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DRAFT M2G Planting (Tree & Shrub) Monitoring Report

Construction Corridor (Spring 2015)

Prepared for
Icon Water

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Abbreviations

Abbreviation	Description
BGGW	Box Gum Grassy Woodland
BWA	Bulk Water Alliance
EMP	Ecological Monitoring Sub-plan
ERG	Environment Reference Group
HLPS	High Lift Pump Station
LLPS	Low Lift Pump Station
LRTEMP	Landscape Rehabilitation and Terrestrial Ecology Management Plan
M2G	Murrumbidgee to Googong Water Transfer Project
ORMP	Offset Rehabilitation Management Plan

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1 Introduction

1.1 Background

Eco Logical Australia (ELA) was commissioned by Icon Water (formerly ACTEW Corporation) to deliver terrestrial ecological services as required by the environmental approval process for the Murrumbidgee to Googong Water Transfer Project (M2G). A component of that service is to provide post-construction rehabilitation monitoring in accordance with the Landscape Rehabilitation Management Plan (LRMP) for the M2G project, which has been undertaken by Blue Gum Ecological Consulting on behalf of ELA.

The following report examines the results of the spring 2015 monitoring session for rehabilitation planting[1] within the M2G construction corridor and structure sites. This is the seventh in a series of bi-annual monitoring studies documenting the progress of tree and shrub plantings.

1.2 Study area

The study area extends from the Low Lift Pump Station (LLPS) at Angle Crossing on the Murrumbidgee River to the discharge facility at Burra Creek, situated near the intersection of Williamsdale and Burra Roads. The pipeline construction corridor is approximately 12 km in length (**Figure 1-Figure 4, Appendix 1**).

The study area falls within the Williamsdale (8726-4N) 1:25,000 Map Sheet and is part of the South-east Highlands Bioregion (Commonwealth of Australia 2012).

1.3 Study aims

The aim of the study is to monitor representative sub-sets of tree and shrub plantings within the M2G construction corridor and record planting success.

As was explained in the autumn 2014 report, there was significant difficulty in discriminating between planted and non-planted herbaceous specimens and the herbaceous component of the planting monitoring was discontinued in spring 2014.

1.4 Planting regime

Almost 5,000 tree and shrub seedlings (Hiko Cells, 45Lt and 300SR containers) were planted within the M2G construction corridor and structure sites during spring 2011 and autumn 2012. Native plantings comprised eleven shrub and nine tree species. In addition, five non-native tree and shrub species were planted in the eastern sections of the construction corridor at the request of landowners.

An inventory of planted species is provided in **Table 1**.

Species selection and planting distribution were guided by former vegetation type, spatial characteristics and vegetation lost as a result of construction. Additional woody plantings were included as part of compensatory measures for habitat loss as well as for amenity.

[1] Concurrent plot-based monitoring for seeding rehabilitation within the construction corridor is presented in a separate report.

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Table 1: Species and quantity planted within the M2G construction corridor and structure sites during spring 2011 and autumn 2012.

Scientific Name	Common Name	Total plantings pipeline corridor	Total plantings structures	Total
Native tree				
Eucalyptus blakelyi	Blakely's Red Gum			
Eucalyptus bridgesiana	Apple Box			
Eucalyptus mannifera	Brittle Gum			
Eucalyptus melliodora	Yellow Box			
Eucalyptus polyanthemos	Red Box			
Eucalyptus pauciflora	Snow Gum			
Eucalyptus rubida	Candlebark Gum			
Eucalyptus viminalis	Manna Gum			
Callitris endlicheri	Black Cypress Pine			
Sub-total		**624**	**148**	**772**
Native shrub				
Acacia dealbata	Silver Water			
Acacia genistifolia	Spreading Wattle			
Acacia rubida	Red Stemmed Wattle			
Acacia siculiformis	Dagger Wattle			
Banksia marginata	Silver Banksia			
Bursaria spinosa	Hairy Bursaria			
Leptospermum myrtifolium	Myrtle Tea Tree			
Leptospermum obovatum	River Tea Tree			
Kunzea ericoides	Burgan			
Cassinia longifolia	Shiny Cassinia			
Indigofera australis	Austral Indigo			
Sub-total		**3,016**	**1,055**	**4,071**
Non-native tree/shrub				
Ulmus parvifolia	Chinese Elm			
Quercus robur 'Fastigiata'	Upright English Oak			
Castanea sativa	European Chestnut			
Populus spp.	Poplar (TBC)			
Pyrus ussuriensis	Manchurian Pear			
Sub-total		**19**	**-**	**19**
Total native trees/shrub		**3,640**	**1,203**	**4,843**
Total non-native tree/shrub		**19**	**-**	**19**

*Note: Greening Australia was engaged by Icon Water to plant an additional **1,300** tree and shrub seedlings. Most of the replanting was undertaken on Icon Water land and some selected private properties in NSW.*

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2 Methods

2.1 Monitoring regime

Permanent monitoring sites were established and are sampled on a bi-annual basis (autumn and spring/summer periods) over a period of at least two-years post-construction.

The current monitoring survey occurred during October 2015.

2.2 Selection of monitoring sites

Twelve tree and shrub monitoring sites were selected from approximately 80 planting arrays within the M2G construction corridor and structure sites (**Figure 1 – Figure 4, Appendix 1**). Six sites (TSP1-6) are situated in the ACT and six (TSP7-12) in NSW (**Table 2**).

The spatial arrangement of sampling sites was influenced by the original placement of planting arrays (most of which were located in areas of former native vegetation), which resulted in fewer sampling sites in the eastern non-native section of the construction corridor than in the central and western sections. Sample sites were also selected to include variations in landform, such as: slope and aspect, soil moisture and vegetation types.

Sample sites were marked with a red-tipped wooden stake, at which grid co-ordinates and photographs were taken.

Table 2: Tree and shrub (TSP) monitoring sites within the construction corridor and structure sites.

Site ID^	Approx. chainage from LLPS	Co-ordinates	Jurisdiction	Property
TSP1	250	691345 - 6060236	ACT	PCS (Murrumbidgee R. corridor)
TSP2	1025	691964 - 6060519	ACT	PCS (Murrumbidgee R. corridor)
TSP3	1350	692256 - 6060605	ACT	Icon leasehold
TSP4	1900	692592 - 6060707	ACT	Icon leasehold
TSP5	2325	693226 - 6060578	ACT	Icon leasehold
TSP6	2650	693528 - 6060505	ACT	Icon leasehold
TSP7	3040	693927 - 6060542	NSW	Smith
TSP8	4975	695663 - 6060392	NSW	Lonergan
TSP9	5475	696175 - 6060305	NSW	Lonergan
TSP10	6425	697084 - 6060204	NSW	Johanson
TSP11	9300	699277 - 6061925	NSW	Latimer
TSP12	11900	701346 - 6063099	NSW	Discharge facility

2.3 Survey techniques

A simple quantitative sampling method was used to measure tree and shrub planting success. Specimens were counted, identified to at least genus level and their health determined according to the following criteria:

- *Good Health* - indicated by vigorous growth, fully leaved with expected colouration for that species;

- *Poor Health* - stems or leaves discoloured, foliage limited or easily dislodged, specimen may appear stunted or heavily browsed;
- *Dead* - absence of leaves, stem or leaves entirely discoloured or desiccated with no visible living vegetative material.

2.4 Key Performance Target

The current Key Performance Target (KPT) for tree and shrub plantings is 90% survival rate, which was arbitrarily set by the BWA and the planting contractor in early 2012. Unfortunately, the KPT provided in the M2G Landscape Rehabilitation and Terrestrial Ecology Management Plan (LRTEMP) does not explicitly refer to a 90% target.

The previous planting monitoring report (M2G Planting (Tree & Shrub) Monitoring Report, Autumn 2015) recommended that the KPT be reduced to 70%, however, there has been no action on this matter.

All new planting was undertaken prior to the current monitoring survey and have been included in the spring 2015 analysis.

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3 Results

3.1 Overview

A total of **158** new plantings were recorded across seven sample sites elevating the total sample population from **701** to **738**. Most new plantings replaced dead or missing specimens and thus maintained the original sample sizes, the exceptions being TSP 6, which increased from **21** to **57** and TSP 7 from **22** to **23**.

Overall **344 (46.6%)** specimens were in good health, **105 (14.2%)** in poor health and **289 (39.2%)** either dead or missing (**Table 3**). The proportion of specimens in good health increased by **5.9%** compared to the previous autumn 2015 results and those either dead or missing declined by **12.7%** over the same period.

All sites that received new plantings (TSP 3, 4, 5, 6, 7, 10 and 12) had improvements in specimen health as a proportion of the planting sample. Of the remaining five sites (none of which received new plantings) three (TSP 1, 2 and 11) exhibited declines in specimen health and two (TSP 8 and 9) showed no change (**Table 3**).

One site (TSP 7) exceeded the 90% KPT and three others (TSP 6, 8 and 12) exceed the proposed 70% KPT (**Chart 1**). However, sites TSP 7 and 8 were among the least populated and accounted for less than 5% of the total sample population. The remaining eight sites had between **7.9%** and **66.7%** of specimens in good health (**Chart 1**).

As with all previous monitoring sessions planting success was differentiated by jurisdiction, with **68.8%** of plantings in NSW in good health compared to **33.7%** of plantings in the ACT (**Chart 1**).

Extrapolating the current results to the original planted population (see **Table 1**) would yield approximately **2,257** (46.6%) plantings in good health, **688** in poor health and **1,898** dead or missing. Assuming a sample error of +/- 5%, the number of plantings in good health could vary from **2,499** (51.6%) to **2,015** (41.6%).

Details of each monitoring site are provided in Sub-Sections 3.1.1 to 3.1.12, below (*Note: bracketed numbers in the central column provide results from the previous autumn 2015 monitoring period*). Summaries of current monitoring results are provided in **Table 3** (also see **Table 5 in Appendix 2** for full data sets) and comparisons with previous results are provided in **Table 4 and Chart 2**.

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Table 3: Summary of tree and shrub monitoring results for the spring 2015 monitoring period.

Site ID	Seedling Health			Combined Poor/Dead*	Total Plantings	% Health		New Plantings
	Good	Poor	Dead*			Good	Poor/Dead*	
TSP1	15	25	52	77	92	16.3	83.7	
TSP2	55	14	58	72	127	43.3	56.7	
TSP3	23	18	54	72	95	24.2	75.8	33
TSP4	6	6	64	70	76	7.9	92.1	4
TSP5	12	2	5	7	19	63.2	36.8	16
TSP6	46	5	6	11	57 (21)	80.7	19.3	55
TSP7	22	0	1	1	23 (22)	95.7	4.3	7
TSP8	8	0	1	1	9	88.9	11.1	
TSP9	16	6	2	8	24	66.7	33.3	
TSP10	86	20	33	53	139	61.9	38.1	20 ^
TSP11	4	4	4	8	12	33.3	66.7	
TSP12	51	5	9	14	65	78.5	21.5	23 ^
Total plantings	**344**	**105**	**289**	**394**	**738** (701)			
Av. per site	**28.7**	**8.8**	**24.1**	**32.8**	**61.5**			
%	**46.6**	**14.2**	**39.2**	**53.4**	**100.0**			

( ) = Refer to previous autumn 2015 monitoring period
*** = Includes missing specimens**
^ = Estimate

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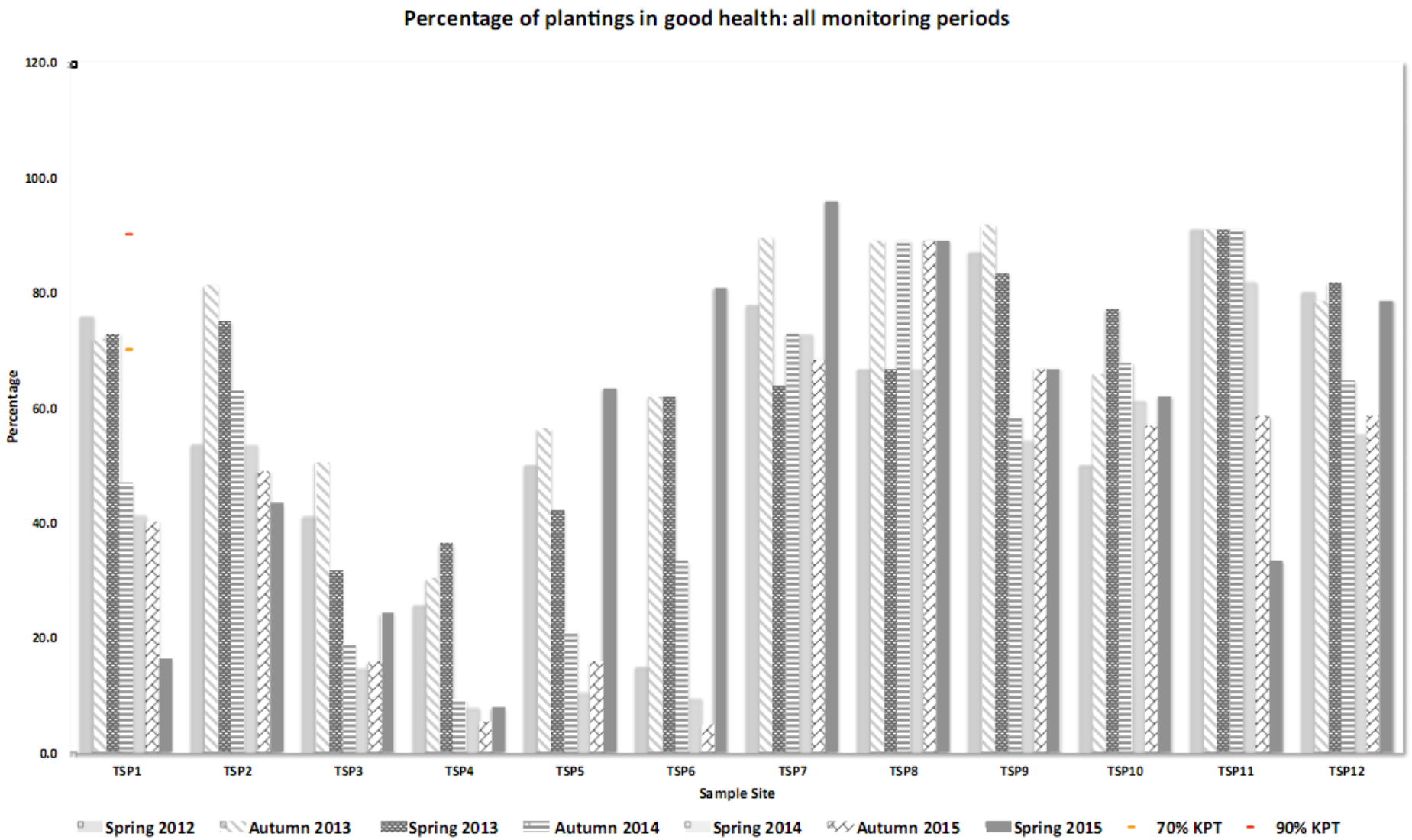

Chart 1: Proportion of plantings in good health at each site during all monitoring periods. ACT sites = TSP 1-6 and NSW sites = TSP 7-12.

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Table 4: Comparison of tree and shrub monitoring results from all sessions.

Monitoring period	Seedling Health			Poor/Dead* Combined	Total Plantings	New Plantings
	Good	**Poor**	**Dead***			
Spring 2012						
Total number	364	188	109	297	661	-
Av. per site	30.3	15.7	9.1	24.8		
%	*55.1*	*28.5*	*16.5*	*45.0*		
Autumn 2013						
Total number	458	81	150	231	689	-
Av. per site	38.2	6.7	12.5	19.2		
%	*66.5*	*11.7*	*21.8*	*33.5*		
Spring 2013						
Total number	451	76	173	249	700	-
Av. per site	37.6	6.3	14.4	20.7		
%	*64.4*	*10.9*	*24.7*	*35.6*		
Autumn 2014						
Total number	343	82	275	357	700	-
Av. per site	28.6	6.8	22.9	20.7		
%	*49.0*	*11.7*	*39.3*	*35.6*		
Spring 2014						
Total number	295	100	305	405	700	-
Av. per site	24.6	8.3	25.4	33.7		
%	*42.1*	*14.3*	*43.6*	*57.9*		
Autumn 2015						
Total number	285	52	364	416	701	-
Av. per site	23.8	4.3	30.3	33.7		
%	*40.7*	*7.4*	*51.9*	*59.3*		
Spring 2015						
Total number	*344*	*105*	*289*	394	***738***	***158***
Av. per site	28.7	8.8	24.1	32.8		
%	*46.6*	*14.2*	*39.2*	*53.4*		

*** Includes missing specimens**

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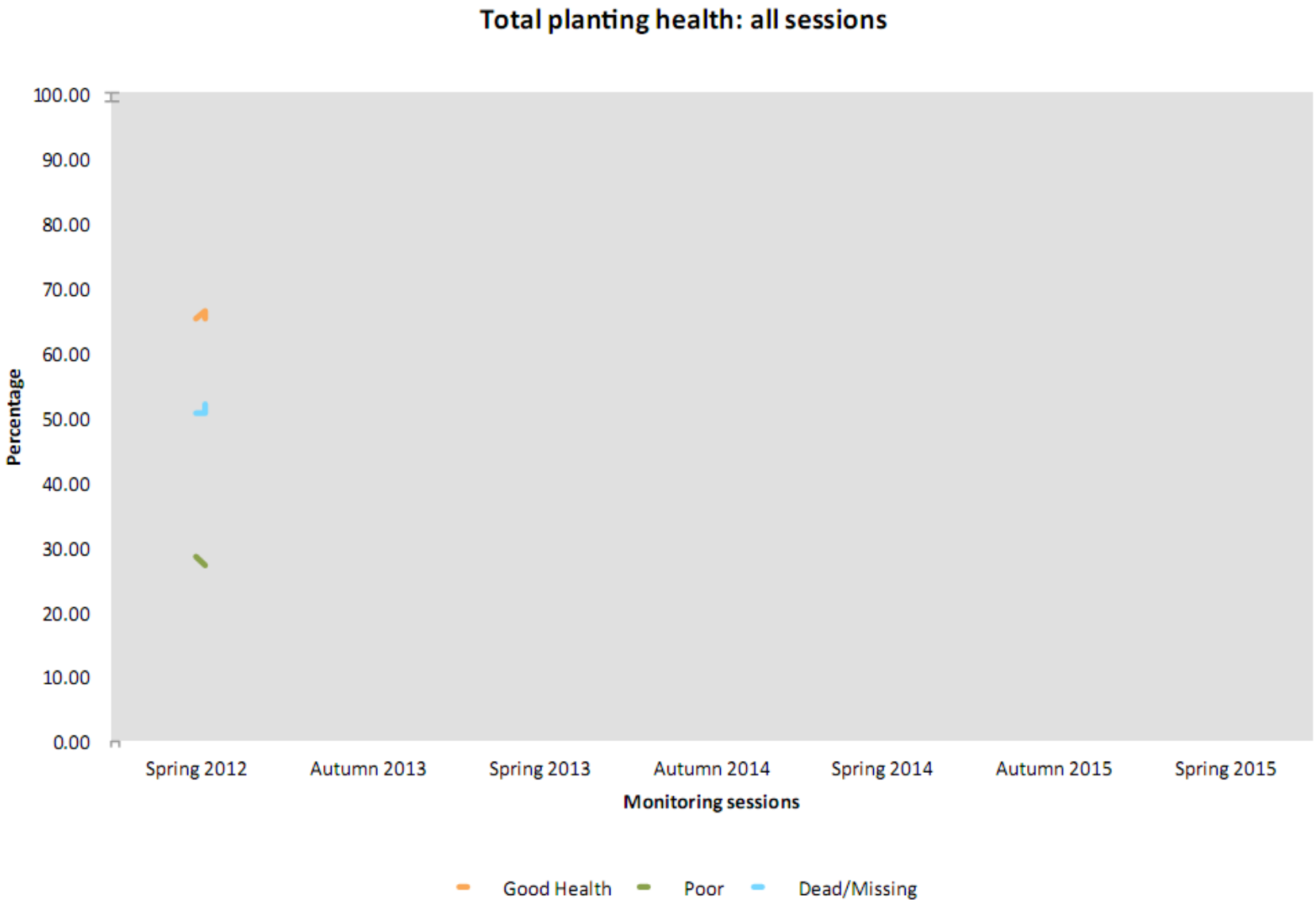

Chart 2: Total planting health across all monitoring periods.

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3.1.1 Monitoring site TSP1

Jurisdiction	**ACT**	**TSP1** Situated within the Murrumbidgee River Corridor immediately W and NW of the HLPS, about 250 m from the LLPS. Planting health declined by **24%** with only **16.3%** of plantings currently in good condition. Replanting was not undertaken at this site. **Recommendation: Provide sufficient maintenance for remaining specimens.**
Co-ordinates	691345 – 6060236	
No. of tree & shrub species planted	**8**	
Seedling health		
Good	**15** (37)	
Poor	**25** (3)	
Dead / Missing	**52** (52)	
Total plantings	**92**	

Plate 1: Monitoring Site TSP1. The image on the left is from autumn 2015 and the right spring 2015.

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3.1.2 Monitoring site TSP2

Jurisdiction	**ACT**
Co-ordinates	691964 – 6060519
No. of tree & shrub species planted	**5**
Seedling health	
Good	**55** (62)
Poor	**14** (6)
Dead / Missing	**58** (59)
Total plantings	**127**

TSP2 is located within the Murrumbidgee River Corridor, about 1,025 m from the LLPS.

Planting health declined by **5.5%** with **43.3%** of plantings currently in good condition. Replanting was not undertaken at this site.

Recommendation: Provide sufficient maintenance for remaining specimens.

Plate 2: Monitoring Site TSP2. The image on the left is from autumn 2015 and the right spring 2015.

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3.1.3 Monitoring site TSP3

Jurisdiction	**ACT**
Co-ordinates	691964 – 6060519
No. of tree & shrub species planted	**4**
Seedling health	
Good	**23** (15)
Poor	**18** (4)
Dead / Missing	**54** (76)
Total plantings	**95**

TSP3 is located within the Murrumbidgee River Corridor, about 1,350 m from the LLPS.

Planting health increased by **8.4%** with **24.2%** of specimens currently in good condition. The increase is attributed to **33** new plantings, but many of these (mostly *Acacia* sp.) were in poor condition.

Recommendation: Provide sufficient maintenance for remaining specimens.

Plate 3: Monitoring Site TSP3. The image on the left is from autumn 2015 and the right spring 2015. *Insert: TSP3 in spring 2012 – within 12 months of planting*.

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3.1.4 Monitoring site TSP4

Jurisdiction	**ACT**
Co-ordinates	692592 – 6060707
No. of tree & shrub species planted	**3**
Seedling health	
Good	**6** (4)
Poor	**6** (7)
Dead / Missing	**64** (65)
Total plantings	**76**

TSP4 is located about 1,900 m from the LLPS within the ACT.

Most plantings either perished or were removed prior to autumn 2014 with the remaining specimens steadily declining in condition. In autumn 2015 only **5.3%** specimens remained in good health. A small number of additional plantings **(4)** advanced this to a modest **7.9%** during the current surveys.

Recommendation: Unless a regular maintenance can be provided planting at this site should be discontinued.

Plate 4: Monitoring Site TSP4. The image on the left is from autumn 2015 and the right spring 2015. Inset: *TSP4 in spring 2012, within 12 months of planting.*

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3.1.5 Monitoring site TSP5

Jurisdiction	**ACT**
Co-ordinates	693226 – 6060578
No. of tree & shrub species planted	**4** (3)
Seedling health	
Good	**12** (3)
Poor	**2** (0)
Dead / Missing	**5** (16)
Total plantings	**19**

TSP5 is located about 2,325 m from the LLPS within the ACT.

Planting health increased by **47.4%** with **63.2%** of specimens currently in good condition. The increase is attributed to **16** new plantings.

Recommendation: Provide sufficient maintenance for new plantings

Plate 5: Monitoring Site TSP5. The image on the left is from autumn 2015 and the right spring 2015.

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3.1.6 Monitoring site TSP6

Jurisdiction	**ACT**
Co-ordinates	693528 – 6060505
No. of tree & shrub species planted	**4** (3)
Seedling health	
Good	**46** (1)
Poor	**5** (2)
Dead / Missing	**6** (18)
Total plantings	**57** (21)

TSP6 is located about 2,650 m from the LLPS - west of and adjacent to the Monaro Hwy within the ACT.

Planting health increased by **75.9%** with **80.7%** of specimens currently in good condition. The increase is attributed to **55** new plantings.
Natural recruitment of Yellow Box *Eucalyptus melliodora* and Blakely's Red Gum *E. blakelyi* in adjacent sections of the corridor.

Recommendation: Provide sufficient maintenance for new plantings.

Plate 6: Monitoring Site TSP6. The image on the left is from autumn 2015 and the right spring 2015.

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3.1.7 Monitoring site TSP7

Jurisdiction	**NSW**
Co-ordinates	693927 – 6060542
No. of tree & shrub species planted	**4** (3)
Seedling health	
Good	**22** (15)
Poor	**0** (0)
Dead / Missing	**1** (7)
Total plantings	**23** (22)

TSP7 is located about 3,040 m from the LLPS within the Smith property, NSW.

Planting health increased by **27.5%** with **95.7%** of specimens currently in good condition. The increase is attributed to **7** new plantings.

Note: Sample site is separated in to two planting areas - northern and southern sides of the construction corridor. Natural recruitment of Yellow Box *Eucalyptus melliodora*, Apple Box *E. bridgesiana* and Broad-leaved Peppermint *E. dives* was observed east and west of this site.

Recommendation: Provide sufficient maintenance for new plantings.

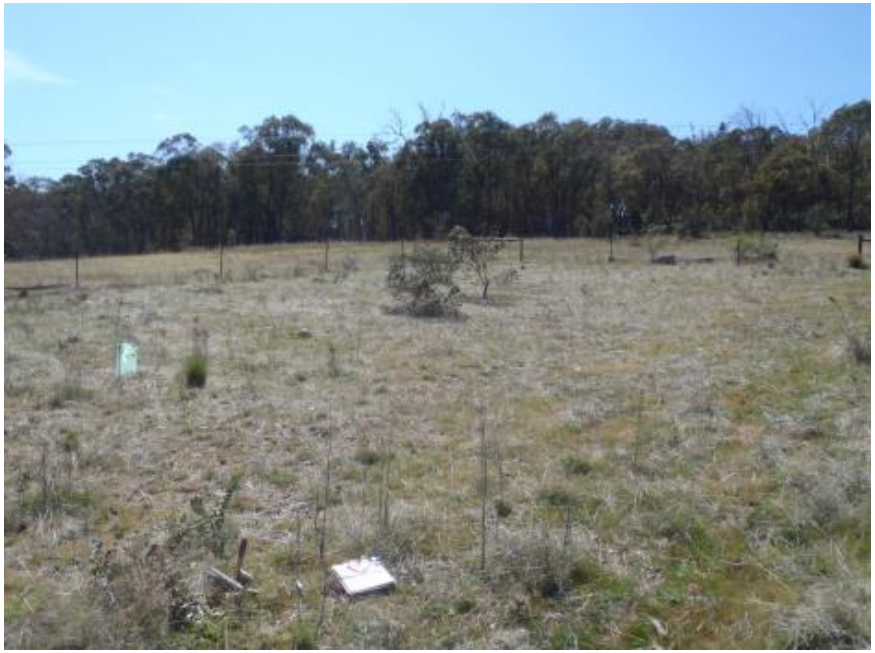

Plate 7: Monitoring Site TSP7. The image on the left is from autumn 2015 and the right spring 2015.

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3.1.8 Monitoring site TSP8

Jurisdiction	**NSW**
Co-ordinates	695663 – 6060392
No. of tree & shrub species planted	**2**
Seedling health	
Good	**8** (8)
Poor	**0** (0)
Dead / Missing	**1** (1)
Total plantings	**9**

TSP8 is located about 4,975 m from the LLPS within the Lonergan property, NSW.

This site contains just **9** plantings. The proportion of specimens in good health remained constant at **88.9%**. Replanting was not undertaken at this site.

Recommendation: Provide sufficient planting maintenance.

Plate 8: Monitoring Site TSP8. The image on the left is from autumn 2015 and the right spring 2015.

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3.1.9 Monitoring site TSP9

Jurisdiction	**NSW**
Co-ordinates	696175 – 6060305
No. of tree & shrub species planted	**3**
Seedling health	
Good	**16** (16)
Poor	**6** (3)
Dead / Missing	**2** (5)
Total plantings	**24**

TSP9 is located about 5,475 m from the LLPS within the Lonergan property, NSW.

The proportion of specimens in good health remained constant at **66.7%**. Replanting was not undertaken at this site.

Note: Plantings are consistently engulfed by pasture grasses, which may affect future planting success.

Recommendation: Provide sufficient planting maintenance.

Plate 9: Monitoring Site TSP9. The image on the left is from autumn 2015 and the right spring 2015.

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3.1.10 Monitoring site TSP10

Jurisdiction	**NSW**
Co-ordinates	697084 – 6060204
No. of tree & shrub species planted	**8**
Seedling health	
Good	**86** (79)
Poor	**20** (18)
Dead / Missing	**33** (42)
Total plantings	**139**

TSP10 is located about 6,425 m from the LLPS within the Johanson property, NSW.

Planting health increased by **5.1%** with **61.9%** of specimens currently in good condition. The increase is attributed to **20** new plantings.

Note: Some tree guards remain choked with herbage that has resulted in the death and poor health of some plantings.

Recommendation: Provide sufficient planting maintenance.

Plate 10: Monitoring Site TSP10. The image on the left is from autumn 2015 and the right spring 2015.

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3.1.11Monitoring site TSP11

Jurisdiction	**NSW**
Co-ordinates	699277 – 6061925
No. of tree & shrub species planted	**3**
Seedling health	
Good	**4** (7)
Poor	**4** (3)
Dead / Missing	**4** (2)
Total plantings	**12**

TSP11 is located about 9,300 m from the LLPS within the Latimer property, NSW.

Planting health declined by **25%** with **33.3%** of plantings currently in good condition. Replanting was not undertaken at this site.

Plantings exhibited vigorous growth up to autumn 2014, after which there was a steady decline in health. Most plantings have become engulfed by pasture grasses, which may have affected the vigour of some specimens.

Recommendation: Provide sufficient planting maintenance.

Plate 11: Monitoring Site TSP11. The image on the left is from autumn 2015 and the right spring 2015.

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3.1.12 Monitoring site TSP12

Jurisdiction	**NSW**
Co-ordinates	701346 – 6063099
No. of tree & shrub species planted	**4**
Seedling health	
Good	**51** (38)
Poor	**5** (6)
Dead / Missing	**9** (21)
Total plantings	**65**

TSP12 is located about 11,900 m from the LLPS near the discharge facility, NSW.

Planting health increased by **20%** with **78.5%** of specimens currently in good condition. The increase is attributed to **23** new plantings.

Recommendation: Provide sufficient planting maintenance

Plate 12: Monitoring Site TSP12. The image on the left is from autumn 2015 and the right spring 2015.

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3.2 Weeds

Broad-leaf weeds such as *Conyza* sp. (Fleabane), *Verbena bonariensis* (Purple-top) and the noxious *Hypericum perforatum* (St John's Wort) and *Echium vulgare* (Viper's Bugloss) were widely encountered within the construction corridor and are discussed in greater detail in the M2G Seeding (Plot) Monitoring Report: Spring 2015.

Two noxious grasses were recorded: African Lovegrass *Eragrostis curvula* was widely distributed within the construction corridor though at low density and Serrated Tussock *Nassella trichotoma* was recorded in low numbers near TSP 7.

Persistent smothering of plantings was observed in the eastern and central sections of the corridor, particularly at Sites, TSP9, 10 and 11.

3.3 Threatened plants

No new observations to report.

3.4 Threatened fauna

No new observations to report.

3.5 Main Observations

- plantings in good health increased from **40.7%** to **46.6%.**
- dead or missing plantings reduced from **51.9% to 39.2%.**
- plantings in poor heath increased from **7.4%** to **14.2%**.
- A total of **158** new plantings were recorded in seven sample sites and is attributed to improved results.
- Planting success remains higher in NSW than the ACT, with **68.8%** and **33.7%**, respectively, in good condition.

3.6 Key Performance Targets

The KPT for tree and shrub plantings was arbitrarily set at 90% (see Section 2.4, above), however, the target is not clearly articulated in the LRTEMP (2014), which states:

> *'**High Conservation Value Woodland**: Ground Cover - >70% vegetation cover of the native species sown and survival of native ground and tree species*'….. and….. '***Native species** (planting success) - all species listed for seeding and planting are present'.* (from Table 3.1 in the LRTEMP).

Recommendations to lower the KPTs to 70% were proposed in the previous (autumn 2015) report.

3.7 Replanting

An additional 1,300 trees and shrubs, representing about 27% of the total planted population, were planted on Icon land and on some private properties. While new plantings have raised the cohort of healthy live specimens the current KPT (90%) would not be met, even if all new plantings were to survive to maturity.

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3.8 Suggested Actions

A number of actions proposed in previous reports relating to replanting and planting maintenance have either commenced or are in train.

The current KPT (90%) is considered onerous and would require continued long-term re-planting and maintenance to keep pace with anticipated losses and ultimately the target may never be achieved. In our opinion the KPT should be reduced to a realistic and achievable target of 70%.

Furthermore, sample sites shown to have significant planting failure (i.e. TSP 4) should not be re-planted.

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4 Conclusion

The current spring monitoring survey was conducted in October 2015 and marks the seventh successive seasonal monitoring survey since the commencement of the study in spring 2012. The study measured the performance of rehabilitation planting using a simple quantitative method to determine planting success or failure.

The current survey found **344** (46.6%) specimens to be in good health, **105** (14.2%) in poor health and **289** (39.2%) either dead or missing. This result represents a modest improvement in specimen health compared to the previous two monitoring periods, but this change is largely attributed to replacement planting as opposed to any observable specimen recovery.

Extensive supplementary tree and shrub planting (approximately 1,300 specimens) was undertaken by Greening Australia during the post-autumn 2015 period. Icon Water will also committed resources to the on-going maintenance of existing and new plantings.

Achieving the current KPT of 90% is considered unlikely and it is recommended it be reduced to 70%.

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Appendix 1: Figures

Figure 1 – Figure 4 display the locations of the tree and shrub monitoring sites within the M2G construction corridor:

- **Figure 1**: Western section
- **Figure 2**: Central-western section
- **Figure 3**: Central-eastern section
- **Figure 4**: Eastern section

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Figure 1: Location of tree and shrub monitoring sites within the western section of the M2G construction corridor.

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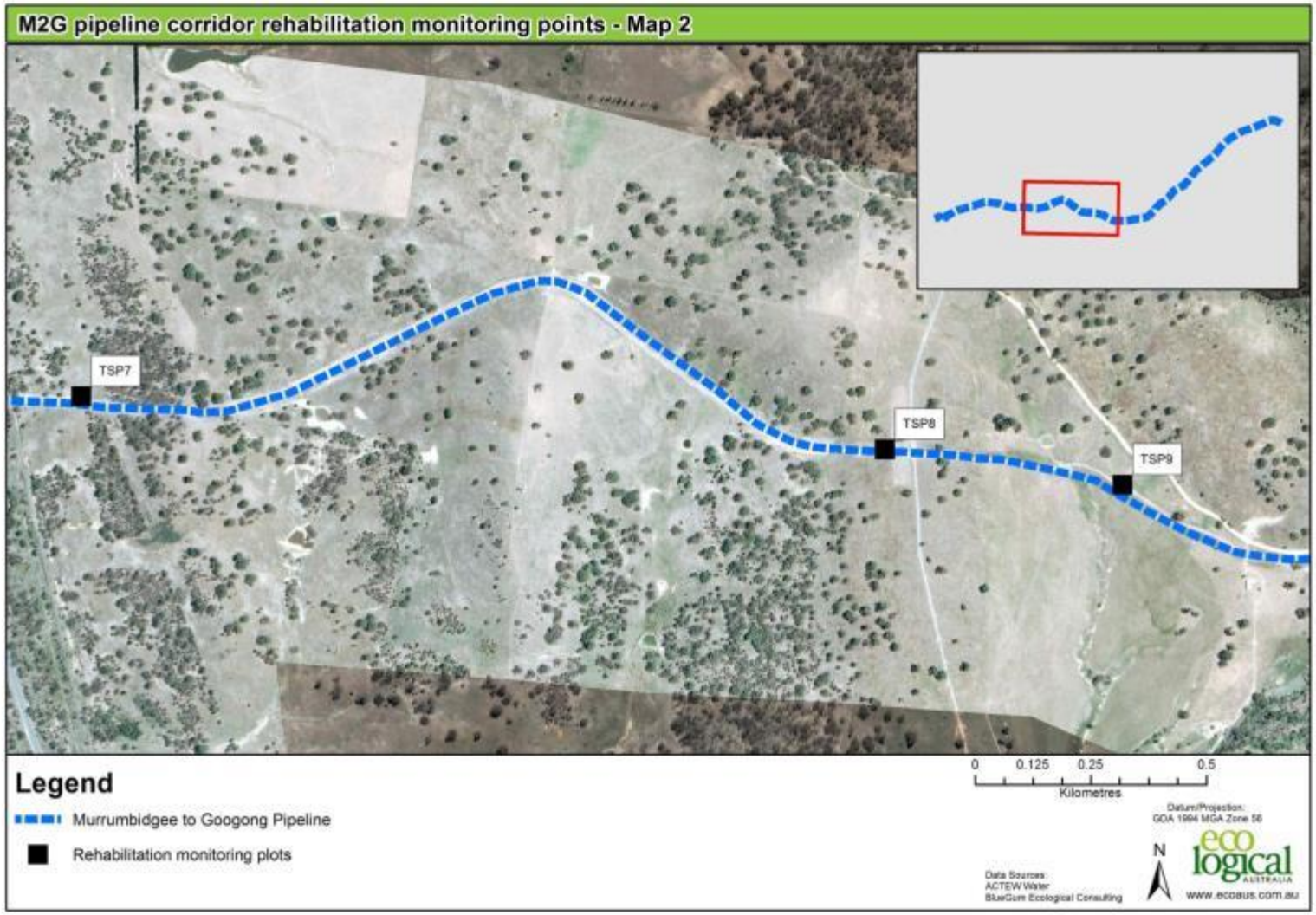

Figure 2: The location of tree and shrub monitoring sites within the central-western section of the M2G construction corridor.

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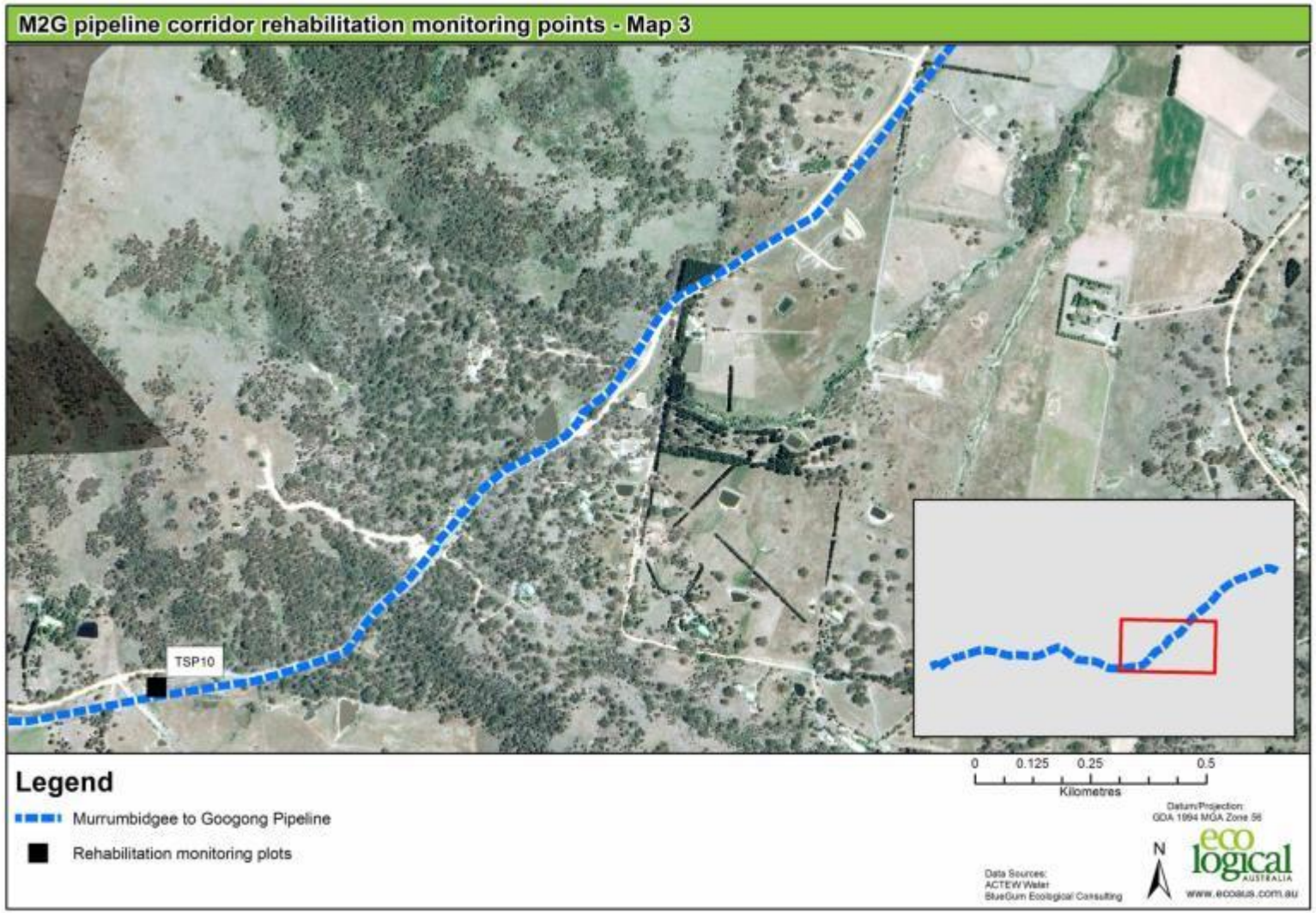

Figure 3: The location of tree and shrub monitoring sites within the central-eastern section of the M2G construction corridor.

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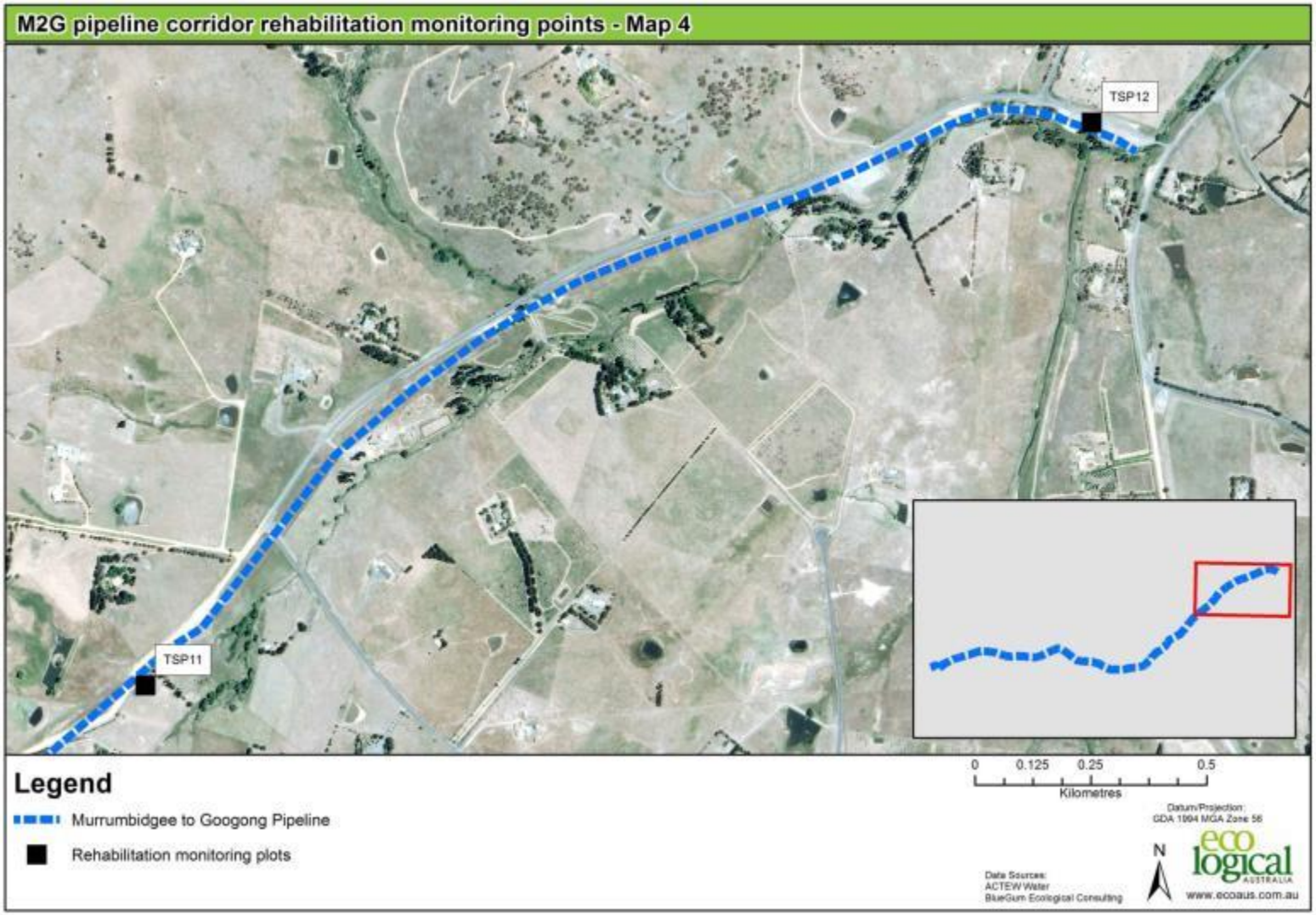

Figure 4: The location of tree and shrub monitoring sites within the eastern section of the M2G construction corridor.

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Appendix 2: Floristic data – tree & shrub plantings

Table 5: Tree and shrub planting data from twelve sample sites: spring 2015 monitoring session.

- **Figures in the dead column are not necessarily species specific.**

Site ID	Species	Good Health	Poor Health*	Dead	Missing	Total	New Plantings
TSP1	*Acacia sp.*	6	11	2		19	
TSP1	*Bursaria spinosa*	1	2			3	
TSP1	*Cassinia sp.*	1	7			8	
TSP1	*E. mannifera*	4	2			6	
TSP1	*E. melliodora*	2	1			3	
TSP1	*Unknown Euc.*		2			2	
TSP1	*Grevillea sp.*					-	
TSP1	*Hakea sp.*	1				1	
TSP1	*Leptospermum sp.*					-	
TSP1	*Unknown*			3	47	50	
Total		**15**	**25**	**5**	**47**	**92**	**0**
% good						**16.3%**	
% poor/dead/missing						**83.7%**	
TSP2	*Acacia sp.*	44	11	2		57	
TSP2	*Bursaria spinosa*	4	1			5	
TSP2	*Cassinia sp.*					-	
TSP2	*Grevillea sp.*	5				5	
TSP2	*Kunzea sp.*					-	
TSP2	*Leptospermum/Kunzea sp.*	2	2			4	
TSP2	*Unknown*			2	54	56	
Total		**55**	**14**	**4**	**54**	**127**	**0**
% good						**43.3%**	
% poor/dead/missing						**56.7%**	
TSP3	*Acacia sp.*	20	8	2		30	
TSP3	*Bursaria spinosa*	1	3			4	
TSP3	*Eucalyptus polyanthemos*	1				1	
TSP3	*Dodonaea sp.*	1	2			3	
TSP3	*Leptospermum/Kunzea sp.*		5			5	
TSP3	*Unknown*			5	47	52	
Total		**23**	**18**	**7**	**47**	**95**	**33**
% good						**24.2%**	
% poor/dead/missing						**75.8%**	

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Site ID	Species	Good Health	Poor Health*	Dead	Missing	Total	New Plantings
TSP4	*Acacia sp.*	4	6	3		13	
TSP4	*Bursaria spinosa*					-	
TSP4	*Dodonaea sp.*	2				2	
TSP4	*Leptospermum sp.*					-	
TSP4	*Unknown*				61	61	
Total		**6**	**6**	**3**	**61**	**76**	**4**
% good						**7.9%**	
% poor/dead/missing						**92.1%**	
TSP5	*Acacia sp.*	5				5	
TSP5	*Cassinia sp.*	4				4	
TSP5	*Dodonaea sp.*	2				2	
TSP5	*E. bridgesiana*	1	2			3	
TSP5	*E. dives**					-	
TSP5	*E. melliodora*					-	
TSP5	*Unknown*			2	3	5	
Total		**12**	**2**	**2**	**3**	**19**	**16**
% good						**63.2%**	
% poor/dead/missing						**36.8%**	
TSP6	*Acacia sp.*	22	3			25	
TSP6	*Dodonaea sp.*	7				7	
TSP6	*E. blakelyi*					-	
TSP6	*E. bridgesiana*	8				8	
TSP6	*E. melliodora*	9	2			11	
TSP6	*Unknown*			6		6	
Total		**46**	**5**	**6**	**0**	**57** (21)	**55**
% good						**80.7%**	
% poor/dead/missing						**19.3%**	
TSP7	*E. blakelyi*	2				2	
TSP7	*E. bridgesiana*	8				8	
TSP7	*E. melliodora*	8		1		9	
TSP7	*E. polyanthemos*						
TSP7	*E. dives*					-	
TSP7	*Unknown Eucalyptus* [A]	4				4	
TSP7	*Unknown*					-	
Total		**22**	**0**	**1**	**0**	**23** (22)	**7**
% good						**95.7%**	
% poor/dead/missing						**4.3%**	
TSP8	*E. mannifera*	4				4	
TSP8	*E. melliodora*	4		1		5	
TSP8	*Leptospermum sp.*					-	
TSP8	*Unknown*					-	
Total		**8**	**0**	**1**	**0**	**9**	**0**
% good						**88.9%**	
% poor/dead/missing						**11.1%**	

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Site ID	Species	Good Health	Poor Health*	Dead	Missing	Total	New Plantings
TSP9	*E. melliodora*	10	6			16	
TSP9	*E. polyanthemos*	1				1	
TSP9	*E. blakelyi*	5				5	
TSP9	*Unknown*			2		2	
Total		**16**	**6**	**2**	**0**	**24**	**0**
% good						**66.7%**	
% poor/dead/missing						**33.3%**	
TSP10	*Acacia sp.*	19	4			23	
TSP10	*Callistemon sp.*	9				9	
TSP10	*Dodonaea sp.*	3	1	1		5	
TSP10	*E. bridgesiana*	4	1			5	
TSP10	*E. mannifera*	8	2	1		11	
TSP10	*E. melliodora*	11	1			12	
TSP10	*E. polyanthemos*	31	11			42	
TSP10	*Unknown Eucalyptus*	1		1		2	
TSP10	*Unknown*			4	26	30	
Total		**86**	**20**	**7**	**26**	**139**	**20**
% good						**61.9%**	
% poor/dead/missing						**38.1%**	
TSP11	*E. blakelyi*	1	2			3	
TSP11	*E. bridgesiana*	2		3		5	
TSP11	*E. melliodora*	1	2			3	
TSP11	*Unknown*				1	1	
Total		**4**	**4**	**3**	**1**	**12**	**0**
% good						**33.3%**	
% poor/dead/missing						**66.7%**	
TSP12	*Acacia sp.*	24	4	2		30	
TSP12	*Bursaria spinosa*	6	1			7	
TSP12	*Cassinia sp.*	1				1	
TSP12	*Dodonaea sp.*	3				3	
TSP12	*E. mannifera*	5				5	
TSP12	*E. melliodora*	1				1	
TSP12	*E. polyanthemos*	1				1	
TSP12	*Leptospermum/Kunzea*	10				10	
TSP12	*Unknown*			6	1	7	
Total		**51**	**5**	**8**	**1**	**65**	**23**
% good						**78.5%**	
% poor/dead/missing						**21.5%**	
TOTAL		**344**	**105**	**49**	**240**	**738**	**158**

[A] = Unknown *Eucalyptus*, probably *E. bridgesiana*

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