

# Townsville field training area health assessment

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## Abstract

The Townsville Field Training Area (TFTA) which is located 50 km west of Townsville, northern Queensland, has a number of important disease and safety threats to the health of military personnel. Since its establishment the training area has not been thoroughly assessed for environmental health risks. In May 2010 a Health Assessment Team (HAT) engaged in a comprehensive sweep of health threats across the training area. This article includes information on the environment, disease threats, range hazards, local health infrastructure, and utilities such as water and sanitation. A risk assessment of the health threats identified in the TFTA and their assigned risk was conducted. Major risks include motor vehicle accidents, heat-related injuries and vector-borne diseases. Environmental health support can appropriately identify, assess and manage possible risks associated with the TFTA. These efforts will support commanders' objectives to achieve the maximum conservation of manpower by preventing disease and non-battle injuries.

## Introduction

The Townsville Field Training Area (TFTA) is located near Townsville on the Queensland coast, 1335 km north of Brisbane, Australia. The Townsville area contains a wide range of terrain and has a frontage of long open beaches bordering the east coast. Topography includes mudflats, mangroves, tidal creeks, marine couch plains, savannah forest amid steep rugged ranges which in some places are rocky and heavily timbered. The TFTA crosses Townsville City Council and Charters Towers Regional Council and covers an area of 2,300 km<sup>2</sup>. The topography within the TFTA is dominated by open sclerophyll forests which feature in the west, rugged ranges and wet rainforest to the north-east, and gentle undulating plains to the south. The TFTA has a tropical climate but, due to its geographical location, rainfall is relatively low. The winter months are dominated by south-east trade winds and mostly fine weather. The summer months bring a hot and humid climate with thunderstorms starting in late October or November. Tropical cyclones are rare, effecting Townsville on average once every 20 years. The aim of this report is to provide



Open sclerophyll forests in the TFTA.

personnel, commanders and formation health planners with information about the potential environmental health risks that exist within the TFTA and in the Townsville region.

### Methods

A combined 1st Health Support Battalion and 2nd Health Support Battalion, Hazard Assessment Team (HAT) conducted a hazard assessment of the TFTA during the period 12 – 21 May 2010. The HAT conducted the assessment using a number of methods. Firstly, a review of available epidemiological data was conducted prior to deployment in order to collate background data and in some cases tailor the field survey. The field survey consisted of site inspections, environmental sampling and analysis, mosquito trapping, as well as liaison visits to Range Control, Queensland Health, Defence Support Group (DSG) and local health facilities. Confirmatory testing was conducted of water and mosquito samples at accredited laboratories. Finally an adapted military risk framework was used to assess the level of risk associated with potential hazards identified. (1)

### Disease threats

The following disease risks have been identified within both the TFTA and the Townsville City Council and adjacent shires. The potential exists for the spread and introduction of these diseases into the TFTA through contact with the civilian community, family members and other military personnel.

#### Water and food borne diseases

Each year water and food-borne disease occurs from contaminated water and food sources and includes amoebic dysentery, *Escherichia coli* infections, *Bacillus cereus* food poisoning, campylobacteriosis, cryptosporidiosis, giardiasis, hepatitis A, salmonellosis and shigellosis. In Townsville Shire there was a number of salmonellosis reported, 826 cases in 2005 to 2010 and an average annual incidence of 112.48 per 100 000 during the period 2003 – 2007. (2-3) Gastrointestinal disease such as *E. coli* and *Salmonella* are quite common in the tropics and many non-potable water sources tested positive for *E. coli*, presenting a hazard in the TFTA. While tests for *Cryptosporidium* on all potable water sources were negative; outbreaks have been associated with drinking water (surface water) and recreational use of water. Waterways and non-potable water sources are a potential hazard for *Cryptosporidium*

in the TFTA, however potable bore water supplies are not seen as a high risk. A risk assessment table of the water and food-borne disease and causative agents on the TFTA can be found in Table 1.

Table 1. TFTA water and food borne diseases risk assessment.

| Water and food borne diseases         |                   |            |        |
|---------------------------------------|-------------------|------------|--------|
| Hazard                                | Likelihood        | Impact     | Risk   |
| Amoebic Dysentery                     | Rare              | Disruptive | Low    |
| <i>Bacillus cereus</i> food poisoning | Rare              | Disruptive | Low    |
| <i>Campylobacter</i> spp. Enteritis   | Rare              | Disruptive | Low    |
| <i>Cryptosporidium</i>                | Rare              | Disruptive | Low    |
| <i>E. coli</i>                        | Occasional        | Disruptive | Medium |
| <i>Giardia intestinalis</i>           | Rare              | Disruptive | Low    |
| Hepatitis A                           | Highly Improbable | Serious    | Low    |
| <i>Salmonella</i>                     | Occasional        | Serious    | Medium |
| <i>Shigella</i>                       | Rare              | Disruptive | Low    |

#### Vector borne diseases

Several vector-borne diseases are endemic and notifiable in north Queensland. These include, but are not limited to, the arboviruses: Barmah Forest (BF), dengue, kunjin, Murray Valley Encephalitis (MVE) and Ross River (RR) as well as *Orientia tsutsugamushi* the cause of scrub typhus. Historical data for vector-borne diseases in Townsville Shire is in Table 2.

Table 2. Historical data for vector borne diseases in Townsville Shire. (2-3)

| Historical data of vector borne disease |             |             |
|-----------------------------------------|-------------|-------------|
| Disease                                 | 2003 – 2007 | 2005 – 2010 |
| Barmah Forest                           | 474         | 497         |
| Dengue                                  | 158         | 176         |
| Malaria                                 | 79          | 55          |
| Rickettsial infections                  | <30         | –           |
| Ross River Virus                        | 1062        | 1177        |

The mosquito *Culex annulirostris* is the primary vector of a number of Australian arboviruses and was collected throughout the TFTA. *Cx. annulirostris* is capable of transmitting BF virus, RR and MVE indicating that these viruses may be circulating in the TFTA at the time of these surveys. Reservoirs of kunjin were identified in the TFTA. No *Aedes aegypti*, the vector of dengue, were collected during mosquito surveillance of the TFTA. However a number of large outbreaks of dengue fever have occurred in northern Queensland in recent years.

Despite cases of malaria being reported in the Townsville Shire, there has been no recorded local transmission. *Anopheles* sp. (primarily *Anopheles annulipes*) was collected during mosquito surveillance of the TFTA. Therefore the training area is theoretically receptive to malaria imported by overseas troops. However, the main vector of malaria in the southwest Pacific region is *Anopheles farauti* and this species has never been collected at TFTA. (4) A risk assessment table of the vector-borne disease associated with TFTA can be found in Table 3.

Table 3. TFTA vector borne diseases risk assessment.

| Vector borne diseases            |                   |              |        |
|----------------------------------|-------------------|--------------|--------|
| Hazard                           | Likelihood        | Impact       | Risk   |
| Barmah Forest                    | Occasional        | Disruptive   | Medium |
| Dengue                           | Highly Improbable | Serious      | Low    |
| Kunjin                           | Rare              | Disruptive   | Low    |
| Malaria                          | Highly Improbable | Critical     | Low    |
| Murray Valley Encephalitis Virus | Rare              | Catastrophic | Medium |
| Rickettsial infections           | Rare              | Serious      | Medium |
| Ross River Virus (RR)            | Occasional        | Disruptive   | Medium |

### Zoonotic diseases

TFTA is a suitable environment for several disease-causing agents that can be transmitted between humans and animals. The historical data for zoonotic disease is in Table 4.

Table 4. Historical data for zoonotic diseases in Townsville Shire. (2-3)

| Historical data of zoonotic disease |             |             |
|-------------------------------------|-------------|-------------|
| Disease                             | 2003 – 2007 | 2005 – 2010 |
| Brucellosis                         | 11          | <5          |
| Leptospirosis                       | 10          | 9           |
| Ornithosis                          | <5          | <5          |
| Q Fever                             | 46          | 47          |

Reservoirs (cattle, goats and dogs) of brucellosis are present in the TFTA. However, the likelihood of coming in contact with the disease is highly improbable, Table 5. Leptospirosis is active at low levels in Townsville Shire. Very low numbers of ornithosis cases have also been recorded in the Townsville Shire however reservoirs (birds) for *Chlamydia psittacosis* were observed in the TFTA. There were also a low number of Q Fever cases in the Townsville Shire and potential animal reservoirs (cattle, sheep and goats) were identified in the TFTA.

### Soil disease

Soil diseases such as hookworm and tetanus are present in TFTA. Spores and larvae of these diseases can remain viable in the soil for years after contamination.(5) However, this risk is substantially reduced due to the Australian Defence Force vaccination protocol, Table 5. Melioidosis is also present at low levels in the Townsville Shire.

### Airborne diseases

Airborne diseases including influenza have the potential to spread rapidly through soldiers who are working in close living conditions on operations. There have been 813 confirmed cases of influenza in the Townsville Shire in the period 2003 to 2007 and an average annual incidence rate of 73.75 per 100,000 during the period 2003 – 2007.(2-3) A less significant airborne risk in TFTA is *Legionella spp.*, Table 5. There has been one case of Legionellosis in the Townsville Shire in the period 2005 to 2010 and an average annual incidence rate of 0.4 per 100,000 during the period 2003 – 2007.(2-3) *Legionella* was identified in previous environmental monitoring of the vehicle hygiene facility at TFTA by DSG.

Environmental threats include dangerous fauna, flora, heat, cold, solar radiation, fire and severe weather.

Table 5. TFTA zoonotic, soil and airborne disease risk assessment.

| Zoonotic disease  |                   |            |          |
|-------------------|-------------------|------------|----------|
| Hazard            | Likelihood        | Impact     | Risk     |
| Brucellosis       | Highly Improbable | Serious    | Low      |
| Leptospirosis     | Highly Improbable | Serious    | Low      |
| Ornithosis        | Highly Improbable | Minor      | Very Low |
| Q Fever           | Highly Improbable | Serious    | Low      |
| Soil diseases     |                   |            |          |
| Hookworm disease  | Rare              | Disruptive | Low      |
| Melioidosis       | Highly Improbable | Serious    | Low      |
| Tetanus           | Highly Improbable | Serious    | Low      |
| Airborne diseases |                   |            |          |
| Influenza         | Occasional        | Disruptive | Medium   |
| Legionella        | Rare              | Disruptive | Low      |

### Environmental threats

Environmental threats include dangerous fauna, flora, heat, cold, solar radiation, fire and severe weather. Commanders and individuals must have a thorough understanding of the range of environmental threats that can be encountered whilst on the training area to appropriately engage in preventative measures.

#### Dangerous fauna – Vertebrates

TFTA is the natural habitat for many vertebrates including snakes, toads, pigs and goannas, Table 6. Several snake bites occur each year during activities on the TFTA and dangerous species include *Pseudechis australis* (King Brown), *Pseudonaja textilis* (Eastern Brown), and *Oxyuranus scutellatus* (Taipan). Cane toads, pigs and goannas are of little danger to humans unless handled inappropriately. No dangerous incidences of these vertebrates have been recorded in the TFTA. However, all are commonly observed in the TFTA and can be easily avoided.

#### Dangerous fauna – Invertebrates

Injuries from invertebrates not only present short term local pain and discomfort but they can also be responsible for asphyxiation and death. Incidences of spider bites have been recorded and it is important that all members follow simple control measures to avoid contact with invertebrates. A list of dangerous invertebrates and associated risk is assessed in Table 6.

#### Dangerous flora

Plants present a health risk to soldiers via two different mechanisms. Many plants can be poisonous if eaten and several are contact irritants that can cause skin irritations and lacerations from contact with sharp hairs or spikes of the plant. The training area is predominantly open grasslands and easily navigated. However, creek lines and high rain fall areas of the range in the north-east contain a wide diversity of dangerous flora, Table 6.

Table 6. TFTA dangerous fauna and flora risk assessment.

| Dangerous fauna – Vertebrates   |                   |            |          |
|---------------------------------|-------------------|------------|----------|
| Hazard                          | Likelihood        | Impact     | Risk     |
| Snake                           | Occasional        | Serious    | Medium   |
| Cane Toad                       | Highly Improbable | Minor      | Very Low |
| Feral Pig                       | Highly Improbable | Serious    | Low      |
| Goanna                          | Highly Improbable | Minor      | Very Low |
| Dangerous fauna – Invertebrates |                   |            |          |
| Centipede                       | Rare              | Disruptive | Very Low |
| Green Tree Ant                  | Rare              | Disruptive | Very Low |
| Paper Wasps                     | Rare              | Disruptive | Very Low |
| Ticks & Mites                   | Occasional        | Disruptive | Low      |
| Spiders                         | Rare              | Serious    | Low      |
| Scorpion                        | Highly Improbable | Minor      | Very Low |
| Whiplash Rove Beetles           | Highly Improbable | Minor      | Very Low |
| Dangerous flora                 |                   |            |          |
| Consuming Dangerous Flora       | Highly Improbable | Serious    | Low      |
| Contact of Dangerous Flora      | Rare              | Minor      | Low      |

### Cold related injuries

Although the TFTA is located in the northern tropical regions of Australia, due to its significant elevation above sea level (approximately 600 m) cold weather injuries can still occur, Table 7. Throughout the winter months of May - August preventive measure should be taken, Figure 1.

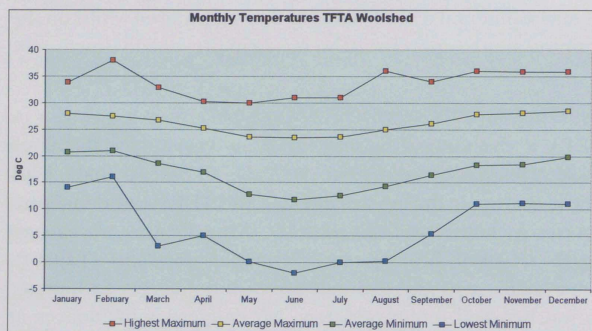


Figure 1. Monthly temperatures TFTA Woolshed 1998 - 2010.

### Heat related injuries

Within the military environment, heat casualties, including deaths, occur in units operating in hot climatic conditions. The TFTA (particularly between the months October - March) will reach temperatures which will cause injury if appropriate action is not taken. A number of factors contribute to heat stress. These include air temperature, humidity, air movement, water consumption, physical activity and acclimatisation. Little can be done about the climatic conditions of an operational environment; therefore prevention of heat injury is centered on control of the latter three factors. Failure to follow preventive measures during operations in hot environments will result in large numbers of heat casualties and a unit's inability to train effectively, Table 7.

### Solar radiation

Solar radiation, in the form of Ultra Violet radiation (UV) in sunlight, poses a low health risk, Table 7. Over exposure to UV

radiation may result in burns, particularly to the skin and eyes, and the formation of skin cancers. Australia has the highest incidence of solar induced skin cancer in the world and it is the most common form of cancer affecting Australians in all age groups.

### Fire

The TFTA frequently experiences wildfires, managed fires and accidental bush fires. These can be ignited by lightning strikes during thunder storms or by spot fires caused by people. Fires such as these have been responsible for the lost of equipment, wildlife and present a significant threat to human life in the training area, Table 7.

### Severe weather events

Tropical cyclones are rare, affecting Townsville on average once every 20 years. However severe storms and weather events from late October until April are sporadic. While most deaths from severe weather events occur as a result of drowning, many lives have been lost in Australia due to collapsing buildings or flying debris which can become lethal in high winds, Table 7.

Table 7. TFTA cold related injuries, heat related injuries, solar radiation, fire, and severe weather events risk assessment.

| Cold related injuries |                   |              |             |
|-----------------------|-------------------|--------------|-------------|
| Hazard                | Likelihood        | Impact       | Risk        |
| Cold related injuries | Highly Improbable | Serious      | Low         |
| Heat related injuries |                   |              |             |
| Heat related injuries | Occasional        | Catastrophic | Substantial |
| Solar radiation       |                   |              |             |
| Solar radiation       | Likely            | Minor        | Low         |
| Fire                  |                   |              |             |
| Fire                  | Highly Improbable | Serious      | Low         |
| Severe weather events |                   |              |             |
| Severe weather events | Highly Improbable | Disruptive   | Low         |

### Other range hazards

Along with environmental threats, TFTA has many hazards caused by the built environment. Unlike environmental threats, these hazards generally occur on specific areas or pathways in the training area. These include asbestos, mining and land contamination, unexploded ordinance, and motor vehicle accidents.

### Asbestos

Asbestos materials are present in the TFTA, the majority being found in building materials such as wall sheeting. In general, asbestos products pose no harm if they are in good condition and are left alone by exercise participants, Table 8. If asbestos products are in poor condition and are disturbed, asbestos fibres may become airborne and be inhaled by humans. At sufficient exposure levels asbestos fibres may cause diseases such as cancer, asbestosis and mesothelioma.

Facilities identified to have asbestos products in poor condition have been cordoned off and are out-of-bounds to exercise participants. An asbestos register is maintained by DSG and is updated regularly. Units entering the training area should consult the DEMS asbestos register for up-to-date information and risk levels.

### Mining and contaminated land

The land that now comprises the TFTA has been the home of many mining and agricultural operations in the past. Gold, silver, copper and uranium have all been mined within the TFTA (or adjacent lands). There are numerous abandoned mines, abandoned landfills, mining shafts and disused cattle dips present within the TFTA, the majority of which have been designated as out-of-bounds to all personnel.

These areas pose a safety hazard to anyone venturing too close and should be avoided, Table 8. Methods used in the mining and agricultural process may also have contaminated local soils and ground water with heavy metals (e.g. Cyanide and Arsenic).



TFTA hazardous site, Argentine smelter.

### Unexploded ordinance

Unexploded ordinance (UXO) is prevalent throughout the TFTA. UXOs are a result of live firing activities and personnel should be wary of UXOs in all sectors, Table 8. If personnel encounter a suspected UXO, they should not disturb it but report its location to range control.

### Motor vehicle accidents

According to range control records, motor vehicle accidents are the most prevalent of incidents in the TFTA, Table 8. Several motor vehicle accidents have occurred in the TFTA including head-on collisions, run-off-road collisions, rear-end collisions, side collisions, and rollovers. These have been due to driver error, speeding, reckless driving, fatigue and poor road conditions. Throughout the range, road conditions vary from good to poor and with high use during exercises the roads will deteriorate quickly. There are also many steep hills,

blind corners, pot holes, dips and washouts that drivers need to approach with caution. Anyone travelling by vehicle through the training area must abide to the speed limit on the range (45kph) and drive according to the prevailing conditions both road and weather.

Table 8. TFTA asbestos, mining and contaminated land, unexploded ordinance, and motor vehicle accidents risk assessment.

| Asbestos                                              |                   |              |             |
|-------------------------------------------------------|-------------------|--------------|-------------|
| Hazard                                                | Likelihood        | Impact       | Risk        |
| Asbestos                                              | Highly Improbable | Serious      | Low         |
| Mining and contaminated land                          |                   |              |             |
| Injuries due to previous mining and contaminated land | Highly Improbable | Serious      | Low         |
| Unexploded ordinance                                  |                   |              |             |
| Unexploded ordinance                                  | Highly Improbable | Serious      | Low         |
| Motor vehicle accidents                               |                   |              |             |
| Motor vehicle accidents                               | Occasional        | Catastrophic | Substantial |

### Water treatment plants

The TFTA has three points of distribution for potable water. The quality of the water varied over the three sites during the assessment.

Chlorine levels at all three water supply locations fluctuated greatly between 0 and 5 mg/L during the period September 2009 to February 2010 (Figure 2). Chlorine levels below 2 mg/L at the point of production are not suitable for consumption by personnel and drops in chlorine levels were reflected in high levels of microbiological activity (Figure 3). Water samples were however negative for *E. coli* at all three of the water points. Environmental health monitoring of water should be conducted prior to and during exercises to ensure chlorine levels are a minimum of 2 mg/L at the point of production. Chlorine dosing of bulk water from the distribution point must occur if chlorine levels do not reach the required standard.

Raw bore water tests conducted by DSG between 2001 and 2008 recorded high levels of lead and uranium in ground water. The tests conducted during this survey however, found these parameters at acceptable levels. Reverse osmosis water treatment plants are installed at most water points to protect against any

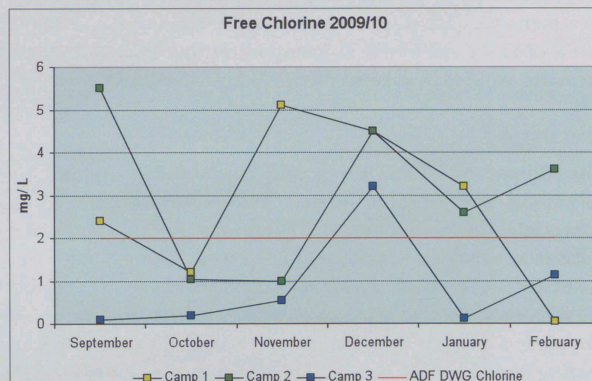


Figure 2. Free chlorine levels (mg/L) across TFTA during the period September 2009 – February 2010.

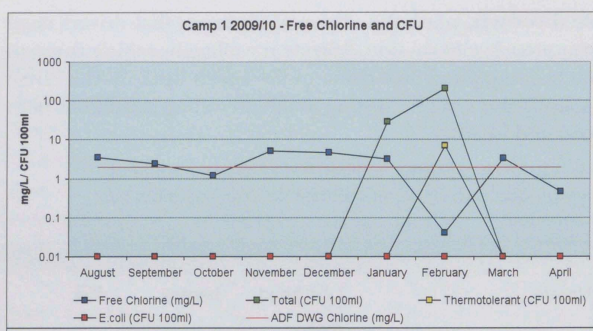


Figure 3. Camp 1, 2009/2010 – Free chlorine (mg/L) versus bacterial quantity (CFU/100 ml).

possible contamination. These plants successfully remove heavy metals, with treated water samples showing levels below the guidelines. It is recommended that routine monitoring is continued to ensure plants are working effectively. As some water points do not have reverse osmosis water treatment plants, regular monitoring needs to be conducted. If results indicate signs of contamination, use of this water should be discontinued until such time as results improve or a reverse osmosis water treatment plant is installed. At the time of this report, water at the three potable water points was not suitable for distribution due to low chlorine levels. Water at the potable water points was however suitable for direct consumption.

Many non-potable water sources are located around TFTA. These are primarily used for showers and latrines (SALs). These sources must not be consumed or used for activities like the brushing of teeth. Hand wash facilities are provided in the SAL. However, it is recommended that anti-bacterial hand washes are used before the preparation of food and drinks. All non-potable water sources tested positive for total bacteria and many were also positive for faecal coliforms. Non-potable water is not suitable for human consumption.

#### Waste treatment plants

The toilet facilities are provided by Defence Support Group (DSG). However, individual units are responsible for daily cleaning. The facilities do not have consumables such as soap, hand wash and paper towel. All units are responsible for the provision of these consumables. Anti-bacterial hand wash is recommended as all SAL water is non-potable. Waste water treatment types varied across the SAL. Treatment types included sediment ponds, adsorption trenches and biocycle treatment. Outputs were monitored by DSG and indicated high levels of faecal coliforms. It is important that these treatment areas are avoided to prevent the spread of infectious pathogens.

#### Discussion

The climate at TFTA is hot and humid which presents a substantial risk of heat related illness. Commanders must appreciate this risk and employ appropriate risk reduction measures which include acclimatisation. The climate also facilitates the proliferation of mosquitoes, ticks and mites which are vectors of many serious diseases. The survey team confirmed the presence of the RR, BF and MVE mosquito vectors. This finding enforces the need for strict compliance with vector control measures and the requirement for environmental health support for all personnel deploying into the TFTA.

Although this study did not cover occupational assessment the highest risk to defence personnel was from motor vehicle accidents. Motor vehicle accidents are a substantial risk to military personnel and must be treated as such. The road system within the TFTA is variable depending on the time of year and recent use. There have been numerous motor vehicle accidents on the range in recent years with several accidents occurring whilst the survey team was present in the training area. All drivers must exercise caution and comply with speed limits as roads are subject to flooding during the wet season (November to April) and rapid deterioration during major exercises.

The close environment of military training also provides opportunities for outbreaks of communicable diseases, particularly food and water borne diseases and those relating to personal hygiene. It is imperative that commanders enforce safe food and water practices and deploy with adequate hygiene supplies such as soap and handtowels.

The TFTA also harbours a variety of flora and fauna which can cause serious illness or even death to troops in the field. Military personnel, in particular medical staff, should be familiar with the main features of these hazardous flora and fauna and all personnel must be aware of the first aid principles required to treat personnel who come into contact with them.

There are a number of other safety hazards in the TFTA. These include UXOs, disused mining shafts, cattle dips, as well as fire and other severe weather events. Personnel need to be vigilant of their own safety and report any safety hazards to range control. It is imperative that commanders consult environmental health support in order to appropriately prepare for the possible risks associated with the TFTA and therefore ensure the maximum conservation of manpower by preventing disease and non-battle injuries.

#### References

- 1 Australian Army. Army technical instruction 01/2007: Military risk management. 14 January 2007. <http://intranet.defence.gov.au/DRMS/uR3816/R3392593.pdf> (accessed May 2010).
- 2 Queensland Health. Communicable Diseases Branch. Valid notifications Townsville LGA 2005-2010.
- 3 Queensland Health. Notifiable condition counts and rates 2003-2007. 10 Feb 2010. <http://www.health.qld.gov.au/ph/Documents/cdb/31764.pdf> (accessed May 2010).
- 4 Sweeney, A.W., R.D. Cooper and S.P. Frances. Distribution of the sibling species of *Anopheles farauti* in the Cape York Peninsula, northern Queensland, Australia. *J. Am. Mosq. Control Assoc.* 1990; 6: 425-429.
- 5 Heymann, D. L. Control of Communicable Diseases Manual. 19th ed. Washington, DC: American Public Health Association; 2008.

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