DPaW Warren Region: Saving Environment Protection and Biodiversity Conservation Act Listed Species in the Walpole Wilderness by Removing Feral Pigs

X0979G

Final Project Report
August 2013

SOUTHCOAST NATURAL RESOURCE MANAGEMENT INC.

CARING FOR OUR COUNTRY

Government of Western Australia
Department of Parks and Wildlife

Acknowledgements

We acknowledge the support and sponsorship of the project by South Coast NRM and the Australian Government's Caring for our Country program.

Thank you to members of the Albany Branch of the Sporting Shooters Association of Australia - Hunting & Conservation Group (ASSA), Lake Muir Denbarker Feral Pig Eradication Group (LMDCFPEG) plantation management staff and private property owners in the Bow Bridge area for the on ground feral animal control undertaken during the project. The willingness to collect and provide accurate data for use by DPaW is greatly appreciated.

To members of the Walpole Nornalup National Parks Association, and in particular to Mavis Sowry, Colin and Jeanne Steele, who assisted with critical habitat monitoring of EPBC listed species, collection and identification of flora specimens.

An enormous amount of field work has been carried out by DPaW employees in feral animal control activities and many days of vehicle and foot based survey work. We would like to especially thank Mick Sawyer for his coordination of field based control activities; Janine Liddelow for her botanical expertise; Justine Gamblin and Charlene Hordyk for data entry and photo analysis; Anthony Thompson, Nathan Blake, Glenn Freeman and Rodney Leggerini for trapping, tracking and capture of pigs; Jason Fletcher, Nic Slatter, Mathew Corlett, Jim Love, Jason Benson, Shaun McHenry, Trevor Brown with support from others for the many hours of survey, recording of pig activity and control of pigs.

The enthusiasm and interest shown in this project, by all involved has helped to protect EPBC listed species within the Walpole Wilderness.

Report compiled by Roslyn Burnside

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1.0 Introduction:

In 2010 South Coast Natural Resource Management in partnership with the Department of Parks and Wildlife (DPaW) formerly Department of Environment and Conservation (DEC), were successful in securing Caring for our Country funding for a project entitled "Saving EPBC listed species in the Walpole Wilderness by removing feral pigs." The funding provided for three years of pig control activities (trapping and humane dispatch) to be delivered across 230,000 ha in the Walpole Wilderness by DPaW, in partnership with the Lake Muir Denbarker Feral Pig Eradication Group (LMDCFPEG) and the Albany Branch of the Sporting Shooters Association of Australia - Hunting & Conservation Group (ASSA).

Prior to commencement of the project, feral pig sighting and activity data collected by DPaW suggested that the distribution of pigs was widespread throughout the Walpole Wilderness and surrounding areas, including private property. Damage to biodiversity had been observed as a result of the pig activity and included significant disturbance to sensitive granite, peat wetland, moist forest and riparian ecosystems due to digging, wallowing and feeding behaviour. In addition, new infestations of *Phytophthora cinnamomi* (dieback) had been detected in areas that were previously known to be free of the disease, prompting concerns regarding the potential of these pigs to spread dieback to high value disease-free areas.

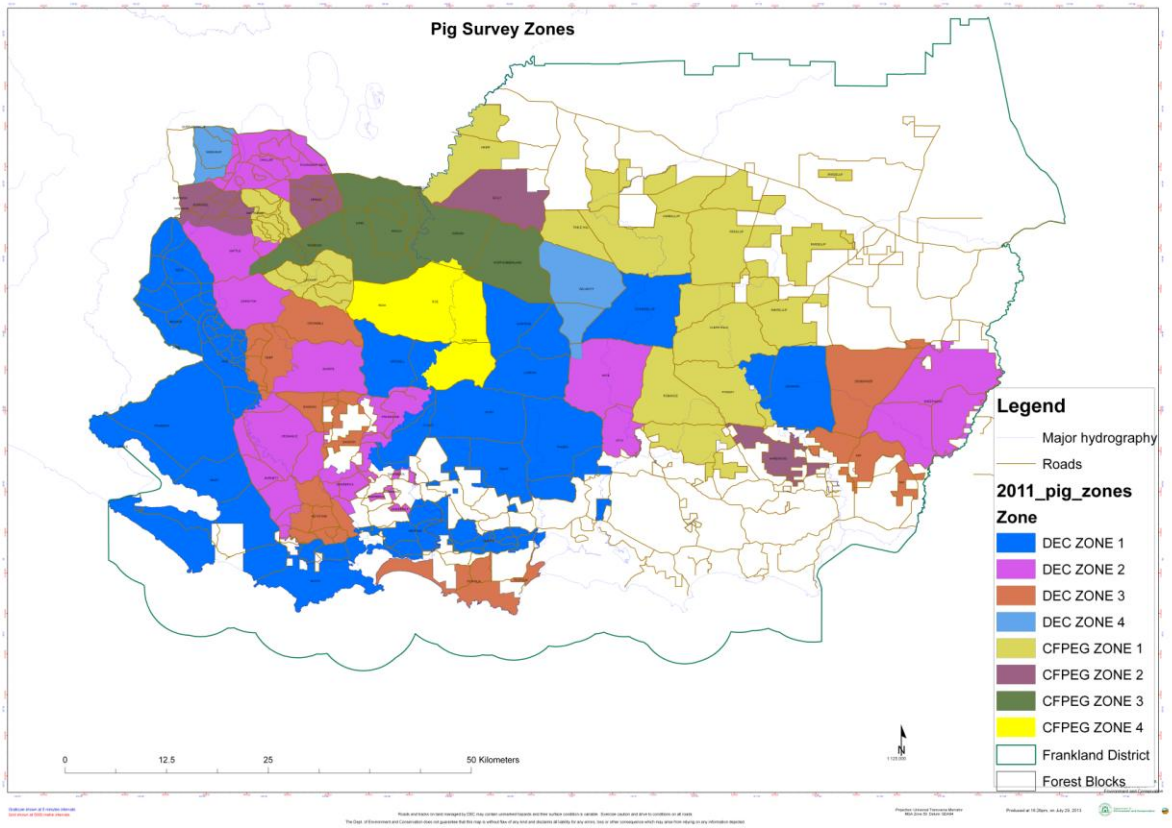
DPaW was already undertaking feral pig control work within the Walpole Wilderness due to the threat they pose to threatened taxa, critical habitat and ecosystem health. The Caring for our Country funds enabled the pig control efforts to be expanded significantly and, in partnership with the LMDCFPEG and ASSA, allowed a larger geographical focus for the project and a stronger focus on habitat most important to commonwealth listed taxa. The funds also enabled a greater level of monitoring and evaluation of the effectiveness of control activities in reducing the threat and impact of pigs on critical habitat for the target species.

There are limited studies that quantify the impacts of feral pigs on biodiversity values and this project contributes to addressing some critical gaps in knowledge to enable more effective prioritisation of control efforts and management of key habitats by land managers. The key objective of this project was to reduce the impact of feral pigs on biodiversity within the wilderness area, and in particular within 630ha of critical habitat for EPBC listed taxa including the sunset frog, Walpole burrowing crayfish, quokka and Reedia.

2.0 Methods:

2.1 Pig control activities

The distribution of feral pigs in the Walpole Wilderness is influenced by natural dispersal and movement patterns as well as the illegal introduction of feral pigs (Spencer and Hampton 2005). Studies in other parts of Australia have shown that sows and juveniles have small, stable home ranges and that boars move distances greater than 10 km (e.g. Saunders and McLeod 1999, Spencer and Hampton 2005). On the basis of this information, critical habitat for EPBC listed taxa was identified and a buffer applied to allow for pig movement and dispersal behaviour. Areas within 20km of critical habitat were considered a high priority for pig survey and control efforts; areas 20-40km were a priority for survey to ensure that any pigs moving towards the high priority areas were detected and managed. DPaW activities were focused primarily within the high priority areas and buffer zones; LMDCFPEG and ASSA extended the buffers further and controlled any pigs moving into these areas from the private property interface and through significant riparian systems.



2.1.1 Figure 1: Pig Survey Zones

Pig survey was undertaken by vehicle and on foot and concentrated on areas in the landscape that had permanent moisture, within and adjacent to habitat areas of high value. Records of sightings from the previous summer were used as a starting point for surveys and 159 points were established within and adjacent to important habitat areas to encourage active foot based survey for pigs. Volunteers from the ASSA completed 22 weekend expeditions during the project, involving 58 volunteers, with foot based surveys through river and creek systems, shooting pigs and/or reporting pig activity to DPaW. A standard reporting format was developed and applied across all groups involved in pig control activities on conservation estate. During pig surveys, information relating to pig activity including the presence of tracks, scats, diggings and wallows; the recency of activity indices; and the approximate area of damage were recorded to provide an activity index. It is unclear how the activity indices relate to actual pig abundance and because sites were visited many times during the season, it is important not to consider pig activity as an indication of density of abundance, but as an indication of potential threat/ impact.(Table 2)

Volunteers and workers involved in the project, either directly in onground control or in assisting with surveys of habitat sites, were provided with information on dieback and Chytrid fungus. This enabled those working in the field to actively practice hygiene measures during all activities, and particularly as they moved from low lying areas upslope or between moist areas, to ensure that dieback was not being moved to uninfected areas and that new chytrid strains were not being introduced into high value wetland or creek systems.

Pig survey efforts concentrated on permanent water sources, including man made water points, creeks, swamps and moist depressions in the landscape. This information contributed to the placement of traps and traps were used only where pig activity was consistent and responsive to pre feed and in areas accessible by vehicle. For inaccessible areas, tracking dogs and planned shooting operations were instigated.

The standard figure 6 trap design with a spring loaded door and trip trigger has proved a popular and successful method of trapping pigs for many years (DAFWA Farmnote No. 36/2003). Traps can be as small as 2-3m across to larger more permanent traps. The mesh is usually 1.2m- 1.5m in height.

An assortment of grains (maize, oats, wheat), commercial pelletized animal feed (horse, pig and marron pellets), and stock lick blocks were used to pre feed trap sites where pig activity was being consistently observed. Pre feed was presented in small piles on a raked sandy section of a road so any animal tracks left in the sand could be easily seen and any preference to the feed noted. Remote sensor cameras were used to monitor the response of pigs to pre-feed and trapping activities and to try and quantify the number of pigs contributing to the observed damage and activity indices. Commercial sow scent (Ulrich) was also trialled in an attempt to attract boars to an area for trapping.

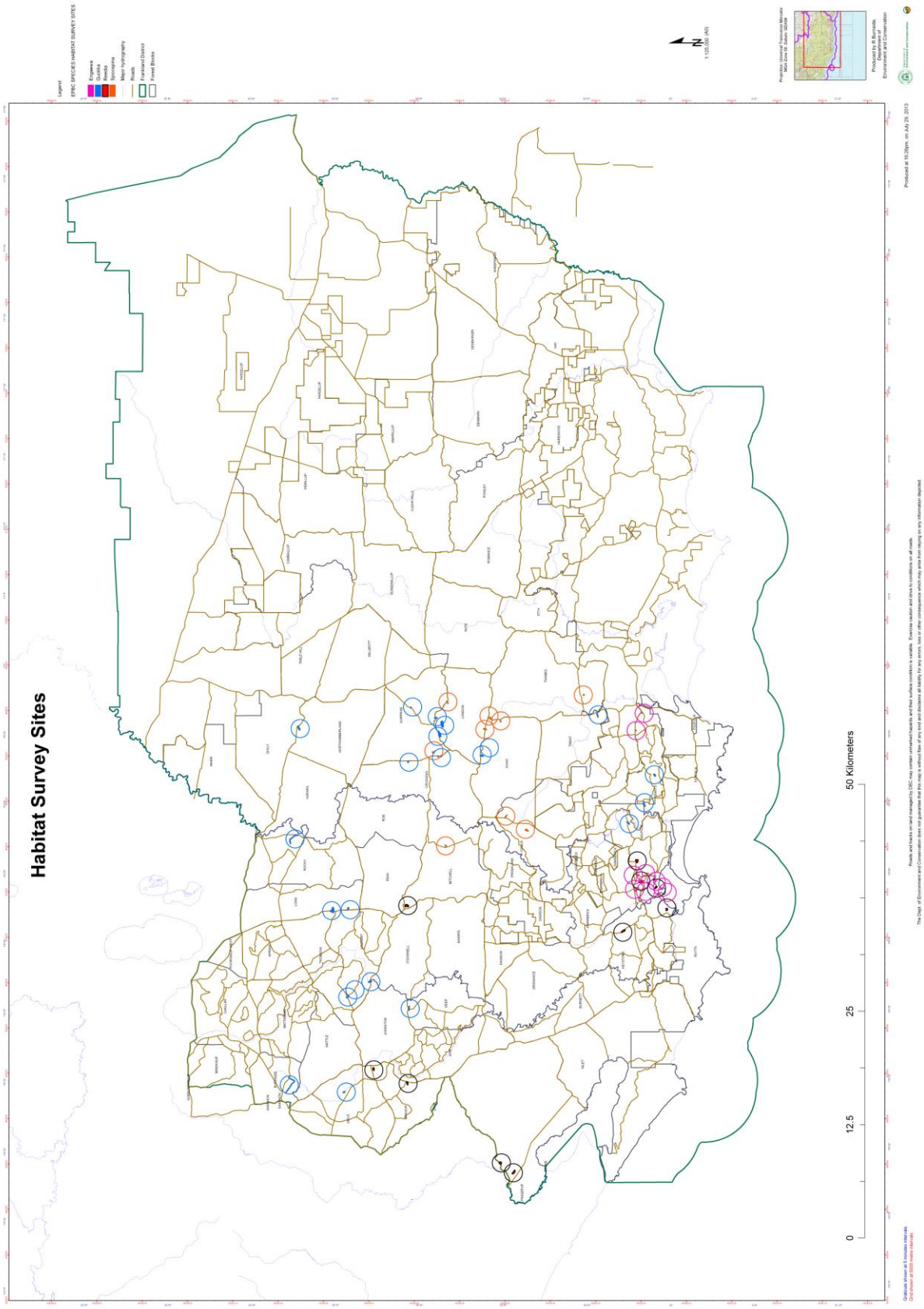
The use of tracking dogs was trialled in the second year of the project and implemented widely in the third year of the project to locate pigs for humane dispatch using a firearm.

2.2 Measuring the impact of pigs and the effectiveness of control activities in reducing impacts

The target species being protected by the project included the sunset frog (*Spicospina flammacaerulea*), Walpole burrowing crayfish (*Engaewa walpolea*), quokka (*Setonix brachyurus*) and Reedia (*Reedia spathacea*). These species are associated with moist habitats including forest, riparian systems and peat swamps, which are visited by feral pigs in summer when moisture at a landscape scale is fragmented and restricted. In order to understand the impact of pigs on habitat quality and the effectiveness (or otherwise) of pig control activities in protecting habitat or allowing habitat to recover, it was necessary to monitor key habitat areas.

The sunset frog is found in isolated and permanently moist peat based swamps within 20km of Bow Bridge (Roberts *et al*. 1997); the Walpole Burrowing crayfish is found in headwater seepages and broad drainage depressions in a variety of soil and vegetation types (Kellie Mantle, 2008) within 20km of Walpole; quokkas are associated with moist riparian systems and moist forest ecotypes and their potential habitat is relatively widespread throughout the Walpole Wilderness Area; *Reedia spathaceae* occurs within paluslopes (on slopes and adjacent streams) that are permanently waterlogged (Tauss, 2001).

Monitoring sites were selected based on the occupancy of habitat by the target species and proximity of the sites to recorded pig activity during the season prior to the project commencing. 49 areas of critical habitat were monitored and covered an area of 128.5 ha (Figure 1; Table 1). Having multiple sites for each target species allowed for spatial separation of sites and selection of habitats that had varying time since fire and different histories of pig activity.



2.2.1 Figure 2: Areas of critical habitat monitored for pig impacts between 2010 and 2013

2.2.2 Table 1: Areas of critical habitat monitored for pig impacts between 2010 and 2013

Target Species	Number of sites	Area covered (ha)
Sunset Frog	11	11
Walpole Burrowing Crayfish	10	10
Quokka	18	90
Reedia	10	17.5

At each site, ten points were monitored with a series of habitat attributes recorded (Table 2) including: landform, under storey, mid storey and over storey height, canopy and under storey cover, vegetation structure, vegetation type, under storey species diversity, fuel age (time since last burnt), season of the last fire event presence of pigs, and dryness of habitat. The multiple sample points were averaged for each site to reduce variability caused by short-term changes in the spatial distribution of individuals. Habitats were monitored prior to pig control commencing and then during each year between 2010 and 2013. Volunteers from the Walpole Nornalup National Parks Association contributed to critical habitat monitoring of EPBC listed species, collection and identification of flora specimens.

2.2.3 Table 2: Habitat variables monitored between 2010 and 2013

Variable	Description
Landform	Description of landform: moist creek = 1; dry creek=2; wet creek=3; heath=4; mid slope=5; ridge=6
Soil type	Soil type and colour - sand, sandy loam, loam, clay, peat
Soil colour	Red, brown, yellow, white, grey or black.
Soil moisture	% moisture using PMS-714 meter - % water - % amount of moisture in the soil of that area
Under Storey Height	Average height of vegetation from ground to lowest vegetation layer (m)
Mid Storey Height	Average height of vegetation from ground to middle vegetation layer (m)
Over Storey Height	Average height of vegetation from ground to tallest vegetation layer (m)
Canopy cover	Average percentage of ground covered by the crown foliage (%). Measured using digital cover estimation techniques (Macfarlane et al. 2000, Macfarlane et al. 2007). Images were analysed manually using Adobe PhotoShop
Under storey cover	Average percentage of ground covered by the understorey foliage (%).Measured using digital cover estimation techniques (Macfarlane et al. 2000, Macfarlane et al. 2007). Images were analysed manually using Adobe PhotoShop
Vegetation Structure	Number of vegetation layers including ground cover, understorey, multiple mid storey layers and overstorey.
Vegetation composition	Flora species within 2 m radius of the point
Relative cover of flora species	A cover code assigned for each flora species; 0= No plants; 1=< 1% cover; 2=1 – 5% cover; 3=5 – 25% cover; 4=25 – 50% cover; 5=50 – 75% cover;

	6=75 – 95% cover; 7=95-100% cover
Relative abundance of target species	Number of calling males of sunset frog during breeding season; number of Engaewa burrows, number of groups of fresh quokka scat and number of Reedia clumps
Time since Fire	Years since the last fire
Presence of pigs	Categorical assessment of presence/ absence based on faecal material, diggings, sightings and camera traps. Pigs present (No=0; Yes=1)
Pig activity type	1=scats; 2=tracks; 3=scats and tracks; 4=diggings and wallows; 5=diggings, scats and tracks; 6=actual sighting
Recency of pig activity	1=fresh (within 2days); 2=within last 2 weeks; 3=older than two weeks; 4=older than this season
Pig activity level	1=High (lots of animals or activity over a long period); 2=Medium (more than one animal); 3=Low (one animal set of prints)
Area of pig damage	1=0-2m^2; 2-2-5 m^2; 3=5-10 m^2; 4=10 to 25 m^2; 5=25-50 m^2; 6= 50 to 100m^2; 7= 100 to 200m^2; 8= >200m^2

Photos points were established to capture changes in vegetation during the project period at representative sites in monitoring sites or in areas showing significant pig damage outside of the monitoring sites.

3.0 Results:

3.1 Pig control

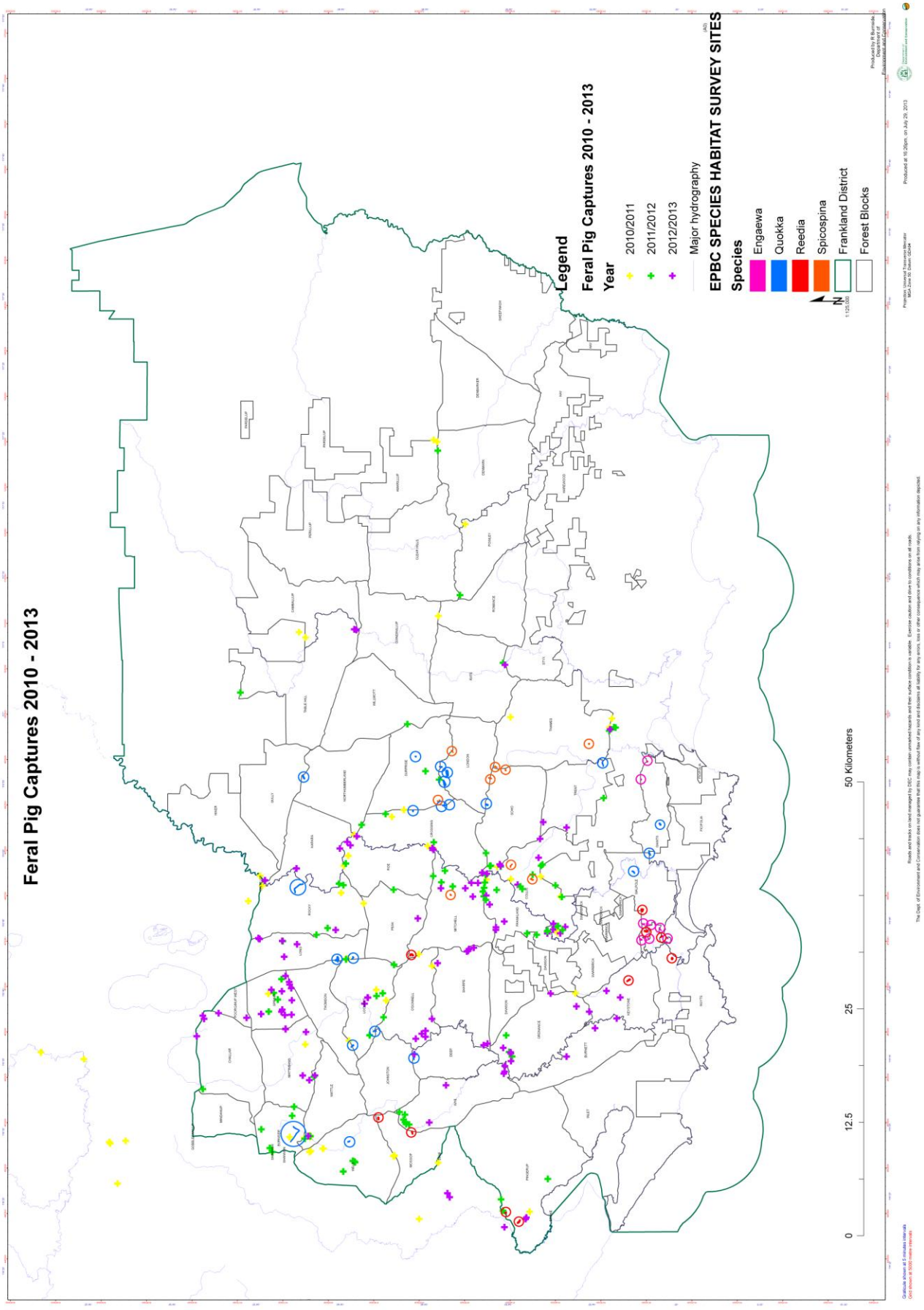
This project implemented 540 days of on ground feral pig control activities over three years in an effort to significantly reduce the number of feral pigs in the Walpole Wilderness area.

The project was a successful collaboration between DPaW and a number of community groups, including the LMDCFPEG and ASSA and other partners such as landholders and plantation managers.

3.1.1 Table 3: Pigs captures between 2010 and 2013 by DPaW, LMDFPEG, ASSA and other partners

CAPTURES BY DPaW									CAPTURES BY OTHER GROUPS				TOTAL
Year	Total # of Captures by	Ground shooting	Captured in Traps	# of Traps	# of Trap nights	# of Females	# of Males	Weight Range KG	Captures by LMDFPEG	Weight Range KG	Captures by ASSA	Other (Gunns, private)	Total captures for year
2010/11	37	0	37	20	286	12	25	35 - 100	103	5-90	0	1	141
2011/12	57	51	6	22	53	27	30	5-90	73	30-75	8	3	141
2012/13	69	64	5	13	80	29	40	5-80	65	7-65	5	12	157

A total of 439 pigs were removed from the Walpole Wilderness area as a direct result of this project. The removal of these individual animals has provided direct benefit to at least 24 of the critical habitat areas monitored as a part of this project. The number of pigs removed each year has remained relatively constant, suggesting that key reproductive animals are not being captured (Table 3).



3.1.2 Figure 3: Pig captures between 2010 and 2013

Prior to the commencement of this project trapping was widely used and proved successful. In year two and three of the project trapping was not as effective. Prefeed trials were undertaken in an effort to increase trap success. Pigs showed no interest in any of the baits being offered, though tracks were observed on the sand nearby. This appears to be a common trait with feral pigs where food will be ignored in one area but readily consumed by pigs in a different area. Commercial attractants were not successful.

The use of tracking dogs proved very successful in 2013 with around 90% of the feral pigs captures being tracked by dogs. A major advantage in using dogs is they can locate pigs with their sense of smell in areas where little or no sign of them is obvious to the surveyors. The limitations of using dogs are that they are best suited to small groups (1-3) of pigs, only very fresh sign of pigs can be tracked by the dogs, and you are limited by the prevailing winds to carry the scent of the pigs if working along a road.

3.2 Measuring the impact of pigs and the effectiveness of control activities in reducing impacts

Of the 49 sites monitored, 18 had pig activity recorded prior to pig control commencing; following commencement of pig control activities 8 sites had pig activity recorded in the first and second year; with 14 sites having pig activity recorded in year three of the project (Table 4).

3.2.1 Table 4: Number of habitat suvey sites where pig activity was recorded

Species	Prior to pig control	First year of pig control	Second year of pig control	Third year of pig control
Sunset Frog	8	6	6	7
Walpole Burrowing Crayfish	0	0	0	0
Quokka	5	0	1	4
Reedia	5	2	1	3

Nine sites had significant damage recorded during the period where pigs were being controlled (Table 5). In the peat wetland areas, damage consisted of uprooting of freshly burnt lignotubers; complete disturbance and dessication of organic soils, to a depth of more than 50cm in places, accelerated oxidification of organic soils and visible collapse of spongy peats; and digging and grazing on vegetation and complete removal of species such as Lepidospermum effusum and Homalospermum firmum, particularly following fire in the habitat. In the forest areas, damage consisted mostly of shallow diggings, some quite extensive but fragmented and diggings tended to disturb only the forest leaf litter and top soil layer.

3.2.2 Table 5: Number of habitat survey sites where damage is > 50m^2

Species	Prior to pig control	First year of pig control	Second year of pig control	Third year of pig control
Sunset Frog	4	4	4	4
Walpole Burrowing Crayfish	0	0	0	0
Quokka	1	0	1	4
Reedia	2	1	1	1

There were a number of sites where pig activity had been recorded but no damage was sustained and in these areas, vegetation density and cover was high (average 85.2%) and the pigs appeared to be moving through the habitat. Vegetation cover was provided by mid storey species. Sites with large areas of damage recorded were areas with high moisture or fringing areas with high moisture.

In 3 of the 4 sunset frog sites with areas of damage >50m² the damage occurred in areas of high moisture in peat or sand/peat soils and tended to be in areas fringing core habitat. The height of midstorey species was similar to sites without damage. Areas of sustained damage > 50 m² within Reedia habitat were noted in areas where vegetation had been affected by fire or pigs prior to the project. Sites with no recorded damage had a high % of vegetation cover and density. At one Reedia site with a portion of the population fenced since 2003, pigs continued to visit the site, traversing along the fence, digging and wallowing in open moist areas. There is only a small portion of the population surviving outside of the fence, and this occurs within an area of very dense vegetation where there was no evidence of pig damage during the period of the project.

Pig activity (scats, tracks, diggings and wallows) and damage was also recorded within a 5km radius of habitat survey sites to provide an indication of potential threat to critical habitat. Evidence of pigs were recorded within 5km of 42 sites prior to pig control commencing; 29 sites following commencement of pig control; 30 sites year two and 31 sites year three (Table 6). For 5 sites significant damage was recorded within 5km during the period where pigs were being controlled (Table 7). 366 pigs were removed from within 5km of 27 sites during this project (Table 7 and 8), providing direct protection to this habitat.

3.2.3 Table 6: Evidence of activity within 5km of habitat survey sites

Species	Prior to pig control	First year of pig control	Second year of pig control	Third year of pig control
Sunset Frog	334	289	328	476
Walpole Burrowing Crayfish	20	0	24	2
Quokka	380	200	191	235
Reedia	146	155	144	211

3.2.4 Table 7: Number of areas where damage > 50m^2 was recorded within a 5km radius of habitat survey sites

Species	Prior to pig control	First year of pig control	Second year of pig control	Third year of pig control
Sunset Frog	Area of damage not recorded prior to commencement of project	12	18	39
Walpole Burrowing Crayfish		0	0	1
Quokka		3	6	23
Reedia		2	7	7

3.2.5 Table 8: Number of sites with captures within a 5km radius of habitat survey site

Species	Prior to pig control	First year of pig control	Second year of pig control	Third year of pig control
Sunset Frog	10	5	8	4
Walpole Burrowing Crayfish	0	0	1	0
Quokka	8	4	10	11
Reedia	2	4	4	4

3.2.6 Table 9: Number of pigs captured within a 5km radius of habitat survey site

Species	Prior to pig control	First year of pig control	Second year of pig control	Third year of pig control
Sunset Frog	27	22	55	40
Walpole Burrowing Crayfish	0	0	1	0
Quokka	133	80	89	39
Reedia	5	15	16	9

One site of particular interest was a sunset frog swamp, which had evidence of feral pig damage prior to the commencement of the project. The pig damage occurred following a spring bushfire in 2002, but did not affect the persistence of the sunset frogs in this habitat, with calling males recorded each breeding season between 2003 and 2012. This site experienced fire again in November 2011 and within days, the pigs had returned to the site with observations of extensive diggings recorded; a total of 29 pigs were removed from within a 5 km radius of this site between 2011 and 2013 and the sustained damage to the site was serious enough (Figure 4) that a fence was erected to exclude pigs from the area. Of interest is the lack of damage to sunset frog habitat in two sites seemingly identical within 8km of this site. Fire was introduced into one of the sites two years prior to the commencement of the project and no pig damage was recorded in the peaty habitat. The difference between this site and the site where extensive pig damage was recorded following fire, was that the peat substrate had not been burnt during the fire. Observations at the site with extensive damage to the peaty habitat indicate that some of the peat substrate had been burnt during the fire. In three additional sites, significant pig damage was recorded in the buffer area and in particular in vegetation fringing the peat system. It is likely that in the absence of control, this activity will spread to the core peat wetland.

3.2.7 Figure 4 Pig damage sustained at sunset frog habitat following fire

Similarly, the Reedia sites in which significant pig damage was recorded have a history of pig activity following fire, dating back to 2003. Three of these sites were fenced in 2003 to protect the plants from pigs and there are very few plants surviving outside of the fenced area as a result of pigs continually returning to these areas, despite targeted removal of animals (Figure 5). There have

been many other Reedia populations burnt in the last ten years that have recovered vigorously, in the absence of feral pigs.

3.2.8 Figure 5: Pig traversing exclusion fence in Reedia system

In areas where pig damage was sustained in the first year and not in subsequent years, photo point data shows that areas where damage was extensive were slower to recover than areas where damage was confined to walking lines or small areas (Figure 6); areas where damage was confined to small areas showed a noticeable increase in vegetation cover (%) in the two years following pig removal.

In areas where pig activity was recorded throughout the project despite targeted pig control, habitat deterioration in terms of soil damage and loss in vegetation cover were recorded.

In freshly disturbed sites, the EPBC listed taxa were still present as evidenced from calling behaviour, burrows, scat and physical sightings. For sites where damage had been sustained over a long period of time, the short range endemic taxa (sunset frogs, Walpole burrowing crayfish and Reedia) were still present but in lower numbers and because these species are unable to find more suitable habitat, populations of these species are at risk in the absence of sustained pig management. The more mobile species (quokka) did not continue to occupy habitat affected by pigs.

3.2.9 Figure 6: Walking lines in dense vegetation

Remote sensor cameras were used to provide an indication of how pig activity and damage relates to pig abundance or density. A camera in a Reedia population recorded one pig six times over six days from January to November 2012; this individual pig created a significant area of damage that had previously been attributed to a group of pigs. Two individual pigs were captured on camera intermittently over 44 days from January 2012 to April 2013 immediately adjacent to a Reedia population. At a location within 1km of a sunset frog population in an area of sustained damage five individual pigs were sighted over six days from April to December 2012. Over a period of 13 days between May and October 2012 one individual was sighted 14 times and two individuals were sighted twice. The pigs are individually identifiable by unique markings and camera trapping has the potential to provide a population estimate through capture-recapture data with a more robust data collection method than we were able to apply during this project.

4.0 Discussion:

The removal of 439 pigs from the Walpole Wilderness is a significant outcome from this project and this had direct benefits to a large number of the 49 critical habitat areas being monitored as well as many others that weren't and a huge range of threatened, endemic and relictual taxa that make this area so important.

The constant number of pigs being removed each year, suggests that control of pigs around high priority biodiversity values does not control pig populations, which is not a surprise given the large areas where control was unable to be implemented within the constrained resources. The current practices are removing pigs causing damage to core biodiversity values, but are not able to target the core reproductive animals. Nonetheless, this approach is successful at protecting high value areas from pigs in the absence of sufficient resources to undertake landscape level pig control programs.

In the absence of this direct habitat protection, there is little doubt that populations and species will be lost, given the observations of damage made to refugial habitat and particularly peat swamps, in this project.

At the commencement of this project, trapping was considered to be the most effective method of capture, based on historical success. Efforts were generally carried out during the summer months, taking advantage of the fact that pigs tend to congregate around water sources during the drier months. During the project the opportunity for DPaW staff to develop skills and partnerships in tracking pigs on foot and with the assistance of tracking dogs has improved capacity and provided flexibility in methods of capture. Positive outcomes were achieved during the project by having the ability to quickly apply a variety of control methods (trapping, tracking with dogs) when fresh sign of activity by feral pigs was observed. The use of tracking dogs has provided the opportunity to extend the times available to capture pigs as this method is less dependent on the requirement for sign of activity associated with drier weather.

A collaborative and coordinated approach to survey effort across the range of groups involved in this project enabled the collection of information in a consistent way. This allowed for a broadscale identification of pig activity in relation to when the activity took place, the impact on habitat and contributed to an understanding of temporal and spatial pig movements. This project has contributed to strong partnerships between DPaW, LMDCFPEG, ASSA and plantation managers to achieve a united approach to pig control and habitat protection.

Habitat surveys identified that the impact on vegetation was influenced by the number of times pigs visited an area. Where pig activity had been recorded over long periods, large areas of damage were also recorded, and sensor cameras suggest that in some cases a single pig can be responsible for the sustained damage. Significant damage was observed after bushfire events in three of the habitat survey sites prior to the commencement of this project. During the project two of these sites were subject to prescribed burning and pig activity was recorded within days. The site where damage was significant was where small areas of peat had been partially burnt away during the fire, opening up the moist substrate beneath and making it easier for pigs to dig and wallow. In the area where the peat remained intact, the vegetative and root material tightly bound the peat surface, making digging more difficult. In areas of dense vegetation evidence of pig activity was confined to walking lines but once these walking lines had been established, it was easier for them to be expanded upon repeat visits and potential damage to a greater area. Digging and wallowing behaviour was most significant in areas where vegetation density was low, often following a disturbance, and moisture was present. Pigs are likely to be returning to these areas, as they provide access to drinking water and the moist soils providing ideal conditions for wallowing. Areas of high damage were often associated with permanent water or proximate to areas with water.

Areas where vegetation has been disturbed by fire are particularly vulnerable to pig damage and the large scale damage to vegetation and soil structure recorded in these areas takes a significant amount of time to recover, if at all; the accelerated oxidisation of peat soils post pig damage and the large scale churning of soil horizons are examples of damage that is unlikely to be repairable. It is subsequently important that any bushfire or prescribed fire management practices implicitly

consider feral pig impacts as a follow up management requirement and that bushfire suppression and prescribed burning operations protect peat substrate from burning.

In a small number of areas of high biodiversity value where pigs are repeatedly returning and continuing to have an impact it has been necessary to install exclusion fences. Although this is not ideal, it does provide a level of security to the habitat until a long term reduction in pig numbers is possible.

Although in some areas, an increase in feral pig activity and damage was recorded following pig control, this can be attributed to an increase in the intensity of survey and the area being surveyed by DPaW staff, partner groups and volunteers. In addition, the inability to quantify the number of pigs contributing to activity indices may mean that the number of pigs has been reduced, but the activity associated with one pig vs five pigs is not distinguishable.

The large amount of data collected during this project contributes to an understanding of where pigs occur in the Walpole Wilderness, their broad movement patterns and relative levels of activity. This data does not provide an indication of pig density or abundance. Limited resources require a focused and target approach to achieve the best outcome possible. This project was successful in protection of critical habitat for threatened species. The 439 pigs removed from the Walpole Wilderness during this project will have reduced the threat to critical habitat, but as long as there are a small number of reproductive pigs that escape control activities, the threat will remain. Prior to this project, it was thought that the pigs disperse throughout the landscape during the wetter months. Although this may be the case for some individuals, images captured on the remote cameras indicate that some animals continue to visit the swamp systems throughout the year. Ongoing pig control is critical to maintain the integrity of important habitat areas and additional effort is required to move away from the areas of critical habitat and locate key reproductive groups to reduce the pig population. Law enforcement effort is also required to prevent further introductions of pigs, which undermine all control efforts.

5.0 Project Learnings:

- Data collected has enabled a more targeted approach to survey and provided a greater understanding of what works best in the field offering greater flexibility for both the method of capture and the timing of activities achieving value for money by the direct benefit gained from the removal of pigs.
- Tracking by dogs and ground shooting has provided the opportunity to extend the time available to capture pigs as there is less dependence on the requirement for drier weather resulting in pigs congregating around key water points.
- Tracking by dogs and ground shooting is not dependent on the pigs uptake of prefeed.
- As a result of trapping activities during the project period pigs seemed to be in smaller groups and therefore more suitable for tracking by dogs.
- The use of cameras has been instrumental in helping us to quantify the number of pigs contributing to observed damage as well as identifying the most appropriate time to target control operations (e.g. how long after fire, time of the day etc).
- Remote sensor cameras have contributed to the accuracy of evidence of activity data by enabling an actual sighting to be recorded.
- In areas of large scale damage where significant amounts of vegetation has been removed evidence of continued acitivity is often difficult to quantify, the use of remote sensor cameras provides critical information about the number and how often pigs are returning to these systems.
- In areas of high biodiversity value where pigs are repeatedly returning and continuing to have an impact it may be necessary to install exclusion fences to provide a level of security to the

population until such times as a long term reduction in pig numbers and therefore the potential impact is achieved.

- During the period of the project an increase in evidence of activity was recorded, this can be directly linked to the increase in foot based survey from 2010 to 2013. In addition to footbased general survey the establishment of 54 pig point surveys in 2010/2011, 2011/2012, 2012/13 and an additional 105 points added in the eastern part of the district provided additional information.
- Established photo points in the landscape require a longer time of recording than was allowed for in the project time to record measurable changes in vegetation.
- Design of survey used to characterise the habitat of selected sites was a valid methodology in regard to documenting vegetation species and the cover provided by the vegetation across the site. It proved less effective in documenting the impact of small amounts of damage and therefore change on vegetation cover over the period of the survey. The % of vegetation cover change did not always reflect vegetation loss observed in the field.
- The characterisation of the habitat did not provide answers as to why a pig will frequent one site and not another, perhaps this relates more to the number of pigs in area and the sites proximity to major river systems and wetlands than directly to vegetation and soil type.
- Data collected during habitat surveys showed variations in soil moisture that may have been influenced by the quality of the measuring equipment and the difference in time of survey in relation to rain events and time of the year.
- In sites where large areas of impact resulting from pig damage post bushfire prior to the commencement of the project, habitat characterisation surveys and the use of remote sensor cameras recorded ongoing pig activity. It was noted in two of the sites where prescribed fire was introduced during the period of the project that pigs returned to the sites within 48 hours of the introduction of fire.
- Peat sytems affected by sustained pig activity have an excelerated rate of decomposition above ground water level and the damage is most likely to be irreversible with the recruitment of seedlings limited. DER Contaminated Sites Branch personnel have offered some advice regarding remedial works that may be trialled by the district.

6.0 Future Recommendations:

- The survey work contributing to knowledge of pig distribution and movement patterns should continue, as this provides valuable information for protection of threatened species and operational control of feral pigs. Using a consistent method of assessing and recording evidence of activity and observed damage enables data collected to be used effectively to prioritise on ground works. Survey on foot and from vehicles is labour intensive and time consuming and provides fragmented data due to the relative inaccessibility of many areas. The development of more strategic survey techniques such as aerial based thermal imagery should be given some priority to enable survey of larger areas, identification of significant remnant groups of pigs requiring control and allow the potential quantification of the abundance of pigs.
- Expand the use of radio-collared 'Judas' pigs to contribute to our knowledge of pig movements.
- This project has demonstrated that in the absence of pig control, critical habitat for EPBC taxa and other threatened, endemic or relictual taxa are at risk of being lost, particularly peat wetland systems. Ongoing control is essential to protect high priority areas for biodiversity.
- This project has also demonstrated that focused trapping and ground control operations can reduce pigs around focal areas and protect areas of critical habitat; however, this approach is highly likely to miss key reproductive animals and so will not contribute to effective pig population control over time. The only way to genuinely control pigs is to have a good understanding of population abundance and distribution and to target resources widely to remove all reproductive components of the population. This requires significant investment and was NOT an objective of this project, given the limited resources.
- This project has confirmed that damage to sensitive habitat by pigs is most likely to be significant following a disturbance such as fire and that this damage can occur within two days of fire. Pig control must be a priority in areas containing peat wetland/ swamp systems and for planned burns must be identified as a requirement immediately post burn and for up to two years following the burn, particularly where there are known occurrences of sunset frog or Reedia.
- Strategic pig survey and capture efforts should be planned around areas where burning is planned or where a bush fire has occurred, to take advantage of pig movements evident after the introduction of fire. Tracking using dogs and footbased survey can be very effective in the more open landscape post fire.
- Peat systems where pig activity has been recorded have an accelerated rate of decomposition due to oxidisation and acidification processes; this damage is likely to be irreversible and results in ultimate collapse of the peat system. Trials investigating the use of mulching and revegetation techniques to stabilise soils and slow the oxidisation processes should be given priority in sunset frog and Reedia habitat where this level of damage has already occurred. There is a possibility that the decomposition process can be slowed down and resilience of the ecosystem to this damaging process improved.
- It would be useful to quantify the chemistry and condition of peaty soils prior to and following pig activity and any opportunities that may be available for active recovery of the condition of these sites.
- There is a need to quantify the recovery of vegetation in areas where pigs have been excluded. This project wasn't long enough to achieve this outcome, but there are opportunities to continue this work in areas where pigs have been actively excluded through fenced exclosures and identical habitat outside of the fences are still being affected by pigs.
- High resolution aerial photography is needed to document the baseline habitat condition within sunset frog, Walpole burrowing crayfish and Reedia habitat and enable temporal and spatial assessment of changes to habitat condition as a result of pigs and other interactive processes such as fire and climate change.

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Appendix:

Photos of EPBC listed species habitat

Summary of habitat survey sites:

Spicospina flammocaerulea – sunset frog

Engeawa walpolea - Walpole Burrowing Crayfish

Setonix brachyurus – Quokka

Reedia spathacea

Sunset Frog habitat

Walpole Burrowing Crayfish habitat

Quokka habitat

Reedia habitat

Spicospina flammocaerulea - Sunset Frog																
Site Name	**Area Surveyed / HA's**	**landform**	**Average soil type /colour**	**Average Moisture / %**	**Range of Height of understorey / M's**	**Range of Height of Mid Storey / M's**	**# of levels of Midstorey over site**	**Range of Height of Canopy / M's**	**% Vegetation cover**	**Pig Activity Type**	**Recency of Pig Activity**	**Pig Activity Level**	**Area of Activity**	**Vegetation Density of Plants Species Measure of Cover Code** **0 = No plants** **1 = < 1% cover** **2 = 1 – 5% cover** **3 = 5 – 25% cover** **4 = 25 – 50% cover** **5 = 50 – 75% cover** **6 = 75 – 95% cover** **7 = 95 – 99% cover** **8 = 100% cover** **Average across site.**	**Burnt During Survey Period**	**Comments**
1A	0.60	Flat	Peat / Sand/grey	17.5	0-0.8	0.2-4	2	0	88.5 (pre fire) 13.6 (post fire)	0	0	0	0	Acacia hastulata (3), Acidonia microcarpa (2), Actinotus (2), Aotus sp. (1), Astartea sp. (1), Banksia quercifolia (3), Beamea sp. (2), Beufortia sparsa (2), Boronia stricta (2), Callistmon glauca (1), Cassytha (1), Cephalotus follicularis (1), Cosmelia rubra (1), Dasypogon bromeliifolius (2), Empodisma gracillimum (5), Eutaxia virgata (3), Gompholobium villosum (1), Homalospermum firmum (3), Kunzea recurva (1), Leucopogon sp. (2), Meelboldina scariosa (2), Meelboldina sp. (4), Melaleuca rhaphiophylla (3), Moss sp. (3), Scheonus multiglumus (1), Sedge sp. (3), Sphenetoma gracilis (1), Stylidium scandens (1), Tall sedge (1), Taxandria fragrans (4), Taxandria linearfolia (3), Taxandria parviceps (1).	Y	Survey area burnt under prescribed conditions in spring 2011. Nil pig activity.
1B		Flat	Peat / Sand/black	17.45	0.4-0.8	0.8-3	2	0	71.4	0	0	0	0	Beumea sp. (1), Beufortia sparsa (1), Acacia hastulata (1), Acacia pentadenia (1), Acidonia microcarpa (1), Aotus passerinoides (1), Banksia quercifolia (1), Beumea juncea (1), Boronia stricta (2), Callistemon glauca (2), Cassytha (1), Cephalotus follicularis (1), Cosmelia rubra (1), Dampiera sp. (1), Drosera sp. (1), Empodisma gracillumum (3), Eutaxia virgata (1), Fine sedge (1), Fungi (1), Gahnia decomposita (3), Gompholobium polymorphum (1), Hakea linearis (2), Homalospermum firmum (3), Leptocarpus tenax (2), Lichen (1), Moss sp. (1), Pteridum esculatum (1), Schoenus multiglumus (1), Sedge sp. (1), Sphareolobium sp. (1), Sphenetoma gracilis (1), Stylidium scandens (1), Taxandria fragrans (2), Taxandria linearfolia (2), Taxandria parviceps (2),	N	Nil pig activity.
1B	0.50	Flat	Peat / Sand/black	20.1	0.3-0.4	1-3	2	0	53.15	4	4	2	4-7	Banksia quercifolia (1), Callistemon glauca (3), Empodisma gracillimum (2), Eutaxia virgata (3), Homalospermum firmum (2), Moss sp. (1). Taxandria linearfolia (1).	N	Pig activity observed as older than 1 season in 2010/11, additional pig activity observed in 2012/13
2A	0.45	Flat	Peat/Sand/black	15.8	0.5-1	1-2	2	0	81.6	0	0	0	0	Acacia hastulata (2), Acidonia microcarpa (2), Actinotus laxus(1), Actinotus sp. (1), Adenanthos obavatus (2), Anarthria scabra (3), Astartea sp. (2), Beamea sp. (1), Beufortia sparsa (1), Beamea juncea (2), Callistem glauca (2), Cassytha (1), Cephalotus follicularis (1), Comesperma flavum (1), Comospermum nudisculum (1), Cosmelia rubra (2), Dampiera leptoclada (1), Dampiera sp. (1), Dasypogon bromeliifolius (3), Drosera sp. (2), Empodisma gracillimum (6), Eutaxia virgata (2), Evandra arista (2), Fine sedge (2), Gymnoscheonus anceps (3), Homalospermum firmum (3), Leptocarpus tenax (2), Leucopogon australis (1), Lichen (1), Lomandra (3), Meelboldina sp. (1), Melanostachya ustulata (2), Moss sp. (1), Pteridum esculatum (2), Scheonus sp. (1), Sphearelobium sp. (2), Sphenetoma gracilis (2), Stylidium assimile (1), Stylidium scandens (1), Taraxis grossa (2), Taxandria fragrans (3), Taxandria parviceps (2), Xanthosia rotundifolia (1).	N	Nil pig activity.

2B		Flat	Sand/Peat	17.2	0.4-1	1-3	2	4	86.9	0	0	0	0	Acacia hastulata (2), Acidonia microcarpa (2), Actinotus laxus (1), Aotus passerinoides (1), Beamea sp. (1), Beufortia sparsa (2), Boronia stricta (2), Callistemon glauca (3), Cassytha (1), Cephalotus follicularis (1), Cosmelia rubra (2), Empodisma gracillimum (5), Eutaxia virgata (1), Fine sedge (3), Gymnoschoenus anceps (3), Homalospermum firmum (3), Isopogon axillaris (2), Leptocarpus tenax (2), Leucopogon australis (1), Lichen (1), Melanostachyua ustulata (3), Moss sp. (1), Schoenus multiglumus (3), Schoenus sp. (2), Sphenetoma gracilis (2), Sphenetoma sp. (2), Sphenetoma squarrosa (2), Stylidium scandens (2), Taxandria fragrans (3), Taxandria linearfolia (2), Xyrus sp. (2).	N	Nil pig activity.
2B	0.43	Flat	Sand/Peat	15.1	0.8	1.5-1.8	2	0		4	3	3	4	Aotus passerinoides (2), Boronia stricta (2), Callistemon glauca (2), Cephalotus follicularis (1), Cosmelia rubra (1), Empodisma gracillimum (3), Eutaxia virgata (1), Fine sedge (1), Homalospermum firmum (3), Moss sp. (1), Schoenus multiglumus (2), Sphenetoma gracilis (2), Stylidium scandens (1), Taxandria fragrans (3).	N	Pig activity noted in 2012/13
3	0.62	Flat	Sand/grey	8.7	0.5-1	1.5-4	2/3	0	89	0	0	0	0	Acacia hastulata (2), Adenanthos obavatus (2), Anarthris prolifera (2), Anarthria scabra (3), Aotus passerinoides (2), Astartea sp. (2),Banksia quercifolia (2), Beamea sp. (1), Beufortia sparsa (3), Boronia stricta (3), Callistemon glauca (2), Cassytha (1), Cosmelia rubra (1), Dasypogon bromeliifolius (2), Empodisma gracillimum (3), Evandra arista (2), Gymnoschoenus anceps (2), Homalospermum firmum (3), Leptocarpus tenax (2), Meleleuca pressiana (1), Melanostachya ustulata (1), Moss sp. (1), Schoenus multiglumus (3), Sphaerolobium sp. (2), Sphenotoma gracilis (1), Sphenotoma squarrosa (2), Stylidium assimile (1), Stylidium scandens (1), Taraxis grossa (1), Taxandria fragrans (3), Taxandria linearfolia (3), Taxandria parviceps (2), Xanthorrhoea preisii (1).	N	
3		Flat	Peat/sand	18.05	0.8-1	1.2-4	2	0	63	4	3	3	1&5	Acacia hastulata (2), Aotus passerinoides (2), Astartea sp. (2), Beurfortia sparsa (2), Boronia stricta (2), Callistemon glauca (3), Cassytha (1), Cosmelia rubra (1), Empodisma gracillimum (4), Eutaxia virgata (2), Homalospermum firmum (3), Leptocarpus tenax (2), Moss sp. (2), Schoenus multiglumus (3), Sphenetoma gracilis (1), Stylidium scandens (1), Taxandria fragrens (3), Taxandria linearfolia (2), Taxandria parviceps (1).	N	Pig activity noted on two survey points in 2012/13
4		Flat / midslope	Peat/sand/grey	15.4	0.6-1.2	1-4	2	4-5	81.9	0	0	0	0	Acacia hastulata (1), Acidonia microcarpa (2), Aotus passerinoides (2), Aotus intermedia (2), Astartea sp. (1), Banksia quercifolia (1), Boronia stricta (2), Bossea sp. (1), Cassytha (1), Cephalotus follicularis (1), Comospermum nudisculum (1), Cosmelia rubra (1), Empodisma gracillimum (4), Eutaxia virgata (2), Evandra arista (3), Flat sedge (3), Fine sedge (3), Gompholobium polymorphum (1), Gompholobium villosum (1), Gymnoschoenus anceps (3), Homalospermum firmum (3), Leptocarpus tenax (3), Lomandra nigrans (3), Moss sp. (1), Schoenus multiglumus (3), Schoenus sp. (3), Scheonus cruentus (3), Sedge sp. (2), Sphaerolobium sp. (1), Sphenetoma gracilis (1), Stylidium scandens (1), Taxandria linearfolia (3), Taxandria parviceps (1).	N	
4	1.64	Flat	Sand/grey	19.9	1-1.4	1.5-3	1	5	71	4	3&4	1	7	Acacia hastulata (1), Boronia stricta (2), Cassytha (1), Empodisma gracillimum (3), Flat sedge (2), Fine sedge (3), Gahnia decomposita (2), Gymoschoenus anceps (3), Homalospermum firmum (3), Lomandra nigrans (2), Moss sp. (2), Schoenus multiglumus (3), Stylidium scandens (1), Taxandria linearfolia (3), Taxandria parviceps (3).	N	Pig acitivity noted over the 3 yrs of survey at two survey points.

7		Flat/ midslope	Peat/sand/grey	15.9	0.2-0.8	0.5-3	2	4	73.2	0	0	0	0	Adenanthos obavatus (2), Anarthria scabra (3), Andersonia cerulea (1), Aotus passerinoides (2), Aotus sp. (1), Astartea sp. (2), Banksia quercifolia (2), Beamea sp. (1), Beufortia sparsa (3), Boronia spathulata (1), Boronia stricta (2), Callistemon glauc (3), Cassytha (1), Cephalotus follicularis (1), Comesperma flavum (1), Cosmelia rubra (2), Dampiera leptoclada (1), Dampiera sp. (1), Dasypogon bromeliifolius (1), Empodisma gracillimum (3), Gymnoschoenus anceps (2), Haemodoriah spicata (1), Homalospermum firmum (3), Hypocalyma sp. (1), Leptocladus tenax (2), Leucopogon alternifolius (2), Leucopogoan australis (1), Lomandra nigrans (2), Melaleuca rhaphiophylla (1), Melaleuca pressiana (3), Moss sp. (1), Persoonia longifolia (1), Schoenus multiglumus (2), Scheonus cruentus (3), Sphaerolobium sp. (1), Sphenetoma gracilis (2), Sphenetoma squarrosa (1), Stylidium scandens (1), Taxandria fragrans (2), Taxandria linearfolia (1), Taxandria parviceps (2).	N	
7	2.87	Flat	Peat	20.25	0.3-0.4	1-1.5	4	2	57.9	2	3	1-3	6-8	Adenanthos obavatus (2), Boronia stricta (2), Callistemon glauca (3), Cephalotus follicularis (1), Cosmelia rubra (1), Dampiera leptoclada (1), Empodisma gracillimum (3), Homalospermum firmum (3), Leptocladus tenax (2), Leucopogon australis (2), Moss sp. (2),Pteridium esculatum (1), Sedge sp. (2), Sphareolobium (1),Sphenetoma sp. (1), Stylidium scandens (1), Taxandria parviceps (2),	N	Pig acitivity noted over the 3 yrs of survey at two survey points.
8		Flat	Peat/ sand	17.71	0.5-1	1-4	2	4	90.9	0	0	0	0	Acidonia microcarpa (1), Aotus passerinoides (2), Astartea sp. (2),Banksia quercifolia (1), Beaumea (2), Beufortia sparsa (2), Boronia stricta (2), Bossea sp. (2), Callistemon glauca(1), Cassytha (1), Cephalotus follicularis (1), Comesperma flavum (1), Cosmelia rubra (1), Dampiera leptoclada (1), Drosera sp. (1), Empodisma gracillimum (2), Eutaxia virgata (2), Ficinia nodosa (1), Fine sedge (1), Fungi (1), Gompholobium polymorphum (1), Gymnoscheonus anceps (2), Homalospermum firmum (3), Leptocarpus tenax (2), Melaleuca pressiana (1), Scheonus multiglumus (2),Schoenus sp. (1), Sphenetoma gracilis (2), Styldium scandens (1), Taxandria fragrans (3), Taxandria parviceps(2).	N	
8	1.31	Flat/ midslope	Peat/ sand	15.70	0.5-0.8	1-2	2	5	88	4	3&4	1,2& 3	1,2& 3	Aotus passerinoides (2), Banksia quercifolia (1), Beamea juncea (20, Boronia stricta (2), Cassytha (1), Cephalotus follicularis (1), Drosera sp. (1), Empodisma gracillimum (2), Eutaxia virgata (1), Ficinia nodosa (2), Gompholobium polymorphum (1), Gymnoschoenus anceps (2), Homalospermum firmum (3), Schoenus multiglumis (2), Sphenotoma gracilis (1), Stylidium scandens (1), Taxandria fragrans (3), Taxandria parviceps (2).	N	Pig activity noted over 3 yrs of survey at 3 points and over 2 yrs at 1 point.
21	1.07	Flat	Peat/sand	16.70	0.4-8	1-3	2	0	76	0	0	0	0	Acacia hastulata (2), Actinotus sp. (2), Astartea sp. (2), Banksia quercifolia (2), Boronia stricta (2), Cassytha (1), Cephalotus follicularis (2), Comospermum nudisculum (1), Cosmelia rubra (2), Drosera sp. (1), Empodisma gracillimum (4), Eutaxia virgata (3), Gompholobium polymorphum (2), Gymnoscheonus anceps (2), Hibbertia perfoliata (1), Homalospermum firmum (4), Leptocarpus tenax (40, leucopogon sp. (1), Lichen (1), Moss sp. (1), Schoenus multiglumus (4), Scheonus cruentus (2), Sphaerolobium sp. (1), Spehenotoma gracilis (1), Sphenotoma sp. (1), Stylidium scandens (3), Taraxis grossa (2), Taxandria fragrans (4), Taxandria linearfolia (2), Taxandria parviceps (3).	N	Nil pig activity.

26		Flat	Peat/sand grey	21.20	0.6-1.2	1.2-3	2	0	94	0	0	0	0	Acacia hastulata (2), Actinotus repens (1), Aotus sp. (1), Beumea sp. (1), Beumea juncea (2), Boronia stricta (2), Callistemon glauca (2), Cassytha (1), Cosmelia rubra (1), Empodisma gracillimum (4), Eutaxia virgata (1), Flat sedge (1), Fine sedge (1), Gahnia decomposita (2), Gymnoscheonus anceps (1), Hakea linearis (2), Homalospermum firmum (2), Leptocarpus tenax (2), Meelboldina sp. (2), Meelboldina tephrina (1), Moss sp. (1), Schoenus multiglumis (2), Sphaerelobium sp. (1), Sphenetoma sp. (2), Stylidium scandens (1), Taxandria fragrans (2), Taxandria linearfolia (3), Xyrus sp. (1).	N	
26	0.66	Flat	Peat/sand black	23.90	0.6	1.2-2	2	0	90	4	3&4	1&2	5 - 7	Acacia hastulata (1), Beumea riparia (1), Beumea juncea (3), Boronia stricta (2), Callistemon glauca (2), Cassytha (1), Cosmelia rubra (1), Empodisma gracillimum (3), Eutaxia virgata (2), Flat sedge (3), Fine sedge (3), Gymnoschoenus anceps (3), Hakea linearis (2), Homalospermum firmum (2), Leptocarpus tenax (1), Schoenus multiglumus (2), Stylidium scandens (1), Taxandria fragrans (3), Taxandria linearfolia (3),	N	Pig acitivity noted over the 3 yrs of survey at two survey points.
28		Flat	Peat/sand	11.60	0.2-0.8	0.5-2	2	8	94.4 (pre fire) 57.7 (post fire)	0	0	0	0	Actinotus sp. (1), Adenanthos obavatus (2), Anarthria scabra (5), Banksia quercifolia (3), Beufortia sparsa (3), Boronia stricta (2), Cassytha (1), Comospermum nudisculum (1), Cosmelia rubra (1), Dampiera sp. (1), Dasypogon bromellifolius (3), Eucalyptus patens (2), Evandra arista (2), Ficinia nodosa (1), Fine sedge (2), Gahnia decomposita (2), Gompholobium polymorphum (2), Haemodoriah spicata (1), Homalospermum firmum (3), Leucopogon australis (2), Lomandra nigrans (2), Moss sp. (1), Pultanea reticulata (1), Sphenetoma gracilis (1), Taxandria fragrans (1), Taxandria parviceps (3)	Y	
28	0.87	Flat	Peat	15.80	0.2-1	0.5-2	2	0	83.2 (pre fire) 47.3 (post fire)	1,2,3,4,5	2,3,4	1,2 & 3	1, 2, 3, 5, 7, 8	Acacia hastulata (1), Actinotus sp. (1), Astartea sp. (1), Banksia quercifolia (1), Beamea sp. (1), Boronia stricta (2), Cassytha (1), Cephalotus follicularis (1), Comospermum nudisculum (2), Cosmelia rubra (1), Empodisma gracillimum (3), Eutaxia virgata (1), Fine sedge (2), Gompholobium polymorphum (1), Homalospermum firmum (3), Leucopogon sp. (1), Lomandra nigrans (2), Meelboldina sp. (1), Moss sp. (1), Schoenus multiglumus (3), Sedge sp. (3), Stylidium scandens (1), Taxandria fragrans (3)	Y	Pig activity noted over 3 yrs at 8 survey points.

Engeawa walpolea - Walpole Burrowing Crayfish																	
Site Name	Area Surveyed / HA's	landform	Average soil type /colour	Average Moisture / %	Range of Height of understorey / M's	Range of Height of Mid Storey / M's	# of levels of Midstorey over site	Range ofHeight of Canopy / M's	% Vegetation cover	# of Engaewa Burrows	Pig Activity Type	Recency of Pig Activity	Pig Activity Level	Area of Activity	**Vegetation Density of Plants Species Measure of Cover Code** **0 = No plants** **1 = < 1% cover** **2 = 1 – 5% cover** **3 = 5 – 25% cover** **4 = 25 – 50% cover** **5 = 50 – 75% cover** **6 = 75 – 95% cover** **7 = 95 – 99% cover** **8 = 100% cover** **Average across site.**	Burnt During Survey Period	Comments on pig activity.
1	0.4	midslope	sand/black	7.68	0.4-1	1.2-3	2	20-30	85.3	0	0	0	0	0	Eucalyptus diversicolor , Agonis flexuosa (3), Corymbia calophylla (3), Hovea eliptica (2), Leucopogon sp. (4), Pteridum esculentum (4), Desmocladus flexuosus (2), Leucopogon verticillata (2), Lichen (2), Patersonia occidentalis (2), Hibbertia cuneiformis (2), Billardiera varifolia (1), Bossia sp. (1), Xanthorea preisii (1), Leucopogon sp. (2), Desmocladus flexuosus (5), Grass sp. (2), Moss (5), Anigozanthos flavidus (1), Pteridum esculentum (3), Bossia sp. (3), Desmocladus flexuosus (4), Dampiera sp. (3), Grass sp. (1), Anigozanthos flavidus (3), Anarthria scabra (1), Macrozamia riedlei (4), Scaevola sp. (3), Cryptostylis ovata (2).	N	NIL
2	0.17	midslope	sand/black	9.9	0.2-0.8	0.5-4	1	0-20	82.1	0	0	0	0	0	Homalospermum firmum (3), Xanthorrhoea preisii (4), Leucopogon sp. (4), Anarthria prolifera (4), Anarthria scabra (2), Moss (2), Eucalyptus marginata (4), Macrozamia riedlei (4), Taxandria parviceps (3), Schaevola sp. (3), Empodisma gracillimum (6), Pteridum esculentum (4), Meleleuca sp. (6), Moss (2), Patersonia occidentalis (3), Homalospermum firmum (3)	N	NIL
5	1.22	flat	sand/grey	17.1	0.4-0.6	1-1.2	1	0	83.5	0	0	0	0	0	Evandra arista (4), Anarthria scabra (3), Taxandria parviceps (4), Cassytha (2), Leptocarpus tenax (2), Schoenus multiglumus (3), Adenanthos obavatus (3), Macrozamia riedlei (2), Empodisma gracillimum (6), Taxandria fragrans (3), Meelboldina sp. (3), Beufortia sparsa (3), Homalospermum firmum (3). Meleleuca sp. (5),Xanthorrheoea presii (1). Gahnia sp. (4), Fine sedge (3), Leucopogon australis (1),Dampiera sp. (1), Boronia stricta (2), Calystachyus (3), Moss (2),Drosera sp. (1).Hibbertia sp. (1)	N	NIL
6	0.46	flat/ midslope	sand/grey	16.31	0.5-1	1.2-1.8	2	4-6	84	0	0	0	0	0	Eucalyptus marginata (3),Empodisma gracillimum (6), Boronia stricta (3), Dampiera sp. (2), Homalospermum firmum (4), Taxandria parviceps (3), Acacia hastulata (2), Schoenus multiglumus (4), Pteridum esculentum (2), Sphaerolobium sp. (1), Taxandria fragrans (3),Homalospermum firmum (5), Flat sedge (3), Beumea sp. (1), Eutaxia virgata (4), Stylidium scandens (4), Gahnia sp. (4), Acacia hastulata (4), Taxandria linearfolia (4), Anarthria scabra (3), Dampiera sp. (2), Beufortia sparsa (4), Evandra arista (4), Drosera sp. (2), Sphenotoma gracilis (1) Moss (2), Lichen (2).	N	NIL
7	0.63	flat/creek	sand/black	15.98	0.3-1	1-4	2	4-6	82.9	0	0	0	0	0	Juncea pallidus (2), Empodisma gracillimum (6), Melelueca sp. (3), Taxandria linearfolia (3), Calystachia (3), Fleabane (1), Taraxis grossa (1), Astartea sp. (3), Gahnia decompossita (4), Scheonus multiglumus (3), Stylidium scandens (2), Sphaerolobium sp. (2),Reedia spathacea (4), Acacia hastulata (4), Astartea sp. (3), Taxandria fragrans (3), Taraxis grossa (2), Boronia stricta (3), Homalospermum firmum (3), Cassytha (3), Leptocarpus tenax (3).Gymonschoenus anceps (2), Lichen (4), Batswing fern (3), Fleabane (2), Gahnia decompossita (4), Calystachia (3), Meleleuca sp. (3), Taraxis grossa (2), Juncea sp. (2), Beumea juncea (3), Lepidosperma gladiatum (3), Lichen (3), Meleleuca microphylla (4), Juncea pallidus (4),	N	NIL

8	0.28	flat	sand/grey	14.6	0.8-1.2	1 - 2	1	4	77.2	0	0	0	0	0	Taxandria fragrans (3), Homalospermum firmum (2), Acacia hastulata (3), Boronia stricta (2), Leptocarpus tenax (2), Taxandria parviceps (1), Cassytha (2), Eutaxia virgata (1), Sedge sp. (1), Empodisma gracillimum (2), Leucopogon australis (1), Anarthria prolifera (2), Comesperma virgatum (1), Exocarpus odoratus (1), Taxandria fragrans (2), Lomandra (3), Boronia stricta (2), Gahnia decompossita (3), Hakea linearis (1), Astartea sp. (1), Dampiera sp. (1), Beumea juncea (1), Taraxis grossa (2), Acacia divergens (1), Thomasia pauciflora (1),Tetrathecea (1), Dampiera leptoclada (1), Beumea juncea (1),Pimelea hispida (1),Tetratheca sp. (1), Acacia divergens (1), Gahnia decomposita (3), Thomasia sp. (1), Taxandria parviceps (1), Gompholobium polymorphum (3), Gymnoschoenus anceps (2).	N	NIL
9	2.19	flat	sand/black	14.4	0.2-1	1.2-2	2	4-8	79.5	0	0	0	0	0	Taxandria parviceps (4), Homalospermum firmum (4), Schoenus sp. (5), Lichen (2), Tree fern (3), Batswing fern (3), Moss (3), Stylidium scandens (2), Taxandria linearfolia (5), Tree fern (2), Empodisma gracillimum (3), fine sedge (3), Pteridum esculentum (3), Schoenus sp. (3), Lichen (2), Beumea sp. (3), Schoenus multiglumus (4), Lepidosperma tetraquetrum (2), Carex appressa (5),Eucalyptus marginata (4), Billardiera sp. (3), Dampiera hederacea (6), Taxandria parviceps (3), Agonis flexuosa (3), Acacia littorea (3), Angigozanthos flavidus (2), grass sp. (3), Schoenus sp. (2). Dock (2), grass sp. (6), Fleabane (2), Cape Gooseberry (3), Thistle (2), Acacia hastulata (3), Taxandria fragrans (3), Eutaxia virgata (4), Batswing fern (3), Astartea sp. (3), Gahnia sp. (4), Moss (3), Stylidum scandens (2).	N	NIL
10	0.25	flat	sand/grey	14.86	0.4-0.8	1 - 1.8	2	0	63.3	0	0	0	0	0	Beufortia sparsa (3), Homalospermum firmum (4), Taxandria fragrans (2), Acidonia microcarpa (2), Evandra arista (2), Taxandria parviceps (1), Xyrus (1), Leptocarpus tenax (2), Pteridum esculentum (1), Gymnoschoenus anceps (2), Cassytha (1) Pteridum esculaentum (1), Dampiera leptoclada (1), moss (1), Lomandra (3), Sphenotoma gracilus (1), Actinotus repens (1), Sphaerolobium (1), Taxandria parviceps (3), Lichen (3), Kunzea recurva (1), Adenanthos obavatus (1), Acacia grandiflora (1), Acacia hastulata (1), Sphenotoma gracilus (1), Schoenus multiglumus (2), Leucopogon paradoxus (1), Anarthria scabra (2), Boronia stricta (1), Dasypogun bromelius (1)	N	NIL
11	3.11	flat/creek	sand/grey	17.12	0.2-1	0.5-2	1	1-7	65.8	0	0	0	0	0	Dock (4), Lotus minor (6), Kikuyu (7), Juncea pallidus (2), Carex appressa (4), Taxandria linearfolia (3), Persicarea sp. (2), Grass sp. (3), Fleabane (3), Melaleuca sp (1), Gahnia sp. (2), Empodisma gracillimum (3),Lichen (1), Adiantum aethiopicum (2),Sedge sp. (4), Juncea sp. (3), Acacia hastulata (3), Acacia littorea (2), Empodisma gracillimum (5), Meleleuca sp. (1), Taxandria fragrans (1), Leptocarpus tenax (4), Scheonus sp. (3), Conosperma flavum (2), Sphaerolobium sp. (2), Taxandria parviceps (4), Cassytha (2), Eutaxia virgata (3), Meelboldina sp. (3), Dampiera sp. (2), Leproidia sp. (2), Fine sedge (2), Hakea linearis (1), Mesomelaena tetragona (1).	N	NIL

Setonix brachyurus - Quokka																		
Site Name	**Area Surveyed / HA's**	**landform**	**Average soil type /colour**	**Moist / Dry**	**Range of Height of understorey / M's**	**Range of Height of Mid Storey / M's**	**# of levels of Midstorey over site**	**Range of Height of Canopy / M's**	**% Vegetation cover**	**Old scat present**	**Fresh scat present**	**Pig Activity Type**	**Recency of Pig Activity**	**Pig Activity Level**	**Area of Activity**	**Vegetation Classified into species providing understorey, midstorey & canopy habitat.**	**Burnt During Survey Period**	**Comments**
Boxhall Creek	3.43	Creek		Moist	0-2	3.2-14		25-35	Understorey - 44.5 Canopy - 80	Y	Y	0	0	0	0	Understorey: Acacia urophylla Anigozanthos flavidus, Boronia gracillipes, Chorilaena quercifolia, Chorizem ilicifoium, Dampiera hederacea, Empodisma gracillimum, Gahnia decomposita, Grass sp., Hibbertia furfuracea, Hovea eliptica, Lasiopetalum floribundum, Lepidosperma effusum, Lepidosperma tetraquetrum, Leucopogon verticillata, Macrozamia reidlei, Melaleuca sp., Moss. sp., Petrophile diversifolia, Pteridium esculentum, Ricinocarpos glaucus, Thomasia paniculata, Thomasia quercifolia. Midstorey: Acacia pentadenia, Agonis flexuosa, Allocasuarina decussata, Callistachys lanceolat, Chorilaena quercifolia, Lasiopetalum floribundum, Leucopogon verticillata, Melaleuca sp., Trymalium floribundum. Canopy: Allocasuarina decussata,Eucalyptus diversicolor, Eucalyptus jacksonii, Eucalyptus guilfoylei, Trymalium floribundum.	N	
Creek Rd	2.66	creek to midslope		Dry to wet	0.5-1.6	2.5-17		12-35	Understorey - 42.5 Canopy - 77.5	Y	Y	0	0	0	0	Understorey: Lepidosperma effusum, Lepidosperma tetraquetrum, Macrozamia reidlei, Pteridium esculentum, Ricinocarpos glaucus, Taxandria linearfolia. Midstorey: Acacia pentadenia, Banksia grandis, Agonis flexuosa, Lasiopetalum floribundum, Leucopogon verticillata, Chorizema illicifolium, Melaleuca preissiana, Thomasia paniculata, Gahnia decomposita, Taxandria linearfolia, Trymalium floribundum, Chorilaena quercifolia. Canopy: Allocasuarina decussata,Eucalyptus diversicolor, Eucalyptus jacksonii, Eucalyptus marginata, Acacia pentadenia.	N	
Crossing	3.74	creek to midslope		Dry	0.2-1.9	0-9		0-30	Understorey - 49 Canopy - 43.8	Y	Y	0	0	0	0	Understorey: Acacia myrtifolia, Adenanthos obavatus, Agonis theiformis, Allocasuarina humilis, Anarthria prolifera, Anarthria scabra, Banksia attenuata, Banksia grandis, Banksia ilicifolia, Banksia quercifolia, Beufortia sparsa, Boronia stricta, Constylis setigera, Dasypogon bromeliifolius, Davisia decurrens, Empodisma gracillimum, Ghania decomposita, Leucopogon australis, Leucopogon distans, lindsaea linearis, Mesomelaena tetragona, Pattersonia occidentalis, Personia longifolia, Petrophile diversifolia, Podocarpus drouynianus, Pultanea reticulatum, Stylidium scandens, Taxandria linearifolia, Taxandria parviceps, Xanthosia floribundum. Midstorey: Acacia divergens, Nuytsia floribundum, Allocasuarina frasierana, Banksia attenuata, Banksia illicifolia, Calistemon glauca, Kunzea sulfurea, Pultenaea reticulatum, Taxandria linearifolia, Taxandria parviceps. Canopy: Allocasuarina frasierana, Banksia attenuata, Banksia illicifolia, Corymbia callophylla.	Y	

Deep	2.58	Creek		Moist	0.2-1.6	0-25		25-40	Understorey - 56 Canopy - 63	Y	Y	0	0	0	0	Understorey: Acacia divergens, Acacia pentadenia, Crowea augustifolium, Anigozanthus flavidus, Bossiaea aquifolium, Dampiera hederacea, Ghania decomposita, Lasiopetalum floribundum, Lepidosperma tetraquetrum, Lepidosperma effusum, Leucopogon verticillatus, Macrozamia riedlei, pteridium esculatum, Persoonia longifolia, Podocarpus drouynianus, Melaleuca preissiana, Thomasia heterophylla, Taxandria linearfolia, Taxandria juniperina, Taxandria parviceps. Midstorey: Acacia pentadenia, Allocasuarina decussata, Bossiae acquifolia, Callistachyus lanceolata, Melaleuca preissiana, Taxandria linearifolia, Taxandria juniperina. Canopy: Allocasuarina decussata, Corymbia calophylla, Eucalyptus diversicolor, Eucalyptus megacarpa, Taxandria juniperina.	N	
Giants	2.86	Creek		Moist	0.3-1.2	5-18		30-35	Understorey - 53.8 Canopy - 78.4	Y	N	0	0	0	0	Understorey: Chorilaena quercifoia, Dampiera hederacea, Ghania decomposita, Grass sp., Lasiopetalum floribundum, Lepidosperma effusum, Lepidosperma tetraquetrum, Leucopogon verticillatus, Macrozamia riedlei, Pteridium esculatum, Thomasia paniculata. Midstorey: Acacia urophylla, Allocasuarine decussata, Chorilaena quercifolia, Gahnia decomposita, Lasiopetalum floribundum, Leucopogon verticillata, Melaleuca preissiana, Trymalium floribundum. Canopy: Alocasuarina decussata, Eucalyptus diversicolor, Eucalyptus guilfoylei, Eucalyptus jacksonii.	N	
Johnson / Lochart	2.48	Creek		Moist	0.4-1.8	5-12		20-35	Understorey - 40.3 Canopy - 64.8	Y	Y	0	0	0	0	Understorey: Acacia divergens, Boronia gracillipes, Dampiera hederacea, Ghania decomposita, Lasiopetalum floribundum, Lepidosperma tetraquetrum, Lepidosperma effusum, Leucopogon australia, Pteridium esculatum, Thomasia paniculata, Taxandria linearfolia, Taxandria parviceps. Midstorey: Acacia divergens, Allocasuarine decussata, Callistachyus lanceolata, Eucalyptus marginata, Eucalyptus diversicolor, Taxandria linearifolia, Taxandria parviceps. Canopy: Eucalyptus diversicolor, Eucalyptus marginata	N	
Lochart	2.94	Creek		Moist	0.9-1.6	7-15		35-40	Understorey - 30.8 Canopy - 73.8	Y	N	0	0	0	0	Understorey: Acacia divergens, Acacia pentadenia, Anigozanthus flavidus, Chorilaena quercifolia, Clematis, Crowea augustifolium, Dampiera hederacea, Hovea eliptica, Lasiopetalum floribundum, Lepidosperma effusum, Melaleuca preissiana, Taxandria linearifolia, Trymalium floribundum, Xanthorhoea gracillis. Midstorey: Allocasuarine decussata, Banksia grandis, Callistachyus lanceolata, Taxandria linearifolia. Canopy: Eucalyptus diversicolor, Eucalyptus marginata, Corymbia calophylla	N	
London	25.24	Creek / midslope / ridge		Moist	0.5-2.6	0-12		0-25	Understorey - 50.1 Canopy - 33	Y	Y	0	0	0	0	Understorey: Acacia divergens, Adenanthos obavatus, Agonis theirformis, Anarthria prolifera, Anarthria scabra, Anigozanthus flavidus, Banksia attenuata, Banksia grandis, Boronia stricta, Comesperma confertum, Conostylis setigera, Dampiera hederacea, Dasypogon bromeliifolius, Empodisma gracillimum, Isopogon sp., Leucopogon distans, Lindsaea linearis, Macrozamia riedlei, Pattersonia occidentalis, Persoonia longifolia, Podocarpus drouynianus, Pteridium esculatum, Pultanea reticulatum, Synaphea intricata, Taxandria linearifolia, Taxandria parviceps, Taxandria theiformis, Xanthorhoea gracillis, Xanthorhoea preisii. Midstorey: Allocasuarine decussata, Banksia attenuata, Banksia grandis, Eucaclyptus marginata, Hovea eliptica, Taxandria parviceps. Canopy: Allocasuarina frasierana, Banksia attenuata, Corymbia calophylla, Eucalyptus marginata.	N	

Long	2.05	Midslope		Dry	0.7-1.2	1.5-7		12-25	Understorey - 73.5 Canopy - 32.4	?	?	0	0	0	0	Understorey: Acacia divergens, Agonis theiformis, Anarthria prolifera, Anigozanthus flavidus, Aotus sp., Astartea fascicularis, Baumea sp., Boronia stricta, Bossiaea ornata, Conostylis setigera, Dampiera hederacea, Empodisma gracillimum, Gahnis decomposita, Grass sp., Hibbertia cunninghamii, Hovea eliptical, Isopogon shpaerocephalus, Lepidosperma effusum, Leucopogon australis, Leucopogon verticillatus, Mesomelaena tetragona, pattersonia occidentalis, Pimlea sp., Podocarpus drouynianus, Taxandira linearifolia, Taxandria parviceps, Xanthorhoea gracillis, Xanthosia rotundifolia. Midstorey: Banksia attenuata, Banksia grandis, Eucalyptus marginata, Hakea linearis, Taxandria linearifolia, Taxandria parviceps. Canopy: Eucalyptus marginata	N	
Northumberland	4.70	Creek / midslope	Sand / grey	Moist	0.1-0.8	0.3-9		0-25	Post Burn: U/s - 28.6 C -27.3	Y	Y	0	0	0	0	Understorey: Acacia divergens, Acacia sp., Acacia myrtifolia, Acacia horrida, Anarthria scabra, Andersonia cerulea, Boronia crenulata, Desmocladus sp., Gahnia trifida, Hypocalyma sp., Hovea eliptica, Leucopogon australis, Leucopogon verticillatus, Melaleuca preissiana, Pteridium esculatum, Thomasia sp., Xanthorhoea preisii, Xanthosia rotundifolia. Midstorey: Acacia brownei, Eucalyptus marginata, Hakea sp., Taxandria linearifolia, Taxandria parviceps. Canopy: Corymbia calophylla, Eucalyptus marginata.	Y	Look at the veg difference between fire interval
Rocky	7.52	Creek		Moist	0.5-1.2	1.6-9		25-35	Understorey - 56.3 Canopy - 47.1	Y	Y	0	0	0	0	Understorey: Anarthria prolifera, Astartea fascicularis, Conostylis setigera, Desmocladus flexuosus, Grass sp., Hakea lissocarpha, Hovea eliptica, Lepidosperma sp., Lepidosperma effusum, Leucopogon propinquus, Lichen, Moss, Pattersonia occidentalis, Pteridium esculatum, Podocarpus drouynianus, Thomasia paniculata, Taxandria linearifolia, Xanthorhoea gracillis. Midstorey: Astartea fascicularis, Banksia attenuata, Callystachyus lanceolata, Taxandria linearifolia, Trymalium floribundum. Canopy: Corymbia calophylla, Eucalyptus marginata, Eucalyptus patens.	N	
Soho	6.46	Creek / midslope		Moist	0.6-15	6-7		15-40	Understorey - 45 Canopy - 81	Y	Y	0	0	0	0	Understorey: Acacia divergens, Anigozanthus flavidus, Anarthria scabra, Billardiera sp., Boronia gracillipes, Cassytha, Dampiera hederacea, Dasypogon bromeliifolius, Gahnia decomposita, Leptocarpus tenax, Lepidosperma tetraquetrum, Lepidosperma effusum, Leucopogon australis, Leucopogon verticillatus, Macrozamia riedlei, Pteridium esculatum, Persoonia longifolia, Thomasia heterophylla, Taxandria linearifolia, Taxandria juniperina, Trymalium odoratissimum, Taxandria parviceps, Xanthorhoea preisii. Midstorey: Banksia grandis, Gastrolobium bilobum, Taxandria linearifolia, Taxandria juniperina, Taxandria parviceps. Canopy: Corymbia calophylla, Eucalyptus marginata, Eucalyptus brevistylis.	N	
Surprise	0.85	Midslope / ridge			0.7-1.1	1.7-3		9-14	Understorey - 46 Canopy - 21.6	Y	N	0	0	0	0	Understorey: Adenanthos obavatus, Allocasuarina fraseriana, Anarthria scabra, Anasca leudis, Andersonia cerulea, Banksia attenuata, Dasypogon bromeliifolius, Podocarpus drouynianus, Taxandria theiformis, Taxandria parviceps. Midstorey: Pultanea reticulatum, Taxandria theiformis, Taxandria parviceps. Canopy: Allocasuarina fraseriana, Banksia attenuata, Banksia quercifolia.	Y	
Surprise - Renzo Rd	0.86	Midslope		Dry	0.4 -1.2	6 - 8		15-34	Understorey - 49 Canopy - 25	Y	N	0	0	0	0	Understorey: Leucopogon verticillata, Sphaerolobium sp Persoonia longifolia, Acacia hastulata, Desmocladus fascicularis, Isopogon sp, Podocarpus drouynianus, Acacia pentadenia, Boronia gracilipes, Leucopogon sp, Thomasia heterophylla. Midstorey: Agonis theiformis, Persoonia longifolia, Bossiaea linophylla, Hovea eliptica, Hibbertia sp, Leucopogon verticillata, Taxandria parviceps, Podocarpus drouynianus, Acacia pentadenia. Canopy: Eucalyptus marginata, Corymbia calophylla	Y	some points unburnt during prescribed burn

Thomson	12.4	Creek, midslope & ridge		Moist	0.5-1.6	5.5-12		15-35	Understorey - 49.1 Canopy - 49.5	Y	Y	0	0	0	0	Understorey: Acacia divergens, Acacia pentadenia, Anigozanthus flavidus, Anarthria prolifera, Astartea fascicularis, Banksia grandis, Boronia gracillipes, Chorilana quercifolia, Dampiera hederacea, Desmocladus fascicularis, Empodisma gracillimum, Ghania decomposita, Hovea eliptica, Lasiopetalum floribundum, Lepidosperma tetraquetrum, Lepidosperma effusum, Leucopogon verticillatus, Pteridium esculatum, Persoonia longifolia, Thomasia paniculata, Taxandria linearifolia, Xanthorhoea gracillis, Midstorey: Acacia pentadenia, Allocasuarine decussata, Banksia attenuata, Banksia grandis, Callistachyus lanceolata, Eucalyptus marginata, Hovea eliptica, Lasiopetalum floribundum, Melaleuca preissiana, Taxandria linearifolia, Trymalium floribundum, Canopy: Acacia pentadenia, Allocasuarina decussata, Corymbia calophylla, Eucalyptus marginata, Taxandria linearifolia, Eucalyptus diversicolor, Melaleuca preissiana.	N	Isolated diggings in creekline adjacent to survey points during 2012/13
Trent	2.79	Creek		Moist	0.2-0.6	1		12-15	Understorey - 18.4 Canopy - 18.8	N	N	0	0	0	0	Understorey: Xanthosia rotundifolia, Allocasuarine decussata, Hovea elliptica, Bossiaea ornata, Anigozanthos flavidus, Eucalyptus marginata, Leucopogon propinquus, Taxandria parviceps, Clematis pubescens, Hakea amplexicaulis, , Podocarpus drouynianusLeucopogon verticillatus, Agonis theiformis, Gahnia decompositaConostylis species, Petrophile diversifolia. Midstorey: Petrophile diversifolia (dead, approximately 1.5m tall), Podocarpus drouynianus, Eucalyptus marginata. Canopy: Allocasuarine decussata, Eucalyptus marginata, Corymbia calophylla	Y	Prescribed burnt spring 2010 prior to first survey.
Wattle	6.98	Creek		Dry	0.9-1.5	3.5-15		15-40	Understorey - 70.2 Canopy - 52	Y	Y	0	0	0	0	Understorey: Acacia pentadenia, Astartea fascicularis, Boronia gracillipes, Bossiaea linophylla, Desmocladus fascicularis, Empodisma gracillimum, Ghania decomposita, Grass sp. Juncea sp. Lasiopetalum floribundum, Lepidosperma tetraquetrum, Lepidosperma effusum, Leucopogon verticillatus, Pteridium esculatum, Persoonia longifolia, Podocarpus drouynainus, Thomasia heterophylla, Taxandria linearifolia, Trymalium floribundum, Xanthorhoea gracillis. Midstorey: Acacia pentadenia, Agonis flexuosa, Astartea faxicularis, Allocasuarine decussata, Banksia grandis, Leucopogon australis, Lasiopetalum floribundum, Melaleuca preissiana, Persoonia longifolia, Taxandria linearifolia, Taxandria parviceps, Trymalium floribundum. Canopy: Corymbia calophylla, Eucalyptus marginata, Eucalyptus megacarpa, Eucalyptus diversicolor	N	Silvics burn cells adjacent to survey area.
Weld	1.64	Creek		Moist	0.8-0.9	6-Sep		25-30	Understorey - 53.4 Canopy - 71.2	Y	Y	0	0	0	0	Understorey: Agonis flexuosa, Boronia gracillipes, Chorilaena quercifolia, Fine sedge, Lasiopetalum floribundum, Lepidosperma effusum, Leucopogon verticillatus, Pteridium esculatum. Midstorey: Acacia pentanendia, Agonis flexuosa, Allocasuarine decussata, Callistachyus lanceolata, Chorilaena quercifolia, Leucopogon sp. Leucopogon verticillata. Canopy: Agonis flexuosa, Allocasuarine decussata, Eucalyptus diversicolor, Corymbia callophylla.	N	Shallow diggings in adjacent to survey points during 2012/13 with no recorded loss of vegetation.

Reedia spathacea																
Site Name	Area Surveyed / HA's	landform	Average soil type /colour	Average Moisture / %	Range of Height of understorey / M's	Range of Height of Mid Storey / M's	# of levels of Midstorey over site	Range of Height of Canopy / M's	% Vegetation cover	# of Reedia clumps	Pig Activity Type	Recency of Pig Activity	Pig Activity Level	Area of Activity	**Vegetation Density of Plants Species Measure of Cover Code** **0 = No plants** **1 = < 1% cover** **2 = 1 – 5% cover** **3 = 5 – 25% cover** **4 = 25 – 50% cover** **5 = 50 – 75% cover** **6 = 75 – 95% cover** **7 = 95 – 99% cover** **8 = 100% cover** **Average across site.**	Burnt During Survey Period	Comments
1		flat	sand/grey	5.6	0.8-1	0-3	1	0-15	68.8	5	0	0	0	0	Acacia hastulata (1), Acacia divergens (3), Acidonia microcarpa (3), Actinotus repens (1), Actinotus sp. (2),Anarthria prolifera (3), Aotus passerinoides (2), Astartea sp. (2), Banksia quercifolia (3), Beufortia sparsa (1), Boronia stricta (1), Boronia gracilipes (1), Cassytha (1), Cephalotus (1), Cosmelia rubra (1), Empodisma gracillimum (2), Eucalyptus marginata (2), Eutaxia virgata (1), Evandra arista (1), Gahnia decompita (1), Homalospermum firmum (4), Leptocarpus tenax (3), Meelboldina sp. (3), Reedia spathacea (2), Sphenetoma gracilis (1), Stylidium scandens (1), Taxandria linearfolia (1), Thomasia sp. (1),	N	Area adjacent burnt in autumn 2011. Survey area not burnt in prescribed burn autumn 2011
1	0.91	flat	sand/grey	7.8	1	3	1	4	68.8	1	2	2	1	0	Acidonia (4),Banksia quercifolia (3),Cosmelia rubra (2), Homalospermum firmum (3), Leptocarpus tenax (4),Reedia spathacea (2) , No vegetation loss.	N	Pig activity observed 24/1/13 on 1 point in the survey area.
2		flat	sand/grey	moist	0.8-1.6	1.5-3	1	0	96.6	37	0	0	0	0	Acacia hastulata (2), Actinotus sp. (1), Actinotus lasux (2), Anarthria scabra (2), Aotus sp. (2), Astartea sp. (2), Banksia quercifolia (2), Beufortia sparsa (2), Boronia stricta (2), Cassytha (2), Cephalotus (1), Dampiera sp. (1), Daviesii sp. (1), Drosera sp. (1), Empodisma gracillimum (3), Evandra arista (2), Gompholobium polymorphum (1), Hibbertia perfoliata (1), Homalospermum firmum (3), Lichen (1), Lomandra sp. (2), Meelboldina tephrina (1), Pultanea reticulata (1), Reedia spathacea (2), Sphenetoma gracilis (1), Stylidium scandens (1), Fine sedge (3), Taxandria parviceps (2), Sedge sp. (2).	N	Nil burning during period of survey.
2	0.95	flat	sand/grey	moist	1-1.2	2	1	0	89.7	0	4	3	3	2	Adenanthos obavatus (1), Aotus sp. (3), Beufortia sparsa (4),Boronia stricta (2),Cassytha (2), Evandra arista (2), Pultanea reticulata (1),Sedge sp. (2),	N	Pig activity observed 24/1/13 on 1 point in the survey area.
4	1.57	flat/ midslope	sand/black	15.4	0.5-1	1-2	2	0	98.8	46	0	0	0	0	Acacia hastulata (2), Acidonia microcarpa (2), Adenanthos obavatus (2), Anarthria prolifera (3), Anarthria scabra (4), Aotus passerinoides (2), Aotus sp (2), Astartea sp (2), Beaufortia sparsa (3), Billardiera sp (1), Cosmelia rubra (1), Dampiera sp. (1), Dasypogon bromeliifolus (4), Empodisma gracillimum (4), Evandra arista (3), Gompholobium polymorphum (2), Gymnoshoenus anceps (2), Homalospermum firmum (3), Leptocarpus tenax (2), Leucopogon alternifolius (1), Leucopogon australis (2), Lomandra sp. (3), Pultunea reticulata (1), Reedia spathacea (3), Schoenus multiglumus (3), Sphaerolobium sp (1), Sphenetoma gracilis (2), tall fine sedge (2), Taxandria fragrans (1), Taxandria linearfolia (4), Taxandria parviceps (2), Xyrus sp (1).	N	Nil burning during period of survey.

5		flat	sand/black	20	0.2-1	0.2-4	2	0-4	88.6 (pre fire) 25.3 (post fire)	9	0	0	0	0	Acacia hastulata (2), Acidonia microcarpa (2), Actinotus sp.(1), Aotus passerinoides (2), Banksia quercifolia (3), Boronia stricta (1), Cassytha (1), Cosmelia rubra (1), Dampiera sp. (2), Empodisma gracillimum (4), Evandra arista (2), Gymnoshoenus anceps (2), Homalospermum firmum (3), Leptocarpus tenax (3), Leucopogon alternifolius (3), Leucopogon australis (1), Leucopogon sp. (2), moss (1), Reedia spathacea (3), Schoenus multiglumus (3), Sphaerolobium sp. (1), Taxandria fragrans (2), Taxandria linearfolia (2), Xyrus sp. (2), Beumea juncea (3), Callistemon glauca (2), Drosera sp. (1), Stylidium scandens (1), flat sedge (1), Eutaxia virgata (2), seedlings sp. (1).	Y	Survey area burnt under prescribed conditions in spring 2011. Point 6 scat, 9 & 10 (print) in 2011/12
5	2.04	flat	peat	18.3	0.2-1.2	1-2	2	0-4	29.6 (pre fire) 21.6 (post fire)	13	4	2-4	1	1,6 & 8	Acacia hastulata (1), Aotus pressiana (1), Cosmelia rubra (1), Empodisma gracillumum (2), Homalospermum firmum (3), Leptocarpus tenax (1), Leucopogon sp. (2), Moss (1), Reedia spathacea (3), Schoenus multiglumus (2), Taxandria fragrans (3), Beumea juncea (2), Callistemon glauca (2), Drosera sp. (1), Pteridium (1), flat sedge (1), seedlings sp. (1).	Y	Pig actvity observed over a number of points over 3 yrs, veg averaged over points affected by pig damage.
8	0.53	flat	sand/black	18.7	0.4-1	1-2	2	0	98.6	32	0	0	0	0	Acacia hastulata (2), Astartea sp. (2), Beufortia sparsa (3), Cassytha (1), Cosmelia rubra (2), Empodisma gracillimum (5), Eutaxia virgata (2), Evandra arista (2), Gompholobium polymorphum (2), Gymnoshoenus anceps (4), Homalospermum firmum (4), Leptocarpus tenax (4), Leucopogon australis (2), Meelboldina sp. (3), Reedia spathacea (5), Scheonus multiglumus (3), Stylidium scandens (3), Taxandria fragrens (3), Taxandria parviceps (4), Taraxis grossa (2).	N	Nil
10	3.27	midslope	sand/black	14.4	0.4-1	1.2-3	2	0	99.2	59	0	0	0		Acacia hastulata (2), Actinotus sp. (1), Adenanthos obavatus (3), Astartes scott river (1), Beufortia sparsa (3), Cassytha (1), Cephalotus (1), Cosmelia rubra (1), Dampiera sp. (1), Drosera sp. (1), Empodisma gracillimum (5), Gompholobium polymorphu (1), Gymnoshoenus anceps (2), Homalospermum firmum (3), Leptocarpus tenax (3), Leucopogon australis (1), Leucopogon sp. (1), Lichen (1), Lomandra polystach (2), Moss (1), Reedia spathacea (4), Schoenus multiglumus (2), Scheonus sp. (1), Spharelobium sp. (1), Sphenetoma gracilis (1), Taxandria fragrans (2), Taxandria linearfolia (3), Taxandria parviceps (3), Taraxis grossa (1).	N	Nil
11					0.2-0.8	0.5-2	2	0	90.4	15	0	0	0	0	Acacia hastulata (2), Acidonia microcarpa (2), Adenanthos obavatus (1), Aotus passerinoides (1), Aotus pressiana (1), Aotus pingergup (2), Aotus sp. (1), Astartea sp. (1), Banksia quercifolia (3), Beufortia sparsa (3), Beaumea sp. (1), Boronia stricta (2), Cassytha (1), Diaspus (1), Desmocladus (2), Empodisma gracillimum (3), Evandra arista (3), Gymnosheonus anceps (2), Homalospermum firmum (3), Isolepsis (1), Leposperma effusum (1), Leptocarpus tenax (3), Leucopogon propinquus (1), Leucopogon sp. (1), Pultanea reticulata (2), Reedia spathacea (2), Scheonus multiglumus (3), Sphenetoma gracilis (2), Sphenetoma squarrosum (2), Stylidium scandens (2), Taxandria parviceps (2), Taraxis grossa (1), Xyrus sp. (1).	Y	Survey area burnt under prescribed conditions in autumn 2011
11	2.20	flat	sand/grey		0.3-0.6	0.5-2	2	0	90.4	2	2	2,3	2,3	0,3	No loss of vegetation		Pig Acitivity observed 30/1/13 at one point in survey area.
13	1.62	flat	sand/black	16.80	0.8-1	0.8-3	2	0	94.8	80	0	0	0	0	Acacia hastulata (2), Acidonia microcarpa (1), Actinotus sp. (1), Adenanthos obavatus (2), Beufortia sparsa (3), Beumea juncus (1), Cassytha (1), Cephalotus (1), Cosmelia rubra (2), Drosera sp. (1), Empodisma gracillimum (3), Evandra arsita (1), Gompholobium polymorphum (1), Homalospermum firmum (3), Leptocarpus tenax (3), Leucopogon australis (2), Leucopogon parviflorus (2), Leucopogon sp. (1), Lichen (1), Moss (1), Pultinea reticulata (2), Reedia spathacea (3), Scheonus multiglumus (3), Spharelobium grandiflorum (1), Sphenentoma gracilis (1), Taxandria fragrans (2), Taxandria linearfolia (2), Taxandria parviceps (2),	N	

14	2.94	flat/ midslope	sand/black & sand/grey	19.48	0.7-1	1.2-3	2	0	98.5	35	0	0	0	0	Acacia hastulata (2), Acidonia microcarpa (2), Actinotus sp. (1), Adenanthos obvatus (1), Anarthria scabra (3), Astartea sp. (1), Beufortia sparsa (3), Beumea juncus (2), Boronia stricta (2), Cassytha (1), Cosmelia rubra (1), Dampiera sp. (1), Drosera sp. (1), Empodisma gracillimum (3), Evandra arista (2), Gompholobium polymorphum (1), Gymnoshoenus anceps (1), Homalospermum firmum (3), Leptocarpus tenax (3), Leucopogon australis (1), Leucopogon sp. (1), Lomandra sp. (2), Moss (2), Pteridium esculentum (2), Reedia spathacea (4), Schoenus multiglumus (3), Sphareolobium sp. (1), Sphenentoma gracilis (2), Taxandria fragrans (3), Taraxis grossa (2).	N	
17	1.41	flat	sand/grey		0.5-1	1-2	1	0	96.3	44	0	0	0	0	Acacia hastulata (1), Actinotus sp. (1), Adenanthos obavatus (2), Anarthria scabra (3), Aotus sp. (2), Astartea sp. (1), Banksia quercifolia (2), Beufortia sparsa (2), Boronia stricta (1), Cassytha (1), Cosmelia rubra (2), Dasypogon bromeliifolus (1), Empodisma gracillimum (3), Evandra arista (2), Gompholobium polymorphum (1), Homalospermum firmum (2), Hypocalymna sp. (2), Leptocarpus tenax (2), Leucopogon alternifolius (2), Leucopogoan australis (2), Leucopogon distens (3), Leucopogon sp. (2), Meelboldina tephrina (1), Pultanea reticulata (2), Reedia spathacea (3), Sphenetoma gracilis (1), fine sedge (2), Taxandria parviceps (2), Sedge spl (3).	N	