

### CASE STUDY: Ex-tropical Cyclone *Beth*, February 1976

Ex tropical cyclone *Beth* crossed the coast near and to the north of Bundaberg. The cyclone was very asymmetric with a band of category 3 intensity winds on the southern flank where it interacted with an intensifying high to the south. Widespread damage occurred in the Maryborough Bundaberg area with 200 homes unroofed, two aircraft damaged and rainfall up to 200 mm caused flash flooding and cut roads for 18 hours. Heavy swell pounded the south coast and the wave recording station at Double Island Pt. recorded a significant wave (peak) height of 5.4 m (10.0 m).

This was an extremely difficult event to warn for and occurred early in the satellite era when there was no precedent to alert forecasters of the danger of the strange looking system as viewed from satellite imagery. Even today it would be a difficult forecast and the numerical model forecasts would most likely not forecast it well. It involved a complex interaction with an upper trough. The case demonstrates an important reason why the Bureau of Meteorology's excellent offshore observational network must not be downgraded to save money for the Government of the day. These offshore observational platforms are an essential ingredient in identifying these dangerous and possibly still unpredictable systems.

Highlighting the problem are these two warnings issued within an hour of each other:

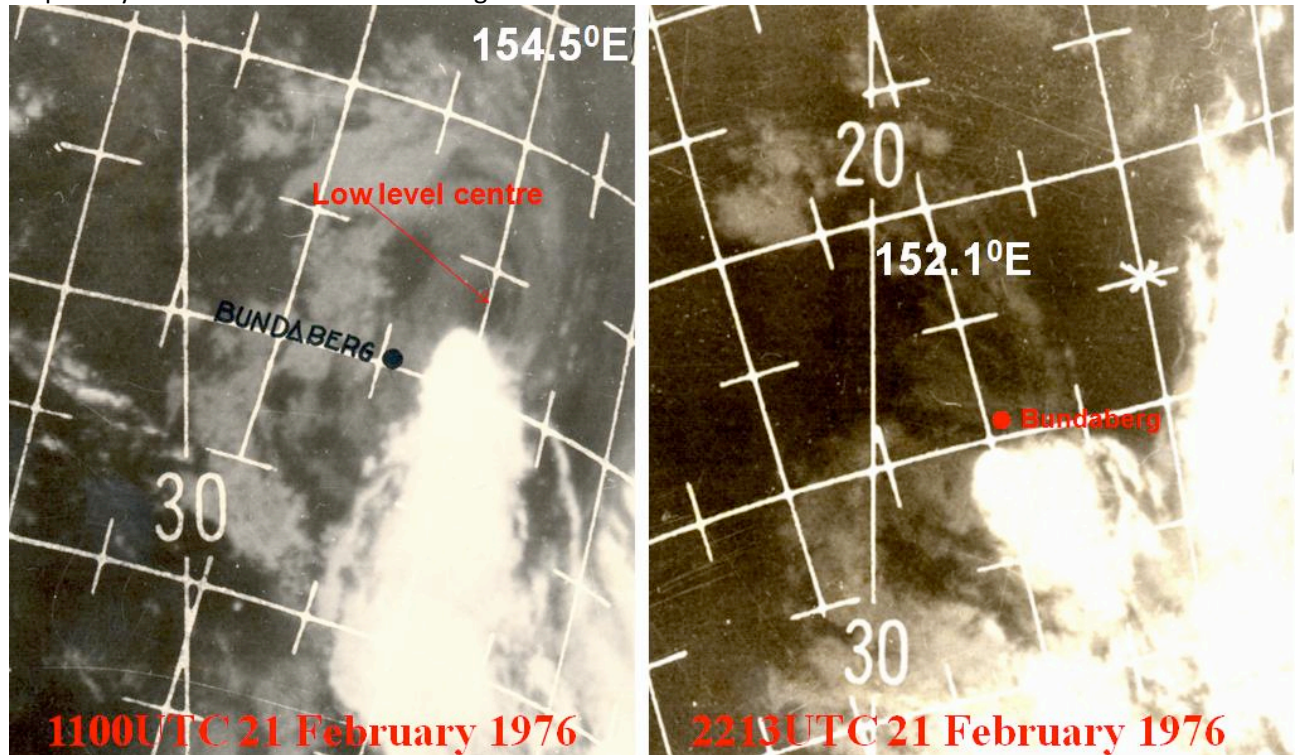
- Gale Warning issued at 2130 UTC (7.30 am local time) 21 February 1976 for coastal waters between Gladstone and Coolangatta: "SW/SE winds 35 to 45 knots should continue for a further 12 hours before easing. A 996 hPa low (ex-tropical cyclone *Beth*) was located at 6 am about 80 km northeast of Bundaberg and moving slowly west"
- An hour later, Gale Warning issued at 2230 UTC (8.30 am local time) 21 February 1976 for coastal waters between Bundaberg and Coolangatta: "The 40 to 60 knot winds with gusts to 80 knots in the Bundaberg/Maryborough area should decrease rapidly in the next 2 hours. An intense tropical low was located at 8 am in the Bundaberg area."

*Beth* had been rapidly weakening in the 24 hours to 2300UTC 20 February and the satellite structure (Figure 1) shows the low level centre at 1100UTC 21 February displaced from the bright white cloud blob which was the location of heavy rain. At landfall over Bundaberg (right frame Figure 2) the bright white cloud was just to the south of that city and there was an indication that the low level centre had moved closer to this heavy rain area as the cloud features gave no sign of a low level centre outside this zone. The heaviest rainfall (Figure 2) can be seen to be south of Bundaberg.

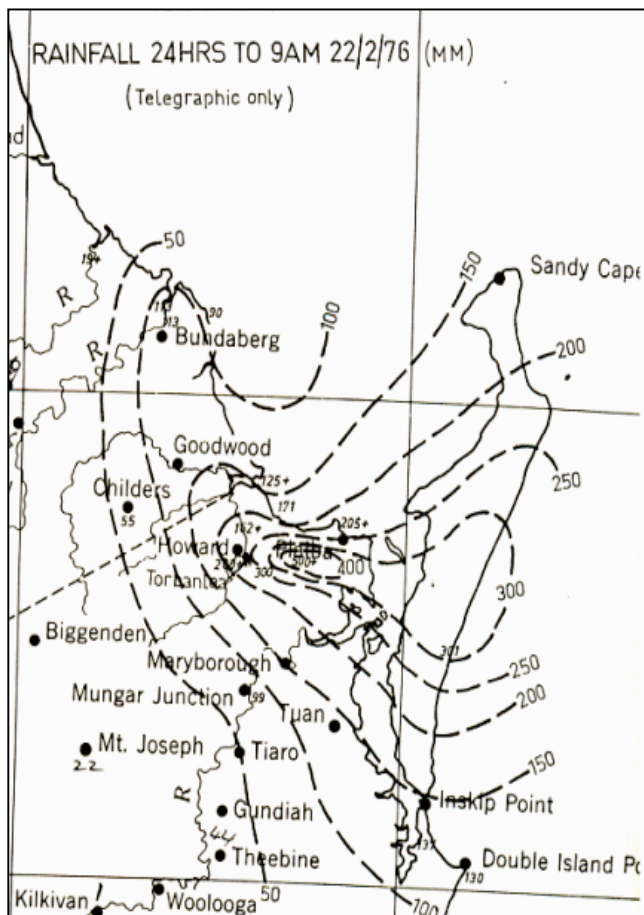
Figure 3 is a close up of *Beth* as it approached Bundaberg. At 9am 21 February (left frame) a ship with average winds of 60knots is shown SW of the centre (wind plot with barb and flag). This would have alerted forecasters at the time but unfortunately the observation was not received at the time. The wind plots just before landfall (right frame in Figure 3) would not alert forecasters to the system being associated with devastating winds. A closer look in Figure 4 shows over the 24 hours up to landfall the pressures rose in the environment around *Beth* especially on the southern side where at Double Island Point the pressure rose from 1006hPa to 1009hpa as the cyclone came closer to that station which increased the pressure gradient over the Bundaberg and Maryborough area.

To gain an appreciation of the wind structure associated with the cyclone a composite wind field was created by plotting all the observed winds and winds assessed by the damage in a frame of reference with respect to the centre of the cyclone (Figure 5) and a band of storm to category three intensity winds are evident south of the centre. A detailed damage survey was carried out and the winds assessed from this survey are shown in Figure 6 along with the arrival time of the destructive wind zone. Note that there were

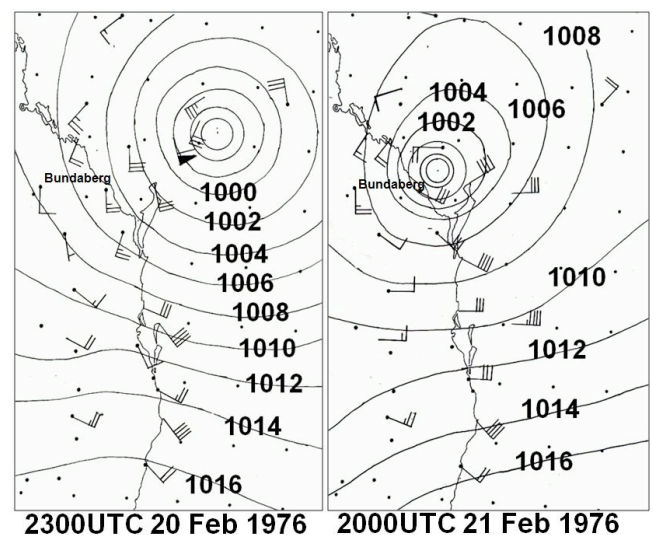
several locations where the survey team assessed the average wind at 65 knots or equivalent to a category three intensity cyclone. This is quite different to the destructive wind zone associated with a mature tropical cyclone where the worst damage is closer to the centre.



**Figure 1** Satellite imagery of ex Tropical Cyclone *Beth* 1100UTC 21 February 1976 (left) and 2213UTC 21 February 1976 (right).

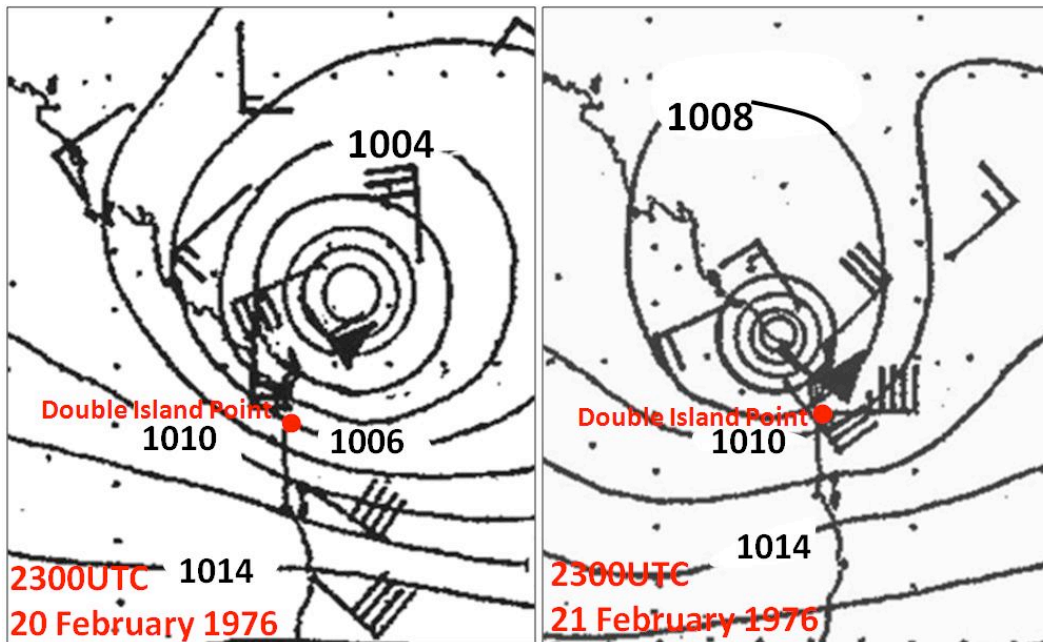


**Figure 2** Rainfall (mm) distribution for the 24 hours to 9am 22 February 1976

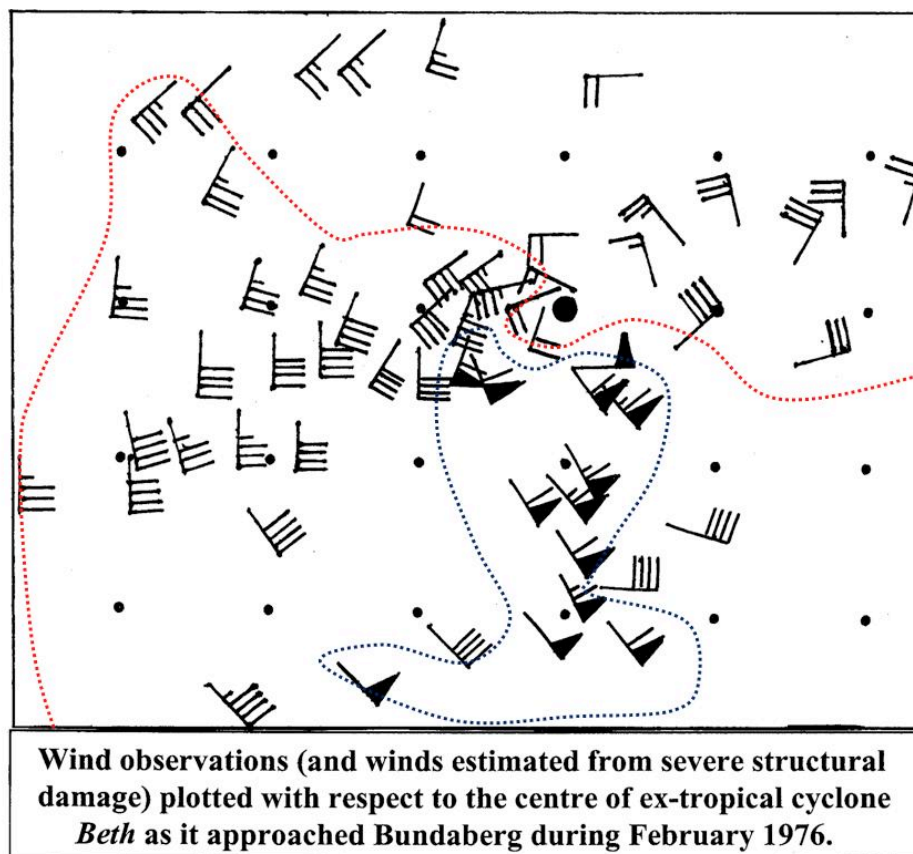


**Figure 3** Mean sea level analyses and wind observations in the left frame for 2300UTC 20 February 1976 (9am 21 February local time) and in the right frame for 2000UTC 21 February 1976 (6am 22 February local time).

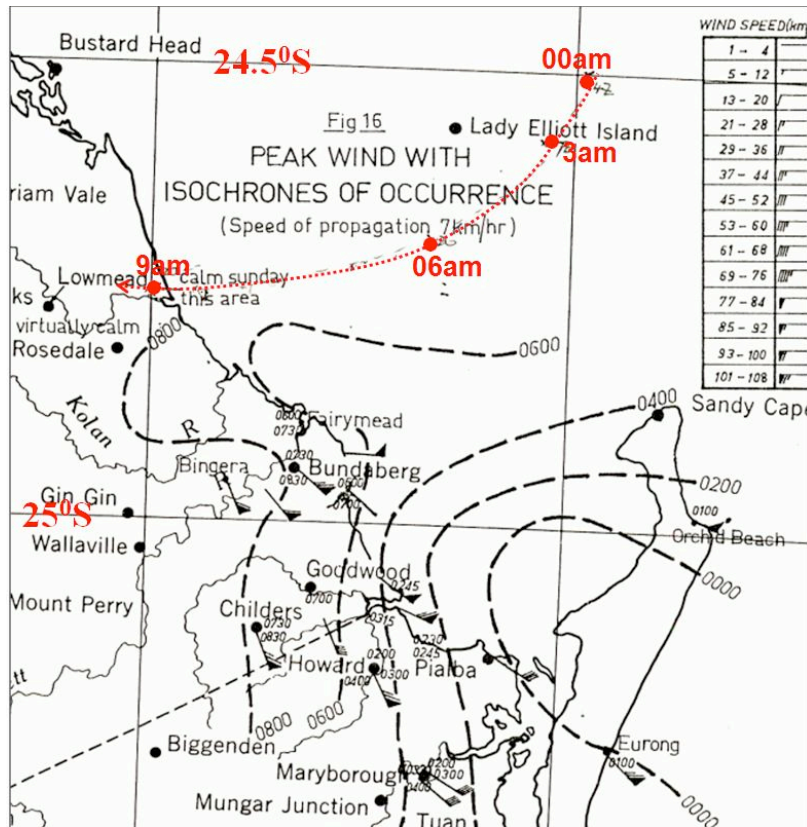




**Figure 4** Mean Sea level analyses and wind observations as ex-tropical cyclone *Beth* moved towards Bundaberg from 2300UTC 20 February 1976 (left) and 2300UTC 21 February 1976 (right).



**Figure 5** Composite mean wind analysis around ex-tropical cyclone *Beth* created by plotting wind observations and damage assessed wind speeds over a 30hour period with respect to the centre of the system. The area enclosed by the blue dashed line denotes winds greater than storm force (average winds 48knots (89km/h) or more) and within the red dashed lines gale force (average winds 34knots (63km/h) or more). In wind plots a flag/barb/half barb represents 50 knots (93km/h)/10 knots (18.5km/h)/5 knots (9.3km/h) respectively. For scale latitude and longitude is shown every degree.



**Figure 6** Damage survey of wind speeds and arrival times of destructive wind zone from midnight to 8am 22 February. The track of the centre *Beth* from midnight to 9am 22 February is shown in red.