Welcome to the

Marine SAR Technical Training Course

NEW ZEALAND
SEARCH AND RESCUE

By the end of this training we want you to be able to:

- Read and interpret New Zealand marine charts for SAR planning purposes.
- Accurately plot positions on a chart using navigation charting instruments.
- Calculate Time/Speed/Distance.
- Plot courses, directions and distances on charts.
- Locate relevant information relating to tidal movements using tide predictions from LINZ and tidal diamonds.

By the end of this training we want you to be able to:

- Use Leeway Tables to calculate the leeway effect on any identified target.
- Identify the relationship between Sweep Width and Track Spacing to calculate Coverage Factor.
- Plot a Search Area Determination and understand the calculations relating to Total Drift Vector length.
- Plot a Search Area Determination for the different plotting scenarios of IPP (target adrift) –Track line Overdue –Position Uncertainty –Time uncertainty.

By the end of this training we want you to be able to:

- Identify Probability of Detection using Coverage Factor and understand the relationship between single searches and multiple searches and the effect of different asset types or heights of eye.
- Understand and explain the relationship between Search Area, Time, Velocity and Track Spacing.

The days programme covers:

1	Charts
2	Plotting Positions
3	Calculations - Time, Speed & Distance
4	Tides
5	Leeway
6	Search Area Determination - Total Drift Vector
7	Coverage Factor
8	Search Area Determination - Trackline Overdue, Position Uncertainty, Time
9	Uncertainty
10	Probability of Detection
11	A = TVS
12	Assessment Activity

In this order:

	Welcome and introductions.
	Charts, Plotting Positions, Calculations, Plotting Courses
	Morning Tea
	Tides, Leeway, Coverage Factor
	Lunch
	SAD, SAC, POD, ATVS
	Assessment
	Afternoon Tea
	Wrap up

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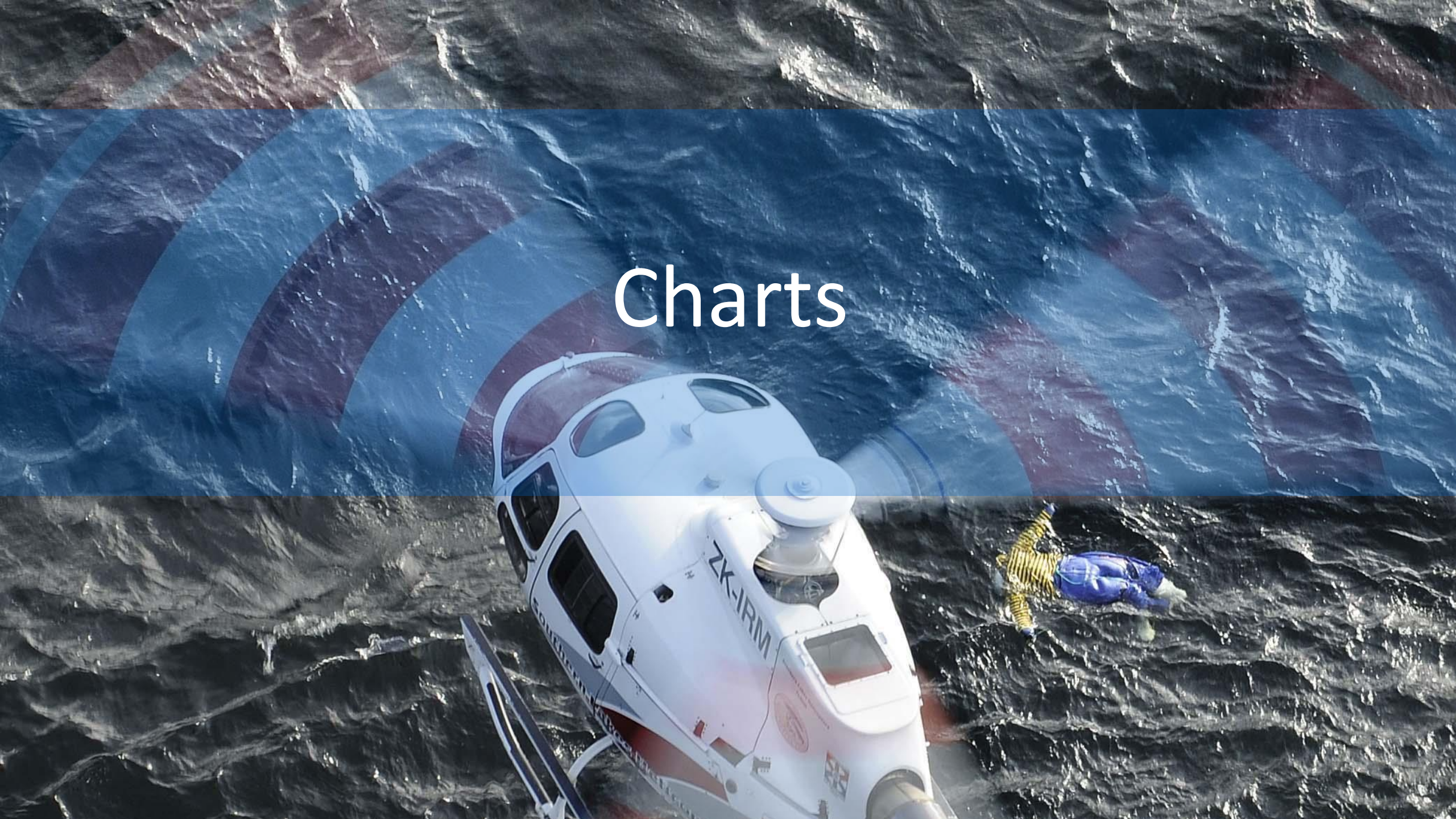
SEARCH AND RESCUE
Rapu Whakarauora Aotearoa

Charts



Land Information New Zealand
Toitū te whenua

NEW ZEALAND

NORTH ISLAND - EAST COAST

BAY OF ISLANDS

DEPTHS IN METRES

SCALE 1:25 000

Depths in metres (under thirty-one in metres and decimetres) reduced to Chart Datum which is approximately Lowest Astronomical Tide.
Heights in metres. Underlined figures are drying heights above Chart Datum; all other heights are above Mean High Water Springs.
Navigational Marks: IALA Maritime Buoyage System Region A (Red to Port).
Positions are on World Geodetic System 1984 (WGS84).
Projection: Transverse Mercator.
Sources: For information on the quality of the hydrography see the Source Data Diagram. Topography derived mainly from Land Information New Zealand data.

SATELLITE DERIVED POSITIONS

Positions obtained from satellite navigation systems referred to WGS 84 Datum can be plotted directly onto this chart. Caution must be exercised in the transfer of geographical positions to other charts not in terms of WGS 84 Datum.

AREA TO BE AVOIDED

To avoid the risk of pollution all vessels greater than 45 metres length overall shall avoid the area indicated. Exemptions apply to: a. All vessels of the Royal New Zealand Navy. b. All fishing vessels engaged in fishing operations. c. Barges under tow, provided the cargo is not oil or other harmful liquid substances as defined in Annexes I

Chart Information Including Title & Scale

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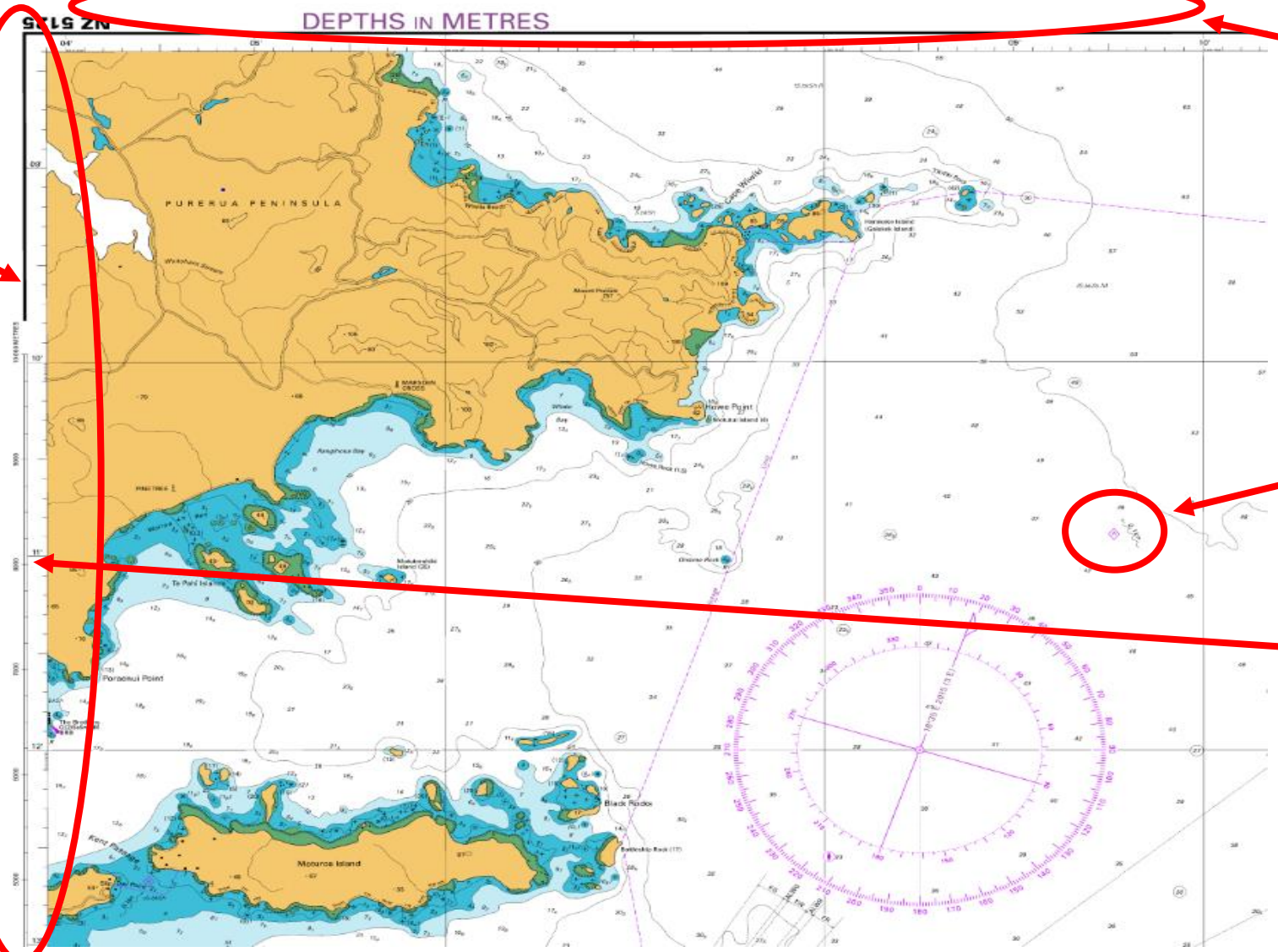
1 degree Latitude
= 60 Nm
1 Minute
= 1NM



Longitude
From North Pole
To South Pole.
Furthest apart at
The Equator.
DO NOT use
to measure
distance!

Tidal Diamond

Latitude
Parallel with Equator.
Equal distance apart
everywhere on Earth

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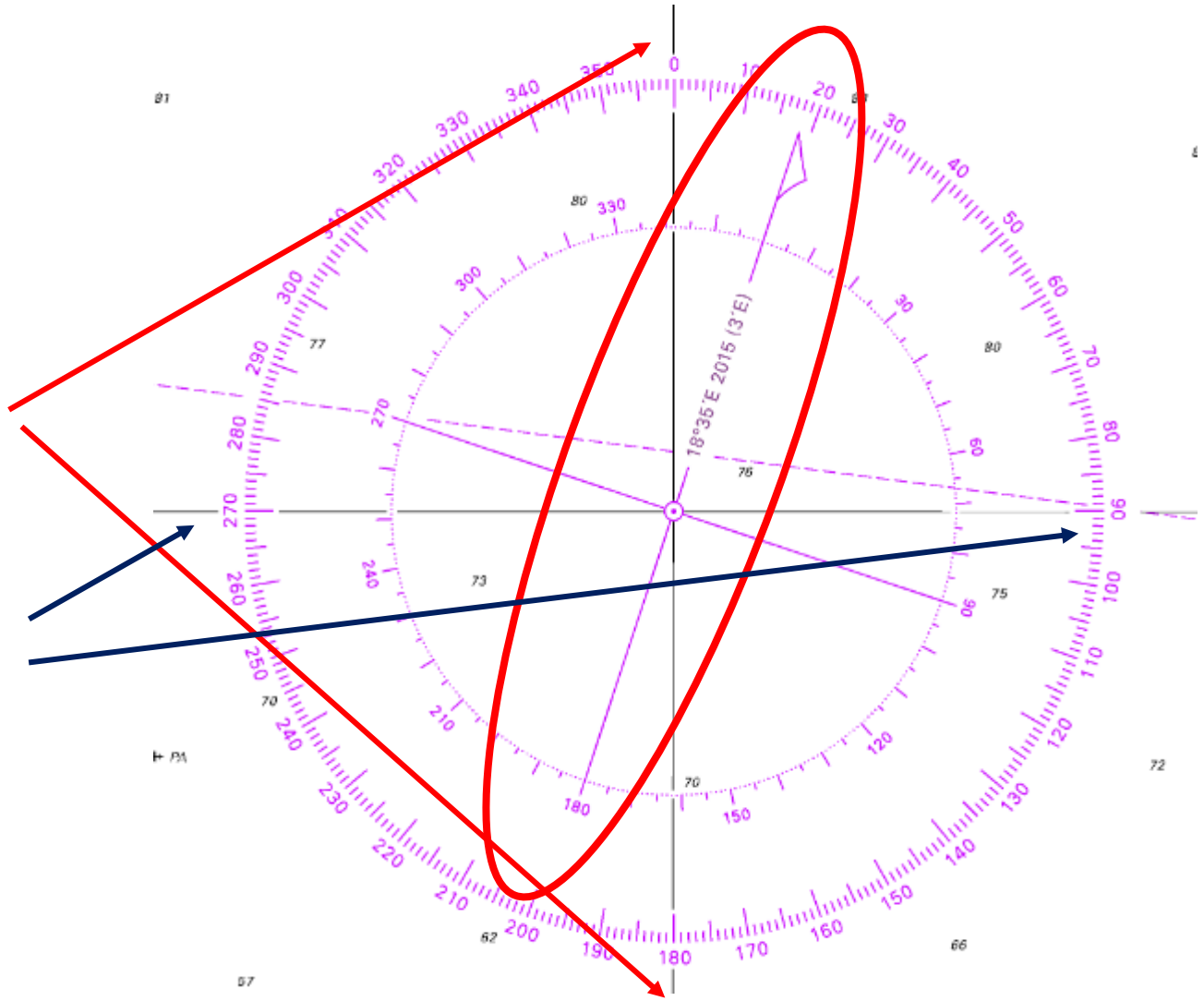
Compass Rose
Also on Plotting Tool

Place Centre over position
Ensure 0-180 line is perfectly aligned
With True North & South
Or

90-270 line is perfectly aligned with
Latitude line



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2:PLOTTING

Positions

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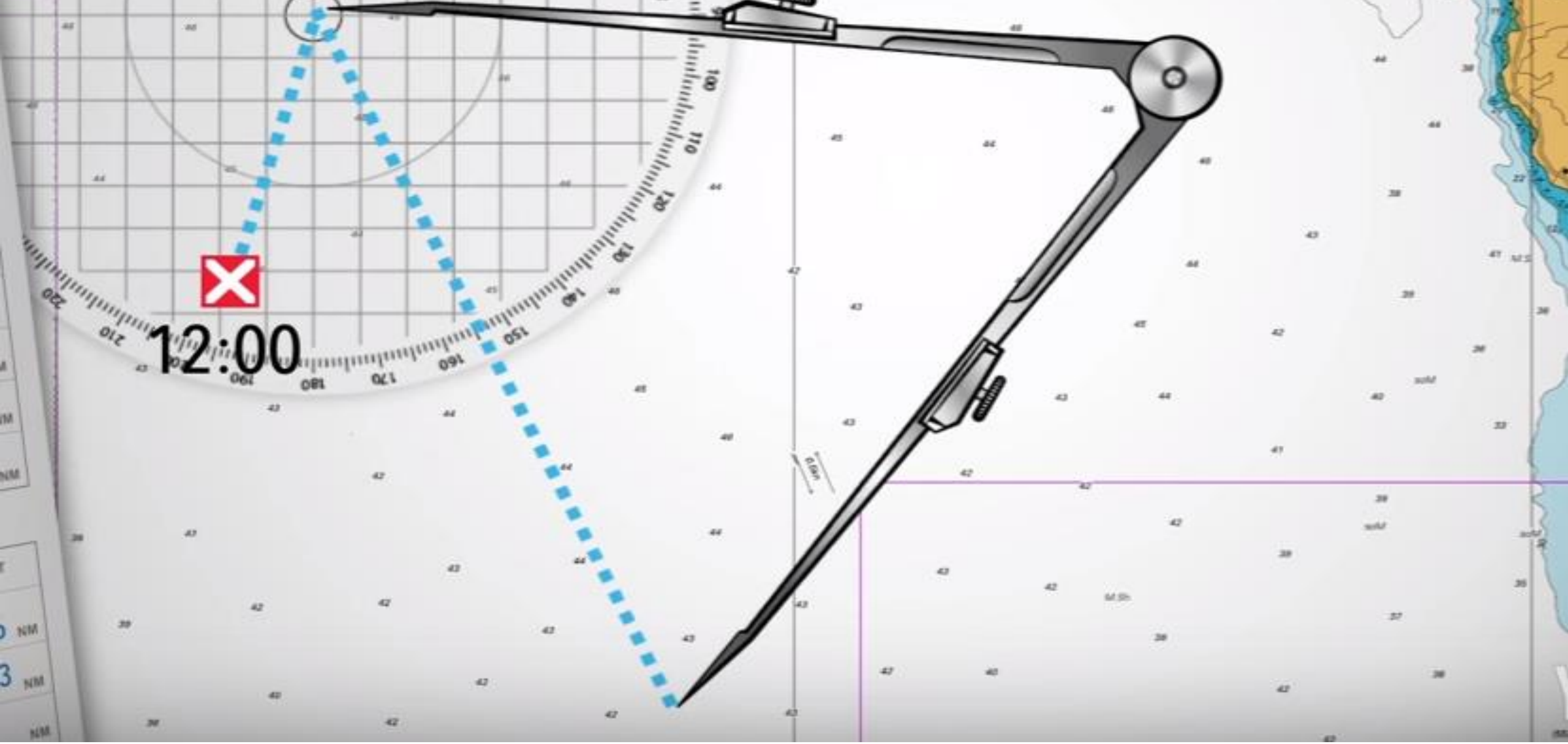

NEW ZEALAND
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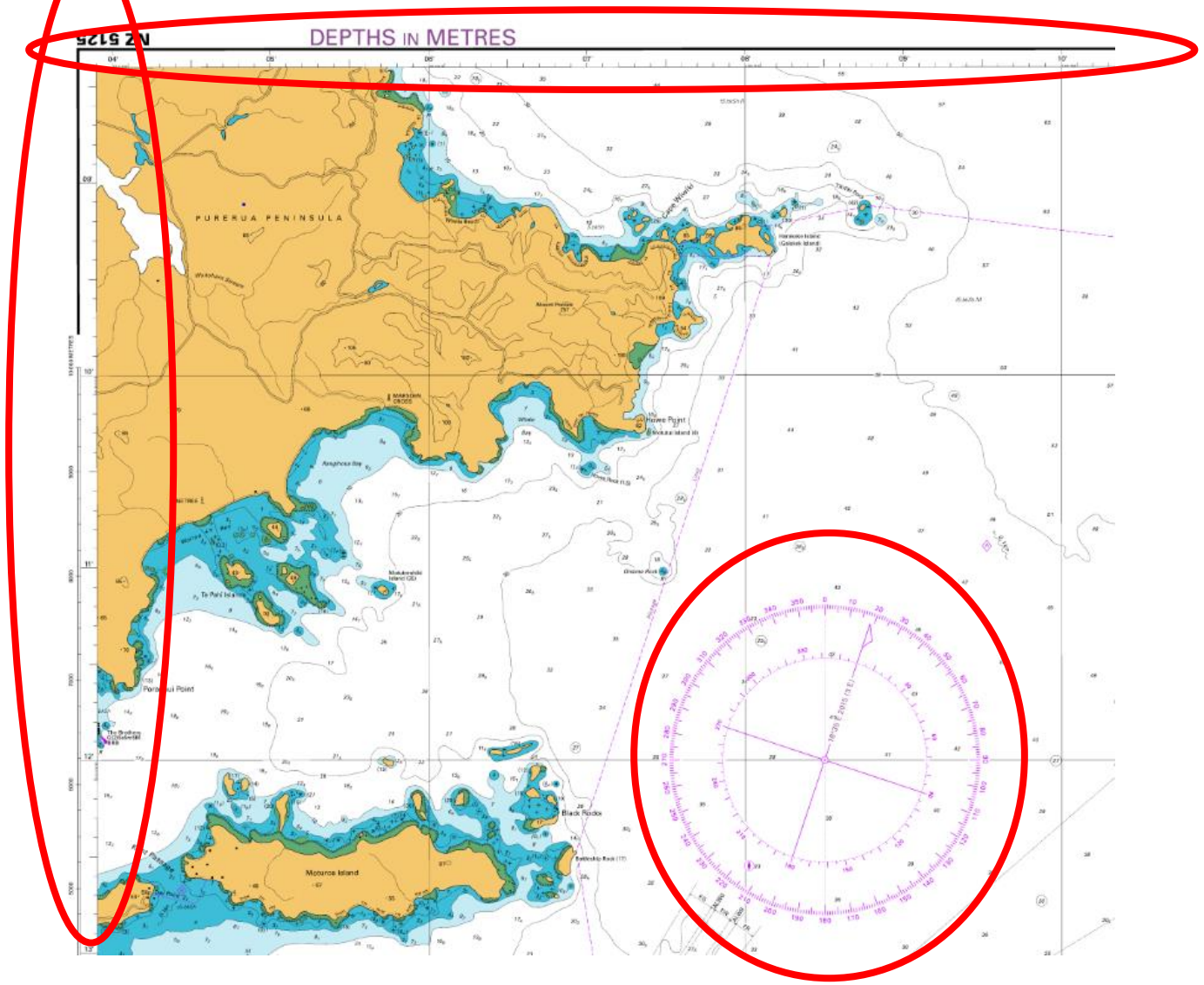

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Practice examples

1.Plot: 35^0 10.87 S 174^0 09.6 E

What is there ?

2.Plot: 35^0 11.38 S 174^0 12.0 E

What is there ?

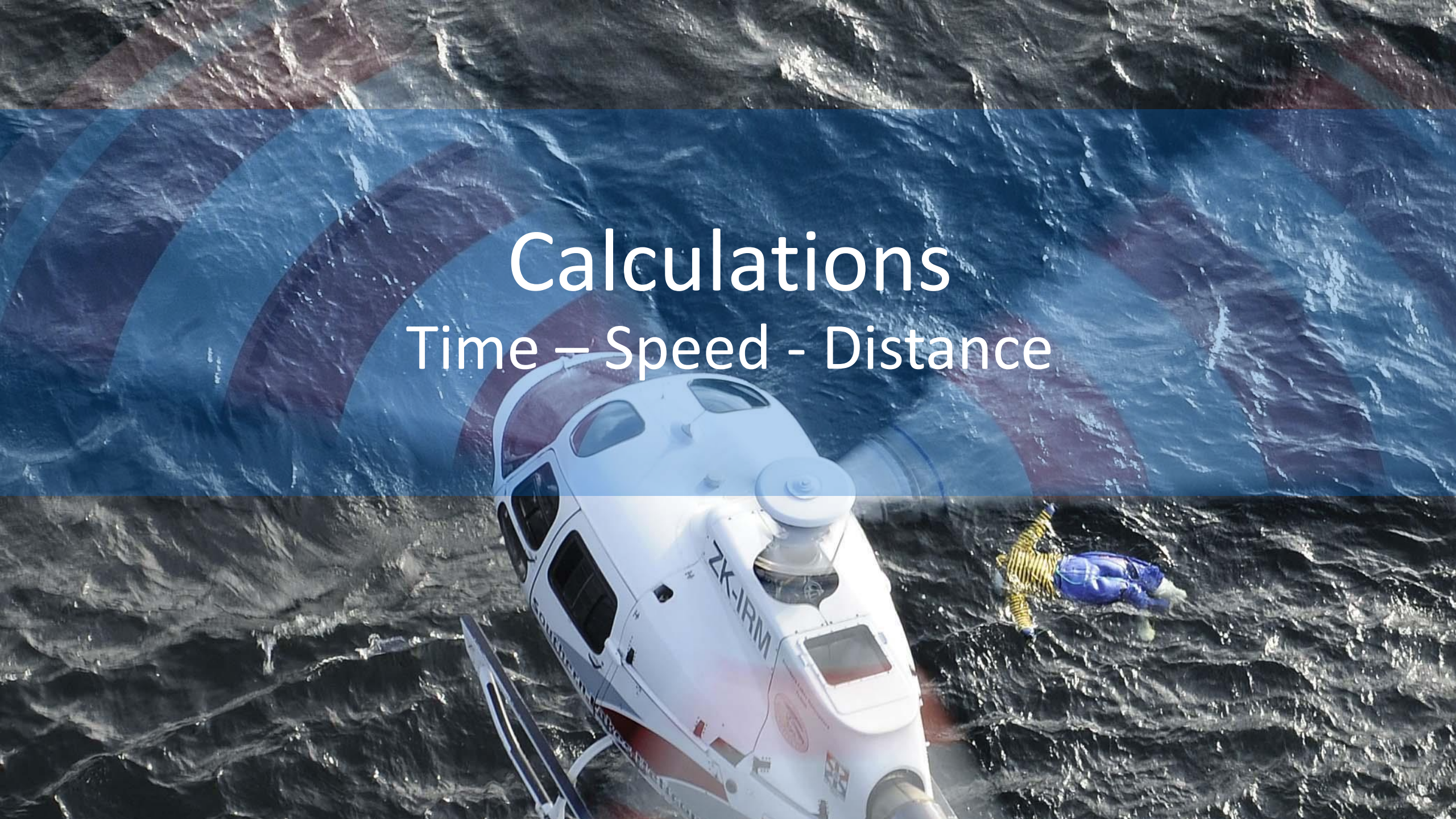
What is the distance between those two positions ?

3. Plot: From 35^0 12.0 S 174^0 08.5 E bearing 320^0T range 1.3 Nm

What is there ?

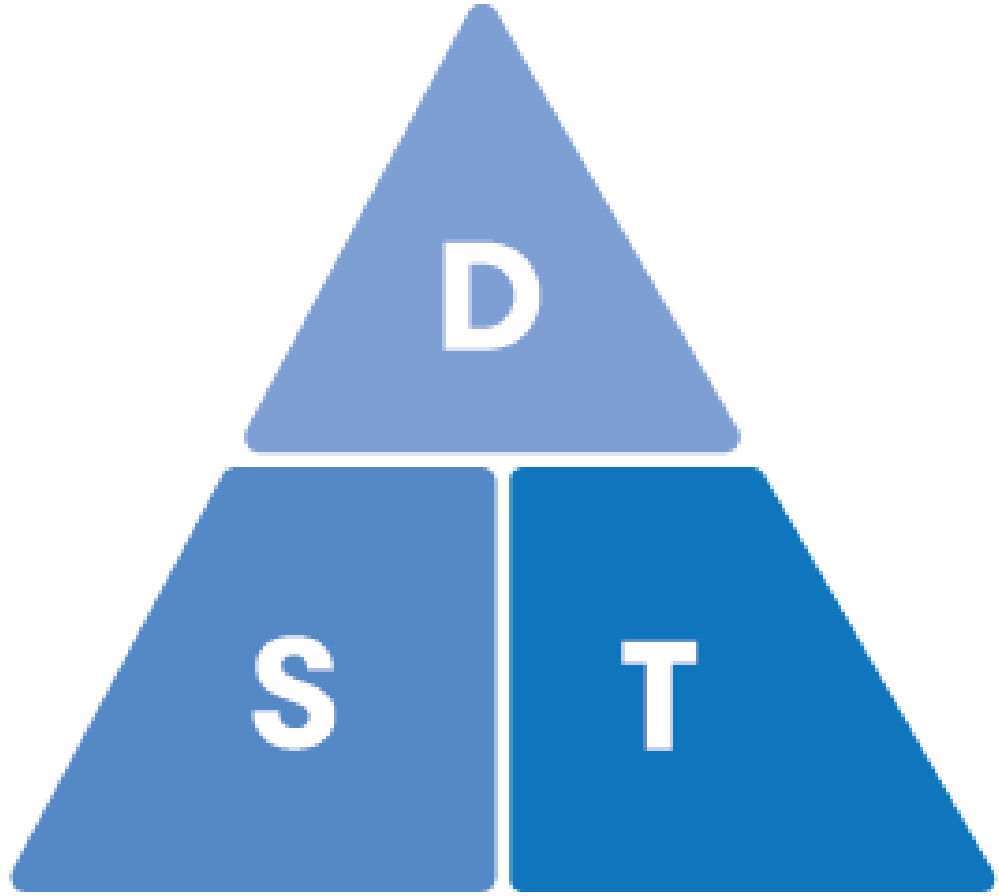
4. Plot from last position: range 3.5 Nm bearing 186^0T

What is there ?



Calculations

Time – Speed - Distance



D = Distance S = Speed T = Time

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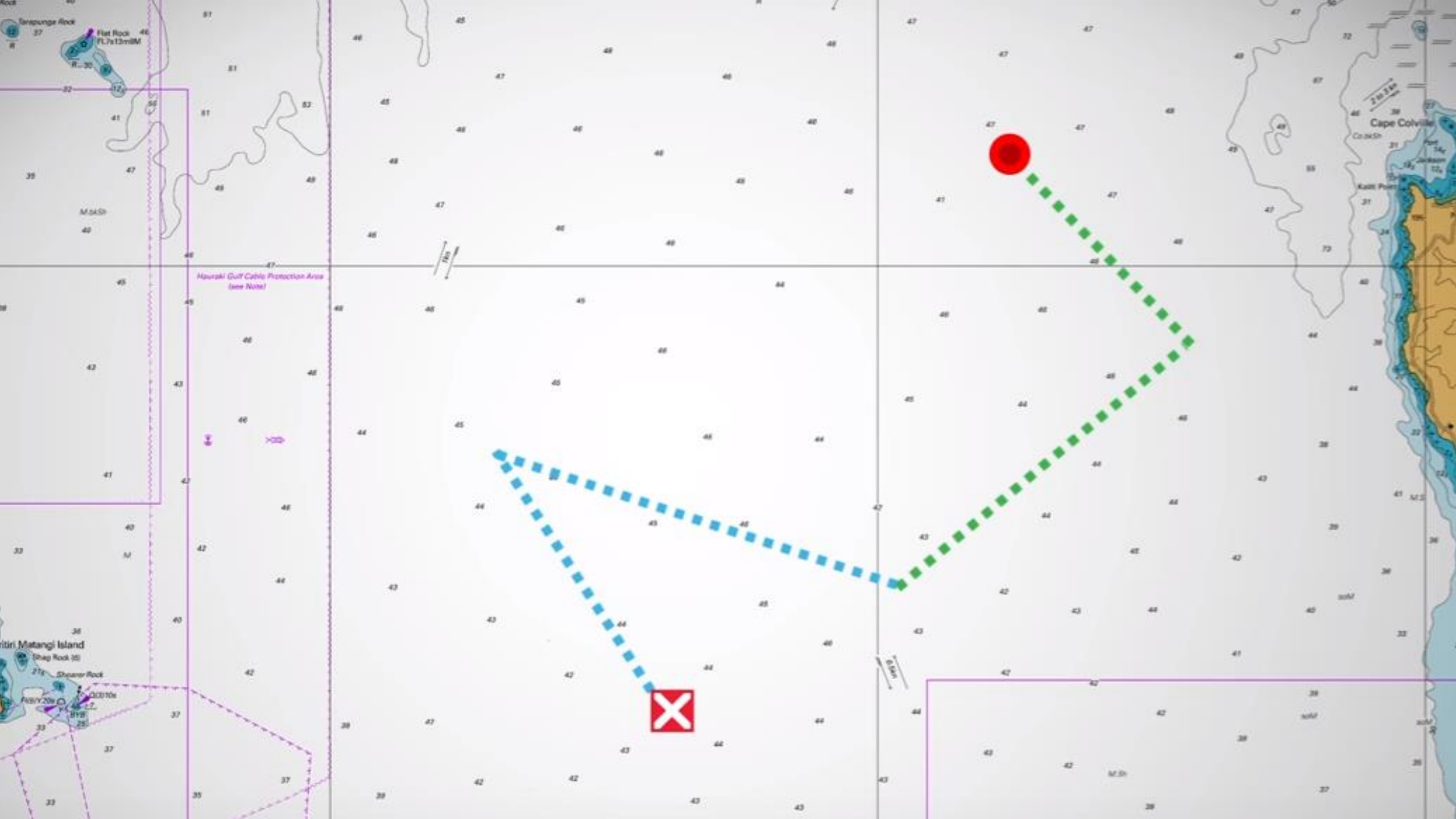
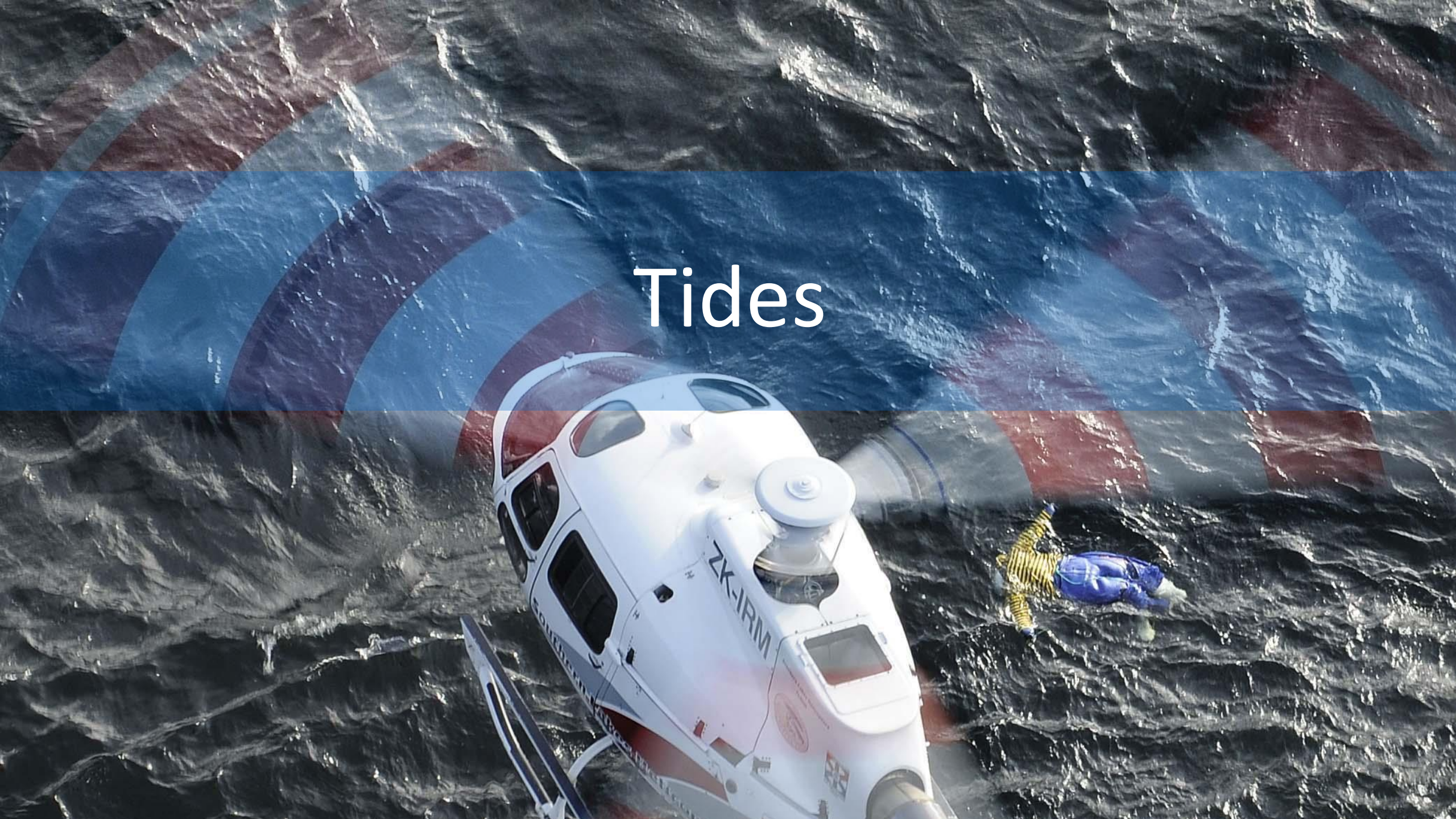
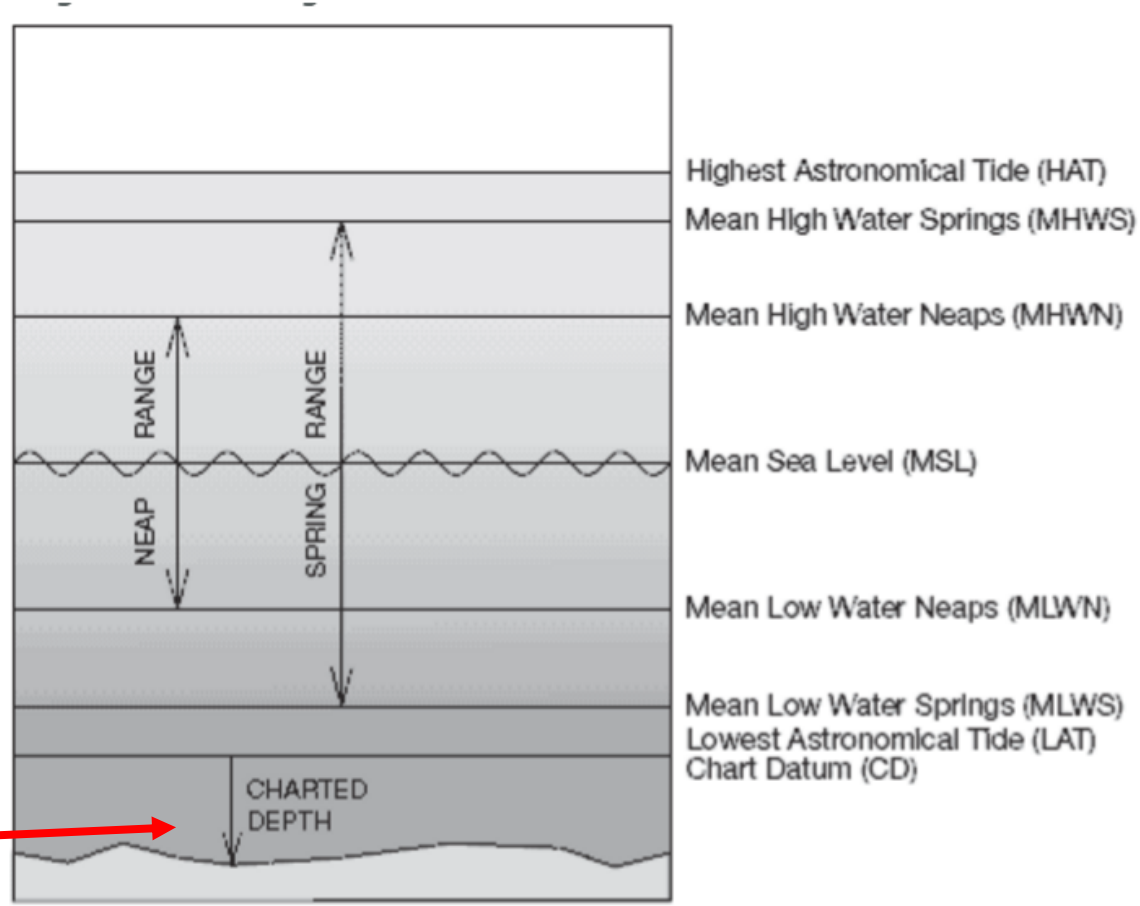
Plotting

Courses and Direction


Tarapunga Rock
Flat Rock
FL7s13mIIM
Cape Colville
Kaiiti Point
Hauraki Gulf Cable Protection Area
(see Note)
Shag Rock (S)
Shearer Rock
Oc(3)10s
BYB

Tides





LAT = Chart Datum
The tide state for chart depths

https://www.linz.govt.nz/sea/tides/introduction-tides/cause-and-nature-tides

https://www.linz.govt.nz/sea/tides/tide-predictions

Hours before or after High Water

Direction water is moving TOWARDS

Tide Diamond refers to location on chart

Rate (speed) water is moving (Nm per hour) in Knots

Tidal Streams referred to HW at AUCKLAND

Hours	Geographical Position	A 35°10′.90S 174°09′.50E		B 35°12′.70S 174°04′.40E		C 35°15′.00S 174°06′.00E		Hours
Directions of Streams (degrees)		Rates at Spring tides (knots)	Rates at Neap tides (knots)					
Before High Water 6	-6	071	0.1 0.0	278	0.1 0.1	275	0.1 0.1	-6
Before High Water 5	-5	225	0.1 0.0	317	0.1 0.1	223	0.1 0.1	-5
Before High Water 4	-4	207	0.1 0.0	314	0.4 0.3	172	0.3 0.2	-4
Before High Water 3	-3	243	0.1 0.1	315	0.5 0.3	169	0.3 0.2	-3
Before High Water 2	-2	194	0.2 0.1	321	0.2 0.1	163	0.4 0.3	-2
Before High Water 1	-1	226	0.2 0.1	262	0.1 0.1	152	0.3 0.2	-1
High Water 0	0	205	0.1 0.1	132	0.3 0.2	126	0.2 0.1	0
After High Water 1	+1	013	0.0 0.0	116	0.2 0.1	018	0.2 0.1	+1
After High Water 2	+2	012	0.2 0.1	114	0.2 0.1	000	0.3 0.2	+2
After High Water 3	+3	031	0.2 0.1	113	0.2 0.2	353	0.4 0.3	+3
After High Water 4	+4	041	0.2 0.1	134	0.4 0.3	344	0.4 0.3	+4
After High Water 5	+5	083	0.1 0.1	173	0.1 0.1	321	0.3 0.2	+5
After High Water 6	+6	098	0.1 0.0	223	0.1 0.1	313	0.2 0.2	+6

	D 35°14′.30S 174°12′.20E		E 35°13′.20S 174°14′.90E		F 35°10′.10S 174°20′.15E		G 35°09′.60S 174°20′.60E		
-6	287	0.1 0.0	173	0.2 0.1	101	0.5 0.4	114	0.4 0.3	-6
-5	288	0.1 0.1	159	0.4 0.3	119	0.2 0.1	116	0.3 0.2	-5
-4	257	0.1 0.1	158	0.4 0.3	204	0.2 0.2	101	0.1 0.1	-4
-3	282	0.1 0.1	164	0.5 0.3	291	0.3 0.2	337	0.2 0.1	-3
-2	272	0.1 0.0	166	0.5 0.3	304	0.7 0.5	292	0.4 0.3	-2
-1	218	0.1 0.0	159	0.2 0.1	305	0.6 0.4	301	0.6 0.4	-1
0	250	0.1 0.1	016	0.2 0.1	296	0.6 0.4	307	0.6 0.4	0
+1	133	0.0 0.0	333	0.3 0.2	284	0.4 0.3	284	0.3 0.2	+1
+2	081	0.1 0.1	341	0.6 0.4	173	0.1 0.1	095	0.1 0.0	+2
+3	066	0.1 0.1	337	0.6 0.4	133	0.4 0.3	146	0.3 0.2	+3
+4	079	0.1 0.1	342	0.3 0.2	118	0.6 0.4	128	0.4 0.3	+4
+5	092	0.1 0.0	315	0.1 0.1	107	0.8 0.5	114	0.4 0.3	+5
+6	154	0.0 0.0	115	0.1 0.0	102	0.6 0.4	113	0.4 0.3	+6

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Land Information New Zealand
Toitū te whenua

Sourced from http://www.linz.govt.nz/
E-mail address customersupport@linz.govt.nz

NEW ZEALAND HYDROGRAPHIC AUTHORITY TIDE PREDICTIONS

AUCKLAND

Lat. 36° 51' S Long. 174° 46' E

JANUARY 2015

N.Z. LOCAL TIMES AND HEIGHTS OF HIGH AND LOW WATERS

	Time	m		Time	m		Time	m		Time	m
1 Th	0444	3.0	**9** Fr	0441	0.6	**17** Sa	0506	2.8	**25** Su	0536	0.3
	1050	0.8		1109	3.1		1105	1.0		1208	3.6
	1709	3.1		1710	0.7		1715	2.9		1809	0.3
	2315	0.6		2332	3.0		2332	0.8			
2 Fr	0545	3.0	**10** Sa	0519	0.7	**18** Su	0605	2.9	**26** Mo	0031	3.4
	1149	0.8		1147	3.1		1202	0.9		0629	0.4
	1807	3.0		1750	0.8		1815	3.0		1300	3.5
										1902	0.4
3 Sa	0013	0.6	**11** Su	0010	3.0	**19** Mo	0029	0.7	**27** Tu	0124	3.3
	0643	3.1		0559	0.8		0700	3.1		0724	0.6
	1244	0.8		1225	3.0		1257	0.7		1353	3.3
	1902	3.0		1829	0.8		1914	3.1		1956	0.5
4 Su	0106	0.6	**12** Mo	0048	2.9	**20** Tu	0123	0.5	**28** We	0219	3.2
	0735	3.1		0640	0.8		0753	3.3		0823	0.7
	1335	0.8		1305	3.0		1350	0.6		1449	3.2
	1955	3.0		1911	0.9		2011	3.2		2052	0.6
5 Mo	0155	0.6	**13** Tu	0130	2.8	**21** We	0215	0.4	**29** Th	0319	3.1
	0823	3.2		0725	0.9		0845	3.4		0925	0.8
	1423	0.7		1347	2.9		1443	0.4		1546	3.1
	2044	3.1		1955	0.9		2105	3.3		2151	0.7
6 Tu	0241	0.6	**14** We	0216	2.8	**22** Th	0306	0.3	**30** Fr	0420	3.0
	0908	3.2		0814	1.0		0935	3.6		1027	0.9
	1508	0.7		1433	2.9		1535	0.3		1645	3.0
	2130	3.1		2043	0.9		2157	3.5		2251	0.8
7 We	0323	0.6	**15** Th	0307	2.7	**23** Fr	0356	0.2	**31** Sa	0522	3.0
	0950	3.2		0909	1.0		1026	3.6		1127	0.9
	1550	0.7		1522	2.8		1626	0.3		1744	2.9
	2213	3.1		2136	0.9		2248	3.5		2350	0.8
8 Th	0403	0.6	**16** Fr	0405	2.8	**24** Sa	0446	0.2			
	1031	3.2		1007	1.0		1116	3.6			
	1631	0.7		1617	2.8		1718	0.2			
	2253	3.0		2233	0.9		2339	3.5			

TIMES LISTED ARE N.Z. DAYLIGHT TIME

Land Information New Zealand
Toitū te whenua

Sourced from http://www.linz.govt.nz/
E-mail address customersupport@linz.govt.nz

NEW ZEALAND HYDROGRAPHIC AUTHORITY TIDE PREDICTIONS

AUCKLAND

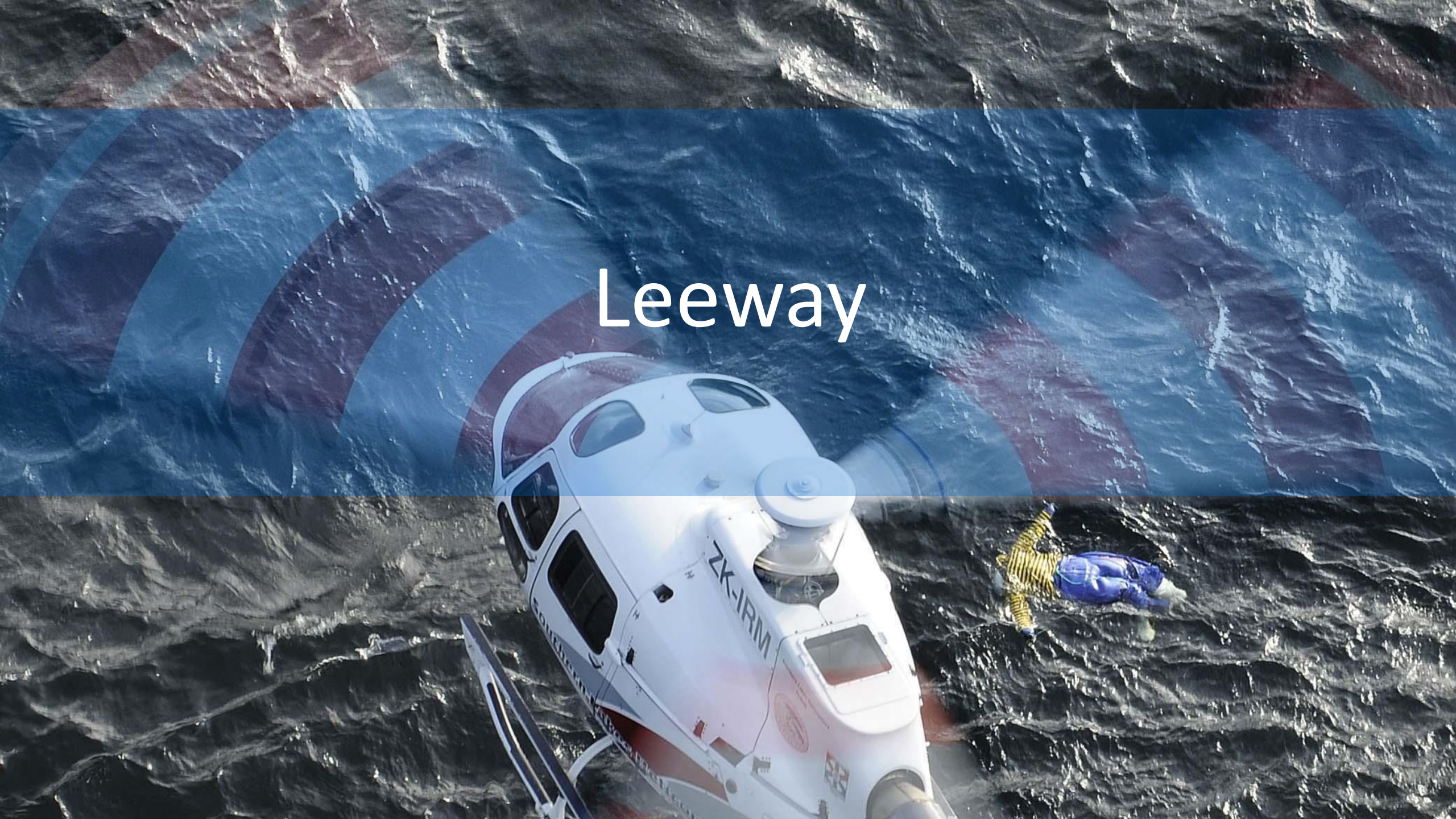
Lat. 36° 51' S Long. 174° 46' E

JANUARY 2015

N.Z. LOCAL TIMES AND HEIGHTS OF HIGH AND LOW WATERS

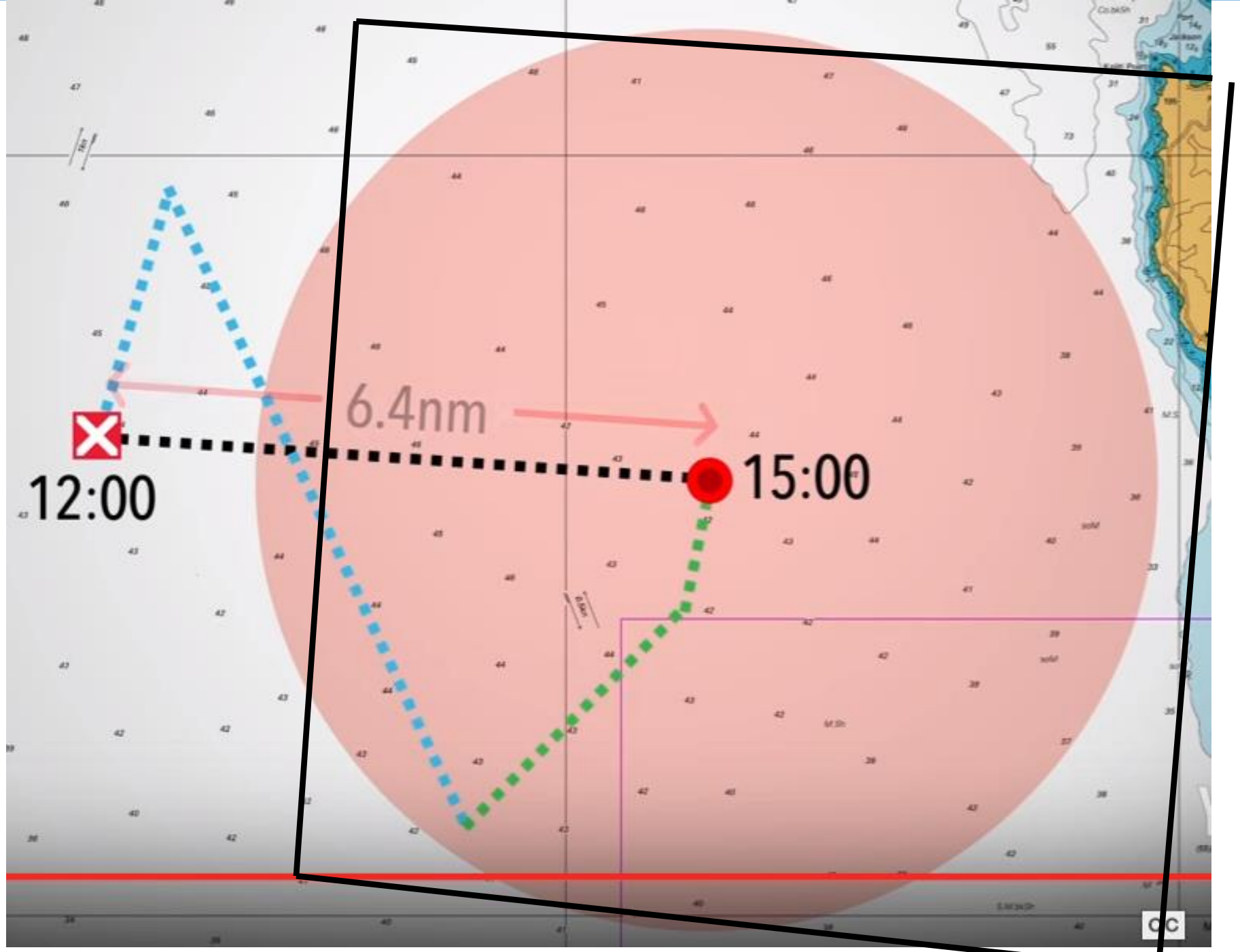
	Time	m		Time	m		Time	m		Time	m
1 Th	0444	3.0	**9** Fr	0441	0.6	**17** Sa	0506	2.8	**25** Su	0536	0.3
	1050	0.8		1109	3.1		1105	1.0		1208	3.6
	1709	3.1		1710	0.7		1715	2.9		1809	0.3
	2315	0.6		2332	3.0		2332	0.8			
2 Fr	0545	3.0	**10** Sa	0519	0.7	**18** Su	0605	2.9	**26** Mo	0031	3.4
	1149	0.8		1147	3.1		1202	0.9		0629	0.4
	1807	3.0		1750	0.8		1815	3.0		1300	3.5
										1902	0.4
3 Sa	0013	0.6	**11** Su	0010	3.0	**19** Mo	0029	0.7	**27** Tu	0124	3.3
	0643	3.1		0559	0.8		0700	3.1		0724	0.6
	1244	0.8		1225	3.0		1257	0.7		1353	3.3
	1902	3.0		1829	0.8		1914	3.1		1956	0.5

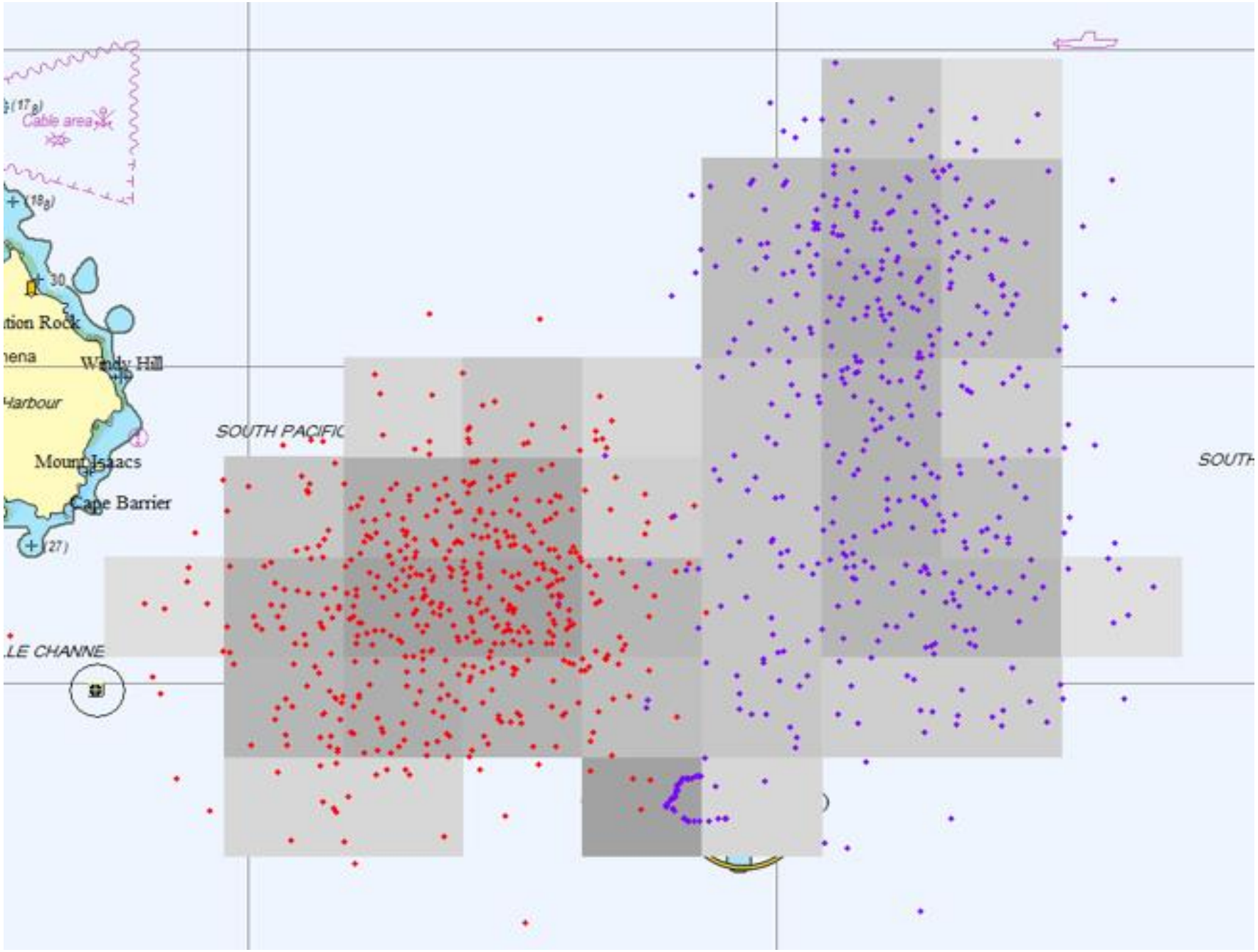
Leeway



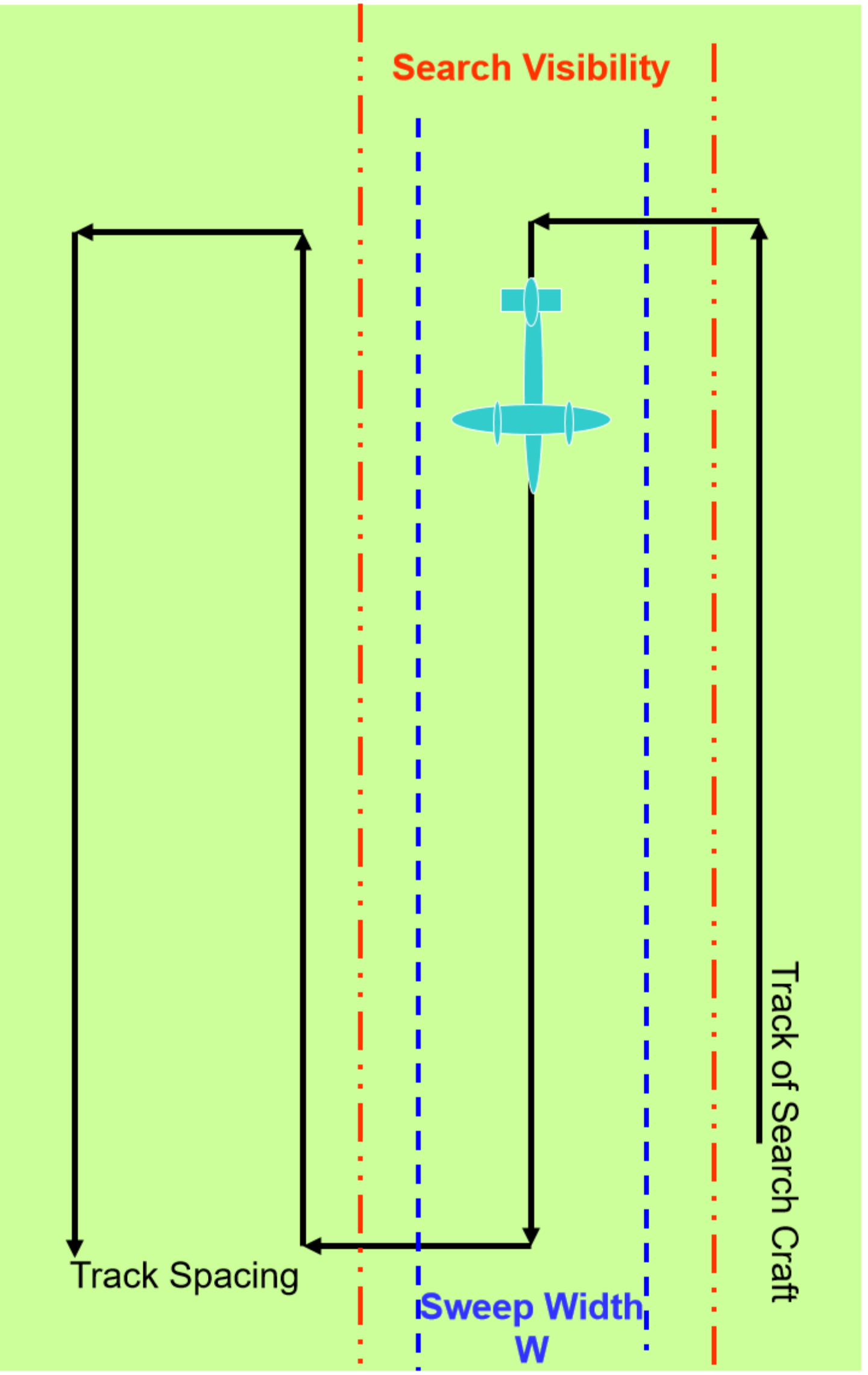
LEEWAY TARGET CLASS				Leeway Speed		Divergence
Category	**Sub Categories**	**Primary Leeway Descriptors**	**Secondry Leeway Descriptors**	**Multiplier**	**Modifier (kts)**	**Angle (deg)**
PIW				0.011	0.070	30
	Vertical			0.005	0.070	18
	Sitting			0.012	0.000	18
	Horizontal	Survival Suit		0.014	0.100	30
		Scuba Suit		0.007	0.080	30
		Deceased		0.015	0.080	30
Survival Craft	Maritime Life Rafts			0.042	0.030	28
		No Ballast Systems	no canopy, no drogue	0.057	0.210	24
			no canopy, w/ drogue	0.044	-0.200	28
			canopy, no drogue	0.037	0.110	24
			caopy, w/ drogue	0.030	0.000	28
		Shallow Ballast Systems and Canopy		0.029	0.000	22
			no drogue	0.032	-0.020	22
			with drogue	0.025	0.010	22
			capzised	0.017	-0.100	8
		Deep Ballast Systems & Canopies	(See Table 1-2 for Levels 4-6)	0.030	0.020	13
	Other Maritime Survival Craft	Life Capsule		0.038	-0.080	22
		USCG Sea Rescue Kit		0.025	-0.040	7
	Aviation Life Rafts	no bllast, w/ canopy Evac Slide	4-6 person w/o drogue	0.037	0.110	24
			46 person	0.028	-0.010	15
Person Powered Craft	Sea Kayak	W/ person of aft deck		0.011	0.240	15
	Surf Board	W/ person of aft deck		0.020	0.000	15
	Windsurfer	w/ person and mast & sail in water		0.023	0.100	12
Sailing Vessels	Mono Hull	Full Keel	Deep Draft	0.030	0.000	48
		Fin Keel	Shoal Draft	0.040	0.000	48
Power Vessels	Skiffs	Flat Bottom	Boston whaler	0.034	0.040	22
		V-Hull	Std Configuration	0.030	0.080	15
			Swamped	0.017	0.000	15
	Sport Boats	Cuddy Cabin	Modified V Hull	0.069	-0.080	19
	Sport Fisher	Center Console	Open Cockpit	0.060	-0.090	22
Power Vessels	Commercial Fishing Vessels			0.037	0.020	48
		Sampans		0.040	0.000	48
		Side Stern Trawler		0.042	0.000	48
		Longliners		0.037	0.000	48
		Junk		0.027	0.100	48
		Gill netter	w/rear reel	0.040	0.010	33
	Coastal Freighter			0.028	0.000	48
Boating Debris	F/V Debris			0.020	0.000	10
	Bait/Wharf Box holds a cubic meter of ice			0.013	0.270	31
		Lightly loaded		0.026	0.180	15
		Fully loaded		0.016	0.160	33

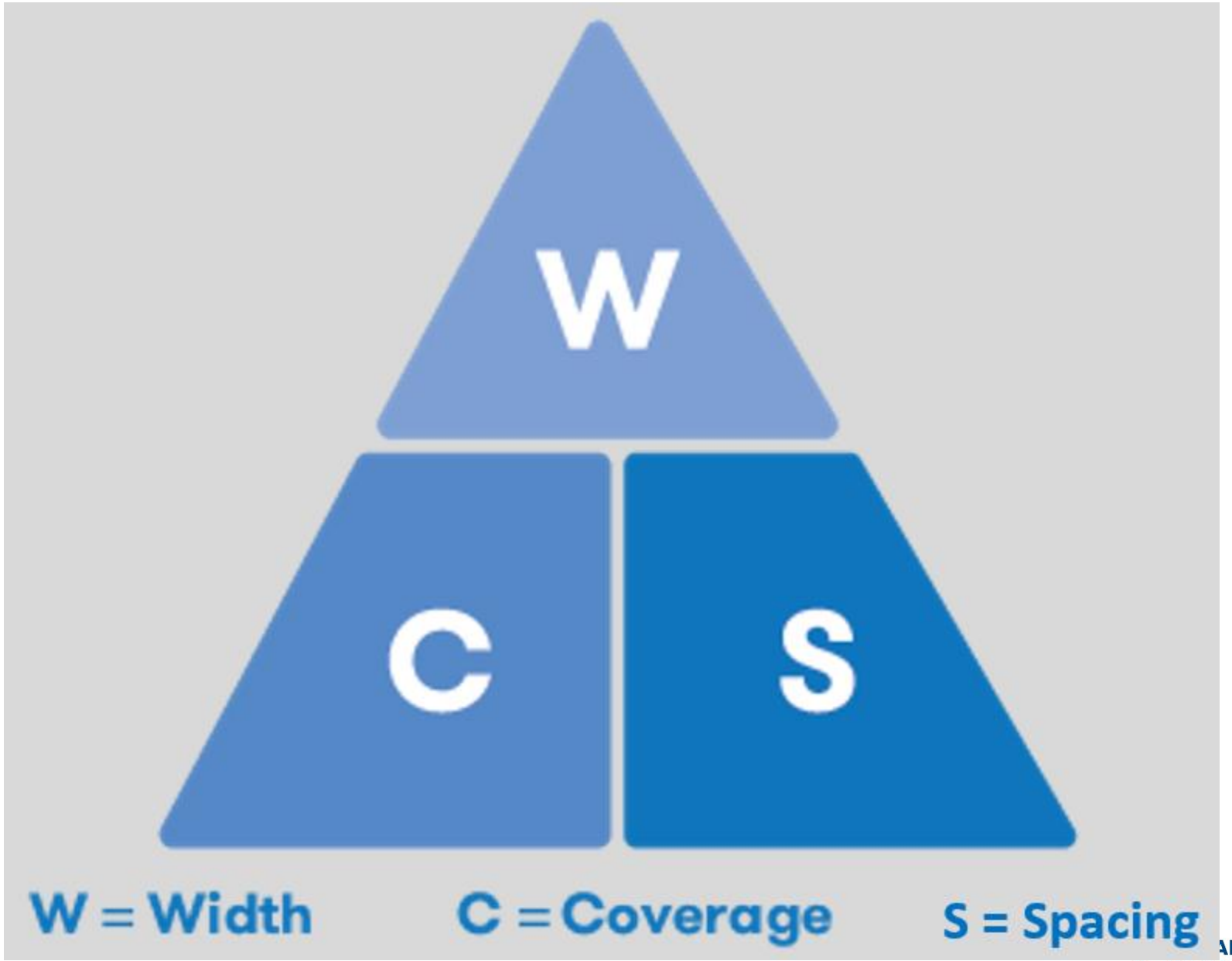
Search Area Determination


6.4nm
12:00
15:00


Cable area
Mount Isaacs
Cape Barrier
SOUTH PACIFIC

Coverage Factor


Search Visibility
Track Spacing
Sweep Width
W
Track of Search Craft


W
C
S
W = Width
C = Coverage
S = Spacing

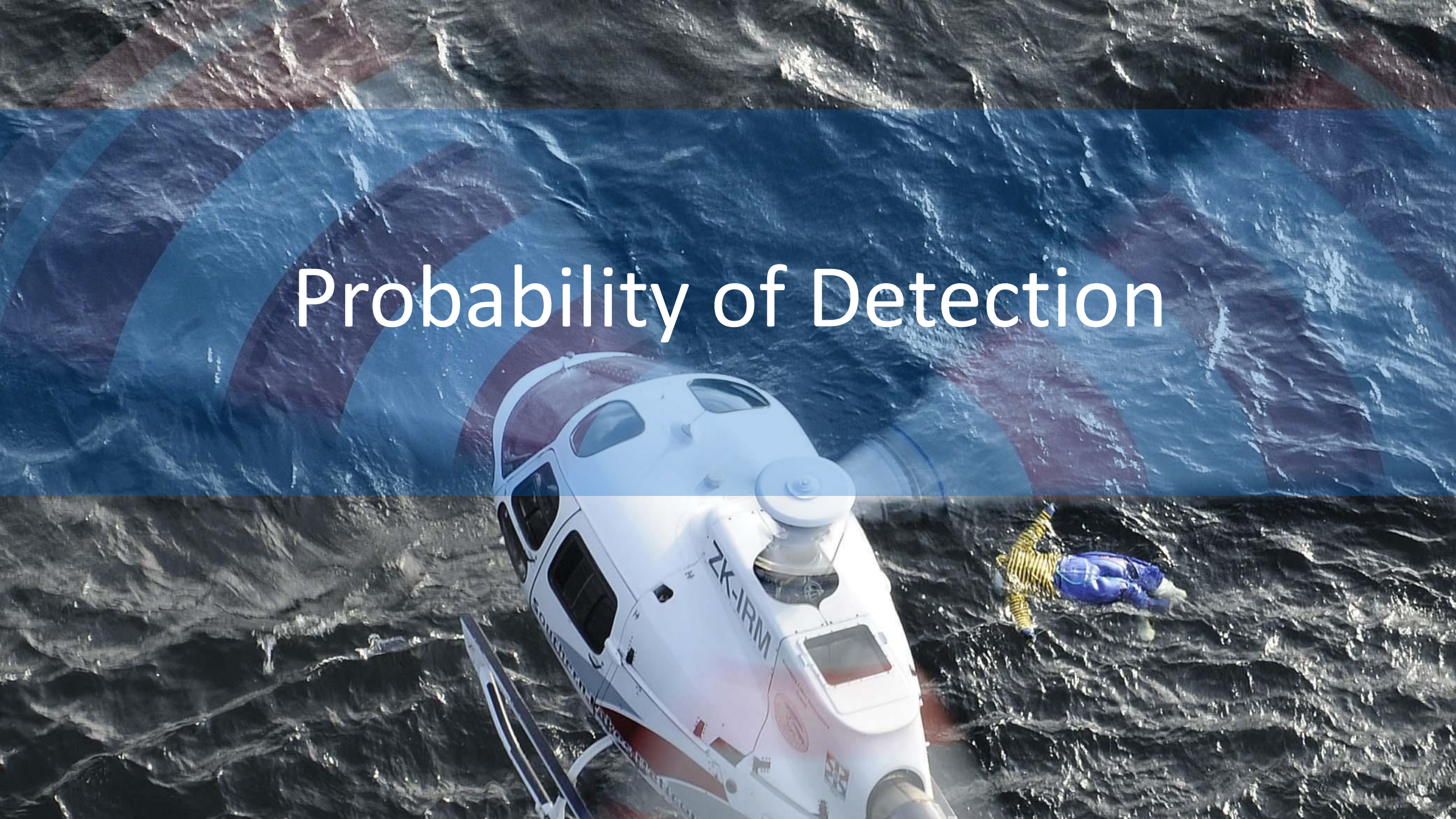
Search Object	UNCORRECTED VISUAL SWEEP WIDTH											
	Height of Eye 8' (1.8 METRES)						Height of Eye 14' (4.2 Metres)					
	Visibility in NM						Visibility in NM					
	1	3	5	10	15	20	1	3	5	10	15	20
Person in Water	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.4	0.5	0.5	0.5	0.5
Raft 1 Person	0.7	1.3	1.7	2.3	2.6	2.7	0.9	1.8	2.3	3.1	3.4	3.7
Raft 4 Person	0.7	1.7	2.2	3.1	3.5	3.9	1	2.2	3	4	4.6	5
Raft 6 Person	0.8	1.9	2.6	3.6	4.3	4.7	1.1	2.5	3.4	4.7	5.5	6
Raft 8 Person	0.8	2	2.7	3.8	4.4	4.9	1.1	2.5	3.5	4.8	5.7	6.2
Raft 10 Person	0.8	2	2.8	4	4.8	5.3	1.1	2.6	3.6	5.1	6.1	6.7
Raft 15 Person	0.9	2.2	3	4.3	5.1	5.7	1.1	2.8	3.8	5.5	6.5	7.2
Raft 20 Person	0.9	2.3	3.3	4.9	5.8	6.5	1.2	3	4.1	6.1	7.3	8.1
Raft 25 Person	0.9	2.4	3.5	5.2	6.3	7	1.2	3.1	4.3	6.4	7.8	8.7
Power Boat <15'	0.4	0.8	1.1	1.5	1.6	1.8	0.5	1.1	1.4	1.9	2.1	2.3
Power Boat 15'-25'	0.8	1.5	2.2	3.3	4	4.5	1	2	2.9	4.3	5.2	5.8
Power Boat 25'-40'	0.8	1.9	2.9	4.7	5.9	6.8	1.1	2.5	3.8	6.1	7.7	8.8
Power Boat 40'-65'	0.9	2.4	3.9	7	9.3	11.1	1.2	3.1	5.1	9.1	12.1	14.4
Power Boat 65'-90'	0.9	2.5	4.3	8.3	11.4	14	1.2	3.2	5.6	10.7	14.7	18.1
Sail Boat 15'	0.8	1.5	2.1	3	3.6	4	1	1.9	2.7	3.9	4.7	5.2
Sail Boat 20'	0.8	1.7	2.5	3.7	4.6	5.1	1	2.2	3.2	4.8	5.9	6.6
Sail Boat 25'	0.9	1.9	2.8	4.4	5.4	6.3	1.1	2.4	3.6	5.7	7	8.1
Sail Boat 30'	0.9	2.1	3.2	5.3	6.6	7.7	1.1	2.7	4.1	6.8	8.6	10
Sail Boat 40'	0.9	2.3	3.8	6.6	8.6	10.3	1.2	3	4.9	8.5	11.2	13.3
Sail Boat 50'	0.9	2.4	4	7.3	9.7	11.6	1.2	3.1	5.2	9.4	12.5	15
Sail Boat 65'-75'	0.9	2.5	4.2	7.9	10.7	13.1	1.2	3.2	5.5	10.2	13.9	16.9
Sail Boat 75'-90'	0.9	2.5	4.4	8.3	11.6	14.2	1.2	3.3	5.7	10.8	15	18.4

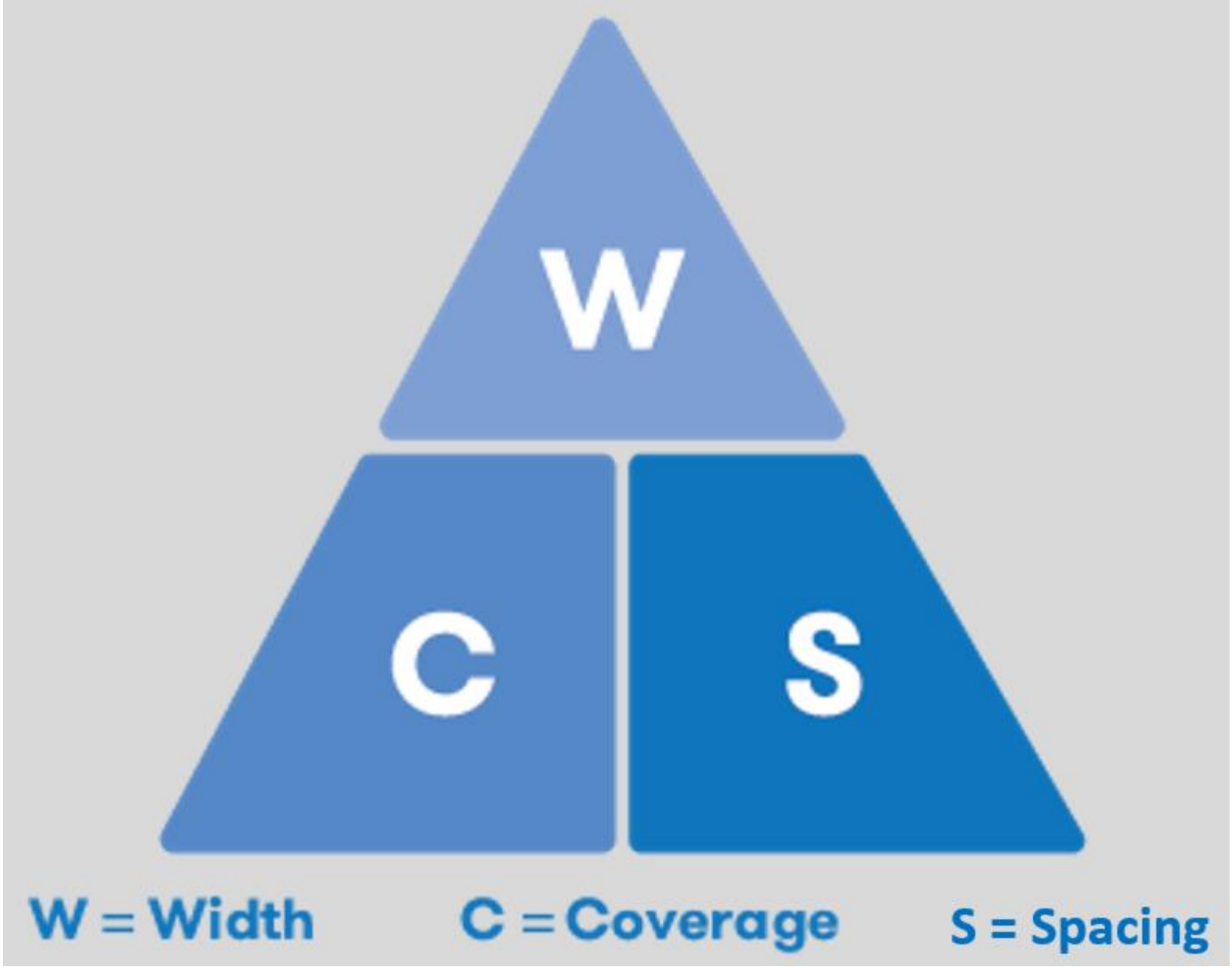
Weather Correction	
Winds > 15 kts Seas 2-3 ft	Winds > 25 kts Seas >4 ft
0.5	0.25
0.5	0.25
0.5	0.25
0.5	0.25
0.5	0.25
0.5	0.25
0.5	0.25
0.5	0.25
0.5	0.25
0.5	0.25
0.5	0.25
0.5	0.25
0.5	0.25
0.9	0.9
0.9	0.9
0.9	0.9
0.5	0.25
0.5	0.25
0.5	0.25
0.9	0.9
0.9	0.9
0.9	0.9
0.9	0.9
0.9	0.9

Search Area Determination

Trackline Overdue
Position Uncertainty
Time Uncertainty

Probability of Detection

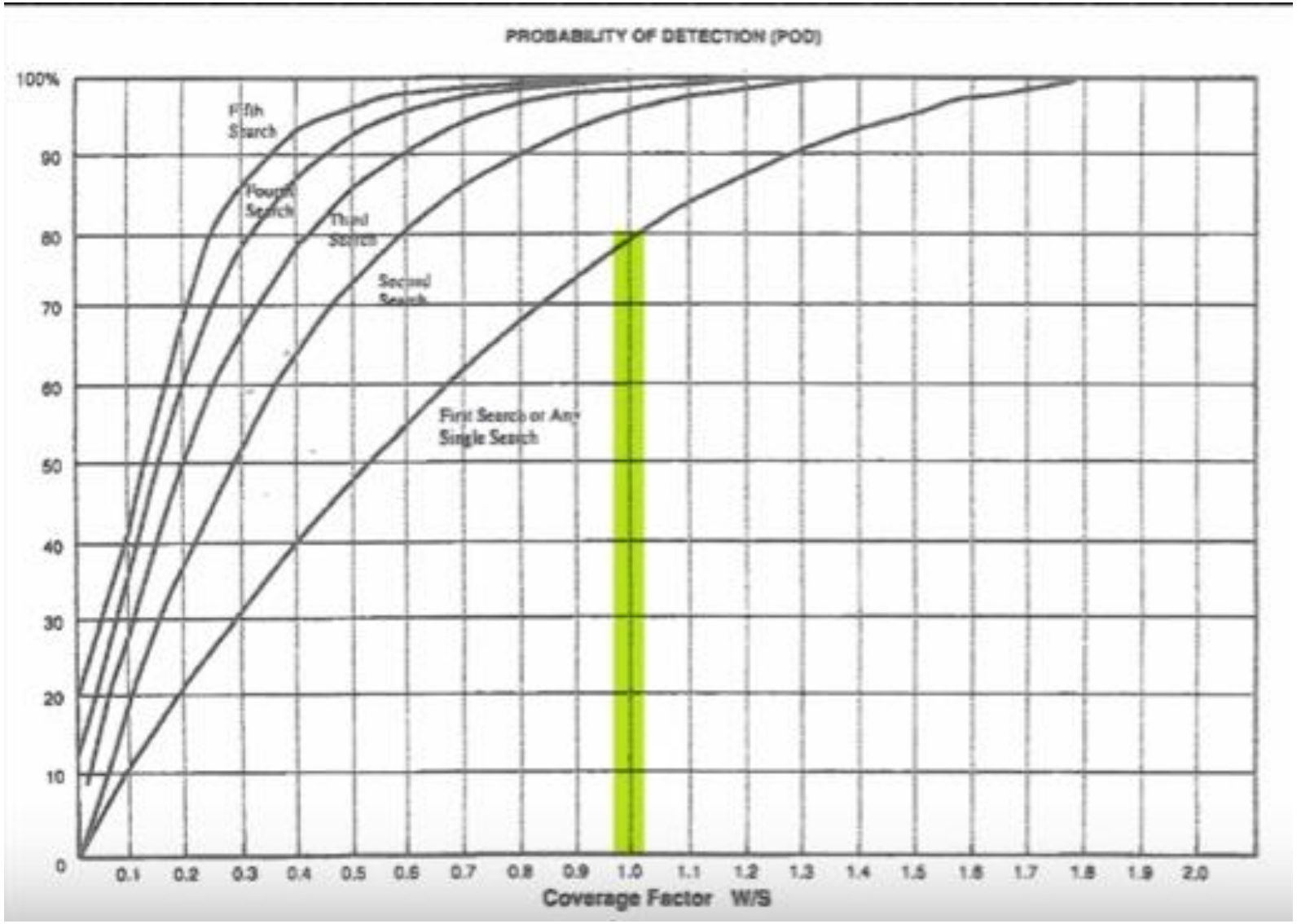



W
C
S
W = Width
C = Coverage
S = Spacing

Coverage Factor / Probability of Detection

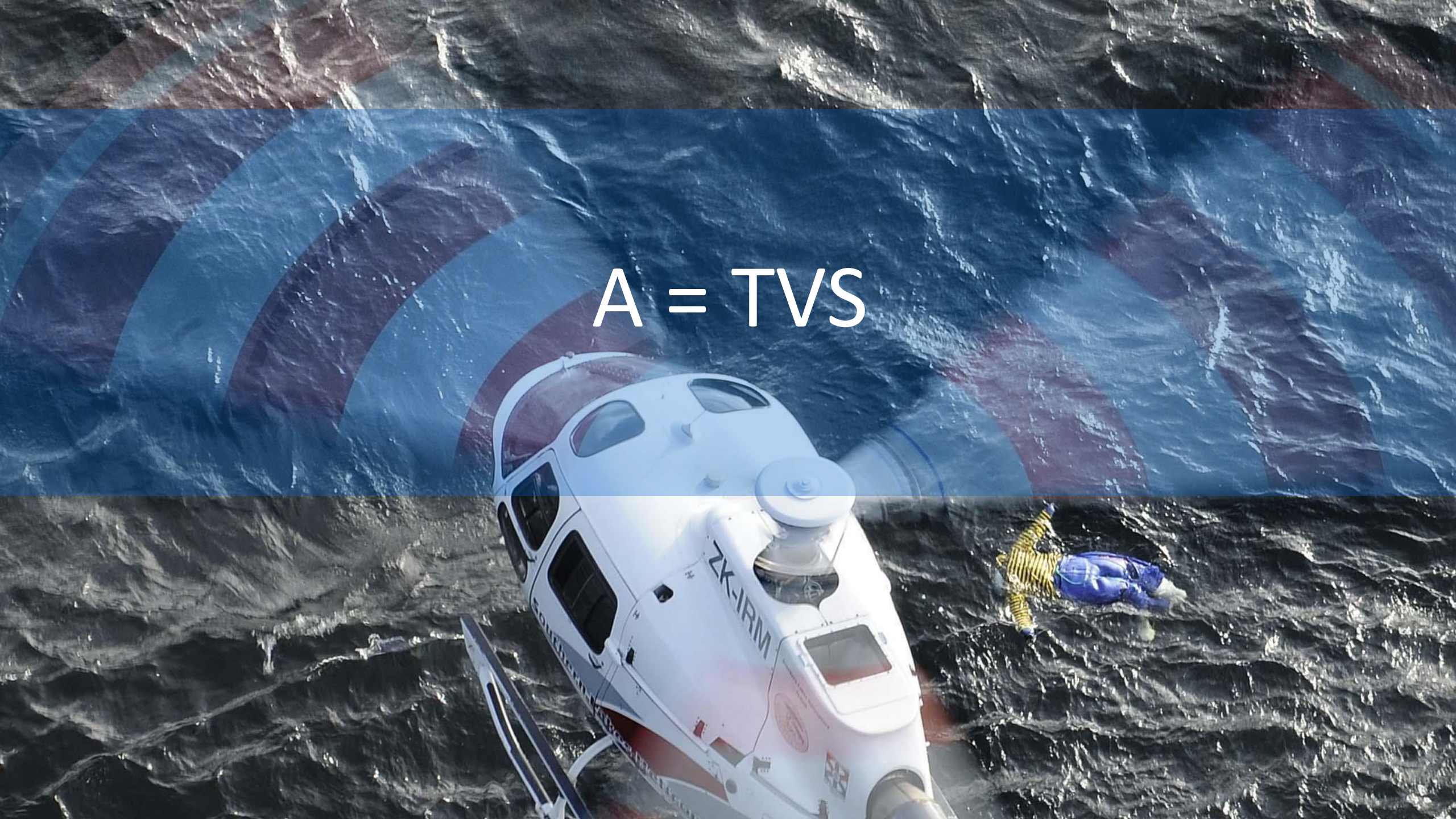
- To increase POD:
  - Multiple searches of same area
  - Reduce track spacing
  - Aviation and maritime search of same area.
- C = 1
  - POD 1st Search 79%
  - POD 2nd Search 96%
- Cumulative POD Cm = n **C1 + ……..Cn**

NEW ZEALAND
SEARCH AND RESCUE
Rapu Whakarauora Aotearoa



NEW ZEALAND
SEARCH AND RESCUE
Rapu Whakarauora Aotearoa

A = TVS



Factors and Formulas

- T = A / (V x S)
- V = A / (T x S)
- S = A / (T x V)

- A = Area to be searched in nm^2
- T = Time in decimals of hours
- V = Velocity is the sum of speed of search vessels
- S = Track spacing in nm

Total Vector

Vector	Direction (deg)	Rate (Nm)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
	Total Direction:	
	Total Distance:	

Other Calculations

Total Water Current

- Flow rate (Kts)
- Time (dec hrs)
- Tide direction (deg)

Leeway

- Wind speed (Kts)
- Multiplier
- Modifier
- *Result (Kts)*
- Time (dec hrs)
- Wind direction (deg)

Search Area Radius

- TDV (Nm)
- Unmodified radius (Nm)
- Modified radius (Nm)
- Search Area (Nm^2)

Distance / Time

- Distance (Nm)
- Speed (Kts)
- Time (dec hrs)

Coverage Factor

- Uncorrected Sweep Width (Nm)
- Weather correction
- Fatigue
- Corrected Sweep Width
- Coverage (%)
- Track Spacing (Nm)

Area / Time

- Area (Nm^2)
- Time (dec hrs)
- Velocity (Kts)
- Track Spacing (Nm)

Conversions

Distance / Speed

- Nm/Kts to Km/Kph
- Km/Kph to Nm/Kts

Time Format

- hh:mm to hh.hh
- hh.hh to hh:mm

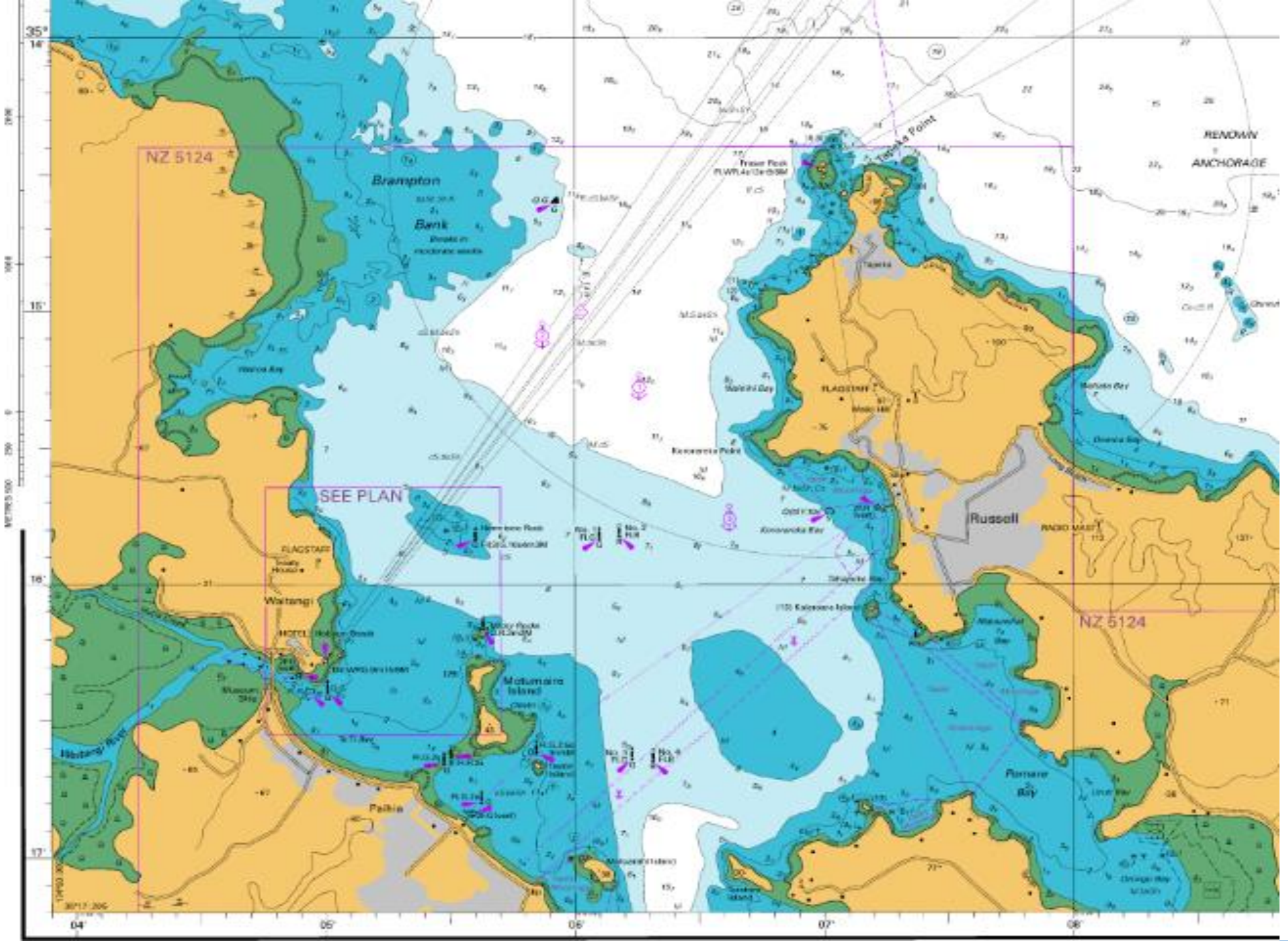
Time Difference	*Date*	*Time*
IPP time		
Search start		
Difference (hh:mm)		
Difference (hh.hh)		

Coordinates	*D*	*M*	*S*	*D*	*M.mm*
Latitude					
Longitude					

Latitude		
Longitude		

NEW ZEALAND
SEARCH AND RESCUE
Rapu Whakarauora Aotearoa

Assessment


NZ 5124
SEE PLAN
Brampton Bank
Waitangi
Matauwhi Island
Paihia
Russell
Tapeka Point
RENDEZVOUS ANCHORAGE
FLAGSTAFF
RADIO MAST
Waitangi River
Parnaire Bay
35°
14'
15'
16'
17'
04'
05'
06'
07'
08'