

Appendix 1- Rehabilitation Table

Annual Rehabilitation Report Form, Rehabilitation Maps and Rehabilitation Summary

Annual Rehabilitation Report Form – Mines

Year Ending: 2017

Mine: Mt Thorley Warkworth

Company: Rio Tinto Coal Australia – Coal and Allied

Plans Attached:

Mt Thorley Warkworth – AER 2017

Approved Mining Operations Plan:

MTW MOP (2015 – 2021) – Approval Date 05/02/2016

Total Area Covered by Mining Operations Plan:

MTW MOP – 6,185ha

Total Area Covered by Mining Lease for This Mine: 6,185ha

Table 1: Rehabilitation Progress 2017

Rehabilitation Activity Type	Domain Identifier	Primary Domain	Secondary Domain	Total Area Last Reported (ha)	Total Area to date (ha)
1.1 Active mining and infrastructure area, facilities, including roads and tracks	1A	Final Void	Final Void	189.1	227.8
	1C	Final Void	Rehabilitation Area - Grassland	0.0	0.0
	2A	Water Management Areas	Final Void	0.0	0.0
	2B	Water Management Areas	Water Management Areas	0.0	0.0
	2C	Water Management Areas	Rehabilitation Area - Grassland	35.0	39.8
	2D	Water Management Areas	Rehabilitation Area - Woodland	0.0	0.0
	2E	Water Management Areas	Rehabilitation Area - Woodland EEC	26.2	22.8
	3B	Infrastructure Area	Water Management Areas	0.0	0.0
	3C	Infrastructure Area	Rehabilitation Area - Grassland	100.7	100.7
	3D	Infrastructure Area	Rehabilitation Area - Woodland	0.0	0.0

	3E	Infrastructure Area	Rehabilitation Area - Woodland EEC	69.0	68.5
	4C	Tailings Storage Facility	Rehabilitation Area - Grassland	75.7	75.6
	4D	Tailings Storage Facility	Rehabilitation Area - Woodland	11.7	11.7
	4E	Tailings Storage Facility	Rehabilitation Area - Woodland EEC	88.3	88.2
	5A	Overburden Emplacement Area	Final Void	0.0	0.0
	5B	Overburden Emplacement Area	Water Management Areas	0.0	0.0
	5C	Overburden Emplacement Area	Rehabilitation Area - Grassland	328.9	320.3
	5D	Overburden Emplacement Area	Rehabilitation Area - Woodland	278.7	267.3
	5E	Overburden Emplacement Area	Rehabilitation Area - Woodland EEC	1323.7	1275.3
	Bulga Sublease Area	N/A - Outside Domain Boundary	N/A - Outside Domain Boundary	12.8	0.9
	Outside Domain Area	N/A - Outside Domain Boundary	N/A - Outside Domain Boundary	1.7	2.1
	Total Active			2541.4	2501.0
1.2 Decommissioning	Total - Decommissioning			0.0	0.0
1.3 Landform Establishment				14.2 (Included in 1.1)	13.6 (Included in 1.1)
	Total - Landform Establishment				
1.4 Growth Medium Development				14.5 (Included in 1.1)	24.5 (Included in 1.1)
	Total - Growth Medium Development				
1.5 Ecosystem and Land Use Establishment	2C	Water Management Areas	Rehabilitation Area - Grassland	0.0	3.5
	2E	Water Management Areas	Rehabilitation Area - Woodland EEC	2.9	2.9
	4E	Tailings Storage Facility	Rehabilitation Area - Woodland EEC	4.0	4.0
	5C	Overburden Emplacement	Rehabilitation Area - Grassland	37.4	34.8

		Area			
	5D	Overburden Emplacement Area	Rehabilitation Area - Woodland	36.7	52.4
	5E	Overburden Emplacement Area	Rehabilitation Area - Woodland EEC	169.5	96.8
	Total - Ecosystem and Land Use Establishment			250.3	194.4
1.6 Ecosystem and Land Use Development	1A	Final Void	Final Void	1.1	0.0
	2C	Water Management Areas	Rehabilitation Area - Grassland	1.7	1.7
	2E	Water Management Areas	Rehabilitation Area - Woodland EEC	3.3	3.3
	3C	Infrastructure Area	Rehabilitation Area - Grassland	5.4	5.4
	3E	Infrastructure Area	Rehabilitation Area - Woodland EEC	0.0	0.5
	4C	Tailings Storage Facility	Rehabilitation Area - Grassland	27.3	27.3
	4D	Tailings Storage Facility	Rehabilitation Area - Woodland	1.4	1.4
	4E	Tailings Storage Facility	Rehabilitation Area - Woodland EEC	35.5	35.4
	5C	Overburden Emplacement Area	Rehabilitation Area - Grassland	507.9	536.1
	5D	Overburden Emplacement Area	Rehabilitation Area - Woodland	11.6	10.2
	5E	Overburden Emplacement Area	Rehabilitation Area - Woodland EEC	221.9	339.8
	Total - Ecosystem and Land Use Development			817.0	961.1
Rehabilitation Activity Type	Domain Identifier	Primary Domain	Secondary Domain	Total Area Last Reported (ha)	Total Area to date (ha)
1.7 Rehabilitation Complete	Total - Rehabilitation Complete			0.0	0.0
1.8 Total Area Disturbed (items 1.1 to 1.7)	1A	Final Void	Final Void	190.2	227.8
	2A	Water Management Areas	Final Void	0.0	0.0
	2B	Water Management Areas	Water Management Areas	0.0	0.0

2C	Water Management Areas	Rehabilitation Area - Grassland	36.6	45.0
2D	Water Management Areas	Rehabilitation Area - Woodland	0.0	0.0
2E	Water Management Areas	Rehabilitation Area - Woodland EEC	32.3	29.0
3B	Infrastructure Area	Water Management Areas	0.0	0.0
3C	Infrastructure Area	Rehabilitation Area - Grassland	106.0	106.1
3D	Infrastructure Area	Rehabilitation Area - Woodland	0.0	0.0
3E	Infrastructure Area	Rehabilitation Area - Woodland EEC	69.0	69.0
4C	Tailings Storage Facility	Rehabilitation Area - Grassland	103.0	102.9
4D	Tailings Storage Facility	Rehabilitation Area - Woodland	13.1	13.1
4E	Tailings Storage Facility	Rehabilitation Area - Woodland EEC	127.7	127.6
5A	Overburden Emplacement Area	Final Void	0.0	0.0
5B	Overburden Emplacement Area	Water Management Areas	0.0	0.0
5C	Overburden Emplacement Area	Rehabilitation Area - Grassland	874.2	891.2
5D	Overburden Emplacement Area	Rehabilitation Area - Woodland	327.0	329.9
5E	Overburden Emplacement Area	Rehabilitation Area - Woodland EEC	1715.1	1711.9
Bulga Sublease Area	N/A - Outside Domain Boundary	N/A - Outside Domain Boundary	12.8	0.9
Outside Domain Area	N/A - Outside Domain Boundary	N/A - Outside Domain Boundary	1.7	2.1
Total Footprint			3608.7	3656.5

Table 2: Soil Management and Erosion, 2017

Soil Stockpiling/ Use	Soil Used This Period (m3)	Soil Pre-stripped This Period (m3)	Stockpile Inventory to Date (m3)	Soil Stockpiled Last Report (m3)
	110,600	74,900	639,824	675,524
2.2 Erosion Treatment	Total Area to Date (ha)	Total Area Last Report (ha)	Total Area This Report (ha)	Area Retreated This Period (ha)
	Not Available	5.0	69.9	0
Approx. area of sheet or gully erosion requiring reshaping topdressing and/or resowing	Not Available			

Table 3: Weed Control

	Area (ha)
3.1 Approx. area adversely affected by weeds as of the date of this report	Not Available
3.2 Area treated for weed control during the period covered by the report	312.3
3.3 Give summary of control strategies used and verification by approval agency(s)	
Species targeted in rehabilitation areas during 2017 included: galenia, Rhodes grass, green panic, couch grass, <i>Acacia saligna</i> , mustard weed (Brassica), farmers friend (<i>Bidens pilosa</i>) and paddys lucerne (<i>Sida rhombifolia</i>).	

Table 4: Management of Rehabilitation Areas

4.1 Area treated with maintenance fertiliser	0ha
--	-----

4.2 Area treated by rotational grazing, cropping or slashing	90ha
Give Summary	90ha Warkworth rehabilitation area licence agreement in place for grazing.

Table: 5 Variations to Rehabilitation Program

Has rehabilitation work proceeded generally in accordance with the conditions of an accepted Mining Operations Plan?	Yes
If not please cite any approval granted for variations, or briefly describe the seasonal conditions or other reasons for any changes and the nature of any changes which have been made.	NA

Table 6: Planned Operations During the Next Repot Period

6.1 Area estimated to be disturbed	117.9ha
6.2 Area estimated to be rehabilitated	100ha

Appendix 2 – Rehabilitation Summary

Rehabilitation Site Name	Type	Coordinates (GDA94)	Area (ha)	Rehabilitation Summary
North Pit North Slope	Woodland	317,340.5 E 6,392,658.1 N	10.5	<ul style="list-style-type: none"> ▪ The landform was constructed from a waste emplacement. ▪ Typical slope of the landform is 10 degrees with a primarily northerly aspect. ▪ Drainage is via easterly draining contours reporting to adjacent existing contour drainage and then to an engineered rock-line chute. ▪ Landform surface preparation comprised bulk shaping, deep ripping, rock raking, and removal of oversize rock material. ▪ Clay loam/sandy clay loam topsoil from existing topsoil stockpiles was spread at a nominal thickness of 100mm. ▪ Soil ameliorants comprising recycled gypsum and mixed waste compost were applied at rates of 10t/ha and 100t/ha respectively. ▪ Growth medium preparation included ameliorant incorporation, rock windrowing, rock picking, and aerating as required, and the area was sprayed with herbicide prior to sowing ▪ Diverse Native Woodland Mix was drilled into an aerated pattern at 14.7kg/ha.
North Pit North Topsoils	Native Grass	317,423.8 E 6,392,331.8 N	6.3	<ul style="list-style-type: none"> ▪ Topsoil stockpile overlies the landform surface. The underlying landform was constructed from a waste emplacement. ▪ Typical slope of the landform is flat (0-2 degrees) and without dominant aspect. Topsoil stockpiles ~3 metres high with gently sloping sides (5-8 degrees) are constructed on the landform. ▪ Drainage is via overland flow to adjacent flat and gently undulating rehabilitation areas, and associated landscape drainage structures such as swales, shallow drainage channels, and basin impoundments. ▪ Landform surface preparation comprised bulk shaping, deep ripping, rock raking, and removal of oversize rock material. Placed topsoils were shaped to a flat mound with gently sloping sides. ▪ Soil ameliorants comprising recycled gypsum and mixed waste compost were applied at rates of 10t/ha and 100t/ha respectively. ▪ The area was sprayed with herbicide prior to preparation of the sandy clay loam soil from the topsoil stockpile surface by chisel ploughing and

Rehabilitation Site Name	Type	Coordinates (GDA94)	Area (ha)	Rehabilitation Summary
				<p>removal of discrete oversize surface rock and timber.</p> <ul style="list-style-type: none"> Native Grass Seed Mix was spread to the disturbed surface 22kg/ha.
Swan Lake Spoil Compost	Woodland	319,126.6 E 6,391,131.4 N	4.7	<ul style="list-style-type: none"> The landform was constructed from a waste emplacement. The area is flat with localised micro-relief undulations (0-2 degrees) and without dominant aspect. Drainage is via overland flow to adjacent existing Swan Lake rehabilitation areas to the north and east. Existing area drainage is managed by a mix of swales and drainage depressions, drainage channels and contours, and a series of basins and engineered rock-lined chutes. Landform surface preparation comprised bulk shaping, deep ripping, rock raking, and removal of rock material as necessary. Substrate material comprised weathered mine spoil. Growth medium ameliorants comprising recycled gypsum and mixed waste compost were applied at rates of 10t/ha and 100t/ha respectively. Growth medium preparation comprised aerating following ameliorant application, herbicide spraying following a fallow period, and re-aeration prior to sowing. Diverse Native Woodland Mix was drilled into an aerated pattern at 14.7kg/ha.
Swan Lake Topsoils	Native Grass	318,894.7 E 6,391,166.4 N	1.1	<ul style="list-style-type: none"> Topsoil stockpile overlies the landform surface. The underlying landform was constructed from a waste emplacement. The area is flat (0-2 degrees) and without dominant aspect. Topsoil stockpiles ~3 metres high with gently sloping sides (5-8 degrees) are constructed on the landform. Drainage is via overland flow to adjacent flat and gently undulating rehabilitation areas, or to the mine. Adjacent rehabilitation areas report to the wider Swan Lake drainage network. Landform surface preparation comprised bulk shaping, deep ripping, rock raking, and removal of oversize rock material. Placed topsoils

Rehabilitation Site Name	Type	Coordinates (GDA94)	Area (ha)	Rehabilitation Summary
				<p>were shaped to a flat mound with gently sloping sides.</p> <ul style="list-style-type: none"> ▪ Mixed waste compost soil ameliorant was applied at 100t/ha. ▪ Discrete oversize surface rock and timber was removed from the stockpiles and the clay loam/sandy clay loam soils were aerated to prepare the seed bed. ▪ Native Grass Seed Mix was spread to the disturbed surface 20kg/ha.
CD RL160	Woodland	319,171.0 E 6,390,161.9 N	10.1	<ul style="list-style-type: none"> ▪ The landform was constructed from a waste emplacement. ▪ The area is flat with localised micro-relief (0-2 degrees) and without dominant aspect. ▪ Primary drainage is overland to the localised drainage depressions and habitat ponds. ▪ Landform surface preparation comprised bulk shaping, deep ripping, rock raking, and removal of oversize rock material. ▪ Sandy clay loam topsoil from existing stockpiles was spread at a nominal thickness of 100mm. ▪ Growth medium ameliorants comprising recycled gypsum and mixed waste compost were applied at rates of 10t/ha and 100t/ha respectively. ▪ Growth medium preparation included windrowing, rock picking, and aerating as required. Discrete areas were sprayed with herbicide prior to sowing as required. ▪ Diverse Native Woodland Mix was drilled into an aerated pattern at 14.7kg/ha.
South Pit North Orica	Woodland	319,799.4 E 6,390,592.9 N	7.8	<ul style="list-style-type: none"> ▪ The landform was constructed from a waste emplacement. ▪ Typical slope of the landform is generally 10 degrees with a primarily easterly aspect. A portion of the lower slope has slopes to 14 degrees and will be reshaped at closure (above explosives reload facility). ▪ Drainage is via easterly draining contours to an engineered rock-line chute which reports to a basal dam. ▪ Landform surface preparation comprised bulk shaping, deep ripping, rock raking, and removal of oversize rock material.

Rehabilitation Site Name	Type	Coordinates (GDA94)	Area (ha)	Rehabilitation Summary
				<ul style="list-style-type: none"> Sandy clay loam topsoils from a combination of West Pit South pre-strip and local topsoil stockpiles were spread to the area at a nominal thickness of 100mm. Growth medium ameliorants comprising recycled gypsum and mixed waste compost were applied at rates of 10t/ha and 100t/ha respectively. Growth medium preparation included windrowing, rock picking, and aerating as required. Seasonal cover crop (oats) was sown to an initial 2.4ha area prior to final sowing of the complete area with Diverse Native Woodland Mix which was spread into an aerated pattern at 14.7kg/ha.
South Pit North	Exotic Pasture (cover crop)	320,849.6 E 6,390,446.7 N	1.6	<ul style="list-style-type: none"> The landform was constructed from a waste emplacement. The area comprises the base of the wider rehab slope with sloping western areas (10 degrees) grading to flat areas (0-2 degrees) along the eastern portion. Drainage is via overland flow to drainage basins along the eastern edge of the area. Landform surface preparation comprised bulk shaping, deep ripping, rock raking, and removal of oversize rock material. A combination of sandy clay loam topsoils from local and Woodlands topsoil reclamation was spread at a nominal thickness of 100mm. Growth medium ameliorants comprising recycled gypsum and mixed waste compost were applied at rates of 10t/ha and 100t/ha respectively. Growth medium preparation included rock removal and aerating as required. Summer cereal (millet) was spread to an aerated pattern at 25kg/ha.
CD RL170	Woodland	320,849.6 E 6,390,446.7 N	6.2	<ul style="list-style-type: none"> The landform was constructed from a waste emplacement. The area has predominantly Northern aspect although with eastern areas of the landform orientated to the NE. The area is generally sloping (10 degrees) with the northern areas grading to flat areas at

Rehabilitation Site Name	Type	Coordinates (GDA94)	Area (ha)	Rehabilitation Summary
				<p>base of slope with localised micro-relief (0-2 degrees).</p> <ul style="list-style-type: none"> ▪ Sloping areas are drained by contours which report to a mid-slope engineered rock-line chute and a series of east flowing drain lines and surge basins prior to spilling to the primary South Pit North engineered rock-line chute. Base of slope areas flow overland to local drainage depressions and habitat ponds on the RL160 level plateau. ▪ Landform surface preparation comprised bulk shaping, deep ripping, rock raking, and removal of oversize rock material. ▪ Sandy clay loam topsoils from existing local stockpiles was spread at a nominal thickness of 100mm. ▪ Growth medium ameliorants comprising recycled gypsum and mixed waste compost were applied at rates of 10t/ha and 100t/ha respectively. ▪ Growth medium preparation included windrowing, rock picking and aerating as required. ▪ Seasonal cover crop was sown to an initial 2.4ha area prior to final sowing of the complete area with Diverse Native Woodland Mix which was spread into an aerated pattern at 17kg/ha.
South Pit Centre	Woodland	320,690.4 E 6,389,367.4 N	10.8	<ul style="list-style-type: none"> ▪ The landform was constructed from a waste emplacement. ▪ The area is sloping (10 degrees) with an easterly aspect. A portion of the lower slope has slopes to 14 degrees and will be reshaped at closure (above shut pad). ▪ The area is drained by contours which report via engineered rock-lined chutes to a basal storage dam. ▪ Landform surface preparation comprised bulk shaping, deep ripping, rock raking, and removal of oversize rock material. ▪ Sandy loam, sand clay loam and clay loam topsoils from ahead of pre-strip areas in North Pit and West Pit South in combination with stockpiled topsoils were spread at a nominal thickness of 100mm. ▪ Growth medium ameliorants comprising recycled gypsum and mixed waste compost were applied at rates of 10t/ha and 100t/ha

Rehabilitation Site Name	Type	Coordinates (GDA94)	Area (ha)	Rehabilitation Summary
				<p>respectively.</p> <ul style="list-style-type: none"> ▪ Growth medium preparation included herbicide application, rock picking and aerating as required. ▪ Diverse Native Woodland Mix was spread into an aerated pattern at 17kg/ha.
South Pit South Area A	Exotic Pasture (cover crop)	321,234.1 E 6,388,626.6 N	5.8	<ul style="list-style-type: none"> ▪ The landform was constructed from a waste emplacement. ▪ The area is sloping (10 degrees) with an easterly aspect. ▪ The area is drained by contours which report via engineered rock-lined chutes to a basal storage dam. ▪ Landform surface preparation comprised bulk shaping, deep ripping, rock raking, and removal of oversize rock material. ▪ Sandy clay loam topsoils from existing stockpiles were spread at a nominal thickness of 100mm. ▪ Growth medium ameliorants comprising recycled gypsum and mixed waste compost were applied at rates of 10t/ha and 100t/ha respectively. ▪ Growth medium preparation included windrowing, rock picking, and aerating as required, and was sprayed prior to sowing. ▪ Seasonal cereal (oats) was air seeded to an aerated pattern at 45kg/ha.
South Pit South Area B	Exotic Pasture (cover crop)	320,726.6 E 6,389,056.5 N	3.7	<ul style="list-style-type: none"> ▪ The landform was constructed from a waste emplacement. ▪ The area is sloping (10 degrees) with an easterly aspect. ▪ The area is drained by contours which report via engineered rock-lined chutes to a drainage channel and then via lower slope drainage structures to a base of slope dam. ▪ Landform surface preparation comprised bulk shaping, deep ripping, rock raking, and removal of oversize rock material. ▪ Sandy clay loam topsoils from existing stockpiles were spread at a nominal thickness of 100mm. ▪ Growth medium ameliorants comprising recycled gypsum and mixed waste compost were applied at rates of 10t/ha and 100t/ha respectively.

Rehabilitation Site Name	Type	Coordinates (GDA94)	Area (ha)	Rehabilitation Summary
				<ul style="list-style-type: none"> ▪ Growth medium preparation included windrowing, rock picking, and aerating as required. ▪ Autumn Winter Rehab Blend (cereal/legumes/herbs) was air seeded to an aerated pattern at 30kg/ha.
Boral Shed	Woodland	318,339.7 E 6,387,539.0 N	2.7	<ul style="list-style-type: none"> ▪ The landform was constructed from excavated natural topography and waste rock emplaced during construction of a relict haul road. ▪ The area is generally sloping (6-12 degrees) depending upon exact location upon the topography of the Charlton Ridge, although with smaller level or near level areas (1-2 degrees). Aspect of the area is generally to the north east. ▪ The area drainage is mixed with sloping areas drained by contours and flatter areas drained by overland flow. All areas drain to dams located on the lower slope. ▪ Landform surface preparation comprised bulk shaping, selective deep ripping, rock raking, and removal of oversize rock material. ▪ Sandy clay loam topsoil from pre-strip areas was spread at a nominal thickness of 100mm. ▪ Growth medium ameliorants comprising recycled gypsum and mixed waste compost were applied at rates of 10t/ha and 100t/ha respectively. ▪ Growth medium preparation included windrowing, rock picking, and aerating as required, and was sprayed with herbicide prior to sowing. ▪ Diverse Native Woodland Mix was drilled into an aerated pattern at 17kg/ha.
Charlton Ridge Sub Site	Woodland	318,937.0 E 6,387,694.7 N	1.1	<ul style="list-style-type: none"> ▪ The landform was constructed from excavated natural topography following rehabilitation of a relict cut-fill pad. ▪ The area is generally sloping (6-12 degrees) with a north-easterly aspect. The north-eastern portion of the area is relatively flat (0-2 degrees). ▪ Drainage is via contours on the sloping areas and overland flow on the flat sections.

Rehabilitation Site Name	Type	Coordinates (GDA94)	Area (ha)	Rehabilitation Summary
				<ul style="list-style-type: none"> Landform surface preparation comprised bulk shaping, selective deep ripping, rock raking, and removal of oversize rock material. Sandy clay loam topsoil from pre-strip areas was spread at a nominal thickness of 100mm. Growth medium ameliorants comprising recycled gypsum and mixed waste compost were applied at rates of 10t/ha and 100t/ha respectively. Growth medium preparation included windrowing, rock picking, and aerating as required, and was sprayed with herbicide prior to sowing. Diverse Native Woodland Mix was spread into an aerated pattern at 17kg/ha.
MTO Bulga Flats	Woodland (flats) Native Grass (drain)	320,088.0 E 6,385,521.4 N	15.6	<ul style="list-style-type: none"> The landform was constructed from a waste emplacement. The substantive northern area is flat with localised micro-relief (0-2 degrees) and without dominant aspect. The elongate southern area is an engineered channel draining the adjacent northern rehab areas. Drainage is via overland flow to adjacent flat and gently undulating rehabilitation areas, local drainage depressions and habitat ponds, and to the engineered earth and rock-lined drainage channel. The drainage channel reports to the Ramp 22 Dam. Landform surface preparation comprised bulk shaping, deep ripping, rock raking, and removal of oversize rock material. The drainage channel was constructed by excavation, compaction, rock-lining (lower reach) and topsoil placement (upper reach). Sandy clay loam topsoil from existing stockpiles was spread at a nominal thickness of 100mm in the upper reach and surrounds. Growth medium ameliorants comprising recycled gypsum and mixed waste compost were applied at rates of 10t/ha and 100t/ha respectively were applied to the upper reach and surrounds. Growth medium preparation included windrowing, rock picking, and aerating as required. Discrete areas were sprayed with herbicide prior to sowing.

Rehabilitation Site Name	Type	Coordinates (GDA94)	Area (ha)	Rehabilitation Summary
				<ul style="list-style-type: none"> Northern flat areas were sown to autumn cereal (oats) cover crop at 45kg/ha. Rehab edges and wider drain surrounds and rehab were sown to summer cereal (millet) cover crop at 35kg/ha. Earth lined drain sections and immediate surrounds were sown to custom Native Grass Seed Mix at 22kg/ha.
MTO RL137 Slope	Woodland	319,983.1 E 6,385,719.7 N	4.4	<ul style="list-style-type: none"> The landform was constructed from a waste emplacement. The area is sloping (10 degrees) with an easterly aspect. Drainage is via north flowing contours to engineered rock-line chute (to be constructed), basal basin and engineered drain on the Bulga Flats. Landform surface preparation comprised bulk shaping, deep ripping, rock raking, and removal of oversize rock material. Sandy clay loam topsoil from existing stockpiles was spread at a nominal thickness of 100mm. Growth medium ameliorants comprising recycled gypsum and mixed waste compost were applied at rates of 10t/ha and 100t/ha respectively. Growth medium preparation included windrowing, rock picking, and aerating as required, and was sprayed prior to sowing. Diverse Native Woodland Mix was spread into an aerated pattern at 14.7kg/ha.
MTO RL155 Topsoils	Woodland	319,641.8 E 6,385,895.4 N	16.6	<ul style="list-style-type: none"> The landform was constructed from a waste emplacement. The area is flat with localised micro-relief (0-2 degrees) and without dominant aspect. Drainage is via overland flow to adjacent flat and gently undulating rehabilitation areas, or to adjacent mine areas. Eastern elements will also drain to contours on the eastern slope and the associated engineered rock-line chute (to be constructed) and downstream structures. Landform surface preparation comprised bulk shaping, deep ripping, rock raking, and removal of oversize rock material. Sandy clay loam topsoil from existing stockpiles was spread at a

Rehabilitation Site Name	Type	Coordinates (GDA94)	Area (ha)	Rehabilitation Summary
				<p>nominal thickness of 100mm.</p> <ul style="list-style-type: none"> ▪ Growth medium ameliorants comprising recycled gypsum and mixed waste compost were applied at rates of 10t/ha and 100t/ha respectively. ▪ Growth medium preparation included windrowing, rock picking, and aerating as required, and was sprayed prior to sowing. ▪ Diverse Native Woodland Mix was drilled into an aerated pattern at 14.7kg/ha.
MTO RL155 Cover Crop	Exotic Cover Crop	319,611.7 E 6,386,022.2 N	3.6	<ul style="list-style-type: none"> ▪ The landform was constructed from a waste emplacement. ▪ The area is flat with localised micro-relief (0-2 degrees) and without dominant aspect. ▪ Drainage is via overland flow to adjacent flat and gently undulating rehabilitation areas, or to adjacent mine areas. ▪ Landform surface preparation comprised bulk shaping, deep ripping, rock raking, and removal of oversize rock material. ▪ Sandy clay loam topsoil from existing stockpiles was spread at a nominal thickness of 100mm. ▪ Growth medium ameliorants comprising recycled gypsum and mixed waste compost were applied at rates of 10t/ha and 100t/ha respectively. ▪ Growth medium preparation included windrowing, rock picking, and aerating as required, and was sprayed prior to sowing. Summer cereal (millet) cover crop was drilled to an aerated pattern at 30kg/ha.
MTO RL155 Spoil Compost	Woodland	319,448.3 E 6,386,078.0 N	6.2	<ul style="list-style-type: none"> ▪ The landform was constructed from a waste emplacement. ▪ The area is flat with localised micro-relief (0-2 degrees) and without dominant aspect. ▪ Drainage is via overland flow to adjacent flat and gently undulating rehabilitation areas, or to adjacent mine areas. ▪ Landform surface preparation comprised bulk shaping, deep ripping, rock raking, and removal of oversize rock material. ▪ Substrate material comprised weathered mine spoil.

Rehabilitation Site Name	Type	Coordinates (GDA94)	Area (ha)	Rehabilitation Summary
				<ul style="list-style-type: none"> ▪ Growth medium ameliorants comprising recycled gypsum and mixed waste compost were applied at rates of 10t/ha and 100t/ha respectively. ▪ Growth medium preparation included rock picking and aerating, as required. ▪ Diverse Native Woodland Mix was spread into an aerated pattern at 14.7kg/ha.
Ramp 22 Dam	Infrastructure (water management)	321,690.5 E 6,385,319.2 N	4.8	<ul style="list-style-type: none"> ▪ This area has been handed back to Mount Thorley Warkworth following completion of a sub-lease agreement with Bulga Surface Operations. ▪ During the period of sub lease the final landform was completed comprising construction of an engineered dam and rehabilitation of areas immediately adjacent the dam. ▪ The landform was constructed from a waste emplacement. ▪ The wider area is flat or sloping consistent with the dam infrastructure and with a generally north easterly aspect. ▪ Surface preparation of vegetated areas comprised topsoil spreading, shallow ripping, and sowing.

Autumn Winter Rehab Blend	Composition (%)
Oats	68
Ryegrass	22
Lucerne	5
Arrowleaf Clover	5

Spring Summer Rehab Blend	Composition (%)
Rebound Millet	57
Chicory	7
Red Clover	7
Lucerne	29

Appendix 3 – Annual Rehabilitation Report



Native Vegetation Rehabilitation Monitoring 2017 – New Sites

Mount Thorley Warkworth and Hunter Valley Operations

Prepared for Coal & Allied

13 March 2018

Document control

Project no.:	3417
Project client:	Coal & Allied Operations Pty Ltd
Project office:	Mudgee
Document description:	Monitoring of new native vegetation within rehabilitation areas at Mt Thorley Warkworth Operations (MTW) and Hunter Valley Operations (HVO) as part of the annual Rehabilitation Monitoring Program.
Project Director:	Rhidian Harrington
Project Manager:	Vivien Howard
Authors:	Vivien Howard and Alex Christie
Internal review:	Rhidian Harrington
Document status:	Rev1
Document address:	P:\Projects\3000s\3400s\3417 RTCA Rehabilitation Monitoring\Report\Final\New Sites 2017

Author	Revision number	Internal review	Date issued
Vivien Howard Alex Christie	Rev 0	R. Harrington	27/07/17
Alex Christie	Rev 1	L. Carter	14/03/18

Niche Environment and Heritage

A specialist environmental and heritage consultancy.

Head Office

Niche Environment and Heritage
PO Box W36
Parramatta NSW 2150
Email: info@niche-eh.com
All mail correspondence should be through our Head Office.

Sydney

0488 224 888

Central Coast

0488 224 999

Illawarra

0488 224 777

Armidale

0488 224 094

Newcastle

0488 224 160

Mudgee

0488 224 025

Port Macquarie

0488 774 081

Brisbane

0488 224 036

Cairns

0488 284 743

© Niche Environment and Heritage, 2018

Copyright protects this publication. Except for purposes permitted by the Australian *Copyright Act 1968*, reproduction, adaptation, electronic storage, and communication to the public is prohibited without prior written permission. Enquiries should be addressed to Niche Environment and Heritage, PO Box W36, Parramatta NSW 2150, Australia, email: info@niche-eh.com.

Any third party material, including images, contained in this publication remains the property of the specified copyright owner unless otherwise indicated, and is used subject to their licensing conditions.

Cover photograph: Native rehabilitation at monitoring site

Executive summary

Context

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by Coal & Allied Operations Pty Ltd (C&A) to undertake monitoring of native rehabilitation post-mining at the Mt Thorley Warkworth (MTW) and Hunter Valley Operations (HVO) mine sites. The monitoring forms part of the MTW and HVO monitoring program, which aims to assess the recovery of native rehabilitation within the HVO and MTW rehabilitation areas. The monitoring follows on from the first round monitoring undertaken by Niche in February and March 2016 at the same sites (Niche 2016), but also includes a number of new sites. This report presents the findings from monitoring undertaken at 25 MTW sites and 29 HVO sites.

Methods

This monitoring report provides the results of the progress of the native vegetation rehabilitation and was undertaken largely in accordance with the methodology detailed in AECOM (2012) *Monitoring Methodology - Post-mined Lands MTW and HVO North Mine Sites*. Two notable amendments to the methodology were employed, based on lessons learnt during the 2016 monitoring period. These amendments include:

- Removal of the 1 x 1 metre pasture/groundcover monitoring and replacement with a BioBanking plot, including a nested 20 x 20 metre plot at each site.
- Introduction of stem density counts along two, 2 metre strips along the length of the 50 metre centre tape.
- Introduction of tree tagging, where endemic trees with a Diameter at Breast Height (DBH) larger than 5 centimetres were marked and numbered, and specific details of each tree was recorded.

These surveys also included the set-up of monitoring plots at 12 reference sites established at Belford National Park and within biodiversity offset areas owned by Rio Tinto and Peabody Energy. The reference sites have been selected to target Biometric Vegetation Types (BVTs) specified in the respective Mining Operations Plans (MOP) for MTW and HVO, these being:

1. HU701 Central Hunter Grey Box-Ironbark Woodland.
2. HU632 Central Hunter Ironbark-Spotted Gum-Grey Box Forest.

The data obtained during the monitoring has been presented in this report and compared with baseline data collected during the 2016 monitoring period and the reference sites established.

Aims

The aim of the monitoring program is to monitor vegetation attributes at rehabilitation sites established in 2016 and reference sites to determine the success of the rehabilitation within the HVO and MTW post-mine areas.

Results

This report compares the data from 2016 with the data collected at the 12 reference sites and 54 monitoring sites in 2017.

Key findings include:

- There is significant variation in the types and ages of the rehabilitation sites that were part of the monitoring project, and therefore there is a high degree of variability in monitoring results including native plant species richness, exotic cover, percentage cover, and projected cover of all strata.
- Rehabilitation sites fall within the reference site soil property ranges and therefore meet the MOP performance criteria.
- Generally the Landscape Organisation Index (LOI) at the reference and rehabilitation sites was high, with an average LOI of 0.98 for the reference sites and 0.9, 0.7 and 0.8 for HVO and MTW woodland – other and MTW woodland – EEC sites respectively.
- The average infiltration scores for rehabilitation sites overall has increased from 42.4 to 51.1 for HVO sites and 37.4 to 41.6 for MTW woodland – other sites. MTW woodland – EEC has dropped slightly from 47.8 to 43.7. This is likely due to the addition of new sites to this domain type.
- All rehabilitation sites fall below benchmark in at least one attribute.
- Due to the density of regenerating shrub species, a number of sites exceed the upper benchmark for Native Ground Cover – Shrubs (NGCS). This is likely a result of the combination of exceptional germination and juvenile canopy and mid-storey species contributing towards NGCS.
- Only one MTW woodland – EEC site is meeting the MOP performance criteria target for Native Overstorey Cover (NOS).
- All other MTW woodland – EEC sites have very low to no NOS. This is due to juvenile trees not occurring in the canopy stratum.
- Eight MTW woodland – EEC rehabilitation sites were within the reference site range values for native mid-storey cover (NMS). Part of the contribution to mid-storey cover however might be due to the presence of juvenile overstorey species which are not yet mature enough to be included in the overstorey and are included as mid-storey.
- Results for woodland – other rehabilitation sites are indicating that the current target for Exotic Plant Cover (EPC) of 0% will be very difficult to achieve. Only two woodland – other rehabilitation sites across HVO and MTW sites met this reference site benchmark level and in both cases these sites had no vegetative cover at all due to a recent knockdown herbicide spray.
- In comparison, the MOP performance criteria target for exotic plant cover for woodland – EEC rehabilitation sites has been set at a more realistic level of 5-33%. Nine of the MTW woodland – EEC rehabilitation sites met this target level. High exotic plant cover scores that exceed the benchmark at new rehabilitation sites are primarily due to the use of cover crops early during the rehabilitation works.
- Most MTW Woodland – EEC rehabilitation sites were not meeting the target levels for total native plant species richness (NPS). Although sites were generally meeting species richness targets for native trees, shrubs and grasses, they were achieving low results for species richness of ‘other species’ (i.e. herbs, forbs and monocots other than grasses etc.). The category of ‘other species’ is where most of the native plant species diversity is found in the reference sites, with results from reference sites showing they contain 10-20 species in this category.
- In relation to NPS, there is not necessarily a correlation between age of the rehabilitation and species richness. Older rehabilitation sites do not necessarily have a greater number of plant species. This is likely to reflect that seed mixes being used since 2011 have had a much higher diversity of species than earlier seed mixes.

- Due to the age of the rehabilitation sites, only eight of the 54 rehabilitation sites had trees with a DBH greater than five centimetres. However, the canopy species diversity at these sites were generally good, with all of these sites falling within the benchmark range.
- No fallen logs or large rocks were recorded at any of the rehabilitation sites.
- The 2017 reference site benchmarks vary from 2016, likely due to seasonal differences. While field surveys were conducted during the same time of the year as the 2016 surveys, many benchmark values are lower. This is likely a result of extended periods of extremely hot weather prior to the 2017 surveys, which is likely to have killed sensitive herbs and forbs compared to the previous year.

Table of Contents

1. Introduction	1
1.1 Overview.....	1
1.2 Background to the rehabilitation monitoring	1
1.3 Project scope and objectives	1
1.4 Monitoring team.....	2
2. Monitoring Sites	3
2.1 HVO rehabilitation areas	3
2.2 MTW rehabilitation areas.....	4
2.3 Native rehabilitation performance criteria, measures and associated indicators	6
3. Monitoring methodology.....	7
3.1 Monitoring dates	7
3.2 Design	7
3.3 Sampling techniques.....	8
3.4 Limitations	12
3.1 Compliance with the performance criteria outlined in the Mining Operations Plan.....	13
4. Results	16
4.1 Growth Medium Development	16
4.2 Ecosystem and Landuse Establishment.....	19
4.3 Ecosystem and Landuse Sustainability	33
5. Discussion	45
5.1 Growth Medium Development	45
5.2 Ecosystem and Landuse Establishment.....	45
5.3 Ecosystem and Landuse Sustainability	48
6. Conclusions	51
6.1 Conclusions.....	51
6.2 Growth Medium Development	51
6.3 Ecosystem and Landuse Establishment.....	51
6.4 Ecosystem and Landuse Sustainability	52
7. References	54
Appendix 1 – Figures	55

Appendix 2 – Monitoring dates.....	75
Appendix 3 – Monitoring locations	77
Appendix 4 – Flora species list	82
Appendix 5 – Visual and Photo Monitoring	122
Appendix 6 – Tree and canopy data	168
Appendix 7 – Agricultural soil analysis results	185
Appendix 8 – Microbial soil analysis results	198

List of Figures

Figure 1. Project location.....	56
Figure 2. HVO and MTW site locations overview	57
Figure 3. HVO survey locations - map 1 (HVOWES)	58
Figure 4. HVO survey locations - map 2 (HVOWES)	59
Figure 5. HVO survey locations - map 3 (HVOCAR)	60
Figure 6. HVO survey locations - map 4 (HVOCHE)	61
Figure 7. HVO survey locations - map 5 (HVOCHE)	62
Figure 8. HVO survey locations - map 6 (HVORIV)	63
Figure 9. HVO survey locations - map 7 (HVOLEM)).....	64
Figure 10. MTW survey locations - map 1 (MTWNPN).....	65
Figure 11. MTW survey locations - map 2 (MTWNPN-NOO).....	66
Figure 12. MTW survey location - map 3 (MTWCDD-SPN).....	67
Figure 13. MTW survey location - map 4 (MTWSPS).....	68
Figure 14. MTW survey location - map 5 (MTWWDL).....	69
Figure 15. MTW survey location - map 6 (MTWMTO)	70
Figure 16. Warkworth reference sites (WARKGB01).....	71
Figure 17. Warkworth reference sites (WARKGB02-03-04)	72
Figure 18. Wambo reference sites	73
Figure 19. Belford reference sites	74

List of Tables

Table 1. HVO rehabilitation areas, establishment conditions and size – Woodland - other domain type	3
---	---

Table 2. MTW rehabilitation areas, establishment conditions, and size – Woodland – EEC domain type.....	4
Table 3. MTW rehabilitation areas, establishment conditions and size - Woodland - EEC domain type	5
Table 4. Soil Surface Condition Indicators (SSCI) used to assess the effect of biological and physical processes on ecosystem function	8
Table 5. The ten site value scores recorded as part the BioBanking assessment	9
Table 6. Weather conditions preceding and during the 2017 monitoring period (BoM Station # 061397) ...	12
Table 7. Weather conditions preceding and during the 2016 monitoring period (BOM Station #061397) ...	12
Table 8. MOP Performance Criteria – MTW and HVO rehabilitation sites	13
Table 9. Growth Medium Development MOP Performance Criteria	16
Table 10. Reference site soil results 2017	16
Table 11. HVO Rehabilitation site soil results compared to MOP target/reference site range values (woodland – other domain type)	17
Table 12. MTW Rehabilitation site soil results compared to MOP target/reference site range values (woodland – EEC domain type)	18
Table 13. MTW Rehabilitation site soil results compared to MOP target/reference site range values (woodland – other domain type)	19
Table 14. Landscape Function Analysis MOP performance criteria	19
Table 15. LFA data for Reference sites	20
Table 16. Landscape Function Analysis scores HVO- woodland other domain type (2017 data)	22
Table 17. Landscape Function Analysis scores for MTW - woodland other domain type (2017 data)	23
Table 18. Landscape Function Analysis results for MTW - woodland EEC domain type (2017 data)	23
Table 19. Landscape Function Analysis scores HVO- woodland other domain type (2016 data)	24
Table 20. Landscape Function Analysis scores for MTW - woodland other domain type (2016 data)	25
Table 21. Landscape Function Analysis scores for MTW - woodland EEC domain type (2016 data)	25
Table 22. Species richness MOP performance criteria	26
Table 23. 2017 Reference site native species count	26
Table 24. 2017 HVO Rehabilitation sites native species count (Woodland – other domain type)	27
Table 25. 2017 MTW Rehabilitation sites native species count (Woodland EEC domain type)	28
Table 26. 2017 MTW rehabilitation sites native species count (Woodland – other domain type)	28
Table 27. Tree species and canopy development MOP performance criteria	29

Table 28. Details of canopy regeneration at reference sites	30
Table 29. Details of canopy regeneration at HVO rehabilitation sites 2017 (Woodland – other)	30
Table 30. Details of canopy regeneration at MTW rehabilitation sites 2017 (Woodland – EEC).....	32
Table 31. Details of canopy regeneration at MTW rehab sites 2017 (Woodland – other)	32
Table 32. Vegetation Structure and Species Richness MOP performance criteria	33
Table 33. OEH Benchmark values for Central Hunter Grey Box-Ironbark Woodland and Central Hunter Ironbark-Spotted Gum-Grey Box Forest.....	34
Table 34. OEH benchmarks and 2017 reference site benchmarks.....	35
Table 35. OEH benchmarks and 2016 reference site benchmarks.....	36
Table 36. Combined reference site benchmarks using combined data from all reference sites and from both 2016 and 2017 monitoring.....	36
Table 37. HVO Woodland – other rehabilitation sites compared to the combined reference site benchmarks	38
Table 38. MTW Woodland – other rehabilitation sites compared to the combined reference site benchmarks	39
Table 39. MTW Woodland – EEC rehabilitation sites compared to the Central Hunter Grey Box – Ironbark Woodland OEH benchmarks	39
Table 40. Vegetation Health MOP performance criteria.....	41
Table 41. Details of canopy maturity at reference sites.....	42
Table 42. Details of canopy maturity at all rehabilitation sites – split by location and domain type	43
Table 43. Habitat Features MOP performance criteria	43

List of Appendices

Appendix 1 – Figures	55
Appendix 2 – Monitoring dates	75
Appendix 3 – Monitoring locations	77
Appendix 4 – Flora species list.....	82
Appendix 5 – Visual and Photo Monitoring.....	122
Appendix 6 – Tree and canopy data	168
Appendix 7 – Agricultural soil analysis results	185
Appendix 8 – Microbial soil analysis results	198

Abbreviations

Acronym	Term/Definition
BBAM	BioBanking Assessment Methodology
BVT	Biometric Vegetation Type
C&A	Coal & Allied Operations
Dbh	Diameter at breast height
EEC	Endangered Ecological Community
EPC	Exotic Plant Cover
FL	Fallen logs
ha	Hectare/s
HVO	Hunter Valley Operations
Km	Kilometre
LFA	Landscape Function Analysis
LFI	Landscape Function Index
LOI	Land Organisation Index
MOP	Mining Operations Plan
MTW	Mount Thorley Warkworth
NGCG	Native ground cover grasses
NGCO	Native ground cover other
NGCS	Native ground cover shrubs
NMS	Native midstorey
NOS	Native overstorey
NPS	Native plant species
NTH	Number of trees with hollows
NPWS	National Parks and Wildlife Service
OEH	NSW Office of Environment and Heritage (formerly DECCW, DECC, DEC)
OR	Overstorey regeneration
PCT	Plant Community Type
SSCI	Soil Surface Condition Indicators
TSC Act	<i>Threatened Species Conservation Act 1995 (NSW)</i>

1. Introduction

1.1 Overview

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by Coal & Allied Operations Pty Ltd (C&A) to undertake the first year of native rehabilitation post-mining monitoring at the Mt Thorley Warkworth (MTW) and Hunter Valley Operations (HVO) mine sites (Figure 1Figure 12). The monitoring forms part of the MTW and HVO monitoring program, which aims to assess the recovery of native rehabilitation across all 29 HVO and 25 MTW sites. This includes an additional 13 new HVO rehabilitation monitoring sites and 8 new MTW rehabilitation monitoring sites. This document outlines the 2017 monitoring results in isolation, but also compares these results with the data collected during the baseline surveys undertaken during 2016 (Niche 2016).

The monitoring methods implemented were largely consistent with the methodology detailed in Monitoring Methodology - Post-mined Lands MTW and HVO North Mine Sites (AECOM 2012).

Information available from the relevant BioBanking benchmark sites and monitoring data from the reference sites have been used to inform the performance criteria targets for native vegetation rehabilitation in the Mining Operations Plan (MOP) for MTW, HVO North and HVO South. The results of monitoring in these new rehabilitation areas have been assessed against the MOP performance criteria in this report.

It should be noted, that monitoring of native vegetation rehabilitation was generally not undertaken prior to 2015 and was first undertaken in 2016 and then subsequently in 2017. The results of these other monitoring periods are presented in a separate report, Native Vegetation Rehabilitation Monitoring 2016 – Mount Thorley Warkworth and Hunter Valley Operations (Niche 2016).

1.2 Background to the rehabilitation monitoring

Rehabilitation monitoring at MTW and HVO is undertaken to satisfy the following regulatory obligations:

- Schedule 3 – Condition 58(i) of Development Consent SSD-6464 (Warkworth Mine)
- Schedule 3 – Condition 36(h) of Development Consent SSD-6465 (Mt Thorley Mine)
- Schedule 4 – Condition 62C(j) of Development Consent DA 450-10-2003 (HVO North)
- Schedule 3 – Condition 36(e) of Project Application PA 06_0261 (HVO South)
- Commitments made in respective Mining Operations Plans (MOPs) for MTW, HVO North and HVO South.

Rehabilitation activities at MTW and HVO involve areas of post-mined lands being returned to either a native ecosystem or a grazing pasture (or grassland). C&A has committed to recreating Endangered Ecological Communities (EEC) to a standard comparable to similar reference EECs. The EECs include Central Hunter Grey Box-Ironbark Woodland and Central Hunter Ironbark-Spotted Gum-Grey Box Forest, which are both listed as EECs under the NSW *Threatened Species Conservation Act 1995* (TSC Act). The area of rehabilitation that is proposed to be returned to EEC communities is 2,114 hectares at MTW and 4 hectares at HVO.

1.3 Project scope and objectives

This rehabilitation monitoring report documents the 2017 monitoring survey results and provides comparisons with reference site data and published OEH benchmark data. Further to the existing

rehabilitation sites, this report includes new monitoring data for an additional 21 new rehabilitation sites that had not been surveyed prior to 2017.

The monitoring involved the following key objectives:

- Establish permanent monitoring sites within each of the new rehabilitation areas (13 at HVO and eight at MTW)
- Complete Landscape Function Analysis (LFA) at all monitoring sites
- Complete visual monitoring at all monitoring sites
- Complete soil analysis at all monitoring sites
- Complete photographic monitoring at all monitoring sites
- Complete tree health characteristic at all monitoring sites
- Provide an analysis of results against reference sites
- Provide recommendations to assist with the improvement of future monitoring and performance indicators.

Based on learnings from monitoring in 2016 at older monitoring sites, the methodology outlined in AECOM (2012) was amended in the following ways:

- Removal of the 1 x 1 metre pasture/groundcover monitoring and replacement with a BioBanking plot, including a nested 20 x 20 metre plot at each site.
- Introduction of stem density counts along two, 2 metre strips along the length of the 50 metre centre tape. The data from these will be compared separately to gauge consistency and determine if this level of collection is required in the future. Sensitivity analysis will also be undertaken to determine if this level of data collection is adequate for this purpose.
- The methodology for the collection of information pertaining to endemic canopy was made a little more prescriptive, where each canopy tree (endemic) with a Diameter at Breast Height (DBH) larger than 5 centimetres was marked with a metal tree tag or similar. Each tree was given a unique number and details including canopy health and reproductive status (flowers/fruit) was recorded.

Given the young age of the rehabilitation monitored as part of these works, some details of the health of the endemic canopy were not collected because individuals that may make up the canopy in the future were not currently developed enough (i.e. they all have a DBH less than 5 centimetres).

1.4 Monitoring team

Data collection for the 2017 monitoring period was undertaken between the 7th and 15th February 2017 with additional monitoring of new sites between the 1st and 3rd May 2017. Ecologists involved with the completion of field monitoring tasks and reporting are listed as follows:

Vivien Howard	Senior Ecologist (Field survey and reporting)
Alex Christie	Ecologist (Field survey and reporting)

2. Monitoring Sites

2.1 HVO rehabilitation areas

Monitoring has been conducted within 29 individual rehabilitation areas across HVO (see Figure 2 to Figure 6), comprised of different rehabilitation establishment conditions. The desired outcome of the rehabilitation is to achieve a native woodland community. Details regarding the establishment and treatment for each site, including the target domain type are provided in Table 1. It is worthwhile to note that two monitoring sites established during the 2016 monitoring period were not revisited as the native seed mixes had not been sown. Locations of the monitoring sites are provided in Appendix 3.

Table 1. HVO rehabilitation areas, establishment conditions and size – Woodland - other domain type

Rehabilitation area name	Area (ha)	Establishment date	Soil and seeding information ¹	Target domain type
HVOWES200801	3.4	2008	Topsoil, native seed broadcasted in 2008	Woodland - other
HVOWES201101	4.4	2011	Compost (with spoil), native seed hydroseeded in 2011	Woodland - other
HVOWES201301	3.7	2013	Compost (with spoil), native seed drilled in 2013	Woodland - other
HVOWES201302	12.7	2013	Topsoil/Compost, native seed drilled in 2016	Woodland - other
HVOCAR200901	14.2	2009	Topsoil, native seed broadcast in 2009	Woodland - other
HVOCAR200902	7.7	2009	Topsoil, native seed broadcast in 2009	Woodland - other
HVOCAR201401	25.6	2014	Compost (with topsoil), natives not sown	Woodland - other
HVORIV201406	3.1	2014	Topsoil/Compost, native seed drilled in 2016	Woodland - other
HVORIV201405	14.3	2014	Compost (with subsoil), native seed drilled in 2014	Woodland - other
HVORIV201404	8.4	2014	Compost (with subsoil), native seed drilled in 2014	Woodland - other
HVORIV201403	4.8	2014	Compost (with subsoil), native seed drilled in 2015	Woodland - other
HVORIV201402	10	2014	Compost (with subsoil), native seed drilled in 2014	Woodland - other
HVORIV201401	5.8	2014	Compost (with spoil), native seed drilled in 2014	Woodland - other
HVOCHE201201	20.8	2012	Compost (with topsoil), native seed drilled in 2013	Woodland - other
HVOCHE201203	26.6	2012	Compost (with topsoil), natives not sown	Woodland - other
HVOCHE201401	9.8	2014	Compost (with topsoil), natives not sown	Woodland - other
HVORIV201502	6.8	2015	Topsoil/compost, natives not	Woodland - other

¹ Soil and seeding information provided by Bill Baxter (C&A)

Rehabilitation area name	Area (ha)	Establishment date	Soil and seeding information ¹	Target domain type
			sown	
HVORIV201503	6.2	2015	Topsoil/compost, second application of gypsum and compost, natives drilled 2016	Woodland - other
HVORIV201501	2.4	2015	Topsoil/compost, natives drilled 2016	Woodland - other
HVOLEM201501	13.4	2015	Topsoil/compost, natives sown first	Woodland - other
HVOCHE201501	24.4	2015	Topsoil/compost, natives not sown	Woodland - other
HVORIV201601	7.9	2016	Topsoil/compost, natives not sown	Woodland - other
HVOWES201602	4.0	2016	Topsoil/compost, natives sown first	Woodland - other
HVOWES201601	6.2	2016	Topsoil/compost, natives sown first	Woodland - other
HVOWES201603	8.1	2016	Topsoil/Composted green waste trial, native sown first	Woodland - other
HVOWES201604	5.0	2016	Topsoil/Composted green waste trial, native sown first.	Woodland - other
HVOCHE201601	21.5	2016	Topsoil/compost, natives not sown	Woodland - other
HVOCHE201602	10.2	2016	Topsoil/compost, natives not sown	Woodland - other
HVOLEM201601	5.0	2016	Topsoil/Composted green waste trial, native sown first (after delay)	Woodland - other

2.2 MTW rehabilitation areas

Monitoring has been conducted within 25 individual rehabilitation areas across MTW (see Figure 10 to Figure 15), comprised of different rehabilitation establishment conditions. These are listed in Table 2 and Table 3 below.

Table 2. MTW rehabilitation areas, establishment conditions, and size – Woodland – EEC domain type

Rehabilitation area name	Area (ha)	Establishment date	Soil and seeding information[1]	Target domain type
MTWNPN201301	23.1	2013	Compost (with topsoil), natives drilled Winter 2015	Woodland -EEC
MTWNPN201401	7.1	2014	Topsoil/compost, natives drilled in 2014	Woodland -EEC
MTWNPN201402	1.9	2014	Compost (with fresh sand topsoil), natives drilled 2014	Woodland -EEC
MTWNPN201403	5.5	2014	Compost (with subsoil), natives drilled 2014	Woodland -EEC
MTWNPN201101	43.3	2011	Topsoil, natives hydroseeded 2011	Woodland -EEC

Rehabilitation area name	Area (ha)	Establishment date	Soil and seeding information[1]	Target domain type
MTWNPN200901	21.8	2009	Topsoil, native seed broadcasted in 2009	Woodland -EEC
MTWCDD201101	8.1	2011	Topsoil, native seed hydroseeded	Woodland -EEC
MTWCDD201301	9.1	2013	Compost (with topsoil), natives not sown	Woodland -EEC
MTWCDD201501	6.4	2015	Compost (with spoil), natives drilled	Woodland -EEC
MTWSPN201401	37.7	2014	Compost (with topsoil), natives not sown	Woodland -EEC
MTWWDL201401	4.7	2014	Compost (with topsoil), natives drilled 2015	Woodland -EEC
MTWWDL201402	8.9	2014	Topsoil/compost, natives drilled in 2016	Woodland -EEC
MTWTD1201501	20.6	2015	Compost (with spoil), native seed drilled 2015	Woodland -EEC
MTWMTO200503	11.7	2005	Topsoil, native seed broadcasted in 2005	Woodland -EEC
MTWSPS201601	5	2016	Topsoil/compost, natives not sown	Woodland -EEC
MTWSPN201602	1.4	2016	Topsoil/compost, natives hydroseeded 1st	Woodland -EEC
MTWSPN201601	8.1	2016	Topsoil/compost, natives not sown	Woodland -EEC
MTWSPN201501	12.2	2015	Topsoil/compost, natives not sown	Woodland -EEC
MTWSPS201602	13	2016	Topsoil/compost, natives not sown	Woodland -EEC
MTWNOO201501	3.7	2015	Topsoil/compost, natives drilled 2016	Woodland -EEC

Table 3. MTW rehabilitation areas, establishment conditions and size - Woodland - EEC domain type

Rehabilitation area name	Area (ha)	Establishment date	Soil and seeding information[1]	Target domain type
MTWMTO200001	6.3	2000	Topsoil, native seed broadcasted in 2000	Woodland - other
MTWNPN200501	13.2	2005	Topsoil, native seed broadcasted in 2005	Woodland - other
MTWNPN200502	4.8	2005	Topsoil, native seed broadcasted in 2005	Woodland - other
MTWMTO201501	8.1	2015	Topsoil, natives not sown	Woodland - other
MTWMTO201601	28.4	2016	Topsoil/compost, natives not sown	Woodland - other

2.3 Native rehabilitation performance criteria, measures and associated indicators

As previously discussed in Section 1.2, performance criteria for the native rehabilitation areas have been detailed in the MOP's (Coal & Allied 2015, 2016a and 2016b), and target values for the criteria have been developed based on reference site monitoring data and information available from OEH BioBanking benchmarks. This monitoring report provides a comparison of results for rehabilitation sites against reference sites, BioBanking benchmark values (where available) and the relevant performance criteria. The results section of this report has been divided based on the MOP performance criteria, with the relevant criteria displayed above the relevant results.

3. Monitoring methodology

3.1 Monitoring dates

Monitoring was undertaken during two distinct periods, including seven days between 7th and 15th February 2017 and three days between 1st and 3rd May 2017. Details regarding the dates, personnel and sites completed for each day during the monitoring is provided in Appendix 2.

3.2 Design

Monitoring was undertaken in accordance with AECOM's (2012) Monitoring Methodology. Niche has summarised the techniques used from AECOM's Monitoring Methodology below.

3.2.1 Rehabilitation monitoring sites

A total of 54 rehabilitation monitoring sites have been established in rehabilitation areas being returned to woodland/forest vegetation, including:

- 29 monitoring sites at HVO (Figure 2, and Figure 3Figure 9)
- 25 monitoring sites at MTW (Figure 2, and Figure 10Figure 15).

For each monitoring site, a marker-post was placed at the start and end point, with the end point established downslope. Waypoints were taken at the start and end point for each monitoring site location (Appendix 3).

Monitoring at each rehabilitation site included the collection of the following data: photo points, visual assessment, Landscape Function Analysis (LFA), soil analysis, and the collection of BioBanking data.

The locations of the monitoring sites, along with their associated descriptions and coordinates have been provided in Appendix 3.

3.2.2 Reference monitoring sites

As part of the monitoring undertaken during 2016, 12 reference monitoring sites were established. These aimed at capturing data around two BVTs specified in the MOP. Six sites were established at each of two vegetation communities:

1. HU701 Central Hunter Grey Box-Ironbark Woodland
2. HU632 Central Hunter Ironbark-Spotted Gum-Grey Box Forest.

Two of the Central Hunter Grey Box-Ironbark Woodland reference sites were established within land managed by Wambo Coal Mine (Figure 18), with another four established in land managed by C&A (Figure 16 and Figure 17).

The coordinates for the location of each reference site is provided in Appendix 3.

BioBanking data collected at each of the reference sites was input into the OEH BioBanking Benchmark Calculator to provide the lower and upper benchmark ranges for each attribute. The reference site ranges were then compared to the OEH benchmarks for both BVTs.

Follow-up monitoring at these reference sites was undertaken during February 2017.

3.3 Sampling techniques

3.3.3 Landscape Function Analysis (LFA)

LFA is a monitoring procedure developed by the CSIRO (Tongway and Hindley, 1997, last revised in 2004) that uses rapidly acquired field-assessed indicators to assess the biogeochemical functioning of landscapes at the hillslope scale. It provides a rapid, reliable, and easily applied method for assessing and monitoring landscape restoration or rehabilitation projects. LFA examines the way physical and biological resources are acquired, used, cycled and lost from a landscape.

Eleven Soil Surface Condition Indicators (SSCIs) (Table 4), each focusing on the measurement of specific biological and/or physical processes, are used to calculate three LFA indices; soil stability, soil infiltration and nutrient cycling. The three indices have scores of 0 to 100, which represent the ecosystem function of the area. These scores provide quantitative measures that may be used to compare rehabilitated areas with reference sites throughout the course of a monitoring program.

An LFA plot and transect was completed at each rehabilitation and reference site.

Table 4. Soil Surface Condition Indicators (SSCI) used to assess the effect of biological and physical processes on ecosystem function

Indicator	Related process
Rainsplash Protection	Rainsplash erosion
Perennial Vegetation Cover	Below ground biomass
Litter	Nutrient cycling of organic matter
Cryptogam Cover	Indication of soil stability and presence of nutrients
Crust Brokenness	Potential for wind and water erosion
Soil Erosion Type and Severity	Type and severity of existing soil erosion
Deposited Materials	Soil stability upslope
Soil Surface Roughness	Water infiltration and retention
Surface Resistance to Disturbance	Effect of mechanical disturbance
Slake Test	Soil stability when wet
Texture	Soil permeability and water storage

3.3.4 BioBanking – site value scores

The NSW Biodiversity Banking and Offsets Scheme – known as ‘BioBanking’, was introduced by the NSW government in 2008. The BioBanking Assessment Methodology (BBAM) assesses biodiversity values as defined by the TSC Act. These values include the composition, structure and function of ecosystems. They also include (but are not limited to) threatened species, threatened populations and threatened ecological communities, and their habitats.

AECOM (2012) refers to the use of ‘site value’ to provide a quantitative measure of the condition of the vegetation within each rehabilitation area. The site value for a particular zone is calculated based on quantitative measures of ten site attributes which are measured along a transect and within a survey plot, and assessed against benchmark values (Table 5). A minimum number of plots are required based on the area of the site being assessed. It was thought to be more valuable to present results for each of the BioBanking criteria rather than just the site value score. In accordance with the relevant MOP performance

criteria, the results for the Woodland - Other rehabilitation areas have been compared to the reference site benchmarks.

BioBanking plots were undertaken at all reference sites and all rehabilitation sites as identified in Appendix 4.

Table 5. The ten site value scores recorded as part the BioBanking assessment

Attribute	Explanation
Native plant species richness (NPS)	Number of native species recorded within a nested 20 x 20 m quadrat.
Native over-storey % cover (NOS)	Recorded at 5 m intervals along a 50 m tape
Native mid-storey % cover (NMS)	Recorded at 5 m intervals along a 50 m tape
Native ground cover (grass) % cover (NGCG)	Recorded at 1 m intervals along a 50 m tape
Native ground cover (other) % cover (NGCO)	Recorded at 1 m intervals along a 50 m tape
Native ground cover (shrubs) % cover (NGCS)	Recorded at 1 m intervals along a 50 m tape
Exotic plant cover % cover (EPC)	Recorded at 1 m intervals along a 50 m tape
Overstorey regeneration	Regeneration is measured as the proportion of over-storey species present in the zone that are regenerating (i.e. with diameter at breast height < 5 cm). For example, if there are three tree species present in the zone but only one of these species is regenerating, then the value is 0.33. The maximum value for this measure is 1.
Fallen logs (m) Length of logs (m) (FL)	Total length of logs recorded within the 20 x 50 m quadrat. To be eligible for inclusion, logs must be >10 cm diameter and longer than 50 cm.
Number of trees with hollows (NTH)	Number of trees with hollows within the 20 x 50 m quadrat.

3.3.5 Visual monitoring

Species composition

The dominant species present in the monitoring area were identified to obtain a 'picture' of the species composition. In rehabilitation areas, this allowed confirmation that the species establishing conformed to the target vegetation types being re-established.

Additionally, notes were made on the general health and sustainability of vegetation as indicated by presence/absence of flowering/fruited adult plants. The presence of plants at reproductive stage is an indication that the ecosystem is recruiting and, as such, capable of self-regeneration. Given the young age of the rehabilitation sites where monitoring was undertaken, minimal details around canopy health and maturity were collected during the 2017 monitoring period.

Habitat and fauna monitoring

Artificial habitat features installed throughout the site as part of the rehabilitation activities (e.g. stag trees) were recorded.

Notes were also made on the presence and extent of habitat features such as free standing water, coarse woody debris, rocks, mistletoes and whether plants were flowering or fruiting.

Disturbance monitoring

Disturbance monitoring was undertaken using the visual monitoring tool developed by AECOM (2012). This technique is a field-based, rapid assessment tool to visually assess and award a score to various contributors. The objective of this monitoring is to identify factors and processes that occur at the landscape/catchment scale and have the potential to impact on the monitoring site. The disturbance monitoring aims to cover those aspects that are not adequately covered in the BioBanking and LFA monitoring tools. The following disturbance categories (and associated disturbance factors) were monitored and assessed at each site:

- Disturbance related to mining activities, including:
 - Evidence of wheeled vehicles, tracked vehicles and foot disturbance
 - Excavation
 - Presence of mine rubbish
- Disturbance related to non-mining activities, including:
 - Evidence of grazing
 - Presence of animal pads
- Presence of exotic weeds and feral animal species
- Presence of domestic litter / rubbish
- Fire disturbance
- Evidence of nearby maintenance activities (i.e. chemical treatments, fencing, earthworks)
- Surface stability and erosion issues, including:
 - Eroding factor (i.e. wind, water).
 - Erosion type (i.e. sheet, rill/gully, pedestal, terracette, scalding (Tongway & Hindley 2004)).

3.3.6 Canopy development and over-storey regeneration

In order to understand the adequacy of canopy development at rehabilitation sites in terms of species diversity, stem density, size and habitat values, two additional assessment techniques were introduced. One captures the adequacy of canopy recruitment, whilst the other captures canopy development and maturity:

- Introduction of stem density counts along two, 2 metre strips along the length of the 50 metre centre tape. The number and species of each individual canopy tree was counted. Where individuals could not be identified to species level, they were identified to genus.
- Information pertaining to canopy development; diversity and density, average trunk diameter, condition of the tree population, and percent of the endemic canopy with reproductive structures. This was undertaken in the nested 20 x 20 metre plot and each tree labelled with a metal tree tag or flagging tape with an ID number to allow for follow-up monitoring. Trees with a DBH less than five centimetres were not included in the count.

3.3.7 Soil analyses

Soil characterisation and analyses were performed to determine the physical and chemical properties of the growing media. Soil samples were collected from all monitoring sites (rehabilitation and reference sites). A composite sample, consisting of a minimum of nine sub-samples collected 10 to 15 metres apart, was collected within a 20 metre radius. The radius was based on a central point five metres in from the 20 metre quadrat tape. All samples were placed in a bucket, and were mixed. The sample was then placed in a plastic bag, labelled, and sent to the Environmental Analysis Laboratory (EAL) and Sydney Environmental & Soil Laboratory (SESL) Australia for analysis.

The following soil parameters were determined:

- pH
- Electrical conductivity (EC)
- Cation balance
- Sodidity
- Soil organic matter content
- Soil texture including clay content.

3.3.8 Photographic monitoring

Photographic monitoring is a simple and useful tool that allows for direct visual comparison of a specific site between monitoring events. Digital photographs were taken at the start and finish transect points at each monitoring site. This included:

- A photograph with the tape (and star picket) in the centre of the frame
- Photograph to the left and right of the centre tape.

3.3.9 Rill survey

In accordance with the LFA methodology (Tongway and Hindley 2004), rill surveys are to be carried out where rills are observed at less than 30 metre spacing across the slope.

None of the monitoring sites were impacted by rill erosion at the time of the 2017 monitoring survey, and therefore no rill surveys were undertaken.

3.3.10 Weather

Temperatures and rainfall in the months preceding the field monitoring period during both 2017 and 2016 are listed below in Table 6 and Table 7.

Conditions during the first round of the 2017 field surveys were dry and hot, with low rainfall recorded. When comparing results between 2016 and 2017 it should be noted that the weather preceding the 2017 surveys had considerably higher temperatures and lower rainfall than historical averages, with the rainfall being notably less than the rainfall which preceded the 2016 surveys. Daily maximum temperatures ranged from 29°C to 45°C.

Table 6. Weather conditions preceding and during the 2017 monitoring period (BoM Station # 061397)

	Monthly mean and total			Historical average (2002-2016)		
Month	Min Temp (°C)	Max Temp (°C)	Rainfall (mm)	Min Temp (°C)	Max Temp (°C)	Rainfall (mm)
October 2016	10.4	25.1	52.2	14.1	26.4	44.7
November 2016	12.7	30.7	52.2	17.8	28.8	83.6
December 2016	17.2	33.0	75	19.4	29.9	70.5
January 2017	19.1	34.4	48.4	20.2	31.5	69.9
February 2017	19.4	36.2	8.1	18.6	32.7	91.9
March 2017	17.7	28.5	129.7	15.1	28.2	64.2
April 2017	10.8	24.1	37.6	11.1	24.7	60.8
May 2017	7.3	21.7	24.6	6.9	21.5	29.3

Table 7. Weather conditions preceding and during the 2016 monitoring period (BOM Station #061397)

	Monthly mean and total			Historical average (2002-2016)		
Month	Min Temp (°C)	Max Temp (°C)	Rainfall (mm)	Min Temp (°C)	Max Temp (°C)	Rainfall (mm)
October 2015	10.0	26.8	42.6	14.1	26.4	44.7
November 2015	14.0	28.8	83.9	17.8	28.8	83.6
December 2015	15.8	29.9	73.9	19.4	29.9	70.5
January 2016	17.7	29.3	208.8	20.2	31.5	69.9
February 2016	17.6	29.0	10.0	18.6	32.7	91.9

3.4 Limitations

Many of the flora recorded in the rehabilitation monitoring sites were in a juvenile or seedling state and could not always be identified confidently. As such, identification may need to be updated in later monitoring years and analyses corrected.

Whilst the reference sites were located within BVTs that were in good condition and within the general region of the study area, they had been impacted by historic clearing, and thus old growth forms of these BVTs were not able to be sampled as reference sites. Considering this disturbance history, the reference sites represent recovering vegetation communities and therefore are useful to compare with the rehabilitation sites during the establishment phase.

Data analysis was limited to a comparison of rehabilitation site, (split by domain type) and reference sites, and to areas of different soil treatment. Details regarding weed management history and seeding rates were not available so data analysis based on these parameters was not undertaken. It was evident during the field visits in January that weather had created sub-optimal conditions for plant growth with the hot dry conditions resulting in stress to many individual plants, including individuals within mature rehabilitation areas and at reference sites in remnant vegetation. This was particularly evident for groundcovers species.

As some of the assessment methods changed between the 2016 baseline and 2017 monitoring periods, not all the key parameters were directly comparable. The ground-cover assessment was not replicated during 2017, therefore this data is not available for comparison. Similarly, new data collected, including details

around canopy maturity and overstorey regeneration cannot be compared at this stage as baseline data is not available.

3.1 Compliance with the performance criteria outlined in the Mining Operations Plan.

The MOP provides a range of performance criteria to assess the native rehabilitation, in terms of establishment and sustainability. Due to the number of sites and the breadth and number of performance criteria, it is difficult to assess the performance of sites against the criteria in one Table. Table 8 provides a list of each of the criteria and provides the table number where it's addressed for each of the sites.

Table 8. MOP Performance Criteria – MTW and HVO rehabilitation sites

Performance Criteria – Growth Medium Development		Subheading	Domain Type	Table Number
1	pH >5.5 and <8.5	Soil Analysis	All Woodland	Table 10 to Table 13
2	Electrical Conductivity <2 dS/m	Soil Analysis	All Woodland	Table 10 to Table 13
3	Phosphorous within levels in analogue sites by Year 5	Soil Analysis	All Woodland	Table 10 to Table 13
4	Organic Carbon within levels in analogue sites by Year 5	Soil Analysis	All Woodland	Table 10 to Table 13
5	Cation Exchange Capacity within levels in analogue sites by Year 2	Soil Analysis	All Woodland	Table 10 to Table 13
6	Exchangeable Sodium Percentage within levels in analogue sites by Year 2	Soil Analysis	All Woodland	Table 10 to Table 13
7	Calcium/magnesium ratio within levels in analogue sites by Year 2	Soil Analysis	All Woodland	Table 10 to Table 13
Performance Criteria – Ecosystem and Landuse Establishment		Subheading	Domain Type	Table Number
1	Based on key physical, biological and chemical characteristics the LFA Stability Index provides an indication of the site's stability and that it is comparable to or trending towards that of analogue sites (%)	LFA	All Woodland	Table 15 to Table 21
2	Based on key physical, biological and chemical characteristics the LFA Infiltration Index provides an indication of the site's infiltration capacity and that it is comparable to or trending towards that of analogue sites (%)	LFA	All Woodland	Table 15 to Table 21
3	Based on key physical, biological and chemical characteristics the LFA Nutrient Recycling Index provides an indication of the site's ability to recycle nutrients and that it is comparable to or trending towards that of analogue sites (%)	LFA	All Woodland	Table 15 to Table 21
4	The Landscape Organisation Index provides a measure of the ability of the site to retain resources and that it is comparable to or trending towards that of analogue sites (%)	LFA	All Woodland	Table 15 to Table 21
5	The number of tree species comprising the vegetation community is comparable to that of analogue sites (no. species/area)	Canopy Development	Woodland - Other	Table 29 and Table 31
6	The number of grass species comprising the vegetation community is comparable to that of analogue sites (no. species/area)	Species Richness	Woodland - Other	Table 24 and Table 26
7	The density of trees is comparable to that of analogue sites (no./area)	Canopy Development	Woodland - Other	Table 29 and Table 31
8	The number of tree species comprising the vegetation community is comparable to that of analogue sites (no. species/area)	Canopy Development	Woodland EEC	Table 30

9	The number of shrub species comprising the vegetation community is comparable to that of analogue sites (no. species/area)	Species Richness	Woodland EEC	Table 25
10	The number of grass species comprising the vegetation community is comparable to that of analogue sites (no. species/area)	Species Richness	Woodland EEC	Table 25
11	The number of subshrub species and understorey species (other than grasses) comprising the vegetation community is comparable to that of analogue sites (no. species/area).	Species Richness	Woodland EEC	Table 25
12	The native plant species richness is within 50-100% or exceeds that of analogue sites (no. species/area). (Use OEH benchmark values)	Species Richness	Woodland EEC	Table 25
13	The density of trees is comparable to that of analogue sites (no./area)	Canopy Development	Woodland EEC	Table 30
Performance Criteria – Ecosystem and Landuse Sustainability		Subheading	Domain Type	Table Number
1	Weed plant cover (calculated as a percentage of total ground cover) is comparable to that of analogue sites. (% Cover)	Vegetation Structure and Species Richness	Woodland - Other	Table 37 and Table 38
2	Total groundcover is the sum of protective ground cover components (dead and live plant material, rocks and logs) and is comparable to that of analogue sites (% Cover)	Habitat Features	Woodland - Other	Table 16 and Table 17
3	The diversity of maturing trees and shrubs with a stem diameter greater than 5cm is comparable to that of analogue sites (no./area).	Vegetation Health	Woodland - Other	Table 42
4	The percentage of maturing trees and shrubs with a stem diameter greater than 5cm that are local endemic species is comparable to analogue sites.	Vegetation Health	Woodland - Other	Table 42
5	The density of maturing trees and shrubs with a stem diameter greater than 5cm is comparable to analogue sites (no./area).	Vegetation Health	Woodland - Other	Table 42
6	Average trunk diameter (dbh) of the tree population provides a measure of age and growth rate and that it is trending towards that of analogue sites (cm).	Vegetation Health	Woodland - Other	Table 42
7	The percentage of the tree population which are in healthy condition and that the percentage is comparable to analogue sites.	Vegetation Health	Woodland - Other	Table 42
8	The percentage of the tree population which are in a medium health condition and that the percentage is comparable to analogue sites.	Vegetation Health	Woodland - Other	Table 42
9	The percentage of the tree population which are in a state of advance dieback and that the percentage is comparable to analogue sites.	Vegetation Health	Woodland - Other	Table 42
10	The presence of reproductive structures such as buds, flowers or fruit on trees and shrubs provides evidence that the ecosystem is maturing, capable of recruitment and can provide habitat resources and that the % population is comparable to that of analogue sites.	Vegetation Health	Woodland - Other	Table 42
11	The proportion of over-storey species occurring as regeneration is within 50-100% or exceeds that of analogue sites.	Vegetation Structure and Species Richness	Woodland - Other	Table 37 and Table 38
12	The percentage of native over storey cover is within 50-100% or exceeds that of analogue sites. (Use OEH benchmark values)	Vegetation Structure and Species Richness	Woodland - EEC	Table 39
13	The percentage of native mid storey cover is within 50-100% or exceeds that of analogue sites. (Use OEH benchmark values)	Vegetation Structure and Species Richness	Woodland - EEC	Table 39

14	The percentage of native ground cover (grasses) is within 50-100% or exceeds that of analogue sites. (Use OEH benchmark values)	Vegetation Structure and Species Richness	Woodland - EEC	Table 39
15	The percentage of native ground cover (shrubs) is within 50-100% or exceeds that of analogue sites. (Use OEH benchmark values)	Vegetation Structure and Species Richness	Woodland - EEC	Table 39
16	The percentage of native ground cover (other) is within 50-100% or exceeds that of analogue sites. (Use OEH benchmark values)	Vegetation Structure and Species Richness	Woodland - EEC	Table 39
17	Exotic plant cover (calculated as a percentage of total ground cover and mid storey cover) is within 5-33% or less than that of analogue sites. (Use OEH benchmark values)	Vegetation Structure and Species Richness	Woodland - EEC	Table 39
18	Total groundcover is the sum of protective ground cover components (dead and live plant material, rocks and logs) and is comparable to that of analogue sites (% Cover).	Habitat Features	Woodland - EEC	Table 18
19	The abundance of native understorey species per square metre, averaged across the site, provides an indication of the heterogeneity of the site and that the number of native species is comparable to analogue sites (no. species/m ²).	Vegetation Structure and Species Richness	Woodland - EEC	Table 39
20	The diversity of maturing trees and shrubs with a stem diameter greater than 5cm is comparable to that of analogue sites (no. /area).	Vegetation Health	Woodland - EEC	Table 42
21	The percentage of maturing trees and shrubs with a stem diameter greater than 5cm that are local endemic species is comparable to analogue sites.	Vegetation Health	Woodland - EEC	Table 42
22	The density of maturing trees and shrubs with a stem diameter greater than 5cm is comparable to analogue sites (no./area).	Vegetation Health	Woodland - EEC	Table 42
23	Average trunk diameter (dbh) of the tree population provides a measure of age and growth rate and that it is trending towards that of analogue sites (cm).	Vegetation Health	Woodland - EEC	Table 42
24	The percentage of the tree population which are in healthy condition and that the percentage is comparable to analogue sites.	Vegetation Health	Woodland - EEC	Table 42
25	The percentage of the tree population which are in a medium health condition and that the percentage is comparable to analogue sites.	Vegetation Health	Woodland - EEC	Table 42
26	The percentage of the tree population which are in a state of advance dieback and that the percentage is comparable to analogue sites.	Vegetation Health	Woodland - EEC	Table 42
27	The presence of reproductive structures such as buds, flowers or fruit on trees and shrubs provides evidence that the ecosystem is maturing, capable of recruitment and can provide habitat resources and that the % population is comparable to that of analogue sites.	Vegetation Health	Woodland - EEC	Table 42
28	The proportion of over-storey species occurring as regeneration is within 50-100% or exceeds that of analogue sites. (Use OEH benchmark values)	Vegetation Structure and Species Richness	Woodland - EEC	Table 39
29	The total length of fallen logs is within 50- <100% or exceeds that of analogue sites. (Use OEH benchmark values)	Habitat Features	Woodland - EEC	Table 39
30	The number of hollows / nesting sites is within 50- <100% or exceeds that of analogue sites. (Use OEH benchmark values)	Habitat Features	Woodland - EEC	Table 39

4. Results

4.1 Growth Medium Development

Table 9 outlines the MOP performance criteria that are relevant to growth medium development. They are applicable to all the rehabilitation sites, regardless of the domain type.

Table 9. Growth Medium Development MOP Performance Criteria

Performance Criteria – Growth Medium Development		Subheading	Domain Type
1	pH >5.5 and <8.5	Soil Analysis	All Woodland
2	Electrical Conductivity <2 dS/m	Soil Analysis	All Woodland
3	Phosphorous within levels in analogue sites by Year 5	Soil Analysis	All Woodland
4	Organic Carbon within levels in analogue sites by Year 5	Soil Analysis	All Woodland
5	Cation Exchange Capacity within levels in analogue sites by Year 2	Soil Analysis	All Woodland
6	Exchangeable Sodium Percentage within levels in analogue sites by Year 2	Soil Analysis	All Woodland
7	Calcium/magnesium ratio within levels in analogue sites by Year 2	Soil Analysis	All Woodland

4.1.1 Soil Analysis

The results of the soil analyses by EAL Australia for key soil chemistry parameters for the HVO and MTW sites are detailed in Appendix 7.

Some of the results for soil properties outlined in the MOP Performance criteria have been compared with data from the reference sites. Data from the reference sites is provided in Table 10. The comparison of rehabilitation site data against the reference site ranges can be seen in Table 11, Table 12 and Table 13.

Table 10. Reference site soil results 2017

Site Name	pH >5.5 and <8.5	EC (dS/m) <2 dS/m	Phosphorus - Exchangeable (Mg/Kg)	Organic Carbon (% OM)	CEC (cmol+/Kg)	Sodium - ESP (%)	Calcium / Magnesium Ratio
WamboSpot1	6.28	0.06	4.73	5.02	8.26	1.16	2.14
WamboSpot2	6.41	0.05	5.94	6.23	14.88	1.53	1.94
WamboSpot3	6.19	0.06	5.28	4.74	8.59	2.17	1.87
WamboGB01	5.76	0.06	9.01	5.87	12.07	3.64	0.8
WamboGB02	6.69	0.1	7.73	7.67	20.44	1.74	2.02
WARKGB01	5.42	0.05	3.36	3.43	7.97	3.27	1.56
WARKGB02	6.03	0.06	5.41	4.97	8.16	2.63	1.99
WARKGB04	5.71	0.09	9.44	8.72	8.25	5.54	1
BEL1	5.44	0.05	5.19	7.05	7.44	4.18	0.65
BEL2	5.93	0.05	3.2	3.69	7.66	2.84	1.66
BEL3	5.69	0.1	5.19	8.17	11.26	4.43	1.28
Range	5.42-6.69	0.05-0.10	3.19-9.44	3.43-8.72	7.44-20.44	1.16-5.54	0.65-2.14
Average	5.96	0.07	5.86	5.96	10.45	3.01	1.54

Table 11. HVO Rehabilitation site soil results compared to MOP target/reference site range values (woodland – other domain type)

Site Name	pH >5.5 and <8.5	Electrical Conductivity (EC) (dS/m) <2 dS/m	Phosphorus - Exchangeable (Mg/Kg)	Organic Carbon (% OM)	Cation Exchange Capacity (CEC) (cmol+/Kg)	Sodium - ESP (%)	Calcium / Magnesium Ratio
Reference Site Average	5.96	0.07	5.86	5.96	10.45	3.01	1.54
Reference Site Range	5.42- 6.69	0.05-0.10	3.19-9.44	3.43-8.72	7.44-20.44	1.16-5.54	0.65-2.14
HVO WES200801	7.24	0.11	17.17	4.43	13.76	2.02	1.10
HVO WES201101	8.44	0.16	87.55	5.64	20.09	2.05	1.48
HVO WES201301	8.37	0.18	146.20	4.36	18.96	1.27	2.24
HVO WES201302	7.81	0.54	186.15	8.84	23.81	1.65	2.74
HVO CAR200901	7.60	0.12	14.96	4.06	17.46	5.53	0.75
HVO CAR200902	7.70	0.08	11.65	2.73	23.27	3.01	1.16
HVO CAR201401	8.03	0.15	48.37	4.80	23.68	3.03	1.85
HVO RIV201406	7.78	0.17	55.85	6.41	22.01	4.98	1.20
HVO RIV201405	8.46	0.12	149.60	3.48	13.50	3.65	2.67
HVO RIV201404	8.80	0.20	101.15	5.29	20.66	6.02	2.30
HVO RIV201403	8.51	0.17	64.77	3.82	21.87	5.43	0.91
HVO RIV201402	8.72	0.48	215.05	8.28	30.22	9.32	1.58
HVO RIV201401	8.80	0.45	243.95	7.67	30.27	9.96	1.07
HVO CHE201201	8.13	0.16	249.90	9.57	23.32	4.04	2.69
HVO CHE201401 - A	7.69	0.13	77.18	4.97	18.25	2.53	1.71
HVO CHE201401 - B	8.14	0.17	244.80	6.27	16.47	3.44	3.95
HVO CHE201203	5.53	0.05	9.52	2.84	4.32	7.06	1.25
HVO CHE201601	8.07	0.52	43.30	6.69	17.75	4.20	1.74
HVO CHE201602	7.77	0.73	71.11	5.58	25.00	4.22	2.15
HVO LEM201501	6.98	0.06	50.64	3.62	7.19	1.70	3.41
HVO LEM201601	6.16	0.07	11.28	1.08	3.55	4.19	1.65
HVO RIV201501	8.36	0.15	54.84	3.78	16.59	5.41	1.98
HVO RIV201502	8.21	0.14	49.59	4.97	18.85	3.93	1.38
HVO RIV201503	7.54	1.69	212.54	7.70	27.52	3.94	5.44
HVO RIV201601	7.75	0.55	80.29	7.30	20.22	3.76	1.16
HVO WES201601	7.58	0.75	117.82	6.88	19.48	3.26	4.07
HVO WES201602	7.48	0.40	57.73	7.18	17.53	3.29	3.30
HVO WES201603	7.24	0.44	58.78	5.79	15.50	6.19	1.33
HVO WES201604	7.76	0.44	32.54	3.64	17.68	1.85	2.67

outside reference site range values

within reference site range values

Notes: pH and EC are compared against the target set within the MOP performance criteria rather than compared to reference

site range values.

Table 12. MTW Rehabilitation site soil results compared to MOP target/reference site range values (woodland – EEC domain type)

Site Name	pH >5.5 and <8.5	Electrical Conductivity (EC) (dS/m) <2 dS/m	Phosphorus - Exchangeable (Mg/Kg)	Organic Carbon (% OM)	Cation Exchange Capacity (CEC) (cmol+/Kg)	Sodium - ESP (%)	Calcium / Magnesium Ratio
Reference Site Average	5.96	0.07	5.86	5.96	10.45	3.01	1.54
Reference Site Range	5.42-6.69	0.05-0.10	3.19-9.44	3.43-8.72	7.44-20.44	1.16-5.54	0.65-2.14
MTWNP201301	6.87	0.08	24.57	2.64	8.04	1.37	2.43
MTWNP201401	6.84	0.1	36.3	5.32	13.33	3.61	1.43
MTWNP201403	8.28	0.2	121.55	4.94	17.27	6.1	1.54
MTWNP201101	8.14	0.07	25.67	3.4	14.09	0.84	1.92
MTWNP200901 - A	6.41	0.15	7.89	4.87	14.24	1.85	1.15
MTWNP200901 - B	8.02	0.16	81.43	5.2	18.25	1.23	2.4
MTWCDD201101	6.95	0.1	8.84	3.82	13.86	6.31	1.27
MTWCDD201301	8.31	0.14	133.45	5.99	16.31	4.44	2.64
MTWCDD201501	8.81	0.19	147.05	5.25	13.02	6.13	1.82
MTWWDL201401	7.41	0.17	86.7	6.74	15.17	8.68	1.53
MTWWDL201402	8.11	0.35	119.85	5.81	20.08	7.59	1.56
MTWTDI201501	9.19	0.8	89.25	10.94	19.61	36.74	1.14
MTWMT0200503	7.71	0.19	11.14	4.94	13.69	4.78	1.11
MTWSPN201401	8.32	0.16	38.42	5.29	15.49	4.04	2.04
MTWNOO201501	7.62	0.13	48.02	4.97	16.96	3.02	1.68
MTWNP201402	6.32	0.03	30.96	4.4625	4.76	0.86	6.78
MTWSPN201501	8.07	0.32	186.04	7.2625	19.72	1.72	4.24
MTWSPN201601	7.04	0.68	112.83	8.085	20.84	4.31	2.85
MTWSPN201602	7.06	0.39	93.94	5.1625	13.59	7.4	1.92
MTWSPS201601	8.23	0.53	103.91	7.6825	20.42	4.88	2.65
MTWSPS201602	7.89	0.67	81.34	4.9525	20.07	4.68	2.24
	outside reference site range values						
	within reference site range values						

Notes: pH and EC are compared against the targets set within the MOP performance criteria rather than compared to reference site range values.

Table 13. MTW Rehabilitation site soil results compared to MOP target/reference site range values (woodland – other domain type)

Site Name	pH >5.5 and <8.5	Electrical Conductivity (EC) (dS/m) <2 dS/m	Phosphorus - Exchangeable (Mg/Kg)	Organic Carbon (% OM)	Cation Exchange Capacity (CEC) (cmol+/Kg)	Sodium - ESP (%)	Calcium / Magnesium Ratio
Reference Site Average	5.96	0.07	5.86	5.96	10.45	3.01	1.54
Reference Site Range	5.42-6.69	0.05-0.10	3.19-9.44	3.43-8.72	7.44-20.44	1.16-5.54	0.65-2.14
MTWMT0200001	7.55	0.15	15.64	2.47	12.43	13.55	0.73
MTWNP200501	7.48	0.09	19.98	3.89	11.66	2.83	1.08
MTWNP200502	7.31	0.09	22.44	5.97	13.07	1.43	1
MTWMT0201501	9.07	0.23	10.5	3.7625	12.69	9.71	1.62
MTWMT0201601	8.49	0.63	53.53	5.215	15.99	10.9	2.01

outside reference site range values

within reference site range values

Notes: pH and EC are compared against the target set within the MOP performance criteria rather than compared to reference site range values.

The above soil analysis shows results from HVO and MTW monitoring sites broken into domain type. The key results include:

- All sites, apart from HVO RIV201404, HVO RIV201403, HVO RIV201402, HVO RIV201401, MTWCDD201501, MTWTD1201501 and MTWMT0201501, fell within the MOP target levels for soil pH. The listed sites that did not fall within the target levels exhibited high alkalinity.
- Only two sites MTWNP200901 – A, and MTWCDD201101 fell within the reference site range for Phosphorous levels. All other rehabilitation sites had higher Phosphorous levels than the reference sites.
- All sites, excluding HVOCAR200902 and HVOCHE201203 meet reference site levels for organic carbon.

4.2 Ecosystem and Landuse Establishment

4.2.1 Landscape Function Analysis

The following MOP performance criteria are relevant to LFA. The results are provided in Table 15 - Table 21. The relevant MOP performance criteria are provided in Table 14. These criteria relate to all sites, regardless of the domain type.

Table 14. Landscape Function Analysis MOP performance criteria

Performance Criteria – Ecosystem and Landuse Establishment		Subheading	Domain Type	Table Number
1	Based on key physical, biological and chemical characteristics the LFA Stability Index provides an indication of the site's stability and that it is comparable to or trending towards that of analogue sites (%)	LFA	All Woodland	Table 15 to Table 21
2	Based on key physical, biological and chemical characteristics the LFA Infiltration Index provides an indication of the site's infiltration capacity and that it is comparable to or trending towards that of analogue sites (%)	LFA	All Woodland	Table 15 to Table 21
3	Based on key physical, biological and chemical characteristics the LFA Nutrient Recycling Index provides an indication of the site's ability to recycle nutrients and that it is comparable to or trending towards that of analogue sites (%)	LFA	All Woodland	Table 15 to Table 21

4	The Landscape Organisation Index provides a measure of the ability of the site to retain resources and that it is comparable to or trending towards that of analogue sites (%)	LFA	All Woodland	Table 15 to Table 21
---	--	-----	--------------	----------------------

Reference Sites

The LFA scores for the Central Hunter Grey Box-Ironbark Woodland and Central Hunter Ironbark-Spotted Gum-Grey Box Forest reference sites were tabulated and are provided in Table 15. It also provides the results and data from the 2016 baseline. Key results include the following:

- Most sites scored an Landscape Organisation Index (LOI) of 1.0
- Most LOI scores were largely consistent, with only minor variation between 2016 and 2017
- WAMBOSPOT2 had the lowest LOI (0.95) across all reference sites
- The average LOI for Ironbark-Spotted Gum-Grey Box Forest was similar to the average for Grey Box-Ironbark Woodland
- The stability scores achieved at many sites reduced overall between 2016 and 2017
- Stability ranged from 53.9 to 68.9 for Grey Box-Ironbark Woodland with WAMBOSPOT2 having the highest stability score of 68.9
- There has been some variation in the LFA scores between 2016 and 2017 at reference sites.

Table 15. LFA data for Reference sites

	Landscape Organisation Index		Stability		Infiltration		Nutrient cycling	
	2016	2017	2016	2017	2016	2017	2016	2017
Central Hunter Grey Box-Ironbark Woodland								
WARKGB01	1	1	69.8	53.9	49.7	65.2	43.2	42.9
WARKGB02	1	0.98	70	59.8	57.6	59	52.1	51.6
WARKGB03	0.84	0.99	57.9	55	49.8	55	38.7	38.5
WARKGB04	0.97	0.98	72.5	58.9	48.4	52.1	48.4	60.6
WAMBOGB1	1	1	58.3	63.5	56.2	57.4	46.3	56.9
WAMBOGB2	1	1	72.5	61.1	48.4	55.5	48.4	50.8
Range	0.84 - 1	0.98 - 1	57.9- 72.5	53.9 - 63.5	48.4 - 57.6	52.1 - 65.2	38.7 - 52.1	38.5 - 60.6
Average	1.0	1.0	66.8	58.7	51.7	57.4	46.2	50.2
Central Hunter Ironbark-Spotted Gum-Grey Box Forest								
BELLSPOT1	1	1	66.7	56.9	51.6	70.4	43.6	41.4
BELLSPOT2	0.94	0.98	81.8	66.7	69.9	61.1	54.2	70.3
BELLSPOT3	1	1	63.9	55.2	65.3	61.8	54.9	64.4
WAMBOSPOT1	1	1	62.5	66.9	74	60.4	65.6	55.6
WAMBOSPOT2	0.96	0.95	72.7	68.9	64.2	58.1	62.1	79.8
WAMBOSPOT3	1	1	69.7	62.2	67.2	73.9	59.7	53.8
Range	0.94 - 1	0.98 - 1	62.5- 81.8	55.2 - 68.9	51.6 - 74	58.1 - 73.9	43.6 - 65.6	41.4 - 79.8
Average	1.0	1.0	69.6	62.8	65.4	64.3	56.7	60.9
Total Range	0.84 - 1	0.98 - 1	57.9-81.8	53.9 - 68.9	48.4 - 74	52.1 - 73.9	38.7 - 65.6	38.5 - 79.8
Total Average	1.0	1.0	68.2	60.8	58.5	60.8	51.4	55.6

The 2016 and 2017 raw data, ranges and average LFA scores for all the HVO and MTW sites broken by domain type is provided in Table 16-Table 21. A summary of the key outcome is provided below.

HVO rehabilitation sites – Woodland other

The raw data, ranges and average LFA scores for HVO - woodland other sites from 2016 and 2017 is provided in Table 16 and Table 19. The comparison columns for each of the four indices are based on the reference site range values for each of these indices.

Based on the data, LFA scores across all indices were fairly consistent for all sites, with no conspicuous outliers. The average LOI score was 0.9 across all sites. High LOI scores, particularly at younger rehabilitation sites, were generally driven by extensive grass cover, rather than development of leaf litter or shrub species.

MTW rehabilitation sites – woodland other

The raw data, ranges and average LFA scores for MTW - woodland other sites from 2016 and 2017 is provided in Table 17 and Table 20. The comparison columns for each of the four indices are based on the reference site range values for each of these indices.

Key results are as follows:

- LOI ranged from 0.41 to 0.96
- Stability ranged from 39.5 to 56.1
- Infiltration was variable and ranged from 28.7 to 56.4
- Nutrient cycling was variable and ranged from 10.3 to 77.8
- MTWCDD201501 had the lowest LFA score.

MTW rehabilitation sites – woodland EEC

The raw data, ranges and average LFA scores for MTW – woodland EEC sites from 2016 and 2017 is provided in Table 18 and Table 21. The comparison columns for each of the four indices is based on the reference site range values for each of these indices.

Key results are as follows:

- LOI ranged from 0.21 to 1.0
- Stability ranged from 44.2 to 73.2
- Infiltration was highly variable and ranged from 8.2 to 65.4
- Nutrient cycling was variable and ranged from 12.3 to 43.1.

Table 16. Landscape Function Analysis scores HVO- woodland other domain type (2017 data)

Site name	LOI	Stability	Infiltration	Nutrient cycling
Reference Site Average	0.98	60.75	60.75	55.5
Reference Site Range	0.98 - 1	53.9 - 68.9	52.1 - 73.9	38.5 - 79.8
HVOCAR200901	0.59	59.4	35.8	39.7
HVOCAR200902	0.93	63	75	61.5
HVOCAR201401	0.75	50.9	59.6	49.9
HVOCHE201201	0.84	56.1	54	47.7
HVOCHE201203	0.96	62.8	58.4	47.7
HVOCHE201401	0.99	51.1	47.9	36.2
HVORIV201401	0.94	67.1	60.5	58.3
HVORIV201402	0.84	53.5	51.6	43.4
HVORIV201403	0.91	53.4	33.1	36.3
HVORIV201404	0.87	55.6	43.2	32.1
HVORIV201405	1	56.7	46.9	32.3
HVORIV201406	0.95	51.6	70.5	15.3
HVOWES200801	0.84	69.6	43.5	72.1
HVOWES201101	0.73	63.8	53.2	54.4
HVOWES201301	0.67	61.9	50	42.9
HVOWES201302	0.96	62	58	47
HVOCHE201501	1	59	57	44.6
HVOCHE201601	1	45	27.6	13
HVOCHE201602	1	44.4	30.9	11.6
HVOLEM201501	1	57.9	75.7	69.2
HVOLEM201601	0.98	59.5	56.7	47.7
HVORIV201501	1	51.1	65.9	47.7
HVORIV201502	1	69	43	47
HVORIV201503	1	61.5	61.9	64.6
HVORIV201601	0.92	67.4	57.4	42.8
HVOWES201601	1	53.3	35.8	23.8
HVOWES201602	0.92	55.1	26.2	17.9
HVOWES201603	0.96	56.1	53.4	49.1
HVOWES201604	0.89	54.6	40.7	30.7
Rehabilitation Site Average	0.9	57.8	51.1	42.7

lower than reference site range values

within reference site range values

exceeds reference site range values

Table 17. Landscape Function Analysis scores for MTW - woodland other domain type (2017 data)

Site name	LOI	Stability	Infiltration	Nutrient cycling
Reference Site Average	0.98	60.75	60.75	55.5
Reference Site Range	0.98 - 1	53.9 - 68.9	52.1 - 73.9	38.5 - 79.8
MTWMT0200001	0.96	56.1	56.4	41.5
MTWNPN200501	0.58	51.3	50.1	43.1
MTWNPN200502	0.67	39.5	41.1	34
MTWMT0201501	0.41	54.4	31.6	31.5
MTWMT0201601	0.69	50.7	28.7	12.3
Rehabilitation Site Average	0.7	50.4	41.6	32.5

lower than reference site range values

within reference site range values

exceeds reference site range values

Table 18. Landscape Function Analysis results for MTW - woodland EEC domain type (2017 data)

Site name	LOI	Stability	Infiltration	Nutrient cycling
Reference Site Average	0.98	60.75	60.75	55.5
Reference Site Range	0.98 - 1	53.9 - 68.9	52.1 - 73.9	38.5 - 79.8
MTWCDD201101	0.71	69.3	49.6	61.5
MTWCDD201301	0.97	60	48	49
MTWCDD201501	0.28	13.3	8.2	5.7
MTWMT0200503	0.35	56.1	45.3	33.5
MTWNPN200901	0.89	73.2	54.1	58.5
MTWNPN201101	0.21	69.3	49.6	61.5
MTWNPN201301	0.61	49.9	29.4	30.8
MTWNPN201402	0.55	53	51.6	44.8
MTWNPN201403	0.95	51.5	39	38.3
MTWSPN201401	0.94	45.2	65.4	49.5
MTWTD1201501	0.64	58.9	22.8	18.6
MTWWDL201401	0.68	44.2	32.5	35.9
MTWWDL201402	0.94	64.5	43.7	46.4
MTWNOO201501	1	52.8	27.5	20.9
MTWNPN201402	1	54.5	53.6	40.2
MTWSPN201501	0.01	57.5	53	38.5
MTWSPN201601	0	55.6	33.4	20.1
MTWSPN201602	0.85	57.6	66	60.1
MTWSPS201601	0.79	50.2	53.2	44.6
MTWSPS201602	0.75	53.9	31.8	20.8
Rehabilitation Site Average	0.8	54.8	43.7	39.7

lower than reference site range values

within reference site range values

exceeds reference site range values

Table 19. Landscape Function Analysis scores HVO- woodland other domain type (2016 data)

Site name	LOI	Stability	Infiltration	Nutrient cycling
Reference Site Average	1.0	68.2	58.5	51.4
Reference Site Range	0.84 - 1	57.9 - 81.8	48.4 - 74	38.7 - 65.6
HVO CAR200901	0.83	66.5	47.4	44.2
HVO CAR200902	0.99	68	46.2	40.1
HVO CAR201401	0.86	61.4	43.3	50.2
HVO CHE201201	0.98	65.4	56.1	76.5
HVO CHE201203	0.91	64.3	57.3	57.5
HVO CHE201301	1	64.2	46.3	67
HVO CHE201401	0.82	55.6	40.2	34.1
HVO RIV201301	0.94	73.1	48.7	52.4
HVO RIV201401	0.69	49	33.2	22.6
HVO RIV201402	0.77	53.9	22.1	13.5
HVO RIV201403	0.86	50.8	22	16
HVO RIV201404	0.96	56	21.3	15.9
HVO RIV201405	1	73.1	64.1	77.8
HVO RIV201406	1	74.4	63.3	75.6
HVO WES200801	0.61	58.8	47.1	46
HVO WES201101	0.95	61.4	35.9	25.7
HVO WES201301	0.88	50.4	27	18.8
Rehabilitation Site Average	0.9	61.5	42.4	43.2

lower than reference site range values

within reference site range values

exceeds reference site range values

Table 20. Landscape Function Analysis scores for MTW - woodland other domain type (2016 data)

Site name	LOI	Stability	Infiltration	Nutrient cycling
Reference Site Average	1.0	68.2	58.5	51.4
Reference Site Range	0.84 - 1	57.9 - 81.8	48.4 - 74	38.7 - 65.6
MTWMTO200001	0.89	58.2	31.8	33.9
MTWNPN200501	0.92	63.3	43.3	39.9
MTWNPN200502	0.95	61.3	37	32.4
Rehabilitation Site Average	0.9	60.9	37.4	35.4

lower than reference site range values

within reference site range values

exceeds reference site range values

Table 21. Landscape Function Analysis scores for MTW - woodland EEC domain type (2016 data)

Site name	LOI	Stability	Infiltration	Nutrient cycling
Reference Site Average	1.0	68.2	58.5	51.4
Reference Site Range	0.84 - 1	57.9 - 81.8	48.4 - 74	38.7 - 65.6
MTWCDD201101	0.98	85.4	65.2	72.1
MTWCDD201301	1	78.7	77.8	64.6
MTWCDD201501	0.14	47.8	10.3	10.3
MTWMTO200503	0.54	54	28.5	21.4
MTWNPN200901	0.93	66.2	40.5	45.8
MTWNPN201101	1	58.7	57.1	53.5
MTWNPN201301	1	63.5	57.1	53.3
MTWNPN201401	0.67	61.9	32.8	21.4
MTWNPN201402	0.96	59.8	39.5	47
MTWNPN201403	0.98	74.6	66.8	65.5
MTWSPN201401	1	73.7	40.7	37.2
MTWTD1201501	0.61	54.4	24	22
MTWWDL201401	0.97	63.7	40.6	36.8
MTWWDL201401	0.97	63.7	40.6	36.8
MTWWDL201402	0.98	66.5	71.4	67.2
MTWWDL201402	0.98	66.5	71.4	67.2
Rehabilitation Site Average	0.9	64.9	47.8	45.1

lower than reference site range values

within reference site range values

exceeds reference site range values

4.2.2 Species Richness

Table 23 to Table 26 below provide species counts of the reference and rehabilitation sites. These tables also highlight the rehabilitation sites that have achieved species richness comparable to the reference sites.

The following MOP performance criteria in Table 22 show performance criteria relevant to species richness. Some of these performance criteria only apply to particular domain types. A comparison of total native plant species richness for rehabilitation and reference sites is presented in Table 24 to Table 26 for information purposes. This measure is only a MOP performance criteria for Woodland – EEC domains and the target relates to species richness in OEH benchmark sites for Central Hunter Grey Box-Ironbark Woodland. A comparison of total native species richness for Woodland – EEC rehabilitation sites against the OEH benchmarks is presented in the Native Plant Species (NPS) column of Table 39.

Table 22. Species richness MOP performance criteria

Performance Criteria – Ecosystem and Landuse Establishment		Subheading	Domain Type	Table Number
6	The number of grass species comprising the vegetation community is comparable to that of analogue sites (no. species/area)	Species Richness	Woodland - Other	Table 24 and Table 26
9	The number of shrub species comprising the vegetation community is comparable to that of analogue sites (no. species/area)	Species Richness	Woodland EEC	Table 25
10	The number of grass species comprising the vegetation community is comparable to that of analogue sites (no. species/area)	Species Richness	Woodland EEC	Table 25
11	The number of subshrub species and understorey species (other than grasses) comprising the vegetation community is comparable to that of analogue sites (no. species/area).	Species Richness	Woodland EEC	Table 25
12	The native plant species richness is within 50-100% or exceeds that of analogue sites (no. species/area). (Use benchmark values)	Species Richness	Woodland EEC	Table 39

Table 23. 2017 Reference site native species count

Site Name	Number of Tree Species	Number of Shrub Species	Number of Grass Species	Number of Other Species	Total Native Plant Species Richness
Reference Sites					
BEL1	2	6	4	12	24
BEL2	2	4	4	12	22
BEL3	4	4	6	12	26
WAMBOG1	2	4	5	12	23
WAMBOGB2	1	6	9	12	28
WAMBOSPOT1	4	9	4	13	30
WAMBOSPOT2	4	7	8	12	31
WAMBOSPOT3	3	7	6	13	29
WARKGB01	2	5	5	14	26
WARKGB02	2	6	7	20	35
WARKGB03	3	6	6	11	26
WARKGB04	2	5	6	10	23
Reference Site Average	3	6	6	13	28
Reference Site Range	1 - 4	4 - 9	4 - 9	10 - 20	22 - 35

Table 24. 2017 HVO Rehabilitation sites native species count (Woodland – other domain type)

Site Name	Number of Tree Species	Number of Shrub Species	Number of Grass Species	Number of Other Species	Total Native Plant Species Richness
Reference Site Average	3	6	6	13	28
Reference Site Range	1 - 4	4 - 9	4 - 9	10 - 20	22 - 35
HVOCAR200901	3	4	1	0	8
HVOCAR200902	3	3	2	0	8
HVOCAR201401*	0	0	2	2	4
HVOCHE201201	0	0	2	3	5
HVOCHE201203*	0	0	2	1	3
HVOCHE201401*	0	0	3	0	3
HVORIV201401	3	5	6	6	20
HVORIV201402	1	1	4	2	8
HVORIV201403	0	2	5	3	10
HVORIV201404	0	2	3	4	9
HVORIV201405	0	0	1	0	1
HVORIV201406	0	0	5	4	9
HVOWES200801	4	6	7	2	19
HVOWES201101	6	7	5	3	21
HVOWES201301	4	2	6	2	14
HVOWES201302*	0	0	4	2	6
HVOCHE201501	0	0	0	3	3
HVOCHE201601	0	0	2	1	3
HVOCHE201602	0	0	1	1	2
HVOLEM201501	1	2	7	3	13
HVOLEM201601	1	5	3	5	14
HVORIV201501	0	0	11	2	13
HVORIV201502	0	0	2	5	7
HVORIV201503	4	4	10	4	22
HVORIV201601	0	0	1	1	2
HVOWES201601	0	3	5	4	12
HVOWES201602	3	11	12	11	37
HVOWES201603	4	6	11	5	26
HVOWES201604	0	6	8	6	20
HVO Average	1.3	2.5	4.6	3.3	11.7

	lower than reference site range values
	within reference site range values
	exceeds reference site range values
	not a MOP performance criteria for this domain type

Notes: * = sites that have not yet been sown with native seed mixes and therefore excluded from site averages.

Table 25. 2017 MTW Rehabilitation sites native species count (Woodland EEC domain type)

Site Name	Number of Tree Species	Number of Shrub Species	Number of Grass Species	Number of Other Species	Total Native Plant Species Richness
Reference Site Average	3	6	6	13	28
Reference Site Range	1 - 4	4 - 9	4 - 9	10 - 20	22 - 35
MTWCDD201101	4	10	5	6	25
MTWCDD201301*	0	0	0	0	0
MTWCDD201501	3	7	13	3	26
MTWMTO200503	2	0	6	12	20
MTWNPN200901	4	6	2	1	13
MTWNPN201101	2	9	2	3	16
MTWNPN201301	0	7	5	3	15
MTWNPN201401	0	12	9	3	24
MTWNPN201403	1	3	3	2	9
MTWSPN201401*	0	0	4	0	4
MTWTDI201501	1	2	8	1	12
MTWWDL201401	3	8	6	6	23
MTWWDL201402*	0	0	5	2	7
MTWNOO201501	0	3	7	3	13
MTWSPN201501	0	0	1	0	1
MTWSPN201601	0	0	0	0	0
MTWSPN201602	0	2	6	5	13
MTWSPS201601	0	0	2	4	6
MTWSPS201602	0	0	0	0	0
MTWNPN201402	0	10	5	7	22
MTW Average	1.1	3.6	4.4	2.8	11.9

lower than reference site range values

within reference site range values

exceeds reference site range values

MOP performance criteria for this domain relates to comparison with OEH benchmark (see Table 39)

Notes: * = sites that have not yet been sown with native seed mixes and therefore excluded from site averages.

Table 26. 2017 MTW rehabilitation sites native species count (Woodland – other domain type)

Site Name	Number of Tree Species	Number of Shrub Species	Number of Grass Species	Number of Other Species	Total Native Plant Species Richness
Reference Site Average	3	6	6	13	28
Reference Site Range	1 - 4	4 - 9	4 - 9	10 - 20	22 - 35
MTWMTO200001	2	2	0	9	13
MTWNPN200501	1	2	4	6	13
MTWNPN200502	2	4	2	2	10
MTWMTO201501	0	0	0	0	0

MTWMT0201601	0	0	2	1	3
MTW Average	1.0	1.6	1.6	3.6	7.8

	lower than reference site range values
	within reference site range values
	exceeds reference site range values
	not a MOP performance criteria for this domain type

Notes: * = sites that have not yet been sown with native seed mixes and therefore excluded from site averages

4.2.3 Canopy Development

Table 27. Tree species and canopy development MOP performance criteria

Performance Criteria – Ecosystem and Landuse Establishment		Subheading	Domain Type	Table Number
5	The number of tree species comprising the vegetation community is comparable to that of analogue sites (no. species/area)	Canopy Development	Woodland - Other	Table 29 and Table 31
7	The density of trees is comparable to that of analogue sites (no./area)	Canopy Development	Woodland - Other	Table 29 and Table 31
8	The number of tree species comprising the vegetation community is comparable to that of analogue sites (no. species/area)	Canopy Development	Woodland EEC	Table 30
13	The density of trees is comparable to that of analogue sites (no./area)	Canopy Development	Woodland EEC	Table 30

Reference site stem density counts

At each rehabilitation and reference site the stem density of canopy species was recorded within two 50 metre x 2 metre quadrats, running along either side of the 50 metre tape. The number of each different kind of over-storey species was recorded and the results are summarised in Table 28 - Table 31, with full results provided in Appendix 6.

Table 28. Details of canopy regeneration at reference sites

Site	Number of species	Stems per hectare (ha)
WAMBOGB1	2	950
WAMBOGB2	1	250
WARKGB01	2	3150
WARKGB02	2	1050
WARKGB03	3	2750
WARKGB04	2	500
Average	2	1442
BELLSPOT1	2	300
BELLSPOT2	2	850
BELLSPOT3	4	1000
WAMBOSPOT1	4	1650
WAMBOSPOT2	4	950
WAMBOSPOT3	3	800
Average	3.2	925
Total Average	3	1183
Range	1 - 4	250 - 3150

Table 29. Details of canopy regeneration at HVO rehabilitation sites 2017 (Woodland – other)

Site	Number of species	Stems per hectare (ha)	Natives sown (Y/N)
Reference Site Range	1 - 4	250 - 3150	
HVOCAR200901	3	1900	Y
HVOCAR200902	3	2400	Y
HVOCAR201401	0	0	N
HVOCH201201	0	0	Y
HVOCH201203	0	0	N
HVOCH201401	0	0	N
HVORIV201401	3	350	Y
HVORIV201402	1	50	Y
HVORIV201403	0	0	Y
HVORIV201404	0	0	Y
HVORIV201405	0	0	Y
HVORIV201406	0	0	Y
HVOWES200801	4	4250	Y
HVOWES201101	6	4650	Y
HVOWES201301	4	600	Y
HVOWES201302	0	0	N
HVOLEM201501	1	100	Y
HVORIV201501	1	50	Y
HVORIV201503	1	50	Y

HVOWES201602	4	1000	Y
HVOWES201603	1	50	Y
HVOCHE201501	0	0	N
HVOCHE201601	0	0	N
HVOCHE201602	0	0	N
HVOLEM201601	0	0	N
HVORIV201502	0	0	N
HVORIV201601	0	0	N
HVOWES201601	0	0	N
HVOWES201604	0	0	N
Average	1.9	908.8	

	lower than reference site range values
	within reference site range values
	exceeds reference site range values

Notes: Sites which have not yet been sown with native seed mixes have been excluded from site averages.

Table 30. Details of canopy regeneration at MTW rehabilitation sites 2017 (Woodland – EEC)

Site	Number of species	Stems per hectare (ha)	Natives sown (Y/N)
Reference Site Range	1 - 4	250 - 3150	
MTWCDD201101	4	1750	Y
MTWCDD201301	0	0	N
MTWCDD201501	3	4850	Y
MTWMT0200503	2	1150	Y
MTWNPN200901	4	3500	Y
MTWNPN201101	2	600	Y
MTWNPN201301	0	0	Y
MTWNPN201401	0	0	Y
MTWNPN201402	0	0	Y
MTWNPN201403	1	100	Y
MTWSPN201401	0	0	N
MTWTDI201501	1	50	Y
MTWWDL201401	3	750	Y
MTWWDL201402	0	0	N
MTWNOO201501	0	0	N
MTWSPN201501	0	0	N
MTWSPN201601	0	0	N
MTWSPN201602	0	0	N
MTWSPS201601	0	0	N
MTWSPS201602	0	0	N
Average	2.0	1159.1	

lower than reference site range values

within reference site range values

exceeds reference site range values

Notes: Sites which have not yet been sown with native seed mixes have been excluded from site averages.

Table 31. Details of canopy regeneration at MTW rehab sites 2017 (Woodland – other)

Site	Number of species	Stems per hectare (ha)	Natives sown (Y/N)
Reference Site Range	1 - 4	250 - 3150	
MTWMT0200001	2	850	Y
MTWNPN200501	1	100	Y
MTWNPN200502	2	1500	Y
MTWMT0201501	0	0	N
MTWMT0201601	0	0	N
Average	1.7	816.7	

lower than reference site range values

within reference site range values

exceeds reference site range values

Notes: Sites which have not yet been sown with native seed mixes have been excluded from site averages.

4.3 Ecosystem and Landuse Sustainability

4.3.1 Vegetation Structure and Species Richness

Results for vegetation structure and species richness for both reference and rehabilitation sites are displayed in Table 37 to Table 41 below. Both OEH and the calculated reference site benchmark values are also shown.

Table 32. Vegetation Structure and Species Richness MOP performance criteria

Performance Criteria – Ecosystem and Landuse Sustainability		Subheading	Domain Type	Table Number
1	Weed plant cover (calculated as a percentage of total ground cover) is comparable to that of analogue sites. (% Cover)	Vegetation Structure and Species Richness	Woodland - Other	Table 37 and Table 38
11	The proportion of over-storey species occurring as regeneration is within 50-100% or exceeds that of analogue sites.	Vegetation Structure and Species Richness	Woodland - Other	Table 37 and Table 38
12	The percentage of native over storey cover is within 50-100% or exceeds that of analogue sites. (Use OEH benchmark values)	Vegetation Structure and Species Richness	Woodland - EEC	Table 39
13	The percentage of native mid storey cover is within 50-100% or exceeds that of analogue sites. (Use OEH benchmark values)	Vegetation Structure and Species Richness	Woodland - EEC	Table 39
14	The percentage of native ground cover (grasses) is within 50-100% or exceeds that of analogue sites. (Use OEH benchmark values)	Vegetation Structure and Species Richness	Woodland - EEC	Table 39
15	The percentage of native ground cover (shrubs) is within 50-100% or exceeds that of analogue sites. (Use OEH benchmark values)	Vegetation Structure and Species Richness	Woodland - EEC	Table 39
16	The percentage of native ground cover (other) is within 50-100% or exceeds that of analogue sites. (Use OEH benchmark values)	Vegetation Structure and Species Richness	Woodland - EEC	Table 39
17	Exotic plant cover (calculated as a percentage of total ground cover and mid storey cover) is within 5-33% or less than that of analogue sites. (Use OEH benchmark values)	Vegetation Structure and Species Richness	Woodland - EEC	Table 39
19	The abundance of native understorey species per square metre, averaged across the site, provides an indication of the heterogeneity of the site and that the number of native species is comparable to analogue sites (no. species/m ²).	Vegetation Structure and Species Richness	Woodland - EEC	Table 39
28	The proportion of over-storey species occurring as regeneration is within 50-100% or exceeds that of analogue sites. (Use OEH benchmark values)	Vegetation Structure and Species Richness	Woodland - EEC	Table 39

Reference sites

OEH Benchmark values

The OEH Benchmark Values for both Central Hunter Grey Box-Ironbark Woodland and Central Hunter Ironbark-Spotted Gum-Grey Box Forest are provided in Table 33.

Based on a comparison of the OEH benchmark values for the two communities the following can be concluded:

- Grey-Box Ironbark Woodland has a higher NPS compared to Ironbark Spotted Gum-Grey Box Forest
- Spotted Gum – Grey Box Forest has a greater NOS range compared to Grey-Box Ironbark Woodland
- Spotted Gum – Grey Box Forest has a greater NMS range compared to Grey-Box Ironbark Woodland
- Ironbark Spotted Gum-Grey Box Forest has a greater NGCG and a greater NGCG range compared to Grey-Box Ironbark Woodland
- Grey-Box Ironbark Woodland has the same NGCS range as Ironbark Spotted Gum – Grey Box Forest
- Grey-Box Ironbark Woodland has a greater NGCO compared to Ironbark Spotted Gum-Grey Box Forest
- NTH is greater in Grey-Box Ironbark Woodland
- FL is far greater within Ironbark Spotted Gum – Grey Box Forest.

Table 33. OEH Benchmark values for Central Hunter Grey Box-Ironbark Woodland and Central Hunter Ironbark-Spotted Gum-Grey Box Forest

Plot name	NPS	NOS		NMS		NGCG		NGCS		NGCO		EPC	NTH	OR	FL
Grey-Box Ironbark Woodland OEH Benchmark Upper and Lower Limits	≥41	15	40	5	20	30	50	5	10	20	40	0	3	1	≥5
Spotted Gum – Grey Box Forest OEH Benchmark Upper and Lower Limits	≥25	20	50	10	60	5	16	5	10	5	15	0	1	1	≥66

NPS: Native Plant Species, NOS: Native overstorey, NMS: Native midstorey, NGCG: Native ground cover grasses, NGCS: Native ground cover shrubs, NGCO: Native ground cover other, EPC: Exotic Plant Cover, NTH: Number trees with hollows, OR: Overstorey Regeneration, FL: Fallen Logs.

4.3.2 Reference sites against OEH Benchmark values

BioBanking data collected at each of the reference sites was input into the OEH BioBanking Benchmark Calculator to provide the lower and upper benchmark ranges for each attribute. The OEH benchmark values have been compared to the reference site benchmark values below in Table 34 and Table 35.

Table 34. OEH benchmarks and 2017 reference site benchmarks

Reference site name	NPS	NOS		NMS		NGCG		NGCS		NGCO		EPC	NTH	OR	FL
Central Hunter Grey Box-Ironbark Woodland															
WamboGB01	25	9.5		0.5		40		2		2		0	0	1	11
WamboGB02	28	13.5		0		32		6		6		0	0	1	22
WARKGB01	25	11.5		8		20		8		2		2	1	1	26
WARKGB02	37	21.5		1		66		0		8		0	0	1	60
WarkGB03	25	7.5		1		32		0		2		0	0	1	15
WarkGB04	22	6		0		26		10		14		0	1	1	10
Reference Site Benchmark Upper and Lower Limits	≥27	13.3	22.8	0.0	10.0	18.0	33.0	1.0	11.0	3.0	26.0	0	≥1	1	≥21
OEH Benchmark Upper and Lower Limits	≥41	15	40	5	20	30	50	5	10	20	40	0	3	1	≥5
Central Hunter Ironbark-Spotted Gum-Grey Box Forest															
BEL1	25	13		0		38		0		14		0	0	1	17
BEL2	22	19.5		0		22		2		36		6	0	1	24
BEL3	25	17		0		14		4		16		4	0	1	27
WamboSpot1	28	14		14.5		28		8		2		0	4	1	82
WamboSpot2	29	13.5		0		24		12		4		0	1	1	15
WamboSpot3	29	26		5.5		22		10		4		0	2	1	12
Reference Site Benchmark Upper and Lower Limits	≥25	6.8	17.5	0.0	4.5	23.0	53.0	0.0	9.0	2.0	11.0	0	≥0	1	≥19
OEH Benchmark Upper and Lower Limits	≥25	20	50	10	60	5	16	5	10	5	15	0	≥1	1	≥66

NPS: Native Plant Species, NOS: Native overstorey, NMS: Native midstorey, NGCG: Native ground cover grasses, NGCS: Native ground cover shrubs, NGCO: Native ground cover other, EPC: Exotic Plant Cover, NTH: Number trees with hollows, OR: Overstorey Regeneration, FL: Fallen Logs.

Table 35. OEH benchmarks and 2016 reference site benchmarks

Reference site name	NPS	NOS		NMS		NGCG		NGCS		NGCO		EPC	NTH	OR	FL
Central Hunter Grey Box-Ironbark Woodland															
WamboGB01	34	13		7		50		6		32		0	0	1	7
WamboGB02	35	19		0		62		12		12		0	0	1	23
WARKGB01	28	15		23		38		0		38		2	0	1	4.5
WARKGB02	31	14.5		1		70		0		62		0	0	1	22
WarkGB03	31	18.5		0		54		0		16		0	0	1	27
WarkGB04	29	2		0		64		28		16		4	1	1	3
Reference Site Benchmark Upper and Lower Limits	≥31	7.5	18.8	0	15.0	44.0	67.0	0	20.0	14.0	50.0	0	≥0	1	≥15
OEH Benchmark Upper and Lower Limits	≥41	15	40	5	20	30	50	5	10	20	40	0	3	1	≥5
Central Hunter Ironbark-Spotted Gum-Grey Box Forest															
BEL1	34	10.5		0		56		2		22		0	0	1	60
BEL2	35	38		2		56		6		50		0	0	1	13.5
BEL3	33	26.5		0		36		2		50		0	0	1	64
WamboSpot1	32	27		14		38		4		12		0	4	1	74
WamboSpot2	27	21		7.5		40		6		12		0	0	1	12
WamboSpot3	34	29		15		30		8		16		0	4	1	13
Reference Site Benchmark Upper and Lower Limits	≥34	15.8	33.5	0.0	14.5	33.0	56.0	2.0	7.0	12.0	50.0	0	≥0	1	≥37
OEH Benchmark Upper and Lower Limits	≥25	20	50	10	60	5	16	5	10	5	15	0	1	1	≥66

NPS: Native Plant Species, NOS: Native overstorey, NMS: Native midstorey, NGCG: Native ground cover grasses, NGCS: Native ground cover shrubs, NGCO: Native ground cover other, EPC: Exotic Plant Cover, NTH: Number trees with hollows, OR: Overstorey Regeneration, FL: Fallen Logs.

Table 36. Combined reference site benchmarks using combined data from all reference sites and from both 2016 and 2017 monitoring

Reference site name	NPS	NOS		NMS		NGCG		NGCS		NGCO		EPC	NTH	OR	FL
Reference Site Benchmark Upper and Lower Limits	≥28	7.4	26.6	0.0	14.6	21.8	64.2	0	10.2	2.0	39.2	0	≥1	1	≥20

Based on a comparison of the reference site benchmarks to the OEH benchmarks of Central Hunter Grey Box-Ironbark Woodland, the following conclusions can be made:

- Reference sites have a lower limit for most attributes, except NGCG and FL
- NPS for the reference site benchmark had a total of 14 species less than the OEH benchmark
- NOS for reference site benchmark has a smaller range than the OEH benchmark and this may be attributed to the historic clearing of the reference sites
- NMS for the reference site benchmark has a lower value of zero, whilst the OEH benchmark has a lower value of five percent
- NGCG for the reference site benchmark has a small range compared to the OEH benchmark
- NGCS for the reference site benchmark has a lower value of one and a higher upper value compared to the OEH benchmark
- NGCO for the reference site benchmark has a lower value of three, whilst the OEH benchmark has a lower value of 20 percent
- FL is higher for the reference site benchmark than the OEH benchmark.

Based on a comparison of the local benchmarks to the OEH benchmarks of Central Hunter Ironbark-Spotted Gum-Grey Box Forest, the following conclusions can be made:

- NPS was the same for the local benchmark and OEH benchmark
- NOS for reference site benchmark has a smaller range than the OEH benchmark and this may be attributed to the historic clearing of the reference sites
- NMS for the reference site benchmark has a lower benchmark value of zero compared to a lower OEH benchmark of ten and the reference site benchmark also has a significantly lower upper value compared to the OEH benchmark
- NGCG for the reference site benchmark is significantly higher compared to the the OEH benchmark
- NGCS for the reference site benchmark has a greater range compared to OEH benchmark
- NGCO for the reference site benchmark has a slightly lower range compared to OEH benchmark
- FL has a lower reference site benchmark than the OEH benchmark.

Considerable variation can be seen between the 2016 and 2017 local benchmark data (Table 34 and Table 35):

- NPS, NMS and NGCG decreased in both vegetation types in 2017 compared with 2016
- NOS has increased slightly in Central Hunter Grey Box-Ironbark Woodland, although it has decreased in Central Hunter Ironbark-Spotted Gum-Grey Box Forest in 2017
- NGCS has decreased for Central Hunter Grey Box-Ironbark Woodland while the range for Central Hunter Ironbark-Spotted Gum-Grey Box Forest in 2017 has increased
- NGCO has reduced substantially over both vegetation from 2016 to 2017
- Another hollow was recorded in Central Hunter Grey Box-Ironbark Woodland bringing the benchmark up to ≥ 1 from ≥ 0 the previous year
- FL has decreased substantially for Central Hunter Ironbark-Spotted Gum-Grey Box Forest in 2017, while the range for Central Hunter Grey Box-Ironbark Woodland has increased slightly.

A combined reference site benchmark has been established utilising data from both Central Hunter Ironbark-Spotted Gum-Grey Box Forest and Central Hunter Grey Box-Ironbark Woodland (Table 36). This benchmark calculation includes data from both 2016 and 2017 and aims to provide a representative benchmark of general vegetation within the region.

4.3.3 Biobanking values for rehabilitation sites against OEH benchmarks and reference site benchmarks.

The MOP performance criteria for Woodland – Other domains require analysis of biometric data against reference sites benchmark values (see Table 37 - Table 38). The MOP performance criteria for Woodland – EEC domains require analysis of biometric data against OEH benchmark values (see Table 39). The data has been tabulated based on site and domain type.

Table 37. HVO Woodland – other rehabilitation sites compared to the combined reference site benchmarks

Plot name	NPS	NOS		NMS		NGCG		NGCS		NGCO		EPC	NTH	OR	FL
Combined Benchmark	≥28	7.4	26.6	0.0	14.6	21.8	64.2	0	10.2	2.0	39.2	0	≥1	1	≥20
HVOCAR200901	9	0		13		0		4		2		30	0	0	0
HVOCAR200902	10	8		0		0		0		0		74	0	0	0
HVOCAR201401*	4	0		0		0		0		0		74	0	0	0
HVOCHE201201	5	0		0		0		0		18		14	0	0	0
HVOCHE201203*	3	0		0		20		0		0		64	0	0	0
HVOCHE201401*	3	0		0		28		0		0		42	0	0	0
HVORIV201401	18	0		0		4		4		20		50	0	0	0
HVORIV201402	7	0		0		14		0		4		38	0	0	0
HVORIV201403	11	0		0		24		0		2		52	0	0	0
HVORIV201404	10	0		0		16		4		10		10	0	0	0
HVORIV201405	1	0		0		0		0		0		60	0	0	0
HVORIV201406	9	0		0		0		2		4		34	0	0	0
HVOWES200801	16	11		2		16		0		2		10	0	0	0
HVOWES201101	21	8		0		12		2		24		10	0	0	0
HVOWES201301	14	0		0		30		0		8		30	0	0	0
HVOWES201302*	0	0		0		50		0		8		30	0	0	0
HVOCHE201501	0	0		0		0		0		0		80	0	0	0
HVOCHE201601	0	0		0		0		0		0		0	0	0	0
HVOCHE201602	0	0		0		2		0		0		0	0	0	0
HVOLEM201501	0	0		0		94		0		0		18	0	0	0
HVOLEM201601	0	0		0		14		4		2		52	0	0	0
HVORIV201501	13	0		0		52		0		0		76	0	0	0
HVORIV201502	7	0		0		0		0		16		100	0	0	0
HVORIV201503	22	0		0		32		4		10		66	0	0	0
HVORIV201601	2	0		0		0		0		0		92	0	0	0
HVOWES201601	12	0		0		64		0		0		88	0	0	0
HVOWES201602	37	0		0		62		24		4		18	0	0	0
HVOWES201603	26	0		0		40		0		0		74	0	0	0
HVOWES201604	20	0		0		42		0		4		38	0	0	0

lower than reference site benchmark

within reference site benchmark

exceeds reference site benchmark

not a MOP performance criteria for this domain type

NPS: Native Plant Species, NOS: Native overstorey, NMS: Native midstorey, NGCG: Native ground cover grasses, NGCS: Native ground cover shrubs, NGCO: Native ground cover other, EPC: Exotic Plant Cover, NTH: Number trees with hollows, OR: Overstorey Regeneration, FL: Fallen Logs.
Notes: 1. * = Sites which have not yet been sown with native seed mixes; 2. A low value for Exotic Plant Cover (EPC) is the desired result.

Table 38. MTW Woodland – other rehabilitation sites compared to the combined reference site benchmarks

Plot name	NPS	NOS		NMS		NGCG		NGCS		NGCO		EPC	NTH	OR	FL
Combined Benchmark	≥28	7.4	26.6	0.0	14.6	21.8	64.2	0	10 .2	2. 0	39 .2	0	≥1	1	≥20
MTWMT0200001	12	0.5		0		0		0		40		18	0	0	0
MTWNP0200501	12	0		3.5		12		0		0		22	0	0	0
MTWNP0200502	11	16.5		12		0		4		0		34	0	0	0
MTWMT0201501	4	0		0		0		0		2		72	0	0	0
MTWMT0201601	0	0		0		10		0		0		34	0	0	0

	lower than reference site benchmark
	within reference site benchmark
	exceeds reference site benchmark
	not a MOP performance criteria for this domain type

NPS: Native Plant Species, NOS: Native overstorey, NMS: Native midstorey, NGCG: Native ground cover grasses, NGCS: Native ground cover shrubs, NGCO: Native ground cover other, EPC: Exotic Plant Cover, NTH: Number trees with hollows, OR: Overstorey Regeneration, FL: Fallen Logs.
Notes: 1. * = Sites which have not yet been sown with native seed mixes; 2. A low value for Exotic Plant Cover (EPC) is the desired result.

Table 39. MTW Woodland – EEC rehabilitation sites compared to the Central Hunter Grey Box – Ironbark Woodland OEH benchmarks

Plot name	NPS	NOS		NMS		NGCG		NGCS		NGCO		EPC	NTH	OR	FL
Central Hunter Grey Box-Ironbark Woodland OEH benchmark	≥41	15	40	5	20	30	50	5	10	20	40	5-33%	3	1	≥5
MTWCDD201101	24	3		6		18		48		12		2	0	0	0
MTWCDD201301*	0	0		0		0		0		0		90	0	0	0
MTWCDD201501	24	0		5		26		24		10		16	0	0	0
MTWMT0200503	19	0.5		0		10		0		6		78	0	0	0
MTWNP0200901	13	17		2.5		2		18		2		2	0	0	0
MTWNP0201101	16	0		5.5		12		26		0		46	0	0	0
MTWNP0201301	16	0		0		12		6		16		28	0	0	0
MTWNP0201401	24	0		8.3		30		22		4		26	0	0	0
MTWNP0201403	10	0		0		6		2		10		66	0	0	0
MTWSP0201401*	4	0		0		16		0		0		10	0	0	0
MTWTDI201501	13	0		0		34		0		50		20	0	0	0
MTWWDL201401	23	0		1.5		20		26		16		16	0	0	0
MTWWDL201402*	7	0		0		10		0		0		80	0	0	0
MTWNOO201501	0	0		0		40		0		2		56	0	0	0
MTWSP0201501	1	0		0		0		0		0		0	0	0	0
MTWSP0201601	0	0		0		0		0		0		0	0	0	0
MTWSP0201602	13	0		0		32		0		0		38	0	0	0
MTWSPS201601	6	0		0		0		0		4		58	0	0	0
MTWSPS201602	0	0		0		0		0		0		34	0	0	0
MTWNP0201402	22	4.9		11.6		54		46		8		8	0	0	0

	lower than 50% of OEH benchmark
	within 50 – 100% of OEH benchmark
	exceeds OEH benchmark

NPS: Native Plant Species, NOS: Native overstorey, NMS: Native midstorey, NGCG: Native ground cover grasses, NGCS: Native ground cover shrubs, NGCO: Native ground cover other, EPC: Exotic Plant Cover, NTH: Number trees with hollows, OR: Overstorey Regeneration, FL: Fallen Logs.

Notes: 1. * = Sites which have not yet been sown with native seed mixes; 2. A low value for Exotic Plant Cover (EPC) is the desired result; 3. MOP Performance Criteria target of 5-33% used for comparison for EPC.

4.3.4 Vegetation Health

Results of vegetation health for reference and rehabilitation sites can be seen in Table 41 and Table 42 below.

Table 40. Vegetation Health MOP performance criteria

Performance Criteria – Ecosystem and Landuse Sustainability		Subheading	Domain Type	Table Number
3	The diversity of maturing trees and shrubs with a stem diameter greater than 5cm is comparable to that of analogue sites (no. /area).	Vegetation Health	Woodland - Other	Table 42
4	The percentage of maturing trees and shrubs with a stem diameter greater than 5cm that are local endemic species is comparable to analogue sites.	Vegetation Health	Woodland - Other	Table 42
5	The density of maturing trees and shrubs with a stem diameter greater than 5cm is comparable to analogue sites (no. /area).	Vegetation Health	Woodland - Other	Table 42
6	Average trunk diameter (dbh) of the tree population provides a measure of age and growth rate and that it is trending towards that of analogue sites (cm).	Vegetation Health	Woodland - Other	Table 42
7	The percentage of the tree population which are in healthy condition and that the percentage is comparable to analogue sites.	Vegetation Health	Woodland - Other	Table 42
8	The percentage of the tree population which are in a medium health condition and that the percentage is comparable to analogue sites.	Vegetation Health	Woodland - Other	Table 42
9	The percentage of the tree population which are in a state of advance dieback and that the percentage is comparable to analogue sites.	Vegetation Health	Woodland - Other	Table 42
10	The presence of reproductive structures such as buds, flowers or fruit on trees and shrubs provides evidence that the ecosystem is maturing, capable of recruitment and can provide habitat resources and that the % population is comparable to that of analogue sites.	Vegetation Health	Woodland - Other	Table 42
20	The diversity of maturing trees and shrubs with a stem diameter greater than 5cm is comparable to that of analogue sites (no. /area).	Vegetation Health	Woodland - EEC	Table 42
21	The percentage of maturing trees and shrubs with a stem diameter greater than 5cm that are local endemic species is comparable to analogue sites.	Vegetation Health	Woodland - EEC	Table 42
22	The density of maturing trees and shrubs with a stem diameter greater than 5cm is comparable to analogue sites (no. /area).	Vegetation Health	Woodland - EEC	Table 42
23	Average trunk diameter (dbh) of the tree population provides a measure of age and growth rate and that it is trending towards that of analogue sites (cm).	Vegetation Health	Woodland - EEC	Table 42
24	The percentage of the tree population which are in healthy condition and that the percentage is comparable to analogue sites.	Vegetation Health	Woodland - EEC	Table 42
25	The percentage of the tree population which are in a medium health condition and that the percentage is comparable to analogue sites.	Vegetation Health	Woodland - EEC	Table 42
26	The percentage of the tree population which are in a state of advance dieback and that the percentage is comparable to analogue sites.	Vegetation Health	Woodland - EEC	Table 42
27	The presence of reproductive structures such as buds, flowers or fruit on trees and shrubs provides evidence that the ecosystem is maturing, capable of recruitment and can provide habitat resources and that the % population is comparable to that of analogue sites.	Vegetation Health	Woodland - EEC	Table 42

Reference site canopy maturity and habitat values

At each reference site, individual canopy tree species with a DBH greater than five centimetres were marked with a metal tree tag or flagging tape and were numbered. This will allow future monitoring to identify trees that were included in counts and DBH measurements. Whether an individual had flowers or fruit was determined by whether there was evidence of these structures on the tree at the time of survey. Therefore, this is likely to under-estimate the maturity of the tree canopy. The results are provided below in Table 41. Full data is provided in Appendix 6.

Table 41. Details of canopy maturity at reference sites

Site name	Average tree width (cm)	Native trees >5cm DBH (20x20 plot)	Native trees >5cm DBH per hectare	Native tree species >5cm DBH	Native trees with fruit/flowers
WAMBOGB1	11.5	22	550	4	0
WAMBOGB2	22	4	100	2	0
WARKGB1	14.8	25	625	2	0
WARKGB2	14	24	600	2	0
WARKGB3	14.5	28	700	3	0
WARKGB4	65	2	50	1	0
BELLSPOT1	18.7	20	500	2	0
BELLSPOT2	19	13	325	2	0
BELLSPOT3	15	21	525	3	0
WAMBOSPT1	22.5	8	200	3	0
WAMBOSPT2	10.75	29	725	2	2
WAMBOSPT3	22	9	225	3	0
Total Average	20.8	17	427.1	2.4	0.16
Reference Site Range	11.5 - 65	2 - 29	50 - 725	1 - 4	0 - 2

Rehabilitation site canopy maturity and habitat values

As for reference sites, each individual canopy tree at rehabilitation sites with a DBH greater than five centimetres were marked with a metal tree tag or flagging tape and numbered. Only a limited number of rehabilitation sites had canopy trees with a DBH greater than five centimetres. Whether an individual had flowers or fruit was determined by whether there was evidence of these structures on the tree at the time of survey. This technique is also likely to under-estimate the maturity of the tree canopy for rehabilitation sites but the same method has been applied at reference sites to provide an equal comparison. The canopy maturity results are provided in Table 42. Full data is provided in Appendix 6.

Table 42. Details of canopy maturity at all rehabilitation sites – split by location and domain type

Site name	Average tree width (cm)	Native trees >5cm DBH (20x20 plot)	Native trees >5cm DBH per hectare	Native tree species >5cm DBH	Native trees with fruit/flowers
Reference Site Range	11.5 - 65	2 - 29	50 - 725	1 - 4	0 - 2
HVOCAR200901	10.5	25	625	3	0
HVOCAR200902	6.5	4	100	3	0
HVOWES200801	6.1	38	950	2	0
HVOWES201101	6.2	17	425	2	0
Average	7.3	21	525	2.5	0
MTWCDD201101	5.8	17	425	2	2
Average	5.8	17.0	425.0	2.0	2.0
MTWMT0200001	7.1	6	150	1	0
MTWNPN200501	15	2	50	1	0
MTWNPN200502	9.1	30	750	3	0
Average	10.4	12.7	316.7	1.7	0.0
Total Average	8.2	17.37	434.4	2.13	0.16

lower than reference site range values

within reference site range values

exceeds reference site range values

4.3.5 Habitat Features

Habitat features such as fallen logs and number of hollow bearing trees were recorded using the BioBanking methodology. The results for these performance criteria are presented in Table 39 of the BioBanking data. The total groundcover components (dead and live plant material, rocks and logs) can be seen in the Stability column of the LFA results in Table 16 to Table 18.

Table 43. Habitat Features MOP performance criteria

Performance Criteria – Ecosystem and Landuse Sustainability		Subheading	Domain Type	Table Number
2	Total groundcover is the sum of protective ground cover components (dead and live plant material, rocks and logs) and is comparable to that of analogue sites (% Cover)	Habitat Features	Woodland - Other	Table 16 and Table 17
18	Total groundcover is the sum of protective ground cover components (dead and live plant material, rocks and logs) and is comparable to that of analogue sites (% Cover).	Habitat Features	Woodland - EEC	Table 18
29	The total length of fallen logs is within 50-100% or exceeds that of analogue sites. (Use benchmark values)	Habitat Features	Woodland - EEC	Table 39
30	The number of hollows / nesting sites is within 50-100% or exceeds that of analogue sites. (Use benchmark values)	Habitat Features	Woodland - EEC	Table 39

All rehabilitation sites were recorded as having no fallen logs, therefore, not within the 2017 reference site range values (for Woodland – Other domains) or within 50-100% of OEH benchmark levels (for Woodland – EEC domains).

The results in Table 39 of the BioBanking data show zero hollow bearing trees recoded across all rehabilitation sites.

Total groundcover at the rehabilitation sites, including protective ground cover components such as dead and live plant material, rocks and logs, has been compared to the reference sites using the LFA data. This can be seen in Table 16, Table 17, and Table 18 of Section 4.2.1 within the LOI column of the LFA results where total groundcover percentage for rehabilitation sites from the 2017 monitoring is compared with the reference site range values.

4.3.6 Visual and Photo Monitoring (Appendix)

The results of the visual monitoring, and photo monitoring are provided in Appendix 5.

5. Discussion

5.1 Growth Medium Development

5.1.1 Soil Analysis

Overall, many of the rehabilitation sites fall within the MOP performance criteria targets or reference site soil property range values and therefore meet the MOP performance criteria. The following conclusions can be made from comparing rehabilitation sites against reference site range values (where applicable) or the target specified in the MOP performance criteria:

- pH falls between the target values specified in the MOP at all sites except HVORIV201404, HVORIV201403, HVORIV201402, HVORIV201401, MTWCDD201501, MTWTDI201501 and MTWMT0201501. These sites have only recently been established and it may take some time for the pH to reduce and become less alkaline, as is seen in older sites. While most sites fall between the values specified in the MOP, many rehabilitation sites show higher levels of pH than that of the reference sites.
- Electrical Conductivity (EC) falls within the required target of <2dS/m as outlined in the MOP for all sites, however the rehabilitation sites are generally higher than the reference site range.
- Phosphorous levels only meet benchmark at two sites, MTWNPN200901-A and MTWCDD201101. Levels of phosphorus at rehabilitation sites were markedly higher than those recorded at reference sites. Many of the older sites do not meet the performance criteria of being within analogue levels within five years of establishment.
- Organic Carbon has met benchmark for all sites excluding HVOCAR200902 and HVOCHE201203. This is likely due to compost being added and the organic matter from short-lived annuals. Sites with a higher number of exotic cover tended to have higher Organic Carbon. These higher Organic Carbon levels may also make it difficult for native species to compete on sites with higher densities of exotic species.
- Cation Exchange Capacity (CEC) falls between benchmark for approximately 70 percent of sites.
- Approximately 46 percent of rehabilitation sites did not meet benchmark for sodium levels.
- Half of the HVO rehabilitation sites and the MTW woodland – other domain sites did not meet the reference site benchmark for Calcium / Magnesium Ratio. MTW woodland – EEC rehabilitation sites all fell within benchmark levels for Calcium / Magnesium Ratio.

5.2 Ecosystem and Landuse Establishment

5.2.1 Landscape Function Analysis (LFA)

LFA data was used to help understand landscapes stability, infiltration and Nutrient cycling capacity. These characteristics are discussed separately below.

5.2.2 Landscape Organisation Index (LOI)

In general the LOI at the reference and rehabilitation sites was high, with an average LOI of 0.98 for the reference sites and 0.9, 0.8 and 0.7 for the rehabilitation sites for HVO – woodland other, MTW – woodland other and MTW – woodland EEC respectively (see Table 15 - Table 21). The variability in the range of scores however, was greater at the rehabilitation sites than the reference sites. The variability in values at the rehabilitation sites is likely to be influenced by the seed treatments applied to those sites and the age of the rehabilitation. For example, many of the rehabilitation sites with a LOI of 1 achieved this result due to the high density of grass species (whether native or exotic). An example of one of these sites with a high density of exotic grasses is HVORIV201405, which is similar to that observed in 2016. This result highlights that LOI does not determine native cover per se, rather it's a determination of site stability. Conversely, sites that achieved relatively low LOI indices were typically spoil/compost sites that had only recently been

established and exhibited little grass or plant cover (i.e. MTWSPN201501 and MTWSPN201601). Changes in the LOI between 2016 and 2017 can be seen in Table 16 - Table 21.

5.2.3 Soil surface condition

Stability

There's some level of consistency between the average stability index for reference and rehabilitation sites, with the reference sites obtaining an average index of 60.75 and the rehabilitation sites obtaining an average scores of 57.8 for HVO woodland – other, 50.4 MTW woodland – other, and 54.8 MTW woodland – EEC sites. As with the results from the LOI (above), stability indicators across the reference sites show greater consistency than the stability indicators for the rehabilitation sites. One of the indicators of stability is vegetation cover, which due to weed treatment (herbicide spray) at some rehabilitation sites, had reduced. This may have contributed to a reduction in the average score at rehabilitation sites. Changes in scores for stability between 2016 and 2017 for reference sites at HVO and MTW can be found in Table 16 - Table 21.

Infiltration

The average infiltration scores for rehabilitation sites overall from 2016 to 2017 has increased from 42.4 to 51.1 for HVO for woodland - other and 37.4 to 41.6 for MTW woodland – other sites. MTW woodland – EEC has dropped slightly from 47.8 to 43.7. This is likely due to the addition of new sites to this domain type. The range of scores was greater for the rehabilitation scores than for the reference sites. This may be due to an increase in the litter component at most rehabilitation sites. Under the methodology, dead and decaying vegetation forms litter and this probably contributed to the higher infiltration scores.

Nutrient cycling

Nutrient enrichment values between 2016 and 2017 showed no obvious trend with the average difference for the reference sites increasing from 51.43 to 55.5, while the average for the rehabilitation sites has decreased from 43.2 to 42.7 for HVO for woodland - other, 35.4 to 32.5 for MTW woodland – other and 45.1 to 39.7 for MTW woodland – EEC site in 2016 to 2017. This is likely due to the addition of new monitoring sites.

5.2.4 Species Richness

Tree species

The results of the native species counts for tree species are discussed in Section 5.2.5 Canopy Development.

Grass species

The reference sites recorded a range between 4 and 9, averaging six grass species overall. Rehabilitation sites were lower recording averages of 4.6 for HVO woodland – other, 4.4 for MTW woodland – EEC and 1.6 for woodland – other sites. At HVO, eleven sites met benchmark for this criteria with four exceeding the benchmark range. Eleven MTW woodland – EEC sites met the benchmark, with one exceeding the benchmark range. Only one of the woodland other domain types at MTW met benchmark for this criteria.

Shrub Species

MTW woodland – EEC domain contained sixteen sites that fell within or exceeded the reference site range, with an average of 3.6 shrub species for MTW woodland - EEC. This average was brought down by the inclusion of the younger sites, none of which meet the local benchmark for number of shrub species.

Other Species

MTW woodland – EEC domain contained only one site each that met the reference site range. The average for these sites was 2.8 which is low in comparison with the reference sites average of 13 species. This may indicate that rehabilitation sites require a greater diversity or higher rate of herbs and forbs added to the seeding mix.

Native plant species richness

MTW woodland – EEC had five sites that were within the MOP target of 50-100% of the OEH benchmark value for native plant species richness. Most sites contain adequate numbers of tree, shrub and grass species, however, they lacked other species such as herbs and forbs which has reduced the overall number of native plant species per site.

The current diversity targets that are in place to guide seed mix formulation require 10 species of herbs and forbs to be included in each seed mix for planting of MTW Woodland – EEC areas. Given the low rates of establishment of herbs and forbs in rehabilitation areas, further investigation of the suitability of the species being included in seed mixes to rehabilitation areas may be warranted. If species currently being used in seed mixes are found to be problematic to germinate or establish in rehabilitation areas then other species that are more suited to rehabilitation areas should be investigated. To achieve higher diversity of herbs and forbs in rehabilitation areas it may also be necessary to increase the sowing rate of herbs and forbs that are added to seed mixes. Low rates of herb and forb establishment may also be due to these species not having enough over-storey protection which may require enrichment planting of herbs and forbs into established rehabilitation areas to address this issue.

5.2.5 Canopy Development

Number of tree species

HVO woodland – other sites contained 12 sites that was within or exceeded the reference site range of 1 to 4 species. These sites recorded an average score of 1.9. MTW woodland – other sites contained three sites that were within the reference site range, with an average score of 1.7.

MTW woodland – EEC contained eight sites that fell within the reference site range. The average value recorded for these sites was 2. Many of the rehabilitation sites had not been broadcast with native seed at time of recording, and as such have not been included in the average.

Many of the tree species recorded over the sites were still at a juvenile stage which made it difficult to correctly identify all individuals to a species level. Furthermore, some seeds may not have germinated at this early stage. Overstorey species richness should continue to be monitored and dependant on the results some site may require additional seeding or enrichment planting in the future to promote the number of overstorey species.

Canopy density

Six HVO woodland – other domain type sites met the reference site range of 250 to 3150 stems per hectare. Two sites HVOWES200801 and HVOWES201101 exceeded the benchmark range. These eight sites recorded an average score of 908.8 stems per hectare. Of the HVO woodland - other sites HVOCHE201201, HVORIV201403, HVORIV201404, HVORIV201405 and HVORIV201406 have previously been sown to natives but have no overstorey species recoded.

The MTW woodland – other sites contained two sites that met the benchmark range, with sites recording an average score of 816.7. All sites that had been sown to natives had overstorey species germinate.

MTW woodland – EEC sites contained four sites that fell within the local benchmark. Two sites MTWCDD201501 and MTWNPN200901 exceeded this benchmark. The average value recorded for these sites was 1,159.1 stems per hectare. MTWNPN201301, MTWNPN201401 and MTWNPN201402 had been previously sown to natives, however, showed no sign of overstorey species germinating.

All the domain types show a large range of variation between sites, in particular MTW woodland – EEC, has sites ranging from 0 to a density up to 4,850 stems per hectare which exceeded the benchmark. Some sites may require tree thinning in the future to more closely align with reference site range values. Thinning will allow understory species to compete for light and help them establish. It will also increase the number of fallen logs on the ground, helping to improve performance criteria for length of fallen logs with that of the reference sites.

The new method of monitoring the stem density of canopy species by counting individuals along the transect, within 2 meters either side of the 50 metre tape and extrapolating to stems per hectare worked well. This method of collecting stem density should continue to be used in future monitoring.

5.3 Ecosystem and Landuse Sustainability

5.3.6 Vegetation Structure and Species Richness

Exotic plant cover

At HVO, two sites fell within benchmark for exotic plant cover HVOCHE201601 and HVOCHE201602. However, these sites actually contained no vegetative cover at all. HVORIV201502 had 100 percent exotic plant cover. The high percentage of exotic cover at some of the rehabilitation sites is due to the use of cover crops which were seeded to stabilise and add nitrogen to the soil.

The MTW woodland – other domain type, did not have any sites which met benchmark levels. The site which contained the highest percentage of exotic cover in this domain was MTWMTO201501 with 72 percent cover.

MTW woodland – EEC contained two sites which fell within benchmark, these were MTWSPN201501 and MTWSPN201601. Again these sites also contained no vegetative cover. The site that contained the highest percentage of exotic cover was MTWCDD201301 with 90 percent cover.

It will be difficult to lower exotic plant cover to a level similar to that of the reference sites, as most of these exotic species have established a large seed bank which may last for many years before germinating. The best way to reduce exotic cover is to establish the native overstorey species, allowing them to shade out the exotic understory species.

Native over-storey cover (NOS)

Only one MTW Woodland – EEC rehabilitation site was within the 50-100% of the OEH benchmark target for this criteria. This is due to the young age of the rehabilitation sites, meaning that establishing overstorey trees are not yet large enough to contribute to the measured overstorey cover. The generally adequate overstorey stem densities in rehabilitation areas, as seen in Table 30, provide confidence that the rehabilitation sites will achieve the target levels for NOS when the trees grow to a sufficient height.

Native mid-storey cover

Six of the MTW Woodland – EEC rehabilitation sites were within the 50-100% of the OEH benchmark target for this criteria. Due to the young nature of the rehabilitation sites, this mid-storey cover may consist of over-storey species that haven't reached maturity and are still growing within the mid-storey stratum.

Native ground cover (grasses)

Nine of the MTW woodland – EEC rehabilitation sites were within the 50-100% of the OEHL benchmark target for this criteria, with one site MTWNPN201402 exceeding the OEHL upper benchmark. Two of the sites that did not achieve the benchmark levels were established pre-2011 prior to the use of native grass seed in the rehabilitation seed mixes. One of these sites MTWNPN200901 also has a very high overstorey stem density (3,500 stems/ha) which would be causing shading and competition for grass species. The remaining MTW woodland – EEC rehabilitation sites that have been sown to native seed mixes but are not yet achieving the benchmark level for native grass cover are mainly new sites experiencing delayed germination due to dry weather.

Native ground cover (shrubs)

MTW woodland – EEC contains eight sites which met MOP performance criteria target levels, of which seven sites exceeded the OEHL upper benchmark. This is likely a result of the combination of exceptional germination combined with juvenile canopy and mid-storey species contributing towards NGCS.

Native ground cover (other)

MTW woodland- EEC had six sites meet benchmark and one site exceed the OEHL benchmark range for Central Hunter Grey Box-Ironbark Woodland. The low results for native plant species richness for ‘other species’ in MTW woodland – EEC rehabilitation sites (Table 25) indicate that a small number of herbs and forbs are contributing to the measured cover for ‘other species’.

5.3.7 Vegetation Health

Tree Diversity (DBH >5cm)

Rehabilitation sites containing tree species with a DBH >5 cm fell between the benchmark range of 1 to 4 species of maturing trees. HVO had an average of 2.5 species of maturing trees at sites which contained trees >5cm DBH, and this was slightly above the reference site average of 2.4 species per site. MTW woodland – other had a single site which contained two species of trees with a >5cm DBH. MTW woodland – EEC supported three sites of mature trees, which produced an average of 1.7 tree species per site. Overall these sites had an average of 2.13 species of tree per site containing trees >5cm DBH (Table 42). While this is a reasonable number of species per site, only eight of the 54 rehabilitation sites recorded trees with a DBH >5cm. No new rehabilitation sites contained trees >5cm DBH which was to be expected. This performance criteria will only improve with time once trees on younger sites have matured and have a larger DBH.

Tree Density (DBH >5cm)

All rehabilitation sites containing tree species with a DBH >5 cm fell between or exceeded the benchmark range of 50 – 725 stems per hectare. HVO sites recorded an average of 525 trees per hectare which was moderately denser than the reference site average of 427.1 trees per hectare. HVO site HVOWES200801 also exceeded the benchmark range with 950 trees per hectare. The MTW woodland – other site produced a score of 425 trees per hectare, which is slightly lower than the reference site average. MTW woodland – EEC produced a score of 316.7 trees per hectare with one site (MTWNPN200502) exceeding the benchmark range. Together all sites containing trees averaged an above benchmark score of 434.4 trees per hectare (Table 42).

These sites would also contain trees that fell below the 5 centimetre DBH cut off, meaning many of these sites may produce higher densities of trees >5 centimetre DBH in the future, as smaller trees mature. If this is the case, management of tree densities will be required into the future to bring numbers down to within

benchmark levels. As mentioned previously, thinning may also be required to improve light penetration in order to improve growth and establishment of ground-storey species.

Tree Health

No quantitative data was collected for tree health, however, visual analysis of sites in the field allowed us tree health at rehabilitation sites to be noted. All trees appeared to be in a healthy to moderate condition, even in the dry conditions in which the rehabilitation sites were recoded. No trees were viewed as being in a state of advanced dieback.

Reproductive Structures

All sites meet benchmark range, however, it should be noted the range begins at zero automatically qualifying sites as reaching the benchmark. Table 42 shows one site within the MTW woodland – other domain containing two trees that had buds or were flowering. This has brought the average for all rehabilitation site domain types up to be comparable to the average achieved by the reference sites. This shows that some of the rehabilitation sites are possibly becoming capable of recruitment.

5.3.8 Habitat Features

Percentage Groundcover (dead and live plant material, rocks and logs)

Total groundcover including protective ground cover components such as dead and live plant material, rocks, and logs at the rehabilitation sites have been compared to the reference sites in Table 15 of the LFA data. LOI represents percentage cover (dead and live plant material, rocks and logs) along the transect. As mentioned above in Section 5.2.2 LOI, was relatively high for both reference and rehabilitation sites. This was a result of the high density of dead or live vegetation, mostly in the form of cover crops.

Rehabilitation sites did not contain any logs or large rocks. Sites contained uniform sized rocks from overburden, but lacked larger boulders and flat habitat rocks that would otherwise naturally occur, and can be seen at some of the reference sites.

Length of fallen logs

No fallen logs were recorded at any of the rehabilitation sites. This performance criteria is something that will develop with time. However, improvement against this criteria could be fast-tracked with the introduction of such features as ‘habitat furniture’. As mentioned above in Sections 5.2.5 and 5.3.7 trees will require thinning in the future and this should be done at such a time and in such a way so that it contributes towards improving performance levels for rehabilitation sites with regard to fallen logs.

No hollow trees were recorded at any of the rehabilitation sites. Hollows would not be expected to develop in any of the rehabilitation sites for many years. Habitat for hollow dependant birds may be improved by the installation of nest boxes in the future.

5.3.9 Visual and Photo Monitoring (Appendix)

The results of the visual monitoring and photo monitoring are provided in Appendix 5.

6. Conclusions

6.1 Conclusions

There is significant variation in the types and ages of the rehabilitation sites which formed part of this monitoring project and thus there is a high degree of variability in the results, particularly for native plant species richness, exotic cover, percentage cover, LOI and projected cover of all strata. Weather conditions varied greatly between the 2016 and 2017 monitoring seasons, which affected the degree of native cover and diversity at both the rehabilitation sites and at the reference sites. Provided below are some of the core outcomes of the BioBanking assessment, LFA, the assessment of tree canopy and over-storey regeneration.

6.2 Growth Medium Development

Generally speaking, many of the rehabilitation sites fall within the MOP performance criteria targets or reference site soil property range values and therefore meet the MOP performance criteria. Most rehabilitation sites met the MOP performance criteria targets for pH, EC, Organic Carbon and Cation Exchange Capacity. Phosphorous levels in rehabilitation sites were generally significantly higher than the reference site range values. High levels of available major nutrients such as Phosphorous will be useful for the re-establishment of vegetation communities in rehabilitation areas. However, there is a risk that high nutrient levels may stimulate weed growth that can compete with the native plants and prevent establishment of the desired vegetation communities. Weed management will therefore be an important intervention to ensure rehabilitation areas continue on the desired trajectory.

6.3 Ecosystem and Landuse Establishment

6.3.1 Landscape Function Analysis

Landscape Function Analysis was undertaken at all rehabilitation sites and reference sites. Generally the LOI at the reference and rehabilitation sites was high, with an average LOI of 0.98 for the reference sites and 0.9, 0.8 and 0.7 for the rehabilitation sites (see Table 16 to Table 21). However, the variability in the range of scores was greater at the rehabilitation sites than at the reference sites. This variability is likely to be influenced by rehabilitation management, with sites with a high degree of herbaceous cover returning a high LOI score and sites that had recently been sprayed and had limited live cover returning a low LOI score.

Three other attributes are measured through LFA, including stability, infiltration and nutrient cycling. Like with the LOI score, there was some consistency between the stability score achieved at the rehabilitation sites and the reference sites. The reference sites obtained an average index of 60.75 and the rehabilitation sites obtaining average scores of 57.8 for HVO sites, 50.4 for MTW woodland – other, 54.8 for MTW woodland – EEC. As vegetation cover is a core component of the stability score, individual site management practises (including high herbaceous cover or conversely herbicide spraying) can dictate this indicator.

The average infiltration scores for rehabilitation sites overall has increased from 42.4 for HVO sites, 37.4 for MTW woodland – other and 47.8 for MTW woodland – EEC to 51.1, 41.6, and 43.7 respectively. MTW woodland – EEC has dropped slightly from 47.8 to 43.7. This is likely due to the addition of new sites to this domain type.

Nutrient enrichment values between 2016 and 2017 showed no obvious trend with average differences for the reference sites increasing from 51.43 to 55.5 and the average for the rehabilitation sites having

decreased from 43.2 for HVO sites, 35.4 for MTW woodland - other and 45.1 for MTW woodland – EEC in 2016 to 42.7, 32.5 and 39.7 in 2017 respectively. This is likely due to the addition of new monitoring sites.

6.3.2 Species Richness

Measures of species richness for trees and grasses are used as MOP performance criteria for all Woodland domain types. Of the rehabilitation sites that had been planted with native seed mixes, 48% of the HVO woodland – other; 60% of the MTW woodland – other; and 47% of the MTW woodland – EEC sites were within or exceeded the reference site range values for native tree species richness. Similarly, 60% of the HVO woodland – other; 20% of the MTW woodland – other; and 71% of the MTW woodland – EEC rehabilitation sites that had been sown with native seed mixes met or exceeded the reference site range values for native grass species richness. These results are expected to improve with future monitoring because many of the sites that didn't achieve the reference site range values were new sites that were experiencing delayed germination due to dry weather conditions.

Additional MOP performance criteria for species richness related to shrubs, other groundcover (i.e. not grasses) and total native plant species apply to woodland – EEC domains. The reference site range for shrub species richness was 4 to 9, and a total of eight MTW woodland – EEC rehabilitation sites met or exceeded the reference site range values for this criteria. Species richness data collected for 'other species' (including herbs and forbs) indicated that in comparison to reference site range values, MTW woodland – EEC rehabilitation sites do not score as well for this attribute. The reference site range is 10 to 20 species, and only one of the MTW woodland – EEC rehabilitation sites fell within this range.

The relatively poor species richness result for 'other species' also impacted on the performance of MTW woodland – EEC rehabilitation sites in terms of total native plant species richness. Only five of the 17 MTW woodland – EEC rehabilitation sites that had been sown to native seed mixes achieved the total native plant species target of 50-100% of the OEH Benchmark for Central Hunter Grey Box – Ironbark Woodland. While many sites meet the canopy, grass and shrub targets, the comparative number of species of herbs and forbs is often too low. This may be due to such species germinating later than other species or not having enough overstorey protection to establish.

6.4 Ecosystem and Landuse Sustainability

6.4.3 Vegetation structure and species richness

Results were generally positive when comparing rehabilitation sites with benchmark ranges, with some sites falling within the reference site benchmark for some of the ten attributes. Given the relatively young age of some of the rehabilitation sites, it is inherent that these sites would not meet benchmark for these attributes. Core outcomes include:

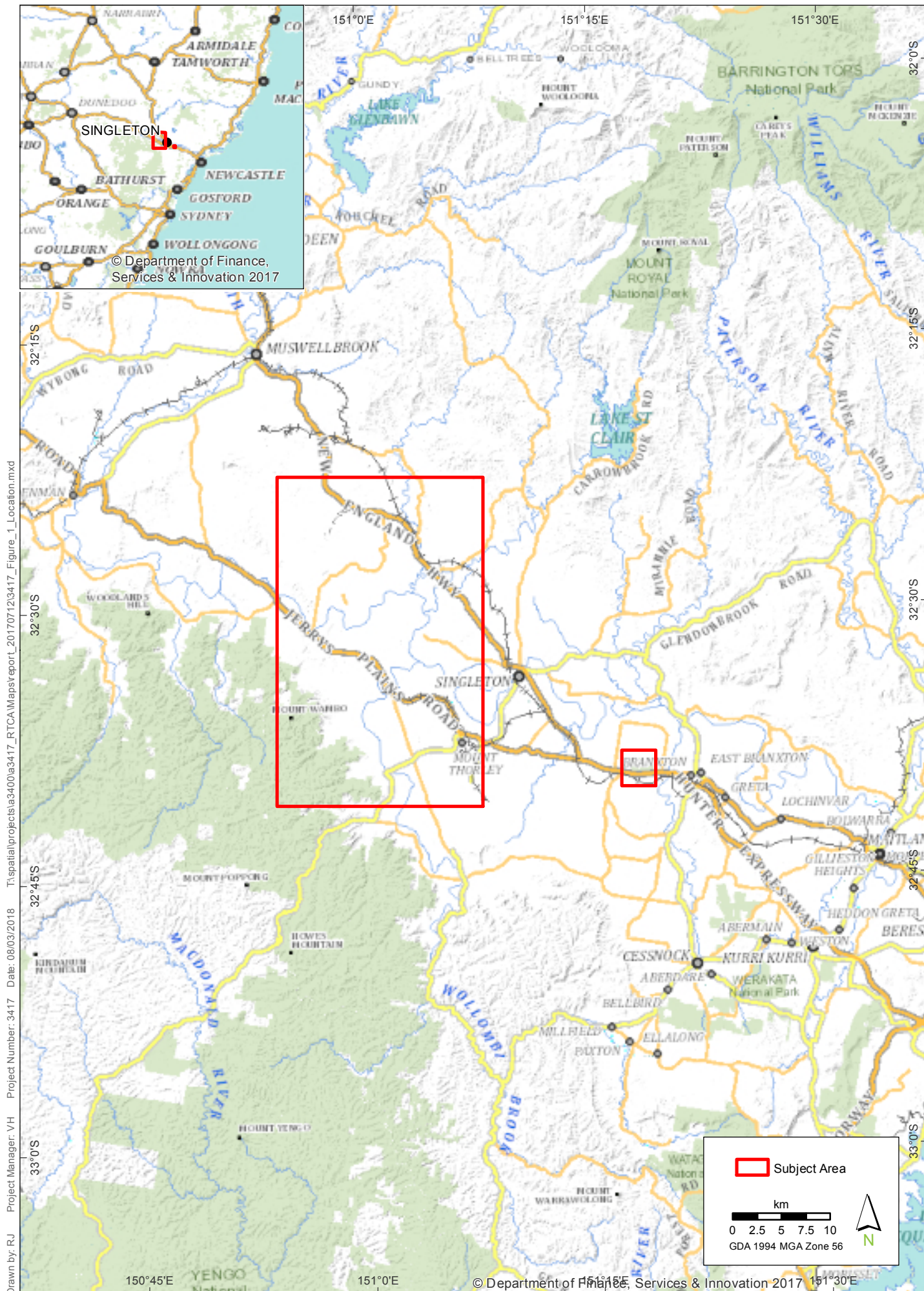
- All rehabilitation sites fall below benchmark in at least one attribute.
- Due to the density of regenerating shrub species, a number of sites exceed the upper benchmark for NGCS. This is likely a result of the combination of exceptional germination and juvenile canopy and mid-storey species contributing towards NGCS.
- Only one MTW woodland – EEC site is meeting the MOP performance criteria target for NOS.
- All other MTW woodland – EEC sites have very low to no NOS. This is due to juvenile trees not occurring in the canopy stratum.
- The 2017 reference site benchmarks vary from 2016, likely due to seasonal differences. While field surveys were conducted during the same time of the year as the 2016 surveys, many benchmark values are lower. This is likely a result of extended periods of extremely hot weather prior to the 2017 surveys, which is likely to have killed sensitive herbs and forbs compared to the previous year.

- The MOP performance criteria for exotic plant cover for woodland – other rehabilitation sites has a target level of ‘comparable to reference site values’. As all of the reference sites had exotic plant cover levels of 0-6%, the reference site benchmark value was calculated to be 0%. Only two woodland – other rehabilitation sites across HVO and MTW sites met this reference site benchmark level and in both cases these sites had no vegetative cover at all due to a recent knockdown herbicide spray. A target level of 0% exotic plant cover is going to be very difficult to achieve in rehabilitation areas due to high weed seed loads present in topsoil.
- In comparison, the MOP performance criteria target for exotic plant cover for woodland – EEC rehabilitation sites has been set at 5-33%. Nine of the MTW woodland – EEC rehabilitation sites met this target level. High exotic plant cover scores that exceed the benchmark at new rehabilitation sites are primarily due to the use of cover crops early during the rehabilitation works.
- MTW Woodland – EEC rehabilitation sites were generally not meeting the target levels for total native plant species richness (NPS). Although sites were generally meeting species richness targets for native trees, shrubs and grasses, they were achieving low results for species richness of ‘other species’ (i.e. herbs, forbs and monocots other than grasses etc.). The category of ‘other species’ is where most of the native plant species diversity is found in the reference sites, with results from reference sites showing they contain 10-20 species in this category.
- In relation to NPS, there is not necessarily a correlation between age of the rehabilitation and species richness. Older rehabilitation sites do not necessarily have a greater number of plant species. This is likely to reflect that seed mixes being used since 2011 have had a much higher diversity of species than earlier seed mixes.
- Eight MTW woodland – EEC rehabilitation sites were within the reference site range values for native mid-storey cover. Part of the contribution to mid-storey cover however might be due to the presence of juvenile overstorey species which are not yet mature enough to be included in the overstorey and are included as mid-storey.
- Due to the age of the rehabilitation sites, only eight of the 54 rehabilitation sites had trees with a DBH greater than five centimetres. However, the canopy species diversity at these sites were generally good, with all of these sites falling within the benchmark range.
- No fallen logs or large rocks were recorded at any of the rehabilitation sites.

7. References

- AECOM (2012) Monitoring Methodology - Post-mined Lands MTW and HVO North Mine Sites. Prepared for Coal & Allied.
- Coal and Allied (2015) Mining Operations Plan – HVO South.
- Coal and Allied (2016a) Mining Operations Plan – HVO North.
- Coal and Allied (2016b) Mining Operations Plan - Mount Thorley Warkworth.
- DECCW (2010) Belford National Park: plan of management / NSW National Parks and Wildlife Service, part of the Department of Environment, Climate Change and Water.
- Niche (2016) Native Vegetation Rehabilitation Monitoring 2016 - Mount Thorley Warkworth and Hunter Valley Operations. Prepared for Coal & Allied.
- Niche (2017) Native Vegetation Rehabilitation Monitoring 2017 - Mount Thorley Warkworth and Hunter Valley Operations. Prepared for Coal & Allied.
- Tongway, D. and Hindley, N. (2004) Landscape Function Analysis: Procedures for Monitoring and Assessing Landscapes with Special References to Mine sites and Rangelands. CSIRO Sustainable Ecosystems, Canberra.

Appendix 1 – Figures



Location map

Native Vegetation Rehabilitation Monitoring

FIGURE 1



HVO survey locations - map 1 (HVOWES)

Native Vegetation Rehabilitation Monitoring

FIGURE 3

Imagery: (c) Nearmap 2018-02-07



HVO survey locations - map 2 (HVOWES)

Native Vegetation Rehabilitation Monitoring

FIGURE 4

Imagery: (c) Nearmap 2015-03-06



HVO survey locations - map 3 (HVOCAR)

Native Vegetation Rehabilitation Monitoring

FIGURE 5

Imagery: (c) Nearmap 2015 - 2018



HVO survey locations - map 4 (HVOCHE)

Native Vegetation Rehabilitation Monitoring

FIGURE 6

Imagery: (c) Nearmap 2017-11-03



HVO survey locations - map 5 (HVOCHE)

Native Vegetation Rehabilitation Monitoring

FIGURE 7

Imagery: (c) Nearmap 2017-11-03



HVO survey locations - map 6 (HVORIV)

Native Vegetation Rehabilitation Monitoring

FIGURE 8

Imagery: (c) Nearmap 2017-11-03



HVO survey locations - map 7 (HVOLEM)

Native Vegetation Rehabilitation Monitoring

FIGURE 9

Imagery: (c) Nearmap 2017-11-03



MTW survey locations - map 1 (MTWNP)

Native Vegetation Rehabilitation Monitoring

FIGURE 10

Imagery: (c) Nearmap 2017-11-03



MTW survey locations - map 2 (MTWNP-NOO)

Native Vegetation Rehabilitation Monitoring

FIGURE 11

Imagery: (c) Nearmap 2017-11-03



MTW survey location - map 3 (MTWCDD-SPN)

Native Vegetation Rehabilitation Monitoring

FIGURE 12

Imagery: (c) Nearmap 2018-01-05



MTW survey location - map 4 (MTWSPS)

Native Vegetation Rehabilitation Monitoring

FIGURE 13

Imagery: (c) Nearmap 2018-01-05



MTW survey location - map 5 (MTWWDL)

Native Vegetation Rehabilitation Monitoring

FIGURE 14

Imagery: (c) Nearmap 2018-01-05

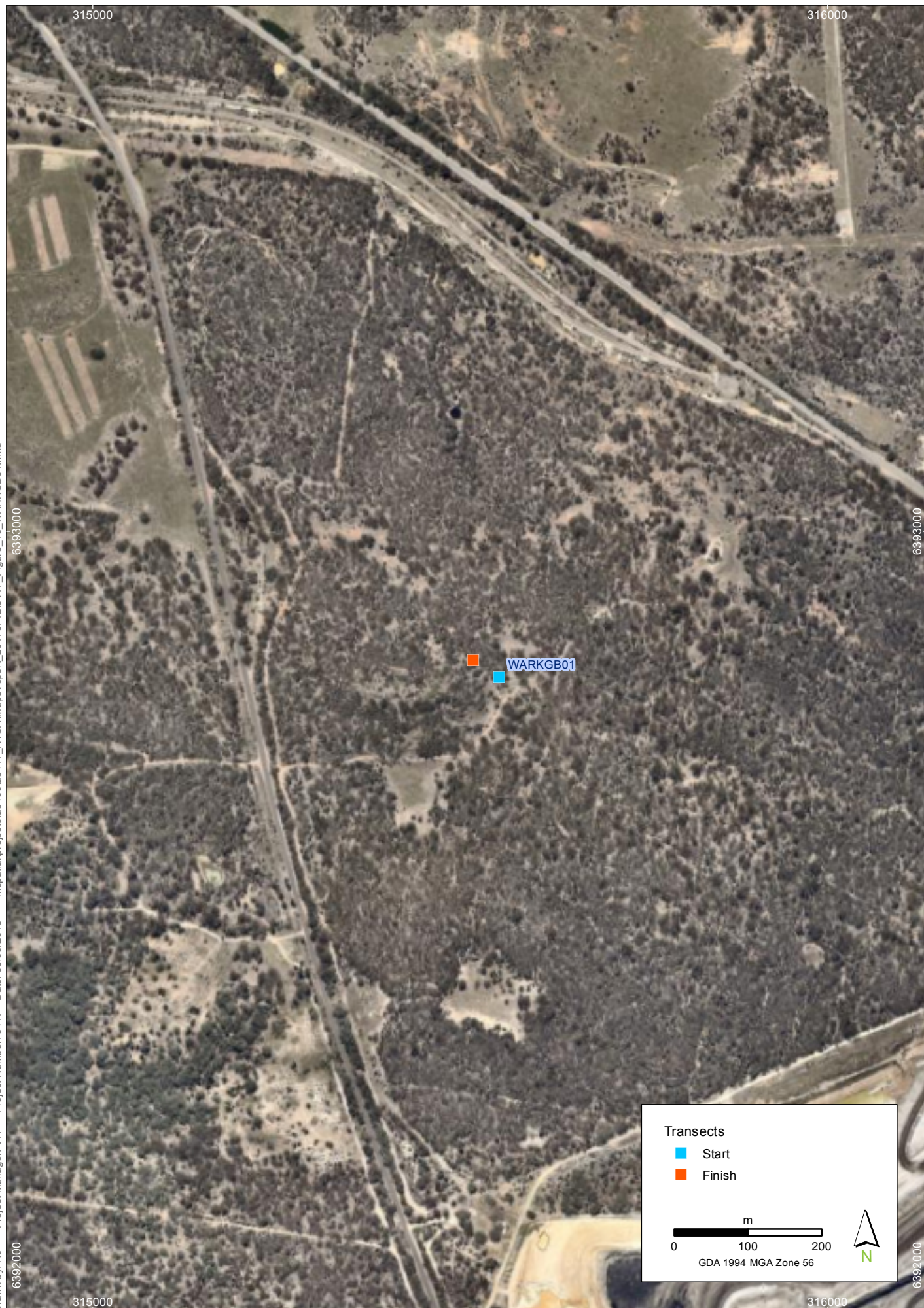


MTW survey location - map 6 (MTWMTMTO)

Native Vegetation Rehabilitation Monitoring

FIGURE 15

Imagery: (c) Nearmap 2018-01-05

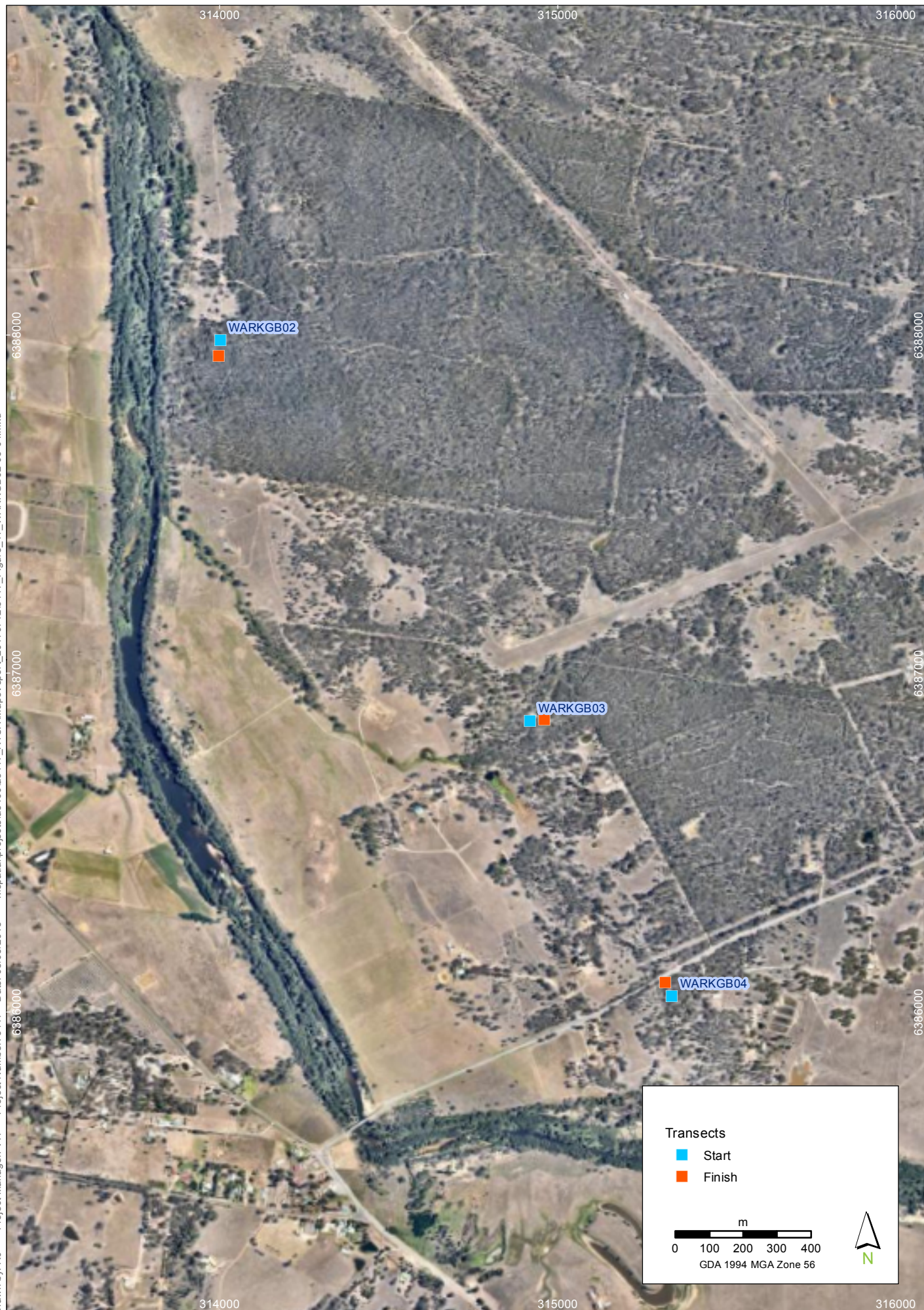


Warkworth reference sites (WARKGB01)

Native Vegetation Rehabilitation Monitoring

FIGURE 16

Imagery: (c) Nearmap 2017-11-03



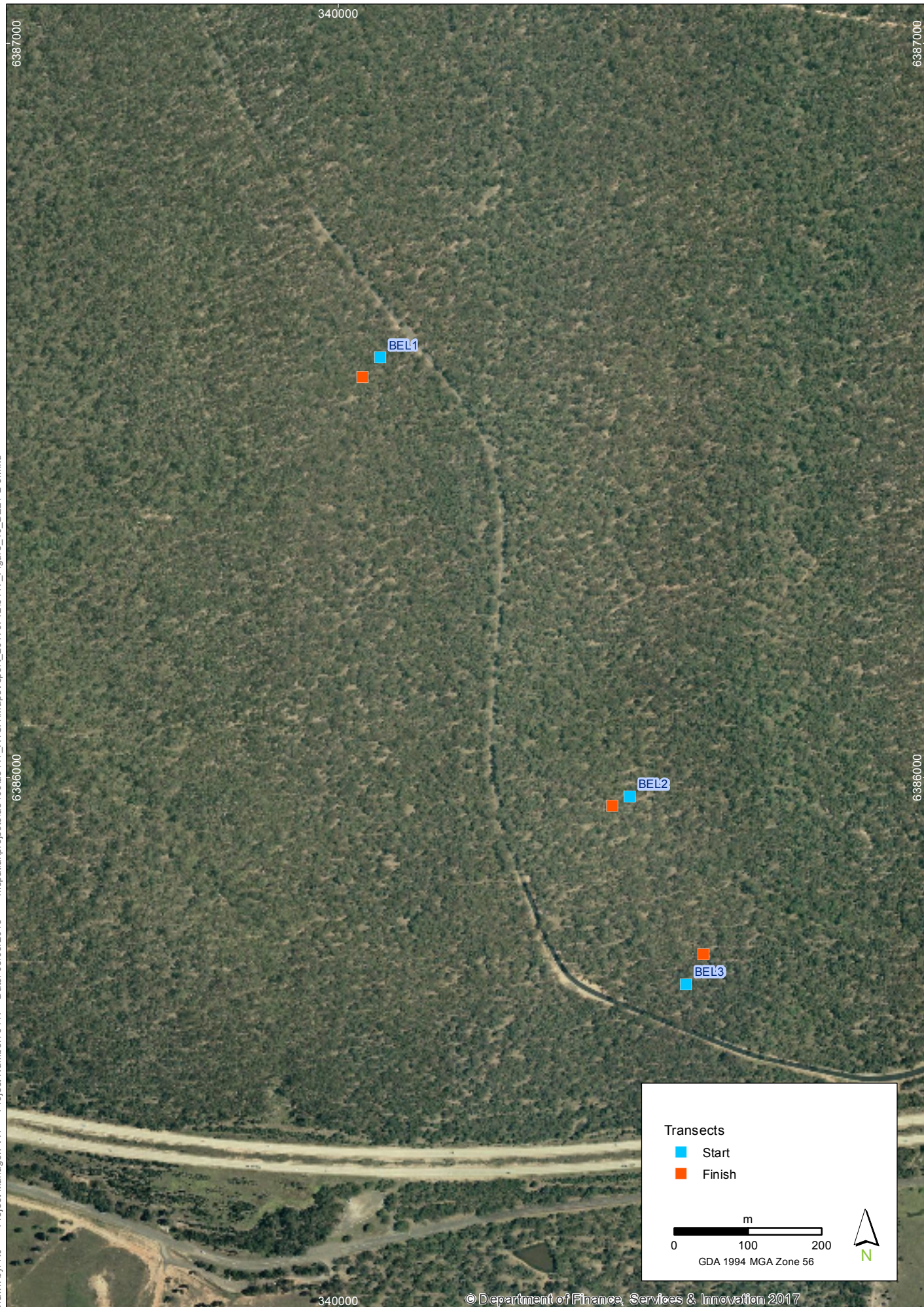
Warkworth reference sites (WARKGB02-03-04)

Native Vegetation Rehabilitation Monitoring

FIGURE 17

Imagery: (c) Nearmap 2018-01-05





Belford reference sites

Native Vegetation Rehabilitation Monitoring

FIGURE 19

Imagery: (c) LPI 2008-12-17

Appendix 2 – Monitoring dates

Location	Survey personnel	Date
HVO CAR200901	Alex Christie, Vivien Howard, Robert Carter and Bill Baxter	13/02/2017
HVO CAR200902	Alex Christie, Vivien Howard, Robert Carter and Bill Baxter	13/02/2017
HVO CAR201401	Alex Christie, Vivien Howard, Robert Carter and Bill Baxter	13/02/2017
HVO CHE201201	Alex Christie, Vivien Howard and Jess Blair	09/02/2017
HVO CHE201203	Alex Christie, Vivien Howard and Jess Blair	09/02/2017
HVO CHE201401	Alex Christie, Vivien Howard and Jess Blair	09/02/2017
HVO RIV201401	Alex Christie, Vivien Howard and Bill Baxter	13/02/2017
HVO RIV201402	Alex Christie, Vivien Howard and Bill Baxter	13/02/2017
HVO RIV201403	Alex Christie, Vivien Howard and Bill Baxter	13/02/2017
HVO RIV201404	Alex Christie, Vivien Howard and Bill Baxter	09/02/2017
HVO RIV201405	Alex Christie, Vivien Howard and Bill Baxter	09/02/2017
HVO RIV201406	Alex Christie, Vivien Howard and Bill Baxter	09/02/2017
HVO WES200801	Alex Christie, Vivien Howard and Bill Baxter	14/02/2017
HVO WES201101	Alex Christie, Vivien Howard and Bill Baxter	14/02/2017
HVO WES201301	Alex Christie, Vivien Howard and Bill Baxter	14/02/2017
HVO WES201302	Alex Christie, Vivien Howard and Bill Baxter	14/02/2017
HVO CHE201501	Alex Christie, Vivien Howard, Robert Carter and Bill Baxter	1/05/2017
HVO CHE201601	Alex Christie, Vivien Howard, Robert Carter and Bill Baxter	1/05/2017
HVO CHE201602	Alex Christie, Vivien Howard, Robert Carter and Bill Baxter	1/05/2017
HVOLEM201501	Alex Christie, Vivien Howard, Robert Carter and Bill Baxter	1/05/2017
HVOLEM201601	Alex Christie, Vivien Howard, Robert Carter and Bill Baxter	1/05/2017
HVORIV201501	Alex Christie, Vivien Howard, Robert Carter and Bill Baxter	1/05/2017
HVORIV201502	Alex Christie, Vivien Howard, Robert Carter and Bill Baxter	1/05/2017
HVORIV201601	Alex Christie, Vivien Howard, Robert Carter and Bill Baxter	1/05/2017
HVOWES201601	Alex Christie, Vivien Howard, Robert Carter and Bill Baxter	1/05/2017
HVOWES201602	Alex Christie, Vivien Howard, Robert Carter and Bill Baxter	1/05/2017
HVOWES201603	Alex Christie, Vivien Howard, Robert Carter and Bill Baxter	1/05/2017
MTWCDD201101	Alex Christie, Vivien Howard and Jess Blair	08/02/2017
MTWCDD201301	Alex Christie, Vivien Howard and Jess Blair	08/02/2017
MTWCDD201501	Alex Christie, Vivien Howard and Jess Blair	08/02/2017
MTWMTO200001	Alex Christie, Vivien Howard and Bill Baxter	09/02/2017
MTWMTO200503	Alex Christie, Vivien Howard and Bill Baxter	09/02/2017
MTWMTO201501	Alex Christie, Vivien Howard, Robert Carter and Bill Baxter	1/05/2017
MTWMTO201601	Alex Christie, Vivien Howard, Robert Carter and Bill Baxter	1/05/2017
MTWNOO201501	Alex Christie, Vivien Howard, Robert Carter and Bill Baxter	1/05/2017
MTWNPN200501	Alex Christie, Vivien Howard and Bill Baxter	07/02/2017

Location	Survey personnel	Date
MTWNPN200502	Alex Christie, Vivien Howard and Bill Baxter	08/02/2017
MTWNPN200901	Alex Christie, Vivien Howard and Jess Blair	15/02/2017
MTWNPN201101	Alex Christie, Vivien Howard and Bill Baxter	07/02/2017
MTWNPN201301	Alex Christie, Vivien Howard and Bill Baxter	07/02/2017
MTWNPN201402	Alex Christie, Vivien Howard and Bill Baxter	07/02/2017
MTWNPN201403	Alex Christie, Vivien Howard and Bill Baxter	07/02/2017
MTWSPN201401	Alex Christie, Vivien Howard and Bill Baxter	08/02/2017
MTWSPN201501	Alex Christie, Vivien Howard, Robert Carter and Bill Baxter	1/05/2017
MTWSPN201601	Alex Christie, Vivien Howard, Robert Carter and Bill Baxter	1/05/2017
MTWSPN201602	Alex Christie, Vivien Howard, Robert Carter and Bill Baxter	1/05/2017
MTWSPS201601	Alex Christie, Vivien Howard, Robert Carter and Bill Baxter	1/05/2017
MTWSPS201602	Alex Christie, Vivien Howard, Robert Carter and Bill Baxter	1/05/2017
MTWTD1201501	Luke Baker, Vivien Howard and Bill Baxter	08/02/2017
MTWWDL201401	Alex Christie, Vivien Howard and Bill Baxter	08/02/2017
MTWWDL201402	Alex Christie, Vivien Howard and Bill Baxter	15/02/2017
BELLSPOT1	Alex Christie and Vivien Howard	06/02/2017
BELSPOT2	Alex Christie and Vivien Howard	14/02/2017
BELSPOT3	Alex Christie and Vivien Howard	14/02/2017
WAMBOGB1	Alex Christie and Vivien Howard	16/02/2017
WAMBOGB2	Alex Christie and Vivien Howard	16/02/2017
WAMBOSPOT1	Alex Christie and Vivien Howard	16/02/2017
WAMBOSPOT2	Alex Christie and Vivien Howard	16/02/2017
WAMBOSPOT3	Alex Christie and Vivien Howard	16/02/2017
WARKGB1	Alex Christie and Vivien Howard	15/02/2017
WARKGB2	Alex Christie and Vivien Howard	10/02/2017
WARKGB3	Alex Christie and Vivien Howard	10/02/2017
WARKGB4	Alex Christie and Vivien Howard	10/02/2017

Appendix 3 – Monitoring locations

Hunter Valley Operations monitoring sites and locations

Monitoring site	Position on transection	Northing	Easting
HVO CAR200901	Start	6405168	310358
HVO CAR200901	Finish	6405171	310311
HVO CAR200902	Start	6403453	309114
HVO CAR200902	Finish	6403430	309076
HVO CAR201401	Start	6403057	309832
HVO CAR201401	Finish	6403083	309872
HVO CHE201201	Start	6400898	315694
HVO CHE201201	Finish	6400937	315660
HVO CHE201301	Start	6400040	315617
HVO CHE201301	Finish	6400044	315667
HVO CHE201401	Start	6399065	315541
HVO CHE201401	Finish	6399040	315582
HVO RIV201401	Start	6398663	311033
HVO RIV201401	Finish	6398633	310994
HVO RIV201402	Start	6398476	311320
HVO RIV201402	Finish	6398516	311293
HVO RIV201403	Start	6398539	311901
HVO RIV201403	Finish	6398558	311854
HVO RIV201404	Start	6398524	312023
HVO RIV201404	Finish	6398476	312029
HVO RIV201405	Start	6398089	312243
HVO RIV201405	Finish	6398114	312269
HVO RIV201406	Start	6397946	312522
HVO RIV201406	Finish	6397895	312522
HVO WES200801	Start	6406920	306340
HVO WES200801	Finish	6406877	306364
HVO WES201101	Start	6409164	308265

Monitoring site	Position on transection	Northing	Easting
HVO WES201101	Finish	6409172	308223
HVO WES201301	Start	6407223	306899
HVO WES201301	Finish	6407251	306859
HVO WES201302	Start	6407365	306889
HVO WES201302	Finish	6407409	306878
HVORIV201502	Start	6398308	311543
HVORIV201502	Finish	6398260	311526
HVORIV201501	Start	6398020	312211
HVORIV201501	Finish	6397998	312256
HVOLEM201501	Start	6394462	316910
HVOLEM201501	Finish	Not recorded	Not recorded
HVOCHE201501	Start	6402006	313968
HVOCHE201501	Finish	6402056	313952
HVORIV201601	Start	6398284	311284
HVORIV201601	Finish	6398245	311314
HVOWES201602	Start	6408560	308357
HVOWES201602	Finish	6408597	308323
HVOWES201601	Start	6410903	309820
HVOWES201601	Finish	Not recorded	Not recorded
HVOWES201603	Start	6409944	309354
HVOWES201603	Finish	6409903	309385
HVOCHE201601	Start	6401634	313555
HVOCHE201601	Finish	6401683	313541
HVOCHE201602	Start	6401299	313072
HVOCHE201602	Finish	6401346	313057
HVOLEM201601	Start	6394768	317039
HVOLEM201601	Finish	6394760	316990
HVORIV201503	Start	311249	6398378
HVORIV201503	Finish	311216	6398340
HVOWES201604	Start	307372	6407327

Monitoring site	Position on transection	Northing	Easting
HVOWES201604	Finish	307394	6407374

Mount Thorley Warkworth monitoring sites and locations

Monitoring site	Position on transection	Northing	Easting
MTWCDC201101	Start	6390304	319599
MTWCDC201101	Finish	6390312	319552
MTWCDD201301	Start	6390165	319516
MTWCDD201301	Finish	6390212	319535
MTWCDD201501	Start	6390074	319049
MTWCDD201501	Finish	6390034	319081
MTWNPN201401	Start	6392128	317619
MTWNPN201401	Finish	Not recorded	Not recorded
MTWMTO200001	Start	6386940	320551
MTWMTO200001	Finish	6386982	320531
MTWMTO200503	Start	6385782	320678
MTWMTO200503	Finish	6385756	320640
MTWNPN200501	Start	6391225	319816
MTWNPN200501	Finish	6391183	319842
MTWNPN200502	Start	6391981	319682
MTWNPN200502	Finish	Not recorded	Not recorded
MTWNPN200901	Start	6391524	319069
MTWNPN200901	Finish	6391535	319027
MTWNPN201101	Start	6392138	318166
MTWNPN201301	Finish	6391519	317995
MTWNPN201301	Start	6391551	318047
MTWNPN201402	Start	6392086	317658
MTWNPN201402	Finish	6392120	317620
MTWNPN201403	Start	6391271	318089
MTWNPN201403	Finish	6391236	318060
MTWSPN201401	Start	6390161	320170

Monitoring site	Position on transection	Northing	Easting
MTWSPN201401	Finish	Not recorded	Not recorded
MTWTDI201501	Start	6392186	319688
MTWTDI201501	Finish	6392236	319692
MTWWDL201401	Start	6388508	319805
MTWWDL201401	Finish	6388526	319849
MTWWDL201402	Start	6388357	319636
MTWWDL201402	Finish	6388309	319624
MTWMTO201501	Start	6385357	321386
MTWMTO201501	Finish	6385331	321427
MTWSPS201601	Start	6389384	320910
MTWSPS201601	Finish	6389413	320949
MTWSPN201602	Start	6389769	320444
MTWSPN201602	Finish	6389775	320494
MTWSPN201601	Start	6390589	320130
MTWSPN201601	Finish	6390630	320158
MTWSPN201501	Start	6390291	319956
MTWSPN201501	Finish	6390332	319984
MTWSPS201602	Start	6388963	320830
MTWSPS201602	Finish	6388975	320879
MTWMTO201601	Start	6385308	320667
MTWMTO201601	Finish	6385305	320718
MTWNOO201501	Start	6391940	320406
MTWNOO201501	Finish	6391979	320438

Reference monitoring sites and locations

Monitoring site	Position on transection	Northing	Easting
BEL1	Start	6386547	340083
BEL1	Finish	6386546	340033
BEL2	Start	6386551	340072
BEL2	Finish	6385962	340373

Monitoring site	Position on transection	Northing	Easting
BEL3	Start	6385719	340474
BEL3	Finish	6385760	340498
WamboGB01	Start	6392661	309215
WamboGB01	Finish	6392618	309194
WamboGB02	Start	6391965	309539
WamboGB02	Finish	6392010	309561
WamboSpot1	Start	6390324	308275
WamboSpot1	Finish	6390355	308311
WamboSpot2	Start	6390550	308504
WamboSpot2	Finish	6390593	308522
WamboSpot3	Start	6390200	308276
WamboSpot3	Finish	6390185	308238
WARKGB01	Start	6392801	315553
WARKGB01	Finish	6392824	315517
WARKGB02	Start	6387985	314002
WARKGB02	Finish	6387939	313998
WARKGB03	Start	6386859	314917
WARKGB03	Finish	6386864	314960
WARKGB04	Start	6386046	315336
WARKGB04	Finish	6386087	315316

Appendix 4 – Flora species list

Flora two-way table: MTW Sites

Family	Species	Common Name	Exotic	MTWCDD 201101	MTWCDD 201301	MTWCDD 201501	MTWMT0 200001	MTWMT0 200503	MTWMT0 201601	MTWNOO 201501	MTWNP0 200501	MTWNP0 200502	MTWNP0 200901	MTWNP0 201101
Aizoaceae	<i>Galenia pubescens</i>	Galenia	X	2			3	2		2	3	2		2
Apocynaceae	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton Bush	X	1				2			2	1		2
Asteraceae	<i>Arctotheca calendula</i>	Capeweed	X						3					
Asteraceae	<i>Aster</i> spp.		X	2	3					2				
Asteraceae	<i>Bidens pilosa</i>	Cobbler's Pegs	X	1				2	2					2
Asteraceae	<i>Calotis lappulacea</i>	Yellow Burr-daisy						2			2			1
Asteraceae	<i>Centaurea solstitialis</i>	St Barnabys Thistle	X		1									
Asteraceae	<i>Cichorium intybus</i>	Chicory	X						2					
Asteraceae	<i>Cirsium vulgare</i>	Spear Thistle	X						2					
Asteraceae	<i>Conyza</i> spp.	A Fleabane	X	2	3	2	1	2			2			2
Asteraceae	<i>Gnaphalium</i> spp.	Cudweed						2						
Asteraceae	<i>Senecio madagascariensis</i>	Fireweed	X	2		2			2			1	1	
Asteraceae	<i>Sonchus</i> spp.	Sowthistle	X		1				2					

Family	Species	Common Name	Exotic	MTWCDD 201101	MTWCDD 201301	MTWCDD 201501	MTWMT0 200001	MTWMT0 200503	MTWMT0 201601	MTWNOO 201501	MTWNP0 200501	MTWNP0 200502	MTWNP0 200901	MTWNP0 201101
Asteraceae	<i>Tagetes minuta</i>	Stinking Roger	X								1			
Asteraceae	<i>Vittadinia cuneata</i>	A Fuzzweed					2	2			2			
Asteraceae	<i>Vittadinia sulcata</i>						2	1				2		
Boraginaceae	<i>Echium</i> spp.		X				5	5				2		
Brassicaceae	<i>Brassica rapa</i>		X							2		1		
Brassicaceae	<i>Lepidium campestre</i>	Field Cress	X			1	1							
Brassicaceae	<i>Lepidium</i> spp.	A Peppergrass	X		2									
Cactaceae	<i>Opuntia aurantiaca</i>	Tiger Pear	X				2	1						
Caryophyllaceae	<i>Petrohragia prolifera</i>	Proliferous Pink	X	1	1	2								
Chenopodiaceae	<i>Atriplex semibaccata</i>	Creeping Saltbush		2		2	2	2						
Chenopodiaceae	<i>Chenopodium album</i>	Fat Hen	X						2					1
Chenopodiaceae	<i>Einadia nutans</i>	Climbing Saltbush						3			1			
Chenopodiaceae	<i>Einadia trigonos</i>	Fishweed				2	2							
Chenopodiaceae	<i>Enchylaena tomentosa</i>	Ruby Saltbush		2			3	3			1			2
Commelinaceae	<i>Commelina cyanea</i>	Native Wandering					2							

Family	Species	Common Name	Exotic	MTWCDD 201101	MTWCDD 201301	MTWCDD 201501	MTWMT0 200001	MTWMT0 200503	MTWMT0 201601	MTWNOO 201501	MTWNP0 200501	MTWNP0 200502	MTWNP0 200901	MTWNP0 201101
		Jew												
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed						1		2				
Cyperaceae	<i>Carex appressa</i>	Tall Sedge						1						
Fabaceae (Faboideae)	<i>Daviesia genistifolia</i>	Broom Bitter Pea												2
Fabaceae (Faboideae)	<i>Glycine tabacina</i>	Variable Glycine		2			2	2		2	1		1	
Fabaceae (Faboideae)	<i>Hardenbergia violacea</i>	False Sarsaparilla												1
Fabaceae (Faboideae)	<i>Macroptilium atropurpureum</i>	Siratro	X						1					
Fabaceae (Faboideae)	<i>Medicago sativa</i>	Lucerne	X						2					
Fabaceae (Mimosoideae)	<i>Acacia amblygona</i>	Fan Wattle		3		2					2	2	3	4
Fabaceae (Mimosoideae)	<i>Acacia binervata</i>	Two-veined Hickory				2								
Fabaceae (Mimosoideae)	<i>Acacia cultriformis</i>	Knife-leaved Wattle		2		2				3				4
Fabaceae (Mimosoideae)	<i>Acacia decora</i>	Western Silver Wattle		2		2				2			2	3
Fabaceae (Mimosoideae)	<i>Acacia decurrens</i>	Black Wattle		2									3	
Fabaceae (Mimosoideae)	<i>Acacia falcata</i>			3									1	3

Family	Species	Common Name	Exotic	MTWCDD 201101	MTWCDD 201301	MTWCDD 201501	MTWMT0 200001	MTWMT0 200503	MTWMT0 201601	MTWNOO 201501	MTWNP0 200501	MTWNP0 200502	MTWNP0 200901	MTWNP0 201101
Fabaceae (Mimosoideae)	<i>Acacia filicifolia</i>	Fern-leaved Wattle								1				
Fabaceae (Mimosoideae)	<i>Acacia implexa</i>	Hickory Wattle		2		2					2	1	2	3
Fabaceae (Mimosoideae)	<i>Acacia longifolia</i>			2								2		
Fabaceae (Mimosoideae)	<i>Acacia mearnsii</i>	Black Wattle												2
Fabaceae (Mimosoideae)	<i>Acacia parvipinnula</i>	Silver-stemmed Wattle										4		
Fabaceae (Mimosoideae)	<i>Acacia salicina</i>	Cooba		2		2							2	
Fabaceae (Mimosoideae)	<i>Acacia saligna</i>	Golden Wreath Wattle	X					2			4	1		3
Fabaceae (Mimosoideae)	<i>Acacia spectabilis</i>	Mudgee Wattle		2		2								
Fabaceae (Mimosoideae)	<i>Acacia</i> spp.	Wattle					2							
Gentianaceae	<i>Centaurium spicatum</i>	Spike Centaury				2								
Geraniaceae	<i>Geranium</i> spp.		X							2				
Malvaceae	<i>Malva</i> spp.	Mallow	X						2					
Malvaceae	<i>Modiola caroliniana</i>	Red-flowered Mallow	X							2				

Family	Species	Common Name	Exotic	MTWCDD 201101	MTWCDD 201301	MTWCDD 201501	MTWMT0 200001	MTWMT0 200503	MTWMT0 201601	MTWNOO 201501	MTWNP0 200501	MTWNP0 200502	MTWNP0 200901	MTWNP0 201101
Malvaceae	<i>Sida corrugata</i>	Corrugated Sida		2			2							1
Malvaceae	<i>Sida rhombifolia</i>	Paddy's Lucerne	X	2				2	2	3	3		2	
Myoporaceae	<i>Eremophila debilis</i>	Amulla		2			2	1			2	2		
Myrsinaceae	<i>Anagallis arvensis</i>	Scarlet Pimpernel	X							2				
Myrtaceae	<i>Corymbia citriodora</i>	Lemon-scented Gum	X								4			
Myrtaceae	<i>Corymbia maculata</i>	Spotted Gum		3		3						5	6	
Myrtaceae	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark		2									3	2
Myrtaceae	<i>Eucalyptus fibrosa</i>	Red Ironbark										3	3	1
Myrtaceae	<i>Eucalyptus moluccana</i>	Grey Box		3			3	1				3	3	
Oxalidaceae	<i>Oxalis perennans</i>									2				
Phyllanthaceae	<i>Phyllanthus hirtellus</i>	Thyme Spurge						2						
Phytolaccaceae	<i>Phytolacca octandra</i>	Inkweed	X			1								
Plantaginaceae	<i>Plantago lanceolata</i>	Lamb's Tongues	X			2		1	2	2			1	2
Poaceae	<i>Austrostipa aristiglumis</i>	Plains Grass				1								

Family	Species	Common Name	Exotic	MTWCDD 201101	MTWCDD 201301	MTWCDD 201501	MTWMT0 200001	MTWMT0 200503	MTWMT0 201601	MTWNOO 201501	MTWNP0 200501	MTWNP0 200502	MTWNP0 200901	MTWNP0 201101
Poaceae	<i>Austrostipa scabra</i>	Speargrass				2								
Poaceae	<i>Bothriochloa macra</i>	Red Grass		2		2		2		4	1			1
Poaceae	<i>Capillipedium spicigerum</i>	Scented-top Grass				1								
Poaceae	<i>Chloris gayana</i>	Rhodes Grass	X	2	5	1					4	1	3	4
Poaceae	<i>Chloris truncata</i>	Windmill Grass				2		2		3	1			
Poaceae	<i>Chloris ventricosa</i>	Tall Chloris		2		3					1			
Poaceae	<i>Cymbopogon refractus</i>	Barbed Wire Grass				2		4			3		2	
Poaceae	<i>Cynodon dactylon</i>	Common Couch		1		2		2	3			1		
Poaceae	<i>Digitaria divaricatissima</i>	Umbrella Grass				1								
Poaceae	<i>Entolasia marginata</i>	Bordered Panic										1		
Poaceae	<i>Entolasia stricta</i>	Wiry Panic								2				
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass				1				3				
Poaceae	<i>Eragrostis curvula</i>	African Lovegrass	X					2			2	2		1
Poaceae	<i>Eriochloa</i> spp.	A Cupgrass							2	2				
Poaceae	<i>Panicum effusum</i>	Hairy Panic				2				2				

Family	Species	Common Name	Exotic	MTWCDD 201101	MTWCDD 201301	MTWCDD 201501	MTWMT0 200001	MTWMT0 200503	MTWMT0 201601	MTWNOO 201501	MTWNP0 200501	MTWNP0 200502	MTWNP0 200901	MTWNP0 201101
Poaceae	<i>Panicum maximum</i>	Guinea Grass	X							4				
Poaceae	<i>Paspalum dilatatum</i>	Paspalum	X	2								2		
Poaceae	<i>Pennisetum clandestinum</i>	Kikuyu Grass	X											2
Poaceae	<i>Pennisetum glaucum</i>	Pearl Millet	X						4					
Poaceae	<i>Rytidosperma</i> spp.			2		2		2					2	
Poaceae	<i>Setaria gracilis</i>	Slender Pigeon Grass	X	1							1			
Poaceae	<i>Setaria parviflora</i>		X							2		2		
Poaceae	<i>Sporobolus creber</i>	Slender Rat's Tail Grass				2		2		2				
Poaceae	<i>Themeda triandra</i>			2										2
Poaceae	<i>Urochloa</i> spp.		X							2				
Portulacaceae	<i>Portulaca</i> spp.		X						3					
Sapindaceae	<i>Dodonaea viscosa</i>	Sticky Hop-bush												2
Solanaceae	<i>Solanum nigrum</i>	Black-berry Nightshade	X			1								
Solanaceae	<i>Solanum prinophyllum</i>	Forest Nightshade					1		1					
Verbenaceae	<i>Verbena bonariensis</i>	Purpletop	X	2			1				2	1		2

Flora two-way table: MTW Sites

Family	Species	Common Name	Exotic	MTWNP N201301	MTWNP N201401	MTWNP N201403	MTWSPN 201501	MTWSPN 201602	MTWSPS 201601	MTWSPS 201602	MTWTDI 201501	MTWWD L201401	MTWWD L201402	MTWNP N201402	MTWMT O201501
Aizoaceae	<i>Galenia pubescens</i>	Galenia	X	2	1		1	2	2			1	1	1	3
Aizoaceae	<i>Galenia</i> spp.		X			4									
Amaranthaceae	<i>Alternanthera</i> spp.	Joyweed						1							
Anthericaceae	<i>Laxmannia gracilis</i>	Slender Wire Lily				1									
Apocynaceae	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton Bush	X		1					1		1			1
Asteraceae	<i>Aster</i> spp.		X	2	2						2				
Asteraceae	<i>Aster subulatus</i>	Wild Aster	X												2
Asteraceae	<i>Bidens pilosa</i>	Cobbler's Pegs	X	4	3	3				1				1	2
Asteraceae	<i>Calotis lappulacea</i>	Yellow Burr-daisy		2								2		2	
Asteraceae	<i>Centaurea solstitialis</i>	St Barnabys Thistle	X								1	1	1		
Asteraceae	<i>Chrysocephalum apiculatum</i>	Common Everlasting						1							
Asteraceae	<i>Cichorium intybus</i>	Chicory	X						3	3					
Asteraceae	<i>Cirsium vulgare</i>	Spear Thistle	X	2	2	1				1	1		1		1
Asteraceae	<i>Conyza</i> spp.	A Fleabane	X	2	3	1			2		1		2		
Asteraceae	<i>Hypochaeris radicata</i>	Catsear	X											2	
Asteraceae	<i>Senecio madagascariensis</i>	Fireweed	X		2			1	2	2	1		2	1	2
Asteraceae	<i>Sonchus oleraceus</i>	Common Sowthistle	X							3					2
Asteraceae	<i>Sonchus</i> spp.	Sowthistle	X	2		2		1	2		1		2		

Family	Species	Common Name	Exotic	MTWNP N201301	MTWNP N201401	MTWNP N201403	MTWSPN 201501	MTWSPN 201602	MTWSPS 201601	MTWSPS 201602	MTWTDI 201501	MTWWD L201401	MTWWD L201402	MTWNP N201402	MTWMT O201501
Asteraceae	<i>Tagetes minuta</i>	Stinking Roger	X											1	
Asteraceae	<i>Vittadinia cuneata</i>	A Fuzzweed			2									2	
Brassicaceae	<i>Brassica rapa</i>		X	4		3		2	3	4			5	1	
Brassicaceae	<i>Lepidium spp.</i>	A Peppergrass	X	2		1					1				2
Cactaceae	<i>Opuntia stricta</i>	Common Prickly Pear, Smooth Pest Pear	X	2											
Chenopodiaceae	<i>Atriplex semibaccata</i>	Creeping Saltbush		2								2	2		
Chenopodiaceae	<i>Atriplex spp.</i>	A Saltbush						1							
Chenopodiaceae	<i>Chenopodium album</i>	Fat Hen	X									1			
Chenopodiaceae	<i>Chenopodium pumilio</i>	Small Crumbweed												1	
Chenopodiaceae	<i>Einadia nutans</i>	Climbing Saltbush				2						2			
Chenopodiaceae	<i>Einadia trigonos</i>	Fishweed										3			
Chenopodiaceae	<i>Enchylaena tomentosa</i>	Ruby Saltbush									2	1			1
Commelinaceae	<i>Commelina cyanea</i>	Native Wandering Jew												1	
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed						1							1
Euphorbiaceae	<i>Euphorbia spp.</i>		X					2							
Fabaceae (Faboideae)	<i>Daviesia ulicifolia</i>	Gorse Bitter Pea			2									1	
Fabaceae (Faboideae)	<i>Desmodium brachypodium</i>	Large Tick-trefoil												1	

Family	Species	Common Name	Exotic	MTWNP N201301	MTWNP N201401	MTWNP N201403	MTWSPN 201501	MTWSPN 201602	MTWSPS 201601	MTWSPS 201602	MTWTDI 201501	MTWWD L201401	MTWWD L201402	MTWNP N201402	MTWMT O201501
Fabaceae (Faboideae)	<i>Glycine tabacina</i>	Variable Glycine						1	2						
Fabaceae (Faboideae)	<i>Hardenbergia violacea</i>	False Sarsaparilla			3							2		2	
Fabaceae (Faboideae)	<i>Indigofera australis</i>	Australian Indigo		2	2			1				1		2	
Fabaceae (Faboideae)	<i>Macroptilium atropurpureum</i>	Siratro	X						1	4					
Fabaceae (Faboideae)	<i>Medicago polymorpha</i>	Burr Medic	X												2
Fabaceae (Faboideae)	<i>Medicago sativa</i>	Lucerne	X						2	4		1			
Fabaceae (Faboideae)	<i>Swainsona galegifolia</i>	Smooth Darling Pea			1										
Fabaceae (Mimosoidea e)	<i>Acacia amblygona</i>	Fan Wattle		3	4							3			
Fabaceae (Mimosoidea e)	<i>Acacia binervata</i>	Two-veined Hickory			4										
Fabaceae (Mimosoidea e)	<i>Acacia cultriformis</i>	Knife-leaved Wattle		3	4	2		1						2	
Fabaceae (Mimosoidea e)	<i>Acacia decora</i>	Western Silver Wattle		3	3	2						2		3	
Fabaceae (Mimosoidea e)	<i>Acacia falcata</i>			3	2							3		3	
Fabaceae (Mimosoidea e)	<i>Acacia implexa</i>	Hickory Wattle				2						3			
Fabaceae (Mimosoidea)	<i>Acacia leiocalyx</i>													5	

Family	Species	Common Name	Exotic	MTWNP N201301	MTWNP N201401	MTWNP N201403	MTWSPN 201501	MTWSPN 201602	MTWSPS 201601	MTWSPS 201602	MTWTDI 201501	MTWWD L201401	MTWWD L201402	MTWNP N201402	MTWMT O201501
e)															
Fabaceae (Mimosoidea e)	<i>Acacia longifolia</i>			2	3							1		3	
Fabaceae (Mimosoidea e)	<i>Acacia paradoxa</i>	Kangaroo Thorn		3	2							1		2	
Fabaceae (Mimosoidea e)	<i>Acacia parvipinnula</i>	Silver-stemmed Wattle			2									2	
Fabaceae (Mimosoidea e)	<i>Acacia salicina</i>	Cooba									1	2			
Fabaceae (Mimosoidea e)	<i>Acacia saligna</i>	Golden Wreath Wattle	X	2		1							1	1	
Fabaceae (Mimosoidea e)	<i>Acacia spectabilis</i>	Mudgee Wattle									1				
Fumariaceae	<i>Fumaria</i> spp.	Fumitory	X												1
Gentianaceae	<i>Centaurium</i> spp.		X										3		
Geraniaceae	<i>Geranium homeanum</i>								1						
Lycopodiaceae	<i>Phylloglossum drummondii</i>	Pigmy Clubmoss							2						
Malvaceae	<i>Malva</i> spp.	Mallow	X												
Malvaceae	<i>Malva sylvestris</i>	Tall Mallow	X				1								
Malvaceae	<i>Modiola caroliniana</i>	Red-flowered Mallow	X	2				2							
Malvaceae	<i>Sida rhombifolia</i>	Paddy's Lucerne	X	4	1	3		2		2		2		1	2
Myoporaceae	<i>Eremophila</i>	Amulla											2		

Family	Species	Common Name	Exotic	MTWNP N201301	MTWNP N201401	MTWNP N201403	MTWSPN 201501	MTWSPN 201602	MTWSPS 201601	MTWSPS 201602	MTWTDI 201501	MTWWD L201401	MTWWD L201402	MTWNP N201402	MTWMT O201501
	<i>debilis</i>														
Myrsinaceae	<i>Anagallis arvensis</i>	Scarlet Pimpernel	X					1	2	2				1	
Myrtaceae	<i>Corymbia maculata</i>	Spotted Gum		1							2	2			
Myrtaceae	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark										2			
Myrtaceae	<i>Eucalyptus fibrosa</i>	Red Ironbark				1									
Myrtaceae	<i>Eucalyptus moluccana</i>	Grey Box				1									
Myrtaceae	<i>Eucalyptus spp.</i>										1	2			
Phyllanthaceae	<i>Breynia spp.</i>													2	
Plantaginaceae	<i>Plantago lanceolata</i>	Lamb's Tongues	X									1	2		2
Poaceae	<i>Austrostipa scabra</i>	Speargrass			3						2			2	
Poaceae	<i>Bothriochloa macra</i>	Red Grass		2	2			2			1		3	1	
Poaceae	<i>Chloris gayana</i>	Rhodes Grass	X	3	2	5	2		2		4	2	2		3
Poaceae	<i>Chloris truncata</i>	Windmill Grass		2				6			4	3	2		
Poaceae	<i>Chloris ventricosa</i>	Tall Chloris			3		2				2	3	2		
Poaceae	<i>Cymbopogon refractus</i>	Barbed Wire Grass			2										
Poaceae	<i>Cynodon dactylon</i>	Common Couch		3	4	2		2	3			2	3	2	2
Poaceae	<i>Echinochloa colona</i>	Awnless Barnyard Grass		2							2				
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass						4						1	

Family	Species	Common Name	Exotic	MTWNP N201301	MTWNP N201401	MTWNP N201403	MTWSPN 201501	MTWSPN 201602	MTWSPS 201601	MTWSPS 201602	MTWTDI 201501	MTWWD L201401	MTWWD L201402	MTWNP N201402	MTWMT O201501
Poaceae	<i>Eragrostis curvula</i>	African Lovegrass	X		2	1								1	
Poaceae	<i>Eriochloa procera</i>	Spring Grass													2
Poaceae	<i>Eriochloa pseudoacrotricha</i>	Early Spring Grass		3	2	2						3	5		
Poaceae	<i>Eriochloa</i> spp.	A Cupgrass						2							
Poaceae	<i>Heteropogon contortus</i>	Bunch Speargrass			3										
Poaceae	<i>Lolium perenne</i>	Perennial Ryegrass	X										3		
Poaceae	<i>Melinis repens</i>	Red Natal Grass	X											2	
Poaceae	<i>Panicum effusum</i>	Hairy Panic				1		2			2	1			
Poaceae	<i>Panicum maximum</i>	Guinea Grass	X						2	4	1		2		2
Poaceae	<i>Paspalidium</i> spp.							1			2				
Poaceae	<i>Paspalum dilatatum</i>	Paspalum	X	2											2
Poaceae	<i>Pennisetum clandestinum</i>	Kikuyu Grass	X		1										1
Poaceae	<i>Pennisetum glaucum</i>	Pearl Millet	X										5		
Poaceae	<i>Rytidosperma</i> spp.				2							2			
Poaceae	<i>Setaria gracilis</i>	Slender Pigeon Grass	X	2								3	2		
Poaceae	<i>Setaria italica</i>	Foxtail Millet	X							2					
Poaceae	<i>Setaria parviflora</i>		X					3							
Poaceae	<i>Sporobolus</i>	Slender Rat's Tail									2				

Family	Species	Common Name	Exotic	MTWNP N201301	MTWNP N201401	MTWNP N201403	MTWSPN 201501	MTWSPN 201602	MTWSPS 201601	MTWSPS 201602	MTWTDI 201501	MTWWD L201401	MTWWD L201402	MTWNP N201402	MTWMT O201501
	creber	Grass													
Poaceae	Themeda australis	Kangaroo Grass												1	
Poaceae	Themeda triandra				3										
Poaceae	Urochloa panicoides	Urochloa Grass	X										2		
Portulacaceae	Portulaca spp.		X				1	2		1					
Rubiaceae	Cyclophyllum longipetalum	Coast Canthium		2											
Sapindaceae	Dodonaea viscosa	Sticky Hop-bush			2										
Solanaceae	Solanum nigrum	Black-berry Nightshade	X					2	2	3		1		1	
Thymelaeaceae	Pimelea linifolia	Slender Rice Flower			2									1	
Verbenaceae	Verbena bonariensis	Purpletop	X		2							2			2
Zygophyllaceae	Tribulus spp.	Cat-head, Caltrop							1						

Flora two-way table: HVO Sites

Family	Species	Common Name	Exotic	HVOCAR2 00901	HVOCAR2 00902	HVOCAR2 01401	HVOCH2 01201	HVOCH2 01301	HVOCH2 01401	HVOCH2 01501	HVOCH2 01601	HVOCH2 01602	HVOLEM2 01501	HVOLEM2 01601	HVORIV2 01401
Aizoaceae	<i>Galenia pubescens</i>	Galenia	X	3		3	2	2	2		1	1			3
Apiaceae	<i>Cyclospermum leptophyllum</i>	Slender Celery	X								1				
Apocynaceae	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton Bush	X	2		2		1							2
Apocynaceae	<i>Gomphocarpus spp.</i>		X									1			
Asteraceae	<i>Arctotheca calendula</i>	Capeweed	X								1				
Asteraceae	<i>Aster spp.</i>		X										2		4
Asteraceae	<i>Calotis lappulacea</i>	Yellow Burr-daisy											2		
Asteraceae	<i>Cassinia arcuata</i>	Sifton Bush					1								
Asteraceae	<i>Chrysocephalum apiculatum</i>	Common Everlasting											2		
Asteraceae	<i>Cichorium intybus</i>	Chicory	X									2			
Asteraceae	<i>Cirsium vulgare</i>	Spear Thistle	X			2								2	2
Asteraceae	<i>Conyza spp.</i>	A Fleabane	X		2	2		2					3	2	3
Asteraceae	<i>Hypochaeris radicata</i>	Catsear	X							2	1		2	2	
Asteraceae	<i>Senecio madagascariensis</i>	Fireweed	X	2	3	2				2	1		2	4	3
Asteraceae	<i>Senecio spp.</i>	Groundsel, Fireweed	X						1						

Family	Species	Common Name	Exotic	HVOCAR2 00901	HVOCAR2 00902	HVOCAR2 01401	HVOCH2 01201	HVOCH2 01301	HVOCH2 01401	HVOCH2 01501	HVOCH2 01601	HVOCH2 01602	HVOLEM2 01501	HVOLEM2 01601	HVORIV2 01401
Asteraceae	<i>Silybum marianum</i>	Variegated Thistle	X							1	1			2	
Asteraceae	<i>Sonchus oleraceus</i>	Common Sowthistle	X								1				
Asteraceae	<i>Sonchus spp.</i>	Sowthistle	X									1	2	4	2
Asteraceae	<i>Tagetes minuta</i>	Stinking Roger	X											2	
Asteraceae	<i>Vittadinia sulcata</i>						1								
Brassicaceae	<i>Brassica rapa</i>		X			4			3						2
Brassicaceae	<i>Lepidium spp.</i>	A Peppercross	X					2	1						
Cactaceae	<i>Opuntia aurantiaca</i>	Tiger Pear	X				1								
Campanulaceae	<i>Wahlenbergia spp.</i>	Bluebell												2	
Chenopodiaceae	<i>Atriplex semibaccata</i>	Creeping Saltbush					2								3
Chenopodiaceae	<i>Chenopodium album</i>	Fat Hen	X											4	
Chenopodiaceae	<i>Enchylaena tomentosa</i>	Ruby Saltbush													4
Chenopodiaceae	<i>Salsola spp.</i>														4
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed										1			
Cucurbitaceae	<i>Citrullus lanatus</i>	Camel Melon	X											3	
Cyperaceae	<i>Carex inversa</i>	Knob Sedge			2										
Cyperaceae	<i>Cyperus spp.</i>									2				2	
Fabaceae (Faboideae)	<i>Glycine tabacina</i>	Variable Glycine				1									
Fabaceae	<i>Hardenbergia</i>	False												2	2

Family	Species	Common Name	Exotic	HVOCAR2 00901	HVOCAR2 00902	HVOCAR2 01401	HVOCH2 01201	HVOCH2 01301	HVOCH2 01401	HVOCH2 01501	HVOCH2 01601	HVOCH2 01602	HVOLEM2 01501	HVOLEM2 01601	HVORIV2 01401
(Faboideae)	<i>violacea</i>	Sarsaparilla													
Fabaceae (Faboideae)	<i>Macroptilium atropurpureum</i>	Siratro	X								1	1			
Fabaceae (Faboideae)	<i>Medicago polymorpha</i>	Burr Medic	X								1				
Fabaceae (Faboideae)	<i>Medicago sativa</i>	Lucerne	X								1				
Fabaceae (Faboideae)	<i>Medicago spp.</i>	A Medic	X									1			
Fabaceae (Faboideae)	<i>Trifolium spp.</i>	A Clover	X			2					1				
Fabaceae (Mimosoideae)	<i>Acacia amblygona</i>	Fan Wattle		3										2	
Fabaceae (Mimosoideae)	<i>Acacia binervata</i>	Two-veined Hickory												2	2
Fabaceae (Mimosoideae)	<i>Acacia cultriformis</i>	Knife-leaved Wattle		4	4										3
Fabaceae (Mimosoideae)	<i>Acacia decora</i>	Western Silver Wattle											2	2	3
Fabaceae (Mimosoideae)	<i>Acacia decurrens</i>	Black Wattle		4	4										
Fabaceae (Mimosoideae)	<i>Acacia falcata</i>												1		3
Fabaceae (Mimosoideae)	<i>Acacia implexa</i>	Hickory Wattle		4	3										
Fabaceae (Mimosoideae)	<i>Acacia salicina</i>	Cooba			5									2	3
Fabaceae (Mimosoideae)	<i>Acacia saligna</i>	Golden Wreath Wattle	X	4		3					1		1		3
Gentianaceae	<i>Centaurium spp.</i>		X		3	2									

Family	Species	Common Name	Exotic	HVOCAR2 00901	HVOCAR2 00902	HVOCAR2 01401	HVOCHE2 01201	HVOCHE2 01301	HVOCHE2 01401	HVOCHE2 01501	HVOCHE2 01601	HVOCHE2 01602	HVOLEM2 01501	HVOLEM2 01601	HVORIV2 01401
Geraniaceae	<i>Erodium cicutarium</i>	Common Crowfoot	X									1			
Geraniaceae	<i>Geranium solanderi</i>	Native Geranium								1					
Geraniaceae	<i>Geranium spp.</i>		X								1	1			
Haloragaceae	<i>Gonocarpus tetragynus</i>	Poverty Raspwort									1				
Malvaceae	<i>Modiola caroliniana</i>	Red-flowered Mallow	X			2						1			
Malvaceae	<i>Sida corrugata</i>	Corrugated Sida		1											
Malvaceae	<i>Sida rhombifolia</i>	Paddy's Lucerne	X			2	1				1	1		2	
Myrsinaceae	<i>Anagallis arvensis</i>	Scarlet Pimpernel	X							2	1	1	2	5	
Myrtaceae	<i>Corymbia maculata</i>	Spotted Gum		5	5									1	
Myrtaceae	<i>Eucalyptus fibrosa</i>	Red Ironbark		2	1										
Myrtaceae	<i>Eucalyptus moluccana</i>	Grey Box		5	2								2		4
Oxalidaceae	<i>Oxalis perennans</i>									2				2	
Plantaginaceae	<i>Plantago lanceolata</i>	Lamb's Tongues	X		3	2			1		1				3
Poaceae	<i>Austrostipa scabra</i>	Speargrass													3
Poaceae	<i>Avena spp.</i>	Oats	X						1						
Poaceae	<i>Bothriochloa macra</i>	Red Grass											2		
Poaceae	<i>Capillipedium spicigerum</i>	Scented-top Grass											2		

Family	Species	Common Name	Exotic	HVOCAR2 00901	HVOCAR2 00902	HVOCAR2 01401	HVOCHE2 01201	HVOCHE2 01301	HVOCHE2 01401	HVOCHE2 01501	HVOCHE2 01601	HVOCHE2 01602	HVOLEM2 01501	HVOLEM2 01601	HVORIV2 01401
Poaceae	<i>Chloris gayana</i>	Rhodes Grass	X	5	5	5	2	4	2						5
Poaceae	<i>Chloris truncata</i>	Windmill Grass				3							3		4
Poaceae	<i>Chloris ventricosa</i>	Tall Chloris							2						
Poaceae	<i>Cynodon dactylon</i>	Common Couch		3		3		3			1	1	6	2	3
Poaceae	<i>Dichanthium sericeum</i>	Queensland Bluegrass												2	
Poaceae	<i>Dichanthium setosum</i>	Bluegrass											2		
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass											2		
Poaceae	<i>Eragrostis spp.</i>	A Lovegrass	X						1						
Poaceae	<i>Eriochloa pseudoacrotricha</i>	Early Spring Grass					2	4	5						
Poaceae	<i>Melinis repens</i>	Red Natal Grass	X											3	
Poaceae	<i>Panicum capillare</i>	Witchgrass	X								1				
Poaceae	<i>Panicum effusum</i>	Hairy Panic			2		1				1			2	4
Poaceae	<i>Panicum maximum</i>	Guinea Grass	X	2	2	3								3	
Poaceae	<i>Pennisetum glaucum</i>	Pearl Millet	X							2	1	2		2	
Poaceae	<i>Rytidosperma spp.</i>								1						3
Poaceae	<i>Setaria gracilis</i>	Slender Pigeon Grass	X						3						3

Family	Species	Common Name	Exotic	HVOCAR2 00901	HVOCAR2 00902	HVOCAR2 01401	HVOCHE2 01201	HVOCHE2 01301	HVOCHE2 01401	HVOCHE2 01501	HVOCHE2 01601	HVOCHE2 01602	HVOLEM2 01501	HVOLEM2 01601	HVORIV2 01401
Poaceae	<i>Setaria parviflora</i>		X										2	4	
Poaceae	<i>Sporobolus creber</i>	Slender Rat's Tail Grass			2								3		
Poaceae	<i>Themeda triandra</i>														2
Poaceae	<i>Urochloa panicoides</i>	Urochloa Grass	X						2						
Portulacaceae	<i>Portulaca oleracea</i>	Pigweed						2							
Portulacaceae	<i>Portulaca spp.</i>		X				2				1			2	
Rubiaceae	<i>Pomax umbellata</i>	Pomax											2		
Sapindaceae	<i>Dodonaea viscosa</i>	Sticky Hop-bush												2	
Solanaceae	<i>Solanum nigrum</i>	Black-berry Nightshade	X			1								2	
Solanaceae	<i>Solanum prinophyllum</i>	Forest Nightshade				2									2
Solanaceae	<i>Solanum spp.</i>		X									1			
Thymelaeaceae	<i>Pimelea linifolia</i>	Slender Rice Flower												3	
Verbenaceae	<i>Verbena bonariensis</i>	Purpletop	X			2		2							

Flora two-way table: HVO Sites

Family	Species	Common Name	Exotic	HVORIV2 01402	HVORIV2 01403	HVORIV2 01404	HVORIV2 01405	HVORIV2 01406	HVORIV2 01501	HVORIV2 01502	HVORIV2 01503	HVORIV2 01601	HVOWES 200801	HVOWES 201101	HVOWES 201301
Aizoaceae	<i>Galenia pubescens</i>	Galenia	X		3	2	2	3	2			2	3	3	3
Apocynaceae	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton Bush	X		2				2	2	2				
Asteraceae	<i>Aster spp.</i>		X	2	2		2		2	3	2				3
Asteraceae	<i>Bidens pilosa</i>	Cobbler's Pegs	X					1	2	5	3	2			
Asteraceae	<i>Calotis lappulacea</i>	Yellow Burr-daisy						1							
Asteraceae	<i>Carthamus lanatus</i>	Saffron Thistle	X	2											2
Asteraceae	<i>Centaurea solstitialis</i>	St Barnabys Thistle	X		3	2									2
Asteraceae	<i>Cichorium intybus</i>	Chicory	X						3		3	2			
Asteraceae	<i>Cirsium vulgare</i>	Spear Thistle	X	3	3						2	1			1
Asteraceae	<i>Conyza spp.</i>	A Fleabane	X	3	2		2	4	2	2	2		1		
Asteraceae	<i>Senecio madagascariensis</i>	Fireweed	X	3	3	1	2	2	2	2	2	2			2
Asteraceae	<i>Silybum marianum</i>	Variegated Thistle	X								2	1			
Asteraceae	<i>Sonchus oleraceus</i>	Common Sowthistle	X						2						
Asteraceae	<i>Sonchus spp.</i>	Sowthistle	X	3	2						3	2			
Asteraceae	<i>Tagetes minuta</i>	Stinking Roger	X						2			1			
Asteraceae	<i>Taraxacum officinale</i>	Dandelion	X									1			
Asteraceae	<i>Vittadinia</i>	A Fuzzweed													1

Family	Species	Common Name	Exotic	HVORIV2 01402	HVORIV2 01403	HVORIV2 01404	HVORIV2 01405	HVORIV2 01406	HVORIV2 01501	HVORIV2 01502	HVORIV2 01503	HVORIV2 01601	HVOWES 200801	HVOWES 201101	HVOWES 201301
	<i>muelleri</i>														
Brassicaceae	<i>Brassica rapa</i>		X	2	2				2	2	2	3			4
Brassicaceae	<i>Hirschfeldia incana</i>	Buchan Weed	X												1
Brassicaceae	<i>Lepidium spp.</i>	A Peppergrass	X									2			
Cactaceae	<i>Opuntia stricta</i>	Common Prickly Pear, Smooth Pest Pear	X				2								
Campanulaceae	<i>Wahlenbergia spp.</i>	Bluebell						1		2					
Casuarinaceae	<i>Allocasuarina littoralis</i>	Black She-Oak												3	
Chenopodiaceae	<i>Atriplex semibaccata</i>	Creeping Saltbush				2									
Chenopodiaceae	<i>Chenopodium album</i>	Fat Hen	X			2	3		2						
Chenopodiaceae	<i>Einadia nutans</i>	Climbing Saltbush				2				2	3				
Chenopodiaceae	<i>Einadia trigonos</i>	Fishweed			3						2			4	
Chenopodiaceae	<i>Enchylaena tomentosa</i>	Ruby Saltbush		4	4									4	4
Chenopodiaceae	<i>Salsola spp.</i>			3	3	2			2	2	2				
Chenopodiaceae	<i>Sclerolaena spp.</i>	Copperburr, Poverty-bush						2							
Commelinaceae	<i>Commelina cyanea</i>	Native Wandering Jew				1		1		3					
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed								2					
Fabaceae	<i>Glycine</i>	Twining									1				

Family	Species	Common Name	Exotic	HVORIV2 01402	HVORIV2 01403	HVORIV2 01404	HVORIV2 01405	HVORIV2 01406	HVORIV2 01501	HVORIV2 01502	HVORIV2 01503	HVORIV2 01601	HVOWES 200801	HVOWES 201101	HVOWES 201301
(Faboideae)	<i>clandestina</i>	glycine													
Fabaceae (Faboideae)	<i>Hardenbergia violacea</i>	False Sarsaparilla												1	
Fabaceae (Faboideae)	<i>Indigofera australis</i>	Australian Indigo												4	
Fabaceae (Faboideae)	<i>Medicago sativa</i>	Lucerne	X								3	5			
Fabaceae (Faboideae)	<i>Trifolium spp.</i>	A Clover	X								2				
Fabaceae (Faboideae)	<i>Vicia spp.</i>	Vetch	X									2			
Fabaceae (Mimosoideae)	<i>Acacia amblygona</i>	Fan Wattle									2		4		
Fabaceae (Mimosoideae)	<i>Acacia cultriformis</i>	Knife-leaved Wattle			3										
Fabaceae (Mimosoideae)	<i>Acacia decora</i>	Western Silver Wattle				1					2		3		3
Fabaceae (Mimosoideae)	<i>Acacia decurrens</i>	Black Wattle											5	3	
Fabaceae (Mimosoideae)	<i>Acacia falcata</i>		X								2			2	
Fabaceae (Mimosoideae)	<i>Acacia implexa</i>	Hickory Wattle									3			3	3
Fabaceae (Mimosoideae)	<i>Acacia longifolia</i>													3	
Fabaceae (Mimosoideae)	<i>Acacia paradoxa</i>	Kangaroo Thorn											1		

Family	Species	Common Name	Exotic	HVORIV2 01402	HVORIV2 01403	HVORIV2 01404	HVORIV2 01405	HVORIV2 01406	HVORIV2 01501	HVORIV2 01502	HVORIV2 01503	HVORIV2 01601	HVOWES 200801	HVOWES 201101	HVOWES 201301
)															
Fabaceae (Mimosoideae)	<i>Acacia salicina</i>	Cooba		1	2	1					3		4	4	1
Fabaceae (Mimosoideae)	<i>Acacia saligna</i>	Golden Wreath Wattle	X	3	3	1			1		2	1			
Geraniaceae	<i>Geranium spp.</i>		X									1			
Lomandraceae	<i>Lomandra filiformis</i>	Wattle Matt-rush											2		
Malvaceae	<i>Malva spp.</i>	Mallow	X				2								
Malvaceae	<i>Modiola caroliniana</i>	Red-flowered Mallow	X		2										
Malvaceae	<i>Modiola spp.</i>		X						1						
Malvaceae	<i>Sida corrugata</i>	Corrugated Sida											2		
Malvaceae	<i>Sida rhombifolia</i>	Paddy's Lucerne	X						2		1		3		
Malvaceae	<i>Sida spp.</i>		X						2						
Myoporaceae	<i>Eremophila debilis</i>	Amulla											3		
Myrsinaceae	<i>Anagallis arvensis</i>	Scarlet Pimpernel	X								2	1			
Myrtaceae	<i>Corymbia maculata</i>	Spotted Gum									2		5	5	3
Myrtaceae	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark									1			4	
Myrtaceae	<i>Eucalyptus fibrosa</i>	Red Ironbark												3	3
Myrtaceae	<i>Eucalyptus moluccana</i>	Grey Box			4	2					1			3	3

Family	Species	Common Name	Exotic	HVORIV2 01402	HVORIV2 01403	HVORIV2 01404	HVORIV2 01405	HVORIV2 01406	HVORIV2 01501	HVORIV2 01502	HVORIV2 01503	HVORIV2 01601	HVOWES 200801	HVOWES 201101	HVOWES 201301
Oleaceae	<i>Notelaea microcarpa</i>	Native Olive												1	
Plantaginaceae	<i>Plantago lanceolata</i>	Lamb's Tongues	X		2				2	2	2	2	1		2
Poaceae	<i>Aristida spp.</i>	A Wiregrass							1						
Poaceae	<i>Aristida vagans</i>	Threeawn Speargrass											2		
Poaceae	<i>Austrostipa bigeniculata</i>	Yanganbil									3				
Poaceae	<i>Austrostipa spp.</i>	A Speargrass							2						
Poaceae	<i>Austrostipa verticillata</i>	Slender Bamboo Grass									2		4	3	3
Poaceae	<i>Avena spp.</i>	Oats	X				1		2						
Poaceae	<i>Bothriochloa macra</i>	Red Grass		2					3		4			2	4
Poaceae	<i>Bromus spp.</i>	A Brome	X												2
Poaceae	<i>Capillipedium spicigerum</i>	Scented-top Grass									3				
Poaceae	<i>Chloris gayana</i>	Rhodes Grass	X	3	5				2		3	1	3	2	3
Poaceae	<i>Chloris truncata</i>	Windmill Grass		2				2	2		3				2
Poaceae	<i>Chloris ventricosa</i>	Tall Chloris							2						
Poaceae	<i>Cymbopogon refractus</i>	Barbed Wire Grass							2				2	2	
Poaceae	<i>Cynodon dactylon</i>	Common Couch		2	3	2					3				
Poaceae	<i>Digitaria brownii</i>	Cotton Panic Grass							2						
Poaceae	<i>Digitaria</i>	Umbrella					4								

Family	Species	Common Name	Exotic	HVORIV2 01402	HVORIV2 01403	HVORIV2 01404	HVORIV2 01405	HVORIV2 01406	HVORIV2 01501	HVORIV2 01502	HVORIV2 01503	HVORIV2 01601	HVOWES 200801	HVOWES 201101	HVOWES 201301
	<i>divaricatissima</i>	Grass													
Poaceae	<i>Digitaria spp.</i>	A Finger Grass	X						2						
Poaceae	<i>Echinochloa colona</i>	Awnless Barnyard Grass						3		2					
Poaceae	<i>Echinochloa spp.</i>		X	2			2				2				
Poaceae	<i>Eragrostis curvula</i>	African Lovegrass	X											3	2
Poaceae	<i>Eragrostis leptostachya</i>	Paddock Lovegrass			2								1		
Poaceae	<i>Eragrostis spp.</i>	A Lovegrass	X						2						
Poaceae	<i>Eriochloa pseudoacrotricha</i>	Early Spring Grass				2		2							
Poaceae	<i>Eriochloa spp.</i>	A Cupgrass							2	2	2	2			
Poaceae	<i>Lachnagrostis spp.</i>							2							
Poaceae	<i>Lolium perenne</i>	Perennial Ryegrass	X				1								
Poaceae	<i>Lolium spp.</i>	A Ryegrass	X						2						
Poaceae	<i>Panicum effusum</i>	Hairy Panic		4	4	2		2	2		2		1		2
Poaceae	<i>Panicum maximum</i>	Guinea Grass	X									2			
Poaceae	<i>Paspalidium spp.</i>								2		1				
Poaceae	<i>Paspalum dilatatum</i>	Paspalum	X						2						
Poaceae	<i>Pennisetum glaucum</i>	Pearl Millet	X	2				2		2	3				
Poaceae	<i>Rytidosperma</i>				3				2		2		2	3	4

Family	Species	Common Name	Exotic	HVORIV2 01402	HVORIV2 01403	HVORIV2 01404	HVORIV2 01405	HVORIV2 01406	HVORIV2 01501	HVORIV2 01502	HVORIV2 01503	HVORIV2 01601	HVOWES 200801	HVOWES 201101	HVOWES 201301
	<i>spp.</i>														
Poaceae	<i>Setaria parviflora</i>		X					2	2	4	4				
Poaceae	<i>Sporobolus creber</i>	Slender Rat's Tail Grass											1		3
Poaceae	<i>Themeda triandra</i>													3	
Poaceae	<i>Triticum spp.</i>		X									3			
Poaceae	<i>Urochloa panicoides</i>	Urochloa Grass	X					1							
Poaceae	<i>Urochloa spp.</i>		X						2						
Polygonaceae	<i>Rumex crispus</i>	Curled Dock	X		1										
Portulacaceae	<i>Portulaca spp.</i>		X			1									
Proteaceae	<i>Hakea sericea</i>	Needlebush												2	
Rosaceae	<i>Rubus fruticosus</i>	Blackberry complex	X						2						
Rubiaceae	<i>Pomax umbellata</i>	Pomax							2						
Solanaceae	<i>Solanum nigrum</i>	Black-berry Nightshade	X		2				2	3	3	1			2
Solanaceae	<i>Solanum prinophyllum</i>	Forest Nightshade										1			
Verbenaceae	<i>Verbena bonariensis</i>	Purpletop	X	1		2			2						2

Flora two-way table: HVO Sites

Family	Species	Common Name	Exotic	HVOWES2 01302	HVOWES2 01601	HVOWES2 01602	HVOWES2 01603	HVOWES2 01604
--------	---------	-------------	--------	---------------	---------------	---------------	---------------	---------------

Family	Species	Common Name	Exotic	HVOWES2 01302	HVOWES2 01601	HVOWES2 01602	HVOWES2 01603	HVOWES2 01604
Aizoaceae	<i>Galenia pubescens</i>	Galenia	X	2	2	2	5	2
Apocynaceae	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton Bush	X		1	2	1	3
Asteraceae	<i>Aster</i> spp.		X	2			2	
Asteraceae	<i>Bidens pilosa</i>	Cobbler's Pegs	X		2	2	5	
Asteraceae	<i>Calotis lappulacea</i>	Yellow Burr-daisy				1		
Asteraceae	<i>Carthamus lanatus</i>	Saffron Thistle	X					2
Asteraceae	<i>Cichorium intybus</i>	Chicory	X		2			
Asteraceae	<i>Cirsium vulgare</i>	Spear Thistle	X			2	1	1
Asteraceae	<i>Conyza</i> spp.	A Fleabane	X	3		2	2	
Asteraceae	<i>Senecio madagascariensis</i>	Fireweed	X1		2		1	
Asteraceae	<i>Sonchus</i> spp.	Sowthistle	X					2
Asteraceae	<i>Tagetes minuta</i>	Stinking Roger	X		2	1	1	
Asteraceae	<i>Taraxacum officinale</i>	Dandelion	X			1		
Asteraceae	<i>Vittadinia cuneata</i>	A Fuzzweed				1		
Asteraceae	<i>Xanthium occidentale</i>	Noogoora Burr	X		2	3		
Asteraceae	<i>Xanthium spinosum</i>	Bathurst Burr	X				1	
Boraginaceae	<i>Heliotropium amplexicaule</i>	Blue Heliotrope	X					3
Brassicaceae	<i>Brassica rapa</i>		X	4	1			4

Family	Species	Common Name	Exotic	HVOWES2 01302	HVOWES2 01601	HVOWES2 01602	HVOWES2 01603	HVOWES2 01604
Campanulaceae	<i>Wahlenbergia communis</i>	Tufted Bluebell				2		
Chenopodiaceae	<i>Atriplex</i> spp.	A Saltbush			1	2		
Chenopodiaceae	<i>Einadia nutans</i>	Climbing Saltbush		2			3	2
Chenopodiaceae	<i>Einadia trigonos</i>	Fishweed		2	1			
Chenopodiaceae	<i>Enchylaena tomentosa</i>	Ruby Saltbush		4				
Chenopodiaceae	<i>Salsola</i> spp.					2		2
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed				1		2
Euphorbiaceae	<i>Ricinus communis</i>	Castor Oil Plant	X					2
Fabaceae (Faboideae)	<i>Daviesia genistifolia</i>	Broom Bitter Pea				2		
Fabaceae (Faboideae)	<i>Daviesia ulicifolia</i>	Gorse Bitter Pea				1		
Fabaceae (Faboideae)	<i>Desmodium brachypodium</i>	Large Tick-trefoil				1		
Fabaceae (Faboideae)	<i>Glycine tabacina</i>	Variable Glycine				1		
Fabaceae (Faboideae)	<i>Hardenbergia violacea</i>	False Sarsaparilla				1	1	1
Fabaceae (Faboideae)	<i>Indigofera australis</i>	Australian Indigo				2	2	
Fabaceae (Faboideae)	<i>Medicago sativa</i>	Lucerne	X					1
Fabaceae (Faboideae)	<i>Trifolium repens</i>	White Clover	X				2	1
Fabaceae	<i>Acacia</i>	Fan Wattle			1	2	2	2

Family	Species	Common Name	Exotic	HVOWES2 01302	HVOWES2 01601	HVOWES2 01602	HVOWES2 01603	HVOWES2 01604
(Mimosoideae)	<i>amblygona</i>							
Fabaceae (Mimosoideae)	<i>Acacia cultriformis</i>	Knife-leaved Wattle				2		
Fabaceae (Mimosoideae)	<i>Acacia decora</i>	Western Silver Wattle			1	2	3	2
Fabaceae (Mimosoideae)	<i>Acacia falcata</i>					2	2	
Fabaceae (Mimosoideae)	<i>Acacia filicifolia</i>	Fern-leaved Wattle					2	3
Fabaceae (Mimosoideae)	<i>Acacia implexa</i>	Hickory Wattle					1	
Fabaceae (Mimosoideae)	<i>Acacia longifolia</i>					1		
Fabaceae (Mimosoideae)	<i>Acacia paradoxa</i>	Kangaroo Thorn				2		
Fabaceae (Mimosoideae)	<i>Acacia parvipinnula</i>	Silver-stemmed Wattle				2		
Fabaceae (Mimosoideae)	<i>Acacia salicina</i>	Cooba						1
Fabaceae (Mimosoideae)	<i>Acacia spectabilis</i>	Mudgee Wattle			2	2	2	3
Gentianaceae	<i>Centaurium</i> spp.		X	2				
Geraniaceae	<i>Erodium cicutarium</i>	Common Crowfoot	X			2		

Family	Species	Common Name	Exotic	HVOWES2 01302	HVOWES2 01601	HVOWES2 01602	HVOWES2 01603	HVOWES2 01604
Geraniaceae	<i>Erodium crinitum</i>	Blue Crowfoot						4
Geraniaceae	<i>Erodium spp.</i>	Crowfoot	X		1			
Geraniaceae	<i>Geranium solanderi</i>	Native Geranium					1	
Malvaceae	<i>Modiola caroliniana</i>	Red-flowered Mallow	X		1		2	2
Malvaceae	<i>Sida cardiophylla</i>							1
Malvaceae	<i>Sida rhombifolia</i>	Paddy's Lucerne	X		2		2	4
Myoporaceae	<i>Eremophila debilis</i>	Amulla				1		
Myrsinaceae	<i>Anagallis arvensis</i>	Scarlet Pimpernel	X		2	2	2	3
Myrtaceae	<i>Angophora floribunda</i>	Rough-barked Apple				1		
Myrtaceae	<i>Corymbia maculata</i>	Spotted Gum				2	2	
Myrtaceae	<i>Eucalyptus moluccana</i>	Grey Box				2	1	
Myrtaceae	<i>Eucalyptus spp.</i>						1	
Oxalidaceae	<i>Oxalis perennans</i>				1		1	
Phytolaccaceae	<i>Phytolacca octandra</i>	Inkweed	X				1	1
Plantaginaceae	<i>Plantago lanceolata</i>	Lamb's Tongues	X	3	1	2	2	2
Poaceae	<i>Aira cupaniana</i>	Silvery Hairgrass	X		2			
Poaceae	<i>Aristida ramosa</i>	Purple Wiregrass					1	

Family	Species	Common Name	Exotic	HVOWES2 01302	HVOWES2 01601	HVOWES2 01602	HVOWES2 01603	HVOWES2 01604
Poaceae	<i>Austrostipa bigeniculata</i>	Yanganbil				2	2	
Poaceae	<i>Austrostipa scabra</i>	Speargrass				2	3	
Poaceae	<i>Bothriochloa macra</i>	Red Grass				2	2	2
Poaceae	<i>Capillipedium spicigerum</i>	Scented-top Grass			2	3	2	
Poaceae	<i>Chloris gayana</i>	Rhodes Grass	X	4	3	2	2	2
Poaceae	<i>Chloris truncata</i>	Windmill Grass		4	2	2	3	2
Poaceae	<i>Chloris ventricosa</i>	Tall Chloris		3		2		
Poaceae	<i>Chloris virgata</i>	Feathertop Rhodes Grass	X		2		2	
Poaceae	<i>Cymbopogon refractus</i>	Barbed Wire Grass				2		1
Poaceae	<i>Cynodon dactylon</i>	Common Couch				1	3	
Poaceae	<i>Dichanthium sericeum</i>	Queensland Bluegrass			3		4	
Poaceae	<i>Dichanthium setosum</i>	Bluegrass						4
Poaceae	<i>Digitaria</i> spp.	A Finger Grass	X		2			
Poaceae	<i>Echinochloa colona</i>	Awnless Barnyard Grass			2			
Poaceae	<i>Eleusine</i> spp.		X				1	
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass						2
Poaceae	<i>Eragrostis</i> spp.	A Lovegrass	X			2		
Poaceae	<i>Eriochloa</i>	Early Spring		6				

Family	Species	Common Name	Exotic	HVOWES2 01302	HVOWES2 01601	HVOWES2 01602	HVOWES2 01603	HVOWES2 01604
	<i>pseudoacroticha</i>	Grass						
Poaceae	<i>Eriochloa</i> spp.	A Cupgrass			2	2		2
Poaceae	<i>Melinis repens</i>	Red Natal Grass	X			1		
Poaceae	<i>Panicum capillare</i>	Witchgrass	X			2		
Poaceae	<i>Panicum effusum</i>	Hairy Panic					2	2
Poaceae	<i>Panicum maximum</i>	Guinea Grass		2	3		1	4
Poaceae	<i>Paspalidium distans</i>					2		
Poaceae	<i>Paspalidium</i> spp.							2
Poaceae	<i>Paspalum dilatatum</i>	Paspalum				1	2	2
Poaceae	<i>Paspalum quadrifarium</i>	Tussock Paspalum			2			
Poaceae	<i>Pennisetum clandestinum</i>	Kikuyu Grass			2		2	2
Poaceae	<i>Pennisetum glaucum</i>	Pearl Millet	X			1	2	
Poaceae	<i>Rytidosperma</i> spp.					2	3	
Poaceae	<i>Setaria parviflora</i>		X		3		5	
Poaceae	<i>Sporobolus creber</i>	Slender Rat's Tail Grass		4				
Poaceae	<i>Themeda avenacea</i>	Native Oatgrass				1	1	
Poaceae	<i>Urochloa</i> spp.		X				2	2

Family	Species	Common Name	Exotic	HVOWES2 01302	HVOWES2 01601	HVOWES2 01602	HVOWES2 01603	HVOWES2 01604
Solanaceae	Solanum nigrum	Black-berry Nightshade	X			2	2	2
Solanaceae	Solanum prinophyllum	Forest Nightshade			2	2	3	3
Verbenaceae	Verbena bonariensis	Purpletop	X	2		2	2	

Flora two-way table: Reference sites

Family	Species	Common Name	Exotic *	BEL1	BEL2	BEL3	WAMBO G1	WAMBO GB2	WAMBO SPOT1	WAMBO SPOT2	WAMBO SPOT3	WARK GB01	WARK GB02	WARK GB03	WARK GB04
Acanthaceae	<i>Pseuderanthemum variabile</i>	Pastel Flower		1			2								
Adiantaceae	<i>Cheilanthes sieberi</i>	Rock Fern			1	1	2						2		
Aizoaceae	<i>Galenia pubescens</i>	Galenia	*												3
Amaranthaceae	<i>Alternanthera spp.</i>	Joyweed											1		3
Anthericaceae	<i>Dichopogon spp.</i>	Chocolate Lily					2			1			3		
Anthericaceae	<i>Laxmannia gracilis</i>	Slender Wire Lily		2										3	
Asteraceae	<i>Calotis cuneifolia</i>	Purple Burr-Daisy				2						2			
Asteraceae	<i>Calotis lappulacea</i>	Yellow Burr-daisy			3								2		
Asteraceae	<i>Cassinia uncata</i>	Sticky Cassinia										2	1		
Asteraceae	<i>Chrysocephalum apiculatum</i>	Common Everlasting						2					1		
Asteraceae	<i>Olearia elliptica</i>	Sticky Daisy-bush		4			4	1	3	5	3		1		
Asteraceae	<i>Ozothamnus diosmifolius</i>	White Dogwood													1
Asteraceae	<i>Senecio madagascariensis</i>	Fireweed	*		1		2	2				2	2	2	3
Asteraceae	<i>Senecio sp. E</i>				2							2			
Asteraceae	<i>Vittadinia cuneata</i>	A Fuzzweed		2			2					2	2		
Asteraceae	<i>Vittadinia sulcata</i>				3										2
Bignoniaceae	<i>Pandorea pandorana</i>	Wonga Vine								1					
Cactaceae	<i>Opuntia aurantiaca</i>	Tiger Pear	*										2	2	2
Cactaceae	<i>Opuntia stricta</i>	Common Prickly Pear, Smooth Pest Pear	*				2	2	2			4	1		
Campanulaceae	<i>Wahlenbergia spp.</i>	Bluebell					2	2			1		2		
Casuarinaceae	<i>Allocasuarina luehmannii</i>	Bullock					5					4	5	5	3
Chenopodiaceae	<i>Einadia hastata</i>	Berry Saltbush										1			
Chenopodiaceae	<i>Einadia nutans</i>	Climbing Saltbush											1		
Chenopodiaceae	<i>Einadia trigonos</i>	Fishweed										2			

Family	Species	Common Name	Exotic *	BEL1	BEL2	BEL3	WAMBO G1	WAMBO GB2	WAMBO SPOT1	WAMBO SPOT2	WAMBO SPOT3	WARK GB01	WARK GB02	WARK GB03	WARK GB04
Chenopodiaceae	<i>Enchylaena tomentosa</i>	Ruby Saltbush													1
Clusiaceae	<i>Hypericum gramineum</i>	Small St John's Wort											1		
Commelinaceae	<i>Commelina cyanea</i>	Native Wandering Jew								2	1		3	3	3
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed											1		
Cyperaceae	<i>Carex inversa</i>	Knob Sedge					2						2		
Cyperaceae	<i>Cyperus gracilis</i>	Slender Flat-sedge												1	
Cyperaceae	<i>Gahnia aspera</i>	Rough Saw-sedge		2	3	3		2	2		2		1		
Cyperaceae	<i>Lepidosperma laterale</i>	Variable Sword-sedge		3	4										
Dilleniaceae	<i>Hibbertia spp.</i>								2						
Ericaceae	<i>Lissanthe strigosa</i>	Peach Heath		3	3	2									
Euphorbiaceae	<i>Amperea xiphioclada</i>										3	4			
Fabaceae (Faboideae)	<i>Daviesia genistifolia</i>	Broom Bitter Pea												2	
Fabaceae (Faboideae)	<i>Daviesia ulicifolia</i>	Gorse Bitter Pea												2	3
Fabaceae (Faboideae)	<i>Desmodium brachypodium</i>	Large Tick-trefoil					2	2	2	3					
Fabaceae (Faboideae)	<i>Desmodium varians</i>	Slender Tick-trefoil		2		3	2	2	2	3	2	2	2	3	
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	Twining glycine									2	1	3		
Fabaceae (Faboideae)	<i>Glycine tabacina</i>	Variable Glycine		2	3	3			2			2	3	3	
Fabaceae (Faboideae)	<i>Hardenbergia violacea</i>	False Sarsaparilla		3											
Fabaceae (Faboideae)	<i>Hovea linearis</i>								1						
Fabaceae (Faboideae)	<i>Pultenaea spinosa</i>	A Bush Pea		3	3										
Fabaceae (Mimosoideae)	<i>Acacia amblygona</i>	Fan Wattle		3				3		3				3	5
Fabaceae (Mimosoideae)	<i>Acacia bulgaensis</i>	Bulga Wattle							4						
Fabaceae (Mimosoideae)	<i>Acacia decora</i>	Western Silver Wattle						2							
Fabaceae	<i>Acacia decurrens</i>	Black Wattle											1		

Family	Species	Common Name	Exotic *	BEL1	BEL2	BEL3	WAMBO G1	WAMBO GB2	WAMBO SPOT1	WAMBO SPOT2	WAMBO SPOT3	WARK GB01	WARK GB02	WARK GB03	WARK GB04
(Mimosoideae)															
Fabaceae (Mimosoideae)	<i>Acacia falcata</i>			3	4	2		3							2
Fabaceae (Mimosoideae)	<i>Acacia implexa</i>	Hickory Wattle					2		3		4	3			
Fabaceae (Mimosoideae)	<i>Acacia mearnsii</i>	Black Wattle		3	4	2									
Fabaceae (Mimosoideae)	<i>Acacia salicina</i>	Cooba													1
Fabaceae (Mimosoideae)	<i>Acacia saligna</i>	Golden Wreath Wattle	*				2	2				1			
Goodeniaceae	<i>Goodenia rotundifolia</i>			1											
Juncaceae	<i>Juncus prismatocarpus</i>						1	2							
Lauraceae	<i>Cassytha pubescens</i>	Downy Dodder-laurel									2				
Lomandraceae	<i>Lomandra filiformis</i>	Wattle Matt-rush			4	5	2	2		2			2		2
Lomandraceae	<i>Lomandra filiformis subsp. filiformis</i>							2	2	2					
Lomandraceae	<i>Lomandra glauca</i>	Pale Mat-rush												2	3
Lomandraceae	<i>Lomandra multiflora</i>	Many-flowered Mat-rush			2			2	2		2	2			
Luzuriagaceae	<i>Geitonoplesium cymosum</i>	Scrambling Lily								2					
Malvaceae	<i>Sida corrugata</i>	Corrugated Sida					3	2	2	2		3	2		
Malvaceae	<i>Sida rhombifolia</i>	Paddy's Lucerne	*												2
Myoporaceae	<i>Eremophila debilis</i>	Amulla				1						3	2		2
Myrsinaceae	<i>Rapanea howittiana</i>	Brush Muttonwood									2				
Myrtaceae	<i>Corymbia maculata</i>	Spotted Gum		5	5	5				5	4				
Myrtaceae	<i>Eucalyptus amplifolia</i>	Cabbage Gum												5	
Myrtaceae	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark		4			2		4		4	5	5	4	4
Myrtaceae	<i>Eucalyptus fibrosa</i>	Red Ironbark				4	4								
Myrtaceae	<i>Eucalyptus moluccana</i>	Grey Box		3	4	5	3	5		5					
Myrtaceae	<i>Eucalyptus punctata</i>	Grey Gum							5		3				

Family	Species	Common Name	Exotic *	BEL1	BEL2	BEL3	WAMBO G1	WAMBO GB2	WAMBO SPOT1	WAMBO SPOT2	WAMBO SPOT3	WARK GB01	WARK GB02	WARK GB03	WARK GB04
Myrtaceae	<i>Melaleuca decora</i>													4	
Oleaceae	<i>Notelaea longifolia</i>	Large Mock-olive						2	3	2	2	3			
Oleaceae	<i>Notelaea microcarpa</i>	Native Olive						4							
Oleaceae	<i>Olea europaea</i>	Common Olive	*	3	3	5									
Oxalidaceae	<i>Oxalis perennans</i>													1	
Phormiaceae	<i>Dianella longifolia</i>	Blueberry Lily			1										
Phormiaceae	<i>Dianella longifolia</i> var. <i>longifolia</i>	A Blue Flax Lily				2	2			2			1		
Phormiaceae	<i>Dianella revoluta</i>	Blueberry Lily		3	3	4	2				2			2	3
Phyllanthaceae	<i>Breynia oblongifolia</i>	Coffee Bush			4	3			2		2	3	2	2	
Phyllanthaceae	<i>Phyllanthus gunnii</i>														1
Phyllanthaceae	<i>Phyllanthus hirtellus</i>	Thyme Spurge											1	1	
Pittosporaceae	<i>Bursaria spinosa</i>	Native Blackthorn		4		3			4	4	4		3	3	
Plantaginaceae	<i>Veronica plebeia</i>	Trailing Speedwell					2							2	
Poaceae	<i>Aristida ramosa</i>	Purple Wiregrass			2	3	4	3		2			4		
Poaceae	<i>Aristida vagans</i>	Threeawn Speargrass		3	1	2		2	3	3	3	4	4	5	4
Poaceae	<i>Austrostipa scabra</i>	Speargrass		2			4	2		2		3	3		
Poaceae	<i>Austrostipa verticillata</i>	Slender Bamboo Grass						2	4		4				
Poaceae	<i>Chloris truncata</i>	Windmill Grass								2					3
Poaceae	<i>Chloris ventricosa</i>	Tall Chloris						2		2					
Poaceae	<i>Cymbopogon refractus</i>	Barbed Wire Grass		3	4	3	4	3	4	4	3	4	3	5	5
Poaceae	<i>Cynodon dactylon</i>	Common Couch												3	
Poaceae	<i>Entolasia marginata</i>	Bordered Panic		2											
Poaceae	<i>Entolasia stricta</i>	Wiry Panic			4	4	2				2		5	4	
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass						2						3	3
Poaceae	<i>Microlaena stipoides</i>	Weeping Grass				2									
Poaceae	<i>Oplismenus aemulus</i>										1				
Poaceae	<i>Panicum effusum</i>	Hairy Panic						2		2					

Family	Species	Common Name	Exotic *	BEL1	BEL2	BEL3	WAMBO G1	WAMBO GB2	WAMBO SPOT1	WAMBO SPOT2	WAMBO SPOT3	WARK GB01	WARK GB02	WARK GB03	WARK GB04
Poaceae	<i>Rytidosperma spp.</i>					2	4	3	2	4	2	3	4	3	3
Poaceae	<i>Sporobolus creber</i>	Slender Rat's Tail Grass													3
Poaceae	<i>Themeda triandra</i>											2	4		
Proteaceae	<i>Grevillea mucronulata</i>									2					
Proteaceae	<i>Persoonia linearis</i>	Narrow-leaved Geebung							3		3				
Ranunculaceae	<i>Clematis aristata</i>	Old Man's Beard									1				
Rubiaceae	<i>Pomax umbellata</i>	Pomax		2		2									
Rutaceae	<i>Boronia pinnata</i>									1					
Santalaceae	<i>Exocarpos cupressiformis</i>	Cherry Ballart							4			3	1		
Sapindaceae	<i>Dodonaea viscosa</i>	Sticky Hop-bush						2	3	2	4				
Solanaceae	<i>Solanum prinophyllum</i>	Forest Nightshade				1			2			2	1		
Sterculiaceae	<i>Brachychiton populneus</i>	Kurrajong						1	1	1	1				
Sterculiaceae	<i>Lasiopetalum spp.</i>								1						
Verbenaceae	<i>Lantana camara</i>	Lantana	*									1			
Zamiaceae	<i>Macrozamia flexuosa</i>								3	3	4				

Appendix 5 – Visual and Photo Monitoring

HVORIV201503

HVORIV201503	MGA 84 Zone 56	
Position	Easting	Northing
Start transect:	311249	6398378
End transect:	311216	6398340

Description:

The HVORIV201503 rehabilitation area occurs on imported topsoil and compost with a second application of gypsum and compost.

The dominant species, including the structure of the site, is provided in the table below.

Disturbance:

Disturbance present at the rehabilitation site consisted mainly of weeds, and grazing by macropods. No evidence of fire was observed in the rehabilitation area. No areas containing rubbish were observed.

Common weeds recorded at the site included *Aster sp.*, *Chloris gayana*, *Pennisetum glaucum*, *Sonchus spp.*, *Setaria parviflora*, *Cichorium intybus*, *Solanum nigrum* and *Bidens pilosa*.

Table. Dominant species and structure at HVORIV201503

Stratum	Height	% cover*	Dominant native species
Tree layer	-	-	-
Midstorey layer	-	-	-
Shrub layer	1.5	<5	<i>Acacia amblygona</i> , <i>Acacia decora</i> , <i>Corymbia maculata</i> , <i>Acacia implexa</i> , <i>Acacia falcata</i>
Ground layer	1	30	<i>Bothriochloa macra</i> , <i>Rytidosperma spp.</i> , <i>Chloris truncata</i> , <i>Austrostipa bigeniculata</i> , <i>Einadia nutans</i> , <i>Cynodon dactylon</i> , <i>Capillipedium spicigerum</i>

*Projected foliage cover

Site photographs at HVORIV201503

Start position 2017



End position 2017



HVORIV201502

HVORIV201502	MGA 84 Zone 56	
Position	Easting	Northing
Start transect:	311543	6398308
End transect:	311526	6398260

Description:

The HVORIV201502 rehabilitation area occurs on imported topsoil and compost.

The dominant species, including the structure of the site, is provided in the table below.

Disturbance:

Disturbance present at the rehabilitation site consisted mainly of weeds, and grazing by macropods. No evidence of fire was observed in the rehabilitation area. No areas containing rubbish were observed.

Site has been weed wiped to kill weeds and reduce competition with natives sown in 2016.

Common weeds recorded at the site included *Aster sp.*, *Solanum nigrum*, *Plantago lanceolata*, *Conyza bonariensis* and *Bidens pilosa*.

Table. Dominant species and structure at HVORIV201502

Stratum	Height	% cover*	Dominant native species
Tree layer	-	-	-
Midstorey layer	-	-	-
Shrub layer	-	-	-
Ground layer	1	15	<i>Commelina cyanea</i> , <i>Dichondra repens</i> , <i>Einadia nutans</i>

*Projected foliage cover

Site photographs at HVORIV201502

Start position 2017



End position 2017



HVORIV201501

HVORIV201501	MGA 84 Zone 56	
Position	Easting	Northing
Start transect:	312211	6398020
End transect:	312256	6397998

Description:

HVORIV201501 rehabilitation area occurs on imported topsoil and compost.

The dominant species, including the structure of the site, is provided in the table below.

Disturbance:

Disturbance present at the rehabilitation site consists mainly of weeds, and grazing by macropods. No evidence of fire was observed in the rehabilitation area. No areas containing rubbish were observed.

Common weeds recorded at the site included *Acacia saligna*, *Galenia pubescens*, *Plantago lanceolata*, *Conyza bonariensis*, *Senecio madagascariensis* and *Chloris gayana*.

Table. Dominant species and structure at HVORIV201501

Stratum	Height (m)	% cover*	Dominant native species
Tree layer	-	-	-
Midstorey layer	-	-	-
Shrub layer	-	-	-
Ground layer	1	40	<i>Bothriochloa macra</i> , <i>Panicum effusum</i> , <i>Austrostipa</i> sp.

*Projected foliage cover

Site photographs at HVORIV201501

Start position 2017



End position 2017



HVOLEM201501

HVOLEM201501	MGA 84 Zone 56	
Position	Easting	Northing
Start transect:	6394462	316910
End transect:	-	-

Description:

HVOLEM201501 rehabilitation area occurs on a combination of topsoil and compost.

The dominant species, including the structure of the site, is provided in the table below.

Disturbance:

Disturbance present at rehabilitation site HVOLEM201501 consisted mainly of weeds, and grazing by macropods. No evidence of fire was observed in rehabilitation area. No areas containing rubbish were observed.

Common weeds recorded at the site included *Senecio madagascariensis*, *Conyza bonariensis* and *Aster spp.*

Table. Dominant species and structure at HVOLEM201501

Stratum	Height (m)	% cover*	Dominant native species
Tree layer	-	-	-
Midstorey layer	-	-	-
Shrub layer	1.5	<5	<i>Eucalyptus moluccana</i>
Ground layer	1	75	<i>Cynodon dactylon</i> , <i>Bothriochloa macra</i> , <i>Capillipedium spicigerum</i> , <i>Dichanthium sericeum</i> , <i>Sporobolus creber</i> , <i>Chloris truncata</i>

*Projected foliage cover

Site photographs at HVOLEM201501

Start position 2017



End position 2017



HVOCHE201501

HVOCHE201501	MGA 84 Zone 56	
Position	Easting	Northing
Start transect:	313968	6402006
End transect:	313952	6402056

Description:

HVOCHE201501 rehabilitation area occurs on a combination of topsoil and compost.

The dominant species, including the structure of the site, is provided in the table below.

Disturbance:

Disturbance present at rehabilitation site HVOCHE201501 consisted mainly of weeds, and grazing by macropods. No evidence of fire was observed in the rehabilitation area. No areas containing rubbish were observed.

Site has been sprayed to kill weeds and cover crop to prepare for natives to be sown.

Common weeds recorded at the site included *Senecio madagascariensis*, *Anagallis arvensis* and *Hypochaeris radicata*.

Table. Dominant species and structure at HVOCHE201501

Stratum	Height (m)	% cover*	Dominant native species
Tree layer	-	-	-
Midstorey layer	-	-	-
Shrub layer	-	-	
Ground layer	0.5	<5	<i>Oxalis perennans</i> , <i>Geranium solanderi</i>

*Projected foliage cover

Site photographs at HVOCHE201501

Start position 2017



End position 2017



HVORIV201601

HVORIV201601	MGA 84 Zone 56	
Position	Easting	Northing
Start transect:	311284	6398284
End transect:	311314	6398245

Description:

HVORIV201601 rehabilitation area occurs on a combination of topsoil and compost.

The dominant species, including the structure of the site, is provided in the table below.

Disturbance:

Disturbance present at rehabilitation site HVORIV201601 consisted mainly of weeds, and grazing by macropods. No evidence of fire was observed in the rehabilitation area. No areas containing rubbish were observed.

Common weeds recorded at the site included *Medicago sativa*, *Bidens pilosa*, *Senecio madagascariensis*, *Sonchus sp.* and *Brassica spp.*.

Table. Dominant species and structure at HVORIV201601

Stratum	Height (m)	% cover*	Dominant native species
Tree layer	-	-	-
Midstorey layer	-	-	-
Shrub layer	-	-	-
Ground layer	1	<5	<i>Solanum prinophyllum</i> , <i>Echinochloa colona</i> , <i>Geranium solanderi</i>

*Projected foliage cover

Site photographs at HVORIV201601

Start position 2017



End position 2017



HVOWES201602

HVOWES201602	MGA 84 Zone 56	
Position	Easting	Northing
Start transect:	308357	6408560
End transect:	308323	6408597

Description:

HVOWES201602 rehabilitation area occurs on a combination of topsoil and compost.

The dominant species, including the structure of the site, is provided in the table below.

It should be noted that a number of regenerating eucalypts and small acacias were recorded in the plot.

Disturbance:

Disturbance present at rehabilitation site HVOWES201602 consisted mainly of weeds, and grazing by macropods. No evidence of fire was observed in the rehabilitation area. No areas containing rubbish were observed.

Common weeds recorded at the site included *Galenia pubescens*, *Plantago lanceolata*, *Senecio mada gascariensis*, *Gomphocarpus fruticosus*, *Melinis repens*, *Pennisetum glaucum* and *Solanum nigrum*.

Table. Dominant species and structure at HVOWES201602

Stratum	Height (m)	% cover*	Dominant native species
Tree layer	-	-	-
Midstorey layer	-	-	-
Shrub layer	1.5	30	<i>Acacia falcata</i> , <i>acacia cultriformis</i> , <i>Acacia paradoxa</i> , <i>Eucalyptus moluccana</i> , <i>Corymbia maculate</i> , <i>Acacia decora</i>
Ground layer	1	50	<i>Capillipedium spicigerum</i> , <i>Dichondra repens</i> , <i>Wahlenbergia communis</i> , <i>Austrostipa scabra</i> , <i>Themeda avenacea</i>

*Projected foliage cover

Site photographs at HVOWES201602

Start position 2017



End position 2017



HVOWES201601

HVOWES201601	MGA 84 Zone 56	
Position	Easting	Northing
Start transect:	309820	6410903
End transect:	-	-

Description:

HVOWES201601 rehabilitation area occurs on a combination of spoil and compost.

The dominant species, including the structure of the site, is provided in the table below.

It should be noted that a number of acacias were also recorded regenerating in the plot.

Disturbance:

Disturbance present at rehabilitation site HVOWES201601 consisted mainly of weeds, and grazing by macropods. No evidence of fire was observed in the rehabilitation area. No areas containing rubbish were observed.

Common weeds recorded at the site included *Chloris gayana*, *Galenia pubescens*, *Bidens pilosa*, *Senecio mada gascariensis*, *Gomphocarpous fruticosus*, *Panicum maximum*, *Sida rhombifolia* and *Solanum nigrum*.

Table. Dominant species and structure at HVOWES201601

Stratum	Height (m)	% cover*	Dominant native species
Tree layer	-	-	-
Midstorey layer	-	-	-
Shrub layer	1.5	<5	<i>Acacia spectabilis</i> , <i>Acacia decora</i> , <i>Acacia amblygona</i>
Ground layer	1	25	<i>Capillipedium spicigerum</i> , <i>Solanum prinophyllum</i> , <i>Chloris truncata</i> , <i>Eriochloa pseudoacrotricha</i> , <i>Atriplex semibaccata</i>

*Projected foliage cover

Site photographs at HVOWES201601

Start position 2017



End position 2017



HVOWES201603

HVOWES201603	MGA 84 Zone 56	
Position	Easting	Northing
Start transect:	309354	6409944
End transect:	309385	6409903

Description:

HVOWES201603 rehabilitation area occurs on a combination of topsoil and compost. The compost that was applied to this area is a composted green waste rather than the mixed source compost typically used in rehabilitation at HVO.

The dominant species, including the structure of the site, is provided in the table below.

Disturbance:

Disturbance present at rehabilitation site HVOWES201603 consisted mainly of weeds, and grazing by macropods. No evidence of fire was observed in the rehabilitation area. No areas containing rubbish were observed.

Common weeds recorded at the site included *Conyza bonariensis*, *Chloris gayana*, *Setaria parviflora*, *Verbena bonariensis*, *Galenia pubescens*, *Bidens pilosa*, *Senecio mada gascariensis*, *Gomphocarpous fruticosus*, *Panicum maximum*, *Plantago lanceolata*, *Sida rhombifolia* and *Solanum nigrum*.

Table. Dominant species and structure at HVOWES201603

Stratum	Height (m)	% cover*	Dominant native species
Tree layer	-	-	-
Midstorey layer	-	-	-
Shrub layer	1.5	<5	<i>Acacia decora</i> , <i>Acacia falcata</i> , <i>Acacia filicifolia</i> , <i>Acacia amblygona</i>
Ground layer	1	30	<i>Einadia nutans</i> , <i>Austrostipa bigeniculata</i> , <i>Austrostipa scabra</i> , <i>Chloris truncata</i> , <i>Rytidosperma spp.</i> , <i>Cynodon dactylon</i> , <i>Dichanthium sericeum</i>

*Projected foliage cover

Site photographs at HVOWES201603

Start position 2017



End position 2017



HVOWES201604

HVOWES201604	MGA 84 Zone 56	
Position	Easting	Northing
Start transect:	307372	6407327
End transect:	307394	6407374

Description:

HVOWES201604 rehabilitation area occurs on a combination of topsoil, compost and trail of composted green waste.

The dominant species, including the structure of the site, is provided in the table below.

Disturbance:

Disturbance present at rehabilitation site HVOWES201604 consisted mainly of weeds, and grazing by macropods. No evidence of fire was observed in the rehabilitation area. No areas containing rubbish were observed.

Common weeds recorded at the site included *Chloris gayana*, *Anagallis arvensis*, *Galenia pubescens*, *Gomphocarpus fruticosus*, *Panicum maximum*, *Heliotropium amplexicaule*, *Sida rhombifolia*, *Brassica rapa* and *Erodium cicutarium*.

Table. Dominant species and structure at HVOWES201604

Stratum	Height (m)	% cover*	Dominant native species
Tree layer	-	-	-
Midstorey layer	-	-	-
Shrub layer	1.5	<5	<i>Acacia decora</i> , <i>Acacia filicifolia</i> , <i>Acacia amblygona</i> , <i>Acacia spectabilis</i>
Ground layer	1	30	<i>Solanum prinophyllum</i> , <i>Einadia nutans</i> , <i>Dichondra repens</i> , <i>Chloris truncata</i> , <i>Dichanthium sericeum</i>

*Projected foliage cover

Site photographs at HVOWES201604

Start position 2017



End position 2017



HVOCHE201601

HVOCHE201601	MGA 84 Zone 56	
Position	Easting	Northing
Start transect:	313555	6401634
End transect:	313541	6401683

Description:

HVOCHE201601 rehabilitation area occurs on a combination of topsoil and compost.

The dominant species, including the structure of the site is provided in the table below.

Disturbance:

Disturbance present at rehabilitation site HVOCHE201601 consisted mainly of weeds, and grazing by macropods. No evidence of fire was observed in the rehabilitation area. No areas containing rubbish were observed.

Site has been sprayed to kill weeds and cover crop to prepare for natives to be sown.

Common weeds recorded at the site included *Conyza bonariensis*, *Galenia pubescens*, *Senecio madagascariensis* and *Sida rhombifolia*.

Table. Dominant species and structure at HVOCHE201601

Stratum	Height (m)	% cover*	Dominant native species
Tree layer	-	-	-
Midstorey layer	-	-	-
Shrub layer	-	-	-
Ground layer	1	<5	<i>Panicum effusum</i> , <i>Cynodon dactylon</i>

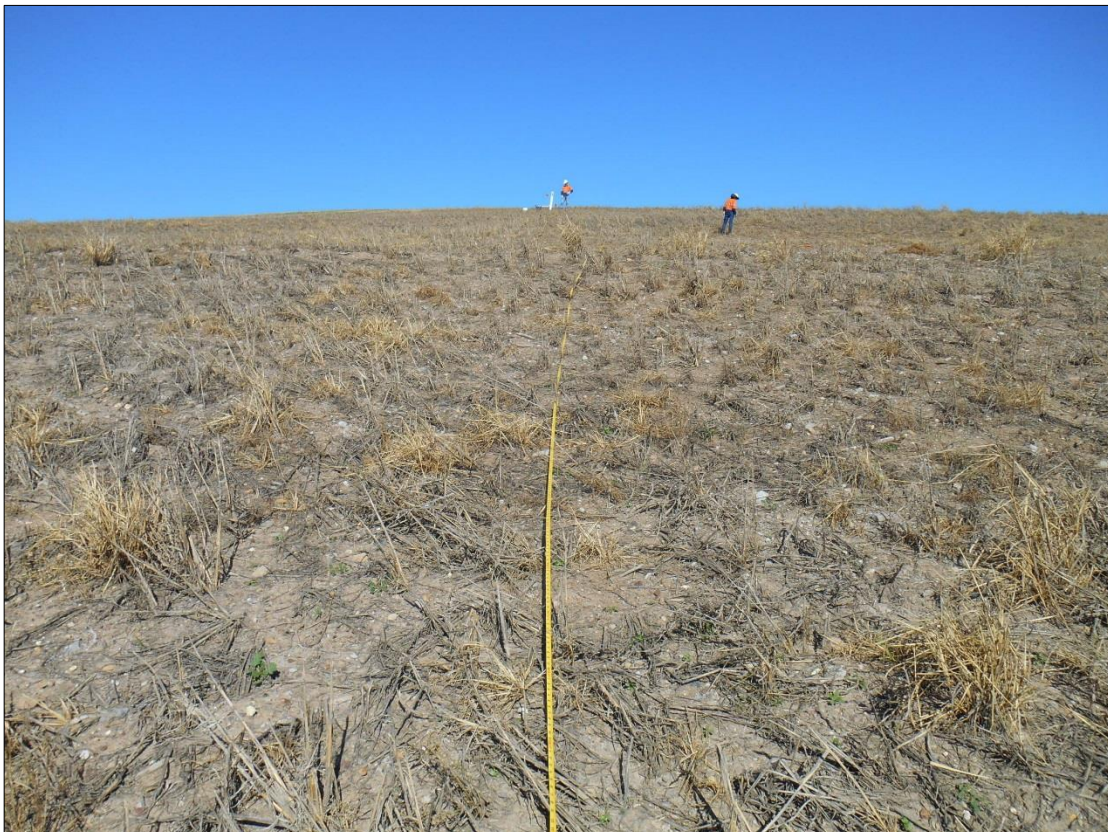
*Projected foliage cover

Site photographs at HVOCHE201601

Start position 2017



End position 2017



HVOCHE201602

HVOCHE201602	MGA 84 Zone 56	
Position	Easting	Northing
Start transect:	313072	6401299
End transect:	313057	6401346

Description:

HVOCHE201602 rehabilitation area occurs on a combination of topsoil and compost.

The dominant species, including the structure of the site, is provided in the table below.

Disturbance:

Disturbance present at rehabilitation site HVOCHE201602 consisted mainly of weeds, and grazing by macropods. No evidence of fire was observed in the rehabilitation area. No areas containing rubbish were observed.

Site has been sprayed to kill weeds and cover crop to prepare for natives to be sown.

Common weeds recorded at the site included *Pennisetum glaucum*, *Macroptilium atropurpureum* and *Galenia pubescens*.

Table. Dominant species and structure at HVOCHE201602

Stratum	Height (m)	% cover*	Dominant native species
Tree layer	-	-	-
Midstorey layer	-	-	-
Shrub layer	-	-	-
Ground layer	0.5	<5	<i>Dichondra repens</i> , <i>Cynodon dactylon</i>

*Projected foliage cover

Site photographs at HVOCHE201602

Start position 2017



End position 2017



HVOLEM201601

HVOLEM201601	MGA 84 Zone 56	
Position	Easting	Northing
Start transect:	317039	6394768
End transect:	316990	6394760

Description:

HVOLEM201601 is rehabilitation area occurs on a combination of topsoil, compost and trial of composted green waste.

The dominant species, including the structure of the site, is provided in the table below.

Disturbance:

Disturbance present at rehabilitation site HVOLEM201601 consisted mainly of weeds, and grazing by macropods. No evidence of fire was observed in the rehabilitation area. No areas containing rubbish were observed.

Common weeds recorded at the site included *Conyza bonariensis*, *Setaria parviflora*, *Galenia pubescens*, *Senecio mada gascariensis*, *Panicum maximum* and *Anagallis arvensis*.

Table. Dominant species and structure at HVOLEM201601

Stratum	Height (m)	% cover*	Dominant native species
Tree layer	-	-	-
Midstorey layer	-	-	-
Shrub layer	1	<5	<i>Corymbia maculata</i> , <i>Acacia binervata</i> , <i>Dodonaea viscosa</i> , <i>Acacia salicina</i> , <i>Acacia amblygona</i>
Ground layer	0.5	10	<i>Dysphania pumilio</i> , <i>Pimelea linifolia</i> , <i>Dichanthium sericeum</i> , <i>wahlenbergia communis</i> , <i>Hardenbergia violacea</i>

*Projected foliage cover

Site photographs at HVOLEM201601

Start position 2017



End position 2017



MTWSPS201601

MTWSPS201601	MGA 84 Zone 56	
Position	Easting	Northing
Start transect:	320910	6389384
End transect:	320949	6389413

Description:

MTWSPS201601 rehabilitation area occurs on topsoil and compost.

The dominant species, including the structure of the site, is provided in the table below.

Disturbance:

Disturbance present at rehabilitation site MTWSPS201601 consisted mainly of weeds, and grazing by macropods. No evidence of fire was observed in the rehabilitation area. No areas containing rubbish were observed.

Common weeds recorded at the site included *Chloris gayana*, *Cichorium intybus* and *Conyza spp.*.

Table. Dominant species and structure at MTWSPS201601

Stratum	Height (m)	% cover*	Dominant native species
Tree layer	-	-	-
Midstorey layer	-	-	-
Shrub layer	-	-	-
Ground layer	0.5	10	<i>Cynodon dactylon</i> , <i>Glycine tabacina</i> , <i>Phylon sp.</i> , <i>Eriochloa pseudoacrotricha</i>

*Projected foliage cover

Site photographs at MTWSPS201601

Start position 2017



End position 2017



MTWSPN201602

MTWSPN201602	MGA 84 Zone 56	
Position	Easting	Northing
Start transect:	320444	6389769
End transect:	320494	6389775

Description:

MTWSPN201602 rehabilitation area occurs on a combination of topsoil and compost.

The dominant species, including the structure of the site, is provided in the table below.

Disturbance:

Disturbance present at rehabilitation site MTWSPN201602 consisted mainly of weeds, and grazing by macropods. No evidence of fire was observed in the rehabilitation area. No areas containing rubbish were observed.

Common weeds recorded at the site included *Setaria parviflora*, *Cichorium intybus*, *Brassica rapa* and *Solanum nigrum*.

Table. Dominant species and structure at MTWSPN201602

Stratum	Height (m)	% cover*	Dominant native species
Tree layer	-	-	-
Midstorey layer	-	-	-
Shrub layer	-	-	-
Ground layer	0.5	30	<i>Chloris truncata</i> , <i>Panicum effusum</i> , <i>Bothriochloa macra</i> , <i>Eragrostis brownii</i>

*Projected foliage cover

Site photographs at MTWSPN201602

Start position 2017



End position 2017



MTWSPN201601

MTWSPN201601	MGA 84 Zone 56	
Position	Easting	Northing
Start transect:	320130	6390589
End transect:	320158	6390630

Description:

The MTWSPN201601 rehabilitation area occurs on imported topsoil and compost.

The dominant species, including the structure of the site, is provided in the table below.

It should be noted no natives or exotic species were recorded at MTWSPN201601.

Disturbance:

Disturbance present at the rehabilitation site consisted mainly of weeds, and grazing by macropods. No evidence of fire was observed in the rehabilitation area. No areas containing rubbish were observed.

Site has been sprayed to kill weeds and cover crop to prepare for natives to be sown.

Table. Dominant species and structure at MTWSPN201601

Stratum	Height (m)	% cover*	Dominant native species
Tree layer	-	-	-
Midstorey layer	-	-	-
Shrub layer	-	-	-
Ground layer	-	-	-

*Projected foliage cover

Site photographs at MTWSPN201601

Start position 2017



End position 2017



MTWSPN201501

MTWSPN201501	MGA 84 Zone 56	
Position	Easting	Northing
Start transect:	319956	6390291
End transect:	319984	6390332

Description:

The MTWSPN201501 rehabilitation area occurs on imported topsoil and compost.

The dominant species, including the structure of the site, is provided in the table below.

It should be noted no native species were recorded at MTWSPN201501. One native species, *Chloris ventricosa*, was recorded which had been sprayed and was dead.

Disturbance:

Disturbance present at the rehabilitation site consisted mainly of weeds, and grazing by macropods. No evidence of fire was observed in the rehabilitation area. No areas containing rubbish were observed.

Common weeds recorded at the site included *Portulaca spp.*, *Galenia pubescens* and *Chloris gayana*.

Table. Dominant species and structure at MTWSPN201501

Stratum	Height (m)	% cover*	Dominant native species
Tree layer	-	-	-
Midstorey layer	-	-	-
Shrub layer	-	-	-
Ground layer	-	-	-

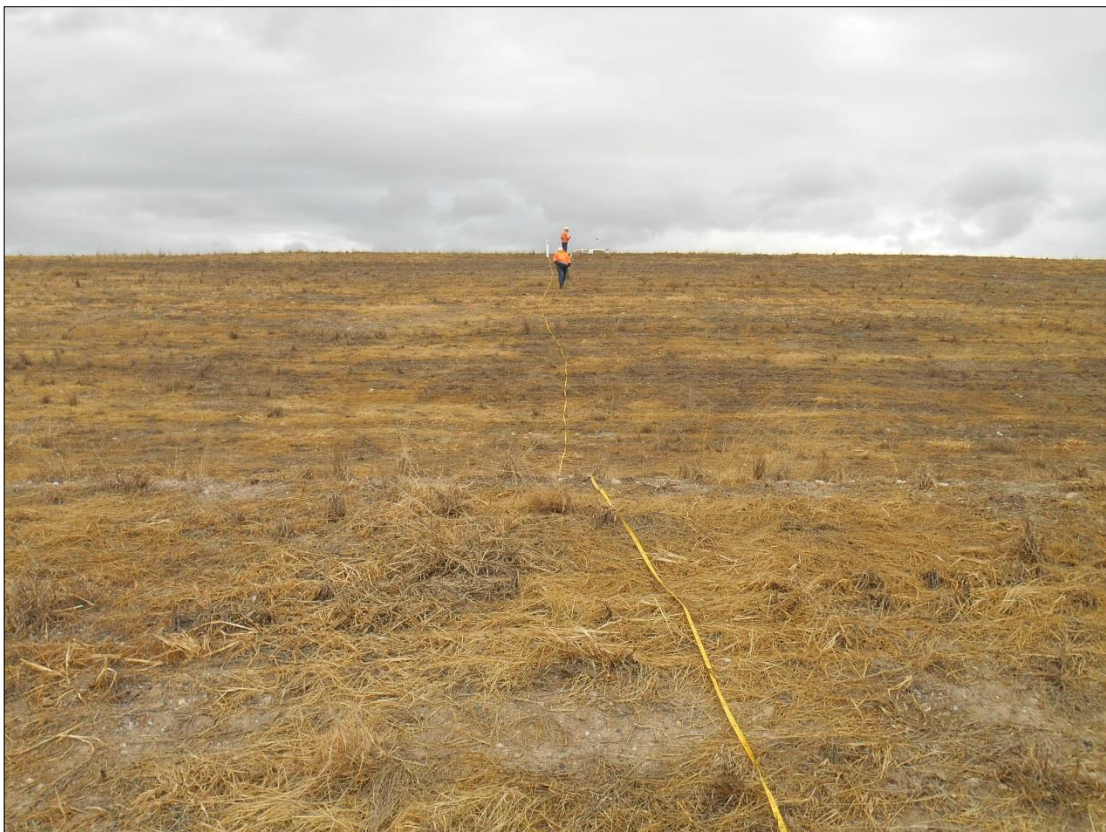
*Projected foliage cover

Site photographs at MTWSPN201501

Start position 2017



End position 2017



MTWSPS201602

MTWSPS201602	MGA 84 Zone 56	
Position	Easting	Northing
Start transect:	320830	6388963
End transect:	320879	6388975

Description:

The MTWSPS201602 rehabilitation area occurs on imported topsoil and compost.

The dominant species, including the structure of the site, is provided in the table below.

Disturbance:

Disturbance present at the site consisted mainly of weeds, and grazing by macropods. No evidence of fire was observed in the rehabilitation area. No areas containing rubbish were observed.

Common weeds recorded at the site included *Macroptilium bracteatum*, *Medicago sativa*, *Brassica rapa* and *Panicum maximum*.

Table. Dominant species and structure at MTWSPS201602

Stratum	Height	% cover*	Dominant native species
Tree layer	-	-	-
Midstorey layer	-	-	-
Shrub layer	-	-	-
Ground layer	-	-	-

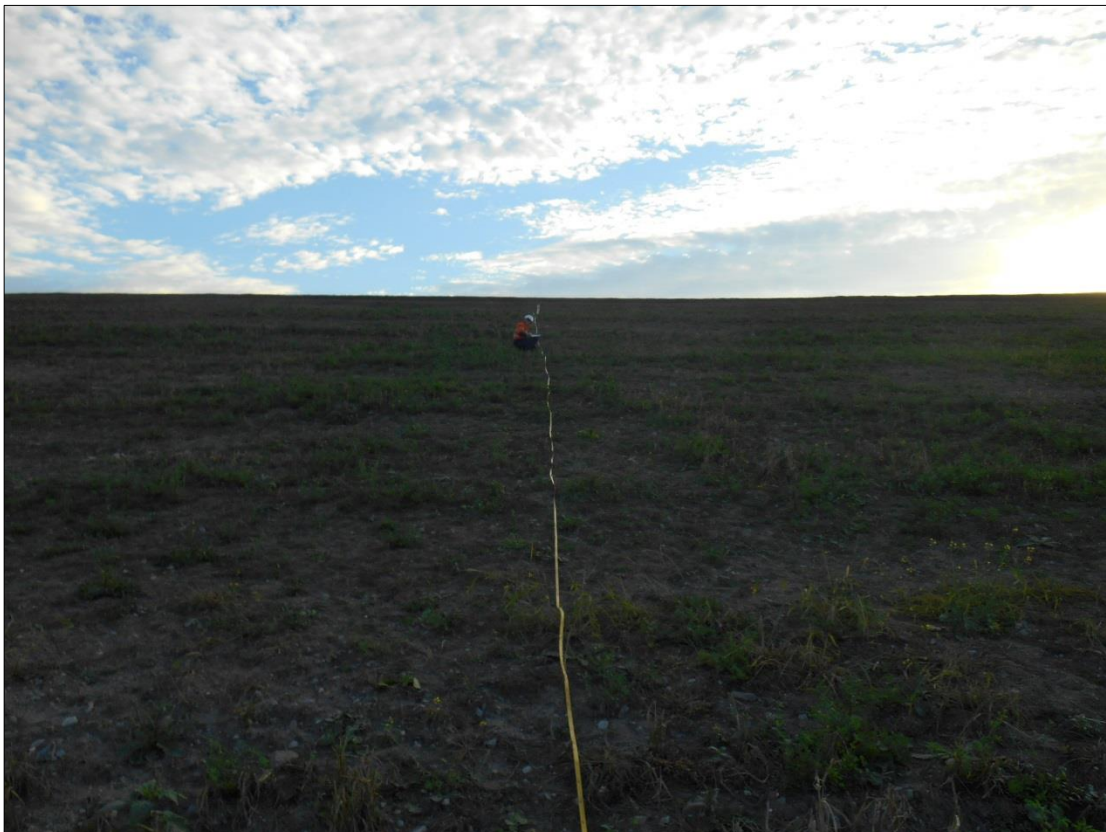
*Projected foliage cover

Site photographs at MTWSPS201602

Start position 2017



End position 2017



MTWNOO201501

MTWNOO201501	MGA 84 Zone 56	
Position	Easting	Northing
Start transect:	320406	6391940
End transect:	320438	6391979

Description:

The MTWNOO201501 rehabilitation area occurs on imported topsoil and compost.

The dominant species, including the structure of the site, is provided in the table below.

Disturbance:

Disturbance present at the rehabilitation site consisted mainly of weeds, and grazing by macropods. No evidence of fire was observed in the rehabilitation area. No areas containing rubbish were observed.

Common weeds recorded at the site included *Panicum maximum*, *Plantago lanceolata*, *Chloris gayana*, *Sida rhombifolia* and *Brassica rapa*.

Table. Dominant species and structure at MTWNOO201501

Stratum	Height	% cover*	Dominant native species
Tree layer	-	-	-
Midstorey layer	-	-	-
Shrub layer	1.5	<5	<i>Acacia cultriformis</i> , <i>Acacia decora</i>
Ground layer	1	40	<i>Sporobolus creber</i> , <i>Chloris truncata</i> , <i>Bothriochloa macra</i> , <i>Dichondra repens</i> , <i>Oxalis perennans</i> , <i>Eragrostis brownii</i> , <i>Panicum effusum</i> , <i>Glycine tabacina</i> , <i>Geranium solanderi</i> , <i>Entolasia stricta</i>

*Projected foliage cover

Site photographs at MTWNOO201501

Start position 2016



End position 2017



MTWMT0201501

MTWMT0201501	MGA 84 Zone 56	
Position	Easting	Northing
Start transect:	321386	6385357
End transect:	321427	6385331

Description:

The MTWMT0201501 rehabilitation area occurs on imported topsoil.

The dominant species, including the structure of the site, is provided in the table below.

Disturbance:

Disturbance present at the site consisted mainly of weeds, and grazing by macropods. No evidence of fire was observed in the rehabilitation area. No areas containing rubbish were observed.

Common weeds recorded at the site included *Bidens pilosa*, *Setaria italica*, *Galea pubescens*, *Plantago lanceolata*, *Chloris gayana*, *Sida rhombifolia* and *Verbena bonariensis*.

Table. Dominant species and structure at MTWMT0201501

Stratum	Height (m)	% cover*	Dominant native species
Tree layer	-	-	-
Midstorey layer	-	-	-
Shrub layer	-	-	-
Ground layer	0.5	<5	<i>Dichondra repens</i> , <i>Enchylaena tomentosa</i> , <i>Cynodon dactylon</i> , <i>Eriochloa pseudoacrotricha</i>

*Projected foliage cover

Site photographs at MTWMT0201501

Start position 2017



End position 2017



MTWMT0201601

MTWMT0201601	MGA 84 Zone 56	
Position	Easting	Northing
Start transect:	320667	6385308
End transect:	320718	6385305

Description:

The MTWMT0201601 rehabilitation area occurs on imported topsoil and compost.

The dominant species, including the structure of the site, is provided in the table below.

Disturbance:

Disturbance present at the site consisted mainly of weeds, and grazing by macropods. No evidence of fire was observed in the rehabilitation area. No areas containing rubbish were observed.

Common weeds recorded at the site included *Pennisetum glaucum*, *Solanum nigrum*, *Portulaca spp.* and *Arctotheca calendula*.

Table. Dominant species and structure at MTWMT0201601

Stratum	Height	% cover*	Dominant native species
Tree layer	-	-	-
Midstorey layer	-	-	-
Shrub layer	-	-	-
Ground layer	-	-	-

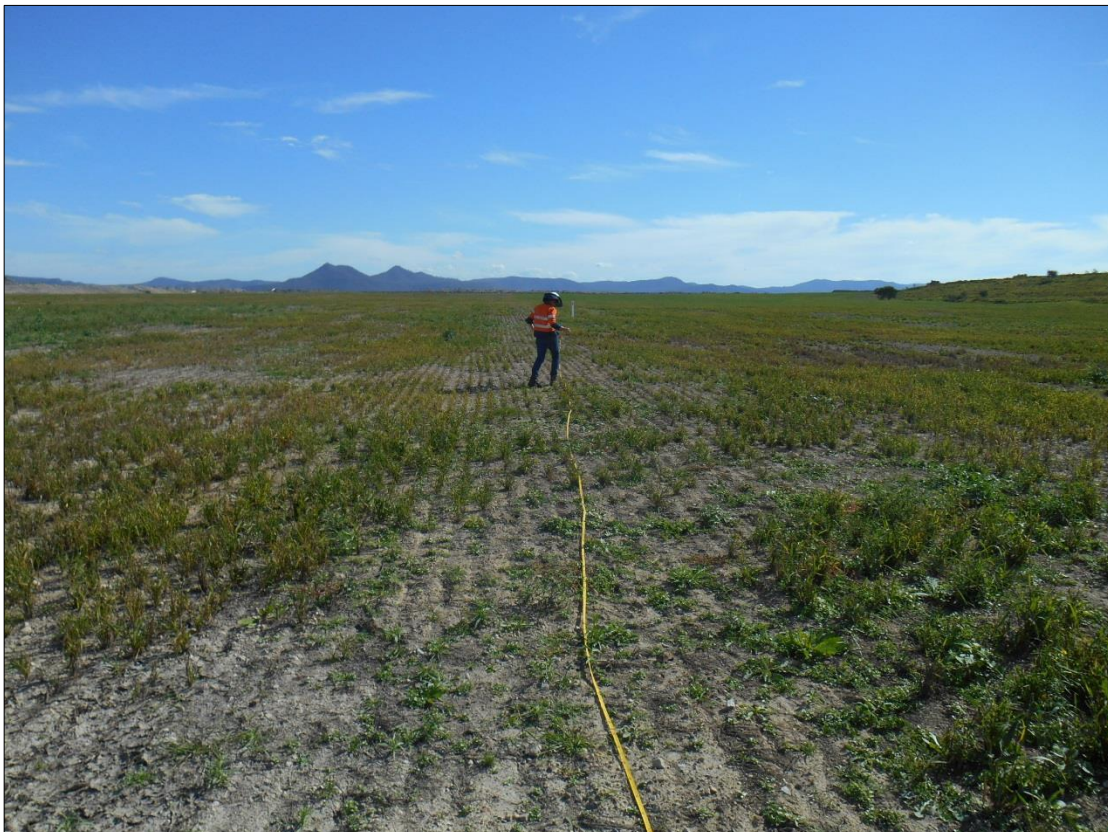
*Projected foliage cover

Site photographs at MTWMT0201601

Start position 2017



End position 2017



Appendix 6 – Tree and canopy data

Bell 1				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
1	<i>C. maculata</i>		20	
2	<i>E. crebra</i>		30	
3	<i>C. maculata</i>		13	
4	<i>C. maculata</i>		16	
5	<i>E. crebra</i>		15	
6	<i>E. crebra</i>		30	
7	<i>C. maculata</i>		12	
8	<i>C. maculata</i>		20	
9	<i>C. maculata</i>		18	
10	<i>E. crebra</i>		28	
11	<i>C. maculata</i>		15	
12	<i>E. crebra</i>		25	
13	<i>E. crebra</i>		12	
14	<i>E. crebra</i>		10	
15	<i>E. crebra</i>		10	
16	<i>E. crebra</i>		10	
17	<i>E. crebra</i>		25	
18	<i>E. crebra</i>		25	
19	<i>E. crebra</i>		30	
20	<i>E. crebra</i>		10	

Bell 2				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
1	<i>C. maculata</i>		20	
2	<i>E. moluccana</i>		16	
3	<i>C. maculata</i>		22	
4	<i>C. maculata</i>		21	
5	<i>C. maculata</i>		20	1
6	<i>C. maculata</i>		12	
7	<i>C. maculata</i>		18	
8	<i>C. maculata</i>		8	
9	<i>C. maculata</i>		13	
10	<i>C. maculata</i>		20	
11	<i>C. maculata</i>		13	

Bell 2				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
12	<i>C. maculata</i>		43	
13	<i>E. moluccana</i>		18	
			244	

Bell 3				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
1	<i>C. maculata</i>		26	
2	<i>C. maculata</i>		25	
3	<i>C. maculata</i>		12	
4	<i>E. moluccana</i>		15	
5	<i>C. maculata</i>		11	
6	<i>C. maculata</i>		28	
7	<i>C. maculata</i>		24	
8	<i>C. maculata</i>		11	
9	<i>C. maculata</i>		17	
10	<i>C. maculata</i>		12	
11	<i>E. moluccana</i>		15	
12	<i>C. maculata</i>		11	
13	<i>E. moluccana</i>		15	
14	<i>C. maculata</i>		10	
15	<i>E. fibrosa</i>		12	
16	<i>C. maculata</i>		8	
17	<i>C. maculata</i>		18	
18	<i>C. maculata</i>		18	
19	<i>C. maculata</i>		12	
20	<i>C. maculata</i>		15	
21	<i>C. maculata</i>		11	

HVOCAR200901				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
1	<i>C. maculata</i>		7	
2	<i>C. maculata</i>		7	
3	<i>C. maculata</i>		7	
4	<i>C. maculata</i>		7	
5	<i>C. maculata</i>		6	
6	<i>C. maculata</i>		12	
7	<i>E. moluccana</i>		13	

HVOCAR200901				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
8	<i>E. moluccana</i>		10	
9	<i>C. maculata</i>		15	
10	<i>C. maculata</i>		11	
11	<i>C. maculata</i>		15	
12	<i>C. maculata</i>		9	
13	<i>C. maculata</i>		5	
14	<i>C. maculata</i>		7	
15	<i>A. implexa</i>		13	
16	<i>E. moluccana</i>		11	
17	<i>C. maculata</i>		13	
18	<i>C. maculata</i>		12	
19	<i>E. moluccana</i>		6	
20	<i>C. maculata</i>		10	
21	<i>C. maculata</i>		5	
22	<i>E. moluccana</i>		7	
23	<i>C. maculata</i>		8	
24	<i>C. maculata</i>		7	
25	<i>E. moluccana</i>		12	
26	<i>C. maculata</i>		9	
27	<i>C. maculata</i>		10	
28	<i>E. moluccana</i>		5	

HVOCAR200902				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
1	<i>E. moluccana</i>		6	
2	<i>C. maculata</i>		7	
3	<i>A. implexa</i>		7	
4	<i>C. maculata</i>		6	

HVOWES200801				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
1	<i>E. moluccana</i>		5	
2	<i>C. maculata</i>		6	
3	<i>C. maculata</i>		5	
4	<i>C. maculata</i>		5	
5	<i>C. maculata</i>		6	
6	<i>C. maculata</i>		6	

HVOWES200801				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
7	<i>C. maculata</i>		5	
8	<i>C. maculata</i>		6	
9	<i>C. maculata</i>		9	
10	<i>C. maculata</i>		5	
11	<i>C. maculata</i>		5	
12	<i>E. moluccana</i>		5	
13	<i>C. maculata</i>		5	
14	<i>C. maculata</i>		6	
15	<i>C. maculata</i>		6	
16	<i>C. maculata</i>		5	
17	<i>C. maculata</i>		9	
18	<i>C. maculata</i>		5	
19	<i>C. maculata</i>		6	
20	<i>C. maculata</i>		7	
21	<i>E. moluccana</i>		7	
22	<i>C. maculata</i>		6	
23	<i>C. maculata</i>		8	
24	<i>C. maculata</i>		11	
25	<i>C. maculata</i>		6	
26	<i>C. maculata</i>		6	
27	<i>C. maculata</i>		6	
28	<i>C. maculata</i>		6	
29	<i>C. maculata</i>		7	
30	<i>C. maculata</i>		10	
31	<i>C. maculata</i>		8	
32	<i>C. maculata</i>		6	
33	<i>C. maculata</i>		6	
34	<i>C. maculata</i>		5	
35	<i>C. maculata</i>		6	
36	<i>C. maculata</i>		7	
37	<i>C. maculata</i>		6	

HVOWES201101				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
1	<i>C. maculata</i>		6	
2	<i>E. moluccana</i>		7	
3	<i>C. maculata</i>		5	
4	<i>C. maculata</i>		5	

HVOWES201101				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
5	<i>C. maculata</i>		6	
6	<i>C. maculata</i>		7	
7	<i>C. maculata</i>		6	
8	<i>C. maculata</i>		7	
9	<i>C. maculata</i>		8	
10	<i>C. maculata</i>		6	
11	<i>C. maculata</i>		6	
12	<i>C. maculata</i>		7	
13	<i>E. moluccana</i>		7	
14	<i>E. moluccana</i>		6	
15	<i>C. maculata</i>		6	
16	<i>C. maculata</i>		6	
17	<i>E. moluccana</i>		6	

MTWCDD201101				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
1	<i>E. moluccana</i>		8	
2	<i>C. maculata</i>		5	
3	<i>C. maculata</i>		4	
4	<i>C. maculata</i>		5	
5	<i>C. maculata</i>		5	
6	<i>C. maculata</i>	flowers	7	
7	<i>E. moluccana</i>		6	
8	<i>E. moluccana</i>		5	
9	<i>C. maculata</i>		5	
10	<i>C. maculata</i>		5	
11	<i>E. moluccana</i>		4	
12	<i>C. maculata</i>		8	
13	<i>C. maculata</i>		5	
14	<i>C. maculata</i>		7	
15	<i>C. maculata</i>		6	
16	<i>C. maculata</i>		6	
17	<i>C. maculata</i>	heavy flower	9	

MTWMT0200001				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
1	<i>E. moluccana</i>		11	

MTWMT0200001				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
2	<i>E. moluccana</i>		10	
3	<i>E. moluccana</i>		7	
4	<i>E. moluccana</i>		9	
5	<i>E. moluccana</i>		6	

MTWNPN200501				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
1	<i>A. implexa</i>	flowers	15	
2	<i>A. implexa</i>	flowers	15	

MTWNPN200502				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
1	<i>C. maculata</i>		5	
2	<i>Unknown</i>		7	
3	<i>C. maculata</i>		10	
4	<i>C. maculata</i>		9.5	
5	<i>C. maculata</i>		13	
6	<i>C. maculata</i>		11	
7	<i>C. maculata</i>		9	
8	<i>C. maculata</i>		9	
9	<i>C. maculata</i>		14	
10	<i>Unknown</i>		8.5	
11	<i>C. maculata</i>		15	
12	<i>Unknown</i>		9.5	
13	<i>Unknown</i>		7	
14	<i>C. maculata</i>		15	
15	<i>C. maculata</i>		8	
16	<i>Oposite leaves</i>		5	
17	<i>C. maculata</i>		8	
18	<i>C. maculata</i>		5.5	
19	<i>C. maculata</i>		11.5	
20	<i>C. maculata</i>		7.5	
21	<i>C. maculata</i>		7.5	
22	<i>Oposite leaves</i>		9	
24	<i>C. maculata</i>		10	
25	<i>C. maculata</i>		11	
26	<i>C. maculata</i>		10	

MTWNP200502				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
27	<i>C. maculata</i>		11	
28	<i>C. maculata</i>		7	
29	<i>C. maculata</i>		9	
30	<i>E. moluccana</i>		9.5	

WAMBOGB1				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
1	<i>A. luehmannii</i>		10	
2	<i>A. luehmannii</i>		7	
3	<i>A. luehmannii</i>		12	
4	<i>A. luehmannii</i>		9	
5	<i>A. luehmannii</i>		8	
6	<i>A. luehmannii</i>		9	
7	<i>A. luehmannii</i>		9	
8	<i>E. fibrosa</i>		21	
9	<i>E. fibrosa</i>		9	
10	<i>E. fibrosa</i>		12	
11	<i>E. fibrosa</i>		18	
12	<i>E. fibrosa</i>		10	
13	<i>E. fibrosa</i>		13	
14	<i>E. fibrosa</i>		6	
15	<i>E. fibrosa</i>		11	
16	<i>E. fibrosa</i>		10	
17	<i>E. fibrosa</i>		17	
18	<i>E. crebra</i>		18	
19	<i>E. moluccana</i>		12	
20	<i>A. luehmannii</i>		11	
21	<i>A. luehmannii</i>		15	
22	<i>A. luehmannii</i>		10	

WAMBOGB2				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
1	<i>E. moluccana</i>		13	
2	<i>E. moluccana</i>		13	
3	<i>E. moluccana</i>		55	
4	<i>E. moluccana</i>		7	

WAMBOSPOT1				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
1	<i>E. crebra</i>		17	
2	<i>E. punctata</i>		35	1
3	<i>E. crebra</i>		17	
4	<i>E. crebra</i>		22	
5	<i>E. crebra</i>		21	
6	<i>E. punctata</i>		26	2
7	<i>C. maculata</i>		6	
8	<i>E. punctata</i>		35	2

WAMBOSPOT2				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
1	<i>E. moluccana</i>	fruit	23	
2	<i>E. moluccana</i>		16	
3	<i>C. maculata</i>	fruit	9	
4	<i>C. maculata</i>		10	
5	<i>C. maculata</i>		12	
6	<i>C. maculata</i>		9, 7.5	
7	<i>E. moluccana</i>		23	
8	<i>E. moluccana</i>		14	
9	<i>C. maculata</i>		11	
10	<i>C. maculata</i>		9	
11	<i>E. moluccana</i>		11	
12	<i>E. moluccana</i>		20	
13	<i>E. moluccana</i>		8	
14	<i>E. moluccana</i>		7.5	
15	<i>E. moluccana</i>		7	
16	<i>E. moluccana</i>		9	
17	<i>C. maculata</i>		48	
18	<i>E. moluccana</i>		13	
19	<i>E. moluccana</i>		13	
20	<i>E. moluccana</i>		15	
21	<i>E. moluccana</i>		14	
22	<i>E. moluccana</i>		9	
23	<i>E. moluccana</i>		13	
24	<i>E. moluccana</i>		8	
25	<i>E. moluccana</i>		18	
26	<i>E. moluccana</i>		12	
27	<i>C. maculata</i>		8	

WAMBOSPOT2				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
28	<i>C. maculata</i>		9	
29	<i>E. moluccana</i>		13	

WAMBOSPOT3				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
1	<i>E. crebra</i>		24	
2	<i>E. crebra</i>		17	
3	<i>E. punctata</i>		28	
4	<i>E. crebra</i>		16	
5	<i>C. maculata</i>		24	
6	<i>C. maculata</i>		17	
7	<i>C. maculata</i>		32	
8	<i>E. crebra</i>		22	
9	<i>E. crebra</i>		18	

WARKGB1				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
1	<i>E. crebra</i>		29	
2	<i>E. crebra</i>		16.5	
3	<i>E. crebra</i>		15	
4	<i>E. crebra</i>		21	
5	<i>E. crebra</i>		17	
6	<i>E. crebra</i>		9	
7	<i>E. crebra</i>		14	
8	<i>E. crebra</i>		16	
9	<i>A. leuhmannii</i>		10	
10	<i>E. crebra</i>		8	
11	<i>E. crebra</i>		16	
12	<i>E. crebra</i>		11.5	
13	<i>E. crebra</i>		14	
14	<i>E. crebra</i>		20	
15	<i>E. crebra</i>		12	
16	<i>E. crebra</i>		10	
17	<i>E. crebra</i>		9	
18	<i>E. crebra</i>		17	
19	<i>E. crebra</i>		12	
20	<i>E. crebra</i>		12	
21	<i>E. crebra</i>		14	

WARKGB1				
22	<i>E. crebra</i>		13	
23	<i>E. crebra</i>		23	
24	<i>A. leuhmannii</i>		18	
25	<i>E. crebra</i>		13	

WARKGB2				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
1	<i>A. leuhmannii</i>		8	
2	<i>E. crebra</i>		26	
3	<i>A. leuhmannii</i>		7	
4	<i>A. leuhmannii</i>		7	
5	<i>E. crebra</i>		14	
6	<i>E. crebra</i>		22	
7	<i>E. crebra</i>		16	
8	<i>A. leuhmannii</i>		8	
9	<i>A. leuhmannii</i>		11	
10	<i>A. leuhmannii</i>		11	
11	<i>E. crebra</i>		14	
12	<i>A. leuhmannii</i>		11	
13	<i>E. crebra</i>		8	
14	<i>E. crebra</i>		9	
15	<i>E. crebra</i>		9	
16	<i>E. crebra</i>		35	
17	<i>E. crebra</i>		18	
18	<i>E. crebra</i>		21	
19	<i>A. leuhmannii</i>		8	
20	<i>E. crebra</i>		18	
21	<i>E. crebra</i>		8	
22	<i>E. crebra</i>		13	
23	<i>A. leuhmannii</i>		8	
24	<i>E. crebra</i>		26	

WARKGB3				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
1	<i>A. leuhmannii</i>		9	
2	<i>A. leuhmannii</i>		11	
3	<i>E. crebra</i>		28	
4	<i>E. amplifolia</i>		9.5	
5	<i>E. amplifolia</i>		9	

WARKGB3				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
6	<i>A. leuhmannii</i>		11	
7	<i>A. leuhmannii</i>		11	
8	<i>E. amplifolia</i>		18	
9	<i>A. leuhmannii</i>		18	
10	<i>E. amplifolia</i>		26	
11	<i>A. leuhmannii</i>		11	
12	1B		17	
13	<i>A. leuhmannii</i>		14	
14	<i>E. amplifolia</i>		19	
15	<i>E. amplifolia</i>		7	
16	<i>E. amplifolia</i>		17	
17	<i>E. crebra</i>		25	
18	<i>A. leuhmannii</i>		14	
19	<i>E. amplifolia</i>		19	
20	<i>E. amplifolia</i>		15	
21	<i>E. amplifolia</i>		9.5	
22	<i>A. leuhmannii</i>		12	
23	<i>A. leuhmannii</i>		13	
24	<i>E. crebra</i>		15	
25	<i>E. amplifolia</i>		21	
26	<i>E. amplifolia</i>		13	
27	<i>E. amplifolia</i>		6	
28	<i>A. leuhmannii</i>		8	

WARKGB4				
Tree Number	Tree Species	Fruit/Flowers	Width range (cm)	Hollows
1	<i>E. crebra</i>		110	3
2	<i>E. crebra</i>		20	

BELL1						
LHS		RHS		Total trees	Width	Trees per m2
Genus	Number	Genus	Number			
<i>E. crebra</i>	2	<i>E. moluccana</i>	1	3	2	0.03

BELL2						
LHS		RHS		Total trees	Width	Trees per m2
Genus	Number	Genus	Number			
<i>C. maculata</i>	3	<i>C. maculata</i>	8	17	4	0.085
<i>E. moluccana</i>	4	<i>E. moluccana</i>	2			
BELL3						
LHS		RHS		Total trees	Width	Trees per m2
Genus	Number	Genus	Number			
<i>C. maculata</i>	3	<i>C. maculata</i>	7	20	4	0.1
<i>E. moluccana</i>	1	<i>E. moluccana</i>	4			
<i>E. crebra</i>	4	<i>E. crebra</i>				
<i>A. leuhmannii</i>	1					
HVOCAR200901						
LHS		RHS		Total trees	Width	Trees per m2
Genus	Number	Genus	Number			
<i>E. moluccana</i>	1	<i>E. moluccana</i>	2	38	4	0.19
<i>C. maculata</i>	17	<i>C. maculata</i>	12			
<i>A. implexa</i>	4	<i>A. implexa</i>	2			
HVOCAR200902						
LHS		RHS		Total trees	Width	Trees per m2
Genus	Number	Genus	Number			
<i>C. maculata</i>	19	<i>C. maculata</i>	24	48	4	0.24
<i>E. moluccana</i>	2	<i>E. moluccana</i>	1			
<i>Unknown</i>	2					
HVORIV201401						
LHS		RHS		Total trees	Width	Trees per m2
Genus	Number	Genus	Number			
<i>E. moluccana</i>	1	<i>E. moluccana</i>	3	7	4	0.035
		<i>Unknown</i>	2			
		<i>E. crebra</i>	1			
HVORIV201402						
LHS		RHS		Total trees	Width	Trees per m2
Genus	Number	Genus	Number			
<i>E. crebra</i>	1			1	4	0.005

HVOWES200801						
LHS		RHS		Total trees	Width	Trees per m2
Genus	Number	Genus	Number			
<i>C. maculata</i>	20	<i>C. maculata</i>	43	85	4	0.425
<i>E. moluccana</i>	4	<i>E. moluccana</i>	4			
<i>Eucalypt sp.</i>	4	<i>Eucalypt sp.</i>	8			
		<i>A. implexa</i>	2			
HVOWES201101						
LHS		RHS		Total trees	Width	Trees per m2
Genus	Number	Genus	Number			
<i>C. maculata</i>	21	<i>C. maculata</i>	30	93	4	0.465
<i>E. moluccana</i>	10	<i>E. moluccana</i>	11			
<i>E. fibrosa</i>	1	<i>E. fibrosa</i>				
<i>E. crebra</i>	2	<i>E. crebra</i>	4			
<i>A. implexa</i>	6	<i>A. implexa</i>	4			
<i>Eucalypt sp.</i>	2	<i>Eucalypt sp.</i>	2			
HVOWES201301						
LHS		RHS		Total trees	Width	Trees per m2
Genus	Number	Genus	Number			
<i>E. crebra</i>	3	<i>E. crebra</i>	2	12	4	0.06
<i>A. implexa</i>	2	<i>A. implexa</i>				
<i>Eucalypt sp.</i>	1	<i>C. maculata</i>	2			
		<i>E. moluccana</i>	2			
MTWCDD201101						
LHS		RHS		Total trees	Width	Trees per m2
Genus	Number	Genus	Number			
<i>Eucalypt sp. 1</i>	4	<i>Eucalypt sp. 1</i>	3	35	4	0.175
<i>Eucalypt sp. 2</i>	2	<i>Eucalypt sp. 2</i>				
<i>C. maculata</i>	5	<i>C. maculata</i>	16			
<i>A. implexa</i>	3	<i>A. implexa</i>	2			
MTWCDD2015						
LHS		RHS		Total trees	Width	Trees per m2
Genus	Number	Genus	Number			
<i>E. fibrosa</i>	1	<i>E. fibrosa</i>	1	97	4	0.485
<i>C. maculata</i>	33	<i>C. maculata</i>	37			
<i>E. moluccana</i>	11	<i>E. moluccana</i>	14			
MTWMTO200001						
LHS		RHS		Total trees	Width	Trees per m2
Genus	Number	Genus	Number			
<i>E. cladocalyx</i>	10	<i>E. cladocalyx</i>	4	17	4	0.085

<i>E. moluccana</i>	1	<i>E. moluccana</i>	2			
MTWMT0200503						
LHS		RHS				
Genus	Number	Genus	Number	Total trees	Width	Trees per m2
<i>E. cladocalyx</i>	14	<i>E. cladocalyx</i>	8			
<i>E. moluccana</i>	1					
				23	4	0.115
MTWNPN200501						
LHS		RHS				
Genus	Number	Genus	Number	Total trees	Width	Trees per m2
<i>A. implexa</i>	2					
				2	4	0.01
MTWNPN200502						
LHS		RHS				
Genus	Number	Genus	Number	Total trees	Width	Trees per m2
<i>C. maculata</i>	13	<i>C. maculata</i>	12			
<i>A. mearnsii</i>	3	<i>A. mearnsii</i>	2			
				30	4	0.15
MTWNPN200901						
LHS		RHS				
Genus	Number	Genus	Number	Total trees	Width	Trees per m2
		<i>C. maculata</i>	43			
		<i>E. crebra</i>	12			
		<i>E. moluccana</i>	14			
		<i>A. implexa</i>	1	70	4	0.35
MTWNPN201101						
LHS		RHS				
Genus	Number	Genus	Number	Total trees	Width	Trees per m2
<i>Eucalypt sp. 1</i>	6	<i>Eucalypt sp. 1</i>	1			
		<i>Eucalypt sp. 2</i>	5			
				12	4	0.06
MTWNPN201403						
LHS		RHS				
Genus	Number	Genus	Number	Total trees	Width	Trees per m2

		<i>Eucalypt sp. 1</i>	2			
				2	4	0.01
MTWTDI201501						
LHS		RHS				
Genus	Number	Genus	Number	Total trees	Width	Trees per m2
<i>Eucalypt sp. 1</i>	1					
				1	4	0.005
MTWWDL201401						
LHS		RHS				
Genus	Number	Genus	Number	Total trees	Width	Trees per m2
<i>C. maculata</i>	3	<i>C. maculata</i>	5			
<i>A. implexa</i>	1	<i>A. implexa</i>	5			
<i>E. moluccana</i>	1	<i>E. moluccana</i>				
				15	4	0.075
WAMBOGB1						
LHS		RHS				
Genus	Number	Genus	Number	Total trees	Width	Trees per m2
<i>A. leuhmannii</i>	8	<i>A. leuhmannii</i>	7			
<i>E. crebra</i>		<i>E. crebra</i>	4			
				19	4	0.095
WAMBOGB2						
LHS		RHS				
Genus	Number	Genus	Number	Total trees	Width	Trees per m2
<i>E. moluccana</i>	3	<i>E. moluccana</i>	2			
				5	4	0.025
WAMBOSPOT1						
LHS		RHS				
Genus	Number	Genus	Number	Total trees	Width	Trees per m2
<i>E. punctata</i>	1	<i>E. punctata</i>				
<i>E. crebra</i>	3	<i>E. crebra</i>				
<i>C. maculata</i>	2	<i>C. maculata</i>	3			
<i>A. bulgaensis</i>	13	<i>A. bulgaensis</i>	11	33	4	0.165
WAMBOSPOT2						
LHS		RHS		Total trees	Width	Trees per m2

Genus	Number	Genus	Number			
<i>E. moluccana</i>	7	<i>E. moluccana</i>	5	19	4	0.095
<i>C. maculata</i>	3	<i>C. maculata</i>	2			
		<i>E. crebra</i>	1			
		<i>A. leuhmannii</i>	1			
WAMBOSPOT3						
LHS		RHS				
Genus	Number	Genus	Number	Total trees	Width	Trees per m2
<i>E. crebra</i>	3	<i>E. crebra</i>	3	16	4	0.08
<i>C. maculata</i>	2	<i>C. maculata</i>	3			
<i>A. implexa</i>	4	<i>A. implexa</i>	1			
WARKGB01						
LHS		RHS				
Genus	Number	Genus	Number	Total trees	Width	Trees per m2
<i>A. leuhmannii</i>	23	<i>A. leuhmannii</i>	26	63	4	0.315
<i>E. crebra</i>	4	<i>E. crebra</i>	10			
WARKGB02						
LHS		RHS				
Genus	Number	Genus	Number	Total trees	Width	Trees per m2
<i>E. crebra</i>	14	<i>A. leuhmannii</i>	2	21	4	0.105
		<i>E. crebra</i>	5			
WARKGB03						
LHS		RHS				
Genus	Number	Genus	Number	Total trees	Width	Trees per m2
<i>A. leuhmannii</i>	27	<i>A. leuhmannii</i>	16	55	4	0.275
<i>E. crebra</i>	1	<i>E. crebra</i>	1			
<i>E. amplifolia</i>	5	<i>E. amplifolia</i>	5			
WARKGB04						
LHS		RHS				
Genus	Number	Genus	Number	Total trees	Width	Trees per m2
<i>E. crebra</i>	3	<i>E. crebra</i>	5	10	4	0.05
		<i>A. leuhmannii</i>	2			
HVOLEM2015						

LHS		RHS				
Genus	Number	Genus	Number	Total trees	Width	Trees per m2
<i>E. crebra</i>	1			1	2	0.01
HVORIV201501						
LHS		RHS				
Genus	Number	Genus	Number	Total trees	Width	Trees per m2
		<i>E. fibrosa</i>	1	1	4	0.005
HVORIV201503						
LHS		RHS				
Genus	Number	Genus	Number	Total trees	Width	Trees per m2
<i>C. maculata</i>	1			1	4	0.005
HVOWES201602						
LHS		RHS				
Genus	Number	Genus	Number	Total trees	Width	Trees per m2
<i>E. moluccana</i>	2	<i>E. moluccana</i>	2	20	4	0.1
<i>C. maculata</i>	9	<i>C. maculata</i>	5			
HVOWES201603						
LHS		RHS				
Genus	Number	Genus	Number	Total trees	Width	Trees per m2
		<i>E. fibrosa</i>	1	1	4	0.005

Appendix 7 – Agricultural soil analysis results

ROUTINE AGRICULTURAL SOIL ANALYSIS REPORT

Job No:	F9706						
No of Samples:	22						
Date Supplied:	24th May 2017						
Supplied by:	Niche-eh						
		Sample ID:		Sample 1	Sample 2	Sample 3	Sample 4
		Crop:		HVOCHE201501	HVORIV201601	MTWSPN201501	HVOWES201601
		Client:		N/G	N/G	N/G	N/G
				RTCA	RTCA	RTCA	RTCA
Method	Nutrient	Units		F9706/1	F9706/2	F9706/3	F9706/4
Morgan 1	Calcium	Ca	mg/kg	1749	1280	2555	2212
	Magnesium	Mg		684	699	364	354
	Potassium	K		169	251	270	183
	Phosphorus	P		14	17	20	10
Bray1 Colwell Bray2	Phosphorus	P	mg/kg	30	27	73	28
				131	80	186	118
				238	141	397	177
KCl	Nitrate Nitrogen	N	mg/kg	23	8.5	48	4.1
	Ammonium Nitrogen			5.0	3.5	2.7	2.9
	Sulfur	S		23	370	110	605
1:5 Water	pH		units	8.15	7.75	8.07	7.58
	Conductivity		dS/m	0.164	0.551	0.318	0.755
Calculation	Estimated Organic Matter	% OM		4.3	7.3	7.3	6.9
Ammonium Acetate + Calculations	Calcium	Ca	cmol ⁺ /Kg	16.84	9.81	14.70	14.42
			kg/ha	7558	4402	6598	6473
			mg/kg	3374	1965	2946	2890
	Magnesium	Mg	cmol ⁺ /Kg	9.63	8.46	3.46	3.54
			kg/ha	2621	2302	943	964
			mg/kg	1170	1028	421	430
	Potassium	K	cmol ⁺ /Kg	1.15	1.19	1.20	0.87
			kg/ha	1010	1038	1055	765
KCl	Aluminium	Al	cmol ⁺ /Kg	0.01	0.01	0.02	0.02
			kg/ha	3	2	3	3
			mg/kg	1	1	1	1
Acidity Titration	Hydrogen	H ⁺	cmol ⁺ /Kg	0.00	0.00	0.00	0.00
			kg/ha	0	0	0	0
			mg/kg	0	0	0	0
Calculation	Effective Cation Exchange Capacity (ECEC)	cmol ⁺ /Kg		28.51	20.22	19.72	19.48
Base Saturation Calculations	Calcium	Ca	%	59.1	48.5	74.5	74.0
	Magnesium	Mg		33.8	41.8	17.6	18.2
	Potassium	K		4.0	5.9	6.1	4.5
	Sodium - ESP	Na		3.1	3.8	1.7	3.3
	Aluminium	Al		0.0	0.1	0.1	0.1
	Hydrogen	H ⁺		0.0	0.0	0.0	0.0
Calculation	Calcium / Magnesium Ratio	ratio		1.7	1.2	4.2	4.1
DTPA	Zinc	Zn	mg/kg	12	13	33	20
	Manganese	Mn		6.6	5.2	5.3	9.0
	Iron	Fe		32	32	40	71
	Copper	Cu		3.2	2.0	4.2	2.9
CaCl ₂	Boron	B	mg/kg	0.74	0.74	0.95	0.94
	Silicon	Si		33	27	25	24
LECO IR Analyser	Total Carbon	C	%	2.46	4.17	4.15	3.93
	Total Nitrogen	N	%	0.19	0.26	0.29	0.29
Calculation	Carbon/ Nitrogen Ratio	ratio		13.3	15.8	14.2	13.7
	Basic Texture			Loam	Loam	Loam	Loam
	Basic Colour			Brownish	Brownish	Brownish	Brownish
Calculation	Chloride Estimate	equiv. ppm		105	353	203	483

Job No:	F9706
No of Samples:	22
Date Supplied:	24th May 2017
Supplied by:	Niche-eh

Sample ID:	HVOCH201501	HVORIV201601	MTWSPN201501	HVOWES201601
Crop:	N/G	N/G	N/G	N/G
Client:	RTCA	RTCA	RTCA	RTCA

Method	Nutrient	Units	F9706/1	F9706/2	F9706/3	F9706/4
Total Acid Extractable	Calcium	Ca	7,508	5,464	10,000	6,464
	Magnesium	Mg	5,993	3,106	1,938	1,309
	Potassium	K	2,087	1,645	1,550	1,405
	Sodium	Na	555	561	238	323
	Sulfur	S	242	633	506	914
Total Acid Extractable	Phosphorus	P	985	434	938	587
Total Acid Extractable	Zinc	Zn	98	80	152	96
	Manganese	Mn	830	257	222	308
	Iron	Fe	40,739	23,036	20,660	25,849
	Copper	Cu	40	23	49	28
	Boron	B	2.6	<2	2.1	<2
	Silicon	Si	1,161	1,804	1,785	2,015
Total Acid Extractable	Aluminium	Al	18,952	7,206	5,720	6,805
	Molybdenum	Mo	0.7	0.9	1.0	0.9
	Cobalt	Co	22	9.3	6.3	8.8
Total Acid Extractable	Selenium	Se	0.6	0.7	0.6	0.7
	Cadmium	Cd	<0.5	<0.5	0.8	<0.5
	Lead	Pb	19	17	39	24
	Arsenic	As	5.5	6.7	7.7	8.2
	Chromium	Cr	40	12	9.4	11
	Nickel	Ni	46	14	12	10
	Mercury	Hg	<0.1	<0.1	0.1	<0.1
	Silver	Ag	<1	<1	<1	<1

EAL Soil Testing Notes

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to <2 mm
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods*
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and Lamonte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts
7. Total Acid Extractable Nutrients indicate a store of nutrients
8. Contaminant Guides based on 'Residential with gardens and accessible soil including childrens daycare centres, preschools, primary schools, town houses or villas' (NSW EPA 1998).
9. Information relating to testing colour codes is available on Sheet 2 - "Understanding you soil results"

Calculations

1. For conductivity 1 dS/m = 1 mS/cm = 1000 µS/cm
2. 1 cmol⁺/Kg = 1 meq/100g; 1 Lb/Acre = 2 ppm (parts per million); kg/ha = 2.24 x ppm; mg/kg = ppm
3. Conversions for 1 cmol⁺/Kg = 230 mg/Kg Sodium, 390 mg/Kg Potassium, 122 mg/Kg Magnesium, 200 mg/Kg Calcium
4. Organic Matter = %C x 1.75
5. Chloride Estimate = EC x 640 (most likely over-estimate)
6. ECEC = sum of the exchangeable cations cmol⁺/Kg
7. Base saturation calculations = (cation cmol⁺/Kg) / ECEC x 100
8. Ca / Mg ratio from the exchangeable cmol⁺/Kg results

Quality Checked: Kris Saville
Manager, Agricultural testing division

ROUTINE AGRICULTURAL SOIL ANALYSIS REPORT

Job No:	F9706						
No of Samples:	22						
Date Supplied:	24th May 2017						
Supplied by:	Niche-eh						
		Sample ID:		Sample 5	Sample 6	Sample 7	Sample 8
		Crop:		HVOCHE201602	HVORIV201503	HVOLEM201601	MTWMT0201501
		Client:		N/G	N/G	N/G	N/G
				RTCA	RTCA	RTCA	RTCA
Method	Nutrient	Units		F9706/5	F9706/6	F9706/7	F9706/8
	Calcium	Ca		1824	3829	249	1129
	Magnesium	Mg		613	474	109	392
	Potassium	K	mg/kg	209	236	60	111
	Phosphorus	P		7.3	16	1.4	1.2
	Bray1			20	52	4.8	2.8
	Colwell			71	213	11	10
	Bray2			136	325	12	8
	Nitrate Nitrogen	N		69	7.5	0.8	3.0
	Ammonium Nitrogen			2.8	2.6	1.3	0.9
	Sulfur	S	mg/kg	412	1585	80	98
	pH		units	7.77	7.54	6.16	9.07
	Conductivity		dS/m	0.728	1.685	0.066	0.233
	Calculation	Estimated Organic Matter	% OM	5.6	7.7	1.1	3.8
	Calcium	Ca	cmol ⁺ /Kg	15.51	21.41	1.95	6.77
			kg/ha	6961	9610	875	3040
			mg/kg	3107	4290	391	1357
	Magnesium	Mg	cmol ⁺ /Kg	7.21	3.94	1.18	4.17
			kg/ha	1962	1072	322	1136
			mg/kg	876	479	144	507
	Potassium	K	cmol ⁺ /Kg	1.22	1.08	0.24	0.50
			kg/ha	1071	944	208	434
			mg/kg	478	421	93	194
	Sodium	Na	cmol ⁺ /Kg	1.05	1.08	0.15	1.23
			kg/ha	543	558	77	635
			mg/kg	242	249	34	283
	Aluminium	Al	cmol ⁺ /Kg	0.02	0.02	0.02	0.02
			kg/ha	3	3	4	3
			mg/kg	1	1	2	1
	Hydrogen	H ⁺	cmol ⁺ /Kg	0.00	0.00	0.01	0.00
			kg/ha	0	0	0	0
			mg/kg	0	0	0	0
	Calculation	Effective Cation Exchange Capacity (ECEC)	cmol ⁺ /Kg	25.00	27.52	3.55	12.69
	Calcium	Ca		62.0	77.8	55.0	53.4
	Magnesium	Mg		28.8	14.3	33.4	32.9
	Potassium	K	%	4.9	3.9	6.7	3.9
	Sodium - ESP	Na		4.2	3.9	4.2	9.7
	Aluminium	Al		0.1	0.1	0.6	0.1
	Hydrogen	H ⁺		0.0	0.0	0.2	0.0
	Calculation	Calcium / Magnesium Ratio	ratio	2.2	5.4	1.6	1.6
	Zinc	Zn		11	27	1.0	2.3
	Manganese	Mn	mg/kg	8.2	9.2	2.4	0.9
	Iron	Fe		38	48	221	14
	Copper	Cu		1.5	3.5	0.2	1.0
	Boron	B		0.79	1.21	0.37	0.19
	Silicon	Si	mg/kg	24	22	30	3
	Total Carbon	C	%	3.19	4.40	0.62	2.15
	Total Nitrogen	N	%	0.25	0.32	0.05	0.09
	Calculation	Carbon/ Nitrogen Ratio	ratio	12.6	13.7	12.1	23.4
	Basic Texture			Loam	Loam	Sandy Soil	Loam
	Basic Colour			Brownish	Brownish	Brownish	Brownish
	Calculation	Chloride Estimate	equiv. ppm	466	1079	42	149

Job No:	F9706
No of Samples:	22
Date Supplied:	24th May 2017
Supplied by:	Niche-eh

Sample ID:	Sample 5	Sample 6	Sample 7	Sample 8
Crop:	HVOCH201602	HVORIV201503	HVOLEM201601	MTWMT020150
Client:	N/G	N/G	N/G	1
	RTCA	RTCA	RTCA	N/G
				RTCA

Method	Nutrient	Units	F9706/5	F9706/6	F9706/7	F9706/8
Total Acid Extractable	Calcium	Ca	5,195	9,557	432	4,600
	Magnesium	Mg	2,125	1,710	253	3,079
	Potassium	K	1,804	1,460	274	1,241
	Sodium	Na	435	565	81	1,481
	Sulfur	S	615	1,926	82	224
Total Acid Extractable	Phosphorus	P	424	903	72	88
Total Acid Extractable	Zinc	Zn	74	133	5.5	60
	Manganese	Mn	476	351	38	244
	Iron	Fe	39,870	27,802	10,758	17,315
	Copper	Cu	21	44	1.7	12
	Boron	B	<2	3.5	<2	<2
	Silicon	Si	2,072	1,977	1,992	1,654
Total Acid Extractable	Aluminium	Al	10,814	9,637	2,980	4,657
	Molybdenum	Mo	0.9	0.9	0.3	0.6
	Cobalt	Co	11	9.3	3.0	7.1
Total Acid Extractable	Selenium	Se	0.7	0.9	<0.5	<0.5
	Cadmium	Cd	<0.5	0.6	<0.5	<0.5
	Lead	Pb	20	36	5.1	13
	Arsenic	As	6.7	6.0	2.6	5.8
	Chromium	Cr	20	31	5.2	4.8
	Nickel	Ni	18	16	2.1	9.4
	Mercury	Hg	<0.1	<0.1	<0.1	<0.1
	Silver	Ag	<1	<1	<1	<1

EAL Soil Testing Notes

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to <2 mm
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods*
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and Lamonte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts
7. Total Acid Extractable Nutrients indicate a store of nutrients
8. Contaminant Guides based on 'Residential with gardens and accessible soil including childrens daycare centre preschools, primary schools, town houses or villas' (NSW EPA 1998).
9. Information relating to testing colour codes is available on Sheet 2 - "Understanding you soil results"

Calculations

1. For conductivity 1 dS/m = 1 mS/cm = 1000 µS/cm
2. 1 cmol⁺/Kg = 1 meq/100g; 1 Lb/Acre = 2 ppm (parts per million); kg/ha = 2.24 x ppm; mg/kg = ppm
3. Conversions for 1 cmol⁺/Kg = 230 mg/Kg Sodium, 390 mg/Kg Potassium, 122 mg/Kg Magnesium, 200 mg/Kg
4. Organic Matter = %C x 1.75
5. Chloride Estimate = EC x 640 (most likely over-estimate)
6. ECEC = sum of the exchangeable cations cmol⁺/Kg
7. Base saturation calculations = (cation cmol⁺/Kg) / ECEC x 100
8. Ca / Mg ratio from the exchangeable cmol⁺/Kg results

Quality Checked: Kris Saville
Manager, Agricultural testing division

ROUTINE AGRICULTURAL SOIL ANALYSIS REPORT

Job No:		F9706		Sample ID:	Sample 9	Sample 10	Sample 11	Sample 12
No of Samples:		22						
Date Supplied:		24th May 2017						
Supplied by:		Niche-eh						
					HVOWES201602	MTWSPN201601	MTWSPN201602	MTWMT0201601
				Crop:	N/G	N/G	N/G	N/G
				Client:	RTCA	RTCA	RTCA	RTCA
Method		Nutrient		Units	F9706/9	F9706/10	F9706/11	F9706/12
	Morgan 1	Calcium	Ca	mg/kg	1435	1595	906	1441
		Magnesium	Mg		323	400	335	434
		Potassium	K		161	327	210	186
		Phosphorus	P		4.8	15	12	6.5
	Bray1	Phosphorus	P	mg/kg	13	40	41	25
	Colwell				58	113	94	54
	Bray2				88	196	149	104
	KCl	Nitrate Nitrogen	N	mg/kg	1.5	123	14	45
		Ammonium Nitrogen			2.6	12	2.3	2.0
		Sulfur	S		262	250	189	329
	1:5 Water	pH		units	7.48	7.04	7.06	8.49
		Conductivity		dS/m	0.403	0.683	0.391	0.626
	Calculation	Estimated Organic Matter		% OM	7.2	8.1	5.2	5.2
	Ammonium Acetate + Calculations	Calcium	Ca	cmol ⁺ /Kg	12.32	13.50	7.65	8.98
				kg/ha	5532	6061	3432	4030
				mg/kg	2470	2706	1532	1799
		Magnesium	Mg	cmol ⁺ /Kg	3.73	4.74	3.97	4.46
				kg/ha	1017	1291	1082	1213
				mg/kg	454	576	483	542
		Potassium	K	cmol ⁺ /Kg	0.88	1.69	0.95	0.80
				kg/ha	771	1480	833	703
				mg/kg	344	661	372	314
		Sodium	Na	cmol ⁺ /Kg	0.58	0.90	1.01	1.74
				kg/ha	297	463	518	897
				mg/kg	133	207	231	401
KCl	Aluminium	Al	cmol ⁺ /Kg	0.01	0.01	0.02	0.01	
			kg/ha	3	2	4	3	
			mg/kg	1	1	2	1	
Acidity Titration	Hydrogen	H ⁺	cmol ⁺ /Kg	0.00	0.00	0.00	0.00	
			kg/ha	0	0	0	0	
			mg/kg	0	0	0	0	
	Calculation	Effective Cation Exchange Capacity (ECEC)		cmol ⁺ /Kg	17.53	20.84	13.59	15.99
	Base Saturation Calculations	Calcium	Ca	%	70.3	64.8	56.2	56.1
		Magnesium	Mg		21.3	22.8	29.2	27.9
		Potassium	K		5.0	8.1	7.0	5.0
		Sodium - ESP	Na		3.3	4.3	7.4	10.9
		Aluminium	Al		0.1	0.1	0.1	0.1
		Hydrogen	H ⁺		0.0	0.0	0.0	0.0
	Calculation	Calcium / Magnesium Ratio		ratio	3.3	2.8	1.9	2.0
	DTPA	Zinc	Zn	mg/kg	18	16	12	7.3
		Manganese	Mn		10	23	13	4.6
		Iron	Fe		36	55	97	27
		Copper	Cu		3.2	1.7	1.2	1.1
	CaCl ₂	Boron	B	mg/kg	0.52	0.74	0.83	0.33
		Silicon	Si		23	43	39	12
	LECO IR Analyser	Total Carbon	C	%	4.10	4.62	2.95	2.98
		Total Nitrogen	N	%	0.25	0.35	0.20	0.15
	Calculation	Carbon/ Nitrogen Ratio		ratio	16.5	13.1	15.1	19.5
	Basic Texture				Loam	Loam	Loam	Loam
	Basic Colour				Brownish	Brownish	Brownish	Brownish
	Calculation	Chloride Estimate		equiv. ppm	258	437	250	401

Job No:	F9706
No of Samples:	22
Date Supplied:	24th May 2017
Supplied by:	Niche-eh

Sample ID:	Sample 9	Sample 10	Sample 11	Sample 12
Crop:	HVOWES201602	MTWSPN201601	MTWSPN201602	MTWMT0201601
Client:	N/G	N/G	N/G	N/G
	RTCA	RTCA	RTCA	RTCA

Method	Nutrient	Units	F9706/9	F9706/10	F9706/11	F9706/12
Total Acid Extractable	Calcium	Ca	4,194	5,144	2,809	4,234
	Magnesium	Mg	1,411	1,806	1,160	1,773
	Potassium	K	1,538	2,261	1,229	1,278
	Sodium	Na	260	431	489	1,069
	Sulfur	S	490	529	375	408
Total Acid Extractable	Phosphorus	P	373	624	356	237
Total Acid Extractable	Zinc	Zn	130	94	50	55
	Manganese	Mn	625	380	142	203
	Iron	Fe	62,088	21,776	15,024	25,814
	Copper	Cu	48	25	13	13
	Boron	B	<2	2.1	<2	<2
	Silicon	Si	2,877	2,063	1,866	1,597
Total Acid Extractable	Aluminium	Al	8,204	9,895	6,625	5,124
	Molybdenum	Mo	4.5	0.9	0.8	0.9
	Cobalt	Co	10	8.4	3.9	5.1
Total Acid Extractable	Selenium	Se	0.7	0.9	<0.5	<0.5
	Cadmium	Cd	<0.5	<0.5	<0.5	<0.5
	Lead	Pb	30	23	16	16
	Arsenic	As	13	5.8	4.8	7.2
	Chromium	Cr	13	11	6.5	6.1
	Nickel	Ni	12	12	5.4	6.7
	Mercury	Hg	<0.1	<0.1	<0.1	<0.1
	Silver	Ag	<1	<1	<1	<1

EAL Soil Testing Notes

- All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to <2 mm
- Methods from Rayment and Lyons, 2011. *Soil Chemical Methods*
- Soluble Salts included in Exchangeable Cations - NO PRE-WASH
- 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and Lamonte Soil Handbook.
- Guidelines for phosphorus have been reduced for Australian soils
- Indicative guidelines are based on 'Albrecht' and 'Reams' concepts
- Total Acid Extractable Nutrients indicate a store of nutrients
- Contaminant Guides based on 'Residential with gardens and accessible soil including childrens daycare centre preschools, primary schools, town houses or villas' (NSW EPA 1998).
- Information relating to testing colour codes is available on Sheet 2 - "Understanding your soil results"

Calculations

- For conductivity 1 dS/m = 1 mS/cm = 1000 µS/cm
- 1 cmol⁺/Kg = 1 meq/100g; 1 Lb/Acre = 2 ppm (parts per million); kg/ha = 2.24 x ppm; mg/kg = ppm
- Conversions for 1 cmol⁺/Kg = 230 mg/Kg Sodium, 390 mg/Kg Potassium, 122 mg/Kg Magnesium, 200 mg/Kg
- Organic Matter = %C x 1.75
- Chloride Estimate = EC x 640 (most likely over-estimate)
- ECEC = sum of the exchangeable cations cmol⁺/Kg
- Base saturation calculations = (cation cmol⁺/Kg) / ECEC x 100
- Ca / Mg ratio from the exchangeable cmol⁺/Kg results

Quality Checked: Kris Saville
Manager, Agricultural testing division

ROUTINE AGRICULTURAL SOIL ANALYSIS REPORT

Job No:		F9706		Sample ID:	Sample 13	Sample 14	Sample 15	Sample 16
No of Samples:		22			MTWNOO201501	HVORIV201501	HVOWES201603	HVOCHE201601
Date Supplied:		24th May 2017			N/G	N/G	N/G	N/G
Supplied by:		Niche-eh			RTCA	RTCA	RTCA	RTCA
Method		Nutrient		Units	F9706/13	F9706/14	F9706/15	F9706/16
	Morgan 1	Calcium	Ca	mg/kg	1074	1242	872	1580
		Magnesium	Mg		457	430	492	585
		Potassium	K		192	154	173	186
		Phosphorus	P		6.7	4.5	5.5	5.0
	Bray1	Phosphorus	P	mg/kg	13	13	15	14
	Colwell				48	55	59	43
	Bray2				65	70	58	51
	KCl	Nitrate Nitrogen	N	mg/kg	1.3	3.9	0.9	11
		Ammonium Nitrogen			2.1	1.8	1.5	1.5
		Sulfur	S		33	27	293	381
	1:5 Water	pH		units	7.62	8.36	7.24	8.07
		Conductivity		dS/m	0.134	0.154	0.440	0.523
	Calculation	Estimated Organic Matter		% OM	5.0	3.8	5.8	6.7
	Ammonium Acetate + Calculations	Calcium	Ca	cmol*/Kg	9.65	9.84	7.81	10.28
				kg/ha	4332	4416	3507	4615
				mg/kg	1934	1972	1566	2060
		Magnesium	Mg	cmol*/Kg	5.75	4.97	5.85	5.92
				kg/ha	1565	1353	1593	1611
				mg/kg	699	604	711	719
		Potassium	K	cmol*/Kg	1.04	0.87	0.86	0.79
				kg/ha	910	766	755	692
				mg/kg	406	342	337	309
		Sodium	Na	cmol*/Kg	0.51	0.90	0.96	0.75
				kg/ha	264	462	494	384
				mg/kg	118	206	220	171
	KCl	Aluminium	Al	cmol*/Kg	0.01	0.01	0.01	0.01
				kg/ha	3	2	2	2
				mg/kg	1	1	1	1
	Acidity Titration	Hydrogen	H ⁺	cmol*/Kg	0.00	0.00	0.00	0.00
				kg/ha	0	0	0	0
				mg/kg	0	0	0	0
	Calculation	Effective Cation Exchange Capacity (ECEC)		cmol*/Kg	16.96	16.59	15.50	17.75
	Base Saturation Calculations	Calcium	Ca	%	56.9	59.3	50.4	57.9
		Magnesium	Mg		33.9	30.0	37.8	33.3
		Potassium	K		6.1	5.3	5.6	4.5
		Sodium - ESP	Na		3.0	5.4	6.2	4.2
		Aluminium	Al		0.1	0.1	0.1	0.1
		Hydrogen	H ⁺		0.0	0.0	0.0	0.0
	Calculation	Calcium / Magnesium Ratio		ratio	1.7	2.0	1.3	1.7
	DTPA	Zinc	Zn	mg/kg	9.2	14	9.0	6.9
		Manganese	Mn		6.4	7.5	6.0	4.9
		Iron	Fe		62	32	62	18
		Copper	Cu		1.1	2.6	1.4	1.8
	CaCl ₂	Boron	B	mg/kg	0.58	0.49	0.89	0.45
		Silicon	Si		32	25	35	19
	LECO IR Analyser	Total Carbon	C	%	2.84	2.16	3.31	3.82
		Total Nitrogen	N	%	0.18	0.15	0.18	0.17
		Calculation	Carbon/ Nitrogen Ratio		ratio	15.6	14.6	18.6	22.5
		Basic Texture			Loam	Loam	Loam	Loam
		Basic Colour			Brownish	Brownish	Brownish	Brownish
	Calculation	Chloride Estimate		equiv. ppm	86	98	282	335

Job No:	F9706
No of Samples:	22
Date Supplied:	24th May 2017
Supplied by:	Niche-eh

Sample ID:	Sample 13 MTWNOO201501	Sample 14 HVORIV201501	Sample 15 HVOWES201603	Sample 16 HVOCHE201601
Crop:	N/G	N/G	N/G	N/G
Client:	RTCA	RTCA	RTCA	RTCA

Method	Nutrient	Units	F9706/13	F9706/14	F9706/15	F9706/16
Total Acid Extractable	Calcium	Ca	4,273	5,515	3,637	6,742
	Magnesium	Mg	2,009	2,546	1,924	3,382
	Potassium	K	1,609	1,577	1,532	1,471
	Sodium	Na	287	422	439	541
	Sulfur	S	266	201	494	584
Total Acid Extractable	Phosphorus	P	350	331	324	360
Total Acid Extractable	Zinc	Zn	59	80	70	67
	Manganese	Mn	259	632	398	520
	Iron	Fe	31,403	35,570	54,331	26,314
	Copper	Cu	13	23	16	22
	Boron	B	<2	<2	2.3	<2
	Silicon	Si	2,059	1,882	2,960	2,166
Total Acid Extractable	Aluminium	Al	9,212	9,874	7,417	5,769
	Molybdenum	Mo	1.0	1.1	1.2	0.7
	Cobalt	Co	6.9	11	8.0	12
Total Acid Extractable	Selenium	Se	0.8	0.8	1.1	<0.5
	Cadmium	Cd	<0.5	<0.5	<0.5	<0.5
	Lead	Pb	17	21	17	15
	Arsenic	As	7.4	6.0	12	5.7
	Chromium	Cr	9.0	21	10	16
	Nickel	Ni	8.5	16	11	18
	Mercury	Hg	<0.1	<0.1	<0.1	<0.1
Total Acid Extractable	Silver	Ag	<1	<1	<1	<1

EAL Soil Testing Notes

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to <2 mm
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods*
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and Lamonte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts
7. Total Acid Extractable Nutrients indicate a store of nutrients
8. Contaminant Guides based on 'Residential with gardens and accessible soil including childrens daycare centre preschools, primary schools, town houses or villas' (NSW EPA 1998).
9. Information relating to testing colour codes is available on Sheet 2 - "Understanding you soil results"

Calculations

1. For conductivity 1 dS/m = 1 mS/cm = 1000 µS/cm
2. 1 cmol⁺/Kg = 1 meq/100g; 1 Lb/Acre = 2 ppm (parts per million); kg/ha = 2.24 x ppm; mg/kg = ppm
3. Conversions for 1 cmol⁺/Kg = 230 mg/Kg Sodium, 390 mg/Kg Potassium, 122 mg/Kg Magnesium, 200 mg/Kg
4. Organic Matter = %C x 1.75
5. Chloride Estimate = EC x 640 (most likely over-estimate)
6. ECEC = sum of the exchangeable cations cmol⁺/Kg
7. Base saturation calculations = (cation cmol⁺/Kg) / ECEC x 100
8. Ca / Mg ratio from the exchangeable cmol⁺/Kg results

Quality Checked: Kris Saville
Manager, Agricultural testing division

ROUTINE AGRICULTURAL SOIL ANALYSIS REPORT

Job No:	F9706
No of Samples:	22
Date Supplied:	24th May 2017
Supplied by:	Niche-eh

Sample ID:	Sample 17	Sample 18	Sample 19	Sample 20
	HVOWES201604	MTWSPS201602	HVORIV201502	MTWSPS201601
Crop:	N/G	N/G	N/G	N/G
Client:	RTCA	RTCA	RTCA	RTCA

Method	Nutrient	Units	F9706/17	F9706/18	F9706/19	F9706/20	
Morgan 1	Calcium	Ca	1542	1519	1225	1984	
	Magnesium	Mg	414	487	629	514	
	Potassium	K	139	178	203	207	
	Phosphorus	P	3.5	3.9	4.0	6.1	
Bray1	Phosphorus	P	6.1	15	10	26	
Colwell			33	81	50	104	
Bray2			25	76	69	149	
KCl	Nitrate Nitrogen	N	5.0	19	13	16	
	Ammonium Nitrogen		1.7	1.8	1.9	2.6	
	Sulfur	S	398	457	20	320	
1:5 Water	pH	units	7.76	7.89	8.21	8.23	
	Conductivity	dS/m	0.443	0.666	0.141	0.532	
Calculation	Estimated Organic Matter	% OM	3.6	5.0	5.0	7.7	
Ammonium Acetate + Calculations	Calcium	Ca	cmol ⁺ /Kg	12.05	12.61	9.82	13.45
			kg/ha	5408	5659	4407	6035
			mg/kg	2414	2526	1968	2694
	Magnesium	Mg	cmol ⁺ /Kg	4.51	5.63	7.14	5.07
			kg/ha	1228	1532	1944	1381
			mg/kg	548	684	868	617
	Potassium	K	cmol ⁺ /Kg	0.79	0.88	1.14	0.88
			kg/ha	691	771	998	774
			mg/kg	308	344	446	346
	Sodium	Na	cmol ⁺ /Kg	0.33	0.94	0.74	1.00
			kg/ha	169	484	382	513
			mg/kg	75	216	171	229
KCl	Aluminium	Al	cmol ⁺ /Kg	0.01	0.02	0.01	0.02
			kg/ha	2	3	2	3
			mg/kg	1	1	1	1
Acidity Titration	Hydrogen	H ⁺	cmol ⁺ /Kg	0.00	0.00	0.00	0.00
			kg/ha	0	0	0	0
			mg/kg	0	0	0	0
Calculation	Effective Cation Exchange Capacity (ECEC)	cmol ⁺ /Kg	17.68	20.07	18.85	20.42	
Base Saturation Calculations	Calcium	Ca	%	68.1	62.8	52.1	65.9
	Magnesium	Mg		25.5	28.0	37.9	24.9
	Potassium	K		4.5	4.4	6.0	4.3
	Sodium - ESP	Na		1.9	4.7	3.9	4.9
	Aluminium	Al		0.0	0.1	0.1	0.1
	Hydrogen	H ⁺		0.0	0.0	0.0	0.0
Calculation	Calcium / Magnesium Ratio	ratio	2.7	2.2	1.4	2.6	
DTPA	Zinc	Zn	mg/kg	4.7	13	8.9	23
	Manganese	Mn		7.4	4.6	5.0	4.2
	Iron	Fe		38	46	25	39
	Copper	Cu		1.3	2.1	1.6	3.9
CaCl ₂	Boron	B	mg/kg	0.64	0.56	0.41	0.67
	Silicon	Si		27	18	8	12
LECO IR Analyser	Total Carbon	C	%	2.08	2.83	2.84	4.39
	Total Nitrogen	N	%	0.15	0.17	0.18	0.24
Calculation	Carbon/ Nitrogen Ratio	ratio		14.3	16.6	15.4	18.4
	Basic Texture			Loam	Loam	Loam	Loam
	Basic Colour			Brownish	Brownish	Brownish	Brownish
Calculation	Chloride Estimate	equiv. ppm		284	426	90	340

Job No:	F9706
No of Samples:	22
Date Supplied:	24th May 2017
Supplied by:	Niche-eh

Sample ID:	Sample 17	Sample 18	Sample 19	Sample 20
Crop:	HVOWES201604	MTWSPS201602	HVORIV201502	MTWSPS201601
Client:	N/G	N/G	N/G	N/G
	RTCA	RTCA	RTCA	RTCA

Method	Nutrient	Units	F9706/17	F9706/18	F9706/19	F9706/20
Total Acid Extractable	Calcium	Ca	4,212	4,410	5,773	7,892
	Magnesium	Mg	1,594	1,808	3,256	3,088
	Potassium	K	1,478	1,370	1,790	1,611
	Sodium	Na	193	458	1,665	557
	Sulfur	S	494	594	210	684
Total Acid Extractable	Phosphorus	P	247	291	380	492
Total Acid Extractable	Zinc	Zn	56	75	79	131
	Manganese	Mn	474	188	567	262
	Iron	Fe	31,840	22,614	40,004	19,427
	Copper	Cu	15	22	22	42
	Boron	B	3.2	2.2	2.5	3.0
	Silicon	Si	1,962	2,025	1,822	1,558
Total Acid Extractable	Aluminium	Al	8,002	7,590	11,780	6,710
	Molybdenum	Mo	0.7	0.9	0.9	0.8
	Cobalt	Co	10	6.3	16	8.4
Total Acid Extractable	Selenium	Se	<0.5	<0.5	<0.5	<0.5
	Cadmium	Cd	<0.5	<0.5	<0.5	<0.5
	Lead	Pb	14	23	18	32
	Arsenic	As	8.1	4.8	8.0	5.1
	Chromium	Cr	8.6	8.0	20	9.3
	Nickel	Ni	9.0	8.7	23	13
	Mercury	Hg	<0.1	<0.1	<0.1	<0.1
	Silver	Ag	<1	<1	<1	<1

EAL Soil Testing Notes

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to <2 mm
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods*
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and Lamonte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts
7. Total Acid Extractable Nutrients indicate a store of nutrients
8. Contaminant Guides based on 'Residential with gardens and accessible soil including childrens daycare centre preschools, primary schools, town houses or villas' (NSW EPA 1998).
9. Information relating to testing colour codes is available on Sheet 2 - "Understanding you soil results"

Calculations

1. For conductivity 1 dS/m = 1 mS/cm = 1000 µS/cm
2. 1 cmol⁺/Kg = 1 meq/100g; 1 Lb/Acre = 2 ppm (parts per million); kg/ha = 2.24 x ppm; mg/kg = ppm
3. Conversions for 1 cmol⁺/Kg = 230 mg/Kg Sodium, 390 mg/Kg Potassium, 122 mg/Kg Magnesium, 200 mg/Kg
4. Organic Matter = %C x 1.75
5. Chloride Estimate = EC x 640 (most likely over-estimate)
6. ECEC = sum of the exchangeable cations cmol⁺/Kg
7. Base saturation calculations = (cation cmol⁺/Kg) / ECEC x 100
8. Ca / Mg ratio from the exchangeable cmol⁺/Kg results

Quality Checked: Kris Saville
Manager, Agricultural testing division

ROUTINE AGRICULTURAL SOIL ANALYSIS REPORT

Job No:	F9706								
No of Samples:	22								
Date Supplied:	24th May 2017								
Supplied by:	Niche-eh								
		Sample ID:		Sample 21	Sample 22	Heavy Soil	Medium Soil	Light Soil	Sandy Soil
		Crop:		HV0LEM201501	MTWNP201402				
		Client:		N/G	N/G				
				RTCA	RTCA	e.g Clay	e.g Clay Loam	e.g Loam	e.g Loamy Sand
Method	Nutrient	Units		F9706/21	F9706/22	Indicative guidelines only- refer Note 6			
Morgan 1	Calcium	Ca	mg/kg	602	449	1150	750	375	175
	Magnesium	Mg		143	57	160	105	60	25
	Potassium	K		137	49	113	75	60	50
	Phosphorus	P		6.1	5.1	15	12	10	5.0
Bray1 Colwell Bray2	Phosphorus	P	mg/kg	24	19	45 ^{note 8}	30 ^{note 8}	24 ^{note 8}	20 ^{note 8}
				51	31	80	50	45	35
				41	41	90 ^{note 8}	60 ^{note 8}	48 ^{note 8}	40 ^{note 8}
KCl	Nitrate Nitrogen	N	mg/kg	2.4	1.0	15	13	10	10
	Ammonium Nitrogen			1.8	2.0	20	18	15	12
	Sulfur	S		17	3.7	10.0	8.0	8.0	7.0
1:5 Water	pH		units	6.98	6.32	6.5	6.5	6.3	6.3
	Conductivity		dS/m	0.059	0.032	0.200	0.150	0.120	0.100
Calculation	Estimated Organic Matter		% OM	3.6	4.5	>5.5	>4.5	>3.5	>2.5
Ammonium Acetate + Calculations	Calcium	Ca	cmol ⁺ /Kg	5.00	3.92	15.6	10.8	5.0	1.9
			kg/ha	2247	1758	6250	4300	2000	750
			mg/kg	1003	785	3125	2150	1000	375
	Magnesium	Mg	cmol ⁺ /Kg	1.47	0.58	2.4	1.7	1.2	0.60
			kg/ha	400	157	580	400	290	150
			mg/kg	179	70	290	200	145	75
	Potassium	K	cmol ⁺ /Kg	0.57	0.16	0.60	0.50	0.40	0.30
			kg/ha	500	143	470	380	300	200
			mg/kg	223	64	235	190	150	100
	Sodium	Na	cmol ⁺ /Kg	0.12	0.04	0.3	0.26	0.22	0.11
			kg/ha	63	21	138	120	101	51
			mg/kg	28	9	69	60	51	25
KCl	Aluminium	Al	cmol ⁺ /Kg	0.02	0.04	0.6	0.5	0.4	0.2
			kg/ha	3	8	108	90	64.8	27
			mg/kg	2	4	54	45	32	14
Acidity Titration	Hydrogen	H ⁺	cmol ⁺ /Kg	0.00	0.02	0.6	0.5	0.4	0.2
			kg/ha	0	0	12	10	22.5	3
			mg/kg	0	0	6	5	4	2
Calculation	Effective Cation Exchange Capacity (ECEC)		cmol ⁺ /Kg	7.19	4.76	20.1	14.3	7.8	3.3
Base Saturation Calculations	Calcium	Ca	%	69.7	82.3	77.6	75.7	65.6	57.4
	Magnesium	Mg		20.5	12.1	11.9	11.9	15.7	18.1
	Potassium	K		8.0	3.4	3.0	3.5	5.2	9.1
	Sodium - ESP	Na		1.7	0.9	1.5	1.8	2.9	3.3
	Aluminium	Al		0.2	0.9	6.0	7.0	10.4	12
	Hydrogen	H ⁺		0.0	0.4				
Calculation	Calcium / Magnesium Ratio		ratio	3.4	6.8	6.5	6.4	4.2	3.2
DTPA	Zinc	Zn	mg/kg	5.3	6.2	6.0	5.0	4.0	3.0
	Manganese	Mn		26	7.1	25	22	18	15
	Iron	Fe		423	91	25	22	18	15
	Copper	Cu		0.4	0.7	2.4	2.0	1.6	1.2
CaCl ₂	Boron	B	mg/kg	0.55	0.31	2.0	1.7	1.4	1.0
	Silicon	Si		29	24	50	45	40	35
LECO IR Analyser	Total Carbon	C	%	2.07	2.55	>3.1	>2.6	>2.0	>1.4
	Total Nitrogen	N	%	0.11	0.11	>0.30	>0.25	>0.20	>0.15
Calculation	Carbon/ Nitrogen Ratio		ratio	18.3	23.8	10-12	10-12	10-12	10-12
	Basic Texture			Sandy Soil	Sandy Soil	..	..	..	..
	Basic Colour			Brownish	Brownish	..	..	..	..
Calculation	Chloride Estimate		equiv. ppm	38	21	..	..	..	..

Job No:	F9706
No of Samples:	22
Date Supplied:	24th May 2017
Supplied by:	Niche-eh

Sample ID:	Sample 21	Sample 22	Heavy Soil	Medium Soil	Light Soil	Sandy Soil
Crop:	HVLEM201501	MTWNP20140				
Client:	N/G	2				
	RTCA	RTCA	e.g Clay	e.g Clay Loam	e.g Loam	e.g Loamy Sand

Method	Nutrient	Units	F9706/21	F9706/22	Indicative guidelines only- refer Note 6
Total Acid Extractable	Calcium	Ca	1,622	1,232	1,000 - 10,000 Ca
	Magnesium	Mg	329	193	500 - 5,000 Mg
	Potassium	K	417	297	200 - 2,000 K
	Sodium	Na	63	<50	100 - 500 Na
	Sulfur	S	121	91	100 - 1,000 S
Total Acid Extractable	Phosphorus	P	163	128	400 - 1,500 P
Total Acid Extractable	Zinc	Zn	17	19	20 - 50 Zn
	Manganese	Mn	108	63	200 - 2,000 Mn
	Iron	Fe	5,762	2,238	1,000 - 50,000 Fe
	Copper	Cu	3.6	5.4	20 - 50 Cu
	Boron	B	2.3	<2	2 - 50 B
	Silicon	Si	1,976	1,346	1,000 - 3,000 Si
Total Acid Extractable	Aluminium	Al	2,869	1,440	2,000 - 50,000 Al
	Molybdenum	Mo	0.3	<0.2	0.5 - 3 Mo
	Cobalt	Co	2	2.2	5 - 50 Co
Total Acid Extractable	Selenium	Se	<0.5	<0.5	0.1 - 2.0 Se
	Cadmium	Cd	<0.5	<0.5	< 5 Cd
	Lead	Pb	6.5	5.5	< 75 Pb
	Arsenic	As	<2	<2	< 25 As
	Chromium	Cr	5.7	2.6	<25 Cr
	Nickel	Ni	2.1	2.2	<150 Ni
	Mercury	Hg	<0.1	<0.1	< 3.75 Hg
	Silver	Ag	<1	<1	.. Ag

EAL Soil Testing Notes

- All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to <2 mm
- Methods from Rayment and Lyons, 2011. *Soil Chemical Methods*
- Soluble Salts included in Exchangeable Cations - NO PRE-WASH
- 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and Lamonte Soil Handbook.
- Guidelines for phosphorus have been reduced for Australian soils
- Indicative guidelines are based on 'Albrecht' and 'Reams' concepts
- Total Acid Extractable Nutrients indicate a store of nutrients
- Contaminant Guides based on 'Residential with gardens and accessible soil including childrens daycare centre preschools, primary schools, town houses or villas' (NSW EPA 1998).
- Information relating to testing colour codes is available on Sheet 2 - *"Understanding you soil results"*

Calculations

- For conductivity 1 dS/m = 1 mS/cm = 1000 µS/cm
- 1 cmol/Kg = 1 meq/100g; 1 Lb/Acre = 2 ppm (parts per million); kg/ha = 2.24 x ppm; mg/kg = ppm
- Conversions for 1 cmol+/Kg = 230 mg/Kg Sodium, 390 mg/Kg Potassium, 122 mg/Kg Magnesium, 200 mg/Kg
- Organic Matter = %C x 1.75
- Chloride Estimate = EC x 640 (most likely over-estimate)
- ECEC = sum of the exchangeable cations cmol+/Kg
- Base saturation calculations = (cation cmol+/Kg) / ECEC x 100
- Ca / Mg ratio from the exchangeable cmol+/Kg results

Quality Checked: Kris Saville
Manager, Agricultural testing division

Appendix 8 – Microbial soil analysis results

Niche Environment and Heritage

A specialist environmental and heritage consultancy.

Head Office

Niche Environment and Heritage
PO Box W36 Parramatta NSW 2150
Email: info@niche-eh.com

All mail correspondence should be through our Head Office

Appendix 4 – Response to Recommendations: Independent Environmental Audit

Response to Non-Compliances and Recommendations MTW IEA 2017

Table 1 Response to the recommendations contained in the audit report.

Reference	Non Compliance	Response	Timing
SSD6464 Sch. 3, C24(a) WMP 7.4.3.1	On the 6th January 2016, a sediment dam overtopped resulting in an uncontrolled discharge.	An internal investigation was undertaken in response to this incident. The investigation and subsequent action plan has been completed to rectify the issues at this dam and to prevent reoccurrence not only at this dam but other dams being constructed or modified. No further action is required in response to this finding.	Complete
MT EIS 2.4.4 (iii)	No ongoing characterisation of overburden materials was conducted.	Mt Thorley mining area has reached the extent of its progression and hence there will be no further requirement for ongoing characterisation of overburden materials.	Complete
AHMP 9	There was no written or electronic record of which personnel had completed site specific environmental training for Cultural Heritage.	The AHMP and the C&A induction require closer alignment to ensure training materials cover all specific Cultural Heritage awareness requirements.	31/12/2017
BMP 5.2.3	On the 8-06-16 a blast was not monitored by the Bulga Village blast monitor due to a software malfunction.	An internal investigation identified the cause of the data loss to be isolated to a GPS fault on a single blast monitoring unit. This fault has since been corrected and no further action is required in response to this finding.	Complete
NMP 6.2	There was no substantive evidence of car-pooling encouragement programs at the time of the audit.	Car-pooling occurs however MTW do not run programs to specifically encourage car-pooling nor is it deemed to be necessary to do so. The Noise Management Plan will be revised to reflect this.	Next management plan review.
20BL170012 C.9 20BL170011 C.9 20BL171930 C.8 20BL171932 C.8	Water flow devices used to measure the volume of water extracted were not approved by NOW (DPI – Water). Three bore licences were found to be non-compliant with this condition, however two were decommissioned and are not in use and one related to the bore licence associated with groundwater inflow to the Warkworth Pit.	Following commencement of the North Coast Fractured and Porous Rock Groundwater Sources Water Sharing Plan on 1/7/2016, Licences 20BL170011 and 20BL170012 have been converted to Water Access Licences (WALs 40464 and 40465 respectively). Revised licence conditions are yet to be issued by DPI Water for review; when draft conditions are issued changes will be sought to reflect that groundwater inflows to a pit excavation cannot be measured using a flow meter. Licences 20BL171930 and 20BL171932 are related to a historical methane extraction project; the bores are not in use. An investigation will be undertaken to determine if the bores	TBA; timing for issue of draft conditions by DPI Water not known at this time. 30/11/2017

Reference	Non Compliance	Response	Timing
		should be formally abandoned and the licences relinquished, or if used for monitoring, an application sought to modify the licence purpose and conditions to reflect no water is to be abstracted.	
20BL170011 C.8 and C.10 20BL170012 C.8 and C.10	Water flow devices used to measure the volume of water extracted were not calibrated. This related to the aforementioned bore licences that did not have flow devices attached and as such are not able to be calibrated.	Following commencement of the North Coast Fractured and Porous Rock Groundwater Sources Water Sharing Plan on 1/7/2016, Licences 20BL170011 and 20BL170012 have been converted to Water Access Licences (WALs 40464 and 40465 respectively). Revised licence conditions are yet to be issued by DPI Water for review; when draft conditions are issued changes will be sought to reflect that groundwater inflows to a pit excavation cannot be measured using a flow meter and thus a flowmeter cannot be calibrated.	TBA; timing for issue of draft conditions by DPI Water not known at this time.
Recommendations			
1.	Complete the Salvage report for salvage work conducted in 2016.	A final report will be compiled to bring together the results and completed compliance actions relating to the MTW 2016 ACH salvage	31/12/2017
2.	Review findings in this audit report that were found "Not Able to be Verified" to determine whether further documentation may be able to be generated to make these items compliant.	C&A will undertake a review to verify the audit components that were listed as "Not Able to be Verified", and action as appropriate to ensure future compliance with these conditions.	31/10/2017