# WEED MANAGEMENT PLAN
# VULCAN COMPLEX PROJECT
# Tenure number: ML700060

**February 2022**

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| Document ID: | 00293151 |
| Version: | 1.0 |

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# 1 Introduction

The Vulcan Coal Mine (the VCM) is a small-scale coal-mining operation being undertaken by Vitrinite Pty Ltd (Vitrinite). The mine managers have a statutory obligation to manage weed risks on the mining lease. This Weed Management Plan has been developed to assist with managing these risks.

## 1.1 Context

The VCM is being undertaken on mining lease (ML) 700060 and operates under Environmental Authority (EA) number EA0002912. Queensland Coking Coal Pty Ltd and QLD Coal Aust No. 1 Pty Ltd are the joint holders of this EA, and both companies are subsidiaries of Vitrinite Pty Ltd. In addition to Vitrinite's obligations under the *Biosecurity Act 2014*, the EA for the VCM stipulates that a weed management plan must be prepared and implemented for the VCM.

The area authorised for disturbance by the EA is shown on **Figure 1**.

The VCM is located in the Bowen Basin, Queensland. It lies adjacent to Saraji Road, 33 kilometres (km) south-southeast of Moranbah and 34 km north-northwest of Dysart. It falls within the jurisdiction of the Isaac Regional Council. The VCM is located immediately south and west of an existing, large-scale coal operation, including the Peak Downs and Saraji mines.

## 1.2 Purpose

This Weed Management Plan (the Plan) describes the objectives, management measures and monitoring program in place to manage weeds on ML 700060 during the operation of the VCM.

The Plan focuses on weeds that are listed as restricted matters under the *Biosecurity Act 2014* as well as any non-native plant species that potentially disrupts the habitat of threatened species of flora or fauna.

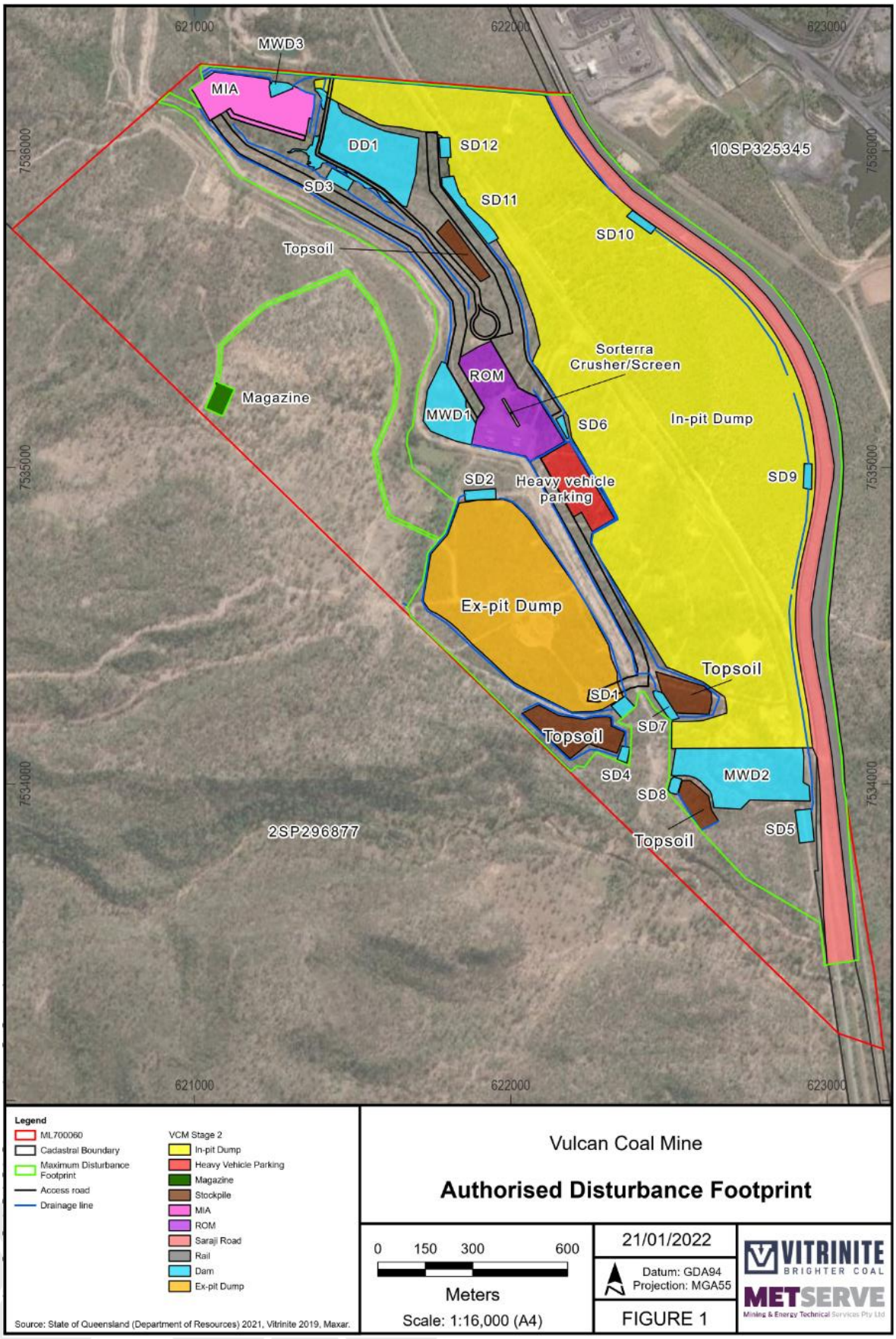


*Figure 1 Authorised disturbance footprint*

# 2 Regulatory Environment

Statutory obligations pertaining to weed management are contained within the EA conditions, as well as within the *Biosecurity Act 2014.* These are summarised below.

## 2.1 EA Requirements

The EA contains a condition (H2) that specifies the preparation of a weed management plan, and describes the information to be contained within this plan (**Table 1**). Vitrinite is bound by the *Environment Protection Act 1994* to adhere to all conditions of its EA.

*Table 1 Conditions of the EA pertaining to weed management*

| ***Condition number*** | ***Condition*** |
|---|---|
| ***H2*** | ***Weed Management*** |
| | *(a) A weed management plan must be developed and implemented for this site outlining:* |
| | *(b) Areas of control priority and the methods used to determine such areas;* |
| | *(c) Strategies to promote dense pasture cover (to decrease weeds establishment) through reduced disturbance;* |
| | *(d) Monitoring methodologies that document the spread of weeds and any new outbreaks;* |
| | *(e) Methods for the control of weeds. These methods should include best practice management;* |
| | *(f) Stringent wash-down and inspection procedures for both machinery involved in clearing/construction activities and those operating outside of designated roads during mine operation;* |
| | *(g) Truck wash procedure to reduce weed infestations; and* |
| | *(h) Promotion of the awareness of weed management issues at the site.* |

## 2.2 Progressive Rehabilitation and Closure Plan

The Progressive Rehabilitation and Closure (PRC) Plan submitted with the EA application describes, among other aspects of mine rehabilitation, management measures pertaining to weed management (Vitrinite 2021). While these weed management measures contained within the rehabilitation planning section of the PRC Plan are not legally binding, conditions within the PRCP Schedule (the second component of the PRC Plan) must be complied with under sections 431B and 431C of the *Environment Protection Act 1994.* Successful compliance with the PRCP Schedule is generally contingent on adherence to the management commitments made within the rehabilitation planning section of the PRC Plan.

As there is a temporal overlap between the rehabilitation and operational phases of the VCM, it is appropriate for any weed management measures adopted during rehabilitation to be implemented through all phases of the VCM.

The following are weed management commitments contained within the PRC Plan:

- Section 5.1: One of the rehabilitation objectives is that "*Weeds listed under the* Biosecurity Act *are not to exceed densities typically present in unmined, grazed landscapes within the ML and neighbouring areas*." This is to be assessed using "*percentage cover within a 10 m × 50 m plot*", as measured "*between February and April, every two years for ten years after planting*".
- Section 5.1: One rehabilitation completion criterion is that "*Rehabilitated areas have ≤0.2% cover of* Parthenium hysterophorus *AND rehabilitated areas have ≤0.1% cover of* Harrisia martinii *AND any other weeds listed under the* Biosecurity Act *are to be present in densities of <1 individual per hectare".*
- Section 6.2.1: One revegetation objective is "*to limit invasion by declared weed species to levels that are similar to those on site prior to mining or representative of adjacent areas*".
- Section 6.2.4: "*Stockpiles are to be monitored annually for weeds and control measures implemented as appropriate*".
- Section 6.2.6: "*A fast-establishing sterile annual cover crop is recommended to be included in the seed mix…to rapidly establish ground cover and minimise topsoil loss*…[and] *help to supress weeds*".

- Section 8: To reduce the risk posed by vehicles contaminated with weed seed, there are to be "*strict vehicle wash-down practices for vehicles entering the site from contaminated areas* [and an] *annual weed monitoring program, to allow the early detection and treatment of new weed infestations*".
- Section 9.1.7: "*Percentage cover of declared weeds… to be measured within a 10 m × 50 m belt transect installed within rehabilitation areas…The entire belt transect is to be searched, and all species of forbs and grasses contained within it are to be recorded. Percentage ground cover of each species is to be estimated to the nearest 0.1%, with 0.1% cover being equivalent to 0.5 $m^2$ total cover within the transect*". "*Field surveys are to be undertaken in the late wet season (February-May), to coincide with maximum growth of grasses and forbs. Permanent monitoring sites are to be installed within all rehabilitation areas, and each end of each transect is to be marked with a star picket. An average of one monitoring site is to be installed per 10 ha of rehabilitated land.*"
- Section 10.3.1 (milestone criteria listed in the PRCP schedule and thereby constituting a condition of the VCM): "*Rehabilitated areas have ≤0.2% cover of* Parthenium hysterophorus *AND ≤0.1% cover of* Harrisia martini. *Any other weeds listed under the* Biosecurity Act *are present in densities of <1 individual per hectare."*

## 2.3 *Biosecurity Act 2014*

The *Biosecurity Act 2014* is the Queensland Government's principal instrument for governing the management of weeds and other invasive species. Schedule 1 and Schedule 2 of the *Biosecurity Act 2014* list species that are prohibited or restricted matters, respectively. The former are not found in Queensland but, if they were to enter, would have serious environmental, economic or lifestyle impacts. Under section 36 of the *Biosecurity Act 2014*, if a person becomes aware of the presence of a prohibited matter in a place they occupy or control, the person must advise an inspector without delay. Furthermore, the person must not take any action reasonably likely to exacerbate, and must take any action reasonably likely to minimize, the biosecurity risk post by the prohibited matter.

Restricted matters are currently present and perhaps widespread in the state, but reduction, control or containment is required to prevent adverse impacts. Weeds are classified as category 2, 3, 4 and/or 5 restricted matters. Under section 42 of the *Biosecurity Act 2014*, category 2 restricted matters must be reported to an appropriate authorised officer as soon as possible after becoming aware of the presence of the restricted matter. Under section 42 of the *Biosecurity Act 2014*, category 3 restricted matters must not be distributed or disposed, unless performed in a way prescribed under a regulation or authorised under a restricted matter permit. Under section 42 of the *Biosecurity Act 2014*, category 4 restricted matters must not be moved, and category 5 restricted matters must not be kept.

# 3 Pre-mining Weed Risk

The following subsections describe the state of ML 700060 prior to the commencement of operations.

## 3.1 Pre-mining Weed Status

A total of 61 species of non-native plants were recorded within the local area (a 6,552 ha area surrounding and containing the ML). Of these, the following weeds were most widespread, occurring at 30% or more of sampling sites (METServe 2020):

- *Bothriochloa pertusa* (Indian Couch);
- *Sida spinosa* (Spiked Sida);
- *Cenchrus ciliaris* (Buffel Grass);
- *Melinis repens* (Natal Grass);
- *Portulaca pilosa* (Hairy Portulaca);
- *Stylosanthes scabra* (Shrubby Stylo); and
- *Urochloa mosambicensis* (Sabi Grass).

Most of the above are pasture species that were intentionally introduced to improve productivity for grazing.

Seven species of weeds detected within the local area are category 3 restricted matters under the *Biosecurity Act 2014*, which prohibits their sale, trade or spread. These restricted weeds are:

- *Cryptostegia grandiflora* (Rubber Vine);
- *Harrisia martinii* (Harrisia Cactus);
- *Hymenachne amplexicaulis* (Olive Hymenachne);
- *Jatropha gossypiifolia* (Bellyache Bush);
- *Opuntia stricta* (Prickly Pear);
- *Opuntia tomentosa* (Velvet Pear); and
- *Parthenium hysterophorus* (Parthenium).

All of the above, except *H. martinii*, are also classed as Weeds of National Significance. While this classification does not introduce additional restrictions, it acts to coordinate management across states.

Most of the above species occur infrequently and in very low densities. The most abundant are Parthenium and Harrisia Cactus, which had an average cover of 0.2% and 0.1%, respectively, on land zone 5 (sand plain), which dominates the ML.

## 3.2 Regional Weed Risk

The *Isaac Region Biosecurity Plan 2020-2023* (Isaac Regional Council 2020) identifies a number of priority weed species that do not currently occur within ML 700060, but which have the potential to invade (**Table 2**). Note that this is not an exhaustive list of all weeds occurring within the region, but is rather a list of those deemed to be of highest priority for management.

*Table 2 Isaac Regional Council's weed priority list*

| Weed | Level of impact | Likelihood of spread | Achievability | Current Extent | Existing priorities | Total* |
|---|---|---|---|---|---|---|
| Rat's Tail Grass (*Sporobolus fertilis, S. jacquemontii, S. natalensis, S. pyramidalis*) | 4.33 | 5 | 3 | 4 | 2.67 | **19.00** |
| Salvinia (*Salvinia molesta*) | 2.33 | 3 | 4 | 5 | 4.33 | **18.67** |
| Bellyache Bush (*Jatropha gossipifolia*) | 3 | 4 | 3 | 3 | 4.33 | **17.33** |
| Rubber Vine (*Cryptostegia grandiflora*) | 2.67 | 4 | 3 | 3 | 4.33 | **17.00** |
| Broadleaved Pepper Tree (*Schinus terebinthifolius*) | 3.33 | 4 | 3 | 4 | 1,33 | **16.67** |
| Parthenium (*Parthenium hysterophorus*) | 4.67 | 5 | 2 | 0 | 4.67 | **16.33** |
| Athel Pine (*Tamarix aphylla*) | 2.33 | 2 | 3 | 5 | 4.00 | **16.33** |
| Chinee Apple (*Ziziphus mauritiana*) | 2 | 2 | 5 | 5 | 2.33 | **16.33** |
| Parkinsonia (*Parkinsonia aculeata*) | 3 | 4 | 3 | 1 | 4.67 | **15.67** |
| Prickly Acacia (*Vachellia nilotica*) | 3 | 4 | 3 | 1 | 4.67 | **15.67** |
| Water Lettuce (*Pistia stratiotes*) | 2.33 | 3 | 3 | 5 | 2.33 | **15.67** |
| Castor Oil Plant (*Ricinus communis*) | 2.67 | 4 | 3 | 4 | 2.00 | **15.67** |
| Hymenachne (*Hymenachne amplexicaulis*) | 2.67 | 4 | 2 | 4 | 2.67 | **15.33** |
| Mimosa Bush (*Acacia farnesiana*) | 2.67 | 4 | 4 | 2 | 2.00 | **14.67** |
| Opuntioid Cacti (*Austrocylindropuntia, Cylindropuntia* and *Opuntia* species) | 1.33 | 3 | 4 | 2 | 4.33 | **14.67** |
| Lantana (*Lantana* spp.) | 2.67 | 3 | 3 | 1 | 4.00 | **13.67** |
| Feral Leucaena (*Leucaena leucocephala*) | 2 | 5 | 3 | 2 | 1.67 | **13.67** |
| Mother-of-Millions (*Bryophyllum delagoense*) | 3 | 4 | 3 | 1 | 2.33 | **13.33** |
| Captain Cook Tree (*Cascabela thevetia*) | 2 | 3 | 3 | 3 | 2.33 | **13.33** |
| Harrisia cactus (*Harrisia martinii, H. tortuosa*, and *H. pomanensis* syn. *Cereus pomanensis*) | 1.67 | 3 | 2 | 3 | 2.67 | **12.33** |

*The scoring systems are described in the *Isaac Region Biosecurity Plan 2020-2023* (Isaac Regional Council 2020). The total of each column reflects the overall priority for control.

## 3.3 Environmental Values Threatened by Weeds

The Terrestrial Ecological Assessment for the Vulcan Complex Project (METServe 2020) and/or the Preliminary documentation submitted for assessment under the EPBC Act (METServe 2021) identified the following environmental values located, or potentially present, within ML 700060 that are threatened by weeds:

- The southern subspecies of the Squatter Pigeon (*Geophaps scripta scripta*) is listed under both the EPBC Act and the NC Act as a vulnerable species. It is a ground-feeding bird that is threatened by Buffel Grass, which forms dense swards that impede movement and foraging (DAWE 2021). Squatter Pigeons have been recorded widely from within the VCM area. The VCM area is already occupied by Buffel Grass, and the areas where this weed does not grow are very sandy and unlikely to be favourable for establishment. Overall, the VCM has a low risk of worsening the impact of Buffel Grass on the Squatter Pigeon.
- The Koala is listed under both the EPBC Act and the NC Act as a vulnerable species. It is likely to occur within the VCM's ML, as it was recorded widely in neighbouring areas. It is not known to be threatened by any weed species.

In addition to these risks to environmental values posed by weeds, weeds also pose a potential risk for rehabilitating the site to a post-mining land use of cattle grazing in accordance with the Progressive Rehabilitation and Closure Plan (Vitrinite 2021). Weeds of greatest concern are those that are toxic to stock and/or that shade out valuable pasture species.

The inherent risks that the VCM could elevate the densities of the restricted species currently occurring on or near the ML are discussed in **Table 3**.

*Table 3 Inherent risk (without controls) that the VCM could spread restricted weeds*

| Species | Inherent Risk | Justification |
|---|---|---|
| *Cryptostegia grandiflora* (Rubber Vine) | Low | Rubber Vine was confined to creek banks further than 1 km south of the VCM. |
| *Harrisia martinii* (Harrisia Cactus) | High | While not in high density, this cactus was recorded in numerous locations within the proposed disturbance footprint. As it can spread via stem fragments, new infestations could establish in soil stockpiles. |
| *Hymenachne amplexicaulis* (Olive Hymenachne) | Nil | Olive Hymenachne is an aquatic weed recorded 9 km south of the VCM's footprint. Potential habitat for the species is present within the ML, but is not to be disturbed by the VCM. |
| *Jatropha gossypiifolia* (Bellyache Bush) | Moderate | A small infestation (<10 plants) of this weed within the VCM area was the only record of the species across the broader survey area. If not controlled prior to soil disturbance, seeds may be spread to new areas (e.g., soil stockpiles, tracks). |
| *Opuntia stricta* (Prickly Pear) | Low | This cactus was only recorded once, 1.8 km south of the proposed footprint. As the VCM will not result in any soil movement between the infestation and uninfested areas, there is a low risk of impact. |
| *Opuntia tomentosa* (Velvet Pear) | High | This cactus occurred widely, in low densities, across most of the survey area, including within the disturbance footprint. As it can spread via stem fragments, there is a risk that new infestations could establish in soil stockpiles. |
| *Parthenium hysterophorus* (Parthenium) | Moderate | Parthenium was abundant on clay soils and alluvial areas (sites with moisture-retentive soil). While disturbance to clay soil is avoided, there will be minor disturbance to riparian areas. |

## 3.4 Control Priorities

Control priorities consider the following attributes of each weed:

- Current absence (prevention is more cost effective than control);
- Current distribution (small, isolated populations are easiest to control); and
- Threat to achieving the desired post-mining land use (restricted plants and/or those affecting pasture productivity pose the greatest threat).

With the above attributes in mind, **Table 4** lists the control priorities for weeds occurring or potentially occurring within the ML.

*Table 4 Weed control priorities at the VCM*

| Priority | Weed category | Examples |
|---|---|---|
| 1 | Restricted or prohibited weed species not currently occurring within the ML | Prickly Pear, Rubber Vine, species listed in **Table 2** and not **Table 3** |
| 2 | Restricted weed species occurring within the ML in few (<5), small (<20 individuals) populations. | Bellyache Bush |
| 3 | Other restricted weed species within the ML | Velvet Pear, Harrisia Cactus, Parthenium |
| 4 | Weeds that are not listed under the *Biosecurity Act 2014*, but which could outcompete pastures in rehabilitated areas | Khaki Weed, Goat's Head, Golden Crownbeard, Noogoora Burr, Coffee Senna, Flannel Weed, Thornapple, Small Caltrop |
| 5 | Unlisted weeds that pose a negligible threat to pasture development | Other species listed in Appendix A |

# 4 Weed Management Objectives

The principal objective of this Weed Management Plan is to prescribe management measures and monitoring programs that fulfil the regulatory obligations of Vitrinite Pty Ltd pertaining to weeds, as described in **Section 2**. The main goal of the plan is to ensure no increase in the density of restricted weeds listed under the *Biosecurity Act 2014* over time.

## 4.1 Success Criteria

Success criteria have been broadly aligned with rehabilitation completion criteria pertaining to weeds. The following are the success criteria for weed management at the VCM:

- The VCM's disturbance footprint is to maintain a percentage cover of Parthenium (*Parthenium hysterophorus*) ≤ 0.2%;
- The VCM's disturbance footprint is to maintain a percentage cover of Harrisia Cactus (*Harrisia martinii*) ≤ 0.1%;
- Any other weeds listed in Table 3 are to be maintained at an average density within the ML of < 1 individual per hectare.
- Any weeds that constitute restricted matters under the *Biosecurity Act 2014* that are not listed in Table 3 are to remain absent from the ML, or (if an infestation begins) are to be eradicated within three years of the initial infestation.

# 5 Weed Management Measures

The following subsections describe the management measures that are to be undertaken in order to manage weed risks of the VCM.

## 5.1 Principles of Weed Management

The *Queensland Invasive Plants and Animals Strategy 2019-2024* (Department of Agriculture and Fisheries 2019a) lists six key themes of effective weed management:

1. Prevention and preparedness;
2. Monitoring and assessment;
3. Awareness and education;
4. Effective management systems;
5. Strategic planning and management; and
6. Commitment, roles and responsibilities.

The weed management measures proposed by this Weed Management Plan incorporate each of these themes, as discussed in the following sections.

## 5.2 Prevention

As costs of weed management increase exponentially as additional weeds become established and/or spread, prevention of new infestations is the principle goal of this Weed Management Plan.

Weeds can spread to the site via soil movement, contaminated vehicles/footwear, the movement of livestock, use of supplementary hay during drought, birds and flying foxes, water runoff from infested areas, and/or wind. While some of these dispersal agents (e.g., birds, wind and water) cannot be easily managed, most serious weeds in the Isaac region are spread primarily by the movement of soil, vehicles/machinery and livestock, which are risks that can be actively reduced through the implementation of weed hygiene practices. These practices are detailed below.

### 5.2.1 Vehicle Washdowns

Soil and seeds carried on vehicles and machinery is the predominate source of new weed infestations in Central Queensland. In addition to being an effective tool for reducing the risk that new weeds are introduced to the VCM's ML, vehicle washdowns are also mandated by condition H2 of the EA.

The Queensland Government describes appropriate methods for washing down vehicles and machinery in their *Vehicle and Machinery Cleandown Procedures* (Department of Agriculture and Fisheries 2019b). These procedures are to be adhered to whenever a vehicle wash-down is required prior to accessing the VCM area.

There are no council-operated wash-down facilities in Moranbah or Dysart. However, commercial facilities are available at:

- Caltex Car Wash, 21 Griffin Street, Moranbah (suitable for light vehicles only);
- Hornery, 257 Railway Station Road, Moranbah (suitable for all vehicles, including trucks).

During the construction phase of the VCM, all vehicles entering the site must have undergone a thorough wash-down prior to entry. The person undertaking the wash-down must adhere to the *Vehicle and Machinery Cleandown Procedures* (Department of Agriculture and Fisheries 2019b). The person undertaking the wash-down must also complete a statutory declaration, which includes the date, time, location and procedures followed.

During the operational and rehabilitation phases of the VCM, ML 700060 is divided into four zones with different wash-down requirements:

- Zone A: Public infrastructure (Saraji Road and Norwich Park branch railway);
- Zone B: Entrance road and light vehicle car park;
- Zone C: Coal loading and hauling route between the ROM pad and the processing plant off site;

- Zone D: Remainder of mining lease (mining pit, waste rock dumps, soil stockpile areas, heavy vehicle parking, water dams, magazine, workshops).

The different risks and weed hygiene protocols to be implemented in each zone are described in the following subsections. Note that the locations of the four zones shift during the life of the mine, as the routes used for haulage change. The project has two main stages:

- Stage 1: While the new Saraji Road is being constructed, coal is hauled off site using the existing Saraji Road (**Figure 2**).
- Stage 2: Once the the new Saraji Road is operational and the old road removed, coal will be hauled through BHP's lease to the north of the VCM, eventually connecting with the new Saraji Road (**Figure 3**).

### *Zone A*

There are no specific weed hygiene requirements for accessing Zone A. Numerous members of the public pass through this zone daily.

### *Zone B*

This zone will primarily be used by light vehicles driving between the site and nearby towns via the public road network. This is a low-risk source of weeds to the mining lease given the limited exposure such vehicles tend to have with weed infestations. The zone itself is comprised of hard surfaces unfavourable for weed establishment. No specific weed hygiene protocols will be required prior to accessing this zone, unless a vehicle has knowingly entered a weed-infested area during the previous week. In this instance, a wash-down will be required prior to entry.

### *Zone C*

This zone is used primarily by road trains for hauling coal between the ROM pad and the washing facility between Moranbah and Coppabella on the Peak Downs Highway. These vehicles have limited exposure to weed seeds given that they remain on formed haul roads and public roads. Any vehicles that enter this zone must undergo a weed wash-down if they are new to the site or have left the haulage circuit and pulic road network for any reason (e.g., for maintenance). The person undertaking the wash-down must adhere to the *Vehicle and Machinery Cleandown Procedures* (Department of Agriculture and Fisheries 2019b). The person undertaking the wash-down must also complete a statutory declaration, which includes the date, time, location and procedures followed.

### *Zone D*

All vehicles and machinery entering Zone D are to have a thorough weed wash-down prior to access. The person undertaking the wash-down must adhere to the *Vehicle and Machinery Cleandown Procedures* (Department of Agriculture and Fisheries 2019b). The person undertaking the wash-down must also complete a statutory declaration, which includes the date, time, location and procedures followed.

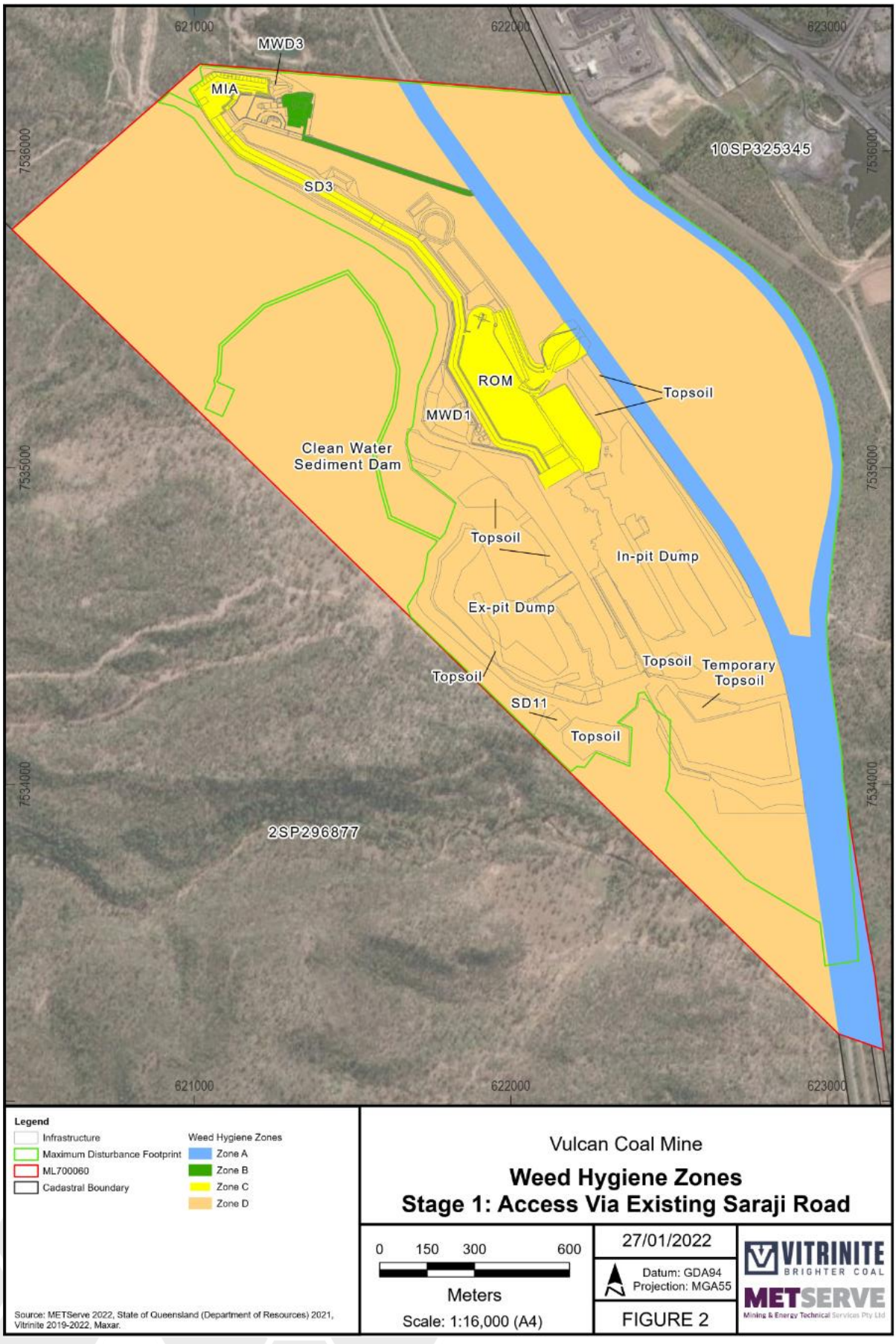


*Figure 2 Weed hygiene zones: Stage 1*

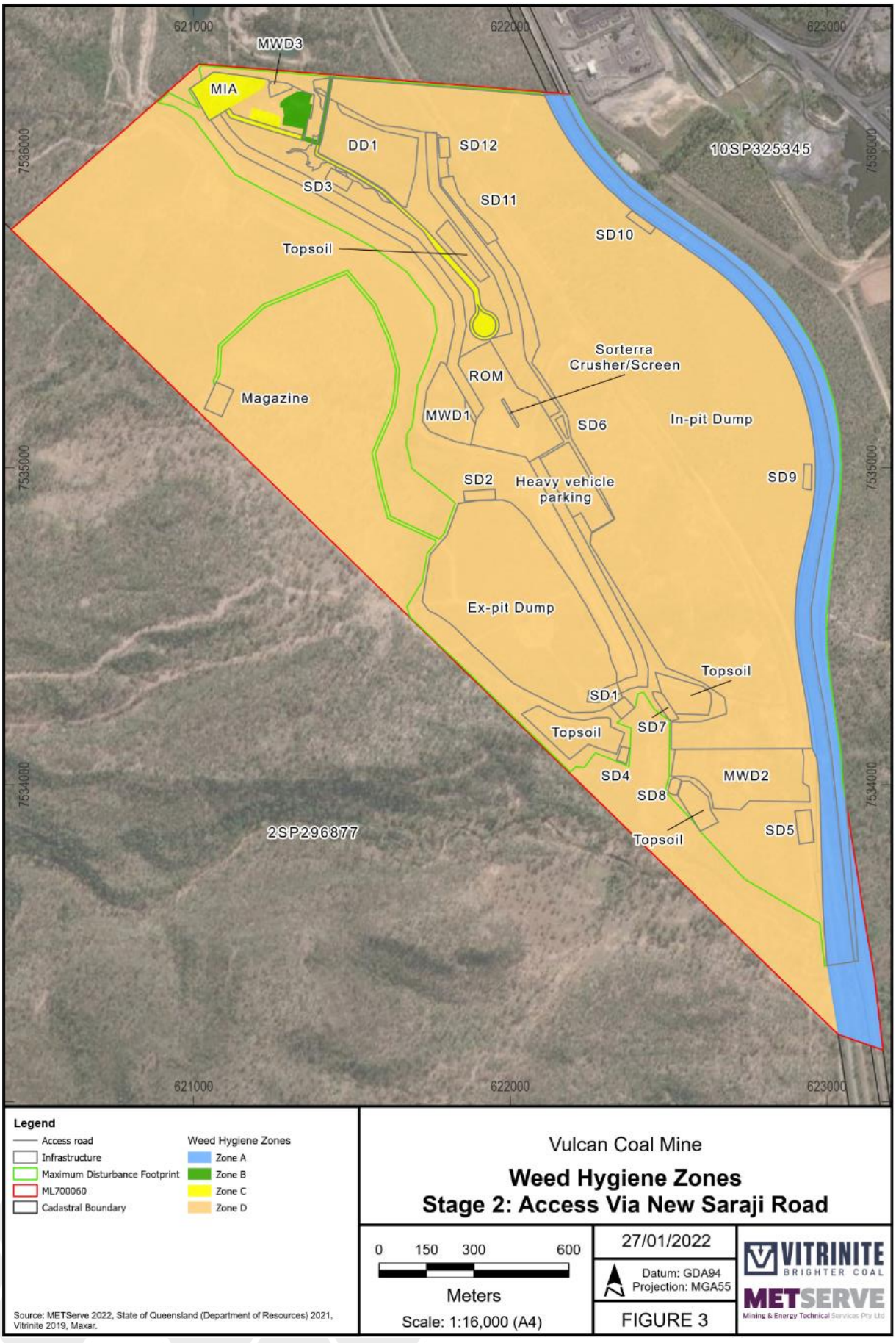


*Figure 3 Weed hygiene zones: Stage 2*

### 5.2.2 Soil Movement

Any soil, sand, clay, gravel, mulch or other materials imported to the site for use during the construction phase of the VCM is to come from a certified weed-free location.

### 5.2.3 Livestock Movement

While the VCM involves limited importation of livestock to ML 700060, some livestock will be introduced to the site in the later stages of the rehabilitation phase. As grazing trials are to be undertaken after the site has been rehabilitation but prior to relinquishment of the lease, these constitute a potential source of weed introduction while the lease is the legal responsibility of Vitrinite Pty Ltd.

If there is a need to introduce livestock to ML 700060, all stock should be quarantined for eight days in a holding yard before introduction to the property. Alternatively, stock should be acquired from certified weed-free properties.

## 5.3 Education

Effective management of weeds relies on broad stakeholder knowledge of the problem and the management issues. All staff and contractors arriving on site for the first time are to undergo a site induction that includes:

- An explanation of the risk posed by weeds and a description of everyone's obligations; and
- Instructions about the zones of the mining lease, and washdown procedures required for each.

In addition to education through inductions, posters depicting the key weeds likely to be found in the mining lease are to be placed in the main office building (where toolbox meetings take place).

## 5.4 Monitoring

Effective weed management is contingent on the early identification and rapid eradication of new infestations. Weed seeds can remain dormant in the soil for up to ten years (varies between species), and allowing new weed infestations to flower and seed can therefore result in significant long-term costs of control.

The monitoring program is designed to efficiently detect new weed infestations, as well as provide data that can be used to assess the success of the Weed Management Plan against the success criteria listed in **Section 4.1**.

### 5.4.1 Baseline Survey

A baseline survey is to be undertaken prior to the start of the construction phase. This survey is to take place in the wet season (December-May), when annual weeds are most detectable.

The survey is to be undertaken by qualified ecologists/botanists with experience identifying weed species in Queensland.

The purpose of this survey is to map the distribution of all restricted weed species inhabiting the mining lease. For each weed species, the mining lease is to be divided into regions with varying weed density. These regions are to be mapped in the field, based on subjective density classes (none, low density, medium density, high density etc). Each region is then to be sampled using transects at a sampling density consistent with **Table 5**.

*Table 5 Weed sampling intensity*

| Region Size | Number of transects |
|---|---|
| 1-10 ha | At least two |
| 10-30 ha | Four |
| 30-60 ha | Six |
| 60-100 ha | Eight |
| 100-250 ha | Ten |
| 250-500 ha | Twelve |
| More than 500 ha | Fifteen |

Percentage groundcover of each weed species is to be estimated in each 10 m × 50 m belt transect. Cover is to be estimated to the nearest 0.1%, with 0.1% cover being equivalent to 0.5 $m^2$ total cover within the transect.

An overall density of each weed within the ML is to be calculated by:

1) Calculating an average percentage groundcover per region by calculating the mean across all the transects measured within the relevant region; then
2) Deriving a final weed density estimate for the mining lease by calculated the weighted mean percentage cover across all regions, weighting by the area in hectares of each region.

These overall weed density estimates will be used as baseline estimates to determine changes in weed densities over time, and are the principal means of assessing success criteria.

### 5.4.2 Milestone Monitoring

In order to track the success of the Weed Management Plan, the monitoring survey described for the baseline survey (see **Section 5.4.1**) is to be repeated every two years throughout the life of the VCM (including construction, operational and rehabilitation phases). Surveys are to be undertaken in the late wet season (February to April), to enable identification of annual weeds.

Once progressive rehabilitation commences, the units of assessment within rehabilitated sites are to be the rehabilitation areas/domains (as defined within the approved PRCP schedule), rather than weed-density regions. The remainder of the ML will continue to be sampled by weed-density regions throughout all phases of the VCM.

Milestone monitoring will identify any changes to weed populations over time, to determine whether overall densities remain at "levels that are similar to those on site prior to mining or representative of adjacent areas".

A final round of milestone monitoring is to be undertaken once rehabilitation is complete, in order to demonstrate the achievement of the final rehabilitation milestone (RM8: achievement of post-mining land use to a stable condition).

### 5.4.3 Inspections of High-risk Sites

In addition to the mining lease-wide milestone monitoring that is undertaken every two years, regular inspections of high-risk sites are to be undertaken by mine environmental staff one month after each heavy rainfall event (defined as >20 mm in a 24-h period). The purpose of these inspections is to identify any new weed infestations soon after establishment, so that they can be controlled before they have an opportunity to seed/spread.

In the event that new weeds are identified during visual inspections of high-risk areas, these should be photographed, and the management response described in **Section 5.5.2** is to be followed.

The following are considered high-risk sites that are to be inspected one month after each heavy rainfall event:

1. Vicinity of wash-down facilities;
2. Edges of light vehicle car park;
3. Topsoil stockpiles; and
4. Edges of haul roads and ROM pad.

Inspections are to take place throughout the construction and operational phases of the VCM, as well as within the first year of the rehabilitation phase (i.e., one year after operations cease). Regular inspections are not required later in the rehabilitation phase as high-risk sites are no longer present and infrequent access by vehicles limits weed transmission.

### 5.4.4 Wash-down Audits

Any new vehicles entering Zone D from off site, or entering Zone C after having left a designated haul road or public road will require authorisation from the Health, Safety, Environment and Community (HSEC) Superintendent or a person designated by the Superintendent. Prior to authorising the entry of vehicles, the HSEC Superintendent or designated person must inspect and approve a weed hygiene declaration (including a completed washdown checklist) completed by the driver.

## 5.5 Management Systems & Strategic Responses

The establishment of a new weed infestation triggers a rapid and effective response in order to contain and eradicate the infestation before it reaches a scale that becomes logistically unachievable to control.

Appropriate actions for managing existing and emerging weed risks vary according to position on the invasion curve (Department of Agriculture and Fisheries 2019a; **Figure 4**).

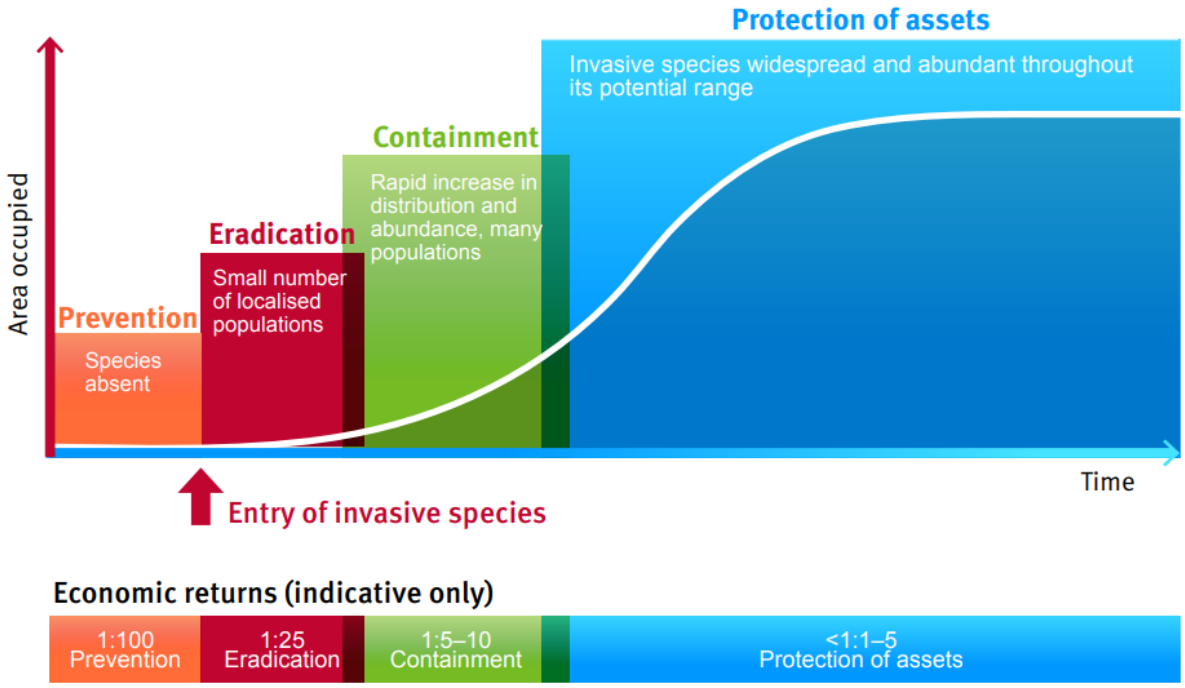


*Figure 4 Actions appropriate to each stage of the invasion curve (Department of Agriculture and Fisheries 2019a)*

### 5.5.1 Pre-existing Weeds

Most restricted weeds currently present on site are likely to fall in the "protection of assets" phase of the invasion curve. Species such as *Harrisia martinii* (Harrisia Cactus), *Opuntia tomentosa* (Velvet Pear) and *Parthenium hysterophorus* (Parthenium) are widespread and may have already reached the full potential extent of occurrence. Their low densities are probably maintained by poor soil fertility and water-holding capacity, as well as a variety of biological control agents introduced to suppress populations (**Section 5.6.3**). If this is the case, these weed species are unlikely to jeopardise the VCM's ability to achieve its objective of no net increase in weed density. Control efforts may not be warranted in such instances. If milestone monitoring indicates that these weeds continue to increase in density over time, control measures will be triggered to contain and reduce the existing infestations.

Other weeds that occur within (*Jatropha gossypiifolia*, Bellyache Bush) or near (*Opuntia stricta*, Prickly Pear and *Cryptostegia grandiflora*, Rubber Vine) the VCM's ML only occur in isolated populations that probably represent an early phase of establishment. In the case of Bellyache Bush, eradication of this weed from the ML is a desirable and achievable objective. For Prickly Pear and Rubber Vine, prevention of infestations within the ML is the objective.

The following measures are to be taken to limit the proliferation of weeds already present on site during construction, operational and rehabilitation phases of the VCM:

- Wherever practicable, construction activities should work from areas with fewer weed species and smaller infestations towards areas where there is a greater abundance of weeds;
- Weed spread should attempt to be minimised by implementing some control measures within the proposed works areas prior to construction;

- Control of weeds germinating on topsoil stockpiles should be prioritised, as weed contamination of this resource will have far-reaching implications once the topsoil is respread over rehabilitation areas.

### 5.5.2 New Infestations

The introduction and proliferation of novel weeds into the mining lease is the principle threat to achieving the success criteria of this Weed Management Plan. While prevention of introduction is the primary means of avoiding new infestations (see **Section 5.2**), successful removal of new infestations that do arise is fundamental and is contingent on the following:

- Timely detection through regular inspections of high-risk sites (see **Section 5.4.3**);
- The identification of new weeds will trigger the following process:

1. The area containing the infestation is to be isolated using hazard tape. No entry by unauthorised people or vehicles is permitted;
2. Identification of the weed is to be confirmed by sending a photograph of the plant using the Weed Spotter App (a Department of Agriculture and Fisheries tool), or a qualified ecologist. If identification cannot be confirmed via a photograph, a specimen should be collected, dried and submitted to the Queensland Herbarium;
3. If the weed is identified as a category 2 restricted matter under the *Biosecurity Act 2014*, it is to be reported to an authorized officer immediately;
4. Following confirmation of the weed's identity, an appropriate control method should be identified by consulting Queensland Government fact sheets (available at https://www.daf.qld.gov.au/business-priorities/biosecurity/invasive-plants-animals/fact-sheets), weed control practitioners, and/or the local Department of Agriculture and Fisheries service centre; and
5. Control methods should be implemented prior to the weed producing its first crop of seed.
6. The isolated area is to remain isolated until no new individuals have been detected following three consecutive heavy rain events (see **Section 5.4.3**).

## 5.6 Control Methods

Successful weed management generally depends on the utilisation of a suite of integrated control measures, including chemical treatments, physical removal and biological control. The preferred control method depends on the species of weed and the context (size and spread of the infestation, and location of nearby sensitive values). The optimal methods for each weed species that establishes within the VCM's ML is listed within the Queensland Government's weed fact sheets (available at https://www.daf.qld.gov.au/business-priorities/biosecurity/invasive-plants-animals/fact-sheets). A summary of the different types of control methods are provided below.

### 5.6.1 Physical Control

Physical control methods include hand removal, tilling, burning or smothering with mulch or black plastic sheeting. Physical control methods are general labour-intensive, but are highly effective and allow target treatment of small infestations without damage to surrounding native vegetation.

Physical control methods are generally the most appropriate for the treatment of newly established weeds (e.g., Bellyache Bush). Like all control measures, physical methods are best employed before the weed set seeds. If seed production is occurring at the time of control, collection and disposal of fruits/seeds should be undertaken to reduce the long-term weed burden.

### 5.6.2 Chemical Control

A wide range of herbicides are commercially available for the treatment of weeds. Herbicides may be broad-spectrum or selective (targeting certain groups of plants). Herbicides have different modes of action (contact, systemic or residual). Some are hormones or hormone-blockers that disrupt the plant's natural growth patterns. Others act to desiccate the leaves or stems, or to cause the plant to drop its leaves.

In general, the most suitable herbicide for use on weeds depends on the species of weed and whether there are sensitive environmental values (native plant species or waterways) nearby. For the preferred herbicides for each weed species, refer

to Queensland Government fact sheets (available at https://www.daf.qld.gov.au/business-priorities/biosecurity/invasive-plants-animals/fact-sheets).

By law, herbicides must be used in accordance with their label. It is recommended that they are also used only by trained professionals, with appropriate personal protective equipment and knowledge about each chemical's potential for harm.

Chemical control is best undertaken early in the growing season, when the weed is actively growing but not yet flowering or seeding.

### 5.6.3 Biological Control

Biological control agents (insects and diseases introduced to control weeds) exist for a number of weed species occurring in the Isaac region. The following weed species rarely reach troubling densities in Central Queensland as a result of their biological control agents:

- Woolly Tree Pear, *Opuntia tomentosa* (eaten by the moth *Cactoblastis cactorum* and cochineal bug, *Dactylopius opuntiae*);
- Prickly Pear, *Opuntia stricta* (eaten by the moth *Cactoblastis cactorum* and cochineal bug *Dactylopius opuntiae*); and
- Harrisia Cactus, *Harrisia martinii* (eaten by the beetle *Alcidion cereicola* and mealy bug *Hypogeococcus festerianus*).

Numerous insects and two fungal diseases have also been introduced to control Parthenium (*Parthenium hysterophorus*), but while these reduce the vigour and density of the weed, additional control methods are often required in certain situations. Likewise, the fungal disease *Maravalia cryptostegiae* and moth *Euclasta whalleyi* have been introduced to control Rubber Vine, *Cryptostegia grandiflora*. While these cause temporary defoliation and reduced seed set, adult vines are not killed.

No biological control agents currently exist for Bellyache Bush, *Jatropha gossypiifolia*.

Most biological agents that have been established for weeds are already widespread in Central Queensland and don't require active introduction.

### 5.6.4 Cultural Control

Certain weeds can be kept at low densities through agricultural practices. For example, many weeds proliferate in response to bare ground exposed by overgrazing, or in pastures that are grazed too soon following fire. By maintaining low cattle densities and vigorous pasture that outcompetes weeds, certain weeds such as Parthenium can be maintained at low densities. In situations of serious infestation, pasture spelling is essential for rehabilitation. This is best done in conjunction with chemical treatment with a selective herbicide, which can hasten the rehabilitation process by removing a generation of Parthenium seedlings and allowing grass seedlings to establish without competition.

## 5.7 Roles & Responsibilities

The roles and responsibilities of personnel are listed in **Table 6**.

*Table 6 Roles and responsibilities*

| Responsible person | Management Measure | Timing |
|---|---|---|
| Health, Safety, Environment and Community (HSEC) Superintendent | Oversee implementation of the Weed Management Plan | Throughout the construction, operational and rehabilitation phases |
| | Prepare and give inductions to new staff and contractors | Throughout the construction, operational and rehabilitation phases |
| | Inspect, or delegate a person to inspect, statutory declarations of weed wash-downs and approve entry to Zones C or D of any new vehicles | Throughout the construction, operational and rehabilitation phases |
| | Production and installation of weed posters in the tool box room | Prior to the start of the operational phase |

| Responsible person | Management Measure | Timing |
|---|---|---|
| | Organise and manage baseline and milestone monitoring surveys | At start of the construction phase, then every two years (during the wet season). |
| Environmental Officer | Undertake regular inspections of high-risk sites | 30 days after every heavy rain event |
| | Implement physical control methods of new weed infestations, as advised by the HSEC Superintendent | As advised by the HSEC Superintendent, following the detection of new weed infestations |
| | Oversee that any materials brought to site are sourced from a weed-free supplier | Throughout the construction and rehabilitation phases |
| | Isolating new weed infestations | Whenever inspections identify new weed infestations |
| | Requesting identification of new weeds | Whenever inspections reveal new weed infestations |
| | Report any category 2 restricted matter or prohibited matter to the authorities. | As soon as these matters are identified. |
| | Liaising with DAF and/or weed control professionals about appropriate control methods for new infestations | Whenever inspections reveal new weed infestation |
| | Oversee the revision of the Weed Management Plan | Throughout the construction, operational and rehabilitation phases |
| Contractor – ecologist/botanist/ weed specialist | Undertake baseline and milestone monitoring surveys and reporting | At start of the construction phase, then every two years (during the wet season). |
| Contractor – weed control specialist | Undertake chemical control of weeds | As advised by the HSEC Superintendent. |
| All staff and contractors | Vehicle wash-downs | Prior to entering Zone D |
| | Report any suspected new weed infestations to the HSEC Superintendent | Throughout the construction, operational and rehabilitation phases |

# 6 Reporting

The following are the reporting requirements of this Weed Management Plan:

1) Baseline and milestone monitoring survey reports: To be prepared every two years by the contractors undertaking the monitoring. These reports should include one map per weed species showing the boundaries of the weed density zones (or rehabilitation areas/domains, for rehabilitated sites). These reports should also present the results from each sampling transect, along with an overall weed density score for each weed species. These reports should also compare how the weed density scores have changed over time to assess whether the success criteria are being achieved. Copies of these reports are to be kept on file by the HSEC Superintendent.
2) Records of inspections: An excel file is to be maintained that records the date, time since heavy rain, name of the inspector, sites inspected and any weed sightings, for each weed inspection of high-risk sites.
3) Copies of weed declaration forms: Scanned copies of weed declaration forms completed for all vehicles arriving to the site (entering Zones C and/or D) are to be kept on file by the Vehicle Maintenance Department, alongside other vehicle onboarding documents.

# 7 Management Plan Revision

The following circumstances will trigger a revision of this Weed Management Plan:

- Milestone monitoring reveals a failure to achieve either of the success criteria listed in **Section 4.1**;
- There are revisions to the species listed under the *Biosecurity Act 2014*; and/or
- The Isaac Regional Council releases an update to their *Isaac Region Biosecurity Plan 2020-2023*.

The HSEC Superintendent will be responsible for instigating and managing the revision.

# 8 References

Department of Agriculture and Fisheries (2019a). *Queensland invasive plants and animals strategy 2019-2024*. Invasive Plants and Animals in Biosecurity Queensland, Department of Agriculture and Fisheries, Queensland Government, Brisbane.

Department of Agriculture and Fisheries (2019b) *Vehicle and Machinery Cleandown Procedures*. Biosecurity Queensland, part of the Department of Agriculture and Fisheries.

Department of Agriculture, Water and the Environment (DAWE) (2020) Species profile and threats database (*Geophaps scripta scripta*). Available at: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Isaac Regional Council (2020). *Isaac Region Biosecutiry Plan 2020-2023.* Current as at 3/2/2020. Available from: https://www.isaac.qld.gov.au/downloads/file/3112/isaac-region-biosecurity-plan-2020-2023

METServe (2020). Terrestrial Ecological Assessment for the Vulcan Complex Project. Report prepared for Vitrinite Pty Ltd by Mining and Energy Technical Services Pty Ltd, Brisbane.

METServe (2021). Preliminary Documentation for referral EPBC 2020/8676: Vulcan Complex Project. Report submitted to the Department of Agriculture, Water and the Environment in June 2021.

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*Appendix A* *Weeds recorded from within and surrounding the ML (METServe 2020)*

| Family | Scientific Name | Common Name | Percentage of secondary sites in each regional ecosystem containing the species | | | | |
|---|---|---|---|---|---|---|---|
| | | | 11.3.25 | 11.5.9 | 11.10.3 | 11.10.7 | Non-remnant |
| Aizoaceae | *Portulaca oleracea* | Common Purslane | 0 | 11 | 20 | 33 | 0 |
| Aizoaceae | *Portulaca pilosa* | Pink Purslane | 33 | 78 | 20 | 33 | 75 |
| Aizoaceae | *Trianthema portulacastrum* | Black Pigweed | 0 | 0 | 0 | 0 | 0 |
| Amaranthaceae | *Alternanthera pungens* | Khaki Weed | 0 | 0 | 0 | 0 | 0 |
| Amaranthaceae | *Amaranthus viridis* | Green Amaranth | 0 | 0 | 0 | 0 | 0 |
| Amaranthaceae | *Gomphrena celosioides* | Gomphrena Weed | 33 | 11 | 0 | 33 | 75 |
| Apocynaceae | *Cryptostegia grandiflora* | Rubber Vine | 33 | 0 | 0 | 0 | 0 |
| Asteraceae | *Acanthospermum hispidum* | Bristly Star Bur; Goat's Head | 100 | 33 | 0 | 0 | 25 |
| Asteraceae | *Ageratum conyzoides* | Billygoat Weed | 67 | 0 | 0 | 0 | 0 |
| Asteraceae | *Bidens bipinnata* | Bipinnate Cobbler's Pegs | 33 | 0 | 20 | 33 | 0 |
| Asteraceae | *Bidens pilosa* | Cobbler's Pegs | 67 | 11 | 0 | 33 | 0 |
| Asteraceae | *Eclipta prostrata* | False Daisy; Eclipta | 0 | 0 | 0 | 0 | 0 |
| Asteraceae | *Emilia sonchifolia* | Tassel Flower; Emilia | 67 | 22 | 0 | 0 | 0 |
| Asteraceae | *Parthenium hysterophorus* | Parthenium Weed | 100 | 11 | 0 | 0 | 25 |
| Asteraceae | *Sonchus oleraceus* | Common Sowthistle | 0 | 0 | 0 | 0 | 0 |
| Asteraceae | *Tridax procumbens* | Tridax Daisy | 33 | 0 | 0 | 0 | 0 |
| Asteraceae | *Verbesina encelioides* | Golden Crownbeard; Butter Daisy | 33 | 0 | 0 | 0 | 0 |
| Asteraceae | *Xanthium occidentale* | Noogoora Burr | 100 | 0 | 0 | 0 | 0 |
| Brassicaceae | *Cardamine hirsute* | Hairy Bittercress | 0 | 0 | 0 | 0 | 0 |
| Cactaceae | *Harrisia martini* | Harrisia Cactus | 0 | 11 | 20 | 0 | 0 |
| Cactaceae | *Opuntia stricta* | Prickly Pear | 0 | 0 | 0 | 0 | 0 |
| Cactaceae | *Opuntia tomentose* | Velvet Pear; Wooly Pear | 0 | 0 | 20 | 0 | 0 |
| Caesalpiniaceae | *Chamaecrista rotundifolia* | Round-leaf Senstive Pea | 0 | 0 | 0 | 33 | 0 |
| Caesalpiniaceae | *Senna occidentalis* | Coffee Senna | 100 | 0 | 0 | 0 | 0 |
| Cyperaceae | *Cyperus rotundus* | Purple Nutsedge | 0 | 0 | 0 | 0 | 0 |
| Euphorbiaceae | *Euphorbia hirta* | Asthma Weed | 33 | 0 | 0 | 0 | 0 |
| Euphorbiaceae | *Jatropha gossypiifolia* | Bellyache Bush | 0 | 0 | 0 | 0 | 0 |
| Fabaceae | *Crotalaria juncea* | Brown Hemp | 0 | 0 | 0 | 0 | 25 |
| Fabaceae | *Crotalaria pallida* | Smooth Rattlepod | 33 | 0 | 0 | 0 | 0 |
| Fabaceae | *Macroptilium atropurpureum* | Siratro | 33 | 0 | 0 | 0 | 25 |
| Fabaceae | *Stylosanthes hamata* | Caribbean Stylo | 67 | 33 | 0 | 0 | 50 |
| Fabaceae | *Stylosanthes humilis* | Townsville Stylo | 33 | 0 | 0 | 0 | 25 |
| Fabaceae | *Stylosanthes scabra* | Shrubby Stylo | 0 | 89 | 20 | 100 | 100 |
| Malvaceae | *Abutilon guineense* | Chinese Lantern | 33 | 0 | 0 | 0 | 25 |
| Malvaceae | *Malvastrum americanum* | Spiked Malvastrum | 0 | 0 | 0 | 0 | 0 |
| Malvaceae | *Malvastrum coromandelianum* | Prickly Malvastrum | 33 | 0 | 0 | 0 | 0 |
| Malvaceae | *Sida cordifolia* | Flannel Weed | 100 | 33 | 20 | 33 | 25 |
| Malvaceae | *Sida spinosa* | Spiny Sida | 33 | 22 | 20 | 100 | 100 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mimosaceae | *Leucaena leucocephala* | Leucaena | 0 | 0 | 0 | 0 | 0 |
| Olacaceae | *Ximenia americana* | Tallow Wood; Yellow Plum | 0 | 0 | 0 | 0 | 0 |
| Passifloraceae | *Passiflora foetida* | Stinking Passionflower | 33 | 0 | 0 | 0 | 0 |
| Plantaginaceae | *Scoparia dulcis* | Licorice Weed | 67 | 11 | 0 | 33 | 0 |
| Poaceae | *Bothriochloa pertusa* | Indian Couch | 100 | 44 | 0 | 33 | 100 |
| Poaceae | *Cenchrus ciliaris* | Buffel Grass | 100 | 33 | 20 | 67 | 100 |
| Poaceae | *Chloris barbata* | Purpletop Chloris | 0 | 0 | 0 | 0 | 25 |
| Poaceae | *Chloris virgata* | Feathertop Rhodes Grass | 67 | 0 | 0 | 0 | 0 |
| Poaceae | *Cynodon dactylon* | Bermuda Grass; Green Couch | 67 | 0 | 0 | 0 | 0 |
| Poaceae | *Digitaria eriantha* | | 100 | 11 | 0 | 33 | 50 |
| Poaceae | *Echinochloa colona* | Awnless Barnyard Grass | 67 | 0 | 0 | 0 | 0 |
| Poaceae | *Eleusine indica* | Indian Crowfoot Grass | 0 | 0 | 0 | 0 | 0 |
| Poaceae | *Eragrostis pilosa* | Soft Lovegrass | 0 | 0 | 0 | 0 | 0 |
| Poaceae | *Hymenachne amplexicaulis* | Olive Hymenachne | 0 | 0 | 0 | 0 | 0 |
| Poaceae | *Hyparrhenia rufa* | Thatch Grass | 0 | 0 | 0 | 0 | 0 |
| Poaceae | *Megathyrsus maximus* var. *maximus* | Guinea Grass | 0 | 0 | 0 | 0 | 0 |
| Poaceae | *Megathyrsus maximus* var. *pubiglumis* | Green Panic | 100 | 0 | 0 | 0 | 0 |
| Poaceae | *Melinis repens* | Red Natal Grass | 33 | 11 | 40 | 67 | 0 |
| Poaceae | *Urochloa mosambicensis* | Sabi Grass | 100 | 33 | 40 | 67 | 100 |
| Rubiaceae | *Richardia brasiliensis* | White Eye; Mexican Clover | 33 | 33 | 0 | 0 | 0 |
| Solanaceae | *Datura leichhardtii* | Thornapple | 33 | 0 | 0 | 0 | 0 |
| Verbenaceae | *Stachytarpheta jamaicensis* | Snake weed | 33 | 0 | 0 | 0 | 0 |
| Zygophyllaceae | *Tribulus terrestris* | Bullhead; Small Caltrop | 0 | 0 | 0 | 0 | 0 |