

## Weed surveying and mapping in urban and urban-fringe bushland: the Hobart experience

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**Summary** The City of Hobart's Bushland and Reserves Unit undertook a detailed weed survey and mapping project within bushland reserves in the city from 2012 to 2015. The primary aim of the project was to identify the most serious, and potentially serious, invasive plants within several urban and urban-fringe reserves, with the main objective then being to develop a comprehensive weed management program in these areas in subsequent years.

The project involved surveys along pre-determined transects, at varying intervals depending on the site and terrain. This approach was necessary due to the dense vegetation and rugged nature of much of the terrain, with limited access in certain areas. The information was digitally captured and then integrated within Council's digital mapping system, for use in planning on-ground weed management.

**Keywords** Mapping, rugged terrain, urban and urban-fringe, weed survey.

### INTRODUCTION

The City of Hobart is a municipality covering the central business district (CBD) and surrounding inner suburbs of Hobart, the capital of Tasmania. The City occupies 77.9 square kilometres (7790 hectares), and has a population of approximately 49,000 (Australian Bureau of Statistics, 2011). Many residents live in suburbs backing onto, or threaded with, substantial tracts of native bushland.

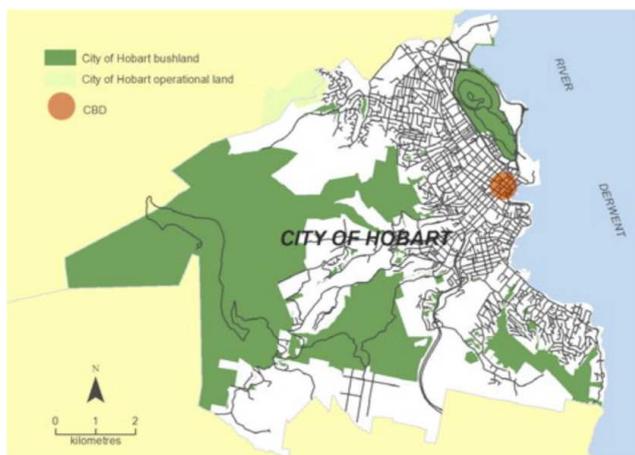
Physically the municipality is characterised by a narrow coastal verge adjoining the foothills, slopes and ridges of kunanyi-Mt Wellington, the 1271 metre high peak dominating the city's landscape. Native vegetation in the City is dominated by a mixture of woodland and forest types, together with smaller areas of lowland grassland and montane, sub-alpine and alpine vegetation.

The municipality retains considerable stands of bushland within just a few kilometres of the CBD. This is largely a consequence of two factors: the steep and rugged terrain limiting wholesale clearing and development;

and, efforts in the 19th and 20th centuries to secure the capital's water supplies through protecting large tracts of water catchment from development (Hobart Water 2009, Futurepast Heritage Consultants 2012).

The City has been responsible for managing various stands of native vegetation going back to the 1860s, initially with an emphasis on water catchment management and recreation activities. Fire management was added in the 1940s but it was not until the late 1980s – early 1990s that works focused on ecological management began, which eventually led to the creation of a bushland unit within Council in 1993–94 (Hickie and Toonen 2014). This unit has since developed a sophisticated bushland management program encompassing strategic planning, asset management, recreation infrastructure, weed, fire and wildlife management, ecological restoration and revegetation works and community 'bushcare' and interpretation activities (HCC 2008).

The City's Bushland and Reserves Unit manages 4589 ha of native vegetation, of which 2966 ha occurs within the municipal boundaries (38% of the total area of the City) and 1623 ha in adjacent municipalities. These latter areas are largely a consequence of historical land purchases and grants aimed at protecting the City's water supplies (HCC 2008).



**Figure 1.** City of Hobart, showing extent of bushland reserves.

## WEEDS AND WEED MANAGEMENT IN HOBART RESERVES

A total of 320 non-indigenous species, sub-species, varieties and cultivars have been recorded in Hobart's public open space parks and reserves, which is 35% of the total of 917 taxa recorded for such areas (City of Hobart 2016). This is broadly similar to the percentage for Tasmania as a whole (Matthew Baker, Tasmanian Museum and Art Gallery, pers. comm.). Around 120 taxa are considered serious, or potentially serious, environmental weeds in Hobart's bushland.

Programmed weed controls have been undertaken in the City's bushland reserves over the last 20+ years, primarily by Council works crews and community 'bushcare' groups, supplemented at times by bush regeneration contractors and occasional correctional teams or labour-market program work teams (e.g. Green Corp/Green Army).

Weed populations have been significantly reduced in this period, however, like any urban/peri-urban bushland, weeds continue to be a major management focus due to factors such as abundant weed sources in adjacent gardens and private bushland, garden dumpings, physical disturbances (historical and contemporary) and weed seedbanks in reserves (a particular issue in Hobart with persistent Fabaceae species such as gorse (*Ulex europaeus* L.), Scotch broom (*Cytisus scoparius* L.) and Montpellier broom (*Genista monspessulana* L.)).

Council's weed management program has been shaped by several factors over the years such as meeting legislative obligations to control/eradicate certain species, restoring and rehabilitating bushland, community requests to control weeds, reducing impacts on recreational activities and reserve amenities, and aesthetic considerations. Another major determinant influencing weed management in the City's reserves for the last twenty years has been, and continues to be, fire.

## FIRE AND WEED MANAGEMENT

Much of Hobart's native vegetation requires fire to maintain ecosystem functionality but with housing abutting so much bushland, wildfires pose a serious threat to life and property. The City of Hobart has therefore developed a detailed prescribed burning regime across its reserve system, with the dual aims of maintaining broad ecosystem functionality while reducing the threat from, and impacts of, any fires that occur. As fire can have a major influence on weed populations, occurrence and abundance, this burn program has incorporated both pre and post-burn weed controls as a basic and fundamental management requirement.

All of the significant reserves in the City have a Fire Management Plan (FMP), which cover a range of issues such as fire history and fire regimes, weed management, threatened species, fauna management, cultural and heritage values, access and recreation. Each FMP identifies the prescribed burn regime for each Vegetation Management Unit (VMU) in a reserve, a VMU being a distinct management area within a reserve. All FMPs are reviewed and updated every eight to ten years.

FMPs have been developed by consultant botanists and ecologists, with City of Hobart staff contributions largely limited to providing background and supplementary information, including the occurrences of certain weeds. However, virtually no information on weeds had been integrated within Council's spatial data and mapping programs – instead, the information had been compiled and presented in hardcopy form, supplemented by written descriptions for each VMU within each FMP.

## WEED SURVEY AND MAPPING PROJECT

With three FMPs due for review or development within the next few years, a decision was made in early 2012 by the Bushland and Reserves Unit to develop a better understanding of the weed issues across the reserve system, particularly in the three areas where the FMPs were to be developed, and in areas where no detailed weed surveys had ever been undertaken.

Recognising that Council's bushland management field staff had the most in-depth knowledge of weeds and the reserves in the municipality, it was decided that they would conduct the weed surveys, capturing digital data using a hand-held Trimble®, Juno 3D and 5B GPS devices with onboard TerraSync™ software. This approach was seen as an ideal means for the Unit to develop technical capabilities and the skills of staff, and ensure data on weed occurrences was incorporated within Council's GIS spatial data base (using ArcGIS® software by ESRI™).

As virtually all weed control records were in hardcopy form only, the project's initial focus was on creating a digital record (summary) of previous weed control works over the last two decades, arranged by VMUs for each reserve. Once this was completed the focus shifted to the field component.

Initial surveying was undertaken in Bicentennial Reserve, a 250 ha reserve located approximately four kilometres south of the CBD in the suburbs of Mt Nelson and Sandy Bay. This reserve had never been comprehensively surveyed for weeds, and because of its urban and peri-urban elements, challenging terrain and dense vegetation, it presented the ideal location to trial and develop survey and mapping methods, train

staff and develop their skills, and monitor the progress of the survey work.

The surveying was undertaken by following designated transect lines across each VMU. Before going into the field these, along with map imagery, were loaded into the Trimble®. Field staff would then follow the designated transect line through the VMU, looking for, and recording weeds, weed numbers and the size of each infestation into the Trimble®. Each day's field data was then uploaded in the office, for eventual incorporation into Council's ARCGIS mapping program.

Spatial data was collected in vector format – points, lines and polygons. Accuracy varied according to the topography and density of the vegetation but was generally within 3–5 metres. This was not considered a problem as the level of accuracy was noted and the plant species documented (mostly shrubs, which from experience, can usually be relocated with this level of accuracy). Each day's field data would then be uploaded back in the office, for eventual incorporation into Council's spatial database. The data was post-processed with Trimble GPS Pathfinder® Office.

In more accessible sections, transects were evenly spaced at 10–20 m intervals. However, in steeper terrain and areas of very dense vegetation, such transect spacing was deemed impractical so a more flexible approach was developed. In certain VMUs this meant 50–100 m distances between transect lines, in other cases, only a portion of a VMU could be surveyed.

Originally it was intended to have one person do the surveying but it soon became apparent that this was not practical as it was difficult and time consuming for one person to be looking for weeds, and entering detailed data. It was also seen as potentially unsafe to have staff working alone in difficult terrain. It was therefore decided to utilise two staff for surveying, except where VMUs were open and easily traversed.

Another early development was the decision to have staff remove weeds as they surveyed, provided plants were easy to hand-pull or cut down. A record was still made of such plants, as a means of monitoring weed occurrences and documenting controls.

The surveying at Bicentennial Reserve took four to six hrs per day, one or two days per week, over the course of a year. Related office based work usually occupied a further six to eight hrs per week.

Once the survey at Bicentennial Reserve was completed, the data was tested by sending works crews out to locate selected weed occurrences. Once it was verified that the methodology was sound, the data was used to shape the weed management works program in the Reserve for the 2013–2016 period. A review was also undertaken to assess how the surveying had

proceeded, and what elements required modifying before moving the project to other reserves.

The major lesson from the review was the recognition that comprehensive surveying across the whole of a large, physically challenging reserve, was very time consuming; to conduct surveys on a similar scale in other large reserves, was therefore deemed to be impractical. Instead, selective surveying would be used in other large reserves.

The project then moved into surveying Ridge-way Park and Waterworks Reserve, two contiguous reserves occupying the foothills and lower slopes of kunayi-Mt Wellington south-west of the CBD. In these reserves the areas surveyed were selected on several factors such as proximity to weed populations on adjacent private properties, past management history, staff knowledge, gaps in existing knowledge, and accessibility. These surveys took around nine months to complete. The project then surveyed several smaller bushland reserves in Fern Tree and South Hobart before concluding at McRobies Gully and parts of Knocklofty Reserve. These surveys took a further nine months to complete. In each instance a similar survey methodology and resource allocation operated to that used in Bicentennial Reserve.

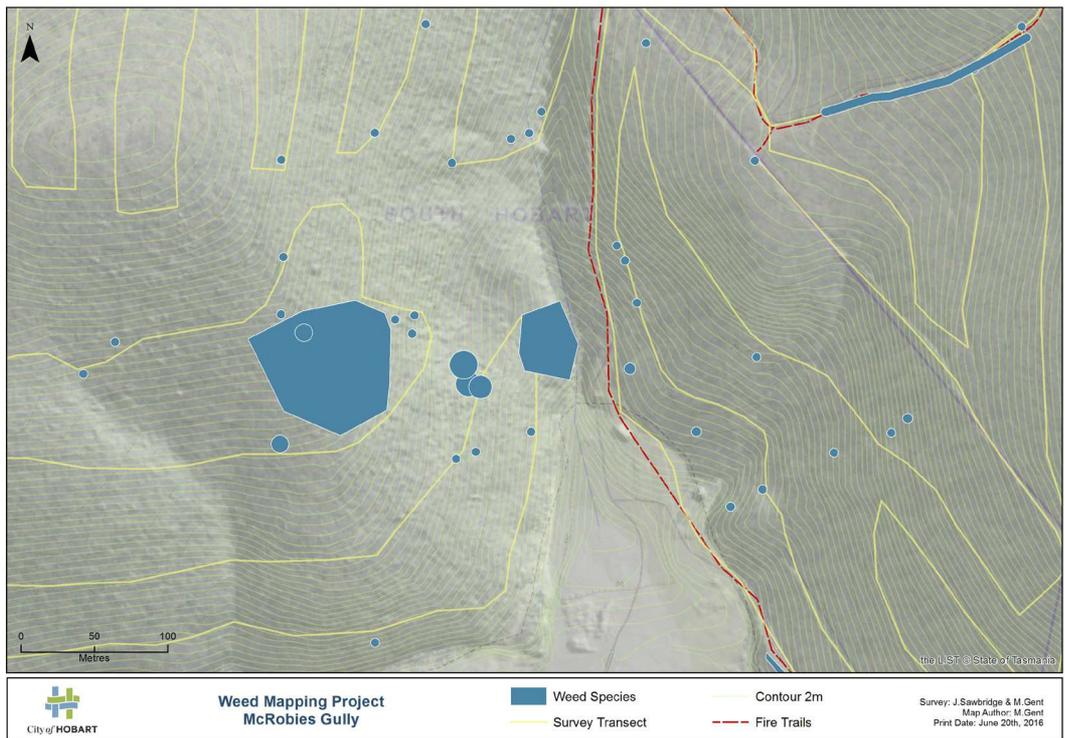
The entire project ran for three and a half years, with the surveying and mapping component taking around two years and nine months to complete. Total staff resources used came to approximately 3600 h, equivalent to around 19 h per week for the life of the project. The total cost was approximately \$144,000, an average of around \$41,000 per annum, almost all of which consisted of staff time and resources (labour and on-costs). At the conclusion of the project a total of approximately 1000 ha of municipal reserve land had been surveyed and mapped.

## CONCLUSIONS

Clearly the project was a snapshot in time, one that will require repeating at some level in future if long-term weed management is to be effective.

That said, the project is considered to have been particularly useful for Council, with several positive outcomes:

- Provided detailed information on weed occurrences in several Council reserves where the level of existing knowledge was poor, inconsistent or non-existent.
- Weed data has been captured digitally for the first time by Council, allowing the information to be readily incorporated into FMPs, and making it easily accessible to staff when planning/implementing prescribed burning and weed management programs.



**Figure 2.** A map (June 2016) showing the location of weeds and the survey transects (in yellow) used at McRobies Gully, City of Hobart.

- Developed a broader and more detailed knowledge of reserves and management issues within Council’s bushland management team.
- Many hundreds of weeds were removed during surveying, saving time and resources in the longer term.
- Staff interest and skills have been significantly developed and enhanced, particularly with technical aspects of surveying and mapping.
- The methodology used provides a broad template and basis for further weed surveys in the municipality in years to come.

However, the project did have some limitations, most notably that not all areas could be surveyed on foot due to the difficult terrain and dense vegetation. This means there are still gaps in determining the possible extent of weeds in some parts of certain reserves. Some of these areas may only be able to be surveyed on foot after a prescribed burn or wildfire passes through, thereby opening the vegetation for a period of time.

One option for future weed surveys in Hobart (and similar rugged areas) is to selectively use an Unmanned Aerial Vehicle (UAV, or drone), accepting that this method also has potential limitations such as range, clarity of image, seasonal timing, identifying target species, cost and the requirement for a certain level of expertise to both use the machines and interpret imagery.

#### ACKNOWLEDGMENTS

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