

**Conservation Management Plan for the dwarf galaxias
(*Galaxiella pusilla*) for the development of Brompton
Lodge, Cranbourne South**



Dwarf galaxias sand pit habitat at Brompton Lodge (2011)

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**Revised report prepared for
Watsons**

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EXECUTIVE SUMMARY

A residential development is planned for Brompton Lodge Precinct, Cranbourne South.

Streamline Research was commissioned to assess mitigation measures that could be used to minimise any impact of the proposed works, after the nationally threatened dwarf galaxias (*Galaxiella pusilla*) was found in sand pit/s on the property.

It is recommended that the proposed construction of a purpose built dwarf galaxias facility is a worthy off set for loss of the poor quality habitat of the man-made sand pit/s in which the dwarf galaxias are currently found in on Brompton Lodge.

It is suggested that a referral for the dwarf galaxias is made to the Commonwealth Government for the proposed development.

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1.0 INTRODUCTION

The primary purpose of this report is to provide a Conservation Management Plan (CMP) for the dwarf galaxias (*Galaxiella pusilla*), a nationally threatened fish species that has been found in an area zoned for urban growth development in Cranbourne South.

The residential development named Brompton Lodge will include housing, roads and open spaces and will be unique in being the first land development to construct favourable wetland habitat for the dwarf galaxias and provide on-going management program for future protection of the species.

A targeted investigation identified the presence of dwarf galaxias in sand pit/s* within Brompton Lodge five years ago (McGuckin, 2008). A thorough survey of all waters on Brompton Lodge several years later reconfirmed the presence of the dwarf galaxias in the sand pit/s and did not find the species elsewhere on the property (McGuckin, 2011). A survey in March 2013 has confirmed the persistence of the dwarf galaxias in the sand pit/s, but few fish were captured in the degraded habitat (McGuckin unpublished, 2013).

The sand pit/s are in poor ecological condition and are less than ideal habitat for the long term survival of dwarf galaxias. Cattle access has destroyed fringing vegetation, emergent and submerged vegetation has almost totally disappeared since 2008. Competition and harassment from eastern gambusia (*Gambusia holbrooki*) has occurred since the invasion of the species during the floods of 2010-11.

Development of Brompton Lodge offers an opportunity for trading the poor quality habitat of the sand pit/s with wetland habitat that is purpose built for dwarf galaxias. The development is to organise the translocation of fish from the sand pit/s to the new habitat and will fund management that will monitor the dwarf galaxias population to ensure future survival of the dwarf galaxias in the area.

Section 1 of this report provides general information on the dwarf galaxias. Section 2 details the proposed Brompton Lodge development, provides information on the current habitat occupied by the dwarf galaxias and details the characteristics of the new wetland habitat that will be beneficial to the long term preservation of the dwarf galaxias.

The principal environmental objectives of this CMP is to assist with:

- Awareness of the dwarf galaxias during residential development of Brompton Lodge
- The construction of a wetland with fringing and aquatic vegetation native to the area (swamp paperbark community typical of watercourses which support dwarf galaxias)
- The construction of a wetland that maintains permanent surface water, one that has suitable water quality conditions for supporting the dwarf galaxias. Interception with groundwater is expected to maintain surface water, replicating the process which currently maintains water in the sand pit/s. Nearby groundwater bores are to be monitored. Contingency is to be made for the supply of water to the wetland if critical water levels were to occur
- Monitoring the dwarf galaxias population during development and into the future

**the sand pits are man-made sand scrapes which constitute two distinct ponds at capacity with up to eight smaller isolated ponds during drier periods (some of which may lack surface water)*

SECTION 1

2.0 DWARF GALAXIAS GENERAL INFORMATION

2.1 Status

The dwarf galaxias is considered of national significance and is listed as vulnerable under the Environment Protection and Biodiversity Conservation (EPBC) Act, 1999. In Victoria, the dwarf galaxias is considered a threatened species (Department of Sustainability and Environment (DSE), 2013) and is listed for protection under the Flora and Fauna Guarantee Act, 1988.

2.2 Description

The dwarf galaxias is a small native fish species (maximum size of 50 mm) which has an exclusive freshwater lifecycle. The species is sexually dimorphic, the males are smaller and more slender than the females, having three longitudinal black stripes along each side of the trunk, and a distinct red strip between the mid and lower black strip. The black stripes are less distinct or absent in females (Cadwallader and Backhouse, 1983). Figure 1 shows an example of both a male and female dwarf galaxias.

The dwarf galaxias is a short lived species, with only a few individuals surviving through to a second year. The spawning period is mainly between winter and spring, but can extend throughout summer when conditions are favourable. Spawning adults are typically over 25 mm in size. Recently hatched young are about 10 mm in size.



Figure 1. Dwarf galaxias.

2.3 Habitat

The dwarf galaxias occurs in waters which have an array of native aquatic vegetation, typically preferring swampy floodplain environments, but can also be found in creeks and rivers. The natural degree of wetland connectivity to a more permanent waterbody (such as a river or creek) may be vital to their long term survival (particularly during extended dry conditions) and must be considered as part of the habitat requirement critical to survival (Saddler *et al.*, 2008).

Dwarf galaxias can be found in two types of habitats, primary habitats which have permanent water, and secondary habitats which have intermittent or ephemeral water regimes. Primary habitats (permanent water sites) are responsible for the long term survival of the species (McGuckin, 2001).

The dwarf galaxias is opportunistic, using flood water for the movement of fish into new habitats. New environments are advantageous to the species as they can provide food for the growth of young and often, have an absence of predators. Spawning has been noted in seemingly unsustainable habitats like puddles created by vehicle wheel marks, pools in low lying grassed paddocks, farm dams and sand pits, an example of which exists within Brompton Lodge Precinct. Long term survival is dependent on persistence of permanent water. Fortunately, for dwarf galaxias washed into the sand pit/s in Brompton Lodge interception with the underlying groundwater has maintained surface water during the recent drought period between 1996 and 2010. With water quality capable of allowing for successful breeding, this secondary habitat has been capable of maintaining a population of dwarf galaxias. It could be replaced with primary habitat with the construction of a wetland specifically designed for the dwarf galaxias.

Loss of the dwarf galaxias primary habitat population in the Eastern Contour Drain is suspected to have occurred when headwater streams dried out during the drought and low lying areas were drained for Settlers Run golf course. By default, the sand pit/s in Brompton Lodge became the only locations that provided habitat for the dwarf galaxias.

The dwarf galaxias population in the sand pit/s in the Brompton Lodge Precinct has localised importance, as it is the one in the Eastern Contour Drainage system. It is, however, not deemed an 'important population' under the criteria listed in the 'Matters of National Significance' (Department of the Environment, Water, Heritage and the Arts (2009).

The Eastern Contour Drainage system is part of the Eumemmerring Creek catchment, a catchment which supports a number of dwarf galaxias populations. The population in the sand pit/s in Brompton Lodge is one of perhaps a dozen that can contribute to long term survival and recovery of the species in the catchment. The sand pit habitat may not be typical habitat for dwarf galaxias and it may have less value than other populations, but it has, unfortunately, been overlooked in the National Recovery Plan (Saddler *et al.*, 2008).

Based on genetic differences there appears to be two forms of the dwarf galaxias in Victoria, an eastern form which extends from the Barwon to the Mitchell basins (which is inclusive of the Bunyip basin which contains the Eumemmerring Creek catchment) and a form of dwarf galaxias from the Corangamite Basin westwards (DSE, 2013). Genetically, the dwarf galaxias population in the sand pit/s in Brompton Lodge is expected to be the same as for other populations found throughout eastern Victoria.

2.4 Populations under threat

With the exception of secure populations in places like Discovery Bay National Park and the Grampians National Park, most populations of dwarf galaxias in Victoria are under threat. Many wetland habitats throughout the range of the species have been destroyed or modified as part of agriculture or residential development.

The type of threats applying to particular populations depend largely on land tenure and management (Saddler *et al.*, 2008). Unfortunately, the majority of populations occur at sites that have little or no formal protection.

No formal protection is given to the dwarf galaxias population in the sand pit/s in Brompton Lodge and this has contributed to the degradation of the habitat since 2008. In the Brompton Lodge development it is recognised that not only will high quality habitat for the dwarf galaxias be constructed but an on-going management program will ensure the long term local survival of the species.

2.5 Threatening processes

There is a number of threatening processes applicable to the dwarf galaxias which are identified in the Victorian Flora and Fauna Guarantee Act 1988 (Victorian Government, 1988). The Victoria's Biodiversity Strategy (Department of Natural Resources and Environment, 1997) outlines key environmental considerations necessary for the preservation of the species.

Victorian Flora and Fauna Guarantee Act 1988

Potentially threatening processes listed under Schedule 3 of the FFG Act, 1988 applicable to the dwarf galaxias are:

- Alteration to the natural flow regimes of rivers and streams
- Alteration to the natural temperature regimes of rivers and streams
- Degradation of native riparian vegetation along Victorian rivers and streams
- Increase in sediment input into Victorian rivers and streams due to human activities
- Habitat fragmentation as a threatening process for fauna in Victoria
- Input of toxic substances into Victorian rivers and streams

Victorian Biodiversity Strategy

Under the Victorian Biodiversity Strategy the conservation and maintenance of dwarf galaxias populations and habitat can be achieved by:

- Maintaining and where necessary restoring ecological processes and biodiversity dependent upon freshwater environments
- Preventing further preventable decline in the viability of any rare species or of any rare ecological community
- Increasing the viability of threatened species and the extent and quality of threatened ecological communities

2.6 Management strategies

The National Recovery Plan for the dwarf galaxias (Saddler *et al.*, 2008) summarises appropriate management strategies to avoid threatening processes. These include:

- No direct loss of habitat through wetland drainage on either public or private land
- No physical alteration to dwarf galaxias habitat as a consequence of land adjoining dwarf galaxias habitat
- No further damage to riparian vegetation
- Damaged or depleted riparian vegetation is protected and (if necessary) supplemented by active revegetation works
- Plans to clear vegetation lying adjacent to dwarf galaxias habitat will not impact upon water quality (no increase in sedimentation/nutrient levels/pesticides/herbicides etc.)

All of the strategies from the National Recovery Plan (listed above) are considered relevant to the Brompton Lodge development and have been adopted in this CMP.

SECTION 2

3.0 DEVELOPMENT DETAILS

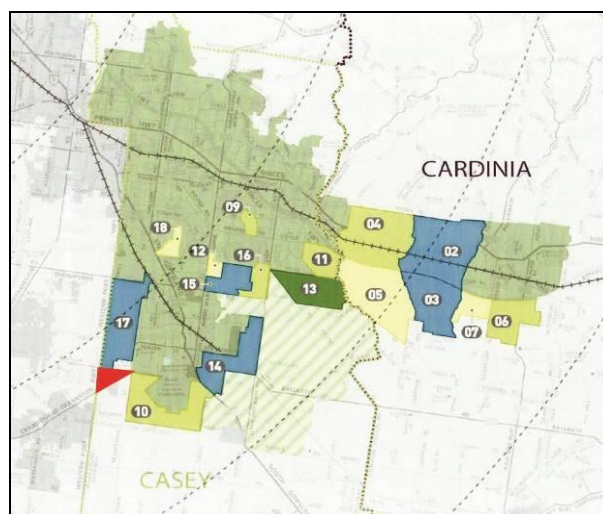
3.1 Location of the proposed residential development

The proposed Brompton Lodge residential development is located to the south-east of Melbourne in Cranbourne South (Figure 2). The allotment is 105 ha, within the City of Casey and has been included into the urban growth boundary of Melbourne (Figure 3).



(Source: map from Leonard, 2011)

Figure 2. Location of Brompton Lodge development.

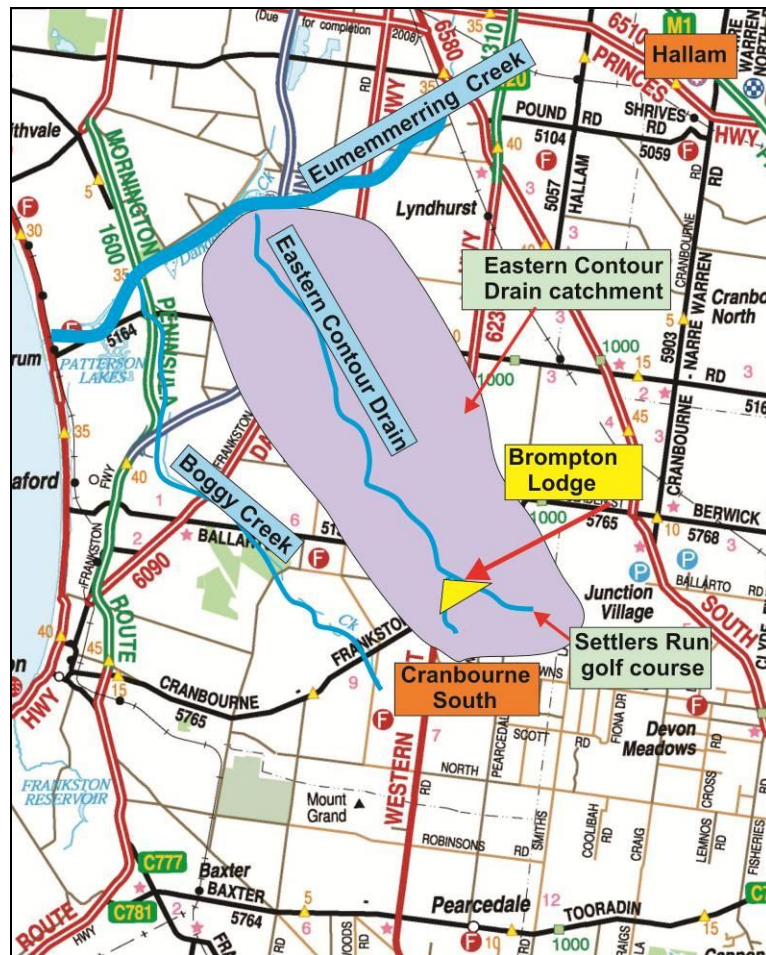


(Source: base map used for this figure was on the Urban Growth Authority web site)

Figure 3. Brompton Lodge (marked in red) and Urban Growth Zones of the City of Casey and the Shire of Cardinia.

Brompton Lodge is located within the upper reaches of the Eastern Contour Drain catchment in a sub-catchment of Eumemmerring Creek (Figure 4). Dwarf galaxias have been recorded in man-made sand pit/s on the property.

Dwarf galaxias have also been recorded at other locations in the Eumemmerring Creek catchment including waterways in the proximity of Hallam and in nearby Boggy Creek.



(base map VicRoads Country Street Directory Edition 8 Copyright © VicRoads 2012 reproduced under licence)

Figure 4. Location of Brompton Lodge Precinct in the Eastern Contour Drain catchment and nearby known locations of dwarf galaxias.

With a known presence of the dwarf galaxias at Brompton Lodge a referral to the Australian Government under the EPBC Act 1999 is to be made for the planned development. The construction of a purpose built wetland for the dwarf galaxias will be designed under strict guidelines acceptable to Department of Environment and Primary Industries and Melbourne Water. Existing drainage through Brompton Lodge will be maintained with the development.

3.2 Dwarf galaxias presence in sand pit/s on Brompton Lodge

A fish survey conducted for VicRoads as part of an upgrade of the Cranbourne Frankston Road found a population of dwarf galaxias in sand pit/s several hundred metres from the road (McGuckin, 2008), in an area that is now referred to as Brompton Lodge. The species was present in large numbers (possibly 1000's) and the first population to be found in the Eastern Contour Drain catchment.

As the sand pit/s where the dwarf galaxias were present had only been constructed 15 years beforehand (in 1993 according to the property owner), the dwarf galaxias must have originated from a nearby population. At some time after the sand pit/s were made and before the drought that commenced in 1996, floodwater allowed for the movement of dwarf galaxias, southern pygmy perch and short finned eels into the sand pit/s. Several native aquatic plants present at that time (*Nitella* spp. and *Potamogeton* spp.) are also expected to have originated from the floodwaters.



Figure 5. The headwater dams and Settlers Run golf course areas that were surveyed for dwarf galaxias following the discovery of the population in Brompton Lodge.

A subsequent targeted survey for dwarf galaxias made for Melbourne Water in the Eastern Contour Drain catchment headwater was undertaken to identify the source population of dwarf galaxias found at Brompton Lodge. The investigation failed to find the dwarf galaxias population responsible for colonising the sand pit/s at Brompton Lodge. Drought and the draining of low lying land with the construction of the Settlers Run golf course (location shown in Figure 5) was suspected to have resulted in the loss of headwater populations of dwarf galaxias (McGuckin, 2008a).

With consideration that Brompton Lodge be added to the City of Casey Urban Growth Zone, a thorough fish investigation was made in 2011 to confirm the presence of dwarf galaxias in the sand pit/s and whether any other locations on the property supported dwarf galaxias. A lower abundance of dwarf galaxias found in the sand pit/s was suspected to be due to dwarf galaxias movement out and recent eastern gambusia movement into the sand pits during flood periods.

Although flooding in 2010-2011 was expected to have been the catalyst for the movement of dwarf galaxias from the sand pit/s no new locations were found for the species in any of the waters on Brompton Lodge (McGuckin, 2011). The same floodwaters allowed for the invasion and establishment of eastern gambusia into the sand pit/s where the dwarf galaxias were present. As eastern gambusia out-compete the dwarf galaxias for both habitat and food they are a threat to the long term persistence of the dwarf galaxias in the sand pit/s of Brompton Lodge.

Figure 6 shows the aerial view of the sand pit/s in which the dwarf galaxias have been recorded at Brompton Lodge. Figure 6 also shows the water depths in these areas (Leonard, 2011). The deeper water areas maintain permanent surface water. Up to eight separate ponds (some of which may be without surface water) exist during dry periods.

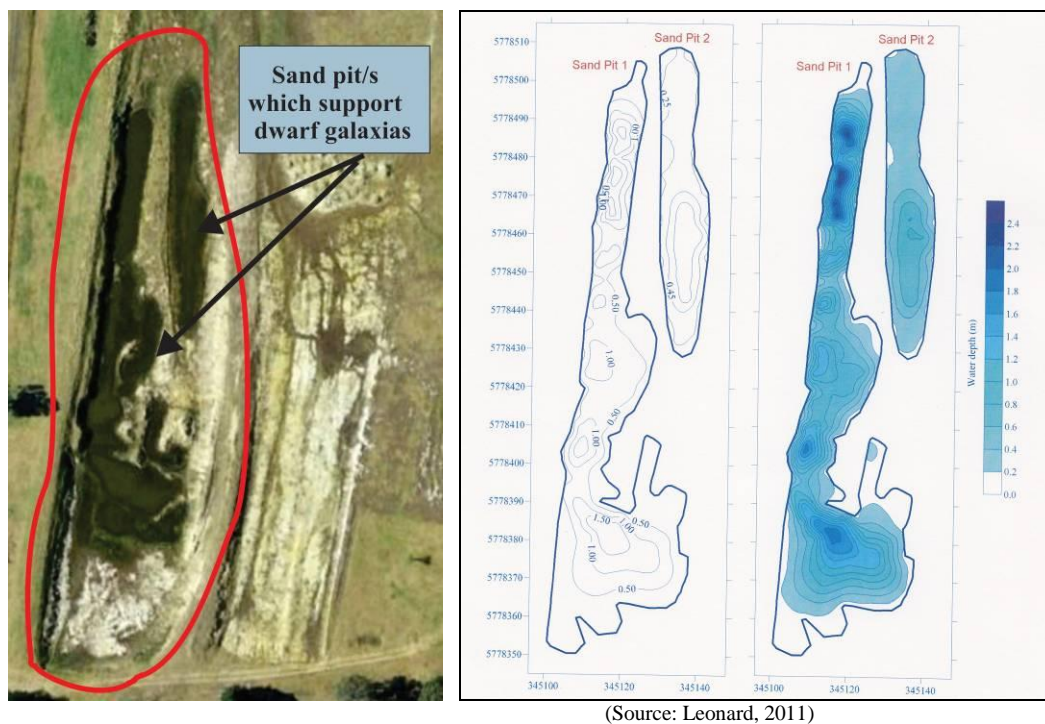


Figure 6. Aerial view of sand pit/s that support dwarf galaxias (on left) and the water depth throughout these areas (on right).

3.3 Dwarf galaxias management considerations (2011)

Seemingly appropriate management including the protection of the sand pit/s was suggested for the Brompton Lodge development two years ago (McGuckin, 2011) with the assumption that the sand pit/s would remain unchanged. Habitat degradation between 2011 and 2013 suggests that it would be unlikely that the dwarf galaxias population in the sand pit/s can be sustained into the future.

In 2011 a 40 m riparian buffer was suggested to isolate the dwarf galaxias habitat from the Brompton Lodge development. Tea tree (*Melaleuca ericifolia*) planted on the fringe of the sand pit/s was suggested for shading, shading that would favour the dwarf galaxias and be unfavourable to the eastern gambusia. Groundwater interception was viewed important in maintaining permanent water habitat for the dwarf galaxias. As an emergency contingency, the use of a groundwater pump was suggested to top up the sand pit/s in the event that water levels dropped below a depth of 1.0 m. Drainage from overflow (during wet periods) was considered necessary, assuming also that the prevention of stormwater drainage from the residential development could occur. Despite these measures a small lowering of the watertable level remains a threat that could lead to the total loss of the dwarf galaxias population in the sand pit/s.

Control measures for eliminating the eastern gambusia, and for future exclusion were considered necessary if the dwarf galaxias population in the sand pit/s of Brompton Lodge was to be protected (McGuckin, 2011). Sounds simple, yet there is no easy process in which the eastern gambusia can be eliminated without threatening the dwarf galaxias population. Even if the eastern gambusia were eliminated, there would still be no guarantee that the sand pit/s would not be re-infested by eastern gambusia in future floods.

3.4 Revised dwarf galaxias management considerations (2013)

The sand pit/s in which the dwarf galaxias are present on the Brompton Lodge are not ideal habitat for the dwarf galaxias, even though they have allowed for the long term survival of a population (Figure 7). The habitat is not natural habitat – it is man made habitat which by accident has been colonised by dwarf galaxias.

Localised flooding since 2008 has allowed for the invasion of the eastern gambusia (*Gambusia holbrooki*) and fish surveys made since that time have found the abundance of dwarf galaxias has dropped dramatically. Based on dwarf galaxias numbers alone the habitat would now appear to be only marginal for the species. Loss of the dwarf galaxias population in the next 10 years is a distinct possibility, as the habitat of the sand pit/s is more acceptable to eastern gambusia than it is dwarf galaxias.

Shaded habitat (which would favour dwarf galaxias) is minimal, comprising less than 10% of the habitat that exists in the sand pit/s. The majority of the habitat present in the sand pit/s is open water, habitat that favours the eastern gambusia.

The loss of emergent aquatic vegetation (particularly *Nitella* spp. and *Potamogeton* spp.) is another factor that may have contributed to the proliferation of eastern gambusia and the decline of the dwarf galaxias population in the past five years.

As water levels in the sand pit/s are related to groundwater, draining these areas to reset the habitat specifically for dwarf galaxias (to remove eastern gambusia) is not easily done. In addition, there would also need to be preventive action to stop further invasion of eastern gambusia.

Unforeseen changes to localised groundwater could potentially result in the sand pit/s drying out. The watertable would have to decline by more than 2.3 m to cause the deeper pond of the sand pit/s to dry up (John Leonard, 2011). Although this is unlikely given there was water in the sand pit/s through the drought period of 1996-2010 it is not impossible (John Leonard, 2011). It would, therefore, be of little value to attempt rehabilitating habitat for dwarf galaxias by fencing and revegetating the sand pit/s, if permanent water can not be assured in the future.

‘Change in land use from open agriculture to built up residential area has the potential to change the on-site water balance. However, it is considered that the on-site changes are unlikely to significantly impact on the position of the watertable beneath the majority of the site. This is because potential water table decline as a result of decreased on-site recharge tends to be off set by increased water applied to household lawns and gardens. However, external factors (climate change, changed land use in areas beyond Brompton Lodge particularly in up-hydraulic gradient areas) could result in lowering the watertable. Consequently, it would be prudent to implement engineering works to ensure that the dwarf galaxias habitat is maintained or at least have plans in-place to maintain the habitat in the event that the watertable falls beneath the base of the sand pit/s’ (John Leonard, 2011).

A purpose built wetland and a 10 year monitoring program is considered a most favourable option for the dwarf galaxias, as it can be a waterway which can be specially built and appropriately managed. Furthermore, it places responsibility on the developers to provide for the creation of appropriate habitat and for the long term protection of the species.

Ideal bathymetry for dwarf galaxias can be incorporated into the newly created dwarf galaxias habitat. Contingency should ensure that permanent water is retained in the purpose built wetland, irrespective of possible future changes to localised groundwater. Draining and resetting in the event of eastern gambusia invasion is to be incorporated in design. Fencing and revegetation is also planned for the newly created dwarf galaxias habitat.

We have advanced considerably in our understanding of how to create favourable habitat for the dwarf galaxias in the past decade. One Melbourne Water wetland in the Hallam Valley provides an example of long term survival of a translocation population of dwarf galaxias to a newly constructed wetland. Other wetland designs (several of which are located on the fringe of Watson Creek) have also recently been constructed with characteristics suitable for dwarf galaxias.



Figure 7. The sand pit/s on Brompton Lodge in March 2013 showing lack of riparian vegetation and cattle pugging of fringes.

Key issues related to the dwarf galaxias population in the sand pit/s at Brompton Lodge are:

- the sand pit/s are man-made and have, quite accidentally through inflow from floodwaters allowed for the establishment of a self sustaining population of the nationally threatened dwarf galaxias (McGuckin, 2008).
- if not for interception with the underlying groundwater the sand pit/s would have probably dried out during the drought period between 1996 and 2012, resulting in the loss of the dwarf galaxias population (McGuckin, 2008a).
- flooding between 2008 and 2011 has allowed a pest species, the eastern gambusia to become established in the sand pit/s. Eradication and future exclusion is necessary for protection of the dwarf galaxias population (McGuckin, 2011).
- change in land use from open agriculture to a built-up residential area has the potential to change the on-site water balance with loss of the dwarf galaxias population (John Leonard, 2011).
- neither the City of Casey or Melbourne Water are prepared to undertake management of the dwarf galaxias population in the sand pit/s of Brompton Lodge (Ross Morcombe, Watsons, pers. com., 2013).
- the 2013 fish survey of the sand pit/s shows that few dwarf galaxias are present (28 fish captured with a population estimated to be only several hundred). The habitat in the sand pit/s is considered in poor ecological condition and is less than favourable for the long term support of dwarf galaxias.

Melbourne Water and the Department of Environment and Primary Industries have not spent money or provided any resources to protect the dwarf galaxias population in the sand pit/s of Brompton Lodge. Lack of protection has resulted in the introduction of eastern gambusia and the degradation of aquatic vegetation since 2008. Further neglect could potentially result in the dwarf galaxias population perishing.

As loss of the man-made sand pit/s is not of the same value as the loss of natural habitat, Streamline Research is of the opinion that construction and management of an appropriate wetland (off-set compensation by the urban development for the sand pit/s), should ensure that the dwarf galaxias population is looked after for the next decade. The newly constructed wetland is to provide an acceptable man-made habitat for the dwarf galaxias, one that has appropriate plantings, a guaranteed water supply and favourable water quality. Sufficient funding is to be set aside to ensure:

- dwarf galaxias translocations from the sand pit/s
- eastern gambusia are excluded from the new wetland,
- permanent water supply
- on-going management program

3.5 Surface water management of the proposed development

The proposed Surface Water Management Strategy for Brompton Lodge is detailed in a separate report (Craigie, 2013).

The proposed open waterway concept design (shown in Appendix 1) complies with Melbourne Water's draft Waterway Corridor Guidelines, addresses groundwater constraints, flood conveyance and flood mitigation requirements and, most importantly, provides for construction of purpose built habitat for protection of dwarf galaxias.

Craigie (2013) provides an excellent appraisal of the approach adopted in the open waterway design:

'All existing drainage lines in Brompton Lodge are artificial in origin. There are no significant environmental values associated with any of them and existing capacity, depth and alignments are not suited to their retention as part of the urban development layout. Instead constructed open waterways will replace the two main drainage lines on amended alignments in dedicated reserves. From a cross-sectional perspective the intent is to establish a naturalised waterway environment which is capable of evolving with time as vegetation communities become established under the changing hydrologic regime associated with catchment urbanisation'.

3.6 Purpose built dwarf galaxias wetland

Construction of a purpose built dwarf galaxias habitat with fringing native vegetation is to be made just to the north of the existing sand pit/s (Figure 8). The design and location of the new wetland will be approved through consultation with Department of Environment and Primary Industries and Melbourne Water. The wetland will be separated from the surface water drainage system up to the 100 year ARI event but provided with freshwater supply as needed (Craigie, 2013). The wetted area of habitat will be approximately 1500 m², which is much larger than the existing areas of the sand pit/s that can be used by the dwarf galaxias.

Shallow margins will be constructed on the wetlands, as these habitats are favoured by the dwarf galaxias. Dense submergent aquatic and riparian plantings (swamp shrub EVC) on the north and western sides of the waterbody will help reduce summer water temperatures and maintain some shaded areas that will favour the dwarf galaxias. Table 1 shows a list of some of desirable native plants that could be used for planting at the dwarf galaxias wetland.

Water table mapping indicates that the water table under the worst measured case (lowest measured elevation) is above the design base of the proposed dwarf galaxias wetland (Leonard, 2013).

The water depth of the wetland will be up to 3.0 m (Figure 9). The deeper water will provide refuge when other parts of the wetland may dry up, providing permanent water throughout summer and refuge habitat during drought periods. There is no plan for large open reaches of water, as they favour pest fish species like eastern gambusia.

The current proposed location of the purpose-built habitat is in a location where it can avoid unnecessary flooding, reducing opportunity for pest fish species accidentally being moved into the habitat. Placement of the dwarf galaxias habitat at the end of the treatment train has merit in providing good quality water inflows, but would greatly increase the likelihood that pest species will enter the habitat during high flow periods.



Figure 8. The existing sand pit/s and the proposed location for the new purpose built wetland.

Table 1. Desirable flora for the purpose built dwarf galaxias wetland.

Scientific name	Common name
<i>Carex gaudichaudiana</i>	fen sedge
<i>Carex inversa</i>	knob sedge
<i>Eleocharis acuta</i>	common spike-sedge
<i>Isolepis inundatus</i>	swamp club sedge
<i>Juncus subsecundus</i>	finger rush
<i>Melaleuca ericifolia</i>	swamp paperbark
<i>Myriophyllum crispatum</i>	upright water milfoil
<i>Nitella/Chara species</i>	stonewarts
<i>Persicaria decipiens</i>	slender knot weed
<i>Potamogeton tricarinatus</i>	floating pondweed
<i>Ranunculus inundatus</i>	river buttercup
<i>Triglochin procerum</i>	water ribbons

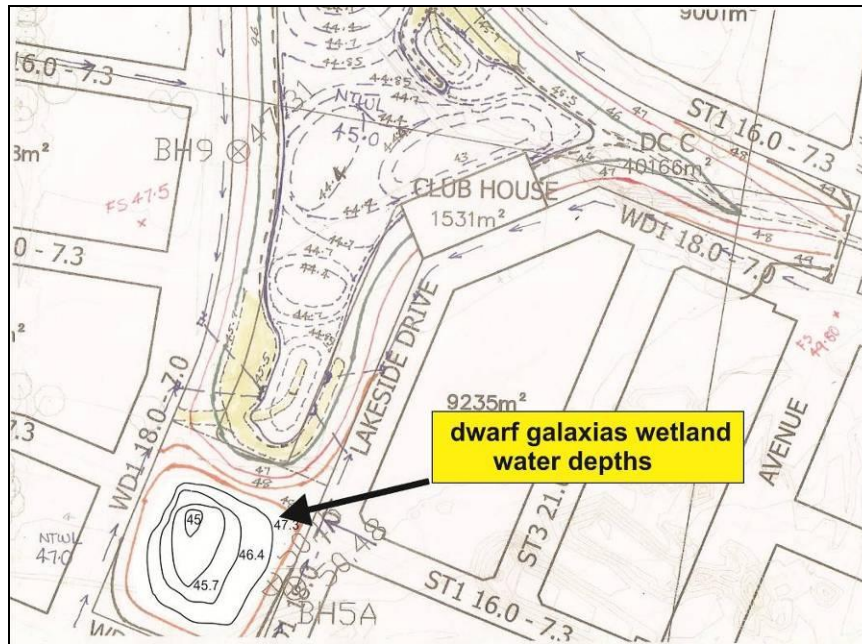


Figure 9. Water depths for the new purpose built dwarf galaxias wetland.

Interception with the underlying groundwater will ensure that the wetland always retains surface water. By having trigger water levels in the wetland any unforeseen hydrological change in the underlying groundwater can be addressed. A permanent bore is to be located on the edge of the wetland so that groundwater levels can also be monitored. If critical water levels occur, contingency will be made to ensure water is put into the wetland.

Maintaining water supply is best addressed by using top up supply from nearby stormwater treatment systems as suggested in the Surface Water Management Strategy (Craigie, 2013). Use of the water will be dependent on the provision of suitable water quality, with the addition of filtration, to prevent pest species access to the dwarf galaxias wetland. Two additional options have been suggested (Leonard, 2013), but are not likely to be used. The first, to construct a supply bore near the wetland has uncertainty due to potential for very low bore yield. The second, which would include the digging of a deep trench/wick to retain water in the wetland may possibly only need consideration if water within the wetland falls more than expected due to stress on the system such as reduced recharge under future climate change.

Bunding above the 1:100 year flood level will prevent accidental water inflow from nearby waterways, preventing species like the eastern gambusia from using floodwaters to enter the dwarf galaxias wetland.

A channel along the base of the wetland will allow for occasional draining of the new wetland should it be necessary (if someone deliberately introduces eastern gambusia or some other pest species). Dwarf galaxias could be collected and housed in aquaria until being put back into the wetland habitat after the pest species have been eliminated.

The new habitat combined with a management plan will provide support for the long term survival of the dwarf galaxias.

3.7 Mitigation measures for preservation and enhancement of dwarf galaxias habitat

A number of mitigation measures are expected to be beneficial to the protection of the existing population of dwarf galaxias in the sand pit/s of Brompton Lodge and to the future protection of purpose built wetland habitat. The measures to avoid impacts for the dwarf galaxias are:

Sand pits

- The existing sand pit/s are to be excluded from the early stages of the development and will not be disturbed until the purpose built wetland has been constructed, aquatic and riparian established and translocation of fish has occurred.
- Construct an earth bund up to 400 mm high around the perimeter of the sand pit/s. The bund must be a minimum of 3 m from the outer edge of the ponds (at capacity) and must be graded, and stabilised to allow vegetation to establish and prevent eroded soil washing into the ponds.
- On the outer edge of the bund, a temporary chain mesh security fence not less than 1.8 m tall must be erected. At 10 m intervals signs must be attached noting that the area within is a significant habitat area and that access is restricted. Earth and construction materials must not be placed within 10 m of the edge of the fencing.
- During construction and until the dwarf galaxias population is relocated to the new purpose built habitat area, water levels and water quality testing must be conducted on a monthly basis with the results available to the relevant government agencies. If the water quality or level drops to a critical point (parameters to be determined), the developer must notify the relevant government agencies to agree on the necessary corrective steps to prevent harm to the dwarf galaxias population.
- During works, a clear indication needs to be made to construction personnel of expected mitigation measures and importance to maintaining ecological condition for the dwarf galaxias in the sand pit/s. Direct disturbance due to construction equipment or indirect disturbances due to spills from machinery could have a detrimental effect on the survival of the dwarf galaxias.
- Contractors need to have contingency for reporting accidents (possible polluting to water or any physical disturbance to the sand pit/s). A chain of command between construction personnel, developer/consultant and Streamline Research is needed to report problems and to provide appropriate on-ground responses. Monitoring following an incident will comprise a survey and appropriate sampling to confirm the extent of the disturbance to the dwarf galaxias. If a spillages occurs, post incident monitoring will be repeated at weekly intervals until the contaminant is no longer considered to be a threat.

New wetland

- Fencing the new wetland should allow for establishment of riparian vegetation without disturbance from the residential development. The shallow slopes of the new wetland should have minimal bank erosion, assist with the filtering of runoff water and help prevent deposition of loose material into the new wetland.

- Stormwater is not to be drained into the new dwarf galaxias wetland. Floodwaters are also to be prevented from spilling into the wetland.
- Maintaining water supply is best addressed by using top up supply from nearby stormwater treatment systems and is reliant on the provision of suitable water quality being filtered to exclude pest species.
- A water quality monitoring program should be incorporated into the fish sampling program. The monitoring program should include measurements of turbidity, pH, dissolved oxygen, electrical conductivity as well as checks on sedimentation and erosion control structures.
- Revegetate riparian zones of the new wetland to increase shade in the riparian zone. This measure by itself is not specifically needed for protecting or enhancing dwarf galaxias habitat, but for improving waterway condition and likelihood that the habitat can be utilised by dwarf galaxias.
- Annual monitoring of the dwarf galaxias population is to be performed by Streamline Research. Reporting will be prepared for the Department of Environment and Primary Industries, Melbourne Water and the City of Casey.

3.8 Fund allocation

The developer will be responsible for:

- the costs associated with construction of the dwarf galaxias wetland and features that will assist with long term functioning like bore maintenance and windmill operation
- fish translocation from the sand pits to the new dwarf galaxias wetland (this will be inclusive of Victorian permit approvals from the Department of Environment and Primary Industries)
- fish translocation to the dwarf galaxias wetland and other nearby waterways at the time of the sand pit draining ie. to move other native fish like the southern pygmy perch and the short finned eel (Victorian permit approval will be necessary from the Department of Environment and Primary Industries)
- annual monitoring of dwarf galaxias wetland and miscellaneous works to ensure dwarf galaxias population remains viable

The new pond will be created as common property on relevant Plans of Subdivision and therefore will be owned and maintained by the Owners Corporation. The monitoring and maintenance will be a permit condition and a requirement registered on title in the Section 173 Agreement. It will be an on-going obligation for the Owners Corporation to own and manage communal assets within the Brompton Lodge Estate.

4.0 CONCLUSION

The nationally threatened dwarf galaxias exists in sand pit/s on Brompton Lodge.

A purpose built wetland is to be constructed to replace the poor quality habitat (man-made sand pit/s) currently being occupied by the dwarf galaxias.

A referral for the dwarf galaxias is to be made to the Commonwealth Government for the proposed development.

5.0 RECOMMENDATIONS

- Allow for the sand pit/s on Brompton Lodge to be drained so that a purpose built wetland can be constructed, monitored and maintained into the future.
- Consult with the Department of Environment and Primary Industries, Melbourne Water and City of Casey for work approvals.
- Provide a referral to Department of Sustainability, Environment, Water, Population and Communities for the dwarf galaxias.
- Streamline Research would like to be involved in translocating dwarf galaxias and undertaking the 10 yearly monitoring program.
- Further consideration needs to be given as to who will ultimately manage the dwarf galaxias habitat in perpetuity.

6.0 REFERENCES

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APPENDIX 1. STAGED DEVELOPMENT AT BROMPTON LODGE PRECINCT

