
**Independent review of Hendra virus cases at Redlands and
Proserpine in July and August 2008**

Report prepared for

**Director-General
DPI&F**

by

AusVet
(Nigel Perkins)

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1 Summary of Hendra cases

1.1 Human cases

Two people were confirmed to have been infected with Hendra virus during the response: a veterinarian and a veterinary nurse. Both individuals were working at the Redlands Veterinary Clinic (RVC) and were in regular, close contact with horses.

The veterinarian was reported by Queensland Health on 15 July 2008 to have tested positive for Hendra virus and died on 20 August 2008 after spending several weeks in intensive care in a Brisbane hospital.

The veterinary nurse was reported by Queensland Health on 18 July 2008 to have tested positive for Hendra virus, also spent several weeks in intensive care in the same Brisbane hospital and was discharged from hospital on 19 August 2008.

1.2 Confirmed Hendra cases in horses at Redlands

Presenting symptoms in confirmed cases included ataxia (stumbling or wobbly gait and leaning to one side), head tilt, facial nerve paralysis, elevations in temperature, heart rate and respiratory rate and purple or congested mucous membranes.

Case R1

R1 had been a long-term resident at the RVC. The horse had been receiving treatment for a musculoskeletal injury and was observed on the morning of 26 June 2008 to be depressed and not eating. The horse deteriorated rapidly and was euthanased later that morning. An autopsy was performed.

The body of R1 was then removed and disposed of by a commercial provider of waste removal services.

Brain tissue in formalin had been collected by RVC staff at autopsy. This tissue was subsequently picked up from the RVC by DPI&F on 7 July 2008 and was forwarded on to the Australian Animal Health Laboratory (AAHL) for Hendra testing. A positive test result was then reported on 10 July 2008.

Case R2

R2 was admitted to RVC for an eye condition on 17 June 2008 and received daily treatment for this condition. On 30 June 2008 the horse was observed to be depressed and inappetent in the afternoon and ataxic. Over a period of several days the horse appeared to stabilise and then slowly improved.

Blood samples and nasal swabs from R2 had been collected from the horse by RVC staff and were picked up from the RVC by DPI&F on 7 July 2008. Initial testing on the samples collected from the RVC on 7 July 2008 returned a positive result for serology tests and a negative result for PCR testing. Additional samples were collected from this horse on 10 July, 18 July, 21 July and 23 July 2008. The horse consistently returned positive serology results and returned positive real time PCR results on some samples including nasal swabs, urine and serum.

R2 was euthanased on 15 August 2008 and an autopsy performed by veterinary pathologists from AAHL. PCR positive test results were reported for 9 of 24 post-mortem samples that were tested. No viable virus was obtained on culture of any post-mortem samples.

The body of R2 was destroyed by incineration at a facility managed by the University of Queensland at Pinjarra Hills.

Case R3

R3 was admitted to the RVC on 4 June 2008 for treatment of a nasal condition.

The horse was observed to be off feed and depressed on the morning of 4 July 2008. The horse deteriorated during 5 July 2008 and was euthanased that afternoon. An autopsy was performed. A variety of tissue samples were collected into formalin and nasal swabs and blood samples were also collected.

The body of R3 was then removed and disposed of by a commercial provider of waste removal services.

A variety of tissue samples in formalin, nasal swabs and blood samples that had been collected either prior to death or at autopsy by RVC staff were subsequently picked up from the RVC by DPI&F on 7 July 2008. Positive Hendra test results were reported on 8 July 2008.

Case R4

R4 had been in the RVC for several weeks with a fractured jaw. In that period he had a three-day window at home (discharged 7 June and re-admitted 11 June). He was observed to be more depressed than expected on 6 July 2008 and deteriorated further on 7 July 2008. The horse continued to be treated under the supervision of RVC staff until the Hendra positive test results were conveyed on 8 July 2008.

Blood, urine and nasal swabs were collected by RVC staff from R4 and were subsequently picked up by DPI&F on 7 July 2008. A positive Hendra test result was reported for this horse on 8 July 2008.

R4 was euthanased by RVC staff working in collaboration with DPI&F on the afternoon of 8 July 2008 and a limited autopsy was then performed by DPI&F staff at RVC. Samples of lung tissue collected from the autopsy were submitted to the Australian Animal Health Laboratory (AAHL) for testing.

The body of R4 was destroyed by incineration at a facility managed by the University of Queensland at Pinjarra Hills.

Case R5

R5 was admitted to the RVC on 23 June 2008 for a skin condition. On 22 July 2008 the horse was febrile but otherwise normal. The following day the horse was febrile and depressed and the horse continued to deteriorate through to 24 July 2008.

Samples were collected from R5 on 23 July 2008 by DPI&F staff and a positive Hendra test result was reported late that night. The horse was euthanased on 24 July

2008 and a full post-mortem completed by AAHL pathologists (assisted by DPI&F staff) on 25 July 2008.

The body of R5 was destroyed by incineration at a facility managed by the University of Queensland at Pinjarra Hills.

PCR positive test results were reported from 11 of 16 samples collected at post-mortem and live Hendra virus was grown in culture from four samples (kidney, spleen, lymph node and spinal cord).

1.3 Other horse cases of interest at Redlands

During the investigation of the cases of Hendra at RVC there were a number of additional horses that had died either at RVC or after being discharged from RVC since 1 June 2008. These cases were investigated to identify the cause of death where possible and rule out the possibility of Hendra virus involvement in these deaths. There were three cases where horses had died or were euthanased in the weeks prior to the first confirmed case (R1), where autopsies had not been performed and where clinical case histories fitted a case definition for suspect Hendra cases including sudden onset of severe disease, fever, rapid deterioration over 24-48 hours, and neurological and/or respiratory system involvement.

DPI&F reports indicate that these three horses are regarded as improbable cases of Hendra virus infection. This finding is understood to be based on investigation of the clinical case histories, testing of available samples from the three horses, and testing of companion horses from the home properties of the three horses. It is important to note that available information does not allow unequivocal determination of the Hendra status of these horses.

These three cases are described briefly here.

Case R6

R6 was housed at a property belonging to a relative of the owner of the horse. The horse was observed to be fine on the evening of 5 June 2008 and was then noticed to be depressed, reluctant to move and had a fever on the morning of 6 June 2008.

The horse was transported to the RVC on 6 June 2008 for veterinary attention. The horse continued to deteriorate and died in the early morning of 7 June 2008.

An autopsy was not performed on the horse. The body of R6 was removed and disposed of by a commercial provider of waste removal services.

Blood samples had been submitted to a commercial veterinary diagnostic laboratory but the only samples that had been retained were blood smears (other samples had been discarded). The blood smears were tested by PCR assay and were negative. This result is not regarded as a conclusive negative test since these samples were not considered to be optimal.

A companion pony that had been resident at the same property (but in a non-adjacent paddock) was subsequently tested (samples collected on 10 July 2008) and found to be negative for Hendra virus.

The lack of available samples for testing mean that it is not possible to state with certainty that R6 was infected with Hendra virus or not.

Case R7

R7 was admitted to the RVC for treatment of different conditions between 10 and 16 May 2008 and between 20 May and 10 June 2008. The horse was discharged on 10 June 2008 and returned home.

The horse was observed to be depressed, stumbling and febrile on 15 June 2008. He was treated at the owners' property by an ambulatory veterinarian on 15 June 2008 and was re-admitted to the RVC on the morning of 16 June 2008. The horse deteriorated through the day and died in the early hours of 17 June 2008.

The horse was taken home by the owner and buried on the owners' property. An autopsy was not performed.

Blood samples had been submitted to a commercial veterinary diagnostic laboratory but the only samples that had been retained were blood smears (other samples had been discarded). The blood smears were tested by PCR assay and were negative. This result is not regarded as a conclusive negative test since these samples were not considered to be optimal.

Companion horses on the owners' property were sampled on 15 July 2008 and tested for Hendra and test results were reported to be negative for Hendra virus.

The lack of available samples for testing mean that it is not possible to state with certainty that R7 was infected with Hendra virus or not. The horse had been diagnosed with other medical conditions that may have contributed to the fatal illness.

Case R8

R8 was admitted to the RVC on 29 May 2008 for abdominal surgery and returned home on 16 June 2008.

The owner reported that the horse was not quite right on Friday 20 June and by Monday morning (23 June 2008), he was depressed, ataxic and obviously ill. He was returned to the RVC on 23 June 2008. The horse deteriorated and was euthanased in the early evening of 24 June 2008.

An autopsy was not performed on the horse. The body of R8 was removed and disposed of by a commercial provider of waste removal services.

Blood samples had been submitted to a commercial veterinary diagnostic laboratory but the only samples that had been retained were blood smears (other samples had been discarded). The blood smears were tested by PCR assay and were negative. This result is not regarded as a conclusive negative test since these samples were not considered to be optimal.

Companion horses on the owners' property were sampled on 15 July 2008 and tested for Hendra and test results were reported to be negative for Hendra virus.

The lack of available samples for testing mean that it is not possible to state with certainty that R8 was infected with Hendra virus or not. The horse had previously been treated for severe colic and this condition may have contributed to the fatal illness.

1.4 Confirmed Hendra cases in horses at Proserpine

Case P1

First noticed to be unwell by the owner on 10 July 2008. The owner rang a private veterinary practitioner (PVP) that evening to discuss the horse. The next morning the owner rang the PVP to report the horse had deteriorated and had a swollen muzzle. The PVP was unable to attend the property until afternoon and the horse continued to deteriorate and died late morning on 11 July 2008.

The PVP visited the property in the early afternoon and performed a limited post-mortem to collect samples for Hendra virus testing. Samples were sent from Proserpine on the afternoon of 11 July 2008, arrived at BSL on the morning of 12 July 2008 and were re-packaged and sent on to Queensland Health Scientific Services laboratory (QHSS). Samples were registered at QHSS on Monday 14 July 2008 and a positive test result was reported that evening.

The horse was then buried by the owners on the property.

Case P2

P2 was a paddock companion to P1. P2 had been sampled for Hendra virus testing on 15 July 2008 and returned negative test results. P2 was then noticed to be unwell on the morning of 21 July 2008. The horse was observed to be febrile and ataxic. A decision was made in discussion with DPI&F to euthanase the horse and perform a limited post-mortem to collect samples for Hendra virus testing.

The horse was euthanased on the afternoon of 21 July 2008 and blood and tissue samples collected via a limited post mortem conducted on the property. The horse was then buried by the owners on the property.

Samples were sent to BSL on 22 July 2008 and received at QHSS on 23 July 2008. A positive test result for Hendra virus was reported on 23 July 2008.

Case P3

P3 was a paddock mate to P1 and P2. P3 had been sampled for Hendra virus testing on 11 and 15 July 2008 and had returned negative tests. P3 was then noticed by the owners to be depressed and showing an altered gait (high stepping) on 21 July 2008. The horse continued to show mild signs of illness on 22 July 2008 and then appeared to recover.

Samples were collected from P3 on 21 July 2008, followed by additional samples on 29 July and 18 August 2008.

P3 was determined to be sero-positive to Hendra virus based on detection of antibodies to the virus.

P3 was euthanased on 4 September 2008 and a full post-mortem performed on the affected property by staff from AAHL and DPI&F. PCR positive test results were reported for 8 of 24 post-mortem samples that were tested. No viable virus was obtained on culture of any post-mortem samples.

The horse was buried on the property following completion of the post mortem.

1.5 Other horse cases of interest at Proserpine

P4

P4 was a paddock mate of P1, P2 and P3. P4 was observed by the owners to be apparently healthy on the afternoon of 2 July 2008 and was then found dead on the afternoon of 3 July 2008. No information is available on clinical signs or progression of any illness that may have been displayed by P4. The death of P4 was attributed to misadventure or snake bite. The body of P4 was buried on the property by the owners.

It is possible that P4 may have been infected with Hendra virus. Available information does not allow unequivocal determination of the Hendra virus status of this horse.

3 Conclusions

Hendra virus is an endemic disease with a low probability of occurrence and terrible consequences for both animals and people.

Events in July 2008 saw the largest combined number of confirmed horse cases since the initial detected occurrence of Hendra virus in 1994. The two incidents – one at Redlands and the other near Proserpine – both involved multiple horse cases with transmission from one horse to another.

Two human cases of Hendra virus occurred as a result of exposures to infectious horses at Redlands, with one person dying and the other recovering from a severe and life-threatening illness.

The two incidents were the result of separate exposure events and were managed separately as two different incident responses.

Quarantine and biosecurity measures were initially implemented by RVC staff as a result of concerns about illness and deaths in horses at the clinic including concern that horses may have been infected with equine herpes virus. Quarantine and biosecurity measures were subsequently strengthened by DPI&F. The most likely scenario indicates that the last case (R5) was infected as a result of virus shed from R4 prior to the euthanasia and disposal of R4 on 8 July 2008. There was then no further spread of infection at the RVC.

The first confirmed case at Proserpine (case P1) is the most likely source of virus that infected the other two cases. Since P1 was disposed of prior to the involvement of the DPI&F, there was no spread of infection at the premise from a period prior to the initiation of the DPI&F response.

DPI&F responded rapidly and effectively, initially to concerns communicated from veterinarians at each location, followed by quarantine and response activities conducted at each of the infected premises. There was no further spread of infection from the time when the DPI&F response was implemented. Investigations were completed of a large number of horses either identified through tracing performed at the infected premises or through separate notifications of suspect cases. No confirmed cases were identified other than those at the two infected premises.

The efforts of all individuals involved in response activities are acknowledged with special mention of the risks encountered and effectively managed by those individuals who were involved in managing suspect and confirmed cases. The impacts of the cases and the associated response is also acknowledged including loss of life, severe illness, and a range of financial, physical and emotional stresses.

Confirmed cases at Redlands presented with clinical signs dominated by neurological signs and including ataxia, head tilt, facial nerve paralysis, fever and purple mucous membranes. The lack of respiratory signs in confirmed cases and the predominantly neurological presentation represented a shift in the presentation compared with many

of the previously reported Hendra cases. Cases at Proserpine showed both respiratory and neurological signs.

Results from post mortem examinations and case presentation history reinforced the importance of Hendra virus commonly infects vascular endothelial cells in many tissues throughout the body with subsequent vasculitis and vascular damage. Variation in clinical signs in different horses may be attributed to variability in the level of damage in particular organs and the response of individual horses to that damage. This also indicates that future cases may also continue to show variable clinical signs even though the underlying cellular effects of the virus may continue to be mediated by the same vascular damage.

There were two surviving, sero-positive horses that had been infected with Hendra virus, developed variable signs of illness and apparently recovered. The existing national policy requiring destruction of sero-positive horses was reviewed and upheld and both these animals were subsequently euthanased.

Information collected during the response indicates that infected horses may shed Hendra virus while in the incubation stages of disease, before they develop clinical signs of illness that could be attributed to Hendra infection. The possibility of apparently healthy, incubating horses posing exposure risk to people is important information in the development of effective recommendations for risk management to minimise the risk of exposure for all people dealing with horses.

All of the issues identified above have contributed to a very high level of interest amongst stakeholders in the incidents.

This review attempts to describe the incidents and the response operations and then identify lessons from these events to inform future preparedness plans and response operations. Consideration has been given to assessing response activities against relevant manuals and procedures as part of this process.

Much of the additional knowledge about the disease resulting from information collected during the response and from recent scientific advances, has already been added to information available on the web site.

It is very important that all individuals and industry groups that have an interest in horses participate actively in the development and implementation of education and awareness programs under a shared responsibility with DPI&F to ensure that effective, precautionary risk management procedures are implemented when dealing with horses to appropriately deal with the potential risks of exposure to Hendra virus.

A number of recommendations have been made as a result of information collected during this review. They are made in attempt to provide constructive feedback to the DPI&F and to industry bodies concerning improvements in procedures and in preparedness to more effectively manage Hendra risk in the future.

4 Recommendations arising from the review

Recommendations are presented from the text of the review with a reference to the relevant section of the review to guide the reader to additional information.

1. It is recommended that efforts continue to be directed to effectively communicating exposure risk to all people who work with horses and to incorporate this information into various guidelines and other documents with a focus on early adoption of precautionary measures designed to minimise exposure risk at all times when interacting with horses.
Section 15.2.
2. It is recommended that specifications be developed for post mortem preparation of suspect or positive Hendra cases for transport and disposal, for safe transportation of a prepared carcass from the site of death or euthanasia to the site of disposal and for disposal of the carcass. These specifications can then be used in discussions with waste removal services to agree on arrangements that can be rapidly implemented during a response. It is recognised that some commercial providers of waste removal services may request that a body be cut into small pieces to facilitate transport and disposal. This approach presents additional exposure risk to people and other animals and it is suggested that specifications for transport and disposal involve the whole body where possible.
Section 15.3.
3. It is recommended that appropriate DPI&F operating procedures are completed or reviewed, identified in manuals and plans, and implemented right from the beginning of an emergency response, acknowledging that these will depend on the scale and activities of the response and the nature of the risks being encountered.
Section 15.3.3.
4. It is recommended that procedures be reviewed to ensure that quarantine notices served on properties for the purposes of Hendra virus provide sufficient detail to cover expected activities and movements, the conditions under which they may be permitted or not permitted to occur and the role of DPI&F staff in performing, supervising, checking and approving activities related to the management of quarantine on the site.
Section 15.3.3.
5. It is recommended that consideration be given to the implementation of a form of review or audit of DPI&F procedures that may be performed by an individual independent of the response activities, with appropriate skills in response activities and procedures (such as EMU staff), and completed early in the operational phase of a response.
Section 15.3.3.

6. It is recommended that the guidelines for veterinarians continue to be the subject of review as required by a working group that includes representation from relevant industry bodies and in particular the Australian Veterinary Association (AVA) including the relevant AVA special interest group, Equine Veterinarians Australia (EVA).
Section 15.4.1.
7. It is recommended that changes suggested in this review document in relation to the guidelines for veterinarians be considered for implementation in the guidelines for veterinarians.
Section 15.4.1.
8. It is recommended that procedures relevant to liaison officers appointed by DPI&F be reviewed and more information provided on the roles of liaison officers as conduits of information flow to and from relevant stakeholders. This should include review of induction and training, and information and other material they should have either available to them or access to during the response. Consideration should be given to the early appointment of liaison officers with communication roles that are independent of response activities.
Section 15.7.
9. It is recommended that management of the DPI&F web site consider the implementation of display of document tracking information on the web, flags or alerts to inform viewers when information has changed and for longer documents such as the guidelines for veterinarians, summary information to indicate the nature of the changes. Consideration should also be given to adding further information to the web site including for example FAQs, links to information on bats, and descriptive summaries of past cases. Other recommendations relating to flow of information to stakeholders are also relevant to the web site.
Section 15.6.
10. It is recommended that DPI&F work with the Australian Veterinary Association (AVA) to review and agree on procedures for timely reporting during a response of clinical signs, progression of disease and results of additional procedures such as post mortem examinations.
Section 16.
11. It is recommended that DPI&F and the Veterinary Surgeons Board of Queensland (VSB–QLD) work together to develop procedures to ensure that a current list of email addresses for those veterinarians that have consented to have their email addresses used for emergency animal disease information, is provided to the DPI&F either as early as possible after confirmation of an emergency disease case to facilitate communication or on an annual basis after renewals have concluded.
Section 16.

12. It is recommended that DPI&F and appropriate peak bodies consider options for improving the coverage rate to veterinarians and allowing sign-up for emergency animal disease information at any time. The VSB–QLD option only allows veterinarians to sign-on for communications on an annual basis. There may be an alternative option that allows veterinarians to sign-on at any time or to provide updates of changes in contact information. This could be achieved by adding functionality to a web site to allow individuals to sign-up for information.
Section 16.
13. It is recommended that the AVA as the peak body representing member veterinarians, continue to work with DPI&F to ensure effective communication with veterinarians and to explore options for further development and improvement of communication.
Section 16.
14. It is recommended that consideration be given to the benefits and costs of offering Hendra diagnostic testing at a laboratory in north Queensland such as the Oonoomba laboratory at Townsville, acknowledging that primary focus on risk management should be directed at the early implementation of precautionary biosecurity measures appropriate for the assessed level of risk for all interactions with horses.
Section 16.
15. It is recommended that initiatives be progressed through the joint involvement of DPI&F and a range of industry bodies such as the AVA and Animal Health Australia (AHA), and accredited providers of safety training for the development of training and preparedness programs for veterinarians and that similar initiatives be progressed with appropriate industry bodies for all people who interact with horses. It is considered important that training is tailored to the needs of the relevant user, available to all relevant people, and that training may incorporate information relevant to biosecurity measures for other diseases in addition to Hendra virus.
Section 16.
16. It is recommended that consideration be given to identification of knowledge gaps and research needs and funding opportunities for future research to address those gaps. This may involve discussions between representatives from relevant industry bodies in a manner similar to the 2007 henipavirus forum.
Section 16.
17. It is recommended that procedures for communication of information relating to orders for destruction of sero-positive horses and the implementation of those orders be reviewed and consideration be given to arranging a face-to-face meeting where possible to allow discussion of what is a stressful and demanding process.
Section 17.2.
18. It is recommended that once a decision is made to euthanase a horse that is either sero-positive or acutely ill with Hendra virus that the action be completed as soon as possible.
Section 17.2

19. It is recommended that DPI&F work with representatives from commercial laboratories to develop or review criteria for assessment and prioritisation of submission forms and to implement systems for adding laboratory representatives to notification and communications concerning emergency animal diseases if they are not already included.

Section 17.3.

20. It is recommended that consideration be given to involvement of people with direct experience in Hendra virus cases in awareness campaigns.

Section 17.3.

5 Introduction

The Hendra virus cases at Redlands and Proserpine in July and August 2008 resulted in serious impacts on affected individuals and concerns about the possibility of changes in the pathogenesis of the virus and its capacity to infect horses and humans.

This review was initiated in August 2008 and commenced in September 2008. The process involved extensive consultation with individuals directly involved in response activities in Redlands and Proserpine including owners of affected horses, private veterinary practitioners, veterinary clinic staff and DPI&F staff. A range of additional stakeholders were consulted including representatives from industry bodies, other government agencies, commercial providers of services relevant to the veterinary industry, private veterinary practitioners, university staff members, pathologists from the Australian Animal Health Laboratory, and members of the public.

In many cases information collected during consultations was used to create written records of discussions. These draft records were produced by the reviewer and were sent to the individuals concerned to allow verification of the reviewer's summary of discussions and provide individuals with an opportunity to correct factual errors and ensure that the final record accurately represented their views. All information collected during the consultation process was treated as confidential and was not released. Records of meetings and other information collected during consultations were then used as sources of information in compiling the final report. In cases where written submissions were received from individuals or organisations the reviewer only contacted the submitter to seek clarification on issues and the written submission was then used as a source of information in compiling the report.

A number of issues were raised by more than one person and issues have been aggregated for the purposes of this review. Where issues were raised and were considered to be not related to the terms of reference they were not generally included in the review. A number of issues were raised that are not specifically identified in the review. This is mostly because they were considered to have been addressed through the description of the response activities. In some cases quite specific comments or concerns were raised that were considered to be better addressed through identification of higher level concerns with general comments as opposed to a larger number of occasionally quite detailed observations and concerns.

Every attempt has been made to use the information collected during the review to accurately describe the events as they occurred and constructively identify opportunities for improvement in preparedness and response capacity for potential future occurrences of Hendra virus.

The review outlines a description of the response activities at both locations that is intended to present a factual summary of events that occurred. This is followed by sections modelled after the terms of reference that identify lessons to be learnt from the response and make recommendations concerning these lessons. Subsequent sections present additional issues and concerns that were raised by individuals during the consultation process, accompanied by a response from the reviewer and a recommendation where appropriate.

6 Terms of reference

1. Identify the lessons to be learnt from the DPI&F's response to the equine Hendra virus cases at Redlands and Proserpine in July and August 2008; with regard to;
 - a. New scientific knowledge including any change in the virus or clinical signs
 - b. DPI&F Standard Operating Procedures
 - c. Standards for handling of suspect Hendra virus cases in all equine – Guidelines for veterinarians (DPI&F website)
 - d. Appropriate veterinary hygiene standards for DPI&F officers
 - e. Applicable workplace health and safety requirements for DPI&F officers
 - f. Communication with private veterinarians, owners of affected animals and other stakeholders
2. Make findings or recommendations in respect of the appropriateness of DPI&F's actions, including adoption of recommendations arising from previous Hendra virus incidents.
3. Engage with relevant stakeholders including the Australian Veterinary Association, the Queensland Horse Council and private veterinary practitioners.
4. Present a report to the Director-General and the Managing Director, Biosecurity Queensland by no later than 31 October 2008.

7 Description of the DPI&F response at Redlands

7.1 Initial involvement and Hendra confirmation

The initial notification to DPI&F of unusual cases of disease and deaths in horses occurred on the morning of Monday 7 July 2008 when the principal of the RVC telephoned DPI&F to report horses that were showing neurologic signs and elevated temperature. One horse (case R3) had been euthanased on 5 July 2008 after first developing clinical signs on 4 July and then deteriorating through the day on 5 July. Another horse (case R4) had displayed mild depression and inappetence on the evening of 6 July and then had displayed fever and neurologic signs on the morning of 7 July 2008.

There was concern that horses may be infected with the neurologic form of equine herpes virus.

A decision was made to declare quarantine on the affected property under the Stock Act (1915) because of the clinical history reported in telephone conversations on the morning of 7 July 2008 between DPI&F staff and the principal of the RVC and the fact that the affected property was a busy veterinary clinic with many people and horses moving into and out of the clinic on a regular basis. The RVC staff had already imposed quarantine by effectively closing the equine clinic and implementing biosecurity precautions in dealing with horses in the clinic.

A DPI&F biosecurity inspector travelled to the RVC in the early afternoon of 7 July 2008 and picked up biological samples that had been collected by RVC staff from four horses. Samples included autopsy samples from two horses that had died at the clinic in the previous two weeks (R1 and R3), and samples from two live horses at the RVC (R2 and R4). For one of the horses that had been autopsied at the RVC (R1), the only sample available was a sample of brain tissue in formalin. Multiple samples including different tissues, cranial spinal fluid and blood were available from the other autopsy case (R3) and samples from the live horses included blood and nasal swabs from both horses and urine from one of the two horses. The inspector also served a quarantine notice to the principal of the RVC. The quarantine notice stipulated equine herpes virus infection as the disease of concern.

Biological samples were received at BSL at around 4:30 pm on 7 July 2008 and assessed. A decision was made to submit samples for Hendra virus exclusion testing before proceeding with investigation of samples for other diseases including herpes virus. Samples from three of the four horses were processed and forwarded on that evening by courier to the QHSS laboratory at Coopers Plains for Hendra virus testing. The sample of brain fixed in formalin from case R1 was processed and sent to AAHL for Hendra virus tests.

Samples were registered at QHSS in the morning of Tuesday 8 July 2008 and preliminary positive PCR test results for Hendra virus were conveyed to DPI&F staff at around 10:00 am, 8 July 2008. This was followed by a series of phone calls from DPI&F staff to notify a number of individuals and organisations including the principal of the RVC, senior departmental staff, the Minister, Premier and cabinet, Australian CVO and CVOs from other state jurisdictions, and representatives from

peak industry bodies including the Australian Veterinary Association, Equine Veterinarians Australia, Queensland Harness Racing, Queensland Racing, Thoroughbred Breeders Queensland Association, Queensland Horse Council and AgForce.

QHSS also notified relevant staff within QH of the test results. A teleconference was held at around 10:30 am on 8 July 2008 that involved representatives from QH and DPI&F to discuss the preliminary test results and begin to plan response activities.

A second round of confirmatory tests was performed on the same samples by QHSS and final test results confirming the positive Hendra test results were reported by QHSS to DPI&F around 4:30 pm on 8 July 2008. This was followed by a further series of notifications from DPI&F to the RVC, department, state government and representatives from stakeholder groups.

7.2 Implementing the incident response

An incident management team was initiated on Tuesday 8 July as soon as the report of a positive Hendra test result was received within DPI&F. The incident case manager as defined under the Biosecurity Emergency Operations Manual was the manager of the south-east region of Biosecurity Queensland and the response team was physically based at the Animal Research Institute (ARI) at Yerongpilly.

7.2.1 Infected premises operations

Response activities were initiated at the infected premise (IP) on 8 July 2008 and continued throughout the response until quarantine was lifted. Activities included implementation and enforcement of quarantine, assessment of the site including any hazards, providing information to the staff on the response and additional support, compiling an inventory of animals on the site, and carrying out disease eradication activities including disposal and decontamination.

Several DPI&F staff including veterinarians and biosecurity inspectors travelled to the RVC shortly after midday on 8 July 2008 and one inspector brought down a trailer loaded with equipment prepared for animal emergency response situations (including disinfectant, personal protective equipment and other equipment relevant to disease response and biosecurity). The team advised the RVC staff on Hendra virus, biosecurity including personal protective equipment (PPE) and decontamination procedures. A specific quarantine area was defined within the property that encompassed all of the horse-related areas of the property. The quarantine area had controlled entry and exit points and a requirement for people entering the quarantine area to follow procedures both at entry (getting into appropriate PPE) and at exit (decontamination and removing PPE) points. The team also began to collect information from RVC staff on the case horses (those horses confirmed by laboratory testing as Hendra positive), other horses in the clinic, and horses that had recently visited the clinic.

Horses within the clinic were not moved from the stalls they were in to minimise any inadvertent exposure of environment, other animals or people to virus. Entry into the stable area was limited to those people who had a genuine need to be there in an attempt to minimise the number of people who were potentially at risk of exposure to

virus. RVC staff continued to provide general care for resident horses (bedding, food, water), to provide veterinary care as required for horses in the clinic and to collect general health data including daily observations of horse health and rectal temperature.

The primary source of information about Hendra virus and appropriate biosecurity including PPE and decontamination was the guidelines for veterinarians. Copies of the guidelines for veterinarians were provided to RVC staff and staff were also referred to the DPI&F web site where the guidelines for veterinarians can be accessed or downloaded.

A team from QH also arrived at the RVC on the afternoon of 8 July 2008 to advise staff on human health concerns, collect information on exposure assessment and plan for further activities including collection of samples from people for testing purposes.

A new quarantine notice was served on the property on 8 July 2008, identifying Hendra virus as the relevant disease.

One horse (case R4) confirmed as Hendra positive, was euthanased in the afternoon of 8 July 2008 and a limited post mortem was performed by a DPI&F veterinarian to collect additional tissue samples for further testing. The body of R4 was then sealed in an impervious horse body-bag in preparation for removal from the site. The body of R4 was removed on 10 July 2008 and disposed of by incineration at a facility managed by University of Queensland (UQ) at Pinjarra Hills.

An additional Hendra case was confirmed in a mare that had been resident at the RVC since 23 June 2008 (case R5). The mare began to show clinical signs on 22 July 2008, and tested positive to samples collected on 23 July 2008. The mare was then euthanased on 24 July 2008 and placed in a body bag. The body was transported to the UQ incinerator site at Pinjarra Hills on 25 July 2008 where a full post-mortem was performed by staff from AAHL and DPI&F. All procedures were performed under strictly controlled conditions and with appropriate PPE. The body of the horse was then incinerated.

On 15 August 2008, case R2 was euthanased at the RVC and transported to the UQ incinerator site where a full post mortem was performed by staff from AAHL and DPI&F and the horse's body then incinerated. This horse had showed clinical signs attributed to Hendra between 30 June and 4 July 2008 and had then slowly appeared to recover. The horse had consistently tested positive on serological tests that detect antibody to Hendra virus and had tested positive on real time PCR tests performed on blood, nasal swabs and urine. A decision was made to order the destruction of the horse under the legislative authority of the Exotic Diseases in Animals Act (1981).

There were occasions when animal equipment was moved from the RVC site. Veterinary equipment was disinfected under formal DPI&F supervision and approval and was then transferred from the RVC to an alternative veterinary hospital facility near Beaudesert to allow clinic staff to continue to offer equine veterinary care to their clients. A horse float was decontaminated by RVC staff and by a DPI&F biosecurity inspector on 5-6 August 2008. The float was subsequently moved from the RVC site

but was returned to the RVC at the request of the site supervisor and remained at the site throughout the rest of the quarantine period.

Horses remaining at the RVC continued to be monitored. Individual horses were occasionally observed to be febrile and any horses showing signs of illness including fever, were sampled and tested for Hendra virus.

Quarantine was lifted on the RVC premises on Monday 25 August 2008. This date represented 32 days since the last acute case (R5) had been euthanased and more than 32 days since case R2 had last tested positive by real time PCR. The longest reported incubation period in horses that were exposed to virus in experimental conditions was estimated at 10 days and the longest incubation period reported from review of information from the first document cases in 1994 was estimated to be 16 days. The time interval to release from quarantine therefore represented at least two incubation periods since the last acute case (R5) and since case R2 had been detected as positive on PCR testing.

7.2.2 Review of response activities

The Manager of the Emergency Management Unit (EMU), part of the Biosecurity Queensland Control Centre (BQCC) completed a brief review on 11 July 2008 of the incident response team at ARI and provided feedback to the south-east regional manager on changes to improve systems and processes used to plan, implement and record response activities.

7.2.3 Changing from incident to project

Management of the Redlands response was changed on 29 July 2008 from an incident response under the direction of the south east region of Biosecurity Queensland to a project with assistance and support from BQCC staff including staff from the EMU. A decision was made to keep the project team at ARI instead of moving the team to the BQCC site at Oxley in part because of the proximity to the DPI&F laboratory and involvement of staff in the response from ARI. The changeover provided an opportunity for a general review of tasks, responsibilities being held by various people involved in the response and systems and procedures.

A Biosecurity Inspector with considerable experience in site supervision of an infected premise (through involvement in the equine influenza response) was appointed as site supervisor. Minor changes were made to the management of the Redlands site including review of site management, revision of entry and exit points to facilitate day-to-day management of the clinic without impacting on biosecurity, provision of additional information and signage on biosecurity protocols on site, and implementation of sign on and off books. Management of horses within the Redlands site was reviewed in discussion with RVC staff and changes were made including compartmentalising the site into blocks of stables with similar assessed risk of Hendra exposure. Portable panels were used to construct temporary yards to allow horses to be moved and provided with an opportunity for turn-out time. Processes were implemented to ensure horses could be moved without any adverse impact on biosecurity.

Systems and procedures were also reviewed at the ARI site and a number of changes made including revision and formalisation of: the induction process for new staff;

incident action plans including prioritisation of tasks with associated timelines and identification of individuals responsible; sign on and off books and general record keeping procedures and management of information related to the response. A number of operating procedures and relevant documents were reviewed and updated where necessary including checking content against any specific issues relating to Hendra virus. These included a generic risk management plan for field veterinarians that was modified for all field staff at the RVC, a respiratory management program document written for avian influenza that was modified and adapted to apply to zoonotic diseases in general including Hendra disease, review of procedures for care and maintenance of powered and non-powered air purifying devices and material safety data sheets (MSDS) for all chemicals that may be used during response activities.

7.2.4 Sampling at Redlands Veterinary Clinic

Several DPI&F staff travelled to the RVC on the morning of 9 July 2008 to collect samples from other horses in the clinic for Hendra testing. There were a total of 36 horses and one donkey at the RVC at this time. The 36 horses included R2 and R5.

Sampling teams consisted of a veterinarian and a biosecurity inspector. One team avoided entering the RVC quarantine area and visited neighbouring properties to inform people of the situation and collect information and samples from horses on neighbouring properties. Two additional teams collected samples from the 35 horses and one donkey resident at the RVC.

Samples were collected from case R2 on multiple occasions through the response (10, 18, 21, and 23 July 2008) because of the high level of interest in assessing status over time for presence of viral genome as determined by PCR testing of swabs and blood and for monitoring antibody status in blood.

A second set of blood samples was collected from horses at the RVC on 23 July 2008, followed by a third sampling on 11 August 2008. There were seven horses that had toxic changes reported in their serological tests that interfered with interpretation of test results. These seven horses were sampled again on 19 August 2008.

Swabs were taken from multiple sites around the RVC area on three occasions (9, 14 and 23 July 2008). Sites included stalls (floor, wall, wire mesh between stalls), examination area in the clinic, nose twitch, door handles, fencing rails, soil, surface water, water troughs, feed bins, feed residue, faeces, plant material and the waste area.

Three of 19 swabs were positive on PCR from the 9 July collection including a mesh divider between adjacent stalls that had housed cases R2 and R3, bloody surface water in the area where a post mortem had been conducted on R4 the previous day, and a stall door handle from the stall where R4 had been housed. Three of 40 swabs were positive on PCR from the 14 July collection including mesh divider between adjacent stalls (stalls that had housed cases R2 and R3), soil in the area where the post mortem had been conducted and the wall of one stall where case R4 had been housed. Two of eight swabs were positive on PCR from the 23 July collection including mesh divider in the stall that contained case R5, and the door of one stall (the stall adjacent to the stall housing case R5). Positive PCR test results from environmental swabs indicate

contamination of surfaces with viral genome and do not necessarily indicate presence of viable, infectious virus.

On 17 July 2008 samples were collected from six poultry, three dogs and three cats that were resident at the RVC and that had been allowed access to areas where horses were housed, examined or treated. Two dogs and one cat returned reactive test results on preliminary Enzyme-Linked ImmunoSorbent Assay (ELISA) testing. All animals then returned negative results on virus neutralisation testing (VNT), considered the gold standard for serology testing.

7.2.5 Veterinary investigations

Veterinary investigations is the operational unit tasked with managing tracing and surveillance activities in the relevant area including tracing, investigation of reports of suspicion of disease, provision of advice on biosecurity, collection of relevant disease and surveillance information and submission of laboratory samples.

Tracing and surveillance activities began on 8 July 2008 during the initial visit of DPI&F staff to the RVC. Additional staff began working in the incident management room at ARI on 9 July 2008 on tracing activities, mainly through telephoning people who had been identified as having links to the RVC. RVC staff were asked to provide a list of clients and horse information for those horses that had visited the RVC or been discharged from the RVC in the period from 1 June 2008. Further information was sought on properties that had been visited by RVC veterinarians acting in an ambulatory capacity and on other people or activities of interest such as waste removal companies or individuals who had removed dead horses from the RVC.

Phone calls involved an explanation of the situation and the reason for the call followed by collection of information using a standardised set of questions. Information was collected on horses that had links to the RVC, other horses on the property, any unexplained illness in horses during the period from 1 June 2008, numbers of dogs and cats on the property, and information on flying fox colonies in the area. People were informed about the situation, about Hendra virus and animal and human health issues, and provided with phone numbers for DPI&F and QH. For those horses that had been discharged from the RVC within the previous 10 days, owners were advised to keep horses confined on the property, and separated from other horses for a further 10 days. These intervals were based on estimates of the incubation period in horses that had developed Hendra virus following natural exposure which was estimated to be between 4 and 10 days.

The tracing team at ARI developed a customised questionnaire for standardised collection of information and developed a spreadsheet system for recording collected information.

Tracing calls provided an opportunity for assessment of risk of Hendra virus as well as informing horse owners of the situation. In cases where the information provided any suspicion of possible Hendra virus exposure or disease, the information was passed on to the veterinary investigations manager within the incident management room to arrange a visit from a field team to investigate the situation and collect samples for testing.

Tracing activities were prioritised according to estimated risk. Highest priority was assigned to contacting owners of confirmed Hendra positive horses, owners of other horses with higher indices of suspicion (such as owners of R6, R7, R8), and those individuals or companies who had been responsible for moving and disposing of horses that had died at the clinic with particular priority being given to individuals who had removed the bodies of R1 and R3. The next priority was to contact those people who owned horses that were currently resident at the RVC. The next priority was to contact those people who were identified as having had a horse attend the RVC (either as an outpatient or as an inpatient) at any time since 1 June 2008. This last group was further prioritised into those people who had had a horse admitted to the RVC from the time when R6 had been admitted (6 June), followed by those people who had had a horse admitted to the RVC between 1 June and 6 June 2008. Horses belonging to staff from the RVC were also assessed and some were sampled and tested for Hendra virus. The prioritisation process was used to ensure tracing staff worked first on contacting owners of horses that were expected to be at higher risk of exposure.

Where horses had moved or were not at the owner's property, tracing staff continued to track horses until they had spoken to a person who had responsibility for the horse at its current location. This ensured that information could be collected on the current status of the horse's health and also that appropriate information on Hendra virus and phone contacts could be provided to that person.

Owners of confirmed Hendra cases (R1, R2, R3, R4) were contacted between 8 July and 12 July 2008. Two owners indicated they were travelling at the time. Owners of other horses that had been admitted to the RVC and had either died or euthanased were contacted between 9 July 2008 and 11 July 2008. Owners of 22 of the 36 animals quarantined in the clinic were contacted on 10 July 2008 and all owners had been contacted by 15 July 2008.

DPI&F records indicated that an additional 56 horses had been identified as having been admitted to the RVC since 1 June 2008. All of these owners were contacted between 10 July 2008 and 16 July 2008.

Where tracing contacts identified any reports of unexplained illness in horses, field teams were generally tasked with visiting the property and collecting samples. In some cases contact was made with a local veterinarian to arrange collection of samples for testing. Examples included:

- One pony (a companion on the property of origin for case R6) was reported to have recently been ill and DPI&F staff visited the property and sampled the pony on 10 July 2008. The pony returned a negative test.
- A report was received of acute disease and death in a mare from the property of origin of a horse quarantined at the RVC. The mare had been treated by a veterinarian for suspected acute metritis following abortion and had displayed signs including ataxia, severe progressive disease over 24-48 hours and frothy nasal discharge when she died. The mare had died on 8 June 2008, about 17 days before a companion horse had been sent from the property to the RVC. An additional companion horse still on the property of origin was then sampled on 16 July 2008 by the attendant veterinary practitioner.

- Several properties were visited by DPI&F staff on 15 and 16 July 2008 and samples collected from companion horses to horses that had died or been euthanased either during or after attending the RVC. These included companion horses to one confirmed Hendra case (R3) and companion horses to cases R7 and R8.

Plans were developed during the period from 14 to 18 July to collect blood samples for Hendra testing from all living horses that had been discharged from the RVC during the period from 6 June 2008 to the onset of quarantine. A decision was made to start this testing at least two weeks after the last horse had been discharged from the RVC prior to imposition of quarantine on 7 July 2008. All owners had already been contacted and health monitoring was already occurring. The 14-day interval ensured sufficient time to allow antibodies to develop in the unlikely event that any of these horses had been infected with Hendra virus and showed little detectable signs of disease. Four field teams were mobilised each consisting of a veterinarian and a biosecurity inspector. The teams were assembled at ARI on Monday 21 July 2008 for induction and proceeded to visit properties and collect samples. A small number of these horses were bled by private veterinarians or DPI&F staff from other regions depending on the locations for horses that may have moved or changed owners since departing the RVC.

There were 55 eligible horses identified in DPI&F records as having been admitted to the RVC on or after 6 June 2008.

Reconciliation of DPI&F accession records for samples submitted to the laboratory for Hendra testing against tracing and surveillance information indicated that 52 of the 55 horses were sampled and tested negative for Hendra virus. Six animals were sampled by NSW DPI staff and one animal was sampled by Victorian DPI because they had moved to locations in those two states. The three horses that were not sampled were all assessed by phone calls and in two cases by DPI&F staff visiting to inspect the animals. All horses that were not sampled were determined to be sufficiently low risk to not warrant sampling based on lack of evidence of disease and time since they had been discharged from the RVC. Owners or carers were provided with information on Hendra and health monitoring.

A large number of additional samples were collected for Hendra testing from horses other than those directly linked or traced to horses at the infected premises at Redlands or Proserpine. It is estimated that in the period from 11 July to 5 September 2008, more than 60 property-visits were completed by private veterinarians or DPI&F inspectors to collect samples for Hendra testing where inspection of accession information indicated that the visits were unlikely to have been the result of tracing and surveillance activities arising from either the Redlands or Proserpine responses.

7.2.6 Disposal of waste and infected material

Biosecurity systems implemented at the RVC included arrangements with two waste removal companies to deal with general waste and particular biomedical waste including sharps containers storing syringes, needles and other equipment used to treat horses or collect samples. Systems were implemented in discussion with waste removal companies and with RVC staff to manage collection and storage of waste at

the RVC, pick-up and transport of waste to an appropriate site, disposal of the waste and appropriate decontamination and general biosecurity. General waste was disposed of in a landfill and biomedical waste by incineration. Appropriate biosecurity and decontamination procedures were reviewed in discussions between DPI&F staff and representatives of the waste disposal companies and were implemented by the waste disposal companies.

There were five horses at the RVC that were confirmed to have been infected with Hendra virus. Two of these (R1 and R3) had been euthanased prior to confirmation of Hendra virus on 8 July 2008 and had been removed and disposed of by a commercial waste removal company. Contact was made with a representative of the company concerned to provide information concerning Hendra virus, to ensure the horses had been disposed of in a way that did not present ongoing biosecurity risk and to provide additional information as requested.

One confirmed Hendra positive horse (case R4) was euthanased on the afternoon of 8 July 2008. Attempts were made late in the afternoon of 8 July 2008 and the morning of 9 July 2008 to arrange with commercial providers of waste removal services to arrange for removal of the body of R4. Phone calls were made to waste removal companies listed in a preparedness plan drawn up to manage disposal of avian carcasses in the event of an outbreak of avian influenza. Companies were informed that the dead horse was known to be positive for Hendra virus and the importance of biosecurity precautions, and that DPI&F inspectors would assist in ensuring adequate biosecurity and PPE, in moving the body (loading and unloading), and in decontamination. Attempts to engage a commercial waste removal company to remove and dispose of the body of R4 were unsuccessful. The University of Queensland was contacted on 9 July 2008 and agreed to take the body and dispose of it by incineration at an incinerator used by the university for disposing of a variety of waste including animal carcasses from the Veterinary School. Approval was obtained on 9 July 2008 from the Environmental Protection Agency (EPA) for disposal of an infected horse carcass at the UQ incinerator.

A fully closed truck from the University of Queensland arrived at the RVC on the morning of 10 July 2008 to transport the body of R4 to the university incinerator at Pinjarra Hills. The body of R4 was loaded onto the truck by DPI&F inspectors and the truck decontaminated prior to leaving the RVC. The truck travelled to the incinerator facility, followed by DPI&F inspectors. At the incinerator the body was loaded into the incinerator by DPI&F inspectors who then decontaminated the truck. The body was incinerated along with the body bag and pallet on which the body had been transported.

The same process was utilised for transport and disposal of two additional confirmed Hendra positive cases: R5 was euthanased at the RVC on 24 July 2008 and transported to the UQ incinerator on 25 July 2008 and R2 was euthanased and transported to the incinerator on 15 August 2008.

7.2.7 Workplace health and safety

All DPI&F staff involved in procedures at the RVC are understood to have received prior training in PPE and decontamination. Only a small number of people were involved in collecting samples from horses between 9 July and 21 July. There were 3

sampling teams (each involving a veterinarian and a biosecurity inspector) operating on 9 July 2008 to collect samples from all horses in the RVC and from horses on neighbouring properties. Individuals involved in this sampling operation also collected samples from two companion horses on properties external to the RVC on 10 and 15 July 2008. A sampling team then visited several properties on 15 and 16 July 2008 to collect samples from companion horses. The small number of people involved meant that induction and review of procedures and PPE was done on an informal and ad hoc manner with individuals.

DPI&F staff were observed to be occasionally non-compliant with recommended PPE while operating inside the quarantine area. Discussions with staff indicated that some individuals found particular types of goggles they were using to be very difficult to wear and that if the fit was less than optimal the goggles tended to fog up and interfere with vision. When this happened the individuals wearing goggles found that the only way they could see was to raise the goggles above their eyes. This issue resulted in discussion of WH&S impacts, reinforcement of the importance of PPE and a Biosecurity QLD workplace health and safety officer (WHSO) was tasked with sourcing a range of different types of eye protection (goggles, glasses, face shields) and making them available to staff involved in the response. PPE was also provided to RVC staff if required.

Formal inductions and review of procedures and PPE for DPI&F field staff were implemented on 21 July 2008 as several field teams were assembled at ARI to begin sampling of horses that had been discharged from the RVC. P2 masks were initially the only form of respiratory protection device being issued to DPI&F staff at induction for field teams. Information contained within the guidelines for veterinarians and Standard Operating Protocol for Respiratory Management – Zoonotic Disease, indicates that disposable P2 masks are suitable for clean shaven people. Disposable P2 masks may not provide adequate respiratory protection in bearded people and both documents recommend that bearded people wear a more advanced form of respiratory protective device such as a powered air-purifying respirator. There was at least one bearded individual who was involved in field team activities between 21 and 23 July 2008 and who wore a disposable P2 mask during this time. The issue was rectified after this time and bearded individuals were provided with induction training and equipment as specified in the guidelines for veterinarians and Standard Operating Protocol for Respiratory Management – Zoonotic Disease.

The reviewer has been made aware of three DPI&F staff who became ill with either respiratory or vestibular symptoms after having been involved in response activities. All individuals notified their respective line managers in line with WH&S requirements for recording and investigating non-notifiable incidents and all received medical advice and Hendra testing. One additional DPI&F staff member incurred a needle injury while assisting in the euthanasia of case R2. This staff member was admitted to hospital for several days as a precautionary measure due to the risks of viral exposure and has been tested negative for Hendra virus since this event. The incident constituted a notifiable incident under Queensland WH&S legislation and Workplace Health and Safety Queensland were notified in accordance with legislative requirements. An incident prevention review is currently being completed on this incident in an attempt to identify any root causes and implement any changes to

procedures and policies that are necessary to minimise the risk of this type of incident occurring again.

8 Description of the DPI&F response at Proserpine

8.1 Initial involvement and Hendra confirmation

The owner first contacted a private veterinary practitioner (PVP) from Cannonvale in North Queensland on the evening of 10 July 2008 to report a horse that was unwell on a property near Proserpine. On the following morning the owner contacted the PVP again to report the horse was markedly worse and had a swollen muzzle. The PVP was unable to attend the property until the afternoon and the horse continued to deteriorate and died late morning on 11 July 2008.

The PVP rang the DPI&F and received advice by telephone from a DPI&F veterinary officer about Hendra virus, PPE, biosecurity and recommendations for a limited post-mortem to collect sufficient samples to test for Hendra virus while minimising risk of exposure to possible virus. The PVP visited the property in the early afternoon and performed a limited post-mortem on the horse, collecting samples for diagnostic testing. The owners were informed about Hendra virus and implemented preliminary quarantine and biosecurity measures while waiting on test results.

The horse was buried by placing the body in a deep, blind ending gully on the property and covering the body with earth. The same location had been used to bury the body of P4, the companion horse that was found dead on 3 July 2008.

Samples were packaged at the PVP's practice and sent by courier to DPI&F facilities at BSL, leaving Proserpine on Friday 11 July 2008.

Samples were received at BSL on the morning of 12 July 2008 and were packaged for submission to QHSS. Samples were received at QHSS on 14 July 2008 at 12:52pm and a positive Hendra test result was reported that evening.

This was followed by a series of phone calls initiated during the evening of 14 July 2008 from DPI&F staff to notify a number of individuals and organisations including the PVP, owner, senior departmental staff, the Minister, Premier and cabinet, Australian CVO and CVOs from other state jurisdictions, and representatives from peak industry bodies including the Australian Veterinary Association, Equine Veterinarians Australia, Queensland Harness Racing, Queensland Racing, Thoroughbred Breeders Association of Queensland, and Queensland Horse Council.

8.2 Implementing the incident response

An incident response was initiated on Monday 14 July as soon as the report of a positive Hendra test result was received within DPI&F. The incident case manager as defined under the Biosecurity Emergency Operations Manual was the manager of the central region of Biosecurity Queensland. The response was managed using staff from Rockhampton, Mackay and Bowen and the infected premises was approximately mid-way between Bowen and Mackay.

8.2.1 Infected premises operations

Response activities were initiated at the infected premise (IP) on 15 July 2008 and continued throughout the response until quarantine was lifted. Activities included implementation and enforcement of quarantine, assessment of the site including any hazards, providing information to the staff on the response and additional support, compiling an inventory of animals on the site, and carrying out disease eradication activities including disposal and decontamination.

Two DPI&F staff including a veterinary epidemiologist and a biosecurity inspector visited the affected property on 15 July 2008. The team provided advice on Hendra virus, biosecurity including personal protective equipment (PPE) and decontamination procedures. PPE equipment was provided for the owners and instructions given on use of PPE and decontamination procedures along with information on minimising risk of exposure to Hendra virus while handling and monitoring health in the remaining horses. Quarantine procedures were discussed and information collected about the confirmed case horse and other horses on the property. Samples were collected from the other four horses on the property for Hendra virus testing.

Two biosecurity inspectors visited the property on 16 July 2008 to serve the quarantine notice and provided additional information on Hendra virus, response activities, and quarantine procedures.

Neighbours were contacted and provided with information on the occurrence of cases at the affected property and about Hendra virus and provided with contact details for DPI&F and QH.

A regional QH staff member contacted the owners to discuss public health concerns and recommended that the owners visit their local hospital to arrange testing for Hendra virus.

DPI&F staff maintained frequent contact with the owners throughout the response. Initial communications with the owners involved senior DPI staff from the Primary Industries Building in Brisbane as well as field staff from Mackay and Rockhampton. During the course of the response, a vacant biosecurity officer position in Bowen was filled and this person then took over most of the operational communication with the owners since the property was closest to the Bowen offices.

A companion horse (case P2) was reported by the owners to be ill on 21 July 2008 and a decision was made in discussion with DPI&F staff to euthanase the horse and perform a limited post mortem to collect samples for Hendra testing. A biosecurity inspector travelled from Bowen to the property on the afternoon of 21 July 2008 and the horse was euthanased by the owners and a post mortem was performed by the inspector. The horse was buried on the property by the owners in the same location as P1 and P4.

Another companion horse (P3) was reported by the owners to be showing mild signs of illness on 21 and 22 July 2008. Samples were taken from the horse on 21 July 2008 by the biosecurity inspector while attending the property to perform a post mortem on case P2. Additional samples were collected on 29 July and 18 August. The horse

returned positive serological tests for Hendra virus antibody indicating previous infection with Hendra virus. PCR tests performed on blood samples were negative.

A review of the policy for sero-positive horses had been initiated as a result of the sero-positive, apparently recovered horse detected at Redlands (case R2) and the existing policy requiring euthanasia of sero-positive animals had been supported. This decision was communicated to the owners. Arrangements were made to euthanase the horse on the property on 4 September 2008. A team of pathologists and other staff travelled to Proserpine on 2 and 3 September 2008. Equipment was brought down to the property from Townsville and a site visit made to the property on 3 September to select an appropriate site for euthanasia, post mortem and burial of the horse. A burial site was selected in discussion with the owner. The site was prepared on 3 September including excavation of a hole, and erection of portable showers and facilities for decontamination. The horse was euthanased on 4 September 2008 and a full post mortem performed. The horse was then buried on the property along with some contaminated equipment used during the process. The site was decontaminated on completion of the procedure.

Quarantine of the affected property was lifted on 12 September 2008.

8.2.2 Veterinary investigations

Veterinary investigations were undertaken at the affected property near Proserpine. All of the horses on the affected premise had been long-term residents at the property. Investigations included discussions with the family members associated with the affected property including consideration of risk for family members living at a different property and discussions with neighbours to the affected property.

There were no links identified between the Hendra cases at Proserpine and those at Redlands and the two incidents were managed as separate events that had occurred at similar times.

8.2.3 Disposal of waste and infected material

Two horses including the first confirmed case (P1) and another horse (P4) that had died suddenly prior to the first confirmed case had been buried on the property by the owners prior to the diagnosis of Hendra virus on the property. The bodies were placed in a large, blind ending gully and then covered with several feet of earth using an excavator. The second confirmed case (P2) was buried in the same way by the owners. The burial site was chosen by the owners and was not physically visited by DPI&F staff.

The third confirmed Hendra case at the Proserpine property (case P3) was buried at a different location that was selected by DPI&F staff in discussion with the owners. A deep hole was excavated at the selected site and the horse's body placed in the hole following completion of the post mortem. The hole was then filled in and the site decontaminated.

The owners were provided with equipment for PPE and decontamination. Waste generated through use of PPE was accumulated by the owners in garbage bags and periodically collected and removed by DPI&F staff during visits to the property.

8.2.4 Workplace health and safety

No illnesses or workplace health and safety incidents involving DPI&F staff were reported during the response.

9 Communication

Initial notifications on receipt of a positive test result at Redlands on 8 July 2008 and Proserpine on 14 July 2008 were described in earlier parts of this report.

A range of communication strategies were employed in an attempt to facilitate rapid communication about the incident(s) to relevant parties. These included telephone calls; face-to-face meetings with representatives of peak industry bodies; media releases; interviews with radio, newspaper and television outlets; emails to peak body representatives and extensive use of the DPI&F web site to mount relevant information.

A face-to-face industry briefing was held on the afternoon of 9 July 2008 at DPI&F premises, 80 Ann Street, Brisbane and representatives of peak industry bodies were invited. The briefing was delivered by the CVO and a QH representative and provided an update on the current situation and an opportunity to discuss any immediate or emergent issues arising. Participants at that briefing were provided with a written briefing of the state of knowledge at that time.

An email was also sent to peak body representatives on 9 July 2008 that contained a word document as an attachment that provided information about the incident including descriptions of case horses. It also provided the text of two fact sheets (one for veterinarians and one for horse owners) that were to be released on the DPI&F web site the following day. The text of the document is provided in an appendix to this report (Appendix 5). This information was intended to be distributed amongst members of the various peak bodies and can be found on the Queensland Horse Council web site dated 9 July 2008¹.

New fact sheets were loaded onto the DPI&F web site on 10 July 2008 including sheets designed to provide information for veterinarians and for horse-owners. These have been reproduced in Appendices 6 & 7.

A media release on 15 July 2008 reported the first confirmed case at Proserpine. This document and associated media reporting at the same time included reference to the first confirmed case in North Queensland (case P1) as coming from a Cannonvale property². The affected property is more accurately described as being near Proserpine and is located south of Proserpine. One member of the owners' family resides on a property near Cannonvale and the PVP's practice is located in Cannonvale. Later media releases referred to the affected property near Proserpine.

A document containing updated information was sent as an email attachment to AVA/EVA representatives by email during the afternoon of 23 July 2008 (text reproduced in Appendix 8). This document was sent prior to laboratory reporting of

¹ <http://www.qldhorsecouncil.com/Hendravirus.htm>

² http://www.dpi.qld.gov.au/cps/rde/dpi/hs.xsl/30_11162_ENA_HTML.htm

the positive Hendra status of case R5 which occurred during the evening of 23 July 2008.

Confirmation of the Hendra positive status of case R5 was followed by phone and email notification of peak body representatives and by a press release on 24 July 2008.

Media releases from Biosecurity Queensland can be found on the DPI&F web site³ and ministerial media releases on the Queensland government web site⁴.

A number of media interviews were provided around this time and additional details can be found in media reports drawn from media interviews or statements. An example is given below.

"Hendra virus usually causes serious lung damage, with massive fluid build-up. While neurological signs from the virus are known to occur, it was the main symptom in the four horses that have so far tested positive for the disease. Two have died. Their primary symptoms were a lack of muscular co-ordination (ataxia), head tilt, facial nerve paralysis, as well as increased temperatures and purple mucous membranes."⁵

CVO Updates were mounted on the DPI&F website on 28 July, 8 August and 19 August 2008, providing information on particular issues arising from the response.

A range of additional information and links were added to the DPI&F web site over the course of the response. These included links to QH press releases, articles on background information about Hendra virus and research publications, information on personal protective equipment (PPE), and information on submission of samples for Hendra testing.

Three different versions of the guidelines for veterinarians were available from the DPI&F web site through the period from 7 July 2008 to the time this review was finalised. The documents were updated in a review process involving extensive consultation with representatives from DPI&F and other bodies and incorporating information from the response as it unfolded. Details on the versions and the updating process are provided in following sections.

Communications between DPI&F staff and individuals at the two infected premises at Redlands and Proserpine were frequent and included phone calls, emails and visits.

The larger scale of the response at Redlands required more staff and a more intensive response at the RVC. This included attendance at the RVC on a daily basis for much of the response by one or more DPI&F staff. In the early stages of the response there were frequently multiple DPI&F staff at the RVC as quarantine procedures were implemented and veterinary investigation activities including sampling of companion

³ http://www.dpi.qld.gov.au/cps/rde/dpi/hs.xsl/30_753_ENA_HTML.htm and http://www.dpi.qld.gov.au/cps/rde/dpi/hs.xsl/4790_11602_ENA_HTML.htm Sourced 26 November 2008.

⁴ <http://www.cabinet.qld.gov.au/MMS/StatementSearch.aspx> Sourced 26 November 2008.

⁵ Horses with Hendra showed unusual signs of disease, 11 July 2008. <http://www.horsetalk.co.nz/news/2008/07/044.shtml> Accessed 25 Nov 2008

horses was undertaken. Later in the response, a biosecurity inspector visited the RVC on a daily basis to collect information on the health of horses in the clinic, check quarantine and biosecurity matters and generally provide support to RVC staff. Teams of DPI&F staff then visited the RVC at intervals to collect samples from horses in the clinic or to investigate health concerns reported by RVC staff. Officers in the incident response room at ARI had primary communication and liaison responsibilities throughout the response. A veterinary officer who had previously worked as a private veterinarian at the RVC was responsible for most of the regular communication with RVC staff over matters directly relating to the response. A veterinary liaison officer was appointed in early August (starting 4 August 2008) as part of the incident response team to provide liaison and communication services to veterinarians about the incidents and response activities.

Staff from the response team also initiated communications with owners of horses either quarantined in the RVC or who had had horses admitted to the RVC since 1 June 2008. Follow-up communications with horse owners included arrangements for sampling of horses, calls to monitor horse health, report test results and responses to queries from owners about response activities or more generally about Hendra virus.

A control group was formed consisting of senior Biosecurity Queensland (BQ) staff, and representatives from other units within the DPI&F, QH and peak industry bodies. The frequency of meetings for the control group was flexible and dependent on issues arising. The control group met daily for the first several days and then less frequently through the remainder of the response. The control group provided an opportunity for discussion of response matters, briefing of representatives not directly involved in the response activities and an opportunity for input into policy from various stakeholder bodies. There is an expectation that representatives from peak bodies and other agencies would disseminate factual information about the response from control group meetings to their respective membership.

The AVA Queensland Division Executive was asked on 24 July 2008 to comment on the adequacy of information provided to veterinarians about the cases at Redlands and Proserpine. Positive feedback was provided to the DPI&F concerning the flow of information and that appropriate information had been made available to the veterinary profession.

In early August a request was made from DPI&F to the Veterinary Surgeons Board of Queensland to be able to access a list of emails for veterinarians registered in Queensland and who had provided an email address on their most recent registration renewal form and given permission for this address to be used to circulate information during an emergency animal disease response. A list of about 700 email addresses from the total of approximately 4000 registered veterinarians was provided by the VSB-QLD and the first email containing information about Hendra virus was sent to these addresses on 5 August 2008 with additional information being sent in the weeks following that.

There was an increase in the number of calls to the DPI&F through the Business Information Centre requesting information about Hendra virus, about response activities and reporting horses with clinical signs that were suggestive of Hendra virus.

Information about the procedures and operations of the Business Information Centre is provided in the Appendices. The Centre offers a single port of call for all enquiries to the DPI&F and a rules-based system is used by operators to respond to calls. During business hours the Centre operates with DPI&F staff within the Primary Industries Building in Ann Street, Brisbane. After hours calls are received by a commercial call centre provider with script or rules-based systems to guide responses.

10 Public health response

QH announced on 8 September 2008 that it would be conducting a review of the QH response to the Redlands and Proserpine Hendra cases.

The QH review is completely separate to this review and information in this review is limited to a brief description of the role of QH in the DPI&F response.

Samples submitted to the DPI&F from horses for real time PCR testing for Hendra virus are sent to the QHSS laboratory at Coopers Plains under an arrangement between DPI&F and QH. The first confirmation of a Hendra positive test result in horses at the RVC on 8 July 2008 was reported by the QHSS laboratory. Procedures within QHSS involve notification of relevant QH staff with public health responsibilities when horse samples are submitted to QHSS for Hendra testing, and when results are reported from Hendra testing performed on horse samples.

QH staff were involved in both Redlands and Proserpine response operations with responsibility for managing public health aspects of the response including assessment and management of testing performed on people and in provision of medical care for individuals admitted to hospital during the response.

There was very frequent communication between QH staff and DPI&F staff, and QH staff participated in regular meetings with DPI&F and representatives from other agencies and peak bodies throughout the response to discuss operations and issues related to the response.

11 Legislative considerations

11.1 Quarantine

A written quarantine notice was served on the RVC on 7 July 2008 in accordance with the Stock Act (1915). The notice specified equine herpes virus as the disease and specified the following conditions:

- No equine to move onto or off the area placed in quarantine
- No equine products, genetic material, manure or feedstuffs to leave the property
- Equine transport vehicles are not to leave the quarantine area
- All personnel must follow Biosecurity/decontamination procedures before leaving the quarantine area.

The initial quarantine notice above was revoked the following day after confirmation of the Hendra positive status of horses on the premises and replaced with a quarantine notice that specified Hendra virus. The conditions remained unchanged.

The RVC premises were released from quarantine on 25 August 2008.

A similar quarantine notice was served on the Proserpine property on 16 July 2008. and the Proserpine premises was subsequently released from quarantine on 12 September 2008.

11.2 Euthanasia of live, sero-positive horses

The HeV Expert Group (see following section for details) was specifically requested on 9 July 2008 to review the existing national policy indicating that horses that were determined to be sero-positive for Hendra virus would be destroyed. It was considered appropriate to review this approach and consider options for management of case R2 in light of any advances in understanding of the disease and causative agent since 1994. The Expert Group produced a discussion paper outlining options for management of live horses that are sero-positive to Hendra virus. The discussion paper was then tabled at a meeting of the Consultative Committee on Emergency Animal Diseases (CCEAD) held by teleconference on 21 July 2008. The CCEAD meeting agreed that there should be no change to the existing AUSVETPLAN policy requiring destruction and disposal of sero-positive horses or other terrestrial animals.

The CCEAD recommendation was based on review of existing knowledge about Hendra virus and the closely related Nipah virus and the importance in minimising human exposure risk over time. Evidence supporting the possibility of recrudescence of infection in an animal that had apparently recovered from an initial infection included the death in 1995 due to Hendra virus infection of a person from Mackay who had been exposed to Hendra virus approximately 12 months prior to his death, and documented cases of recrudescence of Nipah virus infection in around 10 percent of human cases up to 2-3 years after the initial infection. Nipah virus is closely related to Hendra virus. The potential risk to people interacting with the horse over a prolonged period if the horse was maintained in quarantine was considered to outweigh any potential gain in scientific knowledge that may be obtained during that time. A decision was also made to perform a complete post mortem on the animal to ensure that every opportunity was taken to learn as much as possible about Hendra virus infection in horses.

The decision arising from the CCEAD meeting of 21 July 2008 to require euthanasia of the surviving sero-positive horse at the RVC (case R2) was communicated to the owner in a face-to-face meeting held on 21 July 2008 and followed by a letter outlining the decision and the legislative authority under the Exotic Diseases in Animals Act (1981).

The horse was subsequently euthanased under the authority of Section 22 of the Exotic Diseases in Animals Act (1981). The owners were afforded procedural fairness through a show cause process and given an opportunity to comply with the destruction order. A post mortem conducted under the authority of Sections 20 (1) (c) and 20 (4) to allow collection of samples for laboratory investigation of Hendra virus.

One horse at Proserpine (case P3) also tested positive on serology tests for Hendra virus. The owners were informed of the decision that the horse must be euthanased by phone call and a subsequent letter outlining the decision and the legislative authority under the Exotic Diseases in Animals Act (1981). A decision was made in discussion with the owners to perform a third test on the horse and this was conducted on a sample taken from the horse on 18 August 2008. The test returned a positive serology result by VNT and the horse was then euthanased on 4 September 2008.

12 Hendra virus Expert Group

A HeV Expert Group including representatives from DPI&F, AAHL and QH was formed on 9 July 2008 to provide input into policies and procedures. The group reviewed the existing national policy for sero-positive horses and also provided input into policy and procedures during the course of the responses at Redlands and Proserpine. This included in particular procedures to sample horses that had been linked to the RVC through veterinary investigations.

13 Guidelines for veterinarians

There have been three versions of the *guidelines for veterinarians* available from the DPI&F web site through the course of the response to the time this review was finalised. The title of the different versions has changed slightly over time and this review uses the term *guidelines for veterinarians* to refer to the document with a date or version number to differentiate the versions.

13.1 Guidelines for veterinarians (13 February 2007)

These guidelines had last been updated on 13 February 2007 and were available on the DPI&F web site in HyperText Markup Language (HTML) format for direct viewing on the web site and as a downloadable Portable Document Format (PDF) file. The document was titled:

Handling possible and probable Hendra virus cases in equines. Guidelines for veterinarians including procedures for handling cases.

13.2 Guidelines for Veterinarians (Version 1)

These guidelines were titled:

Guidelines for Veterinarians Handling potential Hendra Virus infection in Horses

The guidelines were available from the DPI&F web site from 1 August 2008. These guidelines were formatted using a standard departmental work instruction format and incorporated a date of issue (1 August 2008) and a version number (Version 1).

The guidelines for veterinarians (Version 1) were produced following extensive review of the guidelines for veterinarians (13 February 2007) by a working group implemented by DPI&F soon after the first confirmed Hendra case at Redlands. The working group included representatives from DPI&F, QH, AHIC, AVA/EVA and AAHL. Private practitioners also reviewed the draft guidelines. The guidelines were updated in light of additional information from scientific research and observations and information collected during the response at Redlands and Proserpine.

When the DPI&F web site was updated on 1 August 2008, the PDF version of the guidelines for veterinarians (13 February 2007) was removed and the web link to the HTML version of the guidelines for veterinarians (13 February 2007) was removed. A link was then placed on the web site that directed the viewer to the PDF document of the guidelines for veterinarians (Version 1).

However, the web page for the HTML version of the guidelines for veterinarians (13 February 2007) was not deleted from the DPI&F web site at this time. This meant that an individual browsing the DPI&F web site from 1 August 2008 would have only seen a link to the updated guidelines for veterinarians (Version 1). If an individual had bookmarked the specific Uniform Resource Locator (URL) for the page containing the HTML version of the guidelines for veterinarians (13 February 2007) or if the individual performed a web search using a search engine such as Google, and key words such as "Hendra guidelines", it was possible that the older guidelines for veterinarians (13 February 2007) may have been retrieved. This error was noticed on 20 November 2008 during internal checking of the DPI&F web site and the HTML file displaying the guidelines for veterinarians (13 February 2007) was deleted.

13.3 Guidelines for Veterinarians (Version 2.0)

These guidelines were titled:

Guidelines for Veterinarians Handling potential Hendra Virus infection in Horses

The guidelines were available from the DPI&F web site from 19 November 2008. These guidelines were formatted using a standard departmental work instruction format and incorporated a date of issue (10 November 2008) and a version number (Version 2.0).

These guidelines for veterinarians (Version 2.0) were the result of further review by the working group in light of additional information arising from the response and incorporating feedback solicited through the DPI&F web site by inviting comment and feedback Version 1 of the guidelines.

14 Assistance provided to Redlands Veterinary Clinic

The Queensland government provided a one-off financial payment to the Animal Welfare and Crisis Support Trust Fund, to assist in the management of welfare of the horses involved in the extended quarantine period at the RVC. The Animal Welfare and Crisis Support Trust Fund was established and managed by the AVA and the AVA was involved in discussions with the Queensland government that led to the payment and in managing assistance from the trust to the RVC. The discussions and arrangements were independent of response operations that were ongoing at the RVC.

The assistance was not related to costs associated with provision of shelter, feed and water and was not related to veterinary services or fees. There was also no consideration of compensation for loss of trade.

The assistance recognised the extra-ordinary nature of the situation in that the horses quarantined at the RVC were client-owned animals that had been admitted to a

veterinary hospital for ongoing health care. The assistance was based on ensuring that the ongoing welfare of the animals in the RVC continued to be met throughout the quarantine period.

15 Lessons to be learnt

Confirmation of Hendra virus cases at Redlands and at Proserpine was rapidly followed by implementation of an emergency disease response at each location.

The following several weeks saw multiple confirmed cases of Hendra virus in horses at each location and tragically two human cases and the death of a veterinarian from the RVC.

The response was implemented rapidly and managed successfully in that there were no further infections in people involved in the response, no further spread to horses once the response had been implemented, and there was no confirmed spread to other premises indicating that the infection had been constrained to single premises in each of the two locations.

All those individuals who were involved in response activities are to be applauded for their actions in assisting to investigate and control these incidents. Particular mention is made of those individuals who were directly involved in interacting with confirmed case horses either before or after they were known to have been infected with Hendra virus. This includes horse owners, veterinary nurses and veterinary clinic staff, private veterinarians, waste removal and excavator drivers, University pathologists and staff from the DPI&F, AAHL and QH. Additional mention is made of all the individuals who provided care for other horses in the RVC during several weeks of quarantine, and of the owners of those horses in quarantine and of other horses that had been linked to the RVC. A large number of additional people were involved in aspects of the response including veterinarians and other staff from three eastern states who collected samples from traced horses as well as owners, veterinarians and other individuals who assessed and sampled other horses for Hendra virus testing and additional DPI&F staff who provided support functions including telephonists. Additional people from industry bodies provided important roles in disseminating information and raising awareness about the disease and the response. This brief list of people involved in the response is almost certain to be incomplete but it reinforces the importance of shared responsibility for biosecurity and working jointly to respond to this disease.

The following sections represent an attempt to identify lessons that may be taken from the response and make recommendations in a constructive way to improve preparedness for the almost certain future cases of Hendra virus, minimise risk of human exposure and improve animal disease response if and when a future case is detected.

15.1 Horse exposure risk

Figure 1 displays a timeline for the cases at Redlands and Proserpine.

Case R1 is considered as the index case at Redlands, hypothesised to have been exposed to virus shed from an infected bat. Examination of Figure 1 suggests that case R1 was the likely source of virus that infected cases R2, R3 and R4. Case R4 is then

the most likely candidate as the source of virus resulting in the infection of R5, though it is not possible to exclude case R2 as a potential source of virus that might have infected R5.

Staff at the RVC implemented quarantine and biosecurity measures prior to the confirmation of Hendra virus based on concerns about illness and deaths in horses. This was followed by imposition of formal quarantine and additional response measures by DPI&F that began on 7 July 2008. Four of the five confirmed cases at the RVC were infected prior to the DPI&F response. It is not possible to state with certainty when the last case (R5) might have been infected but it is considered most likely to have occurred as the result of virus shed from R4 prior to the euthanasia of R4 on 8 July 2008.

It is noted that there is uncertainty about the Hendra status of cases R6, R7 and R8 and that alternative scenarios can be generated that involve assumptions about the Hendra status of these horses.

At Proserpine, case P1 is considered as the index case and as the most likely source of virus that infected cases P2 and P3. It is noted that there is uncertainty about the Hendra status of case P4 and that alternative scenarios can be generated that involve assumptions about the Hendra status of this horse. Case P1 died and was disposed of on 11 July 2008, eliminating further risk of exposure. It is reasonable to assume that cases P2 and P3 were already exposed and incubating infection by the time the DPI&F response was initiated on 14 July 2008 and there was then no further spread of infection.

15.2 Human exposure risk

This section has been informed by discussion with medical officers from QH who were involved in assessment of human exposure risks during the response.

It is suggested that effective management of human exposure risk for Hendra virus requires a precautionary and risk-based approach to interaction with on horses.

All confirmed human cases of Hendra virus to date appear to have been exposed while interacting with horses before they suspected Hendra virus. Prior to the Redlands cases it was suggested or assumed that human exposure to Hendra virus was most likely to occur as a result of very close contact with an obviously sick or dying horse or through performing invasive procedures such as a post mortem on a Hendra case. These risks remain important.

It is understood that all of the confirmed horse cases at Redlands were receiving varied levels of veterinary care prior to their expression of symptoms attributed to Hendra virus infection. Confirmation of Hendra virus from laboratory testing was reported on 8 July 2008. By that time, four of the five confirmed Hendra cases had also received veterinary care while displaying signs of illness that could be attributed to Hendra virus and two horses had died and been subjected to a post mortem. It is noted that the horses had presented with signs that were not considered indicative of Hendra virus at the time.

It is also understood from discussions with the regional medical officer from QH that exposure to Hendra virus in one of the human cases of Hendra virus infection that occurred at Redlands is considered to have possibly occurred while performing procedures on a horse that was not at that time displaying clinical signs of illness that could be attributed to Hendra virus infection. Exposure in the other human case of Hendra virus infection may have occurred while interacting with infected horses after they displayed signs of illness attributed to Hendra virus infection.

Exposure from apparently healthy animals may occur if the animal was shedding infectious virus while in the incubation stage of the disease and not yet displaying signs of illness.

This information is considered to be very important for all people involved with horses (horse owners, carers, riders, farriers, dentists, veterinarians and others) since it indicates that there may be risks involved in interacting with horses that are not displaying obvious signs of disease. It is also very important to place this information in context to avoid alarming people unduly and to provide information on risks and risk management that allow people including veterinarians to be informed and to take suitable precautions. Hendra virus in horses is a rare disease. The risks of human infection appear to be very low for people who are engaged in routine horse handling and care. There may be certain procedures that are associated with elevated risk of exposure even in apparently healthy horses that could be incubating the disease. These are likely to include procedures that involve potential exposure to fluids or tissues that may contain virus such as blood, nasal secretions, oral secretions and urine. People performing more invasive procedures such as surgery or post mortem are considered to be at higher risk of potential exposure to fluids or tissues that may be infectious.

This issue has implications for the protective equipment worn by veterinarians when engaged in procedures which generate exposure to equine body fluids and reiterates the need for continued information and education of the general horse community and veterinarians.

It is suggested that effective and risk-based strategies are required for management of Hendra virus risk at all times and for all horses. For veterinarians these strategies may begin during collection of information for all horses being admitted to a veterinary practice including for example consideration of previous health and unexplained illness in the horse being admitted and in companion animals, recent movement history and exposure to bats. Horses with clinical signs suggestive of Hendra cases obviously need to be treated with appropriate caution and PPE. There also needs to be awareness of the possibility of a horse being apparently healthy and possibly incubating Hendra virus. This may mean that certain procedures that have a higher likelihood of exposure to bodily fluids or tissues that could be infectious are managed with higher levels of biosecurity and PPE even in healthy horses. Other procedures may involve minimal additional biosecurity precautions. The key steps involved are likely to be based on a structured assessment of risks and control options as is outlined in a Hazard Analysis and Critical Control Points (HACCP) approach.

The first step in this process requires a paradigm shift that involves recognition and acknowledgement that all horses may present some level of exposure risk regardless

of whether they present with clinical signs of disease or not. Different procedures and activities are likely to be associated with different exposure risks. Particular clinical signs may also indicate elevated exposure risk. In each case assessment of exposure risk should be followed with appropriate risk management or risk reduction procedures mainly based on PPE and general principles of hygiene and infection control and decontamination.

This approach is seen as the cornerstone of effective prevention or minimisation of exposure risk.

It is recommended that efforts continue to be directed to effectively communicating exposure risk to all people who work with horses and to incorporate this information into various guidelines and other documents with a focus on early adoption of precautionary measures designed to minimise exposure risk at all times when interacting with horses.

15.3 DPI&F Standard Operating Procedures

There are a range of documents that may be considered of relevance to standard operating procedures. These include:

- AUSVETPLAN documents:
 - Provide guidelines at the national level on policy, strategies, implementation, coordination and emergency-management plans, as well as disease specific policies.
- Biosecurity Emergency Operations Manual (Revision 2, 22 June 2005):
 - State-level operations plan for emergency animal disease response in Queensland.
- Queensland Emergency Response Plan for Plant Pest and Animal Disease Emergencies (Version 4, November 2005):
 - Provide guidelines for coordination of the initial response of animal, aquaculture and plant health staff to a disease emergency.
- Guidelines for veterinarians handling potential Hendra virus infection in horses (different versions were in place at varying times during the period from July to September 2008)
- Risk Management Plan for Field Veterinarians (Issue number 3, 11 January 2006)
 - Outlines risks to veterinarians associated with field and office duties.
 - Updated during the RVC response but considered to be incomplete
- Respiratory Management – Zoonotic Disease (Draft version, 12 June 2008):
 - Describes the actions and practices to be taken by Biosecurity Queensland staff when planning and conducting respiratory management during a zoonotic disease response that requires respiratory protection.
 - Updated during the RVC response but considered to be in draft form.
- Personal protective equipment and personal disinfection for zoonotic diseases (Draft version, 6 August 2008).
 - Describes actions and practices in relation to personal protection and disinfection for field operations in a zoonotic disease response.
 - Updated during the RVC response but considered to be in draft form.
- Material safety data sheets (MSDS) for all chemicals that may be used during response activities

The actions of DPI&F staff in responding to the positive diagnosis of Hendra virus infection in horses at Redlands and Proserpine were in accordance with national and state operating procedures. There were areas identified in this review where there are opportunities for further improvements in procedures that are considered likely to contribute to more effective preparedness and response activities in the future. These are outlined as recommendations in subsequent sections of this review.

15.3.1 Initial response at the RVC

An incident response team was initiated as soon as a positive Hendra test result was reported for horses at Redlands. Quarantine had already been self imposed by the RVC staff at the premises. Written notice of quarantine under the Stock Act (1915) was served prior to the confirmation of Hendra virus and was updated to reflect the diagnosis of Hendra virus. This early action indicates the concern both conveyed by RVC staff and noted by DPI&F staff on the initial contact on 7 July 2008.

The initial response involving reaction to the confirmation of Hendra virus and mobilisation of a response team was rapid and effective and performed in accordance with operational procedures.

15.3.2 Veterinary investigations

The initial tracing activities included sampling of in-contact horses at the RVC and collection of information on owners of horses in the clinic and owners of horses that had visited the clinic.

Initial enquiries conducted at the RVC identified seven high risk horses by 10 July 2008 that were the focus of initial tracing and surveillance. These seven horses included the four confirmed Hendra cases (all four were confirmed based on laboratory testing performed on samples picked up from the RVC on 7 July 2008 and subjected to testing on 8 July 2008), and the three additional suspect cases (cases R6, R7, and R8).

Tracing and surveillance involved a large amount of information gathering by telephone that was critical in rapidly assessing health status of animals that had been admitted to the RVC since early June 2008 and in guiding further activities based on risk assessment conducted on initial information collected by telephone. It is important not to judge the initial tracing and surveillance activities only by assessment of dates when field teams visited properties. Effective determination of risk and efficient management of resources was dependent on rapid initial telephone contact. Another critical component of the initial tracing and surveillance is the importance of shared responsibilities and the role of passive surveillance. The initial phone contacts with owners provided a two-way flow of information. DPI&F staff were collecting information from owners about horses and using this information to conduct a risk assessment, and in some cases responded to this by tasking field teams to visit properties and assess horses and collect samples. In addition DPI&F staff were informing owners about the situation and about Hendra virus and contact details. In this way owners were playing an important role in monitoring health of their horses and contributing to ongoing surveillance activities.

There were difficulties experienced in arranging for transportation and disposal of the carcass of case R4 following euthanasia of the horse on 8 July 2008. The delays were associated with reluctance of a number of commercial providers of waste removal services to handle the carcass of a confirmed positive horse. The delays did not contribute to increased biosecurity risk because the body was enclosed in an impervious body bag and decontamination of the site and bag had been conducted. However, this experience raises the importance of extending preparedness and planning to the consideration of having prior agreements in place with commercial providers for disposal of bodies that are suspect or confirmed Hendra positive.

It is recommended that specifications be developed for post mortem preparation of suspect or positive Hendra cases for transport and disposal, for safe transportation of a prepared carcass from the site of death or euthanasia to the site of disposal and for disposal of the carcass. These specifications can then be used in discussions with waste removal services to agree on arrangements that can be rapidly implemented during a response. It is recognised that some commercial providers of waste removal services may request that a body be cut into small pieces to facilitate transport and disposal. This approach presents additional exposure risk to people and other animals and it is suggested that specifications for transport and disposal involve the whole body where possible.

Information gathered in the course of the review identified one horse that had inadvertently been omitted from the list of horses that had been admitted to the RVC from 1 June 2008 and that the DPI&F was using for tracing and surveillance. As a result the owner of this horse was not contacted during tracing and surveillance. The horse remained healthy and there is no indication to suspect that the horse had been infected with Hendra virus. This example is a reminder that every effort must be made to ensure that all at-risk animals are identified and traced.

There were three other horses that had been admitted to the RVC since early June and that were traced but not sampled. There were other occasions where DPI&F staff chose not to sample a horse during a property visit conducted to sample companion animals on the property of origin (these were animals that had not been to the RVC but were paddock companions to horses that had visited the RVC). On all occasions the animals were subjected to an appropriate risk assessment process and the decision not to sample individual animals is considered appropriate.

15.3.3 Response procedures

Emergency animal response operations are designed to ensure rapid response to an emergency. The initial response operations defined in the Queensland Emergency Response Plan for Plant Pest and Animal Disease Emergencies (Version 4, November 2005), are designed to be consistent with the Biosecurity Emergency Operations Manual and with AUSVETPLAN documents. Depending on the scale of a response a decision may be made to scale up the initial response to implement the full AUSVETPLAN response structure with a Local Disease Control Centre (LDCC) and a State Disease Control Headquarters (SDCHQ) and other structures as required (forward command posts for example). These structures were all established in the equine influenza response which required activities across a large number of infected premises.

Response activities involving a single infected premises are more usually managed using an incident response team approach implemented within the relevant region of the DPI&F (south east region for Redlands) in accordance with procedures⁶. The team in this case comprised a small group of people, all of whom had previously received appropriate training in PPE and decontamination and many had considerable experience in emergency disease training or in previous responses including for example involvement in the recent equine influenza response. Many of the team were filling more than one role in the response and some individuals were continuing to perform functions other than response activities meaning that they were not 100% allocated to response activities. The combination of a small and experienced team and a single confirmed infected premise, meant that procedures such as induction of individuals involved in the response, reviewing of procedures and logistic issues such as communications and record keeping, were all relatively informal. As the response unfolded and more people became involved in response activities, response activities became more complex and the importance of a more structured and formal application of procedures became more apparent.

A number of procedures were formalised over time as the response unfolded and activities were better defined. This included introduction of formal induction training for DPI&F staff that were joining the response for field work to visit properties and collect samples from horses. A number of changes were made when the management of the Redlands response was changed around the end of July and individuals from the EMU (part of BQCC) became involved in management roles within the response. EMU staff have a preparedness and support function and are involved in the revision and development of operating procedures and preparedness for emergency disease responses.

Procedures that were improved or enforced as a result of changes in the response team at this time included sign-in and sign-out sheets at both the Redlands site and the incident room at ARI to record people movement; formalisation of induction procedures, daily briefings in the incident room and daily action plans; review of roles and responsibilities of staff; centralisation of communications, emails and files; and, review of availability and content of relevant operating procedures and other documents.

The specific operating procedures that were introduced during the response (Risk Management Plan for Field Veterinarians, Respiratory Management – Zoonotic Disease, Personal protective equipment and personal disinfection for zoonotic diseases) are incomplete and need to be finalised.

The fact that these documents were either incomplete or in draft form does not mean that DPI&F staff did not have adequate training or experience in PPE, decontamination and field risk management or that they did not have adequate access to relevant documents. All DPI&F staff involved in the response had received appropriate training prior to being tasked with responsibilities and the guidelines for veterinarians (all versions) provide detailed information on workplace health and safety precautions as well as information on procedures and risks. The operating

⁶ Queensland Emergency Response Plan for Plant Pest and Animal Disease Emergencies (Version 4, November 2005).

procedures provide general information about specific topics that complement the guidelines for veterinarians, and may act as a reference source for questions on related matters such as maintenance of powered air-purifying respirators and in the development of training material. Nonetheless, it is acknowledged that having current versions of all operating procedures and relevant documents available at the beginning of a response is desirable and is an important part of effective risk management.

A biosecurity inspector with extensive experience and training in IP site supervision was involved as an addition to the team at the Redlands site and a number of relatively small changes or refinements were made to procedures at the site that collectively made an appreciable difference to the operations of the site. The impact of these changes was noted by both DPI&F staff and RVC staff. Changes included review and clarification of roles and responsibilities, adjustment of entry and exit points for entry into the quarantine or hot zone, and posting of check lists for staff to use to guide PPE and decontamination procedures.

The impact of formalisation of procedures over time and particularly during the first few days of the management change at the end of July, was noted by DPI&F staff and RVC staff during the course of this review. Much of this impact was in improvements in systems for recording and accessing information and in improved understanding of roles and responsibilities for some individuals either involved in or impacted by the response. The procedural formalisation changes were considered to have little impact on the timely completion of incident response activities including tracing, surveillance and effective control of the response.

There were a small number of situations where earlier adoption or implementation of more formalised procedures may have impacted events more directly. These are outlined below.

There were occasions where recommended procedures for PPE were not fully complied with by DPI&F staff. These included the use of a disposable P2 respirator by a bearded individual during sampling of horses when procedures indicate that an individual must be clean-shaven to ensure an effective face-seal with a disposable P2 respirator and that a powered air-purifying respirator (PAPR) is preferred for bearded individuals⁷. These recommendations have been strengthened in the current guidelines for veterinarians (Version 2.0) which states:

"Disposable P2 or N95 particulate respirators are only suitable for clean-shaven/non-bearded people as a facial seal is critical in ensuring respiratory protection. They depend on an effective seal with the skin of the face and will not provide P2 level protection if the wearer has facial hair including a beard, moustache, side burns or stubble growth. Hence, these people should not take part in any investigations unless different respiratory protection is used, for example a powered air-purifying respirator (PAPR)."⁸

As soon as this issue was identified, appropriate respiratory protection was provided and induction procedures were changed to ensure bearded individuals received appropriate advice and training.

⁷ Guidelines for veterinarians (13 February 2007), page 7

⁸ Guidelines for veterinarians (Version 2.0), page 21

DPI&F staff were observed on one occasion to not be wearing eye protection properly while inside the quarantine area at the RVC. In discussion with the individuals they reported that the goggles they were wearing were fogging up so badly that effective vision was impaired. As soon as this issue was identified procedures were changed to ensure that different types of eye protection were available and individuals could then choose eye protection that was appropriate for the tasks being undertaken and that was checked and fitted to ensure it functioned properly.

When incident control staff at ARI changed after the management change at the end of July, a decision was made to have several management staff from the control room visit the Redlands site to familiarise them with the site and meet individuals from the RVC. The visit did not involve activities that were essential to the response such as examination of horses or collection of samples or that were associated with risk of exposure to virus, and the individuals undertook appropriate biosecurity and safety precautions such that any risks were managed appropriately. While the value of the visit is not contested, it is on reflection not considered to be fully compliant with recommendations to minimise the number of people who may be potentially exposed and to limit the people on-site to those who are essential to the response⁹.

The above three examples were associated with a small increase in risk of exposure due to the non-complete compliance with recommended safety procedures. In all occasions the individuals were not performing high-risk procedures and the risk of exposure remained low. These examples involved highly trained staff and are examples of difficulties in ensuring full compliance with procedures as opposed to lack of awareness of procedures. However, it is considered likely that a more formalised induction process with review of safety procedures and accompanied for example by fit testing of PPE, would have minimised the risk of these occurrences.

There was some confusion over interpretation and application of the conditions of the quarantine notice that was attributed to the lack of detail provided in the conditions on the written quarantine notice that was served on the RVC on 7 July 2008 and again on 8 July 2008. The conditions of the quarantine notice have been reproduced elsewhere in this review (Section 11). The notice lacked details in the conditions under which various movements onto and off the site might be allowed to occur and also did not provide clear and explicit instructions on the role of DPI&F inspectors in supervising, enforcing, checking and authorising activities.

There were occasions where veterinary equipment was taken from the RVC site to another site. This involved cleaning and decontamination of the equipment under the direction of the site supervisor and was conducted in an appropriate manner. There were also a variety of movements off-site during the response including transport of horse bodies and removal of waste material, and movements onto the site including feed, bedding, portable yards and other equipment. These were also arranged with appropriate supervision and checking by DPI&F inspectors. The relevance of these matters is that the need for movements of material on and off the site, the conditions under which such movements might be permitted to occur and the appropriate person

⁹ Guidelines for veterinarians (13 February 2007), page 6

to check, supervise or authorise such movements, were not clearly specified in the quarantine order, leading to a potential risk for misunderstanding.

In addition, a horse float from the RVC site was moved at one stage and then returned to the site after instruction from the site supervisor. The float had been thoroughly cleaned and disinfected by both RVC staff and by the DPI&F site supervisor and there was negligible risk associated with the movement. There appeared to be uncertainty over whether the float could be moved and what conditions might have to be met or what type of approval was required for such movement. These situations were not associated with any disease risk but could have been prevented or better managed by having the quarantine notice provide more details on the conditions and in particular the process(es) for decontamination and biosecurity for movements (on-site and off-site) and other activities that may be expected to occur on-site. In addition the document may be expected to provide clarification of the role of the appropriate DPI&F person (site supervisor) either in performing procedures or in checking that decontamination and biosecurity procedures are being completed to a satisfactory level and the processes involved in obtaining permission for movements or other activities.

It is particularly important that the quarantine notice provide as much detail as is required to effectively manage the site and to ensure the property owner understands responsibilities. While there were DPI&F staff present at the Redlands site on an almost daily basis throughout the response, there was not a continual DPI&F presence ie on many days DPI&F staff came and went as required. It is considered that additional detail in the quarantine notice would provide practical information of value to both DPI&F staff and to the RVC staff to avoid misunderstandings about responsibilities, improve compliance and communication and more effectively manage risk. The same comments apply at the Proserpine site where visits by DPI&F staff were more intermittent.

It is considered that the support role of EMU staff with a focus on procedures, would have been beneficial had it been mobilised at the beginning of the response such that the changes and impacts described above that were observed at the end of July may have been achieved as the incident response team was being formed on 8 and 9 July 2008.

It is understood that Biosecurity Queensland is currently undergoing a structural change, moving from a regional structure to state-wide programs. These changes will have ramifications on the way that training and preparedness activities may be delivered and the way that emergency response operations may be initiated and managed. The EMU is understood to be playing an important role in preparedness including review of procedures in line with the proposed new structure. The importance of procedures in a scalable response system remains critical.

It is recommended that that appropriate DPI&F operating procedures are completed or reviewed, identified in manuals and plans, and implemented right from the beginning of an emergency response, acknowledging that these will depend on the scale and activities of the response and the nature of the risks being encountered.

It is recommended that procedures be reviewed to ensure that quarantine notices served on properties for the purposes of Hendra virus provide sufficient detail to cover expected activities and movements, the conditions under which they may be permitted or not permitted to occur and the role of DPI&F staff in performing, supervising, checking and approving activities related to the management of quarantine on the site.

It is recommended that consideration be given to the implementation of a form of review or audit of DPI&F procedures that may be performed by an individual independent of the response activities, with appropriate skills in response activities and procedures (such as EMU staff), and completed early in the operational phase of a response. This would ensure that any areas where procedures may be improved, are identified early and appropriate action undertaken.

15.4 Guidelines for veterinarians

The Hendra virus guidelines were developed to provide detailed advice to veterinarians on risk management of situations where Hendra virus is a suspect diagnosis.

The guidelines also provide disease-specific information that can be used in conjunction with other procedural manuals or documents for managing investigation, alert and operational stages of a response by DPI&F staff.

A printed copy of the guidelines for veterinarians was mailed to all registered veterinarians in Queensland in May 2005 and updated versions of the guidelines for veterinarians have since been maintained on the DPI&F web site.

The guidelines document is considered to be dynamic and is based on current scientific knowledge about the virus and experiences in investigating and managing the disease. The guidelines are intended to be updated as advances in knowledge and information become available.

The guidelines for veterinarians have had three versions available through the course of the responses at Redlands and Proserpine. The changes made to the guidelines for veterinarians have reflected the input of a variety of stakeholders through the working group that reviewed the guidelines and also information derived from the response itself and in turn based on observations of clinical signs and disease progression in horses and results of laboratory testing and post-mortem examinations.

All versions of the guidelines describe a case definition that is based on current knowledge and provide a framework for assessing the level of suspicion of involvement of Hendra virus.

The current guidelines for veterinarians (Version 2.0) are considered to represent a valuable and informative document that describes the shared responsibility between DPI&F and veterinarians in investigating and managing suspect and confirmed cases. They contain expanded or additional information in a number of sections that have resulted in improvement in the value of the document as a guide to veterinarians. These include:

- Sections 1 and 2 on purpose and scope that outline the shared responsibility between PVPs and DPI&F staff in investigating suspect cases of Hendra virus. The document clarifies the expectation that PVPs will manage investigation of suspect cases, the importance of dialog between PVPs and DPI&F, and a mutual agreement over responsibility for investigating highly suspect cases. DPI&F will play a lead role in managing a response once a Hendra case is confirmed by laboratory testing.
- Section 3 contains a step-by-step summary of procedures for a veterinarian to consider when investigating a horse that may have Hendra virus and each step is linked to a relevant section of the document that provides more detailed information.
- Sections 4 and 5 provide additional information on the background, epidemiology and case definition incorporating information derived from confirmed cases at Redlands and Proserpine as well as information from scientific literature and recent research.
- Section 5.1 is less prescriptive than information in the guidelines for veterinarians (13 February 2007) and outlines a broad framework that allows veterinarians to assess risk without having to assign a particular combination of specific clinical signs in order to achieve a defined level of risk. This change is considered appropriate given the variability in presenting clinical signs for horses that may be exposed to Hendra virus.
- Section 5.5 contains detailed information on workplace health and safety precautions, personal protective equipment and obligations under workplace health and safety legislation.
- Section 5.6 provides detailed information including a step-wise summary guide to sequence of events for investigation of suspect Hendra cases on a property. Each step in the summary guide is then related to a subsequent section where detailed information is provided.
- Section 5.7 contains information on biosecurity advice that can be provided to owners of horses by veterinarians undertaking an investigation of a suspect Hendra case.
- Section 6 describes the limited post mortem approach as used by Biosecurity Queensland staff when collecting samples for Hendra virus testing.

15.4.1 Content of the guidelines for veterinarians (Version 2.0)

The guidelines for veterinarians (Version 2.0) is considered to be an important document for all veterinarians including those who may not be regularly involved in providing services for horses.

The content of the document reflects advances in knowledge about the disease and input from stakeholders.

It is recommended that the guidelines for veterinarians continue to be the subject of review as required by a working group that includes representation from relevant industry bodies and in particular AVA and/or EVA.

It is recommended that changes suggested in this review document be considered for implementation in the guidelines for veterinarians.

Information on human exposure risk has already been discussed in a previous section. The guidelines contains brief information on human exposure risk in the last paragraph of section 4.2 and additional relevant information is contained in subsequent sections that is directed towards prevention of zoonotic risk (Section 5.5.2 for example). It is suggested that information from the recent Redlands cases be reviewed in discussion with medical officers from QH with a view to developing additional information on human exposure risk and incorporating that information into the guidelines for veterinarians. Of particular interest in terms of human exposure risk is the possibility of exposure to Hendra virus when performing veterinary procedures on horses that may be in the incubation stage of Hendra virus infection and not yet displaying overt clinical signs of disease attributable to Hendra virus.

A number of relatively minor changes are recommended for consideration in an attempt to make the guidelines for veterinarians easier to follow and use. All recommendations refer to sections and pages in the guidelines for veterinarians (Version 2.0):

- General comments
 - The last sentence of Section 1 indicates that the document will be updated as more knowledge becomes available. Consider adding the URL for the DPI&F web site where the current version of the guidelines can be found. The URL for the guidelines for veterinarians is provided in Section 4.8 of the document but the link could be more clearly labeled.
 - It is likely that some veterinarians may print copies of the guidelines for distribution to staff or to have on hand when internet access may not be possible (such as in work vehicles). It is very important that a clear message be conveyed that the document may change at any time as advances in knowledge become available and that users should visit the web site regularly to check the available version. This should be accompanied with a clear and easily understood system for recording versions and for communicating when changes have occurred.
 - Different contact details for users to reach DPI&F staff are provided in several places in the document. While it is considered appropriate to provide context specific contact details in different locations, consideration should also be given to providing relevant contact details in a separate section, perhaps by expanding Section 4.7 and making it clear that this section contains contact details. The URLs for relevant web sites may also be included here. In several places the document provides specific phone numbers other than the 132523 or 1800 675 888 for DPI regional or laboratory services for example. It is critical that these numbers be current. There is a reasonable argument for having contact details in a single location in the document so they can be easily checked and updated as required.
 - Information on training requirements and options for sourcing training in PPE and sample packaging and submission is also contained in several different locations in the document while there is a brief and clearly labeled section on training (Section 5.5.5). It is recommended that consideration be give to reviewing the presentation of training

information in the document and to aggregating the information in Section 5.5.5.

- Hyperlinks, Page 4
 - Include reference to this section in the Table of Contents
 - Include reference to the URL for the DPI&F web site where the current guidelines for veterinarians can be found
 - There is a note indicating that non-DPI&F personnel will not be able to access references that are located on the DPI&F intranet. Since this document is intended to act as a source of information for veterinarians, it is recommended that relevant references be made available to readers or that arrangements be made to ensure that relevant content from references is made available.
- Section 3, item 10, page 7
 - Item 10 indicates that all diagnostic results should be reported to QLD DPI&F. It is not clear what this requirement is intended to achieve or how it should be accomplished. It is understood that all samples for Hendra virus testing should be submitted through the DPI&F laboratory system and therefore DPI&F should be aware of the testing and the results. It is recommended that this item be reviewed and clarified.
- Section 4.2, page 8-10
 - There is unfortunately little validated information available about possible pathways of transmission between horses. While it is acknowledged that there was no spread from experimentally infected horses to adjacent control horses in experiments performed under controlled conditions, the occurrence of multiple cases at Redlands and Proserpine is suggestive of spread via direct contact, fomites or separate bat-origin exposures. If spread by fomites is being considered is there any reason that direct contact might be excluded. It is suggested that more detailed information on epidemiology and possible transmission opportunities from the two recent cases be included in this section. It is also suggested that a brief statement be included about the importance of infection control and biosecurity measures to prevent inadvertent transmission of infection through fomites or contamination of the environment as well as through direct contact.
- Section 4.4, page 10
 - The section is titled Training Requirements but may contain information that appears to be more related to the need for practices to develop appropriate operational plans and undergo preparedness training. There may be some inadvertent confusion between this section and the subsequent Section 5.5.5 that provides details on training for PPE. It is recommended that this section be reviewed and an alternative title considered.
- Section 4.6, page 11
 - It is recommended that additional details be provided on how a reader can determine when changes have been made to the guidelines for veterinarians and how the current version can be obtained. It is assumed that any change to the document will be associated with a new release and a new Version number and Issue Date. This needs to be clarified. In addition it is recommended that consideration be given

to providing a flag on the DPI&F web site informing readers when the guidelines have been changed and briefly identifying sections or content that have been changed.

- Section 4.7, page 11
 - It is recommended that contact details provided throughout the document be aggregated and provided in a single location. This Section appears to be an appropriate place but the Section heading may require revision.
- Section 5.5.3, page 20
 - The wording in the document relating to training could be made more informative, particularly the following text:
 - "Training is available from some suppliers of PPE and there are also some commercial providers that can be sourced through due enquiry."
 - It is suggested the information on training in PPE be aggregated to a specific section such as Section 5.5.5 and that wording be reviewed to provide clear information relating that training is necessary to use and maintain PPE effectively, that training should be sourced from an organisation or individual that is an accredited provider of safety training, and that such organisations or individuals may be located by contacting commercial providers of safety equipment or registered training organisations offering training in safety equipment. Mention could also be made of the link already active on the DPI&F web site to PPE information provided on the Department of Health and Aging web site.
- Section 5.6.1, page 22 (also relevant to 5.6.5 and 5.7)
 - Where properties contain more than one horse and the assessed risk of Hendra virus is higher in some horses than in others, activities should involve lower risk animals first and highest risk animals last. This is acknowledged as a general principle of dealing with an infectious condition. It is raised here in part because of concerns expressed by individuals during the consultation for this review. The same information may be appropriate for information released to horse owners in handling suspect cases.
- Section 5.6.6, page 31
 - The last line of this section indicates that samples should be refrigerated. It is not clear whether the instruction relates to all samples, and whether samples need to be refrigerated from the time of collection right through to receipt ie should couriers maintain refrigeration during transport, what temperature needs to be maintained and how it might most effectively be achieved. It is recommended that more detail be provided here to clearly indicate what is required from the time of collection of samples to the time of arrival at the DPI&F laboratory.
- Section 5.6.7, page 31
 - The section on disposal of a carcass provides general information about disposal by burial on-property but does not provide any information about off-property disposal. The guidelines for veterinarians (13 February 2007) contained a suggestion that if on-property disposal is not possible then officers from the DPI&F and the

EPA should be consulted about other options including safety procedures required to move the carcass and sites for disposal. It is recommended that consideration be given to provision of information concerning off-property disposal.

15.5 Appropriate veterinary hygiene standards for DPI&F officers

The phrase veterinary hygiene standards is interpreted as referring to general recommendations that are based on principles of risk assessment and risk management and that are aimed at minimising risks to health associated with exposure to infectious agents.

Reference sources considered relevant to this area include:

- AUSVETPLAN Operational Procedures Manual – Decontamination. Version 3.1, 2008
- AUSVETPLAN Operational Procedures Manual – Disposal. Version 3.0, 2007
- S. Williams (2003). Persistence of Disease Agents in Carcasses and Animal Products. AUSVETPLAN resource document.
- Code for Infection Control. AVA Policy, Section 3.3: Surgical and other veterinary procedures.
- Veterinary Field Investigations – Maintaining Biosafety. AVA Policy, Section 18.1: Other services provided by veterinarians
- Draft Commonly Adopted Hygiene Maintenance Standards for Equine Veterinary Premises in Australia¹⁰
- Guidelines for veterinarians (current version)
- Operating procedures intended for use within DPI&F including
 - Risk Management Plan for Field Veterinarians (Issue number 3, 11 January 2006).
 - Respiratory Management – Zoonotic Disease (Draft version, 12 June 2006).
 - Personal protective equipment and personal disinfection for zoonotic diseases (Draft version, 6 August 2008).

The guidelines for veterinarians (current version) in particular provides disease-specific content on hygiene standards of relevance to Hendra virus and is complemented by related DPI&F operating procedures. Information contained within the guidelines for veterinarians (current version) and operating procedures intended for use within DPI&F are consistent with the content of the relevant AVA policy documents and with AUSVETPLAN documents.

The operating procedures mentioned above are all considered to be under review and updated draft versions were completed during the Redlands response. This work is being completed by the recently formed EMU, that has support and emergency preparedness functions within Biosecurity Queensland.

¹⁰ Draft standards under development by Veterinary Surgeons Board of Queensland, October 2008.

These documents are considered to provide appropriate advice on hygiene standards for DPI&F officers operating in an emergency disease response directed against Hendra virus and other diseases.

There has been considerable interest in the broader issue of hygiene standards and principles of infection control for horse owners and veterinarians given their close contact with horses and potential for exposure to Hendra virus and other infectious organisms. There are concerns over diseases that may spread from one horse to another (contagious) as well as diseases that may spread from horses to people (zoonotic diseases). Hendra virus is obviously a zoonotic disease but there are other infectious diseases of horses that may be contagious to other horses and / or zoonotic (Weese, 2002).

The AVA policy documents above describe infection control practices for veterinarians. These are complemented by the draft hygiene standards that are currently under development by the Queensland Veterinary Surgeons Board. It is understood that further standards or guidelines for infection control are currently being developed by the Australian Veterinary Association and Equine Veterinarians Australia. Additional information on veterinary hygiene standards may be found on the web site of the National Association of State Public Health Veterinarians (NASPH), a North American peak body¹¹. There are also guidelines for horse owners titled *Hendra virus: important information for horse owners* that are available from the DPI&F web site, and have been produced by a working group involving representatives from DPI&F and peak bodies including the Queensland Horse Council (QHC) and AVA.

Guidelines for hygiene standards and infection control in veterinary practices and for horse owners is not within the scope of this review. The topic is mentioned here because of interest expressed by individuals through the consultation process of this review. The development of such guidelines is strongly supported and peak bodies are encouraged to work with appropriate groups including DPI&F and other individuals or organisations to develop guidelines that offer valuable information to their membership in helping to manage risks posed to horses and people by infectious diseases. These activities are important components of a shared responsibility between all stakeholders with an interest in horses.

15.6 Applicable workplace health and safety requirements for DPI&F officers

Occupational Health and Safety obligations are defined in the Workplace Health and Safety Act (1995) and associated Workplace Health and Safety Regulation (2008). Information on the legislation and obligations of employers may be found on the web site of the Queensland government Department of Employment and Industrial Relations (DEIR)¹².

¹¹ <http://www.nasphv.org/documentsCompendia.html>

¹² <http://www.deir.qld.gov.au/workplace/law/legislation/index.htm>

The general duty of care of an employer is to ensure the health and safety of persons to whom the obligation is owed and this generally includes employees and other persons who enter the workplace.

Where specific standards or codes of practice exist that define responsibilities and requirements for a risk-based approach to ensuring health and safety, then actions may be assessed against these specific requirements. Where such standards are not in existence then the duty of care is such that the employer must take into account known scientific knowledge to ensure adequate safeguards are taken to prevent risks to health and safety.

In this case the guidelines for veterinarians (current version) contain specific information on workplace health and safety precautions that are intended to be implemented when an investigation proceeds or where there is contact with known Hendra virus cases.

The information in the guidelines for veterinarians (current version) is complemented by additional details in operating procedures that have been described in previous sections of this review.

The information in the guidelines for veterinarians (current version) and related operating procedures is considered appropriate for workplace health and safety requirements for DPI&F officers.

There was one workplace incident involving a DPI&F officer during the response that constituted a notifiable incident under the Workplace Health and Safety Regulation (2008). This was described in an earlier section of the report and was associated with a needle stick injury incurred by a DPI&F veterinary officer during euthanasia of a Hendra positive horse at the RVC. The incident resulted in the officer being hospitalised as a precaution because of exposure risk, meeting the definition of a dangerous event under the Regulations. The incident was reported to Workplace Health and Safety Queensland and an incident prevention review process has been initiated within DPI&F to investigate the incident.

There were occasions where safety precautions and compliance with PPE recommendations were observed to be less than optimal. These have been described elsewhere in this review. There were also occasions where individuals suffered from other illnesses (flu-like symptoms) after working on response activities. None of these situations resulted in work-caused illness or injury and these do not constitute notifiable incidents. It is conceivable that some of these events may be interpreted as non-notifiable incidents under the Regulations on the grounds that they may have involved exposure of persons to risk to their health. The Regulations indicate that non-notifiable incidents should be brought to the attention of the employer and investigated. All of the events that have been identified in this review were brought to the attention of the relevant supervisor or incident controller and resulted in investigation and changes where appropriate to ensure compliance with recommended procedures.

15.7 Communication with private veterinarians, owners of affected animals and other stakeholders

Communications with the principal of the RVC, the owners of the horses at Proserpine, relevant government agencies and representatives from peak industry groups were initiated as soon as positive test results were reported.

Communication with owners of affected horses and other individuals linked to the infected premises (owners of in-contact or companion horses, providers of services to the clinic and other individuals and organisations) was managed mainly by the incident response team and involved collection and assessment of information about risk and a prioritised approach to contacts that started first with higher risk contacts and worked through the list.

Experiences in the equine influenza outbreak identified the benefit of appointing liaison officers who were independent from all response activities and who could provide valuable communication services to stakeholders. These individuals would be expected to be able to discuss legislative and quarantine issues, workplace health and safety issues and technical information about the disease and biosecurity precautions, as well as information about the response activities. Separation of liaison functions from response activities has a beneficial impact on the flow of information. These officers also provide a valuable two-way flow of information with feedback from stakeholders contributing to identification of issues, initiation of further information for release and to initiatives such as frequently asked questions (FAQs).

Veterinary liaison is also very important given the critical roles that PVPs play in investigation of suspect cases and in response activities in some cases as occurred in the Redlands incident. General comments about separation of liaison functions from response activities as outlined above are considered to apply in more technical liaison roles as well. Communication and liaison activities are outlined in a general way in AUSVETPLAN and Biosecurity Emergency Operations Manual.

A veterinarian was appointed to a veterinary liaison position in early August. Early appointment of a veterinary liaison officer in a future response is considered likely to be beneficial in maintaining communication with veterinary stakeholders.

It is recommended that procedures relevant to liaison officers be reviewed and more information provided on the roles of liaison officers as conduits of information flow to and from relevant stakeholders. This should include review of induction and training, and information and other material they should have either available to them or access to during the response. Consideration should be given to the early appointment of liaison officers with communication roles that are independent of response activities.

A number of veterinarians expressed concern that communication of information through the AVA and EVA would only reach current members of those organisations and that there are substantial numbers of veterinarians registered in Queensland who may not be current members of these organisations. The use of email addresses provided by the VSB–QLD allowed communication to be extended to those veterinarians registered in Queensland who had given permission for their contact

details to be used for disseminating information about emergency animal diseases. Information was first sent to the list of veterinarians from the VSB–QLD on 5 August 2008. Earlier activation of the request for use of email addresses from the VSB–QLD would have assisted in the dissemination of relevant information to those veterinarians who had permitted this use of their contact details.

There was concern over the altered presentation of cases at Redlands with horses showing neurological signs and little evidence of acute respiratory disease that had previously been reported as an important indication of suspect Hendra disease. Information about the neurological presentation was released through a variety of avenues as it became available including media releases and interviews and printed reports and documents. Summary information on clinical signs and progression of cases was contained in reports that were sent by email to peak bodies on 9 July and mounted on the DPI&F web site on 10 July 2008. Further information was included in revised guidelines for veterinarians and horse owners.

Interest has been expressed by some veterinarians in accessing detailed health records for confirmed Hendra cases that had been in the RVC or accessing detailed lists of clinical signs observed in cases over time. There are understood to be a range of issues that appeared to constrain the release of detailed records including for example principles concerning the release of personal information under privacy laws and matters relating to legal and insurance issues. The most appropriate manner in which information might be released is believed to be through the initial investigations of the DPI&F incident response team including in particular the work of veterinary officers and veterinary epidemiologists in reviewing health data for confirmed cases (in this case from health records from the RVC and discussions with RVC staff), and other relevant information. Summary information of clinical signs and disease progression can then be provided by the DPI&F to stakeholders including veterinarians. This process is important because it involves assessment and collation of information and minimises the risk of release of misleading information.

It is noted that timely release of relevant information about cases of Hendra virus, including summary information on clinical signs and progression of disease over time, is very important for all stakeholders, particularly when the clinical presentation of the disease appears to have changed.

Electronic communication via emails and in particular through mounting information on the DPI&F web site offers tremendous flexibility and responsiveness for movement and collection of information. The Hendra virus web pages on the DPI&F web site are considered easy to navigate to – either through a direct link on the home page of the DPI&F site or by navigating through other sections (either biosecurity or animals and animal health). The amount of information on the DPI&F web site that is related to Hendra virus has increased over time, reflecting the level of awareness, interest and knowledge about the virus and disease.

The web site was used for mounting information about the response including media releases, fact sheets, CVO updates, links to information on submission of samples to DPI&F laboratories including downloadable submission forms, and other information of value to stakeholders including links to information on PPE.

There are opportunities for additional information of value to stakeholders to be placed on the web site for public viewing including a frequently asked questions (FAQ) section, and links to information on bats displayed on other web sites such as the EPA¹³. The reviewer is aware of internal DPI&F assessment of the use of the web site in emergency animal disease responses and attended a stakeholder meeting at which this issue was discussed. Initiatives to improve the way information is displayed on the web are supported.

A number of individuals have expressed a desire to see the web site provide information alerting viewers to when changes have been made to particular documents available on the web (alerts or flags). Depending on the size and complexity of an individual document it may be appropriate to summarise briefly the changes that have occurred so a viewer can determine if the changes warrant a new download or more detailed review of material. These initiatives would need to be coupled with a standardised approach to document tracking and version description which has already been implemented for the guidelines for veterinarians for example. These developments would make it simpler and quicker for a viewer to visit the site and determine if any new information has been added and how important it might be.

It is recommended that management of the DPI&F web site consider the implementation of display of document tracking information on the web, flags or alerts to inform viewers when information has changed and for longer documents such as the guidelines for veterinarians, summary information to indicate the nature of the changes. Consideration should also be given to adding further information to the web site including for example FAQs, links to information on bats, descriptive summaries of past cases. Other recommendations relating to flow of information to stakeholders are also relevant to the web site.

There were a small number of concerns expressed over difficulties encountered by individuals in contacting appropriate DPI&F staff through the Business Information Centre and the after hours call centre. The scale of the DPI&F and movement of individual staff between tasks, vacations, and people leaving or joining the organisation, and the possibility of changes in direct contact numbers as a result of these events or due to other reasons, mean that a single point of contact through widely advertised numbers remains the most efficient mechanism for reaching DPI&F staff. DPI&F is contactable through these services at all hours. For after hours calls scripting is used by telephonists to assess information provided by the caller in order to determine whether to escalate a call immediately or to take a message for DPI&F staff to return the call the following working day.

One call was identified from a veterinarian that was made to the after hours service on a Saturday morning. The veterinarian was contacting the service to discuss a suspect Hendra virus case. The call resulted in a message being taken and a return call was made to the veterinarian on the following Monday. This call is acknowledged by the DPI&F as an error in procedure and should have been escalated on receipt through existing procedures to ensure that a DPI&F officer returned the call. A review is being completed as a result of this event to check and modify scripting procedures for call centre staff to prevent this from happening again and ensure that calls from

¹³ http://www.epa.qld.gov.au/nature_conservation/wildlife/living_with_wildlife/flyingfoxes

veterinarians and calls concerning emergency animal diseases such as Hendra virus are responded to in a timely manner.

There are also steps that can be taken by the caller to ensure that the message being received by call centre staff is clear and to minimise any risk of miscommunication. There are instructions in the guidelines for veterinarians (Version 2.0) that indicate that a veterinarian calling the Business Information Centre or the after hours service should:

"Clearly state to the person answering the phone, that you are a veterinarian ringing in to notify a suspect case of Hendra virus."
page 15, Section 5.3, Guidelines for veterinarians (Version 2.0)

There were other reports of occasions where calls from veterinarians to the after hours service were not escalated immediately. A veterinarian reported calling the after hours service to discuss a case prior to leaving the practice to visit the case. The call resulted in a message being taken with a return call being placed by DPI&F during business hours. It is understood that changes to the scripting for telephonists will clearly indicate that all calls from veterinarians are to be escalated and this should improve responses in these situations.

There were occasions where calls to the after hours service resulted in some difficulties in patching the call through to an appropriate person and on occasion loss of the call. In these cases, messages had been collected by the call centre and calls were returned to the calling party by DPI&F staff during business hours. It is acknowledged that these situations are frustrating.

There were also reports of delays or difficulties in contacting appropriate or specific individuals through the Business Information Centre. These issues are also acknowledged as frustrating; however, contacts with any organisation or individual are not always immediately successful for a variety of reasons.

16 Submission from the Australian Veterinary Association (AVA) and Equine Veterinarians Australia (EVA)

The AVA and EVA have collaborated in making a submission to the review. The submission contains 16 recommendations. These are presented below with responses for each item.

It is important to note that the following 16 items represent recommendations as received from the AVA/EVA. They do not necessarily represent recommendations of

this review. The text following the 16 items contains the views of the reviewer including recommendations where appropriate.

AVA/EVA recommendations 1 and 2:

1. *Ensuring an informed veterinary profession which is presented with, or has access to, timely, up-to-date, accurate and relevant information is a key factor in successfully managing disease outbreaks. We recommend that Queensland DPI&F ensure that critical information is made available to the profession throughout any future Hendra outbreak to enable veterinarians to respond effectively to the threats and challenges posed by this virus.*
2. *The essential information required by veterinarians includes: reports on the most recent specific clinical signs of the disease; up-to-date guidelines for veterinarians and for their clients for managing the risks of the disease; timely reports on the location of reported cases and infected properties; timely reporting on horse movements from infected properties; and timely reporting of post mortem results.*

The first two recommendations are considered together. In responding to any emergency animal disease situation the DPI&F does undertake to provide relevant information about the disease and the response activities to all stakeholders including veterinarians.

It is recognised that there is interest and value in timely reporting of clinical signs, progression of disease and results of additional procedures such as post mortem examinations. In the Redlands incident summary information on clinical signs associated with the neurological presentation of cases at Redlands was released through a variety of avenues including face-to-face discussions with stakeholders on 9 July 2008, through documents sent by email to peak body representatives including AVA on 9 July 2008, by posting information on the DPI&F web site on 10 July 2008 and through media interviews. Post mortem examination reports take longer to complete particularly with consideration of time taken for ancillary procedures performed in the laboratory on samples collected in the field.

It is important that information not be released without appropriate assessment as part of the initial investigation. The most appropriate way to release clinical information is considered to be through the DPI&F as a result of initial investigations performed during response activities. It is suggested that DPI&F review procedures to facilitate rapid release of appropriate summary information describing clinical signs and progression of signs in confirmed cases. The same approach can be applied to release of information from post mortem examinations with initial results of gross examination of the carcass followed by a later report including results from laboratory procedures. It is suggested that consideration be given to a case by case description for confirmed cases given that the number of confirmed cases in any incident to date has been relatively low in comparison to highly contagious diseases such as equine influenza. There is considered to be value in development of descriptive reports describing signs, progression of disease and post mortem results for some or all historical cases as well. In some cases there may be existing reports that may be referenced, linked or displayed on the DPI&F web site. Consideration may be given to

involving owners of affected horses or veterinarians who have had direct experience in managing Hendra cases to contribute to brief descriptions of cases. One owner of a confirmed case has recently published an informative book outlining her experiences through the traumatic events surrounding the death of her horse as a result of Hendra virus (Crane 2008).

Guidelines for veterinarians and other information available on the DPI&F web site is intended to provide current and useable information for stakeholders. Material is updated as new information becomes available. The guidelines for veterinarians was updated twice through the course of the responses at Redlands and Proserpine to reflect new information and knowledge obtained as a result of the response and through consultation with stakeholders. The review process involved in updating the guidelines including consultation with stakeholder representatives, involves time. More urgent information such as the changes observed at Redlands in clinical signs of confirmed cases, is better communicated directly in separate documents or reports that can be prepared with shorter time frames. This is the approach that was applied in the response.

Information about locations of infected premises and movements of in-contact or at-risk animals is collected during response activities undertaken by the DPI&F. Every effort is made to rapidly implement response activities including tracing animals that may be at-risk and to assess the risk of potential exposure and respond accordingly. These are all core components of any response to an emergency animal disease. There are privacy concerns that constrain the release of such information. It may not be appropriate for precise details of the location of infected premises or animal movements to be released during this process.

It is understood that the motivation and interest from the profession in receiving detailed information on location of infected premises and of horse movements from infected premises is to allow veterinarians to identify horses that may have elevated risk in association with a particular infected premise and to manage them appropriately. As discussed in Section 15.2 it is suggested that veterinarians (and other providers of services to the horse industry such as veterinary nurses and dentists and indeed all people interacting with horses) develop a risk based approach to minimise the exposure risk for Hendra virus in all horses including recognition that there may be exposure risks from performing procedures on apparently healthy horses.

It is recommended that DPI&F work with AVA to review and agree on procedures for timely reporting during a response of clinical signs, progression of disease and results of additional procedures such as post mortem examinations.

AVA/EVA recommendations 3 and 4:

- 3. We further recommend that Queensland Veterinary Surgeons Board (QVSB) adopt an opt-out email notification system whereby all registered veterinarians in Queensland are immediately notified of relevant information on emergency animal disease such as Hendra, except in the case where they have elected with the QVSB not to receive such information. The current opt-in system, where registered veterinarians must elect to receive critical information does not ensure universal*

coverage to the whole profession of critical emergency disease information.

4. *Close cooperation between QSVB and the Queensland DPI&F is also required to ensure that information is made available to QSVB immediately upon identification of a Hendra threat. Approximately 50% of veterinarians are not members of AVA and therefore do not benefit from AVA emergency communications. AVA recommends that all registered veterinarians should have access to relevant comprehensive and timely information on all emergency animal diseases, such as Hendra.*

Items 3 and 4 are considered together.

The fact that veterinarians registered to practice in Queensland are not all members of the AVA means that information disseminated through the AVA does not reach all veterinarians. The use of email addresses provided by veterinarians to the Veterinary Surgeons Board of Queensland to disseminate information on emergency animal diseases is strongly supported as a means of extending lines of communication to as many veterinarians as possible. Other avenues including web site information, media releases and general news items are all valuable potential mechanisms by which registered veterinarians may be informed about emergency animal diseases. It is important to note that since no single avenue appears likely to reach all relevant veterinarians, that all avenues for notification and awareness need to be explored and used where appropriate. Veterinarians and other stakeholders may become aware of an emergency disease event from a news item and then seek further information from a peak body or the DPI&F.

It is understood that the renewal form for the Veterinary Surgeons Board of Queensland has already been altered to move towards an opt-out system with the only specific additional requirement being that individuals do have to provide their email address on the renewal form for this system to be functional.

It is also understood that the procedure to date has involved the DPI&F requesting a list of email addresses from the VSB–QLD and then the DPI&F managing the sending of information.

It is recommended that DPI&F and VSB–QLD work together to develop procedures to ensure that a current list of email addresses for those veterinarians that have consented to have their email addresses used for emergency animal disease information, is provided to the DPI&F either as early as possible after confirmation of an emergency disease case to facilitate communication or on an annual basis after renewals have concluded.

It is recommended that DPI&F and appropriate peak bodies consider options for improving the coverage rate to veterinarians and allowing sign-up for emergency animal disease information at any time. The VSB–QLD option only allows veterinarians to sign-on for communications on an annual basis. There may be an alternative option that allows veterinarians to sign-on at any time or to provide updates of changes in contact information. This could be achieved by adding functionality to a web site to allow individuals to sign-up for information.

It is very important that all relevant stakeholders have access to current information on emergency animal diseases. Biosecurity is a shared responsibility and all peak bodies have roles to play in raising awareness and member commitment to biosecurity. The DPI&F web site is a logical starting point and a highly efficient way to mount information on emergency animal diseases. Web sites and communication and awareness activities from all relevant peak bodies are also important.

AVA/EVA recommendation 5:

5. *While not all veterinarians are AVA members, the AVA is a trusted and professional source of information for member veterinarians nationwide. It is recommended that AVA is included in all emergency communications to provide access to the broader profession outside Queensland, but also to enable the association to provide support other than communication and information to Queensland veterinarians facing emergency situations. This might include mobilising additional expert support or assistance from the profession to members in need.*

AVA is recognised as the peak body representing member veterinarians from across the country and the importance of AVA participation in a range of activities associated with biosecurity is acknowledged.

AVA/EVA recommendation 6:

6. *Ongoing communication during emergency animal disease outbreaks, such as Hendra, is critically important. AVA recommends that Queensland DPI&F continues to update its website immediately on receipt of key information to ensure veterinarians can access the latest developments. We further recommend that DPI&F include a 'vet-only' section of its website to ensure appropriate information is made available for vets and that vets can report relevant information back to the DPI&F. Queensland DPI&F should also liaise with any other affected states to ensure that those states can update key information in a timely manner.*

DPI&F staff undertake to provide relevant information on emergency animal diseases in a timely manner and particularly during a disease response. There are existing mechanisms for communication between DPI&F and other relevant government agencies both within Queensland and in other states and with national agencies such as the Department of Agriculture, Fisheries, and Forestry (DAFF).

It is assumed that the vet-only section of the web site mentioned in the above item refers to a secure section of the site that only veterinarians can access. While this is technically feasible, it is not clear what information might be made available to veterinarians only through a restricted access 'vet-only' web site. This implies that such information may not be appropriate for release to other stakeholders including members of the public. While it is accepted that some technical information about particular diseases for example may be of more interest to veterinarians, there is no reason to restrict non-veterinarians from accessing such information. In general, the approach preferred by the reviewer is to make information available to all stakeholders in the way that it currently is. Some information may be labeled for

veterinarians and contain more technical content but all stakeholders are able to access all information.

There are existing avenues for all stakeholders including veterinarians to report relevant information to the DPI&F either about emergency animal diseases or other issues.

It is recommended that the AVA as the peak body representing member veterinarians, continue to work with DPI&F to ensure effective communication with veterinarians and to explore options for further development and improvement of communication.

AVA/EVA recommendation 7:

7. *We recommend that Queensland DPI&F has one emergency number for veterinarians to call during disease outbreaks which is available 24 hours a day with a dedicated veterinary resource to respond to enquiries and provide technical information. It is important that veterinarians are able to access advice from Queensland DPI&F on emergency situations on a 24 hour basis so that they can respond appropriately to potential disease threats within the community.*

Queensland DPI&F has existing systems that allow telephone contact 24 hours a day for the purposes above through a small number of contact numbers. A single number (132523) provides an effective point of contact for all calls from within Queensland. There is also a national hotline number (1800 675 888) that offers a free call from anywhere in Australia and that is forwarded to the Queensland centres once an individual nominates Queensland as the state concerned. The system includes procedures for contacting appropriate DPI&F officers to respond to after hours calls. This system is considered to be the most efficient and effective approach to contacting DPI&F.

Information collected in the course of this review identified one occasion where the after hours call centre systems did not escalate a phone call from a veterinarian concerning suspect Hendra virus in a horse. This event has triggered a review and changes in procedures to ensure that all calls from veterinarians and calls concerning Hendra or other emergency animal diseases are escalated appropriately.

There are occasions where calls to the DPI&F result in messages being taken and calls being returned by DPI&F staff. It is understood that calls from veterinarians will be escalated by the after hours service to ensure that veterinarians are able to speak with an appropriate DPI&F officer as soon as possible.

It is very important that feedback and particularly complaints involving failure to establish telephone contact with the DPI&F be provided through the existing compliments and complaints form¹⁴ to ensure that any problems are identified and appropriate corrective action taken.

¹⁴ http://www.dpi.qld.gov.au/cps/rde/dpi/hs.xsl/31_88_ENA_HTML.htm

AVA/EVA recommendation 8:

8. *AVA recommends that a 'stall-side' test be developed in conjunction with the Australian Animal Health Laboratory (AAHL) to assist with the rapid detection of Hendra. This would provide a level of assurance to veterinarians in managing suspect cases and would aim to give an immediate indication of whether Hendra virus is present. AVA has already discussed this issue with AAHL and the support of the Queensland DPI&F in the development of this test would be invaluable.*

Field tests offer the potential for rapid results being generated at the property while a suspect case is being examined or alternatively at a veterinary practice within a short period of time after examining a suspect case.

Development and application of field tests provides a number of challenges that must be adequately dealt with including for example: technical challenges in developing a test that: has adequate performance in terms of sensitivity and specificity; is robust enough to be used in the field under less than ideal conditions; is cost-effective; has sufficient shelf-life to ensure it is practically useful; and, is supported by procedures and policies that cover all possible test outcomes.

Field tests to date have generally not provided the same level of sensitivity and specificity as tests that might be performed in a diagnostic laboratory under controlled conditions and by highly trained staff. This means that there may be a risk of false positive (uninfected animals that return an apparent reactive test result) or false negative (infected animals that return an apparent non-reactive or negative result) results or equivocal results associated with field tests.

Field tests are therefore not likely to allow completely accurate and timely classification of animals as positive or negative while the veterinarian is on the property. They are likely to have test properties and other characteristics that make them applicable under certain situations for defined purposes and only when supported by additional information and actions including follow-up testing performed in a laboratory to confirm interim results.

Development of field tests is considered likely to take considerable time.

The most effective method that can be implemented immediately by veterinarians for minimising risks of exposure to zoonotic diseases such as Hendra virus is considered to be through the development of risk-based biosecurity procedures based on assessment of risk and appropriate use of PPE and decontamination when dealing with horses.

The development of field tests for Hendra virus is supported in principle recognising that this is a longer term objective that is based on availability of funding and appropriate research expertise and that there are uncertainties over whether a suitable field test may be developed.

AVA/EVA recommendation 9:

9. *AVA recommends that PCR testing is available on a 24 hour basis to ensure a fast turn-around for results. The availability of timely and*

accurate test results is a key factor in assisting veterinarians to better manage disease outbreaks.

The desirability of rapid test results is acknowledged and supported.

Horse samples submitted to the DPI&F are currently sent on to the QHSS laboratory at Coopers Plains for real time PCR (TaqMan) testing. Testing can be completed within hours of receipt of a sample under optimal conditions though testing may take longer for some cases for example where there are equivocal results on initial testing resulting in a need for follow-up or supplemental testing procedures to be performed. There is a prioritisation process that is currently applied to determine the level of urgency for testing based on the level of suspicion of Hendra involvement in horses and the possible human exposure risk associated with the case(s). This assessment is done by the DPI&F in discussion with the submitter (usually a PVP) and QH. After hours testing is provided when cases are determined to involve sufficient suspicion and exposure risk.

In many instances testing for Hendra virus using real time PCR testing appears to be relatively straightforward and produces unequivocal results. However, all diagnostic tests do on occasion produce equivocal results, involving additional time for re-testing or supplemental testing procedures and in some cases requiring additional samples to be collected. The point of this is that on occasion final test results are not available for some time even under optimal conditions. Some tests take a long time to perform such as the Serum Neutralisation Test and virus culture.

The most effective approach that to managing risk that can be implemented immediately in suspect cases of Hendra is the use of risk-based, precautionary biosecurity measures prior to collection of samples and therefore prior to diagnostic testing.

Availability of diagnostic testing is discussed further in the response the AVA/EVA recommendation 11.

AVA/EVA recommendation 10:

10. AVA recommends that a dedicated team of veterinarians be identified, trained and made available to assist Queensland DPI&F with post mortems on suspect or confirmed Hendra cases. The conduct of post mortems can be a high risk activity and only veterinarians properly equipped and trained to undertake this procedure should do so.

Hendra virus is an endemic disease and effective preparedness for and response to future cases of Hendra virus involves all stakeholders with an interest in horses. The involvement of AVA and other peak bodies in working with DPI&F to raise awareness and preparedness for Hendra virus and other emergency diseases is applauded and strongly supported.

It is considered appropriate for all veterinarians who may encounter horses in the course of their day-to-day activities to be aware of Hendra virus, associated risks of exposure for other animals and people and to be able to assess risk and respond accordingly. Veterinarians should be trained in appropriate safe work practices

including use of PPE and decontamination before undertaking high risk procedures such as post mortem examination of suspect Hendra cases. Additional training may be required in areas such as how to perform a limited post mortem for suspect Hendra cases and collection, packaging and shipment of samples.

Involvement of a peak body such as AVA in assisting in the raising of awareness amongst members about Hendra virus and other emergency animal diseases, and in facilitating training and preparedness activities in collaboration with DPI&F and other providers, is welcomed and supported.

AVA/EVA recommendation 11:

11. All diagnostic animal health laboratories should be encouraged to implement operating procedures to allow rapid screening for Hendra suspects and if negative safe and efficient processing of other diagnostic tests to determine the cause of the Hendra like clinical signs. Limiting the Hendra testing to Queensland Health labs is not assisting in the diagnosis of non Hendra illness and could lead to under reporting of suspect cases. Hendra exclusion testing capability should also be established in all DPI&F regional animal health laboratories.

It is understood that rapid testing for Hendra virus by real time PCR is capable of being deployed in most diagnostic laboratories provided that laboratory facilities are appropriately designed and constructed for biocontainment purposes, adequate procedures can be implemented for biosecurity and workplace safety, suitable equipment and skilled staff are available to perform the tests, and sufficient support is available both within the laboratory for ongoing quality assurance and from other reference laboratories such as AAHL for ongoing support and quality assurance.

It is understood that in the 12 months between the positive Hendra case in Queensland in July 2007 and the first positive case at Redlands in early July 2008, the QHSS laboratory at Coopers Plains performed Hendra testing on a total of 9 horses and all returned negative results. This is a crude estimate of the background level of Hendra exclusion testing at that time.

There has been a large increase in the number of horse samples being submitted for Hendra virus testing since the confirmed cases at Redlands and Proserpine. The increase in testing may indicate that the level of testing prior to the Redlands cases (9 horses in a 12 month period) represented a lower than desired rate of investigation, and it may reflect some level of over testing due to heightened awareness and concern about the disease as a result of events at Redlands and Proserpine. It is important that Hendra virus testing be completed on all cases where it is deemed appropriate based on the initial investigation by a PVP.

Once a decision is made to submit samples for Hendra virus testing it is considered appropriate that testing for any other conditions not be progressed until such time as a negative result is obtained for Hendra virus. It is recognised that this may delay progression of other diagnostic testing and on occasion may mean taking additional samples but this is justified by the importance of applying appropriate biosecurity measures to minimise inadvertent risk of Hendra virus exposure.

It is considered essential that samples for Hendra virus testing be submitted through a system that ensures notification of the DPI&F of the case under investigation and of test results. This is essential because of the importance of Hendra virus and the responsibilities of the DPI&F in providing support and assistance for PVPs in investigating suspect cases and in initiating a timely response if a confirmed positive result is reported. The current system requiring that samples for Hendra testing be submitted through the DPI&F is failsafe method of ensuring that the relevant agency is aware of testing and of results.

The diagnostic testing service being provided to DPI&F and industry by the QHSS laboratory at Coopers Plains is considered to be of the highest quality. There are unfortunately cost implications in expanding the diagnostic testing services for Hendra virus to all DPI&F laboratories. Increasing the number of laboratories that provide diagnostic testing services for Hendra virus may shorten the time period in some cases from collection of samples to reporting of results but this may not necessarily be directly associated with a reduction in the risk of exposures associated with horses that may be infected with Hendra virus.

It is critical to note that availability of diagnostic aids including field tests and rapid laboratory-based testing are all most effectively used as aids to the early implementation of precautionary biosecurity measures based on the initial risk assessment. Any diagnostic test is likely to be performed after an initial examination and collection of samples from the animal. These procedures represent exposure risk if an animal is suspected of being a Hendra virus case.

The most effective method for veterinarians to manage suspect Hendra cases is to manage a suspect case and other horses on the property based on the level of risk identified through the initial investigation. Every effort should be made to implement appropriate risk-reduction measures right from the time that Hendra virus is first identified as a possible diagnosis and ideally before suspect horses are examined and diagnostic samples collected. These measures should then be continued until such time as diagnostic test results are returned or when ongoing risk assessment indicates that the risk of Hendra is low for example when another cause of illness becomes apparent through investigation of the case.

It is acknowledged that there are additional delays from time of sample collection to testing for samples coming from far northern Queensland for example compared to samples from south eastern Queensland. These delays are mainly associated with time to transport samples. It is understood that one of the benefits of having testing services at the QHSS laboratory in Coopers Plains as opposed to sending all samples to AAHL for testing is the shortened time from sample submission to reporting of results which is due largely to additional transport time required to ship samples to Geelong.

It is recommended that consideration be given to the benefits and costs of offering Hendra diagnostic testing at a laboratory in north Queensland such as the Oonoonba laboratory at Townsville, acknowledging that primary focus on risk management should be directed at the early implementation of precautionary biosecurity measures appropriate for the assessed level of risk for all interactions with horses.

It is suggested that the more urgent priority is to focus on effective risk management measures to reduce exposure risk to animals and people that are implemented prior to diagnostic testing and that are continued until diagnostic test results are reported. Increasing availability of diagnostic testing services does not address this risk effectively and therefore may involve considerable additional expenditure without a commensurate reduction in exposure risk and improvement in management of suspect and confirmed cases.

AVA/EVA recommendations 12 to 14:

- 12. AVA recommends that the Queensland Government raises the profile of the importance of biosecurity in managing Hendra throughout Queensland and that DPI&F promote the benefits of appropriate biosecurity practices to both the community and veterinarians.*
- 13. Veterinarians who deal with zoonotic disease require specific biosecurity training such as the use of personal protective equipment. AVA recommends that DPI&F provides resources for veterinarians who wish to better understand biosecurity procedures relevant to Hendra. This should be linked with the Animal Health Committee initiative to develop emergency animal disease training that includes the Australian Veterinary Reserve, Rapid Response teams and Biosirt. Specialised biosecurity and infection control programs that can be disseminated to veterinarians and horse owners will elevate Australia's biosecurity preparedness. The AVA is well placed to assist with this important initiative.*
- 14. AVA is already doing its part to respond to new demands on the profession presented by Hendra and is securing support from all levels of government to address the issues. Initiatives currently in planning include a statewide travelling seminar series in Queensland and the development of national guidelines for infection control that include measures to defend against the spread of specific zoonotic diseases such as Hendra.*

Items 12, 13, and 14 are considered together.

These items are strongly supported with some provisos.

Raising awareness and education about Hendra virus is a shared responsibility. The DPI&F directs significant resource towards raising awareness about emergency animal diseases and biosecurity. This is reflected in the various documents and information made available by the DPI&F, DPI&F support of industry bodies such as the Queensland Horse Council and through ongoing relationships with all relevant peak bodies. All representative bodies that are concerned with horse activities are considered to have a shared responsibility in raising awareness amongst their members and the broader community about Hendra virus and other diseases.

It is critical that all people who interact with horses have an awareness of the risks and in particular those risks associated with zoonotic diseases including Hendra virus. People engaged in higher risk activities and particularly veterinarians may be expected to have a higher level of technical awareness and training in preparedness for being involved in investigating suspect Hendra cases. However, all interested

individuals should be encouraged to actively seek information and training that may help them manage risks for diseases such as Hendra virus.

It is considered important for veterinarians and other individuals involved in activities that may be associated with a higher risk of exposure to potentially infectious biological material (such as horse dentists and veterinary nurses for example) to have completed training in PPE and decontamination procedures.

It is also important to note that DPI&F is not a registered training provider and is not accredited to provide training on PPE. DPI&F arranges for relevant training to be provided for all DPI&F staff mainly by outsourcing training expertise from registered training providers. Training in PPE for example is achieved by outsourcing training expertise from accredited, commercial providers of safety training.

It is understood that DPI&F staff have provided advice and demonstrations on use of PPE and decontamination in a number of situations including to veterinary students and at veterinary practices. Information prepared by DPI&F including the guidelines for veterinarians also provides a valuable source of information for veterinarians on these matters.

It is recommended that initiatives be progressed through the joint involvement of DPI&F and a range of industry bodies such as the AVA and Animal Health Australia, and accredited providers of safety training for the development of training and preparedness programs for veterinarians and that similar initiatives be progressed with appropriate industry bodies for all people who interact with horses. It is considered important that training is tailored to the needs of the relevant user, available to all relevant people, and that training may incorporate information relevant to biosecurity measures for other diseases in addition to Hendra virus.

The responsibilities of veterinarians, DPI&F, AVA, Animal Health Australia and other industry bodies in developing, funding and facilitating the delivery of such programs will need to be clarified and agreed. There is justification for DPI&F involvement in these activities through its biosecurity responsibilities and through public good and market failure arguments. A similar argument can be made for involvement of Animal Health Australia through its roles in emergency disease preparedness programs including training. Since Hendra virus is an endemic disease and veterinarians may therefore encounter the disease while performing routine veterinary services for horse clients, it would appear that veterinarians have obligations under the Workplace Health and Safety Act (1995) and associated Workplace Health and Safety Regulation (2008) concerning their responsibilities to employees and clients. Veterinarians may also have responsibilities outlined in standards for veterinary hygiene in equine veterinary premises that are currently being developed by the VSB–QLD. The AVA has an existing policy on infection control and is developing further guidelines or policies that will be applicable for zoonotic diseases including Hendra.

It is important that other peak bodies also work with the DPI&F where appropriate to continue to develop awareness and preparedness programs for Hendra virus and other diseases for their members and that these programs . The role of overarching organisations such as the Australian Horse Industry Council and the Queensland

Horse Council in these matters is critical as an efficient way of developing materials that can be disseminated widely through a large number of separate horse organisations.

AVA/EVA recommendations 15 and 16:

15. AVA recommends that further funding be made available for Hendra research including the development of effective testing procedures.

16. AVA recommends that the development of a human vaccine for Hendra be investigated.

Items 15 and 16 are considered together.

It is acknowledged that further research into aspects of the epidemiology and control of henipaviruses is required to continue to improve our understanding of the virus and our ability to minimise its impact on horse and human health.

A large amount of research has been completed over recent years into aspects of Hendra and Nipah virus. A compiled list of references current to 2007 and related to Hendra, Nipah, and Menangle virus can be found on the web¹⁵.

In 2007 the Australian Biosecurity Co-operative Research Centre (AB-CRC) hosted a henipavirus forum in Canberra that brought together over 40 delegates representing the public health, animal health and environment sectors. The forum aimed to review henipavirus research funded by the Australian Biosecurity Cooperative Research Centre for Emerging Infectious Disease (ABCRC), identify any key gaps in knowledge, prioritise research projects to fill these gaps in knowledge, and develop an inventory of key information that may support henipavirus-related practice and/or policy. A report from the forum may be found at the AB-CRC web site¹⁶.

This review has not attempted to comprehensively review the scientific literature but mentions a small number of relevant research projects of interest.

Staff from the DPI&F and from AAHL in particular have been involved in a number of completed projects on henipavirus research both in Australia and overseas, a number of which have been managed through and part-funded by the Australian Biosecurity Co-operative Research Centre (AB-CRC). There are also a number of research projects in progress in Australia and overseas that have relevance to Hendra virus including studies aimed at continuing to improve diagnostic tests for Hendra virus. A large amount of investigative and characterisation work has already been completed on virus isolates from the Redlands and Proserpine cases including sequencing of the genome from isolates and comparison with previous defined Hendra virus isolates. It is understood that further experimental studies are being planned that involve exposure of horses to isolates of Hendra virus including isolates from the recent Redlands cases. This work should provide valuable information on the pathogenesis of the virus including information on development and progression of clinical signs and when experimentally infected horses may shed infectious virus.

¹⁵ <http://www.csiro.au/files/files/p7wp.pdf> Accessed 1 December 2008.

¹⁶ http://www1.abcrc.org.au/uploads/0edd519c-7a39-41d2-9693-b5e8d0c6b847/docs/henipa_adoption_forum_final_report_261107.pdf Accessed 1 December 2008.

This project should provide some very important information on exposure risk that has been highlighted by the identification in the Redlands cases of the possibility of exposure resulting from procedures being performed on apparently healthy horses.

Recent publications from collaborative research involving AAHL and USA-based researchers include work on a vaccine that provides protection against Nipah virus (McEachern et al 2008) and that appears to show promising cross-protection against Hendra virus in preliminary studies performed in cats¹⁷. The same collaborative groups have also published a paper describing development of a human monoclonal antibody that appears to be capable of neutralising infectious Hendra and Nipah virus under experimental conditions with future potential applications including treatment of infections in humans (and possibly animals) and in development of diagnostic tests as well as a research tool under laboratory conditions in experiments involving study of these two viruses (Zhu et al 2008).

There is also considerable effort being directed at better understanding some of the factors that have influenced the emergence of diseases of wildlife that have the capacity to infect animals and people. Examples of recent papers that have direct relevance to bat-borne viruses such as Hendra virus include Plowright et al (2008a, 2008b) and Halpin and Mungall (2007).

It is recommended that consideration be given to identification of knowledge gaps and research needs and funding opportunities for future research to address those gaps. This may involve discussions between representatives from relevant industry bodies in a manner similar to the 2007 henipavirus forum.

¹⁷ Vaccine may combat deadly Hendra virus.
http://www.weeklytimesnow.com.au/article/2008/11/07/23581_national-news.html Accessed 1 December 2008.

17 Other issues raised by stakeholders

17.1 Conduct of the review

Concern was expressed over the following details related to the conduct of the review process:

- *Contact details for the reviewer and where to send submissions were not available on the website;*
- *The Terms of Reference referred to recommendations arising from previous Hendra Virus Incidents which were considered to include the 2006 Hendra virus review. The 2006 Review is identified as a 'public document'; however, individuals reported that trying to locate the 2006 Review report proved difficult, even for staff within the Ministers office.*
- *Some meetings were arranged by a DPI&F staff member and took place within the PIB building, giving an impression that the review was not being conducted in an independent manner.*
- *The scope of the Terms of Reference was considered to be restricted to consideration of DPI&F response and DPI&F staff with regard to hygiene and WH&S as opposed to broader issues of hygiene standards and WH&S obligations.*

Concerns of difficulty in contacting the reviewer and lack of contact information related to the review are acknowledged. This appears to have been an oversight on the part of DPI&F staff during the review process. The reviewer's name was available on the DPI&F web site in conjunction with the review and enquiries to the DPI&F were directed to an appropriate person who could provide contact details for the reviewer. It is suggested that consideration be given to providing contact details for independent reviews in the future.

The reviewer is unable to comment on difficulties that may have been experienced in accessing the 2006 review report. The report was submitted to the office of the Director General and enquiries fielded by the reviewer about the 2006 report have been directed to the office of the Director General of the DPI&F.

Any suggestion that the review process has not been conducted in an independent manner are regretful and are rejected. The review process involved a large number of meetings and consultations including a number of meetings with DPI&F staff. The DPI&F provided a staff person to assist in gathering documents and records from DPI&F sources that were relevant to the review and in identifying relevant DPI&F staff and arranging meetings. The assistance of this staff member was invaluable in facilitating timely arrangement of meetings and in collecting and collating large amounts of information. The staff member also attended some meetings that involved DPI&F staff as a non-contributing observer and mainly in the initial parts of the consultation process. This was done to facilitate assistance in identifying and recording actions that arose out of many early meetings including for example identification of additional documents or records to retrieve and additional DPI&F staff members to arrange meetings with. A number of meetings with DPI&F staff were arranged in the Primary Industries Building and at other DPI&F facilities such as

ARI. This was done for convenience. The DPI&F staff person who provided this assistance has not at any time viewed confidential documents prepared in the course of the review and has not provided input into the content of the review.

The scope of the review and the Terms of Reference are understood to have been developed in a consultation process that involved DPI&F and representatives from industry bodies. The process is considered appropriate. The reviewer was not involved in this process.

17.2 Legislative concerns

There were concerns over why the incident was not declared an outbreak as defined under the Exotic Diseases in Animals Act (1981).

Declaring an outbreak under Section 28 of the Exotic Diseases in Animals Act (1981) is understood to be most appropriate for emergency animal diseases that appear to be spreading between premises such that multiple infected premises are involved. The provision was included in the legislation to give effect to arrangements under the Emergency Animal Disease Response Agreement (EADRA), including compensation arrangements for control measures that may be implemented for highly contagious diseases like foot-and-mouth disease that include destruction of apparently healthy at-risk animals on properties either adjacent to or within a specific radius of an infected premise. Activating EADRA was discussed at CCEAD in relation to the Redlands case but was not considered appropriate as the cases appeared to be confined to a single infected premise.

The response was managed as an incident response under procedures outlined in DPI&F manuals and that are consistent with AUSVETPLAN documents. This approach is considered appropriate.

Concerns were expressed over the use of legislation to order the destruction of horses sero-positive to Hendra virus and that the choice of legislative authority for the order may have influenced whether owners were eligible for compensation for horses that were destroyed.

Quarantine was declared on the two infected premises under the Stock Act (1915) and orders for destruction of the two sero-positive horses were issued under the Exotic Diseases in Animals Act (1981). Both acts are appropriate legislative instruments given that Hendra virus is a notifiable disease in Queensland and is listed as an emergency animal disease in conjunction with the Exotic Diseases in Animals Act (1981).

It is understood that neither of the two sero-positive horses that were destroyed are considered to be eligible for compensation under the Stock Act (1915). Eligibility for compensation therefore was not a consideration in selection of this legislative instrument for response activities.

The decision not to apply Section 28 of the Exotic Diseases in Animals Act (1981) was also made independently of any consideration of issues relating to compensation and was based on issues including the nature of the disease event, the level of

contagiousness and spread, the scale of the response and the need or value of activating the EADRA. Once the decision was made not to apply Section 28 of the Exotic Diseases in Animals Act (1981) then subsequent sections of the Act that discuss compensation are not relevant.

The main reason identified for use of the Exotic Diseases in Animals Act (1981) to authorise destruction of the two sero-positive animals was because it provided the shortest possible time period from notification of the order to the time when the animals could be destroyed under the legislation. The Stock Act (1915) provides similar legislative authority to cause the destruction of an animal but involves a longer potential time interval from the notification of the order to the time when the animal could be destroyed under the legislation. Once the decision had been made to order destruction of the horses there was an intent to implement the destruction order in a timely manner to avoid dragging the process out any further than was necessary.

Concerns over the decision to euthanase sero-positive horses.

The legal process and the issuing of orders to destroy animals under appropriate legislation are of necessity forceful events. Once an order to destroy is issued there is a process that is set in motion that allows the recipient of the order a period of time to comply with the order and arrange euthanasia. If this is not carried out within the defined period of time the order allows for an inspector to cause the destruction of the animal even if the owner has not agreed with the order.

This process is necessary to provide suitable authority to ensure the order is carried out.

Concerns were expressed that euthanasia of sero-positive horses ignored the potential value of these animals for further research into pathogenesis of the disease or in the development of diagnostic tests or therapeutic treatments. Some individuals indicated that they felt there were options available for maintaining these horses in a biosecure environment to protect against risks of future recrudescence and exposure. The owner of one horse indicated that he was willing to enter quarantine with the horse to take responsibility for care of the horse.

All of these issues are understood to have been considered in the decision making process that led to a decision to uphold the existing national policy of euthanasia of sero-positive horses. The final decision was that the potential risks of future recrudescence and viral shedding and the associated human health risks for people who may be interacting with the horse at some stage in the future outweighed any potential benefits that may have been achieved by keeping the horse alive.

The only identified option for effective management of quarantine if the horses were to be kept alive was in a secure facility such as AAHL and it was not considered appropriate in terms of animal welfare and for continuity of maintenance of biosecurity precautions to keep an animal in a secure facility for any period of time. In fact it is highly unlikely that this option would be approved by appropriate animal ethics committees were it to be considered.

The benefits from keeping the horses alive were also considered. Sero-positive horses are not suitable for research into vaccine development. Serum from the horses is of value as positive control serum in diagnostic tests performed in veterinary laboratories. Serum was harvested from animals at the time of euthanasia so this benefit did not require the horses to be maintained alive. The value of sero-positive animals in research projects as a source of antibody was not considered to represent sufficient benefit to offset the risks. In addition there has been recent work describing the production of a monoclonal human antibody with high potency against Hendra and Nipah viruses (Zhu et al 2008), providing a completely safe alternative methodology for production of antibody. Finally the post mortem procedures on the two horses did provide considerable additional knowledge about Hendra virus.

The decision making process employed in reviewing the national policy and the decision to uphold the existing national policy were both considered appropriate. The impact of this decision in resulting in the euthanasia of two horses that were showing no signs of disease at the time they were euthanased is acknowledged. Both animals returned multiple positive real time PCR tests from samples collected at post mortem reinforcing the potential risks if the horses had been kept alive.

Concerns were also expressed that the arrangements associated with the order to euthanase the horse were not clearly communicated to the owners of the last case to be euthanased at Proserpine (case P2). There had been prior communication from DPI&F to the owners about the decision and the general process but the owners were uncertain over the details of what was to happen on the property including arrangements for post mortem procedures, when events would occur and who would be attending. The owners do not recall receiving final notification of when events would be occurring until the day prior to the arrival of an advanced team that was to assess the site and begin preparations.

It is recommended that procedures for communication of information relating to orders for destruction of sero-positive horses and the implementation of those orders be reviewed and consideration be given to arranging a face-to-face meeting where possible to allow discussion of what is a stressful and demanding process.

17.3 Other concerns

Concern was expressed over the time delay from the decision to order destruction of the two sero-positive horses and their subsequent euthanasia.

The decision to progress to euthanasia of sero-positive horses (as per existing national policy) was made at a CCEAD meeting on 21 July 2008. This was communicated to the owner of case R2 who indicated that the decision would be challenged. Time was then required to address legal issues including opportunities for responses from the owners concerned.

The decision to euthanase the two sero-positive horses was based on a desire to minimise risk to people and other animals by eliminating any possibility of subsequent recrudescence of infection and shedding by these horses. Once this decision was made it is considered preferable to minimise the time to euthanasia as a way of

minimising risk. Delays due to legal requirements appear to be unfortunate but understandable. It is suggested that procedures be reviewed to ensure that while this policy remains in force that the time from diagnosis of a horse as sero-positive to euthanasia is minimised.

The last confirmed Hendra virus case at Redlands (R5) also involved some additional delay from the time when a positive diagnosis was made on ante-mortem samples to the time of euthanasia. This delay is understood to have been partly due to the time taken for mobilisation of a team of veterinary pathologists from AAHL and for them to travel to Brisbane to perform a complete post mortem on the horse. While some delay is understandable it is considered important that the primary concern be the welfare of the horse and management of exposure risk at the facility.

It is recommended that once a decision is made to euthanase a horse that is either sero-positive or acutely ill with Hendra virus that the action be completed as soon as possible.

Concerns were expressed over whether earlier horse deaths at Redlands (in particular cases R6, R7 and R8) and an earlier death at the Proserpine property may have been Hendra cases

Information provided in the description of response activities at Redlands indicates that DPI&F identified cases R6, R7 and R8 as suspect Hendra virus cases during the response and directed veterinary investigations to assessment of these cases as a high priority along with assessment of the confirmed cases of Hendra. This was done in recognition of the potential risks associated with these horses and the importance of investigating these cases to determine their status and to monitor the health of companion animals and their owners.

DPI&F records indicate that these three cases are considered unlikely to have been Hendra cases but that Hendra virus could not be ruled out. If one or more horses had died of Hendra virus then it raises the possibility of an earlier index case to the first confirmed case (R1). For one of the cases in particular the scenario also raises the possibility of an exposure or spillover event that could have occurred at a location other than the RVC. As indicated above all of these events were considered possible but unlikely as a result of investigations completed during the response.

It is acknowledged that these cases displayed a number of clinical signs that were consistent with the case definition for Hendra virus. It is unfortunately not uncommon for horses to die with clinical signs that closely resemble those reported for Hendra disease and to subsequently test negative for Hendra virus based on review of the testing of horses throughout Queensland for Hendra virus.

There was also one horse on the Proserpine property that died suddenly several days prior to the first confirmed Hendra case. It is acknowledged that this case may or may not have died from Hendra virus and that it is not possible to unequivocally determine its Hendra status based on available information. If the horse had died from Hendra then it also provided an alternative scenario with an earlier index case and the potential for horse to horse spread or separate bat spillover events to explain subsequent cases. Information collected in the course of this review indicates that the

DPI&F response was aware of the possibility that the earlier case (P4) may have been infected with Hendra virus. The inability to determine the status of P4 did not have any impact on the response activities that subsequently took place on the property.

Should quarantine and movement controls have been imposed on a broader scale than just the Redlands Veterinary Clinic

Concern was expressed that quarantine measures were not imposed on properties other than the RVC, including for example properties where other horses had died with suspicious signs or with links to the RVC. There were also related concerns over the risks posed by horses that had been admitted to the RVC prior to the imposition of quarantine, had potentially been exposed and then discharged to return home.

The initial response to the incident was focused on completing tracing and surveillance activities to establish as quickly as possible the extent of the incident and with particular interest in evaluating the risks of other Hendra cases that were linked to the RVC but that died or expressed disease signs while at another location. Prior experience with Hendra virus had indicated that the potential for spread to multiple properties was likely to be low. The response activities start at the first confirmed case and work outwards until all the possible risk opportunities have been explored. If further cases had been confirmed at other locations then the response would have expanded accordingly.

Evidence of confirmed cases at other locations linked to the RVC may have changed the nature of the response since one possible explanation for multiple infected premises (IPs) may have been the possibility that the disease may have acquired increased capacity to spread. The initial response was therefore focused on the first IP but was prepared for the possible situation of multiple IPs.

As the response unfolded and tracing and surveillance information and associated testing of traced horses did not result in confirmation of any additional infected premises there was increasing confidence that the cases were confined to a single premise.

Equine influenza virus is a highly contagious virus and is exotic to Australia. The combination of these two characteristics mean that early declaration of complete movement controls is a vital part of effective disease control. Hendra virus does not appear to be highly contagious and is an endemic disease. The disparity in the initial response position for these two diseases is a result of appropriately basing response activities on the characteristics of the particular agent that is initiating the response.

Concern was expressed that horses linked to the RVC represented a risk to other people and to veterinarians in other practices.

Horses that had been admitted to the RVC in June and early July were identified as potentially being at-risk of exposure to Hendra virus. Some of those horses had moved by the time that tracing and surveillance began and movement of some horses continued at periods through the tracing period. Some horses were presented to veterinarians in different practices for routine procedures.

The activities of the veterinary investigations component of the response (including tracing and surveillance) have been described. All horses but one were traced and phone contact used to collect health information, inform the owners of the situation and provide additional information on Hendra virus. A number of horses were identified as having elevated risk through tracing history or through reporting of illness and these horses were sampled very early in the response. Other traced animals were sampled over time as part of a complete response to ensure all animals were sero-negative.

Tracing and surveillance activities are intended to be risk based and to be escalated if a risk assessment identifies any reason for concern. This process was implemented effectively and continued to function throughout the response.

However, it is accepted that there is a continual low level of risk of a new Hendra case occurring at any time. There is also a low level of risk of a Hendra case occurring in a horse that had been admitted to the RVC, been exposed to Hendra virus and then discharged from the RVC and that then had expressed disease before the effective implementation of tracing and surveillance. These are risks that are not amenable to prevention by the tracing and surveillance activities centered on the RVC because they either occur separately to the response or prior to the response becoming effective. As has been suggested elsewhere in this report it is suggested that the most effective method for preventing exposure to Hendra is through a risk-based assessment and appropriate use of biosecurity precautions (PPE and decontamination) that is applied to every horse encountered by a veterinarian whether apparently healthy or not.

Concern was expressed that horses outside of the RVC were only tested once for Hendra virus during the response.

Veterinary investigations involved assessment of risk of Hendra virus exposure and disease. Animals at higher risk were prioritised for assessment and testing. Some animals were tested more than once during the response based on assessment of risk. Many of the animals that were linked to the RVC and particularly those that had been admitted to the clinic during the period after 6 June 2008, were only bled once and some were not bled. All animals were monitored through phone calls to owners or carers. The combination of lack of reported evidence of unexplained illness (monitored through phone contact and by owner monitoring) and the time elapsed since horses had been at the clinic provided increasing confidence that animals were unlikely to have been infected with Hendra virus. By the time sampling and testing was performed in horses that had been discharged from the RVC it was 14 days or more since these horses had last been at the clinic. Since the last opportunity for exposure linked to the clinic was when the horses had been at the clinic this meant that the likelihood of horses being infected was very low. A single blood sample was then collected from most of these horses (52 of 55) and tested for antibodies to Hendra virus to ensure that none of these animals were sero-positive indicating prior exposure to Hendra virus. All results were negative.

Concerns were expressed over interpretation of diagnostic tests and particularly the reporting of equivocal results from serology tests.

Additional information has been provided in Appendix 3 on diagnostic tests and interpretation of results. There are occasional difficulties in interpreting diagnostic tests, particularly serology tests. It is particularly important to be careful when reporting results that are uncertain to avoid potential for misinterpretation. Terminology is variable and at times confusing including the use of terms such as "preliminary positive" and "false positive" for serology results that may be reactive due to cross reaction and not because of a positive test result. The use of terms such as a reactive test result or non-specific reaction or result may be preferable when describing the results of ELISA tests.

In some cases horses returned reactive tests on serology testing that involved ELISA tests and there was concern that these results were indicative of the presence of Hendra virus antibody. In all cases virus neutralisation testing was used to provide a final test result. In some cases animals were re-bled and testing repeated to provide additional confidence in test results. An example where this was done involved seven horses that showed non-specific reactions to serological testing on the third sampling of horses in the RVC. These seven horses were then determined to be negative after an additional fourth serology test was completed.

Concerns were expressed over perceptions of delays in testing of samples and reporting of results.

Occasionally during the response there were relatively long periods of time between collection of samples for surveillance testing of horses that had been admitted to the Redlands clinic during June and early July and reporting of results. This is unfortunate and is attributed to the large amount of activity going on at the time. Every effort should be made to report test results in a timely manner.

Some veterinarians expressed concern at the prioritisation process for determining whether diagnostic testing should be done urgently as opposed to the following working day for samples that were submitted after normal business hours. The prioritisation process is designed to ensure testing is done as rapidly as possible for highly suspect cases (including mobilising resources for after hours testing) and that for suspect cases of lower priority testing is done the following working day if samples are submitted out of hours. This process is supported.

It is critical that stakeholders including veterinarians implement appropriate risk management including safety precautions as soon as Hendra virus is identified as a possible diagnosis and preferably before a horse is examined and samples collected. This is the only effective way to manage risk of exposure while performing the initial examination and collecting samples and ensures that diagnostic testing is then used most appropriately as an aid in the management of suspect cases.

Concerns over communication concerning euthanasia in affected horses.

A number of owners of confirmed case horses expressed frustration at the loss of control over events concerning their horses. There was recognition of the risks associated with the disease and for acutely ill horses there was support for the decision to euthanase the horses. Nonetheless, some owners indicated that they felt they were being informed of a decision without being provided with information and

allowed to participate in the decision making process, even though they acknowledged that they would in all likelihood have agreed with a recommendation to euthanase the horse(s).

The impact of the disease and associated decisions on owners of affected horses is acknowledged.

Awareness of the potential risks for other animals

There were dogs and cats and poultry with access to parts of the premises used by horses at the RVC and dogs and poultry at the Proserpine property.

Tests were performed on the dogs, cats and poultry at the RVC and returned a negative result (after an initial non-specific reaction on ELISA in some animals that caused some concern).

The owners at the Proserpine property indicated that they were concerned on learning of the testing that had been conducted at Redlands and of the equivocal initial results given that the owners at Proserpine also had dogs that may have had unrestricted access to areas where one or more of the confirmed positive horse cases had been.

The guidelines for veterinarians (13 February 2007) contained limited recommendations concerning the isolation of suspect horse cases from non-equine animals including pets though it did raise the possibility of Hendra infection in other animals with particular mention of the risks associated with cats and guinea pigs arising from experimental studies. The current guidelines for veterinarians (Version 2.0) contains a new section on Biosecurity advice to owner that includes the recommendation that sick or dead horses be isolated from other horses, people and all other animals including pets. This provides additional clarity for the management of non-equines on properties where a suspect or confirmed case is being managed.

Commercial laboratory services.

There are a small number of commercial providers of veterinary diagnostic services who receive samples from veterinarians on a regular basis. These laboratories do occasionally receive horse samples with a request to perform Hendra testing.

On occasion PVPs submitted samples for Hendra virus testing to a commercial provider of veterinary diagnostic or pathology services. In these cases, the commercial provider then forwarded on the samples to BSL. This process required the commercial pathology service to complete a BSL sample submission form nominating the commercial pathology service as the submitter. When results were reported from QHSS to BSL they were relayed to the submitter who then was responsible for reporting results to the PVP. On occasion this process resulted in additional time before the PVP was notified of test results because of the intermediate reporting steps.

Private laboratories also indicated that they occasionally receive samples where the duty pathologist may consider Hendra virus as a possible diagnosis based on clinical information and history provided by the submitting veterinarian. There is considered to be benefit in DPI&F pathologists working with commercial providers of laboratory

services to develop or review simple criteria by which submission forms may be assessed in commercial laboratories and decisions made on whether a sample should be sent for Hendra testing or not.

It is recommended that DPI&F work with representatives from commercial laboratories to develop or review criteria for assessment and prioritisation of submission forms and to implement systems for adding laboratory representatives to notification and communications concerning emergency animal diseases if they are not already included.

Disposal of bodies.

There were delays experienced at Redlands while arrangements were made to dispose of the body of a horse confirmed with Hendra virus that was euthanased on 8 July 2008. Commercial providers of waste removal services were contacted and refused to take the body. Arrangements were then made to transport the body to the incinerator at the University of Queensland facility at Pinjarra Hills. This facility was used for disposal of an additional three horses during the response.

It is important to have pre-existing arrangements for dealing with animal bodies that may be infectious with Hendra virus and that require disposal away from the infected premise.

A recommendation has been made earlier in this review concerning the development of specifications for transport and disposal of Hendra virus contaminated bodies and the use of these specifications to select commercial providers who are capable of providing the service. This process should ensure that procedures can be activated rapidly in the event that a horse carcass must be disposed of in the future.

A related concern relates to the importance of DPI&F maintaining a suitable facility to allow complete post mortem of a suspect Hendra case. It is understood there is no such facility at ARI but that plans for a new laboratory facility do incorporate facilities in which a full post mortem could be performed on a Hendra suspect case using appropriate PPE. This will ensure that cases can be transported to a facility and post mortems performed where necessary. It is noted that in many cases a field post mortem may be preferred.

Proserpine cases.

Initial reports of the first confirmed case at Proserpine indicated that the case was diagnosed at Cannonvale, approximately 20km north east of Proserpine. The actual location of the infected premise was approximately 20km south of Proserpine. The veterinarian's practice is in Cannonvale and this may have explained the initial error. Reporting of the cases as coming from Cannonvale resulted in intense interest from within the community including attention on individuals in the Cannonvale area who had links to the infected premise near Proserpine. An unanticipated impact was the time and effort spent by individuals in responding to concerns including time spent by DPI&F staff responding to concerns about events at Cannonvale when in fact the infected premise was some 30-40 km away. This experience reinforces the importance of accurate regional reporting of disease cases.

The first two confirmed Hendra virus cases were buried by the owners of the property at a location selected by the owner. The location was discussed with DPI&F staff during the initial response activities but DPI&F staff did not physically inspect the location. At a later date when arrangements were being made to euthanase and dispose of the sero-positive horse at the Proserpine property, a more detailed site inspection was performed and a different site selected for deep burial of that horse. The original site where the other horses had been buried was not considered appropriate on review of that site. This experience reinforces the importance of DPI&F review of burial sites on property once a positive Hendra case is diagnosed. In this case it is considered unlikely that further action would have been warranted particularly exposing and reburial of horses after they had been buried. However, there was an opportunity for feedback on the site prior to the disposal of the second confirmed Hendra case and for selection of an alternative site if the original site had been deemed inappropriate.

There were occasions during the Proserpine response when the sero-positive horse and an in-contact animal were run in paddocks close to a sealed public road, presenting potential for inadvertent contact from motorists or other individuals. There was interest in the value of signage indicating the quarantine status of the property and providing notification to members of the public that caution was needed in the vicinity. It is understood that not all quarantined properties are identified with signage and that this may be discussed with biosecurity inspectors at the time the quarantine notice is served.

Concern was expressed over the time delay from the time when the samples were collected from the first confirmed case at Proserpine. Samples were collected on a Friday, arrived at the DPI&F laboratory on the Saturday and were received at the QHSS laboratory on the following Monday. Test results were reported Monday evening. There will unfortunately be delays in having testing performed as a result of transport time to the laboratory. In this case this was exacerbated by the weekend. The veterinarian took appropriate precautions based on an identified risk of Hendra virus before visiting the horse including ringing and speaking to a DPI&F veterinary officer and receiving advice on safety precautions and on how to perform a limited post mortem. The owner was informed of risk and precautions. The exposure risk was therefore managed effectively from the time the veterinarian identified that Hendra virus was a possible diagnosis. While testing on the Saturday or Sunday would have identified the disease earlier the critical steps of risk management for reduction of exposure risk had already been implemented. This was therefore a good example of the use of appropriate biosecurity precautions to manage the initial investigation of a suspect case and then waiting for the diagnostic test to inform further actions. Performing the diagnostic test on the Saturday or Sunday would have hastened the knowledge that the horse was Hendra positive but would not have changed the response or the exposure risk that had already been encountered.

There were concerns expressed over the fact that a biosecurity inspector was tasked with performing a post mortem on a suspect Hendra case. In this case the individual had extensive experience and training in performing post mortems in cattle and horses and had previously had appropriate training in PPE and decontamination. There are reasonable arguments for saying that all post mortems should be done by a veterinary

pathologist to ensure that cause of death can be established where possible. Failing that a veterinarian may be preferred to a non-veterinarian for the same reasons. However, in this case a veterinarian was not available within a reasonable time frame, the owner wished to have a post mortem performed to test for Hendra virus and the inspector was suitably trained and experienced in the procedures. The fact that the inspector travelled alone to the property and then had to enlist the assistance of the owner in holding sample jars and assisting at some level in collection of samples, is considered less than optimal. The owners had had considerable experience at this stage with PPE procedures and were comfortable with the risk management of their involvement. Again, this procedure involved a limited post mortem performed with appropriate safety precautions under the particular constraints imposed by limited available DPI&F staff with suitable training and expertise. While involvement of two DPI&F staff as a minimum would seem to be reasonable for this procedure, in this case it would have meant that the post mortem may not have been done. Options and risk management need to be discussed with people concerned and in this case this was the approach that was followed.

Concern was expressed over the importance of procedures for field management of suspected Hendra cases by DPI&F and the importance of uniform adherence to standards and procedures for activities ranging from examination of low risk animals first and highest risk animals last, sampling of animals, importance of properly fitting and functioning PPE, and adherence to all PPE and decontamination procedures. It is recognised that the guidelines for veterinarians offers information on procedures. The guidelines for veterinarians (13 February 2007) contained less detail on procedures for field investigation than the current Version 2.0. It is understood that the guidelines for veterinarians are complemented by additional operating procedures for DPI&F staff. The importance of procedures and adherence to procedures is supported by the reviewer and has been the subject of additional discussion in this review.

There was interest in the development of various checklists that may be used as a guide by DPI&F staff, private veterinarians and property / horse owners. Checklists provide the opportunity for simple, step-wise summary description of procedures. Checklists would reduce the risk of inadvertent omission of important response steps to assist in ensuring effective risk management. Checklists and appropriate information for horse / property owners and private veterinarians may also assist individuals in an initial approach to managing a suspect case prior to receiving test results, and in maintaining effective biosecurity after confirmation of a positive result. The guidelines for veterinarians (Version 2.0) and the guidelines for horse owners both have summary information in lists, and the guidelines for veterinarians (Version 2.0) contains check-list style summaries for the steps involved in PPE and decontamination. Feedback is encouraged on the usefulness of the lists in the current guidelines and on the potential application for similar information for other stakeholders including horse owners.

There was interest in the need for implementation of an education / awareness program for wide distribution to horse stakeholders through the combined effort of DPI&F, veterinarians, peak industry bodies, riding clubs, breed associations and individuals. The rare occurrence of Hendra virus events means that there are very few people who have had any experience with the virus. Creation of a proactive and positive attitude requires a heightened awareness of an issue. The need for education

and awareness concerning Hendra virus is uncontested. There may be potential for involvement of people with direct experience in previous Hendra cases in education and awareness campaigns as a way of personalising the experience and lending additional impact to messages. The value of positive role models who can present real-world and personalised accounts of their experiences is considered to be very worthwhile. The account by the owner of the 2006 Hendra virus case at Peachester (Crane 2008) is an informative read that effectively communicates the uncertainties and the challenges faced by individuals affected by Hendra.

It is recommended that consideration be given to involvement of people with direct experience in Hendra virus cases in awareness campaigns.

18 Recommendations arising from the 2006 review

There were four recommendations presented in the 2006 review of an equine case of Hendra virus infection at Peachester. These are presented below:

1. It is recommended that a number of modifications be made to the Hendra virus guidelines in an attempt to clarify issues that have been identified during this review and to ensure that the Hendra virus guidelines remain as the main source of information for private veterinarians and for DPI&F staff in responding to and managing cases where animals may have been exposed to Hendra virus.
2. It is recommended that consideration be given to initiation of field research where appropriate at sites where Hendra virus cases have occurred in an attempt to continue to improve our understanding of the epidemiology of the disease and consequently prevention and control. Such research should be carefully planned and conducted only if there is perceived to be genuine potential for leveraging additional information out of a disease outbreak and if attendant risks associated with the work can be effectively managed. Consideration could be given to planning in advance of field projects that could be implemented rapidly on confirmation of a positive Hendra diagnosis in order to ensure that samples may be collected while events and risk factors associated with horse exposure may still be present and able to be explored.
3. It is recommended that the DPI&F web site and search engine be reviewed with a view to ensuring that the Hendra virus guidelines can be located easily by either clicking through the web site and by searching for key terms such as Hendra virus or Hendra guidelines.
4. It is recommended that DPI&F staff work with representatives from peak industry bodies to develop a mechanism that allows peak industry bodies to provide (and update) contact details (including after hours contacts) for individuals to be notified in the event of a confirmed animal emergency disease event.

A number of suggestions were made concerning the content of the guidelines for veterinarians. The guidelines were updated following this review and the version of the guidelines for veterinarians available on the DPI&F web site at the time of first confirmed case at Redlands was dated 13 February 2007. While not all of the changes

suggested in the 2006 review were made, the modified guidelines for veterinarians (13 February 2007) are considered to incorporate current knowledge at the time (prior to the Redlands cases) and provide detailed information on investigation of suspected cases and workplace health and safety precautions. Since that time significant modifications have been made to the guidelines for veterinarians as a result of advances in knowledge about the disease and from consultation with stakeholders to identify needs. The recommendation is considered to have been taken into account in revisions to the guidelines for veterinarians.

A large amount of research has taken place over the last several years on bat-borne viruses including research on henipaviruses in particular (Nipah and Hendra virus). A number of publications have been identified in the bibliography and discussed briefly in previous sections. There was a henipavirus forum held in 2007 to discuss research into these two viruses and our understanding of bat ecology and factors driving disease emergence has improved dramatically in the last few years. This recommendation is considered to have been achieved.

The DPI&F web site was reviewed and a link placed on the home page to access information on Hendra virus and also links were placed on other pages through Animal Health, Horses and Biosecurity. This recommendation has been achieved.

The last recommendation has also been achieved. Representatives from peak industry bodies were notified rapidly once a positive diagnosis was received.

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20 Appendix 1: Persons contacted in the course of this review

A full list of individuals contacted through the course of this review is available if required. Information was collected through telephone calls, emails, face-to-face meetings and by collection of printed material related to response activities.

Summary information of groups and individuals is provided here.

- DPI&F staff involved in the response including Chief Biosecurity Officer, General Manager Animal Biosecurity, biosecurity officers, veterinary officers, laboratory staff, Business Information Centre staff.
- Redlands Veterinary Clinic staff including veterinarians, nurses and support staff.
- Cannonvale veterinarian involved in the initial investigation of the first confirmed case at Proserpine
- Veterinary practitioners from multiple locations across Queensland.
- Owners of all confirmed Hendra case horses at Redlands and Proserpine and owners of three suspect horses from the Redlands cases.
- Queensland Health
- Queensland Health Scientific Services (QHSS) laboratory
- Environmental Protection Agency (EPA)
- Australian Veterinary Association (AVA)
- Equine Veterinarians Australia (EVA)
- Queensland Horse Council (QHC)
- Australian Horse Industry Council (AHIC)
- Australian Animal Health Laboratory (AAHL)
- QML Vetnostics
- School of Veterinary Science, University of Queensland
- Members of the public and horse owners

21 Appendix 2: Emergency Animal Disease Plans

Emergency animal disease response activities are managed by the affected state and are guided by a number of documents that outline agreed management plans and operational procedures. These include:

AUSVETPLAN

“The Australian Veterinary Emergency Plan (AUSVETPLAN) is a coordinated national response plan for the management and, wherever possible, eradication of exotic disease incursions and outbreaks of certain emerging or endemic animal diseases. The term ‘emergency animal disease’ (EAD) is used in this manual to collectively describe all these disease categories.” (Page 7)¹⁸

AUSVETPLAN exists at the national level. At a state level, animal health authorities are responsible for developing operational plans consistent with AUSVETPLAN, within the legislative framework of the state, for implementation of an accepted national strategy. At a local level, animal health officials in conjunction with local emergency management officials are responsible for developing plans to contain the initial outbreak of an emergency disease while state control plans are being implemented.

AUSVETPLAN documents provide agreed management and operational procedures to be applied in any EAD response as well as national disease strategies for a number of specific EADs. There are additional diseases (of which Hendra virus is one) for which AUSVETPLAN provides a brief policy statement and not a full disease strategy. The AUSVETPLAN brief policy statement for Hendra virus infection is reproduced here.

Australia’s policy for Hendra virus infection

Hendra virus infection is not an OIE-listed disease. The disease has proven to be only mildly contagious outside its natural hosts. Relapse and serious infection in clinically recovered or partially recovered horses can occur.

The policy is to eradicate Hendra virus infection in terrestrial animals using:

- destruction and sanitary disposal of all horses or other terrestrial animals shown, through demonstration of antibodies, to be infected;
- disinfection of the immediate contaminated environment; and
- quarantine of all in-contact animals until repeated serological tests have proven freedom.

These strategies will be supported by:

- tracing and limited surveillance to determine the source and extent of infection and to provide proof of freedom from the disease; and
- a public awareness campaign to encourage cooperation from industry and the public.

¹⁸ AUSVETPLAN Summary Document. Version 3.1, 2008.

Hendra virus is currently included as a Category 2 disease in the EAD Response Agreement. The costs of disease control would be shared 80% by governments and 20% by the relevant industries.

Reproduced from: Page 43, Animal Health Australia (2005). Response policy briefs (Version 3.0). Australian Veterinary Emergency Plan (AUSVETPLAN), Edition 3, Primary Industries Ministerial Council, Canberra, ACT.

Biosecurity Emergency Operations Manual

The Biosecurity Emergency Operations Manual is produced by the DPI&F and serves as a guide for state response activities in the event of an EAD occurring in Queensland. The Operations Manual is therefore applicable in a response to any emergency animal disease.

The following information is quoted from the Preface of the Operations Manual: "The Biosecurity Emergency Operations Manual (referred to as the Operations Manual) is an agreed management plan and set of operational procedures that will operate in the event of a disease outbreak, pest incursion or when there is a reasonable suspicion that a disease exists or a pest incursion has occurred. The Operations Manual should be used in conjunction with AUSVETPLAN, QLDVETPLAN, PLANTPLAN, AQUAVETPLAN, regional plans and any other relevant threat or host-specific plan that may exist, as appropriate."

Reproduced from: Page ii, Biosecurity Emergency Operations Manual, Queensland Government DPI, Revision 2, Dated 22 June 2005.

Guidelines for veterinarians

The guidelines for veterinarians has been discussed in detail in the text of the review.

22 Appendix 3: Laboratory investigations for Hendra virus

It is important that all animal samples for Hendra virus testing be submitted through the DPI&F laboratory system. This ensures that DPI&F are notified of the possibility of Hendra virus infection and if a positive test is returned, it means that the DPI&F are immediately aware and can rapidly implement a response.

Samples submitted to the DPI&F for Hendra virus testing are received at BSL, located at Yeerongpilly, Brisbane. Samples are unpacked in a biohazard class 2 hood and the sample submission form is reviewed by a DPI&F veterinary pathologist who then recommends what tests are to be performed, where samples are to be sent and the level of urgency.

Samples for real time PCR testing are then sent to the QHSS laboratory at Coopers Plains. Many samples are also sent to the AAHL in Geelong. The proximity of QHSS to the BSL laboratory means that samples can be rapidly transported to QHSS and this combined with the speed of real time PCR (results within hours of receipt of samples) means that results may be obtained quickly. For many samples, particularly those that arrived at QHSS in the morning or early afternoon of a working day, test results were reported on the same day.

Samples that arrived at QHSS in the late afternoon, evening or on a weekend or public holiday were not processed until the next working day unless they were accompanied with a specific request for urgent or after hours testing. Urgency of testing for horse samples is based on the assessment and recommendation by the veterinary pathologist and incorporates assessment of the level of suspicion of involvement of Hendra virus and the possible exposure risk to people and to other horses. This assessment is based on the information provided by the submitting veterinarian, often associated with a direct conversation between the pathologist or another DPI&F officer and the submitting veterinarian, and related information about other cases for example.

AAHL is a national centre of excellence in disease diagnosis, research and policy advice in animal health and provides pathology services in relation to Hendra virus. AAHL provides a comprehensive range of laboratory testing services for Hendra virus including real time PCR, serological tests that are validated for horses and other tests such as immunohistochemistry testing of fixed tissue samples. AAHL has high-biocontainment areas suitable for handling live viruses, necessary for virus culture, virus neutralisation testing (VNT) and experimental studies where live animals may be exposed to Hendra virus for investigation of aspects of the disease.

Once a decision has been made at BSL to submit samples for Hendra virus testing and if samples are considered suitable for real time PCR testing, the appropriate samples are packaged in biosecure packaging and sent to QHSS. In many cases samples are also sent to AAHL for testing.

Where a decision is made at BSL to submit samples only for Hendra testing using techniques other than real time PCR (serology and immunohistochemistry tests for example), samples may be sent to AAHL and not to QHSS.

In addition veterinary pathologists from AAHL with experience in exotic diseases and high-biocontainment operations, were involved in performing full post-mortems on horses in Queensland during the response including one acutely ill horse (case R5) and the two sero-positive horses (cases R2 and P3). Tissues collected from these post mortems were submitted to AAHL for examination and testing.

QHSS does also have a range of serological tests for detecting antibodies to Hendra virus. These tests have been fully validated for people but have not been fully validated for application in horses. The service offered by QHSS to the DPI&F is therefore focused on rapid testing of horse samples using real time PCR methods. The geographic proximity of the two laboratories is also important since it means that movement of samples from BSL to QHSS can occur quickly. During the response QHSS did perform serology tests on some of the horse samples. Test results from serology tests performed at QHSS were treated as preliminary results and all serology tests were repeated at AAHL. Final results for serological testing were based on results from tests performed at AAHL.

22.1 Real time polymerase chain reaction (PCR) testing

PCR tests detect the presence of defined sequences of genetic material in a sample. In the case of Hendra virus the test detects the presence of genetic material from Hendra virus. It is important to note that PCR testing does not determine whether viable virus is present since positive test results may occur on samples that contain non-viable virus including fragments of viral genome.

The ability of a specific PCR test to detect viral fragments is dependent in part on the selection of a suitable piece of genetic material as the target sequence in the test. A test that detects one isolate of virus may not detect another isolate from a different outbreak if the two isolates have differences in their gene sequences in the particular region being targeted by the PCR test.

There are many different types of viruses that infect animals and people and some viruses are more likely to change over time than others. RNA viruses for example are considered to have higher rates of mutation producing changes in the genome than DNA viruses. This attribute of RNA viruses is an important reason why influenza virus (a RNA virus) tends to cause repeated infections in the human population year after year. Influenza viruses tend to undergo relatively frequent mutation producing changes in the genetic sequence of the virus. This means that an individual can be vaccinated this year for example against the current strain of circulating human influenza virus and yet still be susceptible to infection with a different strain that may arise in the future.

Hendra virus is also a RNA virus though from a different family to influenza virus. Since 1994 when the first Hendra virus infection was detected there have been relatively few isolates of Hendra virus recovered from horses or people. The limited sequence information available from these isolates indicates that there appears to have been little genetic change over time in the different isolates of Hendra virus (Halpin

and Mungall 2007). There are other examples of RNA viruses that do not appear to undergo a great deal of genetic change over time.

Both QHSS and AAHL have a range of different target sequences for Hendra virus that are used in real time PCR tests. This approach provides additional confidence that tests will return a positive result even if the sample being tested contains viral genome that has some sequence differences to previous isolates. In some cases a test sample may return a positive test to one particular real time PCR and a negative test to another real time PCR. In this case the interpretation is typically that the target sequence being detected by the PCR that returns a negative result has changed sufficiently in the particular virus isolate being tested that it no longer returns a positive result to that test. This type of result may provide indirect evidence of changes in the genome of particular virus isolates.

There are many different types or methodological approaches to PCR testing. Real time PCR (TaqMan) testing is a relatively recent methodology that offers rapid, sensitive and robust test performance. An important advantage of TaqMan-based real time PCR is the speed of diagnosis with results available within hours of receiving the specimen.

It is important to note that real time PCR testing is aimed at detecting the presence of virus or viral fragments. It is therefore most suitable when used for testing horses that are acutely ill and are suspected of being infected with Hendra virus.

22.2 Serology testing

Serology tests detect the presence of antibody in serum.

The presence of detectable antibody in a serum sample specific for a particular infectious agent indicates that the animal has been previously exposed to that infectious agent.

General principles of immunology and experience with infectious agents **other than Hendra virus** indicate that it takes several days (occasionally longer) for an animal to produce antibody following exposure to an infectious agent. In addition there may be individual animal variation in immune response so that some individual animals may produce more antibody than others. There may also be issues associated with cross reactivity, meaning that serological tests may return a reaction that resembles an apparent positive result in some animals that have never been exposed to the particular infectious agent. This is commonly because of cross reactivity due to presence in the serum sample of other non-specific antibody or antibody directed against some other infection that reacts or binds in the serological test.

There are two main types of serology test for Hendra virus antibody that are performed at AAHL.

The first is an enzyme linked immunosorbent assay (ELISA). ELISA tests are relatively rapid to perform and are a very widely used test platform in many laboratories and for many diseases. ELISA tests performed in horses for Hendra virus testing do occasionally produce a reaction that is due to non-specific binding and that does not necessarily indicate the presence of Hendra virus antibodies in the sample.

For this reason ELISA testing is considered to be a preliminary serological test and there is more confidence in a negative test result than a reactive test result.

It is important to note that a reaction in the ELISA for Hendra virus, described as a reactive result or a non-specific reaction, is not necessarily indicative of a positive test result. Laboratories such as AAHL have implemented procedures to allow effective interpretation of test results even for horses that show non-specific reactions in ELISA. These may involve adding additional control assays to a test or running supplemental test procedures.

The second type of serological test that is commonly performed at AAHL is a virus neutralisation test (VNT). VNT requires that the serum sample being tested be mixed with live virus. The live virus in this case is cultured separately in the laboratory and introduced into the VNT for the purposes of the test. If the test sample contains antibody against the virus then the virus will be inactivated or neutralised. If the test sample does not contain any antibody against the virus then the live virus that is introduced into the test sample will continue to grow in an uninhibited manner. VNT assays are laborious and time consuming (require several days) because of the need to wait for live virus to grow in samples. The need for live virus also means that VNT assays for Hendra virus can only be performed in high biosecurity conditions such as the biocontainment facilities at AAHL. In addition there are problems associated with toxic reactions in some horses where other agents present in the serum may inhibit Hendra virus growth.

VNT is the gold standard serology test for detection of Hendra virus antibodies in serum. All ELISA tests that return reactive results are then subjected to VNT testing to determine serological status.

In some horses reactive changes in the ELISA and/or toxic changes in the VNT may mean that additional testing is required including collection of further samples from the horses involved and completion of further testing in the laboratory, adding additional time before results can be reported.

22.3 Virus isolation

Virus isolation requires growth of live virus in cell culture systems followed by confirmation of the identity of the virus.

Live virus may be isolated from a wide range of biological samples including swabs from the nose or mouth, urine, blood and tissues collected at post mortem.

Growth of live virus from a biological sample collected from a horse provides very clear and unequivocal evidence that the horse was infected with Hendra virus.

In contrast failure to recover live virus from a particular sample or a particular horse does not provide unequivocal evidence that the horse was not infected with Hendra virus. For example, virus in samples may have been inactivated or damaged or may have been present at levels so low that it failed to grow in culture.

23 Appendix 4: Business Information Centre, DPI&F

The DPI&F maintains a Business Information Centre at the DPI&F head office, 80 Ann Street, Brisbane. The Business Information Centre acts as a primary contact point for any person wishing to contact the DPI&F by telephone.

The DPI&F Business Information Centre can be contacted through a range of numbers:

1. **13 25 23**
 - a. Main (toll-free) contact number for callers from within Queensland who wish to contact anyone within the DPI&F
 - b. Attracts local call costs regardless of where the call originates from within QLD
2. **07 3404 6999**
 - a. Alternative contact number for callers who wish to contact anyone within the DPI&F
 - b. Main contact number for calls originating from interstate
3. **1800 675 888: National Animal disease watch hotline (freecall)**
 - a. Qld callers are prompted to nominate their state by responding to an introductory message and are then automatically directed to the Business Information Centre.
 - b. The hotline provides a separate specified number to facilitate contact where an individual suspects an emergency animal disease.
4. **1800 025 656: National Drought Hotline (freecall)**
 - a. Qld callers are automatically directed to the Business Information Centre.
 - b. The drought hotline is a separate specified number for callers who are seeking advice or assistance relating to drought issues.
5. **1800 084 881 : National Exotic Plant Pest Hotline (freecall)**
 - a. Qld callers are automatically directed to the Business Information Centre
 - b. This hotline is a separate specified number to facilitate contact where an individual is reporting suspected exotic plant pests.
6. **Various "Hot Phones" that connect callers directly through to the Business Information Centre.**
 - a. 07 3239 0168 - Located at the PIB (Brisbane) DPI&F Office (near the security desk)
 - b. 07 4069 8256 - located in the Mareeba DPI&F Office
 - c. 07 4151 7839 - located in the Bundaberg DPI&F Office
 - d. 07 4936 4965 - Located in the Rockhampton DPI&F Office
7. **Email to callweb@dpi.qld.gov.au**
 - a. Customers can also send email requests for information via the DPI&F website or by direct email to callweb@dpi.qld.gov.au

23.1 Business Information Centre procedures

The Business Information Centre is open from 8.00 am to 6.00 pm, weekdays except Thursday when hours are from 9.00 am to 6.00 pm. The centre is not open on public holidays except the Brisbane Show Holiday in August. (Business hours/days can be

scaled up to meet the needs of business groups eg advertising campaigns and emergency response).

The centre has procedures and scripts in place to guide the way operators handle calls. All operators are trained in procedures prior to beginning work in the centre and there are regular briefings held to update centre staff on current and expected issues so they can provide timely and accurate assistance to clients.

A call to any of the numbers above will result in an operator answering using a script specific to the number dialled. The operator will then act on the caller's information and, using a knowledge base, databases or other electronic and print resources, answer the enquiry or transfer the caller to the DPI&F staff member (for calls to any of the DPI&F numbers) nominated by the business area relevant to the nature of the call. This process can involve the operator searching a database using key words derived from the initial contact. If a transfer is required, the operator will stay with the call until it is connected to a DPI&F staff member. If the first extension does not answer the operator will try additional extensions by working through a list of DPI&F. If the operator is not able to successfully transfer a call then a message is taken and sent to the nominated contact by email with details of the enquiry and requesting a follow up call to the customer.

All calls that are answered by an operator are logged in real time into a customised call logging system maintained on the DPI&F intranet. This system is designed to ensure that calls can be recorded and tracked from the time of entry into the call centre until they are resolved through the actions of the relevant DPI&F staff member. Calls or messages that are not resolved will continue to appear as action flags on the screen of the recipient until they are resolved. The team leader and manager in the Business Information Centre monitor the call logs to identify unresolved calls for follow up and action.

23.2 After hours calls

A call to any of the Business Information centre numbers that arrives after office hours or on public holidays is automatically transferred through to a commercial contact centre that is contracted to provide after-hours support for the DPI&F Business Information Centre.

Operators at this contact centre answer the call with a pre-defined script specific to the number that was dialled. Operators are expected to stay with the call until it is resolved through connecting with a person from a list of after hours contact points or by taking the customers details and advising that the call will be returned on the next business day. The Team Leader of the DPI&F Business Information Centre receives notification by email for follow up and action on the next business day.

With respect to the Animal Disease Watch Hotline, the commercial contact centre maintains a list of 12 names and after hours contact numbers (home and mobile where applicable) for DPI&F staff nominated to respond to a call to this number. Operators would be expected to work through this list until they have contacted an individual to transfer the call to. If after every number has been attempted they are still unsuccessful, the contact centre operator will try the first number once more, and if

unanswered leave a detailed message for urgent follow up. An email is also sent to the Business Information Centre team leader and the Disease Watch Hotline coordinator to ensure that the customer receives a call back as soon as possible.

This process also applies to identified high risk or emergency situations where the caller may not use the Disease Watch Hotline 1800 number to contact the Department.

24 Appendix 5: Document sent to industry representatives on 9 July 2008

The following text was sent via email from the CVO to representatives from AVA (QLD Division), QKD Horse Council (QHC), QLD Health (QH), QLD Racing (QR), Thoroughbred Breeders QLD Association (TBQA), AgForce, and Harness Racing QLD (HRQ)

Hendra Virus Situation Queensland

9 July 2008

Situation

1. On 7 July 2008, a veterinarian advised the Chief Veterinary Officer Queensland of unusual neurological cases in horses at his practice. The veterinarian was of the opinion the equine herpes virus was involved and sought advice on the matter.
2. A total of four horses were reported as being affected over a three week period from late June 2008. One of the horses (Case 3) had been euthanased over the weekend of 5-6 July.
3. Biosecurity Queensland veterinarians attended the practice and secured all available samples, including post mortem samples (Case 1 & 3) and blood from Case 4.
4. The blood samples from Case 3 and 4 were submitted for testing for exclusion of equine herpes virus and Hendra virus on 7 July 2008.
4. Due to the unusual nature of the disease situation, the clinic was quarantine under the Stock Act 1915 on 7 July 2008.
5. At 16.30pm on 8 July 2008, Queensland Health confirmed two positive PCR results for Hendra virus for Cases 3 and 4. In addition, serology on Case 2 was reported as Hendra positive. Samples have been dispatched to AAHL.
6. The case presumptively believed to be the index case was a long term resident of the hospital. It had deteriorated quickly after initially displaying ataxia and then rapidly progressing to being unable to be handled. The horse died on or about 26 June 2008. A brain sample and CSF fluid were taken at the time. The horse was a thoroughbred show horse. (Case 1)
7. The second case was a thoroughbred horse hospitalised for an eye ulcer. Approximately one week into the treatment, it developed mild neurological symptoms that developed further, before the horse recovered. Blood samples were taken from this horse. (Case 2)
8. The third case was a pony hospitalised and treated for a nasal fungal tumour. It was hospitalised for three weeks prior to developing neurological signs. The horse deteriorated and was euthanased on 5 July 2008. A full set of samples is available for this horse (Case 3).
9. The fourth case was an Australian Stockhorse hospitalised for a bilateral jaw fracture. The horse become ataxic on 7 July and deteriorated rapidly. It was euthanased on 8 July 2008 after becoming unmanageable (and subsequent to positive PCR result). Samples are available from this horse, including fresh lung samples. (Case 4)

10. The presenting symptoms in affected horses included ataxia, head tilt, facial nerve paralysis in addition to increased temperatures and purple mucous membranes.
11. There are 37 horses on site at the veterinary practice. All these horses will be tested today 8 July (blood and nasal swabs).
12. Decontamination procedures are underway at the practice under supervision of Biosecurity Queensland.
13. Queensland Health has visited the practice and sampled all persons considered at risk of exposure. Follow up samples will be secured in 14 days time. Counselling has also been provided.

CONSIDERATIONS/ISSUES

14. This is an unusual presentation of Hendra virus, with neurological symptoms the main presentation.
15. Hendra virus was not the initial differential diagnosis in any of the four cases.
16. There are no known bat colonies in the immediate vicinity of the practice.
17. Full epidemiological investigation and tracing of all horses in currently underway.
18. There is considerable media interest in this outbreak. Emphasis is being given that this is not equine influenza, not as infectious and broader industry implications are not expected.
19. It is expected that the practice will remain in quarantine for at least 2 weeks.
20. Further updates will be provided as more results or significant epidemiological information come to hand.
21. Consideration is being given what additional support may be required for the practice as a consequence of the quarantine period.
22. Consideration needs to be given to the future disposition of the recovered horse. Following the 1994 outbreak recovered horses were euthanased owing to the risk of relapse. Biosecurity Queensland has established an expert group to review current scientific knowledge in this regard.
23. Text of updated information sheets for the public and vets is attached¹⁹. These will be posted on the DPI&F website.

RJ Glanville
Chief Veterinary Officer

¹⁹ Text from the Fact Sheet for veterinarians and community information was included in the document sent on 9 July 2008. These two fact sheets are reproduced in the following pages.

25 Appendix 6: Fact sheet: important information for veterinarians

The following information was sent by email to peak body representatives on 9 July 2008 and uploaded onto the DPI&F web site on 10 July 2008 as a one-page, downloadable .pdf file.

Hendra Virus

Important Information for Veterinarians

Hendra Virus is a notifiable disease in Queensland

Hendra virus (HeV, previously known as Equine morbillivirus) is a rare, but potentially fatal, zoonotic disease of horses and humans. Studies have shown that other species, including cats, are susceptible to experimental infection with HeV, but HeV infection of other species is not known to occur naturally.

HeV may be spread between horses and between horses and humans via close contact and previous cases suggest infection via mechanical transmission.

Research suggests that bats (flying foxes, fruit bats) are the natural host for HeV and that spill-over to horses occurs as a rare event. The route of infection between bats and horses is unknown.

Reduce the Risk – Biosecurity Considerations

Stringent biosecurity measures are necessary when dealing with horses known or suspected of having HeV infection, because of the important public health and workplace health and safety issues. Keeping horses away from flying foxes may prevent the spill-over of HeV from bats to horses.

HeV infection is a notifiable disease under Queensland Legislation.

Veterinarians should contact the DPI&F as soon as they suspect a case of HeV in horses or other animals. It is strongly recommended veterinarians seek advice from DPI&F in the investigation of suspect HeV cases.

Advice to Veterinarians/Animal Professionals

HeV infection of horses and humans has occurred as two forms:

Respiratory HeV

- Peracute or acute illness
- Frothy nasal discharge
- Facial oedema
- Body temperature > 40 0C
- Elevated heart rate (>90 beats/minute)

Neurological Hev (primarily seen in the latest cases – July 2008)

- Mild focal neurological signs, including muscle twitching
- Ataxia
- Head tilt, facial nerve paralysis
- Elevated body temperature
- Neurological signs may resolve

To report suspicion of HeV infection contact the DPI&F via :

- DPI&F Call Centre 13 25 23
- Disease watch Hotline 1800 675 888

Find out More

More information, including detailed guidelines for handling suspect HeV cases, is available from www.dpi.qld.gov.au or by calling 13 25 23.

Contact the Queensland Health Hotline on 13 Health (432584) if you have concerns about possible exposure of people to HeV.

26 Appendix 7: Fact sheet: Important community information

The following information was sent by email to peak body representatives on 9 July 2008 and uploaded onto the DPI&F web site on 10 July 2008 as a one-page, downloadable .pdf file.

Hendra Virus Important Community Information

Hendra virus is a very rare cause of disease in horses and humans and is not related to Equine Influenza.

Scientists believe Hendra virus is normally a virus of bats (flying foxes, fruit bats).

The few cases of Hendra virus infection in humans have been the result of very close contact with horses infected with the virus.

Reduce the Risk – Biosecurity Considerations

Hendra virus is not highly infectious. The spread of infection between horses and people can be minimised by good biosecurity measures including:

- ensuring high levels of personal hygiene, including washing hands after and between handling horses
- ensuring all equipment used with horses is clean before and between different horses
- wearing appropriate clothing or gloves to reduce contact with saliva and other discharges from sick horses
- keeping unwashed hands away from your mouth, nose or eyes.

Advice to Horse Owners

Managing Hendra virus does not involve movement restrictions for the general horse population. Movement is only restricted for properties under quarantine for Hendra virus.

Horse movements to events and other activities, including mixing of horses, can continue, however, sound biosecurity measures as outlined above should be practiced.

People working with horses, such as farriers, equine dentists and chiropractors, strappers, vets, or feed delivery merchants should also follow sound biosecurity procedures.

Contact your local veterinarian if you notice changes in the health of your horses or suspect they may be infected with Hendra virus.

Signs that may suggest your horse is infected with Hendra virus include:

- respiratory signs, including frothy nasal discharge and elevated body temperature > 40 0C
- neurological changes, including abnormal muscle twitching, weakness and loss of balance.

Find out More

Contact the Queensland Health Hotline on 13 Health (432584) if you have concerns about possible exposure of people to Hendra virus.

More information is available at www.dpi.qld.gov.au or by calling 13 25 23.

27 Appendix 8: HeV Update sent to AVA on 23 July 2008²⁰

Hendra Virus (HeV) Update

1. Important points for veterinarians to note from the HeV response to date:
 - a. The presentation of these horses at Redlands did not match the known case definition for HeV. Interestingly, testing done to date and some very early gene sequencing work is indicating a slight variation between the Redlands isolate and previous HeV isolates. This work will be progressed.
 - b. Normal post mortem procedures and PPE use in practices may not protect people from becoming infected with HeV. Both people that have tested positive to HeV were exposed to close contact with sick horses and their body fluids and were not protected using their routine precautions.
 - c. Veterinarians should now consider HeV amongst their possible diagnoses for sick horses presenting with acute onset of disease, fever, rapid progression to death or recovery (48 hours) accompanied by either respiratory or neurological signs. Presence of bats in the area is also supportive.
 - d. Flying foxes remain the known reservoir of HeV and the presence of bats in the same general area as infected horses remains a consistent finding.
2. On 7 July 2008, the principle veterinarian of a busy horse practice advised the Chief Veterinary Officer Queensland of unusual neurological cases in horses at the practice. The presenting signs included fever, acute onset, rapid progression, ataxia, head tilt, facial nerve paralysis and purple mucous membranes.
3. A total of four horses have been confirmed as being infected over a three week period from late June 2008. One of the horses had been euthanased and a thorough post mortem undertaken over the weekend of 5-6 July. The other sick horses had also all received close veterinary care.
4. Due to the unusual nature of the disease situation, the clinic was quarantined under the Stock Act 1915 on 7 July 2008. Biosecurity Queensland veterinarians attended the practice and secured all available samples, including post mortem samples and blood samples from 3 of the recent cases.
5. At 10:30 am on 8 July 2008, Queensland Health advised of two presumptive positive PCR results to Hendra from the blood samples submitted. These results were confirmed at 16:30. Samples were dispatched to AAHL where HeV has been confirmed and subsequently 4 horses have been confirmed from Redlands with HeV.
6. Coincidentally, another positive case of HeV was confirmed in a horse that died 11 July 2008 near Proserpine. Of interest is that this case matched the existing case definition that includes respiratory signs and that testing and early gene sequencing work indicates this virus is similar to previously known isolates. Investigations will continue.
7. On the Proserpine property, another horse died on 4 July 08, and in retrospect fitted a respiratory case definition for HeV. No samples are available. Another horse on the property became sick with signs fitting HeV case definition and was post mortemed on 21 July 08. Results are not available for this horse yet. Of the 3 remaining horses on the property, one has been recently sick but appears to be recovering and the other 2 appear healthy at this point.
8. The clinic remains under quarantine and a serological testing program is underway on all surviving horses at the clinic – 37 in total. Only horses that test negative on the serological neutralisation test (SNT) can be considered to be free of HeV. The duration of the quarantine will relate directly to the results of these SNT's and the final of these results should be available next week.
9. HeV is a zoonotic disease and if there is any suspicion in a presenting case, the local Public Health Unit or your GP should also be contacted as soon as possible.
10. The HeV Guidelines for Veterinarians available from the DPI&F website is now being updated. Chris Reardon is the AVA-EVA representative on the group undertaking the update.

²⁰ This update was sent in the afternoon of 23 July 2008, prior to the reporting of Hendra positive status of case R5 and therefore refers to four confirmed Hendra cases at Redlands.

28 Appendix 9: Acronyms and abbreviations

AAHL	Australian Animal Health Laboratory
AHIC	Australian Horse Industry Council
ARI	Animal Research Institute, Yerongpilly (DPI&F)
AVA	Australian Veterinary Association
BQ	Biosecurity Queensland
BQCC	Biosecurity Queensland Control Centre
BSL	Biosecurity Sciences Laboratory, (DPI&F)
CCEAD	Consultative Committee on Emergency Animal Diseases
CVO	Chief Veterinary Officer
DAFF	Department of Agriculture, Fisheries and Forestry
DEIR	Department of Employment and Industrial Relations
DPI	Department of Primary Industries
DPI&F	Department of Primary Industries and Fisheries, Queensland
EADRA	Emergency Animal Disease Response Agreement
ELISA	Enzyme-Linked ImmunoSorbent Assay
EMU	Emergency Management Unit
EPA	Environmental Protection Agency
EVA	Equine Veterinarians Australia
FAQ	Frequently asked question
HACCP	Hazard Analysis and Critical Control Points
HeV	Hendra virus
HTML	HyperText Markup Language
IP	Infected premise
LDCC	Local Disease Control Centre
MSDS	Material safety data sheets
NASPH	National Association of State Public Health Veterinarians
PAPR	Powered air-purifying respirator
PCR	Polymerase chain reaction
PDF	Portable Document Format
PIB	Primary Industries Building, 80 Ann Street, Brisbane
PPE	Personal protective equipment
PVP	Private veterinary practitioner
QH	Queensland Health
QHC	Queensland Horse Council
QHR	Queensland Harness Racing
QHSS	Queensland Health Scientific Services
QR	Queensland Racing
RVC	Redlands Veterinary Clinic
SDCHQ	State Disease Control Headquarters
TBAQ	Thoroughbred Breeders Association of Queensland
UQ	University of Queensland
URL	Uniform Resource Locator
VNT	Virus Neutralisation Test
VSQ-QLD	Veterinary Surgeons Board of Queensland
WH&S	Workplace health and safety
WHSO	Workplace health and safety officer