IN THE PLANNING AND ENVIRONMENT COURT
AT BRISBANE No. BD 2845 of 2006

BETWEEN: **CAROL JEANETTE BOOTH**
Applicant

AND: **RICHARD GEORGE YARDLEY**
First Respondent

ANTJE GESINA YARDLEY
Second Respondent

AFFIDAVIT

Filed on: … October 2006

Filed by: Environmental Defenders Office (Qld) Inc
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I, **Dr Hugh John Spencer**, Director of the Cape Tribulation Tropical Research Station, Cape Tribulation, in the State of Queensland, affirm:

1. I have been asked by the applicant to provide an expert opinion on whether an electric grid constructed on the respondents' property at Hosking Road, Mirriwinni is capable or likely to kill, injure or harm flying-foxes that collide with it. The real property description of the land is Lot 1 on RP 712412, County of Nares, Parish of Bellenden Ker, in the State of Queensland ("**the land**"),

2. I have been instructed in accordance with the Court's practice direction that:

   (a) I have overriding duty to assist the Court and that I am not an advocate for a party; and

   (b) My duty to the Court overrides any obligation I may have to any party to the proceeding or to any person who is liable for my expert fees or expenses (although I note that I am not being paid any fee to provide this report).

Relevant expertise

3. I have studied flying-foxes extensively for over 20 years, in particular their biology and ecology. Academically I have a strong background in Zoology, Botany, Animal Physiology, Neurophysiology and Pharmacology.

4. I also have a strong, secondary background in electronic design and construction (a necessary corollary to being a neurobiologist) and have taught "Electronics for Biologists" courses at several universities.

5. My formal academic qualifications are as follows:

   1965 Bachelor of Science majoring in botany and zoology at the Australian National University

   1971 Master of Science at the University of Manitoba, Canada, on the thesis topic of an analysis of the neural responses of a cockroach trochanteral tactile hair to mechanical stimulation.

   1975 Doctor of Philosophy at the University of Manitoba, Canada on the topic of an investigation of the nature of putative synaptic transmitters in the rat corpus striatum.

6. Following the completion of my PhD, I lectured in the Department of Biology at the University of Wollongong between 1978 until 1988. In 1988 I established the Cape Tribulation Tropical Research Station with my wife, Brigitta, with the purpose of creating a not-for-profit facility for researchers from many disciplines and many parts of the world to increase scientific knowledge and help support efforts to protect the unique Daintree lowland rainforests. Since 1988 I have been a Director at the Cape Tribulation Tropical Research Station and since 1992, when it was created, Director/CEO of the Australian Tropical Research Foundation.

7. My fields of research and professional interest include:

   (a) Tropical ecosystems - cataloging animal and plant diversity, pollination ecology of angiosperms (flowering plants) and biology of bats and insects as pollinating vectors, tropical plants as pharmaceutical sources of pharmaceutical agents.

   (b) Conservation of tropical ecosystems.

   (c) Applications of electronic technology to biology, with particular reference to radiotelemetry.

   (d) Human impact on environmental systems.

   (e) Development and applications of alternative technology and energy.

(f) Development of non-lethal deterrents for flying-foxes.

8. I note that in the area of non-lethal deterrents for flying-foxes, for the past several years I have been pushing for the development of objective assessment technologies for deterrents. I have developed a prototype radar based operating and analysis system, as well as an electric-fence based "aerial grid" driver, for the Queensland Environmental Protection Agency.

Flying-fox classification, biology and ecology

9. Flying-foxes are large bats (Class Mammalia, Order Chiroptera, Suborder Megachiroptera, Family Pteropodidae, Genus *Pteropus*). I have read and I agree with the summary of flying-fox biology, ecology and morphology provided by Dr Carol Jeanette Booth at paragraphs 28-36 her affidavit affirmed on 22 September 2006. I note in particular that flying-foxes are vital for maintaining ecological processes in tropical to temperate forests through their role in pollination and seed dispersal of many species of flowering plants.

How electricity kills, injures or harms humans and flying-foxes

10. A brief explanation of how electricity kills, injures and harms animals such as humans and flying-foxes will assist the Court in understanding the effects that the respondents' electric grids are likely to have on flying-foxes.

11. A basic definition of "electricity" is the flow of electrons, protons or electric charge. Direct current ("**DC**") flows in a constant direction. Batteries, for example, deliver DC. Alternating current ("**AC**") changes direction or alternates from a forward (positive) flow to a backward (negative) flow. Household power outlets deliver AC. AC is substantially more dangerous than DC.

12. Electricity is typically measured in units of volts ("**V**") and amperes or "amps" ("**A**"). A volt is a unit of electromotive force or pressure that causes current to flow. The greater the voltage, the greater the force or pressure for current to flow. Voltage is measured along two points of a circuit, such as two battery terminals. In Australia, 240V **AC** is the standard for household appliances. An ampere is a unit of electrical current. More precisely, it is the flow of a certain number of electrons per second.

13. An ohm is a unit of electrical resistance. The resistance of a material to electrical current flow depends on the physical and chemical properties of the material. The amount of current flow often determines the magnitude of injury.

14. Factors that determine the degree of an electrical injury include the magnitude of energy delivered, resistance encountered, type of current, current pathway, and duration of contact. Systemic effects and tissue damage are directly proportional to the magnitude of current delivered to the victim. Current flow (amperage) is directly related to voltage and inversely related to resistance, as dictated by Ohm's law (I=V/R;

where I=current, V=voltage, R=resistance). Of the parameters described by Ohm's law, voltage usually can be directly determined and is used to gauge the potential magnitude of current exposure and, therefore, the magnitude of injury.

15. Electricity flowing abnormally through the body of an organism (whether human or flying-fox) produces injury or death in three main ways:

    (a) by depolarizing muscles and nerves;

    (b) by initiating abnormal electrical rhythms in the brain (seizures) and heart (ventricular fibrillation); and

    (c) by producing electrical burns both by heating and by poration (producing holes in cell membranes).

16. The pathway taken by an electrical current through the body determines which tissues are at risk and what type of injury is observed. Electrical current that passes through the head or thorax (that is, the upper body or chest) is more likely to produce fatal injury. Transthoracic currents can cause fatal ventricular fibrillation, direct heart damage, or respiratory arrest. Transcranial currents (that is, currents passing through the head) can cause direct brain injury, seizure, respiratory arrest, and paralysis. Electrical currents (of an intensity lower than required to cause outright death) flowing through a person or flying-fox that last for protracted periods (minutes) may also produce brain damage if they interfere with respiratory movement.

17. Ventricular fibrillation may lead to a "heart attack" where the heart stops beating. AC current may produce ventricular fibrillation if the path of the current involves a passage through the chest, arm to arm, arm to leg, or head to arm.

18. Electrical injuries may not be visible to the naked eye because electricity "burns" internally due to the heat caused by resistance to the current in tissues. Large currents flowing through body tissues can cause severe internal burns (literally boiling the tissues).

19. The effects of electricity on animals such as flying-foxes have not been extensively tested and cannot be for ethical reasons. Considerable research has been conducted on the effects of electricity on humans for the purpose of designing electrically safe equipment and the results of this research can be used to infer the effects of electricity on flying-foxes. Flying-foxes and humans are both mammals and have very similar thoracic anatomy and tissue composition. A typical normal body weight male human has a cross sectional area of about 710 cm^2. A flying-fox has a cross sectional area of approximately 58 cm^2 (900 g adult male). The ratio between the cross sectional areas is approximately 12:1.

20. When comparing the effects of electricity on humans and flying-foxes it should be understood that flying-foxes experience 12 times the current density experienced by a

human because of their smaller body size. This is because the same current flowing through a human body is concentrated into a body 12 times smaller so the "current density" is increased 12 times. For example, a 30 milli-amp ("**mA**") current flowing through a human is experienced as equivalent to a 360 mA current by a flying-fox (assuming that the current path would be from the wings to the legs and/or lower abdomen, the most probably path for a bat caught by the legs). This is well above the lethal threshold, regardless of the age, condition or size of the bat. A current level of 360 mA would probably be lethal if applied for 0.5 seconds. That the body is not isotropic is acknowledged, but the distribution of tissues in a flying-fox and human are about the same, and so the simpler analysis still holds.

Will the respondents' electric grids kill, injure or harm flying-foxes?

21. I have not inspected the respondents' farm. I have seen photographs of the electric grids exhibited to Dr Carol Jeanette Booth's affidavit of 22 September 2006. I have been provided with an electrician's report by Steven Joy, dated 10 March 2006, which appears to have been prepared by him after an inspection of the respondents' property. The relevant part of the one-page report reads:

> "**Re: Hoskin Rd. Electrical Report**
>
> My name is Steven Joy. I am a licensed electrical fitter/mechanic and have been in the trade for the past nine years. My qualifications include maintenance & construction work in domestic, commercial and industrial situations.
>
> An electrical inspection was performed on an overhead electrical system designed to electrocute flying animals above the protected crop.
>
> The system consisted of a control box located at the property Dwelling which controlled a grid of fifteen bare conductors (wire) in a vertical, fence like arrangement approximately ten meters off the ground above the fruit trees. A safety inspection was performed on the whole system before any testing and energizing was completed.
>
> The control box had a 10 Amp extension lead from a power source plugged into the 3 pin inlet socket. A 3 amp inline fuse connected the inlet socket to the main switch, to a Photo Electric Cell to a bypass switch and some indicator 'ON' lamps which then fed an isolating transformer. This transformer converted the single Phase 240 volt input into 2 Phases: 1 Phase – 120 volt a/c 0.24 Amps & 2nd phase – 216 volt a/c 0.40 Amps with 382 volts a/c between the two phases. These two phases terminated into a 4 pin surface socket outlet and a 4 pin plug connected the control box through an extension lead to the grid system.
>
> The two phases feed the fifteen conductors with each Phase alternating so that if an animals gets caught between two conductors it creates a dead short between the phases and current will pass through the animal until it is dead. This system should stay energized unless there is a high fault current or a short down to earth and then the 3 Amp inline fuse in the control box should blow, isolating the system.
>
> The low current produced is enough to cause the death of any flying animal big enough to get caught between the conductors.
>
> The control box and any part of the system that had been tested or moved, on this day, was refitted and restored in the original, electrically safe position that it was found in."

22. **Exhibit HJS-1** is a copy of Mr Joy's electrical report.

23. The description provided by Mr Joy is that of a standard "Fyre Fox" unit, used by fruit-growers for crop protection against flying-foxes. I am well familiar with the design and operation of the Fyre Fox grids, and have visited the manufacturer in the past. On 23 October 2006, I examined a Fyre Fox unit similar to the respondents' system. It was labeled "Fyre Fox Flying Fox Eradicator" Number 072 Made by Fyre Fox, PO Box 513 Ingham, 4870." **Exhibit HJS-2** is a series of photographs of this unit taken from all angles, including the label. I determined and drew the circuit diagram for this unit, which is attached as Exhibit HJS-3. I energized the unit, checked its operation and measured the voltages.

24. It is evident from the "Fyre Fox" design that the device is designed to deliver voltages in excess of 400V AC rms (which converts to peak voltage of 1/0.707 = 570 V). The "Fyre Fox" circuit design has little effective current limitation (the 75 watt incandescent lamp in series with the transformer serves as a crude current limiter), so that currents well in excess of 100 mA can be drawn by an animal with a nominal skin resistance of 5-10 K ohms (characteristic of a flying fox). Voltages and currents in this range are more than capable of providing lethal shocks to mammals. Currents in excess of 30 mA are lethal for humans.

25. The respondents' electric grid, as described by Mr Joy, is designed to function as a lethal electrocution device in orchards. In my opinion, there is a very high probability that flying-foxes that collide with the grid while it is operating will die of electrocution, or suffer serious electrical burns to wing membranes (if the current path does not flow directly through the body). Given the issues of relative current flux through the body and the resultant higher expectation of frank electrocution, I would say that the grids would kill, injure or harm flying-foxes (using a plain meaning definition of these words).

26. Another factor to be considered when assessing the effects of the respondents' electric grids on flying-foxes is that the use of the grids during the lychee season coincides with the peak season for flying-foxes to give birth to young. Spectacled Flying-foxes (*Pteropus conspicillatus*) and Black Flying-foxes (*Pteropus alecto*) generally give birth during October-December each year, coinciding with summer food availability. Newborn flying-foxes cling to their mothers in flight. This means that female flying-foxes that encounter the respondents' electric grids have special vulnerability to electric shock potentially causing an abortion or harm to a fetus or newborn flying-foxes clinging to their mother. The potential to kill, injure or harm unborn or newborn flying-foxes in this manner has not been tested and cannot be tested for ethical reasons. There is, however, little doubt that if adults can be killed by the electric grid, then fetuses and newborn flying-foxes will also be killed or injured. Even if the current path does not directly affect the juvenile, it will die of starvation in the event of the death of its mother.

27. As explained above, electrical injuries may not be visible to the naked eye. In addition to potentially causing a heart attack, electricity "burns" internally and, therefore, a

flying-fox that flies away from an electric grid may die of internal injuries or, as a result of burns causing wing necrosis (which means the animal starves to death as it cannot fly) at a later time. It is very difficult to calculate how many flying-foxes might be injured in this manner.

Declaration

28. The factual matters stated in this report are true, to the best of my knowledge except as stated otherwise. I have made all enquires considered appropriate in review of this matter. While I would have wished to inspect the respondents' electric grids myself, this was not possible in the time available to me and my research commitments at Cape Tribulation. The opinions stated in the report are genuinely held by me, and I have referenced all matters I consider to be significant. I understand my duty to the Court and believe I have complied with this duty to the best of my ability. To the best of my knowledge there are no readily ascertainable additional facts that would assist me in reaching more reliable conclusions.

Affirmed by Hugh John Spencer)
at …….. this)
….. day of October 2006)
Before me:)

……
Deponent

…….
Justice of the Peace / Solicitor

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First Respondent

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CERTIFICATE OF EXHIBIT

This and the following one pages is Exhibit HJS-1 to the affidavit of Dr Hugh John Spencer affirmed …. October 2006.

……. ……
Deponent Justice of the Peace / Solicitor

Environmental Defenders Office (Qld) Inc
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✓ CARMS

CNS 6254
CNS 2006/5395

10 March 2006

Queensland Parks and Wildlife Service
Rob Little
Senior Investigator Compliance and Enforcement Unit
Northern Region

Re: Hoskin Rd. Electrical Report.

My name is Steven Joy. I am a licensed electrical fitter/mechanic and have been in the trade for the past nine years. My qualifications include maintenance & construction work in domestic, commercial and industrial situations.

An electrical inspection was performed on an overhead electrical system, designed to electrocute flying animals above the protected crop.

The system consisted of a control box located at the property Dwelling which controlled a grid of fifteen bare conductors (wire) in a vertical, fence like arrangement approximately ten meters off the ground above the fruit trees. A safety inspection was performed on the whole system before any testing and energizing was completed.

The control box had a 10 Amp extension lead from a power source plugged into the 3 pin inlet socket. A 3 amp inline fuse connected the inlet socket to the main switch, to a Photo Electric Cell to a bypass switch and some indicator 'ON' lamps which then fed an isolating transformer. This transformer converted the single Phase 240 volt input into 2 Phases; 1 Phase -120 volt a/c 0.24 Amps & 2nd phase -216 volt a/c 0.40Amps with382 volts a/c between the two phases. These two phases terminated into a 4 pin surface socket outlet and a 4 pin plug connected the control box, through an extension lead to the grid system.

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The low current produced is enough to cause the death of any flying animal big enough to get caught between the conductors.

The control box and any part of the system that had been tested or moved, on this day, was refitted and restored in the original, electrically safe position that it was found in.

Q-Build Electrician - Steven Joy
License # - 51873

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31 Grove Street
Cairns Qld 4870
PO Box 812 Cairns Qld 4870

Telephone (07) 4036 8699
Facsimile (07) 4031 2560
Website www.qbuild.qld.gov.au

ABN 65 266 806 703

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This and the following four pages is Exhibit HJS-2 to the affidavit of Dr Hugh John Spencer affirmed …. October 2006.

……. ……
Deponent Justice of the Peace / Solicitor

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THE AFFIDAVIT OF HUGH
JOHN SPENCER
Filed on behalf of the Applicant

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CERTIFICATE OF EXHIBIT

This and the following four pages is Exhibit HJS-3 to the affidavit of Dr Hugh John Spencer affirmed …. October 2006.

……. ……
Deponent Justice of the Peace / Solicitor

CERTIFICATE OF EXHIBIT TO
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Filed on behalf of the Applicant

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