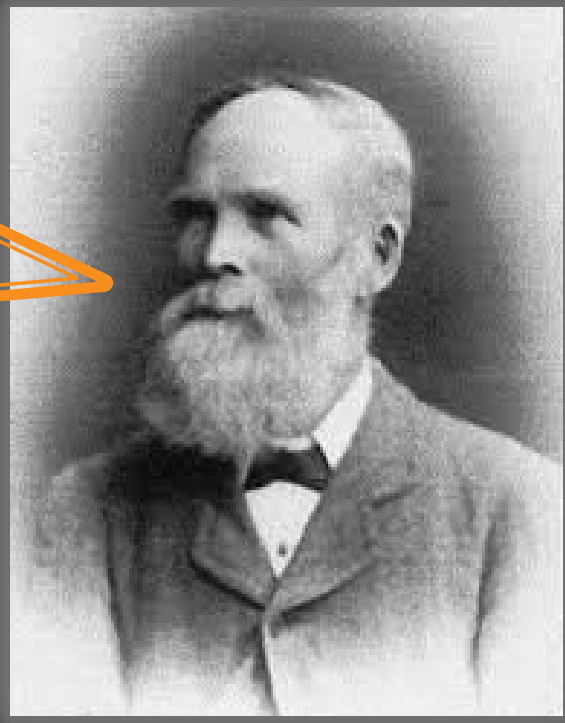
Native Grasses Forum 2016

Shaun Kennedy
Specialist - Vegetation Services
SA Water

Native Grasses
~ for ~
Restoration Hipsters



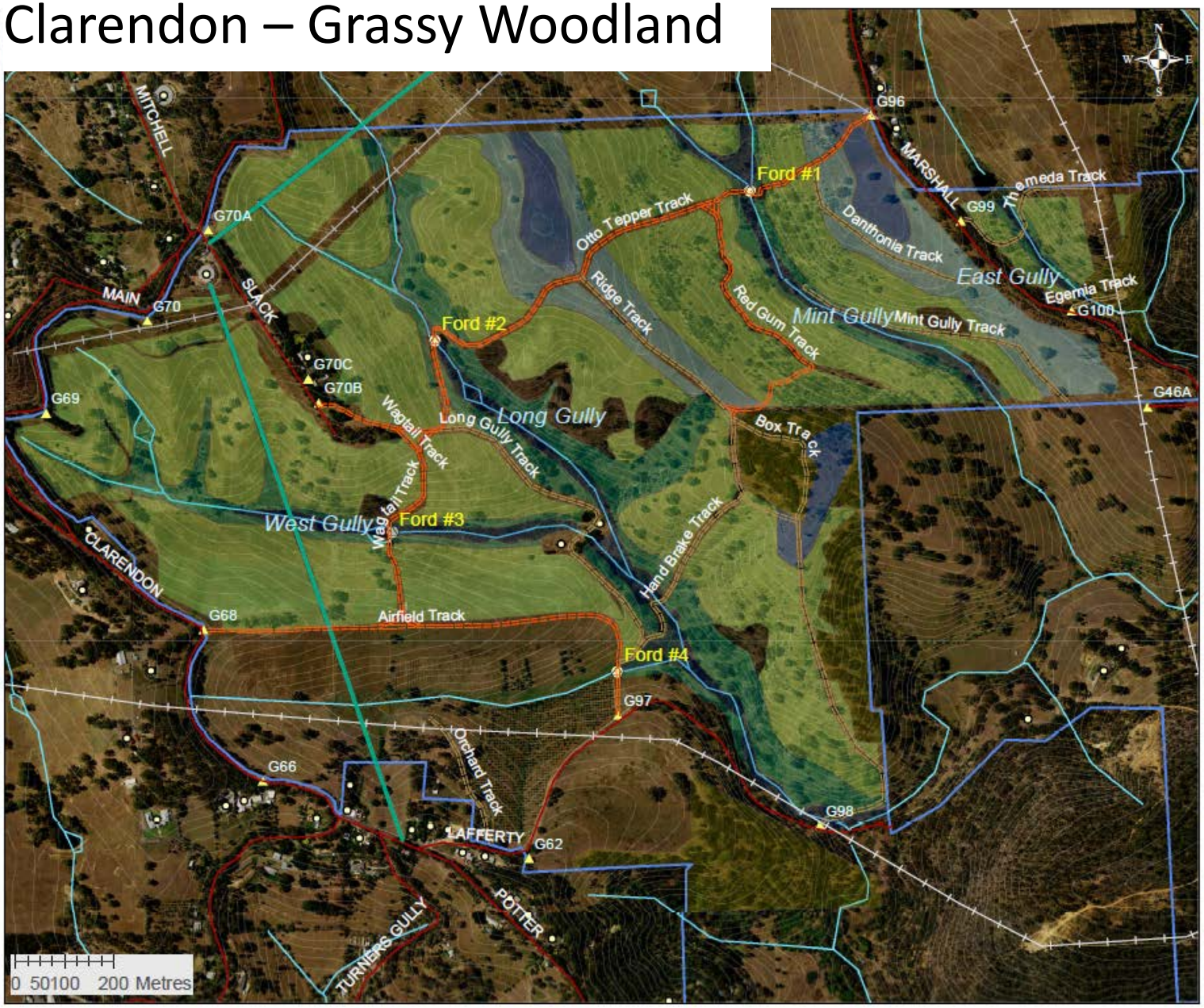
A tailored approach considering…

- ***Nutrients***
- ***Weed seed bank***
- ***Plant species diversity***

Outline

- Case study snap shots
- A word on **P**lanning restoration work
- Project design considerations
  - Nutrients
  - Weed seed bank
  - Species diversity
- Application to project case studies outcomes

Clarendon – Grassy Woodland



CLARENDON RESERVOIR RESERVE

CARBON / ECOLOGICAL RESTORATION PROJECT

FIRE TRACKS MAY 2014

Legend

Clarendon_Tracks_Kennedy

CURCLASS

- Minor Track
- ServiceTrack
- Water Main
- ETSA Transmission

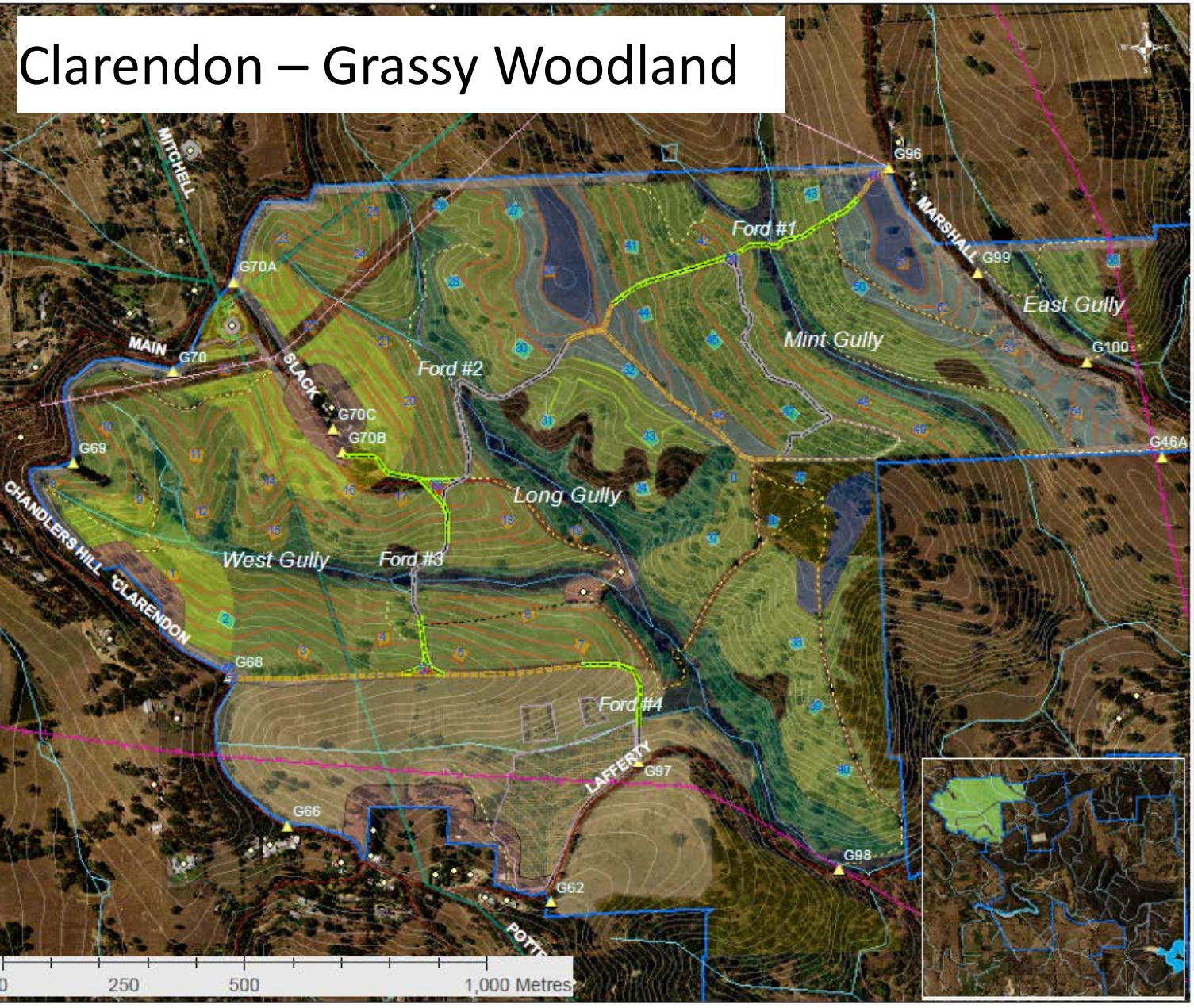
Reveg Zones

Type

- Weeded Area
- Red Gum Swamp 250
- Red Gum Wdl 250
- Blue Gum - Manna Gum Wdl 251
- Blue Gum Wdl 249
- Grey Box Wdl 220
- Remnant mgt
- SAW Reserve Boundary
- Roads
- Fords
- Assets
- GatesMB
- Contours 5 m

S Kennedy, May 2014
Aerial Photo: Aerometrix 2011
Projection: LCC
Coordinate System: GDA 1994
Copyright SA Water Corporation 2014

Clarendon – Grassy Woodland



CLARENDON CARBON BIOSEQUESTRATION - WORK ZONES -

Legend

Reveg Zones
- Weeded Area
- Red Gum Swamp 250
- Red Gum Wdl 250
- Blue Gum - Manna Gum Wdl 251
- Blue Gum Wdl 249
- Grey Box Wdl 220
- Remnant mgt

BioD Patch
- Native pasture
- Scraped
- Scraped and grass sown
- Assets

Alleys - Native Grass
- Scraped and Sown
- Slashed native pasture

Tracks
- Minor Fire Track - Gravel, Crowned
- Minor Fire Track - Gravel, Cut in
- Minor Fire Track - Dirt
- Service Track
- Abandoned track
- ElectraNet Transmission
- ETSA Transmission

Fuel management
- Asset Protection Zone
- Fuel break
- Buffer zone
- Hay cut
- Watercourse
- Transmission Main
- Roads
- Contours 5 m
- Apple orchard - abandoned
- SAW Reserve Boundary

SA Water

March 2013 S Kennedy
Aerial Photo: Aerometrix 2011
Projection: LCC
Coordinate System: GDA 1994
Copyright SA Water Corporation 2012

Clarendon – Native Grass Alleys

[(Nov 2

Grass fire fuel load

Rytidosperma pilosum, R. geniculatum, R. racemosum versus Avena sp. etc

Clarendon Nov 2015 – John Stafford harvest

Noarlunga Downs Wetland

Noarlunga Downs Wetland – Mallee-box Wdl

Noarlunga Downs Wetland – erosion control

Noarlunga Downs Wetland – Interp trail

Noarlunga Downs Wetland – interp trail

Noarlunga Downs Wetland – interp trail

Murray Bridge East – Abandoned waste water lagoon (350 mm rainfall)

Murray Bridge East

Murray Bridge East

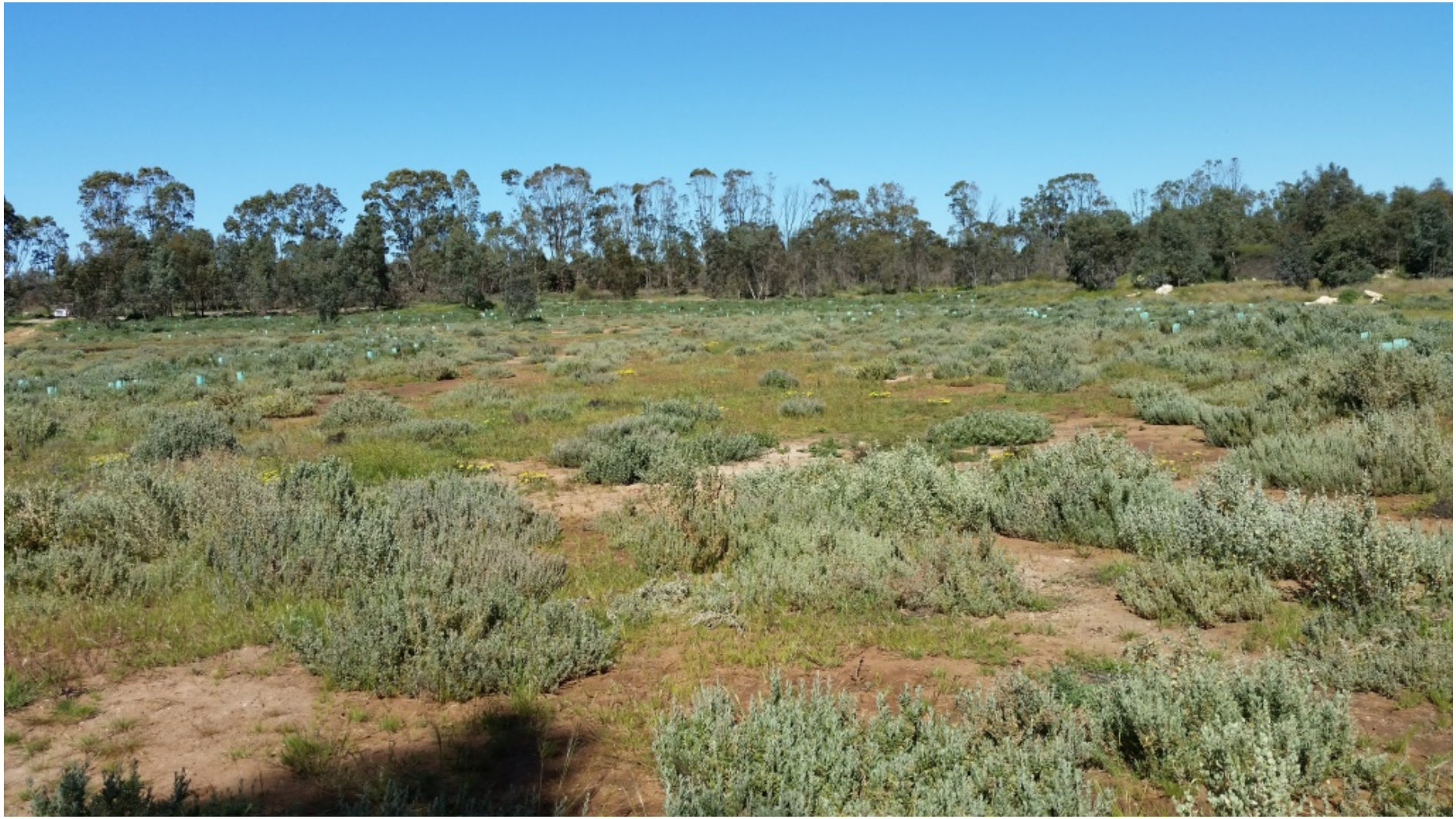
January 2016

Murray Bridge East
Oct 2016

Murray Bridge East
Oct 2016

Murray Bridge East
Oct 2016

Murray Bridge East
Oct 2016



Hahndorf SPS – post construction reinstatement Oct 2012

Hahndorf SPS – post construction reinstatement Feb 2014

Hahndorf SPS – post construction reinstatement June 2014

Hahndorf SPS – post construction reinstatement Jan 2015

Outline

- Case study snap shots
- A word on **P**lanning restoration work
- Project design considerations
  - Nutrients
  - Weed seed bank
  - Species diversity
- Application to project case studies outcomes

Habitat Restoration Planning Guide for Natural Resource Managers

Department of Environment and Natural Resources

Government of South Australia

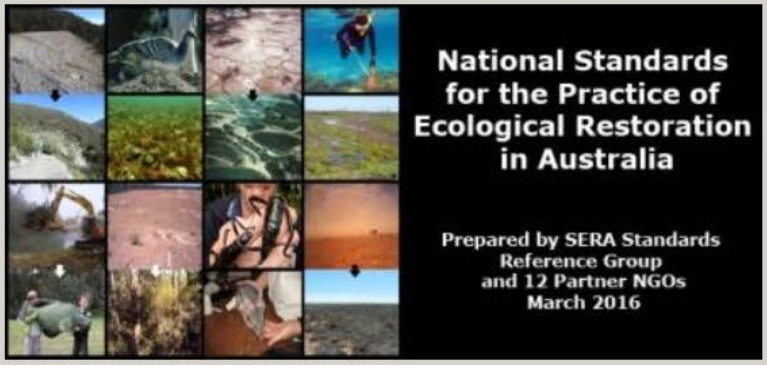
www.environment.sa.gov.au

Contents

- Home
- About SERA
- The SERA Board and Executive Committee
- Conferences
- Industry Communication
- Affiliates and NGOs
- Early Career and Students
- International development
- Carbon and Ecological Restoration
- Resources and Primer
- Case Studies
- National Standards
- Membership
- Contact us

NATIONAL STANDARDS FOR ECOLOGICAL RESTORATION

Click here to read the media release of 18 July 2016.



SERA announced the launch of the National Standards for Ecological Restoration on 15 March 2016 at the National Seed Science Forum, Mt Annan Botanic Gardens, Sydney. Any enquiries may be emailed to tein.mcdonald@seraustralasia.com

The Standards have been designed to encourage all restoration and rehabilitation projects in Australia to reach their highest potential.

AABR

Australian Institute of Landscape Architects 1966/2016

BUSH HERITAGE AUSTRALIA

AUSTRALIAN SEEDBANK PARTNERSHIP

Australian Network for Plant Conservation Inc

Trees For Life

wetlandcare australia

gondwana link

Indigenous Flora and Fauna Association

Trust for Nature

Greening Australia

The Nature Conservancy Australia

SERA's National Standards for Ecological Restoration

"The Standards identifies the principles underpinning restoration philosophies and methods, and outlines the steps required to plan, implement, monitor and evaluate a restoration project to increase the likelihood of its success."

SERA's Key Principles of Ecological Restoration Practice

1. **Ecological restoration practice is based on an appropriate local indigenous reference ecosystem**

2. **Restoration inputs will be dictated by level of resilience and degradation**

3. **Recovery of ecosystem attributes is facilitated by identifying clear targets, goals and objectives**

4. **Full recovery is the goal of ecological restoration but outcomes may take long timeframes**

5. **Restoration science and practice are synergistic**

6. **Social aspects are critical to successful ecological restoration**

Ecosystem Amazeballs

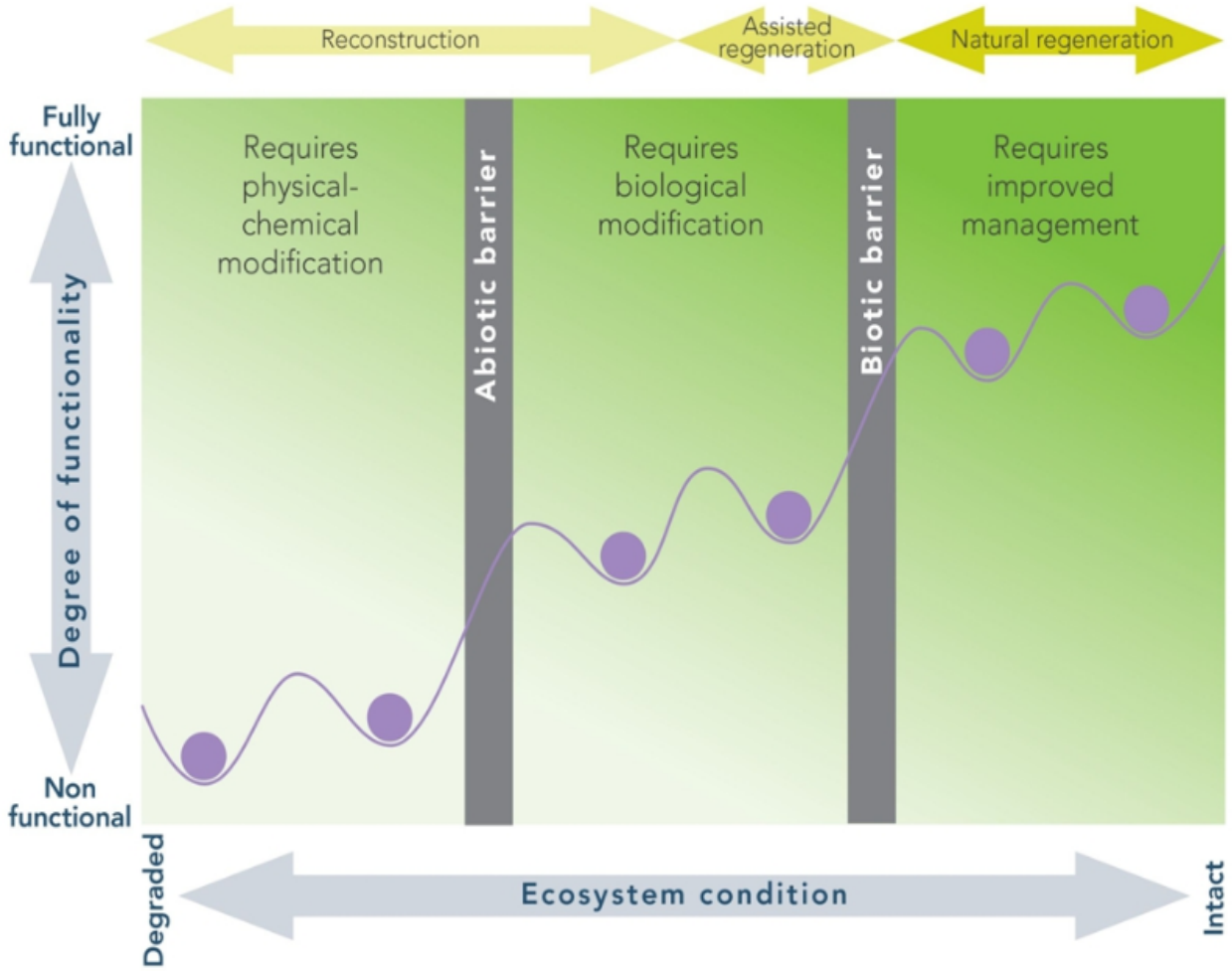
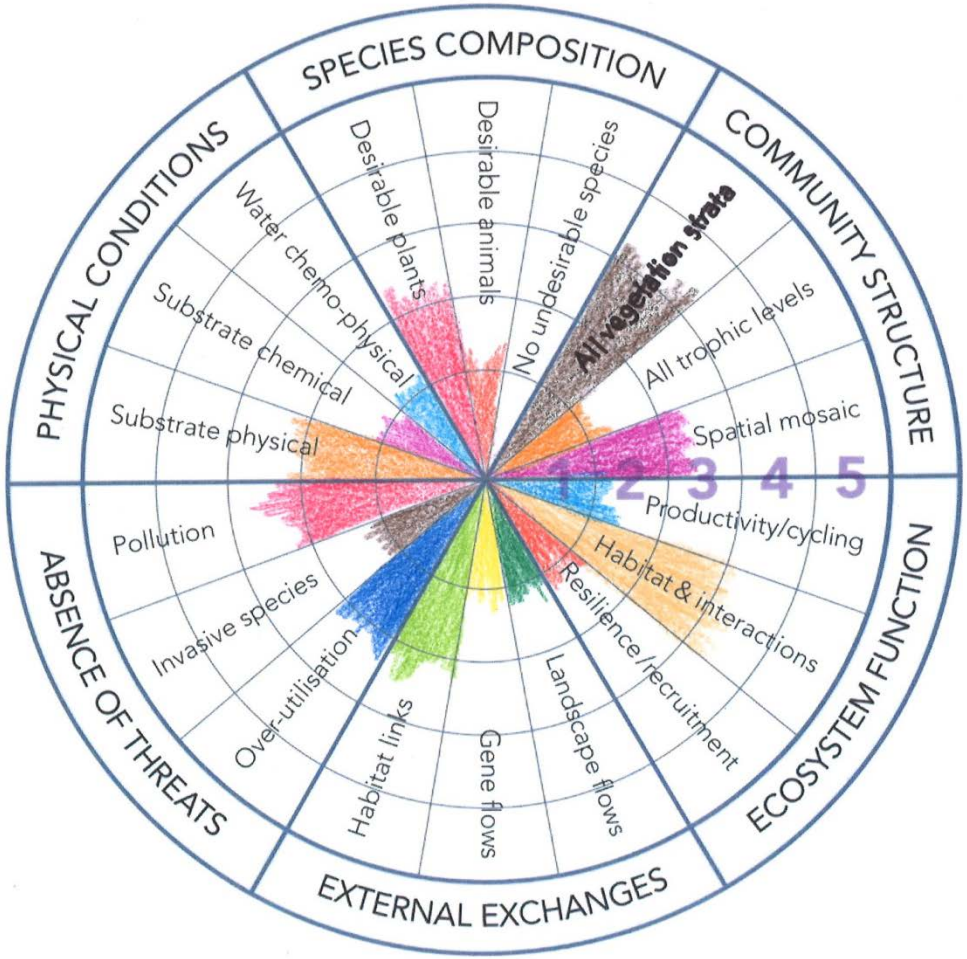


Figure 1. Conceptual model of ecosystem degradation and restoration. (Adapted from Keenleyside et al 2012, after Whisenant 1999, and Hobbs & Harris 2001). The troughs in the diagram represent basins of stability in which an ecosystem can remain in a steady state prior to being shifted by a restoration or a degradation event past a threshold (represented by peaks in the diagram) towards a higher functioning state or a lower functioning state.
[Note: Not all sites in need of physical/chemical amendment depend upon reintroduction for the return of biota - e.g. if colonisation potential in that ecosystem is high.]

SERA's Recovery Wheel



SERA's 5 star evaluation system

ATTRIBUTE	1 STAR	2 STARS	3 STARS	4 STARS	5 STARS
Absence of threats	Further deterioration discontinued and site has tenure and management secured.	Threats from adjacent areas beginning to be managed or mitigated.	All adjacent threats being managed or mitigated.	Larger scale threats starting to be managed or mitigated.	All threats managed or mitigated to high extent.
Physical conditions	Gross physical and chemical problems remediated (e.g pollution, erosion, compaction).	Substrate chemical and physical properties (e.g. pH, salinity) on track to stabilise within natural range.	Substrate stabilised within natural range and supporting growth of characteristic biota.	Substrate maintaining conditions suitable for ongoing growth and recruitment of characteristic biota.	Substrate exhibiting physical and chemical characteristics highly similar to that of the reference ecosystem with evidence they can indefinitely sustain species and processes
Species composition	Colonising indigenous species (e.g. ~2% of the species of reference ecosystem). No threat to regeneration niches or future successions.	Genetic diversity of stock arranged and a small subset of characteristic indigenous species establishing (e.g. ~10% of reference). Low threat from exotic invasive or undesirable species.	A subset of key indigenous species (e.g.~25% of reference) establishing over substantial proportions of the site, with nil to low threat from undesirable species.	Substantial diversity of characteristic biota (e.g. ~60% of reference) present on the site and representing a wide diversity of species groups. No inhibition by undesirable species.	High diversity of characteristic species (e.g. >80% of reference) across the site, with high similarity to the reference ecosystem; improved potential for colonisation of more species over time.
Community structure	One or fewer strata present and no spatial pattering or trophic complexity relative to reference ecosystemOne or fewer strata present and no spatial pattering or trophic complexity relative to reference ecosystem.	More strata present but low spatial pattering and trophic complexity, relative to reference ecosystem.	Most strata present and some spatial pattering and trophic complexity relative to reference ecosystem.	All strata present. Spatial pattering evident and substantial trophic complexity developing, relative to the reference ecosystem.	All strata present and spatial pattering and trophic complexity high. Further complexity and spatial pattering able to self-organise to highly resemble reference ecosystem.
Ecosystem function	Substrates and hydrology are at a foundational stage only, capable of future development of functions similar to the reference.	Substrates and hydrology show increased potential for a wider range of functions including nutrient cycling, and provision of habitats/resources for other species.	Evidence of functions commencing - e.g. nutrient cycling, water filtration and provision of habitat resources for a range of species.	Substantial evidence of key functions and processes commencing including reproduction, dispersal and recruitment of a species.	Considerable evidence of functions and processes on a secure trajectory towards reference and evidence of ecosystem resilience likely after reinstatement of appropriate disturbance regimes.
External exchanges	Potential for exchanges (e.g. of species, genes, water, fire) with surrounding landscape or aquatic environment identified.	Connectivity for enhanced positive (and minimised negative) exchanges arranged through cooperation with stakeholders and configuration of site.	Connectivity increasing and exchanges between site and external environment starting to be evident (e.g. more species, flows etc).	High level of connectivity with other natural areas established, observing control of pest species and undesirable disturbances.	Evidence that potential for external exchanges is highly similar to reference and long term integrated management arrangements with broader landscape in place and operative.

Blank slate


Where did I leave my yellow tape measure?


F#@^%^RKK !!!


Full recovery is the goal
Full recovery is the goal
Full recovery is the goal…

SERA's Key Principles of Ecological Restoration Practice

1. Ecological restoration practice is based on an appropriate local indigenous reference ecosystem

2. Restoration inputs will be dictated by level of resilience and degradation

3. Recovery of ecosystem attributes is facilitated by identifying clear targets, goals and objectives

4. Full recovery is the goal of ecological restoration but outcomes may take long timeframes

5. Restoration science and practice are synergistic

6. Social aspects are critical to successful ecological restoration

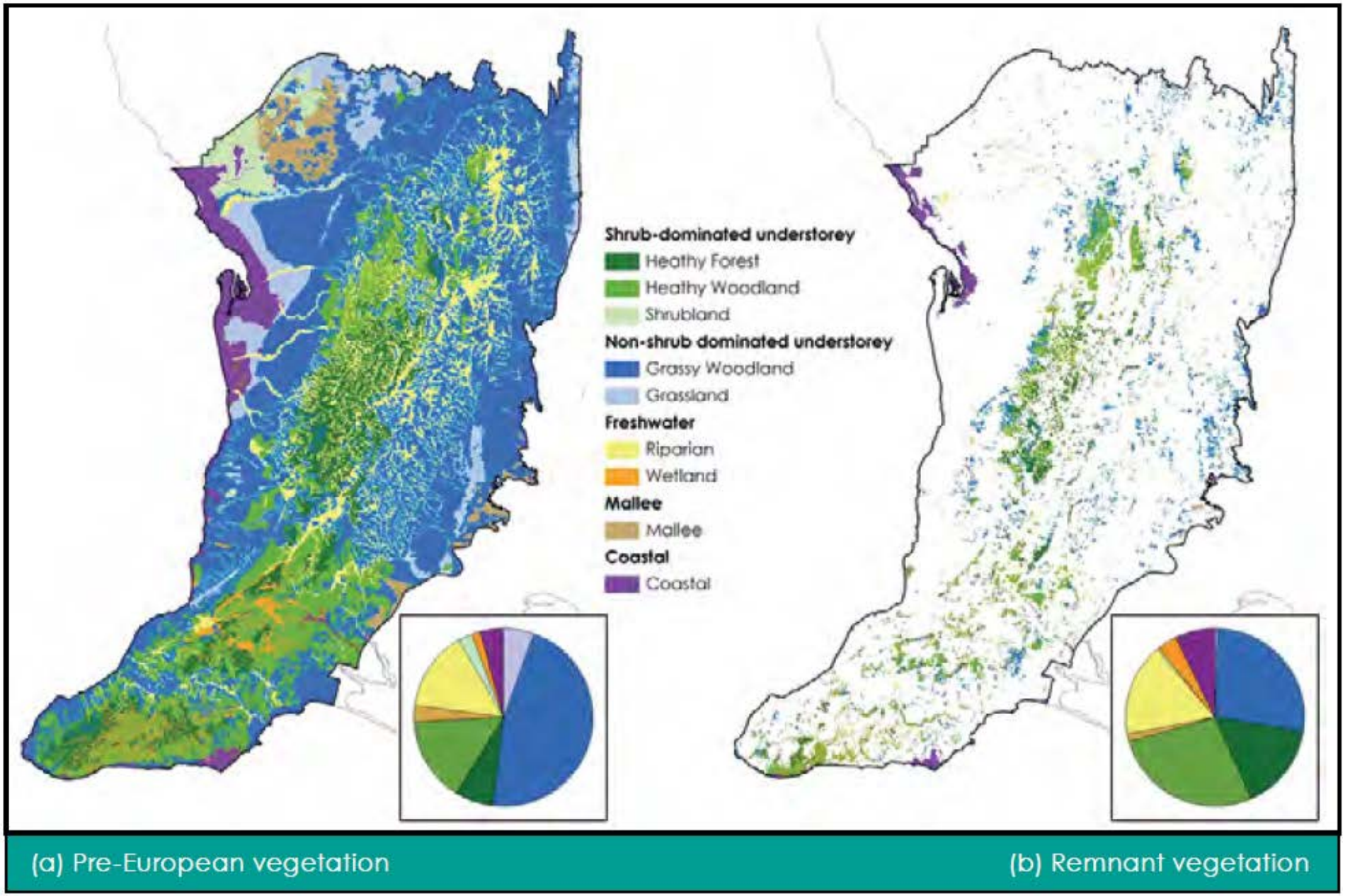
Reference sites

- Species composition
- Structure
- Function and dynamics

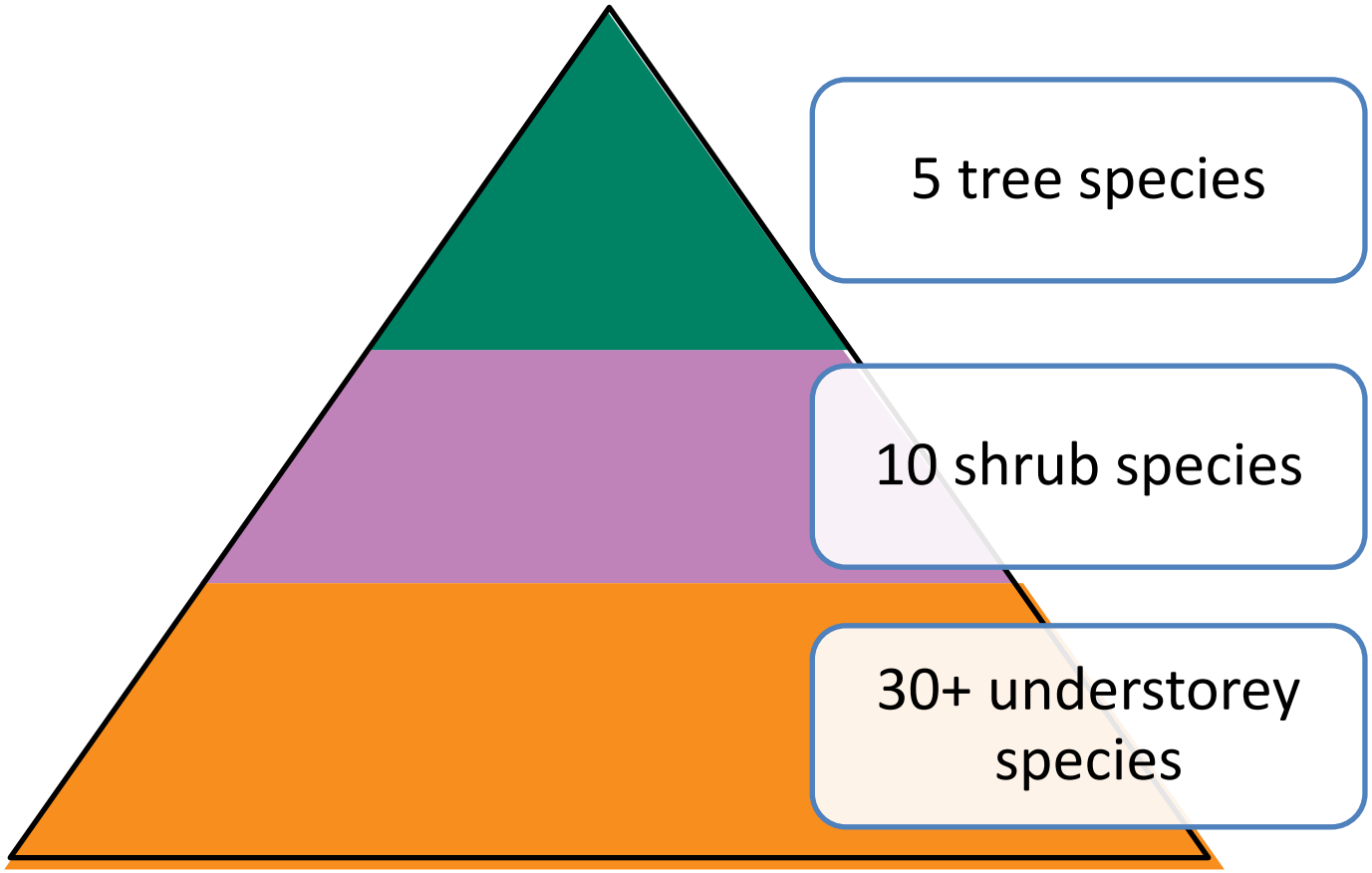
Reference sites – but where do I find one?

Mt Bold Reservoir Reserve ~ 5000 ha remnant

DEH (2009) Informing Biodiversity Conservation for the Adelaide and Mount Lofty Ranges Region, South Australia. Priorities, Strategies and Targets.



Species composition of reference Grassy Woodland



Species composition of reference Grassy Woodland

- Identify functional components
- Focus on what is achievable in your site

SERA:

“returning functions also facilitates restoration…

…That is, recovery is achieved by the processes of growth, reproduction and recruitment of **the organisms themselves over time**, facilitated by the return of appropriate cycles, flows, productivity levels and specific habitat structures or niches.”

Reference site vs Restoration site

Remnant paddock trees

Understorey relics

1847 George French Angas

Ueberreicht vom Verfasser.

Die

Flora von Clarendon u. Umgegend

(Süd-Australien).

Von

J. G. O. Tepper, F. L. S. etc.

Separat-Abdruck aus „Botanisches Centralblatt“ Band LXIII. 1895.

CASSEL.
Druck von Gebrüder Gotthelft.
1895.

schrieben. Es ist die einzige Pflanze des südlichen Theiles dieser Provinz, welche (ausser der weitverbreiteten *Amaryllidee Calostemma purpureum*) ihre Blüten vor den Blättern entwickelt und dieses ausserdem vor dem ersten schweren Regen thut, während die andern nach den Sommerschauern erscheinen.

Correa decumbens Andrews wuchs häufig entlang den Flussufern, besonders den nördlichen und westlichen, also den schattigeren Ufern und zwar von wenigen Fussen über dem Sommerniveau bis wenig jenseits des Bereichs der Winterfluthen. Die einzige andere mir bekannte Gegend, wo sich diese Species findet, ist der obere Lauf des Cygnet-Flusses in Kangaroo Island, wo ich sie 1886 auffand.

Euphorbia eremophila Cunn. Von dieser Art fanden sich nur wenige Individuen an einem felsigen Hügelabhange am „Field's River“ zwischen ein bis zwei Meilen von der Seeküste und gehört dieselbe kaum zu der Clarendon-Flora; ihre eigentliche Heimath ist viel weiter nördlich und dieses vielleicht der südlichste bekannte Standort.

Melaleuca decussata R. Brown. Diese ausgezeichnete Species erreicht hier an den Ufern des Onkaparinga wahrscheinlich ihren nördlichsten Standort und bildete einige schöne Dickichte, welche leider durch die Klärungswuth der Ansiedler mit anderen seltenen, lokalen Pflanzen mehr oder weniger vollständig vernichtet sind. Die rosig purpurfarbenen Blüten und dichte, feine Belaubung geben den Sträuchern ein recht ornamentales Ansehen. Diese Art kommt sonst nur im Südosten und spärlich auf der Kangaroo-Insel vor.

Banksia ornata F. v. Mueller. Obige Bemerkungen finden auch auf diese Pflanze Anwendung. Sie bildet strauchartige Bäumchen, 7—10 Fuss hoch, und kam nur auf dem sandigen Areal zwischen Clarendon und Kangarilla (und nirgends anderswo nördlich davon) vor, während ihre eigentliche Heimath der Südosten und Kangaroo Island ist. Die grossen, zapfenartigen Früchte schliessen die Samen viele Jahre lang ein und öffnen sich sämmtlich nach einem Waldfeuer. Wenn die Art nicht bereits inzwischen vernichtet ist, so steht doch die Vernichtung der kleinen Kolonie recht bald bevor.

Callitris rhomboidea Endlicher. Nur zwei kleine Gruppen und einige einzelnstehende Bäume wurden mir 1882 bekannt, welche sämmtlich im Flussbette und wenig entfernt vom Wasser sich fanden, mit ihren Wurzeln in Felsspalten eindringend (Talkschiefer). Bei meinem letzten Besuche fand sich, dass alle mir erreichbaren Exemplare bereits der Axt des Holzkärrners zum Opfer gefallen waren, um als Feuerungsmaterial seine Kasse um einige Schillinge zu bereichern! Anderswo bin ich dieser Art noch nicht begegnet.

Thelymitra ixioides R. Brown. Diese hübsche südaustralische *Orchidee* — leicht an ihren dunkel gesprenkelten Blumen kenntlich — erreicht hier ihre nördlichste Grenze und fand sich nur an steinigen Bergabhängen oberhalb 1500 Fuss Höhe. Die einzige

SERA's Key Principles of Ecological Restoration Practice

1. Ecological restoration practice is based on an appropriate local indigenous reference ecosystem

2. Restoration inputs will be dictated by level of resilience and degradation

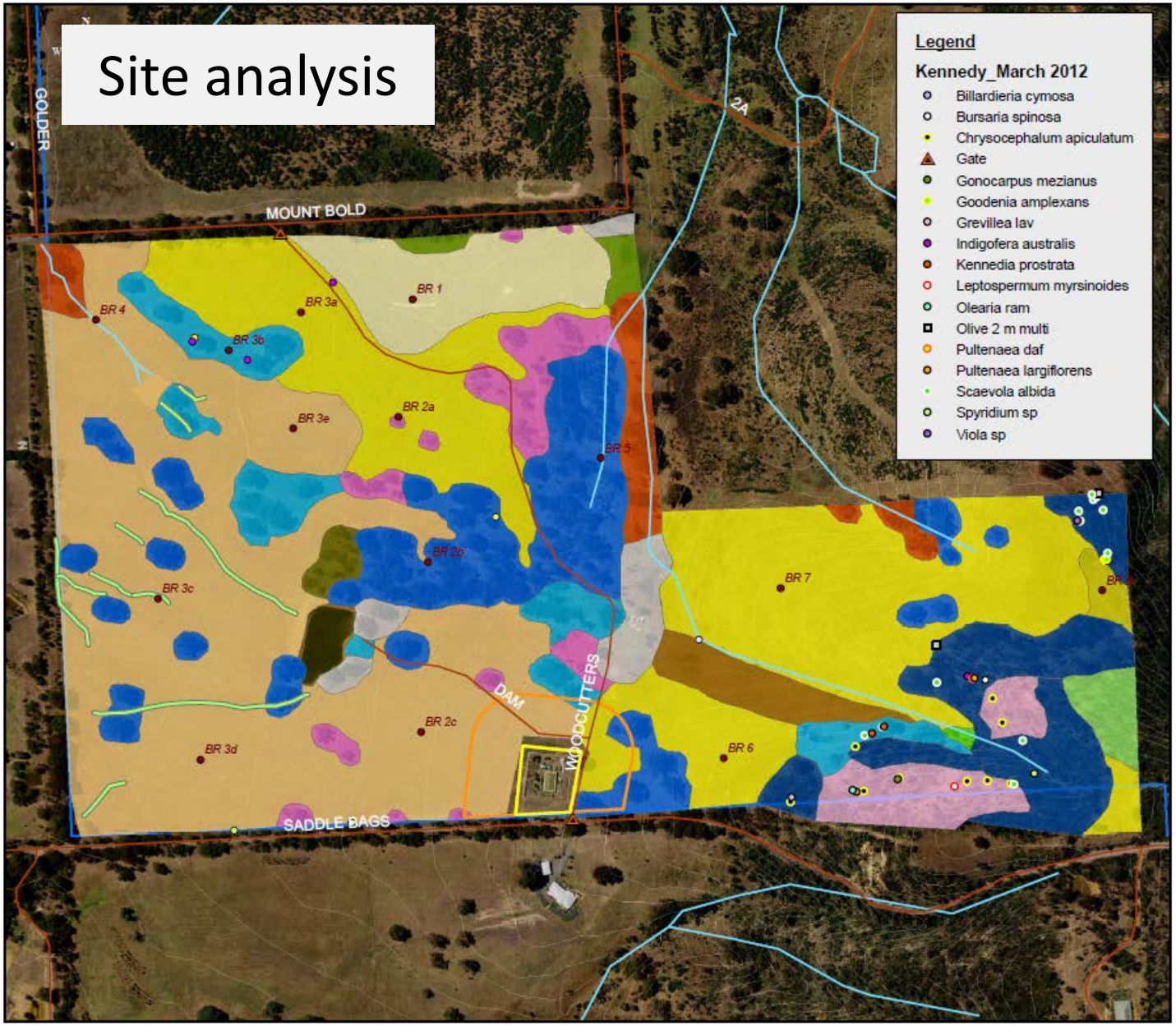
3. Recovery of ecosystem attributes is facilitated by identifying clear targets, goals and objectives

4. Full recovery is the goal of ecological restoration but outcomes may take long timeframes

5. Restoration science and practice are synergistic

6. Social aspects are critical to successful ecological restoration

Site analysis



Kangarilla Restoration Site Mt Bold Gate 48A

Vegetation Survey

Legend

- BushRAT Quadrat

Pt_Misc

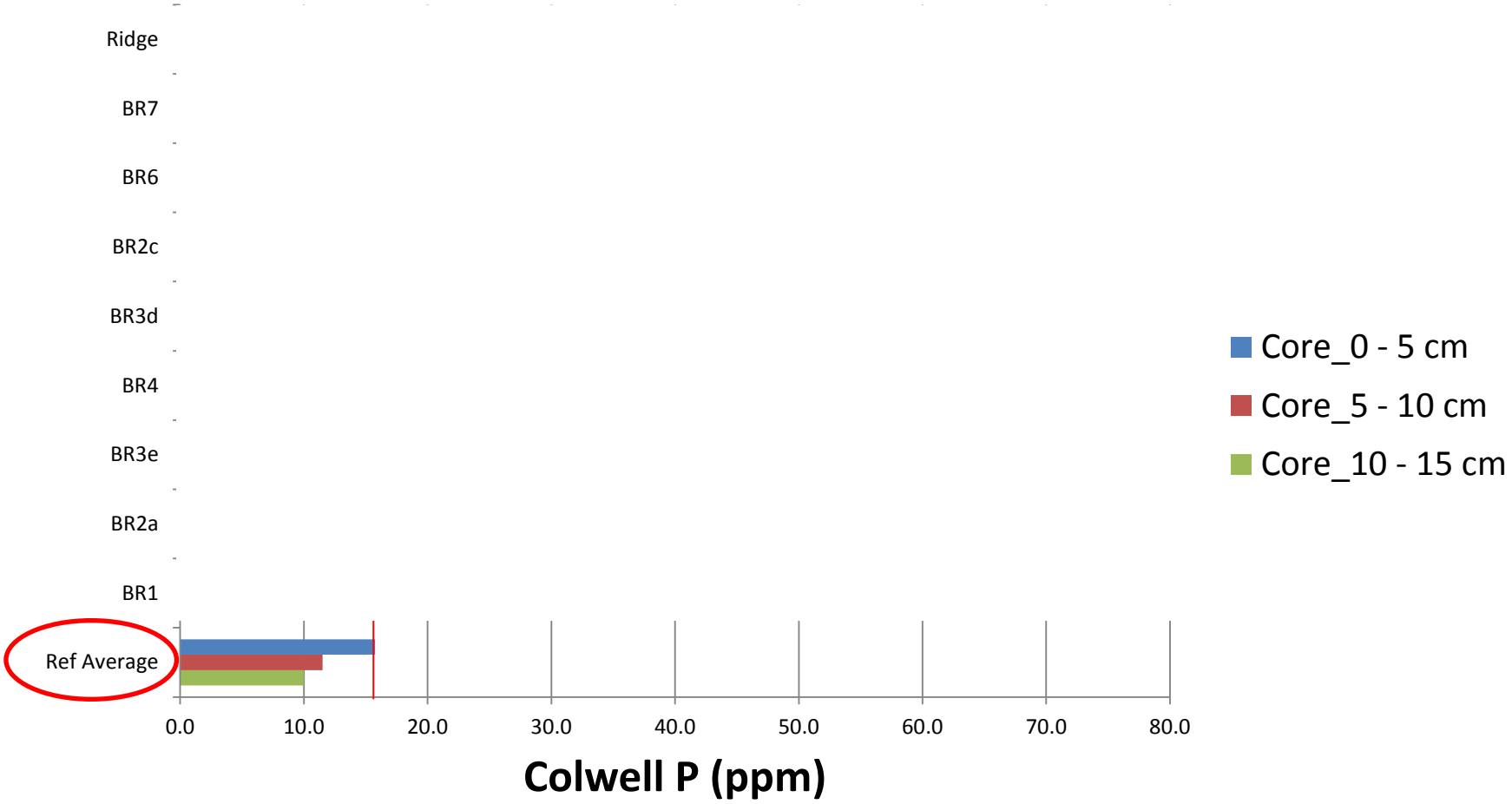
- Blackberry
- Feral bee hive
- Ecotone
- Olive
- Roads & Tracks
- Watercourse
- Residential lot
- Residential A Zone 50m
- Ephemeral drainage lines

Croft Veg Units 2013

- 1 E. leuco - intact Wdl
- 1a E. leuco +intro pasture
- 1b E leuco over +pasture + Euc regen
- 2 E. cosmo Low Wdl
- 3 E. leuco + E. odorata Wdl
- 4 Avena sp. + Austrostipa + regen
- 5 Avena sp. Grassland
- 6 E. camal Wdl
- 7 Plantago lanceolata Herbland
- 8 Exotic Eucalypts Open Wdl
- 9 E. fasciculosa Open Wdl
- 10 Pteridium esculenteum Fernland
- 11 Ehraharta longiflora Grassland
- 12 Lolium sp. Grassland
- 13 Allocasuarina vertillata Wdl
- 14 E. obliqua Wdl
- SAW Reserve Boundary

Map produced: June 2015 S Kennedy
Aerial Photo: Aerometrix 2011
Projection: LCC
Coordinate System: GDA 1994
Copyright SA Water Corporation 2014

Nutrient analysis - Kangarilla



Weed soil seed bank

- 14 sample locations stratified across the site based on mgt units
- Sept 2015
- soil cores taken at 3 depths (0 – 5 / 5 – 10 / 10 – 15 cm)
- Core samples analysed in the lab for seedling emergence at 10 weeks

Botanic Gardens of SOUTH AUSTRALIA

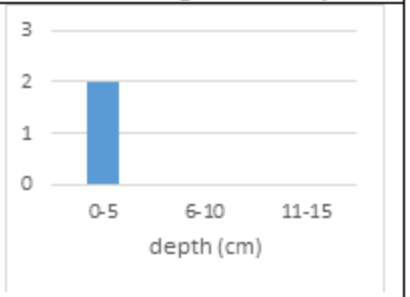
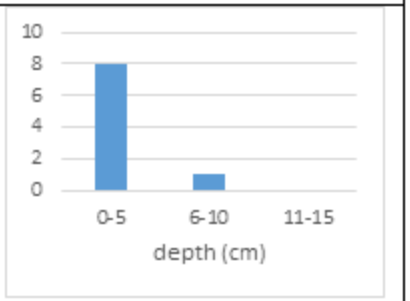
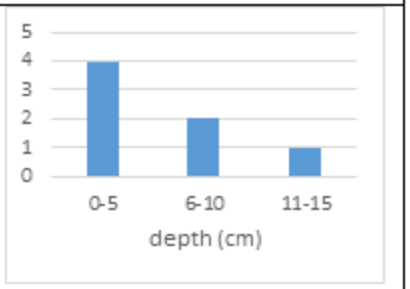
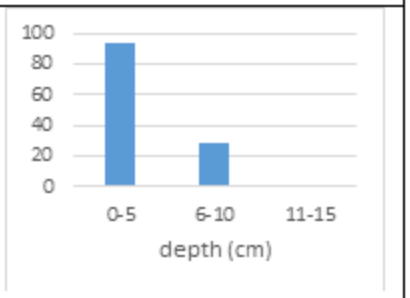
SA Seed Conservation Centre

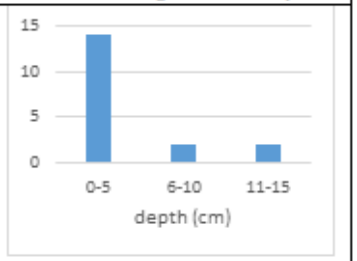
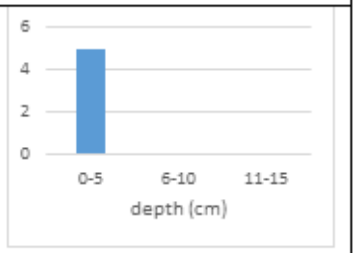
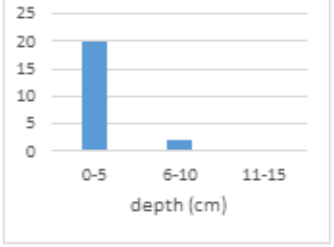
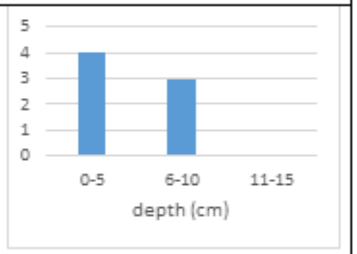
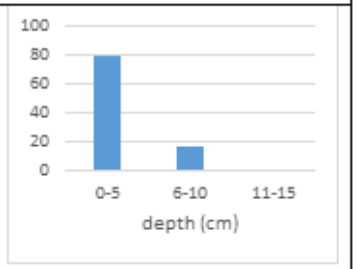
Weed soil seed bank

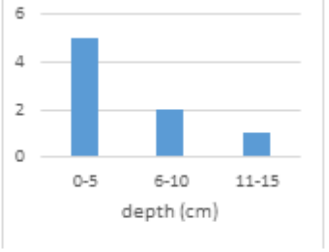
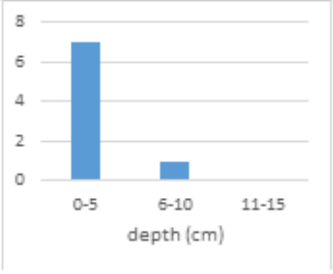
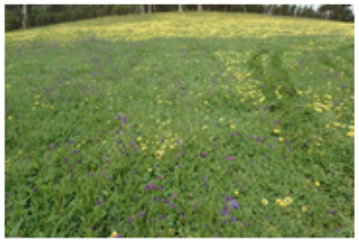
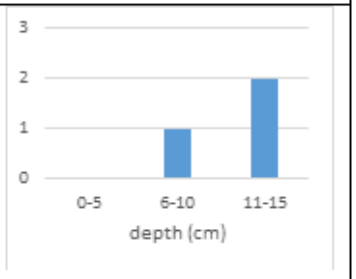
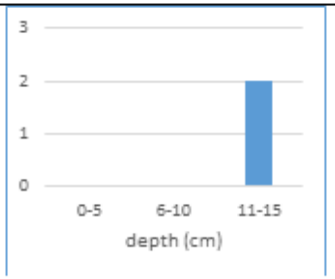
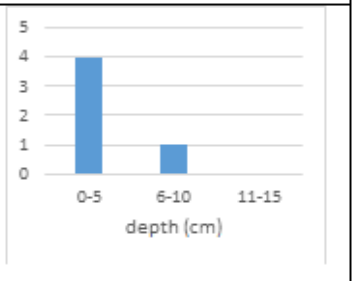
Findings:

- Majority of seedlings (78%) emerged from the top 5 cm of soil
- 19% of seedlings emerging from the 5-10 cm samples
- Only 3% in the 10-15cm layer

Table 5. Graphs showing the seedling number from each depth for each BR Bush Rat site number.

Site	Site Photo	Total # Seedlings at each Depth
BR1		
BR2a		
BR2b		
BR2c		

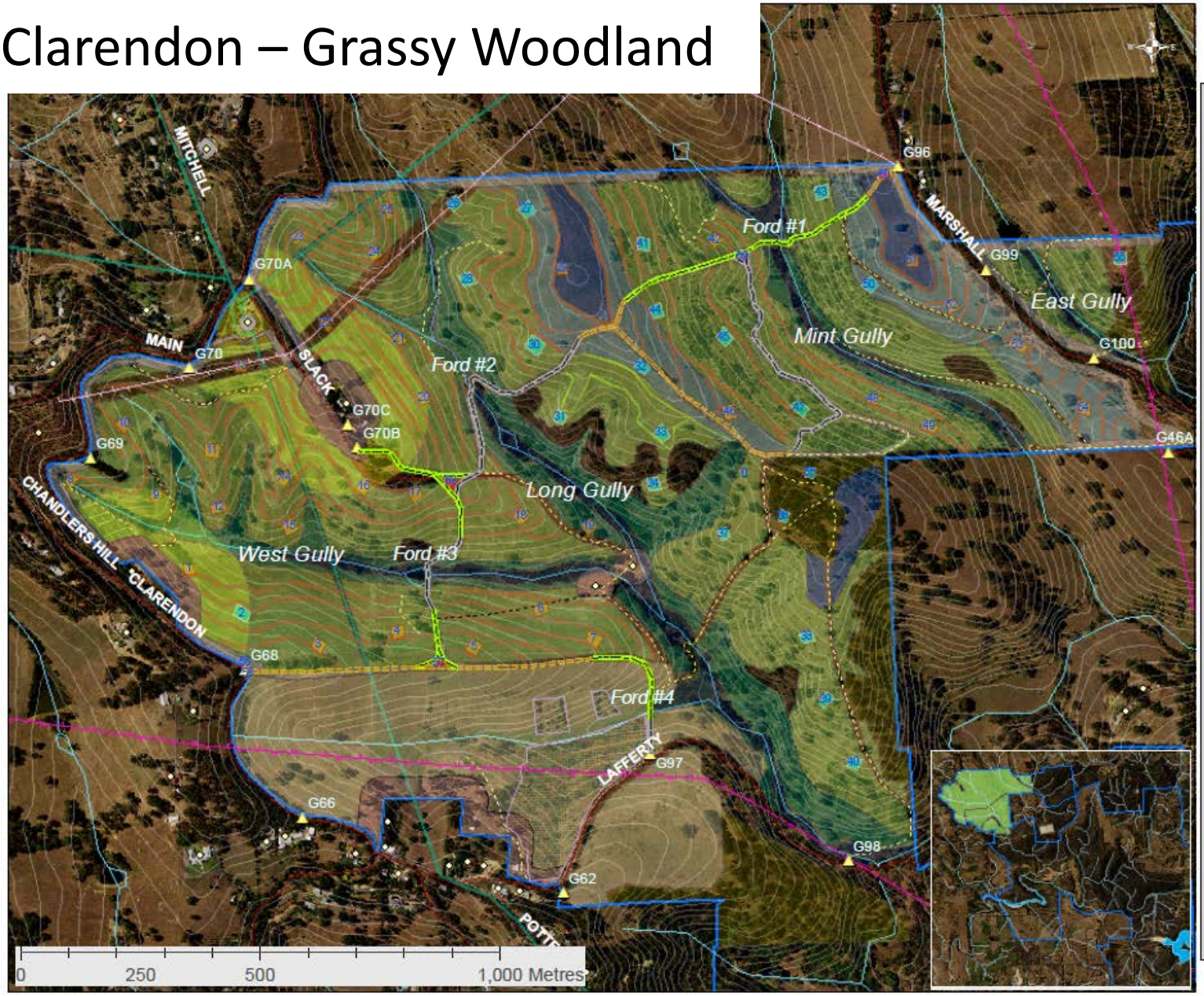
Site	Site Photo	Total # Seedlings at each Depth
BR3a		
BR3b		
BR3c		
BR3d		
BR3e		

Site	Site Photo	Total # Seedlings at each Depth
BR4		
BR5		
BR6		
BR7		
BR8		

Outline

- Case study snap shots
- A word on **P**lanning restoration work
- Project design considerations
  - Nutrients
  - Weed seed bank
  - Species diversity
- Application to project case studies outcomes

Clarendon – Grassy Woodland



CLARENDON CARBON BIOSEQUESTRATION - WORK ZONES -

Legend

Reveg Zones
- Weeded Area
- Red Gum Swamp 250
- Red Gum Wdl 250
- Blue Gum - Manna Gum Wdl 251
- Blue Gum Wdl 249
- Grey Box Wdl 220
- Remnant mgt

BioD Patch
- Native pasture
- Scraped
- Scraped and grass sown
- Assets

Alleys - Native Grass
- Scraped and Sown
- Slashed native pasture

Tracks
- Minor Fire Track - Gravel, Crowned
- Minor Fire Track - Gravel, Cut in
- Minor Fire Track - Dirt
- Service Track
- Abandoned track
- ElectraNet Transmission
- ETSA Transmission

Fuel management
- Asset Protection Zone
- Fuel break
- Buffer zone
- Hay cut
- Watercourse
- Transmission Main
- Roads
- Contours 5 m
- Apple orchard - abandoned
- SAW Reserve Boundary

SA Water

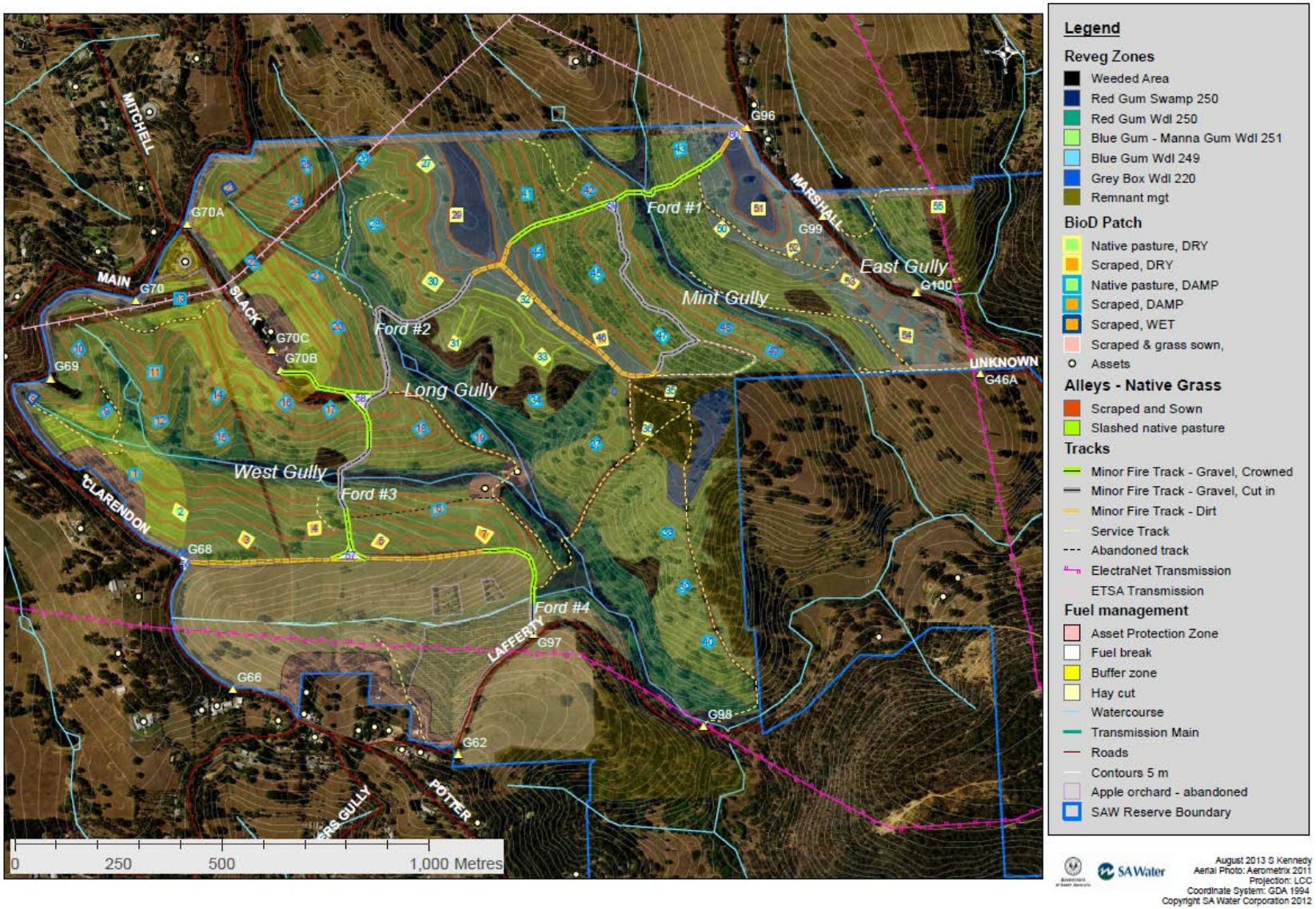
March 2013 S Kennedy
Aerial Photo: Aerometrix 2011
Projection: LCC
Coordinate System: GDA 1994
Copyright SA Water Corporation 2012

Clarendon – Native Grass Alleys

Clarendon – establishment counts

Clarendon Nov 2015 – John Stafford harvest

Clarendon


MITCHELL
G70A
MAIN
G70
SLACK
G70C
G70B
G69
Ford #2
Long Gully
West Gully
Ford #3
CLARENDON
G68
Ford #4
LAFFERTY
G97
G66
G62
POTTER
G96
Ford #1
MARSHALL
G99
East Gully
Mint Gully
G100
UNKNOWN
G46A
G98
0
250
500
1,000 Metres
Legend
Reveg Zones
Weeded Area
Red Gum Swamp 250
Red Gum Wdl 250
Blue Gum - Manna Gum Wdl 251
Blue Gum Wdl 249
Grey Box Wdl 220
Remnant mgt
BioD Patch
Native pasture, DRY
Scraped, DRY
Native pasture, DAMP
Scraped, DAMP
Scraped, WET
Scraped & grass sown,
Assets
Alleys - Native Grass
Scraped and Sown
Slashed native pasture
Tracks
Minor Fire Track - Gravel, Crowned
Minor Fire Track - Gravel, Cut in
Minor Fire Track - Dirt
Service Track
Abandoned track
ElectraNet Transmission
ETSA Transmission
Fuel management
Asset Protection Zone
Fuel break
Buffer zone
Hay cut
Watercourse
Transmission Main
Roads
Contours 5 m
Apple orchard - abandoned
SAW Reserve Boundary
SA Water
August 2013 S Kennedy
Aerial Photo: Aerometrix 2011
Projection: LCC
Coordinate System: GDA 1994
Copyright SA Water Corporation 2012

Understorey work

Biodiversity patches – forb seeding

Noarlunga Downs Wetland

Noarlunga Downs Wetland – Mallee-box Wdl

Noarlunga Downs Wetland – erosion control

Noarlunga Downs Wetland – Interp trail

Noarlunga Downs Wetland – interp trail

Noarlunga Downs Wetland – interp trail

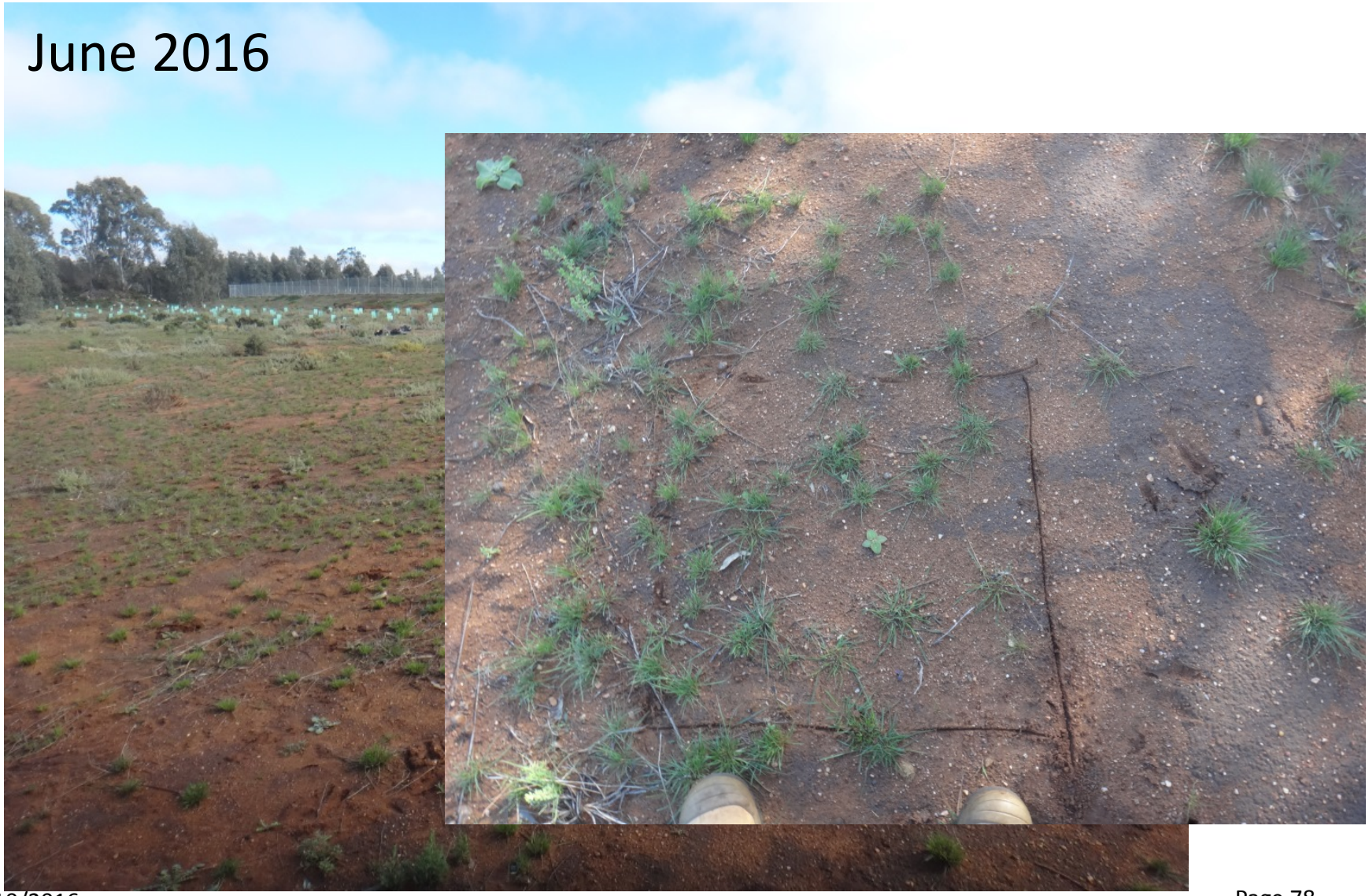
Murray Bridge East – Abandoned waste water lagoon (350 mm rainfall)

Murray Bridge East

Murray Bridge East

January 2016

Murray Bridge East



Murray Bridge East (Tubestock VS Seed)

Tubestock vs Seeding

Grassland Zone 2.5 ha

- Sow rate 29 kg/ha (floret)
  - D. cespitosa, D. setacea, Stipa nodosa, S scabra Ennaepogon, Chloris tuncata

Density result = average 66 pl/m^2

Across 2.5 ha = 1,650,000 ng seedlings

- Chenopod sow rate 17.5 kg/ha

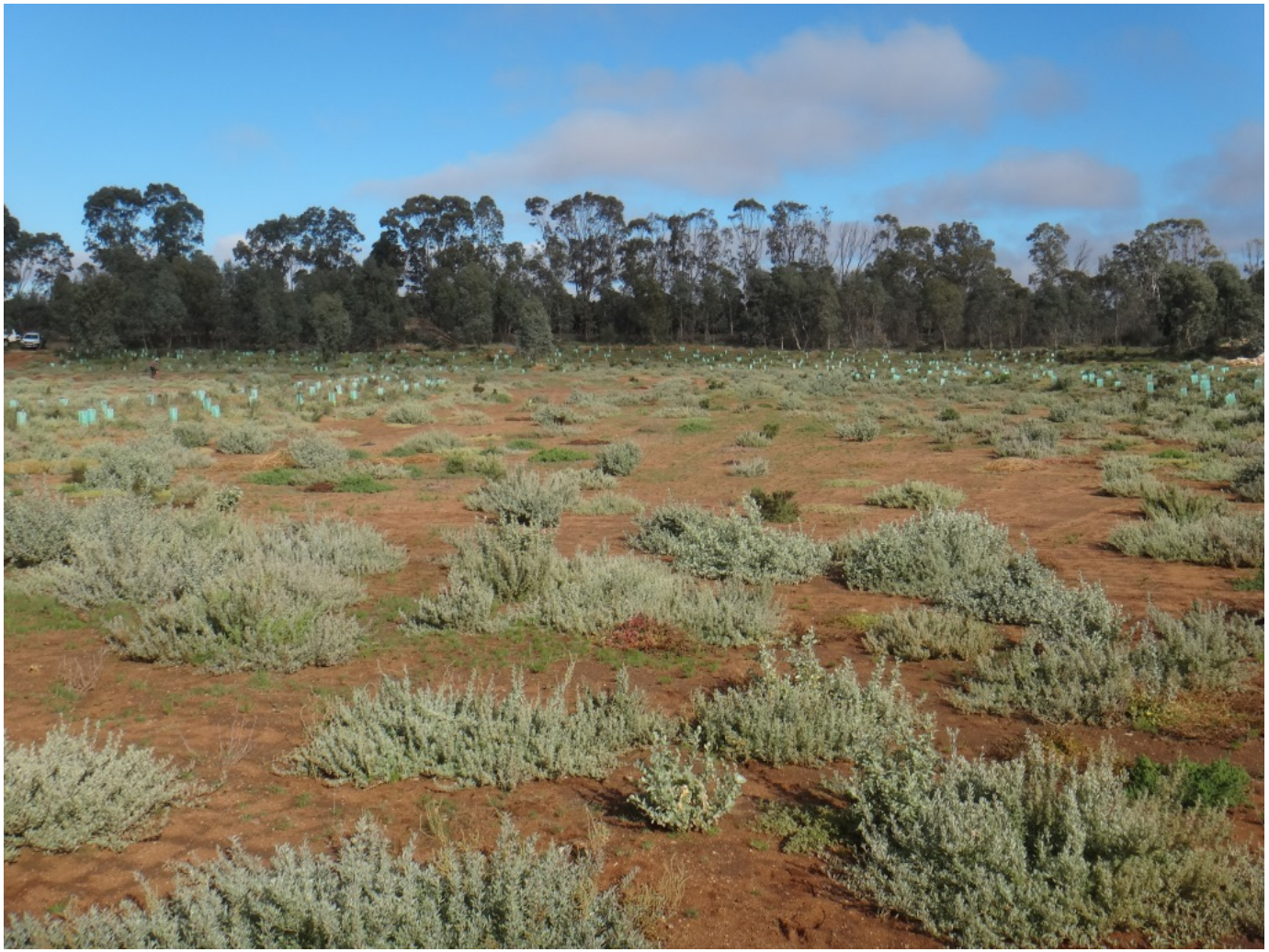
Density result = 1 pl/m2 or 10,000 /ha

- So we're talking 250,000 chenopods

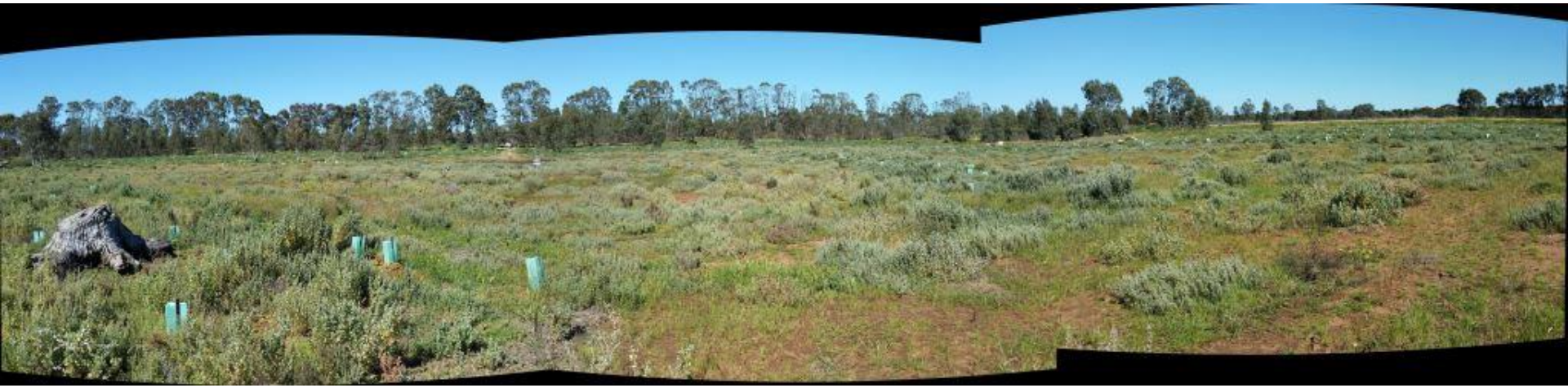
<u>Total = 1.85 million plants</u>

- Seed $12k
- Labour $20k
- $32 k 3ha = $10.6 k/ha
- Works out around $0.01 / plant

Murray Bridge East (350 mm rainfall)
June 2016



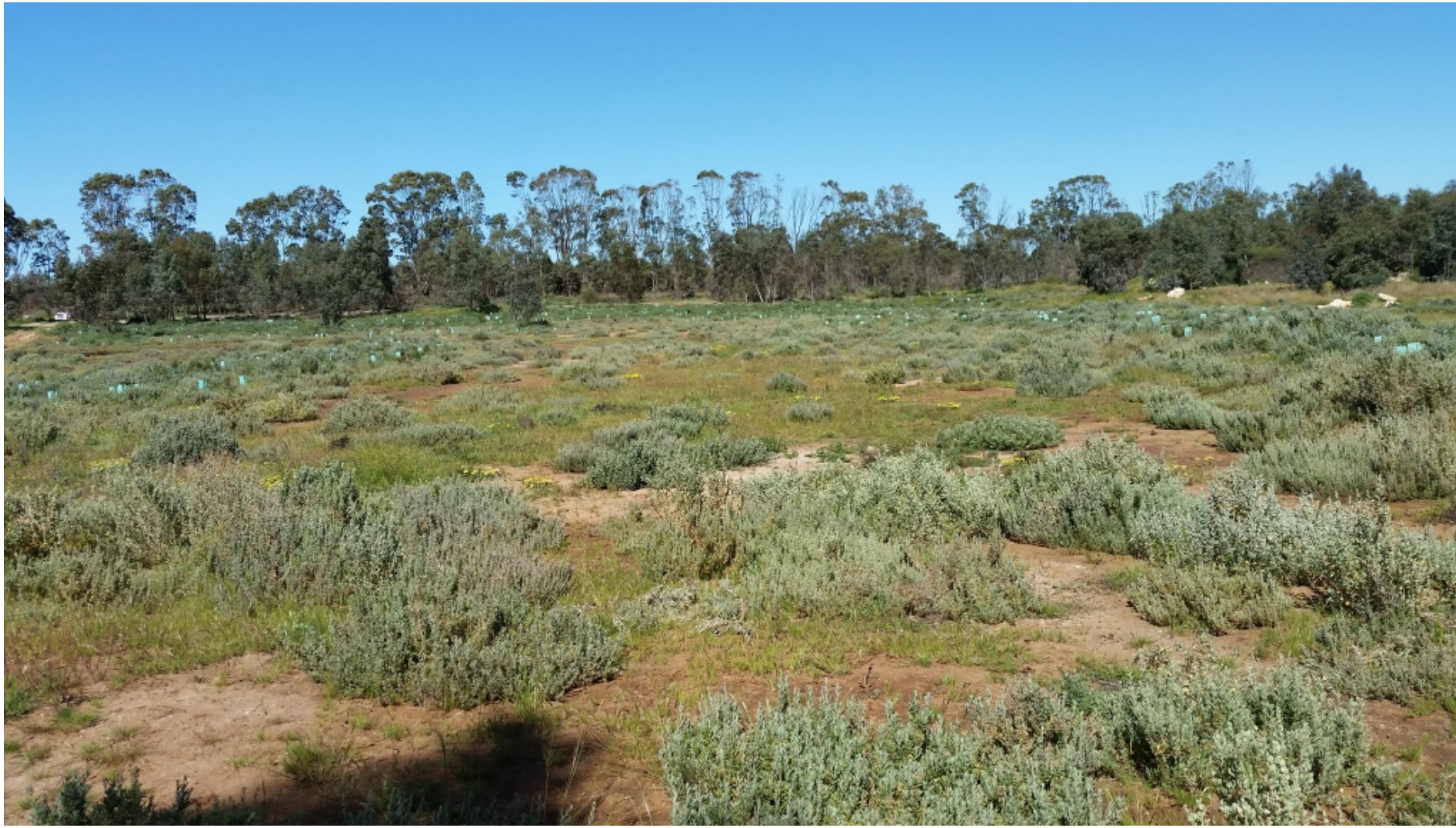
Murray Bridge East (Tubestock VS Seed)
June 2016



Murray Bridge East (Tubestock VS Seed)
Oct 2016

Murray Bridge East (Tubestock VS Seed)
Oct 2016

Murray Bridge East (Tubestock VS Seed)
Oct 2016



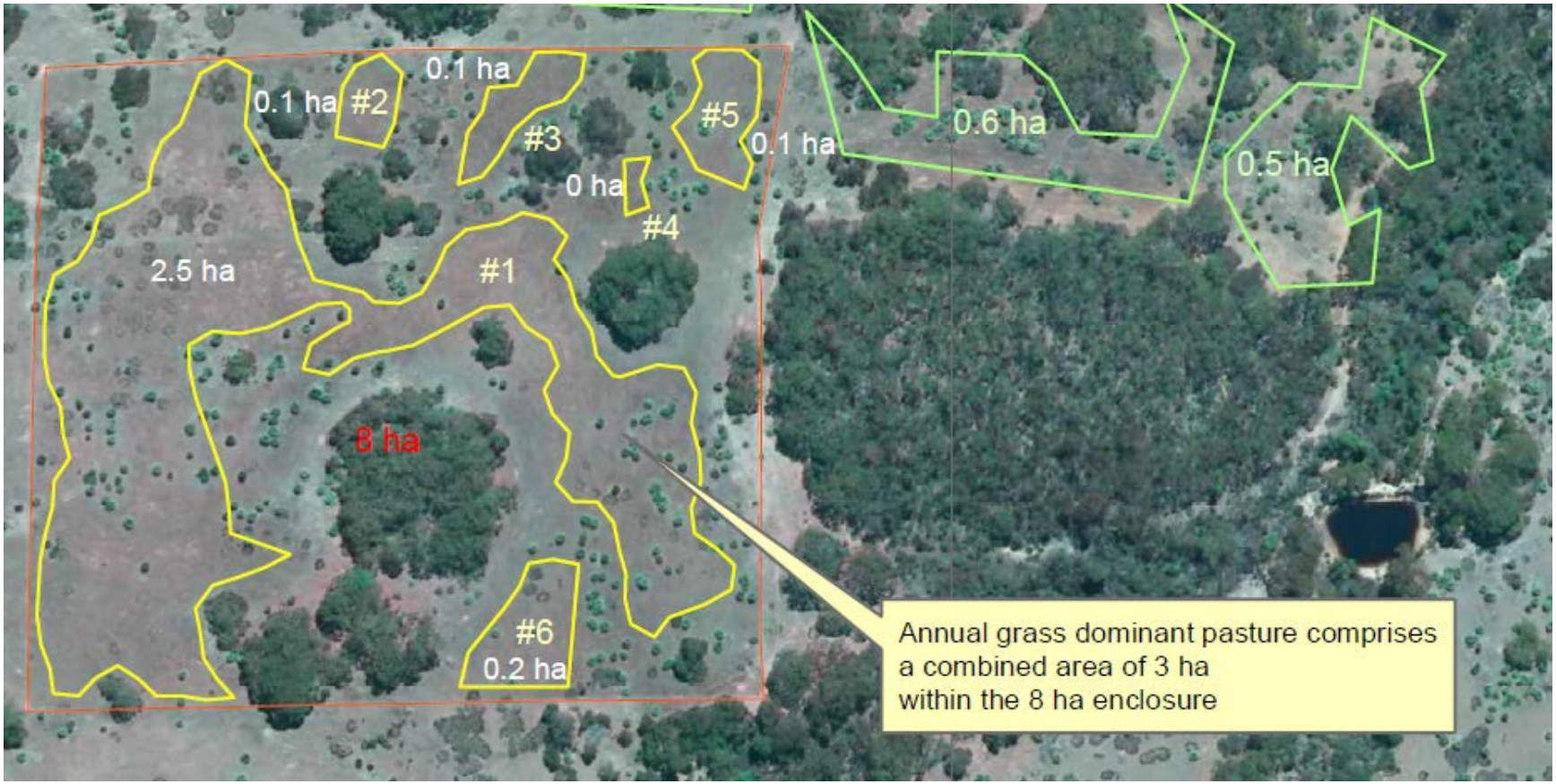
Murray Bridge East (Tubestock VS Seed)
Oct 2016

Hahndorf SPS – post construction reinstatement Oct 2012

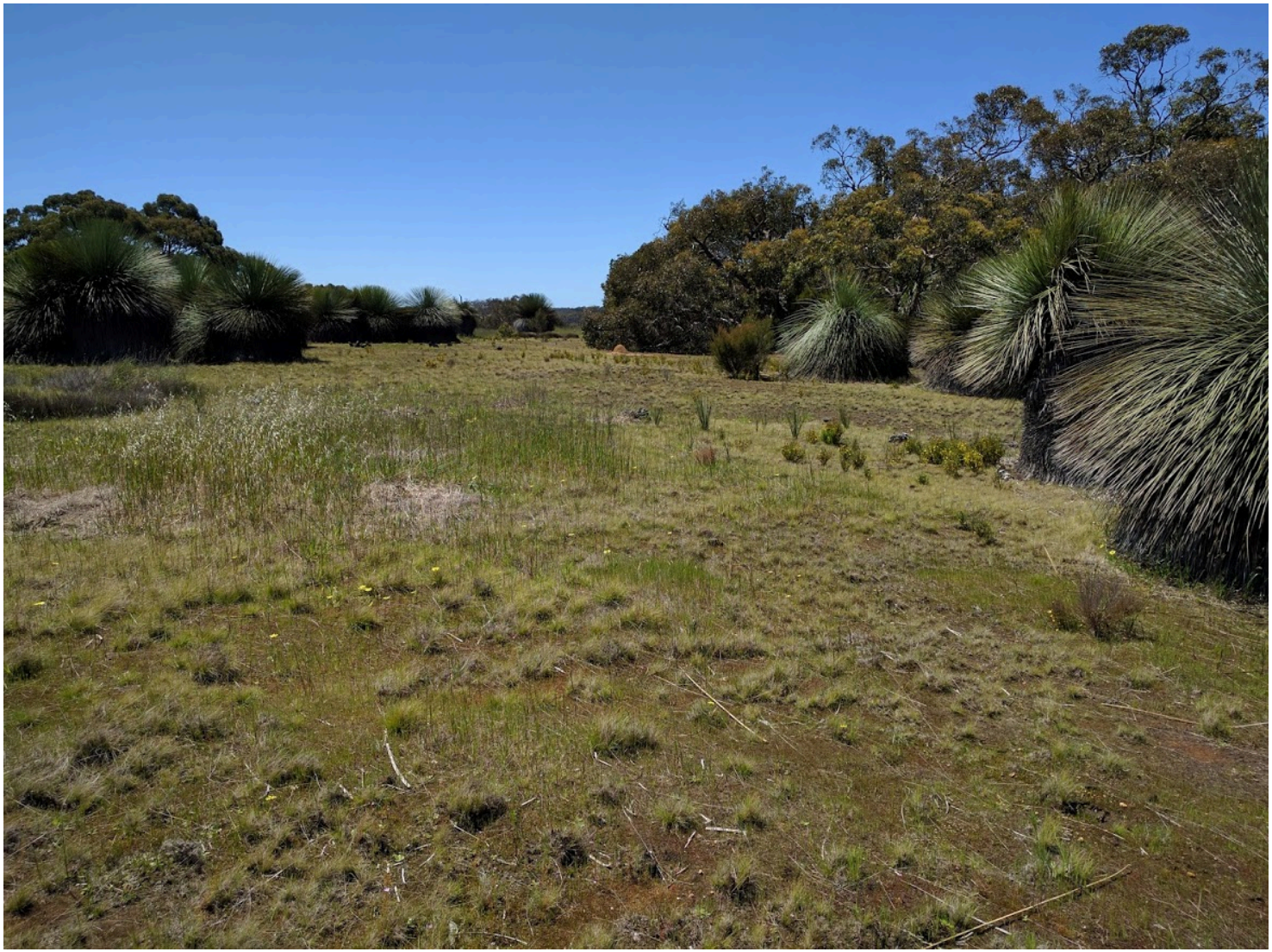
Hahndorf SPS – post construction reinstatement Feb 2014

Hahndorf SPS – post construction reinstatement June 2014

Ecosystem re-assembly - KI

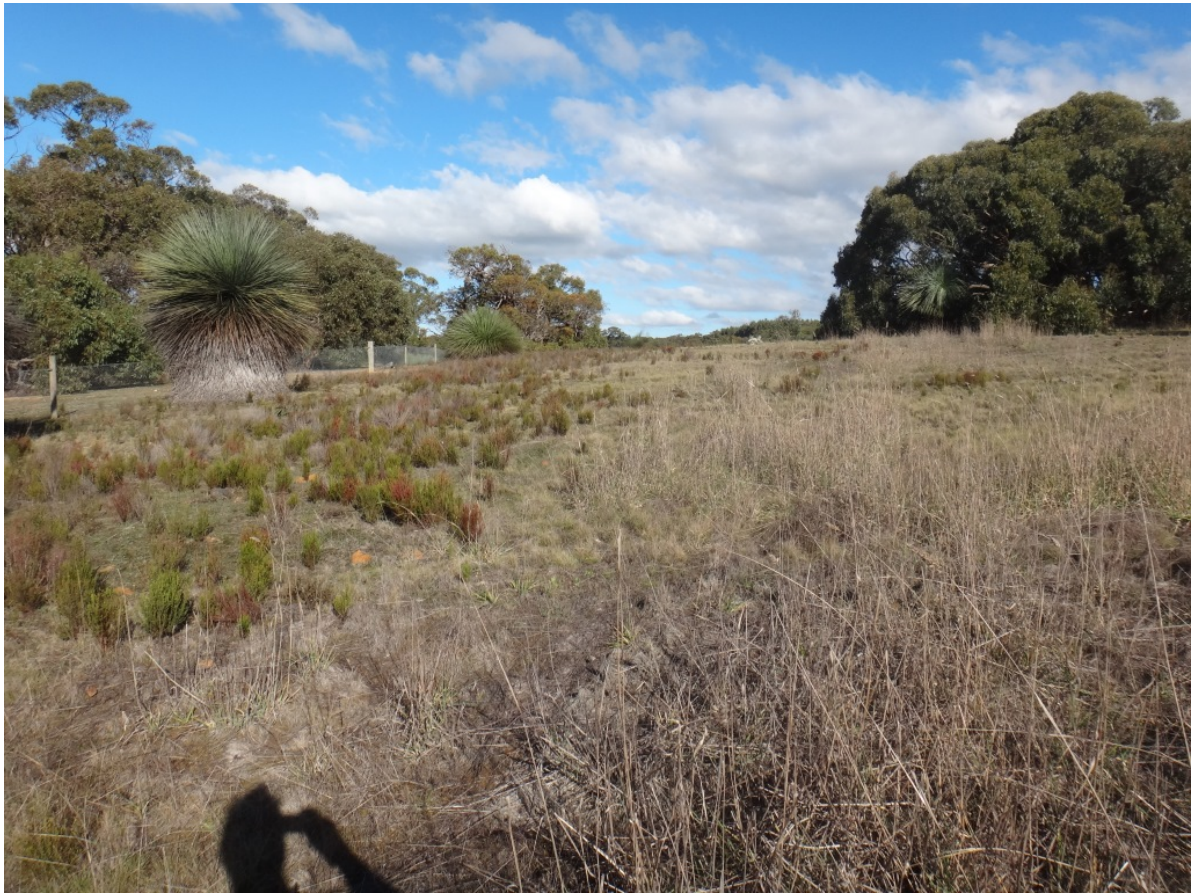


Ecosystem re-assembly



Ecosystem re-assembly

Ecosystem re-assembly



Ecosystem re-assembly

Acknowledgements

Andrew West	Adelaide & Mt Lofty Ranges NRM
Phil Druce	Blackwood Seeds
Jeff Whittaker	Habitats SA Revegetation Services
Tim Swiersen	Ecotypic
Jack James & Grantley Couzner Jon Weise	Fleurieu Fencing & Revegetation
Andrew Byrne & Co.	Wrenhaven Contracting
Glenn Christie	Succession Ecology
Paul Alisauskas	Sporting Shooters SA
Jamie Horne Paul Nichols	LCS Landcapes
Robert Myers	Himself
Luke Kingston Flora Holton Dr. Paul Gibson-Roy	Greening Australia
Louise Farrell	Indigeflora Nursery
Phil Collins	State Flora Nursery

1896

Conserve 30% native vegetation for sustainable agriculture!

TREES AND THEIR ROLE IN NATURE:

BY

J. G. O. TEPPER, F.L.S., &c.

SYDNEY: CHARLES POTTER, GOVERNMENT PRINTER, PHILLIP STREET.

1896.