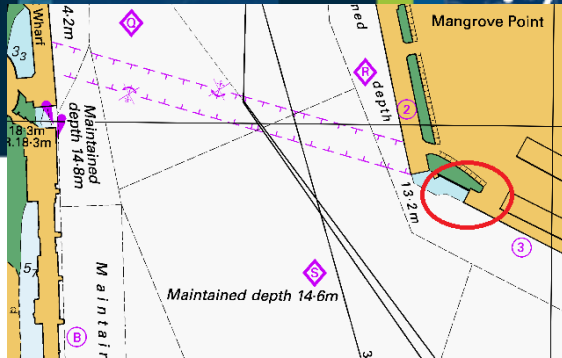
0.0m CD

Draft: 18.2m



Tidal Study Benefits

Study Purpose: Improve UKC



Berth #3

Bcn #15

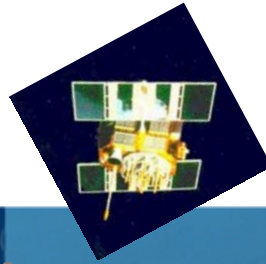
Bcn C1
(Predicted)

CD

LAT

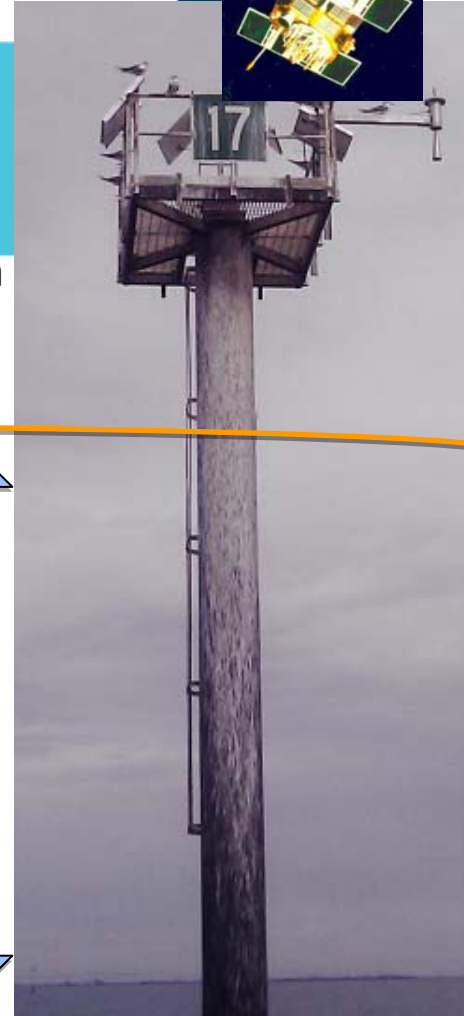
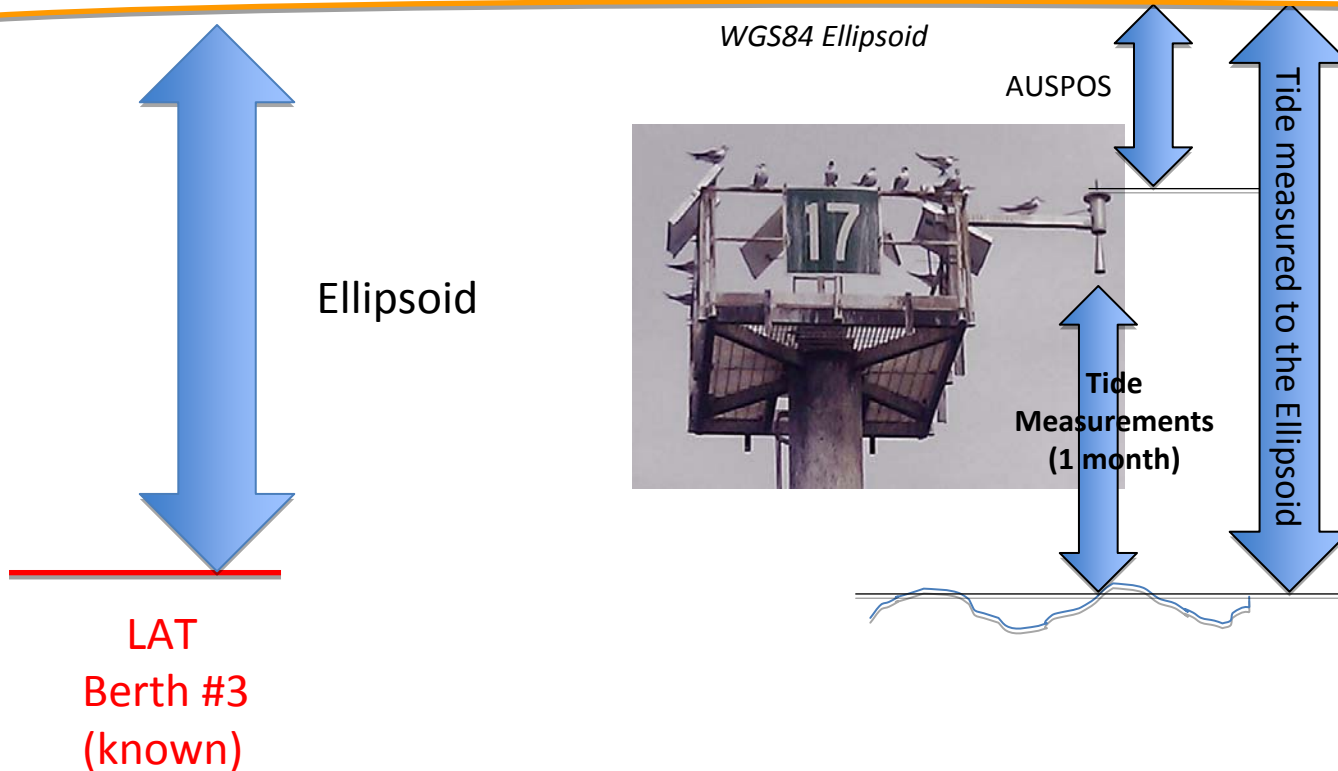
When was it
Established?

..prior to the 12th of Dec '13, vessels sailed through the channel on the 2010 survey data...which was based on a FLAT LAT from the Inner Harbour to the Indian Ocean....



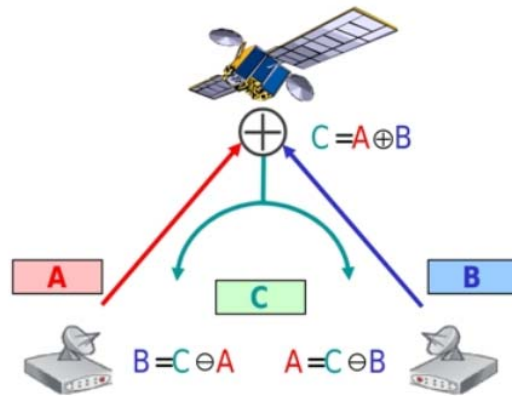
Study Strategy:

.. determine the real LAT at strategic locations (beacons) along the Main Shipping Channel using tidal measurements referenced to the Ellipsoid and thereby determining the actually available navigable depth...



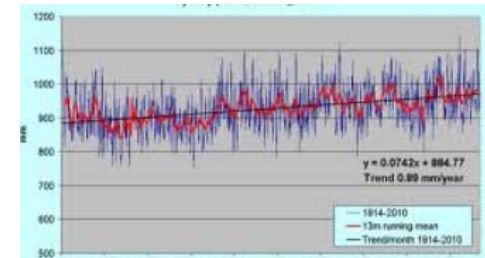


Tidal Study Benefits



Methodology

- Establish TBM on the Beacon (AUSPOS)
- Set gauges to read to the ellipsoid (taped measurements)
- Record tide for > 1 month
- Analysis to derive MSL and LAT to ellipsoid
- Ellipsoid to LAT separation established for surveying purposes

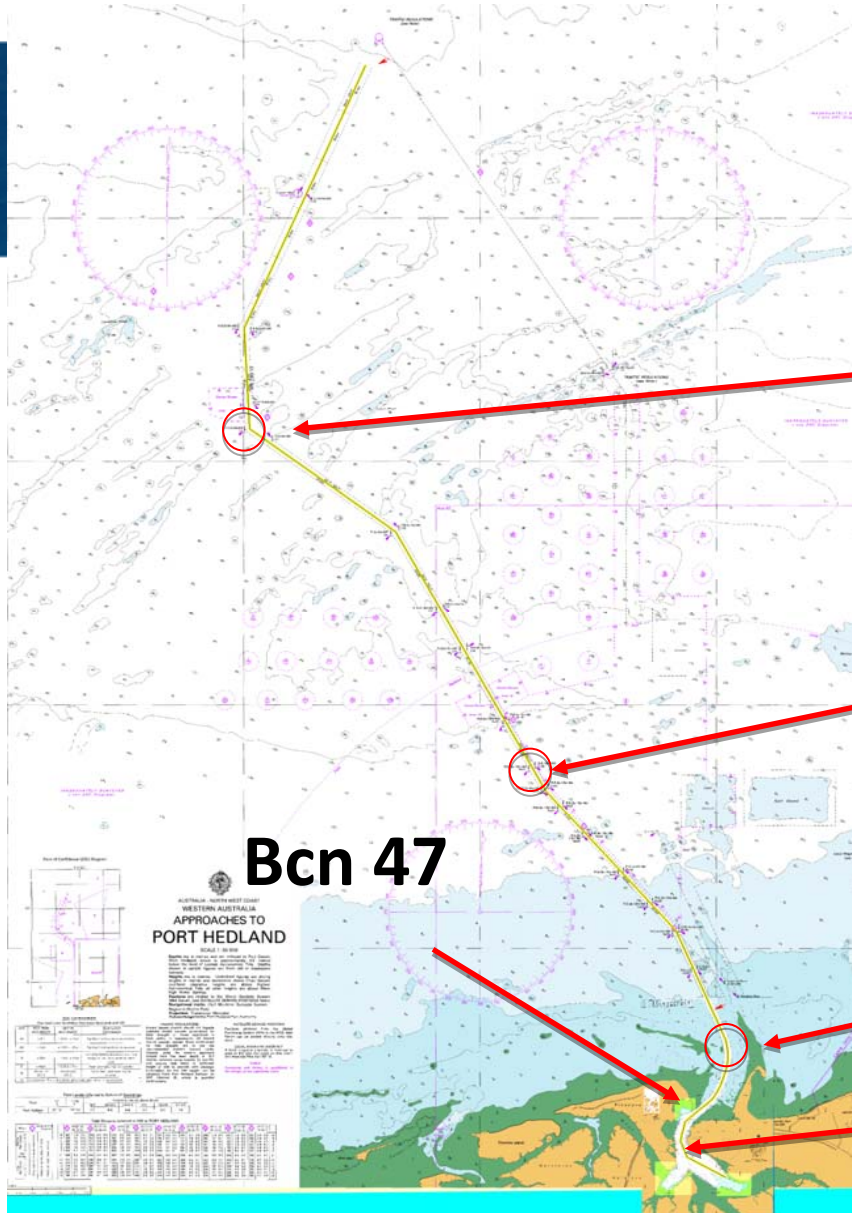


Calculated Tidal Planes for Port Hedland (relative to Mean Sea Level)

NUMBER	RATIO	HAT	MHWS	MHWN	MSL	MLWN	MLWS	ISLW	LAT	SITE NAME
62590	0.143	3.605	2.734	0.670	0	-0.670	-2.734	-3.126	-3.933	Port Hedland (Long analysis)
62590	0.140	3.639	2.735	0.662	0	-0.662	-2.735	-3.119	-3.819	Port Hedland (Berth 3)
6259a	0.141	3.625	2.731	0.654	0	-0.654	-2.731	-3.114	-3.806	Port Hedland (Berth 2)
6259b	0.142	3.570	2.691	0.647	0	-0.647	-2.691	-3.072	-3.751	Port Hedland (Beacon 42)
6259e	0.132	2.921	2.372	0.593	0	-0.593	-2.372	-2.685	-3.549	Port Hedland (Beacon 15)
6259c	0.149	3.459	2.637	0.637	0	-0.637	-2.637	-3.031	-3.677	Port Hedland (Beacon 17)
6259d	0.157	3.247	2.502	0.613	0	-0.613	-2.502	-2.896	-3.502	Port Hedland (Pylon C7)
62585	0.155	3.339	2.492	0.610	0	-0.610	-2.492	-2.879	-3.427	Port Hedland (Pylon C3)



Gauge Locations





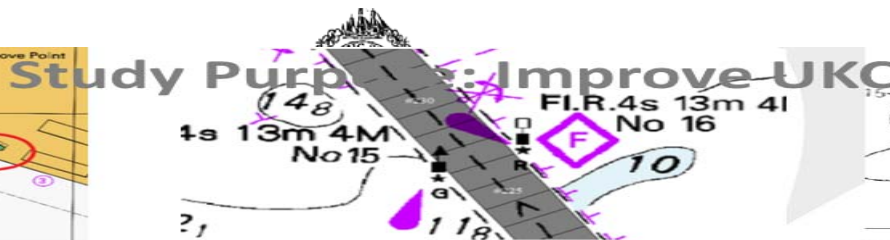
Port Hedland's Hydrographic Survey Method pre-2012



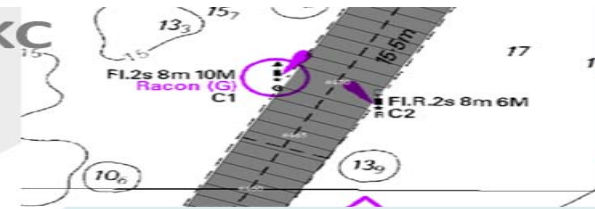
- Surveys previously conducted used predicted tides or observed tides that were extrapolated or corrected.
- Depths were related to a 'Port Datum' not LAT.
- LAT was propagated as a 'flat plane' all the way along the channel.



Berth #3



Bcn #15



Bcn C1
(Predicted)

CD LAT

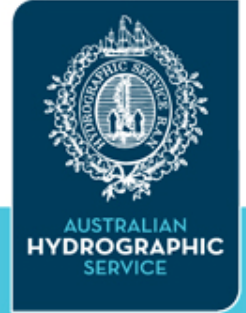
DUKC survey data
(2010)

DoT Study?
(1990)

..prior to the 12th of Dec '13, vessels sailed through the channel on the 2010 survey data...which was based on a FLAT LAT from the Inner Harbour to the Indian Ocean....



The Study results: Ellipsoid to LAT Separations:



Berth #3
(5.463)

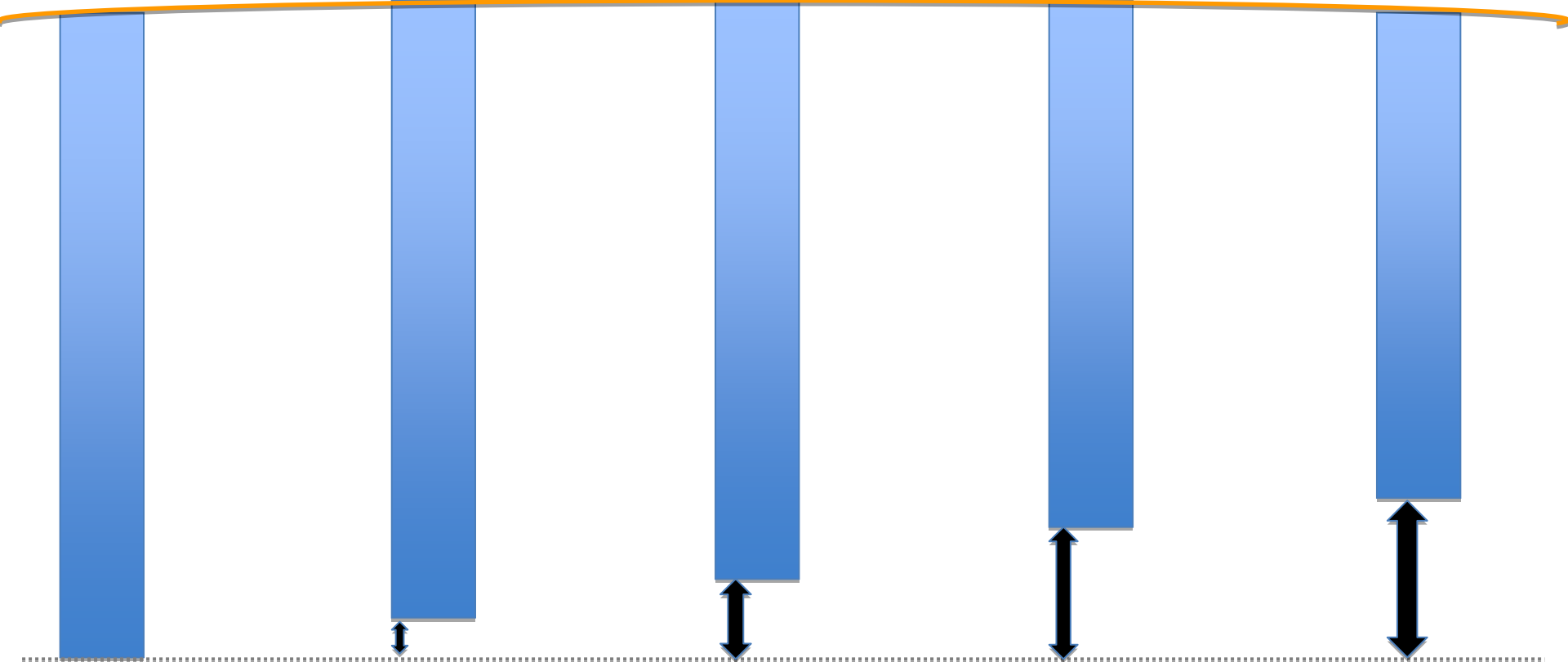
Bcn #47
(5.393)

Bcn #42
(5.013)

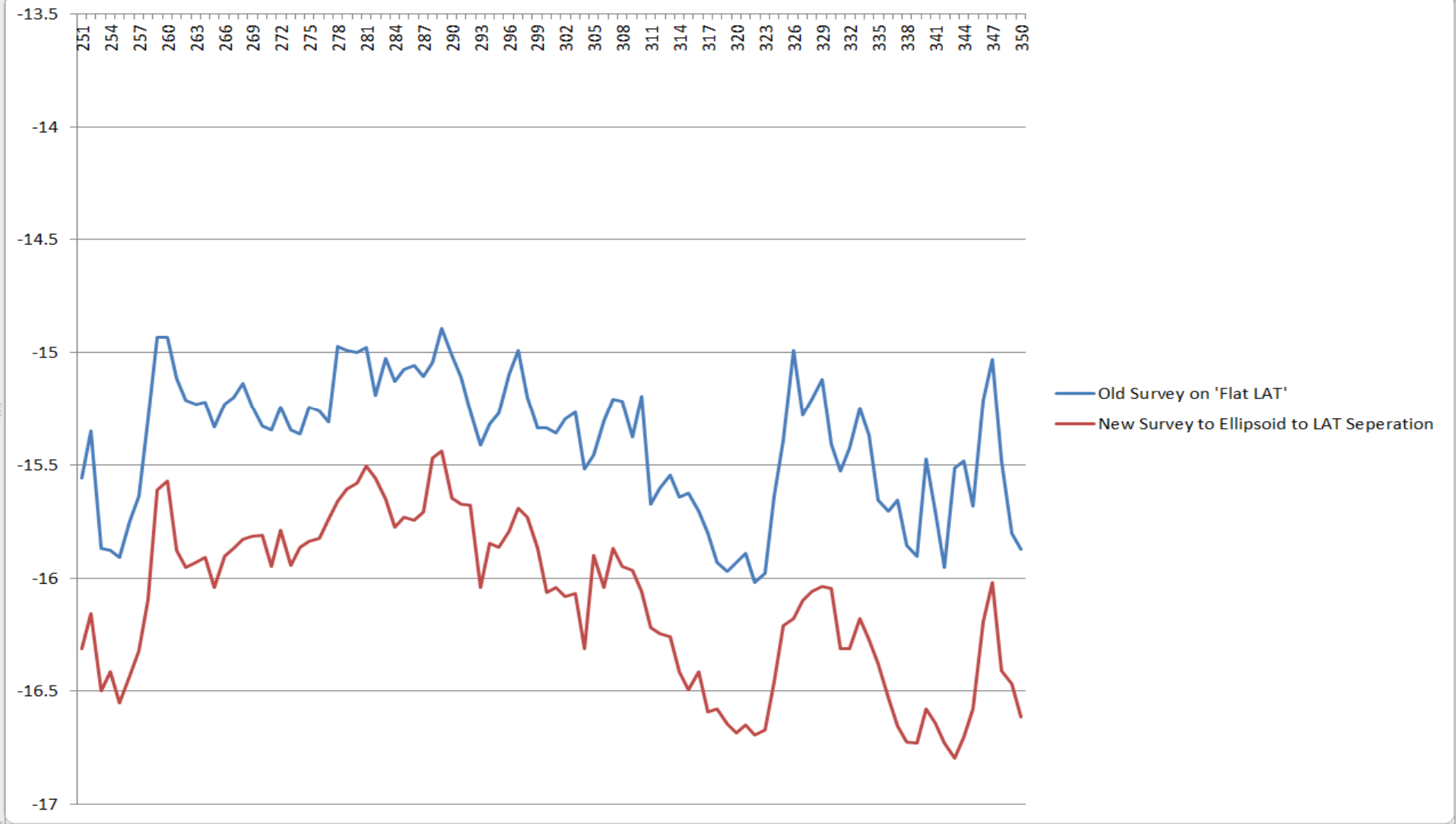
Bcn #17
(4.586)

Bcn #C7
(4.338)

WGS84 Ellipsoid



The Study results: The Benefits – Sounding line





The Benefits....



...with

- The new LAT Model;
- Continuous Tide monitoring;
- Tide Gauge Equipment and software and
- Vessel Management (DUKC © Series 5)....

...combined with

- The 2012 Maintenance Dredging Campaign
- The 2013 Maintenance Dredging Campaign



..per tide..

..plus an additional 0.71m in draft.....



Australian Government

Department of Defence

...additional Benefits....



- Improvement of status:
 - Capacity
 - Hydrographic Surveying
 - Tidal monitoring
- Increasing knowledge of tidal behaviour:
 - Inner Harbour
 - *'Whole of Channel'*
- Gathering and sharing of tidal data for the *'(inter) national Benefit'*

Thanks to Port Hedland Port Authority, Australia

