



THE UNIVERSITY OF
MELBOURNE

Commonwealth Environmental Water Office
Monitoring, Evaluation and Research Program

SOP Vegetation

Standard Operating Procedures
Vegetation v 1.0

23 June 2019



1. Introduction

The Standard Operating Procedure (SOP) for Vegetation Diversity describes the purpose of the annual vegetation surveys on the river bank at selected sites in the lower Goulburn River, how the monitoring will be conducted, who is responsible for specific tasks and how the collected data will be analysed and reported. The document is intended to be taken in the field during any vegetation survey for the MER Program and should be updated throughout the life of the MER Program to reflect any agreed changes to method or procedure.

2. Objective and Hypotheses

Vegetation monitored in the lower Goulburn River will be undertaken to inform Goulburn River Selected Area key evaluation questions and specified Basin-scale evaluation questions (TBD).

Basin-scale evaluation questions:

- To be added once provided by the Basin Scale team (if relevant)

Goulburn River Selected Area evaluation questions:

Prolonged drought, followed by record breaking floods significantly altered the vegetation community on the banks of the lower Goulburn River. Particular effects include the loss of some plant species that were not able to tolerate the extreme conditions and the physical removal of virtually all plants in some sections of the river that experienced severe bank erosion. A wet year in 2016-17, the subsequent dry years in 2017-18 and 2018-19 and also two years of high Inter Valley Transfer (IVT) flows during summer period have also impacted on vegetation. The GBCMA is delivering a combination of summer low flows and spring freshes to try and promote the rehabilitation of native riparian vegetation communities, although IVT flows in summer are impacting on the ability to maintain low summer flows.

Vegetation monitoring in the Goulburn selected area aims to address the following Area specific evaluation questions:

Short-term evaluation questions

- Does the CEW contribution to spring freshes increase seasonal growth of riparian vegetation on the banks of the lower Goulburn River?
- Do flows shift the distribution of riparian vegetation communities on the bank face
- Do responses of bank vegetation differ among sites?
- How does the annual flow regimes (natural, environmental or consumptive) and weather conditions influence the abundance of riparian vegetation communities at the end of the growth season?

Long-term evaluation questions

- What influence do hydraulic variables and bank slope have on the abundance of riparian vegetation communities?
- Is there a positive trend in the abundance of riparian vegetation communities over the medium-long term?

3. Indicators

Vegetation indicators

To address questions relevant to the Goulburn selected area the following vegetation indicators will be monitored.

1. Species abundance

Species abundance will be assessed by measuring the cover of all species in the following strata:

- ground layer (<1 m tall)

From this data the cover of each strata, different plant groups and target taxa will be determined including:

- Cover of all species in the ground layer
- Cover of inundation dependant species
- Cover of grass species
- Cover of target taxa: these include indicator species for Ecological Vegetation Communities or high threat weed
- Cover of terrestrial species

2. Structure

The cover of the following selected structural components will be assessed:

- Groundcover vegetation (<1 m tall);
- Litter (bark, leaves and twigs on ground);
- Lichen crusts and mosses;
- Bare ground
- Logs (>10cm diameter)

Canopy cover (trees > 5 m tall) will not be recorded as this is not a key objective of the flow management for the Goulburn and we propose that other remote based approaches (e.g. drone imagery or Lidar that can survey larger areas would be more appropriate. Understory is mostly absent and is therefore not a sensitive indicator of vegetation outcomes and is not included in monitoring.

Covariates

Hydraulic variables

The vegetation monitoring in the lower Goulburn River will be complemented by Hydrological Assessments as well as Two Dimensional hydraulic models of each site. Hydrological assessments and the hydraulic models that are linked to them are needed to determine what flows have been delivered each year and how long different parts of the river bank have been inundated.

Bank slope

Bank slope at each sampling location will be derived from surveyed elevations along transects obtained in 2016.

4. Locations for Monitoring

Vegetation monitoring on the Goulburn River will be carried out at two monitoring sites in Zone 2: Loch Garry and McCoy's Bridge (Table 2).

Table 1: Location of existing VEFMAP vegetation diversity assessment sites

Site Name	Zone	Zone	Easting	Northing
Loch Gary	2	55	345976	5987892
McCoy's Bridge	2	55	330771	5994884

5. Timing and frequency of sampling

Frequency of sampling

Response of ground layer vegetation (0-1 m) will be monitored before and after the delivery of spring freshes each year and again in Autumn at the end of the growing season and following the cessation of IVT flows.

Timing of sampling

It is expected that spring freshes will favour vegetation growth and recruitment on the bank face in two ways: (1) the deposition of seeds and vegetative fragments (propagules) on the bank face on the receding arm of the flow event and (2) moistening of the soil profile, favouring germination of seed and the growth of extant vegetation. These responses may take up to 8 to 12 weeks (Cottingham et al 2010), although responses over shorter time frames may occur under favourable conditions.

Accordingly, Vegetation assessments will ideally be conducted at each monitoring site immediately before and where possible 8-12 weeks after the delivery of an environmental flow spring fresh of at least two days duration in spring every year for five years.

As flows in the Goulburn River are delivered to meet other environmental objectives (e.g. fish spawning) and inter-valley transfer obligations, there are likely to be constraints that may prevent monitoring occurring at the desired times. As such, some variation in the post-freshes monitoring schedule is likely

In instances where the timing of the post-fresh monitoring cannot be undertaken 8 weeks or more following the end of freshes the program leaders, GBCMA management and the CEWH adviser will be consulted to agree on the optimal timing of monitoring given the prevailing constraints.

Variation to the program

If a spring fresh is not planned in a particular year, the proposed vegetation diversity assessment will be conducted at times that best matches previous monitoring events. These data will provide an understanding of what happens to riparian vegetation if spring freshes are not delivered. If a major flood event occurred between our planned pre- and post –fresh sampling we would not alter our sampling regime. However, if the lower Goulburn River flooded within one month of our post-fresh sampling we would plan to reassess vegetation again 8-12 weeks after the flood event. This would inform how vegetation responses to a major flood differ to freshes. If the lower Goulburn River flooded more than one month after our post-fresh monitoring we would monitor vegetation as soon as possible to establish a new base line and resume our normal sampling regime. Where flood monitoring is triggered it would be necessary to omit a post-fresh monitoring event at some time in the future due to budgetary limitations. We will consult with the other discipline leads, Program Leader, Goulburn Broken CMA and CEWO before deciding which specific monitoring event to omit.

6. Responsibilities and identifying key staff

Field program

Dr Morris and/or Dr Lyndsey Vivian will be responsible for leading and overseeing all field related activities as detailed in

Table 2. Dr Morris and/or Dr Vivian will ensure all staff have a sound understanding of the overall program and in particular the standard operating procedures for vegetation diversity. Dr Morris will be responsible for training all staff in all aspect of vegetation diversity monitoring. Dr Morris or Dr Vivian will demonstrate sampling methods to staff in the field and then supervise staff undertaking these methods until satisfactory competency is demonstrated.

Dr Morris or Dr Vivian will prepare the relevant safety plans, ensure all field staff understand the risks and comply with safety measures. In the field Dr Morris or Dr Lyndsey Vivian will undertake daily site assessments to ensure field sites meet prescribed safety requirements.

Table 2: Nominated persons responsible for field activities.

Field Activities	Nominated Person
Conducting field surveys	Dr Kay Morris/ Dr Lyndsey Vivian (ARI) Technical assistant (GBCMA/ARI)
Relevant training	At least one field staff member should be experienced in plant identification
Safety plans and daily site assessment	Dr Kay Morris/ Dr Lyndsey Vivian (ARI) (preparation) ARI Management (approval)
Confirmation of plant identification as required	Bryan Mole (ARI)
Data Analysis	Dr Kay Morris (ARI)/ Dr Lyndsey Vivian (ARI) Dr Angus Webb (UMelb)
Collating, checking and uploading data	Dr Kay Morris /Dr Lyndsey Vivian Nominated field botanist (ARI)

ARI, Arthur Rylah Institute for Environmental Research, DEPI, Vic

GBCMA, Goulburn Broken Catchment Management Authority

Laboratory requirements (if any)

For species that cannot be identified in the field, herbarium samples will be prepared for species verification by an expert taxonomist at the Arthur Rylah Institute for Environmental Research. Dr Kay Morris will be responsible for the preparation of herbarium samples (see Laboratory methods).

Procedure for transferring knowledge to new team members

Dr Morris will be responsible for ensuring new team members have a sound understanding of the program and are able to competently undertake required tasks. The procedure to induct new staff is as follows:

1. Describe the overall program to the new staff member and introduce to team members.
2. Outline and document the new staff member's roles and responsibilities
3. Explain and provide access to relevant program documents
4. Explain and discuss SOP for vegetation change assessment
5. Explain and discuss the project risk assessment and the required safety measures
6. Demonstrate sampling methods to staff in the field and supervise staff undertaking these methods until satisfactory competency is demonstrated.
7. Explain and demonstrate data collation, analysis, uploading procedures and assist staff in performing these tasks as required

7. Monitoring Methods

Field methods

Sampling approach

At each site bank vegetation will be monitored along 16 transects (8 on each side of the bank) run perpendicular to stream flow at Loch Garry and McCoys Bridge. Along each of these 16 transect vegetation is assessed along multiple 2 m transects that run parallel to stream flow. The location of these 2 m parallel transects are selected to represent a range of elevations. In total 220 parallel transects are sampled.

Perpendicular transects have been previously used to sample vegetation in both the VEFMAP and CEWH STIM programs and can be relocated using GPS coordinates, photos and site markers.

Along each 2 m parallel transect species abundance in the ground layer (<1 m) and understory (>1-5m) is assessed at 10 cm intervals using the point intercept method (Figure 1).

In addition, soil cover types (woody litter, leaf litter, log) are also assessed using the same approach.

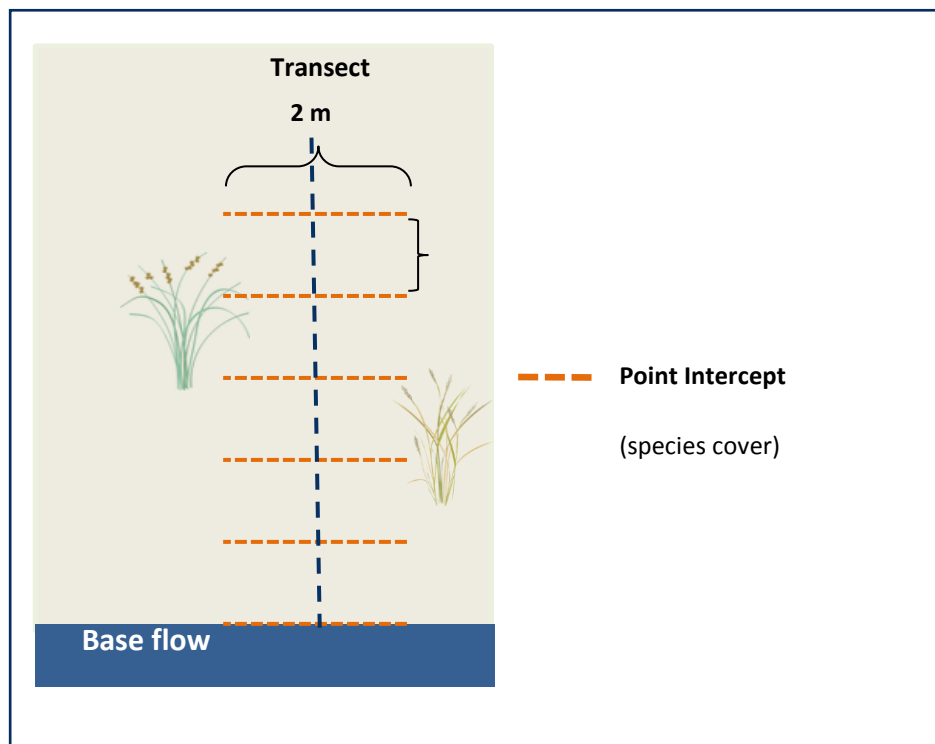


Figure 1 Schematic diagram showing the Vegetation Change sampling method for one transect. The point intercept sampling lines are placed at intervals along the transect line and are used to assess projected foliage cover of species in the ground layer and understory and soil cover types.

Elevation profile

Accurate measures of elevation at 1 m intervals along each perpendicular transect measured in 2016 using a high precision GPS (RTK GPS) were used to select parallel transect that represent a gradient in elevation from the water's edge at base flow to elevation above the level of the spring fresh.

Sample size

Sampling is undertaken at 4-12 parallel transects that represent the range of elevations at each of 16 transects (8 on each side of the bank) at two sites (Loch Garry and McCoys Bridge) in Zone 2. In total 220 parallel transects are sampled.

Species Abundance

Species abundance will be assessed by measuring the cover of species present in the ground layer (<1 m tall). The LTIM Standard Method for vegetation diversity specifies that sampling may be carried out using quadrat or transect based approaches. We have chosen to assess cover along transects using the point intercept method to determine Foliage Projected Cover (FPC), the area covered by a vertical projection of a plant's foliage.

The point intercept method has been used to assess species cover in Australian wetlands by Reid and Quinn (2004) and Raulings et al (2010, 2011). The approach is considered to be more precise than ocular based estimates and therefore more sensitive to change (Godínez-Alvarez et al 2009, Wilson 2011). Moreover, it provides a more objective measure of plant foliage projected cover and therefore there is no need to standardise assessments among users (Wilson 2011). We argue that it would be very difficult to use an ocular based approach to assess foliage projected cover for each species with the precision needed to detect change over the temporal scales required for the LTIM program. The point intercept methods do not detect as many species as ocular based cover estimates (Godínez-Alvarez et al 2009), but this can be compensated for by increased sampling effort.

Point intercept method

FPC of species will be assessed using the point intercept method along parallel transects that span a gradient in elevations and hence inundation histories (Figure1). At each sampling point along a transect, a 2 m measuring tape is placed perpendicular to the transect line (Figure 1). Every 10 cm along this tape the species that intercept a 4 mm diameter rod that is passed vertically into the vegetation is recorded. Percent cover is determined by calculating the total number of points a species is recorded, divided by the total number of points sampled. If a species cannot be identified in the field a herbarium specimen will be collected.

Structure

Cover will be measured using the point intercept method for the following selected structural components:

- Groundcover vegetation (<n 1 m tall);
- Litter (bark, leaves and twigs on ground);
- Lichen crusts and mosses;
- Bare ground
- Logs

Live and dead canopy (trees > 5 m tall) will not be recorded as this is not a key objective of the flow management for the Goulburn and we propose that other remote based approaches (e.g. drone imagery or Lidar) that can survey larger areas are more appropriate for this indicator if required. Understorey is mostly absent and is therefore not a sensitive indicator of vegetation outcomes.

Laboratory methods

Herbarium samples will be prepared in accordance with the guidelines provide by the Royal Botanic Gardens Victoria (see <http://www.rbg.vic.gov.au/science/information-and-resources/national-herbarium-of-victoria/preparing-herbarium-specimens>). All samples should be labelled with the collector's name collection date, collection location and a unique identifier. Every effort should be made to collect flowers and or fruits of unknown specimens to assist identification. For unknown small plants, the whole plant (including underground tissues) should be collected. All samples taken for verification should be pressed when they are fresh taking care to space out structures and to present both sides of foliage.

8. Quality assurance/ quality control

Data capture and storage

Data recording sheets developed by Dr Kay Morris will ensure data are collected in a standardised manner. All data sheets will be checked for legibility and completeness immediately after each transect is sampled. Field sheets will be electronically scanned immediately upon return and uploaded to the central LTIM database on the University of Melbourne server. Data will be entered onto an Excel spreadsheet upon return from the field and checked for completeness and for errors such as spelling of species names.

Species identification

Where necessary herbarium samples will be prepared to confirm species identification by experienced taxonomist.

9. Data Analysis

Structure

The percent cover of each structural element will be calculated using data collected from the point intercept method and entered on spreadsheets following the format and guidelines provided in LTIM Data Standard (Brooks and Wealands 2014). It is calculated by dividing the total number of times a structural component was recorded by the total number of points sampled (i.e. $n=20$) at each sampling unit (i.e. the transect line that runs parallel to stream flow at different elevations along each transect).

Species abundance

Species abundance will be reported as the percent cover of each species in the ground layer or understory layer at each sampling unit along each transect. It is calculated for each structural layer by dividing the total number of times a species was recorded along a sampling unit (ie. horizontal transect line) by the total number of points sampled (i.e. n= 20). The cover of each species in each structural layer will be entered on spreadsheets following the format and guidelines provided in LTIM Data Standard (Brooks and Wealands 2014).

Area scale analyses

To evaluate selected area KEQs we will assess vegetation responses in two ways.

First, we will assess if short term (event based sampling) and longer term (>5 years) response trajectories indicate that vegetation cover is increasing.

Second, we recognise that for a particular river flow regime the duration and frequency of inundation experienced by vegetation will differ with their position along the elevation gradient. Understanding the relationships between river flow regime, inundation history and vegetation assemblages will enable us to predict the vegetation assemblages that are likely to be favoured by different levels of environmental watering. Inundation histories of each vegetation sampling location will be developed using the elevation data collected at each sampling location (RTK GPS) and our 2-D hydraulic models.

10. Reporting

All field data sheets will be scanned and stored on a secure government server by the discipline lead (Dr. K Morris) within 1-2 weeks of each sampling event.

Data files that comply with LTIM Data Standard (Brooks and Wealands 2014) will be loaded on the LTIM MDMS by the discipline lead (Dr K Morris).

11. References

Brooks, S. & Wealands, S. (2014) Commonwealth Environmental Water Office Long Term Intervention Monitoring Project: Data Standard. Report prepared for the Commonwealth Environmental Water Office by The Murray-Darling Freshwater Research Centre, MDFRC Publication 29.3/2013 Revised December 2014.

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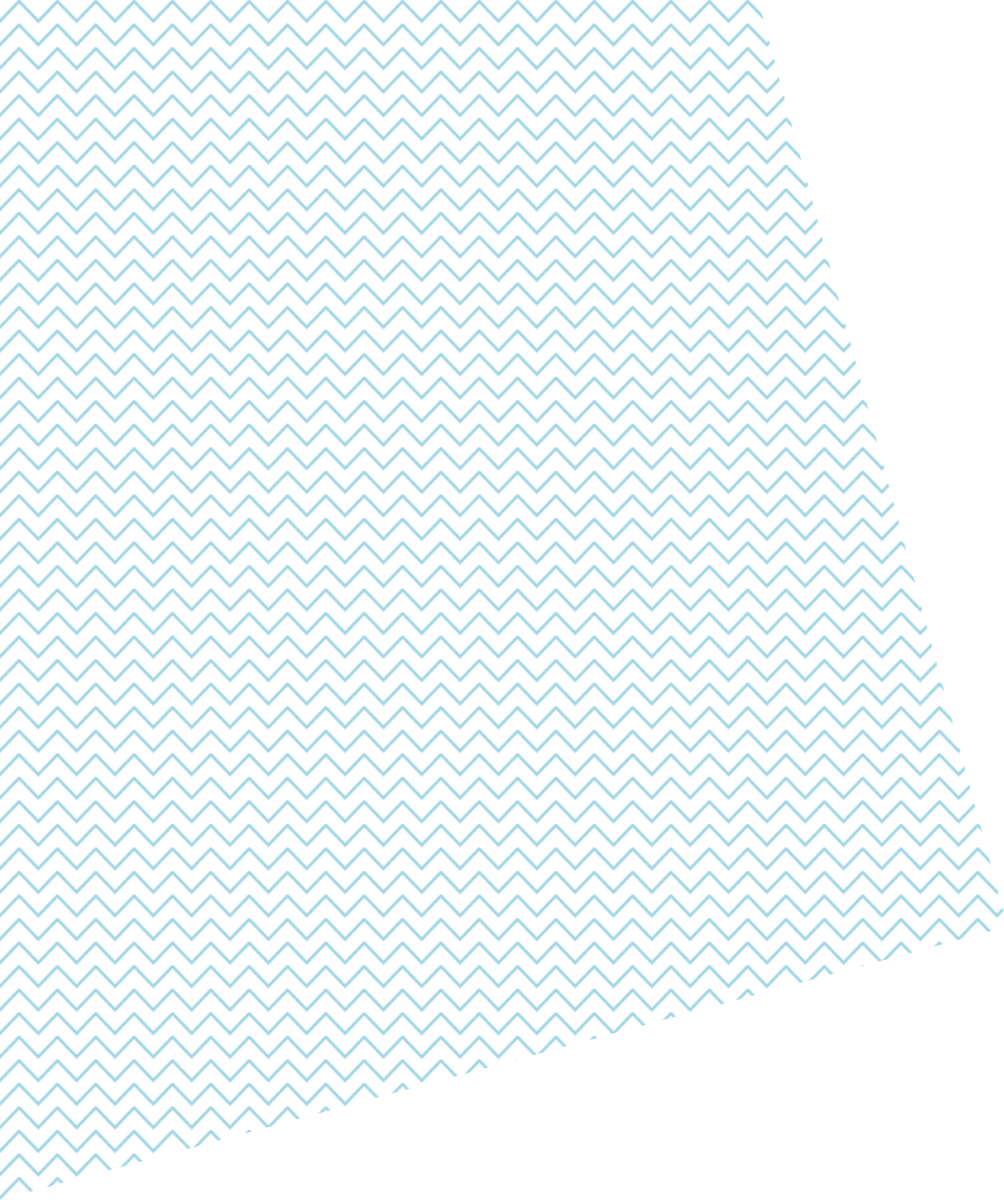
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