Landing Overruns- Human Factors

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Landing Overruns - Human Factors

A review of the events leading to, and lessons learnt from the over-run of flight QF1 at Bangkok Thailand, September 23, 1999.

Landing Configuration

- Operating Boeing 747-400 since 1989
- Standard landing configuration up until 1996 was “Flap 30, Full Reverse Thrust”

Landing Configuration

(continued)

- Review of landing configuration was undertaken due to:
  - Noise levy at Sydney
    - ✓ Flap 25 chosen for lower noise, better fuel economy
  - Carbon Brake Wear
    - ✓ Idle reverse thrust chosen for less noise and longer, harder brake application

Landing Configuration

(continued)

- Landing configuration Policy from late 1996 was:
  - Flap 25, idle reverse thrust *provided* the runway length was not limiting

The Landing

- F/O was pilot flying
- The runway was wet
  - The last landing airplane had reported “good” braking action
  - The airplane preceding QF1 executed a Missed Approach due to poor visibility in heavy rain
  - This was not relayed to the crew of QF1

The Landing

(continued)

- Airplane crossed the threshold high and fast (but within Company limits) and “floated” 10ft above the runway in heavy rain
- Within a period of just a few seconds:
  - The Captain called for “Go- Around”
  - The main gear touched down
  - The rain eased and visibility improved
  - Captain reached over and took control of the thrust levers

The Landing

(continued)

- The Captain initially only retarded # 2, 3 and 4 Thrust Levers
- The F/O immediately realized this and retarded #1 to idle, however:
  - With main gear on the ground and # 1 or 4 T/L advanced, the autobrakes disarmed
  - Speedbrakes deployed automatically after #1 T/L was retarded by the F/O

The Landing

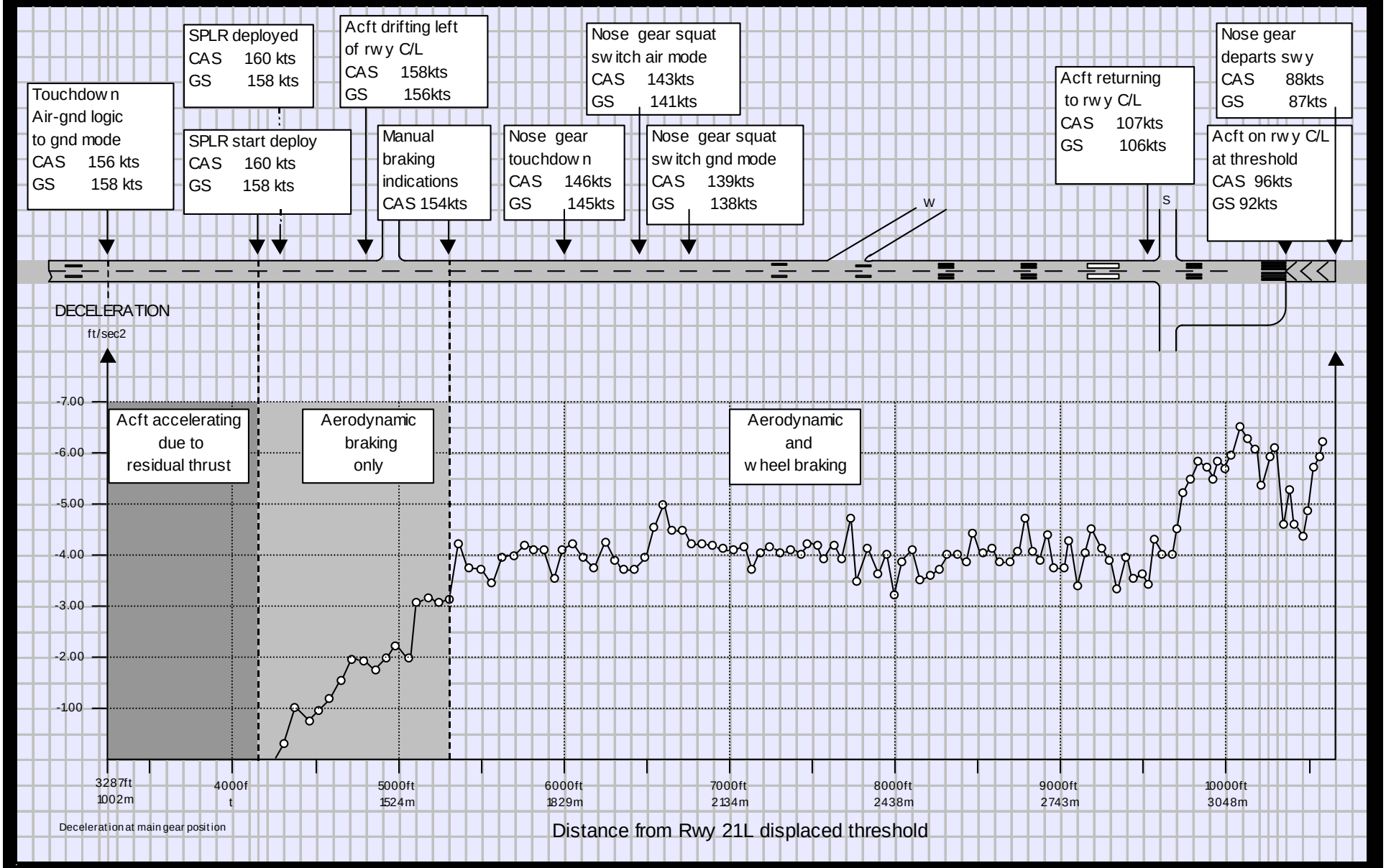
(continued)

- The EICAS message “AUTOBRAKES” was not initially noticed by the Flight Crew
- Manual braking was not applied until 8 seconds after touchdown, approx 5000 feet down the runway
- No reverse thrust was applied for the whole of the landing roll

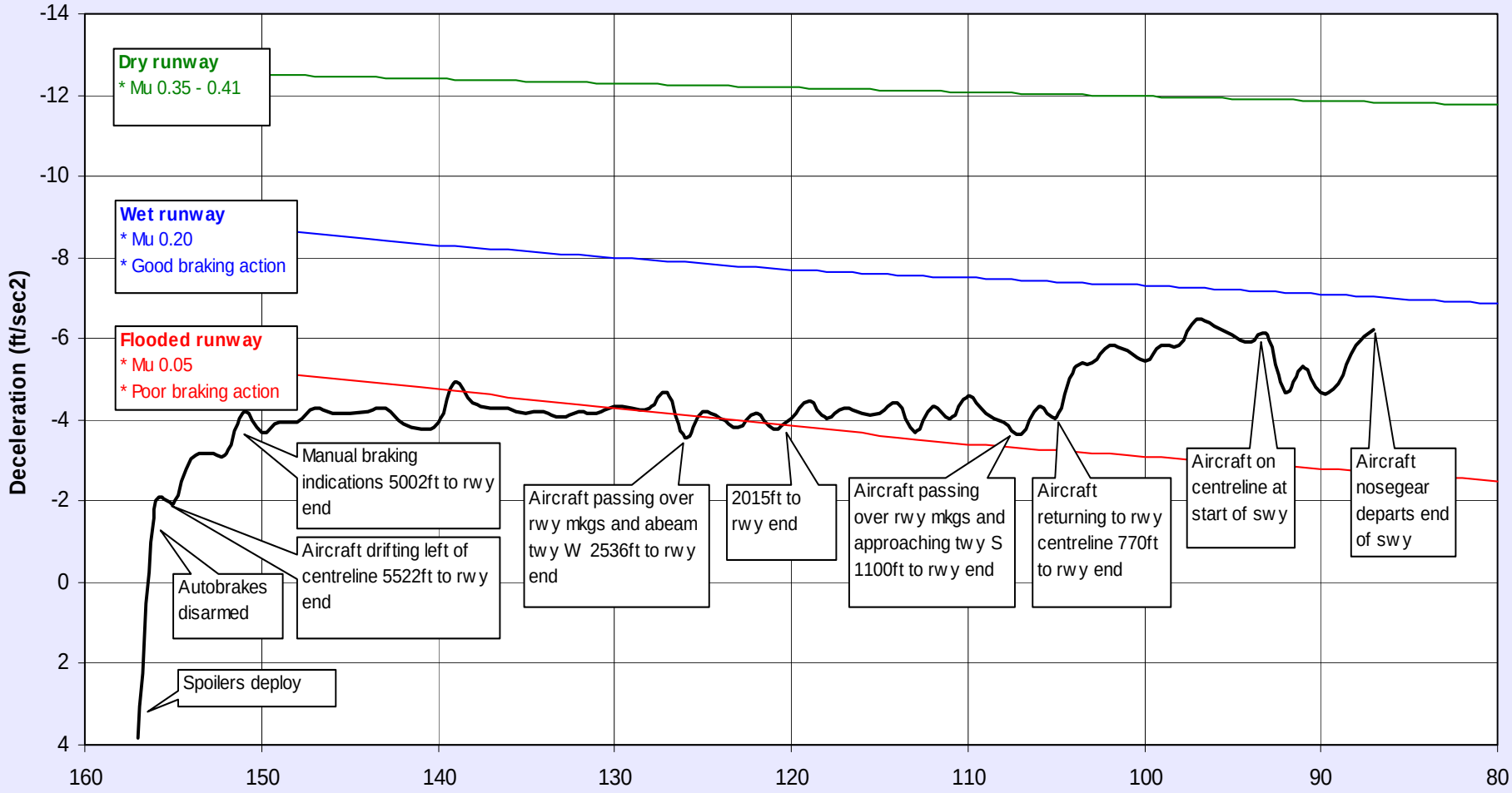
The Landing

(continued)

- When manual braking was applied NO deceleration was felt
- Both pilots exerted maximum force on the brake pedals, still with no deceleration
  - *The airplane was aquaplaning*
- The airplane only began to decelerate as it entered the last 1000 feet of the runway and the groundspeed reduced below 110kts


Touchdown
Air-gnd logic
to gnd mode
CAS 156 kts
GS 158 kts
SPLR deployed
CAS 160 kts
GS 158 kts
SPLR start deploy
CAS 160 kts
GS 158 kts
Acft drifting left
of rwy C/L
CAS 158kts
GS 156kts
Manual
braking
indications
CAS 154kts
Nose gear
touchdown
CAS 146kts
GS 145kts
Nose gear squat
switch air mode
CAS 143kts
GS 141kts
Nose gear squat
switch gnd mode
CAS 139kts
GS 138kts
Acft returning
to rwy C/L
CAS 107kts
GS 106kts
Nose gear
departs swy
CAS 88kts
GS 87kts
Acft on rwy C/L
at threshold
CAS 96kts
GS 92kts
W
S
DECELERATION
ft/sec2
-7.00
-6.00
-5.00
-4.00
-3.00
-2.00
-100
Acft accelerating
due to
residual thrust
Aerodynamic
braking
only
Aerodynamic
and
wheel braking
3287ft
1002m
4000ft
5000ft
1524m
6000ft
1829m
7000ft
2134m
8000ft
2438m
9000ft
2743m
10000ft
3048m
Deceleration at main gear position
Distance from Rwy 21L displaced threshold

Comparison of rollout deceleration on various runway surfaces and VH-OJH 23 September 1999



Ambient conditions:
OAT 25 deg C
QNH 1013.2
WIND 3.6 kt HWC

Acft config for various runway surfaces:
* 252,000 kg Vref25 + 5 kts
* Maximum manual braking
* Spoilers deployed, Idle forward thrust

Human Factors

- Why did this happen ?
- Accident analysis showed:
  - A number of significant active failures and
  - Significant inadequate defences

Active Failures

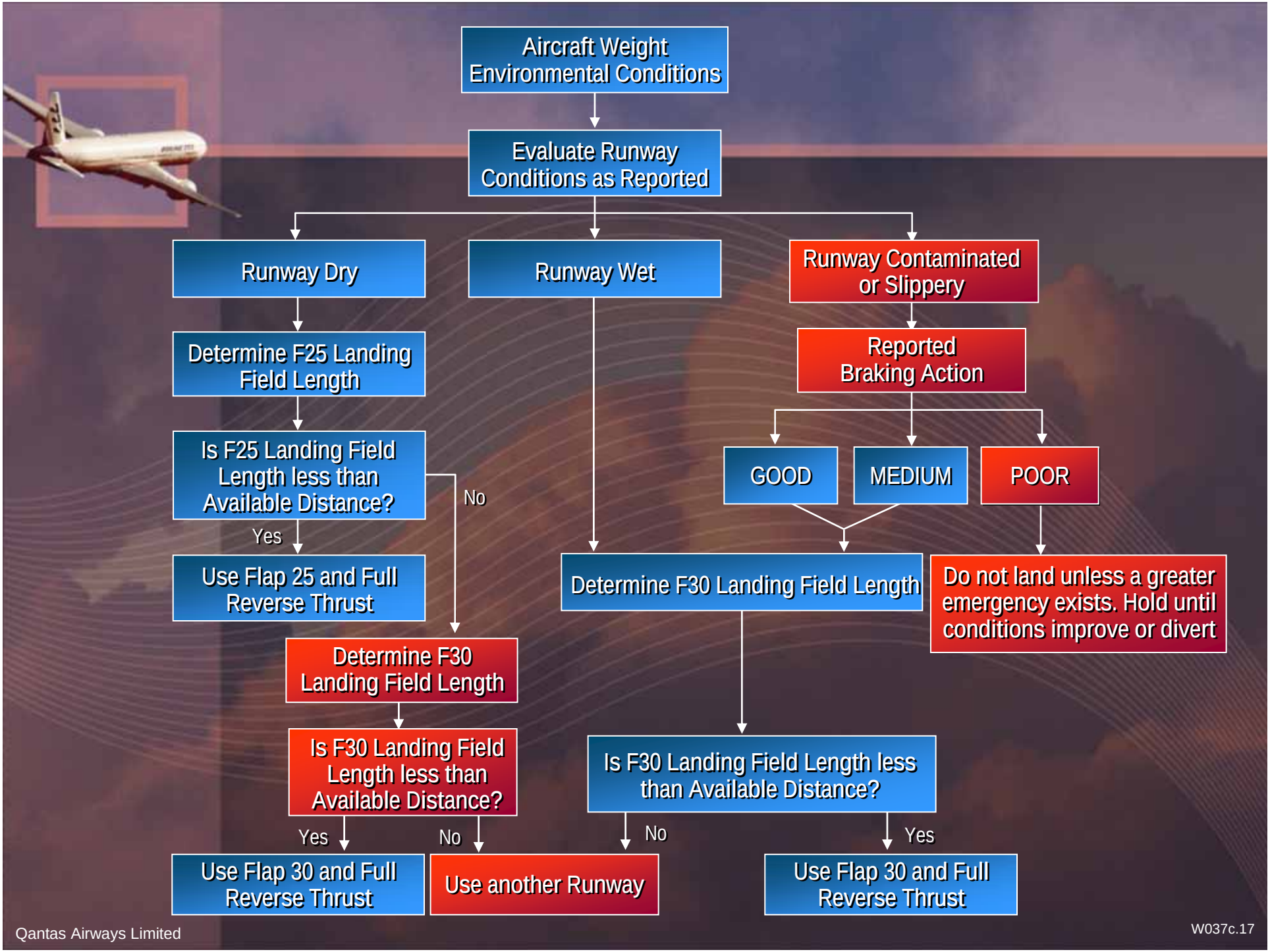
- The runway was affected by water
- Flight Crew failed to use an appropriate risk management strategy for the approach and landing
- The F/O did not fly the aircraft accurately during final approach
- The Flight Crew were confused over who had control and did not select appropriate level of reverse thrust

Inadequate Defences

- Company published information, procedures and training for landing on water affected runways was inadequate
- Flight Crew training in evaluating the procedural and configuration options for approach and landing was deficient
  - The crew may have been “pre-conditioned” to the use of Flap 25 and idle reverse thrust

Change Management

- Published the Boeing document “Landing on Slippery Runways” (doc D6-44247) in the Qantas Flying Manual
- Provided a flow chart to assist Flight Crew in determining appropriate flap and reverse thrust settings


Aircraft Weight
Environmental Conditions
Evaluate Runway Conditions as Reported
Runway Dry
Runway Wet
Runway Contaminated or Slippery
Determine F25 Landing Field Length
Reported Braking Action
Is F25 Landing Field Length less than Available Distance?
GOOD
MEDIUM
POOR
No
Yes
Use Flap 25 and Full Reverse Thrust
Determine F30 Landing Field Length
Do not land unless a greater emergency exists. Hold until conditions improve or divert
Determine F30 Landing Field Length
Is F30 Landing Field Length less than Available Distance?
Is F30 Landing Field Length less than Available Distance?
Yes
No
No
Yes
Use Flap 30 and Full Reverse Thrust
Use another Runway
Use Flap 30 and Full Reverse Thrust

Change Management

(continued)

- Flight Crew use max reverse thrust as the "standard" with idle reverse permitted only under stipulated conditions
- Flap 25 is the normal landing flap on dry runways
- Flap 30 used on wet runways (no credit taken for grooving or PFC overlay)

Change Management

(continued)

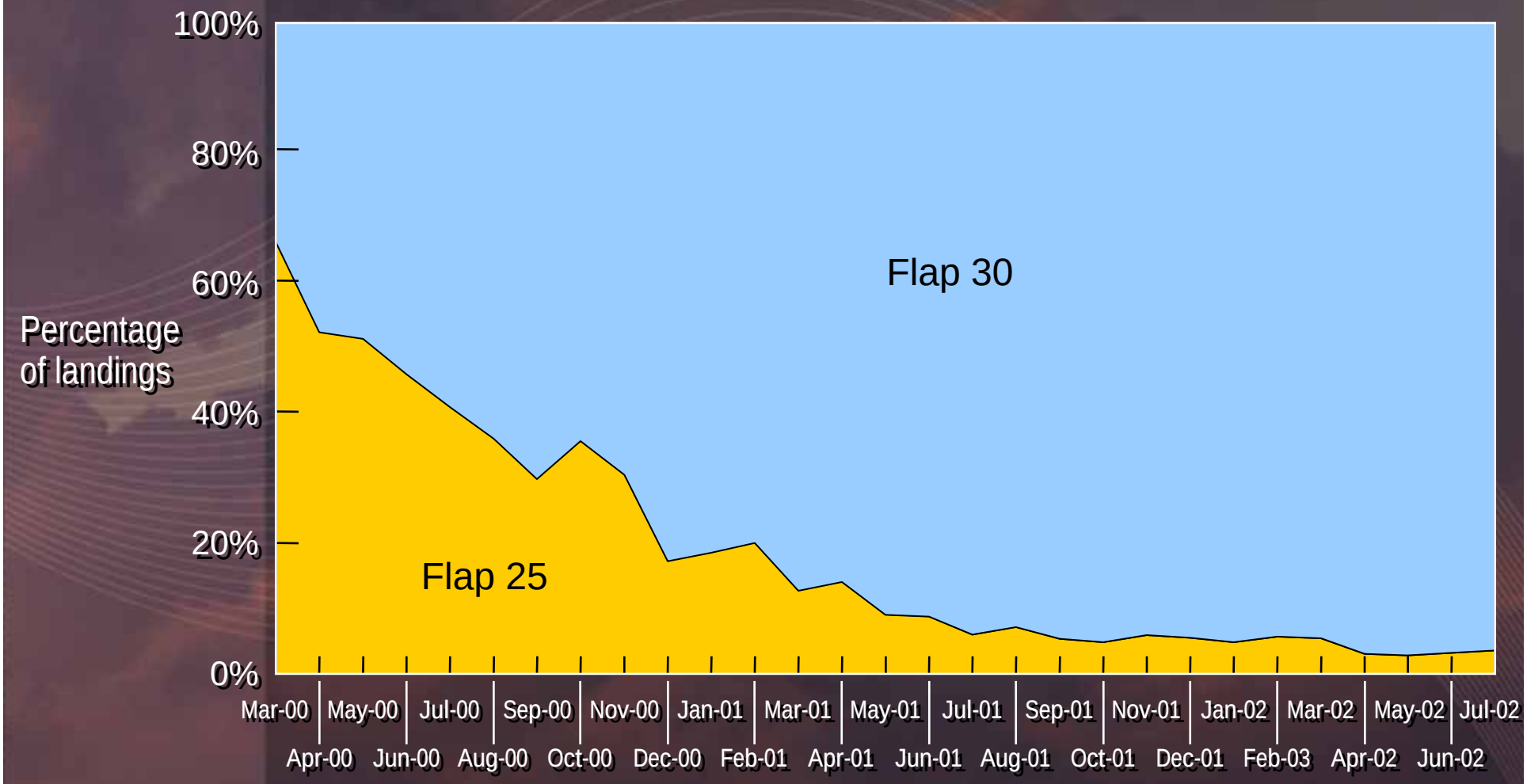
- Produced CBT package summarising performance on slippery and contaminated runways
- Provided detailed stopping distance information for various surface conditions
- Highlighted to crew the importance of using correct techniques for landing on wet, slippery and contaminated runways
- Included call of “AUTOBRAKES” each time this is annunciated on EICAS

Change Management

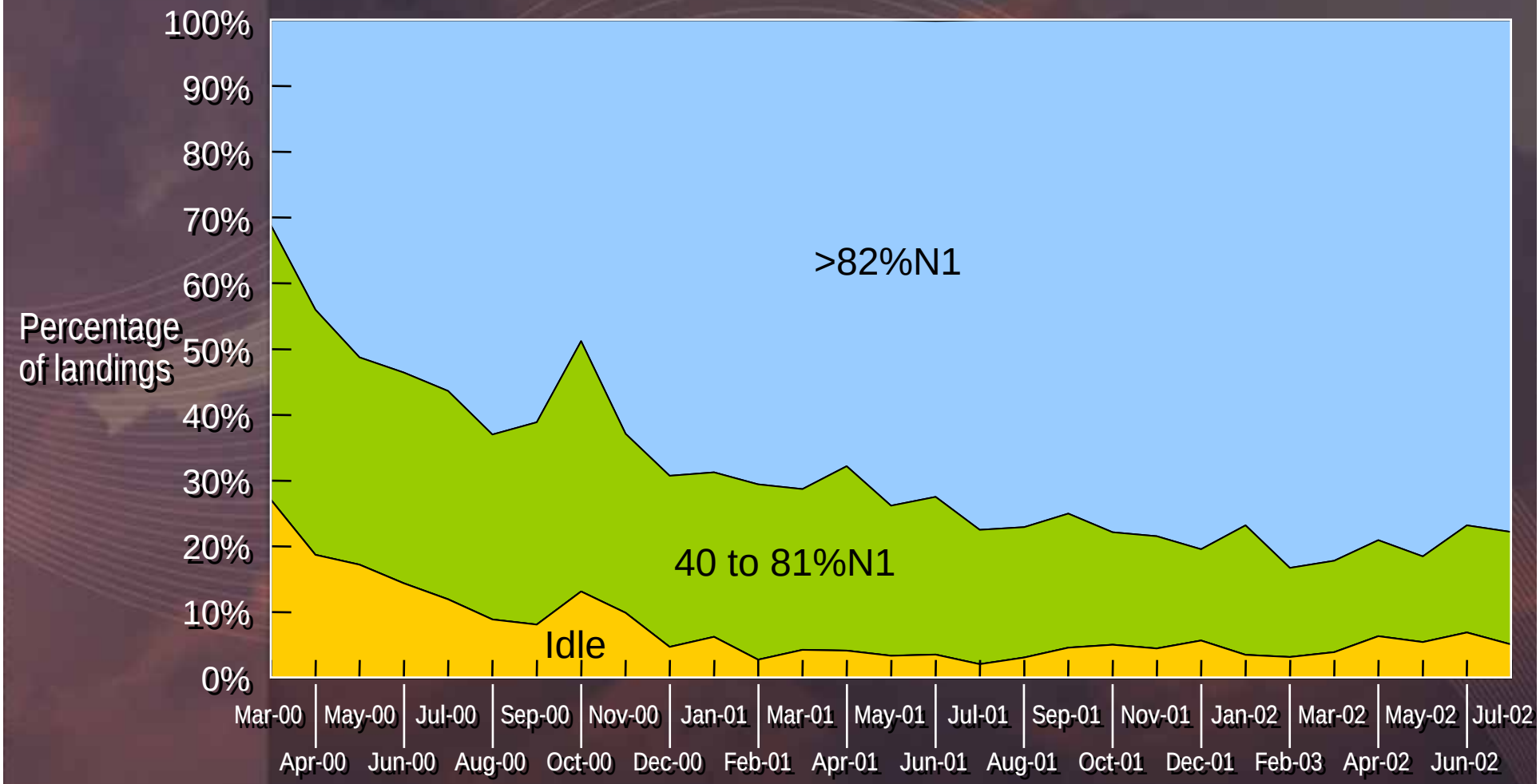
(continued)

- Monitoring of landing configurations and touchdown points has shown:
  - Significant trend towards flap 30 irrespective of runway conditions
  - Max. reverse thrust used on most occasions
  - Touchdown points are closer to the “desired” point. i.e. less “float”

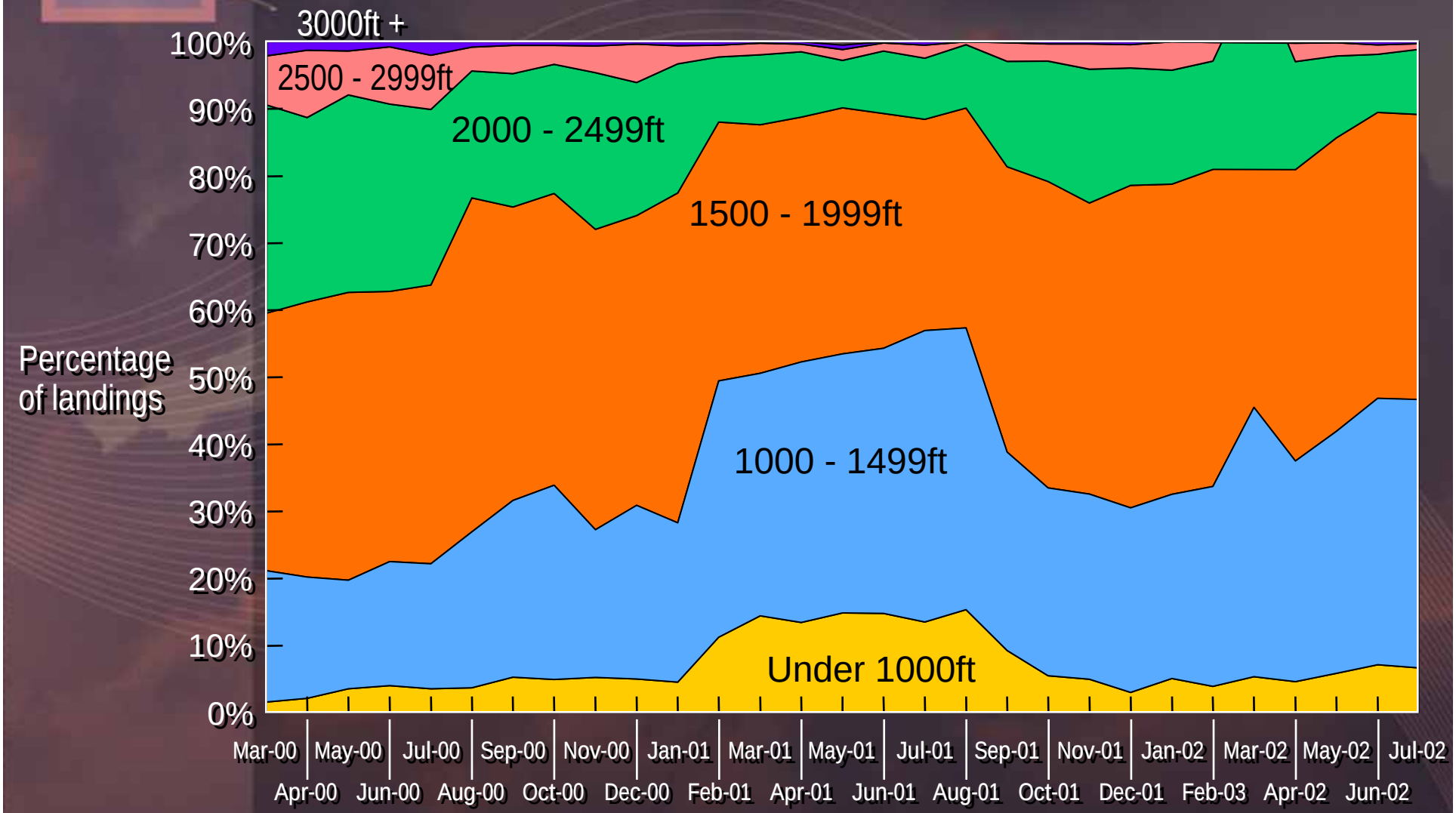
Trend in Landing Flap Setting



Trend in Reverse Thrust Use



Trend in Distance From 50’ to TD



Cabin Communications

- Nose gear collapse resulted in loss of all Flight Deck / Cabin communications
- Confusion existed as to need for evacuation
- Co-location of back-up comms equipment in an area prone to damage is considered undesirable
- Provided Flight and Cabin Crew with procedures to use in the event of loss of Cabin Interphone or PA

Summary

- Provide Flight Crew with the appropriate tools to do the job
- Train Flight Crew to analyse each landing separately to determine the appropriate landing configuration
- Ensure procedures for landing on wet, slippery and contaminated runways are in place and thoroughly understood
- ATSB report available at www.atsb.gov.au