



**Queensland
Government**

**QUEENSLAND JOINT
STRATEGIC FRAMEWORK
for
MOSQUITO MANAGEMENT**

2010 – 2015

July 2010

Foreword

Queensland has experienced an increase in mosquito-borne disease rates over the last 10 years particularly Dengue, Ross River and Barmah Forest virus infections.

The greatest threat to public health is posed by the likely introduction of mosquito-borne diseases such as dengue, chikungunya and Japanese encephalitis brought into Queensland by viremic travellers from countries where these diseases are endemic. The incursions of exotic vectors pose similar threats where these vectors can readily adapt to the conditions.

The mosquito, *Aedes albopictus*, an exotic vector of dengue and chikungunya, has currently established on several islands in the Torres Strait. This vector can easily spread to mainland Australia.

Both Queensland Health and local government have a role in mosquito management including controlling mosquito breeding, promoting self protective behaviours by the public and monitoring rates of vector borne disease. We recognised that collaboration between these agencies is essential for the implementation of coordinated and streamlined mosquito management strategies in Queensland.

This role extends to recognising the impact of climate change and altering existing strategies and programs reduce the impact of mosquitoes on the public.

The Queensland Joint Strategic Framework for Mosquito Management 2010-2015 provides a strategic direction for the management of mosquitoes and mosquito-borne diseases in Queensland.

(Signed)

.....
Sophie Dwyer
Executive Director
Health Protection Directorate
Division of the Chief Health Officer
Queensland Health

(Signed)

.....
Mr Greg Hallam PSM
Chief Executive Officer
Local Government Association of
Queensland



**Queensland
Government**



Acknowledgements

This plan was developed by Queensland Health in collaboration and consultation with experts from the following organisations:

- Australian Department of Agriculture, Fisheries and Forestry
 - Australian Quarantine and Inspection Service
- Department of Employment, Economic Development and Innovation
 - Queensland Primary Industries and Fisheries
- Department of Infrastructure and Planning
 - Local Government
- Department of Environment and Resource Management
 - Environment and Resource Management
- Local Government Association of Queensland
- Brisbane City Council
- Fraser Coast Regional Council
- Gold Coast City Council
- Logan City Council
- Mackay Regional Council
- Moreton Bay Regional Council
- Redland City Council
- Rockhampton Regional Council
- Sunshine Coast Regional Council
- Townsville City Council
- Mosquito Control Association of Australia
- Queensland Institute of Medical Research
- Griffith University
- International vector consultants

Disclaimer

This strategic framework is intended for information purposes only. The information contained within this document is based upon best available evidence at the time of completion. Queensland Health does not accept liability to any person for the information or advice provided in this document, or incorporated into it by reference or for loss or damages incurred as a result of reliance upon the material herein.

Communicable Disease Prevention and Control Unit
Communicable Diseases Branch
Division of the Chief Health Officer
QUEENSLAND HEALTH
PO Box 2368
Fortitude Valley BC 4006
phone (07) 3328 9724
fax (07) 3328 9782
email CDU@health.qld.gov.au
website www.health.qld.gov.au/ph/cdb

Executive summary

The Queensland Joint Strategic Framework for Mosquito Management 2010-2015 defines the priorities for mosquito surveillance, management and control for Queensland.

Priorities for Queensland under this strategic framework include:

1. dengue and the distribution and density of the vector throughout Queensland,
2. exotic mosquito-borne diseases of importance to Queenslanders eg. Chikungunya (CHIKV), malaria and Japanese encephalitis,
3. mosquito-borne diseases of high prevalence in Queensland eg. Ross River virus (RRV) and Barmah Forest virus (BFV),
4. incursions of exotic mosquitoes eg *Aedes albopictus*,
5. climate change and its effect on vectors of mosquito-borne disease mosquito management programs, and

All stakeholders involved in mosquito management acknowledge that mosquito management in Queensland is a complex issue and are committed to a strategic approach to addressing the public health risks associated with mosquitoes and mosquito-borne diseases through the implementation of this strategic framework.

The Queensland Joint Strategic Framework for Mosquito Management balances the regulatory approach to mosquito prevention and destruction with a broader risk-management approach that incorporates a range of strategies to address mosquito-borne disease risks.

For much of the twentieth century the threat of exotic mosquito-borne diseases (dengue, Japanese encephalitis, and malaria) has been restricted to regional areas of north Queensland. Globally the situation is very different; there has been a re-emergence of dengue and other mosquito-borne diseases in novel settings. For example, the introduction of West Nile virus into America and the recent report on a strain of CHIKV linked to fatalities in the Reunion Islands, serve as a warning to Queensland Health and local government authorities to be prepared for rapid changes to the *status quo*.

In Queensland, the prevention and control of dengue has become a major public health concern. North Queensland is experiencing regular outbreaks of dengue and the dengue vector, *Aedes aegypti*, is dispersing across Queensland and has been detected in central and southwest Queensland cities and towns.

There is an urgent need to address the changing distribution of *Ae. aegypti* across Queensland, in particular, to prevent outbreaks in southeast Queensland.

Ae. albopictus, an exotic vector of dengue viruses and CHIKV, has become established in the Torres Strait Islands and was recently found on the northern most tip of Cape York. The risk of dengue transmission in Queensland and other jurisdictions would be substantially increased if this vector became established on the mainland.

The Queensland Joint Strategic Framework for Mosquito Management has been developed in response to the need to provide an integrated approach to mosquitoes and mosquito-borne disease in Queensland. Over the past 10 years, Queensland Health has noted an increase in notifiable arboviruses, outbreaks of dengue in north Queensland and

an increase in Ross River virus infection and Barmah Forest virus infection throughout the state.

The most effective way to manage mosquitoes and their impact is through the use of integrated mosquito surveillance, prevention and control programs. These programs require significant human and financial resources and the success of these programs is greatly dependant on the formation and maintenance of collaborative partnerships.

This strategic framework focuses on four key objectives in mosquito management and the overarching strategies to achieve these objectives.

The four key objectives identified as essential components to effective mosquito management in Queensland are:

1. Surveillance, prevention and control
2. Communication and marketing
3. Education and training
4. Research

The strategic framework assists mosquito management personnel to develop local mosquito surveillance, prevention and control programs, strengthen and maintain collaborative partnerships and ultimately benefits the Queensland population by reducing morbidity and mortality rates associated with mosquito-borne diseases.

Contents

FOREWORD	2
ACKNOWLEDGEMENTS	3
EXECUTIVE SUMMARY	4
1.0 INTRODUCTION	7
2.0 PURPOSE	10
3.0 SCOPE	11
4.0 ROLE OF STAKEHOLDERS IN MOSQUITO MANAGEMENT IN QUEENSLAND	12
4.1 LOCAL GOVERNMENT	12
4.2 QUEENSLAND HEALTH	12
4.3 DEPARTMENT OF ENVIRONMENT AND RESOURCE MANAGEMENT	13
4.4 DEPARTMENT OF EMPLOYMENT, ECONOMIC DEVELOPMENT AND INNOVATION	13
4.5 THE AUSTRALIAN GOVERNMENT	14
5.0 STRATEGIC FRAMEWORK	16
5.1 SURVEILLANCE, PREVENTION AND CONTROL	16
5.2 COMMUNICATION AND MARKETING	18
5.3 EDUCATION AND TRAINING	19
5.4 RESEARCH	21
GLOSSARY	23
INFORMATION RESOURCES	24
INTERNET RESOURCE LINKS	26

1.0 Introduction

Mosquito-borne diseases such as malaria, dengue, Japanese encephalitis (JE), West Nile virus (WNV) infection and CHIKV are causing major public health problems in many countries.

Increased international travel makes it easier for the introduction of these diseases into locations from which they have either been eradicated or in which they have never occurred. Australia and Queensland in particular, provide a suitable environment for incursions of these exotic diseases.

Japanese encephalitis (JE) is a serious infection of the brain. Some people infected with the JE virus have no symptoms, while others may have very severe symptoms such as headache, high fever, convulsions and coma, which can result in death or permanent disabilities. The Asia Pacific region reports 30,000 - 50,000 cases annually.

West Nile virus is common in parts of Africa, Asia and Europe. It emerged for the first time in America in New York City in 1999 and since then has spread to other American states, Canada and to Central and South America. Research indicates that *Culex annulirostris* and *Cx. quinquefasciatus* are competent vectors of WNV. These mosquitoes are common throughout Queensland and pose a risk should WNV be introduced to Queensland.

CHIKV is relatively common in southern and southeast Asia and Africa. There is the potential for local transmission in Queensland due to the presence of the vector *Ae. aegypti* in northern and central Queensland and the exotic *Ae. albopictus* which was first detected in the Torres Strait in 2005.

While the Australian mainland was declared “malaria free” by the World Health Organization (WHO) in 1981, malaria and dengue continue to be major causes of human morbidity and mortality throughout the world. It is estimated one million people die from malaria annually. Malaria prone areas within Australia are confined to northern Australia where the most important malaria vector, *Anopheles farauti sensu lato* (s.l.) complex exists. Locally acquired cases can occur, linked to infected overseas travellers, but are rare.

Dengue is endemic in many neighbouring countries with an estimated 2.5 billion people globally at risk and 22,000 people, mainly children, dying annually as a result of complications from dengue infection. While dengue is not endemic in Queensland, dengue outbreaks have been occurring with increasing frequency and intensity over the last 10 years as a result of increased numbers of viraemic international travellers. The main vector of dengue, *Ae. aegypti* is widespread throughout urban tropical north Queensland and has been detected in many towns in sub-tropical Queensland as far south as Goomeri near the coast and Charleville inland.

Other mosquito-borne diseases such as RRV infection, BFV infection, Kunjin virus infection and Murray Valley encephalitis (MVE) are also endemic in Australia. See Table 1.

Table 1. Annual notifications of selected mosquito-borne diseases in Queensland 2000 - 2009 (Queensland Health)

Mosquito Transmitted Disease	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Barmah Forest virus infection	345	601	387	869	583	680	955	826	1245	797
Dengue	85	42	81	725	275	117	78	120	233	1033
Japanese encephalitis	0	0	0	1	1	0	0	0	0	0
Kunjin virus disease	0	0	0	6	5	1	1	0	1	1
Murray Valley encephalitis	0	1	0	0	0	1	0	0	0	1
Ross River virus infection	1481	1568	885	2514	2005	1179	2611	2137	2846	2149
Yearly Total	1911	2212	1353	4115	2869	2253	3645	3083	4325	3981

RRV and BFV infection are the most common mosquito-borne diseases in Queensland, with an average of 2000 RRV cases and hundreds of BFV cases reported annually. RRV and BFV infections are not life threatening, although symptoms such as polyarthrititis and lethargy can be debilitating and last for prolonged periods of time. There is no specific treatment for, or vaccines to prevent RRV infection, BFV infection and dengue, despite continued research in this area.

The most effective measure to reduce the risk of mosquito-borne transmission is to prevent or reduce mosquito breeding.

Mosquito control in Queensland is the legislative responsibility of local government. Mosquito control programs differ according to mosquito type and habitat. *Ae. aegypti* and *Ae. albopictus* breed in artificial containers such as pot plant bases, rainwater tanks and tyres, as well as in natural habitats such as tree holes, plant axils and bromeliads. *Aedes vigilax* and *Cx. annulirostris*, vectors of RRV and BFV, breed in saltmarsh and freshwater areas respectively. Most regular surveillance and control activities are undertaken by local government in Queensland and focus on saltwater, brackish water and freshwater mosquito breeding sites. These programs aim to reduce the public health risks of mosquito-borne diseases and respond to nuisance complaints from the public.

Surveillance of container breeding mosquitoes, such as *Ae. aegypti*, is inconsistent across the state. The highest level of surveillance activity occurs in north Queensland where there have been cases of locally acquired dengue.

The detection of *Ae. albopictus* on many islands of the Torres Strait in 2005 resulted in a three-year project (jointly funded by Queensland Health and Australian Department of Health and Ageing) to curtail its expansion throughout the Torres Strait and prevent colonisation on the Australian mainland. Despite such efforts, the mosquito species is now established throughout the majority of Torres Strait outer islands. Without timely detection on the mainland, *Ae. albopictus* is expected to quickly colonise and establish itself through much of coastal Australia, thereby enhancing the potential risk of exotic disease outbreaks (eg. dengue and CHIKV).

The spread of *Ae. Aegypti*, further within Queensland, and colonisation of *Ae. Albopictus* may be increased by water hoarding and the water storage practices that started to emerge in the community during periods of low rainfall. Poorly maintained rainwater tanks can breed mosquitoes. Without ongoing and adequate enforcement of the legislation (which requires that rainwater tanks must be mosquito proof), rainwater tanks have the potential to expedite the spread of both these mosquito species.

The Australian Quarantine and Inspection Service (AQIS), a service of the Australian Department of Agriculture, Fisheries and Forestry undertake ongoing trapping and surveillance activities to detect incursions of exotic mosquitoes at international first air and sea ports. AQIS performs these activities on behalf of the Australian Department of Health and Ageing (DoHA). AQIS also works in collaboration with Queensland Health and local government to assist in the control and eradication of exotic mosquitoes from these ports where necessary.

Changing climatic conditions may have an impact on the breeding areas of other mosquitoes such as *Ae. Vigilax*, where soil conditions have undergone significant change and salt pans emerged.

Due to the level of existing endemic mosquito-borne diseases and recent history of outbreaks of exotic diseases such as malaria, dengue and Japanese encephalitis, it is important to have effective and sustainable mosquito management programs in place.

2.0 Purpose

This strategic framework is designed to provide clear direction for mosquito management in Queensland and guides collaboration between the state and local government in Queensland in the priority areas of mosquito surveillance, management and control activities.

This strategic framework seeks to achieve the following outcomes:

- Reduction in the risk of transmission of mosquito-borne disease in Queensland.
- Early detection of disease threats through improved arbovirus and mosquito surveillance and reporting mechanisms.
- Increased systematic surveys for the detection of vectors of mosquito-borne disease.
- Enhanced cooperation, communication and information sharing between Queensland Health, local government and other key stakeholders in managing mosquito breeding areas, mosquito-borne disease and mosquito nuisance.
- Rapid, coordinated and effective response to incursions of exotic mosquitoes capable of causing outbreaks of vector-borne diseases.
- Increased public awareness and community participation in the prevention and control of mosquito-borne disease.
- Establish mechanisms and processes to enhance collaborative and/or complementary action in the delivery of mosquito management services.
- Increase the focus on climate change and its effect on mosquito management programs in Queensland.

Due to increased outbreaks of dengue in Northern Queensland and the real risk of dengue outbreaks in Central Queensland, the control of dengue vectors is the first priority under this strategic framework.

3.0 Scope

The scope of this strategic framework includes:

- Surveillance, prevention and control of mosquitoes and mosquito-borne disease threats that have significant health impacts
- Internal, external and public communication strategies required to support this
- Staff education, training and support required to implement surveillance, prevention and control initiatives, and
- The collection of intelligence required to inform surveillance, prevention and control initiatives.

The strategic framework strengthens the working relationship between local government in Queensland and Queensland Health in their approach to mosquito management issues, by providing a guide to and process for:

- harmonising working arrangements to minimise duplication and gaps
- formulating policies and procedures for service development and implementation
- planning, delivering and evaluating collaborative/complementary services/programs
- developing the Mosquito Management Implementation Plan to address delivery of the key objectives and overarching strategies of the Plan.

This strategic framework does not include advice on the clinical management of people with mosquito-borne diseases nor does it address the risks associated with any other arthropods.

4.0 Role of stakeholders in mosquito management in Queensland

Queensland Government Departments, including Queensland Health, have important roles and responsibilities to play in the management and control of mosquitoes from a health, environmental, land management and legislative perspective.

4.1 Local government

Local governments in Queensland administer and enforce the *Public Health Act 2005* and *Public Health Regulation 2005*, which deals with public health risks from designated pests such as mosquitoes. The legislated role of local government in relation to mosquito management is to manage and control mosquitoes within their local government areas.

The following are examples of some of the tasks in which local government are involved:

- Monitoring of mosquito species and adult mosquito population;
- Investigation of complaints;
- Reducing places where mosquitoes can breed;
- Ensuring proper safeguards are in place to reduce risk of mosquitoes breeding in water tanks;
- Application of larvicides and pesticides through proactive and reactive mechanisms;
- Public education and warning campaigns.

4.2 Queensland Health

Queensland Health seeks to protect the health of Queenslanders, and is responsible for the coordination and support of initiatives to reduce the risk of transmission of mosquito-borne diseases to human and managing the response to outbreaks of mosquito borne disease.

Queensland Health achieves this through:

- Identification of, and mechanisms to prevent or minimise adverse health impacts from notifiable conditions such as RRV and BFV under the *Public Health Act 2005*;
- Working with or supporting local government to prevent or control outbreaks of mosquito-borne diseases such as dengue, Japanese encephalitis and malaria;
- Preventive dengue control programs in high-risk areas;
- Health promotion activities focusing on the prevention of mosquito bites and reduction of household mosquito breeding;
- Facilitation of education and training for health workers covering mosquito management, prevention, surveillance and control;
- Taxonomic reference service to identify mosquitoes;
- Leading and supporting eradication campaigns, in collaboration with AQIS and local government, against the exotic mosquito, *Ae. albopictus*, in north Queensland;
- Contributing to research on mosquito biology and control;
- Surveillance of mosquito-borne diseases;
- Providing an expert advisory resource on mosquito control issues for local governments and other agencies;

- Collaboration with government, research institutions and industry towards the development of new mosquito control products and methods through research and development programs, revision of products and contributing research funds;
- Distribution of annual applied research funds for the control of mosquito-borne diseases in humans and mosquito management programs;
- Provision of advice, interpretation of, guidance notes and operational procedures on legislation relevant to mosquito control ie. *Public Health Act 2005, Public Health Regulation 2005, Pest Management Act 2001 and Pest Management Regulation 2003*); and
- Assistance to local government to develop and implement integrated mosquito management programs.

Other state government departments administer legislation that has an impact on mosquito management and control in Queensland, including the Department of Environment and Resource Management and the Department of Employment, Economic Development and Innovation.

4.3 Department of Environment and Resource Management

The Department of Environment and Resource Management (DERM) is responsible for ensuring that state land is managed for the benefit of the people of Queensland by having regard to the principles of:

- Sustainability: sustainable resource use and development to ensure existing needs are met and the State's resources are conserved for the benefit of future generations
- Development: allocating land for development in the context of the state's planning framework and applying contemporary best practice in design and land management
- Community purpose: if land is needed for community purposes, the retention of the land for the community in a way that protects and facilitates the community purpose
- Protection: protection of environmentally and culturally valuable and sensitive areas and features.

DERM may be involved in approval of works required for habitat modification for saltmarsh mosquito control in accordance with relevant provisions of the *Sustainable Planning Act 2009*.

DERM has designed a wetland management profile¹ to provide information about the distribution, ecology, cultural values, conservation status, threats and management on saltmarsh wetlands and its relationship with saltmarsh mosquitoes within Queensland.

4.4 Department of Employment, Economic Development and Innovation

Fisheries Queensland, a service of the Department of Employment, Economic Development and Innovation (DEEDI) has statutory interests in fish habitat protection and

¹ The saltmarsh wetlands management profile is available from the Department of Environment and Resource Management's website www.derm.qld.gov.au/register/p01719aa.pdf .

management of the impacts from habitat modification (eg. saltmarsh runnels) and chemical application programs for saltmarsh mosquito control in declared Fish Habitat Areas.

Legislative provisions for fish habitat protection and management are in accordance with the requirements under the *Fisheries Act 1994* (and Regulation 2008) and *Sustainable Planning Act 2009* (and Regulation 2009). Stocking of native fish for mosquito control, and control of exotic and noxious fish are also managed under the *Fisheries Act 1994*.

A Fish Habitat Area Code of Practice² has been developed to include the compliance requirements for chemical and biological insect control in declared Fish Habitat Areas (*Fisheries Act 1994* and *Fisheries Regulation 2008*). Fisheries Queensland has prepared Integrated Development Assessment System (IDAS) self-assessable development codes which apply to new runnels (Code Number MP06) and runnel maintenance (Code Number MP02).

Fisheries Queensland administers fish stocking restrictions in Queensland waters (stocked fish species must be native to drainage basin locations) under the *Fisheries Act 1994*, *Fisheries Regulation 2008*, and the *Fisheries (Freshwater) Management Plan 1999*. Fish stocking approvals are required for dams, streams and other waterways that are publicly owned.

Biosecurity Queensland, another service of DEEDI, administers legislation on application and use of agricultural and veterinary chemicals including those used for mosquito control under the *Queensland Agricultural Chemicals Distributions Control Act 1966* (and *Regulation 1998*), *Agriculture and Veterinary Chemicals (Queensland) Act 1994* and the *Queensland Chemical Usage (Agricultural and Veterinary) Control Act 1988* (and *Regulation 1999*).

Infestations of certain aquatic plants can provide havens for mosquito breeding. Aquatic plants such as *Salvinia molesta* and *Hymenachne amplexicaulis*, are declared pest plants under the *Land Protection (Pest and Stock Route Management) Act 2002* and *Land Protection (Pest and Stock Route Management) Regulation 2003*.

4.5 The Australian Government

The Australian government's role in mosquito management is primarily focused within a 400 metre radius of entry points to international aircraft and vessels. Management activities performed by AQIS include:

- Vector monitoring (mosquito trapping and surveillance) at international first ports on behalf of the DoHA as part of Australia's commitment to World Health Organization's *International Health Regulations 2005*
- Notification of reportable mosquito species and breeding sites detected in the international first port zone to DoHA and other stakeholders (control activities for mosquitoes and breeding sites identified are not physically performed by AQIS)
- Ensuring all aircraft cabins and holds disinsection is complete for all arriving international aircraft

² The Fish Habitat Area Code of Practice is available from Queensland Primary Industries and Fisheries' website www.dpi.qld.gov.au/documents/Fisheries_Habitats/FHACoP01-Code-of-Prac.pdf.

- Complete vector deck inspections of all international vessels arriving from high risk seaports
- Ensuring import conditions are met for imported cargo posing a vector risk (e.g. tyres) including mitigation activities such as mandatory treatments and inspections.

The DoHA also administers the National Arbovirus and Malaria Advisory Committee (NAMAC) that provides advice (via a website and disease response plans), advocates policy and negotiates funding for elimination campaigns for exotic mosquitoes.

5.0 Strategic Framework

Objectives

To adequately manage mosquitoes and prevent mosquito-borne diseases in Queensland, the strategic framework uses the four objectives, below:

1. Surveillance, prevention and control To minimise the risk of mosquito-borne diseases and pest mosquito impact on the community.
2. Communication and marketing To provide accurate, accessible and timely information on mosquito issues relevant to the health and well-being of the Queensland population.
3. Education and training To have an appropriately skilled and knowledgeable workforce able to respond effectively to public health risks posed by mosquitoes in Queensland.
4. Research To provide scientific based evidence to support mosquito management strategies in Queensland.

Performance indicators:

Performance indicators that will be used to evaluate the effectiveness of these strategies are under development.

5.1 Surveillance, prevention and control

Surveillance, prevention and control programs are essential for detecting and identifying mosquito problems in an area, evaluating corresponding mosquito-borne disease risk and developing management plans to minimise the associated public health risk to communities.

The first step before establishing any short or long-term control program is to conduct mosquito surveillance.

Information from larval and adult mosquito surveillance will assist public health professionals to determine:

- if an incursion of exotic mosquitoes has occurred
- the major vector or pest species in the area
- the density of vectors and pest mosquitoes throughout the year

- the type of major breeding sites of vector and pest mosquitoes
- the risk of mosquito-borne disease and the pest impact to communities
- control priorities
- control methods
- the effectiveness of implemented prevention and control measures
- resources required to manage the problem.

Mosquito control measures are applied to reduce the numbers of mosquito vectors or pests to a level where humans are at minimal risk from mosquito-borne disease or the impact of pest mosquitoes.

A mosquito control program relies on integrated biological, physical, chemical and behavioural control measures. Programs are aimed at preventing new mosquito breeding sites, eliminating established breeding sites and reducing the contact between mosquitoes and humans. A well balanced program will ensure maximum long-term control at lowest overall cost.

The impact of mosquitoes on the Queensland population varies considerably across local government areas so the implementation of a mosquito management program may range from isolated treatments to a fully integrated control program.

Mosquito population numbers may change from year to year and may be affected by climate change. Therefore, it is important to develop response plans to deal with mosquito problems that exist and are likely to arise in Queensland.

Objective

To minimise the risk of mosquito-borne diseases and pest mosquito impact on the community.

Strategies

1.1	Develop and implement sustainable, prioritised and risk-based surveillance, prevention and control programs that are vector and/or pest mosquito specific and are based on best practice.
1.2	Establish and maintain a central database on resources held by local government and Queensland Health that could be made available to support ongoing responses in Queensland.
1.3	Address the risk of and from incursions of exotic vectors and/or pathogens and the re-introduction of vectors capable of causing a notifiable condition.
1.4	Provide expert advice on mosquito exposure risks and management options to local government, relevant state government departments, developers and town planners to inform planning decisions for new development proposals.

1.5 Encourage and support information exchange and collaboration where appropriate on mosquito surveillance, prevention and control activities being undertaken by Queensland Health and local government, laboratories and research institutions.

1.6 Facilitate compliance with and the consistent implementation of the *Public Health Act 2005*, the *Pest Management Act 2001* and associated regulations, which govern mosquito management and control activities in Queensland.

Evidence of Progress

- Mosquito surveillance, prevention and control guidelines are developed.
- Outbreak response plans for dengue and MVE in Queensland are developed.
- Response plans for the incursion of exotic mosquitoes and for flooding are developed.
- A business case for the introduction of an *Ae. aegypti* surveillance program in Brisbane is developed.
- Existing Mosquito Management Code of Practice for Queensland and the Guidelines to Prevent Mosquito and Biting Midges Problems in New Development Areas are reviewed and updated.
- A network of key personnel for the collaborative implementation of surveillance, prevention and control of mosquitoes is established.
- Local government and Queensland Health resources on mosquito management, including the distribution map for *Ae. aegypti* and *Ae. albopictus* in Queensland are collated and available on the Queensland Health website.

5.2 Communication and marketing

The success of mosquito management programs requires the creation, maintenance, coordination and dissemination of information to major stakeholders, including the general public.

There is a wealth of knowledge in surveillance, prevention and control in Queensland, although currently there is no formal mechanism for sharing this knowledge state-wide.

Existing communication amongst mosquito control personnel on various aspects of mosquitoes and mosquito-borne diseases occurs through:

- Local government Mosquito Control Committee meetings,
- Provision of reports from Queensland Health's Notifiable Condition System (NOCS),
- Joint (local government and Queensland Health) investigations and surveillance,
- Queensland Health websites, the Dengue website, Vector-borne Diseases Early Detection and Surveillance (VEDS) system,
- Meetings of the Mosquito and Arbovirus Research Committee (MARC) and through the MARC website,
- Informal communication between mosquito personnel via phone and email.

There are a number of contact points and communication systems that need to be defined and formalised to support the exchange of information and ideas, particularly on major issues such as mosquito-borne disease outbreaks and exotic mosquito incursions.

Health promotion materials on mosquitoes and mosquito-borne diseases provide information to enhance community knowledge on preventative measures that can minimise exposure to mosquitoes and reduce residential mosquito breeding sites.

Health education on the prevention of mosquito breeding and mosquito-borne diseases currently reaches the public through radio, TV, the print media, information with rate notices, printed materials, presentations at schools and public displays.

Health education materials are currently prepared by Queensland Health and various local governments. Establishing a single authoritative source will facilitate the timely development and review of accurate and informative resources for the general public.

Objective

To provide accurate, accessible and timely information on mosquito issues relevant to the health and well-being of the Queensland population.

Strategies

2.1	Promote a collaborative approach between local government, Queensland Health and other agencies to ensure public messages about mosquitoes are accurate, consistent and targeted to the relevant audiences.
2.2	Establish a shared system or systems to allow partners access to up-to-date information on disease notification, mosquito vectors, vector-borne diseases and other shared common resources.
2.3	Distribute timely information on disease outbreaks and emergence of exotic diseases and exotic mosquito incursions.

Evidence of Progress

- Consistent and up-to-date information on mosquitoes and incidence of mosquito borne diseases is available and maintained by Queensland Health on a web-based central repository.
- Timely distribution of information relevant to stakeholders' needs is available during mosquito-borne disease outbreaks and incursions of exotic mosquitoes.

5.3 Education and training

Local governments across Queensland differ in their capacity to provide mosquito control services and to respond to emergent public health risks. Local governments located near the coastline and in south-east Queensland, in general, have a different focus on mosquito management and control to those in northern Queensland and inland areas.

Effective mosquito control operations must be undertaken by skilled and competent staff to ensure consistency of practice and that quality standards are met. Emphasis needs to be placed on the training, supervision and skill development of staff involved in mosquito management operations.

An increase in the efficiency of mosquito control activities and the selection of appropriate mosquito control methodologies is achieved by developing the knowledge, skills, understanding, attitudes, character or behaviours of the staff involved.

Mosquito control workers require mentoring and access to training and/or instruction in a range of mosquito related topics relevant to their area of work. These may include:

- basic mosquito biology
- calibration of equipment
- safe practice in pesticide handling/application
- mosquito surveillance
- mosquito identification
- collecting and recording of mosquito samples
- integrated mosquito management
- chemical control
- waste handling and spill management
- biological control
- habitat modification
- legislative requirements
- data reporting requirements
- mosquito planning development, implementation and evaluation
- outbreak management.

Trained and proficient staff are essential to ensuring that the outcomes and goals of mosquito management program outcomes are met and that the risk of causing environmental harm is minimised. Mosquito management education and training is currently provided by Mosquito Control Association of Australia (MCAA) in south and north Queensland. This education and training draws on the expertise from personnel of Queensland Health and local government and private sector mosquito management professionals.

Queensland Health – Communicable Disease Branch provides some limited education and training on mosquito identification, surveillance and control methodologies for local government and Queensland Health personnel across Queensland.

Under the *Pest Management Act 2001*, competency based training is mandatory to obtain a Pest Management Technician's licence. This is currently offered through registered training organisations eg.TAFE.

Objective

To have an appropriately skilled and knowledgeable workforce able to respond effectively to the public health risks posed by mosquitoes in Queensland.

Strategies

3.1	Identify and define mosquito management workforce education and training requirements.
3.2	Determine affordable and accessible education and training options for all levels of the mosquito management workforce.
3.3	Identify and facilitate partnerships with registered training organisations as required, to provide sustainable training options.
3.4	Implement best practice staff education and training, as required, to meet workforce capacity.

Evidence of Progress

- Education and training options are available that meet skill development and legislative requirements for all areas of mosquito management,
- Partnerships are established with registered training organisations for the delivery of training in mosquito management..
- All staff working in mosquito management related positions have access to appropriate and sustainable education and training in areas.
- Proportion of staff with competencies or qualifications to undertake prescribed roles and responsibilities.

5.4 Research

Research provides a sound understanding of the biology of mosquitoes and arboviruses, the ecology of mosquito breeding habitats and the nature of the control agents. The success of mosquito management programs is greatly dependent on new and innovative research.

In Queensland, research on mosquito vectors and mosquito-borne diseases has been conducted by several research institutions. This research is funded by the Australian, State and local governments, the National Health and Medical Research Council (NHMRC) and the Australian Biosecurity Cooperative Research Centre (AB-CRC).

Queensland Health, in partnership with some local governments, provides funds to the MARC to employ a research scientist and to undertake research projects relevant to mosquito control management program in Queensland.

The results of this research are published in the MARC Annual Report as well as in scientific journals, allowing access by mosquito control personnel. The results provide scientific data on mosquito biology and the competency of different species of mosquitoes to transmit arboviruses such as dengue virus, RRV, BFV and MVEV. This information also assists in the assessment and selection of the most cost effective control methods.

One highly valuable outcome of MARC research has been the Vector Early Detection and Surveillance System (VEDS) which has provided a simple tool for predicting RRV and BFV outbreaks.

Due to factors such as climate change, the development of new control agents and control methods and the possible incursions of exotic mosquito-borne diseases and mosquito

vectors, ongoing research in this area is essential. Research provides valid scientifically based evidence to inform and guide mosquito management programs.

Objective

To provide scientifically based evidence and systems to support mosquito management strategies in Queensland.

Strategies

4.1	Support research on vectors, reservoir hosts and diseases of current and future significance through collaborative association with research institutions.
4.2	Establish a networked system to disseminate research results.
4.3	Maintain MARC research program.

Evidence of Progress

- Research needs identified, supported and outcomes monitored.
- Mechanism for dissemination of research outcomes to major stakeholders established.
- Research program productivity maintained.

Glossary

AQIS	Australian Quarantine and Inspection Service
Arbovirus	Virus transmitted by arthropods
Arthropod	Invertebrate animals which have jointed limbs, a segmented body and an exoskeleton made of chitin. Examples include insects, spiders, ticks and centipedes
BFV	Barmah Forest virus
CHIKV	Chikungunya virus
Dengue	Mosquito-borne infection with one of four serotypes of dengue virus
DHF	Dengue haemorrhagic fever
DERM	Department of Environment and Resource Management
DSS	Dengue shock syndrome
EHO	Environmental Health Officer
EHW	Environmental Health Worker
Endemic	The constant presence of a disease or infectious agent within a given geographic area or population
Epidemic	The occurrence in a community or region of cases of an illness or other health-related event clearly in excess of what is expected
Exotic	Mosquitoes or diseases which have never been found within a geographic area or population
JE	Japanese encephalitis
KUNV	Kunjin virus
LGAQ	Local Government Association of Queensland
Malaria	A vector-borne infectious disease caused by protozoan parasites
MARC	Mosquito Arbovirus Research Committee
Morbidity	Disease rate
Mortality	Death rate
MVE	Murray Valley encephalitis
NOCS	Notifiable Conditions System, Queensland Health
QPI&F	Queensland Primary Industries and Fisheries
VEDS	Vector Early Detection and Surveillance system
RRV	Ross River virus
Vector	Arthropod which transports an infectious agent from an infected individual (or its wastes) to a susceptible individual (or its food or immediate surroundings)
Viraemia	The presence of virus in the blood
WHO	World Health Organization
WNV	West Nile virus

Information resources

1. Deaths associated with dengue haemorrhagic fever: the first in Australia in Over a century. *Med. J. Aus* 2005, 183: 35-37.
2. Dengue fever importations: Cairns, Aug 07 – July 08. Queensland Health – Tropical Population Health Unit.
3. Department of Environment and Resource Management (2005), Wetland Management Profile - Saltmarsh wetlands. Retrieved 28 June 2010, from www.derm.qld.gov.au/register/p01719aa.pdf.
4. Hanna J, Ritchie S, Phillips DA, Shield J, Bailey MC, Mackenzie JS, et al. An outbreak of Japanese encephalitis in the Torres Strait, Australia, 1995. *Med. J. Aus* 1996: 256-60.
5. Hanna JN, Ritchie SA, Eisan DP, Cooper RD, Brookes DL, Montgomery BL. An outbreak of *Plasmodium vivax* malaria in far north Queensland, 2002. *Med. J. Aust.* 2004; 180 (1):24-8.
6. Japanese Encephalitis Fact Sheet, Division of Vector-Borne Infectious Diseases, National Centre for Disease Control and Prevention.
7. Japanese encephalitis on the Australian mainland. *Communicable Dis. Intell* 1998; 22:60.
8. Malaria Fact Sheet, World Health Organization (2010) Retrieved 28 June 2010, from www.who.int/mediacentre/factsheets/fs094/en/index.html.
9. Outbreaks in North Queensland 1990 – 2008 (updated 3 August 2008). Queensland Health – Tropical Population Health Unit.
10. Queensland Primary Industries and Fisheries (2005). Fish Habitat Area code of practice - The lawful use of physical, pesticide and biological controls in a declared Fish Habitat Area Retrieved 28 June 2010, from www.dpi.qld.gov.au/documents/Fisheries_Habitats/FHACoP01-Code-of-Prac.pdf.
11. Ritchie S, Montgomery B, Walsh I. Production of Mosquitoes in Rainwater Tanks and Wells on Yorke Island, Torres Strait: Preliminary Study: Environmental Health Vol. 2 No. 2 2002: 13-18.
12. Ritchie S, Moore P, Carruthers M, Williams C, Montgomery B, Foley P, Ahboo s, Van Den Hurk AF, Lindsay MD, Cooper B, Beebe N, Russel RC. Discovery of a widespread infestation of *Aedes albopictus* in the Torres Strait, Australia. *Journal of the American Mosquito Control Association*, 22(3):358-365, 2006.
13. Russel RC, Williams CR, Sutherst RW, Ritchie SA. *Aedes (Stegomyia) albopictus* – a dengue threat for southern Australia. *CDI* Vol 29 No. 3 2005: 296-298.
14. Summary of DART intervention for confirmed importations of dengue into Cairns Nov 06 – July 07. Queensland Health – Tropical Population Health Unit.

15. World Health Organization (WHO) Report on Global Surveillance of Epidemic – prone Infectious Diseases – Dengue and dengue haemorrhagic fever; Dengue haemorrhagic fever: diagnosis, treatment, prevention and control. 2nd edition, Geneva, World Health Organisation, 1997.

Internet resource links

Australian Bureau of Meteorology
www.bom.gov.au

Australian Department of Agriculture, Fisheries and Forestry
Australian Quarantine and Inspection Service
www.daff.gov.au/aqis

Australian Department of Health and Ageing
www.health.gov.au

Department of Infrastructure and Planning
Local Government
www.dip.qld.gov.au/local-government-/index.php

Department of Environment and Resource Management
Environment and Resource Management
www.derm.qld.gov.au

Department of Employment, Economic Development and Innovation
Queensland Primary Industries and Fisheries
www.dpi.qld.gov.au

Department of Education and Training
www.det.qld.gov.au

Griffith University
www.griffith.edu.au

Local Government Association of Queensland
www.lgaq.asn.au

Mosquito Arbovirus Research Committee
www.marc.qimr.edu.au

Mosquito Control Association of Australia
www.mcaa.org.au

Queensland Health
www.health.qld.gov.au

Queensland Institute of Medical Research
www.qimr.edu.au

United States of America Armed Forces Pest Management Board
www.afpmb.org

World Health Organisation
www.who.int/en