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Example NTWC SOP - Australia

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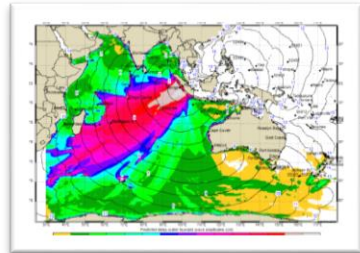
ICG Indian Ocean Tsunami Warning & Mitigation System SOP Workshops July 2023:

*Standard Operating Procedures (SOPs) for
National Tsunami Warning Centres (NTWCs) and
Disaster Management Organisations (DMOs)*

Joint Australian Tsunami Warning Centre



JATWC



Tsunami Scenario Database using **MOST** model

ATWS Project
(2005-2009)



Australian Deep Ocean and Coastal Sea Level Monitoring Network - **ASLOS**

IOTWMS
Indian Ocean
Tsunami
Warning &
Mitigation
System
(IOTWMS)



Bureau of Meteorology

Geoscience Australia

ATWS
Australian
Tsunami
Warning System
(ATWS)

As one of the three designated Tsunami Service Providers (TSPs) for IOTWMS

Issue Earthquake and Tsunami Bulletins to NTWCs in the IOTWMS

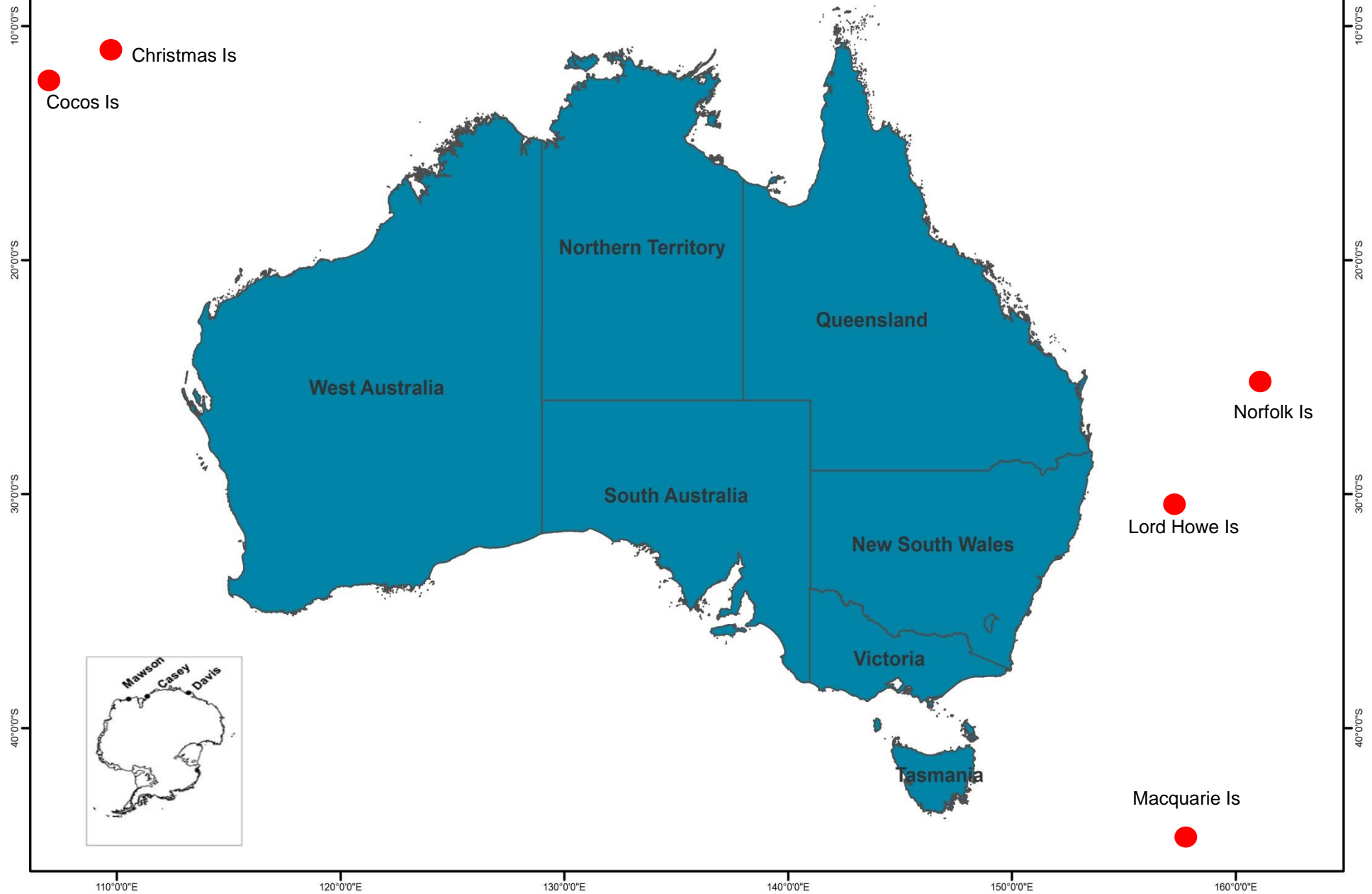
JATWC (2008 – present)
Jointly operated by the **Bureau of Meteorology** and **Geoscience Australia**

As national tsunami warning authority for Australia

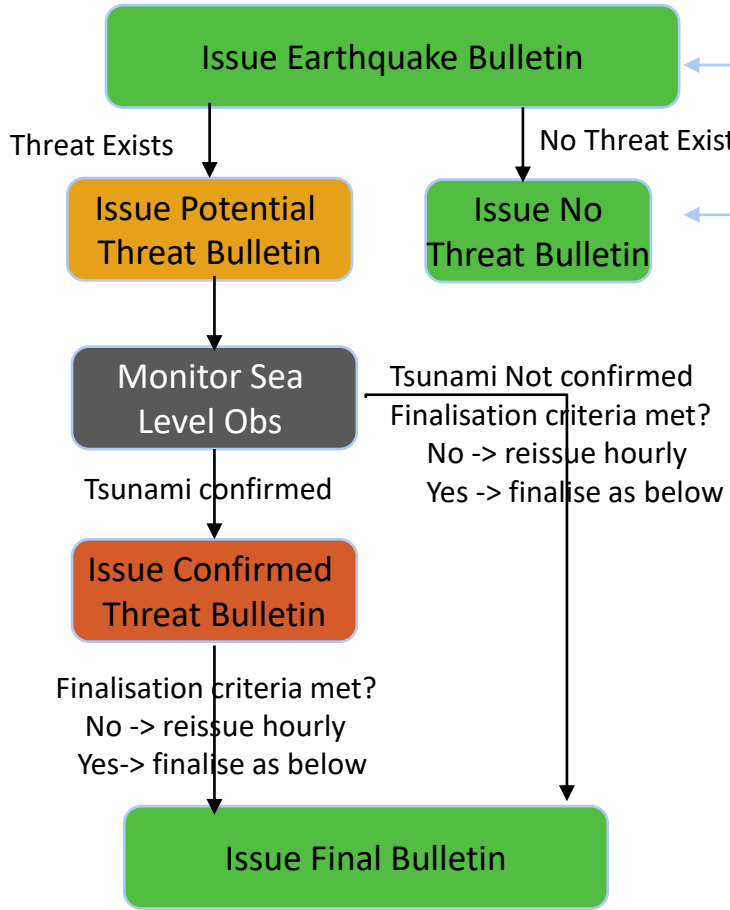
Issue Tsunami Warnings to Australian communities

NTWCs = National Tsunami Warning Centres

Australian Mainland and Offshore Islands/Territories



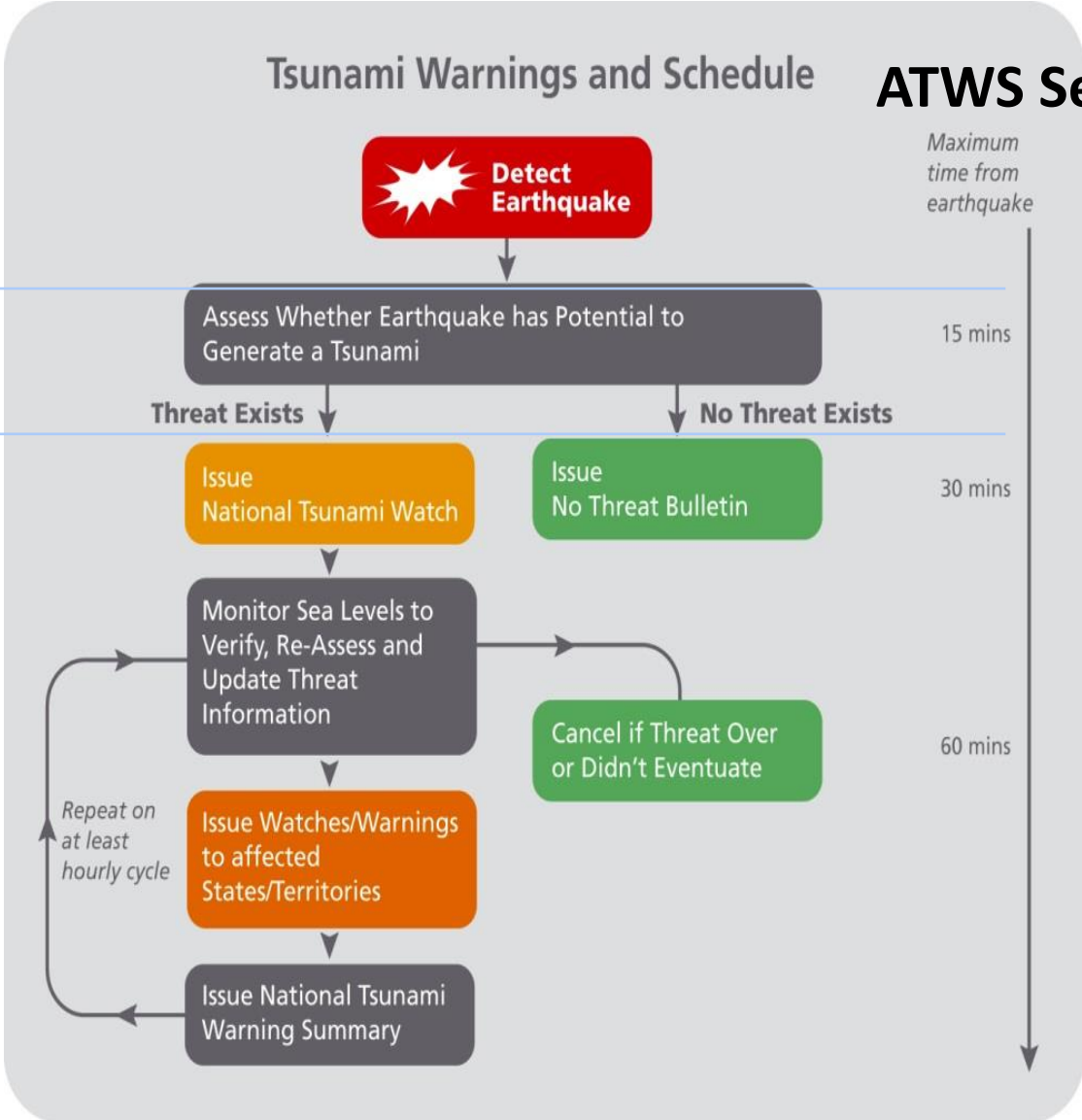
TSP Services



10min
20min

Tsunami Warnings and Schedule

ATWS Services



Maximum time from earthquake

15 mins

30 mins

60 mins

Seismic Tsunamis

With a matching scenario from pre-computed database

Tsunami Threat Classification	95 th Percentile Deep Water Threshold Value	Indicative Threshold Value in shallow water (~ 5m depth)
No Threat	<20cm (Australian continent, and Antarctica) <10cm (Offshore Territories)	<40cm
Marine Threat	20 – 55cm (Australian continent, and Antarctica) 10 – 50cm (Offshore territories)	40cm – 1m
Land Inundation Threat	>55cm (Australian continent, and Antarctica) >50cm (Offshore territories)	> 1m

Without a matching scenario

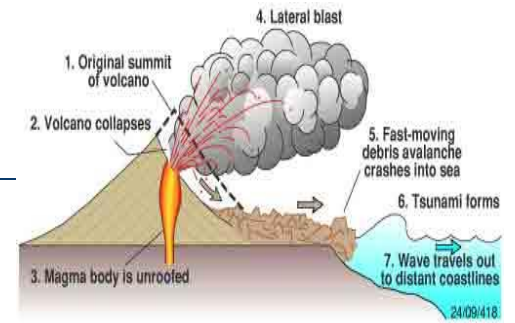
Mag	Action
6.5 to 7.5	The threat area is defined to be within the 1 hour travel time isochrone
7.6 to 7.8	The threat area is defined to be within the 3 hour travel time isochrone
7.9 and above	The threat area is defined to be within the 6 hour travel time isochrone

Non-Seismic Tsunamis

Define a severity level of 1, 3 or 6 corresponding to TTT hours

Severity	Action
Level 1	The threat area is defined to be within the 1 hour travel time isochrone
Level 3	The threat area is defined to be within the 3 hour travel time isochrone
Level 6	The expanding threat area is defined by the elapsed time since event + 6 hour travel time isochrone

Volcanically Generated Tsunamis



VEI	0	1	2	3	4	5	6	7	8
General Description	Non-Explosive	Small	Moderate	Moderate-Large	Large	Very Large			
Volume of Tephra (m ³)	1x10 ⁴	1x10 ⁶	1x10 ⁷	1x10 ⁸	1x10 ⁹	1x10 ¹⁰	1x10 ¹¹	1x10 ¹²	
Cloud Column Height (km) Above crater Above sea level	<0.1	0.1-1	1-5	3-15	10-25	>25			
Qualitative Description	"Gentle,"	"Effusive"	"Explosive"	"Cataclysmic," "Severe,"	"paroxysmal," "violent,"	"terrific"	"colossal"		
Eruption Type	Hawaiian	Strombolian	Vulcanian	Plinian	Ultra-Plinian				
Duration (continuous blast)	<1 hour	1-6 hrs	6-12 hrs	>12 hrs					
CAVW max explosivity (most explosive activity listed in CAVW)	Lava flow	Phreatic	Explosion or Nuée ardente						
Tropospheric Injection	Negligible	Minor	Moderate	Substantial					
Stratospheric Injection	None	None	None	Possible	Definite	Significant			
Eruptions (total in file)	755	963	3631	924	307	106	46	4	0

Table 3.1.3 Summary of Volcanic Explosivity Index (VEI)

Stratospheric injection	None	None	None	Possible	Definite	Significant
Tsunami NOT observed	Nil	Nil	Nil	1 hour	3 hour	6 hour
Tsunami Observed	1 hour	1 hour	1 hour	1 hour	3 hour	6 hour

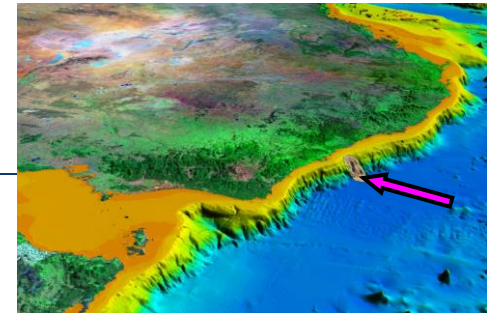
(1) Issue no products and monitor for any potential tsunami: This action should be taken if there is little to no stratospheric injection and there is no evidence a tsunami has been generated.

(2) Create the event in the DST with a Severity of 1 hour: This action should be taken if there is little to no stratospheric injection and there is evidence that a small tsunami has been generated and the impacts are consistent with a low-level Marine Threat.

(3) Create the event in the DST with a Severity of 3 hours: This action should be taken if there is obvious stratospheric injection consistent with a VEI of 4 and/or there are reliable observations or reports that indicate a tsunami has been generated and the impacts are consistent with a high-level Marine Threat or low-level Land Threat.

(4) Create the event in the DST with a Severity of 6 hours: This action should be taken if there is significant stratospheric injection consistent with a VEI of 5+ and/or there are reliable observations or reports that indicate a catastrophic tsunami has been generated.

Landslide Tsunamis



The main area of risk for Australia is a landslide on the continental shelf

If a landslide is identified, then

- (1) *Create the event in the DST with a Severity of 1 hour.* This action should be taken if there are reliable observations or reports that indicate a small tsunami has been generated.

- (2) *Create the event in the DST with a Severity of 3 hours:* This action should be taken if there are reliable observations or reports that indicate a tsunami has been generated and the impacts are consistent with a low-level Marine Threat.

- (3) *Create the event in the DST with a Severity of 6 hours:* This action should be taken if there are reliable observations or reports that indicate a catastrophic tsunami has been generated and the impacts are consistent with a high-level Marine Threat or low-level Land Threat.

Celestial Impact Tsunamis



Approximate impactor radius	Approximate equivalent earthquake magnitude	Severity level
10m	M6.5	3
20m	M7.0	3
30m	M7.5	3
60m	M8.0	3
110m	M8.5	6
200m	M9.0	6

Cancellation of Warnings

The estimated time of arrival of the last wave above the marine threat threshold should be used as a decision point.

A 'tolerance' time can be applied from the actual impact time of the last wave above the marine threat threshold, based on quantitative sea-level observations or reliable qualitative impact reports.

- The 'tolerance' time is defined in Table 3.11.1. Local effects such as seiches and coastal convergence can cause extended periods of even larger waves and these should be considered and discussed with the emergency management authorities prior to issuing Tsunami Threat Cancellations.

Magnitude (M_{wp})	Severity (non-seismic events)	Tolerance time in hours
> 8.5	≥ 6	6
7.5 – 8.5	3	4
< 7.5	1	2

Table 3.11.1 Cancellation tolerance time in hours - time since last tsunameter/ASLOS quantitative observation, or reliable qualitative impact report, above Marine Threat level

Checklist – Initial Response

1. Access, interpret and load earthquake solution

If $M_w < 6.5 \rightarrow$ no action required (unless PTWC issue a statement/message)

If $M_w \geq 6.5 \rightarrow$ discuss details with GA (uncertainty, location, type and depth)

Compare earthquake solutions from different agencies (PTWC / JMA) and discuss discrepancies with GA

Decide on earthquake solution to be used (GA default)

Establish whether the earthquake is tsunamigenic

Load event in DST (Step 1)

If no nearest MOST scenario found, DST will automatically use the TTT Threat assessment method

2. IOTWMS threat assessment

If earthquake in ATWS/IOTWMS source area and $M_w \geq 6.5$

Click IOTWMS Assessment and send Earthquake Bulletin 1

If Indian Ocean source or $M_w \geq 8.0$ outside Indian Ocean, and depth $\leq 100\text{km}$:

If threat to any Indian Ocean countries

Prepare and transmit IOTWMS Potential Threat Bulletin

Else,

Prepare and transmit IOTWMS No Threat Bulletin

Else,

No action required. Move to ATWS threat assessment

Else,

No action required

Checklist – Initial Response

3. ATWS threat assessment

Click ATWS Assessment (Step 4)

If marine threat or above indicated for any warning zone and depth ≤ 100 km

- Assess TTT for urgency

- Establish conference call with affected States/Territories, prioritising communication where threat ≤ 105 min

- Make warning areas contiguous in consultation with affected States/Territories if practical

- Prepare and transmit ATWS National Watch

- Check product on web

- Activate JATWC (establish roles and responsibilities)

- Inform NP managers (through CO) and brief CCC (as workload permits)

- Make entry in event log

Else, if no threat to any warning zone or depth > 100 km

- Prepare and transmit ATWS No Threat Bulletin

- Check product on web

- Monitor obs & media

Felt Earthquake

- Contact GA to request manual solution and discuss event details

- Prepare and transmit Felt Earthquake No Threat Bulletin

- Monitor obs & media

Checklist following the Initial Response

IOTWMS

Delegate responsibility for IOTWMS management to SO if:

- SO is able to perform tasks confidently

- ATWS requires significant attention due to the nature/severity of the event

Confirm CO has notified relevant stakeholders (CCC, PM&C, NP management)

Perform the following tasks regularly throughout the event:

- Monitor observations using TTT as a guide to expected arrival times

- If tsunami signal is observed

 - Issue Confirmed Threat Bulletin hourly

 - Request CO inform relevant stakeholders

- Else

 - Re-issuing Potential Threat Bulletin hourly

When IOTWMS bulletins are no longer required, issue Final Bulletin

Checklist following the Initial Response

ATWS

- Modify threat areas to ensure contiguous warning areas, consulting relevant State/Territory if necessary
- Monitor for changes in earthquake solution and reflect through a new threat assessment
- Monitor observation sites in order of expected tsunami arrival time
- Ensure observations are entered into DST
- Keep States/Territories informed of threat assessment changes or relevant new observations
- Solicit anecdotal observations from emergency agencies via States/Territories
- Trigger relevant tsunameters into event reporting mode one hour prior to expected arrival of waves
- Modify threat assessment by determining an effective magnitude using the envelope method:
 - Consider upgrade if one tsunameter observation is reliable and would change threat areas
 - Consider downgrade only if two tsunameters observations confirm reduced threat
- Notify States/Territories of watch/warning decisions
- Prepare and upload draft products to registered users page and notify States/Territories

Checklist following the Initial Response

ATWS

If threat is immediate (expected arrival within 105 minutes), whether confirmed or not:

- Issue warnings without evacuation order – no requirement to gain approval from affected State/Territory
- Inform relevant stakeholders of warning
- Issue National Warning Summary

If threat is not immediate but confirmed:

- Prepare warnings and upload to registered users pages
- Liaise with relevant State/Territory to seek guidance from agencies on evacuation statement (land threat)
- Reflect evacuation statement decision in warnings (land threat)
- Issue relevant warnings
- Inform relevant stakeholders of warning
- Issue National Warning Summary

If threat is not immediate and not confirmed:

- Issue relevant watches at least hourly



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THANK YOU