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Discussion Paper J Webber**

Revegetation and Weed Management Issues and Discussion Paper for the Satori Resorts Development at Ella Bay



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June 2009

Report Objective

The objective of this report is to identify potential issues that will impact upon revegetation and weed management at the Satori Resorts development site at Ella Bay, North Queensland. A brief discussion of these issues is included as well as recommendations on how to solve these issues. In addition, future research requirements as well as management time-lines, resources and priorities are briefly considered.

Issues and Recommendations

There are five broad issues that will affect revegetation and weed management planning at the Ella Bay site. These are weeds, pest animals, native animals, cyclones and visual amenity. Discussions on each of these topics are included in the following section of the report. Weed and revegetation management are considered together in this report, as revegetation is often the only available long-term, sustainable weed management solution.

Weeds

Due to the productive tropical climate found at Ella Bay there are many introduced plant species that have become invasive. These species can be broken down into those that pose a threat to forested or wetland areas (environmental weeds) and those which pose a threat to open areas such as paddocks and unestablished revegetation areas.

1. Environmental weeds

Based on distribution and impact, the most serious environmental weeds at the site are pond apple (*Annona glabra*), Singapore daisy (*Sphagneticola trilobata*) and hymenachne (*Hymenachne amplexicaulis*). Other ponded pasture grasses and giant bramble (*Rubus alceifolius*) are also plants of concern. Lantana behaves in a similar manner to giant bramble, however it is not as much of a threat and can be managed in the same way as giant bramble. Species with much more limited distributions on site, including allamanda (*Allamanda cathartica*) and pink periwinkle (*Catharanthus roseus*), should be targeted for control as soon as possible before further spread becomes a problem. Guava (*Psidium cattleianum*) has the potential to become a serious issue and again, should be dealt with as soon as possible to avoid this species becoming the next pond apple. However, Guava can be managed in a similar manner to pond apple and will not be discussed separately in this report. A number of vines in the pea (Fabaceae) and passionfruit (Passifloraceae) families may also become problematic on forest edges and at revegetation sites. A closer examination of the issues surrounding the most problematic environmental weeds and brief management solutions are discussed below.

1.1 Pond Apple

The main issues related to pond apple concern the suppression of native plant species, visual amenity after weed control operations, pond apple regeneration, the importance of pond apple as a stream bank stabiliser and the potential that it is a cassowary food source.

Pond apple appears to be an early successional species of damp and sometimes drier habitats. It thrives in areas that suffer from high levels of grazing and trampling by stock and wallabies, damage caused by cyclones and pigs, saltwater incursion and other 'naturally' disturbed areas such as river banks. Despite its very prolific regeneration in these areas, there is often very little or no pond apple regeneration in areas with high levels of cover such as under a dense canopy of native plants or pond

apple trees or in areas with dense groundcover such as pasture or sedge lands. This is the ecological trait which will be most useful for the long-term, herbicide-free control of this species.

In order to achieve the long-term and herbicide free control of pond apple, revegetation efforts should be aimed at achieving dense ground and canopy cover in order to suppress pond apple regeneration. To this end, it is strongly recommended that revegetation plantings be done as densely as possible. These plantings should contain native ground cover, mid-storey and canopy species. Planting should consist of pioneer and secondary plant species (in all strata). After three to five years, these revegetation areas will be structurally complex with the appearance of a tropical forest.

In areas of near pure stands of pond apple and where it forms part of the canopy cover, it is recommended that mature trees be killed and either felled or left standing. Note that this has been identified as an area requiring further investigation. Ideally, the site would be left for some time in order to run-down the soil seed bank, however due to time constraints this may not be possible. In this case, revegetation should start immediately with some very careful foliar spraying or hand removal of pond apple seedlings one to two months after revegetation work. As the revegetation plants establish, the control of pond apple should not occur until it is a couple of meters tall. This will allow for the ground cover to grow up around the weed's base and will assist in the development of a canopy cover layer (see picture 1). Once this has occurred, staff should cut-stump or scrap and paint the pond apple sapling. This approach will minimise the open space created by control operations which in turn will suppress pond apple regeneration. Where pond apple occurs sporadically and the canopy and/or ground cover is high, trees could be killed without the need for revegetation work to take place.



Picture 1. Pond apple surrounded by Sedges.

In areas such as stream banks where pond apple plays a role in stabilising sediments and maintaining stream morphologies it is recommended attempts should be made to establish dense vegetation under the pond apple. Afterwards, it should be killed either all at once or in a staged sequence. It may be difficult to establish vegetation under living pond apple due to shade and/or competition in which case, revegetation could be staged alongside a staged removal of the pond apple trees. The absence of vegetation under pond apple trees in many situations is partly attributable to wallaby activity. If situations occur where it is necessary to leave a certain amount of pond apple trees alive as a source of food for cassowaries, this staged process should be utilised.

At this stage the aim of the revegetation and weed management is not to destroy the pond apple seed bank in the short-term (one to three years) but rather to create environmental conditions that will limit pond apple regeneration. This will lead to the natural death of the seed bank over a three to four year

period as the seed bank longevity is reached. The added benefit of this approach will be to minimise the impact of pond apple seed input from adult trees left alive from staged removal programs as well as seed inputs from native and introduced animal dispersal, storm surges and some tidal activity.

Summary of recommendations

- For the long term control of pond apple undertake dense revegetation plantings, including native ground cover, mid-storey and canopy species;
- In pure stands of pond apple mature trees should be killed and either felled or left standing;
- Where pond apple occurs sporadically and the canopy and/or ground cover is high, no revegetation work is required;
- On stream banks, dense vegetation should be established underneath the pond apple before control.

1.2 Singapore daisy

The main issue with Singapore daisy concerns its matting ability, which suppresses native plant species regeneration. The major area Singapore daisy has invaded at Ella Bay is open beachfront habitat. This species appears to be tolerant of trampling by wallabies. Following initial foliar spraying of Singapore daisy, long-term non-chemical control will be achieved by establishing a dense canopy as well as mid-storey layer and importantly a denser groundcover layer. This will be achieved through revegetation projects. Singapore daisy can also be reasonably shade tolerant and if not controlled, will potentially spread to shaded inland areas of the Ella Bay site. There are scattered patches of Singapore daisy near the homestead which should be subject to immediate control.

Summary of recommendations

- Foliar spraying of beachfront Singapore daisy followed by the creation of dense canopy as well as groundcover vegetation layers through revegetation.

1.3 Hymenachne and other ponded pasture grasses

Hymenachne has the potential to take over large areas of wetlands on site which will destroy water bird and other water dependent animal habitats. This weed also suppresses native plant species regeneration. Wallabies will eat regrowth of Hymenachne once it has been foliar sprayed. Once regrowth has been sprayed it is recommended that where appropriate, riparian canopy and ground cover species be planted at high densities to shade out any further regrowth. In wetlands that are naturally more open, efforts should be concentrated on establishing a dense layer of ground cover potentially including grasses such as the native hymenachne.

Summary of recommendations

- Foliar spraying followed by planting of riparian canopy and ground cover species at high densities where appropriate.

1.4 Giant bramble, scramblers and vines

Giant bramble, lantana and introduced vine species can readily establish along forest edges and also smother young revegetation areas. It is recommended that these types of weeds are mechanically and/or chemically controlled (please note that sometimes physical removal of dead plants can cause damage to surrounding vegetation). For long-term control, it is recommended that native vines and scrambling plant species be included in revegetation areas as well as establishing a dense layer of ground cover along the edges of forests and revegetation areas.

Summary of recommendations

- Mechanical and/or chemical control of introduced scramblers and vines with long-term control achieved through revegetation and by establishing a dense ground cover layer along edges.

2. Open area weeds

Based on distribution and impact, the most serious open area weeds on site would be sickle pod (and other members of the *Senna* genus), snake weeds, other 'peas' (members of the Fabaceae family), tall grasses (in particular Guinea grass (*Panicum maximum*)) and *Ageratum conyzoids* (Blue billy goat weed). There are also several other species that do not have paddock-wide, dense distributions which should be targeted for urgent control to stop further spread. Such species include rat's tail grasses (*Sporobolus* species) that are largely (although not entirely) restricted to roads as well as tracks and *Mimosa*'s (sensitive plants) which occur throughout the site at low densities.

Open area weeds often thrive in full sun areas suffering high degrees of disturbance. There are several options to control these species, including broad acre application of selective broad-leaf herbicides and also potentially using herbicides with pre-emergent properties. Broad-spectrum herbicides such as glyphosate (i.e. Roundup[®]) can also be used although these will also kill the pasture grasses that help suppress the broad leaf weeds. As a result, the broad-spectrum herbicides should be used selectively. Another option is to slash the site. Due to the less palatable nature of the broad-leaf weeds to wallabies on site, these species have a competitive advantage over the heavily grazed grasses. Slashing will have the effect of 'evening out the playing field' which should eventually allow for the grasses to re-colonise the areas currently occupied by the broad-leafed weeds. It will be important to implement some on-site weed quarantine measures to halt the spread of weeds from within site slashing operations. Tall grasses may need to be slashed before regrowth is spot sprayed.

The open area weeds will pose a threat to new and establishing revegetation plantings due to their ability to rapidly grow above planted stock and form dense infestations. It is therefore recommended that for at least the first few months of revegetation establishment in open areas, spot spraying of open area weeds should occur. The main revegetation method recommended in this paper will allow for a rapid development of both a ground and canopy cover which will easily suppress these weeds. Tall grasses will probably require the longest monitoring due to their large size relative to the developing canopy. Where open area weeds occur on stream banks, it may be necessary to use weed matting to stabilise the stream bank and suppress weed regeneration.

Summary of recommendations

- Broad acre application of selective broad-leaf herbicides and/or herbicides with pre-emergent properties;
- Slashing and spot spraying;
- Weed matting in stream banks to suppress weed regeneration;
- Using revegetation to shade out weeds.

3. Weed quarantine and legislative requirements

It is strongly recommended that weed quarantine procedures be implemented to reduce within site, human-mediated weed dispersal. This could involve a wash down of slashing equipment between the three 'paddock' areas. Even more importantly will be reducing the risk of introducing and exporting new weed species through machinery and people working on-site. This has already been partly implemented with the temporary weed seed wash-down facility. In addition to this, it is recommended that employees conduct informal inspections of areas surrounding development activities to identify any

new weed infestations. A user-friendly guide listing potential new weed species with photos and descriptions could be developed and circulated to stakeholders for quick and accurate identification. Another issue will be the control and containment of declared weed species in the class 2 and 3 categories. Resources should be targeted at these species although most are already advised for targeting in this report hence any further specific target programs should not be needed at this stage.

Visual amenity

The main issue with visual amenity, weed and revegetation management is the frequent unsightly appearance of management activities. This is particularly true after control activities for weed species that form a dominant structural component of the landscape, such as pond apple, and/or cover large areas of the site, such as sickle pod. In addition to this, materials used in the preparation of revegetation sites (such as plant protectors) reduce the visual amenity of an area.

In more traditional approaches to weed management, attempts would be made to run-down the weed species seed bank in order to reduce the risk of weed species regeneration from the soil seed bank. While this may be possible in some areas of the site, other areas need to be visually appealing within the next three to four years and will require revegetation works to commence as soon as possible. This is why the revegetation strategy recommended in this report concentrates on establishing a dense groundcover, mid-storey and canopy cover layer. The result of this planting strategy will be the development of structurally complicated areas of vegetation that will take on the appearance of short rainforest after three to four years.

Native animals

Native animals have caused a number of issues at the Ella Bay site. The most obvious of these is the damage caused by the unnaturally high number of Agile wallabies that reside on the site. Their intense grazing pressure and other activities create bare patches and encourage broad-leaf weed invasion in open areas. They will readily and rapidly eat their way through unprotected revegetation areas and stop natural regeneration from occurring in understorey forested areas as well as riparian zones by eating and trampling seedlings. The open areas they create in the understorey of riparian and forested areas encourages weed invasion and causes erosion problems.

It is recommended that revegetation areas be densely planted, particularly around the edges, with plant species that will mechanically obstruct wallabies and reduce the formation of tracks. Such species could include sedges, groundcovers and shrubs which appear to be unpalatable to wallabies. This approach can be used in open area plantings as well as consolidation plantings in damaged areas. It should be noted that plants will need to be protected with either fences or protector bags until they are established. Measures to restrict wallaby access to certain areas may result in increased traffic in other areas so this will need to be considered in management plans. In open areas, management actions should be targeted at reducing the competitive advantage of less palatable broad-leaf weed species by either slashing and/or selective herbicide application.

The issue of cassowaries using pond apple as a food source is discussed in the pond apple section of the report. The other issue with cassowaries, frugivorous birds and wallabies is that they act as dispersal agents for a number of weed species including pond apple. The proposed revegetation approach discussed in this paper largely aims to build resilience into newly established vegetation. This will basically result in create conditions in revegetated areas that are unsuitable for the establishment of most weed species. These conditions will be suitable for the establishment of certain native plant species that may also be brought into the area by these dispersal agents.

Pest animals

The main issue concerning pest animals relates to feral pigs. Feral pigs cause large amounts of physical damage to the landscape, create ideal weed establishment conditions and act as weed dispersal agents. The solution to this problem is to invest resources into feral pig control through trapping and other methods which are already occurring.

Cyclones

Cyclones have the potential to cause widespread damage to forest and revegetation areas. The establishment of dense groundcover, mid-storey and canopy vegetation layers will increase the resilience of revegetation areas to cyclones by creating conditions in the short to medium term that will encourage natural regeneration and weed suppression. These conditions will discourage pond apple establishment where the canopy becomes badly damaged by maintaining a healthy groundcover. Once the groundcover starts to thin in the long term, as the plantings mature, the risk of re-establishment of pond apple from the soil seed bank and localised fresh seed input is greatly reduced due to control efforts and reduced soil seed bank viability.

Issues that may require further research

There are several issues that may require further investigation to identify optimal solutions. Some solutions may be obtained through literature and internet research as well as interviewing professionals from relevant fields, however a large number of solutions will be identified through conducting field trials. Due to the tight time frames involved in aspects of this project, it is recommended that early trials form part of revegetation and weed management activities and that an adaptive approach to management be taken. Trials in other areas, such as in the south-west corner of the site are not as urgent and will be able to optimise large scale revegetation and weed management efforts in these areas. Initial issues that require additional research are listed below. Further issues will be identified as management planning becomes more advanced.

1. What is the best method to keep wallabies out of revegetation areas?
2. Should pond apple trees be left standing or cut down after application of herbicide and commencement of revegetation?
3. What is the optimal planting density and species composition for revegetation areas for the various management objectives (weed control, cassowary corridors, wallaby impedance etc.)?

Estimated time-line and priority areas for revegetation and weed management

Due to development activity being initially concentrated in the northern paddock of the site (details can be discussed at meeting) revegetation and weed management activities should be targeted here and along the paddock side of the eastern site boundary. Within the northern paddock, the north-eastern half should be targeted first due to development starting at this point. Within the north-eastern and eastern part of the site, the areas where the dominant vegetation is pond apple, efforts should be directed at establishing native vegetation as soon as possible. This is to make these areas look visually appealing as quickly as possible. Most of the paddock-forest boundary area in the north-east and

eastern part of the site is dense pond apple but there are native trees behind them which could obscure, at least from a distance, the bare patches caused by pond apple control.

In the open areas of the north-eastern corner of the site, revegetation of designated areas could occur before or during pond apple control operations along the pasture-forest edge. This will help ensure pond apple control areas are visually obscured. Particular attention should be paid to establishing the cassowary corridor in this area of the site at this time as well. During this initial period, it is also recommended that areas with sparse populations of pond apple be subject to control operations where possible. Weed species with limited distributions, both environmental and open area, should be subject to immediate control operations to halt further spread. Activities to convert broad-leaf weed areas back to pasture should also be initiated at this time.

Trials for finding solutions to various issues will form part of the initial revegetation and weed control work in the north-eastern and eastern part of the site (trials will also be initiated at this stage on coastal side of the north-eastern corner). It is also recommended that trials in the south-western part of the site be initiated as soon as possible in order to include results into broader management plans.

Once this initial work has been completed, efforts should be directed at the revegetation and weed management along the coastal and riparian areas of the eastern paddock. The results from the trials in the south-west of the site will then allow for effort to be focused on the western paddock. Much more detailed timing and prioritising will be possible once access is given to more detailed development schedules.

Broad resources required to implement revegetation and weed management plans

In order to achieve desired management objectives within a timely manner, it will be necessary to employ large amounts of effort in the first couple of years of operation to ensure the visual amenity of the site by the three to four year mark. This will require a crew of several weed control and revegetation contractors to be working nearly full time for the first year or two. Following this high effort period the numbers of full time workers could be reduced or continued to achieve management objectives ahead of schedule. Limited amounts of follow up work will be required in revegetation plots following establishment. Resources will still be required to control weeds in open areas as well as to monitor environmental weeds once development becomes more advanced.

Investigations towards a management plan

In order to develop a revegetation and weed management plan it will be necessary to construct a species list of plants and animals found on site (from pre-existing surveys) and that are probably found on site (from surveys in Ella Bay National Park and surrounds). Once this list has been constructed, basic ecological information (from floras and other sources) on native and introduced species should be placed into a spread sheet. This information will be useful when developing planting lists and identifying what species to plant in order to attract certain animals such as cassowaries. Following the compilation of this data, the identification of vegetation communities (most likely the Regional Ecosystem (RE) classification) on site should occur. The appropriate vegetation to establish in the revegetation areas will then be identified. A more detailed inspection of ecological data on the major weed species on site will help future weed management planning.

The areas to be revegetated and those to be developed will need to be identified and reasonably accurately mapped. A broad management plan would then be developed for the site with detailed plans created for the north-eastern and eastern parts of the site which will include trial designs. Once these activities have occurred, a site visit will be required for ground truthing purposes. Following the initiation of the detailed weed and revegetation management plan recommendations, work on plans for other areas will be started and will include information from trials.