Chart Plotter Operation

Planning a Passage and Helming a Passage, (T) or (M)?

Know how your Chart Plotter operates and think about what you are asking of it.
It is a programed data processor relying on external data and your instructions!

When helming; the chart plotter is a real time machine, continuously calculating where you are, cross track correction, bearing and range to destination, etc. based on ship's position.

In the helming mode (T) or (M) bearings can be used as the (M) direction variable (magnetic variation) is read from the chart at the current ship's location.

Default is always (T) and if (M) all crew should be advised.

When Planning; only (T) can be used because once again the Chart Plotter reads variation from the chart at ship's location. In this situation M is meaningless and dangerous.

The recommended approach is always use (T) and convert to (C) prior to passing to the Helm.

A Passage Plan Always (T)

In this example (T) has been set for CTS, if (M) had been set, CTS would have been calculated based on magnetic variation at Ship's position where the plan was calculated.
Direction (M), is a variable, the variable being magnetic variation. Variation varies over the course, that is why (T) is the only true and correct direction that can be used in a planning mode.
So is the CTS column redundant in a Passage Plan?
No, because, transferring the passage plan waypoint Lat Lon position is error prone and CTS is an excellent checksum on the transferred waypoints.

Average Speed	6.0								
Depatture Date	23-May-13								
Departure Time	12:00:00								
Leg Dist	**Total Dist**	**CTS**	**#WP**	**Lat S**	**Lon E**	**Total Hr**	**ETA**	**Weather Zone**
Nm 0.000		° T 0	Barrenjoey	33°34.709 S	151°18.991 E			Hunter
Nm 6.154	Nm 6.154	° T 66	Third Point	33°32.232 S	151°25.752 E	1.026	23 May 13:01	Hunter
Nm 88.793	Nm 94.947	° T 42	Sugarloaf Point	32°26.466 S	152°36.878 E	15.825	24 May 03:49	Macquarie
Nm 60.632	Nm 155.579	° T 17	Tacking Point	31°28.543 S	152°57.998 E	25.930	24 May 13:55	Macquarie
Nm 34.427	Nm 190.005	° T 16	Smoky Cape	30°55.382 S	153°08.813 E	31.668	24 May 19:40	Coffs
Nm 43.576	Nm 233.582	° T 10	South Solitary Island	30°12.423 S	153°17.301 E	38.930	25 May 02:55	Coffs
Nm 17.326	Nm 250.907	° T 12	North Solitary Island	29°55.457 S	153°21.359 E	41.818	25 May 05:49	Byron
Nm 67.427	Nm 318.334	° T 13	Ballina (Whites Head)	28°49.820 S	153°39.067 E	53.056	25 May 17:03	Byron
Nm 11.546	Nm 329.880	° T 5	Cape Byron	28°38.320 S	153°40.248 E	54.980	25 May 18:58	Byron
Nm 26.301	Nm 356.181	° T 357	Fingal Head	28°12.051 S	153°38.789 E	59.364	25 May 23:21	Double I Pt to Pt Danger
Nm 48.816	Nm 404.997	° T 355	Point Lookout	27°23.397 S	153°34.289 E	67.500	26 May 07:29	Double I Pt to Pt Danger
Nm 22.269	Nm 427.266	° T 347	Cape Moreton	27°01.673 S	153°28.784 E	71.211	26 May 11:12	Double I Pt to Pt Danger
Nm 27.777	Nm 455.043	° T 320	Point Cartwright	26°40.385 S	153°08.784 E	75.841	26 May 15:50	Double I Pt to Pt Danger
Nm 0.990	Nm 456.033	° T 259	Leads	26°40.579 S	153°07.698 E	76.006	26 May 16:00	Double I Pt to Pt Danger
Nm 0.288	Nm 456.321	° T 133	Mooloolaba (Bar)	26°40.776 S	153°07.932 E	76.054	26 May 16:03	Double I Pt to Pt Danger

RADAR

RAdio **D**irection **A**nd **R**ange

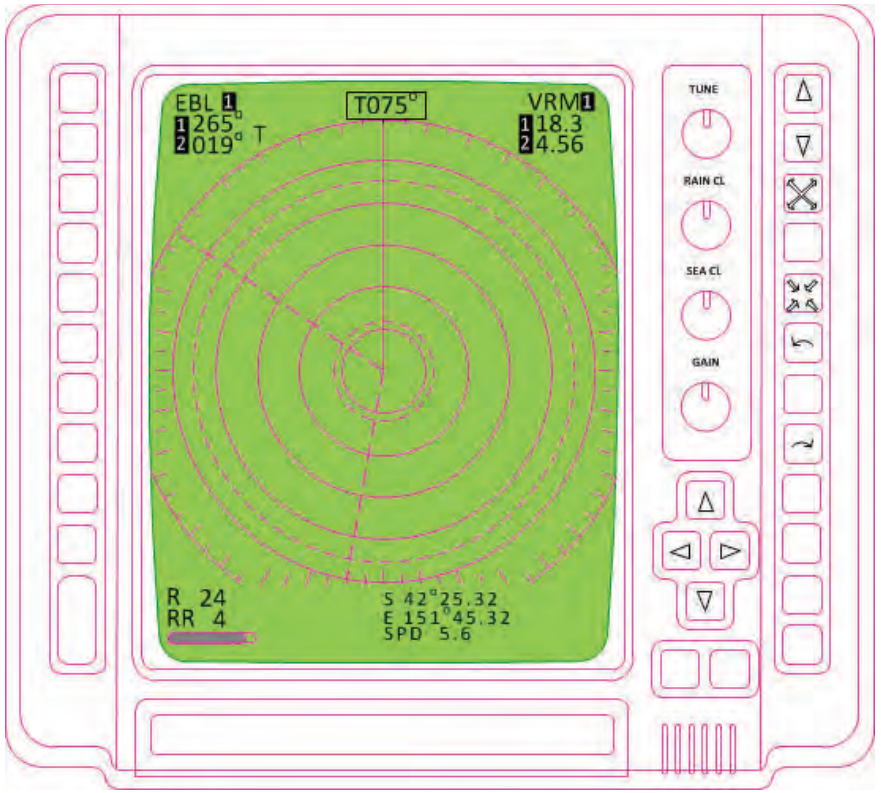
Radar is an interactive navigation aid, it requires a high level of skill and therefore the user must read the operation manual.

It is both a navigation aid for determining bearings and distances as well as a collision avoidance aid.

Most units have at least two Electronic Bearing Lines (EBL) and two Variable Range Marker (VRM) rings. These are used for determining bearings relative to the ships heading and distance from the ship to the object.

The EBLs and VRMs can also define collision avoidance zones and trigger an alarm should a target move into a defined zone.

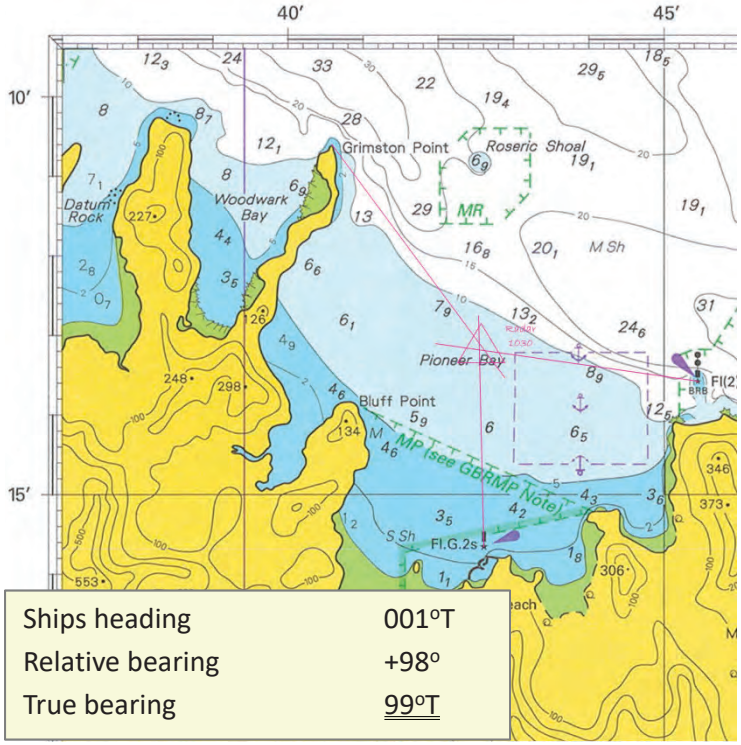
Bearings can be set to relative, true (T) or magnetic (M)

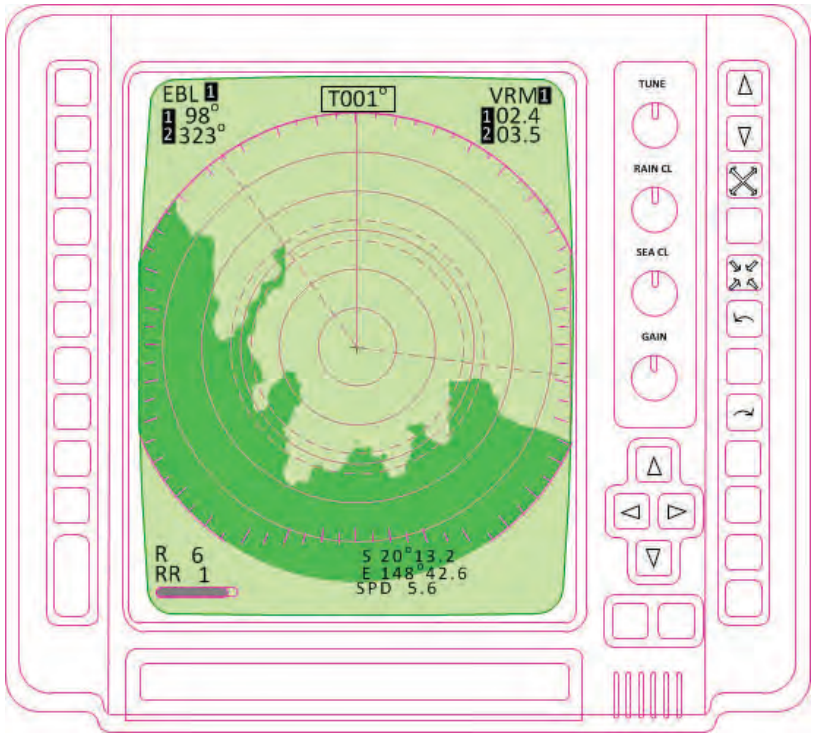


Radar Bearings as LOPs

Three LOPs have been plotted using Radar EBLs to fix a position. As Radar direction relies on the beam width (4°) of the radar unit, this method of position fixing has a high error rate. Always select closer marks rather than distant marks.

The method of calculating the relative bearing is shown below and should not be your first choice.

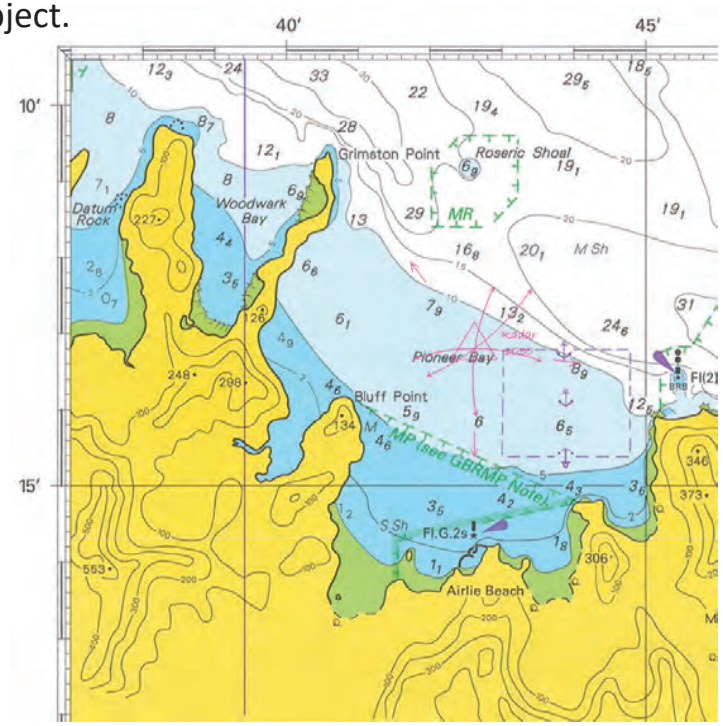


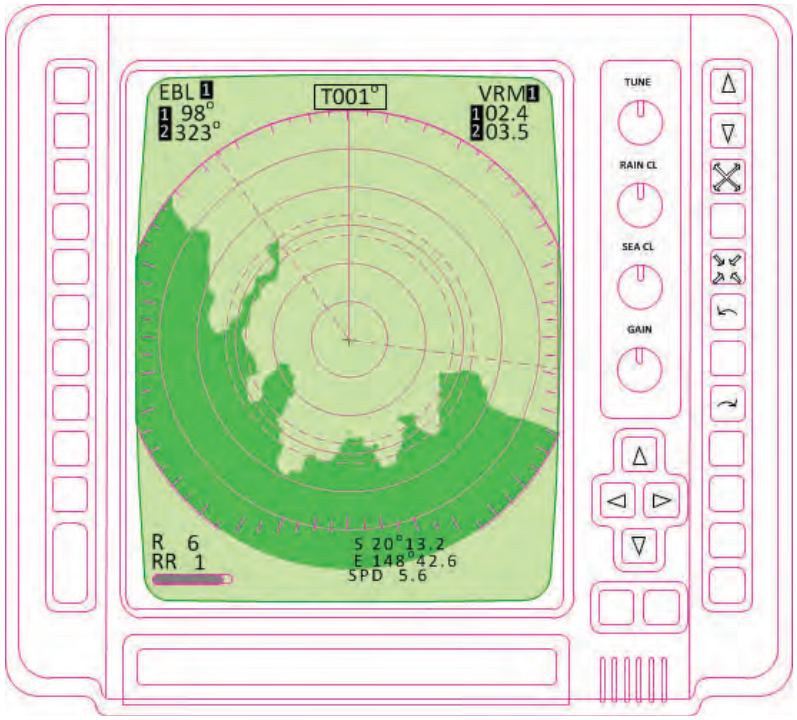


Radar Ranges as LOPs

Variable Range Markers (VRM) have a higher degree of accuracy than EBL ranges, normally within 1% of the scale in use. In this example three VRMs have been taken from the same objects in the previous example. The fix is the cross over point and should be marked as an Electronic Fix with time and a Radar note as shown below.

Combinations of range VRM and bearings EBL can be used where there is only one obvious reference object.





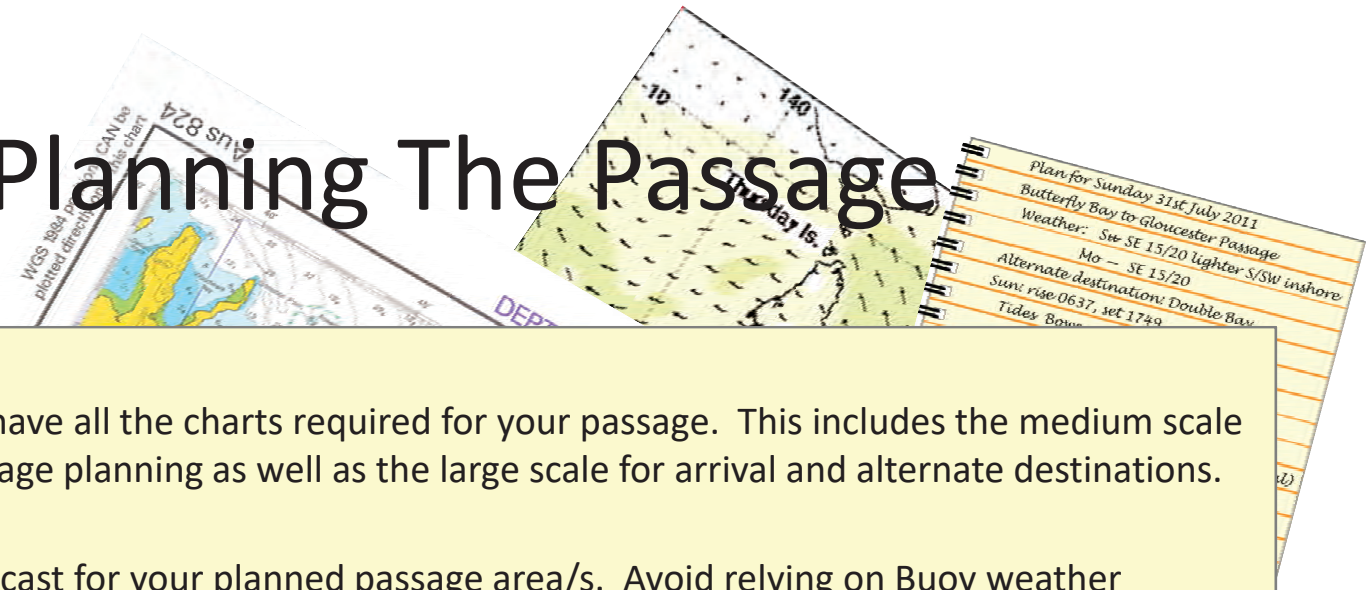
Some Important Radar Specifications

Range	10 scales from .125nm to 32nm.	Height of scanner is important factor
Range ring accuracy	+- 1.5% of range scale or 22m which ever is greater	Distance accuracy
Beam width	4^o (Radome) 2.2^o (Open scanner)	Wide beams increase bearing error, also two close objects can appear as one.
Pulse length	0.08us/2250Hz	Longer pulse can hide a small object in front of larger object

Additional Plotting Symbols

T	True heading
M	Magnetic heading (variation corrected)
C	Compass heading (deviation corrected)
	Intended track
	Current vector
	Course to steer
	Line of position vector (LOP)
	DR position, course steered and Log
	Estimated position, adjusted for set/drift
	Conventional Fix, at least three LOPs
	Electronic Fix, GPS, Radar or depth?

Planning The Passage



Charts:

Make sure you have all the charts required for your passage. This includes the medium scale for general passage planning as well as the large scale for arrival and alternate destinations.

Weather:

What is the forecast for your planned passage area/s. Avoid relying on Buoy weather forecasts as these apply to specific points not areas. Recommendation is the BOM forecast (including feathers) plus buoy forecast and consider differences.

Alternate destinations:

What alternate destinations can you use in the event of sudden strong weather? Make sure you have large scale charts for these locations.

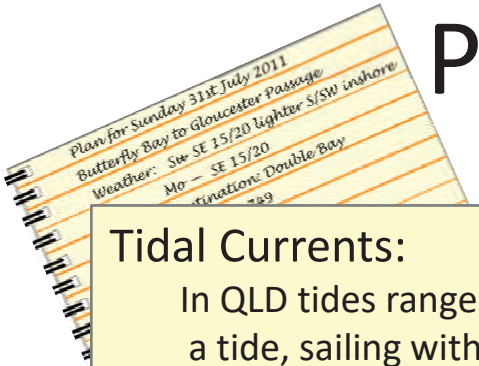
Waypoints:

Select your passage waypoints long before you depart. Make sure they and the rhumb lines are well clear of all dangers. A 1.0nm cross track margin and safety circle is a healthy margin. Mark these planned waypoints on your medium scale chart.

Distances:

What is your planned passage distance?

Planning The Passage



Tidal Currents:

In QLD tides range up to 7m and tidal currents can be as much as 3 to 4 knt. Are you crossing a tide, sailing with a tide (flood or ebb) or sailing against a tide. If sailing against a tide, consider altering your departure date/time.

Arrival Time:

Based on distance, tidal current, planned average speed and other factors, what is your ETA?

Tidal Heights:

What are the tides for arrival? In QLD you will experience large tide falls and knowing how much is yet to fall makes for a relaxed and safe anchorage.

Conspicuous Objects:

What conspicuous objects, such as lights, will you pass? These are worth noting as they confirm your position and may also be points of general interest, such as Cape Byron and Cape Capricorn.

Contact Information:

Handy contacts such as Marine Rescue and or VMR.

Safety:

Have you completed a current safety briefing with your crew? Bad weather, MOB, Fire, Medical, etc.

Example of Passage Plan

Plan for Sunday 31st July 2011
Butterfly Bay to Gloucester Passage
Weather: ~~Su~~ SE 15/20 lighter S/SW inshore
Mo – SE 15/20
Alternate destination: Double Bay
Sun: rise 0637, set 1749
Tides Bowen 0417 0.74
0951 2.35
1610 0.30
2231 3.21
Arrival time: 1600 hrs (low tide on arrival)
Current: North set 1000 hrs thru 1600 hrs
Planned passage speed: 6kn
Passage distance: 29nm
Note: Low tide Gloucester passage on arrival
Planned passage time: 5 hr
Departure time: 1000 hr

VMR442 Whitsundays, VMR487 Bowen
Telephone: (07)4786 1950
Repeaters: 21, 22, 80, 81
Lights: Eshelby Island Fl(2)10s
Stone I. Bowen Fl W 4s

Long Coastal Passage Plans require additional information; see end of slides for example

Don't forget to write down contact details you may require at short notice.

Navigating The Passage

"It is found that anything that can go wrong at sea generally does go wrong sooner or later, so it is not to be wondered that wise sailors prefer the safe to the scientific"
(unknown person)

So what can go wrong?

a) Lat Lon coordinate keying error
b) Navigation hazard (submerged rock) on steered course
c) You are tracking documented waypoints and another vessel using the same waypoints is on the opposite course headed for you
d) Fog or heavy rain suddenly reduces visibility to zero
e) GPS network goes down for an unknown period
f) A navigation instrument fails (Speed, Depth, Chart Plotter or GPS)
g) Ship's power fails, taking out all installed instruments
h) Lightning strike takes out all networked/installed instruments
i) Undetected GPS Datum error
j) Out of date electronic charts
k) Fluxgate compass affected by stray magnetic interference

Should any one of these scenarios occur on your boat, what is the impact?

How do we exploit our highly functional electronic navigation equipment, while practicing a secure and reliable navigation methodology?

Note: This is NOT a complete list!

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A Navigation Methodology

We are here

Navigation Methodology
Planning the Passage
Instruments, GPS, Plotters, Radar
Conventional Charting
Depth and Tides
Compass Errors and Correction
Distance and Direction
Primary Navigation Inputs
Aids to Navigation
Chart Basics and Maintenance

So far we have built a foundation of navigation knowledge, techniques and aids.

Our Objective:

A safe, relaxed and predictable passage.

To use our highly functional and easy to use Navigation Instruments.

Our Goal:

A navigation methodology supporting these objectives and capable of dealing with potential risks.

Navigation Risks

Lat Lon Keying Input Error (23° 14.634'S 150° 55.816'E)

Impact:

- Most significant characters/digits will be detected quickly
- Least significant characters/digits will only have you out in the tens to hundreds of meters, enough to hit a rock.
- Mid range characters/digits are guaranteed to be significant, they are not easy to detect and they make a significant difference.

Contingency:

- When entering a Lat Lon position, check the format, (degrees minutes seconds or degrees minutes decimals), check each charter and then re-check. Does the plotted position make sense?
- Try plotting the position with a bearing and range from a mark, less chance of making mistakes.

Navigation Risks

Navigation hazard on steered course

Impact:

- Damaged or loss of vessel
- Electronic charts are made of layers. Hazards appearing on large scale charts may not appear on small scale charts

Contingency:

- Operate a split screen on your Chart Plotter, one medium/small scale (current position) one large scale (remaining course to next waypoint)
- Plot your intended passage on your paper chart and check for at least a one mile safety margin
- Use only up to date paper and electronic charts and purchase electronic charts from official chart providers
- Maintain your paper charts to latest Notice to Mariners

Navigation Risks

Vessel on opposite course, using the same waypoints

Impact:

- Pilots such as Beacon to Beacon provide recommended waypoints. If you use them in bad visibility you may have another vessel bearing down on you coming in the opposite direction

Contingency:

- Try not to use them and if you do, make sure you maintain a constant visual watch

Navigation Risks

Fog or heavy rain reduces visibility to zero

Impact:

- This is common in QLD, either one can reduce visibility to near zero with very little notice although you will generally see the squall coming in the case of rain

Contingency:

- Take an immediate plot of current position on chart plotter GPS and paper chart. If closing the coast, turn to open water, increase the watch and slow the boat
- Sound warning signals with your horn

Navigation Risks

GPS network goes off line

Impact:

- Loss of GPS renders Chart Plotter useless
- Need to fall back to a conventional paper chart fix

Contingency:

- If you have been running a Boat Log, including paper chart, you can quickly do a DR fix from previous Electronic fix based on COG and SOG. You can then refine the fix to an EP or Fix
- Note: the only way you can manage this risk is with a paper log that includes paper chart, position, time, COG and SOG

Navigation Risks

One Electronic Navigation Instrument breaks

Impact:

- Speed and Depth are two of your primary inputs
- Loss of Speed you will loose STW, LOG, TWA and TWS, LOG is the most serious of this group
- Loss of Chart Plotter is more serious especially if you are not able to access the GPS
- Loss of GPS you will loose position, XTE, SOG, COG and ETA, all serious
- Loss of Fluxgate Compass, you will loose HDG, TWA, TWS and orientation on the Chart Plotter

Contingency:

- A fall back to Conventional Charting will be difficult if out of sight of land if you have lost LOG. If other than Speed, Conventional Charting OK
- What will save the day here is your Hand Held GPS receiver
- With this you can plot position, steer, track XTE Etc and use the Paper Chart

Navigation Risks

Ship power failure taking out all electronic instruments

Impact:

- In this situation you have lost primary and computed navigational inputs and reliant solely on visual and what ever you have as standalone

Contingency:

- Carry a hand held GPS, paper Charts and operate a ship's log incorporating the paper charts, mad if you don't because this risk has a real probability
- It can't be ignored
- Charts and Charting Instruments are required by the Green Book, hand held GPS is strongly recommended
- For the sake of $200.00!

Navigation Risks

Lightning strike takes out all electronic instruments

Impact:

- This is real in QLD waters, I have experienced this
- This results in the total loss of all navigation aids other than sight, paper charts and whatever instruments you have not integrated to the ships electrical system

Contingency:

- Carry paper charts, chartings instruments, know how to use them, use them, be competent in their use and also carry a hand held GPS receiver with at least 24 hours battery supply

Navigation Risks

Undetected GPS Datum error

Impact:

- If your GPS datum is not the same as the Datum used on the chart in use **then the displayed locations of charted features** will be moved by the datum difference

Contingency:

- Current AUS version of all required charts between Broken Bay and Lizard Island are WGS84
- Make sure you have updated your charts and or purchased the current AUS version
- Make sure your electronic charts are current and WGS84. You can check this by looking at chart properties
- Make sure your GPS and Chart Plotter are set to the same datum as your paper charts

Navigation Risks

Out of date electronic charts

Impact:

- Most commercial electronic charts will be out of date by up to 12 months or more, even if you do have the current version. The one exception being AUS ENC charts
- Recent navigation hazards and changes will not appear on your chart

Contingency:

- The only safe way is to have and use current paper charts in parallel with your electronic charts
- Part of your passage planning should be the checking of your full passage route on both electronic chart and paper chart, looking specifically for differences
- Note: latest version of electronic chart can be at least 12 months behind Notice to Mariners

Navigation Risks

Fluxgate compass affected by stray magnetic field

Impact:

- This will modify your HDG reading by an unknown amount. Autopilot will steer incorrectly, other instruments utilising HDG (TWA, TWS, Etc.) will display erroneous information

Contingency:

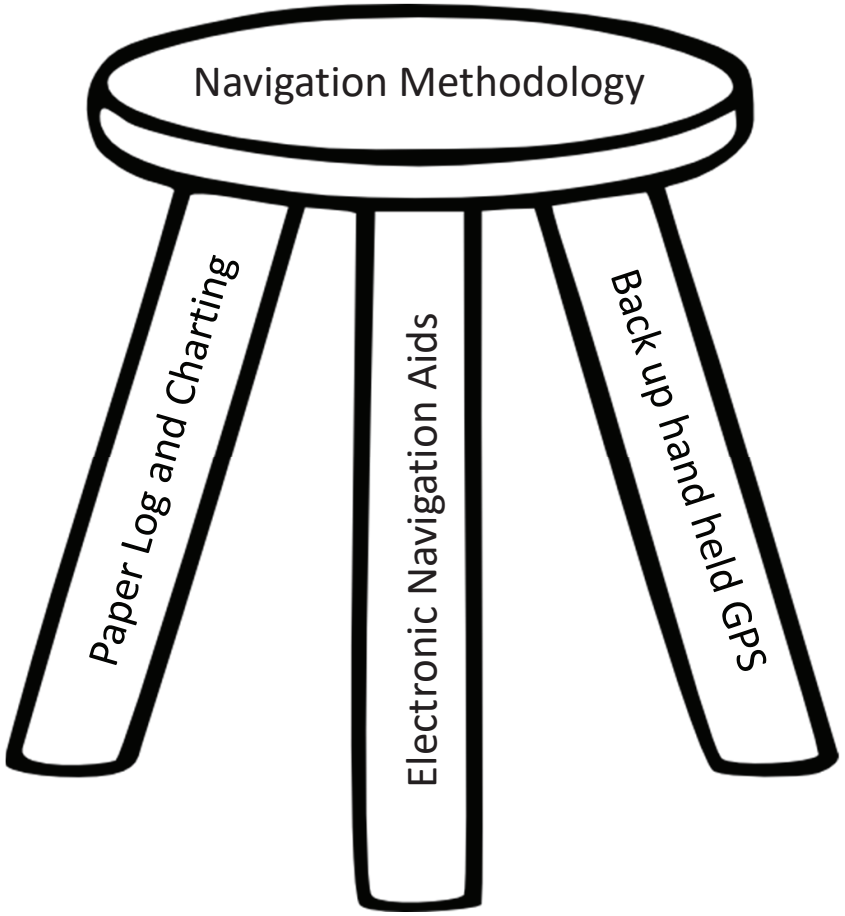
- Know where your Fluxgate compass is mounted, make sure nothing ferrous is stowed in the vicinity, make sure there are no high current devices in the vicinity
- Check your HDG reading against your swung steering compass on a daily basis. If you detect a difference greater than 2^{o}, go investigate

A Navigation Methodology

A stable and workable platform has three legs.

The three legs of a solid Navigation Methodology are;

1. Highly functional electronic tools providing us with quick accurate and reliable information
2. A paper Log Book and Charting system used in parallel with the electronic aids, because they are current and do not break
3. A back up hand held GPS receiver with at least 24 hours of current batteries because Murphy lurks



What We Covered

A Navigation Architecture

Useful Information
Navigation Methodology
Planning the Passage
Instruments, GPS, Plotters, Radar
Conventional Charting
Depth and Tides
Compass Errors and Correction
Distance and Direction
Primary Navigation Inputs
Aids to Navigation
Chart Basics and Maintenance

Questions?