

Standard Operating Procedures for *Vegetation Diversity*
Version 1.2

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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 LTIM and should be updated throughout the life of the Long Term Intervention Monitoring Program to reflect any agreed changes to method or procedure.

Objectives and hypotheses

Vegetation diversity will be monitored in the lower Goulburn River to inform the specified Basin-scale questions and evaluation questions relevant to the Goulburn River Selected Area.

Basin-scale evaluation questions:

Short-term (one-year) and long-term (five year) questions:

- What did Commonwealth environmental water contribute to vegetation species diversity?
- What did Commonwealth environmental water contribute to vegetation community diversity?

Goulburn River Selected Area evaluation questions:

Prolonged drought, followed by record breaking floods has 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. The GBCMA is delivering a combination of summer low flows and spring freshes to try and promote the rehabilitation of native riparian vegetation communities.

We will aim to use the vegetation diversity monitoring to address the following Area specific evaluation questions:

Long-term evaluation questions

- What has CEW contributed to the recovery (measured through species richness, plant cover and recruitment) of riparian vegetation communities on the banks of the lower Goulburn River that have been impacted by drought and flood and how do those responses vary over time?
- How do vegetation responses to CEW delivery vary between sites with different channel features and different bank condition?

Short-term evaluation questions

- Does the CEW contribution to spring freshes and high flows trigger germination and new growth of native riparian vegetation on the banks of the lower Goulburn River?
- How does CEW delivered as low flows and freshes at other times of the year contribute to maintaining new growth and recruitment on the banks of the lower Goulburn River?

Indicators

Vegetation Diversity is a Category II indicator for the LTIM. It does not need to be assessed in all Selected Areas, but where it is assessed it needs to follow the Standard Method that the M&E Advisor has prescribed.

Vegetation Diversity assessments include three sub-indices: structure, tree recruitment density, and species abundance.. Species abundance (measured as foliage projected cover) is designated as mandatory by the CEWH. Tree recruitment and structure are designated as optional by the CEWH but have been selected for monitoring in the lower Goulburn River Selected Area.

The vegetation diversity assessment in the lower Goulburn River will be complemented by Hydrological Assessments (Category I Indicator) as well as Two Dimensional hydraulic models of each site and measurements of Bank Erosion (both Category III Indicators). Hydrological assessments and the mandated one dimensional 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. Two dimensional hydraulic models allow us to quantify the distribution and quality of slackwater and high velocity habitats at each site under different flow magnitudes and therefore assess whether those factors influence plant recruitment or re-establishment. Monitoring bank condition will enable us to evaluate how bank erosion modifies vegetation responses to Commonwealth environmental water. Significant bank erosion has been noted in the lower Goulburn River in recent years and measuring it will help us understand observed vegetation responses to environmental flow releases. The Vegetation Diversity sub-indices and other LTIM Indicators that will complement the Vegetation Diversity Assessment in the lower Goulburn River are summarised in Table 1.

The vegetation diversity assessment described in this SOP will help the stream metabolism, fish and macroinvertebrate assessments that are also planned for the lower Goulburn River. Riparian vegetation influences stream metabolism by providing a substrate (i.e. exposed root masses, as well as submerged stems and leaves) for biofilms, contributing carbon through leaf litter and modifying rates of respiration and photosynthesis through its effect on stream temperature. Bank vegetation also provides physical habitat, shelter and/or food for fish and macroinvertebrates.

Table 1. Vegetation Diversity sub-indices and complementary Category I and Category II Indicators used to evaluate the effect of Commonwealth environmental water on bank vegetation.

	Category I Indicators	Vegetation Diversity Sub-indices					Category III Indicators	
M&E Question	River hydrology	ANAE vegetation type	Species abundance	Functional group	Tree recruitment	Structure	2D Hydraulic model	Bank condition
Basin scale questions								
What did CEW contribute to species diversity?								
What did CEW contribute to vegetation community diversity								
Selected Area questions : Long term								
What has CEW contributed to the recovery of riparian vegetation (measured through species richness, plant cover and recruitment) communities on the banks of the lower Goulburn River								
How do vegetation responses to CEW delivery vary between sites with different channel features and different bank condition?								
Selected Area questions: Short term								
Does the CEW contribution to spring freshes and high flows trigger germination and new growth of native riparian vegetation on the banks of the lower Goulburn River								
How does CEW delivered as low flows and freshes at other times of the year contribute to maintaining new growth and recruitment on the banks of the lower Goulburn River?								



Locations for monitoring

Two monitoring sites are needed for each Zone that is to be assessed, however only Zone 2 will be monitored in this program. Vegetation diversity has been monitored at four sites in the lower Goulburn River (see Table 2) at least once every two years since 2008 for the Victorian Environmental Flows Monitoring Assessment Program (VEFMAP) and the Commonwealth Environmental Water Office Short Term Monitoring Program. Vegetation diversity assessments for the LTIM will use the established VEFMAP sites in Zone 2, for the following reasons:

- Elevation cross section surveys and hydrological modelling have been undertaken at these sites under the VEFMAP program
- Historical vegetation data is available at all sites (VEFMAP 2008, 2010, 2012; CEWH STIM 2013, 2014)
- The sites are considered representative of the Lower Goulburn River

Table 2: Location of existing VEFMAP vegetation diversity assessment sites

Site Name	Zone	Zone	Easting	Northing
Moss Road	1	55	337452	5936179
Darcy's Track-Gardiner Swamp	1	55	351770	5965722
Loch Gary	2	55	345976	5987892
McCoy's Bridge	2	55	330771	5994884

NB. Only sites in Zone 2 will be monitored under the LTIMP

Timing and frequency of sampling

Frequency of sampling

Response of groundcover vegetation (0-1 m) to the delivery of freshes is expected over short time frames (weeks-months) and should be monitored both before and after the delivery of freshes each year. However, in the Goulburn, significant responses of understorey (1-5 m) and canopy (> 5 m) vegetation are not anticipated as freshes will not result in the inundation of the floodplain. As such, understorey and canopy cover will only be assessed once a year prior to the delivery of freshes to assess long term changes and to provide covariate data to interpret groundcover responses to freshes.

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 Diversity 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 the first year of sampling the need to calibrate data against historical data collected through the VEFMAP program may also impose some constraints on the timing of monitoring.

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.

Responsibilities – identifying key staff

Field program

Dr Morris will be responsible for leading and overseeing all field related activities as detailed in Table 3. Dr Morris 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 will demonstrate sampling methods to staff in the field and then supervise staff undertaking these methods until satisfactory competency is demonstrated.

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

Table 3: Nominated persons responsible for field based activities.

Field Activities	Nominated Person
Conducting field surveys	Dr Kay Morris (ARI) lead 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 (ARI) (preparation) ARI Management (approval)
Confirmation of plant identification as required	Expert botanist (ARI)
Data Analysis	Dr Kay Morris (ARI) Dr Angus Webb (UMelb)
Collating, checking and uploading data	Dr Kay Morris 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 species diversity
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

Monitoring methods

Field methods

Sampling approach

At each site bank vegetation will be assessed along 7-8 (on each bank) established transects that span an elevation profile from the water's edge at base flow to mid bank. These transects have been used to sample vegetation in both the VEFMAP and CEWH STIM programs and can be relocated using GPS coordinates, photos and site markers. Staff from the CEWH STIM program will be available to assist with locating transects if required

Species abundance and vegetation structure will be assessed at intervals along each transect using the point intercept method. Tree recruitment density will be assessed within 1 m long x 2 m wide quadrats placed at 1 m intervals along the transect (Figure 1).

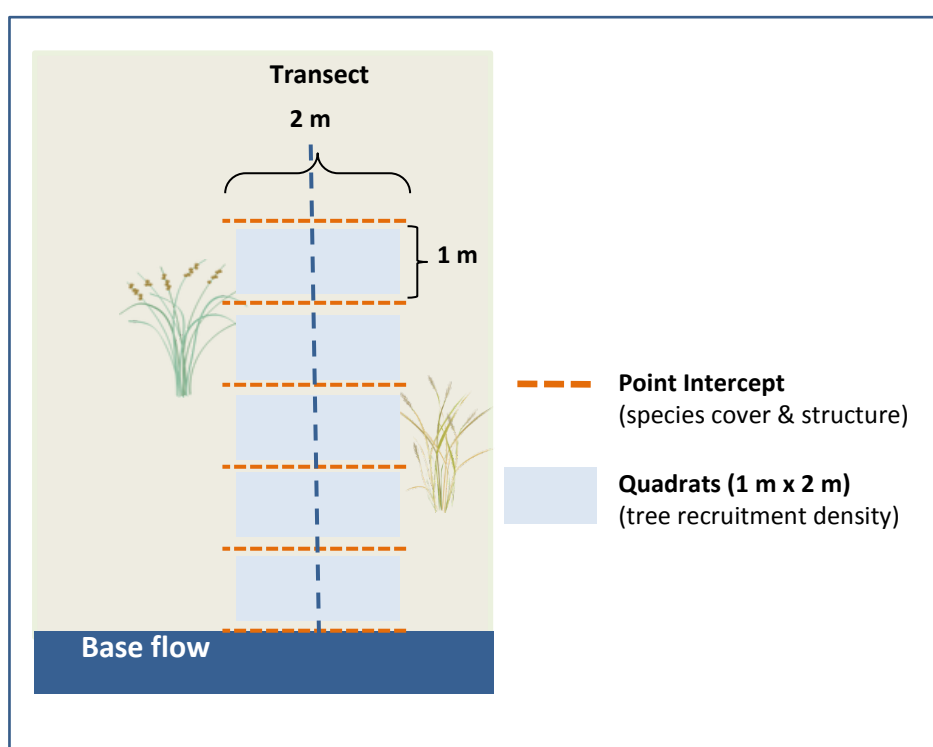


Figure 1 Schematic diagram showing the Vegetation Diversity sampling method for one transect. The point intercept sampling lines are placed at intervals along the transect line and are used to assess projected foliage cover of species in each structural layer (groundcover, understorey and canopy). Tree recruitment is assessed within quadrats placed at the top, middle and bottom of each transect.

Elevation profile

Accurate measures of elevation at each vegetation monitoring point are needed to determine inundation patterns (i.e. timing, depth and duration) under different flow regimes. A high precision GPS (RTK GPS) will be used to establish precise and detailed elevation profiles at each vegetation sampling location along each transect at each site. Elevation measurements using the RTK GPS are made quickly and simply by holding the instrument on the desired measurement location. Experience in surveying is not required and only 30 minute training session is needed to competently operate the instrument. Staff carrying out vegetation diversity measurements will perform elevation measurements following training by equipment technicians.

Sample size

Sampling effort needs to be sufficient to reliably capture species richness in the Selected Area. For each sampling event we will produce species accumulation curves and conduct Chao analyses (Chao et al. 2009) to assess how well our sampling effort captures species richness. The results of these assessments will be analysed in the first year so that sampling effort can be adjusted in subsequent surveys if needed.

Species Abundance

Foliage Projected Cover (FPC), which is the area covered by a vertical projection of a plant's foliage, will be used to assess species abundance. FPC will apply to all vegetation measures (e.g. trees, shrubs, ground, individual species, etc.) used in the monitoring program. 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.

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. Our analysis of sampling effort (described above) will ensure sampling is sufficient to detect most of the species present at each monitoring site.

Point intercept method

FPC of species will be assessed using the point intercept method at appropriate intervals along each transect to ensure a span of elevations and hence inundation histories are represented (Figure1). In the first year of sampling, FPC of species was assessed at 1 m intervals along each transect to an elevation visually assessed to be 3 m above base flow. Following elevation surveys conducted in 2015, it has been possible to strategically sample along transects to ensure the full range of elevations are sampled.

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. FPC for overhead vegetation is determined in the same manner using a crosswire sighting periscope held vertically at each pointing location. Due to the time constraints canopy cover is only assessed at alternate sampling points along each transect,

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 to enable identification by an experienced taxonomist.

Calibration of data with existing VEFMAP and CEWH STIM data

The proposed point intercept method for assessing plant cover differs to that currently applied in VEFMAP and the CEWH STIM program, which both use Bruan-Blanquet cover estimates within 1 m x 1m quadrats. To enable the VEFMAP and CEWH STIM data to be calibrated against the point intersect method and used for the LTIM monitoring by VEFMAP and the CEWH LTIM was undertaken at the same time in the first year providing an opportunity to directly compare methods.

A comparison between approaches will enable us to calibrate historical data and determine whether the point intercept method does provide greater precision and improved power. The results of that analysis will be used to revise our monitoring approach to ensure the optimal design is applied. We believe this evaluation will provide important insights into appropriate sampling approaches for other State and Commonwealth vegetation monitoring programs.

Structure

FPC of each specified structural component of vegetation will be measured using the point intercept method as described above for species cover. Structure is measured as percentage projected foliage cover of the following components:

- Live canopy (trees > 5 m tall);
- Dead canopy (trees > 5 m tall);



- Understorey (trees and shrubs and non-woody plants 1 – 5 m tall);
- Groundcover layer (plants shorter than 1 m tall);
- Litter (bark, leaves and twigs on ground);
- Lichen crusts and mosses;
- Bare ground
- Logs

Although the Standard Method specifies that counts of standing dead trees and linear metres of fallen logs > 10 cm diameter should also be recorded, this requires a quadrat based sampling approach which we have not adopted. To capture similar information we will report the percent cover of logs and percent cover of live and dead foliage of canopy trees using the point intercept method.

Tree recruitment

Recruits are individual plants, which may be seedlings or re-growth from a woody rootstock after grazing.

Recruits are to be counted in each of three height classes

- 20 – 50 cm
- 50 – 130 cm
- 1.3 – 3 m

Recruits less than 20 cm tall are not counted.

Mandatory species include River Red Gum, Black Box, Coolibah and River Cooba. Only River Red Gum occurs at the sampling locations being assessed in this program. Silver Wattle (*Acacia dealbata*) is a common riparian species along the Goulburn River so recruits of this species are also included in the monitoring.

Tree recruitment density is measured as counts of riparian tree species recruits within quadrats placed along each transect. In 2014, 1 m x 1 m quadrats were placed at the top, middle and bottom of each transect. In 2015 the number of recruits found was very low, and in response the sampling effort has been increased. Recruits are now assessed within 1 m long x 2 m wide (horizontal to river flow) quadrats every 1 m along the transect line producing in a continuous 2 m wide belt transect.

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.

Quality Assurance/Quality Control

Data capture and storage

Data recording sheets developed by Dr Kay Morris (see Attachment 1) 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.



Data analysis

Structure

Structure will be reported as summary statistics (mean, standard deviation, median, 10th and 90th percentiles) per site for basin scale reporting for the following:

- Live canopy (trees > 5 m tall);
- Dead canopy (trees > 5 m tall);
- Understorey (trees and shrubs and non-woody plants 1 – 5 m tall);
- Groundcover layer (plants shorter than 1 m tall);
- Litter (bark, leaves and twigs on ground);
- Lichen crusts and mosses;
- Bare ground
- Logs

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 each structural layer (i.e. canopy, understorey and groundcover) 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).

Tree recruitment density

Tree recruitment density will be reported as number of seedlings of each species in each of the height categories per m² of land surface at each sampling unit:

- 20 – 50 cm
- 50 – 130 cm
- 1.3 – 3 m

Summary statistics of tree density m⁻² per site will be calculated from transect data sheets (Attachment 1). For each sampling unit, the total number of recruits will be divided by the surveyed quadrat area. Tree recruitment density data will be entered on spreadsheets following the format and guidelines provided in LTIM Data Standard (Brooks and Wealands 2014).

Area scale analyses

To examine area level M&E question we will assess vegetation responses to CEW in two ways.

First, we will assess if short term (event based sampling) and longer term (1-5 years) response trajectories of vegetation differs between sites. As part of the broader M&E plan for the Goulburn River, a subset of transects may also have bank condition scores (see Bank condition SOP). For these transects, we will assess if bank condition influences short or long term vegetation responses.

Second, we will compare responses to watering at different elevations in the channel and in different plant communities. 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. In addition 2D hydraulic modelling will allow us to identify vegetation sampling locations that experience slackwater or high velocity flows allowing us to



assess how flow velocity shapes vegetation assemblages. For the subset of sampling sites where bank condition has been scored the influence of bank condition on vegetation response to inundation can be incorporated into predictive models.

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).

In the data structure provided, the spatial unit for which data are reported for vegetation diversity is known as an 'assessment unit', which for species abundance and structure is equivalent to the location of the sampling transect placed at different elevations along each transect. For tree recruitment density the sampling unit is the location of the sampled quadrat along each transect. Each row of data provided for vegetation diversity will identify the assessment unit, the temporal extent of the data and a number of additional variables (as guided by the Standard Method). The exact data structure for vegetation diversity is maintained and communicated in the LTIM Data Standard (Brooks and Wealands 2014) and will be enforced by the MDMS when data are submitted.

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Attachment 1 Vegetation Diversity field data sheets

Attachment 1.1 Vegetation community type

Stream or wetland ID:		Date:	
Observer 1:		Observer 2:	
Notes:			

Location

[illegible]

CEWH LTIM Data Sheet 2015: VEGETATION DIVERSITY

Codes for soil surface cover type and soil wetness

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Attachment 1.3 Species record sheet

CEWH LTIM Data 2015: Species record Sheet

[illegible]

CEWH LTIM Data Sheet 2015: TREE RECRUITMENT DENSITY



Attachment 2 Post-flood monitoring in 2016-17

Background

In 2016/17, high flows occurred on the Goulburn River in early August peaking at 25 000 ML/d. High flows persisted into November preventing the pre-fresh vegetation survey from being carried out. It is likely that the magnitude and duration of high flows would have exerted a detrimental effect on the re-establishing vegetation on the lower banks, potentially re-setting the system.

In light of this natural event we have revised the monitoring schedule. The monitoring activities and rationale are detailed in the table below. The GBCMA and the Victorian Environmental Flow Monitoring Assessment Program (VEFMAP) program will also be funding additional activities that will complement the LTIM monitoring activities as described below.

Monitoring program 2016/17

Table. LTIM Vegetation monitoring and complementary studies on the Goulburn River 2016/17

Activity	Date	Funding Provider and (\$K)	Service provider	Rationale
LTIM Vegetation surveys McCoys and Loch Garry	12 & 13 Dec 2016	LTIM \$8K	ARI/ GBCMA	<p>This is the equivalent of the normal 'post-flow' sampling event in spring.</p> <p>Data will provide a new base line post natural high flows</p> <p>Provide a comparison dataset to the Dec samplings in 2014 and 2015 to assess long-term responses to annual flow regime.</p> <p>No canopy data will be collected as this is normally only done in Sept. There is little value in doing this in Dec as there are no comparative data. Canopy cover will be reassessed in Sept 2017</p>
LTIM Vegetation surveys McCoys and Loch Garry	Feb/March date TBD 2017	LTIM \$8K	ARI/ GBCMA	<p>This sampling event will use the funds that would normally have been used for the September sampling</p> <p>Data will inform recovery trajectory and inform future environmental water planning to will facilitate recovery and prevent any adverse responses to flow delivered for other objectives or delivery requirements (IVT)</p>
Elevation surveys McCoys and Loch Garry	5& 6 of Dec 2016	GBCMA (VEFAMP carry over funds) \$7.4K	UAV Australia/ ARI	<p>High flows are likely to have altered the bank profile since it was measure in Dec 2014.</p> <p>Accurate and up to date elevation data are needed as they allow vegetation responses to be correlated with elevation and hence inundation regimes derived from hydrological models.</p>

Activity	Date	Funding Provider and (\$K)	Service provider	Rationale
				This is a valuable additional co-contribution from GBCMA that will improve the accuracy of post-flood vegetation analyses and may also have benefits for 2D hydraulic models.
Bank soil moisture study at McCoys and Loch Garry	6 Dec as initial sampling, with subsequent sampling still to be determined	GBCMA 14K	UoM/ARI	<p>A key objective of environmental water delivery in the Goulburn and elsewhere is to recharge banks moisture stores to maintain bank vegetation. Relationships between antecedent conditions, flow events, and bank moisture, and between bank moisture and vegetation are not known.</p> <p>The basin matter vegetation lead (Sam Capon) has been promoting the benefits of soil moisture sampling since late 2014, but by that stage all funds were allocated. This additional contribution from GBCMA will be of great benefit to the area-scale and basin-scale evaluations.</p>

