Comments for the anonymous referee #1

We would like to thank the Anonymous Referee #1 for this review and the constructive comments. We have addressed his/her comments as follows:

Comment: The reviewer's major concern about this manuscript is the section 4.2. This section should be the focus of this manuscript. Presentation in this section does not reveal how to apply the results such as Figures D1 and D2 as the management tool for ecosystem rehabilitation planning at different locations.

Response: We agree with your comment and we will include a new section (4.3) which includes a new table (Table 3) in the discussion to describe how the results of the design drought method can be used as a management tool for ecosystem rehabilitation.

Table 3. Management actions for addressing specific kinds of drought characteristics identified with SDF curves for the southern hemisphere.

Management domain	**Management actions**	**Type of drought**
Plant species selection	Drought tolerant species	LS, LP, SP, SS
	Quickly germinating species	SS
	Species with physical/chemical dormancy	LS, LP
	Shade tolerant species on southern aspects	LS, LP
	Light tolerant species on northern aspects	LS, LP, SP, SS
	Annual grasses	SS, SP
	Perennial grasses	LS, LP, SP, SS
	Trees	LS, LP
Planting/seeding regime	Trees require repeated establishment	LS, LP
	Annual/perennial grasses are successful after rain events	SS, SP
Soil characteristics	Deep top soil	LS, LP, SP
	Amendments of silt/clay	LS, LP
	Gentle slopes	LS, LP
	Mulching	SS
Irrigation method	Regular irrigation	LS, LP
	Seasonal irrigation	SS, SP
	Critical stage irrigation	LS,LP,SP,SS
	Drainage system	LS, LP

SS – High recurrence of short time scale (3 month) severe droughts
SP – High recurrence of short time scale (3 month) prolonged droughts
LS – High recurrence of long time scale (12 months) severe droughts
LP – High recurrence of long time scale (12 months) prolonged droughts

One of the major outcomes of this study is to support land managers and/or rehab practitioners to make fundamental decisions on appropriate management actions in the context of drought frequency. For rehabilitation to be successful in the face of severe and prolonged droughts, there are a range of management domains and management actions that

need to be considered in response to recurrence intervals, drought severity, and drought duration (Table 3). These management actions can be categorized into four domains: plant species selection; planting/seeding regime; soil characteristics; and irrigation method.

Selection of suitable plant species based on drought type is one of the key management actions for successful rehabilitation. Some management actions can be applied to all drought types (Table 3: LS, LP, SS, SP). These include planting drought resistance species (*Acacia* spp., *Banksia* spp., *Casuarina* spp.); planting drought tolerant species in northern aspects to address drier conditions that result from higher solar radiation causing increased evaporation (Sternberg and Shoshany, 2001); and planting perennial grasses (*Eragrostis* spp., *Themeda* spp. (Bolger et al., 2005)) which may not be affected by long-term water deficits. In locations which have long-term (12 month time scale) droughts with high recurrence of severe and prolonged water deficits (Table 3: LS, LP), such as Mt Isa and Quilpie, over seeding with seeds that have physical/chemical dormancy may increase the probability of germination during favourable time periods (Hilhorst, 1995; Arnold et al., 2014). Additionally, planting drought intolerant species in southern aspects may increase their survival (Sternberg and Shoshany, 2001). However, these species need to be shade tolerant as southern aspects get less solar radiation in winter. Locations with short-term droughts with high recurrence of severe but not prolonged droughts, with rainfall throughout the year (Table 3: SS), such as Wagga Wagga can be planted with annual grasses and seeded by seeds with short germination periods.

Soil characteristics play a critical role in plant available water and a number of strategies may need to be employed to make soil more favourable to plant establishment. Except for mulching, all of the management actions within the soil characteristics management domain can be applied to locations with high recurrence of long-term severe and prolonged droughts (Table 3: LS, LP), such as Quilpie and Mt Isa. For locations with high recurrence of short-term prolonged droughts (Table 3: SP) (e.g. Melbourne), increasing the depth of topsoil can increase water holding capacity (Audet et al., 2013; Bot and Benites, 2005). Similarly, by mixing silt and clay soil in the topsoil and reducing slope gradients may facilitate infiltration and increase soil water retention capacity (Audet et al., 2013). For tropical locations with high recurrence of short-term (3 month time scale) severe and prolonged droughts (Table 3: SS, SP), such as Cairns and Weipa, ground cover such as mulch and planting fast growing cover (e.g Buffel grass) may reduce evaporation and maintain soil moisture to allow for the establishment of drought sensitive slower growing species (Blum, 1996).

Utilising irrigation methods for specific site characteristics is a cost effective strategy for any rehabilitation plan. Regular irrigation with proper drainage systems that distributes water is an effective strategy in locations with high recurrence of long-term severe and prolonged droughts (Table 3: LP, LS). For locations with high recurrence of short-term, severe and prolonged droughts (Table 3: SS, SP), with seasonal rainfall (e.g. Brisbane, Sydney, Kingaroy, Brigalow), seasonal irrigation and irrigation at critical stages of plant growth (Blum, 1996), such as germination, and root or pod development periods is a more efficient way to ensure plant survival throughout drought spells.

Comment: Many results are relating to Table 3 as the authors stated in pages 10 (lines 15, 17, 20), 11 (line 5), and 12 (lines 12, 18, 24). But this manuscript does not contain Table 3. The authors should check whether the wrong table number is used or Table 3 is missing in this manuscript.

Response: Thank you for catching this; we used the wrong table numbers. We revised the references to table 3 accordingly.

Comment: Does the Appendix C stated in pages 11 (line 25) and page 13 (lines 2 and 5) mean Figures C1 and C2 (pages 38 and 39)?

Response: Yes, we added titles of appendices C and D throughout the manuscript.

Comment: The Conclusion section (page 17) should be more specific to include the obtained results of the Eastern Australia.

Response: We agree and added two sentences about our results in the beginning of the conclusion (existing text in italics).

The study revealed site specific patterns of recurrence intervals of short-term and long-term droughts across Eastern Australia. Severe and prolonged short-term droughts recurred most often in tropical climates and temperate Wagga Wagga, while severe and prolonged short-term droughts recurred most often in arid conditions and temperate Melbourne. *Design droughts can be applied to quantify the frequency of drought events – characterised by severity and duration – at different time scales. This is a critical step forward to consider drought in risk assessments for rehabilitation of post-mining ecosystems. Together with design rainfalls, design droughts should be used to assess rehabilitation strategies and ecological management based on drought recurrence intervals, thereby minimising the risk of failure of initial ecosystem establishment due to ignorance of fundamental abiotic and site-specific environmental barriers.*

Comment: Page 7, line 15. RDI3, the I should not be typed as a subscript.

Response: Thanks for catching this! The typo was corrected.

Comment: Page 13, line 24. “Hodgkinson and Flagship, 2010” should be “Hodgkinson et al., 2010”

Response: We revise the reference accordingly.

References

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