C/TRM COURSE

Low Flying in a Wires and Hazards Environment

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- Air
  aer
- Cas
- EM
- CR
- He
- Co
- Sur
- Acc


FLT LT (CAPT) PAUL McGINNESS
US AIR FORCE O-2A
A.F. SERIAL NO 69-7622
SERVICE THIS AIRCRAFT
WITH GRADE 100/130
FUEL
RESCUE
"RED RAT"
420

Official Army War Artist

UAV Drone Pilot

- Trained UAV pilot for RAAF flying Heron MALE RPAS
- Served in Afghanistan supporting Coalition and Special Forces

Currently

- Serving as Army Reserve Officer
  - Australian Defence Doctrine writing
- Manager and Trainer for IPAS Australia

Qualified to operate:

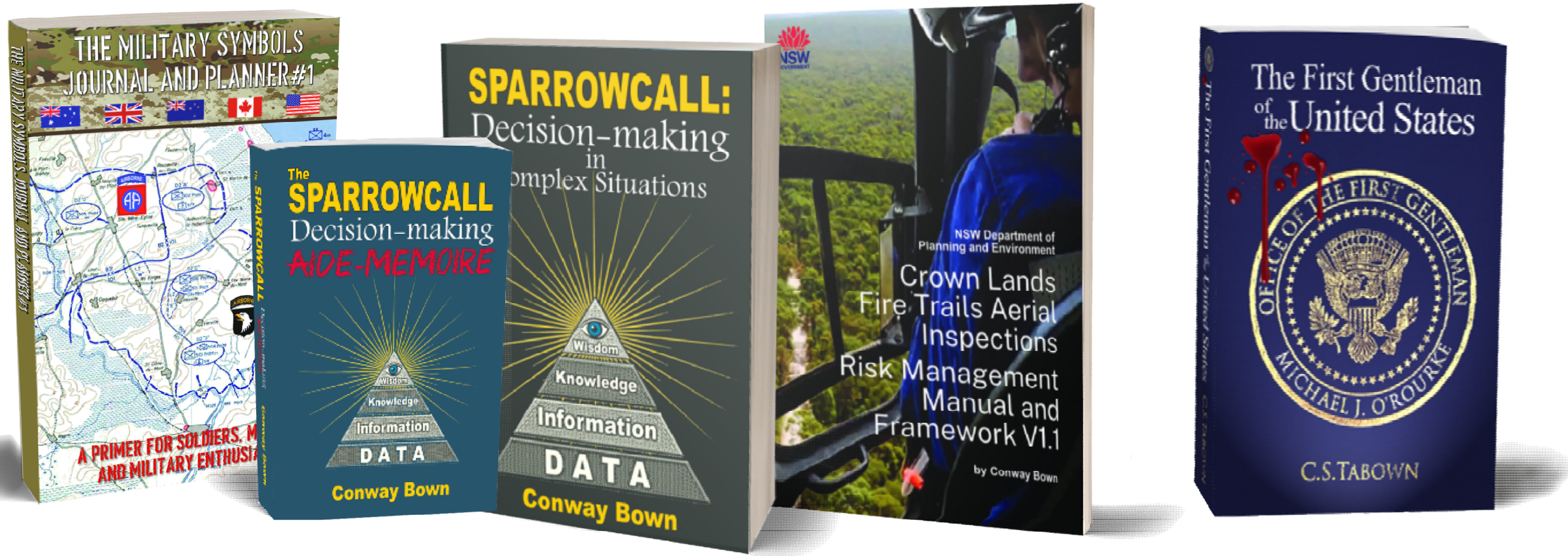
Author and Writer

Military Symbols

Decision-making

Risk management

Fiction: Political Thriller



The IPAS C/TRM Course

- Elm 0.1 Introduction
- Elm 1.1 The Human Body ✓
- Elm 1.2 The Human Mind
- Elm 1.3 The Mind/ Body Interface ✓
- Elm 2.1 Communication
- Elm 2.2 Teamwork ✓
- Elm 2.3 Situational Awareness
- Elm 3.1 Threat & Human Error Management ✓
- Elm 3.2 Judgment & Decision-making ✓
- Elm 3.3 Task Planning Briefing & Debriefing ✓

C/TRM

ELECTIVES

- Elm 4.1 Mission Crew Training
- Elm 4.2 Working Safely Around Aircraft
- Elm 4.3 Low Flying in a Wires/Hazards Environment ✓
- Elm 4.4 Aerodynamics for Non-Aviators ✓
- Elm 4.5 Map Reading and Navigation ✓
- Elm 4.6 Helicopter Landing Site Safety Officer

Elm 4.3 - Flying in a Wires and Hazards Environment

1. What is low flying? What are the rules?
2. Human, Man-made & Environmental hazards
3. Low flying operational considerations

1. What is low flying? What are the rules?

AAS and Low Flying

AOPC310 AAS Learning Guide v1.0 p 31-32

- Low level flight operations
  - During firebombing operations… an AAS [may] request the pilot conduct the operation from a low height, such as 500’ AGL, for
    - Fire line intelligence
    - Due to reduced visibility
    - Target identification
    - Bombing effectiveness assessment.

AAS and Low Flying

AOPC310 AAS Learning Guide v1.0 p 31-32

- Low level flight operations
  - The AAS must ensure low level operations are conducted safely and adhere to the following requirements:
    - Any AAS RW platform must have a wire-strike protection system
    - A thorough inspection of the low-level flight area must be conducted for wires, poles and towers before descending to the required flight level.

      CAUTION: Wake turbulence may be present. Wait for it to dissipate before entering at low level.

AAS Responsibilities

SACFS Air Attack Supervisor (AAS) Learner Guide v1.2 p 105

- Low-level flight operations
  - During firebombing operations, it may be necessary for an Air Attack Supervisor to request the Air Attack Supervisor aircraft pilot to conduct a low level flight operation (i.e. below 500 ft AGL) in order to:
    - Gather/confirm critical fire intelligence;
    - Identify a target for on-going firebombing operations; or
    - Confirm firebombing drop assessments.
  - The Air Attack Supervisor conducting low level operations must ensure a thorough inspection of the low level flight area is conducted for wires, poles and towers prior to descending to the required flight level.

AAS Responsibilities

SACFS Air Attack Supervisor (AAS) Learner Guide v1.2 p 105

- Low-level flight operations
  - The Air Attack Supervisor shall inform firebombing pilots of personnel in a drop zone and clearly identify their location on the ground.
  - The Air Attack Supervisor is responsible for warning ground crews of incoming drops from firebombing aircraft and ensuring they are clear before allowing a firebombing operation to proceed.

AAS Responsibilities

SACFS Air Attack Supervisor (AAS) Learner Guide v1.2 p 105 and following

- Low-level flight operations
- The Air Attack Supervisor shall be alert for:
  - - Traffic hazards such as other and/or itinerant aircraft
- - Flight hazards in the target or filling area, such as:
  - - The presence of ground personnel
  - - Power lines and associated poles
  - - Airborne birds, especially birds of prey
  - - Fences (esp in dams)
  - - Radio and/or TV masts
  - - Snags/stags
  - - Animals or birds on runways or helipads
  - - Known turbulence
  - - Areas of low visibility
  - - Turbulent wind/lee trough effect.

AAS… how do you rack ‘em and stack ‘em

A) MELBOURNE/BRISBANE FIR
B) Beginning of October C) End of March
E) UNNOTIFIED INTENSE AVIATION ACTIVITY ASSW FIREFIGHTING OPS MAY OCCUR WI 5NM RAD AND BLW 3000FT AGL OF OBSERVED FIRES.
ACFT NOT COORDINATED THROUGH THE RELEVANT STATE FIRE AUTHORITY ARE REQ TO REMAIN CLEAR.

- The AAS may be required to allocate airspace levels to aircraft at a fire
- What are the recommended altitudes?

What is low flying, why do it & the rules

Try to stay in the middle of the air.

Do not go near the edges of it.

The edges of the air can be recognized by the appearance of ground, buildings, sea, trees and interstellar space.

It is much more difficult to fly there.

Explaining Low Flying

- Low flying is a specific flight regime
- Normally conducted by
  - Emergency services
    - (police/medical/fire)
  - Military
  - Agricultural
  - Survey
  - Media
  - External load ops
  - Training.

What exactly *IS* low flying?

- ICAO stipulates low flying in its ‘Rules of the Air’
- Contracting states try and harmonise their regulations with ICAO, therefore most states have similar rules.

Explaining Low Flying

- Civilian rules regarding low flying apply to all operators except police, customs and military
- Article 3 of the Convention on International Civil Aviation states:

"This convention shall be applicable only to civil aircraft and… not to state aircraft.

Aircraft used in military, customs and police services shall be deemed to be state aircraft.

The contracting States undertake, when issuing regulations for their state aircraft, that they will have due regard for the safety of navigation of civil aircraft."

Explaining Low Flying

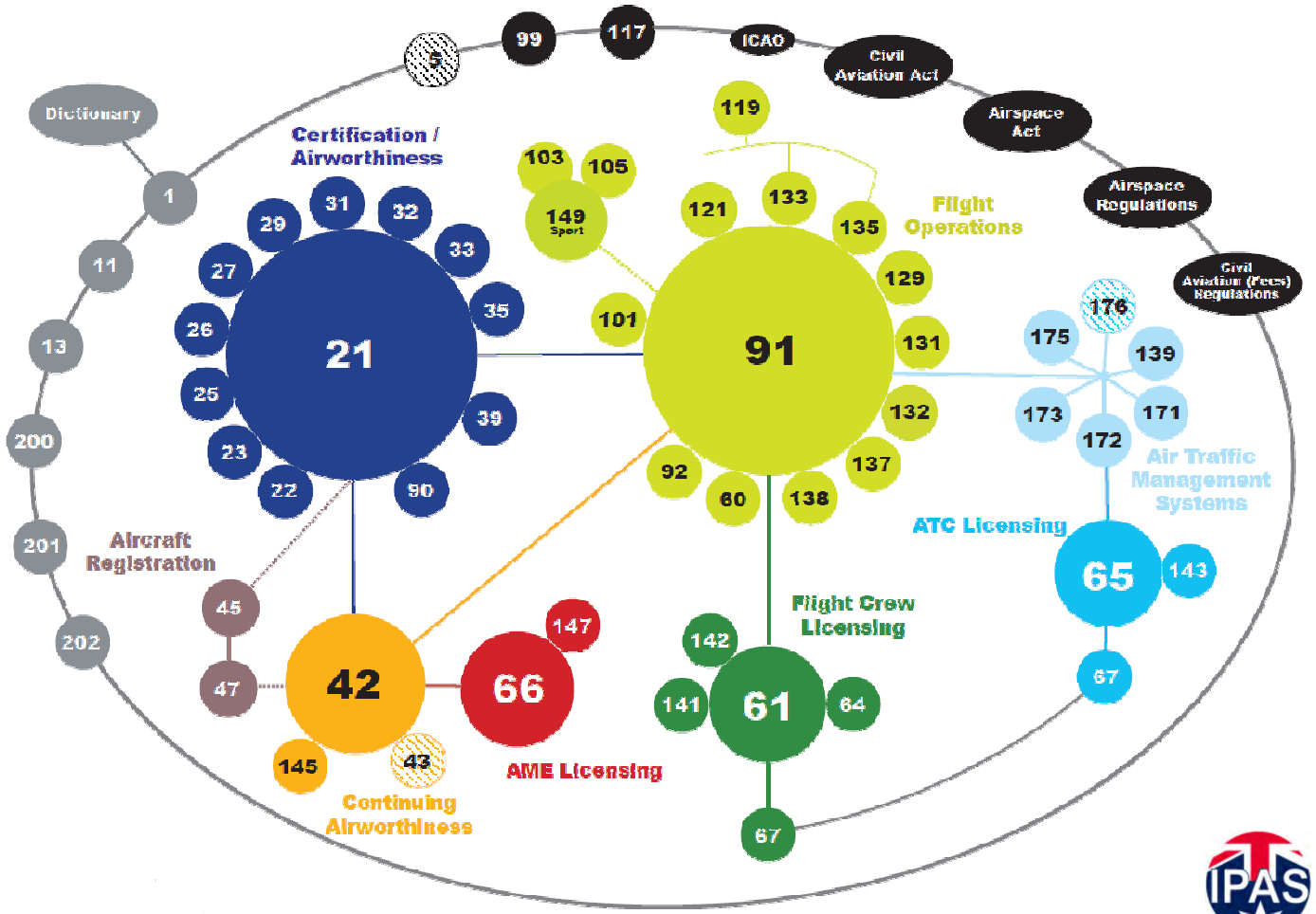
- Australian interpretation:
- State Aircraft:

  "An aircraft of any part of the Defence Force (including any aircraft that is commanded by a member of that force in the course of their duties as such a member), and aircraft used in the military, customs, or police services of a foreign country." (AIP Definitions Gen 2.2)

Legislation, Regulations, Procedures,

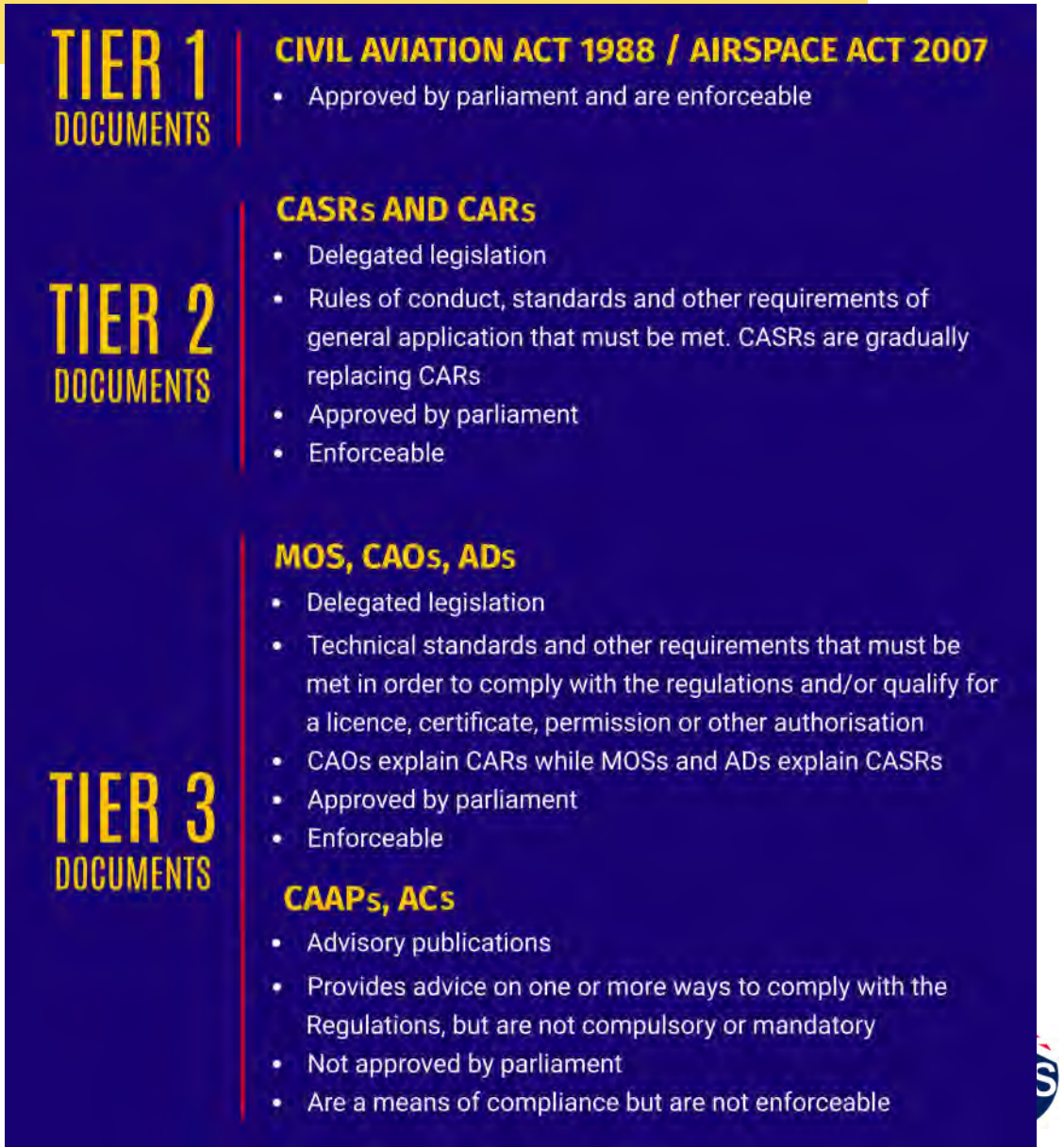
The Civil Aviation Safety Regulations 1998

- There are 1908 pages of rules and regs in CASRs…
  - Let's look at each page starting with page 1…
  - The most important parts are those in the Flight Operations cluster, with Part 91 holding the bulk of info



Legislation, Regulations, Procedures,

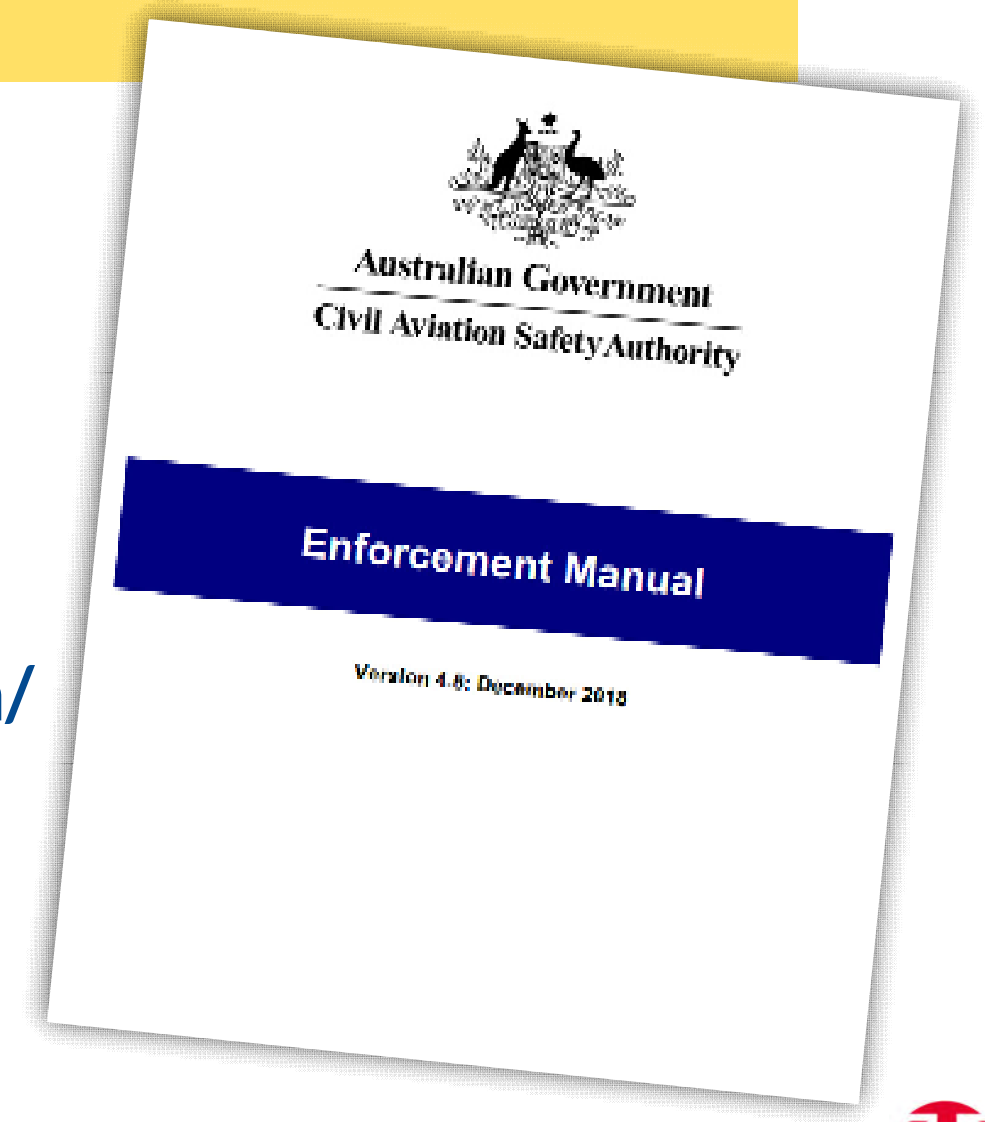
- Aviation rules fall into three tiers
  - Tier 1 – Government Acts
  - Tier 2 – Regulations
  - Tier 3a – Standards, Orders, Directives
  - Tier 3b - Advisories



Legislation, Regulations, Procedures,

Enforcing the regulations

- Violations and Enforcement
  - Almost all aviation rules are rules of strict liability
  - Enforcement Manual has layered actions:
    - Enforceable voluntary undertakings
    - Administrative action (eg suspension/ cancellation of auths)
    - Prosecution
    - Aviation Infringement Notice / penalty units / demerit points
    - Penalty unit = $170



Minimum altitude that is not Low Flying

CASR 91.265, Pt 91 MOS, Chap 12 as harmonized with ICAO Annex 2, Chapt 4

- CASRs apply to civilian aircraft, but what do they say?
  - Lowest altitude permissible that is not classed as 'Low Flying' is:
    - 1000' AHO over populous areas
    - 500' AHO over other areas
    - AHO within 600m (FW) or 300m (RW)
    - Specific weather conditions apply.

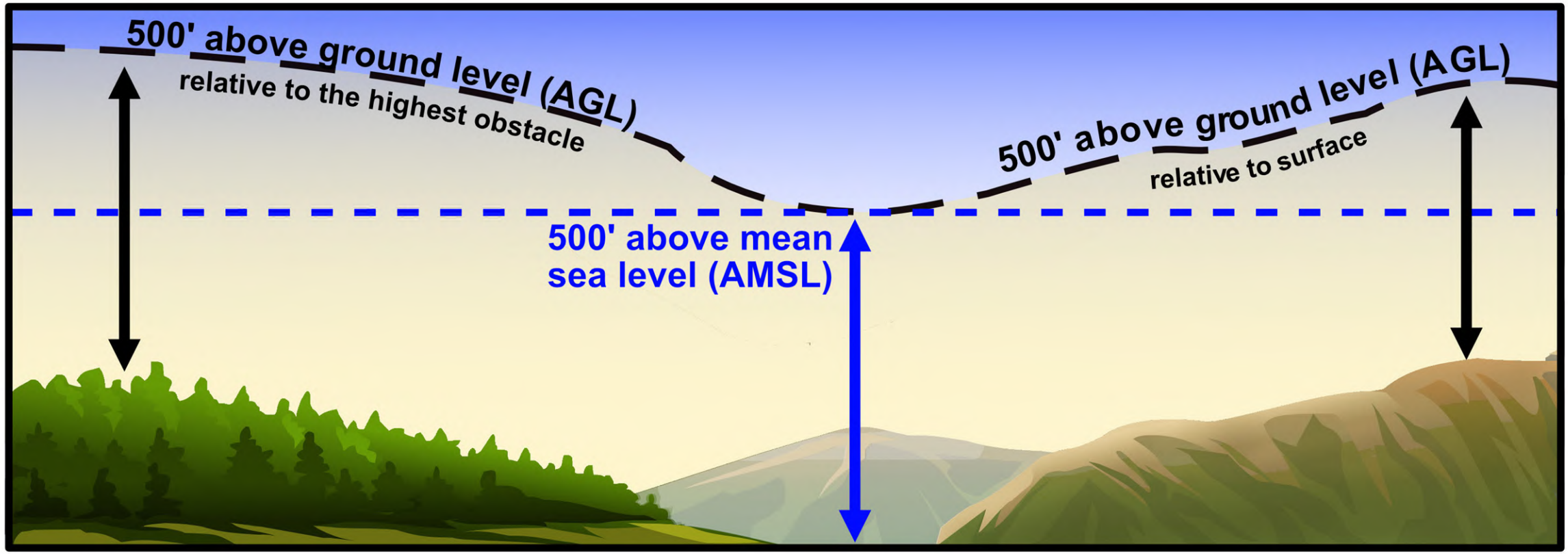
When can you fly low?

Part 138 MOS, Chap 9.02 & 9.03

- CASRs may permit low flying for the conduct of operations in accordance with an approved aerial work operation, however
- Positioning flights must be flown at altitudes above the minimum altitude until the commencement of the work
- Flights must not be flown within 150 m of a person, occupied building vessel or livestock not associated with the aerial work.

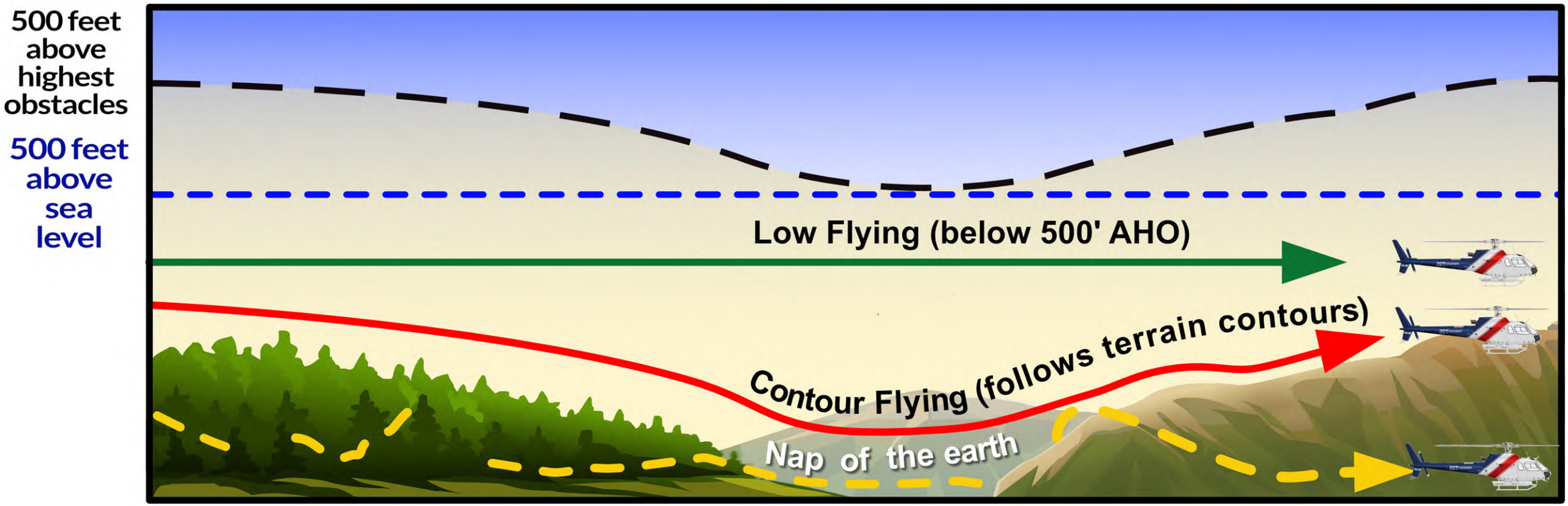
Low flying definitions

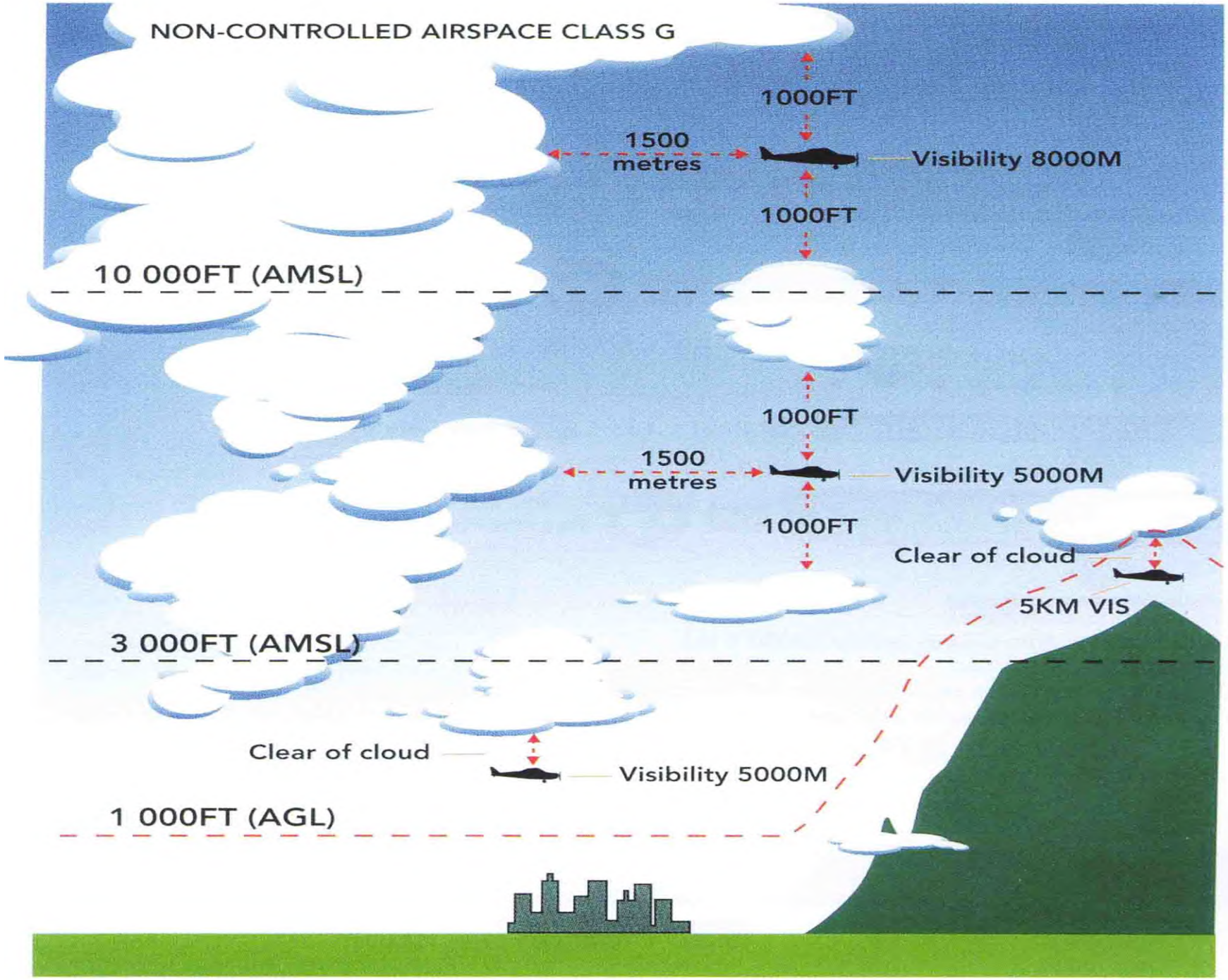
- 500’ AMSL versus 500’ AGL versus 500’ AHO

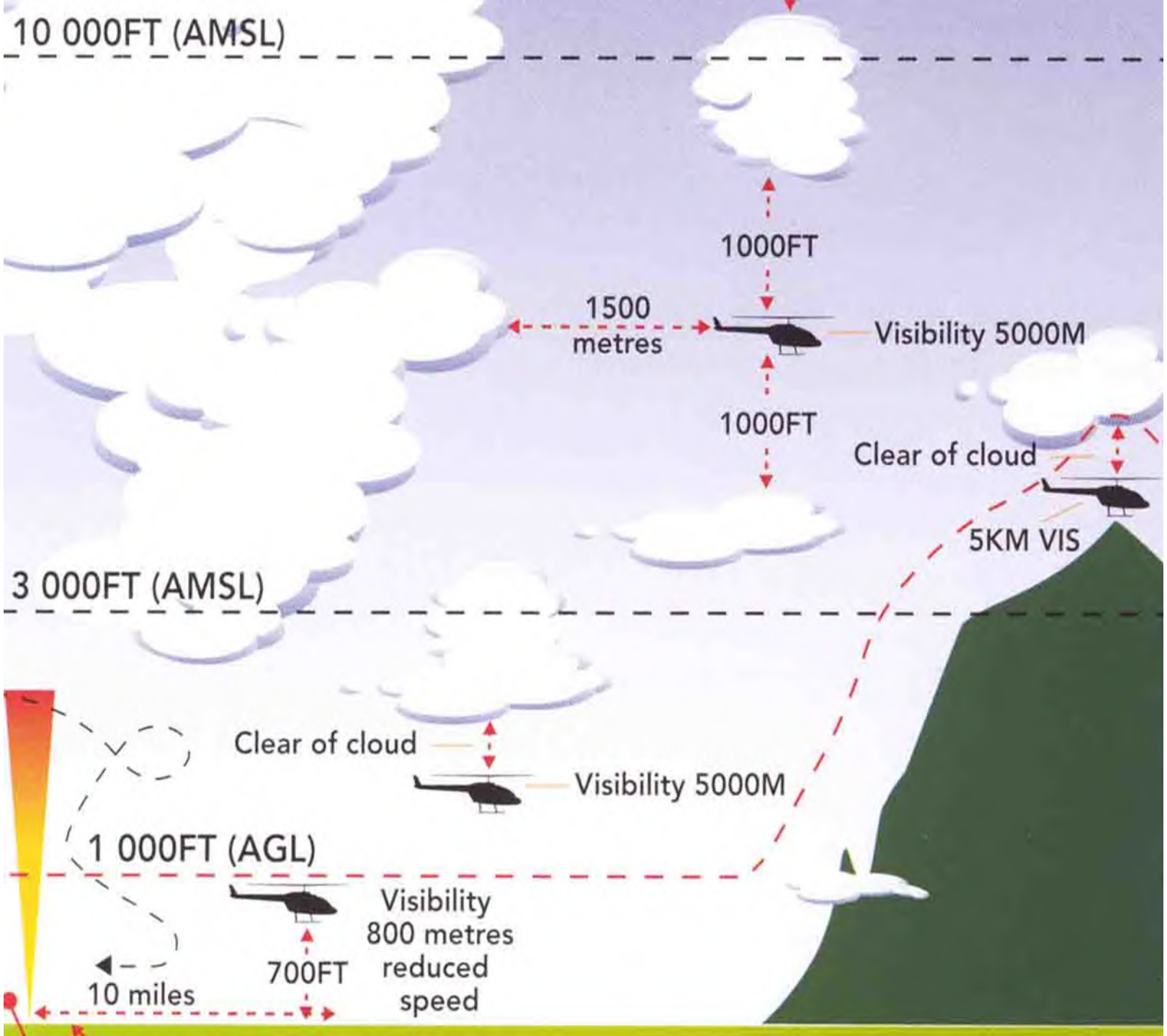


Low flying definitions

- Altitude, Elevation, Height
- Low flying, contour flying, NOE flying, Task specialist




NON-CONTROLLED AIRSPACE CLASS G
1000FT
1500 metres
Visibility 8000M
1000FT
10 000FT (AMSL)
1000FT
1500 metres
Visibility 5000M
1000FT
Clear of cloud
5KM VIS
3 000FT (AMSL)
Clear of cloud
Visibility 5000M
1 000FT (AGL)


10 000FT (AMSL)
1000FT
1500
metres
Visibility 5000M
1000FT
Clear of cloud
5KM VIS
3 000FT (AMSL)
Clear of cloud
Visibility 5000M
1 000FT (AGL)
Visibility
800 metres
reduced
speed
700FT
10 miles

Tall structures database

- ICAO requires tall structures of 150 metres (500’) to be classed as obstacles to aviation and reported
- CASRs are more restrictive. Obstacles must be reported if they are
  - More than 100m in height
  - Within 15km of an aerodrome or is a hazard to aviation
- Defence has further requirements for reporting of obstacles over 30m (100’) in height
- Airservices Australia maintains an obstacle database.

Key Takeaways from Part 1

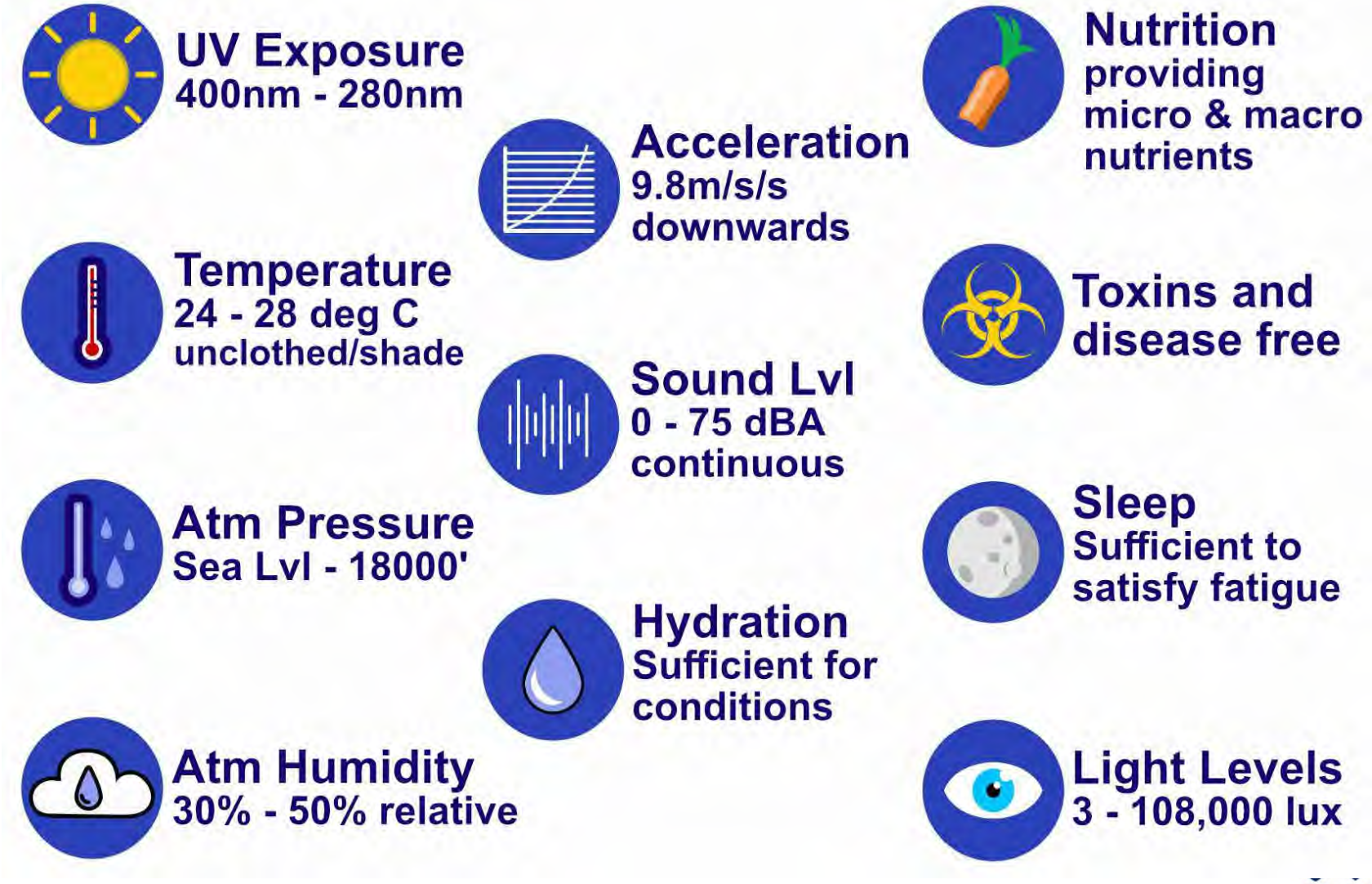
- Low flying rules are stipulated in aviation regulations
- They are enforceable rules
- Emergency services work may require flight below the minimum altitude (ie low flying operations)
- 500’ AHO within 300m (RW) or 600m (FW) and only for that period necessary for the task (ie not transiting)
- Must be able to fly IAW the VFR
  - Below 3000’ AMSL, or 1000’ AGL, clear of cloud, 5000m vis
  - Below 700’ AGL, clear of cloud, 800m vis (helos only)

2. Human, man-made & environmental hazards

Hazards to Low Flying

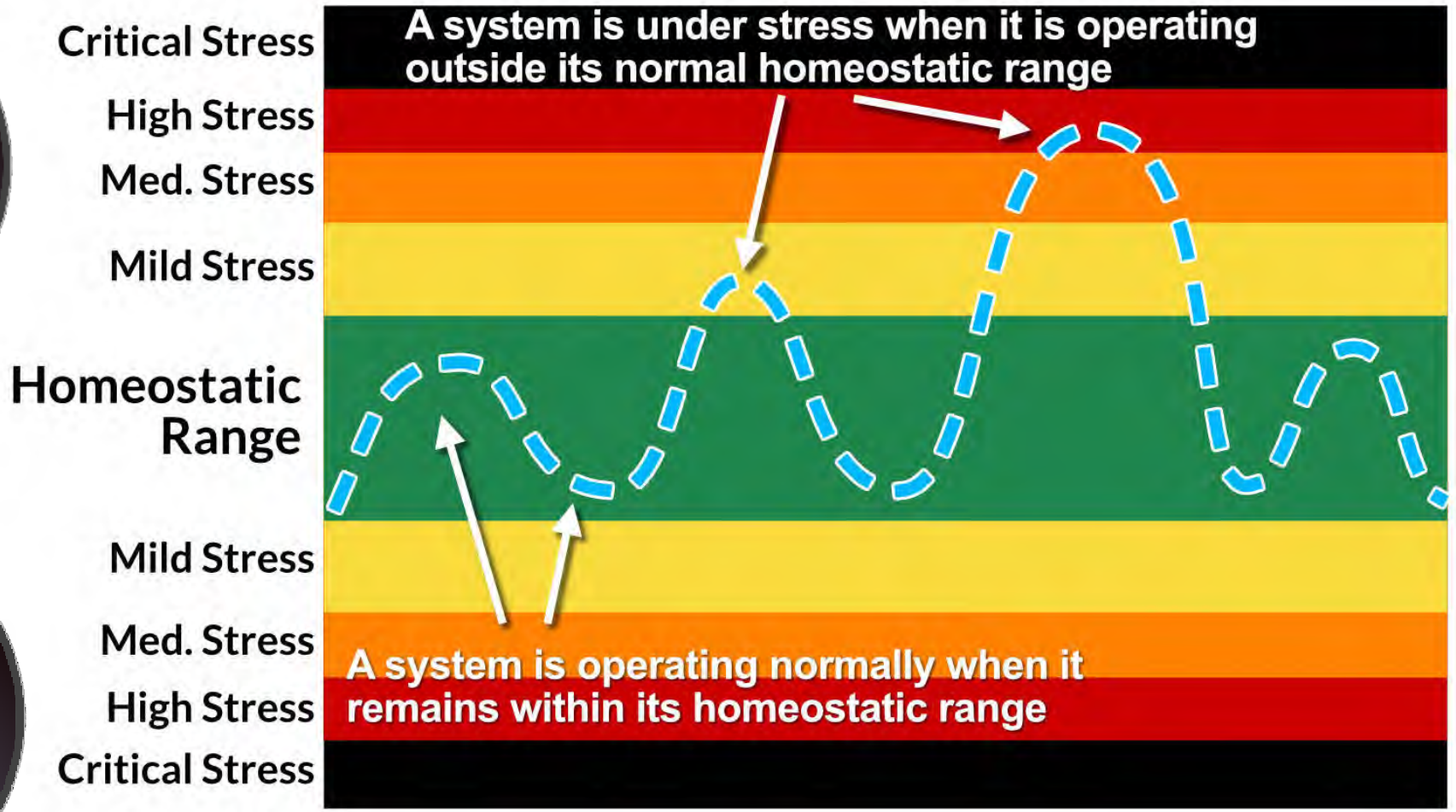
Homeostasis and stressors on the body

- Human Factors
  - Physical
  - Physiological
  - Psychological
- Man-made
  - Obstacles
- Natural
  - Terrain
  - Wildlife
  - Weather



What is stress?

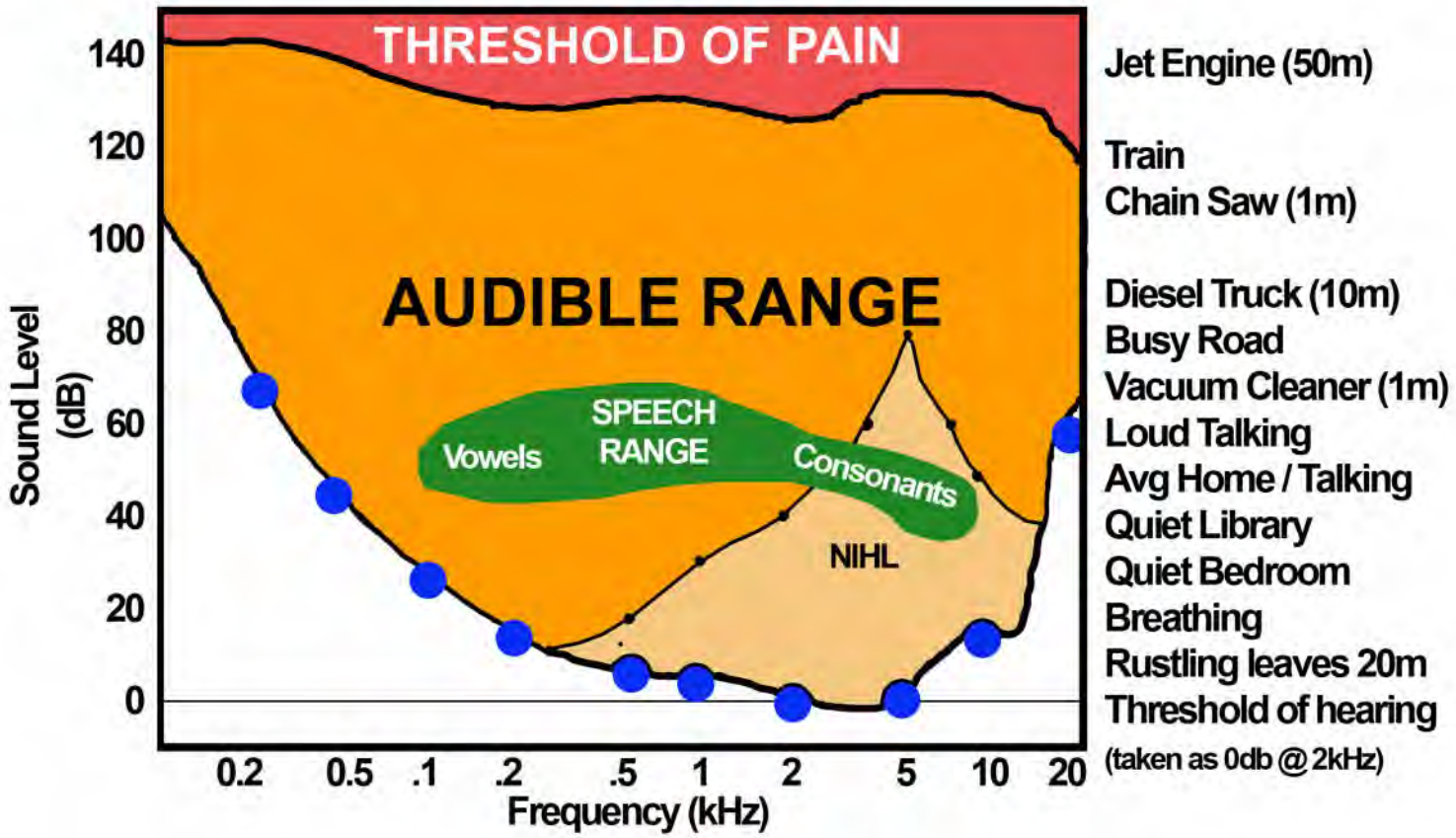
Homeostasis and stressors on systems



Physical Stressors on the Body

Flight and flying machines

- Vibration WBV/HAV and G Forces
- Cramped conditions
- Noise



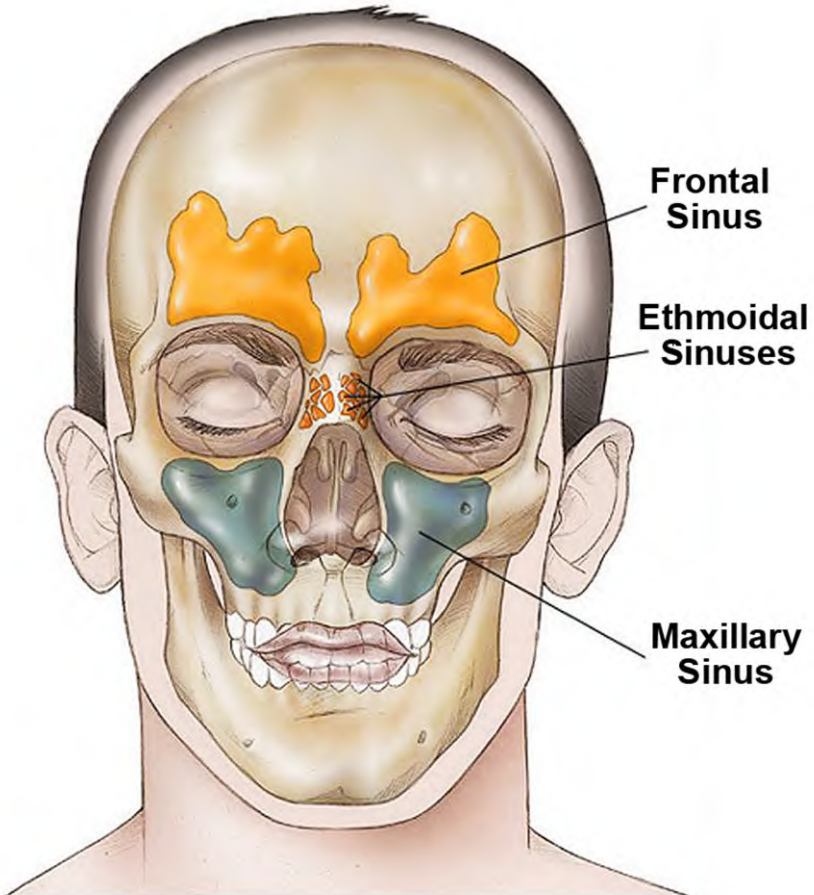
Physical Stressors on the Body

The Environment in which we operate

Temperature
24 - 28 deg C
unclothed/shade

Atm Pressure
Sea Lvl - 18000'

- Dehydration / Blood flow
- Barotrauma



Physical Stressors on the Body

The type of work we do

- Bushfire smoke is carcinogenic

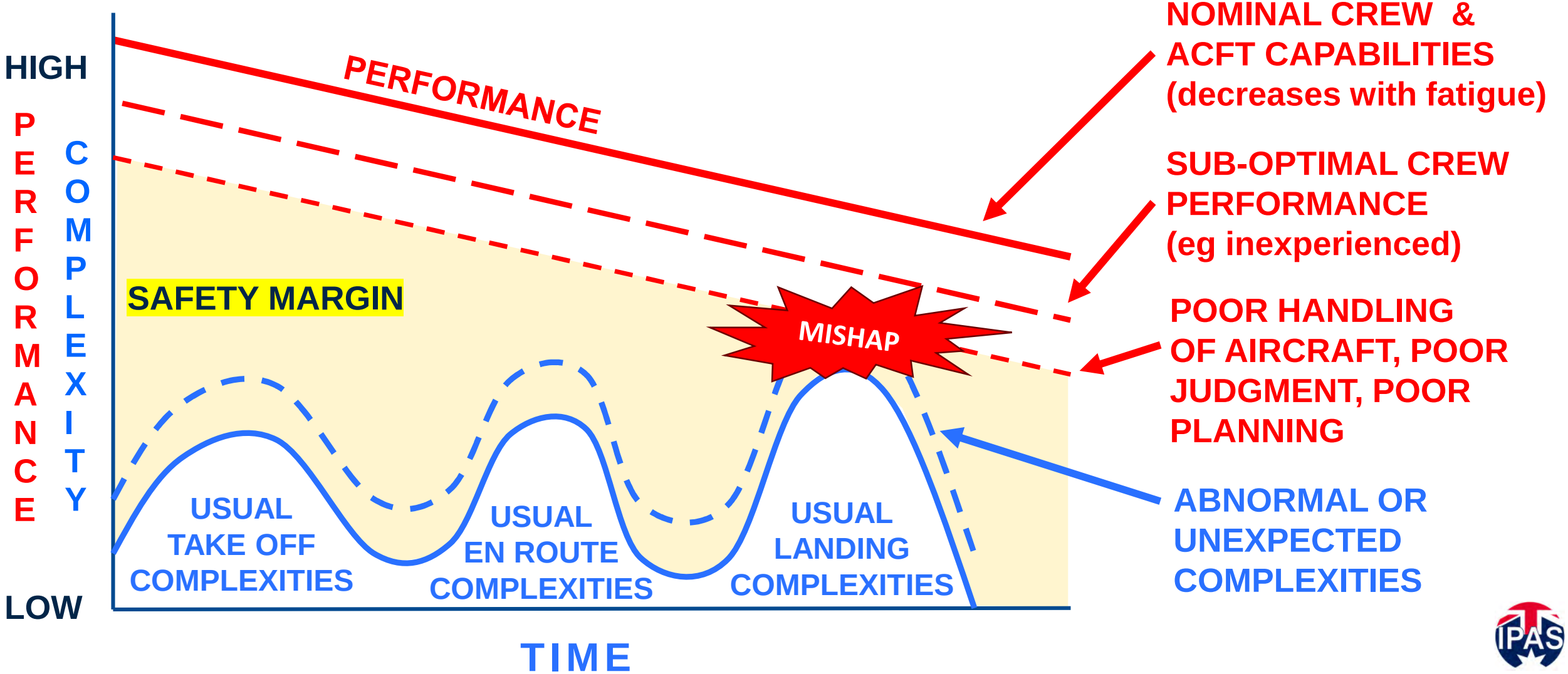
- All of the below cause heightened fatigue
  - Vibrations
  - Cramped conditions
  - Workload (too much or too little)
  - Heat/Dehydration
  - Poor sleep.

Physical and Physiological Stressors

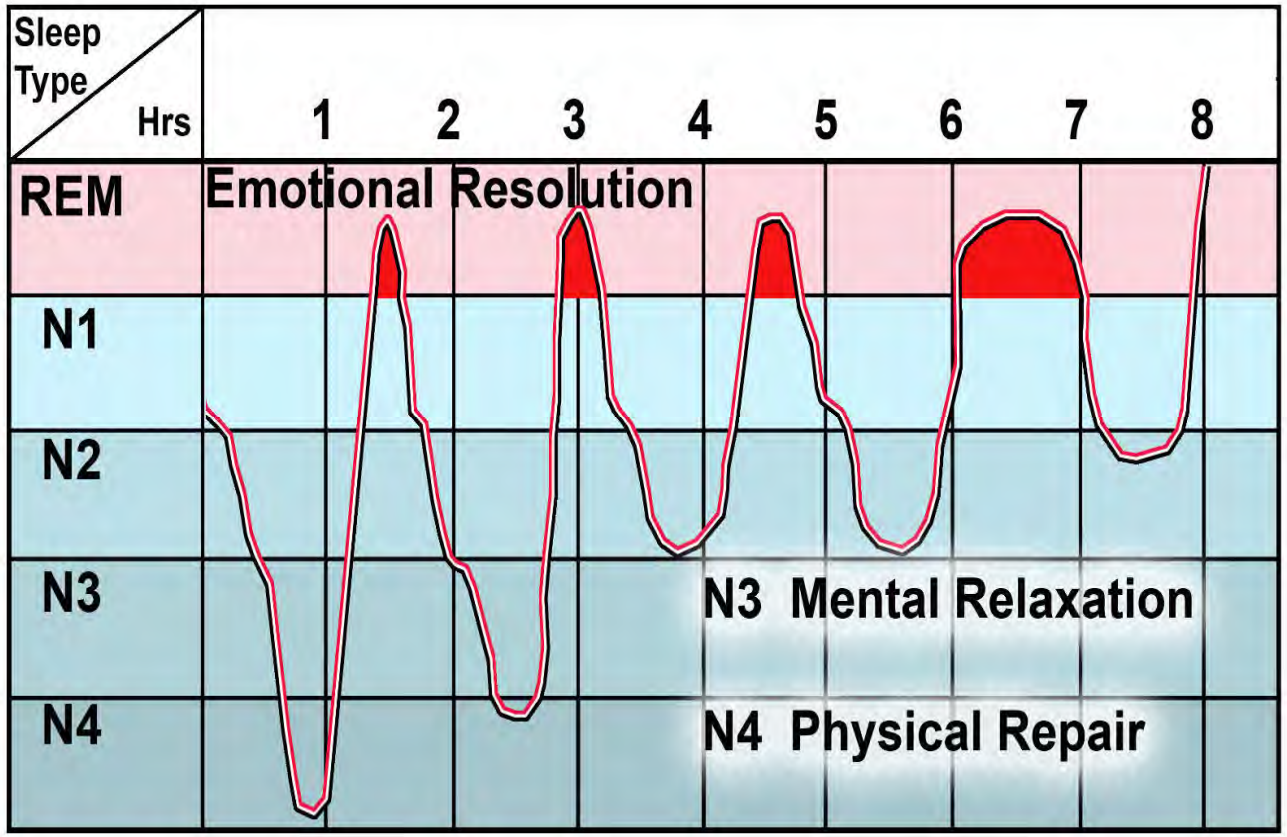
- Vibration (long term)
  - Tendon damage/disc damage
- G-Forces (accelerations)
  - Motion sickness (gender)
- Cramped conditions
  - Hypoxia
  - Pooling blood
  - Fatigue.

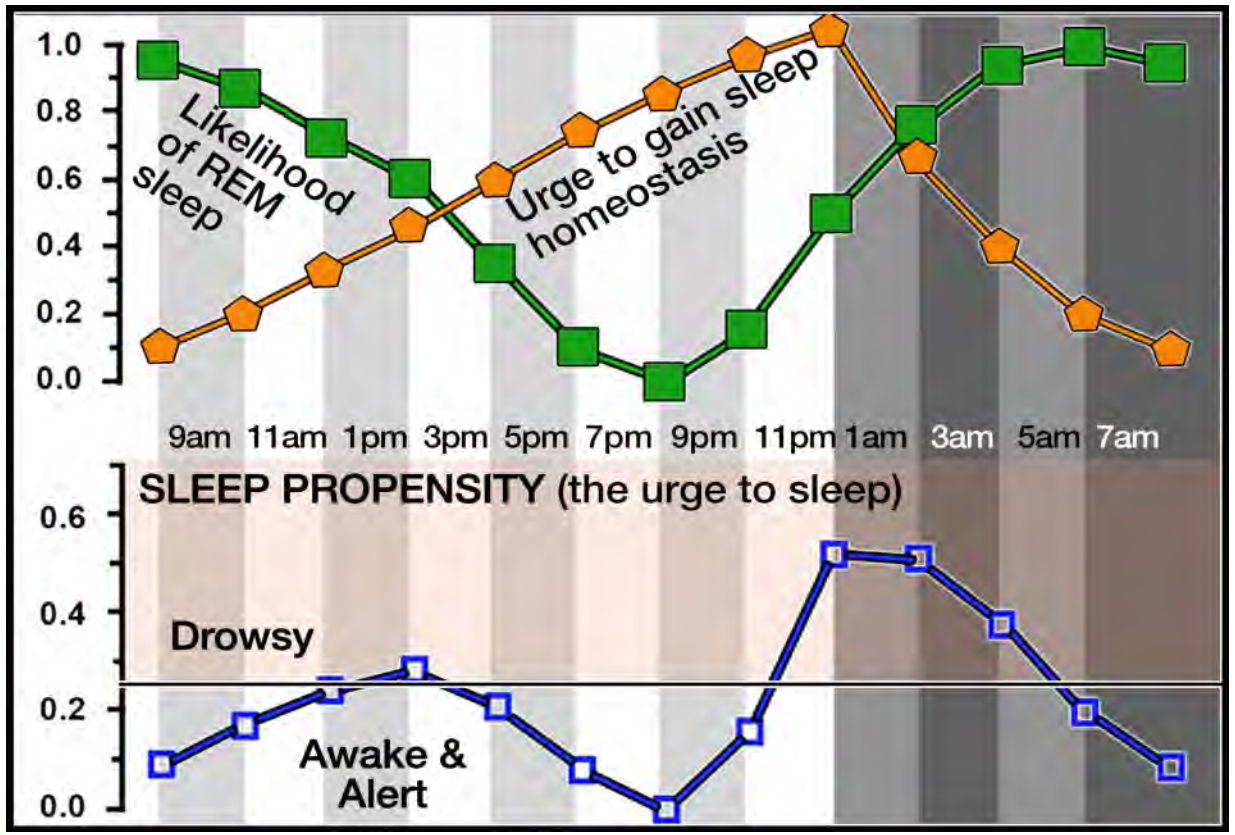
Stress – fatigue and performance

Safety Margin



Stress – fatigue and sleep

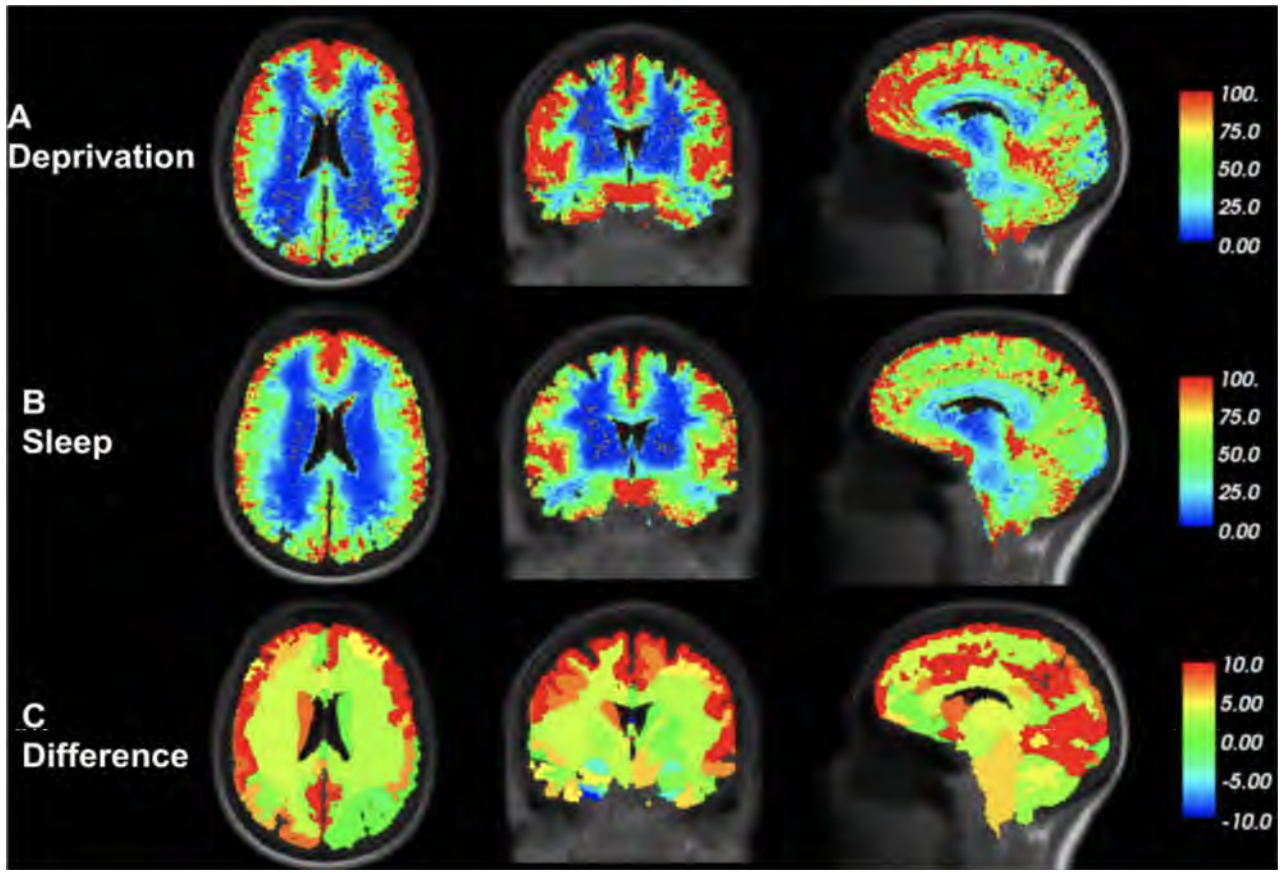




Stress – sleep and effects on the brain

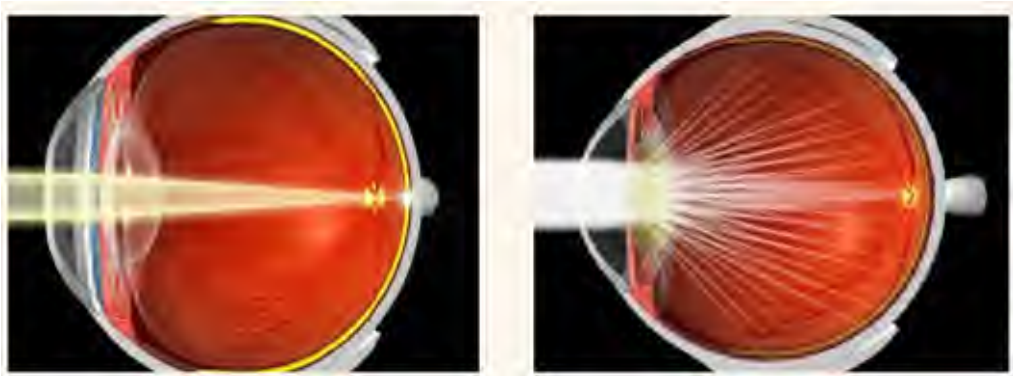
The importance of sleep

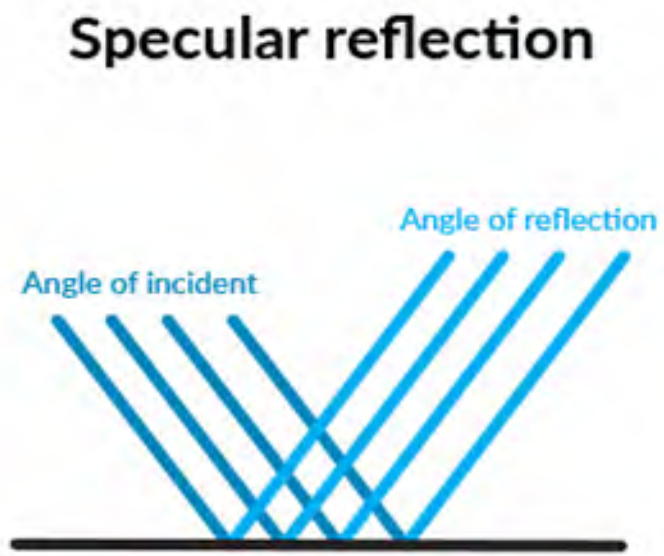
- Brain's toxins are expelled
  - Plaques associated with Alzheimers disease are 'flushed" by CSF as the folds relax and contract
- Weak synapses are disconnected (they say)
- a chronic lack of, or poor quality, sleep increases the risk of high blood pressure, cardiovascular disease, diabetes, depression, and obesity.

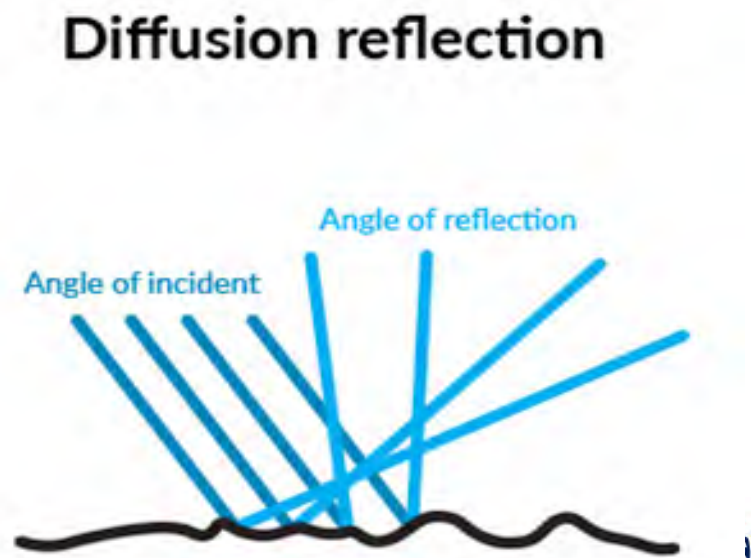


How light works and reaches our brain

- Photons are emitted or are reflected and travel to the eye
- Their frequency and wave-length determine brightness and colour.







Hazards to Low Flying

- Vision – our most critical sense
  - Visual acuity (physiological problems)
  - Obscurations and deflections
    - Windscreen / Airframe* / Obstacles
    - Particulates (smoke, moisture, dust)

Hazards to Low Flying

- Psychological Stressors
  - Mission induced pressures
  - Ego or personal pressures
  - Untrained or inexperienced crew
  - Task is not unclear
  - Distractions
    - Sterile cockpit.

Stress

Stress and Illness

- Stress is needed to maintain our maximum capability… in the correct amount
- Combinative/cumulative
- Holmes Rahre Life Scoring Test
  - >300 – Likely to result in illness
  - 150 – 300, 70% likelihood of illness.

Death of a spouse	100
Divorce	73
Marital separation	65
Jail term	63
Death of a close family member	63
Personal injury or illness	53
Marriage	50
Fired at work	47
Marital reconciliation	45
Retirement	45
Change in health of family member	44
Pregnancy	40
Sex difficulties	39
Gain of new family member	39
Business readjustment	39
Change in financial state	38
Death of a close friend	37
Change to a different line of work	36
Change in number of arguments with spouse	35
Home mortgage over $100,000	31
Foreclosure or mortgage or loan	30
Change in responsibilities at work	29
Son or daughter leaving home	29
Trouble with in-laws	29
Outstanding personal achievement	28
Spouse begins or stops work	26
Begin or end school	26
Change in living conditions	25
Revision of personal habits	24
Trouble with boss	23
Change in work hours or conditions	20
Change in residence	20
Change in schools	20
Change in recreation	19
Change in church activities	19
Change in social activities	18
Mortgage or loan of less than $100,000	17
Change in sleeping habits	16
Change in number of family get-togethers	15
Change in eating habits	15

Stress

Stress in Aviation

- Detection
  - Difficult to detect /insidious
- Incapacitating
  - Staged shutdown
- Recognition
  - Symptoms are different
- ‘Fit-to-Fight’ Concept
  - Physically & Psychologically.

Information Processing

- The human brain performs as a single-channel processor
  - It can receive information in parallel (ie can detect multiple inputs simultaneously), but…
  - …it can only process information in series (ie one thing at a time)

- It relies on previous experience
- All processing activity takes “brainspace.”

Information Processing

- Dynamic, high risk activities such as emergency services, flying etc require significant mental capacity and ability
- Mental ability will be reduced by:
  - Lack of training/experience
  - Lack of recency
  - Fatigue
  - Stress (4 x environments)
- Memory and task saturation are key elements in processing information.

Cognitive processing

How many times did the letter ‘F’ appear?

Cognitive processing

FINISHED FILES ARE THE RESULT OF YEARS OF SCIENTIFIC STUDY COMBINED WITH THE EXPERIENCE OF MANY YEARS

Memory lets you down – write it down!

- Know your SOPs and your job
- Remember:
  - 10 SFOs
  - 18 WOS
  - LACES
- Get a good briefing
- Give a good briefing
- Use your checklists
- Write it down / track decisions.

Mitigations

- Cockpit organised
  - Items within reach / accessible pockets / no FOD
- PPE
  - Helmet with double hearing protection / visor down
  - Glasses – spare pair that's accessible
- Water and food within reach
- Turn up for work fighting fit
- Get moving; have breaks
- Know what the task is and the desired end state
- Know who's who and what their jobs are.


277
VH-XAW

Key Takeaways from Part 2a

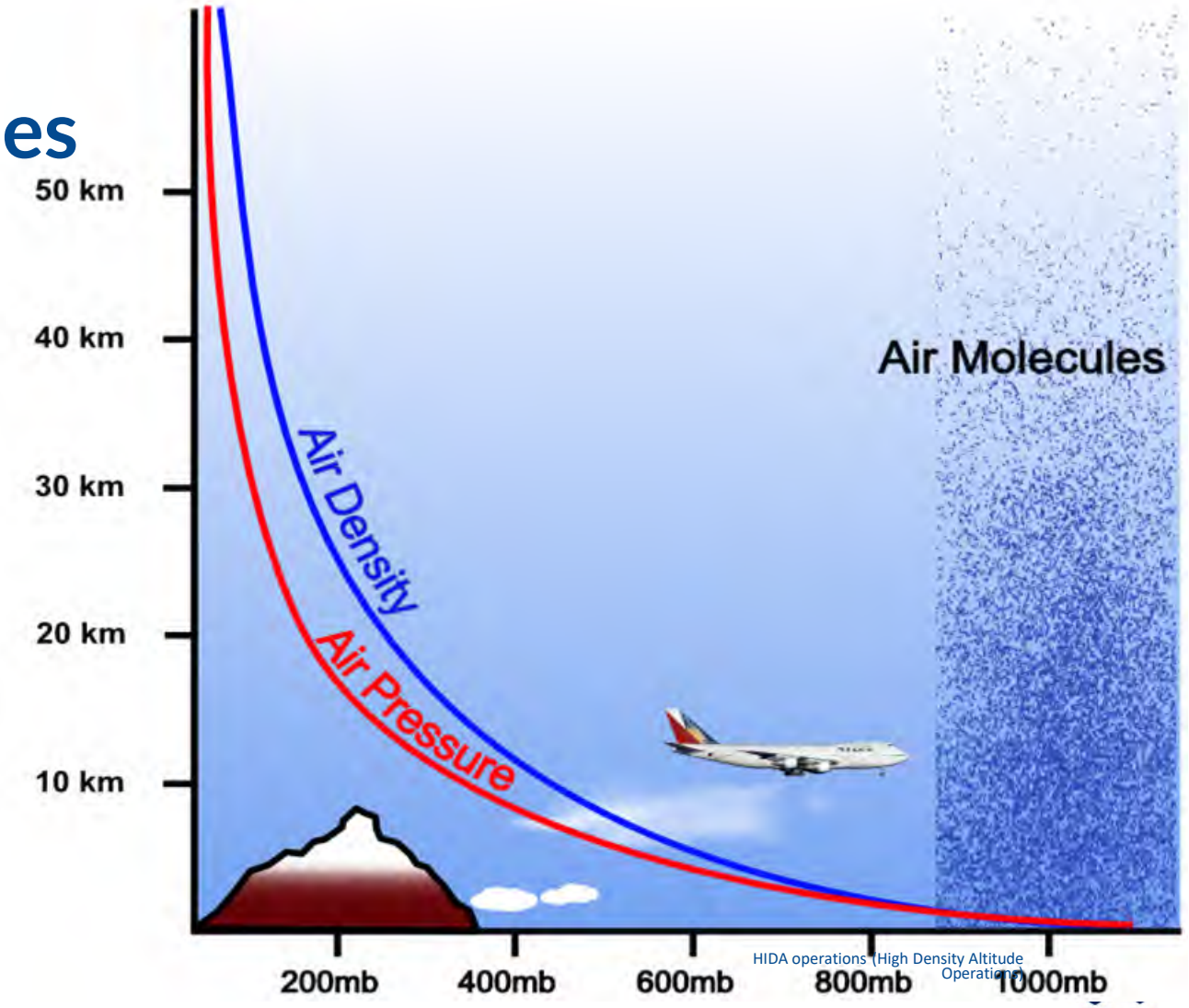
- The human body has evolved to be comfortable in a particular environmental range
- When a system (physical/physiological/psychological) is displaced from its steady state, stress occurs
- Stress is combinative and cumulative
- Know your symptoms and of those important to you
- Fatigue's effects slows down cognition
- The brain can get overloaded and miss things
- Know your job, use SOPs & checklists, write things down.

AIRCRAFT CAPABILITIES

- Aircraft commanders and Mission Crew need to know the limitations to aircraft performance
  - High Density Altitude
  - Power curves and power available
  - Avoid area on Height / Velocity graphs
  - Hovering In Ground Effect vs Out of Ground Effect
  - Power Available graphs
  - OEI Performance
  - Loss of Tail Rotor Effectiveness
  - Weight and Balance and MTOW.

Density Altitude

- In order for a wing/blade to create lift, it needs air molecules to pass over its surface
- The more air molecules, the better the lift
- There are fewer air molecules in hot air, at altitude and or when the air is humid (Hot, High, Humid)
- This is known as a High Density Altitude.



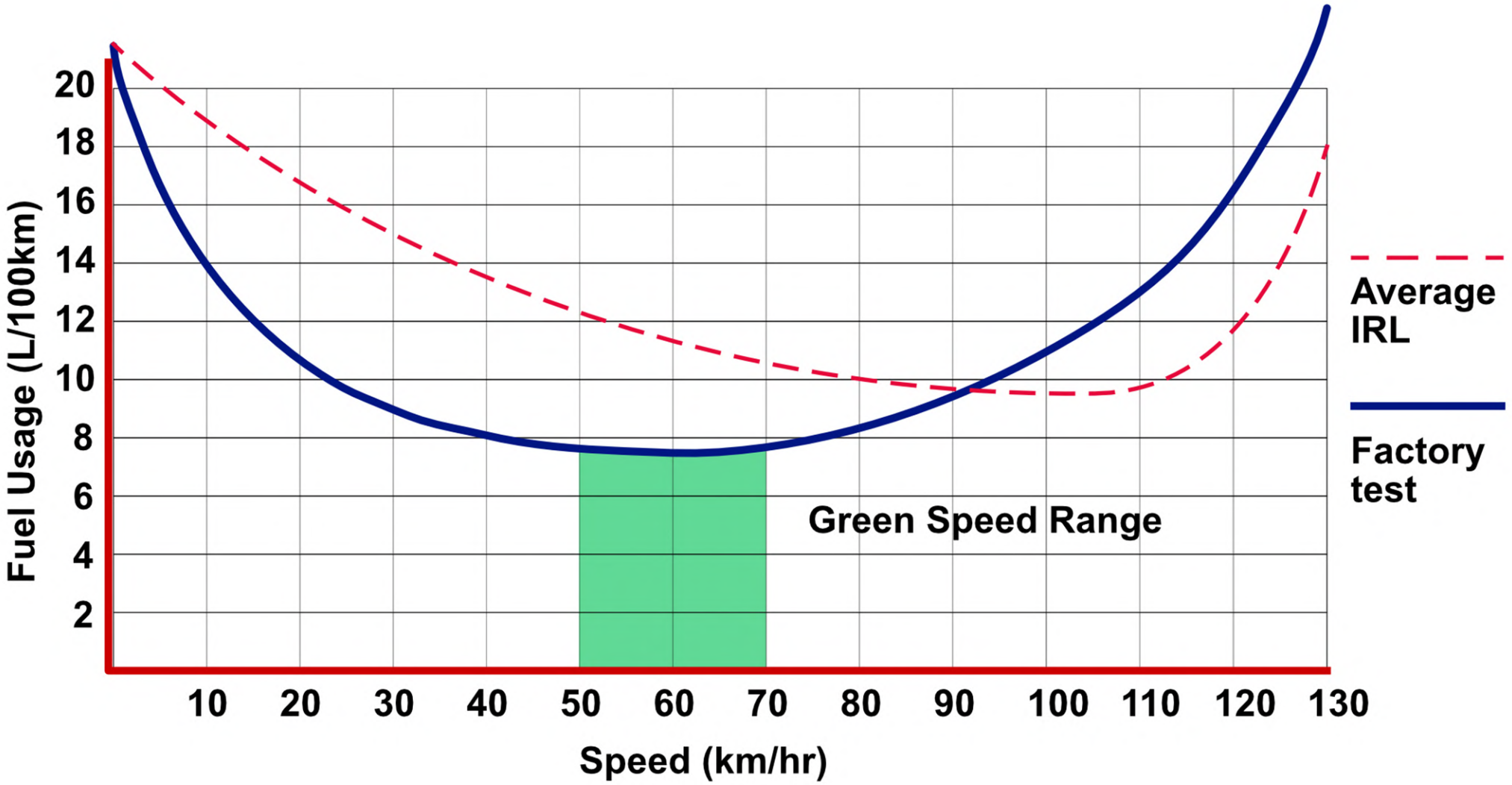
Refresher for aircrew…

- What is the formula used to calculate pressure altitude?
  - Δ pressure x +/- 30’
  - Eg QNH is 1020 = 7 x -30 = -210 ft
- What is the formula used to calculate density altitude?
  - Δ temp x +/- 120’

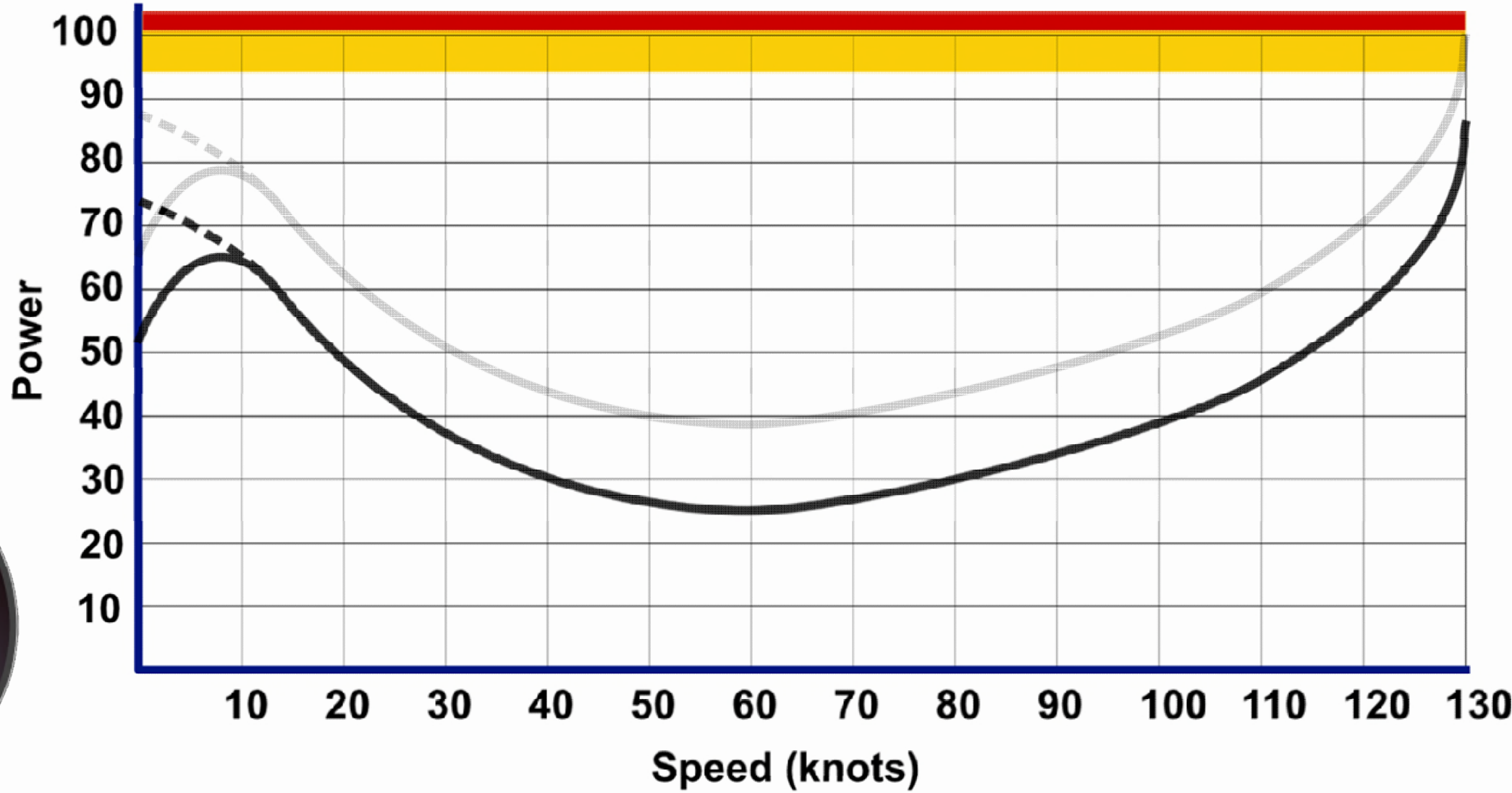
Density Altitude

- Aircraft performance deteriorates with hot conditions.
- Here's an example
- Don't anticipate the change during the day and look what happens…

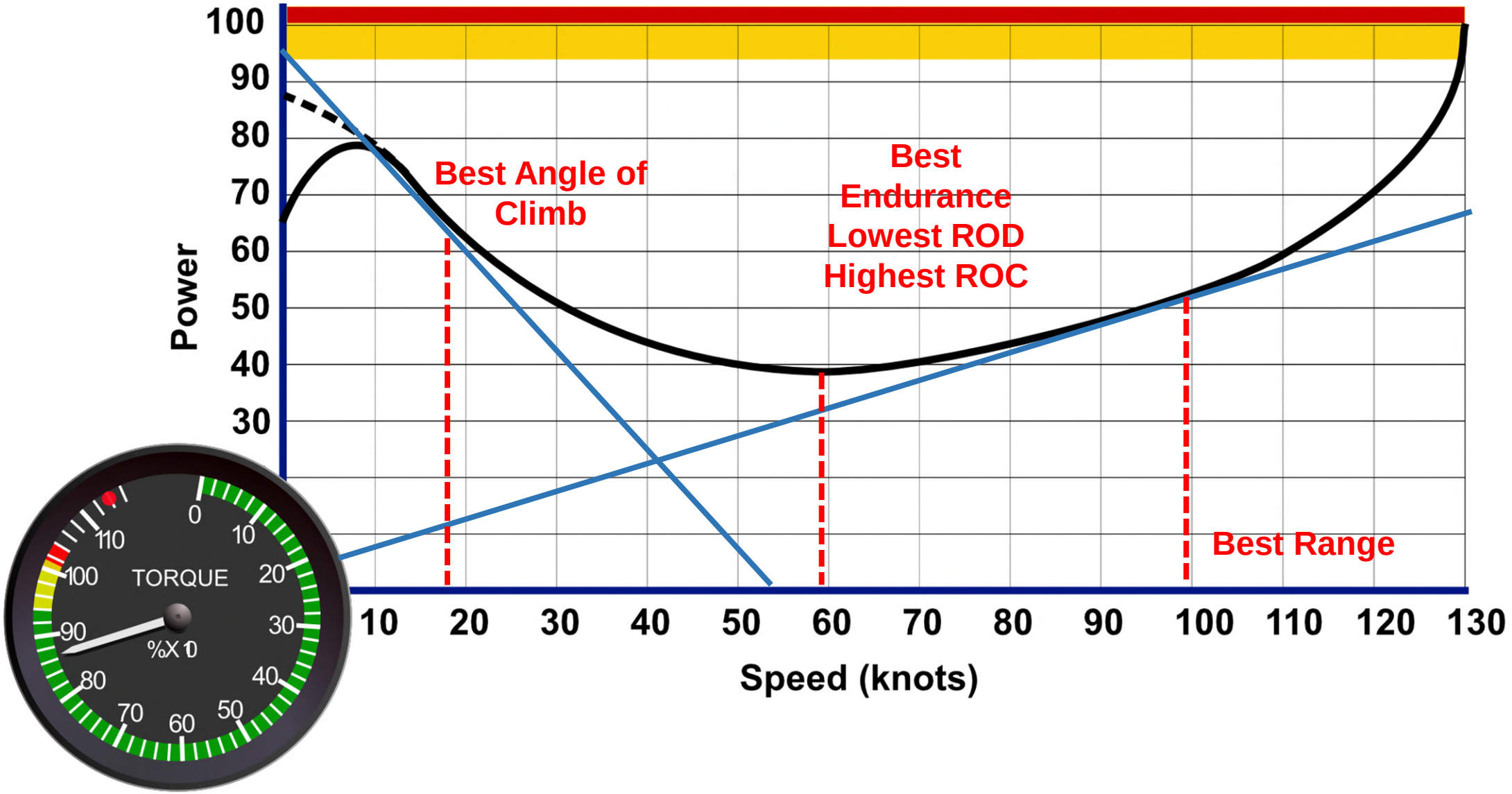
A car's fuel usage vs speed



Power curve and time limited power



Power Curve and Best Speeds



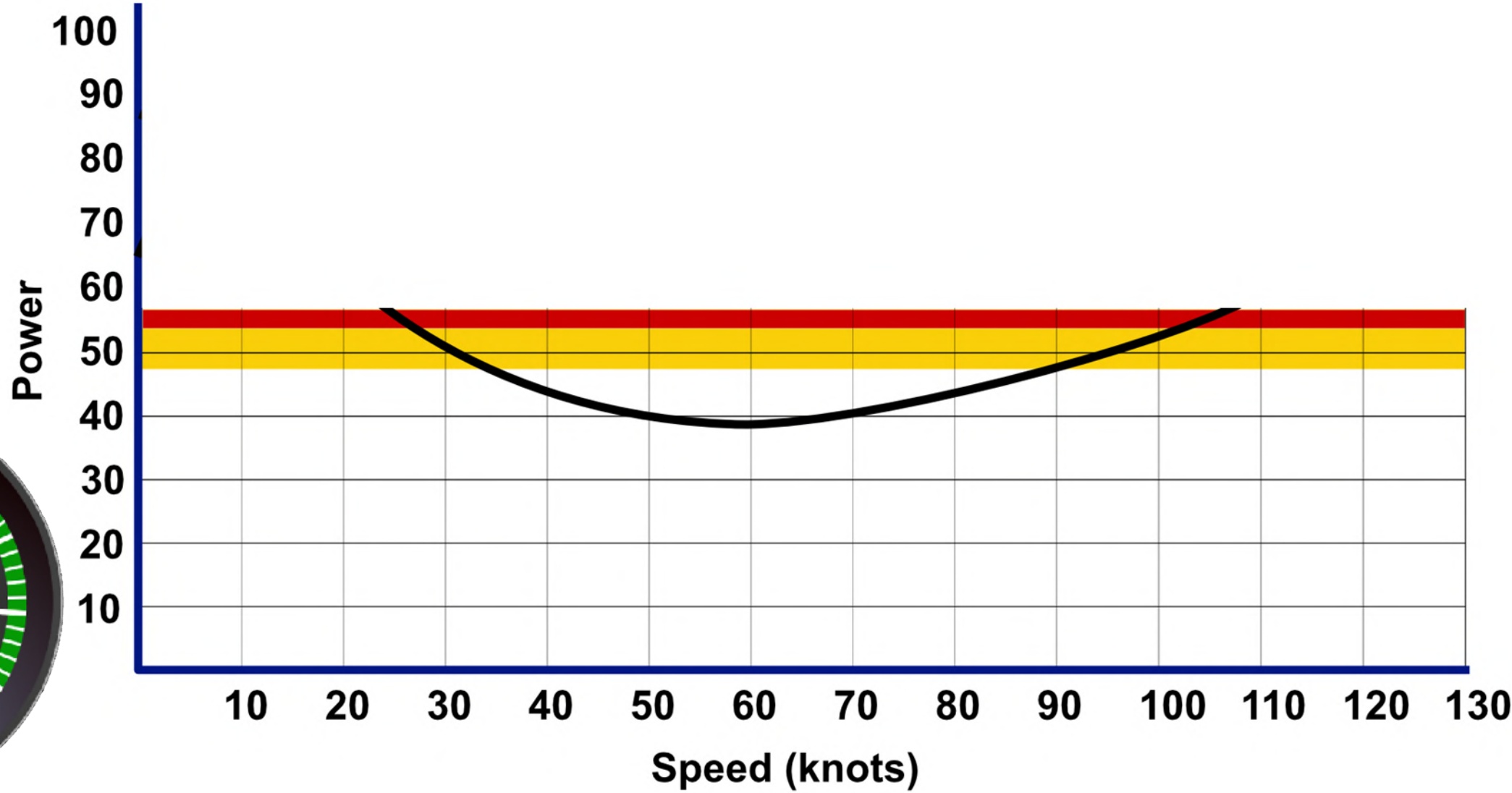
Engine Failures

- Engine failures require special handling techniques and considerations in fixed and rotary wing aircraft;
- OEI performance;
- Landing areas;
- Asymmetric performance (most twin aeroplanes);
- Forced Landings/Autorotations in single engined acft.

Actions after losing power

- Total loss of power in aircraft means:
  - FW
    - the pilot must keep forward airspeed to allow a controlled descent to a suitable forced landing area.
  - RW –
    - the pilot must keep airflow coming up through the rotor blades
    - keep the blade pitch at such an angle so as to allow the airflow to keep the blades spinning
    - prior to touchdown, the pilot can then used this potential energy to slow the rate of descent and gently cushion on.

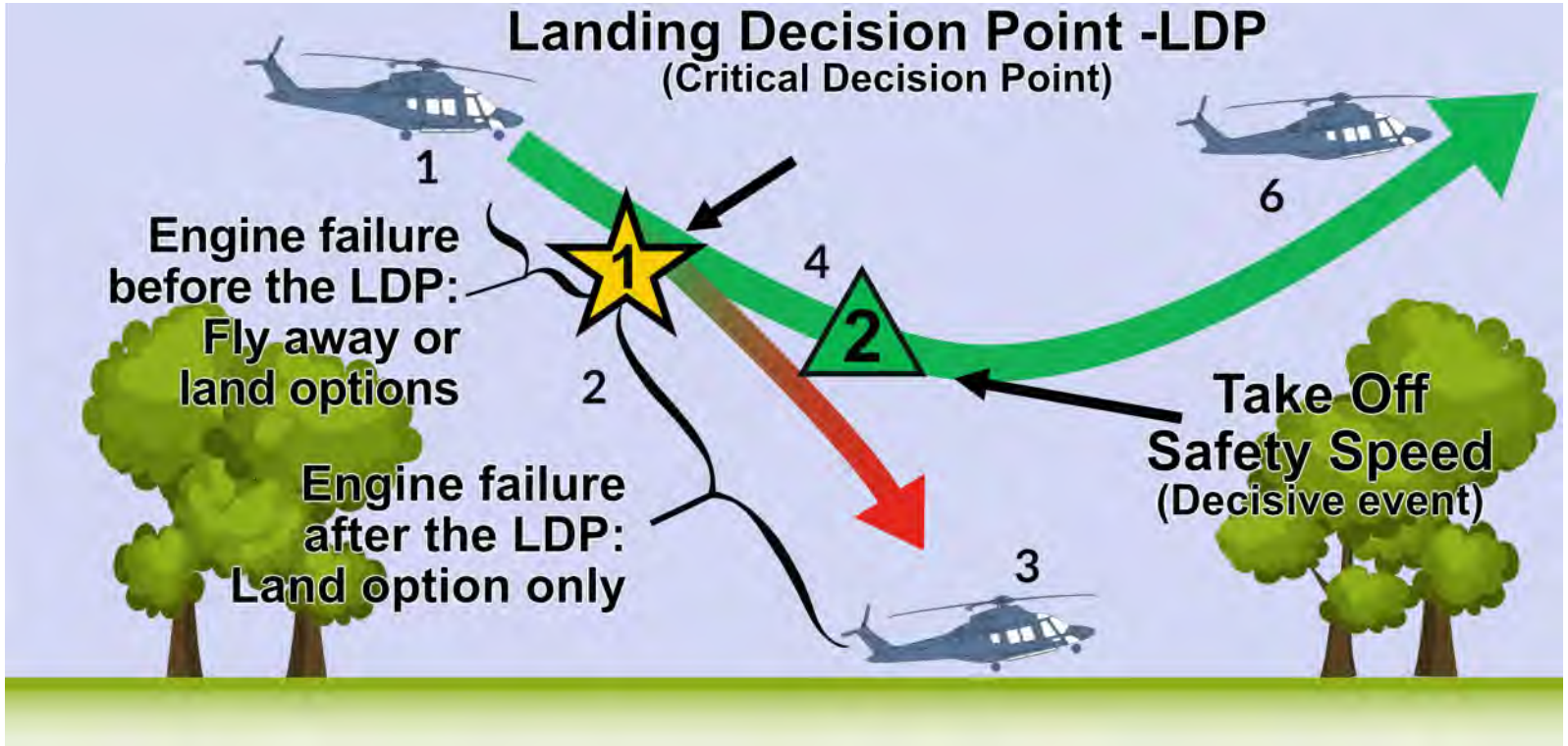
Engine failure in a multi-engined helo



Category A Helicopter Design

ICAO Annex 6 – Chapt 1. Definitions

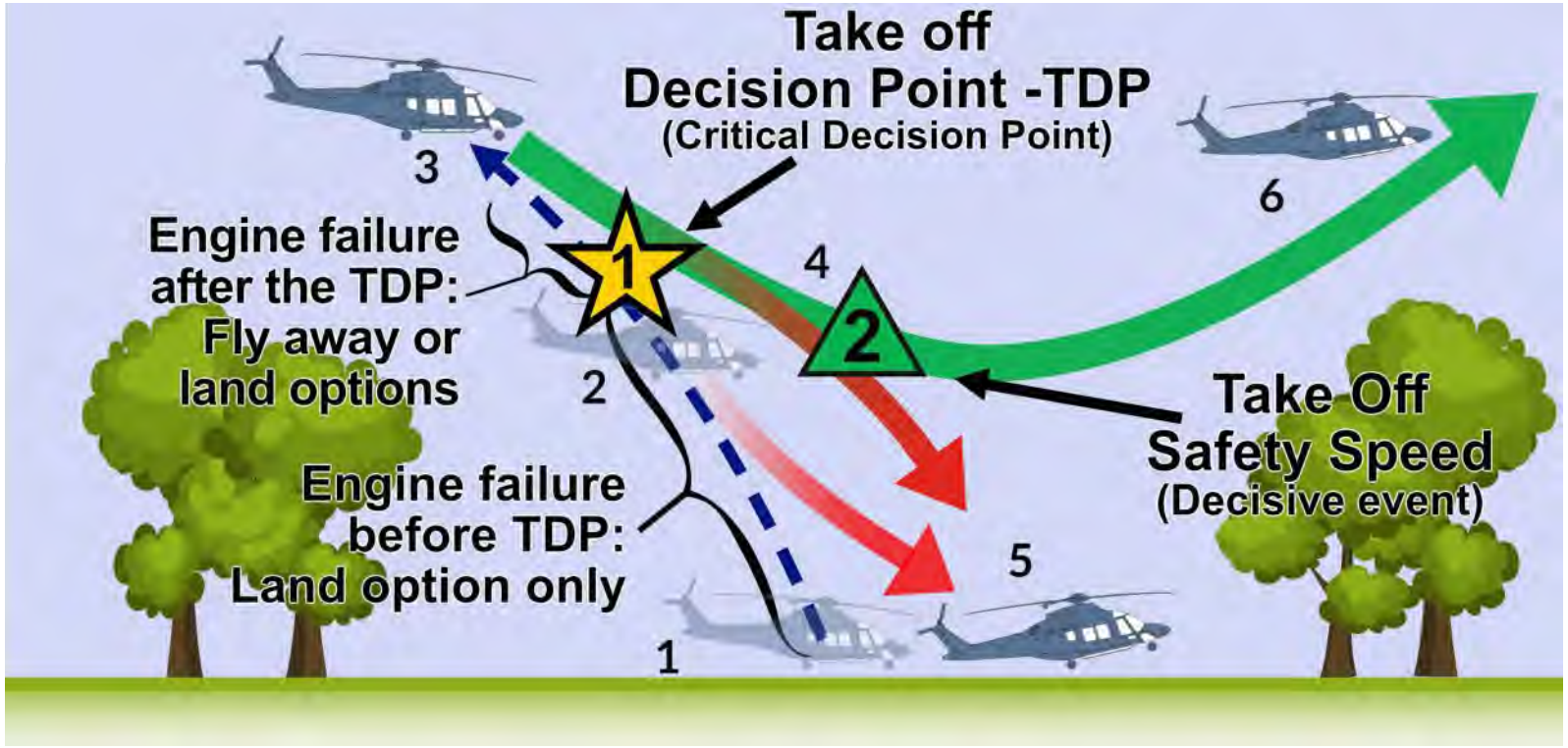
- A Cat A designed helicopter is able to land or take off safely after an engine failure when operated in Performance Class 1 situations
  - Suitable forced landing area
  - Conditions are suitable for the manoeuvre



Category A Helicopter Design

ICAO Annex 6 – Chapt 1. Definitions

- Procedure for take off

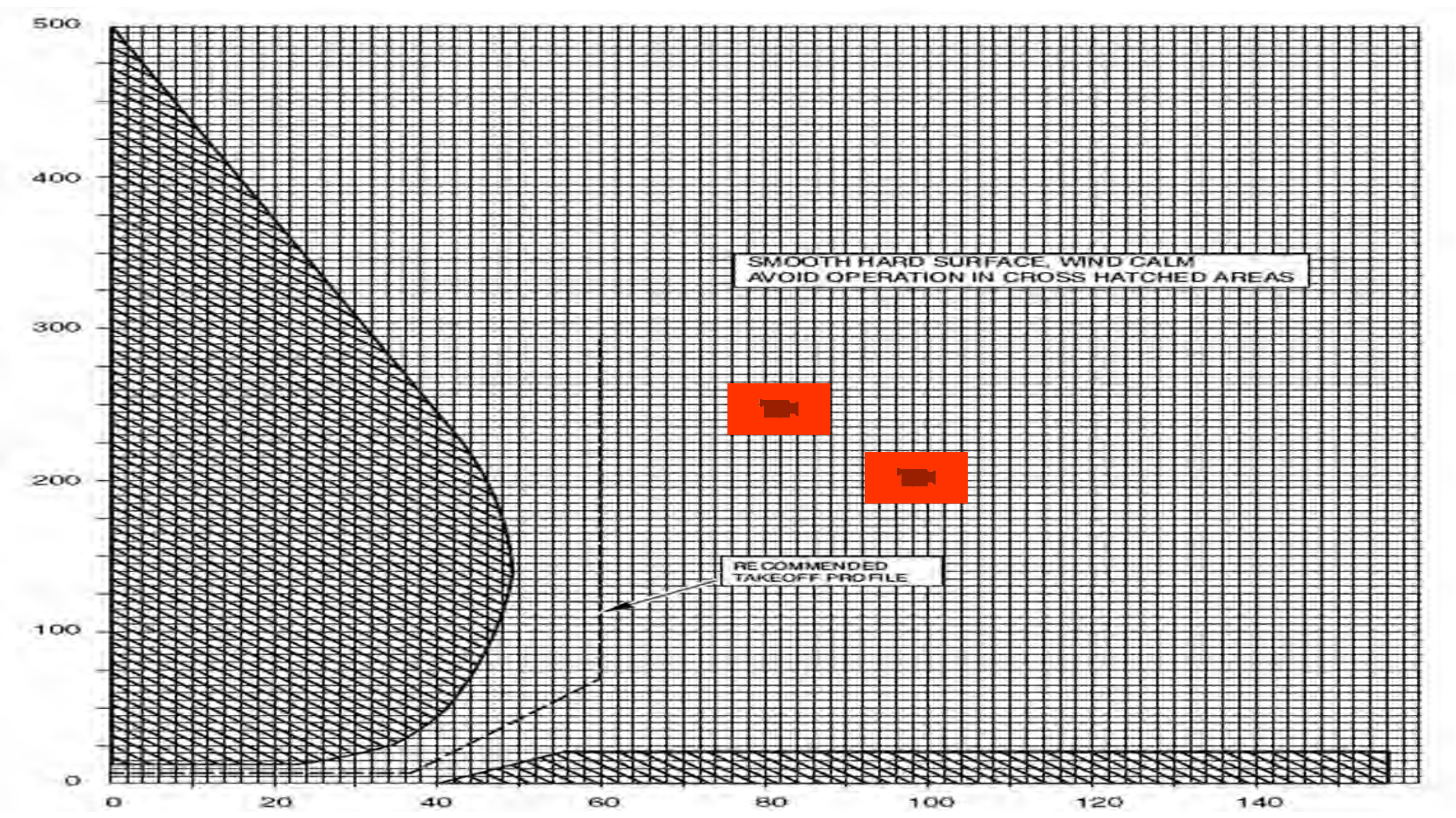


Operating in a ‘Hostile Environment’

ICAO Annex 6 – Chapt 1. Definitions

- ICAO defines a hostile environment as somewhere that:
  - A safe forced landing cannot be accomplished due to surroundings
  - Occupants cannot be protected from the elements
  - SAR will take too long
  - Risk to persons on the ground is unacceptable.

Aircraft operating need cleared areas for external loads and emergencies. Helibase design criteria take this into account. (What's the vis?)


500
400
300
200
100
0
0
20
40
60
80
100
120
140
SMOOTH HARD SURFACE, WIND CALM
AVOID OPERATION IN CROSS HATCHED AREAS
RECOMMENDED
TAKEOFF PROFILE

Confined Area Take Offs

- When departing from a confined area, especially amongst trees, all personnel should watch for obstacles
- People are not used to looking upwards
- Look around the aircraft before departing and positively identify any hazards
- The pilot must be aware of any drift during the departure

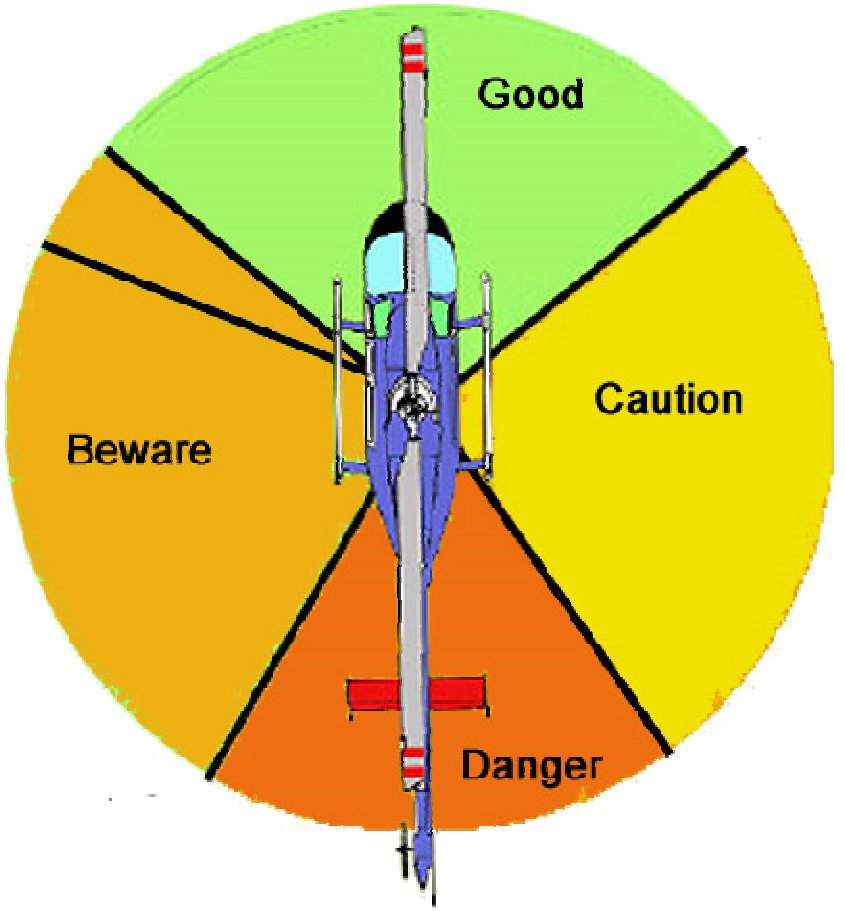
Bell Long Ranger
Loss of Tail Rotor Effectiveness

Hazards to Low Flying

- Power is required by the tail rotor.
- A loss of tail rotor effectiveness (LTE) can be due to:
  - Mechanical failure
  - High aircraft weight and / or poor control
  - Downwind hovering.

LTE

Critical Wind Azimuth Limits B206



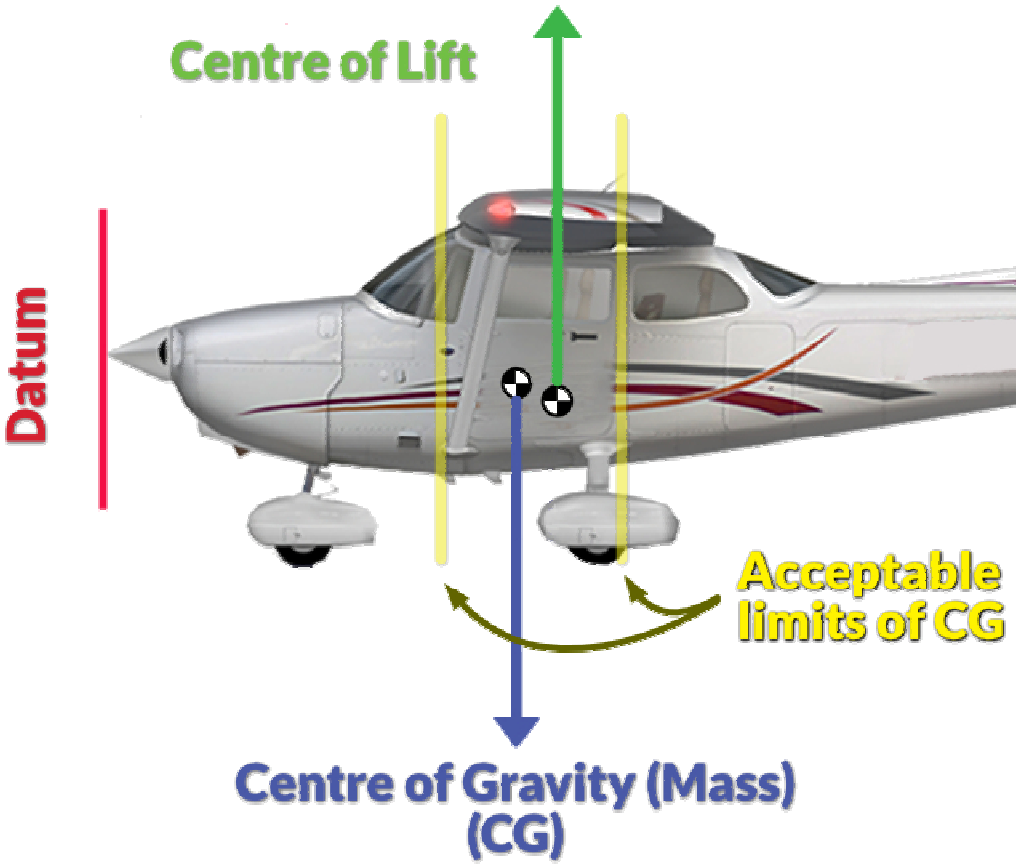
Wind on the nose is the safest and most efficient direction;

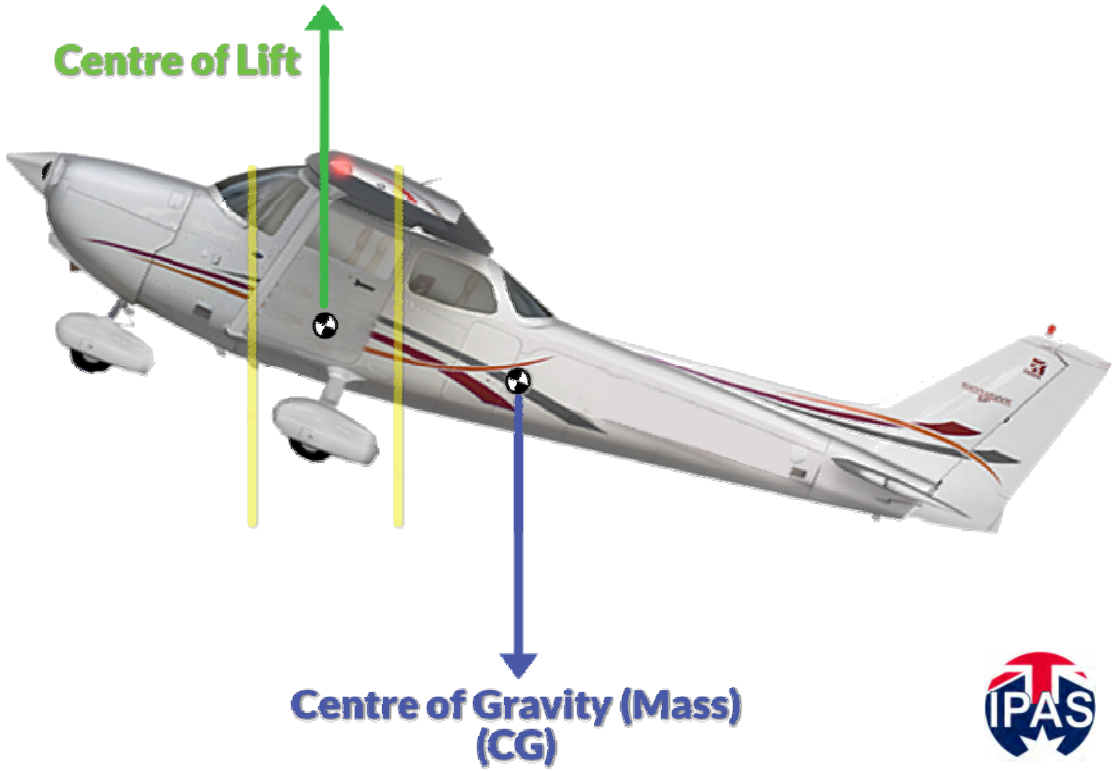
Wind from behind makes the

Cargo, CG, MTOW

- All aircraft will have a MTOW;
- The carrying capacity will depend on the Density Altitude (temperature/humidity/altitude);
- Cargo must be:
  - Properly weighed and prepared;
  - Properly secured; and
  - Properly distributed in the aircraft to ensure balance… let's have a look at CG.

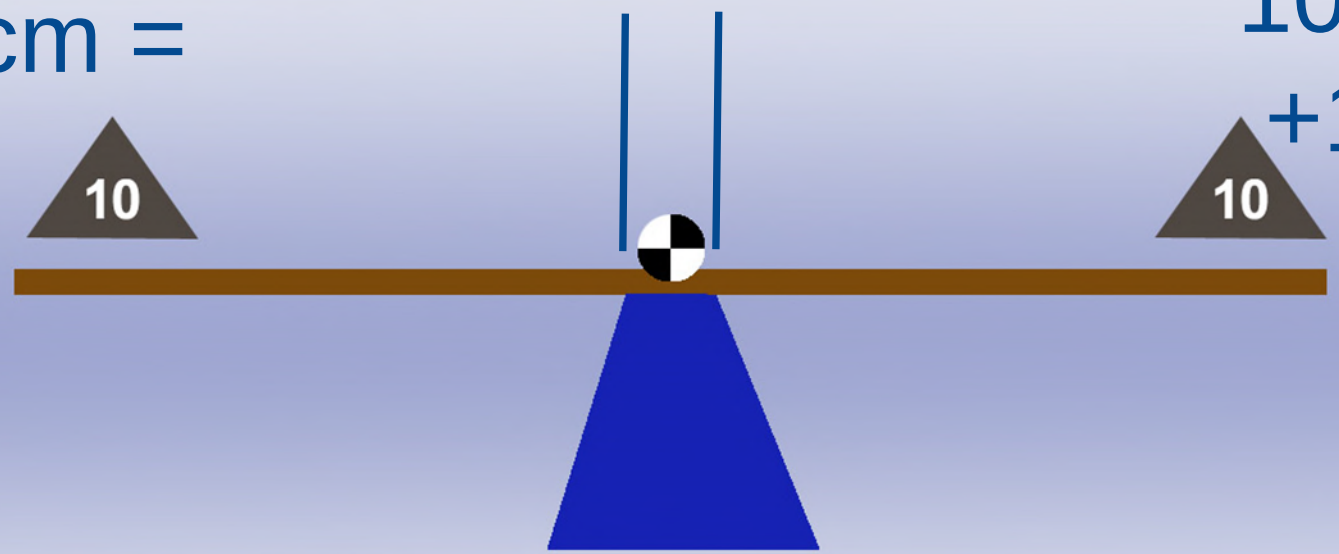
Centre of Gravity





CONDITIONS: Acceptable CG range is -1cm to +1cm
Maximum Weight is 25kg

10KG x -10cm =
-100kg cm

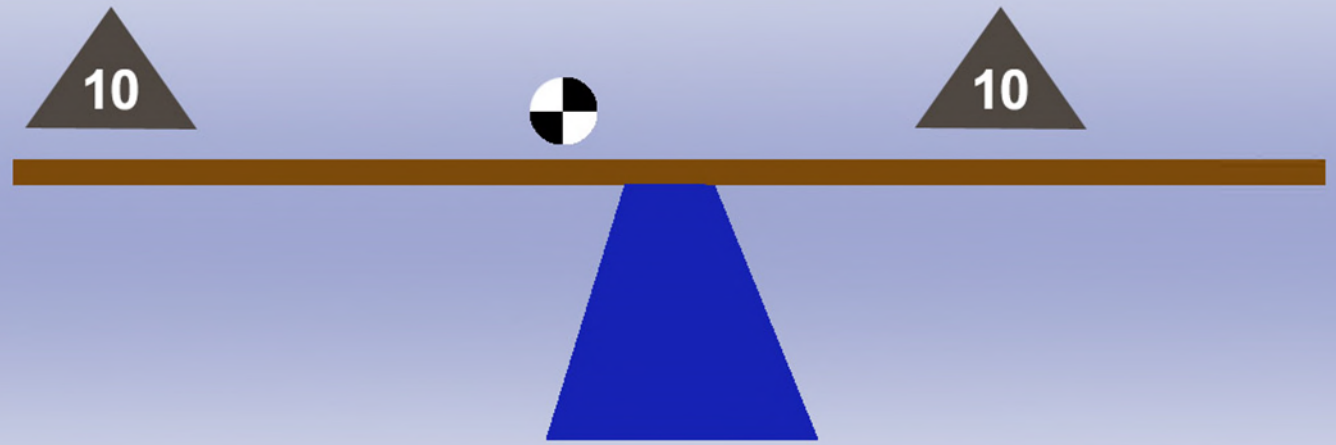


10KG x 10cm =
+100kg cm

CG = Sum of Moments / Sum of Weight = 0cm

Therefore CG is within limits of -1 to +1

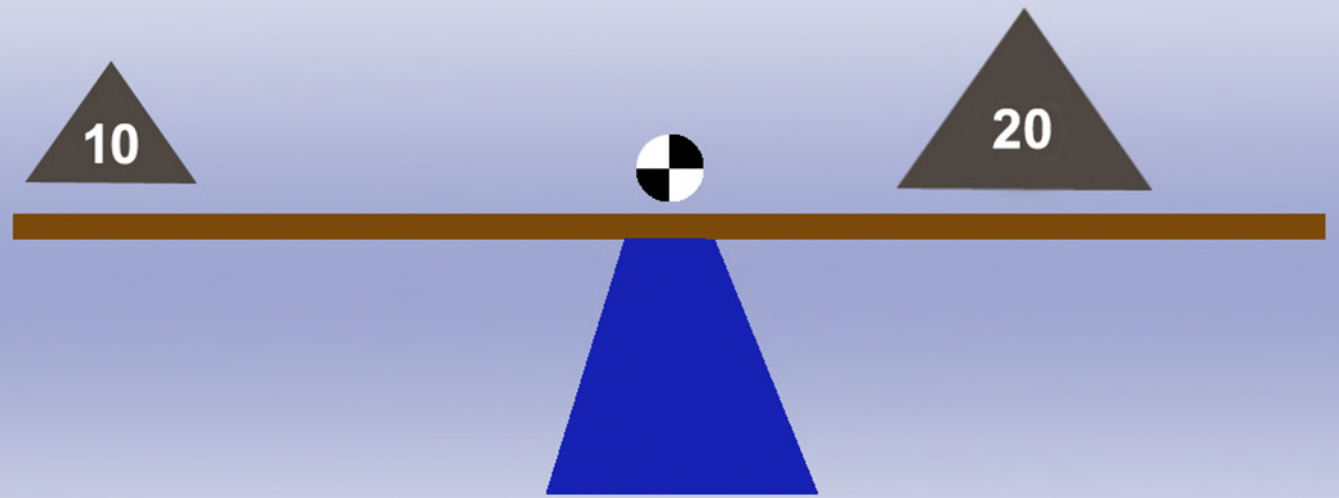
10kg x -10cm = -100 kg cm 10KG x 5cm = + 50 kg cm



CG = (-100+50) / 20 = -2.5cm

Therefore CG is out of limits >-1cm

10kg x -10cm = -100 kg cm 20KG x 5cm = + 100 kg cm

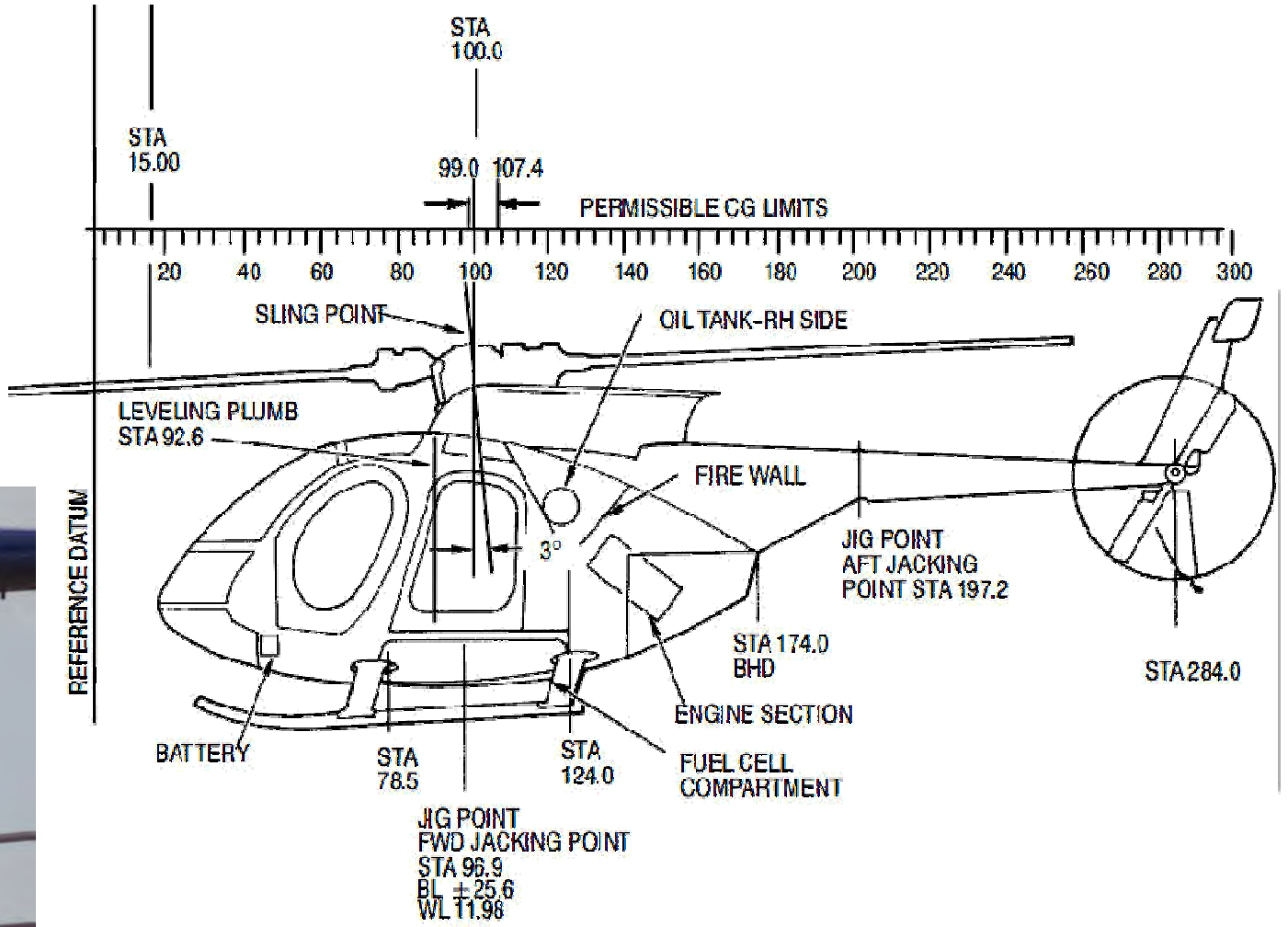


CG = (-100+100) / 30 = 0 cm

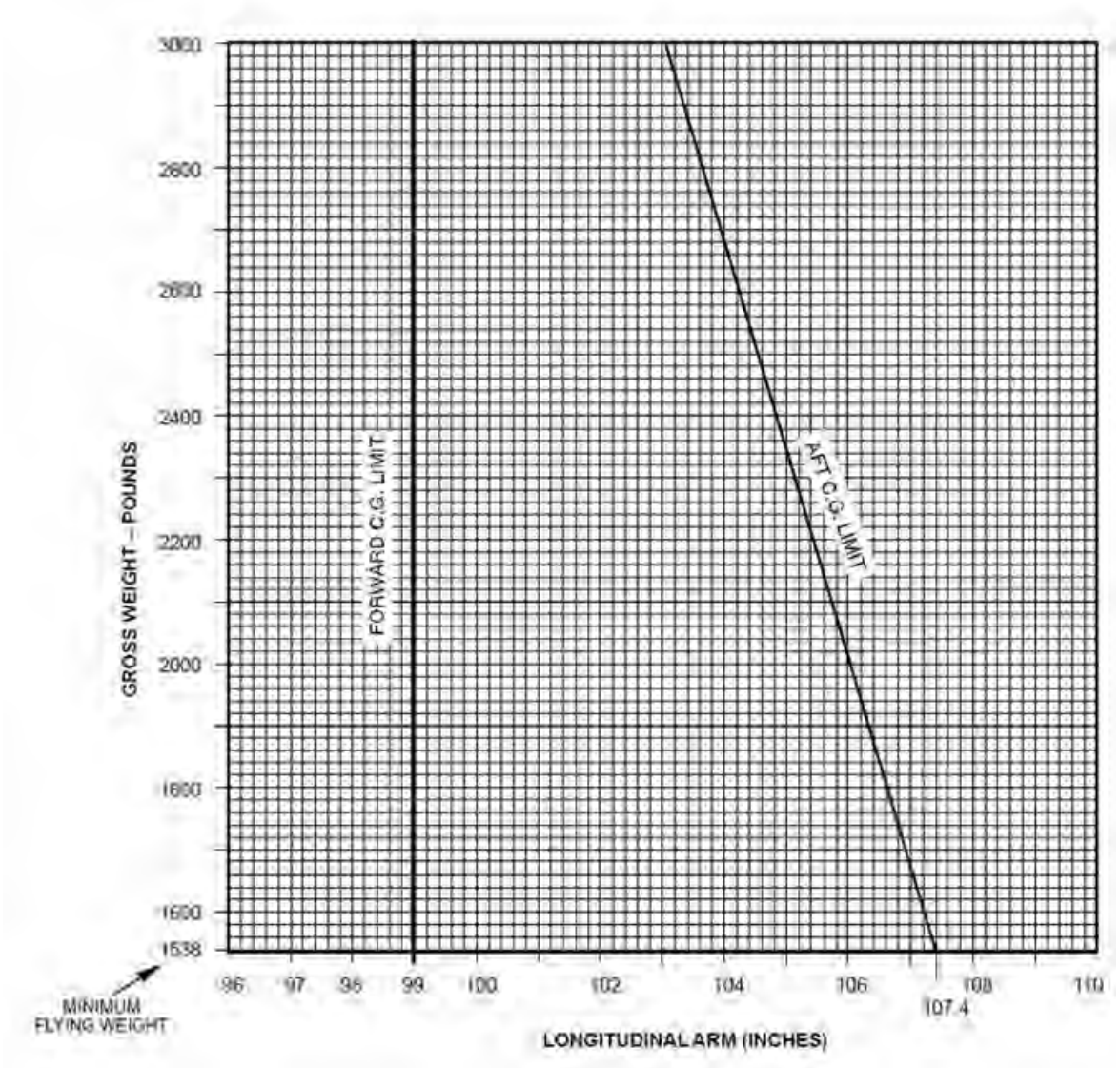
Therefore CG is within limits

But weight is too great!


N369D
CNBC


STA
100.0
STA
15.00
99.0
107.4
PERMISSIBLE CG LIMITS
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
SLING POINT
OIL TANK-RH SIDE
LEVELING PLUMB
STA 92.6
REFERENCE DATUM
FIRE WALL
3°
JIG POINT
AFT JACKING
POINT STA 197.2
STA 174.0
BHD
STA 284.0
ENGINE SECTION
BATTERY
STA
78.5
STA
124.0
FUEL CELL
COMPARTMENT
JIG POINT
FWD JACKING POINT
STA 96.9
BL ±25.6
WL 11.98

Helicopter Centre of Gravity Envelope



Key Takeaways from Part 2b

- Altitude and airspeed are your friends, always have enough to give you options
- Heat is not your friend, so beware when he's around
- Weight and balance cannot be trifled with

Practical Low Flying stuff…

Wires and Towers

Hazards to Low Flying

- Man-made hazards
  - Wires
  - Structures and buildings
  - Payloads, cargo, special materials
  - Traffic and onlookers

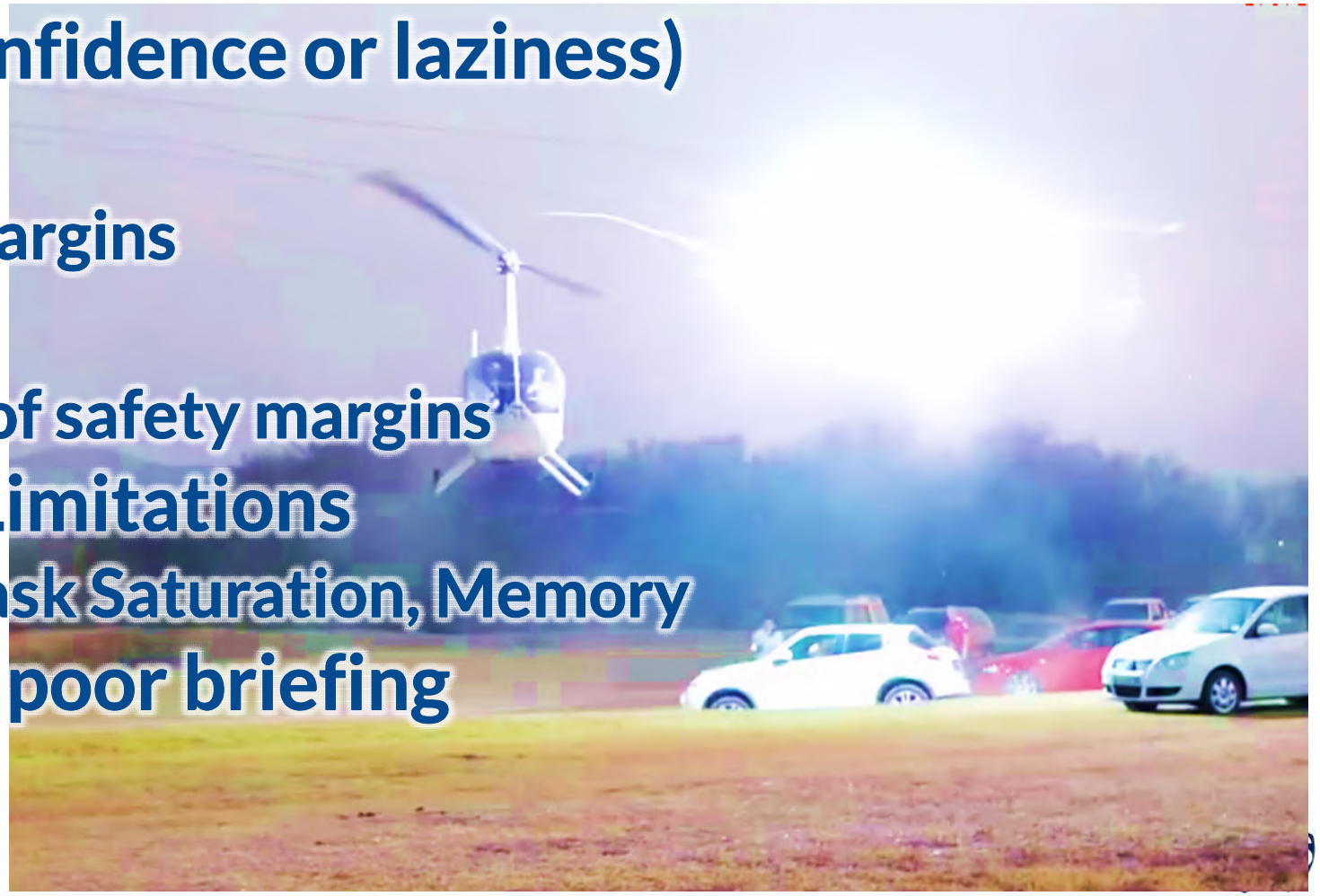
Wires

- 44% of <u>all</u> wire strikes involve helicopters
- 60% were during agricultural ops
- FW outnumber RW 7:1 therefore helicopters are over represented in this statistic.
- 19% of accidents were fatal (38% of RW wirestrikes were fatal)
- The number of cases where the wire was known was… (any guesses?)

63%

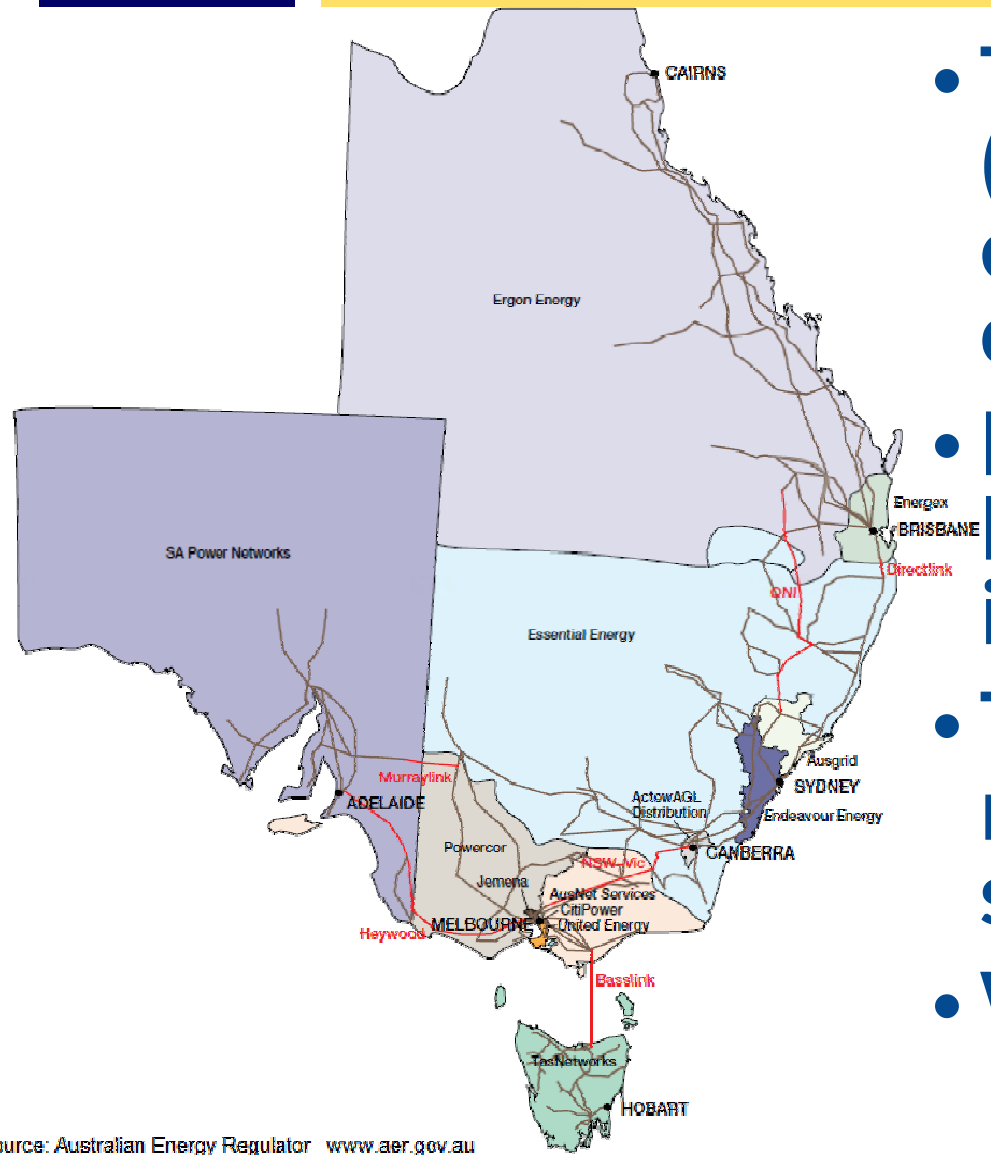
Hazards to Low Flying

- Key reasons for wire strike of known wires
  - Complacency (Overconfidence or laziness)
  - Violation
    - Deliberately cutting margins
  - Errors
    - Unintentional cutting of safety margins
  - Human Performance Limitations
    - Fatigue, Distraction, Task Saturation, Memory
  - Inapproprite duties or poor briefing



The Australian Electrical System

The National Electricity Market

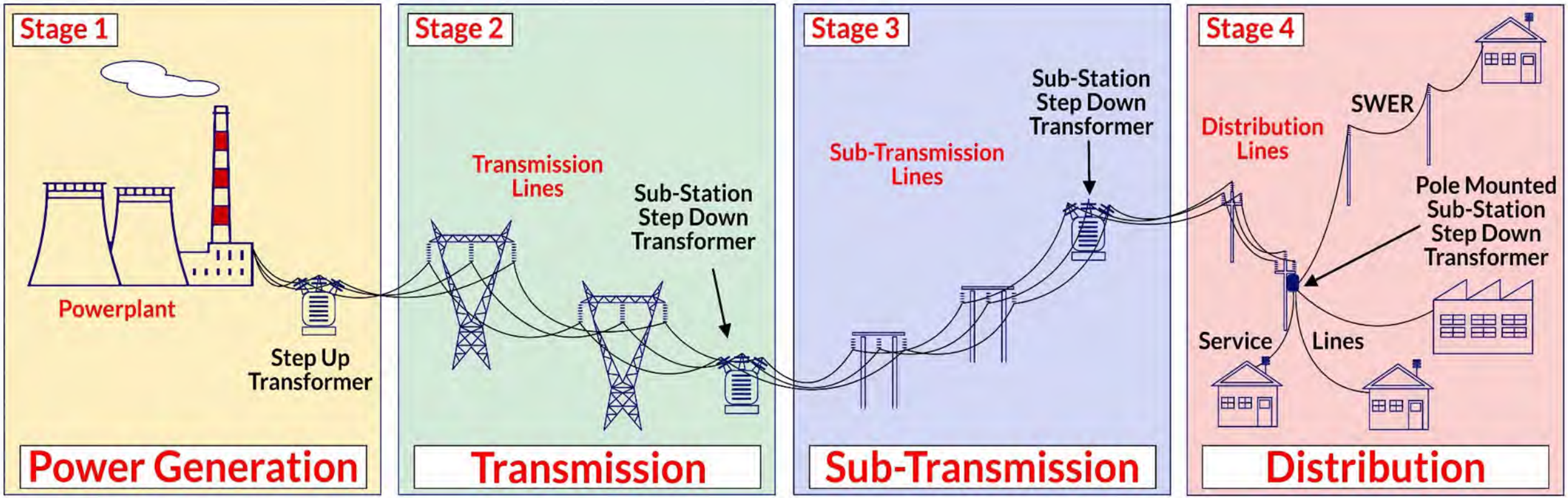


- The National Electricity Market (NEM) is a system of interconnected electrical grids on the east and south coasts
- Electricity providers (eg Ergon, Essential) generate and sell electricity into the grid to their customers
- The NEM provides reliable supply at market rates to the retailers who on-sell to their customers
- WA and NT have their own grids.

Source: Australian Energy Regulator www.aer.gov.au

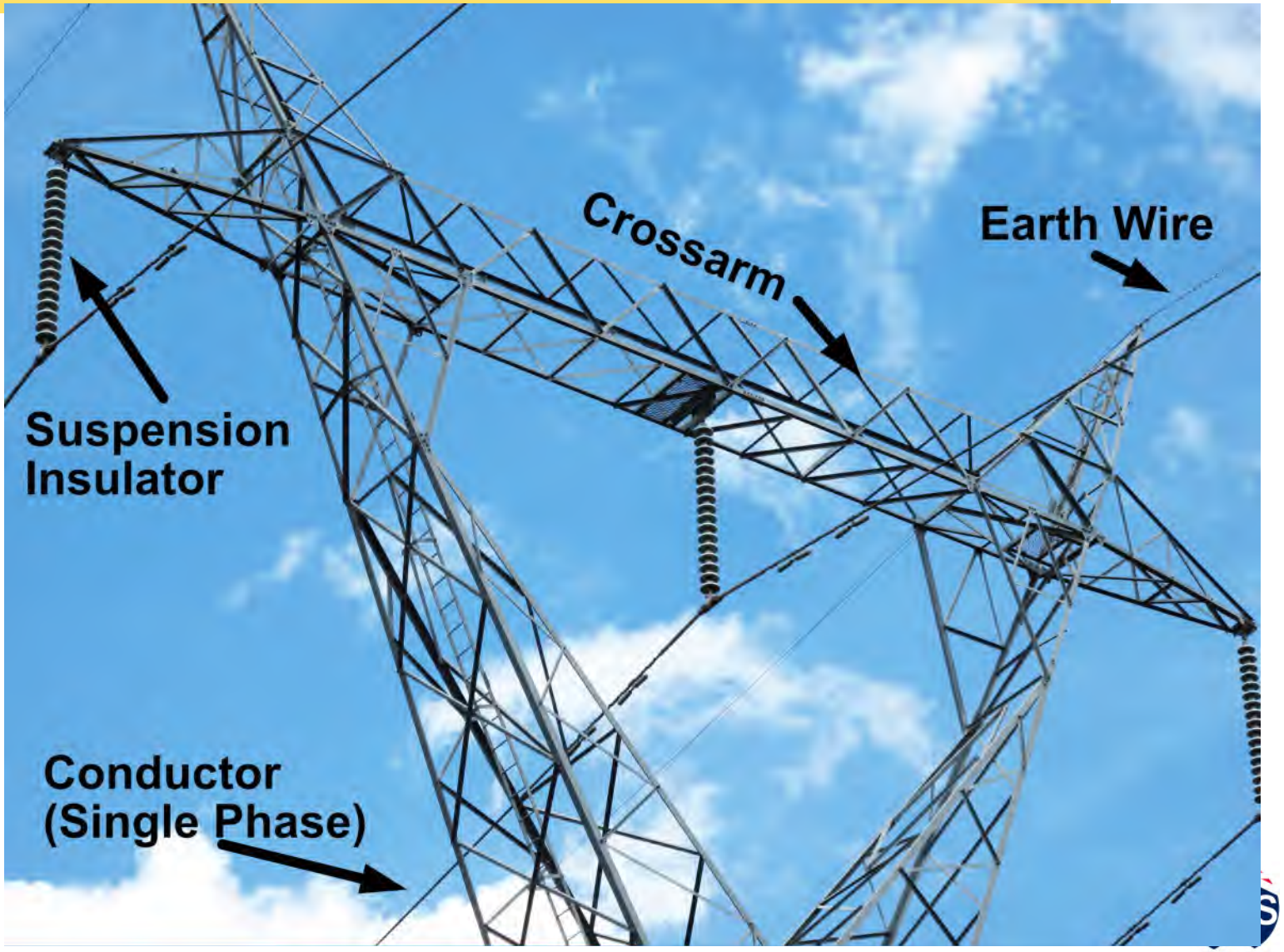
Hierarchy of the electrical grid

- High power must be supplied on demand because it cannot be stored
- It is generated, transmitted and distributed to the final customer in four stages:



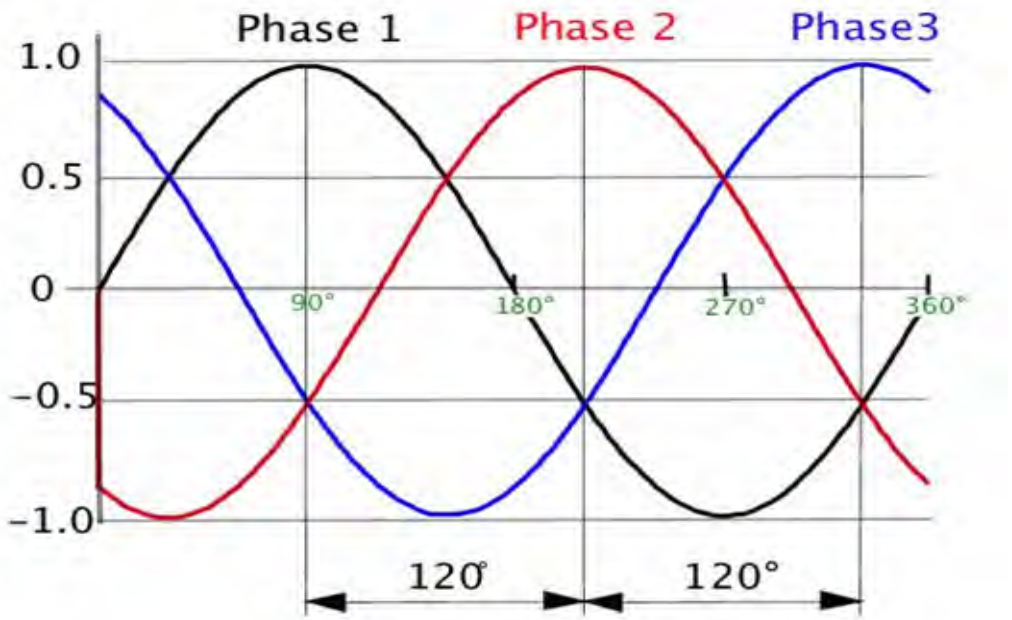
Architecture of a Transmission Tower

- A circuit consists of three phases
- Some towers carry two circuits (ie 6 x wires or 6 sets of bundled wires)
- Some towers carry one circuit (ie 3 x wires)



Conductors and phases

- Electrical power is ‘picked off’ the turbine in 3 locations during the complete revolution of the turbine which is generating AC power
- Each pick off is 120 degrees apart



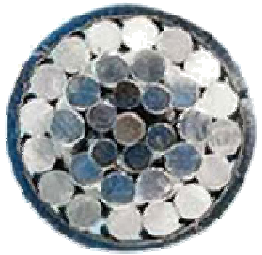
Looking for wires

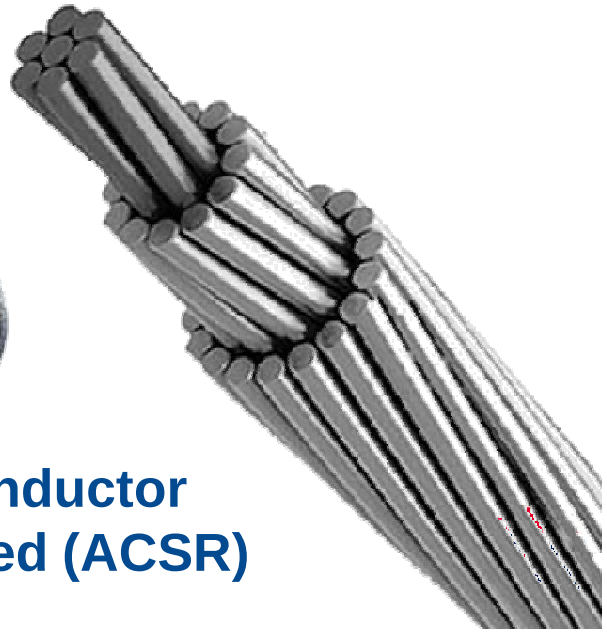
All Aluminium Conductor (AAC)

Galvanised Steel Cable (SC/GZ)

All Aluminium Alloy Conductor (AAC)

Aerial Bundled Cable (ABC)

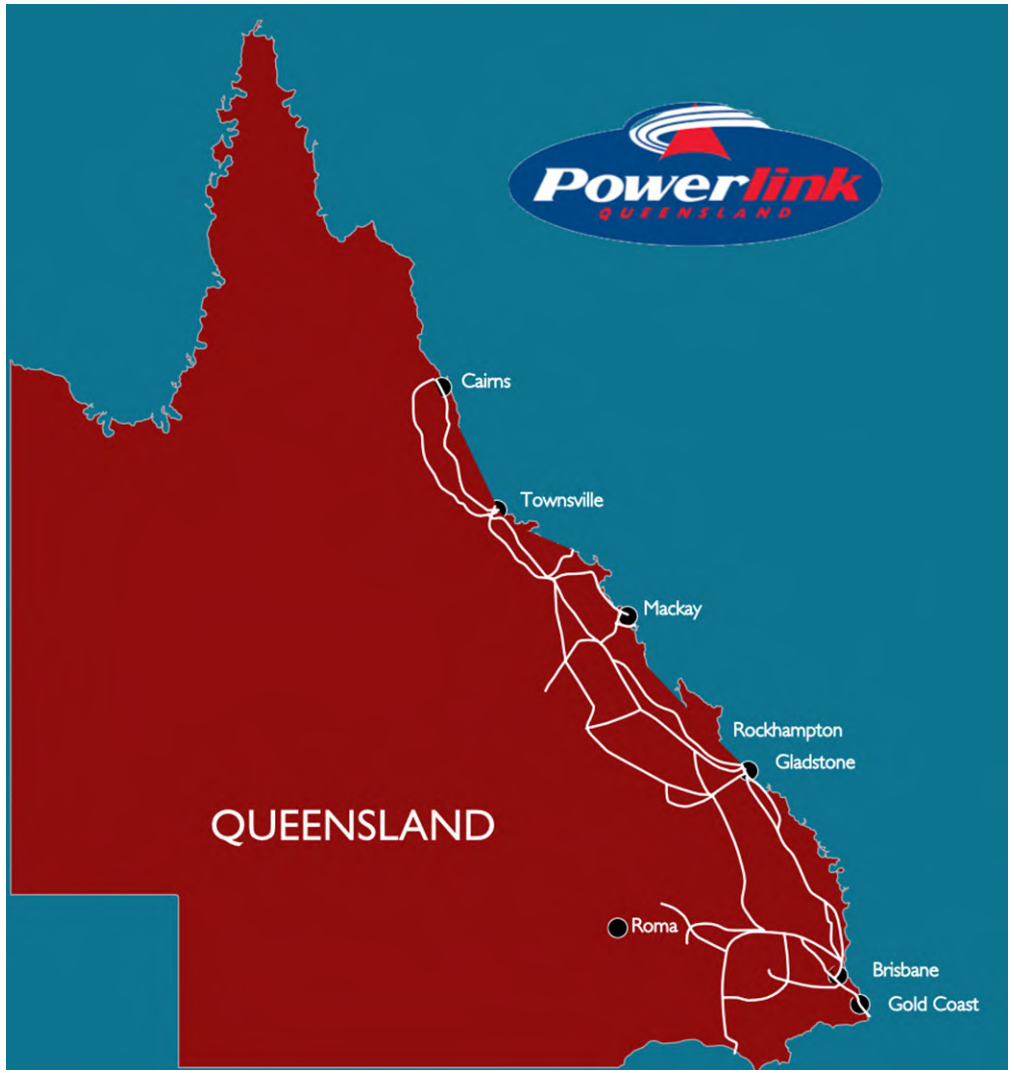




Aluminium Conductor Steel Reinforced (ACSR)

- .
- https://ergon.maps.arcgis.com/apps/webappviewer/index.html?id=5a53f6f37db84158930f9909e4d30286

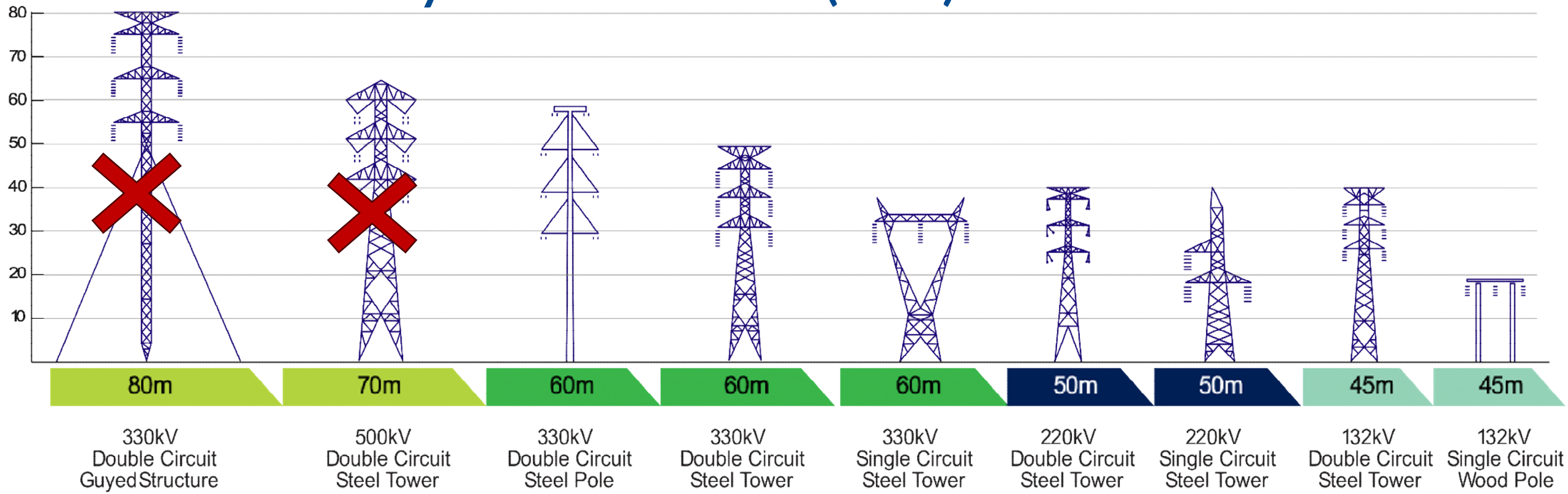
Powerlink Transmission



- QLD transmission provider
  - Cairns to NSW border
  - 15,345 circuit kilometres
  - 147 substations

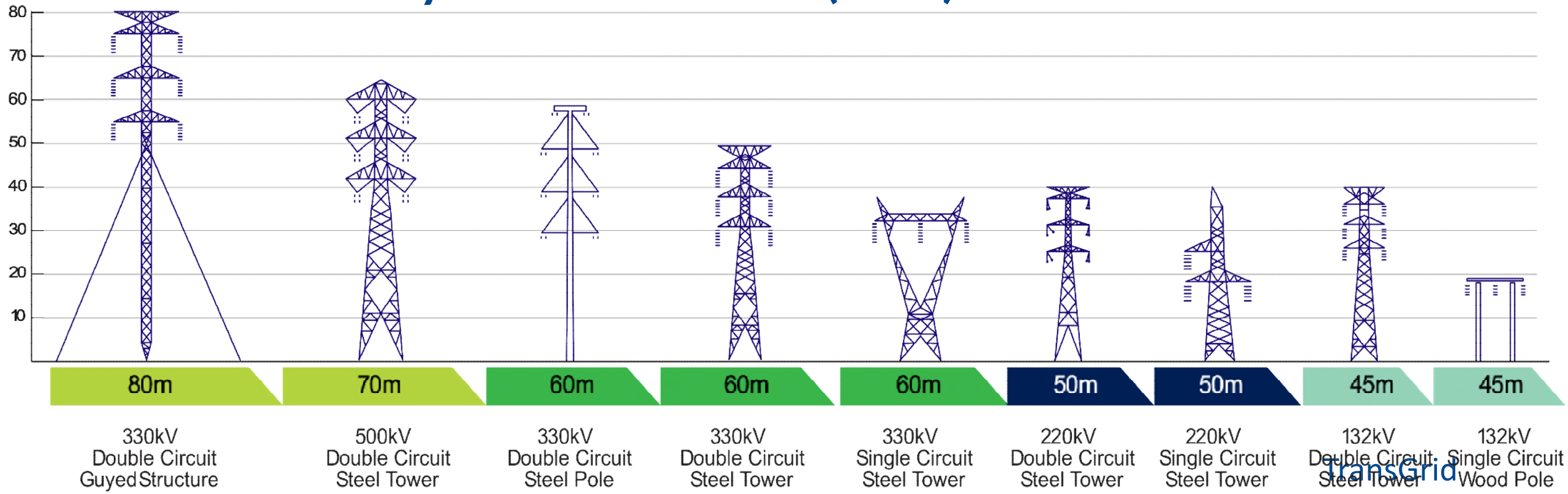
Transmission Structures

- Powerlink towers
  - 330kV to 110kV
  - Not normally taller than 60m (200’)



Transmission Structures

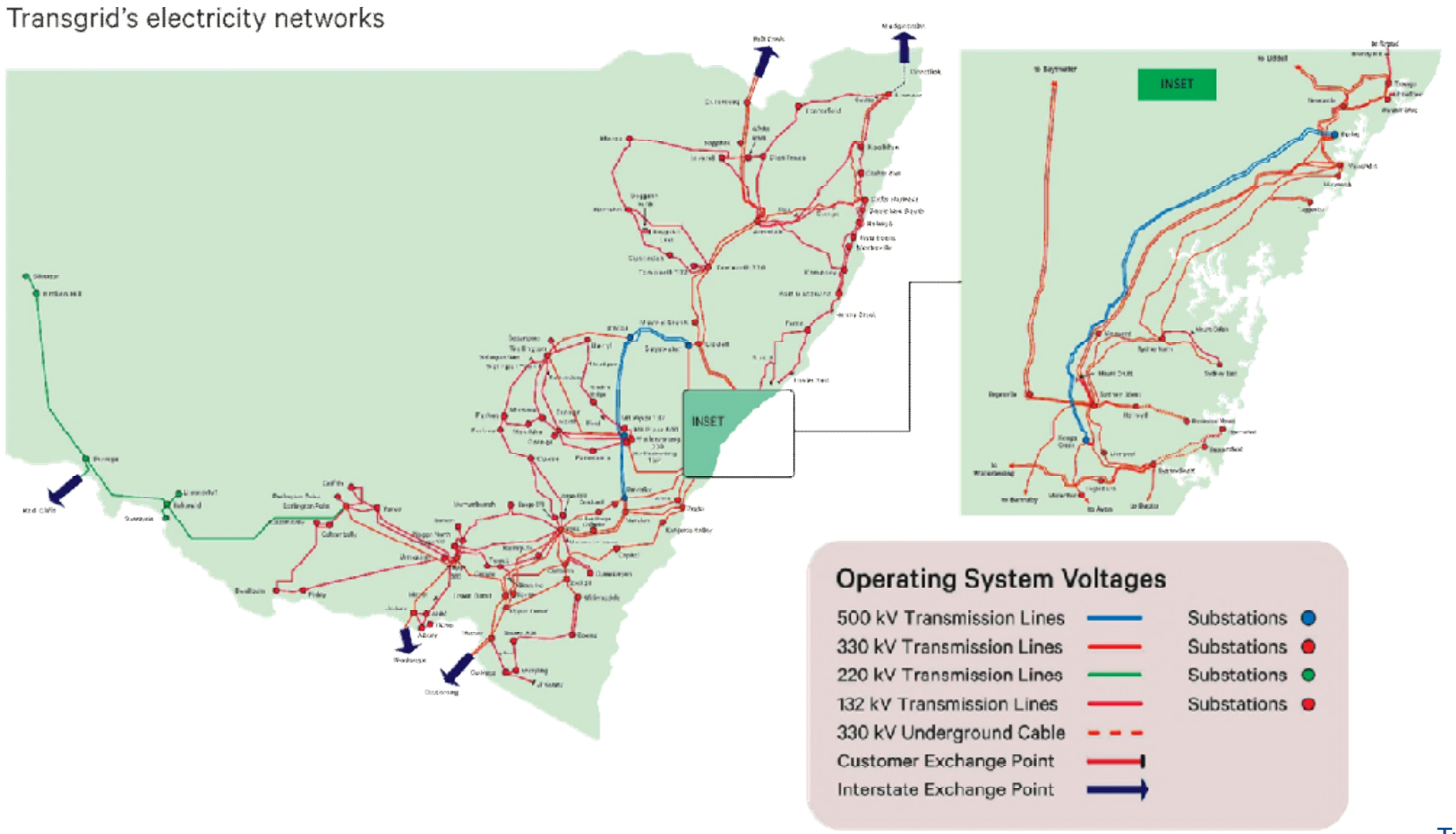
- TransGrid towers
  - 500kV to 132kV
  - Not normally taller than 80m (260')



Hierarchy of the electrical grid

- Transgrid operates the high voltage (HV) electricity transmission network in NSW/ACT
- The network transports electricity from generation sources (eg wind, solar, hydro, gas coal power plants) to large directly connected industrial customers and the distribution networks
- It consists of
  - 13,204 kms of HV transmission lines
  - 119 substations
- Higher voltage = longer transmission distances.

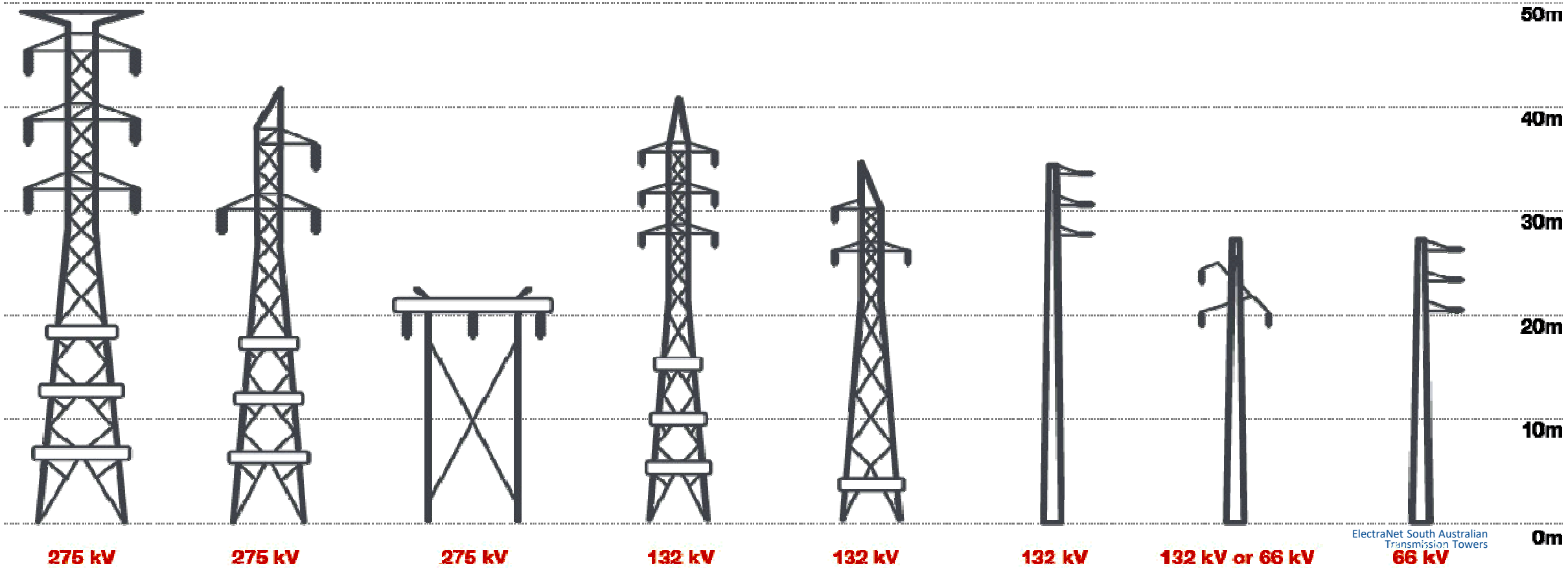
Hierarchy of the electrical grid



Transgrid network

Transmission Structures

- Transmission System (SA)
  - Long-distance transmission – 275, 132 and 66kV

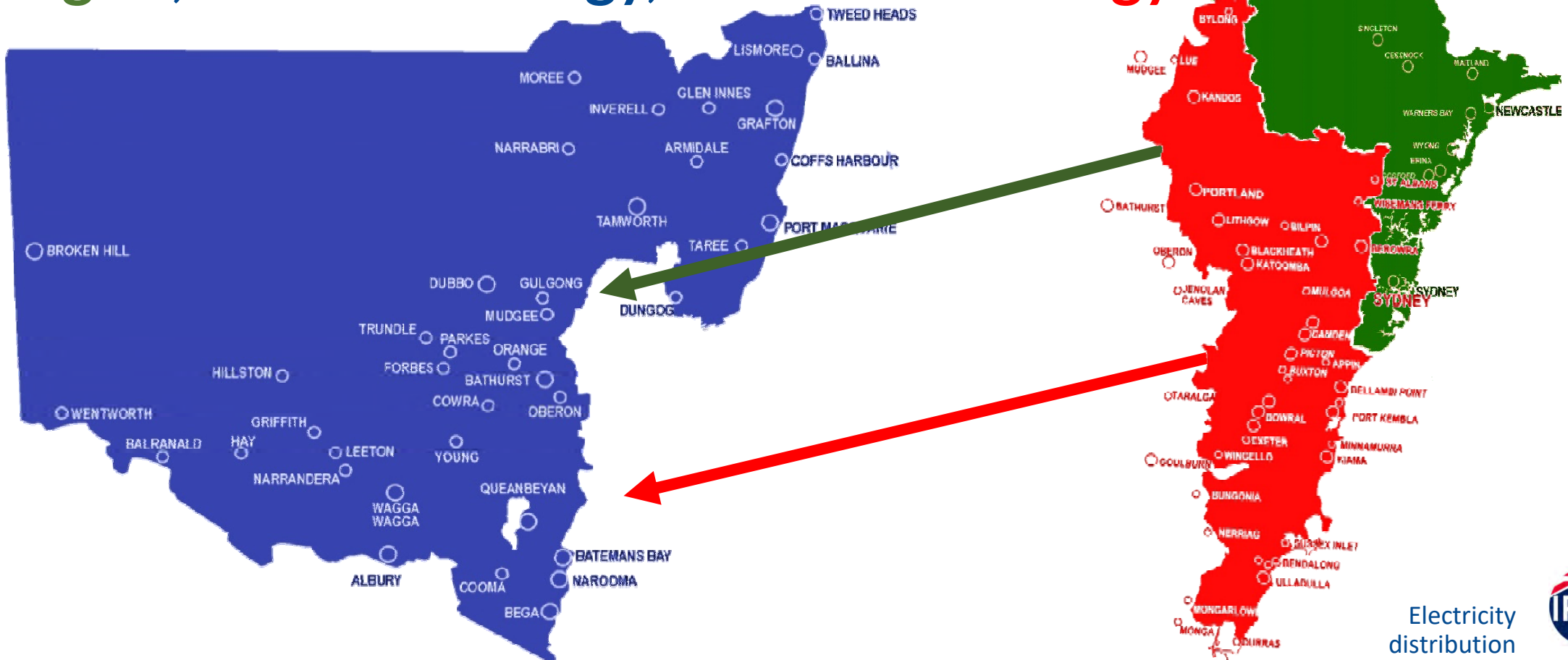


Transmission Structures

Australian Transmission Towers

Hierarchy of the electrical grid

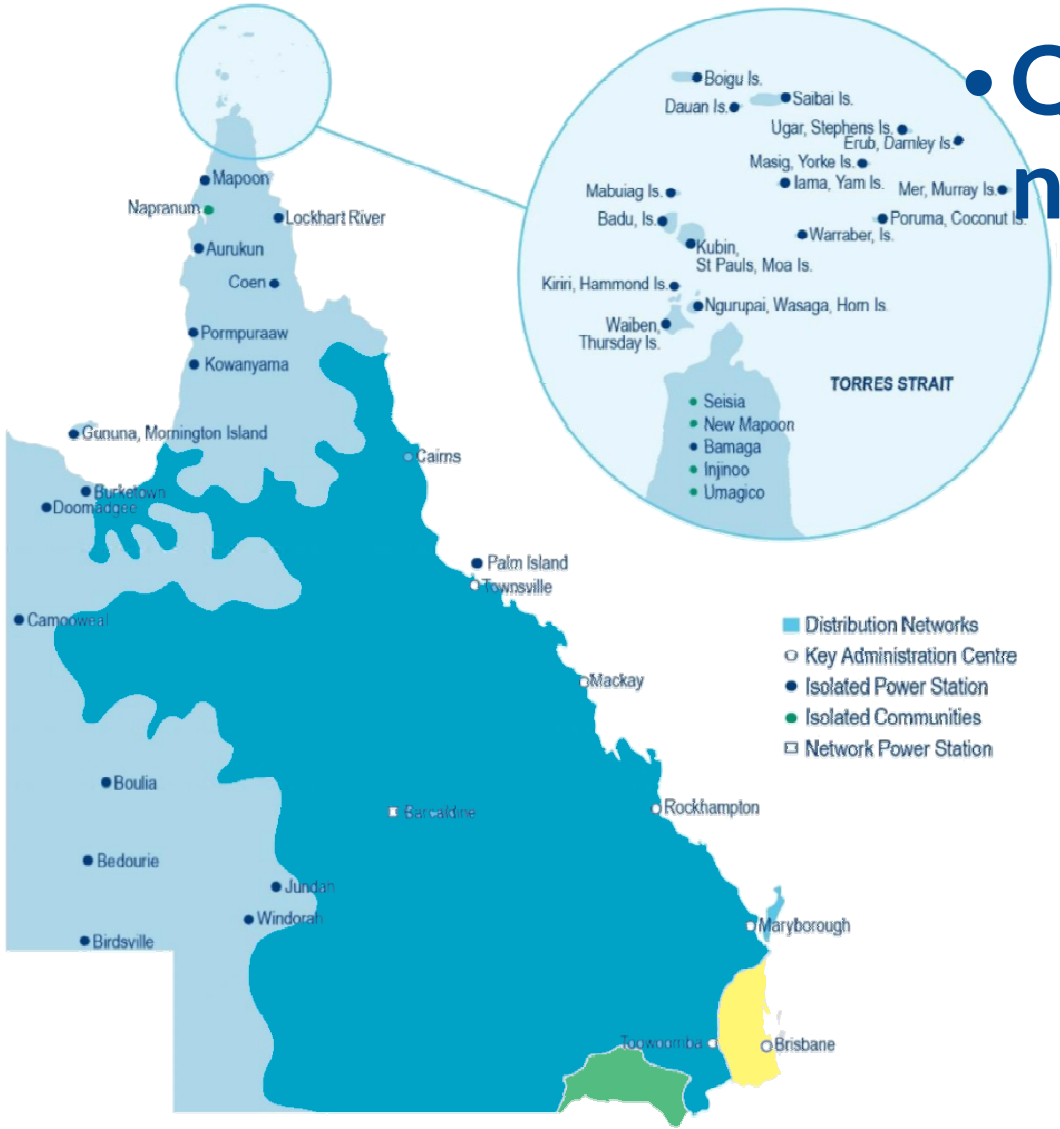
- There are three primary distribution suppliers in NSW
  - Ausgrid, Essential Energy, Endeavour Energy



Distribution System Wire Hardware

- Structure
- Wooden Pole
- Cross arms
- Suspension insulators
- Conductors
- Circuit/Phase
- Earth Wire

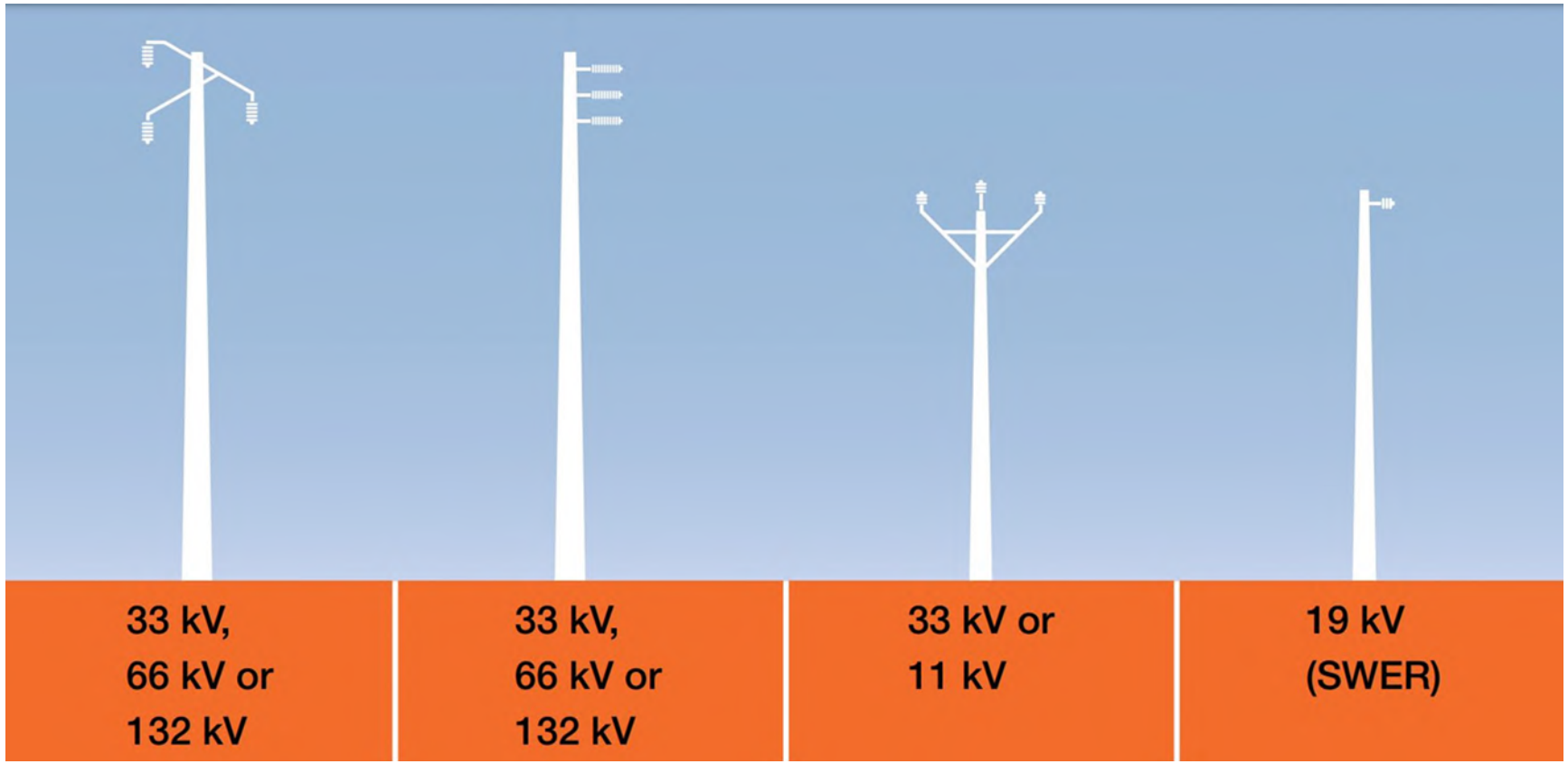
Queensland's Distribution Network



- Queensland's distribution network is serviced by
  - Ergon distribution (dk blue)
  - Ergon isolated network micro grids (not part of the NEM) (lt blue)
  - Energex and others in SEQ (yellow)
  - Essential energy (NSW border, green)

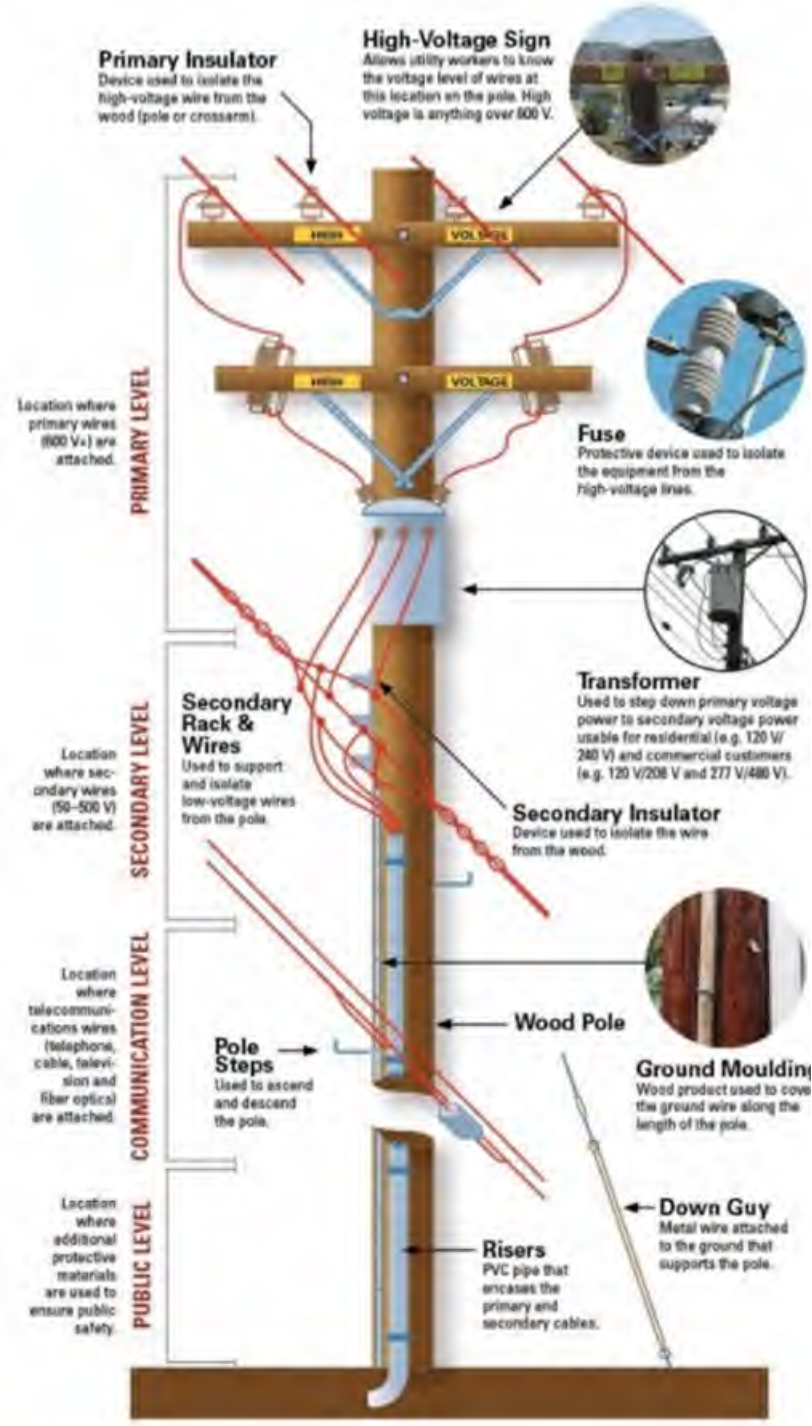
Distribution Towers

- Distribution System (SA)
  - Shorter distance distribution to customers



Distribution System

- Distribution System
  - Supplies to/from customers
  - Low Voltage Distribution 50V to 1000V (1kV)
  - High Voltage Distribution (>1kV)
  - May also have communications systems (eg internet, cable)
  - Pole-mounted sub-station or transformer – reduces voltage and distributes reduced voltage to a dozen or fewer houses.



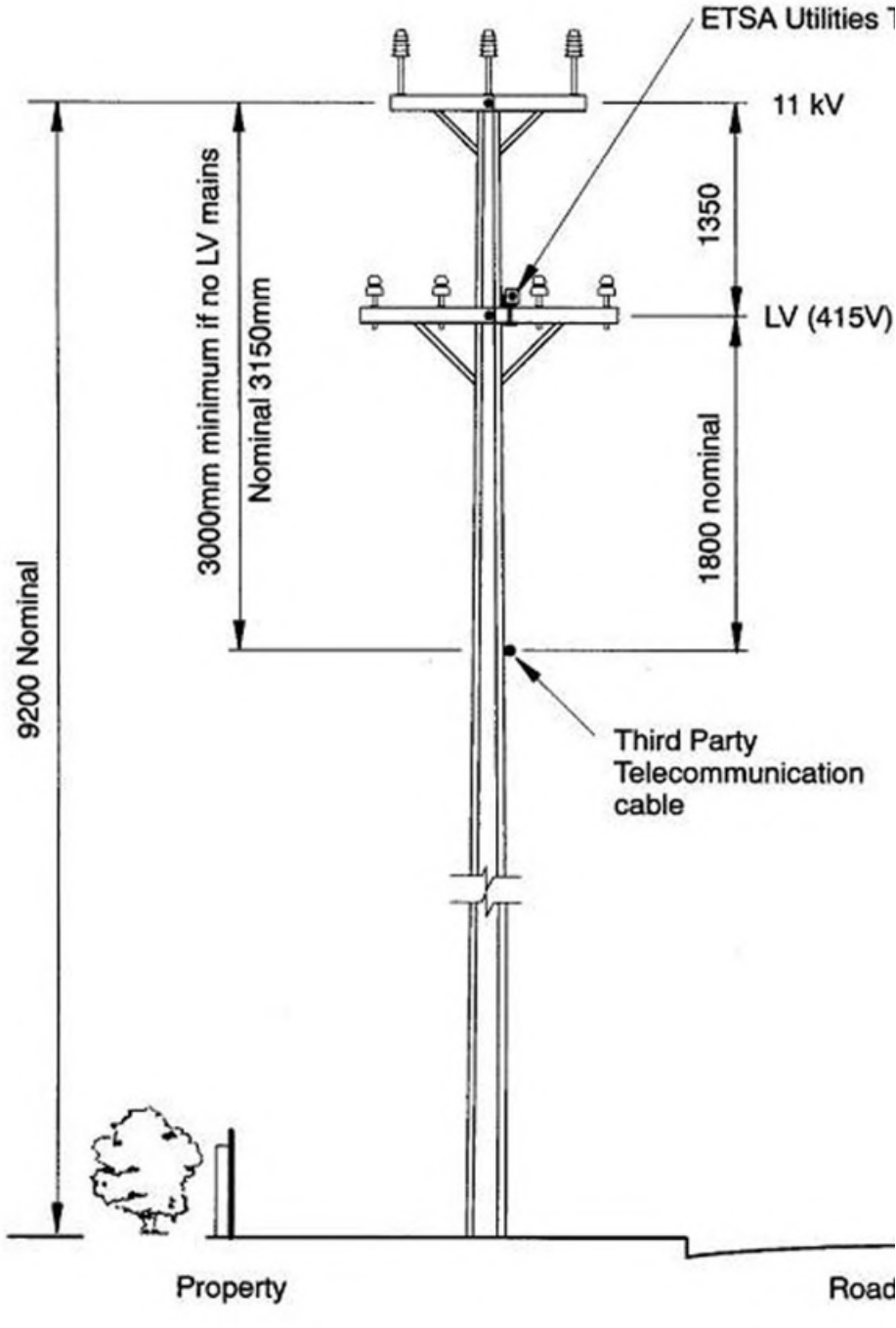
Distribution poles – standard heights

- Distribution lines
  - 3 phases = HV
  - 3 phases + neutral = LV
  - Single line = 240v

- 415 V lines — 6 to 7 m
- 11 kV lines — 8 to 9 m
- 19 kV lines — 11 to 13 m
- 33 kV lines — 10 to 20 m
- 66 kV lines — 10 to 20 m

SA System

- Stobie poles different from NSW/VIC/QLD distribution poles
- Patented in 1924 by Cyril Stobie
- Only found in SA
- Do not always require stays, therefore cross arms (!) are the primary means of spotting changes of aspect run/spurs
- 720,000 stobie poles carrying 200,000km of conductors in SA
(SA Power Networks)



Queensland Distribution Line Spans

Ergon Standard for Distribution Line Overhead para 6.1.3

- Urban Slack –up to around 40m in locations where staying is difficult or not practical
- Urban Standard –typically in the range 40 – 60m
- Semi Urban – typically up to 80 or 100m in rural ranchette type subdivisions
- Rural –generally > 150m

Single Wire Earth Return (SWER)

- Invented in NZ in 1925 by Lloyd Mandeno
- SWERs are common in rural Australia
- Cheap to construct and easy to repair
- There is over 200,000 kms of SWER in Aust and NZ
  - 35,000 kms in NSW
  - 29, 100 kms in SA
  - 65,000 kms in QLD
- 12.7Kv or 19.1Kv are the most common voltages for a SWER
- Hardest to see and easiest to hit.

LLOYD MANDENO - CIRCA 1938 SOURCE: WILLIE MANDENO

Single Wire Earth Return (SWER)

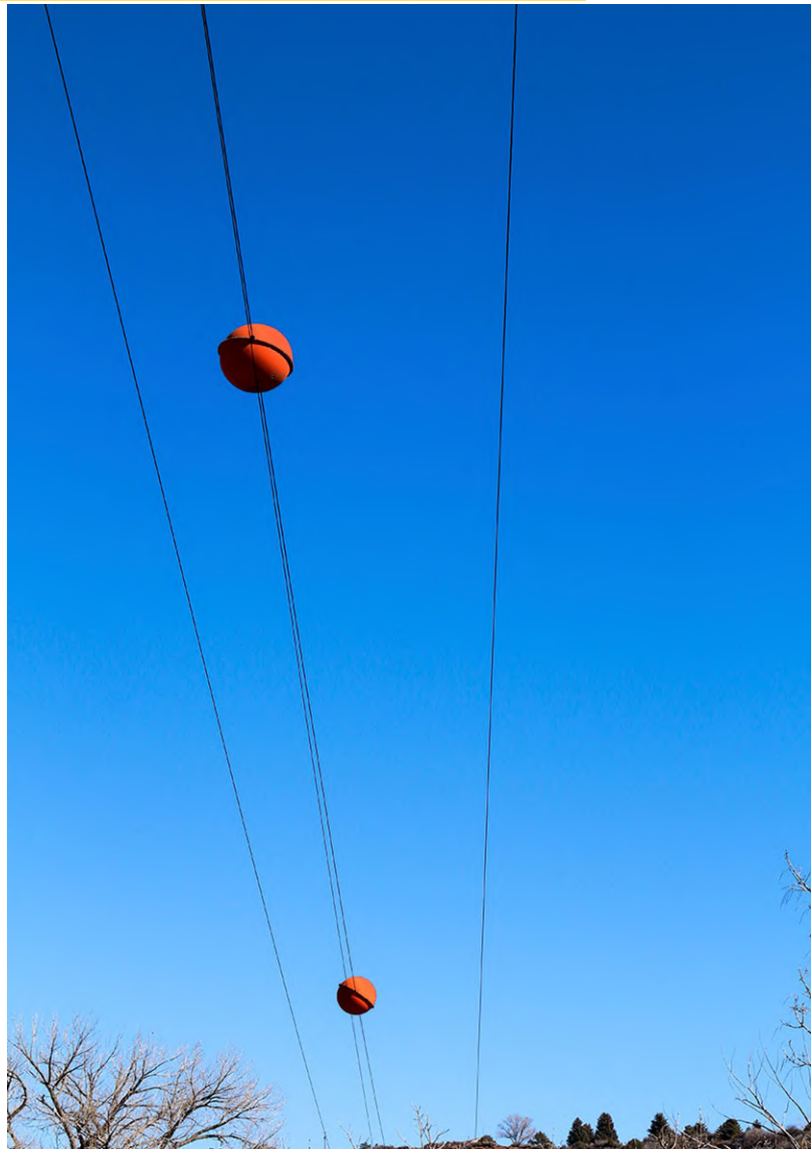
Aerial Bundled Cables and Comms

- Aerial bundled cables (ABC) are often used for LV lines over short spans (eg 240V)
  - They carry three phases and a neutral
  - More expensive / heavier per metre
  - Safer due to their insulation but insulation can break down
  - More inspections required.
- Communication cables are usually
  - Copper
  - Fibre optic
  - Co-axial

Marker Balls

AS 3891.1 and .2 Permanent marking of overhead cables - aviation

- Placement is governed by an AS/NZS
  - Powerlines, in general, must have markers when the line
    - Is higher than 90m
    - Is on a span greater than 1500m
    - Is in proximity to a licenced aerodrome/ALA
- In areas where authorized low flying ops occur, then lines must be marked:
    - For any aerodrome or ALA
    - For a low flying area
- Any other reasonable reason for marking (with costs borne by the person requesting).



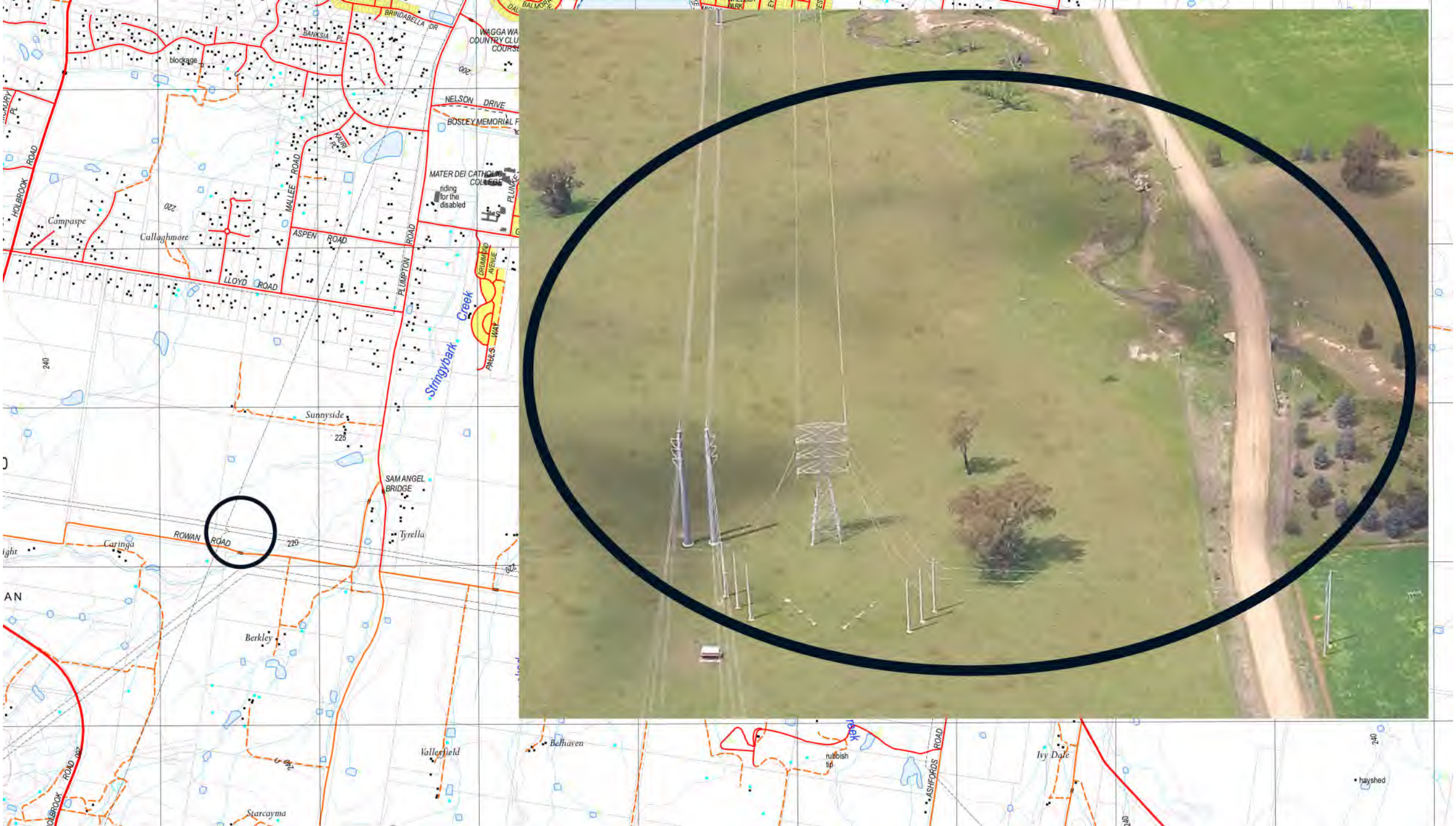
Stay (aka Guy)

- Installed to counteract unbalanced weight loadings such as:
  - Terminations of a run
  - Changes in the circuit's run direction
  - Spurs
  - Long spans
  - Poor soil
- Will often have a white insulator wrap which is easy to see from a distance.

Stay (aka Guy)

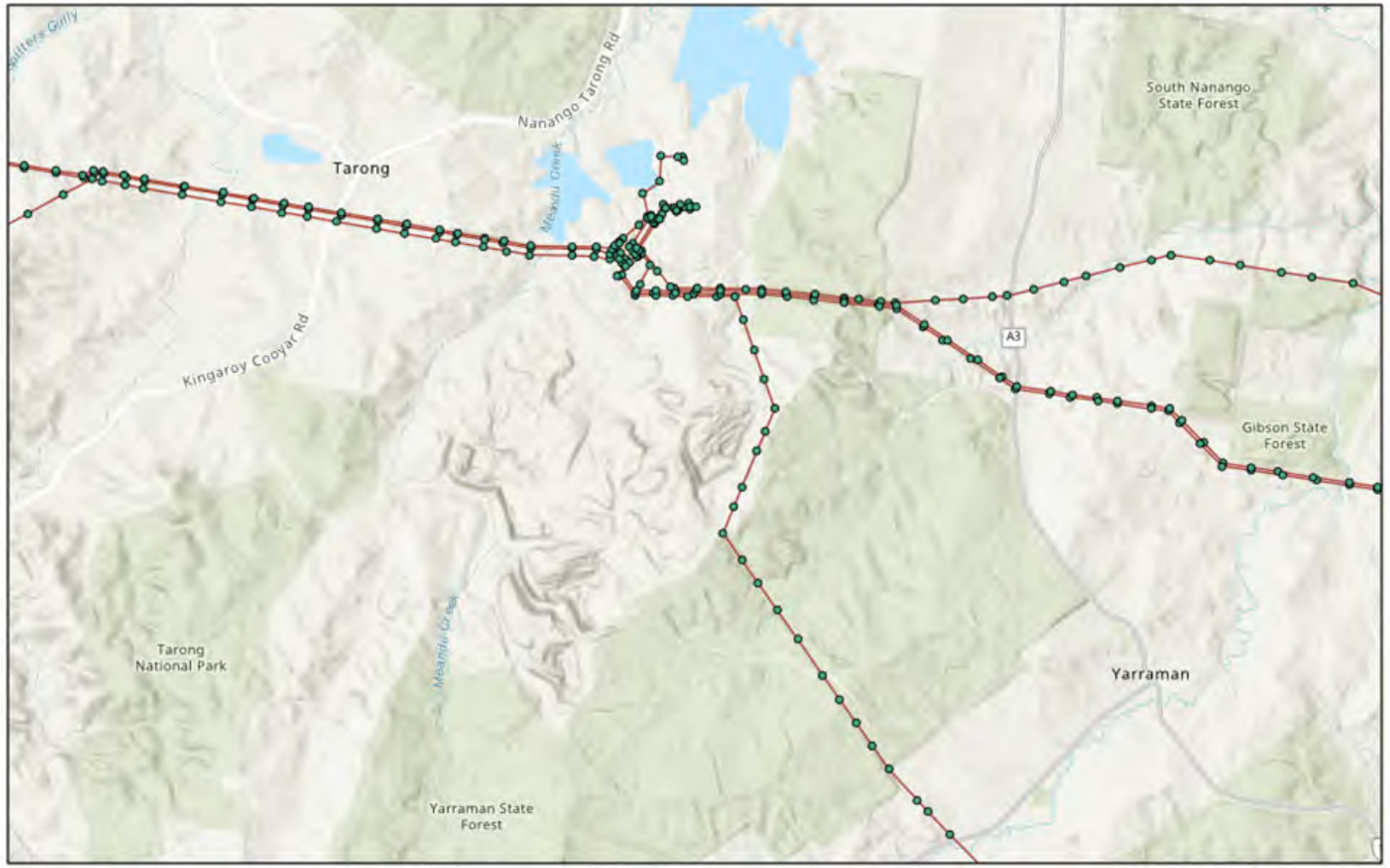
- Ground Stay
- Aerial Stay
- Sidewalk Stay


150°30'
35'
40'
45'
KG
34°30'
WATER SUPPLY CATCHMENT AREA
(RESTRICTED ACCESS)
ILLAWARRA RANGE
ILLAWARRA RANGE
Avondale
Albion Park
Albion Park
WENTWORTH
Wildes Meadow
MORTON
NATIONAL PARK
NATIONAL PARK


BRINDABELLA DR
BANKSIA PL
blockage
NELSON DRIVE
BOSLEY MEMORIAL P
MATER DEI CATHOLIC COLLEGE
riding for the disabled
HOLBROOK ROAD
Campaspe
Callaghmore
MALLEE ROAD
ASPEN ROAD
LLOYD ROAD
PLUMPTON ROAD
DRUMMOND AVENUE
PAULS WAY
Stringybark Creek
Sunnyside
SAM ANGEL BRIDGE
Tyrella
ROWAN ROAD
Caringa
Berkley
Vallerfield
Belhaven
Starcayma
rubbish tip
ASHFORDS ROAD
Ivy Dale
hayshed
220
225
240

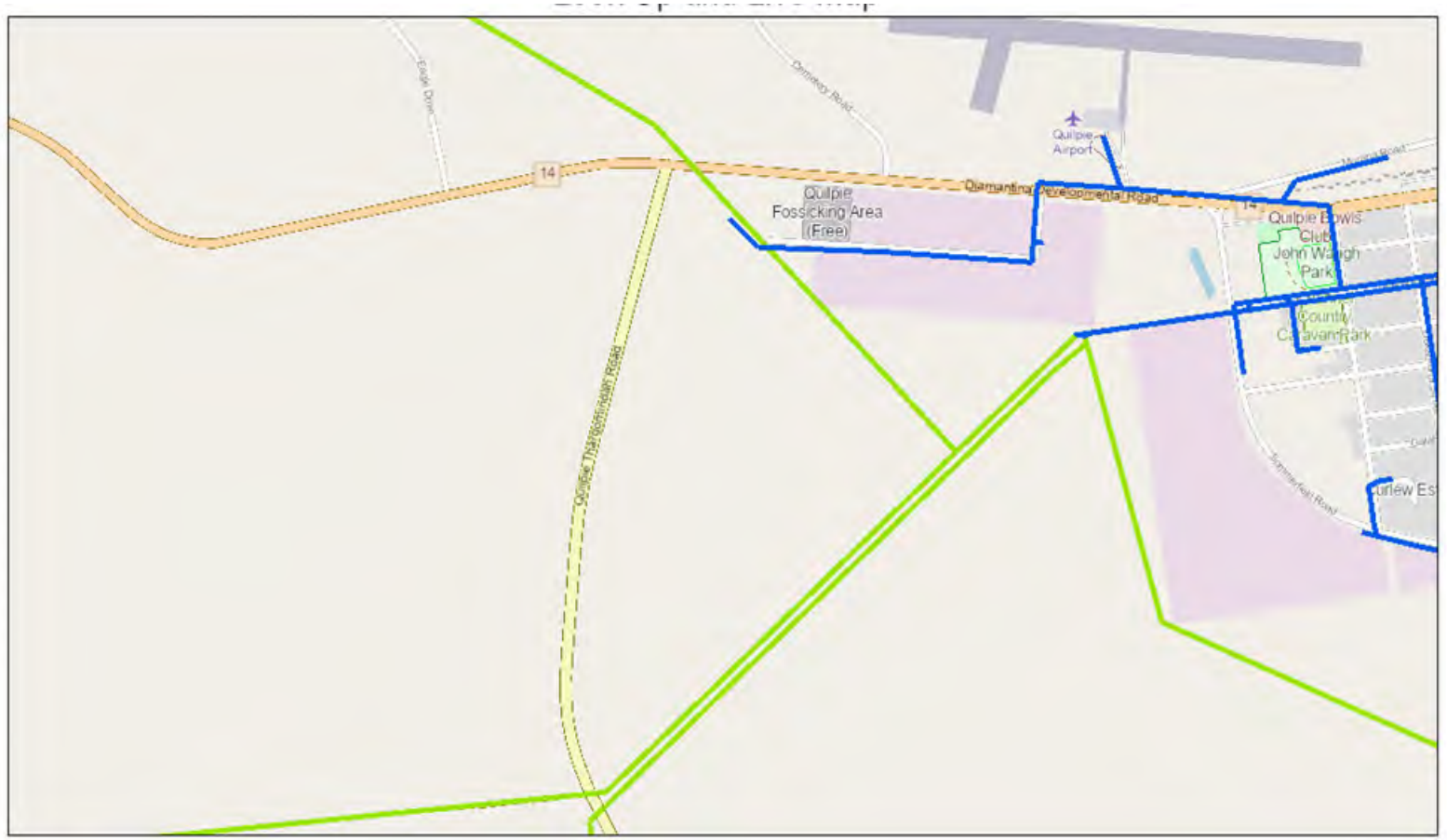
Map Recce

- ARCGIS maps are available to do map recces to assist with aviation operations / exercises
- Powerlink transmission lines Tarong



Map Recce

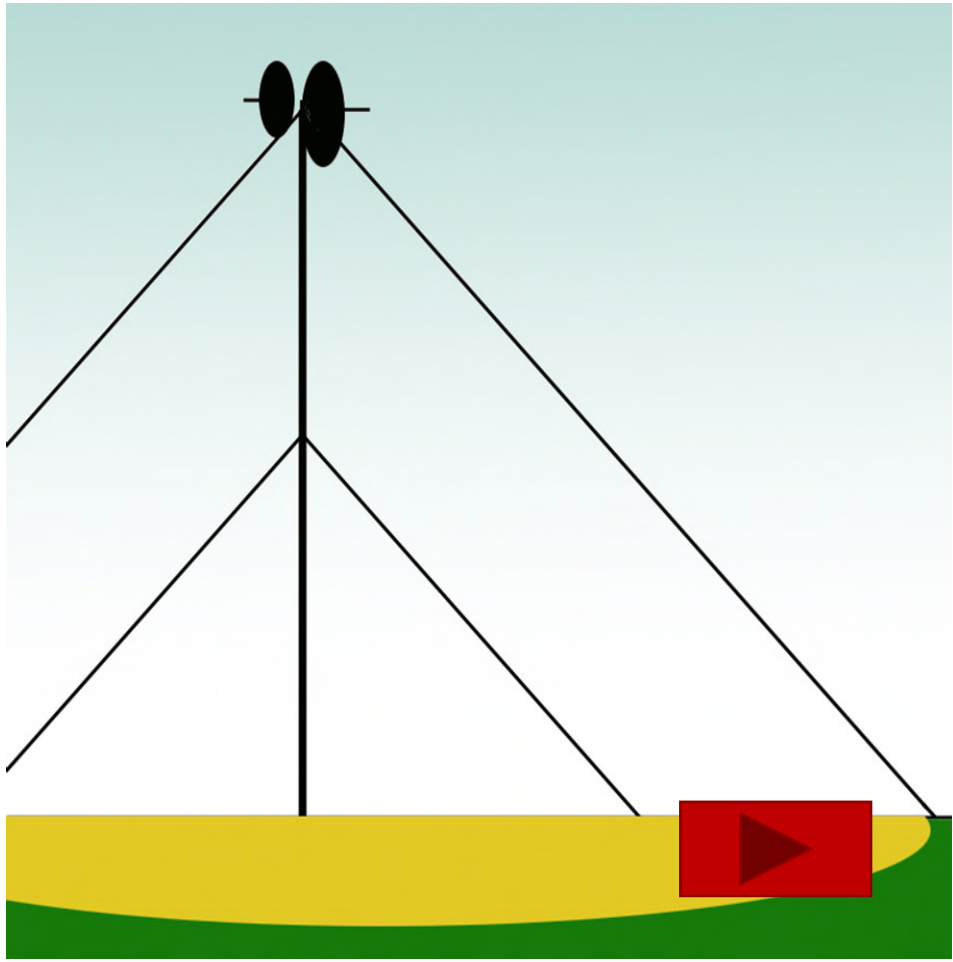
- ARCGIS maps are available to do map recces to assist with aviation operations / exercises
- Ergon distribution lines Quilpie (SWERs in green).



Towers

CASR 175.E / ICAO Annex 4 Chapt 17 Aeronautical Charts – (Obstacles)

- Any tower or structure that is taller than 100m must be reported to AsA
- An aerodrome operator must monitor the vicinity for towers and report them
- AirServices Australia will mark known towers/structures on maps
- Towers less than 100m tall, or unreported, may exist
- Assume towers have guy wires
- Look around the footprint of the tower as wide as the tower is high.

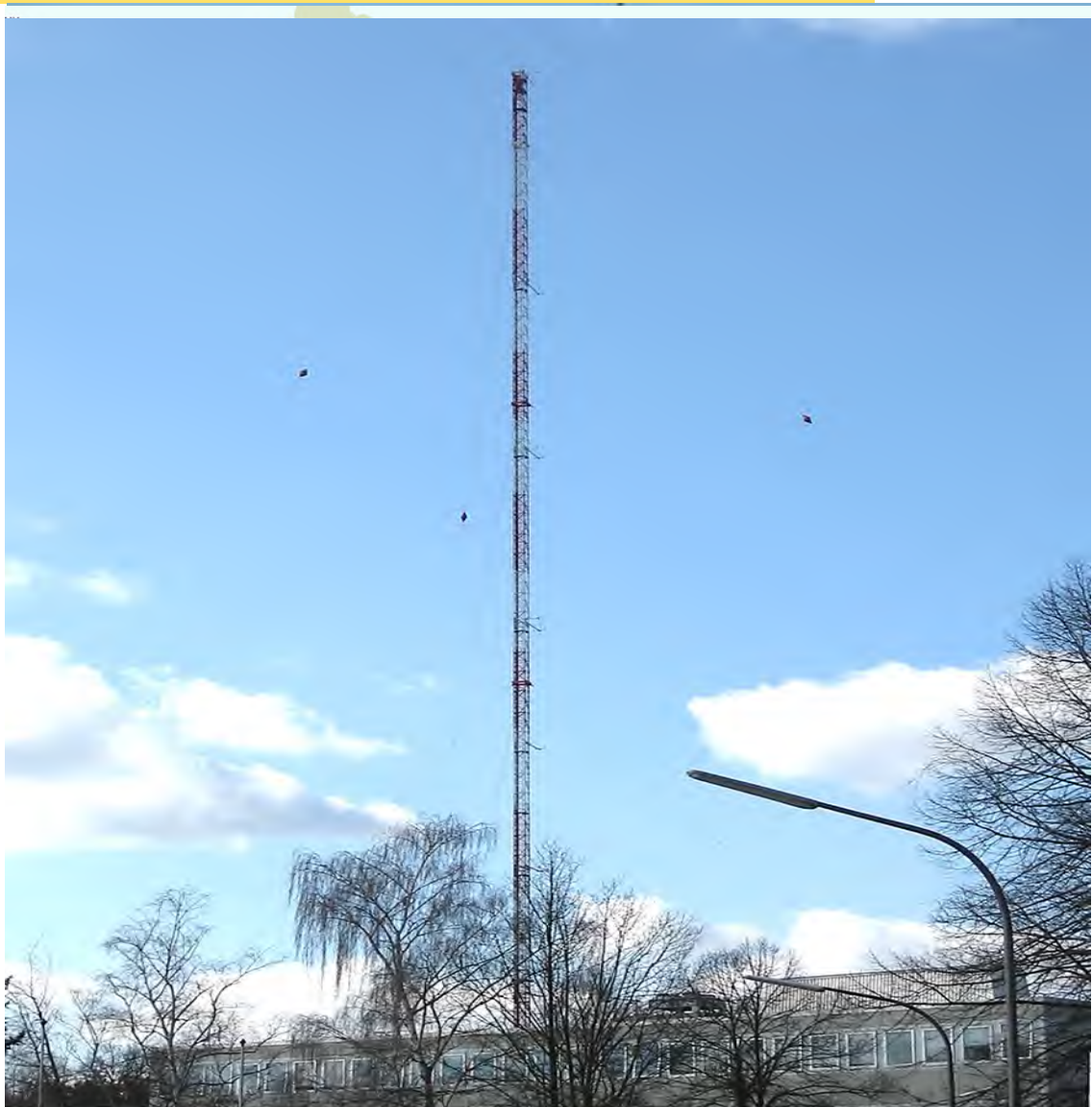


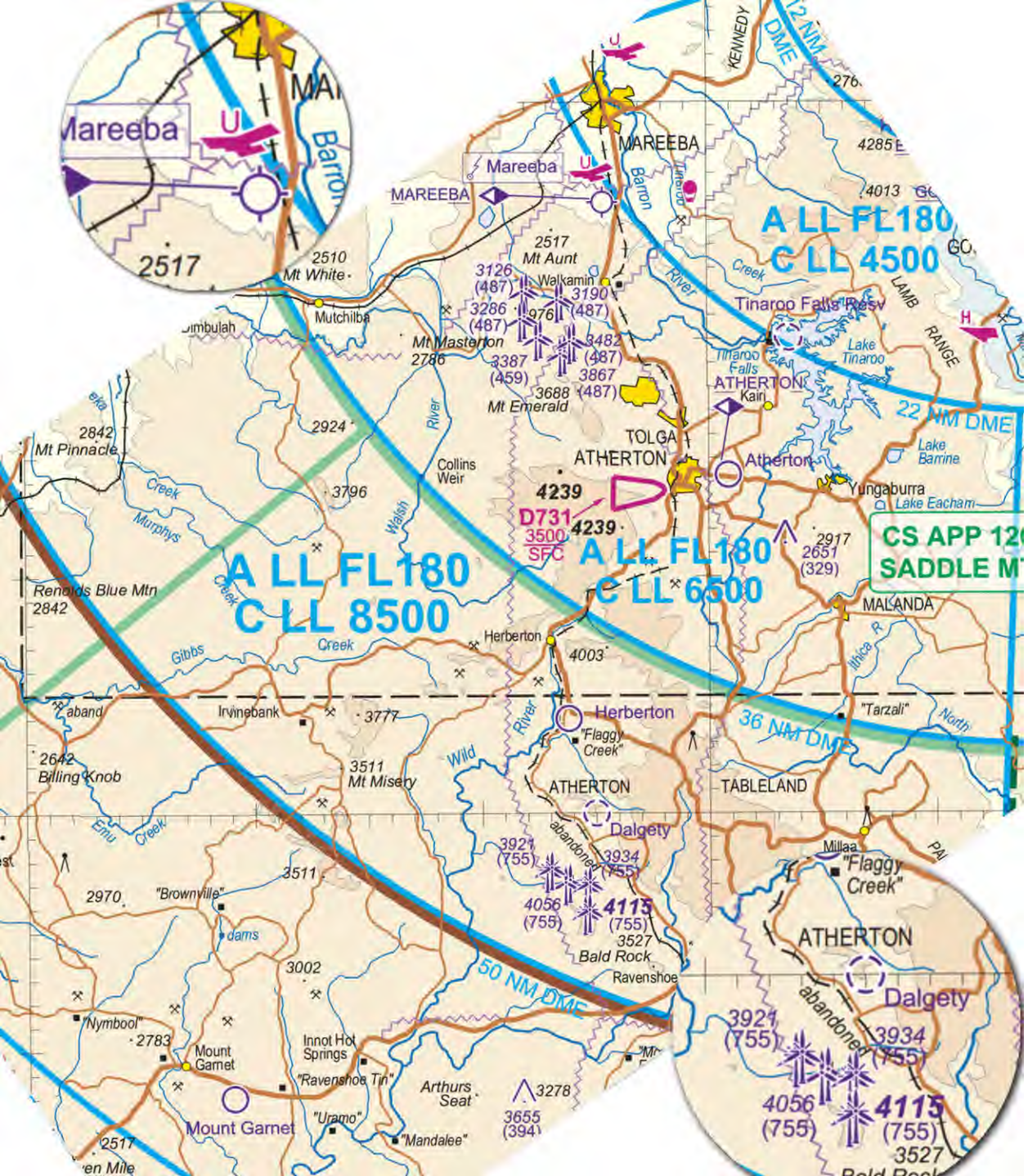
Towers

- A mobile phone tower consists of
  - The tower
    - Lattice, monopole, guyed tower/mast
  - The Base Transceiver Station
    - Houses the equipment
  - The antennas
    - Attached to the tower
  - Utilities
    - Comms equipment
  - Access
    - Roads, tracks, security

Wind Farms and Met Towers

- More wind farms are being constructed in Queensland
- Ergon limited distribution area is to be the priority for alternative energy
- Met towers are erected for up to 2 years prior to wind farms being installed
- Usually guyed lattice.





- **Information on a map**
  - Terrain (incl highest)
  - Spot elevations’
  - Heights
  - Airfields
  - Airspace incl VFR rep pts
  - Airspace users
  - Terrain obstacles and sun/shadow

Drones and other airspace users

- Regulated by CASR 100
- No operations above 400’ AGL (not AHO) legally without certain requirements
  - Eg Licenced, NOTAMs
- Illegal to fly a drone near the site of an emergency when emergency services are in attendance.

Looking for wires

- Look for:
  - Known wire runs from your map recce.
  - Anything that draws power (bldg, pumps, etc)
  - Roads and access tracks and cut vegetation.
  - Anything that is too vertical
  - Anything that looks evenly spaced
  - White marker wraps around stays / 45 degree lines
  - Reflective surface / dark contrasting surface lines
  - Marker balls.

Looking for architecture

- What do the following clues tell you?
  - A suspension insulator string not hanging vertically
  - Pole mounted sub-station
  - A stay
  - Cross arms at different angles (eg 90 degrees)

What do the following pictures reveal?

- Analyse the images and discuss:
  - what conditions help or hinder you to see the object
  - what the object's architecture tells you…

SATPIC

SATPIC

Hazards to Low Flying

- Wedge Tailed Eagle
  - Territorial but may cooperate in pairs
  - Attracted to live prey or carrion… Look for ravens
  - Can see IR & UV light; Can see thermals
  - Raptors will almost never attack upwards

Hazards to Low Flying

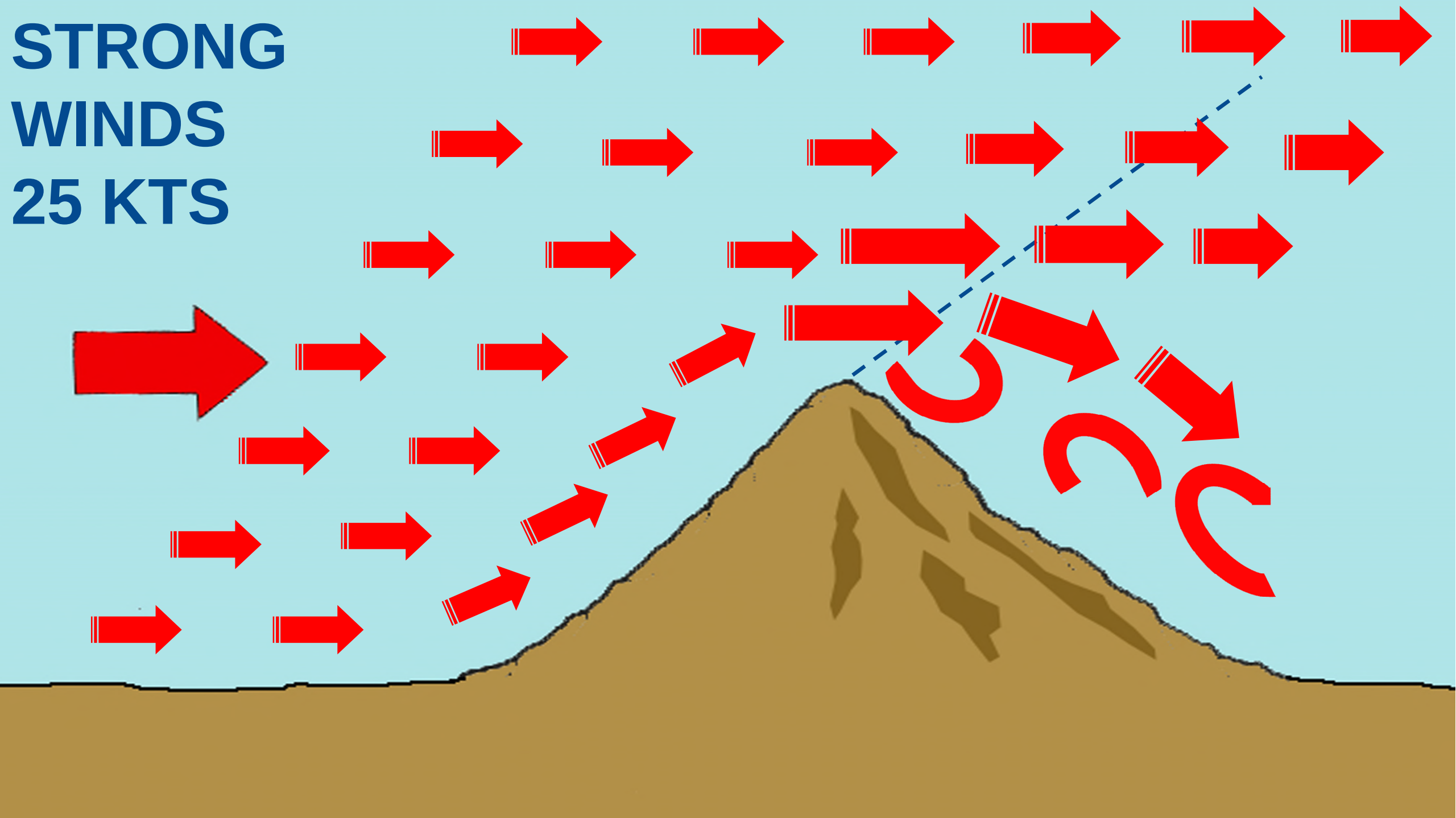
- Wedge Tailed Eagle
  - Aggressive near nesting sites but not their ranges esp dur breeding season (Apr-Sep Mainland, Aug-Jan Tas)
  - Nests are large, usually in tallest trees in the area
  - May be pile of stick at base

Hazards to Low Flying

- High Density Altitude (hot / humid)
- Low Cloud causing IIMC and disorientation;
- Rain hampering visibility and reducing mission effectiveness;
- High wind/turbulence and low flying;
- Thunderstorms and microbursts, usually CBs (summer storms in Australia).

Hazards to Low Flying

- Safe low-level flight requires good SA and understanding of meteorology in general and especially close to the ground:
  - Low Cloud
    - Reduces visibility and sunlight
    - Hides terrain and forces flight at very low level
    - Can cause IIMC
  - Rain
    - Reduces visibility and comfort
  - Wind/Turbulence
    - Can make movement difficult – may cause motion sickness
  - Thunderstorms.


STRONG
WINDS
25 KTS

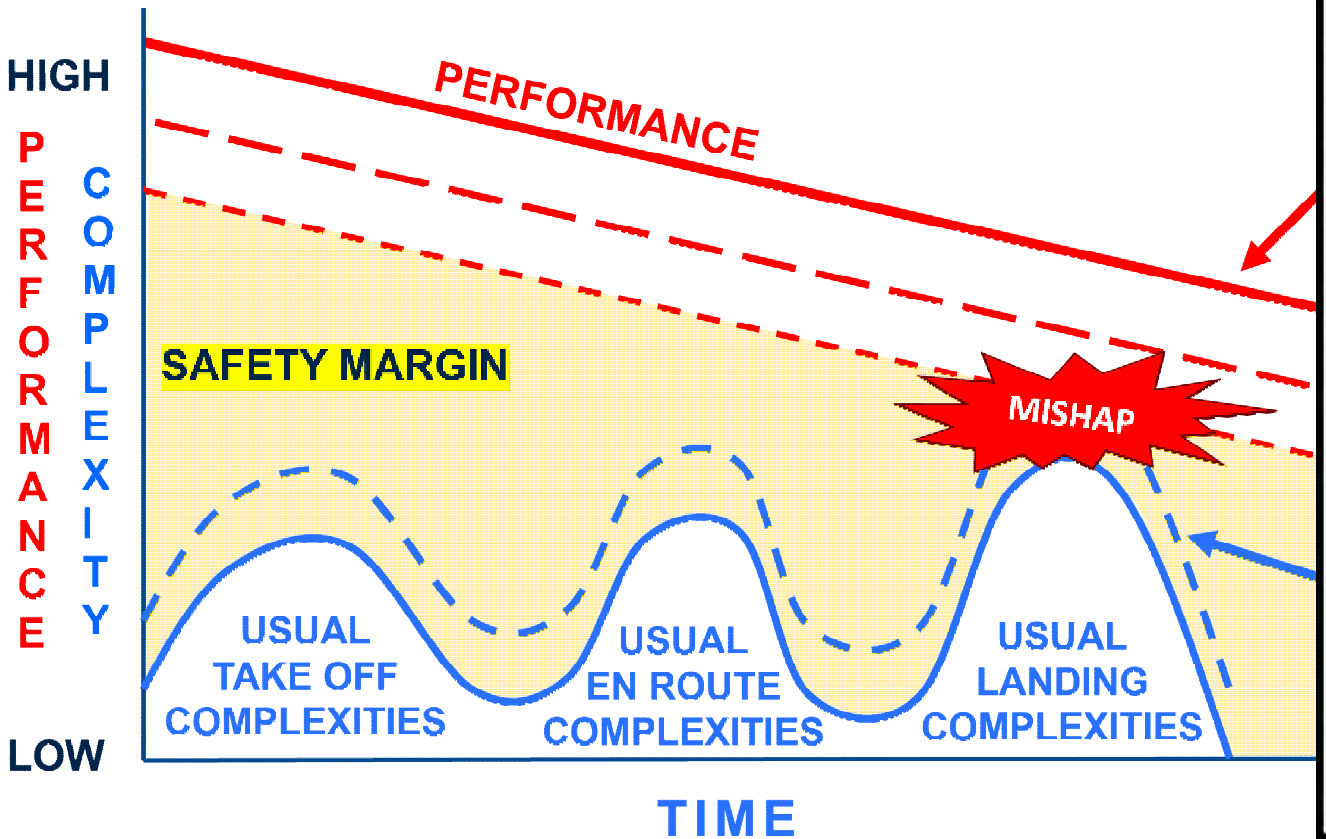
3. Low Flying Operational Considerations

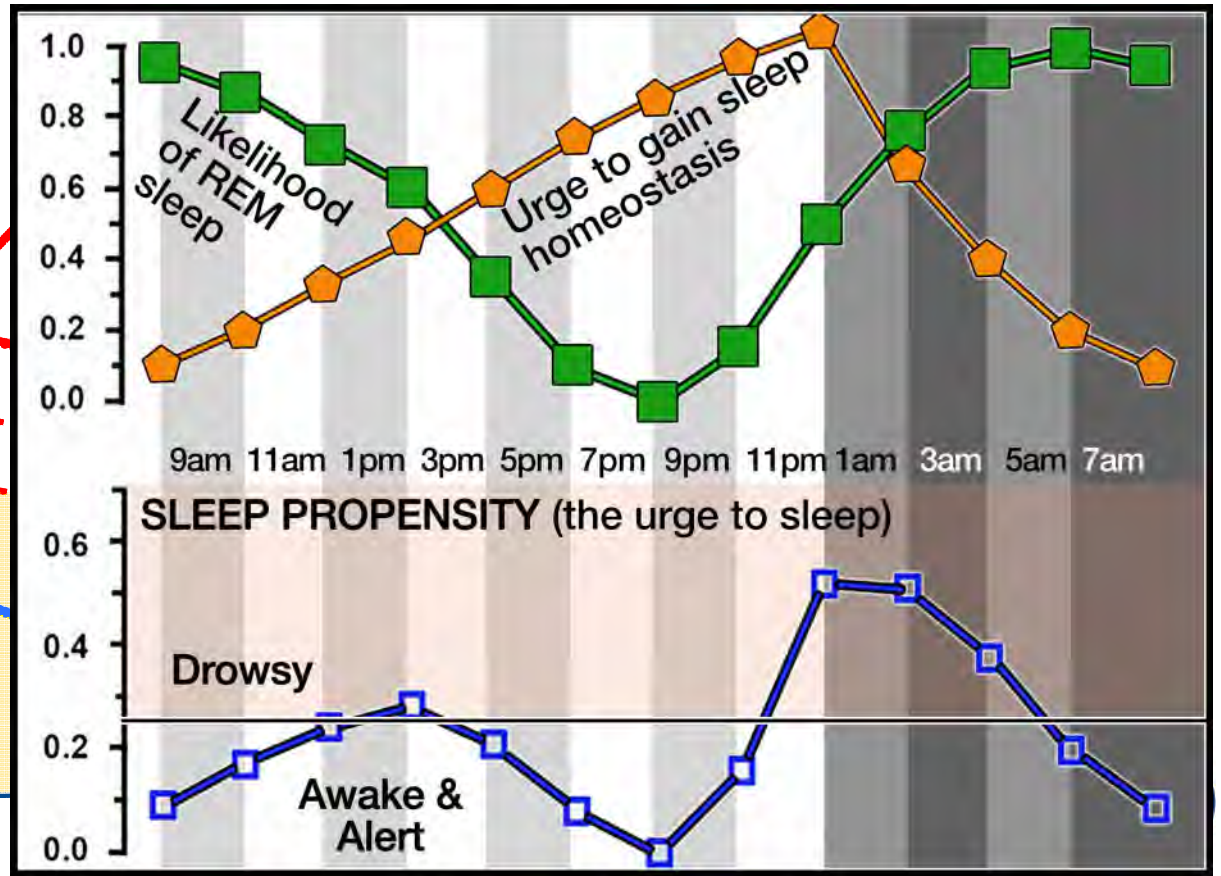
Preparing for flight

- Ensure all pax
  - have PPE and it is worn correctly
- Ensure all cargo and passengers are
  - weighed accurately
  - are placed in appropriate positions in the acft (refer to pilot advice)
- Cargo contents should be marked to confirm that no DG is contained therein.

Be aware of the danger periods

- Tell people when you're tired. If you are, then they probably are also! This is the time to be alert and more wary.





Flying near wires

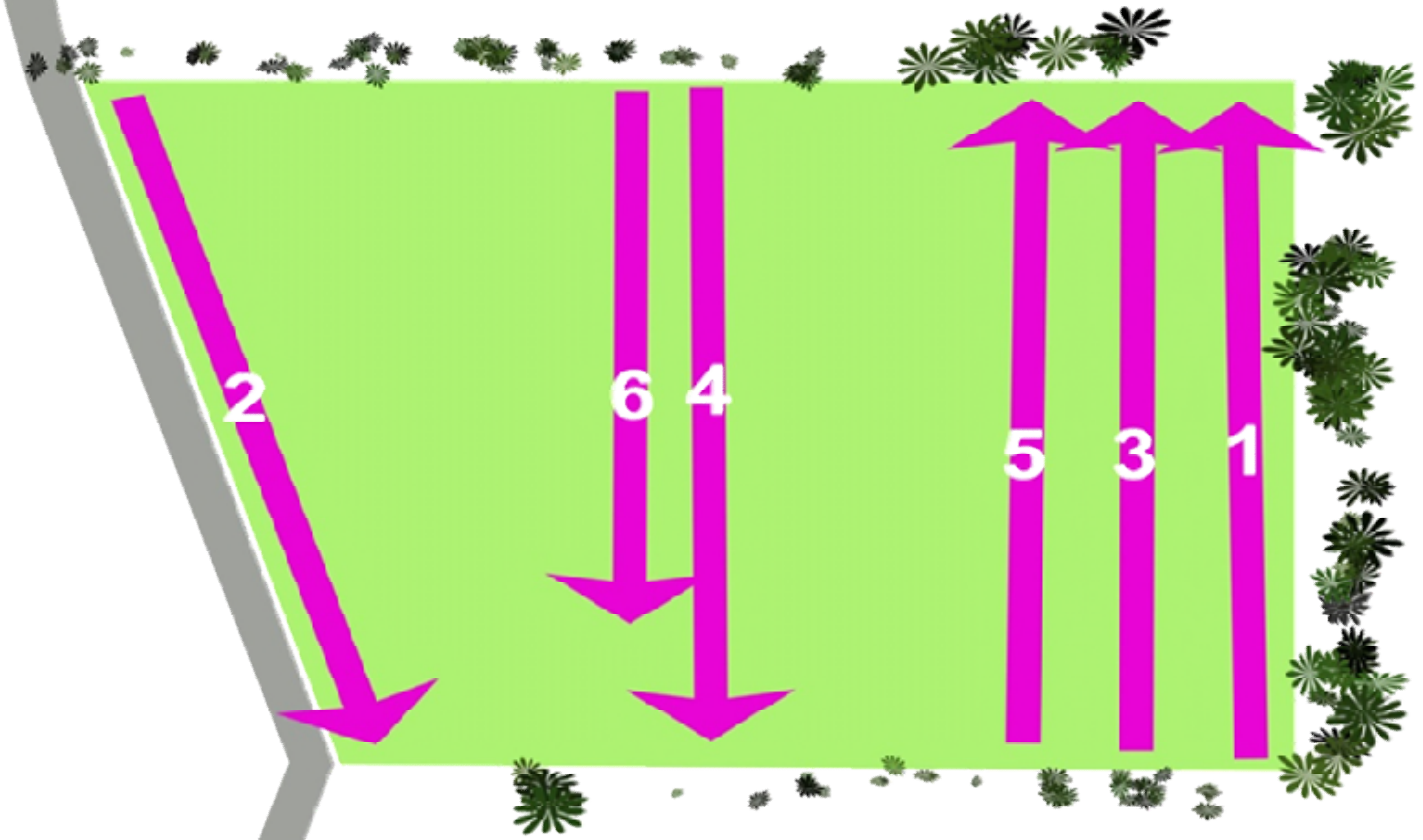
- Almost 2 out of 3 wires that are struck are known about.
- Complacency, fatigue or distraction are usually the reasons for striking a wire.
- Recognise the danger signs.
- Stay alert.
- Read your map.
- Put your aircraft in a position to see them.

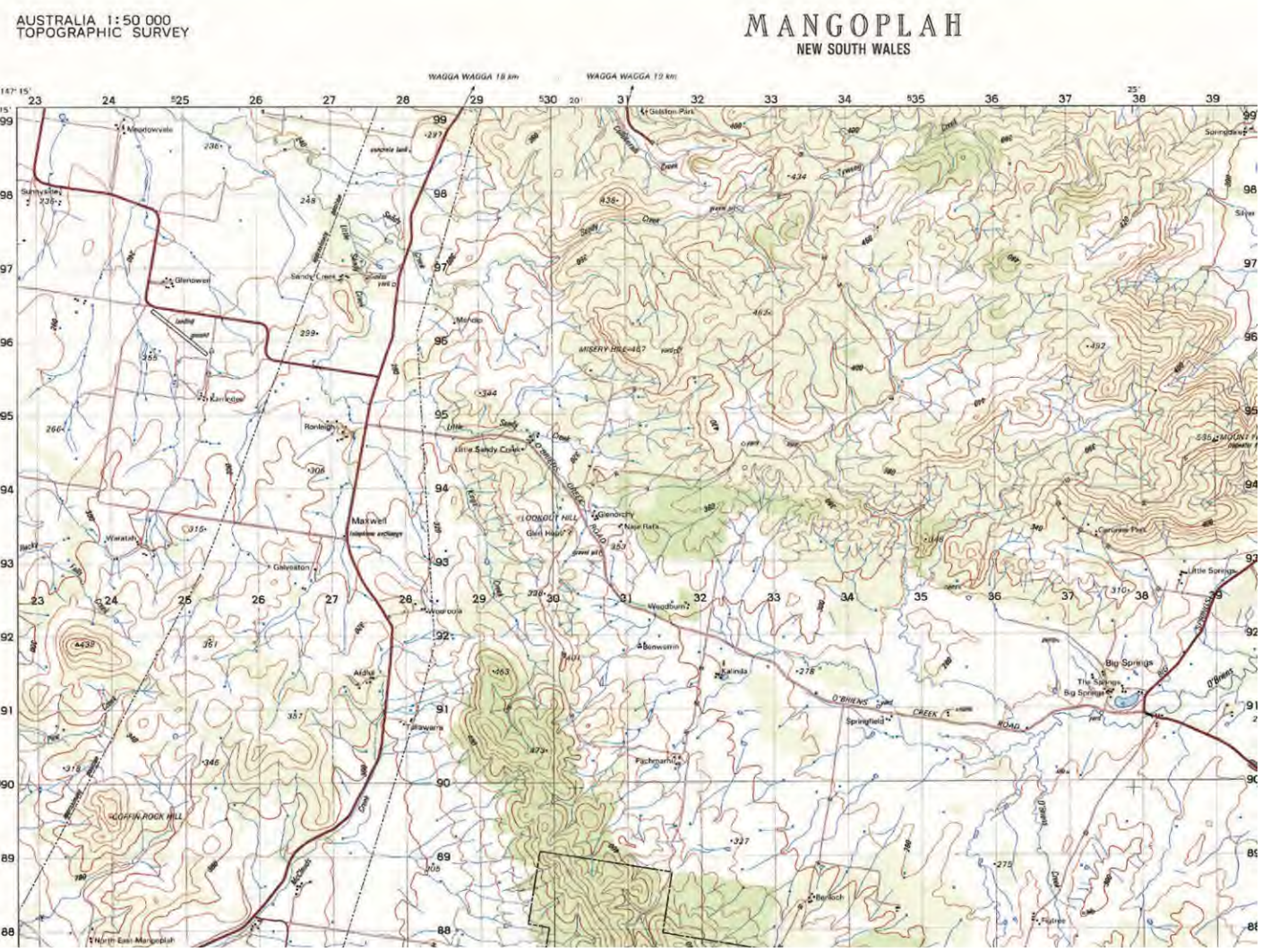
Wire Strike / Tower Avoidance

- Do a thorough map recce before flying
  - Create a hazard box
- Seek local knowledge
- Keep the altitude up until the last minute
- Do a high recce through 360 deg
- Reduce altitude slowly and reduce speed
- Keep the scan going left and right
- COMMUNICATE! Use clock ray/definite direction
- READ YOUR MAP!

Watch this video to see the following:

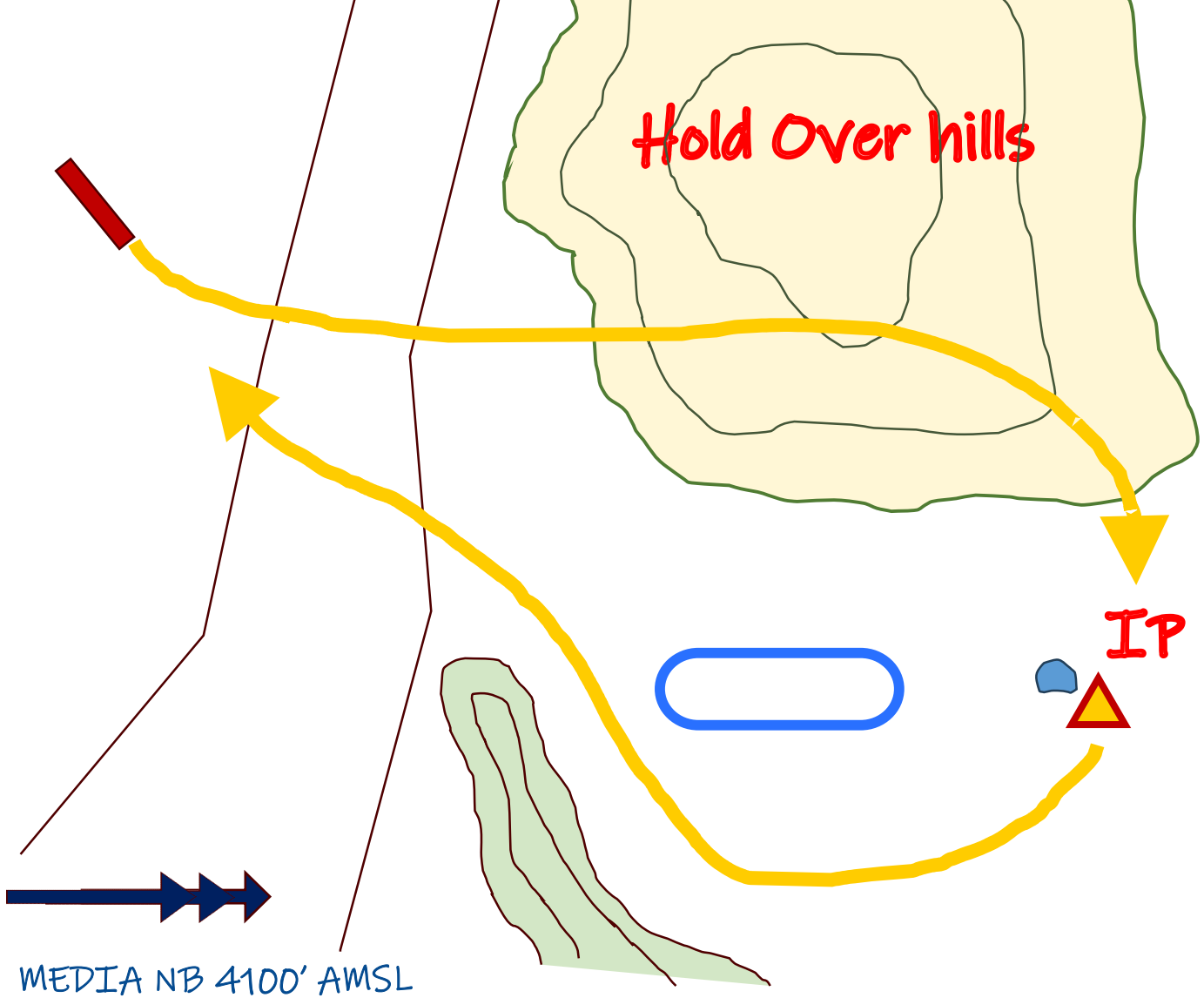
- Mud map
- Aerial Recce
- Articulating his actions
- Flying neighbourly
- Technique



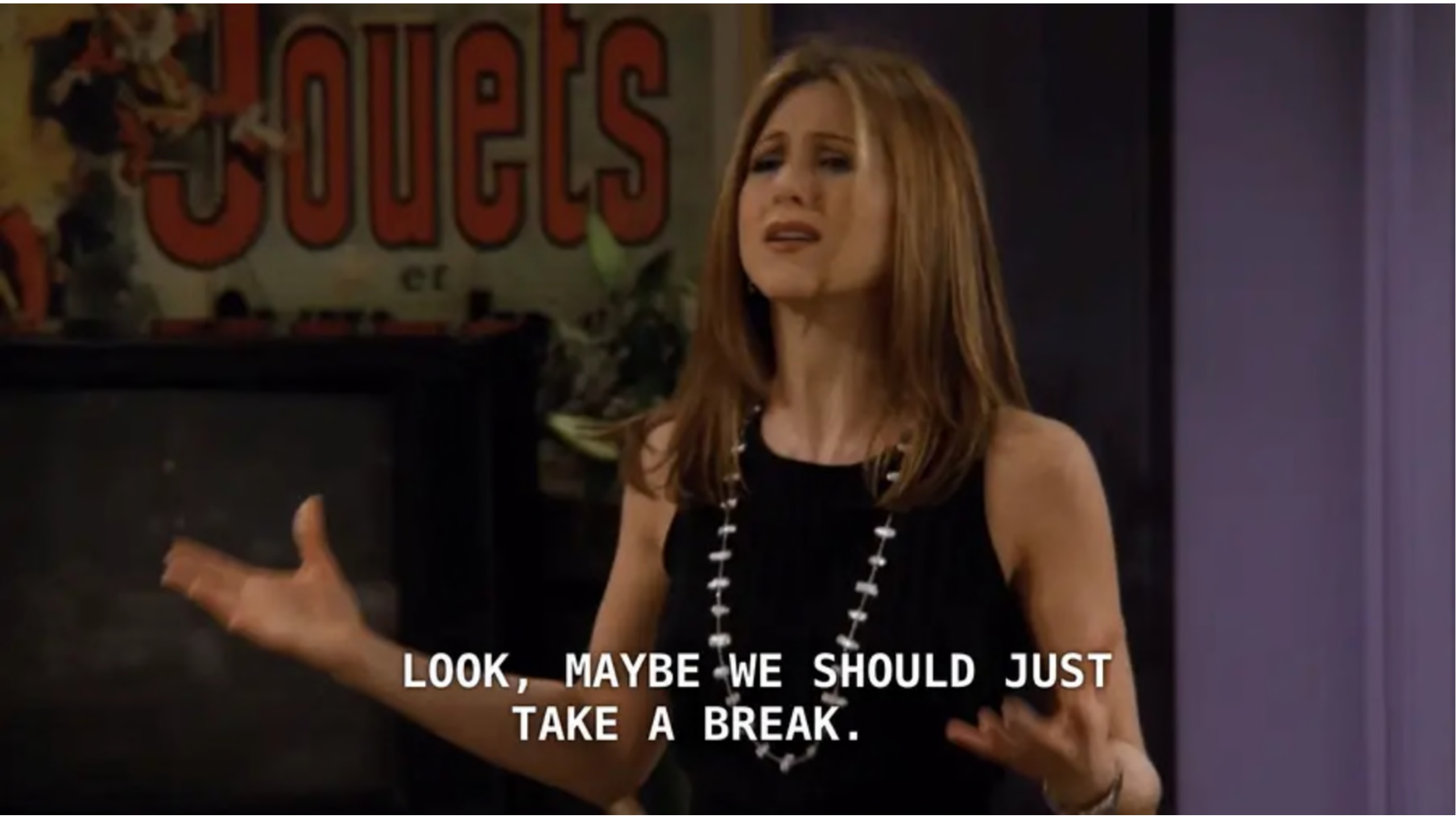


SMEACS MISSION CREW BRIEF

1	**Situation and Preliminary Information**
	Topography - Area to be worked / transited / identified.
	Key hazards - Obstacles, powerlines, terrain, sensitive or restricted areas
	Asset Locs - Other units, landing areas, RVs, Emergency services
	Meteorology - Forecasts / Obs done / Sun / Wind / Likely obscurations
	Notifications - SAR / Flt foll / Flt Plan /Own Org / Client's Org / Permits / PR
2	**Mission - Task Description** (Who, What, When, Why)
3	**Execution - An outline of the activities of the mission**
	Timings - Arrive at airfield, Start/Taxi/TakeOff, Endurance per refuel
	On station - Off station timings. Expected end of mission
	Routes / Altitudes and Area of Operation - describe using a map if avail
	Tasks - Pilot / Mission Comd / Crew / Gnd Spt / Other
	Scan & Duties - Arcs of responsibility / traffic, obstacles, nav, radios, tasks
	Spec Consids - FW / RW Perf IGE/OGE, Cargo, Sling Loads, LZs, Airfields
	Cargo & CG - Cargo weighed. Pilot to confirm CG
3b	**Contingencies - Actions on unexpected events**
	Emergencies - SOPs, Crew Duties, Indications, Checklists, NoComm signals
	Weather - Contingencies in flight / after flight for bad weather
	Risk Management Plan - Risks ID'd, Controls instigated, admin submitted
4	**Administration and Logistics**
	Mission Equipment - Checked / ready / secured / accessible
	Personal and Survival Equipment - Checked / secured / ready
	Accommodation and Transport - Checked and booked
	Dangerous Goods – Pilot notified, checked, paperwork done, loaded / carried
	Fuel / Oil - Location / type / refuellers and all eqpt ready for refuel
	Rations - B'fast-Lunch-Dinner / Drink breaks, locations, timings
	Briefings - Crew, Gnd Spt, Pax briefed, other required briefings
	Personnel - Qualified, current, physical / psych issues, IMSAFE checks
5	**Command and Communications**
	Mission Comd - Delineation of duties
	Acft Comd - Delineation of duties
	Company/Org - Requirements of sortie/task, POC details
	Comms - Freqs ID'd, checked, eqpt serv, back up comms, phone nos, ELT & PLB
6	**Safety, Questions and Additional Points**
	Final Questions or Safety Concerns?
	Debrief - location and time
	Pilot Specific Brief - hand over to pilot for his/her brief (if necessary/reqd)
	Pre-flight Insp and Fuel Check - Aircrew to Complete
	Final Walkaround - Aircrew to Complete, hatches & latches checked
	HLS Security - ID likely hazards. Caution onlookers. Assign security if reqd.



GENERIC SMEACS CREW BRIEF	
0	**Situation and Preliminary Information**
	Topography - Area to be worked / transited identified.
	Key hazards/Assets - Obstacles, Powerlines, terrain, PRDs, FNs.
	Assets - Other units, Hosp, Fire, Landing Areas, RVs.
	Meteorology - Forecasts / Obs done / Sun / Wind / Obscurations
	Notifications - SAR / Flight following / Flt Plan / Company/ Client / Permits / PR
1	**Mission - Task Description** (Who, What, When, Why)
2	**Execution - General outline of the activities**
	Timings - Arrive at airfield, Start/Taxi/TakeOff, Endurance per refuel
	Routes and altitudes and AO
	On station - Off station timings. Expected end of mission.
	Tasks - Pilot / Obsv / Crew / Gnd Spt, Other
	Scan & Duties - Traffic, obstacles, nav, radios
	Spec Consids FW / RW Perf IGE/OGE, Cargo, Sling Loads, LZs Airfields
	CG - ~~Within limits Long/Lat. Ballast (check with aircrew about cargo)~~
3	**Contingencies - Actions on unexpected events**
	Emergencies - SOPs, Crew Duties, Indications, Checklists, NoComm signals
	Weather - Contingencies in flight / after flight
	Task Description Risk Management Plan - Risks ID'd, Controls instigated
4	**Administration and Logistics**
	Mission Equipment - Checked / secured / ready
	Personal and Survival Equipment - Checked / secured / ready
	Accommodation and Transport - ~~Checked and booked~~
	Dangerous Goods – ~~Checked, paperwork, loaded, carried~~
	Fuel / Oil - Location / type / refuellers ready
	Rations - Lunch / Drink breaks, locations, timings
	Briefings - Crew, Gnd Spt, Pax briefed
	Personnel - Qualified, current, physical / psych issues
5	**Command and Communications**
	Mission Comd - Allocation of duties
	Acft Comd - Allocation of duties
	Company/Org - Requirements of sortie/task, POC details
	Comms - Freqs checked, eqpt serv, back up comms, company, ELT
6	**Safety, Questions and Additional Points**
	Final Questions or Safety Concerns?
	Debrief - location and time
	Pre-flight Insp and Fuel Check - Complete
	Final Walkaround – Complete, hatches checked


LOOK, MAYBE WE SHOULD JUST
TAKE A BREAK.