



Port of Brisbane Weed Surveys 2016

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Document Control Sheet

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<p>Synopsis: This report provides the results of the 2016 Annual Weed Monitoring conducted at the Port of Brisbane including baseline assessments of pilot sites.</p>		

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Executive Summary

Annual weed monitoring surveys have been conducted at the Port of Brisbane (PBPL) since 2001. The monitoring program aims to identify the introduction and spread of priority weed species on PBPL lands and to recommend management and control measures as required. Priority weeds are those listed by the Commonwealth Department of Agriculture and Water Resources (DAWR), declared species listed under Queensland's *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act) and environmental weeds listed by the Brisbane City Council. DAWR listed weed species are specifically targeted because of their potential to enter the country *via* containers and other materials shipped and unloaded at the PBPL.

The Commonwealth *Biosecurity Act 2015* came into effect on 16 June 2016 and the Queensland *Biosecurity Act 2014* will come into effect on 1 July 2016. Both Acts deal with pests, including weeds, and provide a risk based approach to pest management based on the likelihood and consequences of the risk. In light of the new pest legislation and based on best-practice land management, the Port's annual weed monitoring program was modified to provide rapid assessments to identify high risk weeds or major changes in weed composition and extent within existing monitoring sites, and to include new baseline assessments of high value habitats and high risk sites potentially vulnerable to weed invasion. This report provides the results for the 2016 weed monitoring program for existing survey sites at Lucinda Drain, Port Gate Drain, Port West Drain, T1-3, Car Precinct and the constructed lake and pilot sites of high environmental value and/or at high risk of weed invasion.

All weed species recorded on PBPL lands are well-established in the Brisbane region and throughout coastal south-east Queensland. No DAWR-listed species were recorded within or directly adjacent to the survey areas and none are likely to occur.

The dominant weed species recorded on PBPL lands included:

- Woody weeds: *Schinus terebinthifolius* which is common in disturbed terrestrial lands and at the upper tidal limit where it can invade saltmarsh communities.
- Vine cover: *Macroptilium atropurpureum* was the most widespread vine species recorded on PBPL lands and was recorded as low infestations (0<5% cover) to dense patches (50-90% cover) which can smother native vegetation.
- Ground cover: The highest weed species richness was recorded in the ground-layer, which is a reflection of the higher richness in groundcover species in the region. Generally high cover (50-90%) recorded in disturbed terrestrial sites and dominated by *Megathyrsus maximus* var. *maximus*, *Chloris gayana* and *Melinis repens*.

Weed invasion on PBPL lands is associated with site disturbance, or in habitats directly adjacent to disturbance, on terrestrial lands and at the limit of HAT. There is no weed invasion within habitats subject to regular tidal inundation. The marine weed species *Rhizophora mangle* has been recorded in Australia, but has not been observed in south-east Queensland and is therefore considered a low risk species. Despite the low risk, regular weed monitoring should be maintained to ensure this species, and potentially high risk taxa, do not establish in Port habitats.

Existing survey areas have remained relatively stable over the monitoring period (2001-2016). No new weed species or sites of significant weed incursion and spread were detected at these sites. Several sites of

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saltmarsh disturbance were recorded across PBPL lands. All sites have been subject to disturbance which has altered site hydrology and promoted weed invasion including the spread of *Phragmites*, an opportunistic native reed species that can invade degraded areas. The exotic shrub *Schinus terebinthifolius* also occurs on pockets of higher ground in the saltmarsh-mangrove ecotone. At some maintained sites the landward edge of the saltmarsh ecotone is also regularly slashed for ground maintenance which is promoting the spread of exotic grasses. Ground works and changing land maintenance practices at these sites could reinstate habitat conditions more suitable for native taxa including saltmarsh species.

The weed species recorded on PBPL lands are widespread in Brisbane and the south-east Queensland bioregion, and for that reason will be difficult to control and are unlikely to be eradicated from PBPL lands. Despite this, it is recommended that PBPL continue weed monitoring as outlined in this report, and control efforts to fulfil landholder obligations under Queensland's LP Act and Biosecurity Act. This includes monitoring the Port Drive corridor and sites of high value habitat, particularly saltmarsh which is vulnerable to disturbance associated with future intended land use. Ongoing management will also reduce potential future costs associated with delaying weed control, particularly the removal of mature woody shrubs and dense vine infestations. In addition, active weed control and habitat restoration in disturbed saltmarsh would improve the habitat condition of this locally restricted and nationally recognised habitat of high ecological value.

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1 Introduction

1.1 Background

Annual weed monitoring surveys have been conducted at the Port of Brisbane (PBPL) since 2001. The weed monitoring program aims to detect and assess the potential introduction and spread of priority weed species on PBPL lands and to recommend management and control measures as required. Priority weeds targeted in the surveys include plant species considered to be exotic or invasive, particularly those listed by the Commonwealth Department of Agriculture and Water Resources (DAWR), declared species listed under Queensland's *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act) and environmental weeds listed by the Brisbane City Council (BCC). DAWR listed weed species are specifically targeted because of their potential to enter the country via containers and other materials shipped and unloaded at the PBPL.

Surveys have been conducted at Lucinda Drain from 2001-2015, with surveys at Port Gate Drain commencing in 2007 (refer Figure 1-1). In 2013 Port West was included in the survey area due to the identification of pest species by stakeholders. In response to a potential weed incursion threat from imported vehicles, weed survey sites at the Car Precinct and T1-3 Overflow Area were included in the monitoring program in 2008. However, given regular maintenance of the Car Precinct and Overflow Areas the risk of weed invasion and spread is considered low in this area and monitoring was reduced to biennial assessments from 2014.

Based on the survey results to 2015, weed composition and distribution at the Port have remained relatively stable over the 15 year monitoring period. All weeds recorded in the survey sites are widespread in the Brisbane region. No DAWR listed species have been recorded and although approximately 27 new plant species arrive in south east Queensland each year, no new weed species to the region have been recorded on Port lands. Eight declared pests (listed as class 2 or 3 under the LP Act) have been recorded including: Broad-leaf Pepper Tree (*Schinus terebinthifolius*), Lantana (*Lantana camara*), Groundsel (*Baccharis halimifolia*), Prickly Pear (*Opuntia stricta*), Chinese Elm (*Celtis sinensis*), Camphor laurel (*Cinnamomum camphora*), Fireweed (*Senecio madagascariensis*) and Giant Parramatta Grass (*Sporobolus fertilis*). Several widespread environmental weeds listed by BCC have also been recorded in the survey sites. All weed species recorded at PBPL are widespread in degraded sites and coastal habitats of south-east Queensland.

1.2 Modifications to Monitoring Program Scope

The Commonwealth *Biosecurity Act 2015* came into effect on 16 June 2016 and the Queensland *Biosecurity Act 2014* will come into effect on 1 July 2016. Both Acts deal with pests, including weeds, and provide a risk based approach to pest management based on the likelihood and consequences of the risk. In light of the new pest legislation and based on best-practice land management, the Port's annual weed monitoring program was modified to provide rapid assessments to identify high risk weeds or major changes in weed composition and extent within existing monitoring sites, and to include new baseline assessments of high value habitats and high risk sites potentially vulnerable to weed invasion.

Introduction

Baseline assessments of new pilot sites focused on the road and rail corridors along Port Drive in order to track the spread and introduction of weeds between the Port and greater Brisbane more effectively (refer Figure 1-2). Freshwater pools and drainage lines across Port lands were also targeted as these habitats are likely to provide more conclusive data on the extent and composition of aquatic weeds, if any, at the Port compared with previous survey efforts which focus on tidal drainage lines which have comparatively low aquatic weed risk.

Most of the pest species recorded on PBPL lands are classed as environmental weeds which are plants that invade native ecosystems and may have significant environmental impacts such as effects on biodiversity and water quality. With the exception of remnant mangroves at Port West Drain (which have low susceptibility to high weed invasion given the saline conditions), current weed monitoring survey efforts at the Port focuses on disturbed habitats with limited ecological value. Therefore remnant freshwater wetlands and saltmarsh communities were also targeted in the pilot baseline assessments to determine the risk and extent of environmental weed invasion in environmentally significant habitats on Port lands.

1.3 Aims

Weed surveys were conducted in April 2016 at Lucinda Drain, Port Gate Drain, Port West Drain, T1-3, Car Precinct and the constructed lake and pilot sites of high environmental value and/or at high risk of weed invasion. The scope of works for the weed survey included the following:

- Record new species or high risk weed infestations at current monitoring sites
- Record the location of exotic invasive species at pilot sites
- Provide recommendations for strategic weed management at the Port.

This report provides the results for the 2016 weed monitoring program for Lucinda Drain, Port Gate Drain, Port West Drain, T1-3, Car Precinct and the constructed lake and pilot sites of high environmental value and/or at high risk of weed invasion.

2 Methodology

In accordance with previous monitoring surveys, weed inspections at existing monitoring sites were undertaken in the post-summer months in April (2016).

The survey was conducted by a BMT WBM botanist and an environmental scientist with extensive survey experience in the Port of Brisbane and coastal south-east Queensland habitats.

2.1 Targeted Weed Species

Species targeted in the survey included the following:

- Weeds listed by DAWR with the potential to invade south-east Queensland:
 - *Asystasia gangetica*
 - *Bassia scoparia*
 - *Chromolaena odorata*
 - *Cleome rutidosperma*
 - *Equisetum hyemale*
 - *Lagarosiphon major*
 - *Mikania micrantha*
 - *Mucuna pruriens*
 - *Myriophyllum spicatum*
 - *Nassella tenuissima*
 - *Striga asiatica*
- Declared Class 1, 2 and 3 species listed under the LP Act (refer Appendix A)
- Species listed by BCC as environmental pests.
- 'High risk' species assessed by Biosecurity Queensland (DAF) such as the potentially invasive mangrove *Rhizophora mangle*.

2.2 Techniques

The weed survey used the random meander technique for recording all exotic and invasive species within the survey sites. All surveys were conducted on-foot to ensure that extensive coverage of the survey sites was achieved. Incidental observations of targeted weed species outside the survey sites were also recorded. The locations of all observed target weed species were recorded on handheld GPS. Weed identification was undertaken on site. Samples of weed species unable to be identified *in situ* were pressed for later verification.

Methodology

2.3 Survey Sites

The extent of survey effort at existing survey sites and new pilot sites is shown in Figure 2-1

The weed survey along Lucinda Drain consisted of recording exotic and invasive species within a 15 m wide belt transect along the entire length of the drain's eastern bank. A visual inspection of the western bank was taken from the eastern bank.

The weed survey along Port West Drain consisted of recording exotic and invasive species within a 15 m wide belt transect along the entire length of the drain's eastern bank.

The weed survey along the southern section of the Port Gate Drain south of Howard Smith Drive consisted of recording exotic and invasive species within a 15 m wide transect along the entire length of the drain's eastern bank. A visual inspection of the western bank was performed from the eastern bank. The plant survey along the northern section of the Port Gate Drain consisted of recording exotic and invasive species within a 2 m wide transect that traversed the entire length of the drain's western bank. A visual inspection of the eastern bank was performed from the western bank.

The weed survey in the T1-3 Overflow area consisted of recording exotic and invasive species within a 2 m wide transect along the entire eastern, northern, western and southern boundaries of the hardstand area and along both banks of the constructed drain just north of the hardstand area.

The weed survey of the Car Precinct Area consisted of recording exotic and invasive species within the easement between the railway and the western boundary of the hardstand area and the banks of the lake adjacent to the previous Visitors Centre site.

All pilot sites were inspected on foot using the random meander technique.

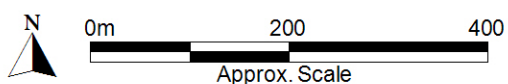


Title:
2016 Survey Coverage

Figure:
2-1

Rev:
A

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



Filepath : I:\B20259_I_BRH Port of Brisbane DLR\DRG\Weeds 2016\ECO_007_200616_2016 Weed Survey Locations.wor

Methodology

2.4 Survey Limitations

Whilst every effort has been made to identify targeted weed species in the PBPL survey sites, the detectability of plant species and the ability to accurately identify these in the field varies with seasonal and climatic conditions which influence the presence of reproductive features (flowers, fruits and seeds) which are useful, and in some cases essential, for species identification. Consequently, the survey conducted should not be regarded as conclusive that targeted weeds do not occur within the survey sites or surrounding lands.

3 Results

The following provides descriptions of weed composition and distribution recorded at the survey sites. Appendix B provides a summary of dominant weed species recorded on PBPL lands.

3.1 Lucinda Drain

3.1.1 Site Description

Lucinda Drain is a constructed channel located east of Lucinda Drive on the eastern edge of the Port. It provides drainage for stormwater run-off from hardstand areas to the north and discharges through the Lucinda Weir into Boat Passage.

The channel banks support planted and naturally recruited shrubs and trees comprised of a mix of local terrestrial species such as She-oaks (*Casuarina* spp.), Figs (*Ficus* spp.), Cotton tree (*Hibiscus tiliaceus*), *Melaleuca* spp. and *Macaranga tanarius*. Introduced shrubs are also widespread and the groundcover is dominated by exotic grasses (refer below). The tidal channel does not contain any extensive aquatic macrophytic cover but supports a low, discontinuous fringe of Grey mangrove (*Avicennia marina*) mangroves. The drain is periodically maintained and mangroves are actively removed to ensure the drain fulfils its primary purpose for stormwater run-off. Extensive mangroves and saltpan lie to the east of the drain associated with the intertidal flats of Boat Passage.

The western bank of the drain adjacent to Lucinda Drive undergoes regular maintenance involving mowing and weed spraying. Poor access along the eastern bank of Lucinda Drain limits regular maintenance but weeds are reportedly removed on an annual basis (RPS, 2013).

3.1.2 Weeds

The following observations were made in the 2016 survey:

- Lucinda Drain remains in a stable condition in terms of weed invasion.
- No DAWR-listed species were recorded within or directly adjacent to Lucinda Drain.
- The declared plants Prickly pear (*Opuntia stricta*) and Giant Rat's Tail Grass (*Sporobolus* sp.) listed as Class 2 under the LP Act were recorded in sparse patches.
- Class 3 declared species listed under the LP Act recorded included: Broad leaved Pepper Tree (*Schinus terebinthifolius*), Camphor laurel (*Cinnamomum camphora*) and Creeping Lantana (*Lantana montevidensis*).
- Exotic species recorded were dominated by environmental weeds well established across Brisbane including: *Opuntia stricta*, *Schinus terebinthifolius*, *Cinnamomum camphora*, *Lantana montevidensis*, Siratro (*Macroptilium atropurpureum*), Rhode's grass (*Chloris gayana*), Green panic (*Megathyrsus maximus* var. *maximus*), Brazilian nightshade (*Solanum seaforthianum*) and Blackberry nightshade (*Solanum nigrum*).

Results

- Consistent with previous surveys, the dominant woody weed recorded at Lucinda Drain was *Schinus terebinthifolius*.
- *Macroptilium atropurpureum* was the dominant vine cover recorded.
- The groundcover was dominated by mown exotic grasses including *Chloris gayana*, *Megathyrsus maximus* var. *maximus*, Red natal grass (*Melinis repens*) and Mossman River Grass (*Cenchrus echinatus*).
- No aquatic macrophyte weed species were recorded. The brackish to saline conditions of the channel limits the establishment of exotic macrophytes known from the region.
- Targeted weed control has removed the Easter Cassia (*Senna pendula* var. *glabrata*) from the channel and apart from this no significant differences in weed composition between the current and previous monitoring surveys were observed for Lucinda Drain.



Figure 3-1 Lucinda Drain 2016

3.2 Port West Drain

3.2.1 Site Description

Port West Drain, located west of Lytton Road approximately 4 km south-west of the Port, comprises a narrow intertidal channel fringed with remnant mangroves dominated by mature *Avicennia marina*. The channel is bounded to the west by extensive mangrove forest and cleared land for industrial purposes lie to the east. No scheduled maintenance work, including weed removal, is undertaken at Port West Drain (RPS, 2013).

3.2.2 Weeds

The following observations were made in the 2016 survey:

- No DAWR-listed species were recorded within or directly adjacent to Port West Drain
- *Baccharis halimifolia* and *Opuntia stricta* listed as Class 2 under the LP Act were recorded

Results

- Three Class 3 declared species were recorded including: *Schinus terebinthifolius*, *Lantana camara* and Madeira Vine (*Anredera cordifolia*)
- Exotic species recorded were dominated by environmental weeds well established across Brisbane including: Mile-a-minute (*Ipomoea cairica*), *Macroptilium atropurpureum*, *Chloris gayana*, *Megathyrsus maximus* var. *maximus*, Cobbler's Pegs (*Bidens pilosa*), Balloon Cotton Bush (*Gomphocarpus physocarpus*), *Melinis repens*, *Solanum nigrum*, *Conyza bonariensis*, *Macroptilium lathyroides*, *Anredera cordifolia*, *Asparagus aethiopicus* and *Asparagus africanus*.
- The dominant woody weeds recorded included *Schinus terebinthifolius*, *Baccharis halimifolia*, *Lantana camara* and Yellow Pea Bush (*Sesbania cannabina*). Other woody weeds included *Gomphocarpus physocarpus*, Phasey Bean (*Macroptilium lathyroides*), Castor Oil Plant (*Ricinus communis*), Coral Berry (*Rivinia humilis*), *Senna pendula* var. *glabrata*, Giant Devil's Fig (*Solanum chrysotrichum*), Wild Tobacco (*Solanum mauritianum*) and *Solanum nigrum*.
- The groundcover was dominated by *Megathyrsus maximus* var. *maximus*, *Chloris gayana*, *Melinis repens*, Johnson's Grass (*Sorghum halepense*) and Vasey Grass (*Paspalum urvillei*).
- Dominant vines included *Ipomoea cairica*, *Macroptilium atropurpureum* and White Passionflower (*Passiflora alba*). Sparse *Anredera cordifolia* was also recorded.
- Common herbs and forbs included *Bidens pilosa*, Lance leaved Rattlepod (*Crotalaria pallida*), Gomphrena Weed (*Gomphrena celosioides*), *Sida* sp. and Purple-top (*Verbena bonariensis*).
- No aquatic macrophyte weed species were recorded and none are likely to occur given the brackish to saline conditions of the waterways.
- With the exception of sparse *Anredera cordifolia* no significant differences in weed composition between the current and previous monitoring surveys were observed for Port West Drain.



Figure 3-2 Port West Drain 2016

Results

3.3 Port Gate Drain

3.3.1 Site Description

Port Gate Drain located in the south-west section of the PBPL lies to the south of Boat Passage in the vicinity of Howard Smith Drive. It collects stormwater run-off from the adjacent hardstand areas and drains into (and partially receives) the tidal waters in Boat Passage. The banks of the drain are constructed of concrete, gravel and/or compacted earth, which limits extensive vegetation growth. The tidal reaches of the drain support sparse fringing *Avicennia marina* seedlings, with a sparse groundcover of Common Reed (*Phragmites australis*), River club rush (*Schoenoplectus validus*) and *Fimbristylis* sp. Outside the tidal zone the banks support a sparse groundcover of exotic grasses and shrubs. It is understood that Port Gate Drain undergoes regular maintenance (including mowing and spraying for exotic species) which is facilitated by the PBPL (RPS, 2013).

3.3.2 Weeds

The following observations were made in the 2016 survey:

- No DAWR-listed species were recorded within or directly adjacent to Port West Drain
- *Baccharis halimifolia* listed as Class 2 under the LP Act was recorded
- Two Class 3 declared species were recorded including: *Schinus terebinthifolius* and *Lantana camara*
- Exotic species recorded were dominated by environmental weeds well established across Brisbane including: *Ipomoea cairica*, *Macroptilium atropurpureum*, *Chloris gayana*, *Megathyrsus maximus* var. *maximus*, *Bidens pilosa*, *Gomphocarpus physocarpus*, *Melinis repens*, *Solanum nigrum*, *Conyza bonariensis*, *Leucaena* (*Leucaena leucocephala*), *Passiflora foetida* and *Macroptilium lathyroides*.
- The dominant woody weeds recorded included *Schinus terebinthifolius*, *Baccharis halimifolia*, *Lantana camara* and *Sesbania cannabina*. Other woody weeds included *Cinnamomum camphora*, *Gomphocarpus physocarpus*, *Leucaena leucocephala*, *Solanum chrysotrichum* and *Solanum nigrum*.
- The groundcover was dominated by *Megathyrsus maximus* var. *maximus*, *Chloris gayana*, *Melinis repens*, *Sorghum halepense*, *Cenchrus echinatus* and *Paspalum* spp..
- Dominant vines included *Ipomoea cairica*, *Macroptilium atropurpureum*, *Vigna* sp. and Stinking Passionflower (*Passiflora foetida*).
- Common herbs and forbs included *Bidens pilosa*, *Capsella* sp., *Conyza bonariensis*, *Gomphrena celosioides*, *Sida cordifolia*, Singapore Daisy (*Sphagneticola trilobata*) and *Tridax* (*Tridax procumbens*).
- No aquatic macrophyte weed species were recorded and none are likely to occur given the brackish to saline conditions of the waterways.
- No significant differences in weed composition between the current and previous monitoring surveys were observed at Port Gate Drain.



Figure 3-3 Port Gate Drain 2016

Results

3.4 T1-3, Car Precinct and Constructed Lakes

3.4.1 Site Description

The T1-3 and Car Precinct areas east of Port Drive at the Port of Brisbane store imported vehicles and as such are potential vectors for newly introduced weed species.

The T1-3 survey area extends around the car parking hardstand and includes a constructed drain to the north. The survey area consists predominantly of regularly maintained lawn which receives stormwater overflow from the hardstand. Landscaped garden beds front Port Drive. The constructed drain in the northern section consists of a concrete channel which is designed to pipe stormwater runoff into the Brisbane River.

The Car Precinct survey area lies to the south and west of the hardstand vehicle storage area. The survey area consists predominantly of regularly maintained lawn which receives stormwater overflow from the hardstand.

The T1-3 and Car Precinct sites are separated by the Queensland Rail freight line and a cleared and regularly mowed easement. Constructed lakes lie south of the Car Precinct.

It is evident that the T1-3, Car Precinct, railway easement and lands surrounding the lakes undergo regular maintenance including mowing, and RPS (2013) reports that these areas are regularly sprayed for weeds.

3.4.2 Weeds

The following observations were made in the 2016 survey:

- No DAWR-listed species were recorded within or directly adjacent to the survey area
- Three Class 2 declared species (LP Act) were recorded including: *Baccharis halimifolia*, Fireweed (*Senecio madagascariensis*) and Common Ragweed (*Ambrosia artemisiifolia*).
- Two Class 3 declared species (LP Act) were recorded including: *Schinus terebinthifolius* and *Lantana camara*
- Exotic species recorded were dominated by environmental weeds well established across Brisbane including: *Senecio madagascariensis*, *Schinus terebinthifolius*, *Lantana camara*, *Ipomoea cairica*, *Ricinus communis*, *Macroptilium atropurpureum*, *Cenchrus echinatus*, *Megathyrsus maximus* var. *maximus*, *Solanum nigrum*.
- Dominant woody weeds included *Schinus terebinthifolius*, *Baccharis halimifolia*, *Ricinus communis*, *Senecio madagascariensis*, *Lantana camara*, *Solanum nigrum* and *Sesbania cannabina*.
- Dominant vines recorded included *Ipomoea cairica*, *Ipomoea alba* and *Macroptilium atropurpureum*.
- The sparse groundcover was regularly mowed. The most widespread groundcovers were *Megathyrsus maximus* var. *maximus*, *Cenchrus echinatus*, *Melinis repens*, *Chloris gayana*, *Digitaria ciliaris*, *Paspalum urvillei* and *Setaria pumila*.

Results

- Common herbs and forbs included *Ageratum houstonianum*, *Bidens pilosa*, *Crassocephalum crepidioides*, *Eclipta prostrata*, *Gomphrena celosioides*, *Lantana montevidensis*, *Conyza bonariensis*, *Hypochaeris radicata*, *Oenothera drummondii*, *Tridax procumbens* and *Verbena bonariensis*.
- Aquatic macrophytes recorded on the lakes edge included Umbrella sedge (*Cyperus involucratus*) and *Ludwigia* spp..
- No significant differences in weed composition between the current and previous monitoring surveys were observed at these sites.



Figure 3-4 T1-3, Car Precinct and Constructed Lakes

Results

3.5 Pilot Sites

To provide broader coverage of weed condition and threats across PBPL lands, baseline assessments of high value habitats and high risk sites potentially vulnerable to weed invasion were carried out. The assessments focused on the road and rail corridors along Port Drive in order to more effectively track the spread and introduction of weeds, particularly DAWR-listed taxa, between the Port and greater Brisbane. In addition, remnant wetlands of high ecological value within this corridor, and at Port West and Pinkenba, were targeted to assess the risk and extent of environmental weed invasion in environmentally significant habitats on Port lands.

Coastal saltmarsh was targeted in the surveys as it is a locally restricted habitat type on PBPL lands, and is listed as a vulnerable community under the *Environment Protection and Biodiversity Conservation Act 1999*. Saltmarsh communities are sensitive to hydrological changes, and typically occur at the terrestrial fringe adjacent to developed land uses which provide a source of potential disturbance and weed invasion. In addition, where the tide has been excluded from saltmarsh habitats for extended periods, saltmarsh vegetation will eventually change to either freshwater or terrestrial communities often dominated by opportunistic weed species, such as *Phragmites australis*¹.

Weed invasion on PBPL lands was found to be associated with site disturbance, or in habitats directly adjacent to disturbance, on terrestrial lands and at the limit of highest astronomical tide (HAT). There was no weed invasion within habitats subject to regular tidal inundation. The marine weed species American mangrove (*Rhizophora mangle*) has been recorded in Australia, but has not been observed in south-east Queensland, and is therefore considered a low risk species.

Pilot sites surveyed included (refer Figure 1-2):

- Bird hide, Lucinda Drive
- Saltmarsh, Fisherman's Island
- Freshwater and intertidal wetlands, Port Drive
- Port Drive road reserve
- Saltmarsh, Port West
- Saltmarsh, Pinkenba
- Saltmarsh, Fort Lytton.

3.5.1 Bird hide and Fisherman Islands

The bird hide adjacent to Lucinda Drive is located within intertidal flats supporting a mix of mangroves, saltmarsh and mudflats which provide important habitat for a mix of migratory waders. These intertidal conditions prohibit the establishment of most introduced weed taxa which are restricted to filled lands above HAT. These terrestrial grasslands are regularly mown and support a range of grass and herbaceous environmental weeds widespread throughout the region. Similarly, weed invasion on Fisherman Islands is restricted to disturbed and filled land adjacent to the

¹ Whilst a native species, *Phragmites australis* can act as a weed in disturbed saltmarsh and can be an indicator that hydrological and salinity changes have occurred in saltmarsh habitat.

Results

Lucinda Drain, with weed invasion being a very low risk to regularly inundated tidal lands. As described above, whilst these high value intertidal habitats may be vulnerable to *Rhizophora mangle* invasion this risk is low. Overall the risk of weed invasion and associated habitat degradation within habitats of environmental value in the northern sector of the Port is considered low.

3.5.2 Freshwater and Intertidal Wetlands, Port Drive

Port lands south of Boat Passage and east of Port Drive support a mix of freshwater and intertidal wetlands of high habitat value which are prone to varying levels of weed invasion.

Whilst the majority of the saltmarsh in this area remains in good condition, several sites are being impacted by weed invasion as a result of past and current land use practices. These sites could be rehabilitated through active restoration of saltmarsh and changing land use practices. Such activities could potentially contribute to an offsets package for proposed marine plant removal and impacts on Coastal Saltmarsh (listed as a Vulnerable community under the EPBC Act) for Port associated activities. Figure 3-5 shows the approximate distribution of disturbed saltmarsh which may benefit from weed control and rehabilitation as discussed in the following section.

Freshwater wetlands east of Port Drive support remnant *Melaleuca* dominated communities which are poorly represented on Port lands. Given their proximity to the rail and road corridors these wetlands are susceptible to weed invasion and were targeted in the surveys.

3.5.2.1 Filled Intertidal Land

Approximately 1.0 ha of previous intertidal and low-lying land east of Port Drive has been partially filled and excluded from tidal inundation (refer Figure 3-5). Whilst a small area of saltmarsh and *Phragmites* reedland remains (approximately 0.5 ha), the altered hydrology and topography has favoured regrowth dominated by terrestrial weed species.

The degraded grassland at this site is dominated by exotic groundcovers including *Megathyrsus maximus* var. *maximus*, *Cenchrus echinatus*, *Melinis repens*, *Chloris gayana*, *Digitaria ciliaris*, *Paspalum* spp., *Pennisetum purpureum* and *Cortaderia selloana*. Patches of *Phragmites australis* also occur in lower lying depressions influenced by freshwater inundation. Whilst this is a native species, *Phragmites australis* can invade disturbed saltmarsh which has reduced tidal inundation and salinity and was also observed invading some intact saltmarsh fringes across this site.

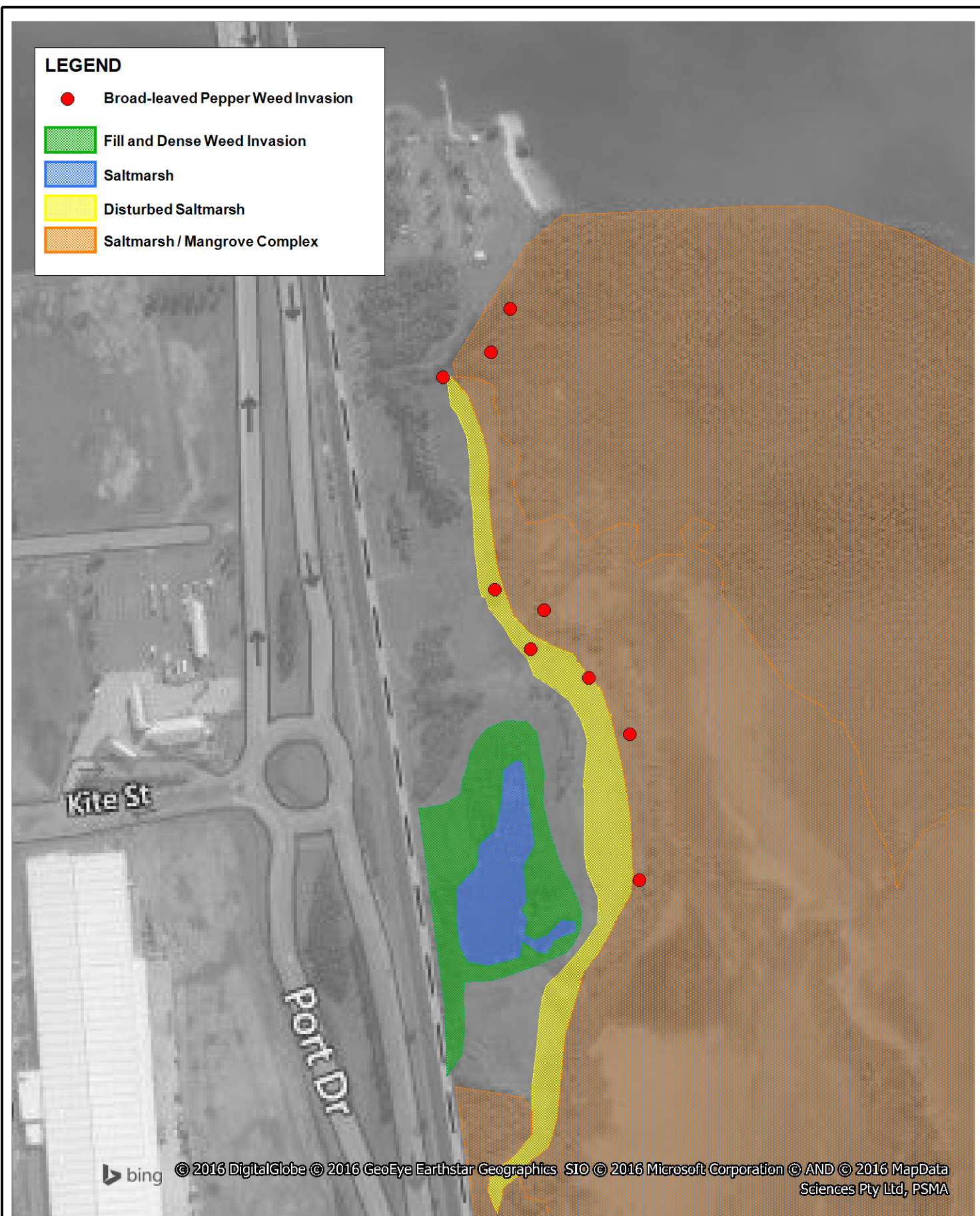
The exotic shrub *Schinus terebinthifolius* occurs as scattered individuals to dense thickets in this area depending on the level of inundation. Other shrubs that occur in this filled and disturbed land include *Stylosanthes scabra*, *Opuntia stricta*, and *Solanum chrysotrichum*. Sparse vines recorded included *Ipomoea cairica* and *Macroptilium atropurpureum*.

All weed species recorded at this disturbed site are widespread across PBPL lands and are well-established in the Brisbane region and throughout coastal south-east Queensland. No DAWR-listed species were recorded within or directly adjacent to this survey area and none are likely to occur. These weed-dominated habitats are likely to provide limited value for local fauna and estuarine species associated with the adjacent intertidal complex. In addition, these degraded

Results

habitats are replacing native communities, including coastal saltmarsh. Coastal saltmarsh could re-establish at this site through the re-establishment of hydrological conditions.

To enhance saltmarsh and reduce weed invasion in this area the ground level could be re-contoured to reinstate tidal inundation within the range suitable for saltmarsh establishment. Some level of variation in topography would need to be maintained during re-profiling to increase habitat diversity and to ensure excessive ponding does not occur. As the proposed works will disturb the ground profile, PASS assessments and mitigation measures would be required prior to any on-ground works. Natural recruitment is the preferred and most cost-effective method of revegetating re-profiled intertidal sites. However, active planting could be carried out to supplement natural regeneration and to fast-track the recovery process, if natural colonisation is slow.



Title:
2016 Weed Monitoring - Port Drive North Pilot Site

Figure:
3-5

Rev:
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BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



Filepath : I:\B20259_I_BRH Port of Brisbane DLR\DRG\Weeds 2016\ECO_004_200616_Port Drive North.wor

Results



Figure 3-6 Filled Intertidal Land

3.5.2.2 Saltmarsh Ecotone

An extensive mosaic of mangroves and saltmarsh occurs east of Port Drive. Whilst the mangroves are not prone to weeds due to regular tidal inundation, the saltmarsh-mangrove ecotone and the upper tidal limit are susceptible to disturbance and weed invasion.

The exotic shrub *Schinus terebinthifolius* occurs on pockets of higher ground in the saltmarsh-mangrove ecotone and is generally associated with a groundcover of *Megathyrsus maximus* var. *maximus*. *Phragmites australis* also forms sparse to localised patches at the upper tidal limit of the saltmarsh. As discussed above, whilst *Phragmites* naturally occurs at the freshwater-saline interface, it can spread rapidly to form extensive stands in saltmarsh and can alter the hydrology, sedimentation, ecology and function of the saltmarsh community with flow on effects to adjacent intertidal habitat.

The landward edge of the saltmarsh at this site ecotone is also regularly slashed for ground maintenance which is removing succulent saltmarsh species, altering local topography and promoting the spread of exotic grasses into saltmarsh habitat.

All weed species recorded at this disturbed site are widespread across PBPL lands and are well-established in the Brisbane region and throughout coastal south-east Queensland. No DAWR-listed species were recorded within or directly adjacent to this survey area and none are likely to occur. However, the weed invasions at the mangrove-saltmarsh interface and at the upper saltmarsh limits are reducing the overall condition of these communities and are providing local sources of weed spread. The regular slashing is also reducing the condition of coastal saltmarsh and promotes habitat conditions more suitable for weed invasion.

It is recommended that *Schinus* at the upper tidal limit are removed to reduce the source of local seed propagules and the local terrain is re-profiled to the range of saltmarsh and mangrove habitat. In addition, regular slashing for site maintenance should be restricted to the area of terrestrial grasses only with a minimum 10 m buffer provided to saltmarsh habitat.



Figure 3-7 Estuarine Ecotone 2016

Results

3.5.2.3 Freshwater Wetlands

The eastern corridor of Port Drive also supports approximately 9 ha of broad-leaved paperbark wetlands of variable condition. The weedy shrublayer comprised sparse to dense patches of *Schinus terebinthifolius*, *Lantana camara*, *Baccharis halimifolia*, *Solanum mauritianum*, *Schefflera actinophylla*, *Phoenix* sp., *Ligustrum sinense*, *Celtis sinense*, *Cinnamomum camphora* and *Senna pendula* var. *glabrata*. The dominant weedy vines included *Araujia sericifera*, *Cardiospermum grandiflorum*, *Passiflora* spp. and *Anredera cordifolia*. Sparse exotic groundcovers restricted to disturbed woodlands at the edge of the road reserve included *Melinis repens*, *Megathyrsus maximus* var. *maximus*, *Cortaderia selloana*, *Melinis minutiflora* and *Andropogon virginicus*.

Despite the high diversity of weeds recorded within these wetlands, the exotic species are widespread in coastal wetlands of south-east Queensland, are restricted to the edge of these wetlands typically within 20 m of the road reserve and are not compromising the condition or value of the *Melaleuca* habitats.



Figure 3-8 Freshwater Wetlands 2016

3.5.2.4 Road / Rail Reserve

The Port Drive road and rail reserve outside the estuarine and freshwater wetlands described above comprised cleared land supporting maintained grasslands and regrowth dominated by exotics and mixed *Acacia* spp.

The groundlayer was dominated by *Megathyrsus maximus* var. *maximus*, *Chloris gayana* and *Melinis repens*. Other groundcovers included *Melinis minutiflora*, *Andropogon virginicus*, *Sorghum halepense*, *Setaria sphacelata*, *Cynodon dactylon*, *Paspalum dilatatum*, *Sporobolus* sp., *Bidens pilosa*, *Ageratum houstonianum* and *Verbena bonariensis*. The dominant vine was *Macroptilium atropurpureum*. Woody weeds included *Lantana camara*, *Baccharis halimifolia*, *Celtis sinense*, *Leucaena leucocephala*, *Ricinus communis*, *Solanum chrysotrichum* and *Solanum mauritianum*.

All weed species recorded at this disturbed site are widespread across PBPL lands and are well-established in the Brisbane region and throughout coastal south-east Queensland. No DAWR-listed species were recorded within or directly adjacent to this survey area and none are likely to occur.



Figure 3-9 Port Drive Road and Rail Reserve

3.5.3 Port West Estuarine Wetlands

Port West supports an extensive mosaic of mangroves and saltmarsh directly connected to the Brisbane River. Similar to other sites at the Port, the saltmarsh-mangrove ecotone and upper tidal limits, which lie adjacent to industrial land uses, are susceptible to disturbance and weed invasion.

The western landward fringe of closed mangrove forest comprises evenly aged *Avicennia marina* over a dense saltmarsh shrublayer comprising *Sporobolus virginicus*, *Sesuvium portulacastrum* and *Enchaelaena stricta*. Very sparse weed invasion was recorded under this dense mangrove canopy and comprised mainly isolated *Asparagus aethiopicus* and *Opuntia stricta*. The even aged *Avicennia* structure, dense saltmarsh understory and presence of weeds in this mangrove zone suggest this area is subject to infrequent tidal inundation.



Figure 3-10 Port West Pilot Sites 2016

Results

Locally elevated sites within saltmarsh landward of the mangrove fringe supported sparse *Schinus terebinthifolius* over a groundcover of *Megathyrsus maximus* var. *maximus* and *Chloris gayana*. More landward sites also supported *Senna pendula* var. *glabrata*, *Baccharis halimifolia*, *Sesbania cannabina*, *Ricinus communis*, *Opuntia stricta* and *Asparagus* spp.. Some *Phragmites* invasion was also occurring at the landward edge of disturbed saltmarsh subject to freshwater ponding.

All weed species recorded within the saltmarsh-mangrove interface at Port West are widespread across PBPL lands and are well-established in the Brisbane region and throughout coastal south-east Queensland. No DAWR-listed species were recorded within or directly adjacent to this survey area and none are likely to occur.

3.5.4 Pinkenba Saltmarsh

The Pinkenba site supports an extensive mosaic of mangroves on the western banks of the Brisbane River. Similar to other sites at the Port, the saltmarsh-mangrove ecotone and upper tidal limits, which lie directly adjacent to industrial land uses, have been impacted by land disturbance and weed invasion. The landward extent of saltmarsh is bounded by rank grassland dominated by *Chloris gayana*, *Melinis repens* and *Megathyrsus maximus* var. *maximus* with a shrublayer of *Schinus terebinthifolius*, *Tagetes minuta*, *Opuntia stricta* and *Gymnocarpus physocarpus*. Some *Phragmites* invasion was also occurring at the landward edge of disturbed saltmarsh.

All weed species recorded at this disturbed site are widespread across PBPL lands and are well-established in the Brisbane region and throughout coastal south-east Queensland. No DAWR-listed species were recorded within or directly adjacent to this survey area and none are likely to occur.



Figure 3-11 Pinkenba Wetlands 2016

Results

3.5.5 Fort Lytton Estuarine Wetlands

In 2015, BMT WBM provided an assessment of a potential habitat improvement area at Fort Lytton on the eastern banks of the Brisbane River. That assessment identified approximately 0.35ha of previously intertidal land at the ecotone between the mangroves and saltmarsh that had been filled and promoted weed invasion. Dominant woody weeds included *Leucaena leucocephala*, *Schinus terebinthifolius*, *Celtis sinense*, *Phoenix* sp., *Lantana camara*, *Phytolacca octandra*, *Solanum nigrum*, *Opuntia stricta*, *Ricinus communis* and *Solanum mauritianum*. Dominant exotic groundcovers included *Chloris gayana*, *Megathryus maximum* and *Sorghum halepense*. Other weeds recorded included *Ageratum houstonianum*, *Passiflora foetida* and *Sida* spp.. The placement of fill has also reduced tidal flow to approximately 0.06ha of saltmarsh which has promoted *Phragmites* invasion.

All weed species recorded at this site are widespread across PBPL lands and are well-established in the Brisbane region and throughout coastal south-east Queensland. No DAWR-listed species were recorded within or directly adjacent to this survey area and none are likely to occur.



Figure 3-12 Fort Lytton 2015

4 Discussion

In terms of weed composition and distribution, the existing survey sites have remained relatively stable over the monitoring period (2001-2016) and no new weed species, or new outbreaks of weed invasion, were recorded in the current survey.

The road and rail corridor adjacent to Port Drive is a potential vector for newly imported species arriving at the Port. However, all weeds recorded within this corridor are widespread throughout south east Queensland and no newly introduced or high risk species were identified. In addition, despite the high diversity of weeds recorded within freshwater wetlands east of Port Drive, the exotic species are widespread in coastal wetlands of south-east Queensland, are restricted to the edge of these wetlands typically within 20 m of the road reserve, and are not compromising the condition or value of the *Melaleuca* habitats.

Several sites of saltmarsh disturbance were recorded across PBPL lands at the Port Drive, Port West, Pinkenba and Fort Lytton pilot sites. All sites have been subject to disturbance which has altered site hydrology and promoted weed invasion including the spread of *Phragmites australis*. The exotic shrub *Schinus terebinthifolius* also occurs on pockets of higher ground in the saltmarsh-mangrove ecotone and is generally associated with a groundcover of *Megathyrsus maximus* var. *maximus*. At the Port Drive and Fort Lytton sites the landward edge of the saltmarsh ecotone is also regularly slashed for ground maintenance which is removing succulent saltmarsh species, altering local topography and promoting the spread of exotic grasses into saltmarsh habitat.

Weed removal and re-contouring the ground level at sites compatible with intended future landuse could be carried out in disturbed intertidal areas to reinstate tidal inundation within the range suitable for saltmarsh, or near-tidal wetland, establishment. Some level of variation in topography should be maintained during re-profiling to increase habitat diversity and to ensure excessive ponding does not occur. As the proposed works will disturb the ground profile, PASS assessments and mitigation measures will be required prior to any on-ground works. Natural recruitment is the preferred and most cost-effective method of revegetating re-profiled intertidal sites. However, active planting could be carried out to supplement natural regeneration and to fast-track the recovery process, particularly if the aim is to promote native freshwater or terrestrial taxa.

Whilst the sites of saltmarsh disturbance recorded across Port lands are not extensive and occur in disjunct patches, this habitat type is restricted on Port lands due to land development at the terrestrial ecotone. In addition, saltmarsh communities have lost 64% of their 1955 extent within Moreton Bay (Queensland Herbarium, 2016) and Coastal Saltmarsh is listed as a Vulnerable community under the EPBC Act. Restoration activities could potentially contribute to an offsets package for proposed marine plant removal and impacts on Port associated activities.

It is recommended that future annual surveys are carried out at the same sites and in accordance with the rapid biological assessment methodologies described in this report.

Conclusion

5 Conclusion

All weed species recorded on PBPL lands are well-established in the Brisbane region and throughout coastal south-east Queensland. No DAWR-listed species were recorded within or directly adjacent to the survey areas and none are likely to occur.

The dominant weed species recorded on PBPL lands included:

- Woody weeds: *Schinus terebinthifolius* which is common in disturbed terrestrial lands and at the upper tidal limit where it can invade saltmarsh communities.
- Vine cover: *Macropitium atropurpureum* was the most widespread vine species recorded on PBPL lands and was recorded as low infestations (0<5% cover) to dense patches (50-90% cover) which can smother native vegetation.
- Ground cover: The highest weed species diversity was recorded in the groundlayer, which is a reflection of the higher richness in groundcover species in the region. Generally high cover (50-90%) recorded in disturbed terrestrial sites and dominated by *Megathyrsus maximus* var. *maximus*, *Chloris gayana* and *Melinis repens*.

Weed invasion on PBPL lands is associated with site disturbance, or in habitats directly adjacent to disturbance, on terrestrial lands and at the limit of HAT. There is no weed invasion within habitats subject to regular tidal inundation. The marine weed species *Rhizophora mangle* has been recorded in Australia, but has not been observed in south-east Queensland, and is considered a low risk species. Despite the low risk, regular weed monitoring should be maintained to ensure this species, and potential high risk taxa, do not establish in Port habitats.

Existing survey areas have remained relatively stable over the monitoring period (2001-2016). No new weed species or sites of significant weed incursion and spread were detected at these sites. Several sites of saltmarsh disturbance were recorded across PBPL lands. All sites have been subject to disturbance which has altered site hydrology and promoted weed invasion including the spread of *Phragmites*. The exotic shrub *Schinus terebinthifolius* also occurs on pockets of higher ground in the saltmarsh-mangrove ecotone. At some maintained sites the landward edge of the saltmarsh ecotone is also regularly slashed for ground maintenance which is promoting the spread of exotic grasses. Ground works and changing land maintenance practices at these sites could reinstate habitat conditions more suitable for native taxa including saltmarsh species.

The weed species recorded on PBPL lands are widespread in Brisbane and the south-east Queensland bioregion, and for that reason will be difficult to control and are unlikely to be eradicated from PBPL lands. Despite this, it is recommended that PBPL continue weed control efforts to fulfil landholder obligations under Queensland's LP Act and Biosecurity Act. This includes monitoring the Port Drive corridor and sites of high value habitat, particularly saltmarsh which is vulnerable to disturbance associated with land use. Ongoing management will also reduce potential future costs associated with delaying weed control, particularly the removal of mature woody shrubs and dense vine infestations. In addition, active weed control and habitat restoration in disturbed saltmarsh would improve the habitat condition of this locally restricted and nationally recognised habitat of high ecological value.

6 References

BCC (2013). Brisbane Invasive Species Management Plan 2013-17. Prepared by the Brisbane City Council, February 2013.

BMT WBM (2014). Port of Brisbane Annual Weed Survey – 2014. Report prepared for PBPL.

BMT WBM (2015). Port of Brisbane Annual Weed Survey – 2015. Report prepared for PBPL.

Brisbane City Council (2014). Weed Classification. <http://weeds.brisbane.qld.gov.au/weed-classification>, accessed August, 2014.

Queensland Herbarium (2016). Intertidal Communities of Moreton Bay. Change in Extent 1955-1997-2012 Mangrove and Associated Communities of Moreton Bay Queensland Australia.

RPS Australia East Pty Ltd (2013). Annual Plant Assessment Port of Brisbane. Report Prepared for the Port of Brisbane, July 2013.

Appendix A DAF Target Weeds

Class 1 pests listed under Schedule 2 *Land Protection (Pest and Stock Route Management) Regulation 2003* (current as at 1 July 2015) are listed below. All sightings of Class 1 pests must be reported to Biosecurity Queensland.

Class 1 Weeds	
7 Acacias non-indigenous to Australia (<i>Acaciella</i> spp., <i>Mariosousa</i> spp., <i>Senegalia</i> spp. (other than <i>Senegalia albizoides</i>)	8 Limnocharis or yellow burhead (<i>Limnocharis flava</i>)
9 Acacia spp. (syn. <i>Vachellia</i> spp.) other than <i>Acacia nilotica</i> and <i>Acacia farnesiana</i>	10 Madras thorn (<i>Pithecellobium dulce</i>)
11 Alligator weed (<i>Alternanthera philoxeroides</i>)	12 Mesquites (all <i>Prosopis</i> spp. and hybrids other than <i>Prosopis glandulosa</i> , <i>Prosopis pallida</i> and <i>Prosopis velutina</i>)
13 Anchored water hyacinth (<i>Eichhornia azurea</i>)	14 Mexican bean tree (all <i>Cecropia</i> spp.)
15 Badhara bush (<i>Gmelina elliptica</i>)	16 Mexican feather grass (<i>Nassella tenuissima</i>)
17 Bitou bush (<i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i>)	18 Miconia (<i>Miconia</i> spp.)
19 Bridal creeper (<i>Asparagus asparagoides</i>)	20 Mikania vine (<i>Mikania</i> spp.)
21 Candleberry myrtle (<i>Myrica faya</i>)	22 Mimosa pigra (<i>Mimosa pigra</i>)
23 Chilean needle grass (<i>Nassella neesiana</i>)	24 Peruvian primrose bush (<i>Ludwigia peruviana</i>)
25 Cholla cactus (<i>Cylindropuntia</i> spp. and hybrids, other than <i>C. spinosior</i> , <i>C. fulgida</i> and <i>C. imbricata</i>)	26 Prickly pear (<i>Opuntia</i> spp. other than <i>O. ficus-indica</i> , <i>O. stricta</i> , <i>O. aurantiaca</i> , <i>O. monacantha</i> , <i>O. stricta</i> and <i>O. streptacantha</i>)
27 Christ's thorn (<i>Ziziphus spina-christi</i>)	28 Red sesbania (<i>Sesbania punicea</i>)
29 Eurasian water milfoil (<i>Myriophyllum spicatum</i>)	30 Salvinias (<i>Salvinia</i> spp. other than <i>S. molesta</i>)
31 Fanwort (<i>Cabomba</i> spp. other than <i>C. caroliniana</i>)	32 Senegal tea (<i>Gymnocoronis spilanthoides</i>)
33 Floating water chestnuts (<i>Trapa</i> spp.)	34 Serrated tussock (<i>Nassella trichotoma</i>)
35 Gorse (<i>Ulex europaeus</i>)	36 Siam weed (<i>Chromolaena</i> spp.)
37 Harrisia cactus (<i>Harrisia</i> spp. syn. <i>Eriocereus</i> spp. other than <i>H. martinii</i> , <i>H. tortuosa</i> and <i>H. pomanensis</i> syn. <i>Cereus pomanensis</i>)	38 Spiked pepper (<i>Piper aduncum</i>)
39 Honey locust (<i>Gleditsia</i> spp. including cultivars and varieties)	40 Thunbergias with the following names: annual thunbergia (<i>Thunbergia annua</i>), fragrant thunbergia (<i>T. fragrans</i>), laurel clockvine (<i>T. laurifolia</i>)
41 Horsetails (<i>Equisetum</i> spp.)	42 Water mimosa (<i>Neptunia oleracea</i> and <i>N. plena</i>)
43 Hygrophila (<i>Hygrophila costata</i>)	44 Water soldiers (<i>Stratiotes aloides</i>)
45 Kochia (<i>Bassia scoparia</i> syn. <i>Kochia scoparia</i>)	46 Willow (<i>Salix</i> spp. other than <i>S. babylonica</i> , <i>S. humboldtiana</i> (syn. <i>S. chilensis</i>), <i>S. matsudana</i> , <i>S. x calodendron</i> and <i>S. x reichardtii</i>)
47 Koster's curse (<i>Clidemia hirta</i>)	48 Witch weeds (<i>Striga</i> spp. other than native species)
49 Lagarosiphon (<i>Lagarosiphon major</i>)	50 Yellow ginger (<i>Hedychium flavescens</i>).

Class 2 Weeds	
51 African Boxthorn (<i>Lycium ferocissimum</i>)	52 Mother of Millions hybrid (<i>Bryophyllum x houghtonii</i> (syn. <i>B. daigremontianum</i> x <i>B. delagoense</i> , <i>Kalanchoe x houghtonii</i>)
53 Annual Ragweed (<i>Ambrosia artemisiifolia</i>)	54 Parkinsonia (<i>Parkinsonia aculeata</i>)
55 Bellyache Bush (<i>Jatropha gossypifolia</i> and hybrids)	56 Parthenium (<i>Parthenium hysterophorus</i>)

Class 2 Weeds	
57 Cabomba (<i>Cabomba caroliniana</i>)	58 Pond Apple (<i>Annona glabra</i>)
59 Chinese Apple (<i>Ziziphus mauritiana</i>)	60 Prickly acacia (<i>Acacia nilotica</i>)
61 Cholla Cacti with the following names— Coral Cactus (<i>Cylindropuntia fulgida</i>) Devil's Rope Pear (<i>C. imbricata</i>)	62 Prickly Pears with the following names— Common Pest Pear Spiny Pest Pear (<i>O. stricta</i> syn. <i>O. inermis</i>) Drooping Tree Pear (<i>O. monacantha</i> syn. <i>O. vulgaris</i>) Tiger Pear (<i>O. aurantiaca</i>) Velvety Tree Pear (<i>O. stricta</i>) Westwood Pear (<i>O. streptacantha</i>)
63 Snake Cactus (<i>C. spinosior</i>)	64 Rat's Tail Grasses with the following names— American Rat's Tail Grass (<i>Sporobolus jacquemontii</i>) Giant Parramatta Grass (<i>Sporobolus fertilis</i>) Giant Rat's Tail Grass (<i>Sporobolus pyramidalis</i> and <i>S. natalensis</i>) Parramatta Grass (<i>Sporobolus africanus</i>)
65 Fireweed (<i>Senecio madagascariensis</i>)	66 Rubber Vine (<i>Cryptostegia grandiflora</i>)
67 Gamba Grass (<i>Andropogon gayanus</i>)	68 Salvinia (<i>Salvinia molesta</i>)
69 Giant Sensitive Plant (<i>Mimosa diplotricha</i> var. <i>diplotricha</i>)	70 Sicklepods with the following names— Foetid Cassia (<i>Senna tora</i>) Hairy Cassia (<i>Senna hirsuta</i>) Sicklepod (<i>Senna obtusifolia</i>)
71 Groundsel Bush (<i>Baccharis halimifolia</i>)	72 Telegraph Weed (<i>Heterotheca grandiflora</i>)
73 Harrisia Cactus (<i>Harrisia martinii</i> syn. <i>Eriocereus martinii</i> , <i>H. tortuosa</i> and <i>H. pomanensis</i> syn. <i>Cereus pomanensis</i>)	74 Thunbergia or Blue Thunbergia (<i>Thunbergia grandiflora</i>)
75 Hymenachne or Olive Hymenachne (<i>Hymenachne amplexicaulis</i>)	76 Tobacco Weed (<i>Elephantopus mollis</i>)
77 Kudzu (<i>Pueraria montana</i> var. <i>lobata</i> syn. <i>P. lobata</i> , <i>P. triloba</i>) other than in the Torres Strait Islands	78 Water Hyacinth (<i>Eichhornia crassipes</i>)
79 Mesquites (<i>Prosopis glandulosa</i> , <i>P. pallida</i> and <i>P. velutina</i>)	80 Water Lettuce (<i>Pistia stratiotes</i>)
81 Mother of Millions (<i>Bryophyllum delagoense</i> syn. <i>B. tubiflorum</i> , <i>Kalanchoe delagoensis</i>)	82

Class 3 Weeds	
83 African Fountain Grass (<i>Pennisetum setaceum</i>)	84 Harungana (<i>Harungana madagascariensis</i>)
85 African Tulip Tree (<i>Spathodea campanulata</i>)	86 Kahili Ginger (<i>Hedychium gardnerianum</i>)
87 Aristolochia or Dutchman's Pipe (<i>Aristolochia</i> spp. other than native species)	88 Lantanas with the following names— Creeping Lantana (<i>L. montevidensis</i>) Lantana or Common Lantana (<i>Lantana camara</i>)
89 Asparagus Fern (<i>Asparagus aethiopicus</i> 'Sprengeri', <i>A. africanus</i> and <i>A. plumosus</i>)	90 Madeira Vine (<i>Anredera cordifolia</i>)
91 Athel Pine (<i>Tamarix aphylla</i>)	92 Ornamental Rubber Vine (<i>Cryptostegia madagascariensis</i>)
93 Balloon Vine (<i>Cardiospermum grandiflorum</i>)	94 Privets with the following names— Broad-leaf Privet or Tree Privet (<i>Ligustrum lucidum</i>)
95 Blackberry (<i>Rubus anglocandicans</i> , <i>Rubus fruticosus</i> agg.)	96 Small-leaf Privet or Chinese Privet (<i>L. sinense</i>)
97 Broad-leaved Pepper Tree (<i>Schinus terebinthifolius</i>)	98 Singapore Daisy (<i>Sphagneticola trilobata</i> ; syn. <i>Wedelia trilobata</i>)
99 Camphor Laurel (<i>Cinnamomum camphora</i>)	100 White Ginger (<i>Hedychium coronarium</i>)
101 Captain Cook Tree or Yellow Oleander (<i>Cassipouira thevetia</i> syn. <i>Thevetia peruviana</i>)	102 Willows with the following names— Pencil Willow (<i>Salix humboldtiana</i> syn. <i>S. chilensis</i>) Tortured Willow (<i>Salix matsudana</i>)
103 Cat's Claw Creeper (<i>Macfadyena unguis-cati</i>)	104 Yellow Bells (<i>Tecoma stans</i>)
105 Chinese Celtis (<i>Celtis sinensis</i>)	106

Appendix B Dominant Weed Species Recorded at PBPL

Species	Common Name	Lifeform
<i>Ageratum houstonianum</i>	Blue billygoat weed	forb
<i>Alternanthera denticulata</i>	Lesser joyweed	forb
<i>Bidens pilosa</i>	Cobbler's pegs	forb
<i>Commelina benghalensis</i>	Hairy commelina	forb
<i>Conyza bonariensis</i>	Flaxleaf fleabane	forb
<i>Crassocephalum crepidioides</i>	Thickhead	forb
<i>Einadia hastata</i>	Berry saltbush	forb
<i>Emilia sonchifolia</i>	Emilia	forb
<i>Impatiens</i> sp.	Balsam	forb
<i>Lantana montevidensis</i>	Creeping lantana	forb
<i>Ludwigia longifolia</i>	Long-leaved willow primrose	forb
<i>Onopordum acanthium</i>	Scotch thistle	forb
<i>Plantago lanceolata</i>	Ribwort	forb
<i>Senecio madagascariensis</i>	Fireweed	forb
<i>Sida rhombifolia</i>	Common sida	forb
<i>Sonchus oleraceus</i>	Common sowthistle	forb
<i>Sphagneticola trilobata</i>	Singapore daisy	forb
<i>Stachytarpheta jamaicensis</i>	Light blue snakeweed	forb
<i>Tagetes minuta</i>	Stinking Roger	forb
<i>Tridax procumbens</i>	Tridax daisy	forb
<i>Verbena bonariensis</i>	Purpletop	forb
<i>Datura</i> sp.	Thorn apple	forb
<i>Andropogon virginicus</i>	Whisky grass	grass
<i>Cenchrus echinatus</i>	Mossman River grass	grass
<i>Chloris gayana</i>	Rhode's grass	grass
<i>Cynodon dactylon</i>	Green couch	grass
<i>Digitaria ciliaris</i>	Summer grass	grass
<i>Megathyrsus maximus</i> var. <i>maximus</i>	Green panic	grass
<i>Paspalum dilatatum</i>	Paspalum	grass
<i>Paspalum distichum</i>	water couch	grass
<i>Phragmites australis</i>	Common reed	grass
<i>Setaria sphacelata</i>	South African pigeon grass	grass

Species	Common Name	Lifeform
<i>Sorghum halepense</i>	Johnson grass	grass
<i>Sporobolus fertilis</i>	Giant Parramatta Grass	grass
<i>Sporobolus virginicus</i>	Sand couch	grass
<i>Cyperus exaltatus</i>	Tall flatsedge	sedge
<i>Cyperus involucratus</i>	Umbrella sedge	sedge
<i>Baccharis halimifolia</i>	Groundsel	shrub
<i>Crotalaria pallida</i>	Rattlepod	shrub
<i>Lantana camara</i>	Lantana	shrub
<i>Opuntia stricta</i>	Prickly Pear	shrub
<i>Phytolacca octandra</i>	Inkweed	shrub
<i>Rivina humilis</i>	Coral berry	shrub
<i>Sesbania cannabina</i>	Yellow pea bush	shrub
<i>Solanum chrysotrichum</i>	Giant Devil's fig	shrub
<i>Solanum nigrum</i>	Blackberry nightshade	shrub
<i>Celtis sinensis</i>	Chinese Elm	tree
<i>Cinnamomum camphora</i>	Camphor laurel	tree
<i>Ficus elastica</i>	Rubber fig	tree
<i>Leucaena leucocephala</i>	Leucaena	tree
<i>Ricinus communis</i>	Castor oil tree	tree
<i>Schinus terebinthifolius</i>	Broad-leaf Pepper Tree	tree
<i>Senna pendula</i> var. <i>glabrata</i>	Easter cassia	tree
<i>Solanum mauritianum</i>	Wild tobacco	tree
<i>Anredera cordifolia</i>	Madeira vine	vine
<i>Asparagus aethiopicus</i> cv. <i>Sprengeri</i>	Basket asparagus fern	vine
<i>Cardiospermum grandiflora</i>	Balloon vine	vine
<i>Ipomoea cairica</i>	Mile-a-minute	vine
<i>Macroptilium atropurpureum</i>	Siratiro	vine
<i>Neonotonia wightii</i>	Glycine	vine
<i>Passiflora foetida</i>	Stinking passionflower	vine
<i>Passiflora suberosa</i>	Corky passionflower	vine
<i>Solanum seaforthianum</i>	Brazilian nightshade	vine



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